RADIO

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THE WORLDWIDE TECHNICAL AUTHORITY • OF AMATEUR • SHORT WAVE AND EXPERIMENTAL RADIO •

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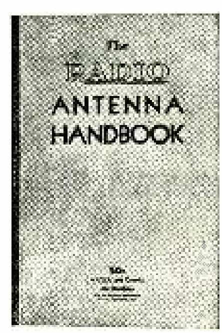

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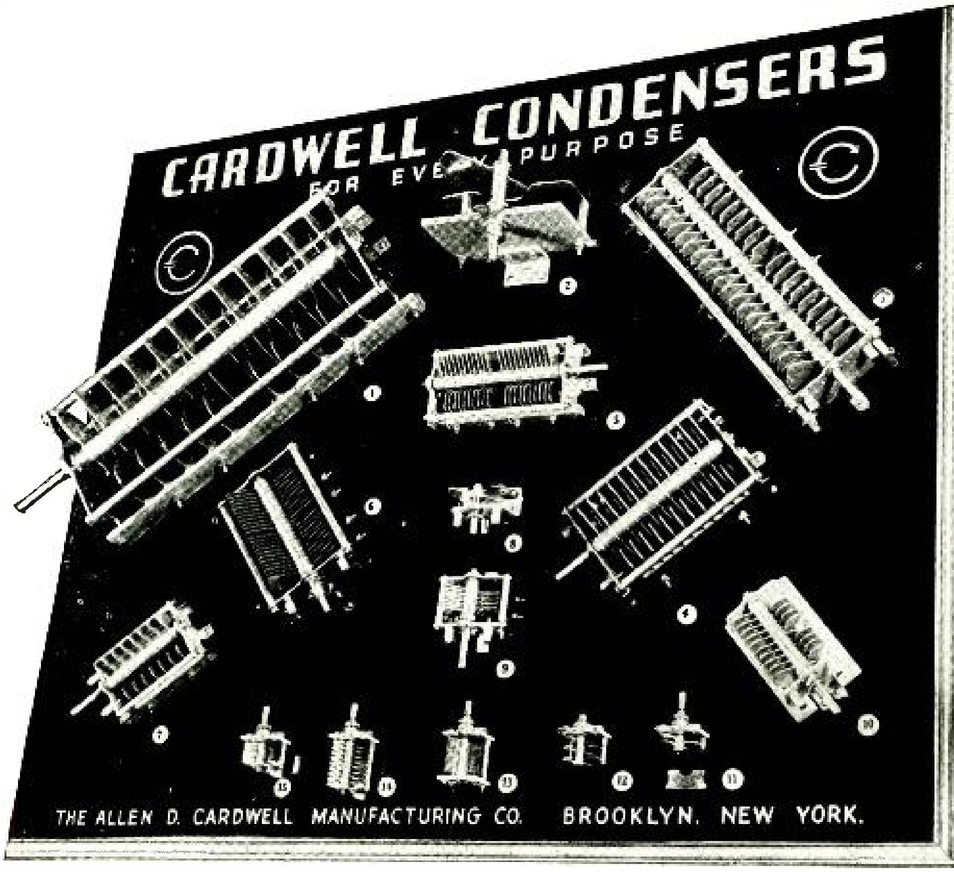

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RADIO

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No. 214 December, 1936

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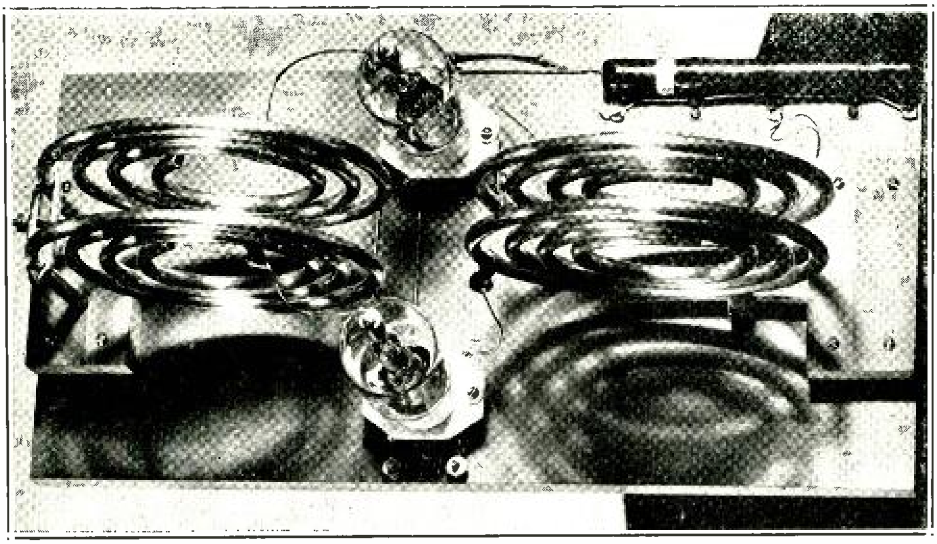
"RADIO" CONTRIBUTIONS

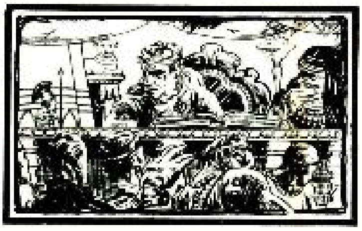
Contributions to our editorial pages are always welcome; though they will be handled with due care we assume no responsibility for those which are unsolicited; none will be returned unless accompanied by a stamped, addressed envelope. We do not suggest subjects on which to write; cover those you know best; upon request, we will comment on detailed outlines of proposed articles, but without committing ourselves to accept the finished manuscript.

Since we regard current "chiseling" policies as decidedly unfair, a small payment will be made, usually upon publication, for accepted material of a technical or constructional nature. Freehand, pencilled sketches will suffice. Good photographs add greatly to any article; they can easily be taken by the layman under proper instructions. For further details regarding the taking of photographs and the submission of contributions see "Radio" for January, 1936, or send stamp for a reprint.

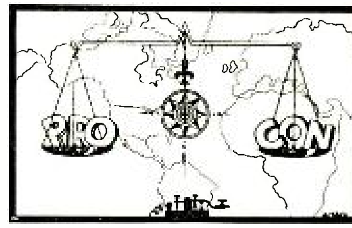
ULTRA-HIGH FREQUENCY CONSTRUCTION



Highly efficient tank circuits in a five-meter oscillator, coiled to permit compact construction



THE OPEN FORUM



Enough Has Been Said

Sydney, Australia.

Sirs:

I have received several letters from indignant American amateurs, asking just who is the W4 referred to in my published letter in your issue of July last.

This I can readily understand, and quite expected that there would be such enquiries.

I am sure, however, that the amateurs enquiring will realize that it would be impolitic to divulge such information at this juncture.

The W4 responsible has undoubtedly had censure enough through the publishing of my letter, which would serve its purpose sufficiently in the widely read pages of RADIO to have the required moral effect.

No good purpose beneficial to amateur radio generally would be served by going into personal details, and I am sure that all will agree with me that such a subject is far better closed.

DON B. KNOCK, VK2NO
Radio Editor, *The Bulletin*

•

Quelling the Bootleggers

Pittsburgh, Pa.

Sirs:

Since the amateurs in the United States were allocated the ultra-high frequency bands below twenty meters there has been a gradual increase of unlicensed stations operating in those bands.

In the Pittsburgh area, during the past two years, unlicensed stations operating in the five-meter band have increased to such an extent that licensed stations find it difficult to operate in the band because of illegal interference.

During the latter part of August a meeting, instigated by W8NQG and W8FFT, was held over the air and the situation was gone over and all licensed amateurs asked to cooperate in clearing the band of illegal operation.

September 1st, a number of amateurs in the Pittsburgh area met at the Hotel Mayfair in Pittsburgh. The meeting was called to order by W8NQG.

Several amateurs present reported that since the meeting held over the air, quite a few of the unlicensed stations had left the band.

W8FFT reported that he had visited a local club whose members consisted of illegal operators. He explained the situation to them and they promised that their members would stay off the air until they received their licenses.

It was decided that all illegal stations heard would be located and warned to stay off the air and, if they still insisted in operating, they would be reported to the Federal Communications Commission and the proper punishment insisted upon.

In order to improve operation on the five-meter band it was further decided that more stable transmitters and receivers which do not radiate be used. Amateurs discussed having several stations equipped to check frequency and to discontinue duplex contacts, and appointing several stations to send code practice for those desiring to obtain a license.

It was also suggested that certain frequencies in the five-meter band be reserved for out-of-town and mobile stations.

It is hoped that, with the cooperation of all the licensed amateurs in the Pittsburgh area, illegal operation can be eliminated.

HARMON W. ARMSTRONG, W8BBV.

•

The Perennial QRO-QRP Question

Lynn, Massachusetts.

Sirs:

RADIO is a great magazine, but would be much better if it advocated a trend to low power.

I believe that the amateur's salvation, so far as the ever-increasing QRM problem is concerned, lies in lower power—150 watts input, no more. At least, it would be better for the average amateur who hasn't hundreds of dollars to spend on equipment. Dx has been and is being worked consistently by those with 150 watts or less input; look at the records of any 210 Dx Club member.

Of course the present trend to higher power tends to limit the amount of hams on the air.

Well, anyway it's something to think about. I'd like to get the views of other amateurs on the subject.

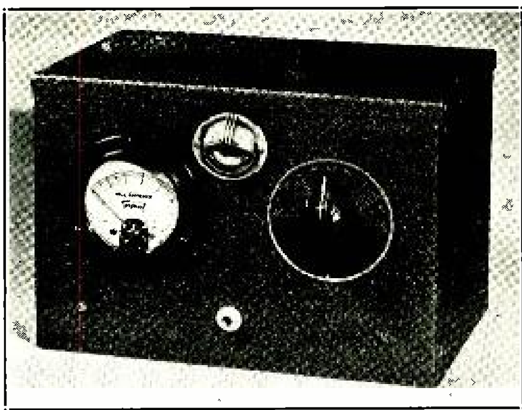
FREDERICK W. ROCKWOOD, W1IOB.

A Modulation Monitor of Wide Utility

By Ray Dawley, W6DHG

Most of the modulation and over-modulation indicators commonly used by amateurs are sadly lacking in the ability to register over-modulation peaks of short-pulse duration. An integrating meter such as a modulator plate meter is taboo when working on the varying, complex waveforms encountered in speech sounds. The inexpensive modulation monitor described tells the true story of your modulation and is easy to get working.

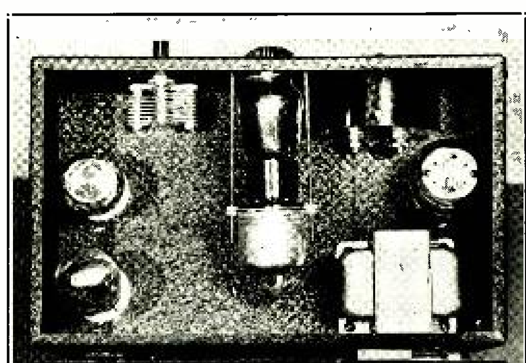
With the recent F.C.C. ruling that all amateur as well as broadcast radiotelephone stations must have a continuously indicating modulation meter, a number of gadgets were immediately presented. Actually, if put to the test, they were not overmodulation indicators at all in the true sense



A Modulation Monitor that Does Everything But Mind the Baby.

of the word, except in a very few cases. Rather, they were carrier shift indicators, modulation power meters, or some similar arrangement of questionable, if any, bearing on over-modulation. Percentage modulation is a peak voltage phenomenon and consequently any unit that does not take this into consideration is not a true indicator. A reversed rectifier connected to the plate return of the final amplifier when it is being plate modulated (as has been advocated in earlier issues of Radio) is an exception, as it instantly indicates when the plate of the final becomes negative, a condition producing no carrier output over a fraction of an audio cycle and consequent overmodulation. A carrier shift meter is definitely not a modulation meter. It merely integrates the average voltage in the modulated wave over a period of about 0.1 second and indicates any change visually by the milliammeter. Bad audio waveform, insufficient excitation to the modulated amplifier, regeneration in any stage carrying modulated r.f., too tight or too loose coupling to the antenna, poor adjustment of a linear omplifier, and any or several of many other conditions will cause a carrier shift meter to move.

Overmodulation is one of the lesser direct causes of carrier shift. Also, quite frequently in the vicinity of the higher modulation percentages, effects such as flattening of the positive audio peaks, and drop in line voltage due to increased drain of class "B" modulators, both of which produce a negative carrier shift, will tend to counteract or even overshadow the positive shift due to overmodulation. Also, any conclusion drawn from a volume indicator, class "B" modulator plate milliammeter, or any similar power integrating meter is bound to be subject to discrepancies due to the wide variance in the average power to peak voltage ratio of the waveform of the common sounds transmitted. The cathode ray tube is a peak-voltage operated device and when used in a properly



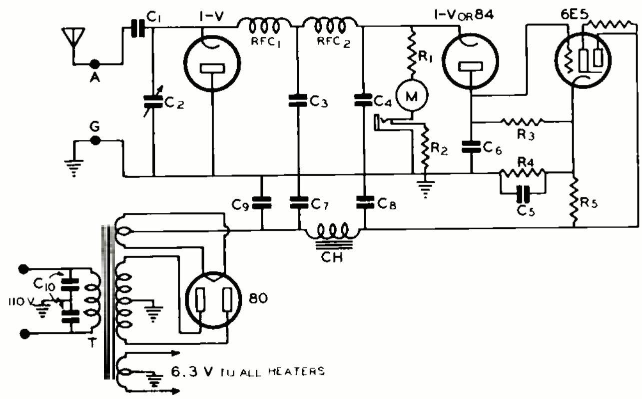
Looking Down into the Monitor, Showing Method of Mounting the "Magic Eye" Tube.

designed circuit with the correct adjustments, a fairly accurate determination of modulation percentage can be made. However, due to the difficulty in observing modulation peaks with a 'scope running on a normal program, this type of a monitor is not approved by the F.C.C. for broadcast station use.

It has been known for some time that it is

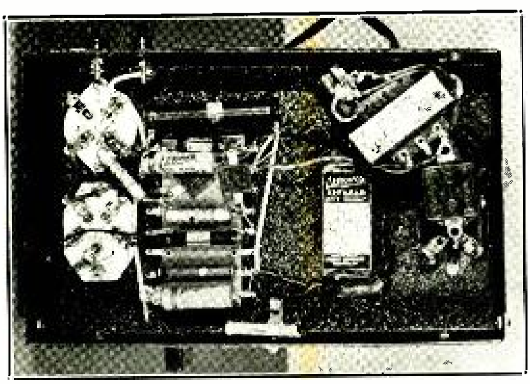
Wiring Diagram of the Modulation Monitor

C_1—.0005 µfd.
C_2—20 to 100 max. µµfd. midget (see text)
C_3,C_4—.0005 µfd.
C_5—.05 µfd.
C_6—.05 µfd.
C_7,C_8—Single 8-8 µfd. electrolytic
C_9,C_{10},C_{11}—.006 µfd. mica
R_1—10,000 ohms, 5 w.
R_2—About 2000 ohms (see text)
R_3—500,000 ohms, 1 w.
R_4—100 ohms, 3 watts
R_5—5000 ohms, 20 w.
R_6—1 meg. (contained in manufactured "eye" assembly)
RFC_1,RFC_2—8 mh. pie wound chokes
M—0-10 ma. d.c.
T—Midget b.c.l. transformer, 6.3 v. fil. winding
L—20 hy, 40 ma. choke



the negative peaks of overmodulation that cause the most serious type of interference. This is obvious when you consider the fact that during a negative peak of overmodulation the carrier is completely cut off; consequently there is a harsh commutation, or "chopping-up" effect, each time the negative peaks are clipped. It is this commutation that produces the hashy sidebands that extend many kilocycles each side of the carrier proper.

What is needed is some form of a peak vacuum tube voltmeter that will indicate visually when the negative modulation peaks approach too high a value. Inasmuch as the 6E5 "Magic Eye" tube is purely a voltage-operated device



Under Chassis View of the Modulation Monitor.

and gives a good visual indication, it lends itself admirably to this use. The unit to be described was designed around this tube as the actual peak indicator.

General Design

The complete monitor can be subdivided as follows:

1. *Input Control Circuit*—Comprised of Condensers C_1 and C_2, C_1 acting as a blocking condenser to keep the d.c. potential generated in the set off the antenna, and C_2 acting as an input control shunt to vary the amount of input.

2. *Carrier Rectifier and Filter*—A 1-V tube rectifies the positive half of the incoming carrier to be filtered to modulated d.c. by the following r.f. chokes and condensers.

3. *Load Resistor, Carrier Shift Meter, and Phone Monitor*—The combination of load resistors, R_1 and R_2, and the 0-10 d.c. milliammeter makes a conventional shift indicator. By plugging a pair of 2000-ohm phones into the jack provided, the resistor R_2 is opened up and the phones substituted. This provides a convenient check on the audio quality of the transmissions. Naturally, if the calibration is not to be disturbed, the resistor R_2 should have the same d.c. resistance as the phones. The resistance of each phone is usually stamped on the back of it, so this resistance is easily determined.

4. *Audio Peak Rectifier*—This tube, a 1-V or 84, rectifies the negative audio peaks, when they exceed a value of about 90% modulation, and feeds them to the 6E5 grid.

5. *Overmodulation Indicator*—The 6E5 tube acts as an indicator of all negative modulation peaks in excess of 90% and is nearly closed at 100% modulation.

6. *Power Supply and Voltage Divider*—The power supply is conventional in utilizing a small b.c.l. transformer, an 80 tube, and a single-section filter to supply 240 volts d.c. to the 6E5 and 6.3 volts to the filaments of all tubes except, of course, the rectifier. The resistor R_4 in series with the bleeder R_5 acts to put a positive potential of about 5 volts above ground on the cathode of the 6E5, and through the resistor R_3 onto the grid of the 6E5 and the plate of the 84 audio rectifier.

Construction and Operation

The whole arrangement, including the power supply, is mounted in a standard shield box, 6½" x 7" x 10". The construction is conventional except, perhaps, for the mounting for the

6E5 tube. This is a complete arrangement, including the escutcheon plate, mounting bolts, and the socket with the leads and one meg. resistor attached, purchased as a single unit. Everything else is self-explanatory from the photographs and circuit diagram. The mica by-passes across the 110-volt line and the input to the power supply were found to be helpful in eliminating undesired pickup from the a.c. line. By connecting these condensers directly from where the line enters the case to ground, interference from this source was reduced to zero.

The actual operation of the instrument will be taken up in some detail to aid in its proper installation. First, the unit should be effectively grounded to the common ground of the transmitter. If it is possible, this should also be connected to a good external ground. Second, because the arrangement takes an actual r.f. power of .5 to 1.0 watt to operate it, fairly close coupling of the transmitter is required. Of course each installation is different, but in most cases an insulated wire wrapped a couple of times around the antenna or a feeder wire will furnish enough coupling. It is important that coupling to the very output of the transmitter only is used; otherwise an erroneous indication may be obtained as you will not be checking what is actually going out over the air. Be careful to avoid stray coupling to the buffer stages. The condenser C_2 must of course have an appropriate value, depending upon the frequency or frequencies to be used. For use in the 14, 28, and 56 Mc. bands a good 20 μμfd. variable is satisfactory. If just 75- and 160-meter phone is used, a small 75-100 μμfd. condenser would be fine, and if all bands are used a 35 μμfd. would be a good compromise value.

To check the unit, it should be turned on and allowed to heat, the transmitter being left off the air. When the tubes have come up to temperature the 6E5's eye should be almost closed, about 1/16″ separation between the halves (or an angle of approximately 5 degrees). If all the resistor and condenser values are correct and none of the parts is defective, this condition will be observed. It is this same amount of deflection that will be observed when the transmitter is on the air and being modulated 100%. Deflections greater than this indicate over-modulation. The adjustment of the arrangement so that this is true is easily accomplished. With the monitor and the transmitter both on, the input to the monitor is adjusted by varying its coupling to the transmitting antenna and the setting of C_2, until the milliammeter shows a deflection of 5 ma. Then. as the transmitter is modulated, no change will be observed until a modulation percentage of 90 is reached, when the eye will start to close. It will be closed the amount indicated in the paragraph before, when 100% is reached.

The milliammeter itself is an excellent carrier shift indicator, any up or down movement with modulation showing non-linearity somewhere in the rig if the line voltage is constant and the carrier is not being purposely varied as in controlled carrier transmission. Also the phone jack provides a perfect aural check on the quality of the transmitter.

If controlled carrier (or some other type of transmission where the carrier power varies) is used, the input to the unit should be adjusted so that, with a modulation percentage somewhat less than 100%, at the full output of the transmitter the milliammeter will show a deflection of 5 ma. Under these conditions the unit will operate the same as with a constant carrier transmitter, provided the ratio of power control from no signal to maximum signal is not over about ten to one.

Explanation

An explanation of the operation of the over-modulation indicator might be in order for those interested. First, when the carrier input is adjusted to show a deflection of 5 ma., due to the 12,000 ohms of resistance in the circuit there is a potential of 60 volts developed from the cathode to ground of the audio rectifier tube, T_2. However, inasmuch as there is a drop of 5 volts across R_4, due to the bleeder current flowing through it, the plate of T_2 is 5 volts above ground. But, looking at it from the other angle, as the plate is 55 volts negative (60—5 volts) with respect to the cathode, there will be no current flow and the "eye" grid will remain at cathode potential. Hence there will be no deflection. Then as we start to modulate, the cathode of T_2 will be swinging above and below $+60$ volts by the following peak voltage:

$$\frac{\%\ \text{mod.}}{100} \times 60 = E_{peak}$$

When this percentage reaches 91% it can easily be shown that the cathode will be swinging between peak values of $60+55=115$, and $60-55=5$. At the negative peaks it is seen that the plate and cathode of T_2 are at the same potential. As the percentage is further increased the cathode will become negative with respect to the plate over an appreciable period of time, and current will flow through R_3 to change the charge on condenser C_6 by an amount ΔE. This ΔE is approximately equal to:

$$(60\text{-}5) - \frac{90 \text{ mod. } 60}{100}$$

(in the values from 0 to -5) if the lowest frequency being transmitted is higher than the reciprocal of the time constant determined by R_3, C_6. It is this instantaneous potential ΔE that is measured by the 6E5 tube. This ΔE becomes —5 at 100% modulation, whereby the eye is closed the same amount as when the transmitter is turned off. This is true because when there is no signal being applied to the monitor there is no voltage drop produced across $R_1 + R_2$, so that the cathode of T_2 becomes negative with respect to the cathode of T_3. This causes a current to flow through R_3, T_2 and $R_1 + R_2$, and as the resistance of R_3 is very much greater than the sum of all the others, the potential across this resistor becomes almost equal to the drop across R_4. Thus we have the 6E5 grid at —5 volts with respect to its cathode, the same condition as is produced with a carrier on the input when modulated 100%.

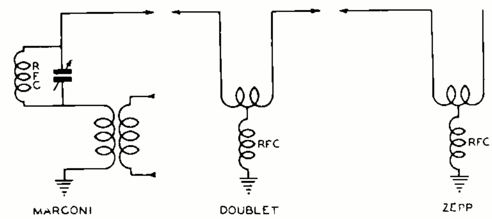
◆

STORMY WEATHER

We have noticed that during severe thunderstorms many amateurs shut down their transmitters so that they can ground their antennas. During these storms, it will be noticed that in a Marconi antenna using an antenna series tuning condenser the condenser will "pop, pop, pop" at a definite time interval, depending upon the severity of the storm and the setting of the condenser. If a d.c. path is provided to ground, it will prevent the antenna from charging up in this manner. Most amateurs throw a grounding switch, which puts them off the air. If the d.c. path to ground is provided through an r.f. choke connected to a point of low r.f. potential on the antenna, we have all the safety of a grounded antenna without going off the air.

Even when no series condenser is used and there is no "popping" to annoy you (such as in a twisted pair doublet), grounding the feeder through an r.f. choke will provide much the same kind of protection that comes from a "lightning rod".

Regardless of the type of antenna or feeder



system used, just remember to connect the r.f. choke to the antenna side of any series condensers, and at a low potential r.f. point if possible (voltage node) because the choke will then have less work to do at radio frequencies.

◆

We notice on the program of George White's *Scandals* (Los Angeles) the following: "Sound reinforcement equipment designed and built by R.A.C. Manufacturing Company."

◆

The many amateurs who showed an interest in the "Selectosphere" described in the October issue of RADIO will be glad to know that the device is now available in kit form.

RECEIVER CONTEST

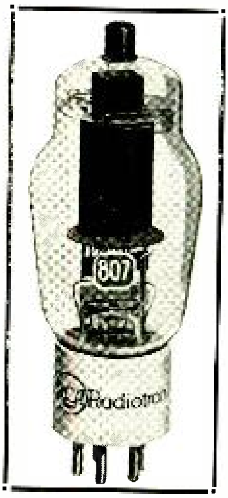
For the best receiver article submitted to "RADIO" before November 30, we are offering the winner his choice of the following transmitting tubes: One HK-354, one Taylor T-200, one Amperex HF-300, two Eimac 50-T's, two Raytheon RK-35's, or one RCA-805.

RULES:

1) *The story must be original and must not have appeared elsewhere.*
2) *All articles accepted for publication will be paid for at our regular rates without regard to the contest. The winner, in addition to the usual cash payment for his manuscript, will receive his choice of the above prizes.*
3) *No rejected manuscripts will be returned unless accompanied by a stamped, self-addressed envelope.*
4) *The members of the* RADIO *technical staff will act as judges.*
5) *Manuscripts must be postmarked by November 30, 1936.*

The receiver does not have to be elaborate to win, may have as few as three tubes. Originality, performance, unique features, and mechanical construction will determine the winner, not the number of tubes. Diagrams may be rough pencil sketches, and the article does not have to be written in flowery language, as the diagrams are redrawn anyhow and the manuscript can be rewritten by us if necessary. However, *good clear photographs* will be a deciding factor in choosing the winning manuscript. Also, be sure to list the components *both* by value (ohms, etc.) and manufacturer's type number. Before announcing the winning receiver, it will be duplicated in our laboratory to confirm the author's performance claims.

Two New Ones: The 807 and 808



R.C.A. has favored the amateur fraternity with a very nifty companion to the 802 in the form of a special 6L6, especially designed for r.f. work. This new version of the 6L6 has been designated as the 807 and at audio frequencies has no advantage over the 6L6. Also, as a straight crystal oscillator it has no particular advantages over the 6L6 or 6L6-G—at least not enough to justify the higher cost.

However, as a straight amplifier, working straight through, or as a doubler at the higher frequencies it gives a much better account of itself than its earlier b.c.l. cousin, the 6L6.

The 807 has a glass envelope, top cap connection, ceramic base (5 prong), and internal shielding to cut down the grid-plate capacity. With proper external shielding, the grid-plate capacity is approximately 0.2 μμfd., low enough to eliminate the necessity for neutralization at most frequencies.

807 Vs. 802

Comparing the new tube with the 802, we find that the 807 has approximately twice the plate dissipation rating of the 802, although one would not be led to believe from the relative sizes of the anodes that there would be that much difference. The grid-plate capacity of the 807 is slightly higher than the 802 (0.2 μμfd. as compared to 0.15 μμfd.), but is not enough greater to make any appreciable difference. However, the output capacity (plate-filament) of the 807 is substantially lower than that of the 802, an important item at 5 meters.

The mutual conductance of the 807 is substantially greater than in the 802, meaning that the 807 will "do its stuff" at lower plate voltage than the 802. In fact, as may be seen from the figures given in the tables, the maximum plate voltage rating is somewhat lower than for the 802, the greater output being obtained by greater plate current, the 807 drawing 100 ma. as against 45 for the 802 at maximum voltage rating.

The 807 has no suppressor grid, and therefore cannot very well be suppressor modulated. However, modulation at the control grid by means of modulating the bias voltage seems to be preferable to suppressor modulation anyhow, even with the 802. The 807 may be high-level modulated by reducing the plate voltage slightly and modulating the plate and screen together, the linearity being very good when a watt or more of excitation is available. For telegraphy or low-level modulation, about a quarter of a watt is sufficient r.f. excitation power.

In doubling circuits the 807 seems to exhibit no advantages over the cheaper 6L6-G, except at frequencies above 20 Mc., where the mud base of the 6L6-G produces a deleterious effect upon the output.

As is usual with R.C.A. tubes of this type, the tube seems to be very conservatively rated in regards to plate voltage, and with care the plate *voltage* may be run up to 1.3 times the rated maximum, though one had best stick to the ratings when working above 14 Mc.

TRANSMITTING BEAM POWER R.F. AMPLIFIER
RCA-807

(Preliminary Data)

Heater voltage (a.c. or d.c.)	6.3 volts
Heater current	0.9 ampere
Mutual conductance, for plate cur. of 72 ma.	6000 micromhos
Direct interelectrode capacitances:	
Grid-plate (with ext. shielding)	0.2 max. μμfd.
Input	11.6 μμfd.
Output	5.6 μμfd.
Maximum overall length	5¾"
Maximum diameter	2 1/16"
Bulb	ST-16
Cap	small metal
Base	medium 5-pin, ceramic

MAXIMUM RATINGS

A.F. Power Amplifier & Modulator—Class AB2

D.c. plate voltage	400 max. volts
D.c. screen voltage	300 max. volts
Max.-signal d.c. plate current*	100 max. ma.
Max.-signal d.c. plate input*	40 max. watts
Plate dissipation*	21 max. watts
Screen dissipation*	3.5 max. watts

*Averaged over any audio-frequency cycle.

R.f. Power Amplifier—Class B Telephony

(Carrier conditions per tube for use with a max. modulation factor of 1.0)

D.c. plate voltage	400 max. volts
D.c. screen voltage	300 max. volts

D.c. plate current	80 max. ma.
Plate input	32 max. watts
Screen dissipation	2 max. watts
Plate dissipation	21 max. watts

Plate-Modulated R.F. Power Amplifier
Class C Telephony

(Carrier conditions per tube for use with a max. modulation factor of 1.0)

D.c. plate voltage	325 max. volts
D.c. screen voltage	250 max. volts
D.c. grid voltage	-200 max. volts
D.c. plate current	83 max. ma.
D.c. grid current	5 max. ma.
Plate input	27 max. watts
Plate dissipation	14 max. watts
Screen dissipation	2 max. watts

R.f. Power Amplifier and Oscillator
Class C. Telegraphy

Key-down conditions per tube without modulation†

D.c. plate voltage	400 max. volts
D.c. screen voltage	300 max. volts
D.c. grid voltage	-200 max. volts
D.c. plate current	100 max. ma.
D.c. grid current	5 max. ma.
Plate input	40 max. watts
Plate dissipation	21 max. watts
Screen dissipation	3.5 max. watts

Typical operation:

Heater voltage	6.3	6.3	volts
D.c. plate voltage	300	400	volts
D.c. screen voltage	250	250	volts
D.c. grid voltage	-50	-50	volts
Peak r.f. grid voltage	80	80	volts
D.c. plate current	95	95	ma.
D.c. screen current	10	9	ma.
D.c. grid current (approx.)	3	2.5	ma.
Driving power (approx.)	0.2	0.2	watts
Power output (approx.)	17.5	25	watts

†Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

NOTE: The RCA-807 may be operated at maximum ratings for frequencies as high as 60 megacycles.

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NEW RCA 808

Low "C", High Mu Triode

First the 35-T, then the RK-35, RK-37, and now the 808. These tubes are all very much alike in characteristics, though the 808, the newest of the group, has somewhat more filament power. The envelope and connection facilities resemble most closely the RK-35, though the anode structure and method of support resemble most closely the 35-T.

Like the 35-T and RK-35, the RCA 808 uses a tantalum anode. For a long time Western Electric, Heintz and Kaufman, and Eimac were the only tube manufacturers who commonly used tantalum elements, but the material seems to be coming increasingly popular as evidenced by the new tantalum-plate Raytheons and the new RCA 808.

The 808 may be used either in class B modulator circuits or for r.f. use up to 30 Mc. at full ratings, and up to 130 Mc. at 50% of maximum rated plate voltage.

The class B audio output ratings are slightly less than 200 watts output per pair at either 1250 or 1500 volts, the higher voltage requiring somewhat less driving power for the same output.

The ratings and typical operating conditions are given below:

TENTATIVE CHARACTERISTICS

Filament voltage (a.c. or d.c)	7.5 volts
Filament current	4 amperes
Amplification factor	47
Direct interelectrode capacitances (approx.)	
Grid-Plate	3 μμf
Grid-Filament	5 μμf
Plate-Filament	0.2 μμf
Top Cap	medium metal
Side Cap	small metal
Base	medium 4-pin bayonet

MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS

As A.F. Power Amplifier and Modulator—Class B

D.c. plate voltage	1500 max. volts
Max.-signal d.c. plate current	150 max. ma.
Max.-signal plate input	150 max. watts
Plate dissipation	50 max. watts

Typical operation:
Unless otherwise specified, values are for 2 tubes.

D.c. plate voltage	1250	1500	volts
D.c. grid voltage	-15	-25	volts
Peak a-f grid-to-grid voltage	120	110	volts
Zero-sig. d.c. plate current	40	30	ma.
Max.-sig. d.c. plate current	230	190	ma.
Load resistance (per tube)	3175	4575	ohms
Effective load res. (plate-to-plate)	12700	18300	ohms
Max.-sig. driving power (approx.)	7.8	4.8	watts
Max.-sig. power output (approx.)	190	185	watts

As R.F. Power Amplifier—Class B Telephony
Carrier conditions per tube for use with a max. modulation factor of 1.0

D.c. plate voltage	1500 max. volts
D.c. plate current	75 max. ma.
Plate input	75 max. watts
Plate dissipation	50 max. watts

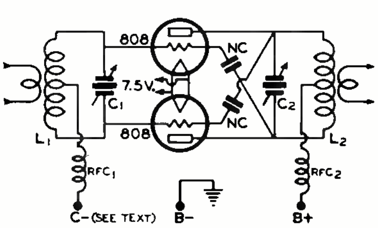
[*Continued on Page 72*]

A 10 Meter Push-Pull 808 Amplifier

By B. A. Ontiveros, W6FFF

While primarily designed for 10-meter operation, either c.w., grid-modulated, or plate-modulated, this amplifier works well on all the lower-frequency bands. It utilizes two of the new 808's and an interesting type of construction. 350 watts on c.w., 250 watts plate-modulated, and 85 watts with grid modulation were easily obtained.

If you build this transmitter, we hope the 10-meter band is still "open" when you finish it, because if it is, you are in for the thrill of a lifetime. If the band has gone into hiding, you can be consoled with the prospect of doing big things on 10 meters in the spring. In the meantime you can put it on some other band



The 808 Push-Pull Amplifier

C_1—80 μμfd. per section
C_2—50 μμfd. per section. 6000 volt spacing
NC—"800" type neutralizers
RFC_1—2.5 mh. 125 ma. choke
RFC_2—2.5 mh. 500 ma. choke

if you wish, for while the transmitter shown in the photograph requires a minute or two to change the plate inductance, it works to perfection on all the lower frequency bands as well as 10 meters. If you wish to use it on bands other than 10 meters, it would be a good idea to incorporate coil chucks or some other more handy means of changing coils, by the way.

The construction shown in the photograph is somewhat unusual, but allows very short and symmetrical leads, a very important item at 10 meters.

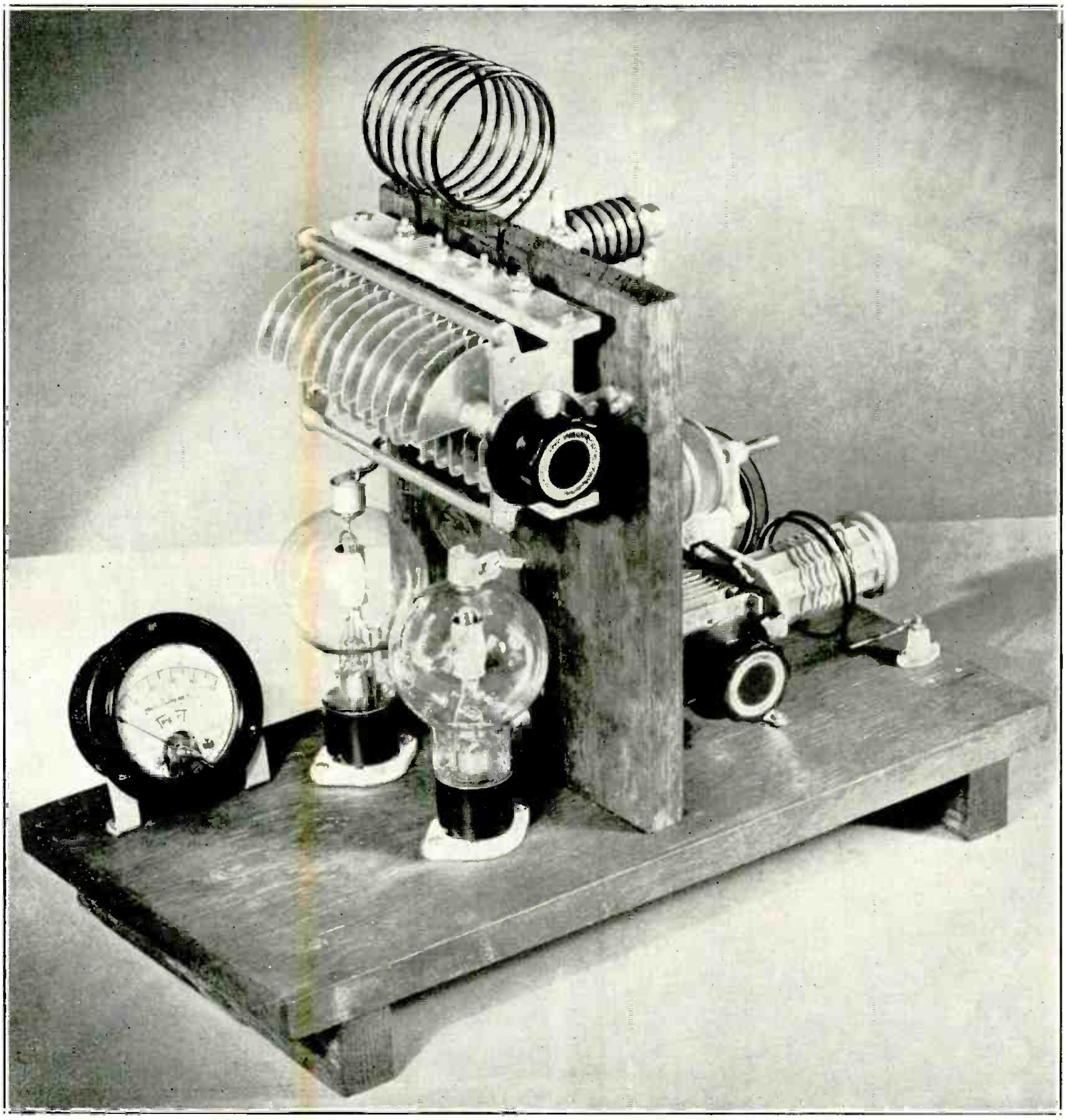
It will be noticed in the diagram that the rotors of the tank condensers are left "floating". This was done intentionally, as the amplifier seems to work better on 10 meters with them ungrounded.

No grid bias is shown, as the transmitter was used experimentally with both grid and plate modulation. For both c.w. and grid modulation, the plate voltage was run at 1800 volts, and for plate modulation at 1500 volts. This is somewhat in excess of the manufacturer's rating, but will do no harm if the plate current is kept below the maximum rated value and the filament voltage is kept well up.

For c.w. and plate modulation, a 2500- or 3000-ohm grid leak may be connected from the bias post to ground. A 22.5- or 45- volt C battery in series will keep the plate current down when excitation is removed, but is not absolutely necessary because the plate current will not rise much, due to the high μ (47) of the tube.

For grid modulation, two 45-volt blocks of battery were used for bias (no grid leak). By using an r.f. driver of good regulation (loaded with a dummy resistor) and push-pull 6A3's for modulators, it was possible to get 85 watts output with the amplifier loading and excitation adjusted for 95% modulation capability, with distortion of less than 10% at that percentage modulation. The tubes run a little red under these conditions, but being used to seeing tantalum plate tubes run white hot, we did not worry much about them. The modulation transformer used was one designed for driving class B 830-B's, 35-T's, HF-100's, etc. with push-pull 2A3's or 6A3's. The primary is connected as usual, and either one half or the whole secondary winding is connected in series with the battery bias, depending upon which sounds the better. Using the whole winding gives more gain, but with certain transformers may give more distortion. If lower (or higher) plate voltage is used for grid modulation, the bias should be changed in proportion. The antenna loading

In response to a number of requests the January, 1937, issue will contain a complete index of all 1936 issues.



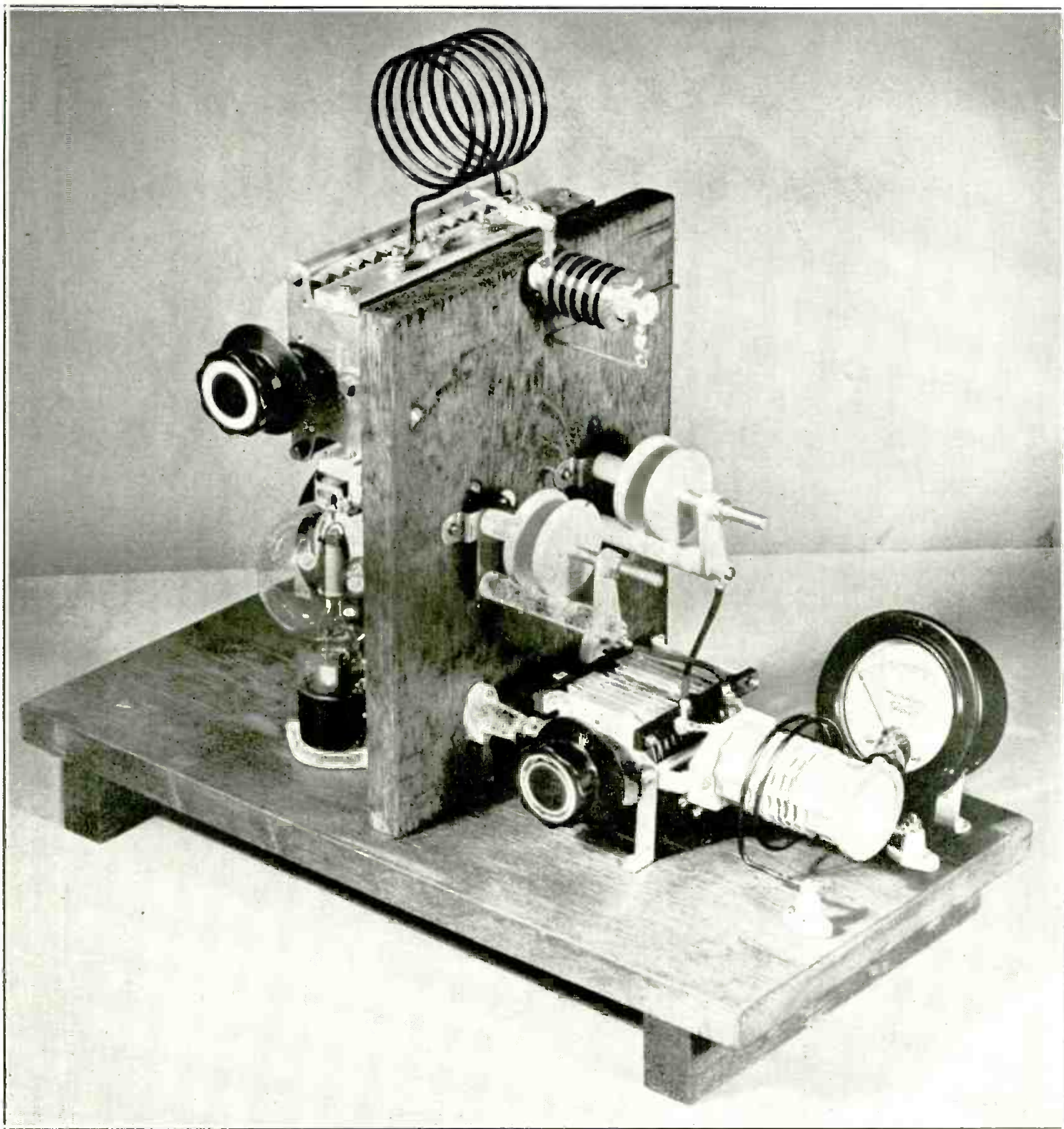
will be much greater for grid modulation, the excitation much less.

On c.w. the amplifier got along nicely on but 40 to 50 ma. of grid current, but for plate modulation required 65 to 70 ma. for best linearity.

Meters

Two meters facilitate the tuning-up procedure. They were mounted directly upon the chassis, but could just as well be replaced by meter jacks, the meters being patched into them by means of cords. The grid meter used was a 100 ma. model, and the plate meter a 500 ma.

Neutralization was effected by the simple process of adjusting the condensers together until no flicker in grid current occurred when the plate tank condenser was tuned through resonance. When grid modulation is used, the excitation may be increased over that which would ordinarily be used for grid modulation while the neutralization procedure is being carried on. It is somewhat easier to get the neutralization adjustment "on the nose" when lots of excitation is available.



The proper method of adjusting the excitation and loading for grid modulation may be obtained from the *Radio Handbook*.

Excitation

Incidentally, while being tested the amplifier was driven by the push-pull 807 amplifier shown elsewhere in this issue. This makes a very simple and effective 300-watt phone/c.w. transmitter for 10 meters: the special 6L6 exciter, the 807 buffer, and the 808 final amplifier, all described in this issue.

Antenna Coupling

Any conventional type antenna coupling may be used with the amplifier, just so that it does not unbalance the amplifier and does not offer an inductive or reactive load.

Cooling the Crystal

By Guy Forest

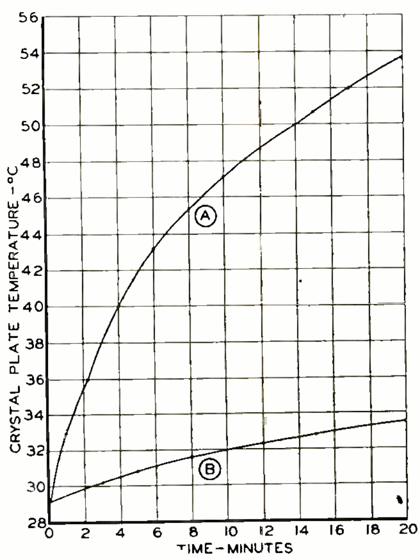


Figure 1

Temperature increase with and without the cooling system described in the text. Curve "A" is for conventional mounting, curve "B" with holder mounted upside down on chassis.

If the title would seem to indicate that this article is concerned with refrigeration, it is misleading. Quartz crystals used for transmitter control have a habit of heating up, and this tale has to do with reduction in heating rather than with creation of below-normal temperatures.

A rise of 10° Centigrade in the temperature of a crystal is not uncommon, and in fact is much less than usual. Even with the low-coefficient cuts such a rise will mean a drift of several hundred cycles on 14 Mc., and for the X or Y cuts the drift would have to be reckoned in kilocycles. If one operates in the fashion of some of the larger dx stations, crowding the band edge as closely as possible, this drift is a most important factor. But even if the transmitter frequency is removed from the band limits, there still is reason to be concerned with the stability of the signal.

How often have you listened to an otherwise excellent crystal signal, but had to stay right on top of the tuning control and follow up on the dial during the course of every transmission? Or how often have you had a steady signal in, and had to stay with the controls because a QRM station was drifting past the wanted signal?

Excepting those cases where the crystal has been mounted ill advisedly near a power transformer or other heat source, the cause of temperature rise is internal, within the crystal. In order to hold down the temperature rise, some adequate provision must be made to get rid of the heat. There are three ways in which the loss might occur: by radiation, in the form of heat waves thrown off from the crystal or holder plates; by convection, being carried off by air or fluid currents passing over and around the heated parts, and by conduction, in heat flow directly through the substance of adjacent materials.

The heat loss due to the first cause is not considerable at the relatively low temperatures

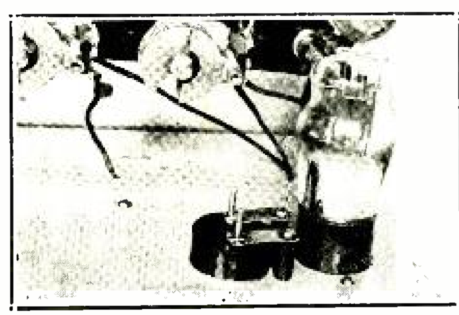


Figure 2

Simple method of cooling the crystal, allowing quick crystal change. The crystal holder must be of the type wherein the top electrode is also the top of the holder. The method is particularly effectual with a copper or aluminum sub panel.

of crystal operation. In any case it could be made larger if the exposed radiating electrodes were finished in dull black rather than polished surfaces. The heat loss due to convection might be increased by means of fins of copper with large surface areas, attached to the crystal electrodes. However, the third possibility offers the best promise of efficiency with but slight changes in the method of mounting the crystal.

Many of the crystals now on the market are sold in holders having one electrode plate exposed. The usual method of mounting is to plug into a socket, where the only chances for heat loss are by radiation from the polished

[*Continued on Page 84*]

More Power at 5 Meters

By Ronald H. Gordon,* W6AAZ

If you are using but 5 or 10 watts on 5 meters, a pleasant surprise awaits you if you build the rig described in this article. Not crystal controlled, but about the next best thing. It is inexpensive, simple, and highly efficient. The 150-watt carrier it puts out will "knock their ears off" where you were unable to get above receiver hiss before, greatly increasing your working radius.

Have you, too, wondered what would happen in the way of dx if you had high power on the five meter band? Since most amateurs utilize power outputs of less than five watts, there has been little opportunity to explore the possibilities of high power at these frequencies. Yet it is very easy to generate more power at higher efficiencies, and this article describes the circuit elements necessary to do this.

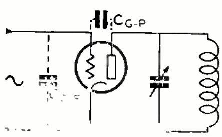


Figure 1

The self-excited oscillator was chosen because of its inherent simplicity. The problem was to make oscillations stable enough to be received satisfactorily by a superheterodyne, and also be quite free from frequency modulation when plate-modulated. But that is not all! Anyone who has tried to raise the input to a five meter oscillator knows that everything gets hot, including the coils, tube, and plate and grid leads. This of course spells low efficiency. Wherever heat is given off in a circuit, energy is being lost, the loss being proportional to I^2R. Hence, when heat occurs in a coil, lead, tube, or resistor we know that one of two things is happening: either the current or the resistance is high. The reason most low power transmitters are inefficient is that the losses do not heat up the parts enough to alarm the operator. But when using higher inputs, all you need to do to correct the inefficiencies is to look for the smoke.

You ask why the losses are greater at five meters than at 80 meters. First of all, unwanted stray capacitance upsets the whole picture. The plate-grid capacitance of the tube makes the r.f. plate current skyrocket, which not only burns up the plate leads but wastes power as well. The grid-filament capacitance raises the r.f. grid current, which makes the tube hard to drive. See figure 1.

The grid-to-filament capacitance acts as a shunt across the excitation and lowers the r.f. voltage actually appearing at the grid structure. Of course, the increased r.f. grid current doesn't aid in keeping the grid leads cool or in raising the efficiency.

This situation can be at least improved by the use of tubes with low capacitances and heavy leads, and also high grid-to-plate transconductance. A high μ is generally desirable.** The latter might at first seem strange, but tests were made which proved that a high μ tube functions best. Several tubes of the same power class and same general design were tried in the set described here. When the surprising fact was revealed that two high μ, low power tubes gave more output with the same input than two low μ tubes of higher power rating, it set the writer to investigating. First of all, a high μ tube can be driven with a low swing. It might take a little more d.c. grid current, but this factor is less important. Less grid voltage swing means that the grid-filament capacitance will pass less grid r.f. current and will have less shunting effect upon the excitation voltage. This is true because when the a.c. voltage across a condenser is raised, the current through the reactance rises proportionately. This is just as true of r.f. voltage as it is of low frequency voltages, including d.c. See figure 2.

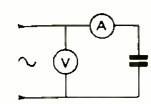


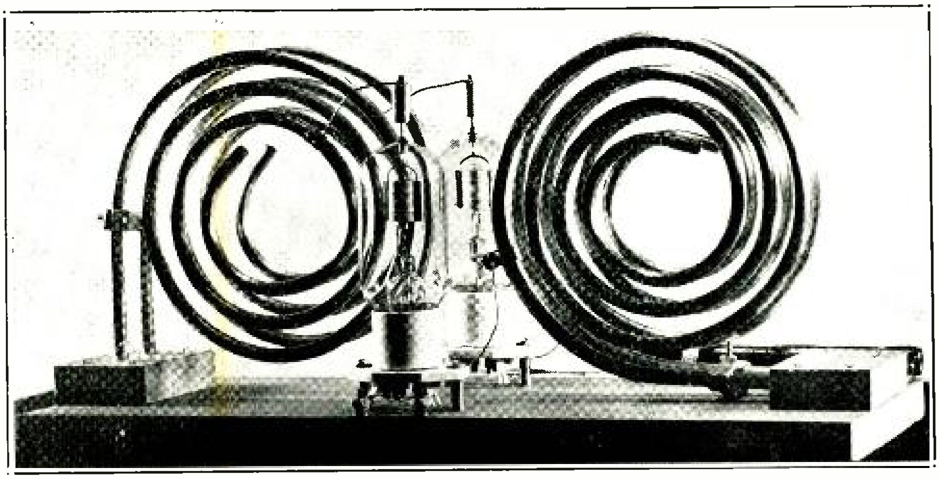
Figure 2

Not only do the leads get hot, but conventional tank coils get hotter—that is, if they are efficient enough to allow operation at all. The resonant lines to be described heat to a certain extent at high power, but if the r.f. voltage were kept as low as it usually is in conventional low-power oscillators, the heat would be negligible.

The function of a tank circuit is to make possible a high resistance or impedance at the resonant frequency. If we want stability we also expect frequency discrimination or Q in the tank. In the plate circuit high impedance is most important, since it determines plate efficiency. Plate efficiency is approximately a function of output or load impedance. Output im-

*25 Silva St., Millbrae, Calif.

**There seems to be a divergence of opinion on this question.—Editor



Bizarre but Highly Effective Method of Mounting the Inductances

pedance must be kept high, which means that a very high impedance tank must be used, so that the load can be coupled relatively loosely. If the tank circuit has too low an unloaded shunt impedance, it acts as a substantial part of the output impedance and absorbs and dissipates power before it can reach the antenna.

Referring to figure 3, if Z_P is very low and Z_T is very high, most of the voltage drop is across Z_T. Since the voltage drop across the tube is low, the watts lost on the plate will be low. But when we couple Z_L, the antenna,

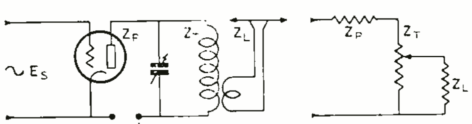


Figure 3

this reflects an impedance into Z_T which lowers the effective value of Z_T. This makes the plate loss rise, but there is a certain optimum value of coupling which gives the most watts output without exceeding the safe plate dissipation.

On the other hand, if Z_P were higher, due to lack of proper excitation, and perchance we used a very poor plate tank, making Z_T low, the voltage drop across the tube would rise and the plate would get hotter. Also, the voltage drop across the tank would fall and decrease the power output. Now when the load is coupled, the reflected impedance lowers Z_T even more and the situation is hopeless. So we give up and demand a high impedance tank.

At high frequencies, a resonant line has a much higher unloaded shunt impedance than a conventional tank coil. The reason for this is beyond the scope of this article, but can easily be shown by experiment if you are ambitious. Terman has shown the mathematical proof of this point. In fact, the impedance goes up as the frequency goes up, so that resonant lines function very well above 60 megacycles. This is where the laws of nature gave us a lucky break. The impedance goes up with the increased diameter of the tubing, both in concentric and parallel lines. Of course the resistance of the line must be kept low, copper tubing being quite essential. If even a small part of the line, such as the shorting bar, is made of brass or iron, the losses will be very high. The impedance also rises as the spacing between the lines increases, until a certain point is reached

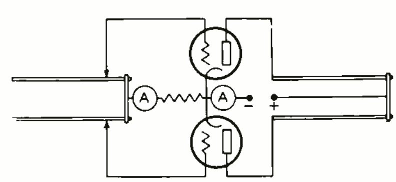


Figure 4

where radiation occurs. In fact, as the two lines are spread farther apart they become better radiators, and if bent out straight make a perfect doublet. Hence it is important to keep the spacing close enough to prevent this loss by radiation.

A resonant line in the grid circuit as shown is used to keep the frequency stable. If adjusted properly, it should make the excitation fall if the frequency drifts to either side of resonance. This will tend to keep the oscillators on one frequency. In order to do this the line spacing must be adjusted for the highest Q, not necessarily the highest impedance. Q is the sharpness, or selectivity, of the tank, while impedance does not specify any sharpness. The highest Q is hard to determine, but is obtained with closer spacing between the lines than is required for highest impedance. The distance between the grid taps should be as close to the shorting bar as is consistent with adequate excitation to the grids. This spacing is about five inches in the oscillator shown but varies with different tubes and tank arrangements.

Tank Construction

As to the construction, the first question in your minds is probably this: How does one manage two four-foot lines without spreading them all over the shack? There is a way to get around the bulky lines if one uses copper tubing small enough in diameter so that it can easily be bent, say 5/16" to 1/2". The writer experimented with various ways of folding and coiling the lines, and it was found that if they were coiled in a flat spiral they functioned practically as well as if they were straight. Each four-foot length of tubing is coiled separately, so that each turn is larger in diameter than the previous turn, and all the turns are in the same plane. Thus, when the two spirals are placed side by side, the two pieces of tubing are equally spaced through their entire length. Strangely enough, this does not change the frequency noticeably. The space saved is quite evident from the photograph. It also allows the leads to be a little shorter and more conveniently arranged.

Suitable Tubes

As for tubes, the 35T and RK35 fill the bill very well. They are the lowest capacity tubes in this power class on the market, and have short, husky plate and grid leads. Since the μ is 30, they are very easy to drive at high frequencies. Also the plate can be momentarily overloaded without danger of gas. This is an important factor at five meters, because during adjustments the tubes sometimes have to take heavy overloads. The 35T's in the rig described have been operated at 2,500 volts without difficulty. If the lines are spaced too closely, an arc between the lines will start. A beautiful self-sustaining arc about four inches high will stand up in mid-air off the plate lead if started with the touch of a pencil.

Typical operating conditions are:

E_p	I_p	I_g	W_{in}	W_{out}
3,000	.190	.025	570	300
2,700	.240	.025	648	300
2,000	.140	.015	280	150
1,800	.160	.012	288	150

These values of output were obtained by soldering one and then two 150-watt lamps to the line a short distance from the shorting bar. The value of W_{out} is therefore approximate, but guaranteed to be low if anything. The tubes are being grossly overloaded at the 300-watt output, but will not show distress at the 150-watt rating if the filament voltage is not allowed to drop below normal.

The grid leak is 12,500 ohms. The use of a d.c. grid milliameter is highly recommended, and it tells as much or more than the plate milliameter about the proper adjustment of the circuit. The efficiency is apparently 50% or thereabouts, but this is overall efficiency and not plate efficiency. The power loss is not all on the plates of the tubes, but is partly lost in heat in the lines; through r.f. radiation of the lines and plate leads; grid excitation; etc. However, 50% efficiency allows considerable power output at these frequencies.

The first night the set was put on the air, everyone called us and wanted to know how many kw. we were putting out. R9 reports were unanimous. Everyone said the frequency drift "just wasn't", and that the signal was very sharp in spite of the high signal strength.

◆

When soldering up a beam antenna located some distance from the nearest 110-volt line, a great deal of time was wasted by trotting back and forth to heat the soldering iron until we got the idea of using the 600-ohm lead-in as a 110-volt line. First disconnect the lead-in from the antenna and connect the soldering iron; then disconnect the transmitter and connect the lead-in to the 110-volt line in the shack. *Don't touch the lead-in while the 110 is on* and have someone stand guard to prevent anyone else from doing so.—W6MZR.

◆

It is a common practice among the VK's to run their 802's at 800 volts. Maybe their volts down there are milk-fed or something.

◆

East Coast Lament

Way out west where men are men and the hams use push-pull HF-300's in their buffer stages.

Noise Reduction with Balancing Coils

By Robert S. Kruse

If you are using a receiving doublet, the chances are you can effect a considerable improvement in noise reduction by the simple means described in this article. As a test, short the two feeders of your doublet and turn up the gain. If you can still hear signals, in spite of good receiver shielding, your doublet needs the following treatment.

The familiar doublet receiving antenna with the twisted-pair downlead usually helps to reduce received noises, but a rather simple departure from the usual circuit often produces a very great additional improvement. To understand why this is possible let us first look at the usual arrangement. The antenna-primary coil is connected to the two wires of the twisted-pair antenna downlead and the *intention* is to couple this coil only magnetically to the tuned secondary coil which feeds the grid of the first tube in the receiver. In costly commercial receivers this intention is made good by inserting a "static screen" or "Faraday screen" between the antenna coil and the tuned coil, so that there can be no capacity-coupling between the coils, but in ordinary amateur and broadcast receivers no such precaution is taken and *at least as much* gets into the set by capacity coupling as by magnetic coupling. To check this, just short-circuit the antenna coil and listen to the noise that still leaks in—yes, and the signals too. This is not surprising, for the coil-to-coil capacity is about the same as that which was formerly used in the "Schnell" receivers as the *only* antenna coupling.

It is rather hard to work a static screen into an existing receiver, but if a doublet antenna with twisted-pair downlead is being used there are two other ways of getting a part of the same effect. Both schemes will also work with any other sort of symmetrical antenna, but not with a Marconi antenna.

Scheme Number One

Scheme number 1 is to operate on the receiver, centertapping each antenna-primary coil and grounding the centertap by an extremely short wire to the chassis of the receiver. Any other grounds on the antenna coils must of course be removed. The purpose of this procedure is to compel the center of the primary winding to have a zero voltage as compared to the receiver. Any attempt of the antenna to act Marconi-style will then place nearly the same voltage on both ends of the primary, which voltage will be very much less to begin with than if the primary were ungrounded, and somewhat less than if the ground were at one end of the primary.

The good effect is not confined only to near-Marconi noise reception, however. If the doublet and the primary coil are anywhere near right for the band in which they are working, we desire and expect a point of maximum current to appear in the primary coil. Even in all-wave receivers we get it more or less exactly. Out-of-band interference, including noises, have a point of maximum current elsewhere, so that the antenna coil is at a voltage different from chassis, permitting us to ground such interferences to chassis.

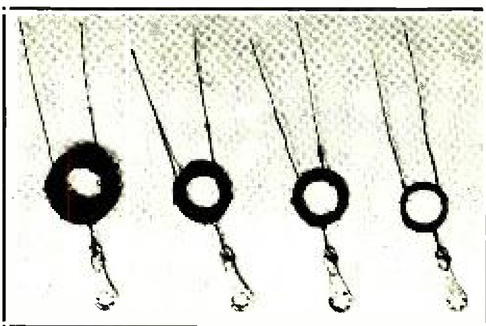
Thus, not only Marconi-action of the antenna, but even Hertzian action at wrong frequencies, is reduced by the presence of the centertap.

For the broadcast-receiver manufacturer it is undesirable to use such centertapped primary coils, as an additional switch blade is required. Since a ground at one end of the coil approaches the useful effect—sometimes—we commonly find receivers with the "low" ends of the antenna coils brought out to an independent terminal which may either go to ground, to chassis, or to the other side of a symmetrical system. For the amateur, the centertapped antenna coil may be worth trying, especially if he has unusually severe noise and weak signals.

Scheme Number Two

In some receivers it was found very difficult to centertap the antenna coils because of the use of fine wires, machine windings, or very compact constructions. This suggested the use of an "artificial centertap" consisting of a centertapped coil connected across the primary, only this new shunt-coil (or "balancing coil") being grounded. It was of course clear that different receivers would require different balancing coils for the same bands. This is so because the primary coils of receivers are not alike. Some of them use a few antenna turns of fairly large size; others use a lumped coil of many turns not very close to the tuned secondary. The many-turn lumped coils are hardest to tap successfully, and it is exactly such coils which work best with the balance coil.

After several evenings of winding and listening it was found that the balancing coils *must* be of small diameter and wound lumped, and with small wire, for best effect. During very severe noise it is important that the leads from the balance coil to the original antenna primary be short and not exposed needlessly to noise-pickup. Two to five inches outside the chassis is plenty to start trouble when noise is bad. The centertap of the balance-coil should be extremely short; those in the photograph are about right.



Balance Coils for 20, 40, 80, and 160 Meter Bands

No layer-wound coil was as good as the "scramble" windings shown in the photograph. Other lumped windings of a systematic sort were tried but did not appear to show an advantage worth the trouble of making them. The final set of coils was wound with no. 26 s.s.c. on a large fountain pen having a diameter of about ½" and tapered enough so the coil could easily be slid off. It is to be understood that the winding is continuously forward in one direction, most of the coils being so small that merely counting turns gives a sufficiently exact centertap, though the final turns are larger than the first ones. In the 160-meter coil this was not found good enough; therefore, two similar coils were wound by using two pieces of wire, winding in opposite directions and connecting the two final (outside) ends together as a centertap for the pair. Nothing in particular is claimed for this winding method. It was satisfactory and simple.

The finished coils were held together by merely winding the ends of the wires through the coil a few times. About a pint of fancy coils failed to show any advantage whatever over these simple gadgets.

Any shunt will of course reduce the signal somewhat if the original antenna coils were right, and the antenna was also right. That antennas and coils can be found wrong is shown by the fact that a too-large shunt coil will at times increase the signal very sharply, but in such cases its noise-reducing effect is usually poor. The proper balance-coil reduces signals slightly and the noise very greatly. For instance, it has been possible at Guilford to listen to W6CIN with almost no noise-interference from a leaky, oxide lightning arrester less than 1000 feet away on a 4600-volt line which passes within 70 feet of the antenna. This was with the balance-coil. When the coil was removed, W6CIN completely disappeared more than 90 per cent of the time and the noise was such as to be audible several hundred yards from the house with the receiving-room windows closed. Similarly, the German broadcasting station DJC had good entertainment value with the balance coil, but was barely audible on its strongest upswings without that coil. This was with a General Electric K-80 broadcast receiver, which is the victim of most first-tests at W1FG. Tests at other times, using the same receiver when the lightning arrester was asleep, showed that the signal strength was decreased by any balance-coil which gave noise-reduction, but that with the best coil this reduction did not exceed 25 per cent in terms of output voltage (audio voltage at the loudspeaker) while the noise-voltages were reduced something like 90-95 per cent, according to measurement. This seems to show a *signal-over-noise improvement of about 7½ times over and above what was accomplished by the use of a doublet.* During the noisy period first mentioned, reception was also attempted with the two downleads of the antenna tied together so that the whole served as a Marconi antenna which gave such heavy noise-voltages that no signal, either phone or c.w., could be identified. Thus the doublet had already given a considerable improvement, but the balance coils gave a further improvement of about 7 times. This was at 20 and 49 meters.

For that particular receiver the most favorable number of turns for the various coils was as follows:

20 Meter amateurs	3.5 + 3.5 turns
25 Meter broadcast	4.0 + 4.0 "
40 Meter amateurs	4.5 + 4.5 "
49 Meter broadcast	5.0 + 5.0 "
75 Meter amateurs	15 + 15 "
160 Meter amateurs	See text

Of these coils the first 3 were working on the "D" range of the receiver, the next two on the "C" range. For the 160-meter amateur band, which falls in range "B" of the receiver, no equally satisfactory coil was devised. A coil having 50 + 50 turns is shown in the photograph and did give noise reduction, but not in anything like the same degree as the other coils. With other receivers it has been possible to secure good results on that same wavelength. Fortunately the 160-meter noise problem is seldom as bad as the shortwave noise problem. The coils used with other receivers differ more or less from those tabulated and a change of a few turns should always be tried. It may be important. For instance:

Observations with K-80 receiver on 25-meter broadcast and 75-meter amateur radiophones, using 70-foot doublet with 100-foot downlead of cotton-covered lampcord.

Coil	*25 Meters*	*75 Meters*
4 + 4	Noise down 90% Signal down 25%	Noise out Signal out
5 + 5	Both down 50%	Both far down
10 + 10	Noise down 10% Signal down 50%	" " "
15 + 15	Noise not touched	Noise nearly out Signal down 20%
25 + 25	" " "	Both down greatly
35 + 35	" " "	" " "
50 + 50	Noise increased	Noise increased

The Downlead

The lampcord downlead was used because 100 feet of lampcord happened to be available at the moment. It is not weatherproof and goes off badly during rain. Other types of downlead check the foregoing except only one. This is a type in which a common rubber covering encloses two stranded wires each having very thin varnished fabric insulation intended to provide a very low line impedance. No combination tested gave good signal/noise improvement with this extremely low impedance type of downlead at any wavelength below 100 meters.

◆

"Here lie the remains of a radio ham,
Now mourned by his many relations.
He went to a powder mill, smoking his pipe,
And was picked up by 21 stations."

ULTRA DX ATTEMPT

Five-meter signals to the moon and back! It sounds like a rather fantastic thought, but several amateurs in New Zealand have thought enough of the possibility to put in a lot of work and equipment in preparation for such an experiment.

Headed by Stuart Kingan, ZL3GD, the group has been working on the theory that the ionosphere, instead of reflecting back the ultra-high frequency radio waves, passes them through as it does beams of light and heat.

In an experiment along this line last year, an i.c.w. oscillator, self excited and using about 20 watts of power, was used along with a 5 meter superhet as described by Kruse in July, 1934. A Yagi type of beam antenna was so mounted that it could be pointed anywhere in the sky. It had three reflectors and three directors. This test was unsuccessful.

It was considered that the experiment was worth an attempt with about a kilowatt, but as the apparatus was not secured, an optimistic attempt was made with what was available.

Another attempt was scheduled with different apparatus for September 2 of this year but we have not learned what results were forthcoming. The transmitter was to be set up at Mayfield with an operator in charge at that point and the receiver was to be set up at Lake Heron, which is the farthest point with which telephone communication could be had. Due to an intervening range of mountains there was thought to be little chance of direct reception of signals.

The transmitter was to consist of a spark gap, set in the center of the antenna and fed from a large induction coil which was arranged with a switch and a large parallel condenser so as to allow the primary current to be built up gradually and then discharged across the gap with an instantaneous power of the order of a thousand kilowatts.

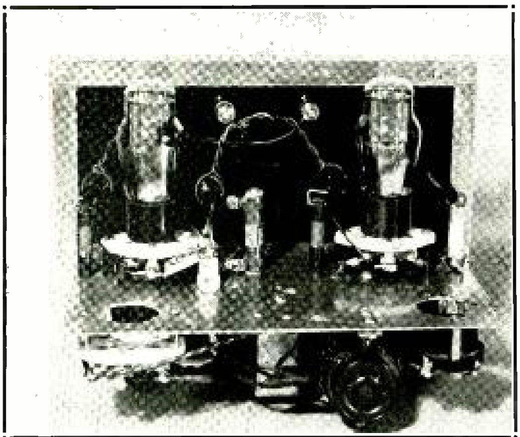
Due to the extremely short duration of the signal, the method of reception was a problem. A receiver was being built using acorn tubes in the r.f. portion, 2 volt battery tubes in the r.f. stages, and with the i.f. running at a frequency in the order of 5000 kc. At this frequency and with the signal duration a ten millionth of a second, the signal would last for only about a half cycle in the intermediate stages; so using cathode ray detection and photographic plates

[*Continued on Page 85*]

A Five-Meter Portable-Mobile M.O.P.A.

By M. P. Rehm, W2HNY*

The original layout was built a year and a half ago and was a transceiver consisting of a 19 oscillator-detector, a 19 class-B modulator amplifier, and a 30 speech amplifier. This arrangement was very satisfactory at the time and, according to reports, worked very well. On receive position, relatively good signal strengths were available and, as a modulated oscillator transmitter, the output was several watts. This was at a time when most everyone was still using broad, "hissy" super-regenerative receivers and frequency-modulated oscillators.

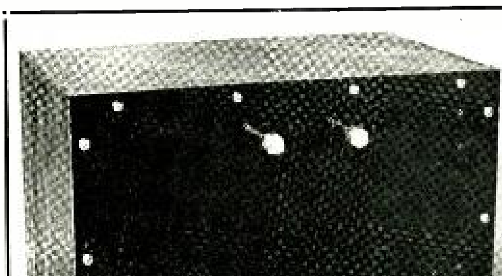


Back View of the R.F. Section

About eight months ago a separate and better receiver was built for portable-mobile work to fit on the steering column of the car under the dash. It has a 6D6 tuned r.f. stage, a 76 detector, and a 42 audio stage. After the receiver was installed and working properly, the transceiver was rebuilt into a transmitter with the same tube complement. The unity-coupled coil was increased in size, in order that no tuning condenser would be needed for 58-megacycle operation. This was quite a satisfactory rig and many good reports were received "en route".

What with the use of more stable transmitters and improved super-regenerative and super-heterodyne receivers at home stations, it was decided to check the performance of this modulated oscillator. A first test showed that the frequency would drop 150 kc. when the antenna load was applied. Of course, this could be corrected by retuning, but loose coupling was necessary or the swinging of the antenna would cause a shift in frequency. This effect should be kept in mind for a later comparison. Very bad frequency shift during modulation peaks was also noticed. Sometimes it was as much as 50 kc. This tended to "mush" the carrier and it could not be received properly on a selective receiver.

A motor-generator is used for power and, with the shifting class-B load changing the voltage, the frequency shifted some more. The two-volt filament supply, dropped through a rheostat from six volts, was used for the microphone. This changed the filament voltage due to varying microphone currents and caused another source of frequency shift. Also, without an elaborate filter in this circuit, generator ripple modulated the carrier. A separate battery remedied these latter ills.



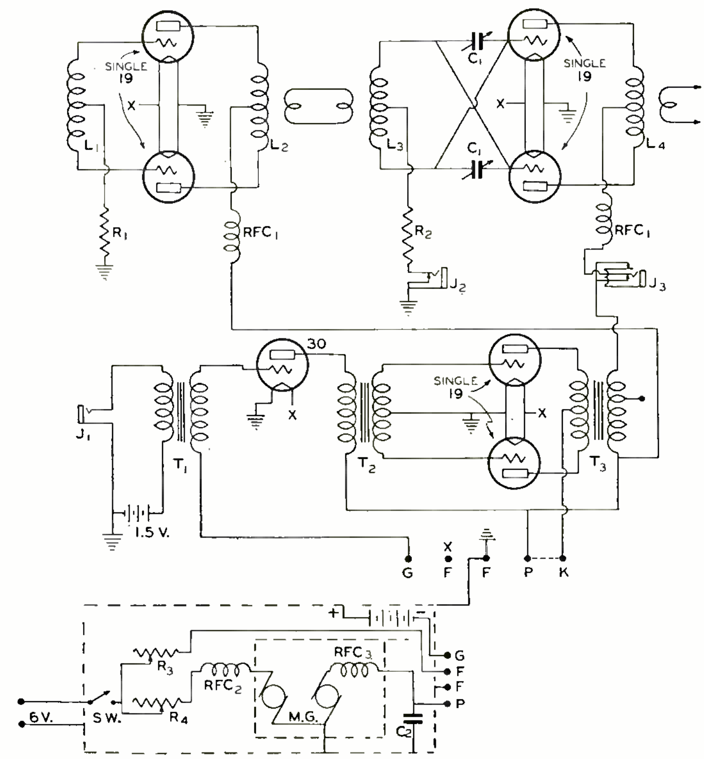
Front view of the case inclosing the r.f. unit. All adjustments are made back of the panel.

From the above, it is apparent that much improvement was needed.

It was decided to try an m.o.p.a. by adding another 19 and rearranging the parts. The transmitter shown in the photographs was revamped from the modulated oscillator. The unity-coupling was replaced with a tuned-grid, tuned-plate circuit and moved over to make room for the r.f. amplifier.

After all adjustments were made, tests showed very much better stability than the

*Montauk Highway, Quogue, L.I., New York



The Portable-Mobile 5-Meter M.O.P.A. Transmitter

L_1, L_2, L_3, L_4—See text
R_1—10,000 ohm 2 watt resistor
R_2—5,000 ohm, 2 watt resistor
R_3—12 ohm 1 amp. rheostat
R_4—1 ohm, 5 amp. rheostat
RFC_1, RFC_2—See text
RFC_3—2.5 mh. pie-wound r.f. choke
C_1—3-30 μμfd. trimmer, isolantite
C_2—16 μfd., 450 volt electrolytic
T_1—Mike to grid transformer
T_2—Type 19, class B input transformer
T_3—Type 19, class B output
J_1—Single open circuit jack
J_2—Closed circuit jack
J_3—Closed circuit filament control jack (see text)

modulated oscillator. With the same antenna load that caused 150 kc. change on the latter, only 20 kc. variation was measured now. Both tests were run by coupling very lightly from the oscillator grid and beating against the fourth harmonic of a receiver tuned to 14,500 kc. The shift was measured with a good frequency meter. Also, frequency modulation and "mushing" of the carrier were reduced to a minimum.

The transmitter in its present state was made fixed-tune to eliminate condenser and lead losses. Slightly better efficiency is obtainable with all inductance. The frequency can be changed several hundred kc. when desired by respacing the coil turns.

Construction

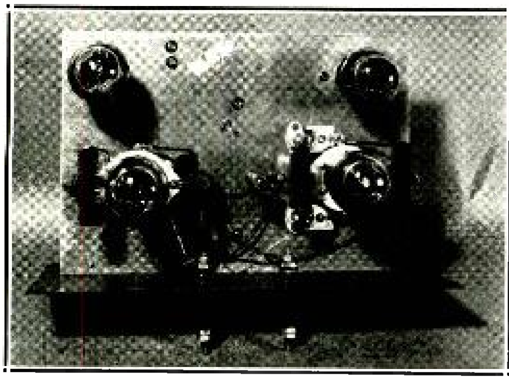
The chassis is a brass plate 6″ x 9″ x 1/16″ fastened by a 9″ brass angle ½″ x ½″ to a 10″ x 7″ steel panel. More ½″ brass angle is mounted around the panel 1/32″ in on all sides to allow for a copper shield can to be fitted over and soldered to the angle flush with the panel.

The only parts necessary on the panel are the two lead-through insulators and three jacks across the bottom for the microphone, amplifier grid, and plate current, respectively. The right-hand jack hole should be drilled large enough for an insulating bushing, since the jack carries the plate voltage. The other two jacks are grounded.

On the underside of the chassis are placed the microphone, input and output class-B transformers, microphone battery, audio tube sockets, and power connection socket.

The transformers are mounted against the chassis with the class-B input transformer at right angles and between the other two. They should be mounted just far enough back from the panel to allow for the jack connections. The audio sockets are mounted ¾″ below the chassis, with long screws and bushings, to make the leads short. The power connection socket is mounted on a steel angle which also forms a leg for the chassis to stand upon. The microphone battery is mounted directly behind this bracket. The lower part of the battery carton is cut away and a ½″ copper clamp made to hold it against the chassis under one of the microphone transformer screws. The positive connection is soldered directly to the cap from the transformer. With a push-to-talk switch, the battery will last indefinitely. The necessary plate, grid, and filament leads for the r.f. tubes go directly to each socket through holes drilled in the chassis. One side of each filament is grounded at the socket.

On the topside are mounted the r.f. tubes, sockets, coils, chokes, and resistors. The oscillator grid and plate coils are soldered to the socket connections and the leads left long enough to mount the coils 2″ above the chassis. This allows the gridleak to stand upright and support the middle of the coil. To support the plate coil, the r.f. choke form is made of a 1½″



Top View of the R.F. Section, Showing Layout of Parts

length of 3/16" bakelite rod tapped at the bottom and screwed to the chassis. A piece of no. 16 hard-drawn wire is put through the top to support the coil. The choke is wound on the center of the form.

The r.f. amplifier coils are mounted similarly except that the ends of the grid coil go to small isolantite standoff insulators. This provides an easy means of mounting the neutralizing condensers from grid to plate on each side of the socket and then crossing the grid coil connections. The r.f. sockets are mounted on 5/8" long studs of 3/8" bakelite rod.

It is very important that the r.f. oscillator and amplifier tubes have their bases slotted between all contacts. This breaks up the direct r.f. path and actually increases the output almost two times. It may be done by making a copper strap to fit firmly around the tube base and clamping same in a vise with the base up. A fine-toothed hacksaw should be used and, by being careful, a deep, angled slot may be cut through.

The link coupling is made of small, flexible, rubber-covered wire wound around the center of each coil and twisted. The open ends are soldered near the middle of the link. The antenna coupling is of the same wire.

Circuit

The circuit diagram shows a "19" as a push-pull oscillator. The coils for 58 megacycles are of no. 14 enameled wire wound on a 3/8" form. The grid coil is 16 turns and pulled open to cover 1¾". The plate coil is 18 turns and about 1¾" long. The plate choke is 50 turns of no. 30 d.s.c. wire.

The r.f. amplifier is push-pull connected with cross-neutralization. The coils are the same as above, the grid coil being 16 turns 1½" long and the plate coil 16 turns, 1¾" long. The plate choke is the same.

The neutralizing condensers are isolantite trimmers, 3 to 30 μμfd., with the ends cut off the upper plates. The jack in the grid circuit reads rectified grid current. The jack in the plate lead has a special connection using "filament control" contacts to keep the high voltage off the front of the panel except when the meter plug is in. This feature can be used to especial advantage on high-powered rigs in conjunction with a meter plug having a bakelite flange for additional protection. The sleeve of the plug should go to the plus side of the meter and tip to negative.

The link coupling is one or two turns, depending upon the coupling needed. The antenna link is three turns for feeding a 75-ohm line and a half-wave doublet.

The speech equipment consists of a single-button carbon microphone and transformer to a 30-speech amplifier. This pushes a 19 class-B amplifier using appropriate transformers. This output is fed from the 5000-ohm tap to the r.f. amplifier.

The power supply is the car battery and a 250 volt 50 ma., m.g. set. A nine-volt bias battery is also needed. With the filtering shown, very slight commutator ripple is present in the carrier. RFC_2 is 25 turns of no. 14 enamelled wire on a 5/8" dowel. RFC_3 is mounted inside the m.g. shield. All power supply parts are in a copper can 8" x 6" x 5" with a four-prong socket connection at one end. The transmitter has a five-point connection, the extra one being for separate class-B voltage. The leads to the battery should be as short as possible and at least no. 14 wire to prevent voltage drop. A three-foot, five-wire cable is used for power connections with a four- and a five-prong tube base.

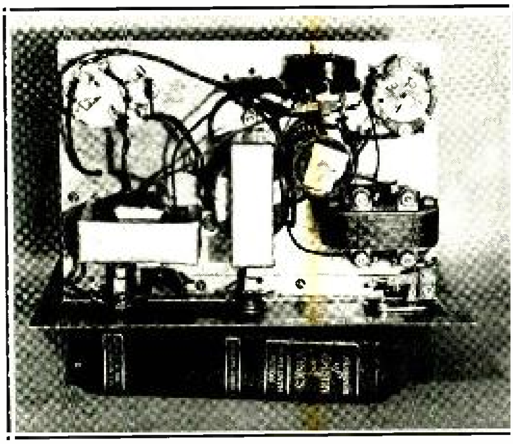
Tuning Adjustments

For initial adjustments, it is best to put meters in the plate leads of all tubes and the grid of the r.f. amplifier. With the power cable plugged in and the m.g. connected to a six-volt battery, the filament rheostat is set to give two volts at the filaments. The m.g. rheostat may be set for about 150 volts at the plates. The transmitter is now ready for tuning.

The oscillator is tuned first. The turn spacing should be changed until the desired frequency is reached with the lowest plate current reading —about 15 ma. With an open-ended plug in the plate jack, the amplifier grid coil is tuned for maximum grid current, which is about 5 ma. The neutralizing condensers are varied with a bakelite screwdriver until no deflection of the grid meter is noticed when tuning the plate coil of the amplifier through resonance.

Now insert the amplifier plate-meter and tune (squeeze) the plate coil to resonance, about 20 ma. Connect the antenna and retune the plate coil. It should load up to 30 ma. at 150 v., giving 4.5 watts and 5000-ohms impedance. Retune all circuits slightly if the exact desired frequency is not obtained. By touching the oscillator grid-coil to stop oscillation, the plate meters should drop to 10 or 12 ma. and the grid meter to about zero.

The audio stages should now be adjusted. The 30 should have 6 to 9 volts of bias, depending upon the plate voltage, and its plate meter should not move when speaking into the microphone. The 19-plate meter will read 15 ma., jumping to about 25 ma. on modulation peaks. A test for audio quality can be made by hooking a pair of phones or a loud speaker from ground to the output transformer through a 2 μfd. condenser.



Looking Down into the Speech Unit

With these adjustments, approximately 80 per cent modulation is obtainable. For full 100 per cent modulation and slightly higher output, 150 volts of battery should be connected to the class-B stage through the extra lead of the power cable. This lightens the load on the m.g. and also makes the voltage steadier.

No doubt many other circuits and arrangements of parts will suggest themselves to ingenious amateurs.

EMISSION MOVIES

By Rufus P. Turner, W1AY

The fact of differences between the types of emission used in radio communication is knowledge as fundamental to radio operators as the "three R's". Nevertheless, amateur conversations on and off the air, and questions received at several information dispensaries betray considerable ignorance along these lines. This latter fact is our sole apology for embarrassing old-timers and others who *know* by presenting this ancient, bedraggled subject at this stage in the game.

"The A1, A2, and A3 of It"

Section 225, Rules and Regulations of the Federal Communications Commission classifies the permissible types of emission:

A1. C.w. Morse telegraphy; printer and slow-speed facsimile
A2. Tone-modulated c.w. and i.c.w.
A3. Commercial telephony
A4. Visual broadcasting
SPECIAL. High-speed facsimile, etc., etc.

Type B emission, not included in the current issue of *Rules & Regulations,* designates the damped wave radiation of spark transmitters. It is described here solely for the sake of completeness and reference, since the spark transmitter, except for emergency purposes, has no place in the modern scheme of communication.

How They Look

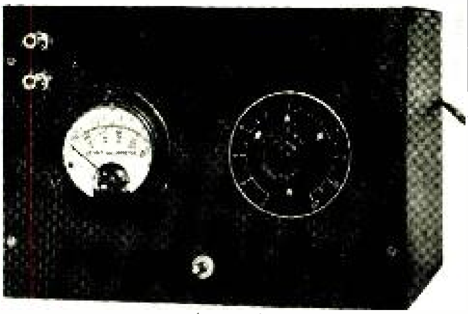
A1 embraces only continuous waves, commonly termed c.w. A wave of this class is the so-called *carrier*. The amplitude is constant throughout (no modulation present) and no breaks occur in the wave train. No sound accompanies such a wave itself tuned in "on the nose" on a non-oscillating receiver, though the start and cessation of the c.w. carrier is denoted by a sharp click or a flaring up of the receiver background noise. Tuned in on either side of zero-beat on an oscillating receiver, the c.w. carrier is heterodyned to produce a clear, clean whistle.

The letter "A" transmitted by c.w. discloses no break in the wave train except between the dot and dash of the letter.

A2 includes both interrupted continuous-waves (i.c.w.) and tone-modulated (or alternating-current) continuous-waves.

I.c.w., as its name implies, consists of the usual continuous wave carrier chopped up into shorter wave trains. The required inter-

[*Continued on Page 85*]



The Vacuum Tube Voltmeter Described in the Text.

An Amateur's Linear Vacuum Tube Voltmeter

By Emil Buchwald*

Among the alternating current voltmeters with which we are familiar, we have the moving iron type and the copper oxide rectifier type. The moving iron type requires from 2 to 5 watts or more, depending upon its range, for its operation. The copper oxide type does not require so much, but it is still not good enough for our purpose. The vacuum tube voltmeter, on the other hand, requires no power for its operation (looking at it from the input side).

Suppose we want to measure the output voltage of an audio transformer. If we hook up the moving iron type voltmeter, the meter will calmly rest on its base and defy you to arouse it from its lethargy. The copper oxide meter will make a brave attempt, but we can't rely on it, since it draws power from the source and will pull down the voltage.

As an analogy, take notice sometime when the "o.w." plugs in the electric flat iron. A slight dip in the electric lights will result. This indicates that the line voltage has departed from the 110 (or 115) volt standard. The same effect takes place when the conventional voltmeter is connected to a high resistance source, only more so. The vacuum tube voltmeter is the answer, and one may be built quite easily.

Figure 1 will show the circuit. Possibly some portions of it are familiar to you. The 27 tube works the same way as the linear detector in the broadcast receiver. The bridge circuit is used to balance out the small current through the milliammeter that will occur with no input voltage. The plate resistance plus the cathode resistor forms one arm and the rheostat the opposite arm. The other two arms are fixed resistors. Any change of grid voltage will cause a corresponding change of plate resistance, consequently disturbing the equilibrium of the bridge.

This change will be reflected in the milliammeter, which can be calibrated to read the voltage impressed between grid and cathode.

Constructional details will be left to the reader, since there may be an odd chassis or cabinet lying around the shack which can be used for the purpose. A power supply extracted from an old broadcast receiver works very well. The meter shown in the photo makes use of a complete power pack, taken from one of the tin-box receivers popular some years ago. They can be picked up for a song, or possibly a friend has one he would be glad to get rid of. The source of power may be constructed of course, using the circuit of figure 1 for a guide. The power transformer may consist of any one of the conventional replacement transformers on the market, as may the choke coils.

R_1, R_2, and R_4 may be one watt carbon resistors, but wire wound resistors are advisable, since carbon resistors may wander from the straight and narrow path, peaking in terms of resistance. R_3 may be a 500 or 600 ohm rheostat. If this value is used, then R_4 will not be necessary. The indicating meter used should be a d.c. 0-1 milliammeter. The meter shown in the photo is a combination affair, but only one scale is used.

Calibration

Calibration is simple, merely requiring a potentiometer and an a.c. voltmeter. This is connected as in figure 2. A 0-100 voltmeter will do very nicely. A 0-20 voltmeter will help a great deal, since it is hard to get an accurate reading on the low end of the scale of the 0-100 voltmeter.

Before calibration is attempted it would be wise to allow the vacuum tube voltmeter to

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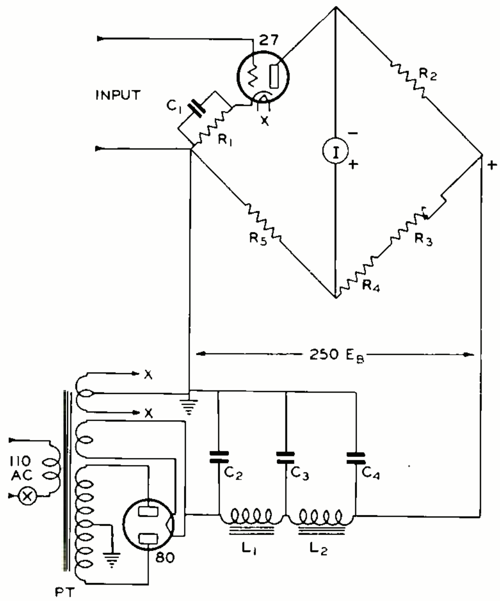


Figure 1

R_1—97,000 ohms, 1 watt
R_2—10,000 ohms, 1 watt
R_3—400 ohm pot. or rheostat
R_4—150 ohms, 1 watt
R_5—25,000 ohms, 1 watt
C_1—1 μfd., 200 volt paper
C_2—8 μfd., 450 volt electrolytic
C_3—8 μfd., 450 volt electrolytic
C_4—8 μfd. electrolytic
L_1—30 hy., 10 ma. or more
L_2—Same as L_1
PT—Midget power transformer
I—D.c. milliammeter, 0-1 ma.

warm up for three or four minutes.

Now then, short circuit the input terminals and adjust the rheostat for zero setting of the milliammeter. Take off short circuiting wire on input terminals and connect input across a.c. voltmeter as in figure 2. Set the input voltage to 50 volts and note reading on milliammeter. If it reads 0.5 ma., then all is well. If it reads below this figure, then the cathode resistance is too high. If it reads above 0.5 ma., then the cathode resistance is too low. In this case it will be necessary to experiment with different resistance values in the cathode circuit until the milliammeter reads 0.5 ma. with a 50 volt input. When the correct resistor has been found, disconnect the input and short circuit it. Reset rheostat for zero setting on milliammeter. Take off short circuiting wire from the input terminals and connect input to a.c. source. Set input voltage to 50 volts and if reading on milliammeter is 0.5 ma., then it is okay. If not, then proceed as in preceding paragraph.

Now disconnect the high range voltmeter and connect the low range a.c. voltmeter. Set the voltage at 10 volts. Reading on milliammeter should be 0.1 ma. Advance the a.c. voltage to 20 and then the milliammeter will read 0.2. Disconnect the low range voltmeter and reconnect the high range voltmeter. Start at 30 volts and continue in ten volt steps until 100 volts is reached. If the scale of the milliammeter is multiplied by 100, it will be noticed that the readings of the two meters will agree over the whole range, except on the upper end, where the milliammeter will fall off somewhat. That is, with an input of 80 volts the milliammeter may read 0.795; with an input of 90 volts the result may be 0.89, etc. If everything is okay, the meter will be practically linear in its reading.

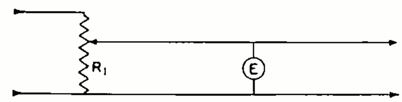


Figure 2

Method of calibrating the v.t. voltmeter. The resistor, R_1, is a 1000-ohm, 50-watt potentiometer, connected across the 110-volt a.c. line.

The vacuum tube voltmeter can be used to measure audio frequency voltages, to determine inductance of choke coils and audio transformers, to determine the turn ratio of audio transformers (or any transformer for that matter). It can be used to measure the capacity of a condenser, or as an output meter for alignment work on receiving sets, etc. It is a most handy gadget to have around for the experimenter, service man, or amateur.

◆

Immediately after hearing over General Electric's short wave station, W2XAF, that Max Schmeling had knocked out Joe Louis, a sports fan in far-away New Zealand was able to place several wagers at most favorable odds that the German would defeat the colored champion. The news on the surprise outcome of the fight had not yet reached that city, 10,000 miles from Madison Square Garden.

This information is contained in a letter of appreciation of General Electric's short wave broadcasts received from C. G. Jamieson of Auckland, who writes in part: "With friends, we listened to the round-by-round description of the Louis-Schmeling fight. As soon as it was finished, one of my friends left and was able to make several bets that Louis would lose. It wasn't hard to get good odds and plenty of takers that Schmeling would be the winner. Keep up the good work."

A New and Practical Directive Antenna

By J. N. A. HAWKINS, W6AAR

The complex directive antenna arrays used by the high-powered, high-frequency, commercial stations have long been of interest to amateurs. However, what with 150- to 300-foot towers scattered over several hundred acres of land, very few amateurs have seriously attempted to copy these installations.

However, there are several simple and practical arrays that can be used in more restricted space, although accurate and practical information on directive arrays has been largely conspicuous by its absence in amateur circles.

Recent developments in stable and efficient 1-meter oscillators, as well as improvements in field strength measuring technique at ultra short wavelengths, has allowed experimenters to try out small-scale editions of various arrays in actual practice with a reasonable expectation that the ultra-high frequency results can be duplicated on the lower frequencies.

As a result of this ultra-high frequency research, some interesting points have come to light about directive arrays that have not been generally appreciated in the past.

Probably the most interesting point about antennas which has been developed is that the current in a half-wave dipole has much more to do with the radiation field than the voltage at the ends of the dipole. It has been found that the two eighth waves closest to the center, or point of maximum current in an antenna, contribute over three times as much to the radiation as the two eighth waves out on the ends, or high voltage points. This point will be covered in more detail in a later article.

Antenna Fundamentals

In analyzing any antenna the direction of current flow through the various portions of the antenna, at any instant, is of the utmost importance. In a broadside array, which radiates best in a direction broadside to the longest dimension of the antenna array, the current in the radiating portions of the array must flow in the same direction, at any instant.

Consider the long wire in figure 1. This corresponds to a three half-wavelengths antenna and may be excited in any of the common methods of antenna feed. Note that in adjacent half-wave sections the current flow, as indicated by the arrows, is in opposite directions. Thus a long wire is not a broadside radiator as the current is not flowing in the same direction, at a given instant, throughout the radiator.

Note that in figure 2 the middle half-wave section of figure 1 has been folded in such a way as to cancel practically all the radiation from that section. Thus it acts merely as a phasing section to allow the current in the remaining two half-wave sections to flow in phase or in the same direction, at any instant. Thus in figure 2 is shown the simplest Franklin or co-linear broadside array. The gain broadside of this simple structure is 1.6 times or 2 decibels over a half-wave vertical reference antenna with the same power in both antennas.

All antenna gain expressions refer to the relative gain over a half-wave vertical dipole excited with the same power as the directive array under consideration.

The gain of the Franklin co-linear type of array is not as great as the more common type of broadside array shown in figure 3, for a given number of dipole radiating elements. This is due to the fact that the dipoles composing the co-linear array already have some directivity broadside, so that the improvement obtained by stacking is less than in the structure of figure 3.

In figure 3 is shown the standard and simple broadside array using two half-wave dipoles spaced a half wave apart. This array gives a broadside power gain of two times, or 3 db. Sterba, of the Bell System, has intimated that the gain of this structure is closer to 4 db than 3 db, but the author's measurements indicate that 3 db is a more accurate figure for average structures.

The method of feeding the array of figure 3 is due to W6ZH and is more desirable than the usual methods of feeding this type of array, which cause a non-symmetrical distribution of current.

The structure of figure 4 is a logical development of figure 3 plus figure 2. It consists of the standard two-element array of figure 3 to which are added the co-linear elements below the feeder or phasing section. Thus the gain of this structure is 3 plus 2 or 5 db. If the gain of the various components of an array is expressed in decibels, the total gain can be ob-

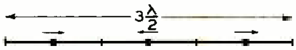


FIG. 1

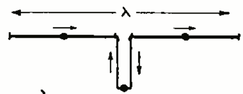


FIG. 2

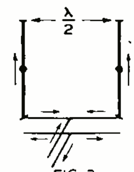


FIG. 3

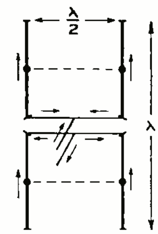


FIG. 4

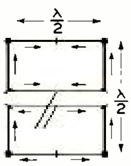


FIG. 5

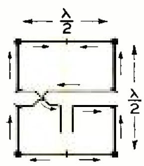


FIG 6

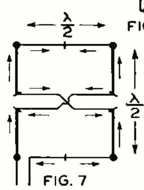


FIG. 7

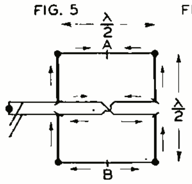


FIG. 8

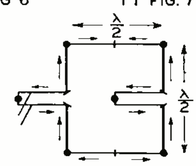


FIG. 9

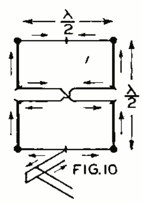


FIG. 10

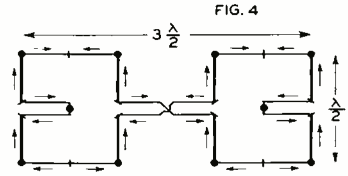


FIG. 11

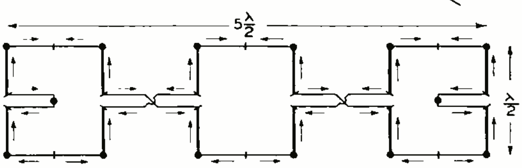


FIG. 12

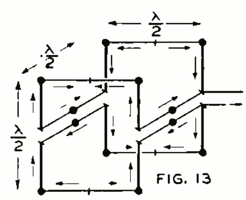


FIG. 13

tained by *adding* the gain in db of the components. Five db represents a power ratio of 3.2 times. Thus the structure of figure 4 makes 100 watts sound like 320 watts in the favored direction.

Note that the points of maximum current in all the antenna structures discussed in this paper are indicated by heavy dots while the points of maximum voltage are indicated by short lines across the wires.

As mentioned earlier, it was determined that the points of high voltage contributed but little to the radiation from an antenna, so that in an effort to reduce the overall dimensions of the array of figure 4 the outside quarter waves were bent over along the dotted lines in figure 4, resulting in the structure of figure 5. Upon measuring the gain, it was found that a loss of two-tenths of a decibel was all that was incurred by thus cutting the overall height of the array in half. Thus the gain of the structure of figure 5 was 3 times or 4.8 decibels. Therefore, as no other disadvantages in the structure of figure 5 developed, it was used as the basis for more complex arrays such as those shown in figures 12 and 13.

Figures 5 to 11 all show various methods of feeding energy to the basic array. Figures 5, 6, and 7 show methods of current feed at a low resistance point. Figures 8, 9, and 10 show methods of voltage feed at a high resistance point. All the feed systems supply energy to a point of practically zero reactance so that tuned feeders are not essential. However, unless the surge impedance of the feeders is equal to the antenna resistance at the point of attachment, some form of impedance transformer such as the quarter-wave stub shown in figures 8 and 9, or a Q-matching section will be necessary.

The feeder arrangement shown in figure 5 gives slightly better current and phase balance throughout the array than either figure 6 or figure 7, *provided* that the array is remote from ground. Due to the fact that this type of array lends itself to series feed as well as parallel feed, as shown in figure 5, the arrangement shown in figure 6 gives nearly as good results as the arrangement of figure 5. The system of figure 7, while slightly less efficient than the arrangements of figures 5 and 6, still gives very good results due to the series connection of the individual elements.

Wherever possible, current feed at a point of low resistance is desirable, as the losses in voltage feed and matching systems are usually somewhat higher than in current feed systems.

Where voltage feed is more desirable for reasons of simplicity, etc., the arrangement in figure 8 gives the best current and phase balance, although the lengths of the radiator and phasing sections must be right on the nose.

The arrangements of figures 9 and 10 are easier to adjust, although the balance is not perfect and the method of figure 10 causes considerable unbalance in the matching section with consequent undesired radiation at that point.

It should be noted that current and phase balance is not nearly so important in the simple array structure shown in figures 5 to 10 as it is in the more complex structures shown in figures 11 and 12. However, an understanding of the disadvantages of tapering current and progressive phase shift can best be obtained by discussing the simple directive structure.

In figure 11 is shown the first step toward increased directivity by placing two of the simple arrays side by side. This gives a structure a wave and a half long and a half wave high. This would be 100 feet long and 33 feet high on 14 Mc. The gain of this structure is 6 times or 7.8 db. Doubling the length of the array in this plane adds 3 db. If the second structure had been added on top of the first structure instead of alongside of it as shown in figure 11, the increase in gain would have only been 2 db, making the total gain thus 6.8 db instead of 7.8 db. This shows the difference in stacking dipoles side by side as against stacking them along their axes.

The array of figure 12 is exactly similar except that it has one more basic element added. The addition of the third basic element adds 2.1 db to the array gain, making the total gain practically 10 db, a power gain of 10 times.

The overall length of this array is two and a half wavelengths, or 166 feet on 14 megacycles, which is not excessive. The pole height should be at least 50 feet and preferably above 70 feet, so that the center of the array can be a good half wavelength above gound.

Adding a similar reflector curtain a quarter wave to the rear of any of the arrays shown will add 3 db to the gain.

The array of figure 12 consists, in effect, of six half-wave dipoles in phase, at least as far as the size of the array is concerned. It takes up the same space as three units of the type of array shown in figure 3. Assuming that an array consisting of three arrays like figure 3 arranged side by side could be fed so that each dipole radiator received equal current in the proper phase (which is almost impossible to achieve in practice), the gain of such a structure would be only 8.1 db, or almost 2 db under the array of figure 12. Even the Sterba transmitting array, such as used at Lawrenceville in the trans-Atlantic phone station, shows only a 9 db gain for the same overall length and height.

The arrays of figures 11 and 12 may be fed in the same manner as figures 5 to 10, although the systems shown in figures 5, 6, and 7 are probably most desirable.

The physical length of each half-wave section in these arrays will depend to a small extent on the wire size used. However, in all the arrangements using series feed, resonance for the whole structure can be obtained by making slight adjustments at only one point, as long as the various half-wave elements are fairly close to the correct length. The phasing sections will be exactly the same length as the radiating sections and by using the formula

$$L = \frac{480}{F_{Mc.}}$$

for dipole length in feet, little adjustment of the whole array will be necessary.

The arrangement shown in figure 13 uses a driven curtain a half wave to the rear of the main curtain and fed 180° out of phase from the main curtain. This second curtain sharpens the beam, although it is still bi-directional. The second curtain adds 3 decibels to the gain of the main curtain, giving an overall gain of 7.8 db. This is quite good gain for a structure only a half wavelength long in its longest dimension. This structure can easily be rotated for 10-meter use and there is no reason why a rotatable 20-meter structure could not be built.

◆

In the first attempt of its kind ever made by science, California Institute of Technology engineers recently sent a flying radio station, attached to a five-foot balloon, 30,000 feet into the stratosphere.

As it soared upwards, the transmitter, on 1.7 meters, transmitted to the ground below accurate data on pressure and temperature. Weighing only two pounds and developed in the institute, the radio was connected with a meteorograph which recorded weather information and in turn broadcast it by a series of signals to a recording tape on the campus.

Three such balloon and flying transmitting stations were sent aloft; only one was recovered. It was found by an Ontario, Calif. resident. The others, it is feared, drifted into the mountains.

The transmitter has a single tiny tube that emits a constant signal, interrupted by a timing device which transmits the data.

The Question Box

By JAYENAY

What are the advantages and disadvantages of primary keying?

Primary keying is effected by placing the key or relay in the primary, or 110 volt side, of the high voltage plate transformer which feeds the amplifier being keyed. Usually, best practice demands that the final amplifier and the last buffer both be keyed to eliminate completely all back wave. Primary keying has the advantage that key thumps and key clicks are effectively eliminated due to the inherent lag in the high voltage filter. Another advantage is that the filter condensers can get by with a lower safety factor than when center tap or grid block keying is used, due to the fact that when the key is up, with primary keying, there is no abnormal voltage across the filter condensers. The disadvantage of primary keying is that a high current key or relay is necessary to handle the high primary current, which can reach from 15 to 20 amperes in a kilowatt transmitter. Another disadvantage lies in the better regulation required in the 110 volt line to minimize light blinking and wide changes in tube filament voltages between the key up and the key down conditions. Excessive capacitance between the leads to the key or relay often accounts for a small back wave. It is surprising how much back wave can be produced by only 5 to 20 volts of plate voltage on the amplifier, which sometimes occurs when the key is up due to leakage or excessive capacitance in the keying leads.

•

Why is not stranded or Litz wire widely used at the high frequencies to reduce losses?

At high frequencies the r.f. losses of stranded and Litz wire are greater than with a single conductor. Litz has no advantage at frequencies higher than about 1500 kc.

•

Is a quarter wavelength of EO1 cable close to an electrical quarter wavelength at any frequency?

Due to the materially reduced velocity of wave propagation in all twisted pair cables a quarter-wave section of EO1 cable will usually be something less than two thirds of a quarter wavelength long. The shortening effect will vary widely with frequency. As there are now several different brands of EO1 cable and as they differ materially in their characteristics, you will have to determine the physical length of a quarter wavelength of your particular cable experimentally at the frequency you plan to use it.

•

I want to protect my gear against overloads. Where are some good locations for fuses?

It is a good idea to put fuses in the plate lead to each rectifier tube. Another good place is next to the r.f. choke through which the high voltage is fed. A fuse goes well in the B-minus lead from the plate transformer center tap to ground. Flashlight globes, dial lights, and small automobile globes make pretty good fuses up to 1000 volts, as the partial vacuum inside the envelope tends to minimize an arc when the fuse blows. Ordinary, small automobile type cartridge fuses are bad in circuits where the voltage across the fuse exceeds about 300 volts when the fuse blows. The "grasshopper" fuses used by the telephone company are good for high voltage applications as they spring wide open when the fuse wire burns out. Perhaps the best high voltage fuses are those made by the Littelfuse Laboratories, although somewhat expensive. Never put any fuses in a bias supply or in series with a grid lead as blowing such a fuse leaves the tube without grid bias. Primary fuses and thermal circuit breakers in the 110 volt line are always a good idea, but usually have so much thermal delay that the gear may fail before the fuse or breaker opens up.

•

Can an amateur join the Institute of Radio Engineers?

Yes, amateurs are very welcome as associate members in the I.R.E. The dues are $6.00 a year. Associate members have practically all the rights of full members. In return for the dues you receive the monthly proceedings of the Institute and can attend the monthly section meetings.

•

Can an amateur 75-meter phone station operate in a plane?

Yes, when the plane is not in motion. The only amateur mobile operation allowable must take place on the 56 to 60 Mc. band. However, it is probable that special permission could be obtained for any bona fide tests you have in mind.

•

Do electrolytic condensers wear out?

Yes, most electrolytic condensers used in radio applications do deteriorate with age and require replacements after from two to five years. Really well-made electrolytic condensers will last for many years but such condensers are usually too expensive for radio use.

•

Is all of a half-wave antenna equally effective in radiating and intercepting signals?

No. Radiation is largely proportional to current and the current distribution in a resonant half-wave antenna is far from equal all along the antenna. The current is highest in the center and lowest at the ends of any dipole. Thus the center of the antenna can be several times as effective in radiating r.f. power as the ends of the antenna.

•

Is there a standard guarantee used by the manufacturers of transmitting tubes?

No. Unfortunately, there is no standard guarantee covering transmitting tubes. Most transmitting tubes rated on the old Western Electric basis were usually good for from 2000 to 5000 hours of life, if not abused. Usually, it was not uncommon for manufacturers to make replacement allowances based on a filament life of 1000 hours, which covered practically all manufacturing defects. However, the newer rating on many tubes are at least twice the older

[*Continued on Page 74*]

Something to Get Excited About

By W. W. Smith, W6BCX

Two coils, one variable condenser, one crystal, one tube, and three-band output. This exciter puts out either 20 watts on 40 meters or 16 watts on 20 meters by merely turning one condenser, and by reversing the two coils will put out over 3 watts on 10 meters. A 160-meter crystal and one extra coil permit 80- and 160-meter output at the twist of a knob.

There was felt a definite need for a simple exciter that would provide 10-, 20-, and 40-meter excitation from one crystal with a minimum of adjustments. Accordingly the Radio technical staff went to work, and after trying and discarding dozens of circuits, the one shown in figure 1 emerged as the answer*.

Though the output is substantially less on 10 meters than on the two lower frequency bands, it is nearly twice that obtainable from a 53 exciter using a 20-meter crystal. In fact, the 10-meter output with a 40-meter crystal compares with that obtainable directly from a conventional 20-meter crystal oscillator running at 400 volts.

Study of the circuit shows that, except for the untuned cathode coil (socket "A"), the exciter uses *no more components* than a conventional pentode or tetrode crystal oscillator. However, the values of some of the components are different from those commonly used in a regular oscillator. The value of C_2 is very critical, and must be 40 μμfd. In a conventional oscillator a much larger bypass would be used. In the circuit shown, if C_2 is made larger, the 10- and 20-meter output will fall off; if it is made smaller, the circuit will become unstable and oscillate independent of the crystal. With the correct value the circuit will self-oscillate weakly at certain dial settings with the crystal removed from the holder, but the self-oscillations will cease when the crystal is plugged into the circuit. If the clerk tries to sell you a 50 μμfd. instead of a 40 μμfd., try another store. 40 μμfd. is a standard size mica condenser, and is preferable to 50 μμfd., though the latter will do in a pinch.

The cathode resistor, R_1, should be wire wound. If trouble is experienced getting the circuit to work properly, it is wise to try a resistor of another make, as the inductance of the resistor has considerable effect on the operation of the circuit. However, the majority of 10-watt wire-wound resistors tried in the circuit all worked satisfactorily and gave identical results. Examination of one that did not work so well showed it to have considerably more distributed capacity than the others, due to the construction.

One side of the heater is grounded directly to the B-minus in the diagram. This saves a bypass condenser. If a common power supply is used on several stages and one of the other

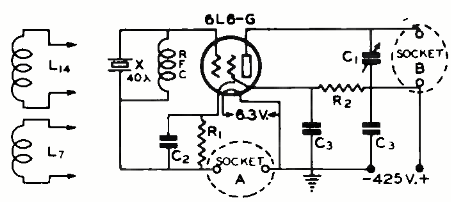


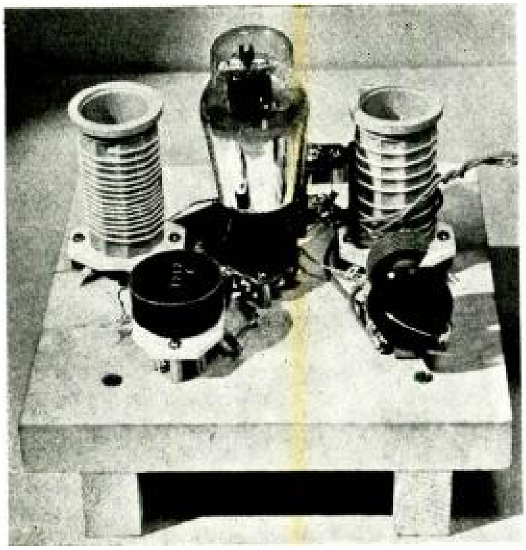
Figure 1

R_1—500 ohms, 5 or 10 watts, wire wound
C_1—100 μμfd. midget
C_2—40 μμfd. mica (critical)
C_3—.004 μfd. mica or .01 μfd. tubular
RFC—2.5 mh., pie-wound
COILS—See text

stages is keyed in the cathode, it would be a good idea to ground the heater of the exciter tube through a .01 μfd. condenser instead of directly. This will avoid the possibility of getting "crossed up" on the d.c. connections and finding one half of the filament transformer shorted, which would be the case if the center tap were also grounded, a common practice. However, if one is careful about filament and plate supply connections, it is perfectly feasible to dispense with the condenser and ground one side of the heater. The heater should be grounded (directly or through a condenser) *right at the tube*. If this is not done, the output will suffer at 10 meters.

Though it is possible to take liberties with the physical layout, the arrangement of parts affects the optimum number of turns on the two coils. Therefore the safest bet is to follow the layout shown in the illustration. If you do

*In connection with the development of this exciter we wish to acknowledge several helpful suggestions from Mr. H. E. Blasier of the Monitor Crystal Co.



The 10-, 20-, and 40-meter exciter unit: no other coils required for three band operation. A single extra coil and 160-meter crystal permit operation also on 80 and 160 meters.

not, you may find yourself in for some coil pruning.

When everything is correct and the circuit is working properly, the condenser should tune to 10 meters with the plates just barely meshed, to 20 meters with the plates just barely meshed (coils reversed), and to 40 meters with the plates nearly all the way in.

Crystal Current

When first measuring the crystal current, several inches of twisted leads were used to the meter. We figured the capacity of the leads would bypass some of the r.f., giving an incorrect (low) reading on the meter. So the leads were shortened, and lo and behold, the reading went *down* instead of up. We were at a loss to explain this until it was discovered that bringing one's hand near the meter raised the crystal current. Evidently the addition of any wire or metal to the crystal circuit increases the regeneration in some manner, causing the crystal current to rise. With the meter out of the circuit, the r.f. crystal current is probably even lower than the values given as read on the meter. (See table I.)

Coils

Both L_7 and L_{14} are wound on standard XP-53 forms, spaced to occupy exactly 2 inches of winding length. L_7 consists of 7 turns of no. 20 d.c.c. and L_{14} consists of 14 turns of the same. Be sure to make the connections to the same pair of base pins on both coils, so that they may be interchanged. If the condenser does not resonate at the points already mentioned, it may be necessary to add or subtract a fraction of a turn on either or both of the coils. However, if the layout shown is followed carefully, this will seldom be necessary.

Tuning Up

When tuning to 10 meters for the first time, care should be taken that one is not tuning the output tank to 13 meters instead of 10 (the third harmonic of 40 meters instead of the 4th). The condenser resonates at 10 meters with the plates nearly out, as already mentioned. It hits 13 meters with the plates a little less than half way in. Just remember that regardless of whether one is working on 10, 20, or 40 meters, the plates should be either nearly all the way in or nearly all the way out. If one observes this rule, he will not have to worry about landing in the "13-meter band".

For maximum output and drive to the next stage on 10 meters, it is essential that the output be link coupled and not capacitively coupled. A tuned grid circuit on the following stage adds another control, but this may be dispensed with as follows:

Fire up the exciter on 10 meters, and link couple it to a coil of about 7 or 8 turns of no. 20 wound on a low-loss 1.5″ form (space wound). This coil does not have to be plug-in. Tune it for maximum excitation to the stage following the exciter by spacing the turns. This self-tuned, 10-meter tank circuit is then left alone, even when changing bands. It will suffice on 20 and 40 meters by reason of the fact that the exciter has so much more "push" on the latter two bands. In other words, it is necessary to design a buffer stage that will get along on 10 meters with but 3 or 4 watts of excitation. There is no reason why this buffer stage should need more than 3 or 4 watts excitation on 20 and 40 meters. And this amount of excitation is available at the grid of the buffer on 20 and 40 meters even with an off-tune tank. If one insists on maximum drive to the buffer on 20 and 40 meters, plug-in grid coils and a tank-tuning condenser may be used instead, on the grid of the buffer stage.

With the values and constants given in the diagram, it is not necessary to measure the plate current, except perhaps for an initial check. Thus, one may dispense with a plate milliammeter for this stage and merely tune for greatest output.

Table I		
Amateur Band (Meters)	*Measured Output (Watts)*	*Crystal Current (R.F. Ma.)*
10	3.5	AT—100 X—110
20	16	AT—76 X—81
40	20	AT—91 X—97

80- and 160-Meter Operation

As described up to this point, the exciter makes an excellent unit for the c.w. man who is interested only in the three dx bands: 10, 20, and 40 meters. Now we will consider the traffic men and the phone men, who are usually interested also in the 80- and 160-meter bands.

By the simple process of buying a 160-meter crystal (if you do not already have one) and winding 52 turns of number 20 d.c.c. close wound on an XP-53 form (it will nearly fill the form), we now have an all-band exciter. This coil, which we will designate as L_{52}, is plugged into socket "B", and L_{14} (already on hand) is plugged into socket "A". With the condenser C_1 all the way in, we have some real output on 160 meters. With the condenser plates nearly all the way out, we hit a husky 80-meter harmonic. For 40, 20, and 10 meters, we use a 40-meter rock and L_{14} and L_7 as already described. Thus we have 10- to 160-meter excitation with but one tube, one tuning condenser, two crystals, and three coils. The crystal current with the 160-meter crystal was too low to read on a 115 ma. current-squared thermogalvanometer, regardless of whether L_{52} was tuned to 80 or 160 meters.

For 80-Meter Crystals

If you already have on hand some 80-meter crystals and want to use them, wind 28 turns of no. 20 d.c.c. on an XP-53 form, spaced to occupy 2 inches. Insert L_{14} in socket "A". With the plates well meshed on C_1 you will have 80-meter output. With the plates nearly out you will hit a strong 40-meter harmonic. The crystal current will run about 40 ma.

You are now able to hit two bands with any 80- or 160-meter crystal merely by twisting C_1 to the proper setting. This in addition to its 40, 20, and 10 meter exciting capabilities with a 40-meter crystal. Considering the fact that one is out only two extra coil forms and a few yards of no. 20 d.c.c., it is probably a good idea to wind up L_{52} and L_{28} anyhow, even if you are not particularly interested in 80 and 160 meters. If you should ever get the notion, you then will be able to get on in a hurry. Besides, some nice extra points can be piled up on 80 meters in the annual dx contests.

In spite of an apparent slight similarity in the wiring diagrams, the exciter is considerably removed from the conventional "tritet" oscillator. A standard tritet arrangement would use a tuned, *high "C"* coil in socket "A" (without which it would refuse to oscillate) and a much larger bypass condenser at C_2. The crystal current would be appreciably higher, endangering the 40-meter crystal, and the output on 10 meters would be considerably less. The exciter

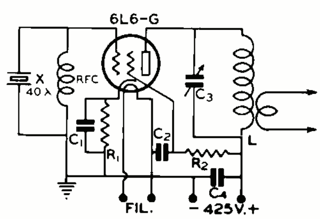


Figure 2

R_1—500 ohms, 5 or 10 watts, wire wound	C_2—.01 μfd. tubular
R_2—20,000 ohms, 5 or 10 watts	C_3—100 μμfd. midget
C_1—40 μμfd. mica 10 watts (critical)	C_4—.01 μfd. tubular
	L—Same as L_{14} of figure 1

of figure 1 does not depend upon the cathode coil for oscillation, as evidenced by the fact that it may be shorted out and the circuit will still work, though with low efficiency on the harmonics (see figure 2). In spite of improved performance over the tritet to which it is distantly related (both being descendents of the Dow oscillator), the exciter of figure 1 actually has fewer components.

A 50-Watt Amplifier Unit

Elsewhere in this issue is shown a push-pull 807 amplifier that is particularly adapted for use with this exciter, either as a buffer for a big output stage, or as a complete 50-watt, all-band transmitter that may be used either for c.w. or grid- or plate-modulated for phone.

In figure 2 is an interesting gadget, a by-product of the development work on the exciter of figure 1. It is a crystal oscillator that delivers power on either 20 or 40 meters with a 40-meter crystal. Scrutiny of the circuit will show it to be nothing but the exciter unit with socket "A" jumpered (or omitted if you prefer

[*Continued on Page 76*]

Dodging By-Pass Resonance

With the increasing use of very short waves, there is reappearing an effect which worried broadcast-receiver makers some years ago. This is the failure of bypass condensers to bypass as expected.

Often it is found that a larger bypass makes things worse instead of better. Several 10-meter transmitters have recently run into this sort of thing, and it does seem puzzling that a smaller capacity should give better bypassing in some cases.

The explanation is that we never have capacity alone. Looking at the top diagram, we cannot have only C; we also have the two connecting wires DA and BE, which have inductance and are therefore properly labeled as L_1 and L_2. The whole combination is a series-tuned resonant circuit. At resonance it is a most effective bypass. To one side of resonance, where we wish to be, it is mainly a condenser. On the other side of resonance, where we land by accident, it acts mainly as an inductance and refuses to bypass unless that inductance is very small indeed.

Since changing the wire-lengths or the condenser capacity moves the resonant frequency, one may get out of it in that way. To avoid difficulty, start by taking the proposed bypass with the lengths of wires to be used, and bending the wires around to make a closed circuit as in diagram 2. Now hold this tuned loop up near the coil of a small oscillator which covers the working frequency and a good range on both sides. Tune the oscillator slowly and watch for "flips" of the plate or grid meter of the oscillator. If one is found, the bypass will perhaps cause trouble even when the wires are straightened out for use. Change the condenser size (usually to a smaller capacity) or contrive to shorten the wires until the resonance frequency is well away from your working frequency.

Just to show that this isn't idle talk, here are a few practical examples of what can happen. On second thought we'll take examples met at ordinary wavelengths, for it happens there also.

A transmitter using a 47-oscillator at 160 meters and two doubler stages to drive a final stage refused to provide proper excitation to the final stage. This final stage was on an independent metal base tied to the chassis of the

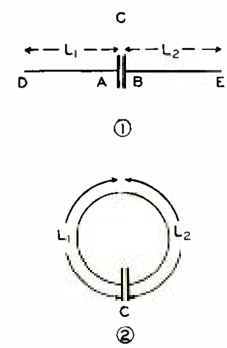


Figure 1
Showing equivalent resonant circuit of bypass condenser and connecting leads.

"driver" stages by a condenser and about 10 inches of wire. The final-stage grid was driven by a lead tapped to the plate coil of the second doubler and was only about 12 inches long. After wasting an hour in trying to get more power from the second doubler someone suspected wrong-side-of-resonance in the chassis-to-chassis lead. It was pulled off and tested with an oscillator. Guilty! When this 0.0005 μfd. condenser was replaced by a 0.0002 μfd. condenser, the final tube immediately went to full rating.

In a well-known broadcast receiver factory, one set refused to become stable. After a steady 20-hour rumpus with the thing, a light dawned —one bypass had a capacity of ½ microfarad. Junking it in favor of 0.2 μfd. settled the matter at once.

Again, a transmitter using an RK-20 tube gave perfectly horrible audio quality at the receiver. No oscilloscope was available and the only possible linearity test was one made point-by-point with d.c. The tube was found to be regenerative in spite of apparently good shielding. It looked like screen regeneration. No other bypass condenser was available and the leads could not be made shorter with the chassis-construction used. After some thought the bypass-condenser leads were replaced by strips of shim brass ½" wide. Immediate peace was the result, since the lowered inductance moved the resonance point.

From this, one might think that the cure is

[*Continued on Page 76*]

An 807 All-Band Push-Pull Amplifier

By Faust Gonsett, W6VR

An all-band amplifier that delivers 50 watts on 10 meters and 60 watts on the lower frequency bands. Requiring no neutralization and but 2 watts excitation, it may be built for $15 including tubes. With the 6L6 exciter described on page 36, it makes an ideal c.w. transmitter. For phone it may be plate-screen modulated by any 40-watt amplifier.

There was great rejoicing when the 802 was released to the amateur fraternity. But the 807 should make one feel twice as good, because at 500 volts it will do as much as a *pair* of 802's and costs no more money than a single one. The tube is inherently a glass 6L6, with improved shielding, top cap connection for the plate, and a ceramic base. But enough of that; the tube is described in detail elsewhere in this issue.

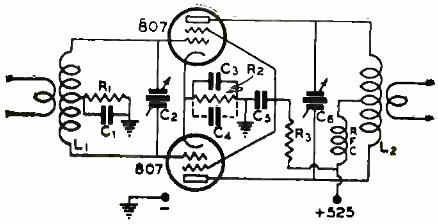


Figure 1

R₁—20.000 ohms. 5 watts
R₂—200 ohms. 10 watts
R₃—10.000 ohms. 10 watts
C₁—.01 µfd. tubular
C₂—100 µµfd. per section, receiving type midget
C₃—.01 µfd. tubular, 600 working volts
C₄—16 µfd. electrolytic, 100 working volts
C₅—.002 µfd., mica, 600 v.
C₆—150 µµfd. per section, 1000 volt spacing, "semi-midget"
RFC—Pie wound r.f. choke, 200 ma., 2.5 to 5 mh.

The amplifier shown in the photograph (to the right of the picture) was designed particularly as a companion unit to the 6L6 exciter described on page 36, and therefore was built on the same type of breadboard. The method of mounting parts as seen in the illustration allows very short r.f. leads, an important item at frequencies above 14 Mc. The socket for the plate tank coil is mounted on the plate tank tuning condenser by means of two brackets. The condenser itself is elevated on two stand-off insulators. This allows shorter leads from the top stator connections of the condenser to the plate caps of the two 807's.

It will be noticed from the photographs that the rotors of the two tuning condensers are left "floating". While it made little difference at the lower frequencies, it actually increased the output at 10 meters. For equal load on the tubes, this makes it mandatory that the final tank be link-coupled to the load (a good idea anyway) and that the link be placed around the *center* of the coil. Likewise the link to the grid coil should be coupled to the center of the coil, and not nearer one end than the other.

If the grid coil, L_1, is "pruned" for the center of the band with no lumped capacity other than the grid-cathode capacity of the tubes, the grid tuning condenser C_2 could just as well be dispensed with. If one were using the amplifier on but one or two bands, it would be a good idea. But pruning grid coils for five bands is somewhat of a job, and for that reason C_2 was incorporated, making critical adjustment of the grid coils unnecessary.

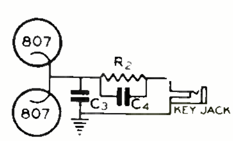
The electrolytic condenser C_4 is necessary only on phone. If the transmitter is to be used only on c.w. it may be left out of the circuit.

If "cathode keying" is used, the circuit of figure 2 should be followed. The jack is an ordinary circuit-closing jack. Removing the plug on the key cord produces the same effect as closing the key.

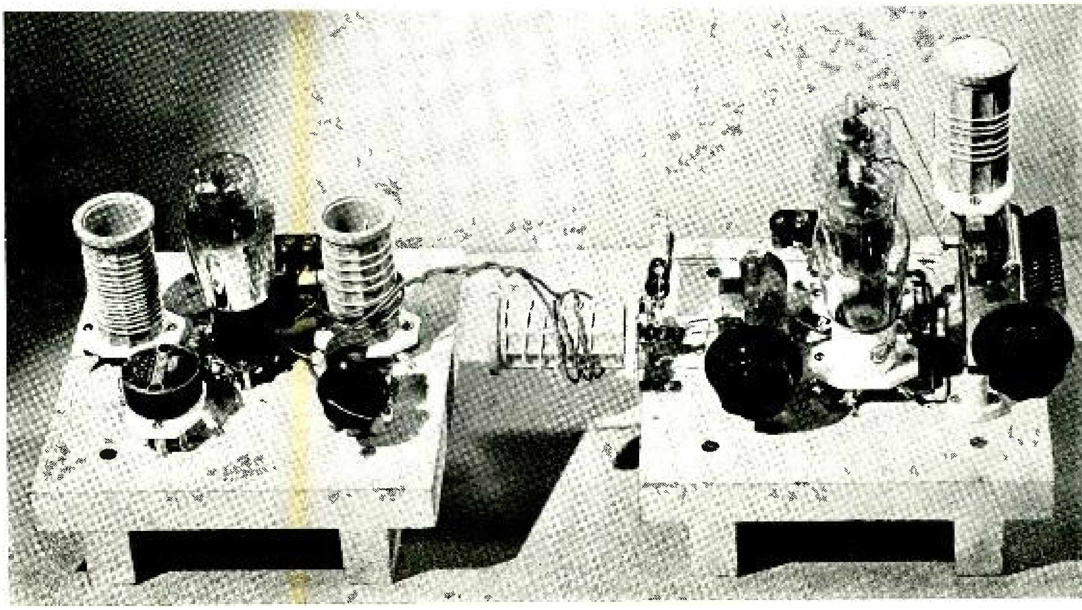
A 0-300 ma. d.c. milliammeter should be connected between "plus 525" and the power supply. This will read the combined plate and screen current. The amplifier should never be loaded up to read more than about 215 ma.

Figure 2

Circuit for cathode keying when telephony is also used.



The excitation requirements are about 0.5 watt or more for c.w., or 2 watts or more for phone (for the 2 tubes). However, as much excitation as is available, up to 5 watts, should be used. More than about 5 watts is not to be recommended, however. The 6L6 exciter shown with the amplifier in the photograph furnishes



The Push-Pull 807 Amplifier with 10-Meter Coils, Being Driven by the Special 6L6 Exciter Described Elsewhere in This Issue.

adequate excitation on all bands for either phone or c.w.

The actual plate-to-cathode voltage will be on the order of 475 volts, due to the drop in plate voltage through the cathode resistor. This is slightly in excess of the manufacturer's rating but does no apparent harm to the tubes. The manufacturer recommends a further reduction in plate voltage when plate modulation is used. However, the voltage was kept the same for both phone and c.w. except on 10-meter phone, when the voltage was reduced 75 volts.

The exciter condenser and the grid tuning condenser are tuned for maximum output of the 807's, as indicated by a small flashlamp inductively coupled to L_2. This adjustment should be made again after the amplifier is loaded up to approximately full output. Some juggling of the link will be necessary for maximum grid drive. However, on all bands but 10 meters there will be an excess of drive, and very little juggling will be required on those bands.

When the outfit is working properly, tuning either the exciter or grid condenser in either direction will lower the output.

If maximum output and minimum plate current do not occur at approximately the same setting on the output tank condenser, C_6, a somewhat higher C coil should be used (a few less turns). The coils should be wound so that the 10-meter band hits with the plates of C_6 nearly out, and the 160-meter band with the plates nearly all the way in (with the other bands correspondingly between).

Incidentally, the tuning condenser on the exciter unit as shown in the photo happens to be tuned to about *13* meters instead of 10 (the coils are for 10 meters). The transmitter was not on the air; it was merely having its picture taken. The harmonic that coincides approximately with the setting in the photo is the one to avoid, as explained in the exciter article.

◆

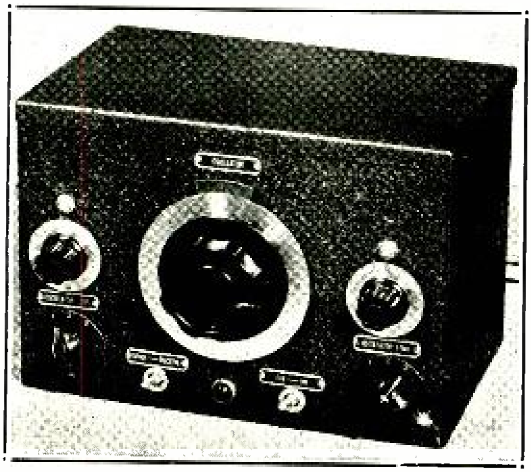
Considerable publicity was given recently to a statement by a noted jurist, whose name was withheld, that hobbies often lead to divorce during the first five years of married life. "To many a man," the judge said, "hobbies are vastly more fixed and are much harder to give up than even his marital happiness . . ." It is of interest, however, to note that the judge harped on outdoor sports which take a man away from his home.

◆

An effective rope size for antenna halyards is ⅜", according to mail order prices—about 79c a hundred feet. But if you need a brass pulley for extra long life, or for use where smoke might corrode a galvanized iron pulley, you may find that the hardware companies do not carry them in sizes larger than 5/16". The answer is to go to a boat supply dealer, where large sizes can be obtained.

QRM Dodging, the Latest in Sports

By George Davis, W6SJ



The Front View of the QRM Dodger

The "Q" signal *QRM* has held the meaning of "interference" for many years, but only in the last two or three has interference become so discouragingly persistent as to be a reason for terminating what started out to be a perfect QSO. The advent of the crystal filter was a life saver to the c.w. man, but was of doubtful aid to the phone man. It has been the writer's experience that few voice-modulated signals could be copied 100% once the crystal was set for elimination of an unwanted signal.

However, it is very seldom that a whole phone band will be completely covered with QRM. Rather, it will be spotty, several clear channels announcing themselves with a rush of noise when one tunes over the band as the a.v.c. opens the gain. If one could easily shift frequency to some of these clear spots, one would, no doubt, try a change. But it is usually quite a job to get up from the operating position, take out the one crystal, and plug in another. So we go on and on, sometimes for an hour or so without a decent contact, only to hear later that we had been completely covered up by two R9 signals all the time. A change of two or three kc. would ordinarily have put us in the clear. It is the purpose of this article to present a complete, self-powered, variable-frequency, multiband oscillator that can be placed upon the operating table alongside the receiver and, through a link to the transmitter, provide a choice of any frequency over 15 or 20 kc. on the 1.8 and 3.9 Mc. phone bands without touching the transmitter. 14 Mc. operation was originally contemplated but, for the time being, was discarded due to the inherent instability of self-controlled oscillators at high frequencies.*

As will be seen from the diagram, the oscillator consists of a type 24-A tube in an electron-coupled circuit. Two band-change switches are provided to shift the grid and plate circuits and a band-spread condenser with a dial which provides one-tenth of a degree readability is paralleled with the grid circuit band-set condenser. A small quarter-watt neon bulb is used as a resonance indicator to save the cost and space of a milliammeter. A small shield can provided ample room for all apparatus but, as can be seen from the photographs of the unit, careful placing of the parts must be exercised. All r.f. wiring was done with no. 12 bus-bar and tied with waxed cord to avoid vibration with a consequent fluttering in frequency. Variable condensers with heavy brass plates and double bearings were selected for the same reason. The plate lead to the tube is quite long but since stability is of prime importance, a sacrifice in efficiency was made in order to get suitable mounting space and shielding for the coils and switches. The neon indicator was found to give better glow with a small

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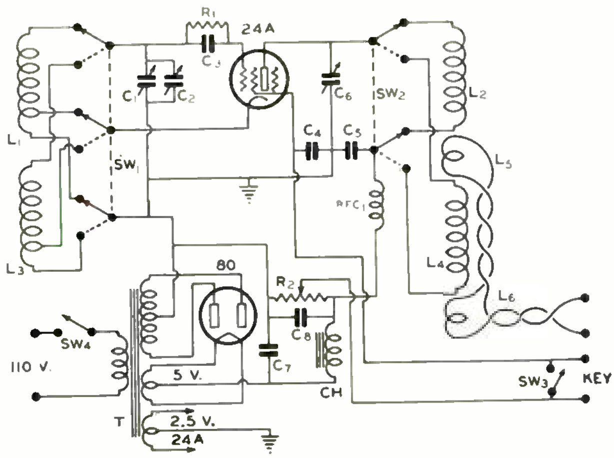
*As the stability of an oscillator is a question of percentage, instability (expressed in cycles or kilocycles) becomes greater at the higher frequencies. There is nothing to be gained by using a low-frequency oscillator and a string of frequency multipliers (though one multiplier is conducive to good isolation of the oscillator) because any instability is multiplied by the harmonic one is working on.

The best variable-frequency control for 20 and 10 meter work is to be obtained from a variable airgap crystal unit, though a *carefully built* "QRM Dodger" is sufficiently stable for amateur *phone* work. For single-signal c.w. reception, it is very difficult to get an electron-coupled oscillator sufficiently stable for work on those bands.

At 75 and 160 meters the "tunable crystal" does not allow enough frequency change, but on those bands an electron-coupled oscillator is sufficiently stable, and may be used for the same purpose to better advantage, even for s.s. code reception where sufficient care is taken in construction.—Editor.



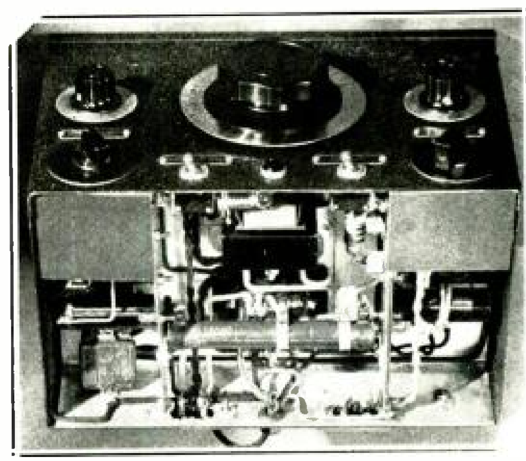
The General Wiring Diagram

C_1—250 μμfd. midget (band set)
C_2—35 μμfd. midget (band spread)
C_3—250 μμfd. mica
C_4—.01 μfd. tubular
C_5—.006 μfd. mica
C_6—100 μμfd. midget (output resonator)
C_7, C_8—8 μfd. electrolytics
R_1—50,000-ohm 1-watt carbon
R_2—15,000 - o h m 50-watt with slider
SW_1—3PDT switch
SW_2—2PDT switch
SW_3, SW_4—SPST toggle switches

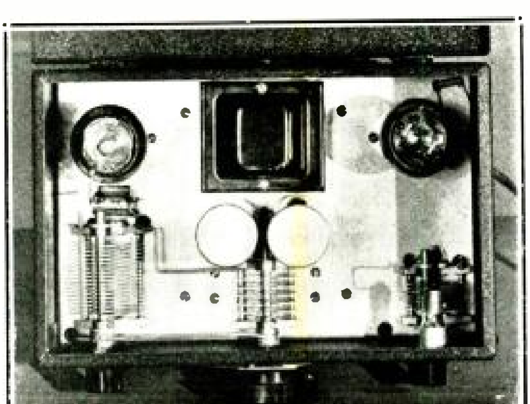
L_1—66 t. no. 24 e. tapped at 19 t.
L_2—80 t. no. 28 e.
L_3—31 t. no. 24 e. tapped at 8 t.
L_4—52 t. no. 24 e.
L_5, L_6—Series link: 2 turns no. 20 hook-up wire on each coil.
Note: All coils close wound on ¾" tubing
CH—18 hy. 50 ma. choke
T—Midget power trans., 275 each side c.t., 5 volts and 2.5 volts.

capacity to ground around the bulb in the vicinity of the plates. Consequently, a wide strip of aluminum was bent so that in addition to serving as the capacity to ground it serves as a means of mounting the bulb to the shield can. The rest of the construction is quite ordinary and becomes self-explanatory through the circuit diagram and photographs.

As for operation, the unit has been used successfully at a local 160-meter phone station and has proved its worth conclusively. The tube lineup in the transmitter is a 47 crystal oscillator, 10 buffer, and an -03A final. Best operation was obtained with the "QRM Dodger" coupled into the grid circuit of the 47 stage. Of course the crystal was removed from the circuit and a coil plugged into its place. A three-turn link was placed around this grid coil and a twisted-pair line brought around the room to the operating position and attached to the "Dodger". The operator was then able to control the frequency of the transmitter without moving from his chair. A change of 120 kc. was made in a test QSO without a noticeable change in volume being reported. However, a change so great as that does require retuning of the other stages for good efficiency, and while 120 kc. shift may be desirable at times, the real advantage comes in being able to make just enough change to slide out from under the QRM.



Under-Chassis View, Showing Construction



Looking Down into the Unit

Devices similar to this are rapidly gaining in popularity even on the 14 Mc. band, though stability is sacrificed in the interests of quick change. On the lower frequency bands, however, it is very difficult, if not impossible, to tell whether the emitted carrier is crystal-controlled or not.

Another additional advantage is that instead of operating as a low-efficiency crystal oscillator,

[*Continued on Page* 78]

Curing "Suppressor Quality"

By Robert S. Kruse, W1FG

If you are the operator of one of the numerous suppressor-modulated phones on the air utilizing an RK-20 in a "tritet" circuit, you can very easily improve your quality and increase your output by the very simple means of adding a low-power crystal oscillator tube for excitation. The improvement is most worthwhile.

Many amateur suppressor-modulated transmitters have a curious quality readily identified by ear. Recently it was possible to "spot" 11 out of 12 such transmitters by merely listening for "suppressor quality" in the 20- and 80-meter bands, then camping on the suspected signal until the operator got around to the customary station-description. The 12th guess was wrong; that man was using an aviation microphone and it was hard to tell much about his quality anyway.

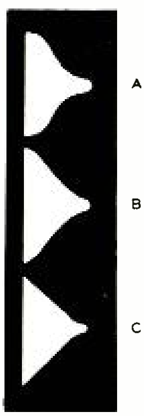


Figure 1

Oscillograms sketched from amateur-made and factory-made suppressor-modulated transmitters.

To get at the cause of this "suppressor quality" the cathode-ray oscilloscope was used on a number of amateur transmitters, likewise on three factory-made ones. With one exception these sets turned out figures as bad as "A". They sounded that bad, too. By readjusting the antenna coupling it was possible to make the figures even worse.

It did not seem reasonable to blame the RK-20 tubes, since their performance in one set was really good, and since these tubes have a good reputation. Comparison of the circuits showed that all but one of the transmitters were using the RK-20 tubes in the (unfortunately) popular circuit which makes the tube serve as combination crystal oscillator and modulated amplifier. The circuit hog-ties the operator as to any adjustment of the r.f. input to the grid of the tube. This and the under-excited appearance of "A", was a broad hint. The fact that one unusually active crystal straightened the curve a trifle confirmed this hint.

External Oscillator

Accordingly the crystals were removed from the RK-20 grids and these grids were driven by means of a link circuit with variable coupling to an external oscillator of ample size. For once an experiment developed as expected. With loose coupling of the link the familiar pattern "A" appeared. As the link coupling was tightened, this gradually and smoothly straightened out and something like "B" appeared. At this point the r.f. watts to the RK-20 grid were 3 to 5 times the power previously supplied by the crystal directly in the RK-20 grid circuit, grid wattage being judged by the rectified grid current on the basis that twice the grid current represents 4 times the grid input watts. Further increase of the grid input helped slightly, and appeared to work no harm even when carried to very high levels, where one might expect damage to the RK-20 grid. The grid input, when curve "B" was obtained, was above that recommended by the tube makers in every case. All of the transmitters could be made to produce figure "B" by merely raising the grid input with a separate oscillator as described, the antenna coupling being properly adjusted meanwhile.

Beaten to It

This was no new discovery. One of the transmitters tested had already attended to the matter. This transmitter is not now on the market; so it is no advertisement to mention the last-year's Sears-Roebuck "International", which was the one good performer of the lot as regards linearity. This transmitter used an independent crystal oscillator working with a receiving audio-pentode which drove a push-pull pair of RK-20 tubes, via a link coupling to a tuned grid circuit.

It was found that the familiar 47-tube turns out about the right wattage, which can readily be adjusted by changing the voltage to that tube. The link coupling used in the "International", like all link coupling, unfortunately runs to tuned circuits in unhandy numbers if much band-changing is to be done.

Complicated?

Such complication is not unavoidable. If one works at the crystal frequency all the way through, one can use a 47-oscillator and a single RK-20 amplifier with only two tuned circuits, which is the same number used in the sets operating the RK-20 as a combination oscillator-amplifier. The circuit is shown in figure 2.

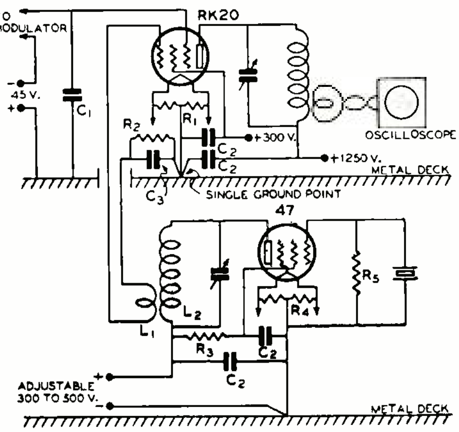


Figure 2
A circuit for avoiding condition "A" of figure 1

C_1—.001 µfd. mica	**R_2—10,000 ohms**
C_2—.01 µfd. mica	**R_3—25,000 ohms**
C_3—250 µµfd. mica	**R_4—50 ohms, c.t.**
R_1—50 ohm c.t. resis-	**R_5—20,000 ohms**

When doubling frequency in the 47-tube one additional tuned circuit is required. It is placed in either the screen lead or the cathode lead of the 47, but the screen position is preferred. This circuit tunes to the crystal frequency (nearly) while the plate circuit of the 47 is tuned to the double frequency.

The combination L_1 L_2 comprises the tuned plate circuit of the 47, and the untuned grid coil of the RK-20. This is not a link circuit in the ordinary sense and will not work if given the usual link-circuit proportions. Accordingly one does not get along with 1 or 2 turns around the 47-plate coil. A simple and satisfactory construction is to place L_2 on the same form as L_1, the turns of L_2 being interwound with L_1 (that is, laid between the spaced turns of L_1). The coil L_2 should have only about ½ as many turns as L_1 and be placed at the low-voltage end. The insulation between the two coils must be good as it will not do at all to have several hundred positive volts arrive suddenly at the RK-20 grid. The lead from L_2 to the RK-20 grid should not be the usual twisted pair but had better be spaced somewhat apart. A single wire and a return to the chassis will do if no instability in the RK-20 results. If rack-and-panel construction with metal chassis-bases is used, the 47 stage can conveniently be one deck below the RK-20 stage.

Push-Pull

The circuit of figure 2 does not fit well into a push-pull RK-20 scheme, whereas the ordinary link coupling with a tuned RK-20 grid coil handles that nicely. It is something of a question whether a 30-watt phone is enough better than a 15-watt phone to justify the additional RK-20 tube, and the additional tuned circuit.

The "Screen Cure"

While on this linearity subject we also checked back on the alleged possibility of improving over pattern "A" by using a screen-voltage supply with series resistance. The idea is that as the tube is modulated the screen current shall vary and because of the series resistor the screen-current changes must cause screen-voltage changes, which are supposed to take the curves out of pattern "A". It did not work out that way. We did not suspect that it would, for previous tests had shown that an RK-20, biased for suppressor modulation, was quite insensitive to changes in screen voltage, the output changing hardly at all when the screen voltage was varied as widely as might happen as a result of the series-resistance device.

For the second time the experiment checked the expectation. Sets producing figure "A" hardly improved at all when the screen supply was changed to the series-resistance form. Those producing figure "B" varied slightly one way or the other.

Antenna Coupling

All modulated tubes are more or less sensitive to the plate-load. In the case of these several RK-20 outfits considerable changes in the pattern could be made by changes in antenna load. No satisfactory way was found of making the best adjustment without an oscilloscope to look at. Of course modulation-linearity can be checked point-by-point, but it is a terribly slow business and the carrier must stay on the air for hours while it is being done time after time until the right adjustment is found. This is offensive to other users of the band; also one does not know it when an accidental

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Improving the Mobile Receiver

Now that we are at last getting out of the transceiver stage of mobile amateur work—to which we were thrown back by over-enthusiasm for ultra compactness—it is time for looking into the things that make a good 6-volt receiver with more than 1¾ tubes.

In thinking of 6-volt receivers, most of us start thinking also about 6-volt tubes. These tubes are indeed quite excellent, but their effect on the storage battery of the family Plymouth or Ford is sometimes just awful. Besides, if one tries to use B-batteries for plate supply, that runs into a replacement and cost problem, while if the job has some sort of conversion device for manufacturing B-voltage—well, that is just so much tougher on the storage battery.

The 2-volt tubes, on the other hand, draw less current, but are reputed to be noisy, especially when used with a conversion device for plate supply. Such a "mechanical B supply" tends to cause a high noise level in any direct-emission (meaning 2 volt) type of tube because of the common couplings due to circulating currents in the wiring, cable shields and chassis. Indirectly-heated tubes do not remove these couplings; they merely dodge them. One wonders if it might not be equally effective to erase the couplings and then to use direct-emission tubes with the corresponding decrease in battery drain.

For instance, if the filament leads are also being used to supply power to a converter (vibrating or rotary), it is pretty clear that the A and B circuits are coupled via this common-lead; hence the filaments are noisy because of the irregular current drawn by the conversion device. But if the filaments are noisy, the whole works is noisy. Thus move no. 1 is to use wholly independent leads right from the storage battery (not the ammeter but the *battery*) so that this coupling is eliminated. In the conversion device it is of course once more necessary to make sure that the input and output currents pursue different paths insofar as this is at all possible; certainly no common lead between the conversion-device and either the set or the A-battery can be permitted. Furthermore, the B-supply or conversion-unit must, insofar as possible, be kept at car-chassis potential (as relates to a.c. and r.f. anyway) by shielding it, grounding its case, and shielding the leads from the storage battery to it. Physically it should be kept distant from the receiver, not in the receiver case. Furthermore, some one point on the receiver chassis is to be taken as the ground point and all grounds in the re-

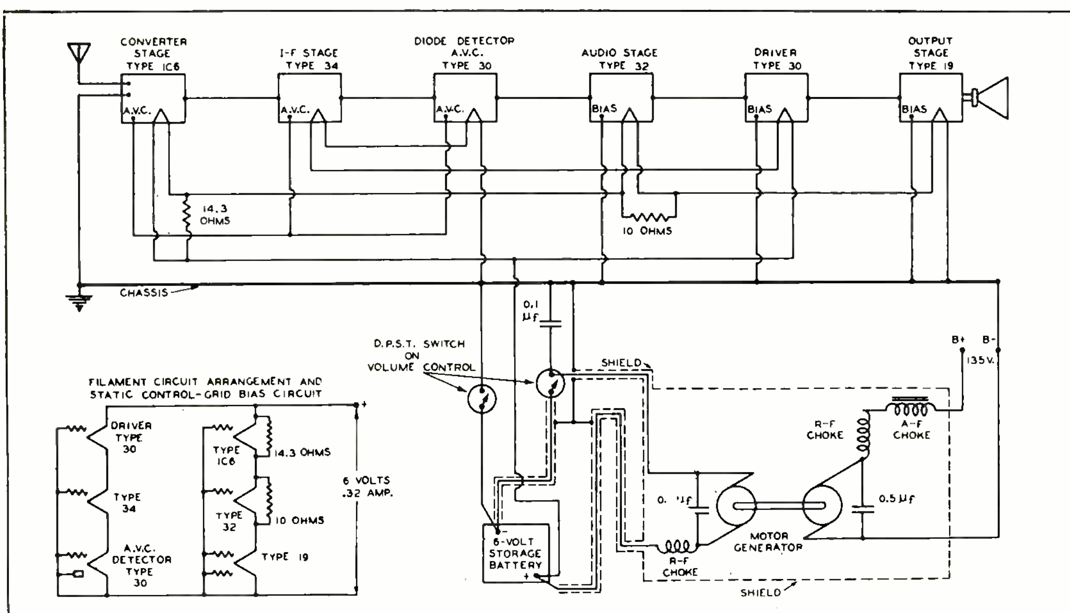

FIG. 1

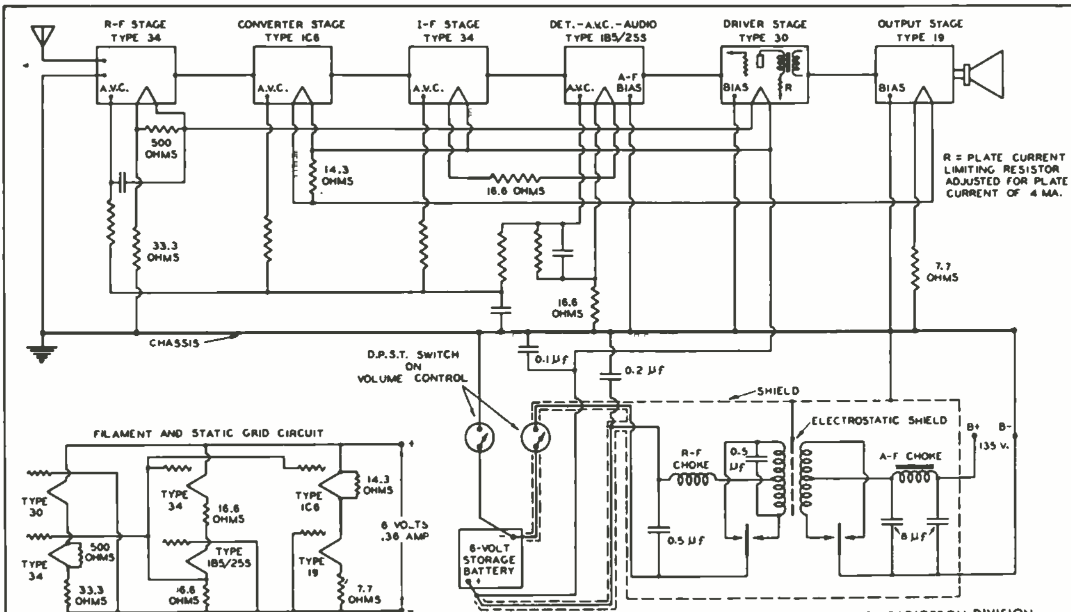

FIG. 2

RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY INC

ceiver be run to that point if decently possible, so that there will not be couplings due to circulating currents in the receiver chassis. Incidentally, shields want to be shields in any case, not return-circuits. This holds for the metal cases of receiver and of B unit, also for the cables between them and from the storage battery. In some R.C.A. laboratory tests the soundness of these warnings was shown as follows:

A receiver was built up as is customary, with common leads to the A-battery, a single shielded cable to the receiver, and the condensers in receiver and conversion device grounded in the customary way. This is the "original circuit". Then independent A- and B-supply leads were run, the B-leads were shielded and the shield grounded to the B-supply can, the necessary separate switches for the separate battery leads installed, and the bypass condensers carefully grounded at a common point. This is the "revised circuit with motor-generator supply", shown as figure 1. The sensitivity of the receiver had not been affected but the noise had been *enormously* decreased. Here are the test data on that:

Noise Output in Milliwatts

Input	*Original circuit*	*Revised circuit*
21 microvolts c.w.	10	5.6
210 " "	10.0	0.78
2100 " "	263.0	0.5

Note that in the "original" receiver the noise got *worse* as the signal became stronger, because the noise modulated the incoming signal, while in the revised receiver the noise had been decoupled from other circuits, and therefore had no chance to modulate anything and thus was gradually submerged as the signal became stronger. By the way, this receiver produced 50 milliwatts output with a 21 microvolt signal modulated 30 per cent.

Where the Noise Originated

To find out what the noise really was, oscillograph measurements were made and the following found:

Across the motor commutator........20 millivolts
Across the 32 filament....................½ millivolt
Across the output..........................100 millivolts

To get this point cornered a little better, a second test was run with a set using a vibrating device for B-supply. This was a more sensitive receiver, requiring but 5½ microvolts to produce the same 50 mw. output as the former receiver. On a similar revision of the circuit the following results were obtained:

Noise Output in Milliwatts

Input	*Original No. 2*	*Revised No. 2*
5.5 microvolts c.w.	5.25	1
55 " "	4.5	1.53
550 " "	13.8	0.03
5500 " "	5.25	0.03

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Uncle Tom's Glossary of Ham Terms

Way down under in the land of kookaburra, where the amateurs sign "VK" and the U.S.A. is considered "local" on anything but 160 meters; in fact, everywhere in the British Empire, from Bombay to Newfoundland, the young squirts kowtow to an austere and venerable personage known otherwise as "Uncle Tom". In fact, he commands as much respect from true British amateurs as does "The Old Man" in this country. We reprint herewith from the *T and R Bulletin* one of his choice expostulations, British spelling and all.

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Good evening, children! Here's your dear old Uncle Tom back again. And to celebrate this happy occasion, what d'you think I've got for you? Why, the long-promised Dictionary of Ham Terms for Tiny Tots, compiled by myself with the help of the authors of "QSA 5 and All That."

(*Special Note*: Readers with no sense of humour are specially asked to remember that the following is meant to be funny.)

Here are the Q scale, the R scale and the T scale. Cut them out and stick them on the wall:—

QSA Scale

QSA 1: My receiver is punk.

QSA 2: What the heck did *you* want to call me for?

QSA 3: *That* ought to stop you trying to rag-chew!

QSA 4: If only my Code will stand it I can copy you quite well.

QSA 5: Just another QSO.

QRK Scale

R 1: I wish to insult you.

R 2: I don't want to work you.

R 3: You are too much trouble to work.

R 4: You only gave me R 5.

R 5: You *may* only give me R 5.

R 6: You are R 9, but I know you have 250 watts.

R 7: You are R 4, but one good report deserves another.

R 8: I am willing to work you.

R 9: You are a dr dr ob and I had my Eno's this morning.

R 9+: I want to borrow something.

QRI Scale

T 1: Your note is unfit for human consumption.

T 2: Who d'you think you are? Covent Garden?

T 3: Either you've lost the key of your Goyder lock or you're sending with a file.

T 4: I am using an A.C. receiver.

T 5: I give it up—don't know what to give you.

T 6: Say, big boy, your note sure has poisonality.

T 7: Ha, ha! I know you fancy your note—that ought to sting you up.

T 8: Think I'd give you T 9 when you only gave me T 8?

T 9: You have a spacer-wave.

•

And now for the first thrilling instalment of Uncle Tom's Glossary of Ham Terms.

Artificial Aerial: An aerial that exists only in the imagination of the G.P.O.

B.C.L.: The lowest form of animal life.

Bottle: See Feeder.

Bug: An instrument for multiplying dots (hence "bughouse"—dotty.)

Crystal: A pane of glass from a doll's-house window.

C.W.: Continuous wave, so called because it is broken up into dots and dashes.

Distortion: Phenomenon to which DX stories are prone.

Dope: Generally inaccurate information given by a ham who doesn't know of anything else to say, to a ham who doesn't want to hear it, inducing a feeling of sleepiness in both.

DX: A kind of ham religion.

Experimenter: A ham with horn-rimmed specs., a copy of the Handbook, and an infinite capacity for picking brains.

Feeder: See Bottle.

Ham: Someone who says "old man" in his sleep.

Hamband: The occupants of the saloon at the local, before, during and after a meeting.

Ham Spirit: The tie of affectionate comradeship that binds together all hams who use the same crystal frequency.

Hi: Conclusive proof that you have made a joke.

Hi (on 'phone): Same as above, but you are being even funnier without knowing it.

OB and OM: Only punctuation ever used by hams.

OW: Legitimate excuse for continual activity on the air.

R: "Received." (Literally, two words copied.)

Self-excitation: Getting keyed up without control.

Shack: A piece of land entirely surrounded by wire.

Theory: Nobody's business.

Wx: A topic of conversation introduced after "dah-dit-dit-dit-dah" six times.

YF: An OW in the early stages of decay.

YL: Legitimate excuse for continual inactivity.

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And now, just a few of the "Q" signals to finish up with.

QRL: Hurry up and pack up. I want to work six more DX stations in the next half-hour.

QRT, QRU: Ditto.

QRX: Stand by till you're blue in the face. I want to make rude noises.

QSV: Send V's, please. I have an Expensive American Wireless and it takes a lot of adjusting.

QRG?: Am I anywhere near the band? Using E.C. here.

QRS: Send double, or even treble. I'm not listening.

QSLL: You're awfully ill-mannered if you don't send your card by air-mail. But you needn't expect an answer to it.

QSP: I will write a garbled version of your message on a scrubby piece of paper, which I shall then lose.

QSY: There's a lot of QRM about. Let's get just the other side of GMR.

QRZ?: Like CQ, but longer.

[*Continued on Page 80*]

Minimum Plate Current and Efficiency

By "Jayenay"

Radio for several years has sponsored the minimum unloaded plate current test for proper and efficient operation of a radio frequency power amplifier. This test of circuit conditions is highly useful, but many requests have come in for an explanation of just what the minimum plate current indicates and why it is a useful and effective test.

The purpose of a radio frequency vacuum tube amplifier is to convert d.c. plate input power into r.f. output of a frequency determined by the frequency of the controlling, or grid excitation, voltage. All r.f. power amplifiers utilize a tuned plate tank circuit as a coupling device between the plate and the load.

The main characteristic of a tuned tank circuit in this application is to provide a high a.c. resistance in series with the plate circuit and at the same time introduce little or no d.c. resistance into the plate circuit. The function of all the various and sundry coupling gadgets between the plate tank and the antenna or other load is simply to convert the actual a.c. resistance of the load into a value of a.c. resistance suitable for the plate circuit of the tube.

As long as the tube is operating, it may be assumed that a.c. plate voltage is being used as far as this discussion is concerned. The average plate current through the tube, as indicated on the plate milliammeter, varies with the applied plate voltage. Thus if we assume, for the moment, that the plate power supply delivers r.f. plate voltage at the operating frequency, it should be evident that if the r.f. plate voltage is constant, the plate current will vary as the a.c. resistance of the tuned plate tank circuit varies.

When an antenna or load is coupled into the plate tank, it has the effect of reducing the a.c. resistance measured across the whole tank circuit. The tighter the coupling, the lower the shunt resistance of the tank circuit. Thus, as the shunt a.c. resistance goes down with tighter coupling, there will be less a.c. voltage drop across the tank, which means high voltage across the tube and more plate current. This is evidently the case because the plate current certainly rises as the coupling to the load is made closer.

When the antenna or load is entirely uncoupled from the tank circuit, the shunt tank impedance should rise to infinity. If it did rise to infinity, it would be evident that the plate current would drop to zero as there would be an infinite voltage drop across the tank circuit, leaving no voltage to force plate current through the tube. The shunt tank resistance does *not* rise to infinity and the plate current does not drop to zero because of the inherent tank circuit losses in the circuit itself.

These losses are resistance losses and manifest themselves by limiting the rise in shunt tank resistance when the useful load is uncoupled. Thus there is always some minimum unloaded value of plate current when the useful antenna load is removed from the amplifier tank circuit. The higher these losses, the lower will be the unloaded shunt resistance of the tank circuit and the more voltage there will be across the tube. Thus the higher the circuit losses, the higher the minimum unloaded plate current. Thus any circuit changes that will reduce the unloaded plate current will reduce the amount of output power that must be expended in heating up the loss resistance of the plate tank circuit and the more efficient the tank circuit and amplifier will be.

The loss resistance might be considered to be a high resistance shunted across a relatively-low useful load resistance. The resultant of these two resistances is always something less than the resistance of the smaller and this resultant is the resistance which appears across the terminals of the tuned plate tank. Thus the higher the value of shunt loss resistance, the lower will be the proportion of total power output dissipated in the circuit losses.

The thoughts expressed above are not strictly accurate, as they are based on assumptions that are contrary to fact. However, for the purpose of explaining the significance of minimum unloaded plate current, they are an entirely useful analogy and contain no fallacies.

It has been said many times that the minimum plate current of an unloaded amplifier should be less than 10% of the normal loaded plate current. From this it might be thought that the inherent circuit losses in such an amplifier would be exactly equal to 10% of the

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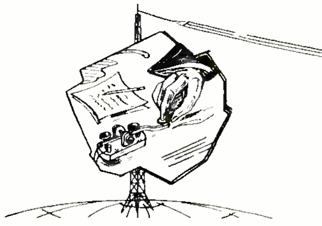
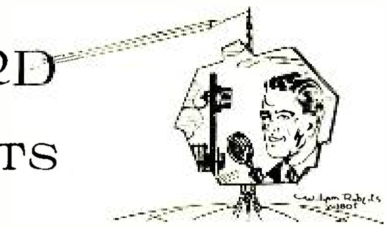


CALLS HEARD AND DX DEPARTMENTS



Numeral suffix indicates "R" strength. Send Calls Heard to Calls Heard Editor, not to Los Angeles.*

Donald W. Morgan, BRS1338, 15 Grange Road, Kenton, Middlesex, England

August 1 to September 6

(All stations heard were between R6 and R8)

(14 Mc. phone)

W 1ADM; 1AXA; 1BLA; 1BLO; 1BQQ; 1BR; 1CCZ; 1CND; 1COJ; 1DLO; 1FLH; 1FNL; 1FZ; 1GE; 1GED; 1GR; 1IAS; 1IRO; 1JJ; 1KK; 1MX; 1ZE; 2AKK; 2BFB; 2BLO; 2BUX; 2CCA; 2CJJ; 2CPA; 2CPT; 2DC; 2EDW; 2ELO; 2EUG; 2FF; 2FHI; 2FPB; 2GFH; 2GKO; 2GN; 2HCE; 2HUQ; 2JEH; 2JNT; 2MJ; 2OJ; 2OX; 2PJJ; 3ACX; 3AKE; 3BBB; 3CBT; 3CC; 3CKT; 3DE; 3ELP; 3EOZ; 3EWW; 3EXC; 3FIH; 3MD; 3OX; 4AEZ; 4AKA; 4ASR; 4AVI; 4BAZ; 4BMR; 4BYY; 4DBC; 4DCI; 4DCR; 4DV; 4EDC; 4EF;; 4FF; 4FM; 4FW; 4TJ; 5BAT; 5CEN; 5DCP; 5ECL; 5SH; 8AKG; 8BQN; 8CMA; 8CNA; 8DLY; 8DW; 8EFW; 8FHW; 8GCF; 8GLY; 8GOY; 8HIA; 8IKE; 8IYM; 8JID; 8JYU; 8LQI; 8QBC; 8RRK 9ATP; 9CB; 9CJC; 9CLH; 9DYH; 9EMS; 9FEE; 9GES; 9UHA; 9ZW; 10XDA. — CO2HY; CO2QQ; CO7CX; CO8BZ; CO8WB; CT1DT; CX1AA; CX2AK; EI8G; HH2B; HI1W; HI5X; HI7G; I1KF; I1KS; I1SAA; KA1ME; IA17; LU3DH; NY2AE; OH2NE; OK3VA; ON4VR; PK1MX. — PY 2BA; 2CK; 2DK; 2EJ; 2EQ; 2QA; 8AB; 8AD. — PZ1AA; SM5SX; SU1AA; SU1AK; SU1CH; SU1KG; SU1SG; SU1KG. — VE 1AR; 1AW; 1DA; 1BC; 1BH; 1BG; 1BR; 1CF; 1CN; 1CP; 1DC; 1DR; 1EA; 1X; 1FG; 1IF; 1IN; 2CA; 2CF; 2HN; 2LQ; 3HC; 3NF. — VO1I; VO1J; VO4Y; VK2AC; VK2AP; VP3DG; VP6YB; VP9R; YV5AA; YV5AM.

Petr. Jastrzembskas, LY1J, Hipodromo 14, Kaunas 1, Lithuania

(14 Mc. c.w)

W 1AHI-5; 1AIH-4; 1AKR-4; 1AQH-6; 1AVJ-5; 1AXA-6; 1BFT14; 1BHQ-5; 1BJP-4; 1BKL-5; 1BPX-4; 1BUX-5; 1CA-4; 1CAB-4; 1CC-4; 1CCA-5; 1CCJP-5; 1CNE-5; 1CNU-6; 1DAH-4; 1DHE-4; 1DLD-6; 1DOS-4; 1DUK-4; 1DZE-7; 1EWD-4; 1EYP-4; 1FET-4; 1FH-6; 1FID-4; 1FTR-6; 1FUP-4; 1GCX-4; 1GF-7; 1GSH-4; 1GVH-6; 1HWP-5; 1HX-6; 1HXW-4; 1IAS-4; 1IBD-4; 1IED-4; 1IIB-4; 1IOB-5; 1IQF-4; 1IQZ-5; 1JLE-4; 1NI-5; 1QV-9; 1RY-5; 1SZ-4; 1TE-4; 1ZB-5; 1ZD-7; 1ZI-6; 2AAL-5; 2ALB-4; 2ALO-6; 2AXZ-5; 2AYJ-5; 2AZL-6; 2BEF-6; 2BJ-5; 2BKK-5; 2BVJ-4; 2CGJ-6; 2CJM-4; 2CLM-4; 2CMY-4; 2CUQ-4; 2CWC-6; 2DIJ-4; 2DLO-6; 2DPA-5; 2DSB-4; 2FL-4; 2FVT-6; 2GFR-4; 2GIZ-4; 2GKR-4; 2GMZ-4; 2GTZ-4; 2GVZ-4; 2ICO-6; 2JME-6; 3AFW-3; 2AGC-4; 3AOJ-4; 3AYS-4; 3BTP-5; 3BSY-5; 3BWA-4; 3BZE-5; 3CHH-4; 3CRK-4; 3DAU-5; 3DBD-4; 3DCG-5; 3DMQ-4; 3DVE-5; 3DZX-4; 3EAX-4; 3EHW-5; 3EIG-5; 3EJM-4; 3EJO-4; 3EMM-6; 3ENX-5; 3EPR-6; 3ERD-4; 3EYS-6; 3FKK-5; 3FYR-4; 3JM-5; 3KF-5; 3KU-4; 3NK-5; 3PC-6; 3SI-6; 3YC-7; 3ZU-5; 4AGP-4; 4AJX-5; 4BBP-3; 4BSJ-5; 4BVD-4; 4CEN-4; 4CYU-5; 4DHZ-5; 4FT-5; 4TR-5; 6BXL-4; 6CGQ-5; 6EJC-6; 6JBO-5; 6KRI-6; 6TI-5; 7AMX-4; 7DVY-3; 7EK-4; 8AAT-4; 8AIE-5; 8AON-4; 8AU-6; 8AYD-4; 8BFG-5; 8BTI-5; 8BZV-5; 8CBC-4; 8CKY-4; 8CTE-4; 8CYT-4; 8DOD-4; 8EIS-5; 8EMW-4; 8EUY-4; 8FIP-5; 8HCL-4; 8HXK-4; 8JIN-3; 8JK-5; 8KKG-4; 8KKR-4; 8KPB-3; 8KWI-4; 8LEA-5; 8LKT-4; 8OKC-5; 9AFN-4; 9CIA-4; 9ELA-4; 9GOH-4; 9IJ-5; 9JFB-4; 9KG-4; 9POV-5; 9TB-4. — CT2AB-6; FT4AF-6; J1MI-3; J2CL-6; J2ME-5; J2LL-4; J5CC-3; J8CA-6; KA1AN-5; OH2HG-5; U9AV-6; VE1EX-4; VE-GE-4; VE1IR-4; VE2AX-5; VE4RO-5; VE5GI-4; VK2PX-6; XU8AG-6; ZL2OQ-4; ZS1G-4.

Eric W. Trebilcock, BERS-195, Telegraph Station, Tennant Creek, North Australia

June 2 to July 5

(7 Mc. phone)

PK3WI-6; VJI-8; VK8FB-6.

(7 Mc. c.w.)

W 1AMR-5; 3DNR-5; 3ERJ-6; 3GGE-5; 4ABS-5; 4CUW-5; 4DCH-6; 4DRZ-5; 5AGZ-6; 5BMI-5; 5BVG-5; 5CVV-5; 5CWW-5; 5DGB-6; 5ERM-4; 5FMZ-4; 5FNV-5; 5RA-5; 6AEF-5; 6AGS-5; 6ANO-5; 6BCK-7; 6DAN-6; 6DBK-5; 6ETE-6; 6EWC-5; 6ITU-5; 6IXY-6; 6JSN-6; 6KJV-6; 6KSY-5; 6LLM-5; 6LWA-5; 6LXI-5; 6MDJ-6; 6MFX-5; 6MSK-5; 6MTD-4; 6MUZ-7; 6MLY-5; 6NAZ-6; 6NID-6; 6NLJ-6; 6ZZC-6; 7AYO-6; 7EUY-6; 7EWL-5; 7FBC-6; 7FQA-4; 7LD-4; 8CBF-7; 8DIX-5; 8DPN-5; 8HHZ-4; 8MMZ-5; 8MWN-7; 8NTA-5; 9GWQ-6; 9ILH-6; 9RVZ-5; 9SSB-6; 9TAD-5; 9VTM-6. — CM2PW-5; CM2RL-6; CR9AA-5; CT1IZ-5; D4BEC-6; D4CFA-4; D4SSA-5; D4TGT-3; D4WYG-3; EA1AT-5; EA3EE-5; EA4AO-4; EA4BV-4; EA5AQ-5; EA5CG-4; EA7BE-4; EI2L-6; EI8J-4; F3HS-4; F8IG-4; F8IZ-3; F8QF-4; F8ZD-4. — G 2KW-5; 2NA-5; 2NJ-4; 2LC-4; 2PNP-5; 2RFP-5; 2TH-5; 2UJP-3; 2WVP-4; 5BOP-6; 5CYP-5; 5GIP-4; 5HA-4; 5JH-4; 5MW-4; 5MY-5; 5TAP-6; 5UI-5; 6CTP-6; 6DXP-4; 6GK-4. — GI2CNP-5; HAF2K-5; HB9BL-4; I1EC-6. — K 6AKP-5; 6EWQ-7; 6DV-6; 6FAZ-3; 6LBH-6; 6LHK-5; 6MXM-5; 6NFU-6; 6NRF-4; 6NXD-7. — KA 1AT-5; 1DD-6; 1EA-5; 1EL-4; 1ER-6; 1FM-5; 1FS-5; 1GR-6; 1HR-8; 1KY-5; 1SP-7; 1TS-8; 1US-6; 4HW-5; 7BK-6; 9NE-6; 9NP-8; 9AK-6; 9WX-6. — ON4DN-4; ON4FE-6; ON4TA-5; ON4UT-4; PA0JV-4; PA0MG-4; PA0PA; PK1GW-7; PK-WB-6; PK3JT-6. — SP 1FF-4; 1FU-4; 1IA-4; 1IH-4; 1JD-3; 1KD-5. — U0LC-5; U2AG-5; U3AS-5; U5AH-5; U5KN-5; U5RC-5; U6WB-4; UK3CH-6; UK3VA-4; VE4QX-4; VE5IR-5; VP6MY-5; VR4JD-7; VU2EM-4; XE1AA-6; XE1IU-5. — XU 2HY-4; 2KY-5; 3GB-5; 3MA-5; 3YF-5; 3YK-6; 8CR-6; 8CT-5; 8EC-7; 8HW-6; 8IS-6; 8RR-7; 8SM-6; 8TT-7; 8UX-7; 8VM-6; 9CB-5. — YR5GB-6; ZS5Z-5; ZS6AM-5.

(14 Mc. phone)

W 2BYF-5; 2BYM-6; 3EOZ-6; 3FIH-6; 3MD-6; 4DBC-6; 4LL-4; 5BEE-5; 5CSR-6; 6AH-7; 6BHF-5; 6BGH-6; 6CNB-4; 6DTE-5; 6EQA-6; 6FMY-6; 6FQY-7; 6GRL-6; 6ITH-6; 6KSO-6; 6LLQ-7; 6LY-6; 6MBE-7; 8ANO-7; 8BYR-6; 9GIC-6; 9NGZ-6; 9RUK-7; 9ZD-6. — HI4F-6; HI5X-6; HI7G-5; KA1AK-7; KA1AN-5; KA1LB-5; KA1ME-6; PK1JR-6; PK1MX-7; PK4AU-5; VE5EF-6; VE5HI-7; VE5HU-6; VE5OT-5; XE2AH-6.

(14 Mc. c.w.)

CE3ANE-6; CM2AB-5; CM2AI-5; CM2EA-7; CM2FA-4; D4ARR-5; D4BBF-5; D4TGP-3; EA3BV-4; EA3DL-5; EA4AP-4; EA5BK-4; EI8B-4; F3KH-5; F8DW-4; F8IG-4; F8NE-4; FA8GK-4; FB8AB-5; FK8AA-8; FM8AD-4; G2ZQ-4; G5MS-5; G5RV-5; G6DL-5; G6NJ-5; G6YKP-6; HAF3D-4; HAF8C-5; HH3L-4; HH5PA-4; HI4F-6. — J 2CB-8; 2CG-6; 2CL-8; 2HQ-6; 2JJ-6; 2KJ-8; 2KX-6; 2LL-4; 2ME-7; 3CR-7; 3EN-6; 3FI-7; 3FJ-6; 5CE-7; 5CL-7; 6DI-6; 6DK-4; 6DO-5; 8CA-5; 8CD-7; 9CA-8. — K 5AA-7; 5AG-5; 5AH-5; 5AY-6; 6BHL-4; 6KCN-6; 6KEF-6; 6KSI-7; 6LBH-7; 6LEJ-8; 6LQZ-5; 6MXM-4; 6NEK-5. — KA1AN-5; KA1HR-4; KA1LB-6; KA1TS-5; KA1US-6; LY1J-4; OA4AQ-5; OH5NR-4; OK2LU-4; ON4AU-5; ON4HC-5; ON4HM-5; PA0AZ-5; PA0CE-3; PK1GW-5; PK1JR-6; PK1MO-8; PK1PK-7; PK1RL-7; PK2KO-6; SU1CH-5; TI3WD-3; U2NE-4; U5AE-4; U9MF-3. — VE 2AA-5; 2CA-5; 2BU-5; 2JK-4; 3ADK-6; 3AHN-4; 3EA-5; 3GO-6; 3HT-5; 3PO-3; 3QD-5; 3IG-4; 3UG-6; 3XQ-4; 4AE-5; 4FW-4; 4IG-5; 4LX-5; 4KF-5; 4OG-5; 4PH-5; 4RU-5; 5BI-6; 5KC-6. — VP2DF-5; VP5AA-5; VQ8AA-6; VR2FF-6; VR4BA-5; VS1AA-5; VS1AF-6; VS2AE-5; VS2AG-6; VS6AH-6; VS6BD-5; VS7GJ-4; VS7RF-6; VU2BJ-5; VU2JB-5; VU2LZ-5; VU7FY-4. — XE 1AA-7; 1AM-4; 1AY-5; 1B-4; 1CM-4; 1DD-5; 1FL-5; 1H-5; 1HF-6; 2C-7; 2N-6; 2O-5; 2Z-5. — XU2HY-5; XU3DF-5; XU3ST-5; XU3ZC-3; XU8AG-8; XU8MT-6; XU8SM-6; YN1AA-5; ZB1H-5.

July 12

(14 Mc. c.w.)

CP1AA-6; SV1KE-5; SB1H-4.

J. V. McMinn, NZ16W, 12 Edge Hill, Wellington, C-3, New Zealand

August 1 to September 1

(7 Mc. phone)

FO8AA-7; LU1EB-6; LU1BH-4; TI1AF-6; TI2OFR-6.

(7 Mc. c.w.)

CT1EN-6; D3DXU-5; D3DFN-5; D4NAP-5; D4NXR-7; D4OFT-6; D4YJI-4; F8XH-5; I1EC-6; OE6AX-5; OE6DK-6; OE7HD-6; SP1FU-6; U3BB-6; U3BX-6; UK3AH-6; UK5AA-6; XE1BC-6; XE1DY-6; XE2DZ-6.

(14 Mc. phone)

W 1AXA-7; 1BLO-7; 1CCZ-7; 1CRW-7; 1SZ-8; 2FOA-7; 2HUQ-6; 2TP-7; 3DQ-7; 3EOZ-7; 3EWW-6; 3FRE-6; 3MD-7; 4CPG-6; 4CWX-6; 4ESY-7; 4FM-6; 4UK-6; 5BEE-8; 5LWU-5; 5PH-7; 6BHO-7; 6BKY-8; 6CKJ-7; 6CLS-7; 6EJC-6; 6GAL-7; 6KM-7; 6LIP-6; 6MDN-7; 6RX-7; 8AAK-6; 8ANO-6; 8DQN-7; 8GOY-7; 8QDU-7; 9CVN-8. — CE3DW-7; CO8RQ-7; CX2AK-6;

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*George Walker, Assistant Editor of RADIO, Box 355, Winston-Salem, N.C., U.S.A.

F8II-5; K6NTV-6; KA1BH-6; KA1ME-7; OA4AA-8; OA4AE-6; PK3RC-6; PK4AU-8; PY2BA-7; TI2FG-6; VE1CR-8.

(14 Mc. c.w.)

CE1AQ; CM8GF; CM8MC. — D 3AOK; 3BAR; 3BEN; 3BMP; 3CFH; 3CDK; 3CUR; 3DLC; 3GKR; 4AEC; 4AEN; 4ANF; 4ARR; 4BEZ; 4BUF; 4CDM; 4CSA; 4DMC; 4DOR; 4GJC; 4HCF; 4JTK; 4KRJ; 4LJM; 4LNM; 4MJC; 4MNL; 4MOL; 4OAR; 4OON; 4ORT; 4OUT; 4OWT; 4PAU; 4QET; 4QFT; 4RVC; 4SNP; 4SXN; 4SXR; 4TFL; 4TKP; 4XCG; 4XJF; 4XQF; 4YBF; 4YCF; 4YEJ; 4YTM; 4YUM; 4YWM; 4ZMY. — F 3AJ; 3AK; 3DN; 8BS; 8EF; 8EO; 8GR; 8GG; 8IG; 8II; 8KJ; 8NN; 8NR; 8NV; 8OK; 8OQ; 8PK; 8VP; 8WK; 8YG. — G 2AX; 2MR; 2TD; 2ZY; 5BJ; 5MA; 5MS; 5OQ; 5VN; 5WP; 5XN; 6DL; 6NJ; 6RB; 6XI. — HAF3D; HAF4K; HAF8C. — HB 9AK; 9AO; 9AW; 9BD; 9BG; 9X; 9Y. — HC2JM; HK2JB; HK3JB; HS1PJ; I1IR; I1TKM; I1ZZ; J2CG; J2CN; J2JJ; J2LU; J5CC; K5AA; K5AI; K5AM; K5AY; KA1AS; LU3HK; LU4DQ; LU8AD; LY1HB; LY1J; LY1ZB; OA4J; OE6AX; OE6DK; OE7EJ; OH3OI. — OK 1ZB; 2AK; 2DF; 2HX; 2LO; 2PN; 2RM; 2RS; 3KF; 3VA. — ON4AU; ON4BDO; ON4DM; ON4DX; ON4HC; ON4HN; OZ2B; OZ2H; OZ5C; OZ7CC; PAOAZ; PAODC; PAOMX; PAONO; PAOVB; PAOZK; PY2AR; PY2BX; PY3AW; SM6WL; SM7UC; SP1DC; SP1GE; SU5NK; U2NE; U3DI; U5KS; VE1CU; VE1IN; VE2DG; VE3ADM; VP5AB; XE1AA; XE1AD; XE1AK; XE1CM; XE2C; XE2O; YL2BB; YM4AA; YM4AD; YN1AA; YR5AP; YU7DX.

Harold Godfrey, W6EYY, 374 29th Avenue, San Francisco, Calif. June 1 to September 1

(14 Mc. c.w.)

CE1AI-5; CE1AN-6; CE1BC-8; CE3AG-6; CP1AA-6; CP1BG-6; CM2AG-6; CM2BJ-6; CM2MU-6; CM2OP-7; CM2RC-7; CM8AI-6; CM8MC-7; CX1CC-7; CX1CX-6; D3BXR-3; D3KSG-4; D3NUR-4; D4ORT-4; EI8B-7; F8EO-6; F8NE-4; FK8AA-7. — G 2AV-3; 2BC-4; 2BK-6; 2NM-5; 2PL-7; 2WQ-6; 5IL-4; 5MS-3; 5PP-4; 5VB-4; 5YH-5; 6GS-4; 6NJ-6; 6QX-4; 6TQ-4; 6VP-4; 6RH-5; 6WY-5; 6XL-5; 6YO-5. — HB9BD-4; HK3JB-7; I1TKM-4. — J 2CB-5; 2CC-7; 2CG-4; 2FI-7; 2FJ-5; 2HY-6; 2LL-6; 2LU-8; 8CA-6; 8CB-6. — K5AA-7; K5AF-6; K5AG-5; K5AH-6; K5AL-8; K6HM-7; KA1LB-4. — LU 3HK-6; 4BH-8; 4OQ-6; 5AN-7; 6AD-5; 6AX-7; 7AZ-8; 7BH-8. — LY1J-4; NY1AA-6; NY2AE-7; OA4J-6; OA4Z-8; OE1FH-4; OH3NP-6; OH3OI-6; OH5NR-6; OK1FK-3; ON4FE-4; OZ2H-5; OZ3L-4; OZ7CC-5; PAOAZ-4; PAOCE-4; PAOJDW-5; PAOMOW-5; PAOQL-4; PK2DU-5; PY2AR-4; SM7UC-5; TI2FG-7; VP1WB-7; VS1AJ-5; VS1AM-5; VS2AG-6; VU3DY-5; ZN2M-6; ZS2A-5.

Frank C. South, W3AIR, 2 Nassau Street, Princeton, N.J. August 10 to October 5 (exclusive of week-ends)

(28 Mc. dx)

D 4AFU; 4AUU; 4DLC; 4FND; 4GDF; 4MDN; 4ORT; 4RVC; 4SMO. — EI2J; EI8B. — F 8EF; 8EO; 8HZ; 8KJ; 8OB; 8UK; 8WK; 8WQ; 8VO. — FB8AB. — G 2HX; 5BM; 5JW; 5QF; 5OJ; 5RI; 5SY; 5WP; 6CL; 6DH; 6HB; 6IR; 6LB; 6NJ; 6OY; 6QB. — HI7G; HK3JB; I1KN; J2IS; K4DDH; K4KD; K4RJ; K5AY; K6MVV; LU1EP; LU8AB; LU9AX; LU9BV; OA4J; OE1ER; OE1FH; OE7EJ; OH7ND; OK1AW; OK2DF; OK2HX; OK2MA; OK2MV; ON4JB; ON4NC; OZ3J; PAOAZ; PAOKW; PAOZK; PY5DQ; SM5VW; SM6QP; SM7UC; TI2EA; VP5GM; VU2AU; XE1AM; XE1AY; XE1CM; XE3AC; ZS1H.

E. H. Swain, G2HG, 31 Woodbastwick Road, Sydenham, London S.E. 26. September 18 to October 4

(28 Mc. dx)

FB8AB; LU7AZ; U9AL; VE1DG; VE1DZ; VE2EE; VE3ADM; VE3AEY; VE3KF; VE4QZ; VK4EI; VK6CA; VK6SA; ZS1H; ZU1C; ZE1JJ. — W 1AVV; 1CGM; 1JNW; 1WV; 1ZL; 2DTB; 2DWN; 2FBA; 2FID; 2TP; 3BVN; 3CGO; 3EVT; 3ZX; 4AUU; 4BMR; 5AFX; 5BEE; 5BXM; 5FDE; 5FHJ; 6GRX; 6JNR; 7AMX; 7BPJ; 7BQX; 7ESN; 8BCT; 8HGW; 8HRD; 8IXM; 8KDO; 8MMH; 8MWY; 8OKC; 9AGS; 9BEZ; 9BPU; 9BYY; 9GDH; 9ICW; 9MIN; 9NY; 9SPB; 9TJ; 9ZT.

Don McVicar, VE4PH, 9819-104th St., Edmonton, Alberta September 18 to October 14

(28 Mc. dx)

F3KH-7; F8EO-7; F8KJ-6; F8VS-6; G2AX-6; G2DV-5; G5KJ-6; G5ML-7; G5NQ-6; G5SY-4; G6BS-5; G6FQ-5; G6LN-6; G6NJ-6; J2IS-8; J2KJ-9; K6MEM-6; K6MVV-8; K6NRF-6; LU6AX-8; LU9AX-7; L79BV-6; PY5QD-6; VK2AS-5; VK2GU-7; VK2JN-7; VK2LZ-6; VK3BQ-5; VK3CP-6; VK3EG-7; VK3MR-8; VK3YO-4; VK3YP-7; VK4AP-6; VK5KO-6; VK6AA-5; VK6SA-5; XE1AY-7; XE1AM-6; YM4AA-7; ZL1CD-5; ZL1DV-7; ZL2BP-7; ZL2FX-4; ZL4FW-6; ZS1H-7; ZU1C-6.

J. J. Michaels, W3FAR, North Wales, Pa. October 1 to October 18

(28 Mc. dx)

CM2FA; D4QET; EI2L F3DN; F8CT; F8MG; F8WQ; FA8BG; G2FS; G2NM; G2TM; G5JW; G5QY; G5RI; G6CW; G6DH; G6LK; G6QB; LU6AX; LU9AX; OE1FH; ON4AP; PAOAZ; PAOZK; SM7UC; TI2EA; VE4HM; VE4IG; VE4QZ; VE5GI; VK3CP; VK3YP; VO1J; VO1N; VP5AC; VP5GM; XE1AY; ZL1GX; ZL1HY; ZL2BJ; ZL2BP; ZL3BJ; ZS1H; ZT5AK; ZT6AK; ZT6Y; ZU1C; ZU6E.

Bohdanov Bartkevich, Nabanowitscha 149, Novosibirsk, Siberia

(3.5 Mc. Phone)

W 1BES; 6ABF; 6BKY; 6DDA; 6FTU; 6ITH; 6LLU; 6LVS; 6KA 8BWH; 9BBU; 9EDW; 9PZ.

(1.7 Mc. Phone)

W6DDS; W6DUF; KGPL.

Frederick W. Rockwood, W1IOB, 22 Neptune Court, Lynn, Mass. September 20 to October 1

(28 Mc.)

D3BWU; D4AKN; D4AUU; D4DLC; D4RVC; D4XCG; EI8B; F8DN; F8EF; F8EO; F8RR; F8WK; F8WQ; FA8BG; G2XC; G2YL; G5BM; B6FS; G6LK; G6QB; HB9J; I1IT; I1KN; K4DDH; OA4J; OE1FH; OH7ND; OH7NF; OK2OP; ON4AX; ON4DX; ON4JB; ON4NC; OZ2M; PAODH; PAOKW; PAOQQ; PAOZK; VP2AT; XE1AY; XE1CM; XE2C; ZS1H.

Larry Eisler, W9WHQ, 8232 South Sangamon St., Chicago, Ill.

(14 Mc. phone)

CO2HY; G5ML; G5NI; HI5S; TI2AV; VO1I; XE1G.

(14 Mc. c.w.)

CM2AD-7; CM2AI-7; CM2AO-5; CMODW-7; CM7AI-6; CM8CK-8; CX1CG-8; CX2AK-6; D4ARR-8; D4BIU-8; D4DVL-5; D4GAD-7; D4QET-6; EA1AB-6; EA4AO-8; EA4BM-7; EA8AF-7; EI9G-7. — F 3AD-7; 3LE-6; 8EO-7; 8FC-7; 8FK-7; 8FY-3; 8JI-5; 8JT-6; 8OK-8; 8TQ-7; 8XH-6; 8ZF-5. — G 2PL-5; 5KG-6; 5LA-7; 5NJ-6; 5OJ-6; 5QY-5; 5VB-6; 6XL-6. — GI5QX-6; HAF3D-6; J2KJ-4; K4DDH-7; K4KD-7; OK2AK-7; ON4DS-5; ON4DX-6; ON4HC-5; PAOCE-7; PAOHT-5; PAOMQ-7; PAOZK-6; SM5SX-8; TI2FG-6; VO2N-7; VP2BX-6; VP5PZ-7; VP5UB-6; XE1AM-9; XE2N-9.

◆

Some amateurs in this country seem to be under the impression that amateurs in Great Britain have to pass a "stiffish" examination. The only examination they have to pass is a 12 w.p.m. morse test. They have to answer certain straight-forward questions of a non-technical nature and pay several fees, one of which is dependent upon the amount of power used by the applicant.

◆

Efficient Guy Wires

If guy wires absorb energy radiated by the antenna, they should re-radiate it all unless the power is lost in wire resistance. No. 12 copper-clad steel antenna wire used as guy wires will have a low loss and re-radiate efficiently. Also, it doesn't rust, thereby giving promise of longer life.

DX

By HERB. BECKER, W6QD
Readers are invited to send monthly contributions for publication in these columns direct to Mr. Becker, 1117 West 45th Street, Los Angeles, California.

Because I lost my catalog of snappy opening paragraphs, this month I'll have to start with the second.

VS8AA

The op pushing the key at VS8AA is Roy Fleming, W6DQD. Roy has a little rig cranked up now and for a lot of the boys, he is adding a new country to their lists. In a letter just received from him he gives some interesting points about what he calls "Hell's Kitchen". In the first place he is with the Bahrein Petroleum Co., Ltd., and will probably be at his present QRA for a period of three years. (Now you dxers can take it a little easier . . . you all don't have to work him the same day.) The whole journey from El Segundo, California, to Bahrein Island covered 13,000 miles, with about 5000 miles of it by plane. The day they landed on the island it was 126 degrees in the shade (but there was no shade). Roy says he will never forget the surprised look on the face of SU1SG, Frank Pettit, when he walked in on him and calmly says, "I'm W6DQD from California". . . Also, he will never forget the time that SU1SG showed him the day he spent in Alexandria. Roy informs me that he has a gang of Arabs working for him, and in order to find out what they are talking about he has obtained a book on Arabic. Well, if any of you birds hook up with VS8AA and you can't quite figure out what he is trying to say . . . you can bet he is still learning Arabic. Anyway, for you fellows who want to QSL him, here is the right address:

Roy J. Fleming, VS8AA,
Bahrein Petroleum Co., Ltd.,
Bahrein Island,
Persian Gulf.

Roy has promised pictures of his layout, together with some views of the surrounding country, and they will be passed along to you through these columns in an early issue of RADIO. For those who haven't worked him, his frequency is usually about 14,420 to 14,440 kc., and with his self-excited rig puts out a T7 sig.

UN2A Liberia, 14,410 Kc.

Here's one that is driving the boys goofy. UN2A has been pounding in all over the U.S.A. anywhere from R6 to R9 and on each QSO something like this can be heard: "You're too darn loud to be in Liberia come on, tell me where the deuce are ya," Well, as far as I can find out, he really is in Liberia and is using quite an elaborate beam antenna system, which I understand is the "double vee" type. An antenna such as that with his 100 watts can do a lot of tricks. So . . . until we hear otherwise, you had better count that one as another country. And to a lot of fellows it will be a new zone (yes, it was a new one for me, too). The week's best laugh was when some of the boys out here were trying to hook him up with W6CXW. CXW was searching the band for 20 minutes and couldn't find UN2A. Trouble was, UN2A was R9 and Henry says, "Shucks, I was looking for some dx . . . I mean something about R3 or R4." HI. CXW was R9 plus there and I think Henry is still in a daze trying to figure the whole thing out. Anyway, we will finish this paragraph with . . . "Do you think UN2A could really be in Liberia?"

Hawaii on Its Toes

K6CGK rises to the defense of the Hawaiian dx gang. In answer to G5YH's crack in June RADIO about the K6's not listening for G stations, K6CGK says, "Why, I have worn out a whole set of key contacts calling G5YH." . . . and then goes on to say . . . "on behalf of the K6 dx gang, I wish the Europeans would listen a wee bit harder and answer the fellows who are trying their best to get the boys on the other side." Here are the members of their dx gang: K6AKP, K6CGK, K6ESU, K6HZI, K6JPD. The following is some of the better dx worked by them during the summer: ES5C, OK2AK, HAF3D, OZ9Q, OZ3FL, LY1J, LA5N, SM5WJ, SM5UU, SM5WL, PA0MQ, PA0FF, OH3NP, OH3OI, OH5OD, SP1HV, YM4AA, EA4AV, FT4AA, FT4AF, FT4AG, and many, many G's, F's, and D4's. Go get 'em, boys!

W3SI has built himself a flock of new transmitters. Charlie now has a separate complete rig on 10, 20, 40, and 80. The 10-meter job goes down to 5 and the 80-meter rig will go to 160. They are contained in eight relay racks. His new receiver is just about completed, and uses a separate front end for each band . . . 14 tuned i.f. circuits. During the first night of the VK-ZL contest W3SI broke his old record for QSO's by working an even 50 stations between midnight and 7 a.m. Just practicin' for the dx contest next year, eh?

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A newcomer . . . his call just a couple of months old, W3GMS, is doing nice work with his pair of tens. Has made his w.a.c. just recently by snagging an African. Uses a Johnson Q-antenna.

Our y.l. friend in Chicago, W9LW, has worked 29 zones and 78 countries. She has two rigs. The main one ends up with push-pull 150T's and around a kw. input . . . the other rig using two RK20's in the final with about 300 watts input. The receivers are a pair of Comet Pro's. Needless to say, being a y.l., her QSL problem is a cinch. W9AFN, Paul Lovegren, who also is in Chicago, has worked 33 zones and 95 countries. Paul has a couple of transmitters. The one he uses on 7 Mc. has two 849's in the final with 1000 watts. On 14 and 28 Mc. bands he changes his final by switching in an 852 buffer kicking two 852's . . . also a kw. Uses a Zepp, and

UPPER LEFT AND RIGHT: Prince Vinh-San, FR8VX, takes along a portable rig to the top of Reunion Island's loftiest peaks. The pretzel-like "mast" was the only thing to be found to which an antenna could be hooked, and from all appearances the antenna is almost too much for it. At any rate, the Prince adds his support.
CENTER LEFT: In the shack of V. E. Solomin, U9AL, Novosibirsk, U.S.S.R.

CENTER RIGHT: KA1LB, Charles L. Suggs, in the Philippines. We wonder what he uses that service gun for, which reposes in such a handy place beside the receiver.
LOWER LEFT: Station of W. G. Leyland, ZE1JM, in Salisbury, So. Rhodesia.
LOWER RIGHT: J8CD, owned by Dr. Ryozo Nagataki, is a popular station in Chosen district, more commonly known to dx men as Korea.

On October 31, W9AJA hooked a station signing EA4AP. The operator at EA4AP said that the station was being run by a bunch of the Associated Press boys in Madrid, and that the original EA4AP was reported dead. W9AJA asked about EA4AO, and the operator replied that he was not sure but he understood that EA4AO was safe in France. The operator said he was uncertain as to how long Madrid would last, as an hour before some big rebel bombers "laid several eggs" and did widespread damage.

Neither RADIO nor W9AJA vouch for the authenticity of the foregoing. It is presented exactly as received from a station on 14,410 kc. with a T6 note signing EA4AP.

for a receiver, an RME. Claims Chicago is the world's worst dx location.

W6RH says that W6BAY up Frisco way worked OZ7C on 14 Mc. phone, and the next day BAY hooked up with So. Africa to make his w.a.c. on phone. Running 600 watts to an HK-354. W6SC using two 35-T's in a new circuit, is on 5-meter phone, and runs 400 watts into these tubes. Phew! Has been doing swell for 5-meter . . . shall we say, 'dx'. SC also has a kw. phone job on 14 Mc. using 150T's. That ol' dxer W6AWA is too busy figuring out fishing and hunting trips to get on the air, through his former sidekick, W6BGW, is talking of getting back into the swing of things again. Oh yeah . . . W6WB, 'Hugo' Bane, is on 20-meter phone giving the boys a treat, using a pair of 35-T's. W6RH, himself has been spending most of his time on the 28 Mc. band and is building up a new rig.

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Ned Jacoby, W8KPB, will be busy at Dartmouth for the next four (long) years and therefore the call of W8KPB will not be busting forth as usual . . . but he is not giving up dx . . . No, sir, they have big plans up there and as soon as he gets his W1 call he will open up his station on the campus. In the meantime he is operating at W1ET, and from what Ned says, this new QRA is sure the berries. Well, that sure sounds OK to me. In one hour's time around 5 a.m., e.s.t. Ned heard FB8AF, VS1AL, VS6AH, VS7MB, 14,175 kc.; MX2B, 14,198 kc.; XU3JC, and PK6AJ. On the ten-meter band heard five continents in four minutes: K4DDH, G6WY, ZL1AY, PY2AG, and ZT6M.

W6ADP worked VU1AN in Arabia, and XU4UU in Tibet. W6HX raised his zone total by working VU2LZ and FT4AF. W8CRA has added a few new countries . . . VR1AK in the Gilbert Islands was no. 123; MX2B was no. 124; and UN2A made it 125.

W9WCM has only been a ham for six months but is rapidly getting into the swing of working dx. So far he has worked a bunch of VK's, FB8AD, K7ELM, and others. He is running 150 watts into a 50T. W8AAJ says his QRA is lousy for Asia but for the other directions it doesn't seem so bad. Some of his better dx includes FR8VX, VQ8AE, VQ8AF, FA8JO, ON4CJJ, ZT6Q, CN8MI, OK1KL, OK2PN, YM4AA, U5KS, FT4AA, HC2MO, PY2IG, PY8AG, PY5QG, ZS1Z, ZT6AL, ZU1T, ZS2Y, FT4AG, I1RRA, and OA4AT . . . and his rig uses an RK-20 final with 100 watts. 19 zones so far. W8BIX also located in Port Clinton, Ohio, is on 10 and 20, does plenty of dx work, but he finds that Asia is the "fly in the soup" for him, too.

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Bob Jardine, G6QX, bought a new Comet Pro and found his dx picking up immediately. Has 87 countries now and 33 zones. He was another G who couldn't hook Europe to complete his quick-time w.a.c. after clicking off 5 continents in five successive QSO's. While at a recent R.S.G.B. convention Bob saw a flock of the boys and said that Johnny Hunter, G2ZQ, nearly wore the polish off the floor going up after so many prizes he won during the session. From the underground channels we hear that a bunch of the G's, including 2PL, 2ZQ, 6QX, and others, had a merry time passing something around underneath the table during some of the lectures. What was it???? Something to do with the "Dx Workers Union" rules???? G2ZQ has two new countries . . . VQ2RS and FR8VX . . . and during the first two week-ends of the VK-ZL contest Johnny netted 4300 points. 2ZQ is going to be on the lookout for W5, 6, 7, on the 3.5 Mc. band during the coming winter.

For the Love of Dx

Here's a portion of a letter from W7AHX and I think it will be of interest to all. " . . . es Herb I hv a heck of a time out hr. U see mi stn is on our farm, which 6½ miles from Eugene, Ore., es I hv no a.c. hr, so after 4 years of QRP battery, Ford coil, es dynamoter wrk, I got sore es wrecked our old 1922 model Ford es use the Ford engine (4 cylinders) to drive via belt, a 1500-v. d.c. generator tt I traded a pr of tens for, hi. Rewound the fields to excite fm a 6-volt d.c. batt es nw this gen. wl gv me fm 100 to 1300 volts measured d.c. So tt is mi pwr supply hr. I house this miniature pwr supply in a small shed 20 ft. fm mi 5' x 6' floor space shack es every time I want to call anione or cum back, I dash out to mi pwr shed, (I cn cut this time 2 seconds if it's rainin' or snowin') es gv Lizzie a couple of spins es dash bk into the shack es throw the excitation switch es we're away . . . (sum fun, 'specially fer a fat guy . . . which I am *not*). Aniwa when I finish mi call I throw the exit. off es dash out es cut the engine es cum back in to mi recvr, hi. The neighbors cn almost tell wht dx I am calling . . . if I dash out fast as the devil, it is either Africa or a VU or VS, es if I just cum out medium it is a J or XU, and if I just merely walk out it's a W or I just wanted to measure the gas. It takes a gallon of gas a day and I suggest that RADIO publish sum dope on hw guys like me cn get more QSO's per gal. of gas. Ani hw it's a lot of fun es I hv bn a ham since 1925 es hv bn gg stronger evri da, es just last week after 11 yrs I made mi w.a.c. . . . yes es Africa was what did it, hi. Mi rig hr is 6A6 p.p. 7 Mc. xtal osc., 6A6 unity cupled (per

"WAZ" HONOR ROLL

G2ZQ	39	G6QX	33
W3SI	39	W6HX	32
W6CXW	39	W5EHM	32
W4DHZ	39	W2BJ	31
W8CRA	39	W3DCG	31
W6GRL	39	W2FAR	31
W6ADP	39	W5CUJ	31
W9TJ	38	W9KA	31
G5YH	38	W6GHU	30
G6WY	38	W9IWE	30
W6CUH	38	W3EVW	30
W6QD	37	W9LW	29
W8BKP	37	W6BAM	29
W2GWE	37	W6GNZ	28
W8OSL	37	W6FKZ	28
W6FZY	37	W3CIC	28
W9PTC	36	W9JNB	28
W6GAL	36	W6HJT	28
G6NJ	35	W3EYS	28
W2BSR	35	W6CEM	28
W1CC	35	W6FZL	27
W1ZB	35	W8BOF	27
W8KPB	35	W8FJN	27
W9KG	34	W6FET	26
W9LBB	33	W9DEI	26
W5AFX	33	W8IDW	26
W9ARL	33	W2DZA	25
W8LEC	33	W7AHX	25
W3EDP	33	Phone:	
W9AFN	33	W5BDB	27

Phone stations need work but 20 zones, but stations must be raised on phone. Stations worked may be either c.w. or phone.

If you have worked more than 25 zones and are willing to produce confirmation on demand, send in your score on a postcard.

Jones) p.p. dblr. driving an 802 buffer which gives its all to a 210 as final on 14 Mc. Mi ant. is the berries es is the reason fer getting Africa becuz b 4 I put it up I had a 3/2 wave zepp es I cudn't get a ZS . . . so 2 wks ago I put up 2 53-ft. sticks (no guys either) es put that end fire ant. tt the *Radio Antenna Handbook* had, the one tt uses 1 reflector, es excited ant. (zepp half wave) es 2 directors . . . all vertical. Is faced fer a peak at abt Dutch East Indies es 2nd da I wuz on with this I QSO'd ZU1V es since have raised ZT6Q, ZS4U on CQ dx . . . sum gg i tnk, es this ant. sure is slick . . ." That, my friends, gives you an idea what George has to do for each and every QSO. He has worked 25 zones and is working out a plan by which he can change bands a little easier. His frequency is usually 14,060 kc

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VK3EG sends some news via W6GHU. The QRA of SV1KE is: Radio SV1KE, Bucharest St., Athens, Greece. The following VQ's are now on: VQ8AA, AB, AC, AE, AF, and AG. During the first two week-ends of the VK-ZL brawl, VK3EG worked 355 different stations in 58 countries, over a period of 50 hours. W6GHU has now worked 58 countries and 30 zones. Last zone was made by SU1WM on 13,998 kc. T9x and will be on quite reguarly. During the last three months GHU has hooked up with 47 different Africans . . . is still using a 210. VK3EG also says that VQ2RS has packed up and is headed for Nigeria, so will be on soon with a nice shiny new ZD call. If any of you birds hook up with him . . . shoot in the info so we can tell the world about it.

Somebody whispered that W8KOL has listened to the strains of "I Love You Truly" and is now a happily married dx man . . . at least he *was* a dx man. On October 3d, W6BAX really went berserk . . . that was the first day of the VK contest and 'OP' QSO'd 54 foreign stations in 5 hours and 28 minutes. . . . The first hour netted him 17 contacts. With all these examples of snappy operating it's a wonder someone doesn't pop up with an achievement such as BAX's, only adding, "I would have done better only had to rebuild Xmtr after the first 20 QSO's." More from BAX: VQ8AB is W. P. Moores, c/o Cable Stn., Ascension Island, So. Atlantic. VQ8AF is on Mauritius and VR1AB is on Gilbert Island. W9NTW still thinks that 7 Mc. is the best dx band . . . Sez if the guys would only get on there we would see plenty of fireworks. Well, let's try it. NTW loaned his receiver to W9SCW so is temporarily blotto. 9SCW's "vee beam" was supposed to be headed for Europe but his best dx comes from the West. (Wonder if he means W6's.)

A letter from K4KD is self-explanatory:

Dear OM:

Say, the guy who is knocking them off since "K4SA went blah-blah on 14 Mc. fone" is K4RJ (R R R *R*) instead of K4KJ. Correct call is "Kansas Four Rotten Jamaica". Finally got some info out of him which sums up to wit: He has worked 23 zones, (yep, 3 more than "KD") including PK and U, and has heard VU and XU, but due to fact that the final 852 bias supply was on the fritz and he was running the 800 buffer into the antenna . . . didn't hook up. Kinda looks like he is gonna add to his 56 countries and be the third K4 w.a.c. (K4SA and K4KD hold the other two). If we had a little less 7 Mc. phone QRM from the neighboring Latin-American Republics, we might knock off a few more dx'ers on 7 Mc., but try and hear them thru the blah-blah.

73, CUL
MAYER "MAW" K4KD.

W9AJA reports that NX2Z, 14,410 kc., is now on at a spot in Greenland designated as Hochsteeter, Foreland. If you want to put a pin on your globe, it is 76.25 deg. North and 19.45 deg. West. The operator is ex-OZ2Z, and he requests that QSL's be sent to: E.D.R., Box 79, Copenhagen, Denmark.

W6FKZ has worked a swell one in VR6M on Pitcairn Island, who will be active there during their summer (which is now). VR6M is on 14,403 kc. and with a T7 sig. FKZ also reports that VK9BA located in New Guinea, is drifting around between 7175 and 7150 kc. T6. FKZ has 28 zones now. Keat, W9KG, says dx low with him . . . only G6YO, YR5OR, ZS2X, G5KT, VP4TM, PY7AG, FB8AF, VQ8AA, F8OQ, PY7AB, U5AX, KA1MD, VK6KB, U9ML, VR2AB, VP2GB, Grenada Island, G5BB, and UN2A (he thinks he is a phoney, hi). W9ALV has been fairly active with tens running at 90 watts. He has snagged some new stuff including YR5OR, G5PP, EI9J, ZT6Q, XU8AG, ZS1AL, D3DSR, D4KMG, HB9AW, D4PAU, HAF4H, PK4MP, PK1RL, U9ML, CT1ZZ, and others. W9LBB worked VS8AA on Oct. 7th, and W8IWI hooked him on Oct. 13th. W9OCL is back on the air after having a one-sided 'bout' with a bunch of lightning last month. W9CCL is doing OK on 20-meter phone. W9CWW in Leavenworth (not the pen) is using a pair of tens and is really working some nice dx, while W9VAT is knocking 'em over, and getting swell reports from his kw. to a 150T.

W1FH is on the air doing something, I guess, but he says not very much. Probably working himself a bunch of W6's. W1CNU is also puttering around back there with his 150T that he has been going to put on the air for a year or so, hi. Better get on, Ralph; lots of nice ZL's to work. W3DCG in Washington, D.C. has 31 zones to his credit and 81 countries. and uses . . . 6-800's with 400 watts input. W8OE worked VQ3MSN, whose frequency was about 14,450 kc. W9AJA got his 80th country by hooking up with UN2A. W3EVW now has 30 zones and 81 countries, and U9AC made it that way. W9AKH has worked 64 countries since March and his rig never uses more than 300 watts into a 211. He likes that single-wire-fed antenna, 66-foot flat top and feeder tapped 11 feet off center. W9OKZ, "ye Ed" of the *Radio Amateur Call Book,* says the QRA of PY8AG (ex-PY1BI) is, Henry Broadbent Hoyer, Rua Oliveira Bello 45, Belem, Para, Brazil. (Tnx.) W8LEC in Detroit worked OS1BR and got this from him: He is located near Jeddah, Hedjaz, uses MOPA rig with 350 watts input, with rectified 500-cycle note on 14,420 kc. Antenna is a bi-lateral beam for U.S.A. Says to QSL via Suliman, Suez, Egypt. I believe that QRA is final . . . at last. W8LEC uses a pair of 242A's with 800 watts input; antenna is a 33-foot vertical rainpipe. 33 zones and 83 countries.

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W9KA, R. W. McCarty, has received about 40 cards from our old pal, VU2CQ, and has forwarded them to their proper destinations . . . Yes, mebbe yours is in there. 9KA says the VU uses a small tube in the final with *220 volt d.c. mains* on the plate at 45 mils. . . . 9.9 watts. McCarty has heard him twice on phone. W8PMA in Charleston, W. Va., has been quite active and has worked OH3NP, OZ4LM, OZ3J, LU8EN, some G's, and others. 150 watts into an 825 final. W2DZA has 25 zones and 63 countries. W2FAR has worked VU2AU 14,050 T8, VU2FP 14,100 T8, and finished the day, which was October 17th, by working ZS2D, CM8AH, ON4FQ, G6VV, G6HB, PA0JV, K5AG, PY2AG, ZL2IJ, ZL4FK, ZL1LM, and VK2TI. All this, you will see, makes an easy 'one day w.a.c.' Also says PZ1AL is r.a.c. on 14,110 kc. W2FAR runs a kw. into two 242A's. W2BJ and W2CVJ met G5GQ, who is visiting in N.Y., and they made the rounds. G5GQ says his new rig is a 6A6, RK-20 and HK-354 final with "50 watts input". MIM. New stations at W2BJ . . . YT7KP in Jugoslavia 14,325 T9, U5AT 14,330 T8, ZB1J 14,336 T9. W3CIC has 28 zones and some new ones for him are J5CC, J2CC, J3FI, J2LU, FB8AF, K7EVM, K7ENA, FB8AB, FB8AD, KA1US, KA1MD, PK1PK, ZE1JS, VK6CP, VK6KB, ZB1H, ON4CJJ.

For those who want to QSL to ZB1J here is how and where: ZB1J, Met. Office, Valletta, Malta. ZE1JG, L. Madgwick, Box 424, Bulwayo, So. Rhodesia.

The SM gang are quite active. SM6WL, SM6QP, and SM7UC were knocking 'em off in the VK-ZL contest. They are also on 28 Mc. and anxious for W6 and W7 contacts. SM6WL worked 5 continents in 3 hours. OZ2M claims the first 28 Mc. w.a.c. for the Scandinavians by getting his on March 27th, 1936. OZ2M has a 12-year-old daughter who will soon be a licensed op . . . call will be OZ2YL.

W5BDB, "Mims", of Texarkana, Arkansas (the man with the donkey) suggests a great idea, and that is for the phone boys to shoot in some of their dx . . . especially the zones. He starts it off by saying he has worked into 27 zones . . . all on phone. W6AM has made a 20-meter phone w.a.c. in two days. Hop to it, you silver-tongued hams, who is next?

Jim Magee, W8CNC, who insists that 80-meter dx is the thing, gives this information: The VK's and ZL's roll in so loud from November to March that even the W6's are QRM'd. Jim says the best time to listen for them is between 4:30 a.m. and 7:00 a.m. (e.s.t.) and he has heard as many as 21 VK's and ZL's on 80 within an hour's time. Also, has hooked up with 9 of 'em in one hour. Most of them are between 3500 and 3650 kc. Let's have some 80-meter dx, as there are possibilities on that band.

Next month is our extra-super-whopper January issue . . . 200 pages . . . and the dx department will be 'xtree spashul' too . . . and so, my good friends, you can now dig up all that dx that you have in your log book and any other interesting news about the dx fraternity, grab the nearest stenographer, sit down with her, and dictate the works to her. Or mebbe, if you get that far, you had better forget the dictation . . . I dunno. Anyway, *November 23d* is the deadline for copy; so use your own judgment.

Understand that Wallie Jones, W9EQG, is on the air again. I'll have to keep my ears open, I guess, as I can't let any of those elusive 9's get past me. Something happened last month, though, and according to my log, a W2 slipped in there somewhere. But don't worry; I'll bear down on my W9 dx this month.

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28 AND 56 MC. ACTIVITY

By E. H. Conklin, W9FM

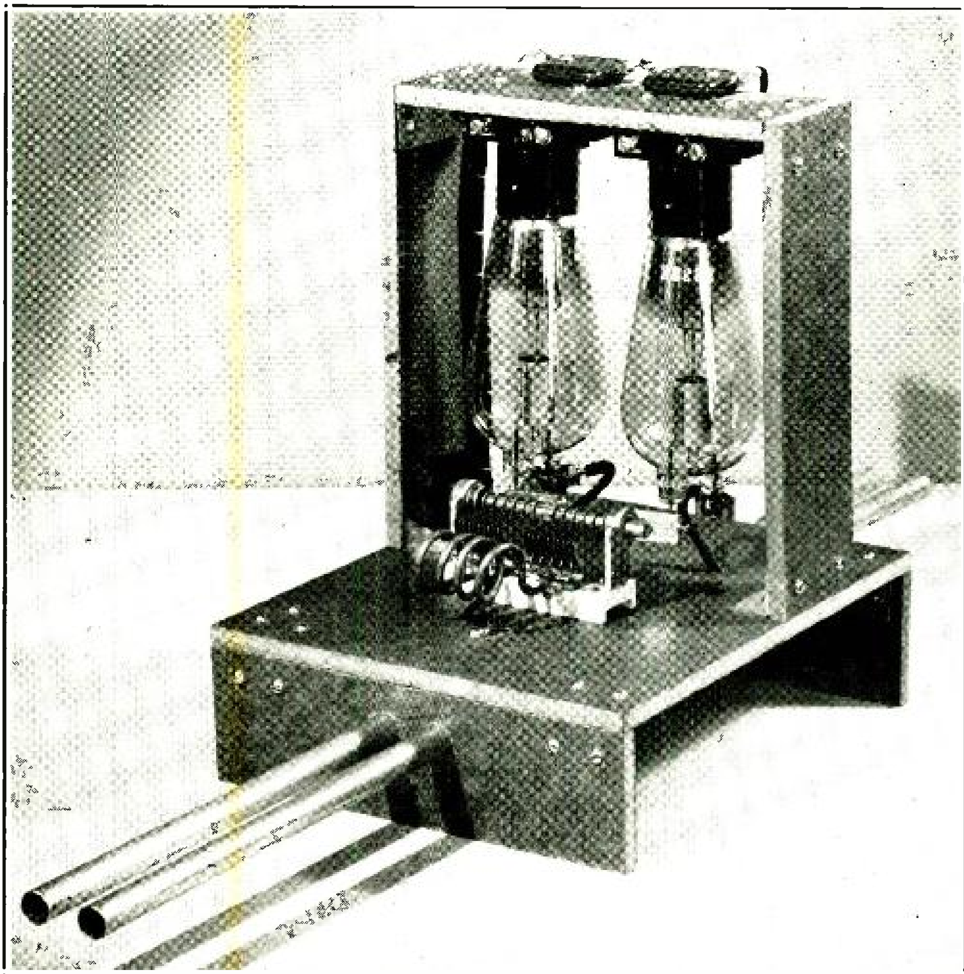
W3SI "Gets Across" on 56 Mc.!

Charlie Myers, W3SI, layed off his broadcast-transmitter rebuilding job long enough to give us a fine bit of news. Charlie promised us some action on five meters, and he made good.

The first European report of W3SI on 56 Mc. that checks accurately with the log was from F8PA, who reported hearing the phone signals QSA5-R5 on May 6, 1936. At the time, Charlie was putting 600 watts into the pair of 852's in the final. The r.f. line-up was a 2A5 crystal stage, two push-push doubler stages, an 805, and the final. This outfit was modulated by a pair of 849's. The antenna consisted of two horizontal, phased half wavelengths about 70 feet high, running north-south. Last winter we reported the reception of W6DOB's five-meter c.w. signals at W3SI.

British Report

E. H. Swain, G2HG, is continuing his work of promoting 56 Mc. dx. In early October he sent us a summary of logs of G stations covering August 13th to September 5. On the morning of the 13th, G6DH heard harmonics of IRU, HAT2 and HBH between 55.6 and 57 Mc. On August 14, G5LB heard between 17:40 and 18:11 G.m.t. a series of phone, i.c.w., and c.w. signals, sometimes very good but usually fading too badly to identify the station. On the 8th, G5LB and G2HG heard harmonics of DOC and IRU in the five-meter band, during the evening.



IDEA FOR SIMPLIFIED 112 MC. CONSTRUCTION

Many of the 5 meter gang are showing interest and considerable activity on 2.5 meters. Here is an idea for a stable oscillator for use on the latter band. It delivers about 50 watts, which is considered "high power" on 2.5 meters. The resonant grid rods have a high "Q" and stabilize the frequency. The frame is of Masonite; the tubes are WE-304B's; the design is due to W6PT.

G2HG logged "CQ de CN8?" on the 25th, the flutter preventing identification. During a thunderstorm on the afternoon of September 5th, the band was alive with commercial harmonics. Some from Hungary and Russia were identified. JNB (Asia!) came in between R8 and R2 at about 17:30 G.m.t. A station sending ZMO incessantly was heard; ZMO is in South Africa.

New Zealand Active on "Five"

According to *Amateur Radio*, published in Australia, ZL3GD (or ZL3XB) was to transmit 250-cycle modulated code signals on 60 Mc. on five days during September and October. If anyone heard any V's being sent with 250-cycle modulation, please communicate with us and with ZL3GD.

VK4AP Wants 56 Mc. Schedules

According to Ernie West, W6JNR, VK4AP has completed his 56 Mc. equipment and is looking for schedules for 2100 G.m.t. daily. The transmitter has a 100-watt final, crystal controlled.

W8OSL Wants Skeds Near Pittsburgh

W8SOL, President of the 210 Dx Club, is using even lower power on five meters. By hoisting his antenna to 68 feet, he has worked four states using a 6A6 in the transmitter. He wants to contact other five-meter stations within 150 miles of Pittsburgh, for long ground-wave or low-atmosphere-bending contacts. He doesn't think he is situated where he can hear the more populous Chicago, New York, and

Boston areas on short skip—but perhaps G2HG's reports will convince him that *something* might be heard on plain c.w.

A Plea for Help

At the Chicago convention, Frank Lester of W2AMJ said that five-meter QRM around New York is too fierce to permit any thought of real dx. However, we think that if more stations would build up sensitive c.w. receivers with tuned antennas coupled to them, some listening during periods of short 28 Mc. skip would be productive of some dx. A simple regenerative detector with battery voltage on the screen, followed by some audio, may be just the thing. Also, we could make use of some c.w. transmissions —or tone modulated with keyed carriers, where there won't be local QRM—regularly placed on the air with automatic keying. A hundred watts or so of crystal controlled 5-meter output isn't hard to get any more, and may help to break the silence on "five" just as a few experimenters helped to get things going on "ten" a few years ago.

On October 1st and 18th, the skip was short on 28 Mc. W3FAR reported W1-2-3 and 8 signals on the 18th right along with Europe, South Africa and the west coast of the U.S.A. This should have permitted 700-1000 mile five-meter work.

28 Mc. Opens Wide

The ten-meter band is wide open at this writing, all continents working both coasts. Conditions have been better than a year ago as regards reliability of working dx, and the band stays open later in the evening. This may permit eastern W stations to work J's this year into November, and again from late January to April or so. Similarly, W6's may get a longer chance at Europe.

In fact, QRM is getting to be a problem. John Michaels of W3FAR has noticed that the first 1000 kc. sometimes sounds like the 80-meter phone band, but few if any of the code boys have moved into the "exclusive" part of the band from 28 to 30 Mc. As it is now, the c.w. boys just come back to each other with the usual, "Sorry OM, but heavy fone QRM on you, c.u.l., etc. . . ."

Move the Phone Band?

Because the second 1000 Mc. of the band presents a somewhat different skip problem than the first 1000 kc., it has been suggested that the A.R.R.L. be asked to make the harmonic of 14,000-14,150 kc., falling from 28,000 to 28,300 kc., exclusively code, extending the phone frequencies beyond 29 Mc. If this were done, we would suggest that we voluntarily follow the use of frequencies as in the 14 Mc. band. W code stations could concentrate on the 28,000-28,150 portion, save 28,150-28,300 mainly for dx—where their crystals mainly fall, avoid using code from 28,300-28,500 where the majority of phones would be, save 28,500-28,700 for dx. stations whose crystals fall around 14,300. Beyond 28,700 kc., there would not need to be any restrictions, voluntary or otherwise. We are not suggesting an F.C.C. rule on the dx portion of the band, but only point out that the usual use of frequencies will work out that way without a regulation, so we might as well "lay off" those frequencies. The code men, however, have asked that the phone band be slid out 300 kc. to be in harmonic relationship to the 14 Mc. phone band edge, removing phone restrictions beyond 29 Mc. (where there is no QRM problem at present).

Greater Activity Noticed

While a large number of stations deserted the 10-meter band from April to late August, little time was lost in getting back when the "die-hards" announced a change in dx conditions. Nelly Corry, G2YL, reported an increase from a half dozen active G's in August to over forty in September.

VU2EB told G6CJ of hearing VK, ZS, and G stations at the unusual hour of 0230 G.m.t. on September 14, but was unable to make a QSO. We haven't found out all the uses of the 28 Mc. band as yet, and there still appears to be plenty of room for the "experimenter" to work on the conditions.

Speaking of India stations, Frank South of W3AIR has been "laying" for one in the early mornings. On October 5th at about 8:30 a.m., after hearing Europeans call VU2AU, he heard ". . . AU-k" and called blind. Back came VU2AU for the first VU-W QSO on 28 Mc. His frequency was about 28,075 kc. The contact lasted until 8:53.

Some new calls appearing on 28 Mc. are: SM7UC; VU2EB; OH7NC; OH7ND; OH7NF; YR5OR; CN8MQ; U1AP; VO1J; VO1N; ON4AP; EI2L; FB8AB; I1IT; PY5QT; K7FDE; VU2AU; KA1AN; H89AO.

For two weeks, W3FAR used a 66-foot zepp, running north-south, but couldn't make a European or African contact. Upon moving the end over towards Europe, he worked them all again. ZS1H wanted to know where he had been (just fruitlessly calling!). If this isn't directivity, at least it is a good argument in favor of spending some time checking up on the radiating system.

W9RHK has been using a 14 Mc. twisted-pair-fed doublet for receiving on 28 Mc., but with little success on dx. After figuring out the probable loss in voltage-loop-feed with the twisted pair, he tried a single-wire-fed 16-foot antenna and also his transmitting antenna. Result: five continents were almost immediately heard.

A W9 recently was working a W6 who claimed an output of 15 watts from a 210 doubler, yet he was a good R9. Changing over to phone with a 3-watt carrier and still doubling in the final, the W6 was R8. Now we suppose that the rest of the phone gang will be moving down to 10 meters!

Station Reports

ZS1H: via G2YL, says that September conditions were "superb with VK, VE, W, LU, and Europeans galore," but no amateurs from Asia, though JNB has been heard. He worked his first VE4 on the 22d (VE4PH—see separate report).

CN8MQ: Reports W's audible every day after September 11; also VE, K5, LU, ZE, ZS, and G, but no VK or Asians. His frequency is 28,002 kc., his input just under two watts from dry batteries, but he gets R8 reports from England!

ZU1C: Working the U.S.A. on 10 watts phone and a 260-foot antenna.

VK4AP: On October 4, heard about 10 G's, giving G6LK an R9 report on code and R8 for phone. Working England as late as 1500 G.m.t. lately. Looking for 56 Mc. schedules with W's.

KA1AN: Now active on 28 Mc.

VK3CP: Via G2YL reported on October 13 that conditions for several weeks were very fine. He also had worked G6DH, G6LK, G5RI, G2PL, F8VS, HB9AO, OH7ND, OH7NF in Europe, not to mention other continents.

U1AP: Has been on ten meters during October.

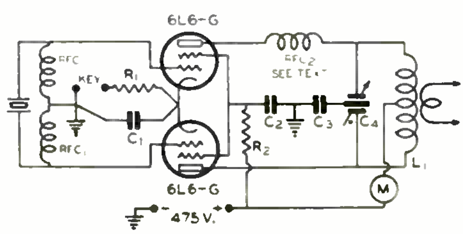
K7FDE: Now on 28 Mc. phone, according to W6ITH who heard him around 4:00 p.m. Pacific time on October 17.

[*Continued on Page 86*]

The Simplest Fifty-Watt Transmitter

50 watts output on 40, 80, or 160 meters; crystal current so low that the crystal just loafs. This crystal oscillator may be used either as a complete 3-band c.w. transmitter or as a driver for a higher powered buffer, doubler, or straight amplifier working on the same frequency.

Approximately 10% of the c.w. transmitters in use on the 80-meter band consist merely of a crystal oscillator and nothing else. These amateurs are content with low power, finding it sufficient for their purpose on that band (semi-local traffic, U.S.N.R. work, etc.), and like the inherent simplicity of a keyed-oscillator transmitter. With 10 or 15 watts out of a 47 or 42 they put a pretty good dent in the 80-meter band.



The 50-Watt Crystal Oscillator

- R_1—200 ohms, 10 watts
- R_2—100,000 ohms, 10 watts
- C_1—.01 μfd., 600 v.
- C_2—.002 μfd. mica
- C_3—.002 μfd. mica
- C_4—100 μμfd. per section midget
- RFC_1—8 mh. r.f. chokes
- RFC_2—8 turns hookup wire wound on pencil
- M—250 ma. d.c. milliammeter
- L_1—Low "C" coil for band used.

We were somewhat surprised to discover, however, that many newcomers and beginners are using keyed crystal oscillators on 40 meters. It is the simplest crystal-controlled transmitter one can construct, and they want crystal control to insure against out-of-band operation. It can later be used to drive a bigger tube, and in the meantime they have lots of fun working a good hunk of the world on 40 meters. With a clear channel and 10 watts in a good 40-meter antenna, one can really go places. And when the QRM is bad it takes at least a kilowatt to get through anyhow. This probably explains the large number of 40-meter crystal oscillators that are tied directly to the antenna.

QRO

It is the purpose of this article to show how to increase the power output of the crystal oscillator transmitter. The little transmitter shown in the photograph delivers 50 watts on 40, 80, or 160 meters with surprisingly low crystal current.

It was found possible, due to the push-pull connection, to substitute a .002 μfd. condenser for the usual .01 μfd. or .02 μfd. screen bypass. This made it unnecessary to use a potentiometer arrangement for screen voltage in order to minimize keying chirps. There is a very slight, though not objectionable, chirp when using the transmitter on 40 meters. However, it is not helped by using a divider for screen potential. For that reason, a single series dropping resistor is used. This has the advantage of automatically reducing the screen voltage when heavy screen current is drawn.

Because of the very high transconductance of the 6L6's, they have a tendency towards a u.h.f.

Small in Size, But Not in Performance

parasitic when used push-pull. This was killed by inserting a small choke of a few turns of hookup wire in one plate lead. This does not unbalance the circuit enough at the fundamental frequency to affect the operation, but it completely eliminates the parasitic.

If the oscillator is to be used on 160 meters, the grid r.f. chokes had best be 8 mh.; otherwise the small 2.5 mh. type will suffice.

For maximum output of the oscillator, induc-

[*Continued on Page 82*]

Designing the Tank Circuit

By J. N. A. Hawkins, W6AAR

The question of the optimum L to C ratio in the plate tank circuit of a radio frequency amplifier has been the subject of much discussion, not to mention some controversy, since the first article on this point appeared in Radio[1]. The table of required capacitance at various frequencies, plate voltages, and plate currents shown in that article has been widely used and other observers have arrived at about the same results.[2] The capacitances shown were obtained by using two assumptions, both of which are reasonably accurate.

The firsr assumption is that the average high efficiency class C or class BC final amplifier will have a d.c. average plate resistance (d.c. plate voltage divided by average d.c. plate current) approximately equal to 3.1 times the a.c. load resistance into which the tube works. There is no logical reason for this; it just does, as shown by many measured and calculated examples. Another similar empirical assumption indicates that the average class B amplifier has an average d.c. plate resistance close to 6.2 times its a.c. load resistance. However, the class B case is not considered separately from the class C or class BC case, as the required Q of a class B plate tank circuit needs only to be about half as high as in a class C or class BC amplifier, due to the fact that plate current flows for 180 degrees in the class B amplifier, with less consequent wave form deformation than in the class C and BC cases where the plate current flow lasts for materially less than 180 degrees. Thus a class B amplifier requires almost exactly the same L to C ratio in its plate tank circuit as a Class C or BC amplifier operating at the same frequency, plate voltage, and plate current.

The second assumption necessary is that the minimum effective loaded Q of the tank circuit vary about as follows:

For single-ended amplifiers:

- For c.w. use....................Q = 5
- For phone use................Q = 10
- For self-excited osc.........Q = 15

For push-pull amplifiers:

- For c.w. use....................Q = 2.5
- For phone use................Q = 5
- For self-excited osc.........Q = 7.5

These latter assumptions as to desirable values of circuit Q are more debatable than the first assumption concerning the ratio of a.c. load resistance to d.c. tube resistance. However, these values of Q satisfy my own harmonic distortion standards and many hours of discussion of these values with various engineers have failed either to shake my confidence in these values or to offer a method of deriving a more useful set of values. Several well-designed commercial c.w. and phone transmitters use values of tank circuit Q which are close to the minimum values shown above, although the better broadcast transmitters use values of Q which are about 25% higher than those shown in the foregoing table.

Push Pull

The values of tank circuit Q shown above for push-pull amplifiers are about 15% lower than I used originally,[3] being exactly half of the single-ended values of Q instead of 60% of the single-ended Q. However, when using extremely low values of tank circuit Q in a push-pull amplifier, care must be taken to avoid extreme ratios of impedance step-down from the tube plates to the load. The point is that at low values of Q, the merit of the circuit depends somewhat upon other factors. Also the use of extremely low values of Q, as in the push-pull amplifier, sometimes makes it difficult to neutralize the amplifier properly, unless it is perfectly symmetrical with respect to ground. The two tubes used in the push-pull amplifier must also have nearly identical characteristics if extremely low C and Q is to be used in the tank circuit.

This slightly lower Q for the push-pull amplifier was suggested by Millen[2] and I am inclined to think he is right, after some further experiment. Using Millen's value of push-pull Q also somewhat simplifies calculation, as all values of the constant K come out as integral multiples of 325, which makes the capacitance formula easy to remember and apply. While speaking of the capacitance formula, I must credit Millen also with a rather obvious simplification, which I overlooked.

The formula in its latest form is:

[1]Hawkins, Radio, Sept. 1935, p. 22.
[2]See Millen, *QST*, June 1936, p. 53.

[3]See also "Low Loss Tank Circuits", Hawkins, Radio, May 1936, page 32.

$$C = \frac{K \times I}{E \times F}$$

Where: C equals capacitance in *micro*-microfarads.
I equals d.c. plate current in *milliamperes*.
E equals d.c. plate volatge in volts.
F equals frequency in *megacycles*
and K is a constant which depends upon the type of amplifier, as follows:

	C.w.	*Phone*	*Self-excited osc.*
Single-ended grid neutralized	2600	5200	7800
Single-ended plate neutralized	650	1300	1950
Push-pull cross neutralized	325	650	975

Here is a close approximation of the formula which can easily be memorized and then a simple mental calculation will allow the approximate capacitance to be obtained for any amplifier at any frequency.

The optimum tank capacitance of a push-pull 40-meter c.w. amplifier operating at 1000 volts and 200 ma. is 10 μμfds. (9.28 μμfds. by the formula). A few moments' inspection of the table of K, shown above, will allow one to remember by what integral factor the 10 μμfds. capacitance shown above must be multiplied for any other type of amplifier than the push-pull c.w. amplifier used in the example to be memorized. For example, as the tank capacitance will be very directly with K, if we memorize the following facts about K we can easily get an answer at 40 meters, 1000 volts, and 200 ma. for any other type of amplifier.

The reference amplifier (push-pull-c.w.) uses the lowest value of K. For phone, multiply the capacitance by 2; for a self-excited oscillator, multiply by 3.

Then also multiply again by 2 if the amplifier is single-ended plate-neutralized; or by 4 if the amplifier is single-ended grid-neutralized.

Also remember that the capacitance varies directly with the d.c. plate current. If the plate current is twice the 200 ma. used in the example above, or 400 ma., multiply the capacitance by 2; and if it is half as great, or any other proportion, multiply by the same proportion.

In regard to d.c. plate voltage and frequency, remember that capacitance varies *inversely* with these two factors. Thus doubling either the frequency or the plate voltage cuts the capacitance in half. If the frequency or plate voltage is multiplied by any other factor then multiply the capacitance by one over that number, or the reciprocal of that number.

This may seem like an awful lot to remember, at first glance, but it only takes a moment or so to memorize and will be very useful if you are faced by the L to C ratio problem without the formula handy. Remember that it is all based upon one actual example of a push-pull c.w. amplifier operating on 40 meters (7 Mc.) at 1000 volts and 200 ma. and the answer is, for this case, 10 μμfds.

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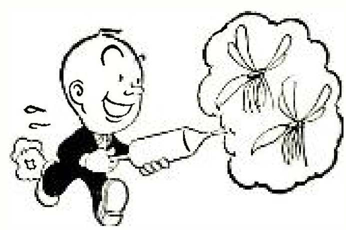


What this country really needs is a good 5c insecticide for transmitter bugs.

◆

On days when the u.h.f. stuff is coming through, the 9-meter police stations occasionally have their troubles. A humorous incident took place recently at one of the west coast 9-meter police systems.

"Calling car number 7; proceed at once to the practice range for drill."

"Okay; car 7 proceeding to the range; out of service."

A few minutes later car number 7 called the main station to report that it had been having difficulty with its receiver and was proceeding to the station to have it fixed. Upon arriving at the station it was discovered that the instructions had not been received, as the receiver had been dead, and nothing was known about the conversation regarding the practice range.

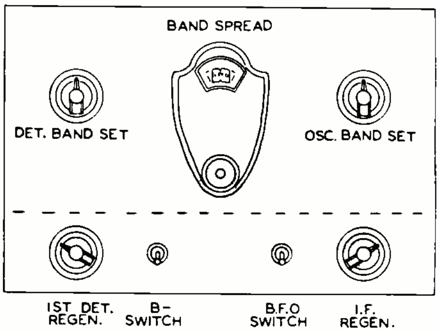
As there are no other police systems in the vicinity on the same frequency, the only explanation is that somewhere in the east a "car number 7" proceeded to the pistol range to discover it was supposed to be in service and *not* at the pistol range.

The Beggar's Mite

By George W. Chinn,* W9EUZ

A theoretical dissertation upon the evolution of the ideal type of inexpensive amateur superheterodyne receiver. Like Topsy, the receiver "just growed', though Topsy did not come out of a "junk box". Most of this receiver did.

In the many types of simple receivers that have been described within the pages of Radio, may be found countless ideas which, when collected together into a single unit, lend themselves admirably to the development of an efficient receiver. This article, then, attempts to coordinate some of the individual features of the various circuits into an effective, inexpensive amateur receiver, simple of construction, and with a fair promise of superlative performance when properly constructed.



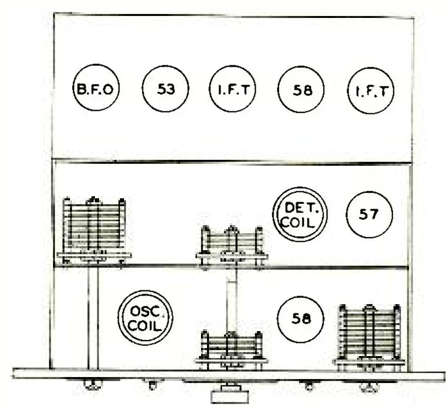
Panel Layout of the "Church Mouse Special"

Briefly, it consists of a four-tube superheterodyne receiver, incorporating extreme sensitivity and single signal selectivity, and in which the four tubes equal the performance of many more. Best of all, the entire receiver may be constructed at a total cost not to exceed ten or twelve dollars!

If you will examine the circuit diagram of the set, you will note that every part of it is familiar, having appeared in various forms on these pages before. The front end is an old friend, a regenerative first detector with suppressor grid injection from an electron-coupled oscillator. The regenerative i.f. stage was described recently in an article dealing with the conversion of an SW-3 to a super. From the same article comes the second detector—beat oscillator combination, consisting of a 53 used as a triode power detector and a BFO tube.

Taking the different parts of the circuit in order, we find that the front end is exactly the same as that used in the "222" receiver designed by Frank Jones, with the addition of a few refinements. These consist of a heavy bleeder to furnish the variable voltage to the first detector, thus allowing smoother control of regeneration, and a voltage divider arrangement for the screen of the oscillator to keep the voltage more uniform. In many receivers of this sort it is noticed that many of the oscillators are not of the electron-coupled type. To my mind this is a big mistake, principally because this type of oscillator is by far the most stable and persistent, having unnoticeable frequency shift with as much as fifty per cent variation of applied voltage. There can be no question but that this is desirable. Another minor advantage of this type circuit is easier coil winding, since there is but one winding with a non-critical tap one-third to one-fourth up from the bottom of the winding.

The performance of this type of front end is very good. It compares very favorably with

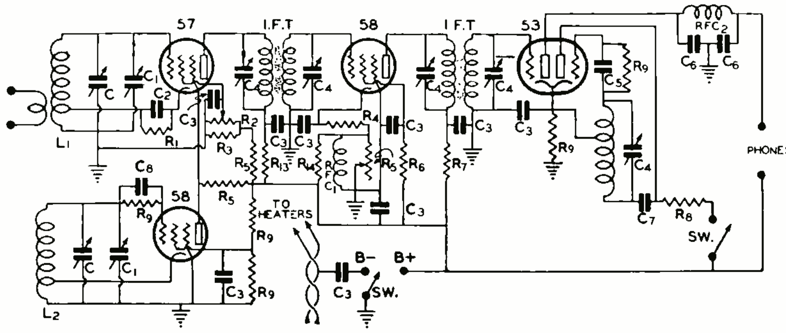


Sub-Panel Arrangement of Parts

a set using a preselector, and measurements made by Frank Jones produce the astounding figures of the image interference being 60 db. down from the desired signal at 40 meters, a rejection of 1000 to 1. The sensitivity was also found to be under one microvolt absolute, which is quite good as compared with manufactured types of communication receivers.

A regenerative i.f. stage is normally consid-

*7350 Dorchester Ave., Chicago, Ill.



General Wiring Diagram of the Inexpensive Superhet

C—100 μμfd. midget	C_6—.0005 μfd.	R_4—500 ohms, 1 watt	R_9—50,000 ohms, 1 w.
C_1—20 μμfd. midget	C_7—.01 μfd. paper	R_5—15,000 ohms, 10 watts	R_{13}—2,000 ohms, 1 w.
C_2—.01 μfd. paper	C_8—.0001 μfd. mica		R_{14}—100,000 ohms, 1 watt
C_3—0.1 μfd. tubular	R_1—1500 ohms, 1 watt	R_6—75,000 ohms, 2 w.	RFC_1—B.c.l. coil (see text)
C_4—B.f.o. trimmer	R_2—50,000 ohm pot.	R_7—2,000 ohms, 1 watt	
C_5—.05 μfd. paper	R_3—4000 ohms, 2 watts	R_8—500,000 ohms, 1 w.	RFC_2—20 mh. or more

ered the equivalent of two ordinary stages, but in this set, by the use of iron core transformers, the advantage becomes even greater. It was felt desirable to allow regeneration in this stage so that the selectivity can be brought up to practically the full single signal selectivity that may be secured with a quartz crystal filter. There is not so much difference between the two (outside of cost), since the rejection action with this simple type is as complete as with a crystal, the difference being that the regenerative type is electrically active or dynamic, while the crystal filter type is passive or static. By using the former type, there is a saving in the cost of a crystal as well as a saving of considerable complicated construction.

Aside from the circuit, the only consideration is ease of construction. The original models of the regenerative i.f. supers made use of a tickler coil, inductively coupled to the secondary of the i.f. transformer to permit oscillation. This is not only difficult to do in many instances, but also complicates the adjustment procedure very much, since it is sometimes necessary to vary the coupling between the coils. The method as used in this receiver allows the i.f. transformers to be used without any alterations, and the b.c.l. coil used for the regeneration is easily accessible for any changes as to number of turns, etc.

The 53 combined second detector and beat oscillator can be recognized as the familiar arrangement shown by Fay Harwood in his "SW3 Conversion". It will, with an ordinary signal, furnish enough power to operate a pair of phones in good style and on good signals will operate an *efficient* dynamic speaker (should one be available) with fair volume. The second section of the 53, used with any of the small, inexpensive beat oscillator coils available, provides a convenient beat oscillator without recourse to trick circuits that are difficult to adjust or the addition of another tube.

The casual observer might inquire as to the whereabouts of the volume control. It is true that there are only two auxiliary knobs beside the tuning, and they both control regeneration, one in the first detector, and the other in the i.f. But as in the Super-Gainer, the first detector regeneration acts very nicely as a volume control, since the stronger signals require less selectivity anyhow; and the old control can be cranked way up for the weaker signals which would be less sensitive. There was no attempt to apply an automatic volume control system for this simple type of receiver, as it was felt that c.w. is the main business of the "church-mouse" ham, and in that case the a.v.c. would be turned off most of the time anyway. For the same reason, the audio output was deemed sufficient, although it is a simple matter to add another stage of audio should it be desirable.

The cost of the receiver can quite easily be kept within the limits mentioned earlier in the article. The most important items, the i.f. transformers, can be purchased for as low as $1.18. The b.f.o. transformer can be secured for something around a dollar. Then outside of the tuning condensers and coil forms, all the rest of the equipment just amounts up to only two dollars or so. I know of one amateur in this district who has built a super for under five dollars, and who has heard ZC6CN and J2GX on twenty meters with a strength of R-9. And

Wave-length	*Detector Coil*	*Oscillator Coil*
160 meters	1¾″ of no. 24 e. close-wound tap at 1¼ turns.	1¼″ of no. 24 e. close-wound. Tap at 1/3 total turns.
80	38 t. no. 22 d.s.c. 1¾″ long Tap at ¾ turn.	32 t. no. 22 d.s.c. 1¾″ long. Tap at 10 turns.
40	12 t. no. 22 d.s.c. 1½″ long. Tap at ½ turn.	11 t. no. 22 d.s.c. 1¼″ long. Tap at 3½ turns.
20	6 t. no. 22 d.s.c. 1″ long. Tap at ¼ turn.	6 t. no. 22 d.s.c. 1″ long. Tap at 1½ turns.
10	3½ t. no. 22 d.s.c. 1″ long. Tap at ¼ turn.	3½ t. no. 22 d.s.c. 1″ long. Tap at 1 turn.
All Forms 1½″ diameter		

that's something in this neck of the woods!

The construction of the receiver follows generally that of some of the Super-Gainer types shown in RADIO. The front panel is symmetrical and dignified, with all controls for the proper operation of the receiver. Behind the panel is located the oscillator compartment with its associated coil and condensers. Shielded from this next aft is the first detector compartment and its equipment. Behind this on the rear row of the chassis, is found the remainder of the apparatus, including the i.f. transformers and tube, and the b.f.o. transformer and second detector tube. It will be seen that this is the diagram in pictorial arrangement, orderly and progressive, permitting the vital leads to be almost negligible in length, and makes for a clean job of wiring. It may seem that there is more shielding than necessary, but it can't hurt any and costs but a few cents more.

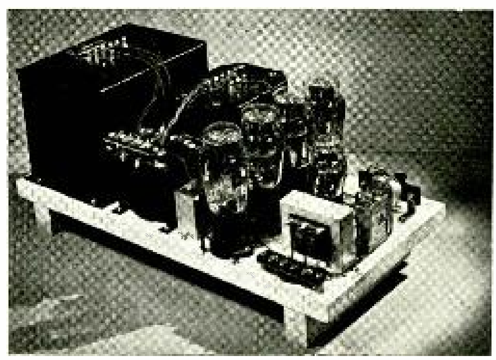
It is recommended that all ground leads be made directly to the chassis, since the chassis is so small anyway that there is hardly any other way of securing shorter grounding leads. Myself, I like nice heavy insulated wire, and enough solder to make all the connections permanent despite rough usage. Also I prefer to have all my fixed condensers and resistors to be fastened rigidly, and not left floating around. Battleship construction of the strongest type will help to keep things where they belong.

There should be no difficulty about aligning the receiver. If some sort of oscillator can be acquired to align the i.f.'s it should prove helpful, but the job can be done without it quite nicely. A 0-50 ma. meter in the plate lead to the second detector is the simplest method of showing resonance, and this is at the minimum dip. Every ham has at least one milliammeter! The i.f. stage should oscillate with the control full on. Quoting Fay Harwood, "If it goes into oscillation before this point the little b.c.l. coil across the potentiometer has too many turns. If it does not oscillate with the control turned clear on, the little coil has not enough turns." That about does it, I guess. Remember that greatest sensitivity and selectivity occur just below oscillation, and neither r.f. nor i.f. should be allowed actually to oscillate.

A receiver of this type should give the ordinary run of "disfinancial" ham a fair chance to cope with the present conditions in most of the bands. It will give about the utmost performance for cost that can be secured. And you don't have to be an engineer to operate it either!

◆

IT DID NOT CHOOSE TO RUN



The Variactor-Controlled "Axis Shifter"

We don't know whether it was because the page number was 13, or because it was a dynamic shift unit. But anyway it jumped right out of the press while the page was being printed, and was not noticed until a number of copies of the November issue had been run.

For the benefit of those amateurs who were interested in the article and objected to the illustration of the "wide open spaces", we are running the cut again. This time we hope it stays at home.

◆

Theme song of a 10-meter phone station on a heavily-traveled boulevard after calling CQ: "Somewhere a Voice is Caaaaaw-ling."

Tuning the Class C Amplifier

By "JAYENAY"

There have been many articles published on the theory and design of class C radio frequency amplifiers. However, a simplified procedure is necessary to enable the beginner properly to adjust his particular amplifier for maximum output and efficiency.

Neutralization

The first step in tuning up an r.f. triode amplifier is to neutralize the plate to grid capacitive feedback. Take, for example, either of the two amplifiers shown in figures 1 and 2. Figure 1 shows a grid-neutralized amplifier and figure 2 shows a plate-neutralized amplifier. The neutralizing procedure is the same in both cases.

First, remove plate voltage from amplifier. Then start the crystal oscillator and apply grid excitation to the amplifier being neutralized. The grid bias can be any convenient value, for the purpose of neutralization. Tune the grid tuning condenser to resonance (C_g) and increase the coupling from the preceding stage until the d.c. grid milliammeter reads a convenient value of grid current. Now tune the plate tank tuning condenser C_p through resonance while watching closely the grid milliammeter. The grid current will dip sharply if the amplifier is out of neutralization. Now slightly vary the capacitance of the neutralization condenser C_n and again tune the plate tank condenser C_p through resonance and observe the change in grid current at resonance. If the change is less than it was before, then the neutralizing condenser was changed in the right direction. If the change is greater than it was before, the neutralizing condenser was moved the wrong way. Keep changing the neutralizing capacitance by small amounts, each time retuning the plate tank for the sharpest variation in d.c. grid current. When the amplifier is perfectly neutralized there will be no change in d.c. grid current when the plate tank condenser is tuned across resonance. The amplifiers shown utilize link coupling but the procedure is exactly the same for any coupling method.

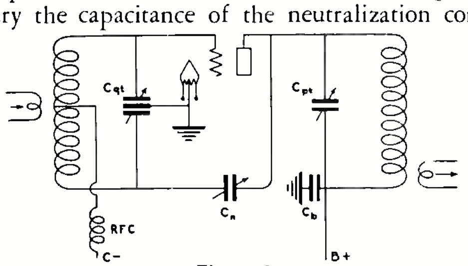


Figure 1
This amplifier is very similar to that shown in figure 2 except that grid neutralization is used. There is little to choose between the two systems of neutralization although grid neutralization allows cheaper tank condensers to be used.

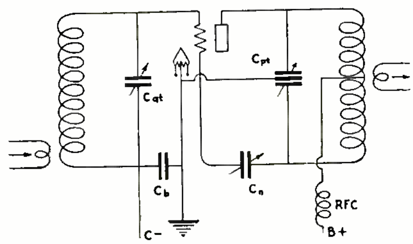


Figure 2
Plate neutralized radio frequency amplifier. Note that the coupling links are located close to points of low r.f. potential on the grid and plate tank coils.

Amplifier Adjustment

The operation of a class C amplifier is dependent upon several variables. Some of these factors can be adjusted by the operator, but most of them are fixed. The operator can vary the negative bias and the antenna coupling, but the grid drive is usually left at all he can get. The d.c. plate current and the plate loss are limited by the size of the tube and are fixed. The d.c. plate voltage is also usually all the operator can get up to the insulation limit of the tube used. Thus there are really only two possible adjustments for the operator, the grid bias and the antenna coupling.

First, without plate voltage, adjust the coupling between the amplifier and its driver stage for maximum grid current in the amplifier, up to the point where the preceding driver stage either shows excessive plate loss or excessive d.c. plate current.

Then adjust the amplifier bias (still without plate voltage) until the d.c. grid current is about 25% of the rated maximum d.c. plate current. Raising the bias lowers the grid current, and vice versa.

Now, the only adjustment left is the antenna coupling. Make the coupling to the antenna, or other load, as loose as it can be made and then apply d.c. plate voltage to the amplifier. Tune the plate-tuning condenser C_p to resonance, as shown by the dip in the d.c. plate milliammeter. As the load is loosely coupled, the d.c. plate current, at resonance, will be quite low. Now gradually increase the antenna coupling in small steps, quickly restoring the plate circuit to resonance with the tuning condenser C_p after each change in load coupling, as changing the coupling will slightly detune the circuit. As the coupling is increased, the plate current in the dip will become higher and higher. Keep increasing the load coupling until either the plate loss or the d.c. plate current reach the maximum allowable value for that particular tube.

With certain tubes, the d.c. grid current may fall off badly when the plate voltage is applied and the load coupled up. If the d.c. grid current drops below 15% of the normal loaded d.c. plate current, it will be necessary to loosen the load coupling, reduce the bias by about 10%, and start all over again to couple up the load so that at normal loading the d.c. grid current is not too low.

This method eliminates any discussion of the absolute value of the grid bias in either volts, or "number of times cut-off". The bias, as adjusted herewith, is entirely independent of the grid excitation supplied by the preceding stage. If the preceding stage does not supply very much excitation, the adjustment procedure automatically adjusts the amplifier for the condition of maximum power gain. If, on the other hand, the available grid drive is very high, the above procedure automatically adjusts for high plate efficiency.

Briefly then, the procedure is as follows:

1. Adjust the driver stage for maximum d.c. grid current without overloading the driver.

2. Adjust the amplifier bias so d.c. grid current is about 25% of normal maximum amplifier plate current.

3. Increase amplifier load coupling until either plate loss or d.c. plate current reaches maximum recommended limit. At this point the d.c. grid current will have dropped somewhat so that it will be about 20% of d.c. plate current.

Amplifier Relationships

Varying one of the following factors at a time, leaving everything else alone, except to restore resonance in grid and plate circuits, has the indicated effect.

1. Increasing the grid drive causes d.c. grid and plate currents to increase. Causes bias to increase unless new B batteries supply bias. Increases power output and increases plate efficiency. Shortens tube life if carried to extreme. Has little effect upon power gain. Plate loss rises to maximum and then goes down.

2. Increasing negative grid bias causes d.c. grid and plate currents to decrease. Lowers power output but increases plate efficiency. Lowers grid to plate power gain through stage. Plate loss goes down.

3. Increasing d.c. plate voltage causes plate current to rise and grid current to fall slightly. Increases power output very rapidly. Practically no change in plate efficiency, but grid to plate power gain goes up. Plate loss rises.

4. Increasing antenna or load coupling causes increase in d.c. plate current and decrease in plate efficiency so also increases plate loss. Grid current drops slightly. Power output increases. Grid to plate power gain goes up.

These relationships hold true for triodes over rather wide limits. In multigrid tubes these relationships hold over a narrower range in variations. Multigrid tubes suffer from peculiar secondary emission effects and quasi-saturation which makes some of the relationships reverse themselves after a certain point is reached. No general rules can be applied to a simplified tuning procedure for maximum output and efficiency from multi-grid tubes.

If maximum power output and minimum d.c. plate current do not occur at the same point, when tuning the plate tank through resonance, the plate tank circuit has too many turns on the coil and not enough tuning capacitance. In other words, the loaded tank Q is too low.

◆

Annual Navy-N.C.R. QSO Day

On Navy Day, October 25, 1936, numerous amateur radio stations affiliated with the Naval Communications Reserve were enabled to make contact with the U.S.S. Chester, NAVF, handling a message and receiving a special QSL card in confirmation.

The contact with NAVF was limited to officers and men of the 12th Naval District, and the amateur stations were contacted in the range of frequencies between 3500 kc. and 3900 kc. with the naval vessel operating on 3475 kc. The U.S.S. Chester was in the vicinity of San Francisco, so arrangements were made to work the nearby stations during the daylight hours. The amateurs in the more distant parts of the 12th Naval District were contacted during the evening. Two receivers were used on the Chester with two operators on watch. One keyed the transmitter and worked a station while the other tuned the other receiver looking for other stations calling them. A total of 91 contacts was made, which represents a substantial increase over the contacts which were made last year.

The drill was under the supervision of Lieut. Sydney J. Fass, USNR, W6NZ, who was radio chairman for Navy Day, 12th Naval Dist., and was carried out in regular naval radio procedure.

Light Bulb Resistors

Ordinary tungsten filament light bulbs make excellent load resistors for radio frequency and audio tests, since they are non-inductive. However, their resistance increases with an increase in power that is applied to them. The table gives the resistance of standard 115-volt bulbs at various wattages. At approximately one-third rated wattage, the filament will show dull red. At two-thirds rated wattage, the filament is bright yellow.

If it is desired to test a 30-watt audio amplifier having a 500 ohm output, two 40-watt bulbs could be used in series. At 30 watts output from the amplifier, the two bulbs will light to a dull red since each tube will be dissipating 15 watts, and the load on the amplifier will be 510 ohms.

Light bulb resistors are very useful for terminating untuned feed lines while adjusting coupling to the final amplifier. The bulb will serve as an indicator of maximum r.f. at the same time coupling adjustments are being made.

Various series or parallel arrangements of bulbs will enable the user to secure an infinite number of resistance values. One of the most valuable uses for the light bulb resistor is as a dummy antenna for adjustment of the transmitter.

The resistor may be either clipped across a few turns of the tank coil in the same manner that an untuned transmission line is coupled, or it may be connected across a tuned circuit which is then coupled to the tank. The transmitter can then be completely checked for frequency, percentage of modulation, quality and power output without causing QRM or risk of receiving a "pink slip" from the F.C.C.

If the resistance of the dummy antenna is reasonably close to that of the radiation resistance of the antenna, a double pole, double throw switch can easily be arranged to shift the output of the transmitter from one to the other. The readings on the r.f. ammeters, with the dummy antenna connected, will give a quick check on the performance of the transmitter.

In damp weather, the antenna meters will show higher current if the antenna insulation is poor, although the radiation will be less than in dry weather when the antenna current readings are less. A comparison between antenna currents under the two conditions, with the dummy antenna being used to make sure the output of the transmitter is the same, will quickly show up poor antenna insulation. The table is reprinted with permission from the Thordarson Transmitter guide.

LIGHT BULB RESISTANCE CHART

Resistance of 115-Volt Tungsten Bulbs

	WATTAGE RATING					
Watts	25	40	50	60	75	100
5	349	195	148	119	90	65
10	412	228	175	139	106	74
15	470	255	194	153	116	81
20	497	273	207	163	124	87
25	529	291	220	172	132	92
30		306	231	181	137	96
35		319	241	189	143	100
40		331	249	197	148	103
45			257	204	153	106
50			265	211	158	110
55				215	162	112
60				220	166	115
65					169	117
70					173	120
75					176	122
80						124
85						126
90						128
95						130
100						132

◆

It seems a bunch of "wise guys" took exception to the R.C.A. "Proof of the Pudding" ad when it ran on the back cover of August QST. They smugly pointed out that the cards were obviously faked, because "the ad was published before the dates on the QSL cards".

We hate to disappoint these human ferrets, but in practically every other country than the U.S.A., 9/4/36 means *9th April, 1936,* and not September 9th as it does in this country.

◆

A b.c.l. friend of ours was surprised to learn that there is now a school where one may learn to be an amateur radio operator. He said it was the first time he knew that they became hams on purpose.

◆

What we would like to know is the difference between "output", "measured output", and "actual measured output".

Filter Condenser Considerations

The filtering effectiveness of any condenser varies directly with its capacitance and as the square of the applied voltage. Thus a two "mike" 1000-volt condenser has twice the filtering effectiveness of a one µfd. 1000 volt. Also note that a one µfd. 2000 volt condenser has *four* times the filtering capability of a one µfd. 1000-volt condenser. Likewise a one µfd. 3000-volt condenser has *nine* times the available energy storage capability of the one µfd. 1000-volt condenser we have used as a reference.

The cost of a condenser should be directly proportional to its energy storage, *except for differences in the quantity produced.* By taking the one µfd. 1000-volt condenser as the standard unit of energy storage (or filtering capability) for transmitting condensers, we can easily compare the cost of condensers of different sizes and ratings by referring to each odd size as so many standard one µfd. 1000-volt units. Another way of saying the same thing is to find out how many one µfd. 1000-volt units would have to be connected in series-parallel to get the same effective filtering and insulation.

One of the better lines of oil-filled filter condensers was compared, as shown in the following table, with the standard one µfd. 1000-volt condenser in that line.

All of the condensers shown below are the same make and are of the same quality. In other words the safety factors and construction are proportionately the same for all the sizes and voltage ratings indicated.

In the table the capacity and voltage rating (peak) is shown in the first two columns. The next column shows how many standard one µfd. 1000-volt units that particular condenser represents and the fourth column gives the list price for the condenser. The last column shows the list cost divided by the standard units, which gives the list price per unit of capacitance. The costs in the last column would all be exactly the same except for slight differences due to quantity production and particular competitive situations. The differences shown are interesting but very hard to explain logically.

The wide variation in cost per unit of filtering effectiveness suggests that transmitters should be designed to use the most economical combination, where possible, for most watts per dollar.

FILTER CONDENSER TABLE

µfds.	Working Volt. (D.C.)	No. of standard filtering units	List price	List price per "unit"
1	1000	1	$ 3.00	$ 3.00
2	1000	2	4.50	2.25
4	1000	4	7.00	1.75
1	1500	2¼	3.75	1.66
2	1500	4½	6.25	1.39
4	1500	9	9.00	1.00
1	2000	4	5.25	1.31
2	2000	8	8.00	1.00
4	2000	16	11.00	.62*
1	2500	6¼	14.00	2.24
2	2500	12½	17.00	1.36
4	2500	25	25.00	1.00
1	3000	9	18.00	2.00
2	3000	18	23.00	1.29
4	3000	36	30.00	.86
1	4000	16	26.00	1.62
2	4000	32	30.00	.93
1	5000	25	30.00	1.20
2	5000	50	34.00	.68*

The amateur net prices are 40% under the list prices shown.

THE OCTAL SOCKET

The new "octal" 8 pin plug and socket assembly used on the new metal tubes is becoming popular among different equipment manufacturers besides tube manufacturers.

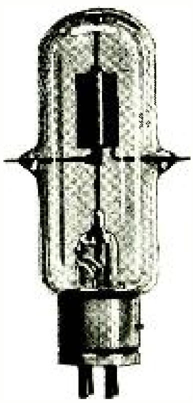
Some of the devices which are being made with an octal base designed to fit a standard octal socket include:

- Copper oxide rectifier units
- Ladder, T and H pads and faders
- A wide variety of relays
- Plug-in meters
- A, B, and C batteries
- Filter condenser blocks
- Audio filters and equalizers
- Tank coils and air core inductances
- Audio and power transformers
- Ripple filter chokes
- Crystal filters and resonators
- Bleeder and ballast resistances
- I.F. Transformers

The wide use of this form of standard plug-in connection is to be encouraged as it materially increases the flexibility of transmitter, receiver and amplifier equipment. The contact between the pins and the socket is very good with most of the newer sockets and the reliability of such contacts is probably just as good as the average soldered joint. In cases of component failure or maintenance the plug-in arrangement materially simplifies the work involved in installing a new component.

What's New

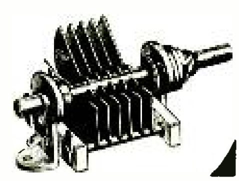
HK 154



The accompanying illustration, which was not on hand when the new HK-154 characteristics were given on page 82 of the October issue, shows in detail the novel mechanical construction of the tube. The bringing of the plate lead out the side of the tube instead of the top makes it possible to get short plate tank leads without having to mount the plate tank on "stilts". The tube has a medium-low μ and a rated plate dissipation of 50 watts. The tube has a hard glass envelope and tantalum grid and plate; it fits a standard UX socket, which is used only for filament connections. For further characteristics, refer to the October issue.

◆

New Midget Condenser



Bud Radio Inc. of Cleveland, Ohio, recently announced its new and improved line of midget condensers. This new line of condensers possesses many additional features not used before on Bud midgets, outstanding of which is the improved rear bearing contact springs which insures an absolute minimum of electrical contact loss throughout the entire useful life of the condenser. The front bearing of these condensers also possesses an exceptional contact comprised of a combination of spring and crimp washers which in addition create the correct tension on the rotor for smooth and stable operation.

Bud condensers are made in two styles, the single and double bearing styles, and in the single and double section types. Aside from the usual single spaced models these midget condensers are also available in the double and triple spaced models for use in transmitter tuning and neutralizing, and all usable capacities are available from 10 $\mu\mu$fd. to 350 $\mu\mu$f.

◆

New Crystal Microphone

A new public address microphone known as the B-1 has been placed on the market by The Brush Development Company, Cleveland, Ohio. It offers at a lower price, though somewhat lower output, many of the operating features found in the Brush Sound Cell microphone.

Internal spring mounting, eliminating external shock absorbers and other makeshift attempts at external cushioning, and permitting the stand or even the microphone itself to be handled while it is in use . . . non-directional pickup . . . and the ability to run long leads with only slight loss—are some of the features built into this new model. Thoroughly modern and attractive appearing wire-mesh cases that permit the sound to pass through, eliminating the heavy bass and distortion of pressure doubling and permitting close speaking . . . small size . . . and Brush's rugged construction are others.

Size of the Brush B-1 microphone, 3½" long 1⅞" wide, ¾" thick. Weight, complete with the locking type plug and socket, 11 ounces. Output level minus 72 db. Full details, prices, etc., can be secured from The Brush Development Company, Cleveland, Ohio.

◆

"Selectosphere Kit"

The new, selective transducer (loudspeaker) described in the October issue of RADIO is now available in kit form, easily assembled by a novice in but a few minutes. It is designed for a peak frequency of 800 cycles, for use with a pentode output tube. No circuit alterations in the receiver are necessary.

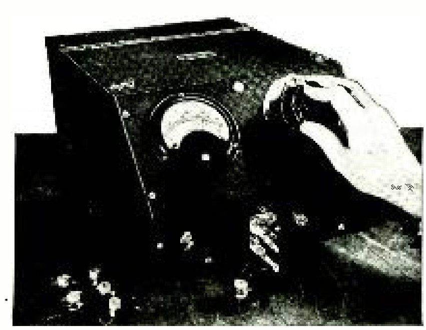
The device stands about seven inches high, and is finished in black crackle. The noise-reducing qualities and selectivity rival crystal filter reception. Used with a crystal filter-s.s. superheterodyne, the "Selectosphere" improves reception still further.

The kit is manufactured by the Selectosphere Co., Box 3, Newtonville, Mass., and the price, in our opinion, is most reasonable.

◆

Checker for Production Testing

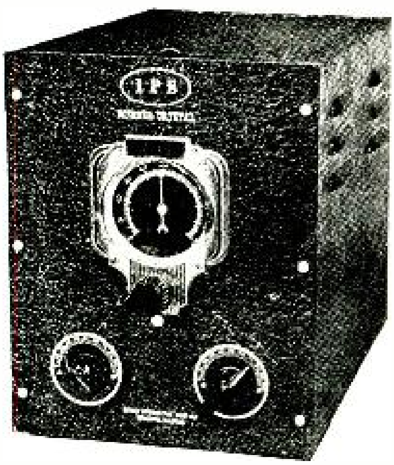
A precision instrument for the production testing grouping and adjusting of coils and condensers at radio frequencies, permitting greater accuracy in less time is announced by the Boonton Radio Corporation, Boonton, N. J. Known as the type 110A QX-Checker, this instrument provides a simple, dependable stable method of comparing the Q, as well as the L or C of a radio component, with a given standard. The Q of coils is directly read in percentage variation from the given standard, the standard being rated at 100%.



The QX-Checker is a companion instrument of the Q-meter in general use in well-equipped laboratories and engineering departments. This new instrument is intended for use by the production staff, and is set to given tolerances within which must come production units that are to be passed. Even though the instrument assures a high degree of accuracy, it may be operated by the usual factory personnel. What is more, the instrument is pre-set by the authorized engineer or foreman who has access to the controls within the cabinet. The operator then manipulates the single dial and reads the Q percentage on the meter, and notes whether the dial is within the pencil-marked tolerance points or not. The dial may be read in micro-microfarads for capacitance and, indirectly, for inductance variations from the standard.

The instrument comprises a power supply, r.f. oscillator (100 kc. to 25 mc.), tuning circuit and specially designed vacuum-tube voltmeter, housed in a metal cabinet with convenient sloping front panel.

"Rubber Crystal"



The Radio Apparatus Mfg. Co., 6341 Broadway, Chicago, has recently released a device designated as the "IPS Rubber Crystal" which permits continuously variable frequency control. It is a stabilized electron-coupled oscillator using a special circuit, and delivers more output than the conventional crystal oscillator tube running at 450 volts.

It is designed for use on the operating table beside the receiver, the output being link-coupled to the stage in the transmitter that would ordinarily be fed by a crystal oscillator stage. Thus the operating frequency may be shifted at will from the operating position, no readjustment of the transmitter proper being required over a fairly wide range of frequencies. It has been found that the frequency may be shifted as much as 50 kc. either side of optimum at 14 Mc. with a negligible drop in output (without retuning the transmitter).

The unit is available for use with either two 6L6-G or type 59 tubes. A matched power supply is offered as an optional unit for those who wish it.

New Type Oscilloscope

The Neobeam Oscilloscope is a new electronic-measuring device using a gaseous discharge tube to make sound visible. The exact wave pattern is traced on the four-inch calibrated screen with clear definition between amplitude and frequency.

The principle by which the gaseous oscilloscope tube operates is that the area of the glow covering the elongated cathode is proportional to the current passing through the tube. On alternating current the electrodes glow alternately, depending upon the frequency of the impressed voltage. This development, while new, is along the line of experiments started by Mr. E. Gherke in 1904. His tube used plate electrodes 1/4" wide and 6" long and was filled with nitrogen gas. As described above, the glow on the electrodes was proportional to the current in the circuit, and the image was reflected from a revolving mirror whose axis was paralleled with the axis of the tube. This system, however, would only respond to potentials above 2,000 volts, and was not useful outside the laboratory.

The oscilloscope tube as now developed measures 6" overall by 1/2" diameter and is filled with special purified neon gas. The two electrodes are 2" long by 1/16" diameter and set at each end of the tube so as to develop a four-inch image. The ignition potential has been reduced to one-tenth of Gherke's tube.

In the Neobeam Oscilloscope, the image is reflected upon a revolving mirror so as to sweep the image horizontally across the line of vision of the observer. The sweep is controlled with a Vari-Speed Motor unit calibrated in R.P.M. This direct reading feature is especially important in making frequency determinations with the oscilloscope.

One microvolt input is sufficient to produce a full-scale deflection of the image on the four-inch calibrated screen. This extreme sensitivity is hard to imagine; for example, one foot of bare copper wire attached to the end of the shielded cable which is connected to the input terminals of the oscilloscope provides sufficient pick-up to indicate a 60-cycle line five feet away.

The unit as illustrated measures 8 3/4" wide by 10" deep by 13" high and weighs twenty-five pounds. The panel has an etched chrome finish with a 4" calibrated screen in the upper center. The cabinet is finished in black crackle and is fitted with a strong leather handle.

The Neobeam Oscilloscope opens a new field in audio measurement and is especially adapted to the rapid study and demonstration of audio frequencies at low cost. The schools find it ideally suited for the demonstration of alternating current phenomena, sound, pitch, timbre, frequency, and wave form.

New Transmitter Manufacturer

Rocke International Electric Corp., 100 Varick Street, New York City, announces formation of the U.S. Transmitter Corporation, a new organization manufacturing all types of communication apparatus. Transmitters, receivers, and amplifiers for the government and export market are now being made in the corporation's new plant at 75 Crosby Street, New York City.

A. Pleasanton, formerly of Marine Radio Co., is plant manager. Frank Edmonds, formerly with Meissner and United Transformer Corp., is chief engineer.

25B5—25N6-G Output Tube

Arcturus has added to its line a 25B5 and its octal base counterpart, a 25N6-G tubes. This is a duplex-triode power output tube permitting circuit simplicity, and it is particularly designed for a.c.-d.c. sets.

[Continued on Page 88]

The 808 Triode

[*Continued from Page 15*]

Typical operation:

Filament voltage (a.c.)	7.5	7.5	volts
D.c. plate voltage	1250	1300	volts
D.c. grid voltage	-30	-35	volts
Peak r-f grid voltage	65	60	volts
D.c. plate current	55	45	ma.
D.c. grid current (approx.)	1	1	ma.
Driving power (approx.)	3	2	watts
Power output (approx.)	22	22	watts

As Plate-Modulater R.F. Power Amplifier—
Class C. Telephony

Carrier conditions per tube for use with a max. modulation of 1.0

D.c. plate voltage	1250 max. volts
D.c. grid voltage	-400 max volts
D.c. plate current	125 max. ma.
D.c. grid current	35 max. ma.
Plate input	135 max. watts
Plate dissipation	35 max. watts

Filament voltage (a.c.)	7.5	7.5	volts
D.c. plate voltage (a.c.)	1000	1250	volts
D.c. grid voltage	-210	-225	volts
Peak r-f. grid voltage	360	360	volts
D.c. plate current	120	100	ma.
D.c. grid current (approx.)	35	32	ma.
Grid resistor	6000	7000	ohms
Driving power (approx.)	11.5	10.5	watts
Power output (approx.)	85	105	watts

As R-F Power Amplifier and Oscillator—
Class C Telegraphy

Key-down conditions per tube without modulation

D.c. plate voltage	1500 max. volts
D.c. grid voltage	-400 max. volts
D.c. plate current	150 max. ma.
D.c. grid current	35 max. ma.
Plate input	200 max. watts
Plate dissipation	50 max. watts

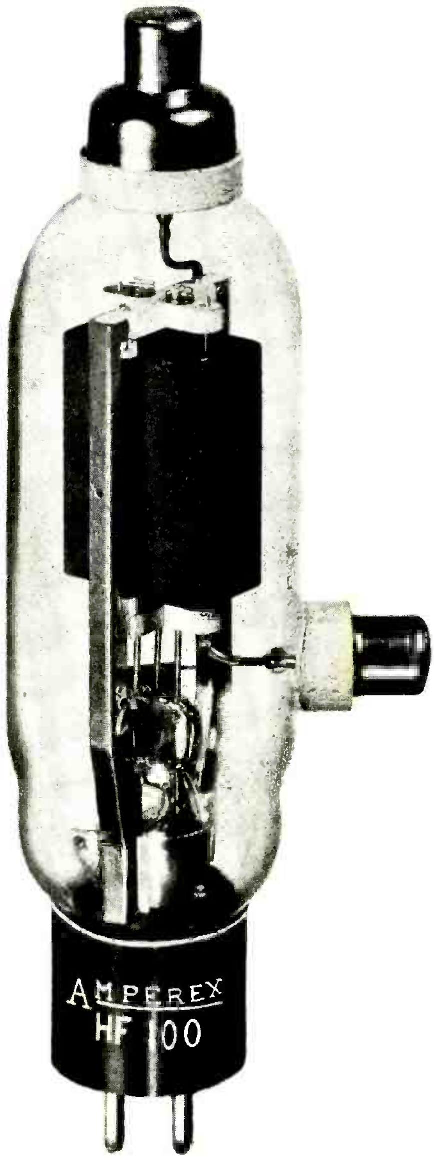
Typical operation:

Filament voltage (a.c.)	7.5	7.5	volts
D.c. plate voltage	1250	1500	volts
D.c. grid voltage	-150	-200	volts
Peak r-f grid voltage	300	350	volts
D.c. plate current	135	125	ma.
D.c. grid current (approx.)	30	30	ma.
Driving power (approx.)	8	9.5	watts
Power output (approx.)	120	140	watts

"... It is absolutely the easiest tube on the American market to drive ..." WRITES W4AZK, GRIFFIN, GA., OF THE

AMPEREX HF 100

AND WHAT'S MORE ... "Any of the fellows getting ready to revamp the old rig and want to hear the HF100 just give us a call"



But here's the letter . . . read it yourself

Gentlemen:

We are so genuinely pleased over the new Amperex type HF100 transmitting tube that we just had to write about it. Before buying the tube may we state that it was a toss up between the HF100 and another popular make of tube having the same characteristics. After installing the HF100 we kept a careful log on filament and plate voltages and plate and grid currents. **It is absolutely the easiest tube on the American market to drive with a given input.**

(Note: 260 watts of output can be obtained with 2 watts of driving power.)

Below are some of the reports received and stations worked in **one** evening from eleven o'clock PM to six o'clock AM and in a location very unsatisfactory for DX. The figure after the call letter indicates the signal strength as reported to us by that station. An input of 200 watts was used at 14,160 kc.

W6ISH-9	VE4CW-8	G2NQ-8	VP9R-8
VE1BR-9	F8LL-9	F3EO-8	VE2BG-9
W6FGU-8	TI2DC-7	G6AH-8	TI2CR-7
W7AOT-8	G2MV-7	VK5LL-7	TI5JJ-8

This was two weeks ago and we are having the same consistent reports come in. We cannot say too much for the HF100 as we believe it to be a tube that cannot be beat. Any of the fellows getting ready to revamp the old rig and wanting to hear the HF100, just give us a call.

Very truly yours,
David S. Traer, Lewis M. Maddox; W4AZK.

$10

CHARACTERISTICS

Filament........Voltage 10 Volts
Current 2 Amps.
Amplification Factor........23
Grid to Plate Transconductance @ 100 ma........4200

Direct Interelectrode Capacitances:

Grid to Plate........4.5 uuf.
Grid to Filament........3.5 uuf.
Plate to Filament........1.4 uuf.

Write to our Engineering Department for Complete Data

AMPEREX
ELECTRONIC PRODUCTS, Inc.
79 WASHINGTON STREET • BROOKLYN, NEW YORK

The Question Box

[*Continued from Page 35*]

W.E. ratings; so very few manufacturers guarantee filament life when operated within ratings. One or two manufacturers guarantee their tubes unconditionally against gas, which is a good idea as most tube failures in amateur hands are directly traceable to gas poisoning of the filament emission. Your best insurance against tube failure is to avoid even momentary overloads and keep the filament voltage well up.

•

I am planning a new receiver. Should I use the octal sockets or stick to the older sockets? I am going to use glass tubes.

I think that the octal sockets are desirable for all new receivers and speech amplifiers. The octal-glass tubes now include practically every type available in the old glass type and you may want to change to metal tubes later on. The sooner the octal base becomes standard the better for everyone.

•

What is meant by the term "minimum plate voltage" in referring to a class C amplifier?

The plate voltage, at any instant, on a class C amplifier is the sum of the d.c. plate voltage plus the a.c. voltage drop across the a.c. load resistance. When the a.c. plate voltage has the same polarity as the d.c. plate voltage the sum of the two may be close to twice the d.c. plate voltage. One-half an a.c. cycle later the a.c. plate voltage is opposite in polarity to the d.c. plate voltage so the two neutralize and the actual plate voltage is the *difference* between the two. At the instant when the a.c. plate voltage is most negative the actual plate voltage (d.c. plate volts minus a.c. plate volts) may only be a couple of hundred volts. This represents the "minimum plate voltage" and is important because plate current in a class C amplifier flows only when the plate voltage is down near the minimum plate voltage and therefore the actual voltage drop across the tube, and the plate loss, occurs when the instantaneous plate voltage is lowest.

•

Does grid leak bias waste more excitation power than battery bias on a class C amplifier?

This question has probably been the subject of more argument in ham circles than any other one controversy. The answer is no. For a given bias voltage and d.c. grid current the excitation power dissipated in all types of bias supply is the same.

•

Would a combination antenna consisting of a vertical and a horizontal dipole joined somehow at their centers be particularly useful for ham use?

Offhand, I don't know. It might but I am inclined to think that its disadvantages would at least offset any possible advantages. Try it and see. Most ham progress has come from disagreeing with current practice.

•

What can be done to reduce the QRM in the phone bands? Is single sideband transmission coming?

Single sideband transmission will probably come if something better doesn't come along first, but it is still a ways off for ham use.

Phone QRM could be reduced materially by causing all phone stations to use voice-controlled relays to cut the carrier on and off, together with single dial frequency control. The effect would be full break-in and each pair of stations in QSO would get on the same frequency. The next, and most important step, would be a greater respect for the rights and efforts of others, to the end that each operator talks only when he has something to say and not just to hear his own voice.

•

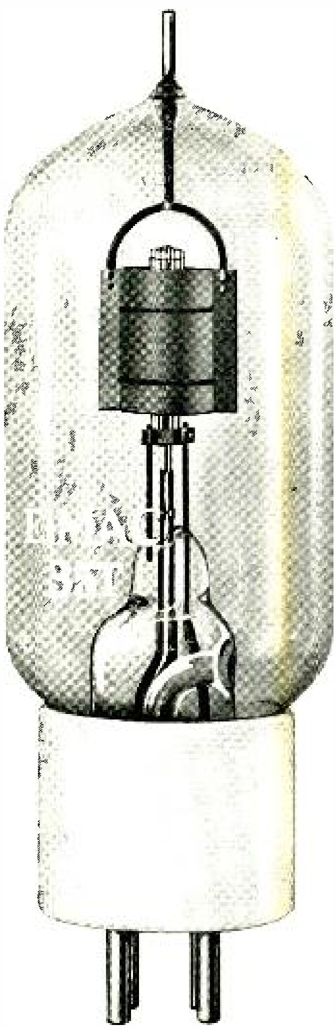
What are the first symptoms of a transmitting tube going flat?

Usually the d.c. grid current starts to drop and the plate starts to run slightly warmer. The operator usually blames his buffer stage and cranks the buffer up until the grid current on the final is normal again. Then the grid current drops some more and the operator usually tears out his buffer stage and rebuilds. Maybe he blames his buffer tube, thinking it flat when the real trouble has been in his final tube all the time. A drop in d.c. plate current and r.f. output are the last symptoms of a flat tube that appear. As a tube flattens out it gets harder to excite to full output.

THE EIMAC 35T

THE ANSWER TO THE AMATEUR'S PRAYER

The EIMAC 35T Fills Every Requirement of Your Present or Future Transmitter



EIMAC 35T
Actual Size

Class "C" R.F.

Single tube rated at 170 watts output. Users report nearly double this output under overload conditions.

Two tubes give ¼ kilowatt output with only 1100 volts on the plate.

Push-pull 35Ts give 200 watts output on 5 meters.
(High mu simplifies bias problems and saves on excitation power)

Class "B" Audio

A pair of 35Ts give 235 watts of class "B" audio output with practically no distortion.
(High mu simplifies bias requirements)

Crystal Oscillator

High mu plus extremely low interelectrode capacities makes possible 40 to 60 watts output from a single 35T as a crystal oscillator. Low value of RF crystal current. Conventional circuit with only one tuned circuit.

Frequency Multiplication

60 watts output with 60% plate efficiencies when quadrupling with a single tube.

100 watts output when doubling.
(Excellent electrical characteristics makes "trick" circuits unnecessary)

The EIMAC 35T does not have to be "nursed". Accidental momentary overloads of two, three, or four times the "normal" plate dissipation will not release gas from the tantalum electrodes exhausted by EIMAC'S exclusive pumping process.

Get your EIMAC 35T today from your leading dealer

EITEL-McCULLOUGH CO. *Inc.*

SAN BRUNO, CALIFORNIA, U. S. A.

6L6 Exciter

[Continued from Page 38]

Crystal Warning

In the course of trying different 40-meter crystals in the exciter, it was discovered that an occasional AT-cut crystal would be deficient in 10-meter output. All X-cuts on hand gave full output on 10 meters, but it was discovered that one out of four of the AT-cut crystals tried would not work well on 10 meters, although the output on 40 and 20 meters with these same crystals was all that could be desired. We have not yet had time to determine just what causes these crystals to be deficient in 10-meter output, but suspect the type of mounting has something to do with it. The many crystals tried were mounted in several different types of holders. If the exciter works well on 20 and 40 but will not deliver 3 watts or so on 10 meters at full voltage, it is a good idea to try a borrowed crystal in order to determine if the crystal is responsible.

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SAFE CRYSTAL CURRENT

Amateurs will spend several dollars for a plate meter for a stage containing a $.49 receiving tube, but they make no move towards measuring the crystal current of a crystal costing several times more. It is all the more inconsistent when one considers that one can keep a check on the crystal current for just a few cents. A small Mazda lamp makes a good indicator of approximate r.f. current when one knows how to interpret the relative brilliancies. Two Mazda bulbs are analyzed in the following table. They may be used to read antenna current, feeder current, crystal current, or any r.f. current up to 0.25 amp., where an indicator of fair accuracy and negligible inductance and resistance is required. The type 46 is preferable for reading crystal current, as it offers less resistance to the circuit. If the current is too low to light the lamp you may be sure that the crystal is safe. If you are curious to know what the crystal current is below this value, the type 502 will serve the purpose down to 50 ma.

CURRENT VS. BRILLIANCY FOR MAZDA LAMPS

	Type 502	Type 46
Just Visible	50 ma.	95 ma.
"Bright"	100 ma.	180 ma.
Full Brilliancy	150 ma.	250 ma.
Rated Voltage (Full Brilliancy)	5 v.	6.3 v.
Watts Dissipated (Full Brilliancy)	0.75 w.	1.6 w.

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By-Pass Resonance

[Continued from Page 39]

always a smaller condenser or less-inductive wires (fatter or shorter). Here are some examples on the other side of the fence:

A broadcast-station transmitter working in the low-frequency end of the band was encountering "drummy" non-linear modulation during the late hours of the evening. Stage-by-stage examination showed that the trouble lay in the modulated tube, that it was regeneration, and that it showed up only late at night when the line voltage was up. This stage had independent filament supply, supposed to be properly bypassed to the transmitter frame, to which at *other* points were returned the grid and plate circuits of the tube. Since moving all bypasses to a common chassis-connection did not help much, the filament bypass was doubled with an immediate great improvement, satisfactory to the station staff. Since the original bypasses had been 0.1 μfd., this looked like bypass resonance. Without dis-assembling the "cold" transmitter a small oscillator was pushed into the set, the original bypass arrangement restored, and resonance spots hunted. The test-oscillator grid meter kicked heartily at a frequency just three channels away from the station frequency.

Exactly the same thing was met at 40 meters in a c.w. transmitter several years ago; so the broadcast folks have no monoply of it. Of course the c.w. set didn't show poor modulation; it just oscillated itself silly, for being an amateur set it didn't have to wait for high voltage—it had high voltage all the time.

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We understand that the Five Meter Bootleg Club was turned down in its request for affiliation with the A.R.R.L.


Super SKYRIDER
by the hallicrafters
TONE CONTROL
BAND SET
BAND SPREAD
PITCH CONTROL
R.F. GAIN
A.V.C.
OFF
ON
BANDS
REC.
SEND
OUT
IN
CRYSTAL PHASING
B.F.O. INJECTION

The "QRM Dodger"

[Continued from Page 43]

the first tube in the transmitter is running as an amplifier, being excited on its output frequency. Result: an increase of excitation all down the line.

An exact duplicate of this unit can be built for approximately twenty dollars, and considering the fact that it provides an oscillator stage in addition to its other advantages, it becomes a very reasonable and worthwhile investment.

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Curing "Suppressor Quality"

[Continued from Page 45]

change takes place—and they *always* do. Ask any good broadcast-station engineer. There's an idea: you will do the station much more good by purchasing a cathode-ray tube instead of buying a "pull" tube to go opposite the "push" tube. Just use the oscilloscope and get the "push" tube to push harder and sound better.

The "Variable Mu Horn"

With the best adjustment of antenna coupling, screen voltage, supressor voltage, r.f. input, and a gridleak of about 7500 ohms on the RK-20, we emerge with a figure about like "C". To a man used to suppressor-modulation diagrams this looks good. To one used to neutralized triodes it looks terrible on account of the horn at the tip of the figure. This tip seems to be due to a variable-μ action of the suppressor grid. Very probably it could be eliminated by a re-design of the RK-20 tube. We did nearly eliminate it by a circuit dodge. It is doubtful if either expedient is worth while. The "horn" looks unpleasant on the cathode-ray screen but its elimination does not do anything important to the sounds heard at the receiver when voice only is used. With steady sounds of 100% modulation it can do some damage, but who cares if that damage takes place only when someone is saying "Helooooooooooooo"? If this horn is very large the input of the RK-20 is not well shielded from the output.

Figure "C" seems satisfactory for amateur voice communication and a considerable improvement over the operation of many sets now on the air. Note that the conclusions apply to RK-20 tubes only.

Mobile Receivers

[*Continued from Page 47*]

The two circuits are both economical as to battery drain, the filaments requiring 0.32 ampere for no. 1 and 0.38 ampere for no. 2 so that the converter-device is almost the entire load. The power supply circuits may be studied closely to real advantage when designing 5-meter mobile gear. Most of the foregoing information was taken from the R.C.A. Manufacturing Co. "Application Note no. 46".

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Uncle Tom's Dictionary

[*Continued from Page 48*]

QRI?: I am using raw A.C. Can you read me, by any chance?

Test VK, ZL: CQ U.S.A.

Fone stations only: I can't read code, so it's no good calling me on C.W.

"Dear OB": Hell! You again?

Foto-for-foto: A meaningless formula. Possibly continental equivalent to QSLL.

QRM spitch: Sorry, didn't get that. You might send a bit slower next time.

And so, for the present, dear readers, we leave you. Brickbats thankfully received, preferably by post, but *not* across the table at Convention Dinner.

◆

Efficiency Yardstick

[*Continued from Page 49*]

power output. This is not true because the circuit losses unloaded are many times the losses when properly loaded. As a matter of fact, when the minimum unloaded plate current is 10% of the loaded plate current, the tank losses approximate only 1% of the plate power input to the amplifier, when operating properly loaded. This amount is quite small but the losses rise rapidly as the ratio of unloaded current to loaded current goes down. The formula shown below gives a good approximation of the loaded circuit losses expressed in percentage of the plate input.

$$\% \text{ circuit loss} = \left\{ \frac{10 I_2}{I_1} \right\}^2$$

Where I_1 is the normal loaded plate current and I_2 is the unloaded minimum plate current, both in milliamperes.

This loss is not the difference between amplifier input and output. It is only the inherent circuit loss and does not include the tube loss. However, it is closely related to the tube loss as it is impossible to get high tube efficiency unless the inherent circuit losses are held to a very low value. In other words, if the circuit losses are higher than allowable, it will be impossible to get high plate efficiency from the amplifier tube. This is especially important as the plate voltage goes up. As the d.c. plate voltage on an amplifier is raised, the minimum plate current when unloaded will go up. At high plate voltages the inherent circuit loss has a much more detrimental effect on the amplifier plate efficiency; so with high plate voltages more pains are necessary to eliminate circuit losses in order to achieve the benefits of high plate voltage in raising tube efficiency.

High inherent circuit loss also adversely affects the linearity of an amplifier which is grid or plate modulated. An amplifier will always neutralize better when the inherent loss in the plate tank circuit is held to a low value.

In order to get low loss tanks, use exceptionally short and direct r.f. leads. Cut off that last inch from grid, plate, and neutralizing leads. Use husky one-eighth inch copper tubing for r.f. leads, even for a 210-stage. Use as little as possible supporting material in the plate coil, even if it is Mycalex. Avoid Bakelite insulation in general, although certain rare types of Bakelite are quite low loss. Check the bearing contact in the plate tank condenser and solder or bolt a husky pigtail to the rotor if in doubt. Keep the amplifier symmetrical with respect to ground, if possible, to avoid circulating currents where such currents should not be.

Use as few r.f. chokes as possible and try different sizes for minimum plate current. Avoid long, stranded leads to the tube elements. When such leads must have a certain amount of flexibility to avoid placing strains on the glass envelope of the tube, use only an inch or so of flexible conductor.

Don't skimp on the plugs and jacks used to connect the tank coil to the tank condenser. Don't forget that the circulating tank current is usually many *amperes*, not milliamperes, and only a small fraction of an ohm resistance at this point will cause considerable loss. If possible use big, husky, quarter-inch plugs and screw chucks that can be cinched up. One or two manufacturers make a spring jack for quarter-inch plugs which is good.

Make all joints in wiring solid. *First* make a good wrapped wiping contact; *then* make a good clean and big soldered joint over the wound or wrapped joint. Solder has rather high resistance. Sometimes metal panels or wood breadboards are close enough to the coil to cause induced losses, but usually a single coil diameter clearance will allow sufficient spacing.

A low C tank circuit has somewhat lower losses, *when unloaded*, than one with somewhat higher capacitance. However, too low a C to L ratio may cause excessive losses under load, due to too low a Q. The test of circuit merit (Q) when loaded is to see that minimum plate current occurs at the same point on the tuning as maximum r.f. output.

Close coupling between turns in a tank coil is desirable as it raises the inductance for a given amount of wire and loss resistance. However, it also increases the distributed capacitance of the coil, which may or may not be a disadvantage, depending upon frequency, etc. Sometimes too close coupling actually increases losses due to increasing eddy current losses in the coil conductor. However, turn spacings of about one diameter of the tank coil conductor will usually be satisfactory.

Simple 50 W. Transmitter

[*Continued from Page 59*]

tive coupling must be used. To put it into operation, one merely increases the loading until it will not key cleanly regardless of the setting of C_4. Then back the loading off a bit and adjust C_4 for cleanest keying. The output under these conditions (with a good crystal) will be of the order of 50 watts.

As a Driver

There is no reason why the oscillator cannot feed a buffer or final instead of an antenna. The advantages of starting out at a high power level have been known for a long time, but this usually means high crystal current. Not so with this oscillator. And it may be used to drive a 150-watt doubler stage on 20 meters directly, which may drive a 1 kw. final. This makes a 20-meter one-kilowatt rig with but three stages.

Coils

The plug-in tank coil shown in the photo is a small, manufactured type which is wound with phosphor bronze wire and mounted upon a standard 5-pin base. These coils are available for any band ready-made, but any efficient coils may be used, just so long as they tune with a very small value of tank capacity. The output of the oscillator falls off somewhat when high "C" is used, and the stability is just as good with a low "C" plate tank.

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"Oscillation"

"The writer has just completed a modern single signal superhet. on Frank Jones' lines following the Super Gainer design in RADIO (U.S.A.), but, for the time being, made *minus* the quartz crystal filter. Initial tests reveal that for all practical purposes such a filter is unnecessary. Of all receivers yet used by the writer, this is indeed the shining star. It will be described in detail on this page in the near future. A regenerative 6C6 detector, with 76 oscillator, is followed by a 6D6 I.F. stage and 79 regenerative second detector. The intermediate transformers are Aladdin iron core, and more than justify their inclusion. Although transformers of this make are not normally obtainable in Australia, there are several iron-core makes now putting in an appearance. From the moment the receiver was lined up and tested, DX 'phone stations which previously were only a weak carrier were heard and *understood*. The combined second detector and beat frequency oscillator work perfectly, and altogether the receiver is a revelation."
—*The Bulletin* (Sydney).

"Radio" for Christmas

AN IDEAL GIFT

RADIO's annual Christmas gift rates will be in effect from November 15th to January 15th. To radio amateurs with a "fellow ham" to remember, to radio employees with a radio-minded employer who must not be forgotten, and to radio manufacturers and distributors who want to remind a favored customer repeatedly through the year of their appreciation of his business, a RADIO subscription is an ideal (and effortless) solution of that puzzling Christmas shopping problem.

ONE SUBSCRIPTION	$2.50
TWO SUBSCRIPTIONS	4.00
THREE SUBSCRIPTIONS	5.00
ADDITIONAL SUBSCRIPTIONS, each .	1.50

These rates apply for the U.S.A., Canada, Newfoundland, Cuba, and Mexico. To other independent American countries and Spain, add 50c per subscription. Elsewhere, add $1.00 per subscription.

YOU MAY ENTER OR RENEW YOUR OWN SUBSCRIPTION AT THESE RATES

Rates for more than one subscription, as listed above, apply only on gift orders entered and paid for at one time by one individual or company. Unless otherwise requested, the subscriptions will be commenced with the January issue, which will be delivered as near Christmas as possible, together with an attractive card announcing the gift and the sender's greetings; those who are at present subscribers will automatically have subscriptions extended unless otherwise requested.

Cooling the Crystal

[*Continued from Page 19*]

plate or by convection currents—both very small. However, if the crystal holder is merely turned over and mounted face down on the metal chassis, or panel, a substantial improvement will immediately result.

The curves shown in figure 1 are typical of the reduction in drift attained by this method. To obtain the curves a 3.5 Mc. crystal was operated in the conventional oscillator circuit with a 53-type tube. The radio-frequency current through the crystal was held constant at 75 milliamperes. Both runs were started with the crystal cold, and in the first case the temperature rise of the top plate of the holder was measured, while mounted in the usual socket. The second run was taken with the holder mounted top down on the aluminum chassis. After this illuminating finding, a little clip arrangement was made of spring brass and Formica studs for plug-in mounting in this position. The arrangement is shown in the photo. Of course, continuity between the plugs and the exposed plate of the holder must be checked, so that the grounded plug can be marked. Then the holder always can be plugged in with the exposed electrode on the grounded side of the circuit.

Another mounting scheme is to slot out the screw holes on a wafer socket, push it on the crystal holder, then turn it upside down and slide the slots under the heads of screws of just the right length. Still another arrangement utilizes mounting details as outlined above, but holds the crystal plate tight against a fairly large block, 3 or 4 inches on a side, of copper, brass, or aluminum. The idea is to provide a mass of large thermal capacity and good conductivity to soak up rapidly the crystal heat, and then to throw it off from the large surface areas. The block may or may not be fixed to the chassis. If the chassis warms up in operation from other heat sources, the block had best not be attached to any heat-conductive material. Any simple little thermometer will enable one to tell within a degree or two the temperature changes on crystal plate, chassis, or heat block, and a slight amount of judicious experimenting can be made to result in a much cooler crystal.

Ultra Dx Attempts

[*Continued from Page 25*]

was not feasible as no plates could be secured that were fast enough.

It was finally decided to use an oscillator in the intermediate stages which would be set past the oscillation point in such a way that oscillation would occur when the signal "triggered" it, provided that the signal was above the background noises, and a deflection would be noted in the plate current milliammeter. The receiver would then have to be reset. Due to a time lapse of about three seconds for the signal to travel to the moon and back, even if the receiver were set off by the initial transmission, it should be possible for the operator to reset the receiver.

Following the attempt with instantaneous spark on September 2, a transmission of 250 cycle i.c.w. was to be directed towards the moon. The power was to be around 100 watts and listeners were requested to co-operate.

In an attempt to do some five meter dx without the help of the moon, schedules during the spring (our fall) will be kept. During these, the beam will be placed in various positions, both with regard to elevation and direction, and the waves will be changed from vertical to horizontal polarization. The transmissions will be of the form:

V V V V de ZL3XB (or ZL3GD),

and the positions of the beam will also be sent. These, too, will be on 250 cycle i.c.w., and again listeners are asked to co-operate by sending in reports.

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Modulation Movies

[*Continued from Page 29*]

ruption is accomplished at the transmitter by means of any suitable make-and-break device, such as a rapidly-revolving commutator ("tone-wheel") or buzzer with auxiliary contacts connected in the radio circuit. The rate at which the interruptions occur determines the pitch of the tone given to the signals. Unlike pure c.w., i.c.w. rides into a non-oscillating receiver as musical signals.

The other class of emission included in type A2, tone-modulated c.w., is obtained by *modulating* the carrier at the desired tone frequency instead of chopping it up. The carrier amplitude rises and falls at the modulating frequency but is nowhere cut off as in i.c.w. It is this class of A2 emission that is universally misnamed "i.c.w." by the 5-meter crowd.

Tone modulation is obtained frequently by introducing an audio-frequency oscillator at the input terminals of the speech amplifier of a radiophone transmitter or by keying a buzzer or similar device before the microphone. It is also accomplished by supplying the final amplifier plate with alternating voltage of the desired tone frequency in place of the usual d.c. It is this latter system that is employed in the familiar commercial 500-cycle transmitters.

At this point, it is stressed that when the d.c. voltage supplied to the transmitter tube plates is of such character that it undergoes some periodic variation, though not falling low enough in value at any time to cause a break in the carrier, an unwanted A2 type of modulation is given the carrier. Poor filtration and a host of other causes which introduce rapid fluctuations in the plate voltage will result in this evil. It is imperative that amateurs operating in c.w. bands remove any factor which might introduce undesirable modulation effects.

A3 phone emission differs from the tone-modulated A2 wave only in that the modulating frequencies used in the former are those of voice or music rather than the steady note of an oscillator or other tone device. Cut-off periods are absent, and appear only when over-modulation enters the picture.

Successive amplitudes decrease more or less uniformly in type B emission until the waves finally die out, after the manner of a free-swinging pendulum, whereupon there ensues a cut-off period and the chain of events is repeated. This effect prompted the name, *damped* waves. It is high damping due to the cut-off periods that gives rise to the broad-tuning feature of type B emission. The same factor causes a phone signal to tune broadly when over-modulated.

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28 and 56 Megacycles

[*Continued from Page 58*]

VE4PH: Claims first VE4 contacts with Africa, Asia, and YM4 on this band. He believes that he is the only VE4 to work all continents on "ten", the only other VE w.a.c.'s, so far as he knows, being VE2EE and VE5AC; if the impression is not correct, write to him. Using a 24A electron-coupled oscillator, 46 and 802 doublers, 800 final with 85 watts input. Receiver is an autodyne using a 77 and a 76. Antenna is a vertical doublet. His calls heard list gives J2KJ an R9 and J2IS an R8!

G2YL: September conditions were excellent; twenty countries, all continents, being reported by G stations. This is a great improvement over September 1935 when the band was reported dead on fifteen days, a total of nine stations then being reported in Europe, South Africa, and Argentina. Aussies came through during the last ten days in September, the usual time being around 0800 G.m.t. but occasional stations are reported as late as 1245. J2IS was heard working OH, but no other Asians. Africa was heard daily after the 6th. South Americans were heard on about thirteen days, including OA4J and LU stations, usually com-

28 and 56 Mc. Reports

· Reports and other material referring to the 28 and 56 Mc. bands, should be sent to E. H. Conklin, W9FM, Assistant Editor of RADIO, 512 No. Main St., Wheaton, Illinois, who will correlate and assemble the data for publication. Reports should *reach him* by the 22d of each month.

ing through when conditions for U.S.A. were comparatively poor, at times from 1330 G.m.t. onward. The only Central Americans were XE1AY, K5AY, and TI2EA. North America was consistently good after the first week, apart from four days when only one station was heard each day. Sometimes such stations as W6GRX and W7AMX and many W5's were R8. Some of the west coast W's heard by G's in September were W6BXL, W6ADP, W6DOB, W6DTB, W6GRX, W6GUQ, W6HB, W6HJT, W6JNR, W7AMX, W7BPJ, W7BQX. In the first half of October, the band was booming. VK4AP has been coming through as late as 1500 G.m.t. ZL's have been getting through for the first time on record (contests do seem to help!), ZL3DJ especially. Also, J2IS and J2JK have been heard. On the 12th, I worked W6JJU R8 both ways—loudest W6 ever heard here *on any band*. (Jerry, you win after all—but won't Kathleen be jealous of these YL's?)

W3AIR: Reported October 2 after QSO with J2IS from 7:50 to 8:15 p.m. E.s.t. TDC and JNJ had been R8 all evening, indicating the possibility of hearing J's. FB8AB has been coming in fine on 28,300 kc. with a T7 signal. Conditions were fairly good since middle of August although signal strengths are weaker than a year ago. On October 5th, worked VU2AU (28,075 kc.) at 8:30 a.m. for 41st country on "ten".

W9ZT: Reported on September 25th, just missing last issue. G's and F's coming in R8-9 on phone and code. Africans and J's practically nil. VK-ZL loud, as early as 2:30 p.m. Central time. LU9AX, NY2AE phone, and CM2AF best from south. Using 250 watts input, poorest report R6 from OZ2M. Dx more consistent than U.S.A.

W6ITH: Using phone only. Working mostly VK's but have been reported in Europe several times.

W1IOB: Member of 210 dx club; uses 210 as final doubler, 50 watts input. Worked all dx called in three continents—mostly Europe—except SM7UC and I1IT. Receiver a single 24A!

W3FAR: Daily report covers October 1-18. Europe in late forenoon with combination of short skip bringing in W9 and W1 signals on the 1st. On the 7th, 8th, and 16th, ZS1H and XE1AY heard, but no Europeans. On the 17th VK-ZL signals by the dozen from 3 to 6 p.m. in their contest. Combination of dx with short skip again on the 18th with W1-2-3 and 8 signals coming in. Short enough to permit five-meter work at 700-1000 miles. Band open for W work a good share of the time. Dx and domestic signals are now lasting until 8:30 or 9 p.m. daily.

W6JNR: Europeans coming in well mornings. Have been concentrating on OE1FH ad SM7UC with no luck.

W9JNB: First fall dx was K6MVV on September 13. First European. F8WK on the 17th, followed by OK1AW and a dozen others. ZT2B, FB8AB, and ZE1JJ were heard up to the 21st, but no South American signals until LU9AX on October 1st. VU2AU came in October 5th and was worked on the 7th for WAC/WBE. He pushed the S-meter on the HRO up to S9 on peaks. ZU1C was R9 on low-power phone on the 14th. Using 7 Mc. crystal in a 6L6 quadrupler, 802 buffer, RK20 final. Antenna is 99-foot end-fed, used for receiving and transmitting. Work with W9HAQ at Broadcast Station WHBF—both of us being w.a.c. on 28 Mc. Can any other mid-west B.C. station make that claim? Incidentally, W9HAQ will soon be back on ten with a pair of HK354's.

New Radio Club

An open house for all radio amateurs and SWL's was held October 8 by the newly-organized Midwest Amateur Radio Association, in its quarters in the Midwestern Club, Chicago. About 100 attended.

The club was formed in order to further personal contacts of hams with each other and to provide a link between hams and SWL's who tune in on them. Several modern receivers have been installed in the clubroom and a 300-watt transmitter is now in the process of construction.

W9JNF is president; W9WAF, vice president; W9TTZ, secretary, and W9SZW, publicity director. They meet the second Thursday of the month. Midwest Radio Mart is sponsor.

What's New

[Continued from Page 70]

Used as a single ended class "A" amplifier with 110 volts d.c. supply, this tube will develop 2 watts of audio at 9% total harmonic distortion.

The tube operates without "C" bias, obviating the need for bias resistor with its necessary filter network. Because the grid does not draw current (since an automatic bias is applied within the tube) the input impedance is high and the tube needs no special driving equipment such as is necessary for class "B" operation.

Inexpensive Cathode Ray Tube

R.C.A. has released a new low-voltage cathode ray tube of the high-vacuum, electrostatic type. This tube, designated as the 913, is quite different from other cathode ray tubes. It is constructed like an all-metal receiving tube, except that the end of the metal shell is replaced by a fluorescent viewing screen approximately one inch in diameter.

The 913 is designed for operation with an anode voltage as low as 250 volts, and will stand as high as 500 volts. It is provided with two sets of electro-static plates for deflection of the electron beam. The luminous spot produced by the 913 has a greenish hue.

Because of its low cost, unusually small size, and its ability to produce a bright image at extremely low voltages, the 913 is especially suited for use in compact, portable, oscillographic equipment. For example, the 913 may be built right into a transmitter as an integral part, thus giving a constant check on the operation and modulation of the transmitter. Because of its low price, amateurs will find many uses for the tube where previously the cost would have been prohibitive.

The tube has a 6.3 volt 0.6 amp. heater, and except for the "window" in the end looks outwardly very much like a metal 6L6.

◆

160-meters is a good place to get rid of a good many jokes that are not funny in print or in the theater any more.

TUBE TECHNIQUE

By Jayenay

150T: Recent laboratory tests on typical 150T's indicate that the manufacturers' rating of 200 ma. maximum space current can be exceeded under proper conditions of filament voltage. A single 150T gave 1000 hours of life at 500 ma. average d.c. space current when operated at 6 volts filament voltage. At 5.7 volts filament voltage and 400 ma. space current 2000 hours of life can be expected. At 5.5 volts and 300 ma. the life can be proportionately extended. At the rating of 5.0 volts and 200 ma. space current at least 5000 hours of life and in many cases 10,000 hours of life will be obtained. The life at 5.3 volts is practically the same as it is at 5 volts.

Above 200 ma. the ratings are being exceeded; so do not expect the guarantee to be upheld if operated under these conditions. Also it is highly important that an *accurate* filament voltmeter be used to measure the filament voltage *at the socket.*

50T: Life tests on the 50T also show that the space current rating can be safely exceeded at higher than normal filament voltage. At 5.5 volts on the filament 250 ma. of average d.c. space current still allows a life of 2500 hours or so.

35T: Life tests on the 35T have not been completed but indications are that probably 175 ma. space current at a filament voltage of 5.5 volts will still allow well over 1000 hours of life.

HK354: Filament characteristics are quite similar to the 150T and the space current may be increased with an increase in filament voltage, the useful life being shortened about as given for the 150T.

Warning

If an attempt is made to run these thoriated filament tubes at a plate current much in excess of the rated maximum value without increasing the filament voltage, the tubes will be damaged, possibly permanently.

The actual number of hours the key of a c.w. transmitter is "down" during a year of average amateur operation is surprisingly small. Therefore, the raising of the filament voltage in order to run more plate current (and input) is a wise expedient for such a rig if not carried too far. If carried to extremes, one would be better off to spend more money and get a larger tube in the first place.

The long and short of subscription addresses as taken from our foreign stencil files:

Interessengemeinschaft Furrundfunkschutzrechte E.V. (I.G.R.), Zimmerstr, 3-4, Berlin SW 68, Germany

F. Fleming,
Suva, Fiji

•

All celluloid (what ham hasn't used it) is, and always has been, made by the same company.

East Rockaway, L. I.

Sirs:

During the last 10 years the undersigned has been engaged in radio, both as a hobby and an occupation, as the owner of an amateur station and as service manager for a large radio concern which at the present time is servicing more than 100,000 sets in the metropolitan area.

Discussing the problem of interference with amateurs and studying the complaints from set owners, I find that 60 per cent of the complaints are caused by so-called man-made electrical interference that usually is easily avoided if the source is properly filtered.

This opinion is shared by most radio editors, engineers, manufacturers, dealers, amateurs, a large number of public officials, and a slowly increasing percentage of the general listening public.

Realizing that a great service could be rendered to the entire radio industry if this nuisance could be curbed, I have started a nation-wide drive against all sources of radio interference.

To make this dream a reality I have formed The National Association for the Prevention of Radio Interference, a non-profit association supported by contributions and whose officers are to serve without pay.

The members accept no responsibility other than a pledge to support a general policy of noise reduction and suitable legislation.

On this basis, the New York Herald Tribune has supported the program editorially. The New York Journal, New York Times and New York Sun have given us splendid publicity and the New York World-Telegram and the Pittsburgh Press are sponsoring the campaign. Hugo Gernsback is aiding the campaign editorially in Radio Craft.

A few of the people who have helped to launch this program are Mr. Arthur L. Hodges, editor, Nassau Daily Star of Lynbrook, L.I.; Hon. Alanson Abrams, Mayor of East Rockaway, L.I.; L. A. Hammarlund, manufacturer; Capt. Horace L. Hall, New York Sun; Ted Rogers, World-Telegram; Si Steinhauser, Pittsburgh Press; I. A. Mitchell, United Transformer Co.; Harrison Radio Co.; Leeds Radio Co.; and the Long Island Federation of Radio Clubs. N.B.C. and C.B.S. have given invaluable help.

On account of radio complaints the Long Island Lighting Co. has rebuilt most of its transmission system; the Queensboro Gas and Electric Co. all of its system; the New York and Queens Electric Co.; the United and the Edison Electric Co. have done extensive work along these lines. This is also true of many electric companies throughout the country.

The Public Service Commission of the State of New York has persuaded the Long Island Railroad Co. to begin extensive repairs to its system.

All complaints that are sent in will be carefully studied and used to persuade the guilty parties to reduce the interference. They will also be used to persuade a few manufacturers to change the design of their equipment.

Investigation has convinced us that there are very few sets that are of modern design that are not affected to some extent by easily avoidable interference, and many sets in thickly-populated sections are unable to pick up more than two or three stations above the noise level due to some electrical gadget.

There will always be a few people who have no regard for the rest of the community and to take care of them, the complaints will be used to convince local and national officials that legislation is a necessity.

The most progressive manufacturers of electrical household appliances, which in the past have been notorious creators of radio interference, such as oil burners, refrigerators, and kindred equipment, are now building them in such a manner that they no longer cause radio disturbance. This can be accomplished through proper designing at a small additional cost, and in some instances at an actual saving.

The present generally-accepted source of high frequency disturbance are therapeutic equipment, such as diathermy machines, x-ray and associated devices, and automobile ignition systems. Improved design in therapeutic equipment on the part of some manufacturers has greatly reduced the disturbance of this class of appliance. The automobile industry to date seems to have taken no step to eliminate the disturbance caused by ignition. However, we believe this can be done at the cost of a few cents a car, inasmuch as the air transport companies have solved this problem on their large planes.

The work before the National Association for the Prevention of Radio Interference represents a large undertaking. We can accomplish our purpose, which is improved radio reception for the millions of radio set owners in the country, only through the support of a large number of persons. We urge you to give us your personal assistance in this drive, as well as the benefit of any suggestions or criticisms you may care to make.

FRANK L. CARTER, *Chairman.*
National Association for the Prevention of Radio Interference.

◆

If you wanted to buy the equivalent amount of electricity that is contained in the average lightning flash, it would cost you about 29 cents.

CALCULATING REACTANCE

In alternating current work, both at audio and radio frequencies, we oftentimes need to know the impedance of a condenser of a given capacity to a certain frequency. For instance, in bypassing a cathode resistor of say, 2000 ohms, we want a condenser that will offer only about 1/10 the resistance (or 200 ohms) at the lowest frequency it is desired to pass. Another case: Our final amplifier is on 160 meters (1950 kilocycles) and has a non-inductive "center tap" resistor across the filament of the 210. The resistor is 30 ohms (15 ohms per section). Will there be any advantage in shunting each half of the resistor with a "double oh two" to allow the r.f. an easier path back to the filament? Or will the 0.002 µfd. condenser have a higher resistance to the r.f. than the 15 ohms it is across?

A chart giving the reactances of different capacities at different frequencies, to be reasonably complete, would make a book of five place logarithms look "sick". Fortunately, knowing one combination, it is easy to calculate any other; all we have to do is to remember *one* and do a little work with pencil and paper. Or, if the problem is in round numbers it can be done "in your head". (Where else would one do a problem?)

The reactance of a 1 µfd. condenser at 1 kc. (1000 cycles) is 159 ohms. For nearly all practical purposes we can use the figure 160 and simplify the calculation. If one memorizes those figures, it will be unnecessary ever to refer to a book. As the capacity goes up, the reactance goes down, and vice versa. Ten times the capacity, one tenth the reactance. So we *divide* 160 by the capacity of the condenser we're worrying about. Likewise as the frequency goes up, the reactance goes down. Ten times the frequency and we have one tenth the reactance. So again we must divide.

To get the reactance offered by a 0.004 µfd. condenser at 2000 kilocycles, we do as follows:

$$\frac{160}{0.004 \times 2000}$$

We divide the capacity in µfd. times the frequency in kc. *into* 160. The answer will be the reactance in ohms.

In the foregoing calculations we have assumed a perfect condenser. In practice, one seldom meets with perfect things. For that reason the impedance of a condenser at 20 meters (14,000 kc.) will not be exactly equal to the reactance as computed by the formula. The reactance of a 0.006 mica condenser at that frequency is already so low that increasing the capacity several times will only reduce the reactance by a fraction of an ohm. In actual practice the 0.006 μfd. condenser will be found to have *lower impedance* at 14,000 kc. than a 1 μfd. condenser, which, according to the formula, is all "wet". This is so because it is impossible to make a condenser without its having physical dimensions. And therefore the windings or plates or leaves of the condenser have inductance and resistance, which are enough to affect the impedance at very high frequencies. By making the condenser smaller physically and using good design the inductance and resistance are reduced, and even though the capacity may be smaller, it will offer less impediment to r.f. at 14 megacycles.

◆

Once there was a broadcasting station staff that practiced for weeks until they could exchange the big water-cooled tubes in less than ¼ of the time stated by the makers of the equipment. They had it down to lodge-drill-team perfection. So a foreign engineer came to visit them and at 1 A.M. they staged a show for him. They shut down the station, snatched the 6 foot tube out of the transmitter, slapped in another, spun down all the wingnuts, slipped on the connections like greased lightning, swung the tube holder upright, slapped shut the safety door and stood to attention while the chief punched the "on" button and—the big tube blew up!

◆

At first we thought we had tuned in on one of those 160 meter drunken parties, but listening closer we recognized it as the classic "A skunk sat upon a stump. The skunk thunk the stump stunk, and the stump thunk the skunk stunk."

Later we heard the same ham working someone, and when questioned about the skunk business, declared that he had been testing, and that he considered the customary "one, two, three, four" as sissy stuff.

Osockme, Japan.

Radio Magazeen
Dear Gentlemen and Ed.—

Oh joy; oh great hissing intake of air through teeths with pleezed expressions! What you think, hon. ed.? Scratchi have received diploma from Podunk Correspondence School and are now certified wireloose enginear. It are result of much study and burning of midnite oils till Scratchi's peepers looking like a pair of 6E5's on an R-9 signal. Diploma it are say to world at large that I are now Hashafisti Scratchi, H.S.E., and fully entitled to fix anybody's radio who will pay for same, and also free if cannot collecting for work. I believeing the H.S.E. stand for "hot stuff engineer", but according to amachoors at local club the H.S. stand for something else.

Pending such radio repair works, none of such which are come yet to Scratchi's shop to date in spites of diploma, I are working on program layout for my cousin, J. Pierpunk Scratchi, the great industrial typhoon. He are president of Scratchi Abrasive Co. Ltd. Inc., whose slogan are "Scratchi abrasives are a grate material. Ask the man who hones some."

Scratchi Abrasives are going on world hookup next week through Irrational Broadcasting System. Program manager at I.B.S. tell my cousin Pierpunk that even though it are an abrasive program, no rough stuffs will be tolerated, so Pierpunk are give me job of thinking up a slick program.

The Scratchi Abrasive hour are to follow the program of transniptions put on by "Smiling Isaac Mioshi, the Genius of Credit," who give discount of 20 per scent on down payment of 30 per scent on any suit or topcoat, with 27 months to pay the balance of 85 per scent, and if we are worried about payments will lending you monies to make same. He sine off by asking, "Ladies, have you thrilled to the credit of Smiling Isaac Mioshi?" Then giving the oclocks at sound of gong in Scratchi Abrasive Time, and Scratchi hour are start.

Are procuring the presents of the great Bing Kinoshi as gest artistics, and thinking he should knocking them for a loop, especials the young ladies. Opening number will be "Nagasaki", sung by Kinoshi, with male audience furnituring the "boo boo boo boooo".

Are not sure abouts rest of program, hon. ed., as are working on it now, but will signing off with Hashamura's Original Hillbillies playing "Japanese Sandmans" as Scratchi Abrasive Co. theam song. Are not collosus idear, hon. ed.?

Respectively yours,
HASHAFISTI SCRATCHI.
"Idle of the Air Lains"

◆

A new cathode ray tube has been released (RCA 913) that has a 1-inch screen and sells for considerably less than the 3-inch ones. You will be seeing a lot of this tube in the near future in amateur measuring equipment. Watch for these in RADIO.

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THE 200 PAGE

SPECIAL ANNUAL NUMBER

OF

RADIO

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BUYER'S GUIDE

● Where to Buy It

PARTS REQUIRED FOR BUILDING EQUIPMENT SHOWN IN THIS ISSUE

The parts listed are the components of the models built by the author or by "Radio's" Laboratory staff. Other parts of equal merit and equivalent electrical characteristics may usually be substituted without materially affecting the performance of the unit.

●

GONSETT 807 AMPLIFIER

L_1, L_2—Wound on Hammarlund XP-53 forms
C_2—Hammarlnd MCD-100-S
C_6—Cardwell MT-70-GD
RFC—National R-154

ONTIVEROS 808 AMPLIFIER

C_1—Cardwell MR-100-BD
C_2—Cardwell XG-50-KD
NC—National NC-800
RFC_1—Bud 920
RFC_2—Hammarlund CH-500

DAVIS QRM DODGER

C_1—Hammarlund MC-250-M
C_2—Hammarlund MC-35-SX
C_6—Hammarlund MC-100-M
C_7, C_8—Aerovox G-5 8 μfd.
T—Thordarson T6638
CH—Thordarson T1753

DAWLEY MODULATION MONITOR

"Eye" assembly—Amphenol
RFC_1, RFC_2 — Hammarlund CHX
M—Triplett 321
T—Inca C62
L—Inca D-1

The Marketplace

(a) Commercial rate: 10c per word, cash with order; minimum, $1.00. Capitals: 13c 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 often as desired.

(b) Non-commercial rate: 5c per word, cash with order; minimum, 50c. Available only to licensed amateurs not trading for profit; our judgment as to character of advertisement must be accepted as final.

(c) Closing date (for classified forms only): 25th of month; e.g., forms for March issue, published in February, close January 25th.

(d) No display permitted except capitals.

(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) No commissions nor further discounts allowed. No proofs, free copies, nor reprints sent.

(h) Send all Marketplace ads direct to Los Angeles accompanied by remittance in full payable to the order of Radio, Ltd.

(i) We reserve the right to reject part or all of any ad without assigning reasons therefore. Rates and conditions are subject to change without notice.

MODULATOR UNITS as described on page 18 July issue of RADIO, less microphone, $77.50. Dual power supplies on same size chassis, $75.00. Output transformers are our type A-150-M. A real 150 watt universal output transformer, will match most tubes, 7 impedance ratios. Input and output transformers, $16.50 per pair. LANGRICK RADIO ENGINEERING SERVICE, W6PT, 626 Maltman Avenue, Los Angeles, Calif.

FBXA in fine condrion. 20, 40 and 80 coils, tubes, heavy power supply and speaker in matching case. $40.00. W6LVK, 2931 South Catalina, Los Angeles.

BEST cash offer takes complete R.C.A. ACR-175. W6CAW.

FABERADIO crystals are the finest. Crystal holders of the new design. Folder sent free. FABERADIO, Sandwich, Illinois.

STAMP brings you sample Radio Data Digest. Keeps posted. Saves money. Kladag, Kent, Ohio.

QSL's. Distinctly different! Samples! "Fritz", 203 Mason Ave., Joliet, Ill.

FABERADIO crystals are the finest. Crystal holders of the new design. Folder sent free. FABERADIO, Sandwich, Ill.

DIATHERMY machine, page 17, October RADIO. Built in our type 14BH steel rack. $6.85. 19 pounds. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

ANNOUNCING a forty-meter oscillator that is fracture-proof and has zero temperature coefficient. Write. CRYSTAL SHOP, Barre, Vt.

QUICK SERVICE on QSL cards. Send for samples. Radio Printers, Lewiston, Minn.

"T9" 40-meter crystals; highly active—ground to resist fracture, only $1.50 postpaid. Fully guaranteed. Attractive 40-meter ceramic plugin holder, $1.10 postpaid. COD orders OK. "Eidson's", Temple, Texas.

YOUR PHOTO on QSL and SWL cards. Low Prices. Samples Free. Ham's printed stationery. 100 sheets and 100 envelopes, $1.00 postpaid. Baker Bros., 204 Carroll, Akron, Ohio.

AMATEUR radio licenses, complete training. Resident and correspondence courses. Every graduate a licensed operator. N. Y. Wireless School, 1123 Broadway, New York.

STAMP brings you sample Radio Data Digest. Keeps posted. Saves money. Kladag, Kent, Ohio.

QSL, SWL Cards. Neat, Attractive, reasonably priced, samples free. Miller, Printer, Ambler, Pa.

QSL s. 300 one-color cards, $1.00. Samples. 2143 Indiana Avenue, Columbus, Ohio.

VIBROPLEXES, bought, sold, exchanged. Rebuilts, $6. New large base bugs, $9. Lydeard, 28 Circuit, Roxbury, Mass.

RAW QUARTZ—finest quality, for the manufacture of piezo crystals. Largest, most complete and varied stock in America. Brazilian Importing Co., Inc., 6 Murray St., New York City.

STEEL shield cans, chassis, panels, racks, cabinets. Send sketch for estimate on your layout. R. H. Lynch, 970 Camulos, Los Angeles, Calif.

SPECIAL 866B's—$3.75. 866's—$1.65. Guaranteed six months. F. B. Condenser mike heads $10.00. 100 watt Universal Class "B" transformers $8.00 pair. Langrick Radio Engineering Service. W6PT. 626 Maltman Ave., Los Angeles, Calif.

SARGENT Model-20 super, A-1 receiver, $35. Two RK 20's, used less than two hours, guaranteed, $10 each. W6NYB, Box 1512, Station D. Los Angeles, Calif.

QSL's. 300 one-color cards, $1.00. Samples. 2143 Indiana Ave., Columbus, Ohio.

SELL—200-watt phone transmitter. Complete. Reasonable for cash. W6HBN, 672 West Pine, El Segundo, Calif.

QUICK SERVICE on QSL cards. Send for samples. Radio Printers, Lewiston, Minn.

1000-WATT PHONE transmitter, complete from condenser microphone to antenna. High level modulated by 204-A's in class B. Everything runs at conservative rating when operating at 1 kw. Sell for reasonable cash offer. Will install free within 100 mile radius of Los Angeles. W6ABF.

VOLTAGE amplifier and power supply, November RADIO, page page 18, were built in our type "S" cabinets. Size 7x10x6¼". Cabinets. $2.20 each. 6 pounds. R. H. Lynch, 970 Camulos, Los Angeles.

ANNOUNCING: Eidson "T9" 80 and 160 meter crystals—as good as our unbeatable 40's. Dependable—powerful X-cut. Close frequency supplied, 40, 80 or 160, $1.50—fully guaranteed. "T9" ceramic plug-in holders, $1.10 postpaid. C.O.D. orders OK. "Eidson's", Temple, Texas.

NEWEST QSL's! 14 Different Samples. "Fritz", 203 Mason, Joliet, Illinois.

DISTINCTIVE "QSL's—SWL's!". Stamp; samples. W9UII Press, 2009 Freemont Street, Chicago.

SUPER-SIGNAL third-harmonic forty-meter crystal going over big. Information on request. CRYSTAL SHOP, Barre, Vermont.

PLATE transformers—new, Hilet, 2½ kw., 160 lb. Guaranteed, $39.00. Send for circular. Leitch, Park Dr., West Orange, N.J.

QSL's and SWL's that are different. One day service. Radio Printers, Lewiston, Minn.

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best by test

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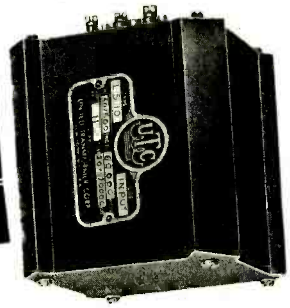
LINE TO GRID TRANSFORMER	UTC LS 10 ($9 net)	Best competitive unit found ($25 net)	Poorest characteristics of any high fidelity units
Measured deviation between 30 and 1000 cycles	1.0 DB	1.5 DB	13 DB
Measured deviation between 1000 and 10,000 cycles	.4 DB	1.2 DB	3 DB
Measured deviation between 1000 and 15,000 cycles	.9 DB	2.8 DB	7 DB
Measured deviation between 1000 and 20,000 cycles	1.2 DB	2.5 DB	17 DB
DB rise at resonance (Approx. measure of phase shift)	0 DB	2.8 DB	2.8 DB
Hum at maximum position	1 DB	4 DB	42 DB
Hum at minimum position	0 DB	2 DB	10 DB

Critical organizations, that check claims, buy UTC Linear Standard audios



• UTC *Leads . . . others follow*

FREQUENCY RANGE

Claims for wide frequency response are common today. UTC is the only organization that **GUARANTEES** its frequency response and it specifies the widest range of all: 30 to 20,000 CYCLES ± 1 DB.

PHASE SHIFT

Low distributed capacity is of paramount importance in audio components. The exclusive UTC winding method costs more but assures lowest possible capacity . . . makes 20,000 cycle response possible . . . and assures negligible phase shift.

HUM PICKUP

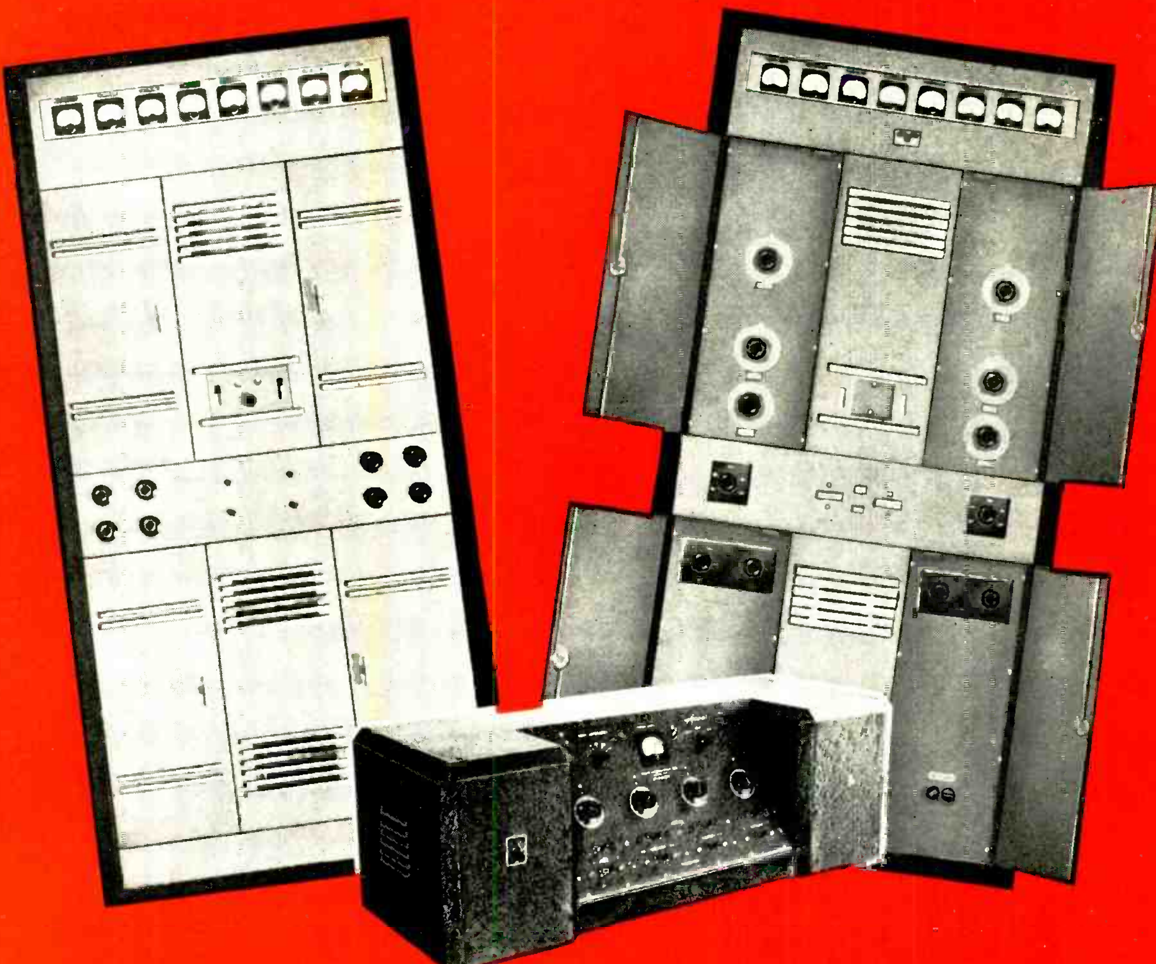
Most manufacturers have already adopted some form of humbucking coil structure and cast ferrous case. Both of these developments were pioneered by the UTC engineering staff. But UTC's hum balanced coil structure is designed for **POSITIVE SELF BALANCE** and the UTC cast alloy has **FIVE TIMES THE PERMEABILITY OF ORDINARY CAST IRON.**

TRI-ALLOY MAGNETIC FILTER

In addition to their normal shielding, UTC low level input transformers now incorporate **TRI-ALLOY MAGNETIC FILTERING,** a new method of shielding which reduces hum pickup tremendously. This **MAGNETIC FILTER** was developed after a thorough analysis of hum reduction methods. Rotation in one plane was found of practically no value. Orientation in two planes, while much better, makes necessary unusual and unworkmanlike mounting and loses most of its effect if the field plane is altered or if stray flux from surrounding equipment is encountered (frequent in remote pickup equipment). The **MAGNETIC FILTER** makes possible a transformer which in its worst pickup position has a hum level far lower than any other transformer in its best position. The nearest available transformer on the market under $25 shows 17 DB greater hum than the UTC LS-10. This UTC advancement in shielding is the greatest forward step in ten years.

UTC SALUTES THE PACIFIC NORTHWEST BROADCAST STATIONS

The great majority of better equipped High Fidelity Broadcast Stations are satisfied users of UTC Linear Standard Audio and Power Components



KPQ's new High Fidelity transmitter . . . equipped with UTC Linear Standard components exclusively.

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KPQ	KUL	KID	KOOS	KGVO	KRLC	KINY
KMED	KIRO	KSEI	KACJ	KGEZ	KAST	KGBU

Most of these stations are 100% UTC . . . as are the police stations of Aberdeen, Wash. . . . Everett, Wash. . . . Bellingham, Wash. . . . Mt. Vernon, Wash. . . . Wenatchie, Wash.

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