1932

MODERN RADIO

EDITED BY ROBERT S. KRUSE

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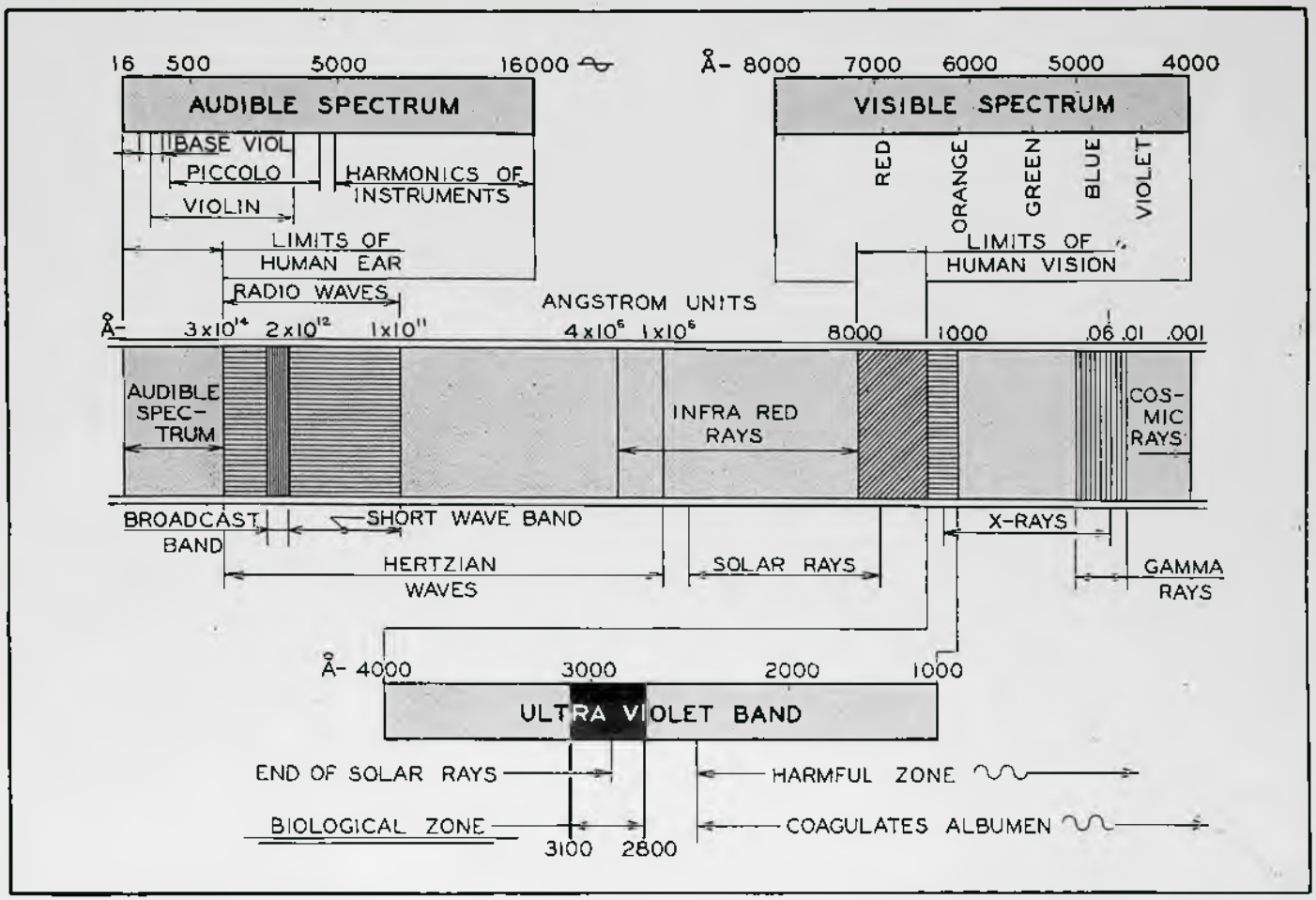
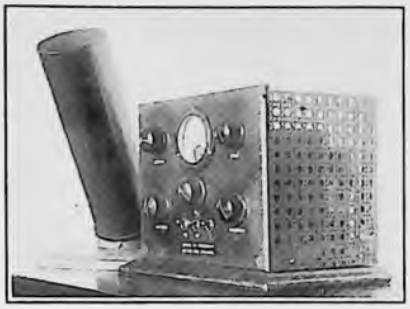
THE ETHER AND AUDIBLE SPECTRUM



Courtesy Arcturus Radio Tube Co.

TESTING RADIOPHONES WITH THE CATHODE-RAY TUBE

By Ralph R. Batcher*



A cathode-ray tube magnetically shielded (left) and its power supply.

THE METHODS DESCRIBED HERE HAVE JUST BEEN USED AT ONE OF THE OUTSTANDING BROADCASTING STATIONS TO CORRECT ERRORS NOT PREVIOUSLY DISCOVERED WITH ORDINARY MONITORING EQUIPMENT.

The three things required of a modern radiophone transmitter are, of course,

1—Frequency stability.

2—High modulation percentage.

3—Good fidelity, that is undistorted reproduction.

These will now be taken up in turn:

1—Frequency Stability

Frequency comparisons can be made about as conveniently through other means as with the cathode-ray tube. These means are well known and need not be discussed further here, although something will be said in a later paper on such comparisons.

2—Measuring Modulation Percentage

By way of review, if in Fig. A the normal or unmodulated carrier is as shown at N, then when modulation starts it will swing up and down as shown by the peak P and the minimum M, and the percentage of modulation will be:

$$\% \text{ modulation} = 100\ (P-M)/(P+M)$$

Since M and P are easily measured on the cathode-ray screen the percentage modulation is easily discovered. One may, for convenience use a pair of dividers, transferring the measurement to a scale.

However—we are ahead of ourselves—as yet we have not even set up the tube for making the measurement.

There are several ways of making such a setup, and fortunately the simplest one gives the most information. For instance if we were to undertake to produce a picture of the wave train as in Fig. 2A we would need to produce the horizontal deflection by means of a "sweep circuit" or "linear time base oscillator" (such as previously described) connected to the horizontal-deflection plates. The vertical deflection may be produced by a pickup coil placed near the antenna coil and connected to the vertical-deflection plates. However, to obtain a nice clear picture resembling that of Fig. 2A we would need a steady-frequency audio input, and in order to find out anything about the linearity of the modulated stage we would need a known audio wave form and some knowledge of harmonic analysis. If we didn't have these things we could, of course, still determine the upward and downward modulation from

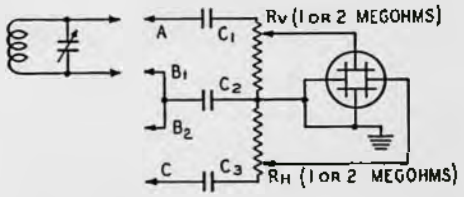


Fig. 1. Test circuit. As usual the circle represents the cross section of the cathode-ray tube and the lines inside are the four deflection plates. The two vertical lines are the plates producing horizontal deflections, the horizontal lines are the plates producing the vertical deflections.

the relative height of the normal carrier N, the peak P, and the minimum M—but simpler schemes will do all of these things.

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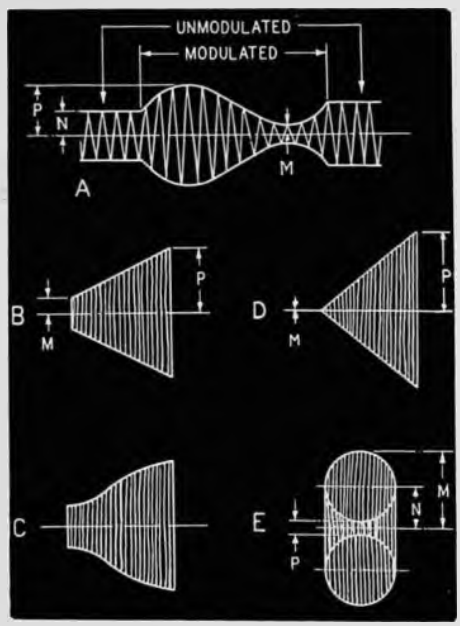
Simpler Circuits.

Most of the difficulties can be avoided by using the circuit of Fig. Fig. 1. Note particularly that two of the deflection plates of the tube are grounded. The vertical deflection is obtained by connecting the leads A and B to the tank circuit of the Class C modulated tube (or even better, to the antenna), or else to a wavemeter circuit coupled to the same. C1 and C2 are of about 1 to 10 micro-microfarads, not over that. The horizontal deflection is provided by the modulation (audio) voltage. To obtain this deflection the terminal C3 is connected to the modulator plate, or to the secondary of the modulation transformer plate if condenser-resistance coupling is used, or to



The type of figures which appear on the cathode ray tube-screen. The separate lines are not actually as distinct as shown, tending to run together and produce a uniformity illuminated area. This is quite satisfactory since the outer shape of the area provides all the information. Figure A requires a timing oscillator or sweep circuit, the others call for no equipment beyond the bare transmitter and the cathode-ray device.

the secondary of the modulation transformer if that type of coupling is used between the audio and r.f. tubes.

For many tests, especially with low-powered transmitters, it is possible to omit (in Fig. 1) the condensers C1 and C2, also the resistor Rv. The tuned coil can then be moved or rotated to control the amplitude of the deflections. Another way of simplifying this part of the circuit is to omit the tuned circuit (leaving C1, C2 and Rv in place) and connecting directly the clips A and B1 directly to one of the tuned tanks in the transmitter. Before doing this, better consider any d.c. voltage that may be present in the tank circuit and be sure that C1 will certainly "hold" it.

Similarly the horizontal deflection plates (see Fig. label) can be connected directly across some portion of the audio amplifier where there is an a.c. (audio) voltage drop but no d.c. drop, whereby C3 and Rh can be omitted. For instance the leads B2 and C can usually be connected across the secondary of an audio amplifying transformer without affecting the normal load of the transformer, and without introducing any d.c. voltage into the cathode-ray tube. The idea of so carefully avoiding d.c. voltages is of course that such a voltage will move the entire figure off-center, or even entirely off the cathode-ray screen.

Now IF the modulation is 100% and without distortion there will result a figure like D. Note that if our percentage modulation equation is applied to this figure it will read:

$$\% \text{ modulation} = 100\ (P-0)/(P+0)$$
$$= 100\ (P)/(P) = 100\%$$

If the modulation is undistorted but less than 100% the figure B will appear, while if the Class C tube is non-linear we will have figure C. The transmitter can then be worked on and at any moment you can SEE WHAT IS GOING ON. The commonest defect of all, will of course be that there is 100% modulation (or even more) but with distortion in either the audio amplifier or the modulator. The present test does not show defects in the audio amplifier—that comes in a moment—but will, of course, show the condition of 100% but DISTORTED modulation in the form of a figure like D, but with curved sides. The Class C bias and r.f. input are then adjusted until a figure like D appears.

Exceptions

If the audio frequency happens to be out of phase one may see none of the figures just described and instead there

(Please turn to Page 20)

LABOR-SAVING SHORT-WAVE CHART

A Batcher Abac

Ralph Batcher* is well known for his book of radio charts similar in character to the one herewith. As this sample proves he still uses his spare time and slide-rule saving the rest of us work.

The chart is very simple to use. Pick a value of inductance and a value of capacity on the chart. Lay a rule connecting those two points in a straight line from the microhenries scale on the left to the micromicrofarads line in the center. If the rule is long enough it will pass across the meters (wavelength) line on the right. The point where the rule crosses meters give the wavelength to which the inductance and capacitance chosen will tune.

Or connect a wavelength and an inductance and find the capacity; or connect a wavelength and a capacity and find the inductance.

If the table seems shy, double BOTH capacity and inductance to double wavelength. This extends it to any figure. Or, if you have an inductance outside the range of the chart, take a value half that or ⅓ or ¼ to fit it in the scale, then, if half is used multiply meters figure by 1.4, if ⅓ by 1.73.

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TAPPED COILS FOR 1933 SHORT WAVE CONVERTERS

By Richard F. Shea

In this article is described an improved short-wave converter circuit used with great success, tuning from 15 to 200 meters, with tapped coils for both oscillator and detector units. The advantage of tapped coils is in simplicity, reduced cost, and less switch capacity—therefore improved sensitivity. A converter using

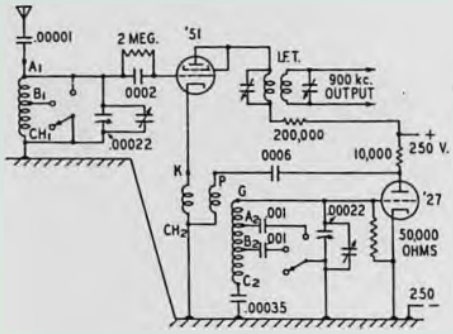

Fig. 1. Circuit of the 1933 converter. The secondary terminals of I.F.T. are connected to the antenna and ground posts of a broadcast receiver tuned to 900 kc. after which the primary and secondary trimmers of I.F.T. are adjusted for strongest "background." Quietest reception is obtained with a T.R.F. broadcast receiver.*

this circuit and with an additional i.f. stage tuned to 900 kc. (the intermediate used here) has consistently pulled in the European 25 meter broadcasts on a fairly sensitive T.R.F. set, bringing them in with pep about equal to almost local reception. The image ratio is about 10-1, when tracking properly, and the noise ratio is excellent.

Figure 1 shows the circuit and constants. Figure 2 illustrates the construction of the oscillator coil. The main coil (grid coil) is wound in three parts, as shown. All windings are close wound, and the spacings between the sections of the grid coil are shown. The plate and pick-up coils are wound about centrally between the sections, and all coils are connected together and to the soldering lugs as shown. Points A, B, and C go to the points of the switch through condensers of .001, .001 and .00035 μμfd., respectively. (See Fig. 1.)

Fig. 3 shows the detector coil, also wound in three sections, with their connections, spacings and other constructional details.

The ranges of these coils, used as shown in Fig. 1, with the trimmers properly adjusted, are as follows:

Oscillator:

(1) 9.0-19.4 Megacycles
(2) 4.2- 9.6 "
(3) 2.3- 4.5 "

The corresponding ranges of the detector are:

(1) 8.1-18.5 Megacycles
(2) 3.3- 8.7 "
(3) 1.4- 3.6 "

TABLE OF COILS

Coil No.	Turns	Wire
1	6	No. 28 D. S. C.
2	4	No. 32 D. S. C.
3	2	No. 32 D. S. C.
4	11	No. 28 Enameled
5	3	No. 32 D. S. C.
6	5	No. 32 D. S. C.
7	27	No. 28 Enameled
8	5¼	No. 28 D. S. C.
9	13	No. 28 Enameled
10	34	No. 28 Enameled

It must be borne in mind that it is impossible to make such an all wave system track on all bands perfectly. By using the correct series condensers and properly adjusting the minimum capacity, all three ranges can be made to track at the two extremes but all cannot be made to track throughout, as the i.f. is a different percentage of the detector frequency at the extreme frequencies. Thus, if we adjust the split condenser

* I.F.T. may be a 175 kc. unit removed coils, condensers and shield from a broadcast receiver. From ⅓ to ⅔ of the turns are removed from each winding by small installments until it is possible to tune to 900 kc. (when connected to the receiver) with the IFT trimmers near minimum setting. In some receivers best response is obtained when the original antenna transformer is disconnected from the first tube's input grid (top cap) and one lead of IFT run to this point with the other run to chassis as before. The secondary of I.F.T. must then be returned.—Editor.

plates to make the detector and oscillator follow on any one band the other two bands must necessarily go out of tracking at some spots in their ranges. The only possible thing to do is either compromise by adjusting so that fairly good tracking is obtained all over, or else trim carefully for the lowest band, where best tuning is needed to give good reception on foreign stations, letting the lower frequency bands suffer somewhat, as there is usually less need for all this pep here.

A few words about this oscillator. When using tapped coils for an all-wave oscillator quite some difficulty is run into in obtaining the proper compromise of tickler turns. If too many are used the range will be materially cut down at the high frequency range due to reflection from the plate circuit, while if too few are used the oscillator will refuse to percolate at the low frequency end. Also, the tickler must not be too far from the smaller section of the

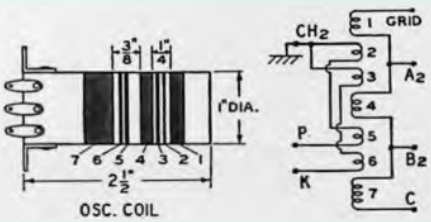

Fig. 2. The oscillator coil system labeled to correspond with Fig. 1.

secondary, or the oscillator may stop at the low frequency end of range 1. Another effect noticed with tapped coils is a tendency to instability at the extreme high frequency end. The plate coupling condenser has very pronounced effect on this, and best value has been found to fall between .0005 and .0007 μμfd. Higher value than this may produce a violent disturbance at the high frequency end, while lower value will stop the oscillator at the low frequency end.

Another point to mention is that it has been found that the variable-mu type of tube is a better high frequency detector than the ordinary screen grid tube from the noise standpoint. When using a 224 tube for a detector considerable trouble was experienced with a periodic disturbance, reminiscent of the noise we used to have due to leakage between cathode and heater in the earlier models of a.c. tubes. Using the 551 or similar variable-mu tubes seems to cure this.

One last suggestion: It has been pointed out that it is impossible to make all ranges track perfectly. Of course, the use of a trimming condenser would help this, but the additional minimum

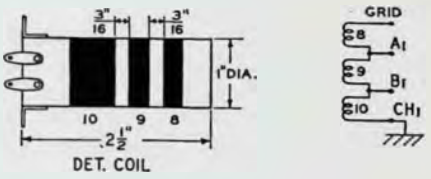

Fig. 3. The antenna-to-detector coil.

capacity from this would ruin things by making a much bigger tuning condenser necessary. However, it is suggested that our old friend, the variometer, can help us out here. What is suggested is to take such a coil as illustrated in Fig. 3, reduce the turns to possibly 2, 11 and 32 turns, and stick a small rotary tickler inside the coil, about in between the two smaller sections. This will allow a small variation in inductance, without increasing the minimum, and thus requires no change in circuit details. The effect will be most at the high frequency range, and the condenser gang should be adjusted at the low frequency band, the trimmer taking care of the other bands. The writer would greatly appreciate hearing through "Modern Radio" from anyone making this up.

WSM of Nashville now has the tallest of all antennas—878 feet.

Common Modulator Mistakes

By Robert S. Kruse

• • •

"The antenna ammeter is a liar"—The Book of Beep.

The demand for our 1931 modulation articles has exhausted the issues carrying them. Since the demand continues the story is here retold in 1933 form.

Too frequently it is believed that all is well with a radiophone when (A) it sounds fairly well and (B) the r.f. meters rise 22% or more when a steady note is sung or whistled into the microphone.

A radiophone may pass both tests, be understandable and even reasonably "like a good broadcast station for fidelity"—and still be far below the possibilities of the same equipment with a few changes and adjustments, each of which we will first name and then detail briefly as to cause and cure.

C—Checking the Class C r.f. Tube

Though the r.f. meters rise the "sacred 22%", the Class C r.f. stage may not be operating in a linear manner, either positive or negative peaks being too large. This sounds considerably more

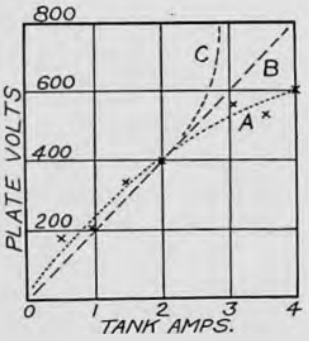

Fig. 1. Curves such as obtained while testing Class C r.f. tube-to-be-modulated for correct operation, and correcting its faults.

formidable than it is, though one may as well admit that the disease is so common that one of the best known broadcasting stations in America was recently found to be clipping off its negative peaks, and practically EVERY amateur radiophone so far examined has done more or less of it until changes were made.

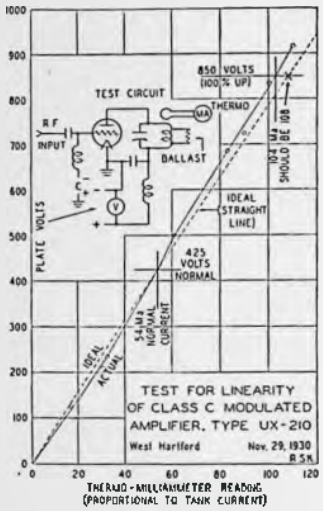

Fig. 2. Experimental curve on a well-proportioned Class C stage-to-be-modulated. The circuit shown is a variation of the one described in the text.

The first test is to determine if the Class C r.f. tube is really ABLE to respond in the proper "linear" or "proportional" manner when modulated. We will worry about the modulator itself a little later. By linear operation we mean that the r.f. current in the tuned tank circuit of the Class C tube should increase or decrease in direct proportion to the plate voltage on that tube, as in Fig. 1. Thus if the tube is usually run on 400 volts supply and has a 2 ampere tank current, then the tank current should rise to 3 amperes at 600 volts and 6 amperes at 800 volts. There is no need to go higher than twice-normal plate voltage.

How to Test

To make the test the modulator tube

is removed from its socket and an r.f. meter either put into the tuned tank of the Class C tube or else coupled to it. The station's supply of resistors and spare B "subs" is then gathered and various plate voltages are applied to the Class C tube—the plate voltmeter and the r.f. tank meter being read each time. Since the meter readings are ordinarily odd ones we will probable emerge with some rather ragged "points" such as suggested by the "X" marks in Fig. 1. However they justify the first curve A—and it is very evident that something is far from well, for the curve is anything but "linear"—meaning straight. The effect is clearly due to regeneration AND THIS IS WHAT HAS AILED 8 out of 10 sets which have been examined. In "The Modulated Tube Without Batteries" we showed how regeneration may be reduced by using gridleak bias on this tube —all details are given in that paper.* If this does not effect a cure, there is need of improved r.f. plate chokes and bypasses (route the latter directly to the filament centertap of the Class C tube itself—not to some other place on the

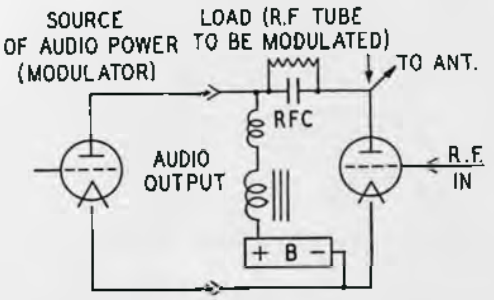

Fig. 3. This looks alright, though there should be an r.f. choke in the modulator plate lead. It will BE alright IF (and only if)

(A) The path through the B supply has a very high audio impedance so as to prevent waste of audio power through this circuit.

(B) There are no large audio impedances in series with the r.f. tube to prevent audio power reaching it.

Figs. 4, 5 and 6 show how easily these rules may be violated.

shield or some general-purpose ground), or perhaps the neutralization needs checking up—it generally does about once a week below 80 meters unless one uses a screen-grid Class C tube. When the regeneration is taken out we get something like curve B—and now we KNOW that the Class C stage is O. K.

If curve C appears the r.f. input from the buffer is too low. In most amateur stations there is no danger of this. The class C grid is usually over-driven violently which in turn makes high demands on the crystal tube, whose voltage must be raised to 400 volts or more, whereupon frequency-drifting results as the heavy load is thrown off and on. The proper operation is, of course, with the crystal tube running constantly at some moderate voltage, and the buffer taking just enough input to drive the Class C tube fully—just a little more than enough so that we can obtain curve B.

Now Will it Modulate?

The Class C tube is now right, but this does not guarantee that the modulator is able to swing the Class C tube fully and properly. The only real guarantee that this is being done comes NOT from watching an r.f. tank or antenna meter, but from some sort of peak voltmeter, or from a cathode-ray oscilloscope. The second method is described in this issue by Mr. R. R. Batcher who shows how to use it, the other method will be shown a bit later. If neither of these devices is at hand one must inspect the chances of failure carefully and hope that they have all been cured.

D—Checking Up the Coupling System

Even when the modulator is large enough, the Class C tube is linear and a steady note test produces the sacred 22% rise in antenna current, it will often be found that the modulation seems quite low when talking and that monitor or distance tests show the best effect with more audio input than needed for the steady note 22% business. (This is provided by louder talking than seems necessary for the steady note test, or by advancing the gain control.) In this case one may suspect that the coupling between the modulator and the Class C tube is not too good, although it probably works very well at the medium frequencies where the whistle test is

* "Modern Radio", Nov., 1932. Copies at 25c.

usually made. This can best be shown by example. Figure 3 shows the essential parts of a certain small transmitting station's modulation system, a run-of-mine "100% modulation system". Table A shows what the thing actually did when tested. YET THIS STATION PRODUCED A VERY GOOD "SACRED 22% RISE" TEST WHEN WHISTLED TO, BECAUSE THE OPERATOR ALWAYS WHISTLED AT ABOUT 900 CYCLES. Just the same it transmitted

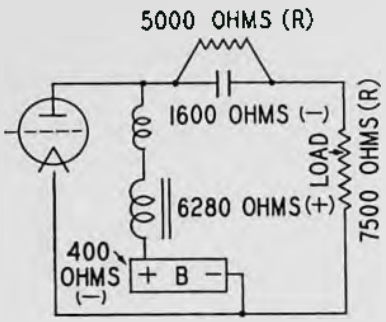

Fig. 4. Typical badly designed small radiophone using 500 volt plate supply with a '50 tube to modulate a '10. The drop resistor is 5,000 ohms, its bypass 1 microfarad—a common combination. The condenser impedance at 100 cycles is 1600 ohms—almost one-quarter as much as the r.f. tube's plate resistance! The choke is a cheap 30 henry (?) affair reduced to 10 henrys by the plate current of 90 Ma. It offers only 6280 ohms impedance to waste of audio through the B supply.

With the '50 audio tube on the edge of overload the set was barely able to produce 55% modulation.

The 7500 ohm resistance represents the Class C plate circuit into which we are so unsuccessfully trying to put audio power.

indifferently because the low notes couldn't get through the undersized bypass around the 5,000 ohm resistor—but could almost as easily escape through the inadequate modulation choke. On the other hand at 3,000 cycles (see Fig. 5) the excessive distributed capacity of the modulation choke let the audio escape—but in between at about 1,000 cycles the affair was semi-resonant and worked fairly well on whistle tests. Result—tiny speech with only fair intelligibility and no "character".

The cure was obviously some readjustment in constants without any change in diagram. Fig. 6 shows what took place with slight changes. Note that the modulation UPWARD was 90% to 99% over the useful voice range. The downward modulation was—alas—about 102% to 110% and the negative peaks were being clipped off a bit. Still the thing sounded very well at that and was, in fact, better than most of those tested.

High Hat

However we decided to make it a very high hat affair and put another '50 in parallel with the first and a 10,000 ohm resistor across the audio system as shown. This power-wasting device pre-

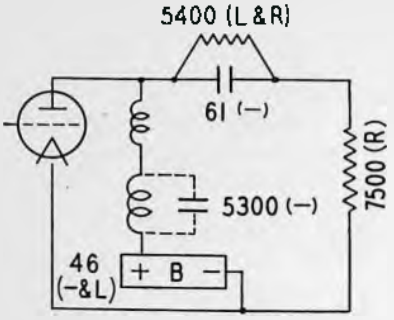

Fig. 5. The circuit of Fig. 4 examined at 3000 cycles. At this frequency the resistor bypass will serve since its impedance is now down to 61 ohms—but the same effect has caused the modulation choke (which has distributed capacity galore) to drop to 5300 ohms impedance. Again it fails to do business and the measured modulation at audio overload was but 48%.

PERFORMANCE

A—With circuit as in Figs. 4 and 5.

Frequency Cycles Per Sec.	% Modulation at Audio Grid Overload
100	54
1000	60
2000	55
3000	48
5000	30

Negative peaks not sufficient to cause cutting.

vents the audio system from being so unequally loaded on the upswings and downswings, therefore reduces tendency toward negative peak-cutting.

Class B

When using a Class B modulation device which shows tendencies toward negative peak-cutting, put a resistor across the secondary where it will use up no d.c. power—only the excess audio on the negative swings. Even so crude a thing as a listening test will show the improvement—and until one has done a little measuring it is hard to believe how terribly crude a method one is using when listening to one's own chatter or

when depending on the reports of other amateurs who are mainly pretty decent fellows and don't care to report the truth—especially when it may be a heterodyne interference that makes the thing sound that way.

Bugs

It is customary to calculate amateur modulators so that the full audio output rating is barely sufficient to produce 100% modulation. Such a rig seems practically invariably to cause negative-

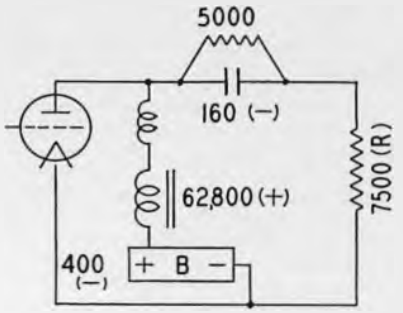

Fig. 6. The same circuit as in Figs. 3, 4 and 5 but with changes in constants, as follows:
(A) Resistor bypass increased from 1 to 10 microfarads.
(B) Cheap modulation choke replaced by 5 chokes in series, each 20 Hy.

Measured modulation now above 90% over most of the range—WITH NO CHANGES WHATEVER IN THE AUDIO AMPLIFIER. The "quality" (meaning fidelity) was greatly improved also.

PERFORMANCE

B—Same system with constants of Fig. 6.

Frequency Cycles Per Sec.	% Modulation at Audio Grid Overload
100	90
1000	94
2000	92
3000	90
5000	84

Negative peaks cut about 10% at 1000 cycles, less at other frequencies.

C—Same system with a second '50 placed in parallel with the first and the "wasting" resistor of 10,000 ohms across the modulation choke.

Frequency Cycles Per Sec.	% Modulation at Audio Grid Overload
100	95
1000	100
2000	100
3000	95
5000	83

Negative peaks clipped slightly at 1000 cycles only.

peak clipping while about 50% increase in the size of the modulator greatly decreases the tendency. An adequate modulator is therefore cure No. 1. However this is a big subject and must be detailed later in a separate article,

STEELS

Data sheets C-100-E and C-100-M of the Allegheny Steel Company at Brackenridge, Pa., give the core losses in watts per pound and per kilo, for 12 well-known transformer sheet steels, in gauges 22 to 29 inclusive, when worked at a magnetic density of 10,000 gausses, which is to say 64,516 lines per square inch.

MORE ON DYNAMOMETER METERS

From a letter of Mr. R. D. Hickok, President of the Hickok Electrical Instrument Company, is quoted as following:

"The movement used in Hickok Dynamometer Meters is very simple and consists of but two coils only, a fixed field coil, which is embraced by the moving coil. The size, shape and relation of

these coils results in a very efficient movement in which the scale is entirely uniform in a wattmeter, while in the voltmeters and ammeters the scale increases uniformly—as in a slide rule.

The moving coil is wound of aluminum wire, resulting in a very light and rigid structure. Damping is secured by a suitable vane operating in an air chamber.

These instruments have the advantage over the magnetic vane (moving iron type. Ed.) that they are correct at d.c. and at all frequencies up to 5,000 cycles. The dynamometer type instrument lends itself for many special uses such as direct-reading mutual conductance meters, harmonic analyzers and other special adaptions."

Bringing the Amateur Receiver and Transmitter Up to Date* (Part 2)

By Robert S. Kruse

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For the reasons given in Part 1, automatic volume control will be discusssed only very briefly.

The fearsomely named 55 and 85 tubes have been discussed before and need not be gone into here. The general idea is the same as explained for the Wunderlich tube, and similarly the tube comprises a detector and a self-contained triode amplifier. The only difference is that the Wunderlich tube is a gridleak detector with the advantage of sensitivity, while the 55 and 85 are diode detectors with the advantage of power-capacity.

Therefore Fig. 2 applies directly.

Simpler Schemes

One can do the whole thing with ordinary tubes, and Figure 4 shows one scheme that works rather well, though without great fading range. This isn't altogether a defect as the noise isn't so terrible when a signal goes out. In passing—resistances are most important in a.v.c. systems and the addition of an ohmmeter is strongly urged.

Hand Volume Control

When automatic volume control is being used, there are two possible sorts of hand control to set the level at which the a.v.c. is supposed to hold the signal. The simplest thing is to put a potentiometer—or even a rheostat of half a megohm or so across one of the audio grid circuits. Alternative ways are too numerous to list—and in general are audio controls or combinations of them with antenna-input controls.

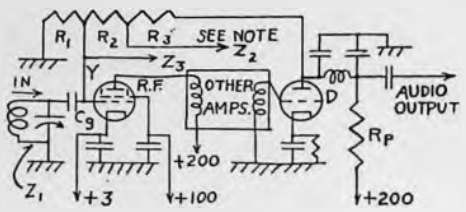


Fig. 4. A limited range A. V. C. system easily added to existing receivers. If the r.f. tube is a 24 and the detector a 27 the voltages will be about as shown and resistors as follows: Rp = 250,000 ohms, R1 = one meg., R2 and R3 = 2 megs. each. Change as needed for 58, 51 or 35 tubes. Y need not be connected as shown. If preferred, cut at Z1, transfer Cg to this gap and connect Y to lower end of tuned coil. If another r.f. stage is to be controlled use lead Z2 in same manner. If an i.f. stage is to be controlled use lead Z3 through a ¾ meg. resistor to the i.f. grid. Many variations are possible.

Note: A zero has been omitted from the cathode voltage shown, 30 is correct for 24, and on up to 60 for other tubes.

R.F. Controls

When there is no intention to use a.v.c. the best controls are those that operate elsewhere than on the audio system. Ignoring the "IN" position of the switch, in Figure 4, let us assume it has been thrown to the "UP" or "Hand Control" position. Now R1 should be of about 400 ohms, R2 of 5,000 if it's the first detector of a super, or 450 if it isn't an i.f. tube. If it is a detector followed by audio, this tube

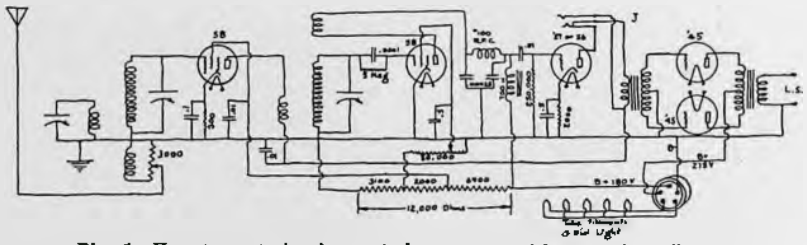


Fig. 5. How to control volume at the antenna without tuning effect.

*Abstracted from a paper read before the 1932 Amateur Radio Convention at Topeka, Kansas.

must not be controlled. R4 is a "reversed taper" 15,000 ohm control and R5 is so chosen that there will be 30 volts across R4 when it is set for lowest volume. If 58 tubes are used, provide 40 volts—if 35 or 551 tubes, provide 50 volts.

Complications Enter In

It isn't always so simple. In T. R. F. sets intended for c.w. reception with an oscillating detector, one will change the beatnote badly with such a control—and if there isn't even one r.f. tube (in 1932????) the thing is out of question. Only one chance remains, to control the input from the antenna as in Figure 5, which is a diagram of the National Company's SW-58 receiver. Even this simple scheme will not work out unless inter-

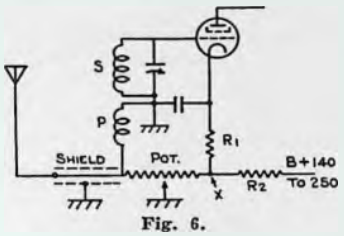


Fig. 6.

locking between the tuned circuits is most carefully wiped out. This story was told in our January issue.*

Where two stages of T. R. F. are used—or else where it is not intended to oscillate the detector, the very effective scheme of Figure 6 is to be used. The potentiometer is again of 15,000 ohms, R2 is chosen to produce 30 to 50 volts across it as before, and R1 is 400 ohms. If the set is a "super" the first detector cathode is connected to "X" through 5,000 ohms.

THE C.W. RECEIVER

The story of the 1933 receiver for c.w. was told in one meaty article by Frank C. Jones in our November issue—and what a receiver that is! Economical to the last degree, simple to operate—but WOW!

Next month—The Transmitter

* Copies at 25 cents.

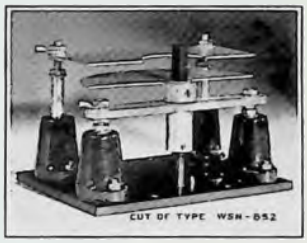
HOG WILD

A dozen new tubes have been released this year—and nobody knows why. We are hearing loud wails from dealers, from jobbers and from the unhappy makers of set analyzers that must be done over every ten days. Nobody knows what is likely to last—everyone is sure to be stuck with dead stock.

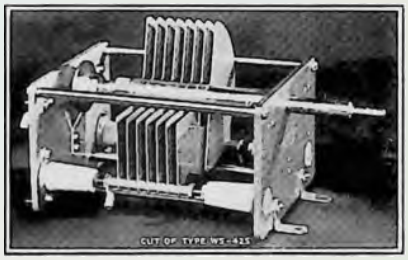
Certainly there is no sane reason for making things worse by building each type in three filament voltages and with 5, 6 or 7 pin bases. You didn't know they now have 7 pins? Good Lord—by the time this is printed someone will have devised a 9-pin base and thought of two more needless filament voltages.

NEW CONDENSERS

The Wireless Shop line of variable transmitting condensers has been redesigned to use a special insulation known as "Coorsite" in the form of sub-



Type WSN-852 for neutralizing 852 tubes up to 3500 plate supply volts.



Type WS-425, .00025 for 4000 volts.

stantial pillars. The plates of all types are rounded and polished to increase the breakdown voltage. The shafts are ½", one end being turned down to ¼" to receive standard dials while a 1" disc near the other end provides a contact surface for the laminated bronze spring which carries the current to the rotor. The shaft is adjustable endwise without disturbing the alignment. Further information is available from The Wireless Shop, 150 Glendale Blvd., Los Angeles, California.

THE GERMAN RADIO EXHIBITION

By W. F. Cotter

The annual Radio Show of the German broadcast industry recently concluded in Berlin, shows an amazing step forward. Where, previously, engineering efforts had been confined to obtaining the utmost efficiency per tube, at the expense of simplicity of operation and with the probability of higher unit cost, the display this year shows apparatus economical in design, of attractive appearance and, above all, simple in operation. In previous exhibitions, sets of one, two and, in one instance, three seasons old were displayed as normal adjuncts to the line. This year is virtually a clean sweep, since the outstanding set of the 1931 Show is not even included in the list.

One can hardly review the sets offered without first considering the price of tubes, since this affects, in a major way, the design. Reference is made to a.c. tubes. A variable mu, screen-grid tube, metal coated, is priced at $3.75, a power pentode at $4.50, a triode at $3.00, and the remaining tubes correspondingly.

Sets divide themselves into three classes—first, the simple local station set, a three-tube affair, single selective circuit with regeneration; then the five-tube, three-tuned circuit, single-control receiver, either with two low-frequency stages, or with a screen-grid detector coupled to a power pentode; and finally the super-heterodyne, which is shown in simple as well as in elaborate forms.

The mechanical design is well thought out, and usually quite ingenious. Now that single control has arrived, a variety of novel station indicators is to be seen, some quite elaborate in their mechanical arrangement. Table model receivers with built-in dynamic speakers appear to be the most popular type. In some models provision is made for the connection of a second dynamic type speaker to meet the demand for dual speaker operation.

Super-heterodynes are usually provided with automatic volume control, either through the medium of a separate tube, or by utilizing the direct-current component of second detection. The use of a single screen-grid tube as combined oscillator and first detector is quite common.

Keeping in mind the complication of providing reception on the two broadcast wavebands and switching for phonograph pick-up, one may observe the prices at which the sets are offered. It is customary to consider the cost of tubes separately, and this will be done here. Models referred to are table type, for alternating-current operation, with built-in dynamic speaker.

	Set	Tubes
One and two tuned circuits, 3 tube	$30	$10
Three tuned circuits, T.R.F., 5 tube	55	18
Super-heterodyne, 6 tube	65	24
More elaborate "super"	80	28

Reference might be made to two features usually included in a set of any pretensions, namely: A connection for using one side of the power supply line for antenna, and the provision of either an in-built or an externally connected wavetrap to be used against the local station. Considering that the urban population lives mainly in apartment houses, and that one high-power transmitter serves a large region, these features appear quite desirable.

NOISELESS

The Tobe Deutschmann Corporation of Canton, Mass., offers a new noiseless-reception rig that seems unusually good. Not only is the shielded leadin and its associated transformer built along lines we have found to be thoroughly practical, but in addition the kit includes a filter for preventing noises from wandering into the receiver via the 110 volt cord that supplies its power. Must make a lot of other folks feel sorta sheepish to overlook so obvious a thing. We do!

APOLOGY AND PROMISE

We apologize most sincerely for the non-appearance this month of the Hatry "everlasting" set-analyzer that does not get out of date. Mr. Hatry has devised a further improvement and the story is being held for the January issue so that this change may be added. It's well worth waiting for.

* Radio Engineer, United American Bosch Corp.

TOBE

By-pass condenser for use in Sparton chassis—available in ½ mfd. and 1 mfd. sizes.

New Tobe midget condenser. Safe for all by-pass circuits. Working voltage 600 volts d.c. Test voltage 3000 volts d.c. Available in capacities from .001 mfd. to .1 mfd.

This trademark is now placed on the most complete line of carefully constructed condensers, both the conventional paper type and electrolytic, ever offered to the trade. From the small midget condenser to the large transmitting unit, the complete Tobe line has been groomed for the immediate acceptance of the service dealer. The years of development work in the construction of our Filterettes, where condenser failure not only means loss of service but even endangers life, makes this new line of condensers possible. We know you will be pleased with this new condenser line. The trademark, Tobe, on each condenser is your guarantee that the condenser will perform fully to your expectations.

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The new Mackay Radio and Telegraph Co. 1 kilowatt transmitter. Two of these transmitters are in service in the radio of the Manhattan, largest American-built liner. The long-wave transmitter provides five pre-determined wavelengths, between 1800 and 2400 meters. The intermediate-wave transmitter is equipped to provide five wavelengths in the 600-800 meter region. The wavechange switch is seen at the center of the panel. The Manhattan also has a 1 kilowatt short-wave transmitter, built in the same type of frame but with a slightly different panel. It works in the 15 to 60 meter region.

An airport installation of National Company rack-and-panel receivers. The lowest unit in the rack is the power supply, next is an SW58 stand-by receiver (one TRF, regenerative detector and two audio), then an AGS short-wave superheterodyne with automatic volume control, next the coil rack and finally the loudspeaker. Either receiver may have its output switched to the speaker or to the headset or one may be connected to each receiver so that the operator may copy from one set without losing track of another channel. The white rectangles are calibration charts for the AGS receiver.

A By-product of Radio

MICROPHONE SAM, SON OF RAGTIME RASTUS

Do you remember Ragtime Rastus, the little negro doll that danced on the phonograph record with joyous disregard of time and tune? Rastus has a son, who not only dances to radio or phonograph music but does it in absolutely perfect time, though he never heard the tune before. As a matter of fact Microphone Sam never does hear a tune for his brains are in his feet, or at least just underneath them.

As you see from the photograph, Sam carries his own dancing platform and his own pickup microphone. The microphone is placed near a loudspeaker (inside the set if desired) and the music is conveyed through the connecting cord into the electrical "kicker" under Sam's feet. This takes not one single milliwatt from the radio set and can't possibly cause any audio distortion; the radio set has only to trigger off Sam's private power supply to cause him to start dancing—and that's where the surprise comes in. When a symphony is played Sam shuffles slowly, rocking back and forth in time with the music, if a tap-dance tune arrives Sam's manner changes and his feet snap up and down in perfect time, and it takes nothing but the proper music to send him into a wild arm-flinging breakdown.

Becoming very, very slightly technical we may say that Sam's life is insured for a long period of activity. His constitution is simple and rugged. His appetite for milliamperes is small and his battery will last a long time. He believes in minding his own business, so he has a filter to keep his machinery from making noises in the nearby radio receivers. He isn't prejudiced; while he prefers radio music he will dance to a phonograph or a piano. We even saw him do a good eccentric dance to accompany a speech on the Farm Board, which shows that he has humor.

We're indebted to National Company, of Malden, Mass., for this joyous piece of nonsense. May it brighten Christmas in many homes.

Allied Art

First there was Ag that discovered clothing by adopting a rather ripe hide that a couple of saber-toothed tigers had killed each other about. 30,000 years later Wah made some shoes out of rawhide. We don't know who first thought of using fire because he was killed for it and everyone moved away from there that night. 284,000 years later the first house was built. The first decent stove appears to have been invented day before yesterday by Benjamin Franklin, and the first decent light yesterday by Thomas Alva Edison.

Having managed to keep from freezing, starving, or going to bed at 3:00 P. M. in January we began to feel a bit set up and prattle about having "risen superior to nature's laws"—until someone discovered that we needed sunlight —not Edison's light—to grow properly.

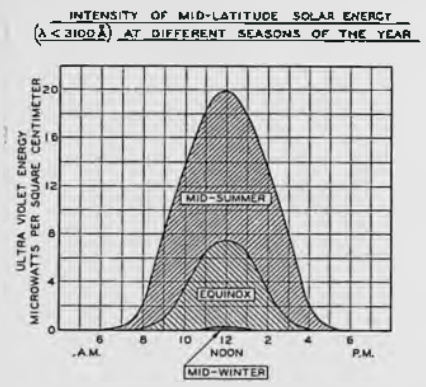

Fig. 1. Wherein a northern climate is lacking. The curves show the sunlight intensity at a wavelength of 3100 Angstrom units—where the beneficial light begins.

Well we got that sunlight in the most nightmarish way thinkable—from the oil in the livers of codfish! Then some one found that an arc lamp will do some good—though it is a little like removing freckles with dynamite. Then came the tungsten-plus-mercury "sunlamp" which isn't quite so formidable but must still be treated with awe (come around sometime and ask for details and evidence).

Now finally—about 356,000 years after Ag—we have a sunlamp that will kill the fleas without killing the dog—or it will provide the equivalent of the sunlight vitamine without injury to the surface or subcutaneous tissue. We no longer need to use a 3-inch field gun to kill sparrows.

And that's where Arcturus Radio Tube Company comes in. Their Sirian Sunlamp (Advt. ?) comes in sizes from 60 to 300 watts, and screws into the 110-

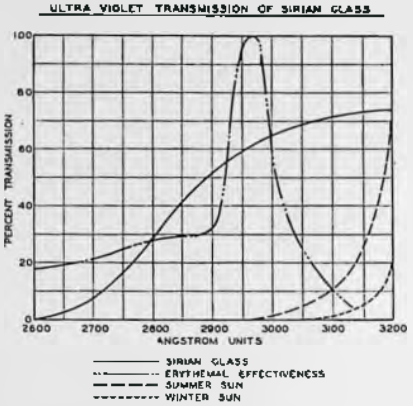

Fig. 2. This figure should be studied in conjunction with the frontispiece of this issue. The two lowest curves may be disregarded. The curve "Erythemal efficiency" (sunburn efficiency) indicates that the most useful wavelengths are those between 2800 and 3200 Angstrom. The curve "Sirian Glass" shows how these wavelengths are transmitted, but cutoff occurs sharply on entering the region below 2800, whose evil effects are explained in the large chart appearing as the frontispiece of this issue.

volt sockets without any adapting equipment. It may be used as an ordinary illuminant and continuous exposure is said to be harmless, nor does there seem to be any reason for doubting that statement as may be seen from the transmission curves in Fig. 2 which shows how the special glass bulb transmits the desired light in the ultravol violet region but cuts off before the harmful region is reached. The relation of the helpful and harmful types of light may be studied in the large chart which appears as the frontispiece of this issue. This is seemingly a case of reducing an extremely valuable health aid to a safe and practical form. Our compliments.

Fig. 3. The Sirian Sunlamp.

The new fibre guard slips over the Truvolt. Protects you and resistor from accidental contact with hands or tools.

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2—Full-length fibre guard protects resistor from injury by contact with tools.

3—Fewer sizes required to supply all standard needs.

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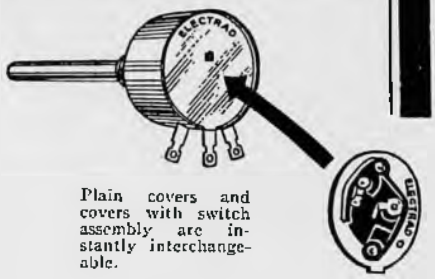

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(Continued from Page 5)

will appear a figure like E but this is very rare and the cause is usually evident. The percentage is less easy to gauge from this figure, though the equation is the same as before. It may therefore be desirable to try to obtain the other type of figure on the screen which can usually be done a different phase. B and B1 of course go to the filament circuit or the common chassis of the r.f. and audio tubes.

Incidentally—the tests are supposed to be made with a sinusoidal audio input, or something pretty close to it. The ingenious operator will be able to rig up something suitable—even a tuning fork held before the microphone is not to be sneezed at, though its constant dying off is an annoyance. An audio-frequency vacuum-tube oscillator or an electrically-driven tuning fork are very convenient, but the wave form must be rather good.**

Another Method

If preferred, one may instead connect clip A as previously described, but attach clip C to the tank of one of the earlier r.f. stages—in which case condenser C3 is also reduced to 1-10 micro-microfarads. The figure then resulting is simply a slanting straight line as long as one does not modulate. When one modulates the SLOPE of this line changes, that is it rocks or rotates back and forth giving the figure shown. The equation for calculating percentage modulation is the same as before, the test for linearity is again the straightness of the edges of the figure.

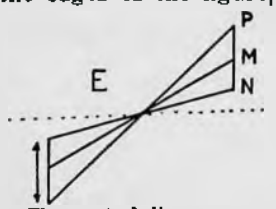


Fig. 3. The central line appears when not modulating. Modulation causes it to rock about its center. P is the steepest position, corresponding to modulation peaks.

Fig. 3 shows the type of figure appearing on the screen of the cathode-ray tube in this case, though it looks differently when seen in action because the entire area of the two triangles is lighted rather evenly when modulation is going on. Since this method deals entirely with radio frequency potentials it is very easy to use. It works best with HIGH VACUUM cathode-ray tubes as these give greater definition (clearer pictures) at high frequencies.

In transmitters in which the final r.f. tube is modulated, very simple connections are possible. Simply couple one pair of deflection plates to the tank circuit of the modulated tube, and the other pair of deflection plates to the tank circuit of a previous (unmodulated) r.f. stage. Referring to Fig. 1 this means that a coil is connected between A and B1 and coupled to the modulated tube's tank, while another similar coil is connected between C and B2 and coupled to the previous r.f. tank circuit. These coils may be tuned as suggested in Fig. 1 but this is frequently not necessary, and of course it is much simpler to get along without tuning if enough voltage can be picked up in that way to make a figure large enough to be studied easily. The figure, by the way, is again of the form shown in Fig. 3.

The general precautions as to the use of cathode-ray tubes have been mentioned before, and need not be gone into again here.** One additional precaution should be attended to; the static and magnetic fields around a radiophone transmitter are rather intense, hence the tube itself should be shielded by being enclosed in a metal tube, preferably of steel. In the writer's rig, a Shelby steel tube with 3/32" walls is used. The use of steel offers protection against 60 cycle stray fields from transformers and choke coils, which would not be kept out by other metals.

So much for the general idea. Many interesting modulation problems are beautifully solved with a cathode-ray tube, and in the next article we will show examples of such solutions, showing how they exposed weaknesses of typical transmitters—what was done about it—and what the cathode-ray tube showed "after taking."

(To be continued)

** A suitable oscillator will be described in "Modern Radio". Meanwhile the tuning fork is a good bet.

** See "Modern Radio" for May, 1932, "How to Use Cathode Ray Tubes", and part 2 of the same article in "Modern Radio" for July, 1932, and part 3 in "Modern Radio" for August, 1932. All three copies for 50 cents. Separate copies 20 cents each.

BeST BUSt

A Bestbust is also sometimes known as a Qwertyuiop to purists. "Modern Radio" has on occasion been guilty of busts of minor nature which some keen chap or another has immediately jumped on. This display of energy is commendable and deserves more than it usually earns. Consequently "Modern Radio" is going to offer a reward for Bestbusts.

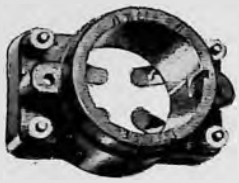
Conditions: Find an error, or several errors, in "Modern Radio". What you do with it or them is up to you; but what you do about or with them must be transmitted to the editors. The reward will be a subscription for the best job of doing. Meritorious runners-up will also be rewarded, no foolin'.

The bases of judgment will be quantity of errors, humor or brilliancy of the epistle describing them, and the subtlety of the error or errors.

• NEW and USEFUL •

REMLER 50-WATT SOCKET

The Remler Co., Ltd., of 2101 Bryant Street, San Francisco, offers two new 50-watt sockets at $2.50. Type 53B is of



bakelite and serves most purposes. For severe r.f. use there's type 53XM of low power-factor mica composition.

The Belden Manufacturing Co. is producing a shielded leadin that combines the transposition and shielding advantages of twisted pair plus shielding. Two separate wires, rubber-covered, are twisted within a braid covering partly filled out with a hemp twist in addition. Over the entire cable is a high-grade rubber sheath to exclude rain and increase durability.

With this type of wire the antenna transformer should be inductively (not auto-transformer) coupled to the twisted pair within the sheath.

RED AND BLUE

Two very nice tube-data booklets have been issued by R. C. A.-Cunningham. The first one is a blue-covered 84-page booklet called "The Cunningham Radio Tube Manual, Technical Series No. C-10" and may be had for 25 cents from the Commercial Engineering Section, E. T. Cunningham, Inc., Harrison, N. J. It's not one of these tiresome advertising fake booklets, but full of useful data, going quite a ways beyond the ordinary pocket manual. If, for any reason, you are averse to blue—go back and read about the red-covered "R. C. A. Radiotron Manual"—just substitute "R. C. A." wherever we said "Cunningham". Otherwise the books are identical.

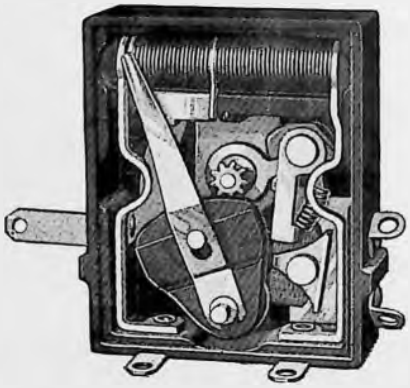
WHAT L?

Frequently the honeycomb type of coil finds a use in radio circuits. A rough rule to estimate the inductance of a given coil of this type may prove of value. It will be found that the inductance varies from $L=60\ N^2$ to $L=70\ N^2$, where the former value is applied to small coils and the latter to large ones, with intermediate values proportionately between 60 and 70. This rule does not give results as accurate as the manufacturer's own curves, but may be used to select roughly a coil for a particular job.

R. R. B.

TONE TRICK

A new tapped Bradleyometer is announced by the Allen-Bradley Company, 1311 South First Street, Milwaukee, Wisconsin. It is well known that the threshold of audibility is a great deal higher at low and high frequencies than it is in the middle register. Therefore, a type of volume control is necessary which varies the frequency characteris-



tics of the audio amplifier so as to prevent highs and lows from disappearing when the volume is cut down. A tap on the resistance element is brought out to a fourth terminal. The network necessary to provide tone correction is usually connected between this tap and the grounded (or low potential) end of the resistance element of the tapped Bradleyometer.

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E—a.c. or d.c. socket-power receiver circuits without constants..... 1.50

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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.

2. The right is reserved to return remittances for any questions which it is impossible to answer.

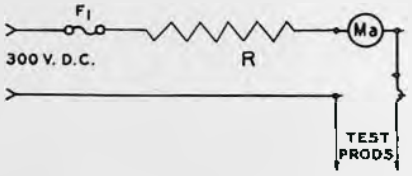
3. No attention will be paid to radiograms, telegrams or letters (other than those under class G) which are not accompanied by a remittance. Please use money order—loose cash may not arrive.

4. Address letters, "Modern Radio", 101 Allyn Street, Hartford, Connecticut.

THE SIMPLEST CONDENSER TEST

One of the simplest and best of all condenser testers is a 300 volt B-supply and a 0-300 volt d.c. meter with a resistance of 1,000 ohms per volt. The b-sub can be made up readily from standard parts, while the voltmeter is, of course, nothing but a 0-1 milliammeter in series with 300,000 ohms. The test is made by simple connecting everything in series as shown in the diagram. If the condenser is "blown" the entire voltage will go through and the meter will read full-scale. If the 300,000 ohm resistor wasn't there it would go around 5 or 6 times and need repairs.

On the other hand a good paper condenser will have a resistance of 10 to 100 megohms and the meter-needle will barely move. On a mica condenser, nearly regardless of capacity, there should be no movement of the needle. Pitch-dipped, and other relatively bare cartridge-type condensers should be



watched carefully. Very few of them are moisture proof, also the pitch chips easily unless kept on by an outer shell of metal, or at least cardboard. 400 volt condensers of this sort, after a shelf-life of only 60 days have frequently shown resistances of only 1 to 10 megohms, giving a reading of 10-100 volts on the test-meter. Electrolytic condensers are another story; a simple rig for testing them was shown on page 18 of the March issue.

A large radio distributor recently had the associate editor check a "surplus" lot of electrolytic condensers. The condensers had been "dumped" by a manufacturer, ages unknown. Checks of samples sent showed 50% of them bad, mostly very high on leakage and a good share low in capacity. Those that were good were mostly low in capacity. When is a bargain a bargain?

FIREWORKS !

The American Radio Audience League wants some channels assigned to churches and schools and desires less advertising on the air. "National Broadcast Reporter" gets feverish about this and denounces it as "grabbing" of channels.

Meanwhile Congress orders the F.R.C. to investigate the advertising on the air and the F.R.C. makes a report mainly on the asinine basis of asking the advertisers if they are behaving themselves.

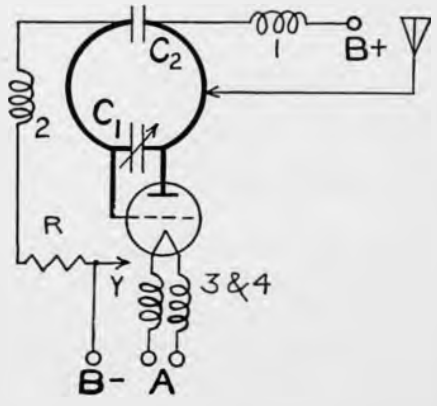
At the same time Canada proposes to get channels more in proportion to its area instead of continuing to fret along with the measely half-dozen the U. S. A. doled out on the damphool basis of population—as if radio transmission were by population!

Also Canada's parliament is worked up over a government radio system with limited ads.

Here at home the war between transcriptions and wire nets continues—with A. T. & T. on both sides of the scrap.

The industry can't be very dead.

History or News?

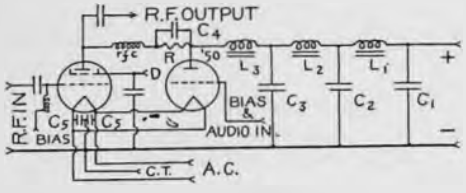


Watch "Modern Radio" for a surprise-story.

MODERN RADIO QUIZMATIC

This is a double-barreled quizmatic for transmitting amateurs and servicemen together. As usual, a year's subscription (or extension) for the most to-the-pint answer and six months to the next four, our judgment to be final.

Part 1. The modulator diagram is so wrong that it didn't even deserve being drawn up in our draftsman's precise manner—we just made a pen-sketch of it. What needs to be done to make it respectable? Answer by diagram, words, or both. By the way—assume the rectifier uses '66 tubes and supplies 600 volts.



THE SICK SIRKUT

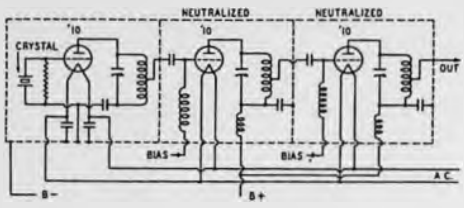
Assume the following constants:

L1 and L2, 30 Hy each.
L3, 5 Hy.
C1 and C2, 4 μfd each.
C3, 2 μfd.
C4, 1 μfd.
C5, C5, .01 each.
R, 5000 ohms.
Plate supply from an adequate transformer, with center-tapped secondary rectifier—two '66 tubes.

Part 2. A broadcast receiver two miles from a 5-kilowatt station is bothered by "cross modulation." The volume control operates by changing the screen voltage of the two r.f. amplifiers—type 224. A neighbor fetches the critter to you—"you know all about radio"—and wants it cured. What to do?

October Winners

First Prize—C. R. Rognes, Winona, Minnesota. Second Prizes go to Messrs. R. W. McIntosh of Presque Isle, Maine; David Atkins of Piedmont, California; Jack Provis of Idaho Falls, Idaho; Theodore Harhat of Chicago, and Herb Walleze of Hazelton, Pa. To the other entrants—good luck for another time.



Here's what ailed the diagram.

1—No plate supply to oscillator.
2—Several shorts to shielding.
3—Both amplifier stages unstable because grid and plate chokes are in the field of the tuned tanks.
4—No connection between B minus and the filaments—either transformer centertap or a centertapped resistor needed.

Also there were the following errors, less vital, but real.

5—No filament bypasses on amplifier tubes.
6—B+ bypasses should strike shield at junction of filament bypasses of same stage, avoiding r.f. currents in the shield.

Other suggestions offered by contestants are:

7—Keep B+ lead from filament circuit to avoid hum.
8—Make grid leads adjustable on plate coils.
9—Better use no plate chokes than to put them inside of shield.
10—Add at least one meter to permit good adjustment.

Finally—many suggested a choke in series with the oscillator grid leak. There's room for argument here. It increases the output (which isn't necessary to drive the tubes shown) and also tends to make the crystal lose control—which is not so good.

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Short Circuits

• • •

Sign in a small Eastern town: "Ralph Nicholson, PhG., D.V.M., B.B., LL.D.—Druggist Veterinarian."

Just got a letter from one of the early birds in the 5 meter game saying: "—and they seem to be using about the same equipment we used years ago." Right. Let's get ahead with our 5 meter stuff. The commercial folks are the only ones that seem to have any good transmitters, for instance, W6XAO and the Empire State pair of stations—now you name some good STABLE amateur 5 meter senders.

Well, well—after all these years we have a "power detector" in the true sense, meaning the detection takes place in the final or "power" tube. It's done in the little Crosley 3-tube superhet which uses a 47 pentode as a second detector AND output tube. Now watch and wait.

PRACTICAL PSYCHOLOGY

The drug-stores discovered that two slices of bread could be cut as thin as one and called it a "counter lunch." Then they brought out the "three-decker," raised the price and stopped customers from eating the paper napkins by mistake.

PITY THE FOREIGNER

Touched off by an editorial in "Christian Science Monitor" we offer our own brief dictionary showing how to mispronounce American words so they will sound right to the natives. We whittled some of these out of our own heads:

Geogyah, New Yohk City (except on the east side where it's New Yoik), N'awlins, Myameeee, Chkago, Vuhmont, Lung Eyelend, Kneticut, New Hampshr, Illinoy, Rud Eyeland, Mizurah, Nawth Cahlinah.

We could go on and on—in Hartford one hill gets called Byoona Vista, in Kansas I've heard about Santa Fee Railroad and on the west coast there's a town named Laws Angeleez. And once we heard a citizen tell about his new erl boiner.

NBC's funny bells are reported to sound that way because they are not bells but some sort of an oscillator that oscillates the way a bell doesn't.

International broadcast as it reached Hartford: "Niph adrowssingh miph awrjence I am aware oph bzzzz muph not often accorded to agh speakrrrzz and am hence glupglup woohawooha-woohawoohawooha—"

The "F" question on page 26.

There are six F's in the sentence. If you caught three you are of average intelligence. If you spotted four you are bright, if you saw all six you are a genius and should stop wasting time on this foolishness. (DeLaval Monthly)

And now the nonsense of 1932 is ended. May it take into the past all of your ills and worries and may this Christmas and New Year bring you much of the joy of work well done.

Christmas Special

Two

One Year

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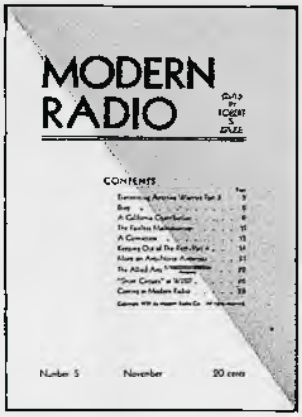

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Offenbach Electric Co., San Francisco
Radio Manufacturer's Supply Co., Los Angeles
Radio Supply Co., Los Angeles
Sea Cliff Radio & Elec. Co., San Francisco
San Francisco Radio Exchange, San Francisco
Warner Bros., San Francisco
Warner Bros., Oakland
Wenger-Brill Co., Oakland
Zach Radio Supply Co., San Francisco

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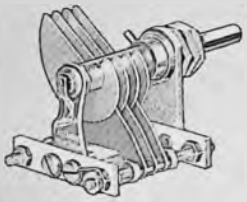

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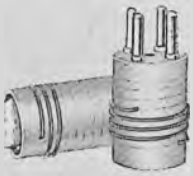

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