MODERN RADIO

EDITED BY ROBERT S. KRUSE

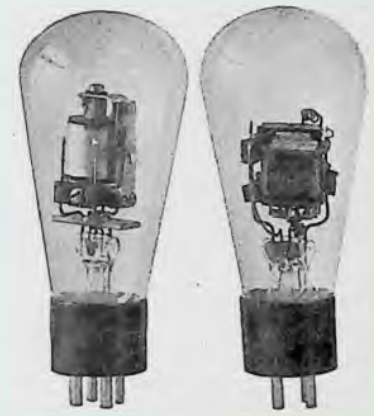
CONTENTS

Number 6 December 20 cents

A Promising New Device

All airplanes and automobiles, many boats, and a growing number of farmhouses, have their own electric generating plants. Such a plant almost invariably consists of a d.c. generator charging a 6, 12 or 32 volt storage battery. To drive a radio receiver from such a supply one must either depend on dry-cell "B" batteries for plate supply or else feed the storage-battery power to some device which steps it up to a higher voltage suited to the plate circuits of the receiver. The most obvious way of doing this is to use a motor-generator, in which a d.c. motor drives a small a.c. 110 volt generator from which a perfectly normal a.c. receiver may be operated. This is practical if the storage battery is big, but hardly fits into an automobile or airplane. An ingenious variation is the Keller-Fuller device described in our last issue* which supplies the receiver filaments direct from the battery and uses a small inverted rotary-converter (more efficient than a motor-generator) to supply low-voltage 60 cycle a.c. to a step-up transformer whose secondary feeds a normal rectifier-filter system as in any household receiver. The battery demand is much diminished by this change. The other possibility is the dynamotor with d.c. output at plate voltage. Later we shall see useful types with efficiency ingeniously improved and the normal troubles of a small high-voltage d.c. commutator reduced satisfactorily.

At a recent meeting of the Connecticut Valley Section of the Institute of Radio Engineers, a unique plate-supply device was demonstrated by Mr. Alvin D. Bedrossyan of the Superior Radio & Electric Co. of Springfield, Mass. The Bedrossyan device works from low-voltage d.c. supplies such as 6 and 32 volt storage batteries, and in slightly modified form may be used at 110 volts d.c. Unlike most devices of this sort it has no rotating machinery, brushes or commutators. It is in fact surprisingly simple in principle, being a buzzer-type of interrupter from which the power is fed to a step-up transformer, thence to a rectifier and filter system. In view of the exceedingly poor performance of devices which have previously attempted to use similar principles it was surprising to find the device nearly soundless in itself, and even more so to find that there was only the faintest imaginable plate-supply noise at the speaker of a 10 microvolt motor-car receiver when working with the Bedrossyan plate supply. This is due to several ingenious devices. The first of these is the use of a special buzzer built into a vacuum-bulb similar to that of



Two Types of Bedrossyan Buzzers

the UX-210, the vacuum nearly eliminating the sound, greatly reducing sparking and thereby stabilizing operation. Incidentally the buzzer is readily replaced. Filtering and shielding are used at several points to prevent r.f. disturbances from reaching the set by way of the plate supply leads, the battery line, or the antenna system. Half-cycle rectification is used, and where economy is important, as in a motor-car set, the rectifier may be of the gaseous type to eliminate the filament load.

The device is a nice illustration of the fact that one can do a lot of hard things well, if effort is put into them.

* "A California Contribution", p. 9, November.

The Crystal's Rival

Could anything be more pleasing than a device that will stabilize the frequency of even a 20 kilowatt oscillator without adding even one tube, coil, condenser or C battery? Very well—here 'tis. In the November issue of the "Proceeding of the Institute of Radio Engineers" there is a story by Messrs. Conklin, Finch and Hansell which we herewith abstract—and to which we add this and that.

The Lecher Wire

In its simplest form the new device goes back to the venerable Lecher wire —which is nothing but a long antenna worked on a harmonic so that there are several voltage loops along it as in Fig. 1A. It should be over 10 wavelengths long for best effect, but we have shown only 2½ wavelengths in Fig. 1. If the point P at the left of 1A is connected (through a stopping) condenser to the plate of a tube and the point G at the right is connected to the grid of the same tube the tube will oscillate, for as you see the voltage (r.f.) of the two points is always opposite—which is what it takes to make the tube oscillate. Now

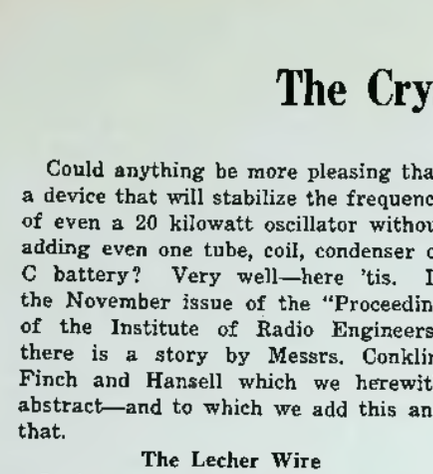


Fig. 1

suppose that the wavelength attempted to become shorter. Then the 6th zero-voltage point would move in to the left, and if it got as far as in Fig. 1B there would be no grid excitation and oscillation would stop. Actually it would not get that far—the grid would merely be slowed down a little until the waves had obligingly rearranged themselves as in 1A—and the original frequency was restored. Should the tube wander in the reverse direction the 5th zero-voltage point would tend toward the position shown in 1C. The important point

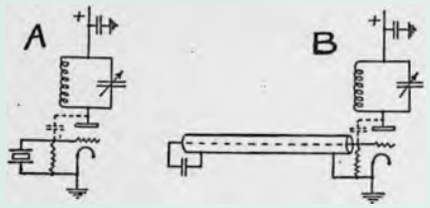


Fig. 2

is that in B the half-wave crawled to the left and in C it crawled to the right; in B we therefore fed the grid a LAGGING input and slowed it down, while in C we fed it a LEADING input and hurried it along. Always the wavelength is pushed back where it belongs. We have real wavelength control—is it good enough? As to that, see Fig. 6. Many a non-temperature control crystal does worse than this—and of course both crystal and line improve with temperature control.

The Difficulties

The wires ought to be long, and radio rooms frequently measure 9 feet by 10. One way out of this is shown in Fig. 1D. The inner tube is about 1" in diameter, the outer one is ordinary 3" copper "leader" or "rainspout" such as is used to take the water from the roof to the best place for washing the driveway cinders into the petunia bed. Unfortunately smaller diameters are not too good, though more will be said on that later.

One may also coil the line into a long thin solenoid as shown in Fig. 1E—recollect the "resonance wave coil" of Squier and the Fleming "Cynometer" of 1905? The tube is of copper, covered with insulation and then wound with one layer of insulated wire. Details will be given later, though probably the true experimenter will not wait to be told. This arrangement also should be long, several wavelengths more than shown, but

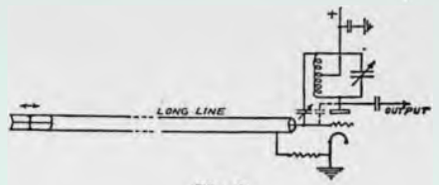
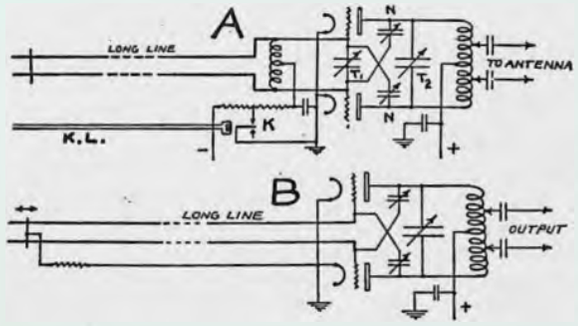


Fig. 3

even so is reasonably compact. The extreme ends should not be used—allow for a long "dead end". This device must work at rather moderate voltages hence the plate connection must be tapped down the coil a ways, while the grid can tie on directly if anyone wishes to insist on it. The circuits can otherwise be as shown in the several figures.

Circuits

Fig. 2A is the usual amateur crystal-



A—The WIK Circuit

B—A Variation

Fig. 4

control circuit, which is to say a tuned-plate and tuned-grid oscillator in which the crystal is the tuned-grid circuit. In 2B this has been replaced by the line—which is obviously a tuned system, else waves would not be stationery in it as in Fig. 1. This circuit will work with lines of A, E or D type, but since the weakness of the tuned-plate-and-grid circuit at high frequencies is to overexcite the grid (and ruin crystals) there had best be partial neutralization as in Fig. 3, for an effect that ruins crystals will hardly help the wave-form in the present system. The proper degree of neutralization will produce rational r.f. and d.c. grid currents. If you are stubborn and will write enough letters the tube makers will give in and send you a little booklet about the tube you are using wherein the proper grid currents are set down.

2 and 3 Wire Lines

In Fig. 4A is shown a circuit used at WIK with 20 kw. tubes at 13,930 kc. The line was of No. 6 copper wires each 10¼ wavelengths long, which is 27.1 meters or 89 feet in U. S. money. K is the key, applying a blocking bias whenever the battery current is taken off the keying line K L. The key filter is not shown.

Since all amateurs have heard WIK approximate 10,000 times the effectiveness of the system needs no comment. The purr was due to line vibration from generators in the building.

In 4B the grid tank is left off and the whole job turned over to the line. This drops out the center-tapped grid coil, hence the third wire to connect the grid-leak to the line-bridge. Incidentally—a leak is better than other bias.

Untuned Lines and LOW C Tanks

A beautiful variation is shown in Fig. 5. Here the tubes are fully neutralized, so as to be non-oscillating. The only feedback is through the line. The line is no longer a tuned system but like an ordinary power line it merely carries TRAVELING (not stationary) waves from the generator (plate) to the load (grid circuit). The plate tank must not try to control, hence it has a large coil and small air condenser—a welcome relief from the costly and inefficient "High C" circuit. Now if the line is tapped far enough up the plate coil the line controls. Frequency is then changed

by changing the electrical length of the line, either by a bridge scheme like that of Figs. 2 and 4 or by changing one of its distributed constants with an additional conductor. The last had best be done most carefully if trouble is to be dodged. The tap on the grid coil is moved until a neon tube shows no voltage bumps along the line—showing that

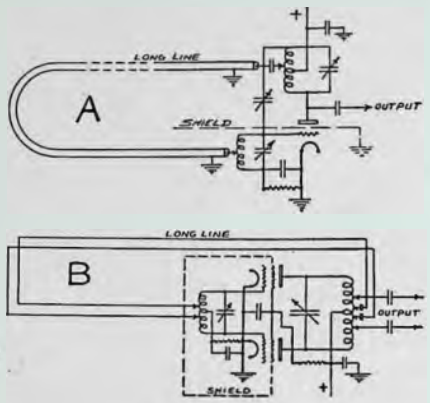


Fig. 5

power flows one way only—to the grid. Fig. 5B shows a pushpull arrangement of this sort and from these two figures one can build both one-tube and pushpull affairs with either neutralized triodes or tetrodes.

Mirabile dictu—(what is a radio magazine without a Latin gag line?) the same length of line will hold the frequency shifting down to about the same number of cycles, regardless of wavelength—which is to say the system is BEST at high frequencies. Furthermore the control is BEST at full load, and finally the compact lines of Fig. 1D and 1E will work most conveniently with one tube, hence we get away from a cross-compound oscillator and save more machinery. Isn't it amazing how everything about the system saves money? Let's go into it carefully in another issue.

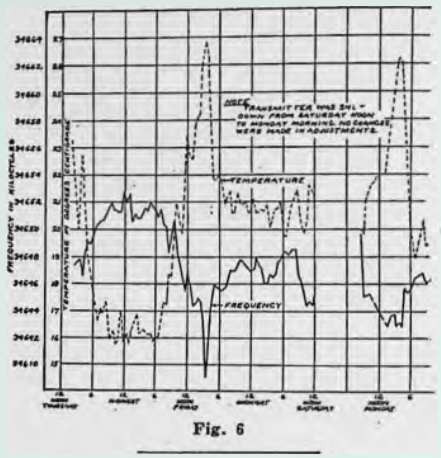


Fig. 6

HELP!

"Modern Radio" has many requests for copies 1, 2 and 3 (July, August and September)—and our own supply is completely exhausted. If you are willing to sell yours please tell us what copies you have and what your price is. We will then refer one of our subscribers to you.

On the other hand, if you wish to have some of those copies please write us and ask to be put on the BACK COPY WAITING LIST.

Much time was spent by the executors in winding up a London estate—it consisted of 100 clocks.—Christian Science Monitor.

Editor
ROBERT S. KRUSE

Associate Editor
L. W. HATRY

Published Monthly by
MODERN RADIO CO.
101 Allyn Street
Hartford, Connecticut

Business and Advertising Manager
N. T. YOUNG
Tel. 5-2733

Contributing Editors—BOYD PHELPS, PERRY O. BRIGGS

Entered as second class matter at the post office at Hartford, Conn. (permit application pending), June 20, 1931, under the act of March 3, 1879. Yearly subscription $2.00 in U. S. and Canada, $3.00 in foreign countries. Single Copies, 20c.

Contributions not returned unless accompanied by stamped, self-addressed envelope.

Shortwave Superheterodynes
Plus First-Detector Regeneration

By L. W. Hatry, Associate Editor

It is not pretended that the sensitivity of a good short-wave superheterodyne is improved by adding regeneration to the first detector; this could only happen if the intermediate system was poor in amplification. None the less, first-detector regeneration is a very real asset, for it **greatly** increases the "adjacent channel" selectivity of the first detector's tuned input circuit. This is much worthwhile since this tube usually has but one tuned circuit to protect it against all the radio in the world—and an overload will cause modulation that goes right on through the rest of the system.

Making the first detector regenerative is not difficult. I have consistently

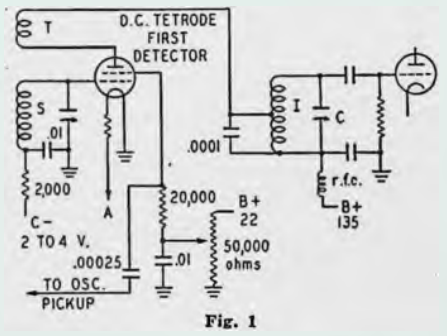


Fig. 1

recommended the space-charge first detector connection for non-regenerative work, but if this tube is to be regenerative the screen-grid connection should be used, for under that condition it is the quieter of the two, works as well as the space-charge connection and is more economical of plate current, besides giving better tube life. The d.c. form appears in Fig. 1, while Figs. 2 and 3 show circuits suitable for a.c. tubes.

In general the tickler T, shown in all three circuits, has the same number of turns as S (S being tne tuned secondary of either an antenna input transformer or an inter-stage transformer fed by an r.f. amplifier tube) when the latter coil has less than 10 turns. When S has 10 to 20 turns, T has perhaps ⅔ as many and when S has 20 to 40 turns T will

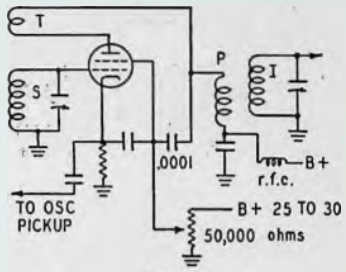


Fig. 2

need only about ½ as many. Above 40 turns T may be as small as ⅓ of S. The rules are not precise.

The coil I is an I.F. auto-transformer tuned to the desired intermediate frequency by the variable condenser shunted across it and the .0001 fixed condenser which also serves as an r.f. bypass. This arrangement is superior to that of using the whole coil in the detector plate coil, especially with supers using 500-1600 kc. intermediate frequencies, or where the tuning condenser C is less than .0001. Even so it may be necessary to reduce the number of turns in I by about 10% because of the loading effect of the detector input system.

Where a.c. tubes are used the circuit of Fig. 2 will work with a good deal of certainty. It is unlikely to suffer from differences between tubes but is inconvenient because the oscillator r.f. and the signal r.f. tend to affect the intermediate amplifier and cause more hiss than usual. The constants are as before.

The circuit of Fig. 3 is the preferred connection for the 224 or other a.c. tetrodes when used as regenerative first detectors. Although the tickler-in-the-screen arrangement is somewhat critical, and the right number of tickler turns

must be found for the tube used, this is unimportant to the home-builder. A tube lasts from 1 to 4 years, after which the tickler may be changed to fit a new tube, or a suitable tube for the old tickler found by testing two or three tubes in the socket. The circuit

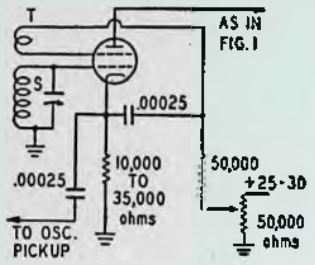


Fig. 3

is dissatisfactory for production use, due to this lack of uniformity in the best of standard tetrodes.

The screen bypass C2 may be connected to ground instead of cathode if the circuit is to be merely regenerative, but never in oscillation or on the edge of oscillation. The connection shown gives oscillation with ease and reliability and is convenient when a regeneration control is to be placed on the panel. The regeneration will of course be controlled by controlling the screen voltage. The cathode resistor is not critical. The best tube is the 224 though variable-mu tetrodes seem generally to work satisfactorily and, to oscillate.

PERRY O. BRIGGS JOINS OUR STAFF

"Modern Radio" is very much pleased to be able to announce that Mr. Perry O. Briggs has joined its staff as Contributting Editor. Mr. Briggs has extensive and varied radio experience. Beginning with an amateur radio station in 1919 (1JBF), he has since participated in every sort of organized amateur radio tests and experiments, being one of the few that succeeded in both the first and second Transatlantic Test. He has done radio laboratory work at the American Radio Relay League, and in both the R. E. L. and the Grebe organizations. Since 1928 he has also been engaged in research and laboratory work for Warner Pictures, Inc., in connection with the development of independent sound systems and sound recording on film and discs, specializing on the latter.

THE 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.

UNIVERSAL RADIO UNION

Sr. Amando Cespedes Marin, owner-operator-manager-entertainer of NRH, the famous "Smallest broadcasting station in the world" at Heredia, Costa Rica, has made so many friendly contacts through his broadcasting that he proposes a listeners' organization to be called Universal Radio Union—a name which is good in Spanish, Italian, French and other languages, in addition to English. In a circular to radio listeners he asks their opinion of these aims—

To consolidate the opinion of listeners and defend their interests.

To have a powerful shortwave station, a magazine for the exchange of experience, opinion and humor.

To make mutual friendships by exchange of communications, books, souvenirs, etc., as well as confirmation-of-hearing certificates.

To award certificates and prizes.

Opinion is also solicited as to a proper membership fee. Communications should go to Sr. Amando Cespedes Marin, Heredia, Costa Rica.

Modulating Tetrodes and Avoiding Balanced Stages

In most radiophone transmitters, both amateur and commercial, the radio-frequency amplifier tube-to-be-modulated is used in the general way suggested by Fig. 1. Because it is a triode (3-element tube) neutralization is necessary, and

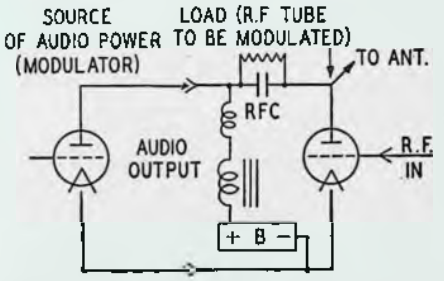


Fig. 1. The basic circuit of any plate-modulated (Heising) r.f. amplifier stage as used in nearly all present 'phone transmitters, including the so-called "100% modulated" sorts.

slight mis-adjustment of the neutralizing condenser causes severe modulation distortion as was explained in the August issue.*

This uncertainty can largely be avoided by replacing the triode by a screen-grid tetrode. Thus a '10 may be replaced by a '65 and a '52 may be replaced by a '60. Like the triodes these tubes must be properly biased for class C operation, in other words they must be so biased as to produce an r.f. tank current directly proportional to the plate voltage as shown for a triode (type '10) in Fig. 4.

When operating as in Fig. 4 the tube's plate current (rather obviously) is also proportional to the plate voltage, as shown by the dashed line in Fig. 2. A screen-grid tube as ordinarily used does not follow such a straight line but instead behaves as shown by the crooked solid line in the same figure. To straighten this kinked line out we must

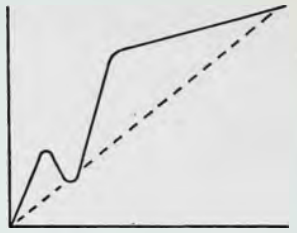


Fig. 2. When the plate voltage of a triode with class C bias is changed (for example the '10 of Fig. 2) the plate current changes along the straight dashed line. A screen-grid tetrode follows the useless solid line unless used as explained.

modulate the screen as well as the plate. This can be done by using the circuit of Fig. 3, in which the screen is fed *modulated* d. c. through a dropping resistor.

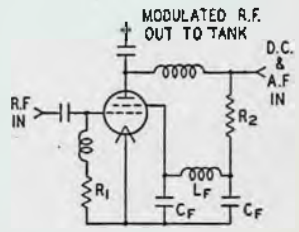


Fig. 3. A circuit for modulating a screen-grid tetrode. Constants are given in the table.

Table of Constants

R. F. Tube	Plate Voltage	Max. Ma.	R1	R2	Screen Volts
865	500	60	10,000 or 75 volts	25,000	plus 125
860	2,000	100	10,000 or 200 volts	100,000	plus 300

The bypasses CF and R. F. choke LF keep R. F. off the screen but admit A. F. to it.

The screen-bypass can not be as large as usual, for we do not wish to bypass the audio—only the r.f. At the same time it is necessary to keep the screen free of r.f. which would cause regeneration and lead to the same distortions as a mis-adjusted neutralizing condenser. The screen bypasses should therefore be non-inductive and should have low resistance, while their capacity must be as high as can be tolerated without excessive loss of high audio. Obviously short leads and mica condensers are indicated, and any capacity above .0005 or there-

* See Page 6, "HELP!".

abouts will begin to "cut highs". A .0005 bypass is ample at 5 meters, and acceptable at 80 meters, but in the standard broadcast band one must admit the effect is not too good and for this work the tetrode is inferior to the neutralized triode.

NOTES

1. Voltages are for the non-modulating or "resting" condition.

2. The audio plate-input from the modulator to the r.f. tetrode may be from any one of the modulator systems described in this and previous issues of MODERN RADIO. A system suitable for modulating a '10 will in general serve with the '65 and one suited to a '52 or '04 will work with a '60.

3. If the modulating system is one which has no modulating transformer but instead operates the modulator at a higher voltage it may be necessary to change the voltage-dropping resistor. The right value is one which will cause the r.f. tube to work at ½ to ⅔ of the modulator voltage while taking a d.c. input (watts) equal to twice (or less) the number of audio watts which may be delivered by the modulators. Measure the plate voltages with a "1,000 ohm per volt" meter.

4. If the plate voltages are less than 80% of those shown R2 must be changed to reduce the screen voltage in proportion.

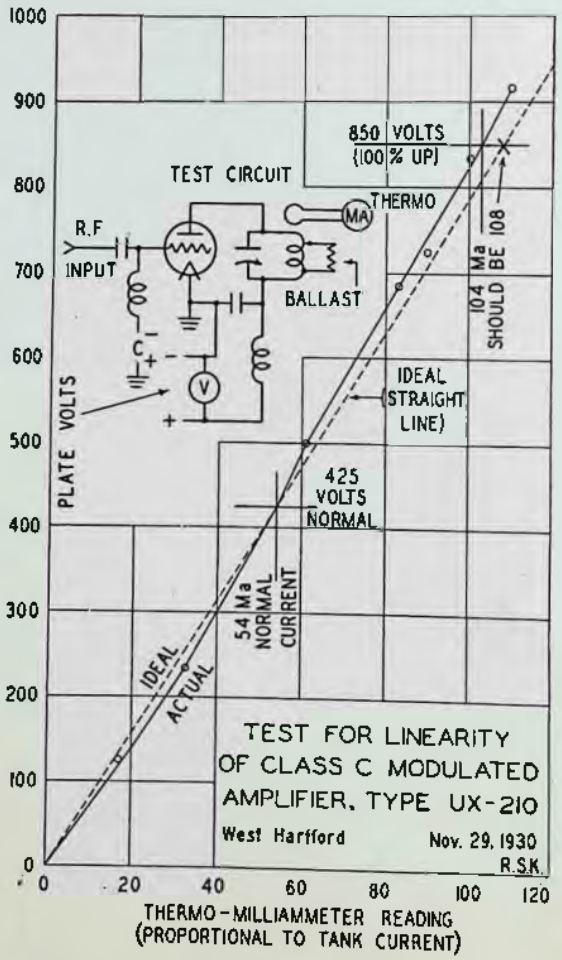
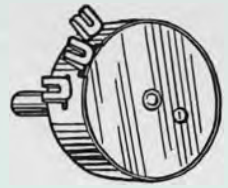


Fig. 2. A proper class C test curve, obtained as explained in our August issue. This type of curve is possible when the circuits and biases are so chosen that (a) the plate current increases directly as the plate voltage (linear or proportional as shown by dashed line in Fig. 3) and (b) the plate-circuit efficiency is essentially constant. It is also evident that the r.f. watts output are proportional to the watts input (d.c. plus audio).



Simple Volume Control

in Amateur and Broadcast Receivers

By L. W. Hatry, Associate Editor

Every volume control replacement is costing the set owner 50% more than necessary because manufacturers have made no attempt to standardize electrically and mechanically, nor has fierce competition seemed to persuade set manufacturers of the wisdom of a return-mail service on replacement of freak parts.

These imbecilities of the set manufacturer are no excuse for similar soft-brained groping among us who repair. We can standardize within limits and do reliable, satisfactory work at reasonable prices. However, we have two problems: 1. to educate the customer to understand that substitutes are a **necessity** for quick service and, 2. to educate ourselves into the ability to make **intelligent** substitution.

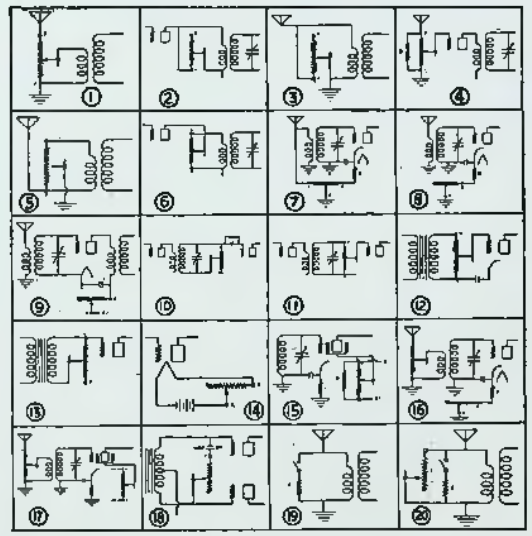


Fig. 1
What it all boils down to.

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	31
16	15,000 ohm (Antenna) Twin 50,000 ohm (Cathode)	no data
17	15,000 ohm (Antenna) Twin 50,000 ohm (Screen)	no data
18	1 megohm	no data
19	1 to 60 ohms (See note)	no data
20	15,000 ohm reverse taper R is as in 19	no data

This idea is not original with "Modern Radio"; in fact Electrad has cooked the whole thing down to 20 diagrams which are shown as Fig. 1.

Circuits 1 to 7 inclusive offer the prize example of standardization advantage, for all seven can be satisfied with a **single type** of volume control, one of 15,000 ohms built to give the practical equivalent of a logarithmic resistance curve (R against rotation angle). This is the so-called "tapered" volume-control. Designed to produce increased volume as its arm is rotated to the right this control hits about 3,000 ohms in center position; it has 13,000 ohm on the right half of the turn, 2,000 on the left.

Circuits 1, 3, 5 and 7 can be installed in most receivers. The best circuit is 7 but 5, 3 and 1 are sometimes a necessity. 7 carries the same defect as 3 and 1 in that any of these three circuits results in a shorted antenna winding with the consequence of detuning of the first tuned-circuit at low volumes on strong stations. If the town is filled with locals this tuned circuit should be aligned while the volume control is set as near the short-circuit (lowest volume) position as possible. The receiver will be "out" for DX but the local selectivity, which is usually most important in such cases, will be high. Use your own judgment, accept no rules save those dictated by your observation of your customers' wants. Always install circuit 7 if possible as it reduces tube sensitivity along with antenna input: the overall result being much quieter reception.

All these circuits must be wired correctly to have them control locals properly. Notice Fig. 2A: here the wire lengths A and B are interposed between the volume control resistance and the antenna coil. When the control is set for lowest sensitivity (volume), and the antenna coil seems to be short circuited, they can represent more than enough ohmage (reactance) to allow the 50 kilowatt WTIC in Hartford to have full volume for any average living room if the receiver has about 20 microvolts sensitivity. But in 2B the antenna is shorted through the arm of the volume-control, the lowest reactance that can be got. Control is adequate. To use circuit 2B it may be necessary to disconnect the regular antenna-coil ground from the chassis so that the circuit gets to chassis only at the volume-control.

A final precaution regarding these circuits: In Fig. 2B the placement of the receiver coil and antenna terminal are frequently such, in relation to the volume-control, that both the leads from the control to the coil and from the control to the antenna will be long and nearly parallel. If so, capacity transfer will produce an effect that 2B wiring cannot overcome. In this case both the antenna lead and the coil lead may have to be run through grounded metal braid. Act according to results.

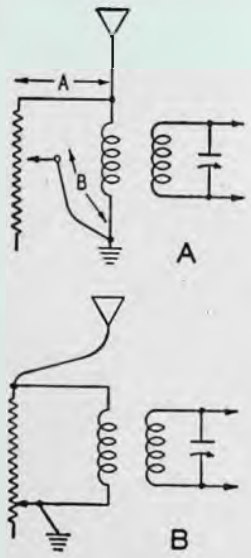


Fig. 2 Wiring Precautions.

Circuit 5 avoids the shorting of the antenna coil and consequent broadness of input circuit tuning when the control is set for low sensitivity. However, the end 3 of the antenna coil is left ungrounded by the control and some signal will get to it by capacity effect from the antenna lead. In a sensitive set with partial shielding this permits signals to leak through. This may be stopped by stopping the capacity effect—which is done by putting metal braid (grounded to chassis at both ends) over that part of the antenna lead which is inside the set. With this circuit the receiver should be aligned with the volume control set for ¾ full volume.

The chief and important point is that circuits 1, 3 and 5 can be, to the advantage of the receiver and its owner, installed in dozens of receivers now containing more complicated controls. In fact some receivers in Hartford will not reduce WTIC's volume to a suitable point without disconnecting the antenna, whereas the installation of an antenna volume-control such as has been described is sufficient of a change to eliminate this inconvenience. I recommend unreservedly that receivers equipped with only screen-grid voltage control of volume be changed to antenna circuit volume-control forthwith, wherever a strong local station is proving the former method inadequate.

Some receivers are designed to use antenna potentiometers of 2000 to 5000 ohms. A good universal potentiometer for this use is the Yaxley No. 52,025, which has 25 ohms in the left third and 2000 in the remainder of the travel of the slider.

There is one exception to all this. Some receivers have large antenna coils built honey-comb style and designed to resonate below 700 kc. This is in order to raise the low-frequency sensitivity of the receiver. Here the antenna potentiometer resistance can spoil the effect of the resonance bump. In such sets stick to the volume control devised by the manufacturer unless the lower broadcast frequencies are of little importance to the set owner. The manufacturer ought to have used sense enough to do his "bumping" elsewhere in the receiver—but who are we to argue?

In another issue of "Modern Radio" we will carry on to other service problems, interlocking with the present story—which keep handy. The other circuits of Fig. 1 will be taken up.

Incidentally, receivers that tend to blow condensers while the tubes are warming up can be relieved by installing a "bleeder"—unless the transformer is too small to stand the additional load without beginning to smell like a fire in a tanyard.

And if you make a better mousetrap Russia will hire you to teach her the trick and then undersell you.—*Dubuque American Tribune.*

"—I do not wish to miss a number. It is just about the best little magazine of its kind I've been able to get my hands on. I regret that I have not had one sooner."

J. R. Donovan, Chief WTOC,
Savannah, Ga.

"I'm all for Modern Radio and wish you success."

C. R. Rogness, W9EGG,
Winona, Minn.

"Have read too many articles by Robert S. Kruse to miss the opportunity; as to L. W. Hatry, his contributions to any magazine make it worth the subscription price alone."

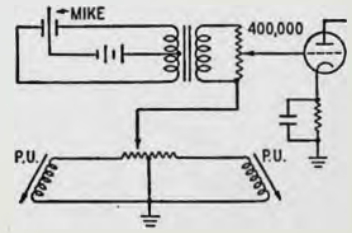
Cyril Fossey, Salt Lake City, Utah.

"My only criticism—Modern Radio should be an inch thick each issue."

Alden C. Packard, Claremont, Calif.

SWITCHLESS FADER

While lacking a number of things a fine fader should have the circuit shown here, will handle a microphone and two pickups practically and can be made



from stock potentiometers. If one cares for these dizzy announcements on a musical background that can be done also.

Harmonic Oscillators
for Station and Shop
By L. W. Hatry, Associate Editor

An extremely neat and highly useful type of oscillator is one which is operated with very strong feedback so as to give an output rich in strong r.f. harmonics which are of course spaced apart by exactly the main or fundamental frequency. Thus a highly regenerative 200 kc. oscillator will have harmonics 200 kc. apart at 400, 600, 800, 1000, 1200, 1400, and so on, while a 250 kc. oscillator will prove harmonics at 500, 750, 1250, 1500—. Thus a very stable low-frequency oscillator may be used to provide a whole series of higher frequency spots covering a wide range without coil changes. The scheme can be used at any frequency range but is well illustrated by the Day-rad test oscillator which uses the fixed frequencies just mentioned to provide spots in the broadcast range for

The Day-rad Oscillator and Output Meter

service-shop use. It includes several ingenious devices, is a good job, and no apology whatever is necessary for using it as an example of the harmonic oscillator. The ideas used in its makeup lend themselves to home-copying excellently.

Primarily the Day-rad oscillator contains the familiar regenerative circuit with the equally familiar grid-leak and condenser combination which causes modulation of the oscillation by partial blocking, which is to say periodic overbiasing, the period being determined largely by the tube and the time-constant of the condenser-leak combination. Its controls are a battery switch, a filament rheostat, and I.F. tuning control, a switch for choosing the broadcast frequencies and an attenuator for controlling the output.

A tuning control, and attennator for controlling the output and a switch for choosing frequencies. This switch has four positions, giving the following combinations:

Switch Position	Fundamental in Kilocycles	Harmonics Appearing at Same Setting
A	130 fixed	260, 390, 520 (630, 780, 910, 1040, 1170, 1300)
B	170-183 tunable	340 to 1830, position of harmonics depending on oscillator tuning.
C	200 fixed	400, (600, 800, 1000, 1200, 1400, 1600, 1800, 2000)
D	250 fixed	500 (750, 1000, 1250, 1500, 1750, 2000, 2500)

NOTE—The bracketed values are in the broadcast band.

Fortunately grid-leak modulation automatically means that the self-modulated circuit is rich in harmonics. The harmonics up to the 10th or 15th are fairly strong, allowing one with the 200 kc. fundamental to reach as high as 3000 kc. (100 meters), a useful feature.

This system of obtaining the frequencies minimizes the shielding requirements, for the harmonics are not as strong as the fundamental, and the design of the attenuator may be simple.

A '30 type tube, a 22½ volt "C" battery and four dry cells comprise the accessories for this oscillator. These fit within the carrying case but terminals are provided for the connection of external batteries of larger capacity where the oscillator is put to permanent shop use. Making such an oscillator is not difficult. Getting it calibrated is equally easy. All that is necessary is a broadcast receiver. For instance, about 400 turns of No. 30 d.s.c. wire wound on a two inch form (bunch the turns) will tune from about 3000 to 1500 meters with a .0005 tuning condenser. The proper choice of fixed condensers will give fundamental frequencies (tickler about half the size of the tuned coil) between 100 and 200 kc. The third harmonic of 200 kc. is 600 kc. and additional harmonics will be spaced 200 kc. apart, thus you would have a fundamental of 200 if the receiver dial showed oscillator signals at 600, 800, 1000, 1200 and 1400 kc. Similarly other fundamentals may be used and identified by the fact that the harmonics are separated by frequency differences of which each is equal to the fundamental.

In cases calling for many dial-spots, a fairly husky oscillator tube with 90 to 180 volts of B may be used at a fundamental of 50 kc. and thus give 30 tuning points or 20 harmonics within the broadcasting band.

Working from the suggested tuning coil one may arrive at nearly any size of coil for any useful frequency by assuming that the inductance varies as the square of the number of turns, which is to say that 800 turns would give four times the inductance, and hence twice the wavelength without changing the condenser, or 3000 to 6000 meters, 100 to 50 kc. One's assumptions will work out with no precision but they are easily corrected by changing the capacity of the tuning condenser one way or the other.

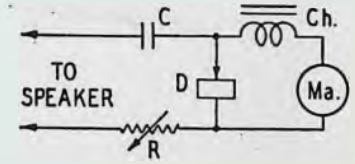
In exactly the same way one can work out a higher-frequency device whose harmonics strike the amateur bands. It is only necessary to remember the last part of sentence one of this article.

MAKING YOUR OWN OUTPUT METER

A. C. voltmeters frequently serve well as output meters. The modulation amplitude of the signal being gauged must be constant and modulation preferably at one frequency; don't try to line up on a broadcast station. The A. C. milliammeter likewise is a good output meter. Use 100 or 50 ma. range across voice-coils of dynamics. Use the voltmeter ranges above 16, such as 50, 75, 110, 125 or 150, across a magnetic speaker or the primary side of the dynamic output transformer.

The diagram shows a simple output meter, for which one can claim no great convenience, but which may be put together from the things found in the average shop, radio station, or laboratory. It is a thoroughly workable makeshift for aligning tuned circuits (I.F. or R.F.) when using a modulated signal from an oscillator.

D is a fixed crystal detector, preferably of the carborundum sort as these have good overload capacity. C is a paper (not electrolytic) condenser with a capacity of 2-4 microfarads for an a.c. voltage of at least 200. Ch. is almost anything in the form of a choke coil, providing the resistance is not too high. An audio transformer will not work well; an old B-sub choke is quite good. R is a variable resistor of almost any convenient sort with a maximum



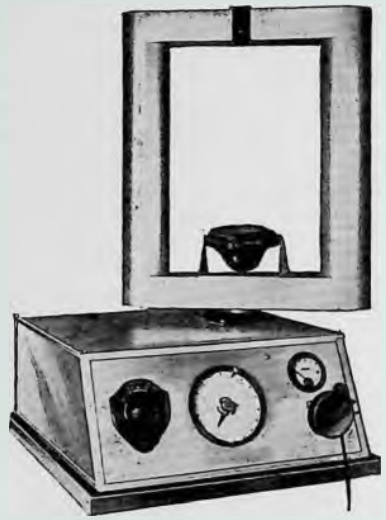
of about 5000 ohms. It should always be set at maximum when starting a test, and cut down gradually until a decent meter reading appears. Failure to do this will call for frequent meter and detector replacements. Ma. is an ordinary d.c. milliammeter with a 1 or 1½ milliampere scale.

Naturally this is not a "constant impedance" device—but neither are several of the output meters now sold. There is good reason for this; when doing receiver alignments *it is not of importance to keep the load impedance constant.* The only time when that is of any consequence is when one wishes to *measure* the output in milliwatts.

Patent 1817451 has 975 claims. Well —why not?—isn't it an adding machine patent?

A Radio Pelorus

The type of radio compass used on large vessels is altogether too large, costly and heavy for the cabin cruiser or yacht. For such vessels there has been developed by the Turret Products Co. of 24 Water Street, New York City, a compact radio compass receiver which is appropriately called the Radio Pelorus.



The tuning range of the receiver if from 450 to 1100 meters, covering a wide variety of stations on which to take radio bearings. The set uses 3 stages of screen-grid t.r.f., a screen-grid detector and a stage of audio, all designed for high gain, since audio fidelity is of almost no importance in this work. A plate-current meter on the panel is used, in working with modulated signals, the minimum meter reading being obtained when the loop is turned to the minimum-signal position. When working with signals in which the carrier is interrupted by keying the meter necessarily jumps, hence 'phones are resorted to. Both are in circuit at all times.

Since the practical usefulness of any radio compass depends on correct indications of direction it is essential to provide a correction for the directional distortions of the received signals, due to the presence of the boat's hull and rigging. In the Radio Pelorus this is done simply by means of a compensating scale (center of panel), which consists of two circles differing ½" in diameter. The outside circle is graduated in degrees to port and starboard, having the bow of the boat at the top of the scale. The pointer, which rotates with the loop, terminates at the inner circle. When the pelorus is installed stations are tuned in whose direction is known and for each one a line is drawn (more or less radially) from the end of the pointer (apparent direction) to some point on the outer circle scale which shows the true direction of the station. Thus the system which requires many words to explain, is very simple in use.

FRANCIS R. EHLE
PRESIDENT

INTERNATIONAL RESISTANCE COMPANY

NOVEMBER 5, 1931

WESTERN'S NEW TUBE

The new Western Electric general-purpose 50 watt tube has the following characteristics:

Filament, 3¼ amperes at 10 volts.

Plate, 45-95 milliamperes at 750 to 1000 volts, impedance 2500 to 4000 ohms.

Grid, 30 to 60 volts depending on service.

Amplification constant, 11-13.

THEY ARE AT LOS ANGELES

In answer to many requests we give the address of the Keller-Fuller Mfg. Co., Ltd., 1573 West Jefferson Boulevard, Los Angeles, California, makers of the Radiette Troubadour which was the subject of "A California Contribution", in our November issue.

The Practical Advisor

THE RIGHT RESISTOR FOR THE JOB

This is the first of some simplified information for experimenters and servicemen who prefer quick reference to arithmetic.

Column R shows the standard radio resistor values in ohms; manufacturer's freaks are near enough to them to make the table useful in all cases. Columns 1W, 2W, and so on refer to size and mean "1 watt", "2 watt", etc. Example —a 1,500 ohm resistor is needed to carry 50 milliamperes. Start at 1500 in the R column, go to the right until you strike a figure slightly larger than 50, which this time means 55, under 5W. Thus a 5 watt resistor will do, but will be running at full rating, therefore hot. To run "warm" continue to the right until you strike a figure about 1½ times the load current—in this case 80, which is in the 10-watt size. To run "cool" go on to a current figure twice the current to be handled, in this case 112 in the 20 watt column. Other values can be "guessed in" as follows:

Sticking to one ohmage (resistance value); doubled current requires 4 times the rating in watts, tripling requires 9 times the rating. ½ the current calls for ¼ the wattage rating, cutting the current to ⅓ calls for 1/9 the wattage rating.

Sticking to one size of resistor (wattage rating); twice the resistance drops the current capacity to .7, three times the resistance drops it to .6 of the original. Half the resistance allows 1.4 times the current, one-third the resistance allows 1.7 times the current.

OHMS	WATTS RATING (W) OR SIZE								
R	1W	2W	3W	5W	10W	20W	25W	50W	100W
100	100	140	175	223	320	448	500	700	1,000
200	70	98	120	154	225	315	350	490	700
250	65	91	112	143	208	291	325	455	650
500	44	67	75	97	141	197	220	308	440
750	37	52	61	82	118	165	185	259	370
1,000	32	45	35	71	103	144	160	224	320
1,500	25	35	43	55	80	112	125	175	250
2,000	22	31	38	49	71	100	110	154	220
2,500	20	28	34	44	64	90	100	140	200
3,000	18	25	31	40	58	81	90	126	180
4,000	15.5	22	26	34	50	70	73	103	155
5,000	14	20	24	31	45	63	70	98	140
7,500	13	18	22	29	42	59	65	91	130
10,000	10	14	17.5	22.3	32	44.8	50	70	100
12,500	8.8	12	15	19.3	28	39	44	62	88
15,000	8.2	11	14	18	26	33	41	57	82
20,000	7	9.8	12	15.4	22.5	31	35	49	70
25,000	6.5	9.1	11.2	14.3	20.8	29	33	46	65
30,000	5.8	8.1	9.2	13	18	25	29	41	58
35,000	5.3	7.5	9	12	17	24	26	37	53
40,000	5	7	8.5	11	15.5	22	25	35	50
50,000	4.4	6.7	7.5	9.7	14.1	20	22	31	44
60,000	4.1	6	7	9	13	18	21	30	41
70,000	3.8	5.3	6.5	8.4	12	17	19	28	38
75,000	3.7	5.2	6.1	8.2	11.8	16	18	26	37
100,000	3.2	4.5	3.5	7.1	10.3	14.3	16	23	32
150,000	2.5	3.5	4.3	5.5	8				
200,000	2.2	3.1	3.8	4.9	7.1				
250,000	2	2.8	3.4	4.4	6.4				
300,000	1.8	2.5	3.1	4	5.8				
400,000	1.55	2.2	2.6	3.4	5				
500,000	1.4	2	2.4	3.1	4.5				
750,000	1.3	1.8	2.2	2.9	4.2				
1,000,000	1	1.4	1.7	2.2	3.2				

RATED CURRENTS (MILLIAMPERES)

NOTE—This material is from *Modern Radio's Pocket Book for Radiomen*, see page 18.

Book Review

THE BOOK OF NRH

"Me and Little Radio NRH"; by Amando Cespedes Marin, published by Amando Cespedes Marin, Heredia, Costa Rica, Central America. 272 pages, 68 illustrations. $2.50 postpaid.

Those thousands in all continents who have listened with delight to Sr. Marin's incredible low-power shortwave broadcasting station need not be told that the Book of NRH is entrancing. It breathes that same eager and friendly enthusiasm which causes listeners in twenty countries to tune regularly to 30.8 meters for an hour at Heredia in the mild warmth of the high plateau of Costa Rica. Quoting from a letter of a reader to the author, "I have found it to be a delightful narrative, not only because of the interesting description of your difficulties in the station, but also because there is all through the book a constantly recurring suggestion of the peace and fragrance and friendliness surrounding your home in the tropics—."

Surely—here is amateur radio in its highest form.

(Please turn to Page 21)

Readrite

NO. 550

OSCILLATOR

(Licensed by A. T. & T. Co.)

$18 Net to dealer $30 list

$21 Net to dealer with output meter

If not at your Jobbers we will ship direct when remittance accompanies order.

A sturdy modulated instrument carefully made. Completely shielded with separate battery compartment. Furnished with 22½-v. and 3-v. batteries. Uses one '30 tube. Direct reading broadcast band (550-1500 kc.) and intermediate band (120-185 kc.). Also 260-262 kc. i. f. has sharp signals using second harmonic intermediate. Operating instructions attached in case cover with shielded wire leads. Very compact. In leatherette case, 6 x 11½ x 5½ in. Weighs but 8 pounds. Built to high standards.

Every serviceman should have the No. 550 oscillator to align r. f. gang condensers, locate defective r. f. transformers, adjust i. f. transformers, check oscillator stage and determine sensitivity of a receiver. A necessary instrument. Get yours today. Write for catalog of servicing instruments.

Readrite Meter Works
Established 1904
20 College Ave., Bluffton, Ohio

The "line post" (left) and a normal high-tension pin insulator (right).

The Allied Arts

QUIETING THE "HIGH LINES"

Everyone from Seattle to Key West knows what an awful row a high-tension transmission line can make in nearby radio receivers—also how fruitless it is to talk to the unhappy owners of the offending high-line, for they have no obvious way out except to re-insulate the line at an appalling cost.

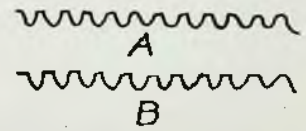
It is very pleasing to find that a new high-tension line insulator has been designed especially to prevent such difficulties on new lines. The insulator in question is made by the Lapp Insulator Co. of LeRoy, New York, and is known as the type 8052 "linepost". It differs from a normal pin-type insulator in a number of ways. As is shown by the following table:

Good, Standard Pin-type Insulator	Characteristics	Lapp No. 8052 Linepost
45,000	Rated voltage	45,000
140,000	Dry flashover	120,000
50,000	Radio noise begins	60,000
52,000	Audible corona	75,000
20%	Leakage distance	22½
5" to 10"	Distance kept dry	None
10 degrees	Deflection at 3,000 pounds pull	Practically none

In normal pin insulators the design attempts to raise the critical voltage and keep a part of the leakage path dry at all times by the use of broad petticoats. This results in a leakage path composed partly of the dry porcelain surface and partly of a wet porcelain surface. As every radio man knows only too well such a non-uniform path is ideal for generating high frequency losses and disturbances because of the abrupt changes in voltage through the system. The effect is not much different from that which causes high radio-frequency losses in non-uniform insulating materials of the moulded type. In the Linepost, therefore, the design aims at a uniform wet leakage path. This accounts for the peculiar pillar construction, with the narrow petticoats which are so designed that rain will splash over the entire surface and make a continuous, and therefore quiet, leakage path. Good electrical contact with the supporting pin is intentionally provided to insure silence at that point, and the lower splash-lip acts as both an arcing-short terminal and a means of spray-moistening the lowest petticoat. The shallow petticoats are said to prevent "pocketing" of an arc with consequent cracking, also to have such strength that the ordinary .22 calibre bullet or hand-thrown stone will do no damage. A jacketed rifle ball will not penetrate the metal base but if aimed a trifle higher may knock off part of one petticoat before being deflected. This causes no service interruptions.

O-o-o-o-o-o!

From Kosmos (Berlin), we take oscillograms A and B, of which A is the sound "oo", as made by a person and B



is the howl of a dog—a Schnautzer, who sang tenor.

That seems to settle the proper spelling for our hound's midnight song to the moon.

(Please turn to Page 22)

The Allied Arts

RECORDS AND RADIO

By Perry O. Briggs

There is no reason why "Electrical Transcriptions" should be less enjoyable than actual broadcasts—and there are excellent reasons why they should be better. It is sad to relate that the majority of transcriptions are poor simply because the job was done by a recording laboratory with inadequate equipment; a maker of 75 cent records never has and never will produce a pleasing transcription!

We are too much depressed by the thought "It's just a record". Yes, it is a record, and in earlier years it was frequently enough an ordinary actual 75 cent record running at the ordinary phonograph speed of 78 r.p.m. Today's "transcription" (if of high quality) is an entirely different thing. Little does the average listener realize how much effort lies behind a good transcription program, nor how much the record differs from the old phonograph record. Records run 10 and even 15 minutes at 33⅓ r.p.m. The reproduction is accomplished by means of a highly developed electro-mechanical pickup, capable of recovering practically everything the transcription offers, and it offers much for it was made with the one purpose of broadcasting and actual high-quality broadcast studio technique was used in the recording. The three best laboratories in New York draw much of their talent from the NBC and Columbia studios. Those artists that are under exclusive contract assume pseudonyms for the occasion! The cost of making one such high-quality transcription sometimes far exceeds the cost of a similar studio program—which must be recovered in the subsequent saving in telephone-line charges, and the time-convenience. It is also interesting to notice that in transcriptions 7½ minutes are allowed in an hour's program for the sales talk and introductions which frequently take up double and triple that time in direct broadcasts.

Advertisers have lately begun to appreciate the advantages of such transcriptions, not all of which are here mentioned. As more money is spent there will be further refinement of the recording art and it will be even more true that a good transcription can, and often will, surpass the actual broadcasts in entertainment value and technical perfection.

TOO BIG FOR US

Our good contemporary, electronics, never ceases to remind us that the "electronic art" touches all human endeavor. The argument is supported in a startling manner by an Arcturus Radio Tube Company chart entitled, "Scope of the Electron Tube", in which more than 350 kinds of uses of electron tubes are listed under the general heading of space, localized and wired electrons and 44 sub-heads such as criminology, music, chemistry, household, illumination, measurement, navigation, army, navy, high-frequency furnaces, etc.

We only regret that the chart is equal to about 8 of our pages.

TELEVISION KINK

In adjusting the background brightness of a television neon lamp it is most convenient to use a high resistance rheostat—not a carbon-strip affair but a wire-wound one of the sort shown on page 18 of our September issue. If too much modulation escapes via the rheostat place both an r.f. and an audio choke in series with it—but not in series with the lamp. The rheostat is, in the first case, connected directly across the lamp and may be called an impedance adjuster.

"Short Circuits" at W2BP *

R. S. Ould, of Washington, D. C., sends us a nice new U. S. patent—on a rose! If anyone doubts this he may send us a request for a copy of the patent, being sure to enclose a self-addressed and stamped envelope. Don't paste the stamp on too tightly as we may wish to use it for some other purpose.

. ...

Shortwave fading is like the bandsaw; there's always as much going down as coming up.

. ...

If all the listeners were put end to end, with their feet to the northeast they would still be inclined to blame static and fading on the neighbors.

. ...

By the way—the idea of the pentode was supposed to be that it saved a tube or two. This somehow fails to account for push-pull pentodes in 11-tube sets.

. ...

Anyone know a station of any sort that is operated more snappily than WCK of the Detroit Police Department?

. ...

We know a fellow that uses $1 meters but doesn't trust an adding machine.

. ...

No lamp-posts have been provided for weak and overstimulated business to cling to, and so they are apt to cling to one another. The embrace is called a merger.—*Henry Ford.*

. ...

The lad that used to turn in front of a line of traffic without giving hand signals now operates a transmitter without bothering to listen.

. ...

"The over-enthusiastic televisionists are making their big mistake in thinking that television will repeat the glamorous history of radio broadcasting, when every sign indicates that it will not and indeed cannot. Conditions are altogether different from what they were ten years ago. Today we have a Federal Radio Commission, an aggravating patent situation, an overabundance of radio factories, a lot of politicians with radio axes to grind and—worst of all—a sophisticated buying element that has been spoiled by high-quality broadcasting and high quality talking motion pictures." Robert Hertzberg in "Radio Design".

. ...

In an ad. we read: "The resistors in a broadcast receiver must sometimes run from breakfast to bedtime before they rest."

See—one of them went to sleep right where it stopped and the rest are walking home mighty slowly.

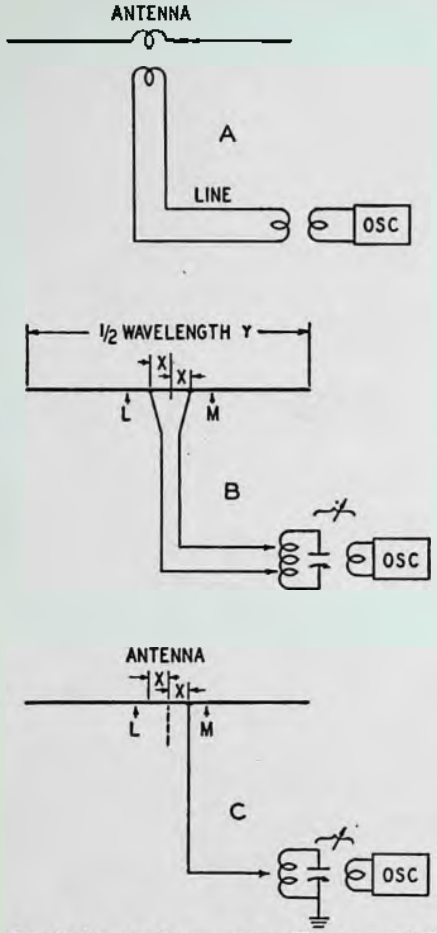
. ...

Patent 1823697 is on special handcuffs to keep a prisoner in the back seat of a police Ford from whacking the driver.

* Station and column operated by Boyd Phelps.

WE WERE WRONG

An incorrect version of the illustration herewith appeared in the October issue of "Modern Radio"—incorrect because the dimension Y was shown as the half-length of the antenna whereas it



should be as shown now. The corrected illustration was run in the November issue—and the printer forgot the paragraph calling attention to the change! He is a good printer, too.

However—we believe it is all right this trip and will explain again that the feeder is supposed to strike the antenna at such a point that the X distances are 1/7 of the Y distance.

For simplified adjustments see October and November issues.

A faultless design is one that hasn't gone into production.

THE BAZAAR

Please abide by these rules:
1. 5c 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.

Baird Wired S/W and television receiver in cabinet, new, regular $110, sell for $49.50. Regular $100 televisor, also new, sell for $44.50. Harold Johnson, Bloomfield, Conn.

The Bazaar sold a $55 receiver for one amateur ten days after the issue carrying the ad was mailed. Try it, it can work for you. If the Bazaar does not produce results we'll refund. Your ad sent in now will appear in our February issue. "Modern Radio," 101 Allyn St., Hartford, Conn.

Every amateur or experimenter likes to own a good broadcast receiver. Standard well-known brands as well as Pilot, Insuline, National, etc., whom every experimenter has familiarity with. Trade in your old battery or two or three year old electric for an up-to-date receiver. Terms are cash, you save by it. Write us. Hatry & Young, Hartford, Conn.

FOR SALE—W. E. 250 watt sockets and good imitations, $3; 1000v, 300 ma, double commutator Esco generator coupled to ½ horsepower 110-220v. single phase Westinghouse motor, both units good condition, cost $175, make offer; Camera, improved Seneca view, 6½" x 8", bellows and racks extend 27", lens f.6.3 Zeiss convertible anastigmat, B. & L. shutter 1/100th to 3 sec. and time. Has levels, reversible back, many adjustments, bright nickel finish, 6 double cut-film holders, focusing cloth and carrying case. Ideal for model, portrait or scenic work. Complete, $40. Quartz blanks cut to size or high precision crystals any reasonable frequency, reasonable prices. Boyd Phelps, Box 247, Hicksville, L. I., New York.

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

AN ALTOGETHER DIFFERENT RECEIVER
HOW TO USE RESISTORS IN TANK CIRCUITS
SAVING C BATS. IN 'PHONE STATIONS
SIMPLE MODULATION METERS
HIGH-GRADE NOTHINGS
THE TYPES OF AMPLIFIERS EXPLAINED MORE SIMPLY
TUBE-SAVING TRANSMITTER LAYOUTS

New and Improved

I. C. A. CONQUEROR

Short and Long Wave Receiver
Pentode and Variable-Mu Tubes,
Ear Phone Jack,
Phonograph Connection
14 to 1000 Meters
Models for A.C. and D.C.
Currents and Batteries

AT NEW LOW PRICES

The new 1932 I. C. A. Conqueror employs an entirely new circuit. 100% more efficient than last year's model. Far surpasses any other receiver on the market in workmanship, electrical and mechanical efficiency, selectivity and volume.

Models are available for A.C. or D.C. currents, 110-220 volts, and battery operation.

We call particular attention to the D.C. Model. No other manufacturer has yet offered the radio public a short wave receiver that can be operated from a D.C. line circuit 110 or 220 volts.

I. C. A. CONQUEROR POWER-PACK

This new Power Pack is carefully designed to maintain the so necessary constant voltages mandatory for short-wave work. It is fitted to the Conqueror, is hum-free, strongly built and will give great satisfaction.

Send for New 44 Page Free Catalog

The new I. C. A. 44-page catalog illustrates, describes and prices the world's most complete line of radio and Television Sets, Parts and Accessories. Write for your copy today.

INSULINE CORPORATION OF AMERICA

23-25 Park Place Cable Address "INSULATING" **New York City, U. S. A.**