R/9

No. 59
October, 1934
15c in U. S. A.

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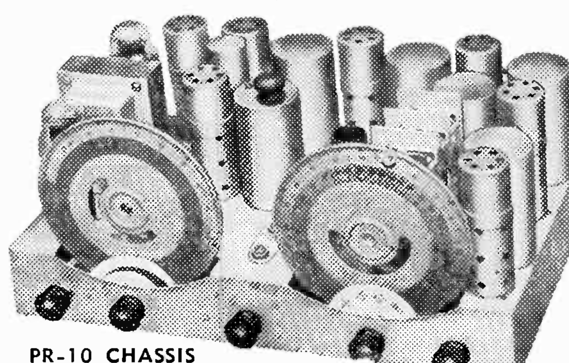

PR-10 CHASSIS

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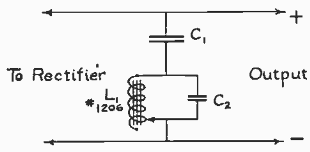
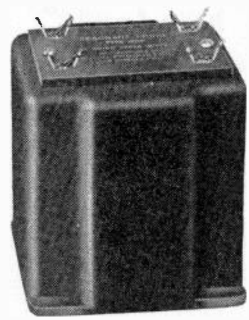
THE AMATEUR'S PAGE



Resonant Filter

AUDIO PRODUCTS CO.
Los Angeles



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RESONANT FILTER

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The interest in resonant filter has been growing of late, and we notice quite a number of these "3-phase" notes on the air now. Among the best of these are W8BTI, W6CXW, W2ZC, W6FT, W9JSG, W6AWA, and W6DLN—and in each case a saving of about one-third regular filter cost has been made. The high power men are especially the ones to benefit from resonant filter, because only a single 1 or 2 µfd. high voltage condenser is required.

"Necessity is the mother of invention"—that explains the origin of resnant filter. October 1, 1933, found W6CUH-W6QD holding the sack with a lone 2 µfd. filter condenser for the last two stages, result: an XNDC note. Exactly five days later a long forgotten passage in a radio text came to mind and saved over $40 worth of additional H. V. filter. Consequently, a resonant choke was rigged up and the station remained on the air. A variety of weird notes were obtained at times, but soon most of the tricks were discovered and now we feel that enough dope is available to insure success to everyone.

The filter consists of a simple series-resonant circuit connected across the output of the rectifier as shown in the cut above. The filter is tuned to the ripple frequency (usually 120 cycles) and effectively bypasses it, leaving the higher harmonics that produce the "3-phase" effect. C_2 is a small smoothing condenser (¼ voltage rating of C_1) to prevent impact excitation and oscillation in the rectifier; its capacity depends directly on the load, 1 or 2 mfd being used in most cases. C_1 is rated as usual for a given transformer voltage and can be 1 or 2 mfd, but it *must* resonate with L_1 to the ripple frequency

$$\left(f = \frac{1}{2\pi\sqrt{LC}}\right).$$

The choke shown beside the circuit is a special model designed for resonant filter work and is a good example of what is required for this service. Enough taps must be provided for adjustment with either 1 or 2 mfd series condensers. The DC resistance must be low to provide a high resonant peak. Only a small air-gap is necessary because no DC flows through the choke.

The steps required to obtain maximum results from resonant filter can be easily summarized. (1) Adjust taps on the choke until the best note is obtained; (2) vary C_2 for best results; (3) re-adjust C_2 if changes in load are made; (4) *don't* use an input choke; (5) use a low resistance choke.

The resonant filter notes now on the air are good proof of the excellent results obtainable with this money-saving filter. Even so, plenty of experimenting should be done before deciding on a final adjustment. If you hear W6CUH (7010 Kc), give us a call and we will get together on your resonant filter and go after a "WIZ" note. 73.

C. D. PERRINE, JR., W6CUH,
Amateur Equipment Engineer,
Audio Products Company.

Audio Products Co., formerly The Wireless Shop

(Same Company—Same Management—Same Products, but New Name and Address)

4189 West Second Street, Los Angeles, California

Dedicated to the of the Transmitting Rights and Interests Radio Amateur

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No. 59 October, 1934

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CORRESPONDENCE AND MANUSCRIPTS

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—Courtesy, "Westways"

THE SIERRA NEVADA
from the Sequoia Park—Mount Whitney Trail

FREQUENCY DOUBLING IN THE FINAL AMPLIFIER

By CHARLES D. PERRINE, JR., *Assistant Technical Editor*

Frequency doubling in the output amplifier of a c.w. transmitter* can be accomplished with high efficiency, which as usual makes high output possible. With the proper adjustments an HK-354 tube has been operated here as a frequency-doubler (7 mc. to 14 mc.) with a plate input of 750 watts. The plate remained without color change under keying. Equal results can be obtained with other tubes.

What's New About That?

Doubling in the final stage is by no means new, but its full possibilities have only recently been brought to light. Many of the first crystal-controlled transmitters doubled, and even quadrupled, in the final amplifier stage, but as a rule the efficiency and output were low. Even today most frequency-doublers are little better; they are used merely *as* doublers, other stages being relied upon for most of the gain. In a few instances frequency doublers have been operated so as to give considerable power-gain, but small tubes were used and an output stage working "straight through" followed, and was depended upon to give most of the power.

Now the frequency-doubling amplifier can be made to handle nearly as much power as a "straight" amplifier *if properly adjusted.*

For example, in doubling from 7 megacycles to 14 mc. we were able to operate an HK-354 tube with a plate-input of 750 watts (without plate color), which compares well with the usual 800—1000 watts input for the same tube working "straight through."

Among the advantages of doubling in the output amplifier are (1) the speed and ease with which one may shift to either of two amateur bands, and (2) the greatly simplified construction of the transmitter. For such 2-band operation *only the final tank coil* need be plug-in. The stages previous to the final one usually need no readjustment. This should be of particular interest when link coupling is used. An incidental advantage is that stability is easily obtained when doubling in the output stage. A case in point is the water-cooled tube at W6CUH; it was only by the trickiest adjustment that this tube could be operated as a "straight" amplifier on 14 mc., but as a doubler from 7 to 14 mc. it has performed remarkably well.

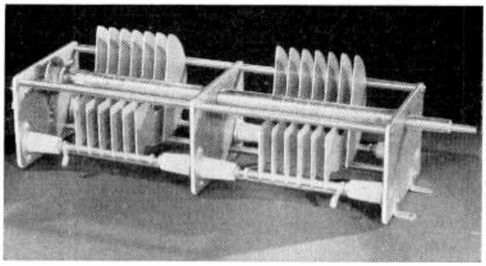


Figure 1.
A high efficiency split-stator condenser for C_4 such as recommended by the author.

How to Do It

The requirements for a successful doubler are not remarkably different from those for a *high efficiency* "straight" amplifier. A high-L plate tank circuit, L_3C_4 must be employed. C_4 should really be of the split-stator variety in order to realize a lower minimum capacity, permitting more inductance to be used in L_3. The plate voltage has a surprising effect on doubler efficiency and should be as high as the tube structure will permit. A plate-circuit efficiency of 80% is attainable with the HK-354 tube working at 5000 volts.†

* It is commonly stated, with some justice, that a frequency-doubling amplifier should not be voice-modulated. However the thing is not wholly impossible, as shown by several 20 meter phone stations which plate modulate a 203A frequency-doubler and secure something more than mere intelligibility.—TECHNICAL EDITOR.

† This is 2½ times rated voltage but is quite safe for this tube if the plate dissipation is kept within rating.—TECHNICAL EDITOR.

High bias and excitation are essential to high-output frequency doubling. By "high bias" is meant a value far beyond the usual "class C" value of 2 or 3 times cutoff. In the case of the HK-354 just mentioned the bias was 2500 volts, or half the plate voltage. Naturally the only way to obtain such a voltage conveniently is with gridleak bias. This type of biasing also has the advantage of adjusting itself to the available excitation, which in any case must be high. A good ratio to keep in mind is that the "driver" stage should have a plate input of about one-third as many watts as are being put into the plate of the doubler. Thus the HK-354 running at 750 watts plate-input requires a driver with a plate-input of about 250 watts. Incidentally this is also the proper exciter or driver input for an HK-354 running as a "straight" 7 mc. amplifier with 1000 watts of plate input. This explains why adjustments are needed only in L_3-C_4 when going from "straight" to "doubling" operation in the final stage.

Setting Up

Referring to the diagram, L_1 is a link which in our case was supplied from a 242A stage. The 100,000 (not 10,000) ohm gridleak is intended to develop a 2500 volt bias, which will take place when the rectified grid current flowing through *R* is 25 ma., which is easily measured by a d. c. meter in series with the "low" end of *R*. The voltage rating of C_4 may appear excessive but with "high L" circuits unusual voltages develop at this point. With the HK-354 tube which we are using as an example a 3-inch arc can be drawn from the plate tank—not when it is without any load, but when it is putting 600 watts into the antenna!

Other Tubes

The application of the principles of "power doubling" to other tubes must be apparent from this example. Requirements for the 852 are about the same as for the HK-354. The common 1000 volt, 100 watt tubes which we still call "50 watters" will easily handle 350 watts of plate input when used as frequency-doublers. The plate voltage should be about 2000, the gridleak about 25,000 ohms, and the plate-input of the driver should be about 120 watts (⅓ of 350). The Sylvania 825 and similar tubes will double nicely with 200 watts input at 2000 plate volts, using a 30,000 ohm gridleak and a driver stage with 75

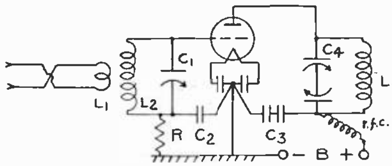


Figure 2

Circuit of a high-efficiency frequency-doubling output stage for operation at 14 megacycles (output).

L_1—3 turns No. 12, 3" diameter at filament end of L_2.

L_2—12 turns No. 10, 2½ diameter, spaced and self-supporting.

L_3—10 turns, 4½" diameter, coil 5" long. While the current is small mechanical considerations suggest large wire, or a ¼" strip or tubing.

C_1—50 μμfd. (0.00005 μfd.) 3000 volts condenser.

C_2—Mica bypass, about 200 μμfd. (0.0002 μfd.), 3000-5000 volt.

C_3—2000 μμfd. (0.002 μfd.) mica condenser, 5000 volt.

C_4—35 μμfd. (0.000035 μfd.) split-stator condenser, or 2 single condensers in series.

Filament bypasses as usual.

R—100,000 ohms to dissipate 75 watts "cool rating."

r. f. c.—150 turns No. 30 enameled wire on ½" dowel.

The constants are for the HK-354 tube.

watts of plate input. High-L and link coupling should be used in all cases. Keying can be accomplished in any of the usual ways; the writer prefers primary keying, the reasons for which *R/9* may present in another issue.

A final warning: tuning must always be done with reduced plate voltage and the antenna load must *never* be removed while the full voltage is on the tube.

EDITORIAL NOTES

If in doubt about the proper gridleak, recall that the leak is to provide a bias equal to about 6 or 7 times cutoff. Cutoff isn't so definite as books sometimes make out, hence an approximate value will serve and we can get at it in simple ways.

(1) Divide your plate voltage by the amplification constant "μ" of the tube,

[*Continued on Page 33*]

THE UNPROFITABLE CLASS B R. F. AMPLIFIER

By ROBERT S. KRUSE, *Technical Editor*

Radio transmitting apparatus is so sinfully costly that it is a shame to use it to less than the very best advantage. It is therefore distressing to find in low-power voice or music transmitters such an arrangement as shown in figure 1.

What ails the arrangement can best be shown by example. Suppose that we had a low-power radiophone such as outlined in figure 2, and wished to raise the output. Usually the hopeful improvement would take the form of figure 3, almost certainly with either '52 or '60 tubes in the final stage. $200 to $400 having been spent in adding that stage with the necessary additional tuned circuits, meters, high-voltage transformer and whatnot the owner is hugely astonished to find that there is no apparent improvement in his reports! He is worried and bewildered. There is a logical reason for the failure:

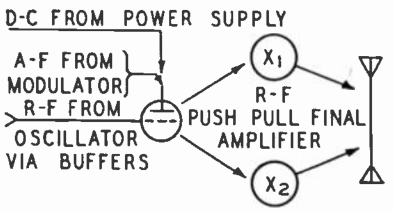


Figure 1.
The so-called "class B" r.f. output amplifier stage of a radiophone transmitter.

The modulated '10 tube was formerly putting perhaps 6 watts into the antenna with peaks of perhaps 24 watts. The pair of '52 or '60 tubes emits a 37.5 watt carrier with peaks of 150 watts. This sounds impressive, but after all it is but 6 times as many watts, and the antenna voltages are but 2½ times as great as before—and the signals at the distant receiver are but 2½ times as great as before. A signal improvement of 2½ times usually is blamed on the "good conditions today" and calls for no comment. Thus one has doubled the cost of the station with no improvement that arouses any comment from the listener—and one could have done almost exactly as well by adding another '10 tube and another '50! This is so very much cheaper that the unprofitable nature of figure 1 must be very apparent.

"But the best broadcasting stations use it"!

Yes indeed they do—they also support the antenna with a pair of Milliken steel towers. Both things are unfortunate necessities of high-power operation—*to be avoided if possible!* Also one must admit that they make the best of a bad matter by using high-μ tubes in the Class B amplifier-after-the-modulation-stage. Thus a ¼ kilowatt modulated tube will be found running a stage whose carrier level is 5 kilowatts—a power-stepup of 20-to-1. Applying this lesson to the amateur station of figure 3 we should substitute final tubes which would provide a carrier level of perhaps 150 watts with peaks of about 600 watts—in other words a pair of 849 tubes, or at least a pair of 204A tubes. This change increases the cost of the final stage from 30% to 45% but pays good dividends in tripling the output. The recent dark warning that the 204A and 849 are "hard to neutralize" is quite true—a good amplifier is always harder to neutralize than a poor one, but it can be done soon enough if the filtering and shielding are of any account—and usually one needs but little shielding at that.

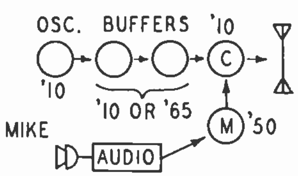


Figure 2.
A straightforward low-power radiophone, 6 watts carrier output.

That's a rather powerful transmitter and one may wish to drop down a bit. A remarkably wrong way to do this is shown in figure 3—low output for high cost and high voltage. Far better to use the '03A tube ($\mu = 25$) in the final stage. The carrier level will be nearly the same, the plate voltage half as great, the grid bias required ¼ as great and the necessary r.f. and audio inputs from the modulated tube C, also only ¼ as great. Thus one can chuck out all the '10 tubes and drop back to nice cheap receiving tubes of the '27, '24 and '45 types, running from an ordinary receiver-type power supply. The transmitter costs about 40% as much as the figure 3 arrangement. The signals at the distant receiver are essentially the same, and one should get killed only half as dead when taking hold of the highest B-plus!

One might even think of going down another notch and using a final r.f. stage with high-μ 7½ watt tubes (type 841)—but this becomes silly since the results are by no means equal to the simpler rig of figure 2.

Surely the use of the screen-grid 75 watter (type '60) must have occurred to the reader—look at the fine big theoretical μ *that* has. Unfortunately secondary emission, high internal impedance and high input capacitance somewhat damage the picture—but if the transmission frequency isn't above 2,000 kc. there's something to the '60 in the last stage of figure 3.

Back to Figure 2

Now that's out of our minds—let's go back to figure 2, where we don't modulate at all until the last r.f. tube is reached. Bah—old-fashioned "high power" modulation! I wonder—I wonder. Why was it abandoned in the first place? It never has been except in stations whose last stage was too big to modulate—and stations which copied those big stations. Even at this moment there is a brand new experimental transmitter in Saxonburg, Pa., in which some 60 kilowatts of audio are delivered by the modulator to the last r.f. stage—so one cannot even claim that figure 3 represents the latest broadcasting practice. Getting it through our foggy minds that figure 2 is *not* out of date we see that—

The difficulty of providing the audio power for figure 2, even at a 1 kilowatt level, isn't so severe—but the home-grown transmitter is seldom concerned with 1 kilowatt levels—else why would it be fiddling about with the 38 watt rig of figure 3? The tube C takes ⅔ of its power in the form of d. c. from the plate supply, and ⅓ in the form of audio from the modulator M. If C is a pair of 7½ watt tubes drawing 30 d. c. watts we need 15 audio watts to modulate it—and can get it from a "50 watt" type 845 tube working as a plain class A distortionless amplifier—or we may choose to get the 15 audio watts from a pair of '10 tubes working in the overloaded push-pull arrangement which is now called "class B audio." This is nearly as good if all the proper precautions are taken —of which more in another place. If the stage C consists of a pair of '52 tubes—*and the '52 is a grand Class C tube-to-be-modulated because of its superb insulation*—, or of a pair of '03A tubes we will need such an audio input as may be

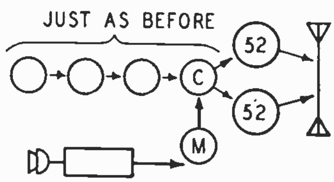


Figure 3.
How to spend twice or three times as much while gaining a slight improvement.

had from a class A distortionless modulator using the '49 tube, or else from a pair of '03A tubes in the previously mentioned class B scheme. The equipment is all commercial in any case, and no trick building is needed.

[*Continued on Page 22*]

THE FABLE OF THE FOX AND HOUNDS

There was once a cunning Fox whose well-hidden lair was not far from the kennel of some fine but foolish Hounds. The Fox doubled and twisted on his trail and obscured it so well that the Hounds would not catch him when he stole the farmer's chickens and even the bones which were fed to the Hounds. His favorite trick was to drop a dead Rabbit in his trail when they were chasing him. The Hounds would stop and fight among themselves for the Rabbit. The Fox would then slip quietly behind them while they were fighting and help himself to whatever he wanted in the farmyard. The Hounds never got wise to this trick and, losing their juicy bones, nearly bit themselves to pieces.

Moral

Let not your main purpose be diverted by unimportant side issues.

"But what has this ancient fable to do with amateur radio?" you ask. Simply that the amateurs are discussing and are about to vote on a resolution that "the maximum power input of an amateur transmitter shall be limited to 100 watts." This resolution is the Rabbit which the wily Fox is using to make the amateurs fight among themselves while he helps himself to what he wants. He laughs in glee while they forget their main purpose and squabble about an unimportant side issue which actually can be remedied by attaining the main objective.

Let's be more specific. The amateur's chief purpose today is to eliminate the intolerable interference which exists in his channels. High-power stations obviously interfere with low-power stations closely adjacent thereto. But the high-power is not the primary cause of the trouble. When the amateurs get more and wider channels a 5 kw. set need not interfere with a 5 watt set. It's not the power of the set but the crowded condition of the channels that is primarily responsible for the interference.

A simple and much-used analogy of the high versus low power situation is in the comparison between the radio amateur and the automobile driver. When the highways became too congested the drivers didn't have to stay home because there wasn't room enough for them on the road. The old highways were widened and new ones were built. When the power of automobiles was increased so that more speed could be attained, the speed limit was raised. When still higher-power cars came into the market, white lines on the highways marked a slow-man's row and a speed-burner's row.

So it is with amateur radio. When the channels are widened, there should be a place where the high power man can work unmolested in a narrow path, and the low power men can have still more room in which to work without interference from the high power signals.

The art of amateur radio is progressing. It must not be given a set-back by internal wrangling about power limitation. Let us instead demand still higher power and *wider channels*, so that more stations, low and high power alike, can operate with greater freedom. The high power stations can be restricted to a narrow band of their own, where they cannot run over the great majority of low power users. Perhaps a special license, one that only an *experienced* high power man can secure, can be issued to those who must use a kilowatt. Nothing is more dangerous than the hand of an inexperienced novice at the controls of a modern high power amateur transmitter. When wider channels are made available for the amateur and when a special channel is set aside for the high power man, there is no reason why any amateur with an ordinary license should be permitted to "sit in" on the same channels with the more-experienced high power men. Let him first prove his worth as a capable, efficient amateur before he is permitted to use the maximum permissible amount of power. A similar condition exists among the phone men; before an amateur can operate with phone in the 75 and 20 meter bands he must first prove that he is qualified to use the special-privilege bands.

Consequently the solution is *not* in low power, but in new allocations so that amateurs, high and low power, can have more space in which to work. Before we vote ourselves out of the present 1 kw. privilege which we now enjoy, wouldn't it be more wise for us to regulate our affairs in such a manner that the high power man will not seriously interfere with those who are using low power?

From various sources has come information that this power-reducing idea is another of those cleverly engineered schemes from interests opposed to amateur radio—interests which have worked against amateur radio ever since the amateur took a few dollars in revenue away from the more hardened financiers who want to capitalize on all of radio's traffic. Nothing would please these interests more than to see the amateurs embroiled in a terrific scrap over power limitation. They are already chuckling up their sleeves. We quote from a letter received a few days ago:

"I know for one thing—that if the hams are all reduced to low power it will please the commercials mightily. When this same proposal was presented some years ago the general manager of one of the commercial communications systems told me that it would be 'pie' for the commercials. With the amateurs all reduced to low power the commercials could walk into the amateur bands regardless, but with a few 1 kw. amateurs scattered throughout the amateur bands they make so much QRM that the commercials can't buck it. That is one commercial man's slant on the question of putting all hams on low power. So you can tell your friends who are working for low power that the commercials hope they will keep doing what they are doing, because the commercials like it."

Read that again, fellow amateurs, and perhaps you will get a new and different slant on this power reducing situation. If the plan succeeds, and if the amateurs devote their time to giving up more of their privileges, we may yet see the day when the amateurs will be reduced to no power at all.

The keystone of the present radio act is that every station, in order to justify its use of the air, must be operated for "public interest, convenience and necessity." Every commercial interest that applies for license must convince the government that its proposed station will do just that, and the new legislation to be enacted next year will have the same keystone.

Applicants for amateur station licenses have not yet been required to prove in what way their stations will serve the public interest. Other than those amateur stations that are handling message traffic for the public, there are few that can comply with the basic requirement of the law. The amateurs once enjoyed many privileges but lost most of them by neglecting to fight for their retention. It is proverbial, the world over, that a right not insisted upon is regarded as waived. If the amateurs stop wrangling among themselves over inconsequential trifles and do some real scrapping for their fundamental rights, they will have a lot more to be thankful for in the years to come.

Let us waste no further time nor effort on this high versus low power discussion. We have a bigger task before us, a nobler one. Let us get down to the bottom of it all . . . right to the fundamental issue, *and stick with it!* What we want is more room. Then none of us need worry whether we have a watt or a kilowatt input.

●

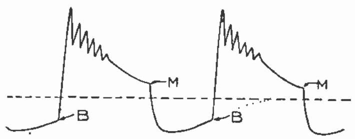
46,000 Station Licenses

According to a recent release of the Federal Communications Commission the number of valid outstanding amateur radio station licenses on June 30, 1934, was 46,390.

SPARK TUBE

By far the most portable of all plate supplies for a small tube transmitter, consists of a vibrator spark coil, such as supplied for the Model T Ford car, driven by dry cells which also feed the filament of the tube. It weighs much less even than one block of the man-killing battery plate supplies which burden down the experimenter today.

The output wave form of a spark coil, when working into a resistance load, looks more or less like that shown herewith. The vibrator opens or breaks the circuit at *B* and a very deep surge ensues. Now you may recall that the primary circuit consists of the battery, the



primary winding and the vibrator in series — but there is a spark-absorbing condenser across the vibrator. Hence when the vibrator opens we have left a series tuned circuit consisting of the absorbing condenser, coil primary, and battery in series. These oscillate at a very high pitched audio rate (generally around 5,000 cycles) and put the saw-teeth on top of the main surge. These die down before the main surge has fallen very low and we continue along the normal decay-curve to the point *M* where the vibrator has just closed or "made" the circuit. The decay-curve is then knocked out of existence and its place taken by the curve corresponding to the core-magnetising as the primary current flows once more. This curve also would like to die down as shown by the dotted (not dashed) curve, but at *B* the core magnetization has become high enough to pull the vibrator toward it, another break ensues, and the whole show repeats. In some coils the lower or "make" half-cycle is much smaller than shown.

Filtering

This is what we are required to filter "adequately" — whatever that means. Since the wave is usually more lop-sided than shown we can afford to throw away the lower half and use a ½-wave rectifier. One of the simplest of all ways to do this is to put a 1/16" spark gap in one of the leads to the first filter condenser which should then be of glass, and have a capacity of about 0.01 μfds. It may be followed by a receiver plate-supply choke and a second filter condenser of something like 4 "mikes," 1000 volt rating. This sounds like a dizzy contraption but it would work very nicely if ("there—I knew it wasn't any good!") we could key at the filter output. In a portable rig we don't want to key the filter output; we want to key in the coil primary to save power, and you can't key through 30 hy. and 4 mikes. Therefore we must either put a bleeder resistor across the 4 mikes and waste precious watts to be able to key in the filter output, or else we must cut down the filter inductor and capacitor until it will not drag out all the dots and dashes. For portable use, idea 2 is the way to go at it. Cut the choke down to about 5 hy. and the second condenser to about 1 mike, which is still pretty good if your spark coil vibrator works rather fast (high pitch), then key in the primary. The rectifying spark gap in the filter-feed lead should be adjustable to get the best tube input. A milliammeter is a necessity, and you will have it anyway for the maximum performance of a 1-mouse-power set isn't obtained except with crystal control, for which you should have the ma. meter anyway.

Stationary

When it comes to use at a fixed station we have something else again. The spark-gap rectifier kicks up the same sort of fuss as an electrical furnace-igniter which forgot to shut itself off.

[*Continued on Page 24*]

THE PERPETUAL ANALYZER

Never out of date

By L. W. HATRY*

It is the purpose of this paper to describe an analyzer that cannot go out of date through tube changes, and to show that such an analyzer can be much simpler than many of the present types, far less costly in the long run—and of course much less of an annoyance to the user.

It is necessary to review somewhat to make clear the advantages of such a type.

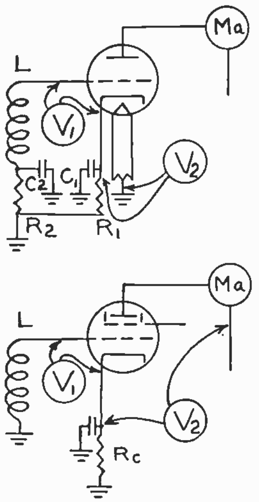


Figure 1
In most from-the-socket measurements on the common circuits shown the milliammeter may be left in the plate circuit and the voltmeter moved to one of the positions shown. The fact that the cathode (or filament in a d. c. tube) is a common point in these measurements simplifies the switching. These measurements are among the PRIMARY analyzer measurements—those which can't be done equally well with loose meters.

The present analyzers are too rigid in makeup, and have gone beyond the sensible region of giving us sensible and necessary facilities — and traveled far into that region where they must be sold on "features;" the more is crammed into the box, the better the analyzer! These complex traveling laboratories are not properly portable, not properly simple, and tend to confuse the user and to make him forget that his work is based on a few simple fundamentals. Incidentally, nothing becomes obsolete more rapidly than an analyzer that has a cut-and-dried test for everything.

It is about time that we throw overboard the fol-de-rol and extra gadgets, together with the inflexibility that is constantly causing analyzers to become obsolete to the great distress of manufacturers, dealers and servicemen. How? *That is the story.*

What Is Really Required?

Why do we want an analyzer rather than separate meters with cords and prods—or clips? Would a box full of separate meters be just as good?

This brings us to the main points which are as follows:

1—An "analyzer" is excusable only if it *saves time*—and that is the reason for the use of the tube-base plug and its connecting cord; one can get into the *tube* circuits without taking time to cut or solder. This is the *primary* business of an analyzer. See figure 1).

2—The analyzer should attempt to indicate perhaps 60% of the ordinary troubles directly by from-the-socket measurements, and some of the rest should be indicated indirectly.

3—It is foolish to attempt to make from-the-socket measurements meet every possible condition. Monstrous cost and complexity result through such attempts to avoid a little thinking, or use of separate meters. Provision must therefore be made for *readily* permitting the separate use of the meters with cords and prods. This is the *secondary* business of the analyzer.

* Hatry and Young, Inc., 203 Ann Street, Hartford, Conn.

4—It must keep up with tube changes without using a basketful of attachments—otherwise there is the high cost of obsolesence, and much time lost in attaching and detaching the extra pieces.

How?

Now then—*how* do we wish to have these things done? Voltage measurements at the sockets have been recommended for this purpose, but alone they do not tell the story. Many circuits are too complex if viewed from the sockets. Furthermore, as many of us know, it is not possible to check all socket voltages with an analyzer containing meters of any reasonable cost. Many of the circuits are of such high resistance that even a "1000-ohms-per-volt" meter will not read voltages correctly. It is, for example, not uncommon to find 500,000 ohms in a grid circuit operating at voltages between 3 and 50, so that the greatest available current is far below a milliampere, and hence not able to operate ordinary voltmeters. The same thing holds in the case of some screen voltages, some power-detector circuits, most space-charge grid currents and a variety of special and automatic volume control circuits.

The Main Point

One can right here vastly simplify the whole thing by remembering that in the great majority of cases the vacuum tube is normal if its plate voltage *and* plate current are normal. The 245, for example, must be normal if its plate current is around 30 ma. when the plate voltage is around 250. There *must* be bias or the current would be different. Similiarly the 247 shows 27 to 30 ma. with proper bias, plate voltage being near 250. What if the other voltages are unknown; they *must* be nearly correct or we could hardly have the conditions just named. We carry the tests to the *other* tube circuits only in order that we shall know that some exceptional and startling thing has not taken place—some thing that can happen once in a thousand cases.

The fundamental soundness of this line of attack makes it essential that the analyzer (*as a time saver*) *shall read plate current and plate voltage simutaneously on separate meters.* This is requirement No. 1 of a good analyzer, yet of all the many test kits sold during the last several years only three prominent ones have fulfilled this very important requirement. They were the Jewel 409, Weston 547, and Weston 565.

Of these the Weston 565 was, in my opinion, far and away the most useful to servicemen in general. Do you wonder why all other analyzers were "approved" by various Service Managers for manufacturers? I don't. Those men were thoroughly familiar with their one line of sets, knew what faults to expect in them and could tell all about them with a very few tests — and the kit happened to make those tests. But you or I must work with all sorts of receivers and other vacuum tube equipment; we can't depend on a few trick tests listed in a manual—we've got to go back to vacuum-tube fundamentals, which are the same in all sets. Our kit will then be *simpler*, and be useful on any set. But remember that the fundamental vacuum tube effects all require observing a current and a voltage at the *same* time.

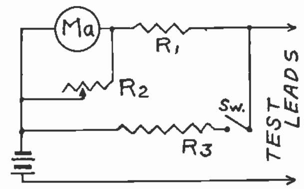


Figure 2
The simple ohm-meter circuit to be used in the analyzer for measurements of resistance. Usually such measurements are not from the socket, and in any case the analyzer plug and cable are not needed—hence this is among the SECONDARY analyzer functions, which can be done by loose meters also.

The Right Kind of Analyzer

For these reasons my "right kind of an analyzer" has a multi-range milliammeter which might as well be permanently in the plate circuit and it has a multi-range voltmeter which can be con-

[*Continued on Page 23*]

MICROPHONE AND POWER LEVELS SIMPLIFIED

By E. E. Griffin*

There seems to be some uncertainty in the minds of radio men as to the output level which may be expected from a microphone, and as a natural result there is likewise uncertainty as to the amplification that will be required to produce some certain final amplifier output for public address work or to modulate a radiotelephone.

Somewhat naturally the radioman feels that the microphone manufacturer should state once for all what output level is to be expected from each type of "mike." As will be shown, this is not practical and any such figure would be the worst of misinformation. However, it is possible to lay down guiding rules and this will be done here in a brief way, with the hope that it will be of aid to the user of microphones.

It is seldom that a technician can talk without making pencil marks on paper, and this discussion will therefore begin with the printed equivalent of such pencil marks. With them before us we can get down to business.

First I refer you to the large chart on the logarithmic scale. After a slight analysis you can readily see that it has all mathematics of amplifiers, microphones, photo-electric cells, etc., worked out on a fairly usable scale and gives you an exact mental picture of the whole amplifier and acoustic set-up. On the right-hand scale you will find the power level in db. (referred to 0.006 watts as zero) while the diagonal lines represent the actual power in watts, milliwatts and microwatts. Just for an enlargement on our mental picture we have placed the most popular output tubes at their various wattage handling capacity on the upper scale, while also you will find the average range for magnetic pick-up, the maximum and minimum power outputs of various carbon microphones and below that the various power outputs of various photo-electric cells as used in sound production work.

"Zero Level"

As you no doubt know there is considerable confusion existing as to just what zero level on our present db. scale is supposed to be. Some authorities consider zero level as the threshold of audibility, while others take it as the output of a certain carbon microphone.

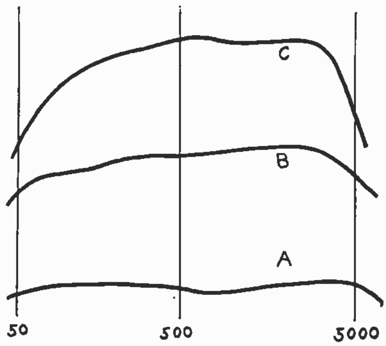


Figure 2

Representative response curves for a high-quality studio microphone A, a good "close talking" microphone B and a good medium-priced microphone, the corresponding prices being about $90, $75 and $25.

This company has adopted the standard as set forth by the General Radio Company, which standard, I might also state, is being gradually adopted throughout the motion picture industry here on the Coast. Accordingly, if you follow the zero line of the present chart through you will find that it passes the diagonal "power" line at 6 milliwatts.

Microphone Levels

Now with this chart to base on let us get at the subject in which we are primarily interested. First of all, I wish to point out the fact that microphones

* Vice-President and Chief Engineer, Universal Microphone Co., Inglewood, California.

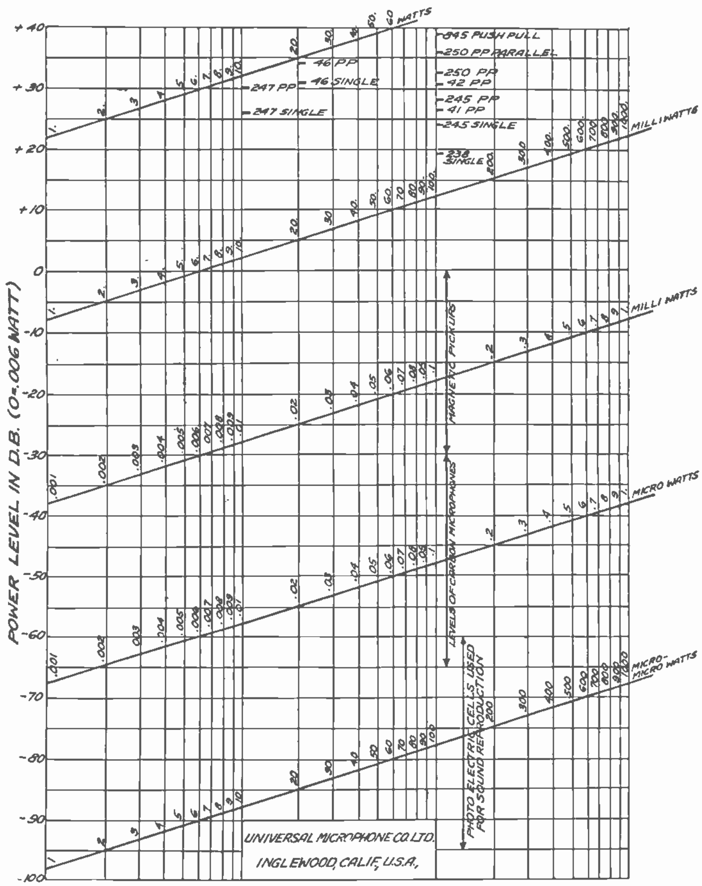


Figure 1.

Suppose we have a microphone known to deliver about "minus 50 db." when drawing 10 ma. per button and being spoken to at one foot. We need an amplifier output of 500 peak volts across a 10,000-ohm load. What must the amplifier be like?

500 volts peak = 350 volts r.m.s. and if connected across 10,000 ohms produces an input of

$$\frac{E^2}{R} = \frac{350 \times 350}{10{,}000} = 12.25 \text{ watts.}$$

This output level at once suggests a push-pull pair of 2A3 tubes coupled to the load through on output transformer which will convert the 10,000-ohm secondary load into a 5,000-ohm load (plate to plate) as required by the 2A3 tubes. (The turns ratio is 1.4/1 comparing secondary to whole primary.)

Meanwhile we see from the chart that 12.25 watts is about 33 db. "up," which is 83 db. above the microphone level. The amplifier gain overall should be about 90 db., a rather high gain preferably broken into two sections—a "pre-amplifier" and a main amplifier separated from each other—a fact better appreciated if one considers that 90 db. gain is a power multiplication of 1,000,000,000 times, so that a very small percentage of feedback causes distortion. If the input and output load impedances of the amplifier were equal the voltage amplification would be 31,600. The final line-up is accordingly a 3-stage main amplifier and a 1 or 2-stage pre-amplifier, choice in the latter case depending on the tubes used in the main amplifier.

Again—the same problem but with a high sensitivity microphone spoken to at 3 inches, with 20 ma. per button and an output level of —22 db. The gain required is now from —22 to plus 33 or 55 db. This can be done nicely by the 3-stage main amplifier alone, as it is (from the chart) a power ratio of 12.25 watts/.04 milli-watts = 300,000 or, for equal impedances, a voltage gain of 546.

run in considerable variation of grades, types, and purposes. In general, the more sensitive a microphone, the less tone quality it has (figure 2), while the greater fidelity of tone quality, the less its sensitivity. Likewise the tone quality is generally directly proportional to price.

The Effect of Distance

There are two highly variable factors affecting the output of a microphone in general use. First, the volume of sound reaching the microphone (or the actuating pressure), and second, the amount of d.c. exciting current with which it is supplied. First let us consider an actuating sound pressure which would be a duplicate of a person speaking in a perfectly normal voice with his lips at a distance of 6 inches from the microphone. If this microphone happened to

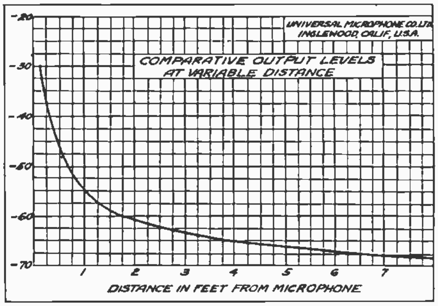


Figure 3

be a Universal Model LL in the "M" or Medium sensitivity grade we would get an output of approximately —48 db., provided the button current on the microphone averaged 8 milliamperes per button. Should the speaker move one foot away from the microphone the volume of output would drop to —54 db., while if he should move away to a distance of two feet the output would drop to approximately —61, all other conditions remaining the same. Should he move up to the microphone and speak directly into it, the output level would be approximately —30 db., quite a whale of a difference from the two-foot distance — in fact, *considerably more than one stage of high quality amplification.*

The comparative output levels of microphones at variable distances are graphically illustrated in figure 3, which is generally quite surprising to those who have not given it consideration before. This chart really has nothing to do with a microphone at all. It simply illustrates the falling off of energy with increase in distance from the source and is applicable to any sound radiating body in free space.

Microphone Current

In carbon microphones the next variable factor is the variation of sensitivity or output with variation of button current, which you will find graphically illustrated in figure 4. Here I might state that the hiss or "carbon rush" level in the granular type of microphones also varies in approximately the same relation with button current as is given by the graph and is generally about 30 db. below its output level. The graph is taken on the same grade and type of microphone as we described heretofore, that is, a medium grade that is subjected to a sound pressure equivalent to a normal speaking voice spaced six inches from the face of the microphone. It is quite surprising to note that with a current variation of from

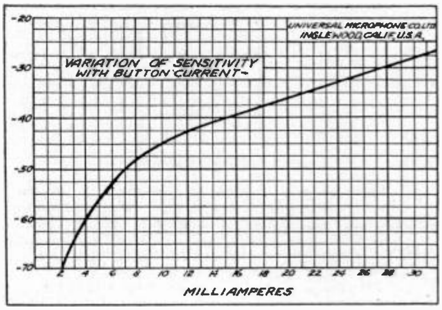


Figure 4

2 milliamperes to 30 milliamperes we can get a variation of output from —70 to —28 db., which explains why it used to be common practice to include a potentiometer in the microphone circuit and have a continuously variable current range of from 0 to enormous value. These were the days when amplifiers generally fell short and the microphone had to be depended upon to furnish enormously high output in order to drive them at a sufficiently high level.

[*Continued on Page 30*]

MISCELLANY

5 Meter Requirements Modified

The following Order was adopted by the Telegraph Division of the Federal Communications Commission on August 1, 1934:

> Until further notice, the provisions of Rule 381* shall not be construed to apply to amateur operation on frequencies above 56,000 kilocycles.

●

Haigis 5 Meter Transceiver

The type AM Haigis 5 meter transmitter-receiver uses two tubes of the low-drain 2-volt type. One of these is a 30, used as a transmitting oscillator, or as a blocking-super-regenerator, depending on the switch position. The other tube, type 33, is used as an audio amplifier when receiving, and as a modulator (voice) or audio oscillator (i. c. w.) when sending. A rheostat provides for 6 volt operation of the filaments. The oscillatory circuit is of the "semi-Armstrong" type.

●

A Radio Handset

A lightweight handset, specifically designed for radio work, has just been marketed by Universal Microphone Company. It weighs but 9 ounces, including the 5 foot, 3-conductor cord, one wire of which is common to both the high-output mike and the 2000 ohm single watchcase receiver. The type number and the price are not yet known; write to the makers at Inglewood, California.

* RULE 381. The frequency of the waves emitted by amateur radio stations shall be as constant and as free from harmonics as the state of the art permits. For this purpose, amateur transmitters shall employ circuits loosely coupled to the radiating system or devices that will produce equivalent effects to minimize keying impacts and harmonics. Conductive coupling to the radiating antenna, even though loose, is not permitted, but this restriction does not prohibit the use of transmission-line feeder systems.

Membership Amendment

An argument seems to be in full swing as to who started the ball rolling which resulted in the recent change in the A.R.R.L. by-laws regarding voting for Directors by which the votes of unlicensed amateurs who have not been members of the League continuously since May 15, 1934 will not be counted.

R/9 cannot see the importance of the question. The important point is that it *was* done, even though it is but a step in the right direction.

Our records show (1) that the idea was proposed spontaneously in many parts of the country by amateurs everywhere; (2) that Rocky Mountain's Andrews was the first Director to take any definite action to make the League once again what is has always claimed to be, an *amateur* organization.

●

Assistant Director

Philip Snyder, W6UT, at Altadena, California, is being congratulated by his many friends on his appointment as Assistant Director of the Pacific Division of the A.R.R.L. The appointment was made by Director S. G. Culver after considering many recommendations. W6UT is also President of the Pasadena Short Wave Club.

●

Uncle Dave in Europe

David L. Marks, more commonly known as "Uncle Dave" among amateurs, is in Europe on a business trip and is anxious to contact as many foreign amateurs and clubs as possible. He is making his temporary headquarters at 3 Kensington Gardens, Northshields, Northumberland, England.

A portable ham transmitter goes along with him for use wherever possible. Mr. Marks in addition to expanding his own export business is representing a number of American radio firms including the publishers of *R/9*.

HOW, WHEN, WHERE

to QSO a fellow ham

Frequency	Date	Miscellaneous	Time
u 1715 kc. band	1 Sunday	r ragchew	a A.M.
v 3500 kc. band	2 Monday	t traffic	p P.M.
w 7 mc. band	3 Tuesday	j trans-Pacific traffic	12m noon
x 14 mc. band	4 Wednesday	q DX	12p midnight
y 28 mc. band	5 Thursday	e experimenting	¼ 15 min. past hr.
z 56 mc. band	6 Friday	g can give accurate QRG	½ 30 min. past hr.
* freq. is doubled at times	7 Saturday	f phone chiefly used	¾ 45 min. past hr.
† freq. is doubled or quadrupled at times.	d daily	k official relay station	**Miscellaneous**
	b daily except Sunday	o official observer	c crystal control
	i irregular		h m.o.p.a
			s self-excited

Figures with four of five characters indicate frequencies. Those followed by "a", "p", or "m" indicate time. Those in bold face indicate days of the week. CW is assumed unless phone is specified. If you do not use certain specific frequencies, omit frequency designation; just use proper band symbol. One-line listings are free to subscribers; others 50c per year or fraction thereof. Listings not giving definite operating hours are not acceptable; however, if definite hours are specified for at least on band, others used frequently but irregularly may be covered by "i". Listings must be sent us exactly in the form here specified; time does not permit our "translating" them.

Listings are automatically dropped after three insertions unless renewed. Keep yours up to date. Only up to date, accurate information is useful.

W1—

Connecticut

EFW—3850; d 6-7½av & 4-5½av; r & t.

Massachusetts

EFM—3558; d 6½-7¾pv; 1 9a-12mv.

W2—

New Jersey

BPY—3588† c; d 11a-1p 4½-8p 11p-1a; r & t.

EKO—3563†c; d 6-7av 4-5pv; t & 9.

New York

AIQ—3550; 2-5 7¼-8pv; 7 7¼-8pv; r & t.

DQW—3563; 3, 5, 7, 6½-9pv; r & t.

FKO—7028c; d 7p-1½aw; t & e.

W3—

Delaware

BAK—3640c; d 7-9 av;4½-5pv; t.

BTQ—1794; d 7-12pu; i wxz.

Maryland—D. C.

AKX—1940c; d 6¼-7½pu 10-11½pu; f.

BWT—3600, 3627c, 7220; d 6-8pv; 10½-12p; r & t.

CIZ—3710; d 4-6½av; 1, 7 iv; r & t.

CQS—3720c; d 5-7av & 4½-5pv; j-relay only.

DF—3955c, 14,200; d 5-7pvx.

TX—3700; 3-7 & 1 6¾-7½pv; r & t.

VJ—3575*c; d 5½-11pv; 1 all day v; r & t.

New Jersey

AEJ—3785; 2-6 9½-2pv 7-10pv.

APB—3530c; d 1-7pv. 3818c; 7-8pv; r & t.

BYK—3508*; d 10½p-2av; r & t.

Pennsylvania

AWN—7050c; d 7-10pw; r & t.

BEY—3720c; d 6¼-8pw; t.

BPY—3610*c; 7052*c; d 7-11pvwx. 56,400; i f.

BRZ—1942c; d 5½-7auf; 7¼-8½puf; r & t.

BYS—3581, 7162, 14080; d 7-8av; d 6-8pw; 1 ix; r & t.

CAA—7280; d 7¼p-1aw; r & t.

GS—3688c; d 11p-1a; 1 12m-2pv; t.

MC—3655c; d 6½-8¼pv; r & t.

W3OK-WLQC—3781c, 3497.5c; 2, 4, 6 7-7½av; 2-6 6-7½pv; 2 6-11½pv.

TX—3700; 1-7 6¾-7½pv; r & t.

VR—3550c; d 10a-2½p, 12½a-2av; r t.

Virginia

AAJ—3740c; 2, 4, 6, 7, 12m-2pv; 5-7pv; r & t.

[*Continued on Page 32*]

Example

W6QX—3550† c; d 5½-7aw; 2-6 7-9pv; 1 2-5pyf; r & e; g.

This listing indicates that W6QX works on 3550 kc., and at times doubles to 7100 or quadruples to 14200 kc.; the transmitter is crystal controlled; daily from 5:30 to 7:00 a.m. he works in the 7 mc. band (i.e., on 7100 kc.); Monday to Friday he works from 7:00 to 9:00 p.m. in the 3500 kc. band (i.e., on 3550 kc.); on Sunday he works from 2:00 to 5:00 p.m. in the 28 mc. band (no definite frequency) on phone. He is chiefly interested in ragchewing and experimenting, and can measure your frequency accurately.

SHORT CIRCUITS

Overheard at World's Fair

BALLYHOO MAN: "Could I interest you in the Sky Ride?"

RADIO JOBBER: "Hell, no. I just bought one from Don Wallace!"

•

Sure there is such a thing as Sales Resistance. "I ohm little because I bought little."

•

'Scuse it please—but why is it a "velocity mike" when the wire is straight and a "dynamic mike" when it is coiled up?

•

"Communist Band Shattered by Bomb"—headline. Bandspread—eh?

•

How about a jig-saw puzzle using the various radio inspection districts?

•

The woim hereby toins—we deny emphatically that radio is wrong in reducing the loud high notes of tenors and sopranos. A screech sounds terrible in a concert hall, and it sounds terrible by radio—but radio knows how to stop it.

•

1934 auto models disclose accentuated streamlines, slant-back radiators, round hoods, roll tops, skirted fenders, and wide flared backs—or are we in the dress department.—*New Haven Register.*

•

Speech by chief engineer of auto factory via radio to servicemen: "—study this car so that when they start piling up on the road—"

•

The boss of W1ANC sez that King Pradjadhipok (?) should never have gone back to Siam—look at the fine white elephants we have for him right here—Radio City, f'rinstance.

•

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.

•

Read It Out Loud

An electron is about 1/10,000,000,000,000 of an inch across, and a current of one ampere, lasting for only a second represents about 6,000,000,000,000,000,000 electrons, each of which weighs about 9/10,000,000,000,000,000,000,000,000,000 of a gram.

•

Also, we grieve over the passing of the electrolytic charger and B eliminator. They never reached the full of their possibilities. Nobody ever thought of lighting up the jars with colored bulbs; and somehow ingenuity slipped in failing to develop gold-fish and *flora aquaria* suitable for making them more decorative.

•

A Sierra Madre, California, resident has succeeded in raising in his garden a 15-foot sunflower and it is believed that the fair-minded Kansan will concede that it soon will be large enough for transplanting.—*Christian Science Monitor.*

•

Depression or no depression, we understand the Heaviside layer is going up again this winter.

•

Brother Clifford thinks there is little novelty in railroad radio as he has owned many sets which whistled at every station.

•

Capone is supposed to have boasted that no law existed that money couldn't forget. Now what do you suppose he'd do with Ohm's law?

•

It is very difficult now to determine a person's social class unless you take time to observe which law he breaks.—*Hartford Times.*

•

The pleasantest story we have read for a long time relates to an afternoon in the Sudan, with a temperature of 125 degrees.

Unprofitable Class B

[*Continued from Page 10*]

"Scheme 2B"

There is another expedient which is even simpler, much less costly, and quite gratifying in its results. This is simply to replace the tubes C and M in figure 2 with other tubes that fit the job better. If we replace the '10 type "class C" tube-to-be-modulated by a 203A tube of 50 watts rating we will find the bias arrangements to need no changing, though we need a 10 volt filament supply. Then If we replace the '10 type "class C" tube M with an 845 tube of 50 watt rating we have an arrangement that will put into the antenna a 70 watt carrier instead of a 7 watt one, and give about the same percentage modulation as before. This is roughly twice as good as the pair of Class B '52's!

The plate supply voltage will need to be raised to about 1200 or 1300 but this can be obtained from a single pair of '66 rectifiers, and it is quite possible that they are already in use. If the drop-resistance method of coupling modulator to modulatee is being used, the resistance will need to be somewhat decreased; 3500 to 4000 ohms will do for various individual tubes. The only flaw is that the 845 requires nearly twice the audio input voltage to the grid that was needed for the '50 modulators. We now have a '50 and a '10 without jobs. One may accordingly leave the '50 in place and use it to drive the 845 as an additional audio stage, or else simply put a '10 in the preceding stage and use it to "push" the 845; even a 245 will do. Suitable voltages and couplings are assumed.

Summing up—the 2B variation of figure 2 will produce twice as strong a carrier as figure 3—and furthermore, 2B requires no r.f. grid battery, adds no adjustments to figure 2, operates rectifier and filter at 500 or 1,000 volts less, and costs about $60 less than figure 3. Need one say more to label figure 3 as "unprofitable"?

Which combination appeals to you I cannot say—but hope it isn't the one of figure 3.

The Perpetual Analyzer

[*Continued from Page 15*]

nected to *any* socket terminal. This meter arrangement provides for all of the *primary* analyzer work, that is, it provides for the work which is carried on through a cable and tube-base plug. As will be shown a little later, these things can be done without the usual multitude of "adapters," and both the analyzer itself and the switching arrangement may be so made as to provide for future types of tube bases, or for new and curious ways of connecting tube elements to the base-prongs. Present analyzers do not have this flexibility, nor do most of them provide another of the conveniences of the new analyzer—that the analyzer plug may be left in the set when using the instruments with prods, without the usual risk of "blowing" something, for the meters are completely cut loose from the cable when connected to the binding posts.

The Circuit

The circuit will be described by building it up from its parts, without stopping to give constants at this point.

1—The milliammeter must have several ranges and also be capable of being switched to a pair of posts which permit it to serve as an independent meter with leads. Thus it may have a range-switch and a "position-switch."

2—The voltmeter is under control of three switches: *a*—a range switch for picking the correct scale! *b*—a reverse switch to get correct polarity; *c*—a "tube switch" which throws the voltmeter (set to any range) to any socket terminal, or to binding posts for external use—and which has extra contacts to allow for future freak sockets.

3—The ohm-meter circuit is the simple but long-range one of figure 2. When switched into this circuit the milliameter is cut free from all other circuits.

4—A socket group, which includes a socket of each present type and has room for new types.

The association of these circuits and parts into a complete analyzer will be shown in the second part of this paper —and you will be surprised at the low —*and final*—cost of this type of analyzer.

•

Amos, of the Amos and Andy team, went to wartime radio school at Harvard, pounded brass on a destroyer, and maybe sent some of us traffic. We don't know about Andy but have seen messages that look as if he must have handled them.

Spark Tube

[Continued from Page 13]

Rude comments result, and it is better strategy to use a tube rectifier. The RCA-878 is exactly the thing, and costs only $11.00! The next best bet, the 81, costs too much also, and we look longingly at the 70c type 80, likewise obtainable at 54c, 39c, and 38c. But that high peak voltage does not look so good to a tube rated at 550 maximum a. c. volts, meaning a peak of 780, as compared to 5,000 or so with our spark coil.

Voltage Limiters

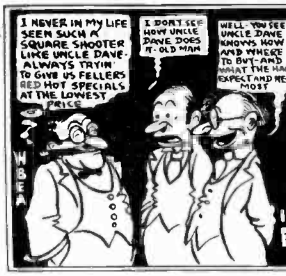
Two pretty good dodges are possible. The first is very old, and consists of putting a condenser (such as Leichner's glass type D-3) across the coil secondary *before* we get to the rectifier. If we assume that the vibrator is going at 500 breaks per second it takes about 0.01 µfd. of pretty good mica or glass condenser to get the peak down to such a value that an 80 used as a ½-wave rectifier will not break down, meaning a lot more than 500 volts even so. The price of this condenser rather spoils the whole economy picture and it is easily shown that for stationary use, or for carrying around from station to station it is cheaper, better, and easier, to use an ordinary plate supply as will be described for "Radiococcus" in these pages next month.

However, since we've started our rabbit out of the brush, let's run him down. We started to say that there are two good ways of getting the voltage peak down, and we are still interested from a purely portable standpoint where no a.c. line is available.

Very well, the second scheme is (alas) to tear the secondary off the spark coil, and replace it with a new winding of about 1/10 as many turns, and of a wire about No. 30 in size. Insulation can consist of double silk covering, and of thin paraffined paper between layers. Since the voltage is lower the thing can be done with one winding about half as long as the core (different from the old high-tension secondary), winding in plain even layers.

Laws

Now then—when and where may it be used? Mister — anything we put



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TUBE SPECIALS

	Light Duty 30-day Gtd.	Heavy Duty 90-day Gtd.	Ex. Heavy Duty 6-month Gtd.
210. 15-watt...	$ .89	$1.20	$1.75
866.	.77	1.95	3.35
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The biggest buy in the country on Weston slightly used but perfect model 301 milliameters, ranges 0-5, 10, 25, 50, 100, 150, 200, 250, 300, 500 mills. All recalibrated with new scales. EACH $3.69

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Write In for Our New Ham Catalog—Just Off the Press!

UNCLE DAVE'S RADIO SHACK

356 BROADWAY

FOREIGN TRADE SOLICITED
Long Distance Phone: 4-5746

ALBANY, N. Y.

down here might be all out of date when you picked this magazine up a few months from now. We must ask you whenever considering either outright spark-coil plate supply, or a rectified and filtered plate supply of the same sort, to look up the latest rules of whatever body governs radio by that time, making sure to discover what is then regarded as all right for portable equipment, and whether "adequate" filtering has yet been defined.

—R. S. K.

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.*

•

First we "modernize" all radio receivers by replacing the push-pull '45 output system with pentodes, then we spend a year or two in getting back the fidelity—but meanwhile we add a "tone control" to permit the set-owner to obtain several sorts of distortion.

•

"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 Communications 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.*

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Material of Plates..........................Aluminum
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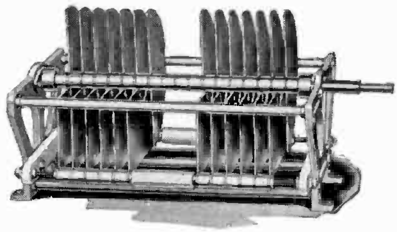
Overall Height.......5⅝" (Rotor Plates Extended)
Material of End Plates..............Cast Aluminum
Contact Material ....Spring Brass, Plated
Contact Method..................................
.....Split Spring Bearing at Each End of Shaft
Shaft Material.................................
........"Diamond X" Rod, Ground and Polished
Shaft Diameter..............⅜" Through Bearings
Shaft Extension Diameter...¼" for Standard Dials
Shaft Ex. Length.....2" from Front of End Plate
Spacer Collars..............Brass, Cadmium Plated
End Plate Tie Rods..............................
................5/16" Brass Rod, Cadmium Plated
Insulation .... Steatite

DESIGNED TO DO A HARD JOB WELL—AT LOW COST



Other Capacities and Air Gaps to Order

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Type	Maximum Capacity Each Section	D.C. Breakdown Voltage	No. of Plates Each Section	Actual Air Gap	Length Less Shaft Exten.	Net Price
807	72 mmf.	5,000	7	.168"	7½"	$6.47
813	140 mmf.	5,000	13	.168"	10"	8.28
821	235 mmf.	5,000	21	.168"	13½"	11.22
1407	43 mmf.	11,000	7	.356"	9¾"	7.35
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Pfanstiehl Single Sideband Super

Complete with Coils for 20-40-80-160 Meter Bands

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AN AMATEUR BAND RECEIVER

With all the desirable features . . . automatic as well as manual volume control, airplane dial, full AC operation, receive-transmit switch, the ability to log accurately, good image suppression, crystal IF filter, special treatment of metal parts for tropical and salt air service, 3 watts audio output, unusual stability and gain especially on the 20 and 10-meter bands, hum-free at all frequencies, all components operated at half of their rating, earphone jack, coils thoroughly moisture-proofed. Each set individually calibrated, 8 tubes including rectifier.

Write for Circular—Dealer Inquiries Solicited

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Oscillations

Houlton, Me.

Sirs:

. . . I have never in my radio experience seen so much news in so few pages as you have put into *R/9*. . .

PHILLIP E. CLARKE, W1BKN.

●

Atlanta, Ga.

Sirs:

Have received sample copies of your magazine and enjoyed them very much. I have noted an improvement in each issue along technical lines and the advertisements, but I hate to see so much valuable space consumed with the A. R. R.L. controversy.

I agree with J. E. Williss, W7SQ, that the revision of the League should be accomplished without the fur flying too much. It seems that a petition would be in order about now. After the petition had all the dissenters names affixed, it could be forwarded to the League.

There is room in amateur radio for another good technical magazine. You are the logical contender for the space, and I would like to see you succeed. Why not conduct your crusade against the policies of the League through other channels and give your magazine a chance to gain in technical importance? . . .

H. H. PAYNE, JR., W4WC.

[*If reader Payne will suggest other channels likely to be successful gladly will* R/9 *use them.*—EDITOR.]

●

Lancaster, Calif.

Sirs:

. . . You deserve credit, fellows, for your wonderful spirit and fearless energies and we are all standing behind you.

If you knew how many would like your magazine, but whom the depression holds out, you would feel highly flattered at the esteem with which your magazine is being accorded on every side. . . .

L. R. POTTER, W6AKW.

●

Jacksboro, Texas.

Sirs:

R/9 covers a large band of frequencies in the radio library spectrum and I fear I cannot afford to be without it, so here's my subscription for a year.

J. W. CHERRYHOMES, W5HH.

●

New York City

Sirs:

. . . You have the makings of a good medium for the hams, and are to be congratulated for the stand taken upon various subjects which have to do with the welfare of ham radio.

C. G. WILLOUGHBY, W2RT.

●

Manila, P. I.

Sirs:

First of all I want to congratulate you on your splendid work in putting out what we all may say is a real he-man amateur magazine.

I've been a member of the A.R.R.L. for nine years and am still a member, but your magazine *R/9* has them all beat. My compliments to the staff of *R/9 for the best amateur magazine in print.*

I'm sure all the KA Gang will give you a big hand. More power to you, *R/9*.

FRANK SPEIR, KA9FS.

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Microphone and Power Levels Simplified

[*Continued from Page 18*]

From figures 3 and 4 it can be readily seen that if a microphone is given the absolute maximum of current and a person talks directly into the microphone an output level closely approaching zero level will be obtained. Considering the variations possible in both the button current and the sound pressure actuating the microphone, it can be seen that an overall variation of from 60 to 80 db. is possible. Greatest fidelity of response to variations in sound pressure will be had when the microphone is used at the lower levels. Our recommendations are a button current of from 5 to 10 milliamperes, while the spacing to the microphone will naturally vary with the particular model chosen.

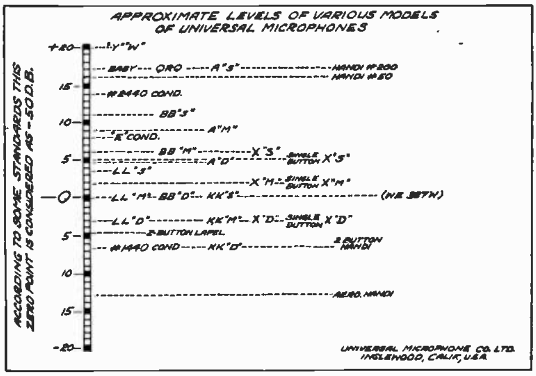

Figure 5

The zero level in this diagram is different from that of the other figures.

Where Figures Lie

In regard to this point, I am submitting to you figure 5 which gives the carious output levels of our complete line-up of carbon microphones when used with a button current of 10 milliamperes and subjected to a sound pressure variation equivalent to a normal speaking voice spaced six inches from the microphone itself. In this chart observe the little notation specifying the zero level on this scale as equal to —50 db. on the other charts. Reasonable as such a chart may appear, these volume levels are *in no way* representative of what the microphone's outputs would be in practice. In normal use the conditions are quite different. For instance, an aeroplane HandiMike would be used pressed tight against the mouth, which position when considered in the light of figure 3 would immediately raise its level some —25 db. In addition to this, the aeroplane type is used at a much higher current value per button than the 10 ma. current taken in figure 5, and thus in the end its output might be in the neighborhood of —10 to —20 db. Another example is the Baby and QRQ. Either of these highly sensitive models when spoken directly into may have an output level closely approaching "zero level"—that is 6 milliwatts.

These variations are so large as to be confusing to the user until he understands their causes as shown in figures 3 and 4. With these figures in mind the information of such a tabulation as figure 5 can be translated with some correctness into the probable performance under the conditions actually to be used. Then with the microphone's output fairly well known the amplifier may be laid out to provide whatever gain may be necessary to rise from the level of the microphone to that of the amplifier's required output—always with due allowance for some spare gain to compensate for adverse conditions or for power-wasting devices such as "mixers" or "equalizers."

GOOD NEWS

for slightly deflated Ham pocketbooks!!

Here are some bargains that are real bargains in every sense of the word! The prices are low, (unbelievably low in some cases) and, what is more important, the quality is high. In addition to the representative items listed here we have thousands more in stock.

Our more than eight years of service to the amateur trade enables us to supply anything you may need at our usual low prices. You will like our prompt service, too!

We suggest that you order soon. Our money back guarantee and our record of honest dealing is your protection.

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Every tube we sell is brand new and in perfect condition. Our liberal replacement guarantee applies in all cases.

U. S. Army 100 Watt Screen-grid 860 tubes Regular $35.00. In original cartons.........$14.75

866 Heavy Duty 60 Day Guarantee **$1.25**

DeForest 210.....$1.45; 281.....$1.25; 45...... .35
Good grade 46, 56 and 82 tubes, 3 for...... 1.00
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NEW! 859. Improved 865. Graphite anode. Grid lead to cap. Isolantite base. FB!.... 6.95
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Supersensitive ¼ watt for neutralizing, etc., each, 25c; three for .... .65
205-D 20 watt AF tubes...$1.45; 864-A........ .85
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Dubilier 5000 volt, .002.......................$ .85
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Dubilier metal cased. Porc. insulators. 2 Mfd, 1000 volt, $1.20; 4 Mfd., $2.10; 1 Mfd., 2000 volt 2.95
General Radio type 247-M or 247-K, .00025 variable condensers. Original boxes. Special .45

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AMERTRAN Power Block. Transformer delivers 600 volts each side of CT at 150 ma. Four 2½ volt windings. Tapped primary. Enclosed with two 25 henry filter chokes in a neat crystal finished metal case. Leads brought to bakelite terminal strip. Weighs 21 lbs. You know AMERTRAN quality! Brand new in original cartoons. List price $42.50. Special $4.95
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2½ volt, 12 Amp. CT for 866's. 10,000 volt insluation.. Tapped primary 1.25
Amertran De Luxe audios. Slightly used, but perfect.
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56 mc interruption coils .... .48

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Polymet 25 henry, 200 Milliamp power chokes 1.95
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Thordarson 20 H, 125 MA Power Chokes..... .69
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G. E. METERS. 2" D'Arsonval movement with zero adjuster. With instructions and shunt wire for converting to any desired MA scale. Front panel mount........ .... 1.25
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Center-tap resistors. 20, 50, 75, or 100 ohm.. .09
2 ohm, 5 Amp. Heavy Duty rheostat........ .23
Glazed porcelain strain insulators. Per doz... .30
G. E. 55 watt soldering irons. 110 Volt. Regular selling price, $4.50. SPECIAL......... 1.95
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Hardwick-Hindle 22,000 ohm, 50 watt resistor with four taps. FB for bleeder or divider.. .55

Deposit required with all orders

HARRISON RADIO CO. Dept. 99 142 Liberty St. **New York City**

(VISIT OUR WHOLESALE SALESROOMS WHEN IN TOWN!)

How, When, Where

[*Continued from Page 20*]

W4—

Florida

ZZQ—3545*c; 2, 4, 6, 1¾-2½av; r & t.

North Carolina

AGL—1933.4c, 3607.6c; d 8½-10puv; r & t.
ALK—3550*c, 7200; d 8-11pvw; r & t.

Tennessee

BPC—1998; d 5-6½auf & 4-9puf; r & t.

W5—

Texas

VV—7102, 7160; d 5-7pw 10-11pw; 3 & 6 12p-2aw; t & q.

W6—

Southern California

AM—3720, 7250, 14392, 2900, c; 1 1-8awq; 2 7-12pwr; xyzi; q r & e.

Central and Northern California

FFP—d 12½-2aw; 3 7-12puv; 7, 1 5-11-pxy; r t & g.
HCQ—7050† c; d 7-9pw; r, t, & q.

W8—

Ohio

AAJ—3516†, 3533†c; d 10½a-12mw; 4-6½pw; r & q.

New York

CPC—3740 c; d 3½-12pv; 7 10a-2pv; r & t.

W9—

Illinois

JKJ—14304c; b 6a-12mx; r, t, & q.

Wisconsin

ARE—14,190c; 2-6 5-6½px q; 7 1-5px; 1 9a-4px f; r & e; 14,290 i q.

The Marketplace

(a) RATE: *5c per word, cash with order; minimum, 50c. Capitals: 8c per word. For consecutive advertising, 15% discount for 3rd, 4th and 5th insertions; 25% thereafter. Break in continuity restores full rate. Copy may be changed as often as desired.*

(b) QTH ADS: *25c straight. Subscribers allowed one free QTH entry per year on request.*

(c) CLOSING DATE: *25th of second month preceding nominal date of issue (e.g., March forms close January 25th).*

(d) DISPLAY *arrangements not acceptable except capitals; no proofs, free copies, nor reprints sent.*

e) USED, *reclaimed, defective, surplus and like material must be so described.*

(f) ADS *not relating to radio or radiomen are acceptable, but will be grouped separately.*

(g) WE *reserve right to reject part or all or any ad without assigning reasons therefor.*

(h) REMITTANCE *should be payable to the order of* R9, LTD., *negotiable at par in U.S.A. funds. Send all* MARKETPLACE *ads direct to Los Angeles office. No discounts or commissions allowed.*

BARGAINS in new and used transmitting parts. Write for bulletin. DeMotte Radio Sales Co., 46 Bridgham St., Providence, R. I.

W1WV says "These QSL's are surely FB. Just what I wanted." Do you want samples of our Call Cards? Send for some. W9APY, Hinds & Edgarton, 19 S. Wells St., Chicago, Ill.

W5BQU says "The QSL's you printed are just what the doctor ordered." We'll send you samples, OM. What do you say? W9APY, Hinds & Edgarton, 19 S. Wells St., Chicago, Ill.

STEEL Cabinets. 7"x10" panel, 6" depth. Hinged lid. Chassis deck and panel removable. Black lacquered. $1.85 postpaid. Only three dozen. R. H. Lynch, 970 Camulos, Los Angeles.

D. & W. Crystal and Holder, your approximate frequency, 160 or 80 meters. $1.50 complete. D. & W. Laboratory, Rockford, Illinois.

CRYSTALS within three kilocycles your specified frequency, 80 or 160 meters, $1.50. W1BD, Barre, Vermont.

Frequency Doubling

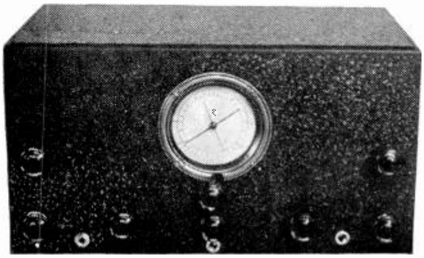
[*Continued from Page 8*]

and multiply by 6 or 7, which is the proper bias voltage to be gotten by varying R until the milliammeter in series with it says I × R equals what you just calculated. Remember to multiply ma.× 1000 × ohms.

(2) If μ is not known, replace R with some batteries across which is a voltmeter. Remove L_1. Now juggle the battery bias with a *low* plate voltage until plate current *just* starts. Divide this plate voltage by this grid voltage to get a fair value of μ.

1-wire untuned antenna feeders, if properly tapped to the antenna, can be clipped to the plate tank without upsetting the operation.

McMURDO~SILVER



THE NEW 5C PROFESSIONAL SINGLE SIGNAL SUPERHETERODYNE

The 5C is the 1935 improved model of the now famous 5B—choice of W9USA of the World's Fair and amateurs the world over in preference to all available competition.

The first outstanding feature of the new 5C is the accurately calibrated large airplane "watch" dial, having one pointer for the three-gang main tuning condenser, and a second pointer on a O-100 division scale for the three-gang band spread condenser—available by simply pulling out the tuning knob!

The 5C has a new high-gain tuned r.f. stage on all bands for image selectviity and excellent signal to noise ratio, a crystal filter circuit sacrificing absolutely no signal volume for its extreme selectivity, and manual or automatic volume control at the turn of a switch, plus all the features that have made the 5B famous, including air tuned i.f. amplifier. That it is far in advance of all other competitive receivers is proven conclusively by the roster of its users—from W9USA to Col. Foster, W6HM.

Technical Features

SENSITIVITY: Every 5C receiver shipped from the laboratory is guaranteed to have a sensitivity of 1 microvolt absolute or better.

SELECTIVITY: Each 5C will have selectivity curve 28 kc. wide 10,000 times down without crystal, or 50 cycles wide with crystal.

FIDELITY: The overall antenna to speaker fidelity of the 5C without crystal is uniform to 6 decibels from 30 to 4000 cycles—or absolutely uniform over the entire fundamental musical range at the loud speaker output. Yet by means of the crystal control knob, 50 cycle selectivity can be had at will.

POWER OUTPUT: The undistorted power output of the 5C is three watts.

VOLUME CONTROL: The 5C is equipped with audio volume control for use when the A.V.C. is switched in, and with manual i.f. sensitivity control for use when A.V.C. is switched out for high speed telegraph reception. By the turn of a knob the sensitivity can be raised to the maximum and very weak distant stations may be brought in easily—or lowered for locals.

CIRCUIT: All wave superheterodyne employing a '58 r.f. amplifier, 2A7 high efficiency first detector and electron coupled oscillator, two '58 i.f. amplifier stages, '55 diode second detector, diode A.V.C. and triode first audio stage. '58 audio beat oscillator for C.W. code reception, 2A5 in Class A power output stage, and one '80 rectifier.

WAVE LENGTH RANGE: 13 to 200 meters, or 1500 to 23,000 kc. in three low C bands.

DIAL: One illuminated dial accurately calibrated (error not over 1%) in megacycles (thousands of kilocycles) for the three short wave bands. Tuning ratio is nine to one.

BAND SPREAD TUNING: All stations can be tuned on the main dial, or will be found well spread out and easy to tune on the band spread dial, which, located on the main large airplane "watch" dial, is brought into use by simply pulling out the tuning knob, which then operates the band spread pointer and three-gang band spread condenser. Band spread 200 degrees for 80 and 160 meter, 100 degrees for 20 and 40 meter amateur bands approximately, and available anywhere in range of receiver by pulling out tuning knob.

WAVE LENGTH CHANGE: One knob, with colored indicators matching dial scale colors. Knob actuates positive three position, six-gang selector switch having positive non-wearing, silver plated contacts.

I. F. AMPLIFICATION: Two stages of dual air tuned 465 kc. amplification using a total of five "Litz" wound tuned circuits and two '58 super control tubes.

SHIELDING: All r.f. and i.f. circuits completely shielded from external pickup. Two antenna binding posts only "hot" points exposed. Heavy cabinet provided with hinged top for easy access.

LOUD SPEAKER: Specially designed and matched Jensen dynamic unit in cabinet 7" square and 3½" deep.

TROPICAL CLIMATE PROVISION: All transformers, coils and condensers specially sealed against moisture, particularly for tropical climates. All filter condensers, power transformers, chokes and resistors greatly oversize to avoid possibility of breakdown in places remote from replacement part sources.

FINISH: Crystaline black on all parts except tube and r.f. shields, which are polished aluminum.

DIMENSIONS AND WEIGHT: 17" long over all, 10¾" deep and 8¾" high.

ANTENNA: Separate r.f. primaries for each band allow use of doublets or Marconi antennaes at will.

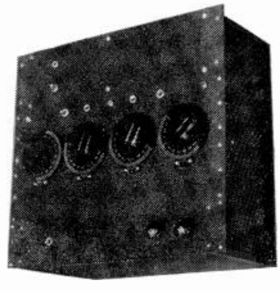
CRYSTAL: When ordered, the 5C can be supplied with special Bliley quartz crystal resonator in Bliley holder and with i.f. amplifier properly aligned to exact crystal frequency.

Type 5C communication receiver, as above, complete with eight tested Raytheon tubes, Jensen speaker and cabinets, ready to operate, list price $124.50. Net price to amateurs $74.20. Order it direct or from your dealer.

Add to above for Bliley 465 kc. crystal in Bliley holder and specific receiver alignment for individual crystal supplied, list price $15.00. Net price to licensed amateurs $9.00.

TYPE 10D 100 WATT PROFESSIONAL PHONE-C. W. TRANSMITTER

The type 10D transmitter is the amateur's dream come true. It provides 100 to 120 watts of crystal controlled r.f. power on the 10, 20, 40, 80 and 160 meter amateur bands modulated 100% with high fidelity broadcast station modulation, all at a cost below what you can build it for! $119.70 net to amateurs, from your dealer or direct.



Send 3c stamp for new complete catalog describing above items, E. C. Frequency Meters, New Airplane Dials, Relay Racks, R. F. Chokes, Audio, Power and Filter Transformers, and a host of new and interesting amateur and commercial apparatus.

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