RADIO

ESTABLISHED 1917

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

This Month:

1938 Version of Jones "222" Receiver
Design and Feed of Close-Spaced Arrays
Pack Transceiver for 90-Cm. Operation
40-Watt Beginner's Transmitter with 809

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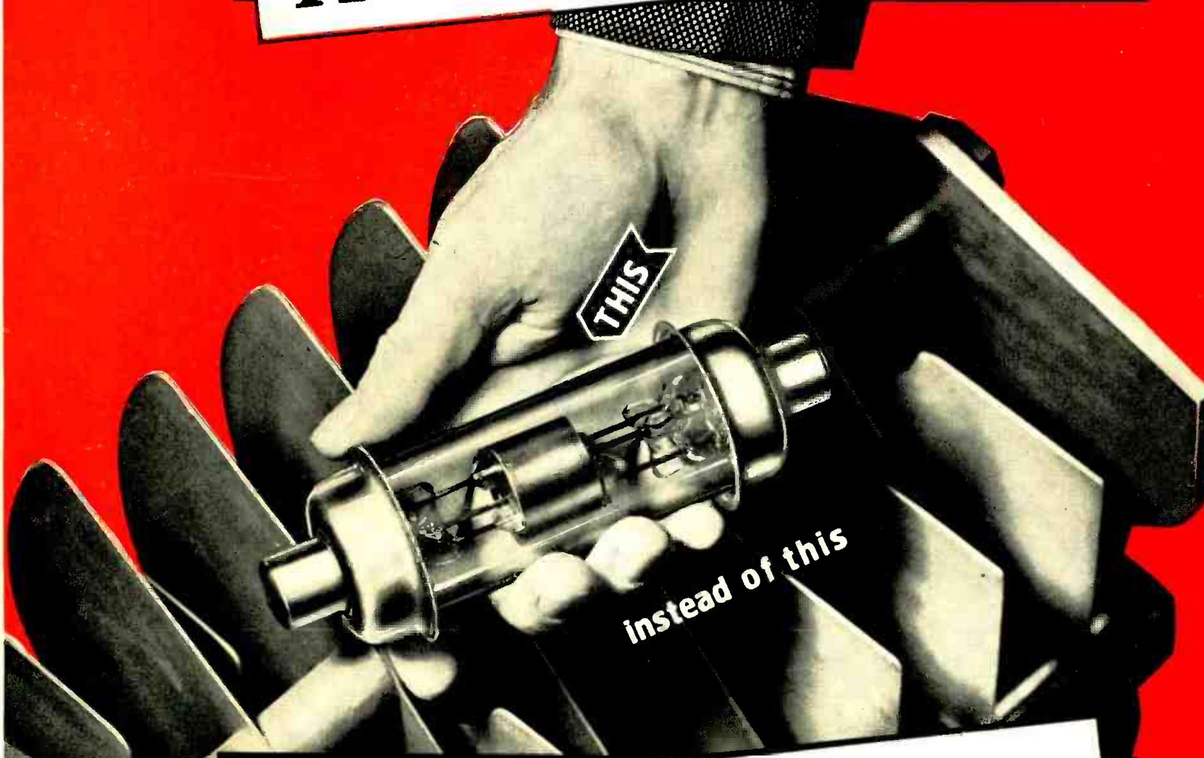

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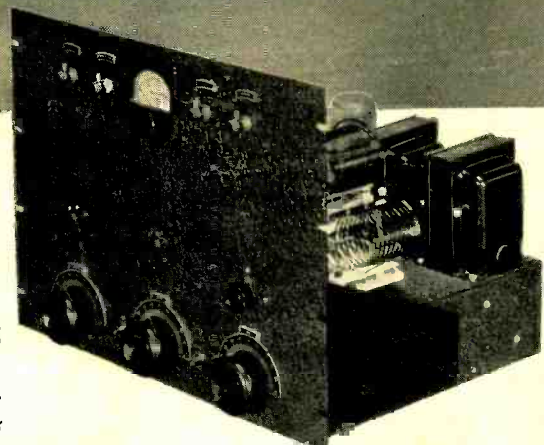

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Chapter 1
Fundamental Electrical Principles and Radio Theory
Chapter 7
Radio Receiver Construction
Chapter 12
C.W. Transmitter Construction
Chapter 2
Vacuum Tube Theory and Practice
Chapter 8
Radio Receiver Tube Characteristics
Chapter 11
Exciter Constr
Chapter 14
Radiophone Transmitter Construction
Chapter 4
Learning the
Chapter 16
Power Supplies
Chapter 5
Antennas, Feed S
and Coupling M
Chapter 6
Radio Receiver Theory
Chapter 10
Transmitter Theory
Chapter 20
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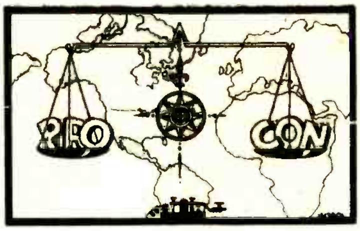


The Open Forum

WHY MASS PRODUCTION OF LIDS?

Laurel Springs, N. J.

Sirs:

Y n l is it customary now days for most radio clubs to get a buzzer and key and sound the mating call to round up a lot of children and announce said children are about to be taught the code? (Note: club dues 25c per month; non-members not eligible for code class.)

When "yours truly" started in radio away back in 1912 along with a lot of other old timers, there weren't any lids. We had our code practice by listening to ship-to-shore traffic and copying press from NAA and in this way developed some good operators and radio men (excluding myself). The aforementioned code practice of days gone by is still available and it may encourage good operating for future amateurs.

I wonder if it is really ham radio when a child can memorize the questions and answers in the license manual and by some trick of fate is able to receive 13 w.p.m. on the day of his examination, and that day only? Does that increase our ranks as amateurs or are the lids outnumbering us? I'll bet my underground vertical beam that for every honest-to-goodness amateur there are 25 lids in these here United States.

Getting to the point, here's my version as I see it (with the present regulations).

1. Little Aubrey in knee pants reads about this wonderful radio business where you can talk all over town for practically nothing.

2. Little Aubrey discovers old magazine that tells how to build five-meter transceiver, which he builds out of junk b.c.l. sets acquired from local dump. With the aid of a screw driver and a few minutes spent in a telephone booth, he is the proud but questionable owner of a mike.

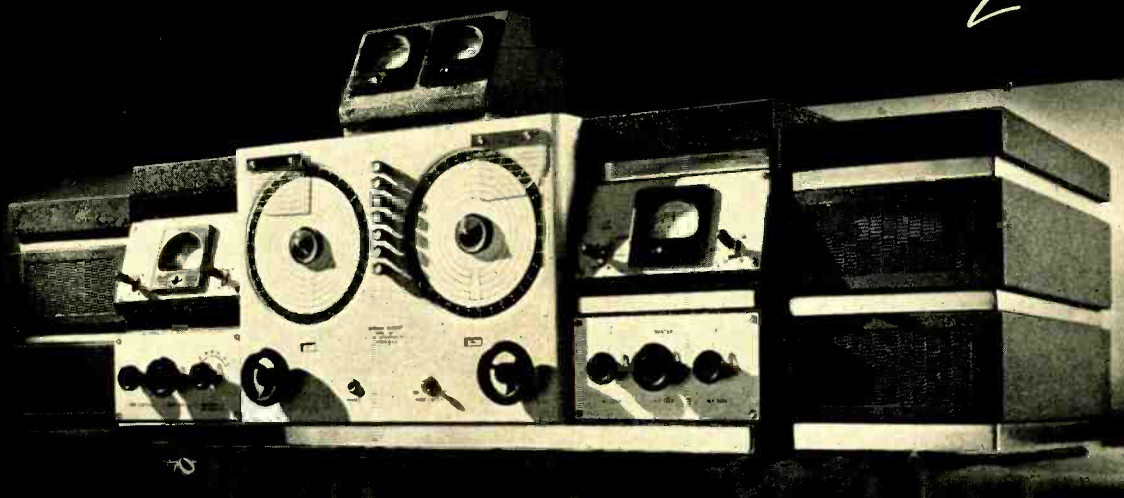
3. Little Aubrey bootlegs on five with a friend's call (said friend is unaware of the fact) quite some time until he is finally convinced by some kind licensed amateur that he

[*Continued on Page 75*]

diversity reception for the amateur

the skyrider Diversity

Model DD-1



A Dual Diversity Receiving System

Readers of QST are familiar with the work on Diversity Reception by Mr. James J. Lamb and Mr. J. L. A. McLaughlin*, and that of Mr. McLaughlin and Mr. Karl W. Miles** more recently reported.

The SKYRIDER DIVERSITY represents the culmination of several years' work by these engineers.

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3. Improvement of signal-to-noise ratio over any single receiver.
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The 1938 "RADIO" NOISE REDUCTION HANDBOOK is a completely different addition to RADIO'S unique library of essential information for every radioman. It tells you how to eliminate or greatly reduce practically every form of radio noise except natural static.

Particular emphasis is laid on the elimination of the noise at its source, and how to locate the source. When that is impractical, a new, highly effective modification of the noise balancing method used in commercial work can be used with almost equally good results. A complete description, theoretical and constructional, of the application of this old telephone "gag" to modern radio work is included.

When noise does get into the receiver, one of the practical noise limiters described will "work wonders" in increasing signal readability.

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June • 1938 Number 230

RADIO

In this issue "Radio" presents:

Frontispiece: Harold P. Westman - - - - - - - - - - 10

ARTICLES

The 1938 "Model 222" Receiver—*Frank C. Jones, W6AJF* - - - - - 11
New Design Data on the Flat-Top Beam—*John D. Kraus, W8JK* - - - - 15
An Inexpensive, Light Duty Beam-Rotating System—*R. E. Lauth, W8MPJ* - 19
Operation of Zero-Bias Modulators—*Thomas A. Gross, W1JZM-VE1IN* - - 21
And Now, a Midget Portable Receiver—*L. V. Broderson, W6CLV* - - - 24
A Manually-Operated "Push-to-Talk" Relay System—*Vernon C. Edgar, W6CRF* 27
What's Happening to "Ten"? - - - - - - - - - - 29
A Disc-Type Frequency Meter for Amateurs—*Guy Forest* - - - - - 30
A Midget 90-Cm. Transceiver—*De Forest O. Romain, W2IEV* - - - - 35
Practical Design of Close-Spaced Unidirectional Arrays—*W. W. Smith, W6BCX* 38
For Beginners: An Inexpensive Exciter-Transmitter—*Jack Rothman, W6KFQ* - 42
A Cathode-Ray Oscilloscope for $1.37—*E. H. Conklin* - - - - - - 45
Solenoid-Type Relay Construction—*E. R. Johns, W7BTH* - - - - - 50
A Beat-Frequency Audio Oscillator—*H. W. Anderson, W6CCG* - - - - 52

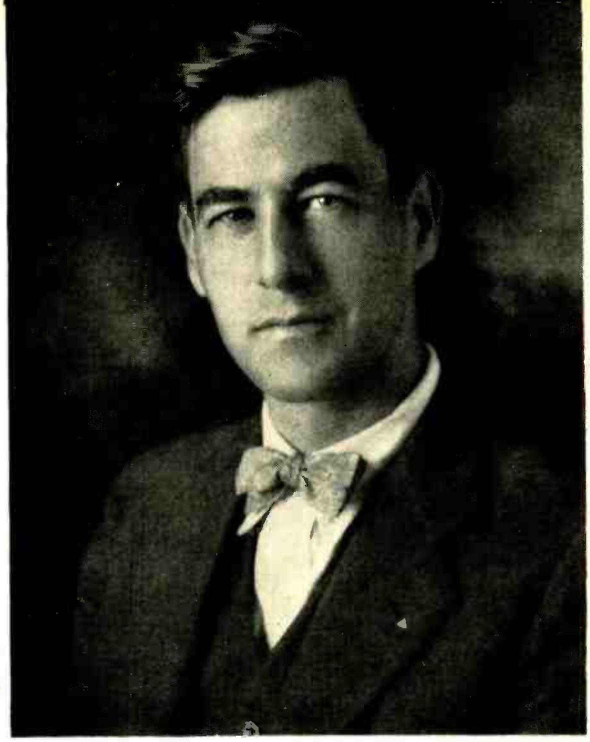
MISCELLANEOUS FEATURES

Radioddities - - - - - 14
Strays - - - - - - - - 20
F.C.C. and Emergency Communication - - - - 23
Pickups - - - - - - - 26
Expedition: 1938 Style - - - 34
Something for Nothing - - - 49
Pictorial: "The Big Moment" —*W6NJT* - - - - - - 59
Lament of a Retired 210 —*W6OFD* - - - - - 96
Advertising Index - - - - 96
Buyer's Guide - - - - - 97
The Marketplace - - - - 98

DEPARTMENTS

Open Forum - - - - - - 6
Dx - - - - - - - - 60
Postscripts and Announcements - 65
56 Mc. - - - - - - - 66
Yarn of the Month - - - - 68
Calls Heard - - - - - 72
Book Reviews - - - 74, 79, 95

THE WORLDWIDE TECHNICAL AUTHORITY OF AMATEUR, SHORTWAVE, AND EXPERIMENTAL RADIO



Harold P. Westman

HAROLD P. WESTMAN is another of the well-known figures in radio engineering who entered this field through the familiar amateur route. He became interested in amateur radio in 1918 and obtained a license shortly after the war ban on amateur activities was lifted. Although he has held both amateur and commercial licenses in the intervening time, his present interests lie more in radio principles and in the design and construction of equipment.

■ His name is familiar to old-time amateurs as he was made assistant technical editor of "QST" in 1927, and technical editor in 1928. In 1929 he became assistant secretary of the Institute of Radio Engineers, and was appointed secretary in 1930. Since that time he has been instrumental in the editing and publishing of the "I.R.E. Proceedings," a publication needing no introduction to technical-minded radio amateurs.

■ As is typical of outstanding men in any field, his hobbies are diversified. A few of his interests are indicated by his membership in the Amateur Astronomers Association, the American Radio Relay League, the Institute of Radio Engineers and the Veteran Wireless Operators Association.

(Photograph—Continental, by R. M. G., Inc.)

The 1938 "MODEL 222" RECEIVER

By FRANK C. JONES*
W6AJF

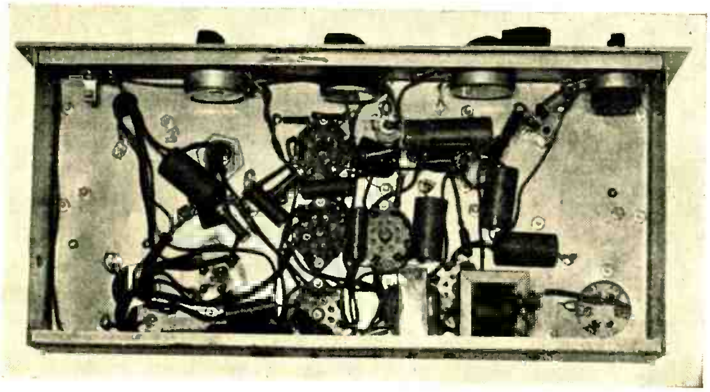
A good superheterodyne receiver can be as easily built as a t.r.f. set and for practically the same cost. The new 6J8G hexode converter tube is very effective for the front end of a superhet receiver, being much more sensitive and stable than the 6A7 or 6A8 tubes. The 6J8G tube as an oscillator-mixer tube is more sensitive than a 6L7—6C5 or 6J7 combination and the frequency stability is very nearly as good. The receiver illustrated here follows somewhat along the design lines of the model 222 receiver originally described in RADIO several years ago. Modern tubes and circuit arrangements have greatly improved the performance.

Integral Noise Silencer

A new noise suppressor circuit with a 6H6 tube is shown in this receiver. It is one of the most effective circuits developed for reducing automobile ignition interference in the short wave bands. The 6H6 twin diode tube is connected in push-pull across the headphone and first audio amplifier so it knocks off both negative and positive noise voltage peaks. In fact it tends to punch a hole in the signal during the short time period of a strong noise peak. It is entirely automatic and has no effect on any moderate strength voice or c.w. tone signals. The circuit can be applied to nearly any existing receiver by means of a center-tapped choke, a 6H6 tube and a volt or two of cathode delay bias. The delay bias is necessary to allow the desired signal to pass on to the headphones or final amplifier stage without attenuation or distortion. Noise peak voltages run as high as 5 to 20 times as great as the desired signal but are of such short duration that they may only sound as loud or possibly two or three times as loud as the desired signal without noise suppression. These peaks are greater than the delay bias and cause the diodes to become conducting. This drops the diode impedance from nearly infinity to a few hundred ohms and so they act as a short circuit across the audio amplifier.

The diode center-tapped choke can be the primary winding of a push-pull pentode-to-voice coil output transformer. The delay bias can be from a dry cell or from the self-bias resistor in the final amplifier as shown in the circuit diagram. The usual 400-ohm resistor has an additional small 30-ohm wire-wound resistor connected in series with it to ground. The bias of a volt or so across this 30-ohm re-

*Engineering Editor, RADIO.



Short point-to-point connecting leads as contrasted to "pretty" but inefficient right angle bus wiring are exemplified in the under-chassis view of the "222".

sistor provides the delay bias for the 6H6 noise suppressor. This is the same as connecting a negative bias to each 6H6 plate.

Electrical Line-Up

The receiver consists of a regenerative first detector-oscillator, a 1600 kc. i.f. amplifier, a regenerative second detector, a noise suppressor and two stages of audio amplification. A high-C oscillator provides good frequency stability in the high frequency oscillator. A low-C first detector circuit provides high gain and good signal-to-noise ratio. It was found that the cathode of the 6J8G tube could be connected through a regenerative feed-back coil coupled to the first detector circuit in order to obtain very high gain on 10 and 20 meters. This causes a small interlocking effect, especially on 10 meters, but this is not troublesome and the regenerative gain offsets this disadvantage. Another advantage of regeneration is that it nearly eliminates image interference since 1600 kc. i.f. also helps in this respect. Regeneration is controlled by varying the screen-grid voltage on the 6J8G tube.

H.F.O. Circuit

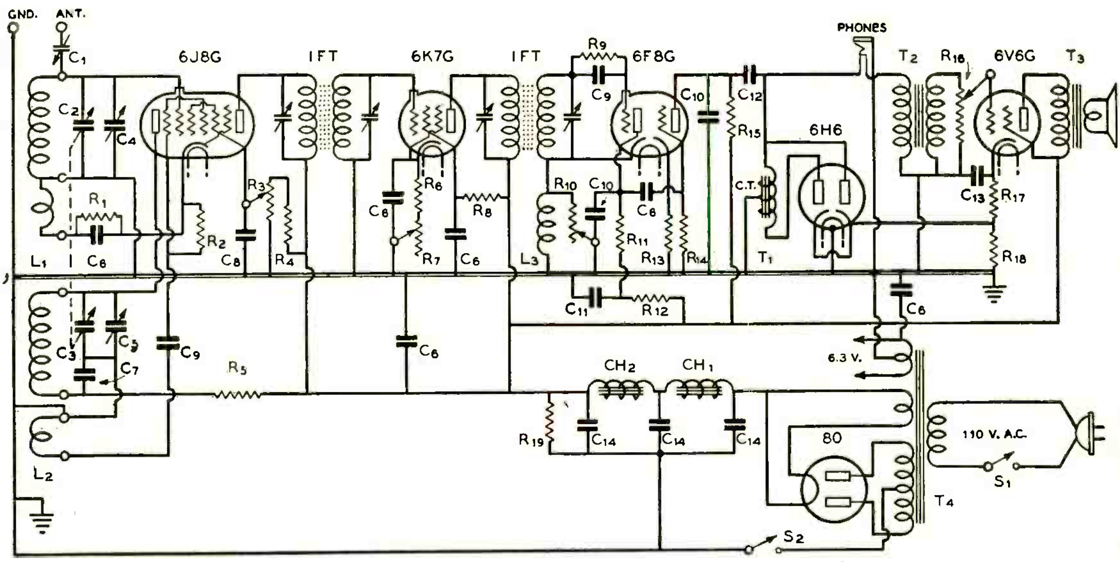
A reversed-feedback oscillator circuit was used, as that is supposed to give better results with a 6J8G tube in the high frequency bands. The plate of the oscillator is tuned 1600 kc. higher in frequency than the incoming signal. The oscillator grid is connected to the usual untuned tickler coil. This is a reversal of the usual connections for oscillators. The two windings are wound in the same direction for the oscillator coils with the grid out one end and the plate out the opposite end on the coil forms. The cathode coil on the detector coils must be reversed from the usual tickler direction of winding in order to obtain regeneration.

Oscillator-Detector Ganging

The high-C oscillator and low-C detector circuits are ganged together and track very well over all of the relatively narrow amateur bands. The oscillator padder is a 100-μμfd. condenser set on all bands at about 2/3 of its full capacity. The 20-μμfd. detector trimmer condenser is controlled from the front panel as it is necessary for regeneration adjustments. The gang condenser consists of a Hammarlund MCD-35-MX double-spaced midget 2-section condenser. Plates were removed until the rear section (detector) had five plates and the oscillator had nine plates. This leaves four dielectric spaces between rotor and stator plates for the detector and eight spaces for the oscillator. The latter has twice as much maximum capacity as the detector-variable section and so the oscillator tracks 1600 kc. from the detector over the whole range of the tuning dial. The preliminary oscillator padder condenser setting must be correct and the coil inductances correct for proper tracking. Small errors can be corrected by manual control of the detector trimmer, though this isn't necessary if care is taken in adjustment of coil turn spacing before cementing the turns in place on the coil forms. Elimination of an r.f. stage greatly simplifies construction of the receiver and reduces ganging problems. An r.f. amplifier-preselector would provide a better signal-to-tube noise ratio; however, the sensitivity of the set as shown is very good.

The I.F. Amplifier

1600 kc. iron-cored i.f. transformers provide enough i.f. gain and selectivity in one stage since the second detector is regenerative. The 6F8G tube is somewhat similar to the 6N7G or 6A6 except that both cathodes are brought out through separate leads. The separate con-



- C_1—3-30-µµfd. mica trimmer
- C_2, C_3—Rebuilt condenser; approx. 15 and 30 µµfd. respectively
- C_4—20-µµfd. midget variable
- C_5—100-µµfd. midget variable
- C_6—.01-µfd. 400-volt tubular
- C_7—.005-µfd. mica
- C_8—0.1-µfd. 400-volt tubular
- C_9—.00005-µfd. mica
- C_{10}—.002-µfd. mica
- C_{11}—0.5-µfd. 400-volt tubular
- C_{12}—.25-µfd. 400-volt tubular
- C_{13}—25-µfd. 25-volt elect.
- C_{14}—8-µfd. 450-volt elects.
- R_1—300 ohms, ½ watt
- R_2—50,000 ohms, ½ watt
- R_3—50,000-ohm potentiometer
- R_4—25,000 ohms, 1 watt
- R_5—50,000 ohms, 1 watt
- R_6—300 ohms, ½ watt
- R_7—50,000-ohm potentiometer
- R_8—100,000 ohms, 1 watt
- R_9—10 or 20 megohms
- R_{10}—1000-ohm potentiometer
- R_{11}—50,000 ohms, ½ watt
- R_{12}—25,000 ohms, ½ watt
- R_{13}—500 ohms, ½ watt
- R_{14}—250,000 ohms, ½ watt
- R_{15}—50,000 ohms, ½ watt
- R_{16}—1-megohm potentiometer
- R_{17}—400 ohms, 3 watts
- R_{18}—30 ohms, 1 watt
- R_{19}—25,000 ohms, 10 watts
- S_1—A.c. line switch
- S_2—"B" voltage on-off switch
- L_1, L_2, L_3—See text
- IFT—1600-kc. iron-core i.f. transformers
- T_1—Primary of p.p. pentode-to-voice coil transformer
- T_2—3:1 audio transformer
- T_3—6V6G-to-voice coil transformer
- T_4—650 volts c.t. 65 ma.; 6.3 volts, 1.6 amp.; 5 volts, 2 amp.
- CH_1—30-hy. 65-ma. filter choke
- CH_2—2500-ohm speaker field
- J—Phone jack

nections allow self-bias to be used on the a.f. amplifier section and grid-leak detection on the other 6F8G section. A 6A6 tube can be used in place of the 6F8G by eliminating the 500-ohm cathode resistor; all other resistor values will remain the same.

Detector regeneration is controlled by a 1000-ohm variable resistor across a small cathode coil. The latter has 30 turns of no. 26 d.c.c. wire jumble wound on a ½" diameter porcelain insulator rod which is fastened to the under side of the chassis near the 6F8G socket. The second detector is made to oscillate for c.w. reception and can be made highly regenerative for greater selectivity in phone signal reception.

The i.f. transformers are of the interstage type with fairly high gain and selectivity characteristics. 1600 kc. i.f. has the advantage of little image interference trouble and also gives better osc.-mixer action in the first detector circuit on the 10- and 20-meter bands. A 465 kc. i.f. has a closer frequency relation between the oscillator and detector so there is more interlocking and noise generation in the first detector circuit at high radio frequencies.

Mechanical Construction

The receiver was built into a standard 8"x 8" x 16" cabinet with a 7"x 3"x 15" chassis. A 4½"x 4½" partition of 12 ga. aluminum acts as a support for the detector trimmer and as a shield between the oscillator and detector coil and condensers. The shield is slotted to fit over the tuning condenser. The 100-µµfd. condenser is mounted on a separate bracket near the tuning condenser and should have a lock-nut adjustment to insure its remaining set at the same capacity value at all times. A vernier dial is connected to the tuning condenser through a flexible shaft coupling. The audio transformer

222 RECEIVER COIL DATA
ALL 1½" COIL FORMS

BAND	OSCILLATOR		DETECTOR	
	Plate	Grid	Grid	Cathode
160	26 turns closewound no. 22 d.c.c.	15 turns no. 26 d.c.c. closewound	85 turns no. 26 enam. closewound	9 turns no. 26 enam. closewound
80	17 turns no. 20 d.c.c. 1" long	9 turns no. 26 d.c.c. closewound	40 turns no. 24 d.c.c. 1¼" long	7 turns no. 26 d.c.c. closewound
40	10½ turns no. 20 d.c.c. 1" long	6 turns no. 26 d.c.c. closewound	21 turns no. 22 d.c.c. 1¼" long	5 turns no. 26 d.c.c. closewound
20	5 turns no. 20 d.c.c. 1" long	4½ turns no. 26 d.c.c. ¼" long	10 turns no. 20 d.c.c. 1¼" long	3 turns no. 26 d.c.c. ¼" long
10	2 turns no. 18 enam. ½" long	2¾ turns no. 26 d.c.c. ¼" long	4⅓ turns no. 18 enam. ¾" long	1¾ turns no. 26 d.c.c. ¼" long
		All above coils start at end of tuned plate coil winding		All above coils start at end of tuned grid coil winding opposite winding direction

and center-tapped choke are mounted along the rear edge of the bottom of the chassis. A tube socket serves as a loudspeaker cable connection at the rear. As can be seen from the photographs, not very many parts are used in the construction of the complete receiver. The circuit is quite simple and nearly fool-proof in construction, and operation of the set is not at all complicated.

The antenna is capacitively coupled to the first detector grid through a 3-30-μμfd. mica trimmer condenser. Too much capacity here will prevent full benefit of regeneration in the 6J8G detector. The latter should not oscillate at any time in the detector section. The triode oscillator can be checked for oscillation with each coil by connecting a 0-110 d.c. voltmeter from ground to "plate" side of the 100,000-ohm oscillator resistor. A sudden dip in the meter reading will occur if a finger is touched to either the grid or plate of the oscillator. Lower values of plate resistor result in greater oscillator r.f. voltage but will prevent first detector regeneration. A regenerative first detector does not require much r.f. voltage from the oscillator in this circuit.

The power transformer, choke, filter condensers and 80 rectifier tube are mounted at one end of the 7"x 15" chassis. The detector section is at the rear of the chassis at the opposite end. The 6J8G tube is mounted near the detector tuning condenser. 6K7G tube is mounted between the two square shaped i.f. transformers. The 6J8G, 6K7G and 6F8G tubes are all shielded. The front panel was made of 10 ga. aluminum 8"x 16" in size. Complete coil data is given in the coil table.

•

Radioddities . . . .

W6QX was assigned a hotel room in Boston with a number starting with *W6*.

•

Former F.C.C. Chief Engineer Craven lately warned the Commission against licensing too many super-power broadcast stations, pointing out that such stations would build up a barrier against smaller stations. There are two tons of radio hams who will say *yea, brother*.

Broadcast hash is sold in cans by the A. & P.

•

Calling attention to Edison's early discovery of the "effect", WLW broadcast music picked up by a small receiver using one of the early Edison electric light bulbs as a detector.

•

The 8th and 9th Call Areas are the only ones without coast lines.

New Design Data on

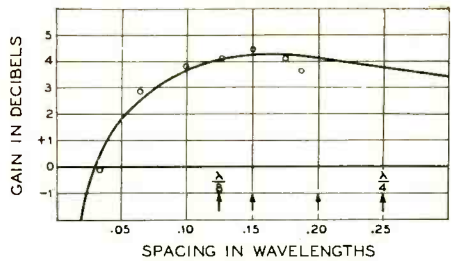


FIGURE 1

THE FLAT-TOP BEAM

By JOHN D. KRAUS,* W8JK

By means of closely-spaced elements, the flat-top beam antenna provides a substantial gain in a minimum of space. Basically, the antenna is a driven array in which a pair of closely-spaced elements is fed with currents 180 degrees out-of-phase. The resulting radiation is a maximum in the plane of the elements and broadside to them.

Spacing

The phasing of 180 degrees is employed because it is obtained in a very simple manner. With this phase difference a substantial gain is present for a considerable range of spacings. The spacing of one-eighth wavelength, which has been recommended in previous articles[1,2,3] is a very convenient and effective value. However, the amount of gain depends on the spacing used.

The curve of figure 1 shows the manner in which the gain of two out-of-phase elements changes for a range of spacing from zero to 0.30 wavelength. The gain refers to the field strength in the plane of the closely-spaced pair of radiators and at right angles to them as compared to the field strength of a single radiator of the same type with the same power input in both cases. The curve applies only to the case of 180-degree phasing, such as used in flat-top beams.

Data for plotting this curve were obtained by evaluating equation (50) of Brown's article on "Directional Antennas",[4] for the particular case of two horizontal half-wave antennas, having currents equal in magnitude and 180 degrees out-of-phase, ground effects neglected. Brown's equation (50) and the meanings of the symbols used are given in the appendix at the end of this article.

An experimental test of the gain-spacing curve of figure 1 was conducted at W8JK. This was done by measuring the gain of a flat-top beam with seven different spacings (0.032 to 0.185 wavelength). The flat-tops were of the 14-Mc. 2-section or 4-element variety. The field strength of each was compared with the field strength of a 14-Mc. double-zepp antenna (two colinear half-waves in phase), the same power input to the antennas being used in all cases. The ratio of the field strength of the 2-section flat-tops to the double-zepp gave the gain for each spacing. The results of this test are indicated by the small circles in figure 1. The agreement of the experimental values with the curve is quite satisfactory. The falling off of the gain at the 0.175 and 0.185 wavelength spacings can be attributed to ground effects present when the spacing distance is equal to about half or more of the height of the flat-top above ground.

Each antenna was suspended in turn at the same height above ground (approximately three-eighths wavelength) between the same pair of poles. The field strengths were measured with a meter calibrated in terms of relative field strength[5] and located at a distance of about two wavelengths broadside to the antennas. All of the antennas were tuned to resonance by quarter-wave stubs and were fed by a 600-ohm transmission line connected to the

*Arlington Blvd., Ann Arbor, Michigan.

[1] "Small but Effective Flat-Top Beam", J. D. Kraus, RADIO, March, 1937, p. 56, and June, 1937, p. 10.

[2] "Directional Antennas with Closely-Spaced Elements", J. D. Kraus, *QST*, January, 1938, p. 21.

[3] "Flat-Top Beam Antennas", J. D. Kraus, *Television and Short-Wave World* (London), February, 1938, p. 101.

[4] "Directional Antennas", George H. Brown, *Proc. I.R.E.*, Jan., 1937, p. 94.

[5] "Directive Antenna Systems", J. D. Kraus, *R/9*, June, 1935, p. 13.

stub. The transmission line and stub were assumed to have the same efficiency, throughout the test.

Conclusions Regarding Spacing

The important conclusions from the curve and test are:

1. The optimum spacing with respect to gain is about 0.15 wavelength. The gain over the reference antenna at this spacing is about 4.3 decibels.
2. The gain with one-eighth (0.125) wavelength spacing is about 4.2 decibels. This is only a small fraction of a decibel less than at 0.15 wavelength. This difference is negligible for most practical cases.
3. As the spacing is decreased to less than one-eighth wavelength, the gain falls off rapidly. In addition, there is greater difficulty in feeding the flat-top when closer spacings are used. These facts make eighth wavelength spacing appear to be about the minimum desirable for 180-degree phasing.
4. The gain at 0.20 wavelength spacing is about 4.1 decibels or only about 0.2 db less than for 0.15 wavelength spacing.
5. The gain at 0.25 wavelength (quarter wave) spacing is about 3.8 db or about 0.5 db less than for 0.15 wavelength spacing.
6. The gain at about 0.03 wave spacing is zero. That is, the maximum radiation of a single section (2-element) flat-top having this spacing would be the same as the maximum radiation from a single half-wave antenna with the same power input.
7. A useful range of spacings for flat-top beam antennas lies between one-eighth and one-quarter of a wavelength for fundamental operation.

Dimensions

Eight varieties of flat-top beam antennas are shown in figure 2. They are divided into two groups, center-fed and end-fed. Each group includes flat-tops of 1, 2, 3, and 4 sections. To

TABLE I—Flat-Top Beam Design Table

FREQUENCY	Spacing	S	L_1	L_2	L_3	L_4	M	D	A (¼) approx.	A (½) approx.	A (¾) approx.	X approx.
7.0-7.2 Mc.	λ/8	17′4″	30′	60′	52′8″	44′	8′10″	4′	26′	64′	96′	4′
7.2-7.3	λ/8	17′0″	29′6″	59′	51′8″	43′1″	8′8″	4′	26′	63′	94′	4′
14.0-14.4	λ/8	8′8″	15′	30′	26′4″	22′	4′5″	2′	13′	32′	48′	2′
14.0-14.4	.15λ	10′5″	15′	30′	25′3″	20′	5′4″	2′	12′	31′	47′	2′
14.0-14.4	.20λ	13′11″	15′	30′	22′10″	......	7′2″	2′	10′	29′	45′	3′
14.0-14.4	λ/4	17′4″	15′	30′	20′8″	......	8′10″	2′	8′	27′	43′	4′
28.0-29.0	.15λ	5′2″	7′6″	15′	12′7″	10′	2′8″	1′6″	7′	16′	24′	1′
28.0-29.0	λ/4	8′8″	7′6″	15′	10′4″	......	4′5″	1′6″	5′	14′	22′	2′
29.0-30.0	.15λ	5′0″	7′3″	14′6″	12′2″	9′8″	2′7″	1′6″	7′	16′	23′	1′
29.0-30.0	λ/4	8′4″	7′3″	14′6″	10′0″	......	4′4″	1′6″	5′	14′	21′	2′

Dimension chart for flat-top beam antennas. The meanings of the symbols are as follows:

L_1, L_2, L_3, and L_4, the lengths of the sides of the flat-top sections as shown in figure 2. L_1 is length of the sides of single-section center-fed, L_2 single-section end-fed and 2-section center-fed, L_3 4-section center-fed and end-sections of 4-section end-fed, and L_4 middle sections of 4-section end-fed.

S, the spacing between the flat-top wires.

M, the wire length from the outside to the center of each cross-over.

D, the spacing lengthwise between sections.

A (¼), the approximate length for a quarter-wave stub.

A (½), the approximate length for a half-wave stub.

A (¾), the approximate length for a three-quarter wave stub.

X, the approximate distance above the shorting wire of the stub for the connection of a 600-ohm line. This distance, as given in the table, is approximately correct only for 2-section flat-tops.

For single-section types it will be smaller and for 3- and 4-section types will be larger.

The lengths given for a half-wave stub are applicable only to single-section center-fed flat-tops. To be certain of sufficient stub length, it is advisable to make the stub a foot or so longer than shown in the table, especially with the end-fed types. The lengths, A, are measured from the point where the stub connects to the flat-top.

Both the center and end-fed types may be used horizontally. However, where a vertical antenna is desired, the flat-tops can be turned on end. In this case, the end-fed types may be more convenient, feeding from the lower end.

The approximate gains of the different types over a half-wave comparison antenna are as follows: Single-section, 4 db; 2-section, 6 db; 3-section, 7 db; and 4-section, 8 db. These correspond to power gains of about 2.5, 4, 5, and 7, respectively.

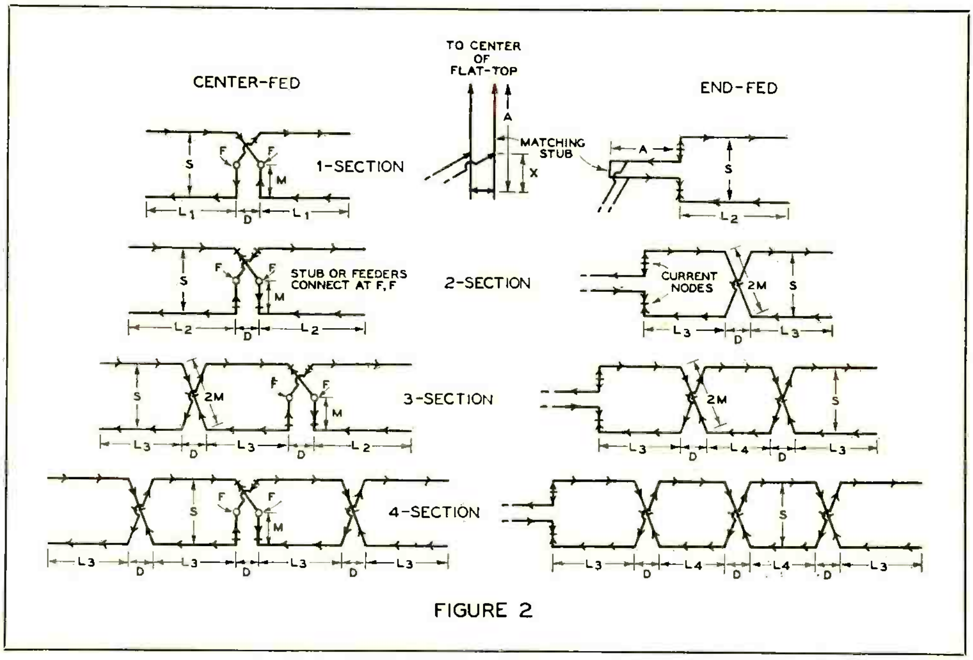


Figure 2. Top views of eight varieties of flat-top beams, showing both center and end-fed types. Dimensions for these antennas are given in the table, and the symbols used are explained in the note accompanying the table.

maintain the proper phasing, cross-overs are used between sections.

Fortunately, the flat-top beam is not critical as regards exact dimensions since compensation can be made by adjusting the line or stub feeding it. The exact length of the flat-top wires necessary for resonance on a given frequency depends to a considerable extent on the details of the construction used. Hence, it is difficult to predict the precise lengths necessary. Accordingly, a stub and transmission line or zepp feeders are the most practical feed methods. If the flat-top is somewhat too short, the feeders or stub can be made longer, or *vice versa*.

Flat-top dimensions which are close to optimum are listed in Table I. The meanings of the symbols used in the table and figure 2 are listed in the note accompanying the table. The dimensions given produce approximately the current distributions shown by the arrows on the antennas in figure 2. The phase reversal or current node points are indicated by small cross lines.

The dimensions given in Table I are calculated for the center of the band listed in the column headed "Frequency", but will be quite satisfactory for use on any frequency within the band or somewhat beyond. It may be noted that a few of the dimensions listed are slightly different than recommended in previous articles.[1,2,3] In these cases, the dimensions shown in the table produce a small improvement in current distribution but result in little or no noticeable change in performance.

Short-wave antennas, coupled by stubs, Q-bars, or directly to non-resonant transmission lines, are commonly adjusted to present a resistive load to the feed system. This adjustment is usually made by shortening the antenna until resonance is obtained. The wires of a flat-top beam must be shortened for this same reason. With one-eighth wavelength spacing, the shortening necessary because of this reactance effect is about the same as with the common half-wave antenna, namely, about 5 per cent. However, there exists also another effect not present in simple antenna systems. This is the loading due to the cross-overs. Depending on a number of factors, such as the construction and spacing of the cross-over, this produces an additional shortening of 5 to 10 per cent with eighth-wave spacing between elements. Accordingly, the flat-top beam elements must be considerably shortened in length in order to obtain proper phasing of the various parts. The shortening necessary is somewhat less for smaller than eighth-wave spacing, and is more for wider spacing.

The precise amount of shortening required in any particular case depends considerably on the individual installation. The dimensions of the flat-top beams as given in the table are close enough for all practical purposes and the exact tuning of the system to resonance is accomplished by adjusting the stub or feed system. Thus, flat-top beams are fed conveniently by means of a matching stub. Various types of line can be used to feed the stub as will be described later. The alternative arrangement is to use zepp feed and do all the tuning at the transmitter.

Table I lists flat-top beam dimensions for operation in the 7-, 14-, and 28-Mc. bands. These dimensions can be extended to other bands or frequencies by applying the proper factor. Thus, for 56- to 58-Mc. operation the values for 28 to 29 Mc. are divided by two. Dimensions are also listed for four different spacings. Obviously, other spacings than the ones given may be used. However, four were selected which have approximately the same gain and which cover a range of 2 to 1 in spacing. Data for only eighth-wave spacing are listed for 7 Mc. Wider spacing can, of course, be used on this band, but will probably in most cases be inconveniently large. Dimensions for flat-tops of all four spacings, namely 0.125, 0.15, 0.20, and 0.25 wavelength, are listed for 14-Mc. operation. Only two spacings, 0.15 and 0.25 wave, are given for the 28-Mc. band since the dimensions on these frequencies are fairly small and fewer different spacings are required. Further information concerning the data in the table as applied to figure 1 is given in the note accompanying the table.

The dimensions listed in the table were determined largely by experiment. All of the eight types of flat-top beams shown in figure 2 have been tested on 14 Mc. at W8JK. All types have been tried with eighth-wave spacing and a number of types with other spacings. In all cases, the flat-tops were fed by means of stubs, and in each case the location of the shorting wire on the stub was adjusted to resonate the array. A 600-ohm transmission line was used to feed the stub. The approximate current distribution on a number of the antennas was checked by means of a neon lamp on a long stick. The measurements and observations made on the antennas indicated empirically which dimensions would give approximately the current distributions shown by the arrows in figure 2. The dimensions given in the table are based almost entirely on measurements on 14-Mc. antennas. For the 7- and 28-Mc. bands the proper dimensions are assumed to be twice or one-half of these values.

Resistance

The resistance of one of the elements of a flat-top beam as measured at a current loop is small. This is a result of the close spacing and out-of-phase currents. Less spacing decreases this resistance, whereas wider spacing up to about 0.6 wavelength, increases it. Brown[4] has given data on this effect. The location in an antenna system at which a knowledge of the resistance is of particular importance is the feed point. On flat-top beams tuned with a stub this point is at the bottom of the stub. With the exception of the single-section center-fed flat-top, the impedance where the stub connects to the antenna is too high to be practical for any type of non-resonant feed line. The stub, however, may be considered to act as a Q-section when the shorting wire is removed. The resulting resistance which appears at the shorting wire location may be called the "bottom-of-the-stub" resistance.

The spacing and wire size of the stub are, of course, factors in determining this resistance. The resistances given in the following data are based on a stub of number 12 wire with 6-inch spacing (600-ohm type). As a "rule of thumb" we may say that, in round numbers, the bottom-of-the-stub resistance of a single-section flat-top is 10 ohms, 2-section 20 ohms, 3-section 30 ohms, and 4-section 40 ohms. These values are for 0.125 wave spacing. For 0.15 wave spacing the values are about 40 per cent greater, for 0.20 wave spacing about 2 times larger, and for 0.25 wave spacing about 3 times as much. The above values apply to either center-fed or end-fed arrays, but it should be emphasized that these values are only very approximate, and are intended merely to indicate roughly the magnitude of the resistance. For many practical cases this is sufficient. The exact value in any particular installation depends on a number of factors. It is well known, for example, that the resistance of a half-wave radiator may vary as much as 40 per cent with height above ground. This is with the antenna more than a quarter-wave off the ground. At smaller heights the variation may be even greater. In the case of the flat-top beams, the ground effect appears to become important when the height is less than about twice the flat-top spacing.

The bottom-of-the-stub resistances given in the preceding paragraph were determined largely by measurements made on 14-Mc. flat-

[*Continued on Page 80*]

An Inexpensive, Light Duty

BEAM-ROTATING SYSTEM

By R. E. LAUTH,* W8MPJ

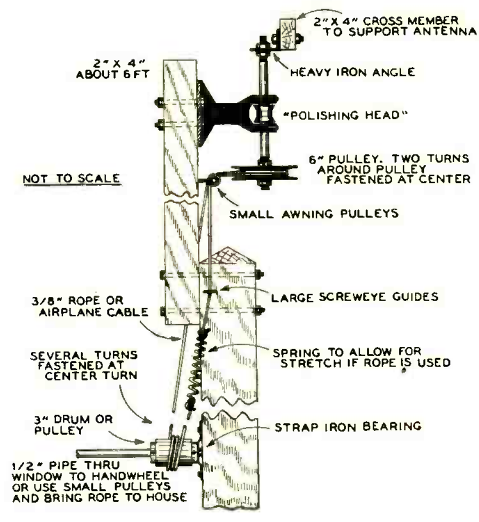
For some months there has been a seemingly endless stream of descriptions of various and sundry antenna rotating systems. So, one more such description should do no harm especially since it has several very desirable features along the lines of economy, simplicity, and lightness of weight. It is hoped that this article may help some of those fellows who have been longing to own a rotatable beam but have been hesitating because of constructional difficulties or lack of finances.

This rotating head, supporting a half-wave antenna and close-spaced director, has been in use at WHIO for several months as a receiving antenna for high-frequency relay broadcast service and is giving very satisfactory results.

Hand operation is used since the antenna remains in one position almost all the time. However, it is readily apparent from the accompanying sketch that it would be only a minor problem to install motor-drive. In which case, slip-rings for the feeders would be desirable, thereby eliminating the necessity of a motor reversing arrangement. Of course, these additional refinements, if included in the design, would cancel a large portion of the economy feature.

Supporting Poles

Undoubtedly, the best kind of support for one of these "modulated windmills" is a telephone pole. One of these is especially desirable since the tuning-up process usually requires considerable climbing of the pole to make adjustments. A good husky pole with steps on it makes this job a pleasure. Now the mention of a telephone pole shouldn't scare anyone because for a comparatively small charge it is usually possible to purchase a twenty-five to thirty-five foot pole in pretty good condition from the local phone or power company. Delivery charges for a reasonable distance will run a couple of dollars more.



Setting the Stick

A pole this size isn't such a tough job to set if you use a little trickery on it. First, instead of digging a hole, dig a trench several feet long and four or five feet deep at the end where you want the pole and diminishing toward the other end. By rolling the pole into line with this trench with the butt-end directly above the deep end you will find it surprisingly easy to push it up into position. This means more digging but is well worth it when it comes to raising the pole. Secondly, one additional helper will be plenty. Even though most of your neighboring hams are "wise" to pole-raisings, you can usually find one newcomer who is still enthusiastic and glad to help.

The Radiator

Oftentimes the most perplexing question is what to use for the radiating elements of the antenna. The answer is electrical conduit. Ask for the "thin-wall" kind in the smallest size, which is half inch. This tubing is enameled

*361 Cherry Drive, Dayton, Ohio.

inside and out and will cost on the average around five cents a foot. The only disadvantage is that it is only made in ten-foot lengths, but one length of this tubing with telescoping sections of aluminum tubing in each end for tuning will provide ample length for a ten-meter antenna, and it is sufficiently rigid that it need only be clamped in the center. For twenty meters, two lengths could be spliced by using a solid rod in the center, in which case only a small supporting platform would be necessary.

The "Polishing-Head" Rotating Support

The top bearing, which is really the "heart" of the set-up, is simply a "polishing head" procurable in most twenty-five cent to one dollar stores for around ninety cents. By turning this bearing on end and moving the shaft upward as far as allowable, so that the antenna will clear when rotated, the bearing problem is solved. Note that the entire weight of the antenna is on the set-screw which holds the small V-pulley in the center—so be sure it is plenty tight. If a supporting structure of any weight is used, it might be well to drill into the shaft or flatten it at one point so the set-screw will have something to bite into.

The top belt pulley should be wide enough to allow for two turns of rope with a little to spare so the rope will not climb over itself when the antenna is turned. Since the small pulleys are placed only about three inches apart, the allowable rotation is considerably more than 360 degrees.

When rope is used for the belt, it is necessary to insert a spring at some point to allow for shrinkage when wet; otherwise, something may pull loose at one end or the other. This does not hinder the operation in any way except that there will be a slightly "soft" feeling when going one way because the spring will give a little before the antenna starts to turn. Small "airplane cable" would make an ideal belting material but would be more expensive and might alter the beam characteristics of the system inasmuch as it is a conductor.

Where the base of the pole is visible from the operating position, a very satisfactory direction indicator may be made by simply nailing a board to the pole vertically, marked with the points of the compass, with a marker fastened to one of the control ropes. Or an "ohmmeter" direction indicator as suggested by Roberts in the January, 1938, RADIO, may be used.

Thus we have covered the constructional problems and ten or twelve dollars should cover the entire cost with some to spare, depending, of course, on the amount of incidental hardware and miscellaneous material the individual constructor may have available.

Performance

As to performance, the results we have obtained seem to bear out fully the claims made for this type of antenna in several articles in RADIO and other publications. Specifically, it shows about 6 db gain in the forward direction as compared to a simple half wave; the front to back difference is around 14 db, with a difference of about 24 db between the front and either side, these measurements all being read on the RME 69 meter.

It is hoped that this discussion has helped to show that it is not entirely impossible for almost anyone to own a rotatable antenna. It is the author's belief that if such systems were used more liberally on twenty and ten meters, they would go a long way toward reducing the terrific QRM on those bands. It seems quite obvious that if we can reduce the strength of signals from unwanted directions in our receivers and can at the same time concentrate our own signal in only the desired direction, a great deal of interference to all concerned can be eliminated. And, selfishly, we will have a much better chance of getting through.

For Heavier Work

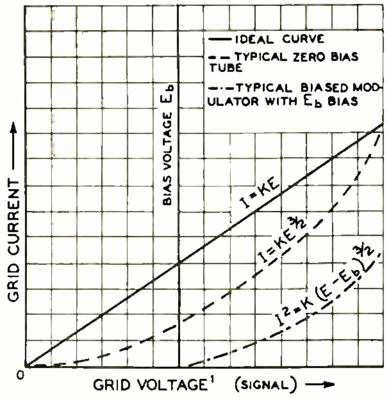
If the rotating structure is too heavy to be supported by a polishing head, a saw mandrel or grinding head of suitable size may be utilized in the same manner. They are, however, more expensive.

Strays . . .

A radio watch, designed to be operated by broadcast impulses, was exhibited at a recent meeting of Union Pacific Railroad jewelers.

Jewelry according to the communication scheme—the new lapel pins for milady which spell out the initials of the wearer in a two-flag semaphore signal.

In contrast to the modern manufacturer's ad quip, *taking the IF out of the I. F.*, is the one we found in a 1922 ad, *taking the freak out of radio-frequency*. And, take it from us, there were plenty of freaks in r.f. amplifiers in those days.



GRID CURRENT PLOTTED AGAINST GRID VOLTAGE

FIGURE 1

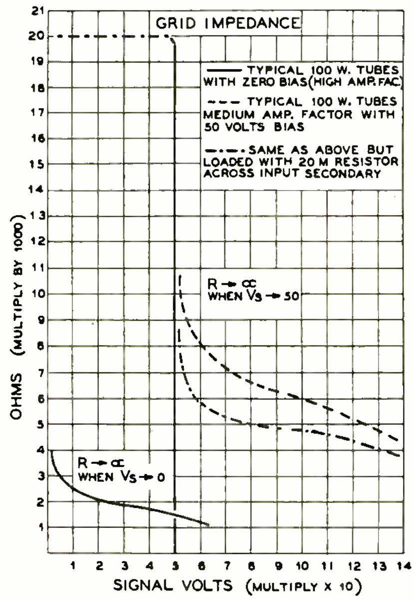


FIGURE 2

By

THOMAS A. GROSS*
W1JZM-VE1IN

Operation of ZERO-BIAS MODULATORS

Zero bias tubes were introduced for class-B audio service to remedy some of the shortcomings of the arrangements which use bias in order to hold the plate dissipation within the tube ratings. Zero bias tubes have high plate impedances making bias unnecessary.

Everyone is familiar with the advantages brought about by the elimination of the bias supply and by the tolerance of the zero bias modulator for poor plate supply regulation. The simplification of the driver to class-B grid matching problem is however less appreciated.

With the zero bias circuit, one of the grids is always positive with respect to the cathode regardless of the magnitude of the signal voltage. Thus during the complete audio cycle, grid current is flowing. Figure 1 illustrates grid current curves for several types of class-B amplifiers as explained by the captions. For reasons explained later, the ideal grid characteristic is linear and described by the function $I_g = KE_g$. The function[1] $I_g = KE_g^{3/2}$ for zero bias operation is an approximation of the ideal and is definitely a closer approach than a biased system. In practice many zero bias tubes have a tapering grid configuration to obtain a more nearly uniform grid current-grid voltage relation.

Grid Input Impedance

Since the grids draw current during the entire audio cycle, the zero bias grids present a finite load impedance to the input transformer at all times without resorting to loading resistors. A transformer working into a biased modulator is properly terminated during only a part of the cycle. Figure 2 shows the impedance that could be expected from typical amateur tubes under various conditions. In these graphs the grid impedance is considered infinite when both grids are negatively charged. Actually, however, the positive ion filament emission and ionization within the tubes do allow grid current to flow when they are negative, but the resulting impedance is extraordinarily high. The capacitative reactances present do not serve to load the transformer and for that reason they were not considered in computing the values for the graphs.

Laboratory Tests

Since the effect of an undetermined load upon a transformer was uncertain, an experi-

*Bowdoin College, Brunswick, Maine.

[1]This equation is approximate as this grid is assumed to be a plate of a diode.

mental class-B amplifier simulating amateur conditions was set up in the Bowdoin College physics laboratory. Careful measurements were made by the author to determine whether the theoretical advantages of zero bias operation would present themselves in practice. The arrangement used for the tests is diagrammed in figures 3A and 3B. A Vreeland oscillator supplied audio voltages perfectly free from harmonics, thus permitting oscillograms to detect whatever distortion that would be developed in the class-B amplifier. A vacuum-tube voltmeter was used during the frequency runs because its high input impedance of 5 megohms would not disturb the operating conditions.

Response curves of a number of input transformers were made. Laboratory standard transformers did not show appreciable frequency distortion in the biased circuit, but a cheap transformer performed very poorly in the same circuit. Figure 4 is a response characteristic of a typical amateur input transformer when used both with zero bias and 20 volts bias respectively. Evidently when the transformer is properly terminated, the load resistance tends to dampen the oscillatory circuits composed of the leakage reactance of the transformer, the inductance of the secondary, and the capacities of the transformer windings and tube elements.

Some photographs were taken with the oscilloscope which illustrate discontinuities caused

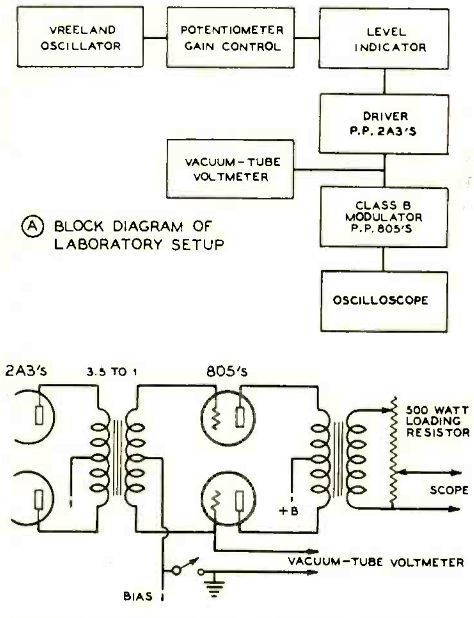


FIGURE 3

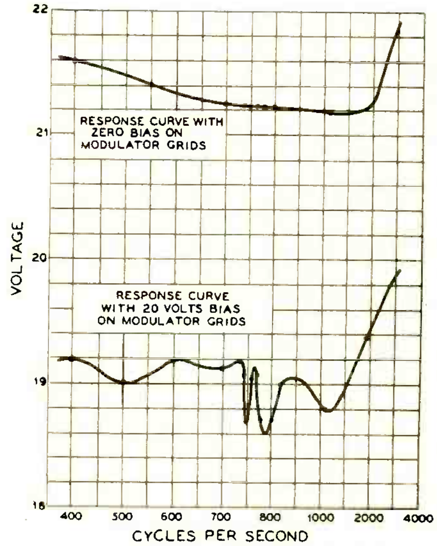


Figure 4. Frequency response of laboratory setup with voltages measured from one class B grid to ground with vacuum tube voltmeter.

by operation with biased modulators. A few of these are reproduced in figures 5 to 7.

To determine the turns ratio for the input transformer of a class-B amplifier, it is necessary to know the optimum load impedance for the driver plates and the impedance of the modulator grids. Since the impedance ratio of the transformer is equal to the square of the voltage or turns ratio, the turns ratio of the transformer is:

$$(\text{Pri}/\tfrac{1}{2}\ \text{sec})\ \text{turns ratio} = \sqrt{\frac{\text{driver plate load}}{\text{grid impedance}}}$$

The grid impedance should be calculated from E_g/I_g, for one tube when E or I is at a maximum. If the class-B grids are shunted with a loading resistor, the resulting impedance should be calculated by Ohm's law. If the turns ratio is specified in accordance with the above directions, the modulators will be working into the optimum load only during large signal voltage excursions. At lower signal levels the grids reflect back to the drivers a higher load. This is desirable because the light load reduces harmonic distortion present in the driver output. When the driver is called on to deliver much power, the load is at an optimum for greatest power output.

In practice, the modulator grids are shunted by a loading resistor in most modulator circuits. Thus even with the biased modulator the input transformer can operate into a finite load at all times. However, this resistor must be a com-

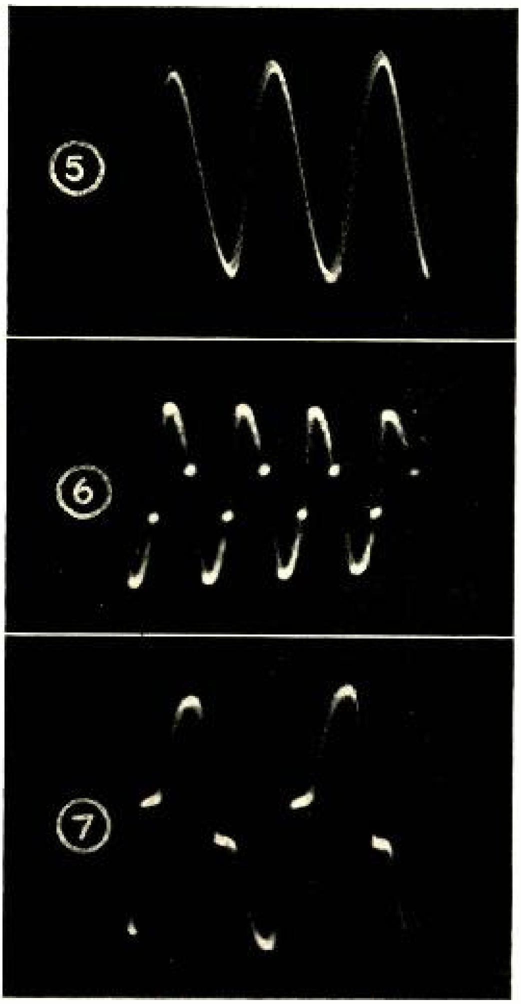


Figure 5. Oscillogram of distortion free output of zero-bias modulator operating under normal conditions.

Figure 6. Output of modulator under same conditions of figure 5 except for 20 volts of grid bias.

Figure 7. Same as figure 6 but with increased power output and increased sweep frequency to show the discontinuities resulting from biased operation.

promise between driver power loss and load correction. This loading resistor should be connected, contrary to some writers, across the secondary and not the primary of the input transformer.

A number of papers[2] have been recently published advocating the use of low modulator plate load impedances to obtain high peak power outputs with speech signals. This practice is entirely practical but care should be used to prevent distortion developing from the nonlinearity of the plate characteristic at large plate currents. The linear characteristic can be considerably extended if the filament voltage is increased 5 per cent. The ease of excitation of the modulator is considerably greater when a low plate impedance is used, and conversely the modulator is difficult to drive when operating into a high impedance load. This suggests the possibility of a grid meter as an aid in "tuning up" the modulator. The author has found that this indicator is extremely important in making adjustments. Low grid current readings may also be attributed to low filament voltage or worn out tubes. It must be realized that the modulator load impedance should not be made *too* low as the harmonic distortion will then be increased.

[2]Fortune, RADIO, April, 1938. Anderson, *QST*, March, 1938.

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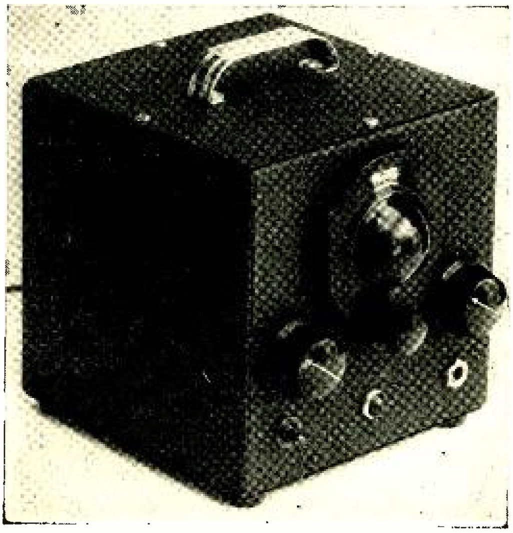
F. C. C. and Emergency Communication

There has been doubt in the minds of many radio people, broadcast, amateur and commercial, as to what extent stations of one service could communicate with stations of another and to what extent stations could overstep their licensing limitations when emergency conditions arise. A recent release by the Commission, brought about, no doubt, by the Southern California flood emergency last March, gives the following pertinent information:

"The Federal Communications Commission desires to call the attention of all licensees of radio facilities in the Southern California flood area of the provisions of Rule 23 of the Commission's Rules and Regulations permitting such licensees, during the period of the emergency, where normal communication facilities are disrupted, to engage in emergency communications beyond and above those authorized by the license. This means that a broadcast station may handle messages concerning safety of life and property, amateurs may engage in the transmission of such messages, other stations may communicate with points other than those specified in the license, etc.

"During the flood of the Ohio and Mississippi Rivers in February of last year, radio was a very valuable asset in preventing the loss of

[*Continued on Page 85*]



And Now, a Midget
PORTABLE RECEIVER

By L. V. BRODERSON,* W6CLV

For vacation-minded amateurs and portable addicts this receiver should prove of considerable interest. To those who have read the article "A 20-Watt Midget Portable" described in the April issue of RADIO no further introduction will be necessary. It is readily recognized as the companion unit to that transmitter.

Although designed primarily for the 7-Mc. band, on all frequencies it out-performed the regular station receiver. The "Midget" has now become the main receiver at the author's station.

Six inches square, weight 7½ pounds, compact and efficient, smooth regeneration and plenty of wallop characterize this little set. Perhaps most important, its total cost need not exceed fifteen dollars.

The Circuit

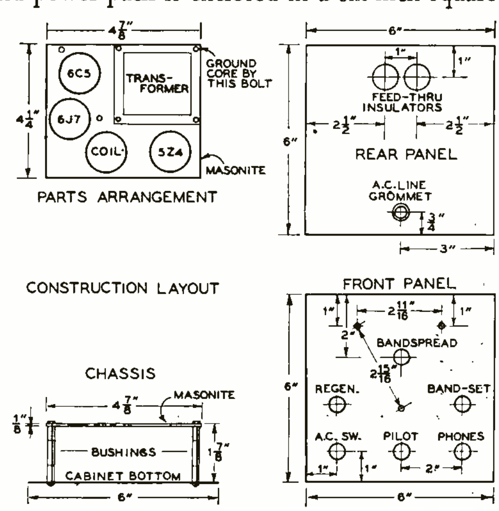
Nothing startling about the circuit—it is time-proven and fool-proof and has been described in handbooks before. With a few modifications it became the logical solution to the quest for circuits that featured a minimum of parts consistent with performance. A 6J7 detector with cathode regeneration, resistance coupled to a 6C5 audio stage—that's all there is to it. Regeneration is controlled by varying the screen voltage on the 6J7, and of course, single dial tuning is used on the detector.

The absence of a volume control in the audio stage will be noted. For those whose locations are subject to line pickup and objectionable background noises, a 500,000-ohm potentiometer may be inserted in place of the 500,000-ohm fixed resistor in the grid circuit of the 6C5.

The resistance coupled audio amplifier consumes less space than transformer or impedance coupled layouts and in addition, weighs considerably less. Furthermore, no objectionable "fringe-howl" is encountered as is usually the case with transformer coupled audio stages.

Construction

The entire receiver including all tubes, coil and power pack is enclosed in a six-inch square



*515 Salinas Nat'l Bank Building, Salinas, Calif.

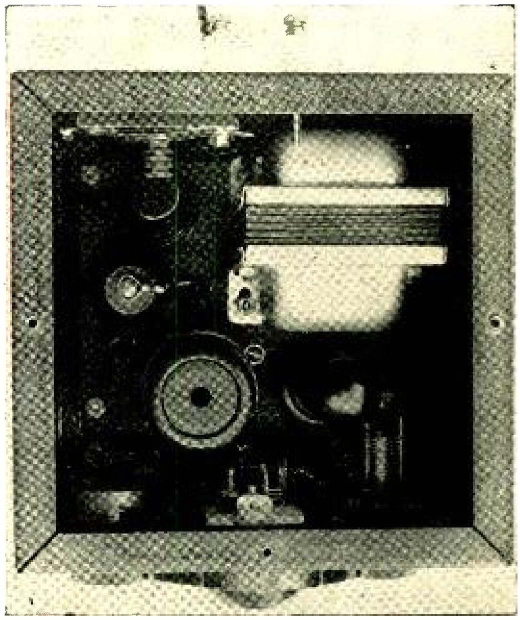
black crackle finish metal cabinet. Top and bottom lids are removable. A three-inch chrome plated drawer handle is mounted on the top lid by two small bolts. The rear panel contains the two feed-through insulators for antenna and ground connections, or for a doublet lead to an antenna coupling coil. An a.c. outlet grommet completes the parts placement for this panel.

On the front panel is mounted the band-spread condenser which occupies the center position. Below and to the left is the regeneration control and opposite this is the band-set condenser. The lower portion of the front panel holds the a.c. on-off toggle switch, pilot light and 'phone jack. Both band-spread and band-set condensers are of the high frequency type and about half the size of standard midget variables, making them ideal for this work. Four rubber feet fastened to the base of the cabinet complete its outside appearance.

The chassis consists of a piece of masonite 4¼"x4⅞"x⅛". It is held in place by four brass bolts running through the bottom plate and is built up to a height of 1⅞" by means of bushings. A glance at the parts placement diagram will show the position of each piece of apparatus mounted above this deck. All other parts are underneath, hidden from view. At the rear right corner is the power transformer and directly in front of this the 5Z4 rectifier socket. To the left of the rectifier is the coil socket and at the rear left, the 6C5 amplifier tube. The 6J7 detector is placed in front of the amplifier socket and slightly to the left. The upright bolt building up the chassis also holds the right rear mounting lug of the transformer in place and automatically grounds the core.

Beneath the Masonite deck are mounted all fixed resistors, by-pass condensers both mica and tubular, filter choke and filter condensers. Rather a formidable assortment, but by using small resistors, midget condensers, dwarf size filter condensers and choke, this alarming array fits in very nicely. All leads are necessarily short and by-pass condensers are located where they should be—at the point to be by-passed. Heater and pilot light leads of course are twisted and those leads that appear to run too close for comfort may be spaghetti insulated. In such confined quarters one cannot help but make leads direct to their connecting points. It is quite impossible to create any sharp bends—there isn't enough room.

The greater portion of the wiring including switch, pilot light and 'phone jack is done with



Bird's-eye view of interior of receiver, in which layout of parts may be seen very clearly.

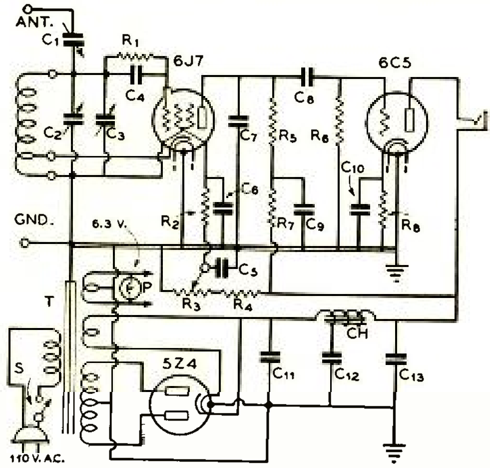
the masonite deck removed from the cabinet. Those leads going to parts mounted on the front panel (as well as grid cap and antenna coupling condenser leads) may be connected after the unit has been assembled.

Both variable condenser rotors are grounded to the front panel. The regeneration control, a.c. on-off switch and pilot light are already insulated from their terminals. The 'phone jack, however, is "hot" and must be insulated from the metal panel.

Parts placement on the masonite deck need not necessarily be followed too closely. Again, the "junk-box" will in all probability have a major part to play in the construction of this unit and one will be guided according to what parts are already available. Midget type sockets, however, are almost a necessity. Most standard sizes allow their terminals to protrude too far on either side of the socket below the chassis. There are several good sockets made which are really midget in size and still retain good insulation and contact.

Power Supply

The power transformer furnishes 330 volts each side of center tap. In addition it also supplies the necessary heater voltages for the entire receiver. The filter choke is tapped for better filtering. A dwarf-size double filter con-



SCHEMATIC DIAGRAM

C_1—25-μμfd. midget variable or 3-30 μμfd. trimmer
C_2—15-μμfd. midget variable
C_3—100-μμfd. midget variable
C_4—.0001-μfd. mica
C_5—0.1-μfd. 400-volt tubular
C_6—.01-μfd. 400-volt tubular
C_7—.0001-μfd. mica
C_8—.01-μfd. mica
C_9, C_{10}—0.5-μfd. 400-volt tubular
C_{11}—1.0-μfd. 400-volt tubular
C_{12}, C_{13}—8-μfd. 450-volt electrolytic
R_1—5.0 megohms, ½ watt
R_2—100,000 ohms, ½ watt
R_3—50,000-ohm potentiometer
R_4—20,000 ohms, 1 watt
R_5—100,000 ohms, ½ watt
R_6—500,000 ohms, ½ watt
R_7—20,000 ohms, ½ watt
R_8—1500 ohms, ½ watt
L—See coil table
S—A.c. line switch
CH—Tapped 20-hy. 50-ma. filter choke
P—Pilot light
T—660 volts c.t., 40 ma.; 6.3 volts, 1 amp.; 5 volts, 2 amp.

denser, 8 μfd. each section, rated at 450 d.c. working volts, and a 1 μfd. tubular of the same rating complete the filter system. This combination effectively filters the output of the 5Z4 rectifier tube and compares favorably with more elaborately designed filters.

Coupling Systems

The antenna can be inductively coupled to the grid of the 6J7 detector through a separate antenna coil, or capacity coupled by means of a small variable condenser. The latter method is used in this receiver solely for the sake of simplicity. Both methods are equally effective. Any small condenser from 15 to 25 μμfd. will suffice to couple the antenna to the grid circuit.

Operating Data

With a plate voltage of 250 and coils wound as described, regeneration will occur with the regeneration control about half way on. If the receiver oscillates too strongly, the cathode tap may be moved a fraction of a turn nearer the ground end. Slight experimenting with the cathode tap (especially on 14 Mc.) and the trying of different grid leak values will insure maximum results.

With the 15-μμfd. variable condenser set at half its capacity, the band set condenser is meshed until the desired frequency is located. A little "give and take" with these two condensers will set the center of the bands at the half way mark on the dial. The 15-μμfd. condenser is capable of spreading these frequencies over a good portion of the dial.

COIL SPECIFICATIONS

3.5-Mc. band: 31 turns, close wound. Cathode tap 1½ turns up from grounded end.
7-Mc. band: 16 turns spaced to 1¾". Cathode tap two turns up from grounded end.
14-Mc. band: 8 turns spaced to 1½". Cathode tap 2½ turns up from grounded end.
All coils are wound on 1½" diameter forms with no. 22 d.c.c. wire.

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Pickups . . .

A familiar voice on the air is that of Dr. Hard, long known as XE1G. He is on 28 Mc. these days, now using the call XE1GE.

XE1G will soon be heard again on 14 Mc., but this time it will be Saul Hernández, in Pachuca, Mexico. He is just completing his transmitter which ends up in a pair of T55's in the final.

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Acting particularly in the case of police radio applicants requesting authority to employ A2 emission, the FCC has advised that it does not class the regular tone signal, sent out for the purpose of securing the attention of prowl cars, as A2. Such a transmission is included under A3, telephony, unless the tone is actually keyed for telegraphic communication.

A Manually-Operated "PUSH-TO-TALK" RELAY SYSTEM

By VERNON C. EDGAR,* W6CRF

In listening over the various amateur phone bands it becomes quite obvious that there is a great deal of needless QRM caused by the endless talking of some individual who has a lot to say but who has no means of knowing whether or not he is being heard at the other end. He not only causes some other station a lot of grief by interference, but his own signal is more often than not badly heterodyned. Then, the portions of his previous transmission must be repeated, probably with more interference on the second transmission.

A number of solutions for this problem have been suggested in the past. Voice-operated relay control and push-to-talk are the two most commonly used methods. The voice-operated system has the advantage that it requires no manual effort to operate it, but it has the definite disadvantage that the threshold adjustment is critical. If the system is made to operate on too low an audio signal, the speaker of the receiver may trip it off, or a large crowd in the room may have the same effect. On the other hand, if the threshold is made too high, certain parts of the beginning of a sentence may be missed. For the phone man who is not disinclined to push a button when he wants to talk, an adaptation of the system to be described is recommended.

There is really nothing very complicated or involved about the push-to-talk system. Many amateurs are now using a system of control on their transmitter that could very easily be converted into push-to-talk. It is only necessary that some sort of non-locking switch or key be placed conveniently near the operating position and that this switch be able to cut off the receiver, turn on the transmitter and switch the antenna from receiver to transmitter when it is operated. It can in most cases be accomplished through the judicious use of two or possibly three relays. Many varied control systems are possible. The arrangement in use at this station can be taken as representative.

Operation

When one presses the key or switch in this system, the oscillator takes off, causing relay number one to open the "B" negative for the receiver. Then, since plate voltage is on the exciter stages during stand-by periods, when excitation is applied to them the relay in the plate circuit of the 801's will close and apply a.c. to the primaries of the plate transformers

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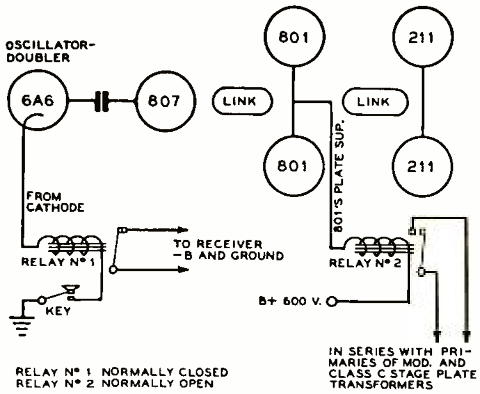


Block layout of the Push-to-Talk System.

of the final and modulators. The rig is then on the air. When the key is opened, everything takes place in reverse: the excitation is removed, the relay in the plate circuit of the 801's opens and the plate voltage is removed from the final and modulators, and, of course, the receiver "B" negative is again closed and it becomes operative. The whole sequence of operations takes place quicker than the batting of an eye. Push the key and talk, open it and listen.

The Relays

As has been mentioned before, the operation of the whole system depends upon properly designed relays in the various control circuits. The first relay (schematic diagram) was made from the power relay as used in an old Philco "B" eliminator. It happens to be a double-pole double-throw but it need be only a single-pole single-throw as only the lower contacts are used. The upper contacts in this case are used as stops.

The relay as it originally stands would require too much current to actuate it from the plate current of the oscillator as desired. Consequently, it must be rewound with more turns of finer wire to make it more sensitive. The coil is removed and the no. 18 wire stripped off (it can probably be used to wind buffer tank coils at some future time). Then the spool is rewound half full of no. 30 enameled wire. The relay is reassembled and the coil pig tails soldered to the coil terminals on the bakelite panel. When the coil on this relay is *not* energized, the lower contacts are closed, hence we have what is desired—a normally-closed relay that can be actuated by the normal cathode current of the oscillator stage.

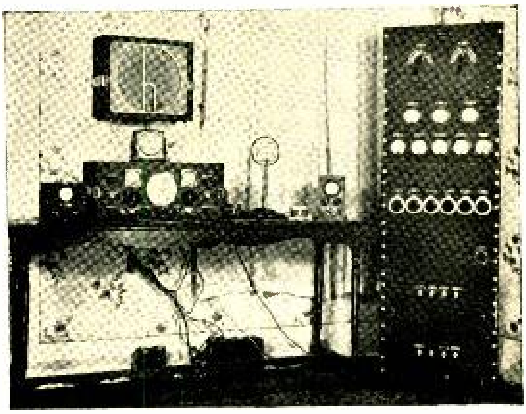
The oscillator is to be keyed as you would normally key it when using break-in on c.w. In my case, using a 6A6 oscillator-doubler, I key in the cathode circuit. The relay just described has its coil in series with one wire from the 6A6 cathode and the key. The return from the key is to the transmitter ground. When the key is closed, the current flowing in the oscillator cathode through the relay coil, through the key contacts to ground, energizes the relay coil opening the relay contacts. The contacts on this relay are in series with the receiver "B" negative to ground. Opening of the relay contacts stops the receiver without turning off the filaments. This operation now takes care of the receiver in our "push-to-talk" arrangement.

As the exciter stages all return to zero or near zero plate current when the excitation is removed, the power supplies for these stages may be left on. Since the primaries of the plate transformers for the final and modulator are removed from the line when relay number two opens, no trouble will be experienced from this source. It is quite important that the plate voltage be removed from the modulators when they are not loaded by the final stage. If this is not done, it is almost certain that any audio surge will puncture the windings of the output transformer.

For relay number two, I resurrected an old 53-ohm pony relay to which I soldered a pair of dimes on the existing contacts. Now came the joker—how to use this relay as an underload relay. The first thought was the oscillator circuit. No sale. With only twenty-five ma. plate current on the oscillator, no regulation of the relay was possible, as it either remained closed or open; no happy medium could be obtained. The second buffer was looked at but on close observation was found to have 600 volts under load and 750 volts no load. The relay coil was next wired in series with the plate supply to the 801's and the key operated. The spring tension was light and there was a resounding crack as the current energized the coil. The key was released and the relay was a little sluggish in returning to the open position, so a course of adjustment was deemed advisable. Excitation on the 801 stage was backed off until the 801's were only drawing 50 ma., and the spring on the relay was adjusted so that the contacts would not quite close on keying the rig. Then the excitation was increased on the 801's until 60 ma. was reached, and just before the 60 ma. point, the contacts definitely closed. This was decided upon as the best operating adjustment, as excitation furnished from the 801 buffer stage to the final was sufficient to cause the final to draw better than half of its normal plate load. The transmitter was keyed fast, slow, and otherwise and everything worked nicely. By varying the 801 excitation, in all cases it was found that the relay acted as a true underload relay should. It always opened when the current to the 801 stage reached approximately 55 ma. A tendency toward chattering in this relay was eliminated by placing a pair of 1-μfd. 400-volt condensers across each of the relay coils.

Came the time for operation. The receiver was turned on and warmed up, and a CQ sounded forth. Ha! an answer—believe it or not. The other station, W6ASK, was told that "push-to-talk" was in use. He replied that he also used "push-to-talk". Then ensued a two-hour QSO, with sometimes only two or three words used on a transmission. The operation was so rapid on my system that by a slight touch on the dash contact of the bug key, one word could be spoken and the carrier off, that it was almost like duplex operation without the bad characteristic of duplex of having the carrier continuously on. Then again when QRM came on, we immediately knew it and stood by, until the frequency cleared, not only helping the other fellows on our frequencies but ourselves as well, as there was not a lot of extraneous talking going on while being QRM'd.

In my case I use a separate receiving antenna, but for those fellows who are using a relay or hand switch to cut the transmitting antenna over to the receiving position, a relay, double-pole double-throw, can be made or purchased,



This is the complete station, W6CRF, minus the antenna.

and the coil placed also in series with the buffer stage. This, then, would operate with the same regularity as the underload number two relay. The adjustments would have to be made in the same manner. The contacts on the transmit side would close simultaneously with the contacts on the number two relay. The contacts on the receiver side must close as soon as the contacts on number two relay open. Once the relay was adjusted for the transmit side to coincide with relay number two, the receive position would take care of itself.

A warning here. In several cases of using a 110-volt a.c.-operated antenna relay on the antenna change over position, a hum developed in the carrier. But this same 110-volt a.c. relay works swell when the coil is taken from the 110-volt line and used as described above. Another warning—insulate high voltage relays from metal panels. It pays in the long run.

What's Happening to "Ten"?

After the international contest each year, the 28-Mc. band goes through a change, most noted for the fact that Europeans are no longer regularly heard, and transcontinental signals pass out. After a few days of little or no dx, the band often comes back for one or two short stretches of good conditions before appearing to close up for the summer.

What happens can be pictured very well in the F_2 layer data which goes through a marked seasonal change. Weekly noon measurements provided by the National Bureau of Standards, together with a calculated maximum frequency which will be returned to the earth (at a distance of 2200 miles and multiples thereof) are given below:

Date	Virtual Height (km)	Critical Frequency	Max. usuable Frequency
Nov. 17	240	13,300	40,700
Nov. 24	250	14,900	47,000
Dec. 1	240	14,700	48,000
Dec. 8	240	12,300	38,700
Dec. 15	230	12,200	39,500
Dec. 22	240	14,100	51,000
Dec. 29	230	11,800	37,500
1938			
Jan. 5	250	12,100	38,700
Jan. 12	240	11,200	34,600
Jan. 19	260	13,400	41,100
Jan. 26	260	13,100	40,100
Feb. 2	250	13,600	42,700
Feb. 9	270	14,400	45,100

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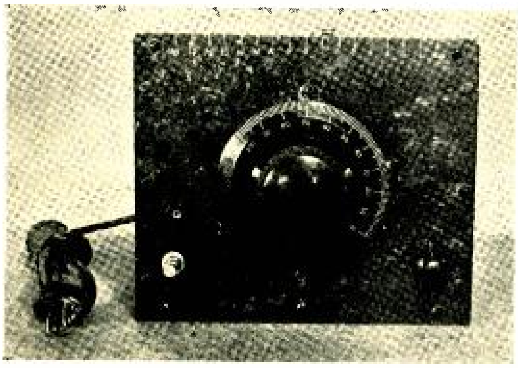


A Disc-Type

By GUY FOREST

A recent trend in amateur radio exemplified by the "rubber crystal," the "signal shifter," the "variable-frequency crystal," etc., indicates a growing demand for transmitters not tied down to a single spot. This demand for frequency flexibility brings with it a need for frequency measurement. A frequency meter sets out signposts in the bands telling where one's own transmitter is located and where to look for others. Many points of frequency-meter design can be applied to self-excited oscillators for driving modern transmitters.

It is the purpose of this article to describe the construction of a heterodyne-type amateur frequency meter whose total cost is less than that of a precision vernier dial. Nevertheless its maximum error lies well within the bounds of present day practice and is conservatively rated at less than 0.1 per cent.

The design is comprised of a 6J7 electron-coupled oscillator whose fundamental covers the 160-meter band and whose harmonics cover all the other bands. A 1-V rectifier and simple resistance-capacity filter provide plate voltage for the oscillator. All power comes from the supply line via a line-cord resistor. The frequency control for the 6J7 is a disc condenser having an unusual length of scale.

There are two major requirements for an accurate heterodyne frequency meter. One is precision in the frequency control, denoting ability to read, set, and reread the dial to a fineness considerably better than the net overall accuracy of the meter. The other is stability of the oscillating circuit, to a comparable degree of fineness, in order that the actual oscillating frequency at later times and under different conditions shall not stray from the calibrated value. The various factors which affect these two requirements, and the steps taken to eliminate them, will be outlined concurrently with the details of construction.

The Dial

Taking the 80-meter band as representative, the frequency spread is 500 kilocycles, from 3500 to 4000 kc. At 3500 kc., if the dial is to be read to an accuracy of 0.1%, it must be read to 3500 cycles. Thus the dial coverage must at least be 500,000 cycles and the style of scale must allow determinations to 3500 cycles. However, all the other factors of error must be allotted a part of the percentage and for the dial alone 1/5 of the total is a conservative estimate. In other words, the indications should be good to 1/5 of 3500 cycles, or 700 cycles. In the frequency meter shown, the precision is attained by means of a disc condenser.

An aluminum disc is mounted on a shaft which rotates in a threaded bearing. The travel through the nut brings the rotor to and from an insulated stator plate. To cover the 80-meter band a 4-inch dial must spin some eight times for a total scale length of 100 inches. The least spread occurs between 3500 and 3600 kc., where 100 dial divisions are needed to cover 100 kilocycles. Figuring that the dial can be estimated to ½ of a division the precision comes out about 500 cycles, as compared with the "budget" figure of 700 cycles. At the other end of the band the spread is greater and the precision comes close to 100 cycles.

The Tuning Condenser

Referring to figure 1, the rotor disc is cut from 16-gauge hard aluminum, trimmed to size and smoothed with a file. The cutting should be done with a hacksaw rather than heavy snips in order to keep the piece perfectly flat. To the back of the disc, in the center, is riveted a square piece of 1/16-in. sheet brass (or galvanized iron). The rivets on the front of the disc must be countersunk to preserve a smooth surface. The brass plate is for soldering to the ¼-in. machine bolt which, with head cut off, serves as a shaft. The diameter of the bolt body will be found to be something less than ¼ inch, and both the brass piece and the rear bearing plate must be drilled to fit. Make a jig to hold the bolt perpendicular to the disc while soldering. This must be done carefully because the face of the disc should run true, preferably to better than 1/64 inch.

The stator plate for the disc condenser is supported by three steatite ⅝-in.-high stud insulators on the panel. There should be fiber washers placed between the stator plate and the studs to lessen the danger of cracking the ceramic.

Assembly

A good procedure to follow in assembly, to get a true-running condenser, is to fasten the insulators and stator plate to the panel and the latter to the baseboard with the side braces. After checking the rotor to be sure it runs true, hold it flush against the stator plate with the shaft protruding through the nut in the front panel. Mount the rear bearing plate on the baseboard, fastening it and the brace in the position allowing easiest turning of the shaft. Next solder the bearing nut flush with the face of the front panel, taking care to have a V groove in the top of the bolt threads just emerging clear of the nut. At the front bearing, a short piece of piano wire, about .035-in. diameter, is sprung over the V groove and under the heads of the 4-36 machine screws. At the rear bearing a similar piece of spring wire goes under the shaft. These springs keep practically all backlash out of the dial. Put a drop of oil on each spring and bearing.

The protruding shaft must be built up to ¼-in. diameter by winding on shim brass or copper strip. The dial is a standard 4-in. diameter plain bakelite model graduated 0-100 for 180°. In order to read it over a complete revolution, two index pointers are made of bus wire and fastened under screwheads on the panel. They extend about ¾ inch out from the panel at the top and bottom of the dial. The dial is read at whichever pointer its scale appears.

The range of the disc condenser covers several turns and an auxiliary scale is needed to keep track of them. It is made with fish line,

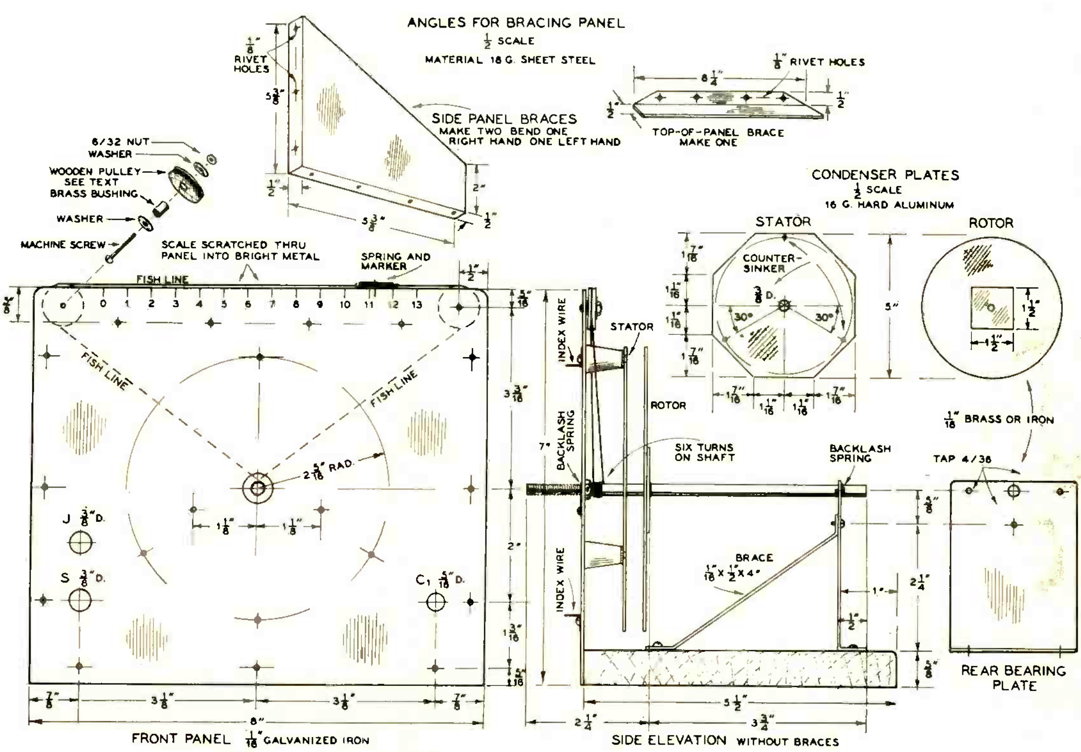


Figure 1. Constructional details for assembling the frequency meter.

two small wooden pulleys, and a small spiral tension spring. The details are shown in the sketch. The fish line should be small enough that, if wrapped in the threads of the shaft, it will lie without bulking or overlapping. Facing the panel, the line from the left pulley wraps clockwise and to the rear on the shaft between the front panel and the stator plate. Have the rotor about its own thickness from the stator, then tie the two ends of the line on the takeup spring close to the right pulley. Pinch a short piece of bright, tinned hookup wire into the middle of the spring for a pointer.

After the panel is painted, a scale should be scratched along its top edge with vertical marks for each 100 divisions rotation of the circular dial. If counterclockwise rotation of the dial increases its reading, the vertical marks should be numbered from left to right; or, vice versa. When taking readings, the linear scale across the top will show the hundreds figure and the circular-dial scale the ten and units figures. For instance, when the circular dial rests at 77 and the top panel marker is between 5 and 6, the setting is read 577.

Electrical Design

Electrical details of the frequency meter are given in the circuit diagram, figure 2. The meter is not completely enclosed in a shield box because to do so would confine the heat from the tubes and increase the warming-up time. Tests show that equilibrium is reached about 12 minutes after being turned on and the total drift during this warm-up period is of the order of 1 kilocycle. Thereafter the frequency is affected by temperature to the extent of about 20 cycles per degree Fahrenheit. A range of room temperature, up or down, of 25° F. will lead to errors of as much as 500 cycles. (All figures given in cycles are referred to 3500 kc.) Because the shielding is not complete, objects may not be brought too close to the top or rear of the unit, six inches being about the minimum allowable clearance.

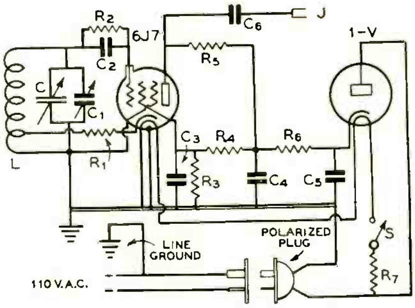


Figure 2

- C—Disc condenser (see text)
- C_1—100-μμfd. midget variable
- C_2—.00004-μfd. fixed mica
- C_3—.006-μfd. fixed mica
- C_4,C_5—Dual 4-μfd. 450-volt electrolytic
- C_6—Twisted hookup wire 6" long
- R_1—250 ohms, ½ watt
- R_2—50,000 ohms, ½ watt
- R_3,R_4—75,000 ohms, 1 watt
- R_5—100,000 ohms, 1 watt
- R_6—10,000 ohms, 1 watt
- R_7—350-ohm line cord resistor
- S—A.c. line switch
- J—Insulated tip jack

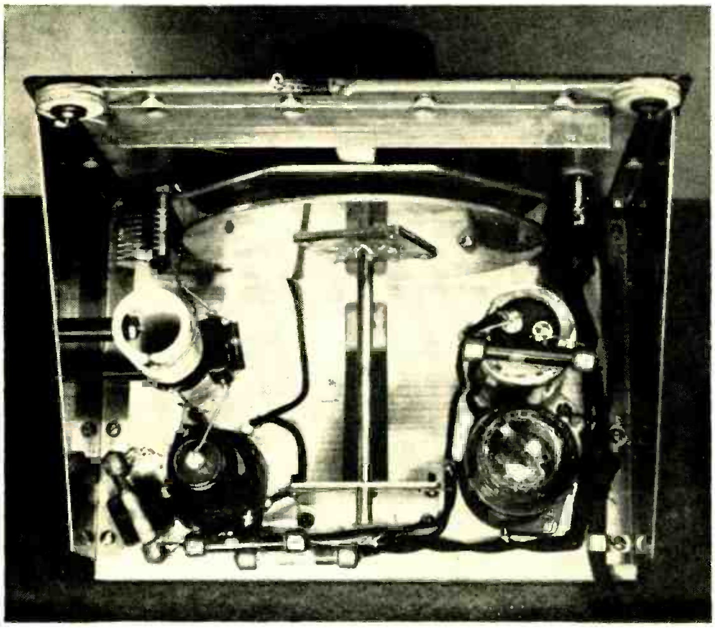


Figure 3. In this top view may be seen the placement of the panel-stiffening brace and the side braces.

Stability

The effects of filament, plate, and screen voltage on the frequency must be taken into account, but the source of each is the a.c. supply line and it is sufficient to consider the lumped effect of variation in line voltage. The purpose of the cathode resistor R_1 is to stabilize against this factor. Varying the supply from +10% to -5% gives rise to random fluctuations, none of which is more than 100 cycles. In order to have a nearly permanent value of inductance the coil L is wound on a ceramic form, and is mounted rigidly with ¾-in.-long bakelite bushings and screws to the side-brace piece. The coil should be given a coat of dope and aged for several days before final calibration. Using a coil of this sort, most of the circuit ageing which takes place will be of a capacity nature and can be corrected by changing very slightly the pad condenser C_1. The output loading has negligible effect on the frequency. The angle-brace construction, including the stiffener across the top back of the panel, is aimed at mechanical stability and permanence of dimensions.

A polarized plug had best be put on the line-cord resistor. The polarized plug has parallel-blade contacts similar to those of standard plug, except that one blade is about 1/16-in. wider than the other. It may be obtained from electrical supply houses and will fit most duplex receptacle outlets, but can be inserted only in one way. Initially, when setting up the frequency meter, plug the cord into the receptacle where it is to be used. Test with a voltmeter, a neon lamp, or a 10-watt tungsten lamp between the metal panel and a grounded wire. If voltage is present, reverse the leads into the polarized plug. The ordinary unpolarized plug will work, but it is heartily recommended that the method outlined be followed so as to be 100% safe against accidental shocks or short circuits.

Alignment and Calibration

To line up the condensers, turn the rotor until there is a 7/16-in. gap from the stator plate. Assuming the frequency meter is to be used for general coverage, to include the 1715-2000-kc. and the 3500-4000-kc. bands, the pad condenser should then be adjusted to hit 2000 kc. However, if most of the work is to be done on the 7.0-Mc. band and higher, C_1 should be set to yield 1875 kc. This will give coverage from 7500 to 7000 kc. which will take in all the higher bands, and the spread on the dial will be wider than in the first case.

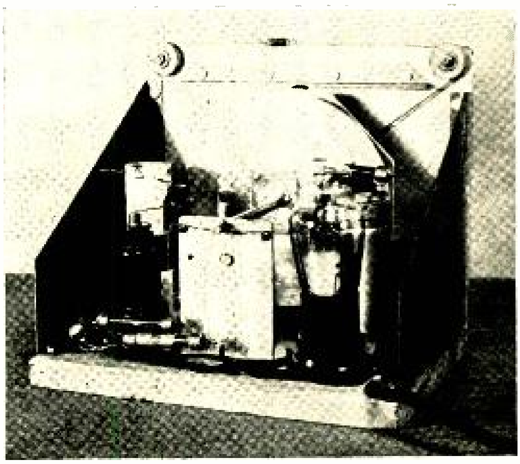


Figure 5. Looking at the frequency meter from the back.

The calibration must be plotted to a large scale, since there would be no point in striving for precision on the dial and then throwing it away on the curve sheet. The curves are plotted on cross-section paper ruled 5 divisions to the half-inch, both horizontally and vertically. The paper is sold in rolls or in large-size sheets under trade designations such as Dietzgen no. 307 or Keuffel and Esser no. 282G or 328G. A sheet cut to size of 12 by 18 inches is about right. The horizontal scale is made 10 inches long, 10 kilocycles to the inch, and the calibration is plotted in sections of 100 kilocycles each, for the 3.5 Mc. band. The vertical scale is arranged so that 50 dial divisions correspond to 1 inch.

A heterodyne frequency meter in general cannot be considered a frequency standard over extended periods of time, but must be checked against primary or secondary standards. The meter should be verified every month or so by setting the dial to the calibration for a known frequency, and then changing the pad condenser if and as necessary to give zero beat on that frequency.

●

At Harrisburg, Illinois, Mrs. I. W. Reynolds, who owns no radio, hears broadcast music emanating from a hot laundry stove in her home. Several local radio technicians have explained the phenomenon in terms of rectification of radio waves by clinkers in contact with the stove grate. Mrs. Reynolds certainly has something there, though we are inclined to think of less miserable radio receivers for use on sweltering mid-July evenings.

Expedition: 1938 Style

By ELMER H. CONKLIN

The style and speed of expeditions have changed during past years, with greater use now being made of planes. A new expedition is about to get under way to Netherlands, New Guinea—the island sometimes called Papua, in the Malay Archipelago north of Australia. The purpose is to study the flora and fauna in the central part of the island.

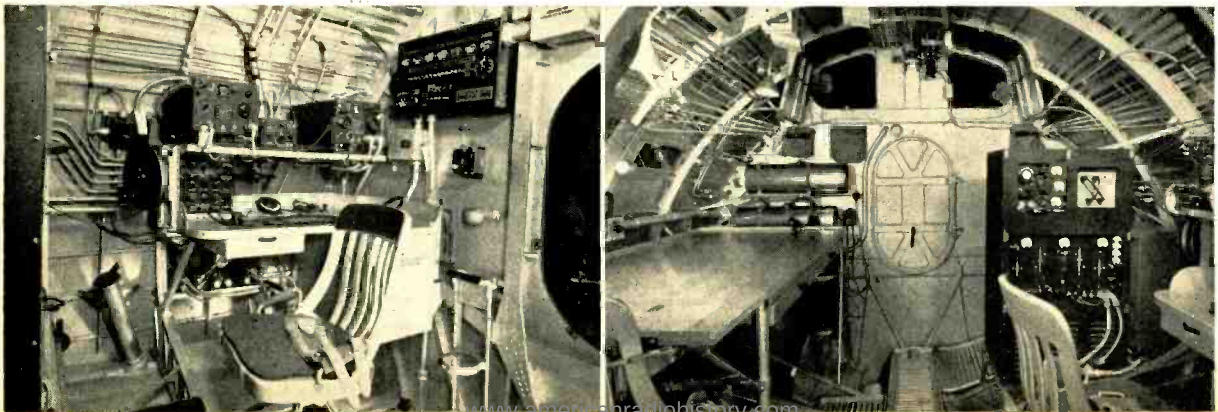
The owner of the plane and head of the expedition is Richard Archbold. The pilot is Russell Rogers, with Gerald Brown as flight engineer. The mechanic is William Sanderson, while Raymond Booth is the radio operator.

The plane is the bi-motored Consolidated PBY-2, almost identical to the PBY-1 shown in the accompanying picture. The transmitter aboard uses two RK46's, similar to the RK20 except for the 12-volt filaments. Both code and phone will be used, the latter by suppressor modulation of the final amplifier. The assigned frequencies include 3105 and 6210 kilocycles but very likely 12,420 will be used most of the time. Plans call for almost continuous operation while the plane is in flight.

Permission has been granted by the F.C.C. to contact amateur stations. W6LYY has arranged a schedule with the plane, KHAHX, and, if possible, a schedule will be kept with WHD in New York. Some general amateur work may be done particularly if W6LYY is unable to maintain contact, but the amateurs will be obliged to receive the plane's signals on 12,420 kc.

The expedition started from Miami, Florida, flying to San Diego during April and leaving San Diego about May 2 for a flight across the Pacific via Midway, Wake, Guam, and the Philippines using the Pan American Airways facilities. After arriving at New Guinea, inland flights are expected to be made nearly every day for a year and a half before returning to the United States.

• This is one of the most complete radio and interior communication systems ever provided in any airplane. It consists of a main transmitter, auxiliary transmitter, two complete receivers, a radio direction finder and an intercommunicaton system which extends throughout the ship and also permits both pilots to use the radio facilities directly when necessary.

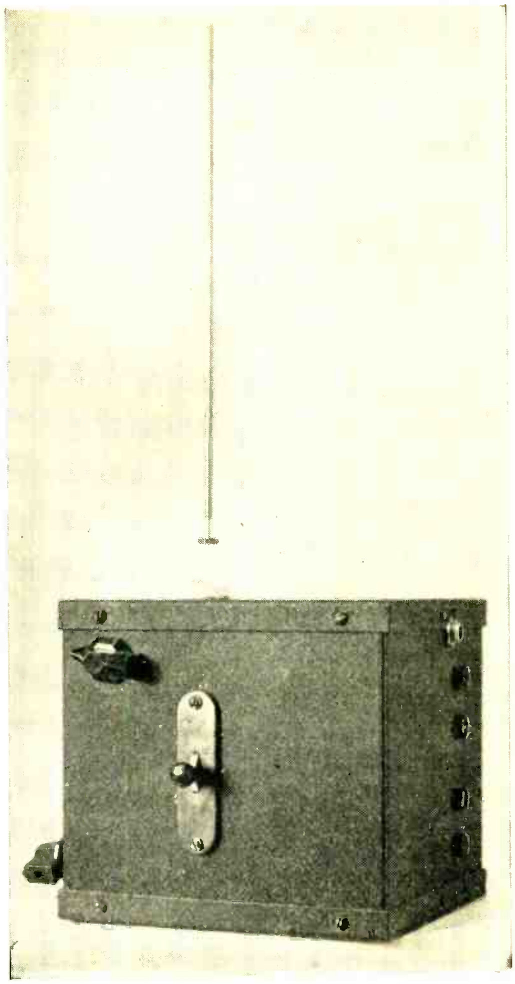


A Midget 90 Cm. TRANSCEIVER

By

DE FOREST O. ROMAIN*

W2IEV



When we drew up the circuit of this midget outfit, it was not our intention to write it up for a magazine; we didn't think it would be that good! However, tests have proven it to be quite unexpectedly worthwhile. So we should like to pass on the information to those other experimentally minded amateurs who like to construct similar outfits for themselves.

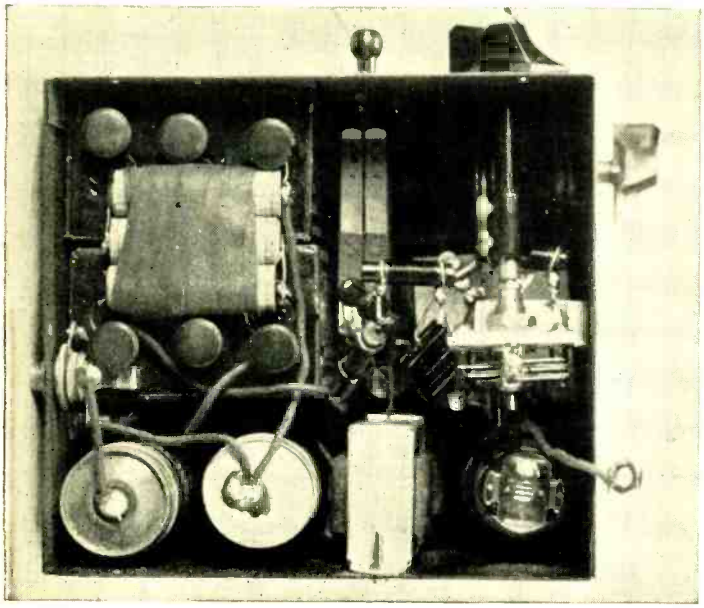
For people of such nature, there is unlimited interest and fascination in these lower wavelengths. Undiscovered powers may still be found, such as were found in earlier experiments on the higher wavelengths. It may be possible that greater than the "quasi-optical" distances may be had; not through reflection by the Kennelly-Heaviside layer, but through the refraction, or bending, of the waves by warm and cool layers of air. We already know this happens occasionally down on the five-meter band and permits greater distances to be covered. Because this effect has been found to be more pronounced on the higher frequency bands than on the lower, indications show there may be a greater effect in the one-meter region and below—time will tell. As for now, we can make use of the centimeter waves because of the possibility of making portables which are really portable.

*421 Ringwood Ave., Pompton Lakes, N. J.

Construction: Oscillator

These units were built with one outstanding purpose in mind—to make them as small as possible, and still to have them work. The smallest metal cabinets found listed were 5½x 6x5½ inches, so the complete units were put into these boxes. The circuit used is a form of the "Lecher" oscillator, modified so that it can be worked as a self-quenching detector in receiving position. About the best way to place the parts in the box is the way shown in the above picture, although they could be arranged differently to suit one's own needs. Since most of the oscillator circuit is isolated by the radio frequency chokes, it doesn't matter if the d.c. leads are a trifle long.

Looking down into the box, one should have little difficulty in discerning the various parts. Near the tuning condenser may be seen the r.f. chokes, wound on ¼-inch fibre shafting. They



Looking down on the top of the unit. The two 45-volt plate batteries fit into the left section of the box with the 4½-volt modulator bias battery on top of them. The 6-volt flashlight-cell filament battery is behind them and the 4 p.d.t. transmit-receive switch is alongside.

consist of 25 turns of no. 22 enameled wire (closely wound). These chokes are extremely critical and may require alteration to be adapted for the specific transceiver.

The wires forming the "Lecher" system are directly underneath the tuning condenser and consist of two lengths of no. 12 bus wire, seven inches long, and bent into the shape of the letter "S", one end being soldered onto the acorn tube socket, while the other is soldered onto the tuning condenser. They are spaced between ⅛ and ¼ inch apart and varied so that the transceivers may be "lined-up", both tuning to the same frequency at a given setting of capacity. The farther these two wires are separated, the lower the frequency at which they oscillate.

Notice how the antenna connection is made. The nut shown extending from the cabinet is fastened to the jack of the insulator when the cover is placed onto the cabinet. The antennas used by us were half-wave affairs as shown in the pictures. They were tapped onto the plate wire, close to the tuning condenser. One-half wave at this frequency is approximately eighteen inches. Care should be taken to see to it that the part of the antenna inside the cabinet is counted in making up the eighteen inches.

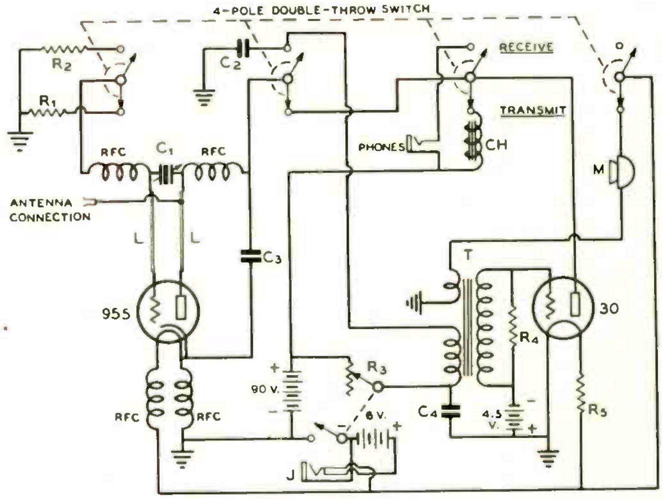
One might think that a receiver down on this wavelength would tune extremely sharp. This is not the case here, mainly because of the split-stator arrangement on the tuning condenser, which makes the capacity to orientation ratio very small. The condenser used is a midget 15-μμfd. Cardwell Trim-air. The two stator plates were removed and sliced in half, whereupon they were replaced on the condenser. With this arrangement, the rotor remains neutral and just varies the coupling between the two stator plates. Of course, with this arrangement, the rotor can only be varied 90 degrees, but it does add much to the vernier tuning action. Condenser C_3 is in the circuit to provide a short path for r.f. feedback, in receiving especially. For this reason, the leads to C_3 should be as short as possible. Without this condenser, very unstable regeneration will result.

The Modulator and Power Supply

Very little need be said about the modulator. Tests have proven that the 30 does a grand job of completely modulating the 955 oscillator. The popular, old "Heising" system of modulation is again used. The ½-megohm resistor across the output of the audio coupling transformer is to prevent audio howl.

Last, and far from least, comes the power supply. Burgess puts out the ideal "B" batteries for such portable outfits; they are small, light, and inexpensive for their size. Z30P's are the ones, and two of these comprise our plate source. We have used them for about thirty-five hours to date and still have lots of power in them. Long "B" battery life is largely accounted for by the fact that the current con-

C₁—Rebuilt 15-μμfd. midget condenser (see text)
C₂—.002-μfd. fixed mica
C₃—.0001-μfd. fixed mica
C₄—.25-μfd. 400-volt tubular
R₁—25,000 ohms, ½ watt
R₂—5 megohms, ½ watt
R₃—200,000-ohm potentiometer with switch
R₄—500,000 ohms, ½ watt
R₅—50 ohms, 5-watt filament resistor
CH—11-hy. midget choke, low current
T—Midget mike and audio plate to grid
RFC—25 t. no. 22 enam. on ¼" fiber rod
L—Lecher wire plate circuit (see text)
J—Midget closed circuit jack



sumption of the combined modulator and oscillator is only approximately 6 ma. on transmitting and about 3 ma. on receiving.

The filament battery life is not quite so promising when using flashlight cells. For this reason, we have a jack arrangement whereby a "Hot-Shot" battery, or four dry-cells, may be plugged in for home use. In this way, the flashlight cells are saved and just used for real portability. The jack is so arranged that it cuts the flashlight cells out of the circuit when the external battery is plugged in and then reconnects them when the plug is withdrawn. It may be seen on the right side of the cabinet. Since the 30 needs 4½ volts grid bias, when run at 90 volts plate, three midget flashlight cells are used for this purpose. These may be seen lying flush on top of the two "B" batteries.

Operation

In the receiving position, if working properly, there should be the usual hiss found in all super-regenerative receivers. For best reception the regeneration control should be turned back until just on the verge of where the set goes into this hiss. Here will be found a spot where the modulation will come through with comparatively little hiss. If the regeneration control is advanced further, signals may still be received, but the sensitivity drops off.

One will find that the outfit will more than likely transmit best on one frequency. This may be due to the antenna radiating best on this frequency, or perhaps just that the oscillator works better on that frequency. For our sets, we found the best frequency by experimentation and marked the dial. They receive on almost the exact frequency upon which they transmit.

Measurement of Frequency

The actual frequency of the transceiver may be found by hooking a piece of wire about five feet long onto the rig, in place of the antenna. Then, by coupling a milliameter in the plate circuit of the oscillator, the frequency may be found thus:

Draw a small screw driver along the wire, noting the plate meter. A few inches from the bottom of the wire, near where it couples to the oscillator, a rise in plate current should be noted when passed over with the screw driver. Mark this point on the measuring wire, and continue on until a second rise in current is detected. The distance between these two points is one-half the actual wavelength of the oscillator. This may be measured with a foot rule and later converted into centimeters, by use of the formula: $\text{cm.} = 0.3937 \times \text{inches}$, where cm. equals the wavelength in centimeters, and the factor 0.3937 is multipled by the number of measured inches between the two points. The frequency in Mc. may be obtained from the wavelength in cm. by dividing this value into 30,000. Thus, if the wavelength is 90 cm., the frequency is 333 Mc. If a milliammeter is not available, similar calibration may be made by listening in receive position and noting the points on the wire where the regeneration either ceases or decreases. May we point out that the results are only approximate in either case and hair-line precision is not obtained.

[Continued on Page 70]

Practical Design of Close-Spaced

UNIDIRECTIONAL ARRAYS

By W. W. SMITH,* W6BCX

A horizontal dipole used at 20 meters exhibits considerable sky-wave directivity, due to the fact that radiation at vertical angles not falling between 10 and 20 degrees is not ordinarily effective in producing signal at the distant point. The radiation at these vertical angles is "down" from 12 to 18 db off the ends of the dipole regardless of its height above earth. Thus the dipole is bidirectional, exhibiting approximately 15 or slightly more db discrimination at 10 meters and approximately 15 or slightly less db discrimination at 20 meters.

By using a properly adjusted director or reflector in conjunction with the dipole, it is possible to increase the foreward gain approximately 5 db and attenuate the power radiated to the rear as much as 12 db, the latter attenuation being obtainable with a close-spaced (tenth wave) director possessing just the right amount of capacitive reactance. A director will have only a slight effect on the radiation off the ends, which is low to begin with, but by reinforcing the radiation from a dipole in one broadside direction and attenuating it in the opposite direction, a substantially unidirectional array is obtained.

Because the director will minimize the effect of the earth upon the pattern of the driven dipole, the radiation from the dipole will be at lower, more useful angles. For this reason a dipole of such height above ground that there is but little power radiated at low angles (a quarter wavelength above earth, for example) will oftentimes exhibit more than the theoretical 5 db gain when a director is added. If the dipole is far removed from earth, the gain will more nearly approach the theoretical value when a director is added. If the dipole were sufficiently removed from the earth that the effect upon the dipole were negligible, it might seem advisable to raise the director so that a plane including both dipoles would make an angle of about 15 degrees with the earth. Because the nose of the pattern (in a vertical plane) is so broad, actually little improvement would be noted.

*Editor, RADIO

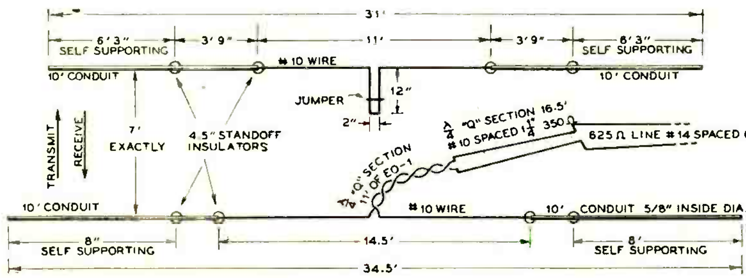
The foregoing is presented in an attempt to clarify much confusion that exists among amateurs as a result of attempting to apply Brown's patterns (I.R.E. *Proceedings*, January, 1937, figure 28) to a *horizontal* driven dipole and director arrangement. The field patterns shown are for vertical radiators; when applied to horizontal radiators, the patterns apply to the vertical directivity. In fact, unless the horizontal dipoles are far removed from earth, the patterns will not apply at all, because of the effect of the presence of the earth on the vertical directivity. Nevertheless a horizontal driven dipole and director spaced a tenth wavelength makes an excellent unidirectional 10- and 20-meter array even if we cannot apply Mr. Brown's patterns to the horizontal directivity. In fact, for low-angle sky wave propagation the horizontal arrangement will show a sharper (horizontal directivity) "nose" than a vertical dipole and director, and with approximately the same front-to-back discrimination.

While Mr. Brown's original paper is a little too involved to be readily assimilated by the average amateur, much has appeared in the last year in various publications describing several amateur applications of his findings. However, there still exists considerable difference of opinion among amateurs as to the best and simplest methods of adjustment and feed. The following discussion will concern itself with these two problems.

Without going into detailed discussion or comparisons, we will merely state that most advantages are obtained when the parasitic element is used as a director, with tenth wavelength spacing, and this combination will be assumed in the following discussion.

If the director is self-resonant, the theoretical gain will be about 5.5 db, or maximum. However a lobe appears to the rear[1] which is only

[1]In Brown's paper the "backward" radiation refers to radiation towards the parasitic element regardless of whether it is used as a director or reflector. In the discussion presented here, backward radiation will refer to radiation in a direction away from the director rather than towards it.



14.2 MC. UNIDIRECTIONAL ARRAY
ROTATABLE 7 X 18.5' WOODEN SUPPORTING STRUCTURE REQUIRED

Practical Design for Rotary Close-Spaced Unidirectional Array Utilizing "Double Q" Matching System.

about 5 db lower in amplitude than the forward lobe. By shortening the director slightly so as to produce sufficient capacitive reactance to introduce approximately a − 14 degree phase angle, it is possible to increase the front-to-back ratio to approximately 17 db and still obtain nearly 5 db gain. Because of the effect of the earth upon the vertical directivity of horizontal antennas and arrays, these theoretical forward gains do not strictly apply to a driven horizontal dipole and close spaced director. In actual practice the forward gain at vertical angles of approximately 15 degrees will be almost identical regardless of whether the director is adjusted for greatest discrimination or for greatest forward gain.

Because the adjustment of the director for maximum discrimination is quite critical, it must be accomplished by cut and try; it is not practical to cut the director according to a design table and then assume that it is correct. The radiator, however, is not so critical, and it may be cut safely to a predetermined length which, because of the reactance presented by the director, will be slightly longer than if it were resonated without the director being present. This leaves only the director adjustment to be made.

The common practice is either to "prune" the director an equal amount at either end, or, in the case of tubing, to use telescoping end sections which may be slid in or out a few inches. This is awkward for two reasons: first, it is necessary to make *two* alterations each time in order to keep the system symmetrical, and second, it is difficult to reach the ends of the director if it is high above ground. Unfortunately, it is not the best practice to adjust the director at a height that can be reached easily and then raise the affair atop the pole. It is much better to make the director adjustments with the array at the height at which it is to be operated.

By making the director about a foot shorter than the probable length and splitting it at the center, the director may be adjusted from the *center*. This portion of the array is easily reached from the supporting pole, and center pruning requires only one adjustment. Thus proper adjustment of the director length is greatly facilitated. While it would probably be unwise to carry the idea further and fold several feet at the center of both radiator and director to obtain a more compact array, center-shortening only the director by a matter of but a few inches has no detrimental effect on the practical operation, and offers a simple method of varying the electrical length and thus the reactance offered by the director.

Feed

There is considerable divergence of opinion as to the most satisfactory methods of feed for the system described. A delta-matched *open-wire* line is highly satisfactory from an electrical standpoint, but requires careful adjustment and complicates the problem of rotation. However, use of a delta-matched system makes it unnecessary to know the exact impedance we are attempting to match; we need merely slide the taps along until standing waves on the line disappear.

The delta-matching system should *not* be employed with low impedance twisted cable. Many amateurs are under the impression that with 72-ohm cable they need but tap out on the radiator to "points of 72 ohms". If this were the case, there would be little energy transfer because with a system having such low radiation resistance the 72-ohm points would be only a few inches apart and delta matching would not provide sufficient coupling coefficient.

It should be borne in mind that in a delta-matched system we do *not* attach the feeders to points equal to the line impedance (72 ohms in this case) but to points equal to the surge impedance of the fanned out line at the point of attachment. In other words both EO-1 cable and a 600-ohm open line constructed of no. 12 wire would attach approximately to the same points in a delta-matched system, the impedance of the radiator at the points of attachment being in the general neighborhood of 800 ohms in both cases. The surge impedance of the *fanned* out line at the point of attachment will also be in the neighborhood of 800 ohms. The impedance transformation in either case is a result of the gradual fanning out of the line to a higher surge impedance. In the open wire line we fan it out from 600 to approximately 800 ohms, which can be done with no bad effects. But when we attempt to fan out a 72-ohm line to approximately 800 ohms the transformation is too great and results are not particularly satisfactory.

Other common methods of matching require that the radiation resistance of the driven radiator be known with a fair degree of certainty. The radiation resistance of a driven dipole when a director is spaced a tenth wave from it is close to 14 ohms *when the director is resonant,* the condition giving greatest theoretical forward gain. But when the director is shortened slightly to give best front-to-back discrimination, as advocated earlier in this article, the approximate radiation resistance of the driven dipole is *no longer 14 ohms, but is 28 ohms.* The exact value will depend to an extent upon the height above ground; it will always be fairly close to 28 ohms, however.

A highly satisfactory method of feeding a close-spaced array of the type under discussion is illustrated in the accompanying diagram. Two, quarter-wave "Q" sections are utilized to transform the 28-ohm radiation resistance to an appropriate value for matching a two-wire open line. The first "Q" section consists of 72-ohm EO-1 twisted cable. Because the propagation along such a line is slower than for an open line, the quarter wave section is only 11 feet long for 14.2 Mc.[2] The flexible nature of this cable provides a highly satisfactory method of connection to the rotatable dipole, as it may be allowed to bang against guy wires without bad results and cannot short out by "twisting over on itself." The quarter-wave section transforms the 28-ohm radiation resistance to about 195 ohms. This value is not high enough to produce excessive voltage across the EO-1 cable, and the cable will easily stand 400 watts in the antenna without heating or showing signs of breaking down. While the use of EO-1 cable cannot ordinarily be indorsed for use as a "Q" section, it is quite permissible to use it as as done here because the impedance transformation is not very great—no greater, in fact, than in many amateur installations where the cable is used to feed an 80- or 160-meter doublet close to the ground, such antennas having quite low radiation resistance. The losses in the cable will be very low by virtue of the short length required: 11 feet on 20 meters and 5.5 feet on 10 meters.

A 350-ohm "Q" section is used to transform the 195 ohms to 625 ohms, the latter being the surge impedance of the open line (no. 14 wire spaced 6 inches). This "Q" section consists of no. 10 wire spaced 1.2 inches, and is 16.5 feet long. The small size ("2 inch") Johnson spreaders will provide 1.2″ spacing for the no. 10 wire if the two wires are run through the holes provided for the serving wires rather than fastened to the ends of the spacers. This 350-ohm "Q" section may be run down the supporting pole, the top attaching to the EO-1 cable "Q" section and the bottom to the 625-ohm line. This arrangement requires that the 625-ohm line leave the pole considerably below the radiator and director. This is to be recommended anyway, because if the feeders leave the pole only a few feet below the array it will cause unbalance in the array at certain positions of rotation, and will cause the input to the transmitter to vary excessively as the array is rotated. The feeders also will distort the radiation pattern if they leave the pole too close to the dipoles.

[2]See "How Long Is a Quarter Wave?", J. N. A. Hawkins in *QST,* November, 1937.

Physical Construction

An excellent 20-meter array may be constructed by following the accompanying diagram. The new, *thin-walled* galvanized steel conduit, available from most electrical supply houses in 10-foot lengths, is used as illustrated in order to permit a smaller wooden supporting structure. The conduit is not expensive and a 10-foot length in the ⅝" inside diameter size is quite rigid. Because of the high voltage present and for the sake of mechanical strength, large, 4½-inch ceramic standoff insulators are used to fasten the four lengths of conduit to the wooden supporting structure where indicated.

Besides the eight large standoff insulators and four lengths of conduit, the following are required: Exactly 11 feet of EO-1 cable. 65 feet no. 10 wire. 18 "2 inch" ceramic spreaders with holes spaced 1.2 inches. Sufficient no. 14 wire and 6-inch spreaders to reach from the pole to the transmitter.

Design of the wooden supporting structure and rotating mechanism will be left to the ingenuity of the individual constructor, because so much has already appeared on the subject and because no two amateurs have the same idea as to the most desirable physical construction of their particular installation.

Adjustment

The easiest method of adjustment calls for a sensitive field-strength meter placed at least a hundred feet from the antenna and as high as possible. Lacking a field strength meter, enlist a *local* amateur who has a sensitive "R" meter on his receiver. The adjustment giving the best discrimination on the local ground wave will also give the best discrimination at distant points. An attempt to check with an amateur at a distant point while making adjustments will result in difficulty because of fading effects.

With the array pointed *away* from the assisting amateur or the field strength meter, slide the jumper (be sure low resistance copper clips are used) towards the director an inch at a time. The antenna coupling at the transmitter should be adjusted each time to *keep the input to the transmitter the same.* As the jumper is slid towards the center of the dipole (electrically shortening the director), the field strength will decrease. When a certain critical point is reached, the field strength will start to increase. The jumper is adjusted (keeping the transmitter input constant) for minimum field strength, and then slid *away* from the director about one inch (lengthening it two inches). At this point the front-to-back discrimination will be greatest, and the forward gain will be only slightly, if any, less than the maximum obtainable.

This method of adjustment is simpler and quicker than rotating the array each time to check the front-to-back ratio, and a study of Brown's figure 24 indicates that it is just as accurate.

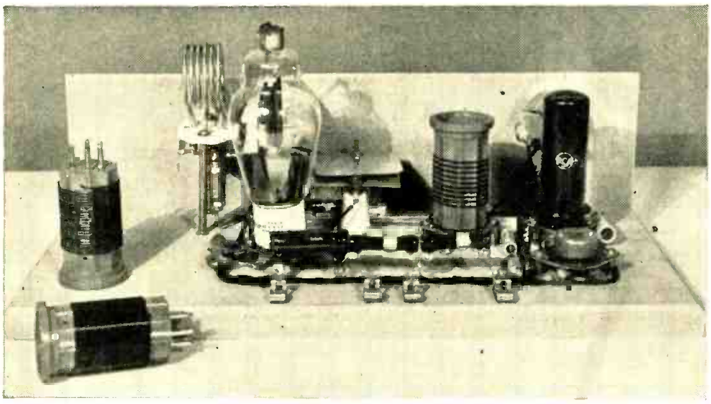
When this adjustment has been made, a check for standing waves should reveal nearly uniform current and voltage along the 625-ohm line. If standing waves are very noticeable, it indicates that an error has probably been made in trimming the director length, as the radiation resistance will vary considerably from 28 ohms if the director length is off more than a very few inches.

Because of the heavy current flowing at the center of the director, the jumper should be replaced with a soldered shorting wire after the correct position has been determined.

This type of array is quite critical as to frequency, though it may be used over the entire 20-meter band with fair success if cut for the middle of the band. A 14.2-Mc. array will have approximately the same forward gain over the whole band, but will exhibit noticeably better discrimination (front-to-back ratio) at the center of the band than at the edges.

A 10-meter array can be constructed with both dipoles entirely of conduit, the director being split the same as illustrated for the 20-meter array to facilitate adjustment. Because the 10-meter band is so wide, it is advisable to cut the array either for 28.5 Mc. (for use from 28 to 29 Mc.) or for 29.5 Mc. (for use from 29 to 30 Mc.). Cutting the dimensions given for the 14.2-Mc. array in half will be approximately correct for a 28.5-Mc. array. Two 8' 7" lengths of conduit could be used for the radiator of a 28.5-Mc. array, with two 7' 8" lengths serving as the split, adjustable director. The spacing between radiator and director would be 3.5 feet, and a 3.5 ft. by 3.5 ft. rotatable wooden supporting structure would be sufficiently large. The 72-ohm EO-1 "Q" section would be 5.5 ft. long and the 350-ohm section would be about 8 ft. 3 inches long, the spacing remaining the same (1.2 inch).

For a 29.5-Mc. array the radiator length, the director length, the spacing between the two, the 72-ohm "Q" section, and the 350-ohm "Q" section should all be shortened by 3 per cent.



For Beginners . . .

AN INEXPENSIVE EXCITER-TRANSMITTER

By JACK ROTHMAN,* W6KFQ

With the introduction in the April RADIO of Frank Jones' newest crystal oscillator circuit for harmonic output, an obvious application was to follow one of these oscillators with an 809 operating either as an amplifier or doubler. The resulting exciter-transmitter is indeed a "natural" for the beginner; for that matter, one of these units makes an excellent 25-40 watt exciter for all band use by more advanced amateurs. And of course the beginner could very easily add a medium power amplifier to the little rig when his proficiency and financial condition permit.

With only four easily-constructed coils and two crystals, one on 40 and the other on 80 meters, it is possible to obtain about 25 watts output on 28 Mc. and a good "healthy" 40 watts output on the next three lower frequency bands: 14, 7 and 3.5 Mc. On the lower frequency bands the 809 operates as a neutralized amplifier, while on 28 Mc. the 809 must double. Only one 600-volt, 175-200 ma. power supply with good regulation and a filament transformer capable of supplying 6.3 volts at 3.5 amperes are needed to operate the rig. The 809 operates directly from the 600-volt supply and a voltage divider supplies the screen and plate potentials for the 6L6. With the dividing resistors shown in the schematic diagram, the 6L6 screen operates at about 260 volts and the plate at about 350 to 370.

The Coils

Coil no. 1 has 6 turns of no. 10 wire, center tapped, and air-wound to a diameter of 1½". Another piece of no. 10 wire is soldered to the center of this coil as the center tap; this wire and the two outside ends of the coil itself are plugged directly into the coil socket, thus eliminating a coil form and making a more efficient coil. This coil can be seen plugged into the 809 amplifier coil socket in the back view of the rig.

Coil no. 2 has 10 turns of no. 18 wire spaced to 1½" on a 1½"-diameter coil form. This coil is shown plugged into the oscillator coil socket in the back view of the exciter-transmitter.

Coil no. 3 has 20 turns of no. 18 wire, center tapped, and spaced to 2" on a 1½"-diameter coil form. This is the coil lying inverted upon the subpanel.

Coil no. 4 has 40 turns of no. 18 enameled wire, center tapped, and close wound on a 1½"-diameter coil form. This is the coil lying on its side in the rear view.

With just these four coils and two crystals (all the coils are interchangeable from the oscillator to the amplifier), it is possible to ob-

*Laboratorian, RADIO.

tain a large number of different circuit combinations. With the addition of a 160-meter crystal, other combinations are made possible.

Mechanical Construction

In the unit shown in the photographs construction has been simplified and made as inexpensive as possible. The parts are mounted upon a ¾" wooden baseboard and the two tuning condensers and the plate circuit metering jacks for the oscillator and 809 are mounted upon a low panel of tempered masonite. All sockets, except the isolantite one used for the final tank coil, are of the inexpensive wafer variety. The neutralizing condenser for the 809 is made from two 1½" standoff insulators and a pair of aluminum or sheet tin plates. Inexpensive 600-volt tubular paper condensers are used in the various by-passing positions instead of more costly mica capacitors.

If desired, the exciter-transmitter may be built upon a metal chassis and panel with isolantite sockets throughout and with a manufactured neutralizing condenser, where appearance is a more important consideration. But the unit as it now stands operates very efficiently and smoothly with no trace of instability or parasitics. However, where the unit is to be used as a rack-mounted exciter, the metal-panel and chassis would be more desirable.

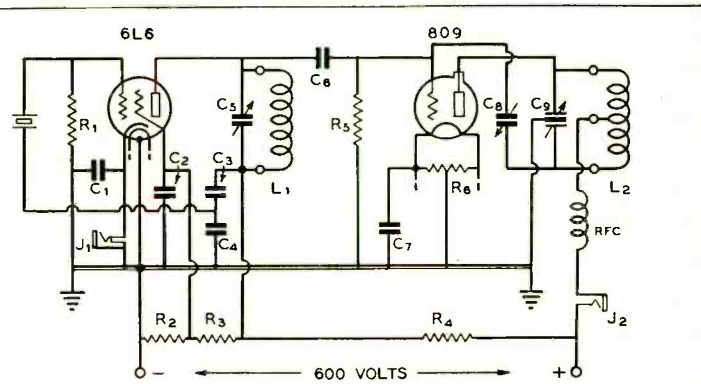
In a rack-mounted installation it would be necessary to insulate the oscillator tuning condenser and the amplifier metering jack from the panel. Also, it would be advisable to use a tube socket for the power supply connections, although fahnestock clips mounted upon a bakelite strip or a manufactured terminal strip could be used.

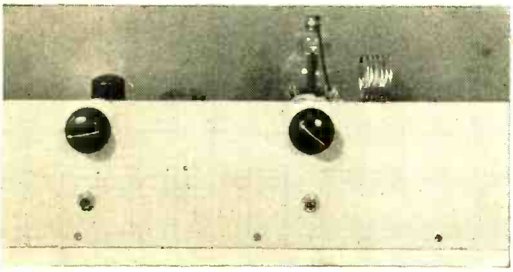
Tuning Up

The tuning-up operation for this rig is indeed simple; no difficulty should be experienced by even the beginner to whom this is his first transmitter. Plug the 40-meter crystal in the oscillator crystal socket, put coil number 1 in the oscillator and coil number 2 in the 809 coil socket. Then place a 0-150 d.c. milliammeter in the oscillator metering jack. Then, with a flashlight lamp and a pickup loop coupled to the oscillator tank, peak up the output of the oscillator. The condenser will hit resonance about 2/3 in and the output will be on 20. Next couple the flashlamp pickup loop to the amplifier plate tank and resonate this tank by noting the lamp brilliancy.

There is, under these conditions, no plate voltage on the 809. But since there is small chance of the amplifier being perfectly neutralized on the first try, the lamp will probably glow. Then the spacing between the two plates of the neutralizing condenser is varied by bending one until minimum indication is obtained on the pickup lamp. Then the pickup loop is removed. The final neutralizing adjustment can best be made by noting the indication on the crystal stage milliammeter and adjusting the neutralizing condenser until this meter flickers a minimum amount as the amplifier plate tank is tuned through resonance. It should be possible to obtain a point where no perceptible variation in oscillator plate current is obtained as the amplifier tank condenser is tuned through resonance. This is the point of most perfect neutralization of the amplifier.

R_1—50,000 ohms, 1-watt carbon
R_2—20,000 ohms, 10 watts
R_3—5000 ohms, 10 watts
R_4—2000 ohms, 30 watts
R_5—7500 ohms, 10 watts wire wound
R_6—30 ohms, 10 watts c.t. (not needed if fil. trans. has center tap)
C_1—.01-μfd. paper tubular
C_2—.01-μfd. paper tubular
C_3—.002-μfd. paper tubular
C_4—Probably 250-μμfd. mica (try 150, 250, 375, and 500 μμfd. See text)
C_5—140-μμfd. midget variable
C_6—.0001-μfd. mica or paper tubular
C_7—.01-μfd. paper tubular
C_8—Two sheet metal plates, one adjustable (see text)
C_9—100-μμfd. per section, receiving type midget.
RFC—2.5 mh. 125 ma. r.f. choke
L_1, L_2—See text





Simplicity itself—front view of the gadget.

This neutralization adjustment, if made on 20, will hold for operation on all bands.

The plate milliammeter may then be placed in the metering jack for the 809 amplifier and the plate voltage applied. The plate current should dip to about 25 ma. at resonance with no load coupled to the stage. Out of resonance the plate current should go off scale. Then, if the crystal is removed from its socket, or an open key is plugged into the oscillator jack, the plate current on the 809 should drop to about 35 ma. This should be obtained with a conventional choke-input 600-volt plate supply using an 83 rectifier with the normal regulation experienced in such a supply.

If plate current conditions much different from this are obtained, there is probably something wrong with the rig. It is possible that the amplifier is out of neutralization. If this is the case, an indication will be obtained when the pickup lamp is coupled to the output tank and the crystal has been removed. If the amplifier is oscillating, the neutralization procedure had best be repeated with more care. The amplifier really is quite easy to neutralize providing the layout has been made the same and providing care is taken in making the adjustments.

The only place where trouble might be encountered with the unit is in the oscillator stage. Since this circuit is a regenerative one, it is important that the correct amount of regeneration be employed. The value of condenser C_4 in the schematic diagram is what determines the amount of regeneration in the oscillator circuit. If this condenser is made too small, too much regeneration will result and the crystal current will be excessive. Also it is possible that the oscillator will oscillate "without benefit of crystal." If it is made too large, the output of the 6L6 on harmonics of the crystal frequency will be low and the rig will not key smoothly and rapidly. The value shown in the diagram has been found by experiment to give the best results in a number of cases. However, if in some special case one of the above mentioned possible difficulties is encountered, the value of this condenser can be increased or decreased until the trouble is eliminated.

Operation

Perhaps the best method of describing the operation of the unit is to describe the various methods of operating it on each band and to mention the operating conditions that can be expected when on this band. First, the oscillator cathode current should run between 70 and 85 ma. depending upon the band upon which it is operating and depending upon whether it is doubling or operating straight through. The 809 stage may be loaded to approximately 100 ma. for operation on all bands. This, of course, gives an input of about 60 watts.

28-Mc. Band

For operation on 10 meters, a 40-meter crystal is used in the oscillator. Coil no. 2 is used in its plate circuit and resonance at 20 will be found with the tuning condenser practically clear out. Then, with coil no. 1 in the 809 plate circuit, the final is resonated as a doubler to 10. Under ordinary conditions the unloaded plate current on the 809 at resonance will be about 28 ma. With the 809 loaded to 100 ma. the output will be about 25 watts on this band.

14-Mc. Band

There are a number of different combinations whereby operation on 20 may be accomplished. First, the conditions previously used in neutralizing the 809 stage may be used for 20-meter operation. These are: 40-meter crystal in the oscillator, coil no. 1 in the oscillator plate circuit and coil no. 2 in the plate circuit of the amplifier. Under these conditions the output of the oscillator will be on the second harmonic of the crystal frequency and the 809 stage will be operating as a neutralized amplifier.

Now, if desired, coil no. 3 may be placed in the oscillator plate circuit, an 80-meter crystal substituted for the 40-meter one and the same coil (no. 2) left in the 809 plate circuit. Then, with the oscillator plate condenser tuned nearly *out,* the output of the oscillator will again be on twice crystal frequency or 40 meters and the 809 stage will

[*Continued on Page 90*]

A Cahode-Ray Oscilloscope for $1.37

By

E. H. CONKLIN*

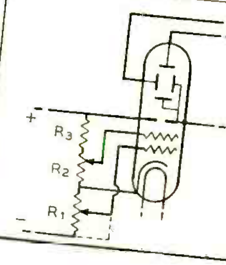


FIGURE 1

BASIC OSCILLOSCOPE CIRCUIT

R1 - 25000 Ω POTENTIOMETER WITH SWITCH

R2 - 50000 Ω POTENTIOMETER

R3 - 125000 Ω 2W. RESISTOR

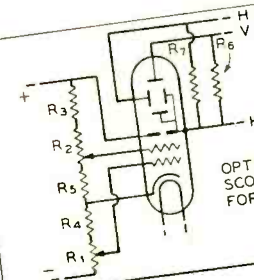


FIGURE 2

OPTIONAL BASIC OSCILLOSCOPE CIRCUIT. SEE TEXT FOR RESISTANCE VALUES

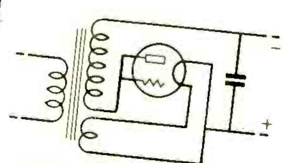


FIGURE 3

SIMPLE POWER SUPPLY USING ANY AVAILABLE RECEIVING TUBE AS A RECTIFIER

Many articles have appeared describing complete cathode-ray oscilloscopes that can be built by the amateur. These have often been portable instruments useful for almost any of the more common measurements that a scope can make. As a result, one thinks of them in terms of the commercial models advertised for radio service and laboratory use.

While such a gadget is undoubtedly useful, it leads us away from the amateur's specific requirements—and sometimes his pocketbook. Amplifiers are necessary for many applications but the average amateur station already has an amplifier or two in the receiver and transmitter. Power supplies are available in several pieces of equipment. To demand that an oscilloscope contain a couple of power supplies, amplifiers, and a linear sweep circuit, is often to discourage its purchase or construction.

It is the purpose of this article, therefore, to illustrate the facility with which a simple scope can be thrown together cheaply, and to get completely away from the complex circuit diagrams which are generally drawn so that the functions of the various parts can hardly be traced.

The cathode-ray tube is, to a degree, similar to an ordinary tetrode, even to the point of being capable of generating radio-frequency oscillations. A cathode heating current, a "control grid" bias to govern the output or intensity, and a "screen grid" voltage to regulate the "quality" or focus, are necessary in addition to the usual plate or anode voltage. These can be obtained from a power supply already in use around the station.

*Associate Editor, RADIO.

The Voltage Divider

All of the voltages, except that for filament heating, are obtained from a low-current bleeder which in its simplest form is composed of two potentiometers and one resistance, as shown in figure 1. The bleeders or voltage dividers used in commercial scopes have a resistance such that the current flow is between one-third and three milliamperes, with a total resistance between 145,000 and 1,800,000 ohms, for the one- and two-inch tubes. The lowest current permits the use of a filter condenser of less than one microfarad without requiring a smoothing choke. The heavier values of bleeder current make it necessary to use several microfarads of filter condenser to obtain a sufficiently low a.c. ripple voltage. Chokes are not generally used.

The intensity control, R_1 in figure 1, supplies a negative grid bias to the tube; higher grid voltages decrease both spot size and intensity. This should be adjustable to cut-off, requiring some sixty volts drop across this potentiometer, and accounting for a resistance which is usually slightly greater than 10% of the total bleeder resistance. In some cases a small resistor, R_4 in figure 2, is placed in series with R_1 at the end to which the cathode connects, making it impossible to adjust the grid bias all the way to zero. This reduces the maximum spot briliancy that can be obtained, and may at times prevent an adjustment that would burn the screen. Its resistance may be only 1,000 ohms; so it hardly need be considered as altering the total divider resistance.

When only a low voltage is available to operate the scope, it is not necessary to use quite so much of it in the grid potentiometer. By connecting the arm to the negative lead, as shown in the dotted line of figure 1, the unused voltage can be made available for the anode. In calculating the wattage requirements of the bleeder resistor, then, it will be necessary to consider the reduction in total bleeder resistance and consequent increased bleeder current.

The focusing control, R_2, supplies a positive voltage of about 100 to 200 volts to what is comparable to the screen grid in a tetrode. The resistance of this potentiometer, in commercially built apparatus, varies between 20% and 33% of the total divider resistance, with most scopes using a value of 25% to 27%. Because only the upper half of a potentiometer of that size is used, a smaller one and a fixed resistance, R_5 in figure 2, will make a somewhat better arrangement due to the greater spread of adjustment, and the lower power dissipation requirements of the potentiometer. The fixed resistor usually is between one-sixth and one-half of the resistance allotted to this control, the rest to be accounted for in the potentiometer itself.

The balance of the divider is generally lumped in one or two fixed resistors.

The power dissipation requirements of the bleeder resistors should not be overlooked. Potentiometers rated at one watt should not be run at a considerably higher value. The following table of maximum resistances for one watt power dissipation for various bleeder currents may facilitate design, but a larger factor of safety should be allowed:

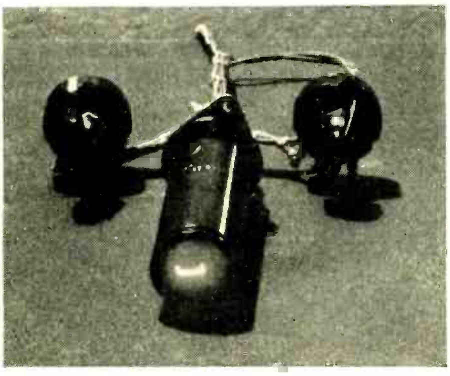
CURRENT	1 MA.	2 MA.	3 MA.
Voltage drop	1000 v.	500 v.	333 v.
Max. resistance	1 megohm	250,000	111,000

The Power Supply

The divider can be connected across any available power supply developing a *peak* voltage of between 250 and 600. Higher voltages increase the speed of the electrons, which increases spot intensity, decreases its size and moderately reduces the deflection sensitivity. Inasmuch as the load on the supply is very small, it can be used without any bleeder other than the voltage divider in the scope, in order to take advantage of the peak transformer voltage. If the supply is used in this way, the filter condensers will have to be able to stand the peak voltage output of the transformer.

If the available supply has too low a voltage, one plate of the full-wave rectifier tube can be disconnected from the transformer and the negative filter lead moved from the center-tap connection to the free end of the transformer, thus doubling the voltage and using a half-wave rectifier. Here again, be careful not to blow the filter condenser. A voltage doubling circuit can also be used, but the one- and two-inch tubes do not demand high enough anode voltages to require it.

If a separate power supply for the scope is desired, it is only necessary to obtain a transformer with a total secondary voltage between 200 and 450 volts r.m.s., and apply it to almost any available receiving tube as a half-wave rectifier. Even the old 222, an early screen-grid receiving tube, will handle a three-inch scope which requires a thousand volts. The filter can be a single microfarad condenser. The simple power supply is shown in figure 3. Be sure to mount the transformer where it won't distort the electron beam—preferably well behind the cathode-ray tube base. When a built-in power supply is used, the anode is generally connected to ground, thus putting the "cold" deflecting plates and the chassis at the positive supply potential, with the cathode and heater highly negative in respect to ground. In this way, the high voltage leads can be made more inaccessible, especially with the one-inch 913 tube, which has a metal shell connected internally to the anode (positive). When the voltage is obtained from the power supply of a receiver or other equipment around the station,



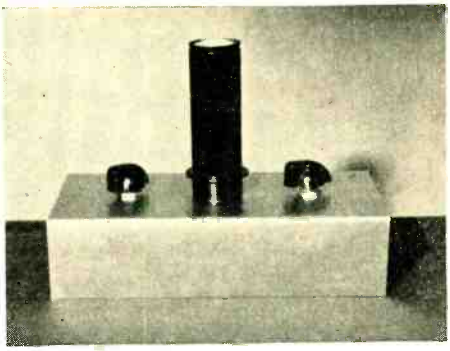


Figure 4. (Right) Basic oscilloscope operating from external power.

Figure 5. Mounted basic oscilloscope, using circuit and parts listed under figure 1. Cost, $1.37 plus tube.

it is convenient to leave the ground on the negative in the supply, in which case the operator must be careful not to get between ground and the tube shell or the "cold" deflecting plate lead, which become "hot" with respect to the supply voltage and ground. If the scope is used in any application where the power supply will be shorted or the circuit under study disturbed, blocking condensers of about 0.1 microfarad should be placed in the deflecting plate leads and a "leak" resistor shunted across each set of plates.

Some care may also be necessary in using an external heater transformer. If the latter happens to be connected through other equipment to the high voltage supply from which the cathode-ray tube is operating, the intensity control could be shorted because the cathode of the tube is internally connected to the heater.

The Deflecting Plates

We now come to the business end of the cathode-ray tube, the deflecting plates. These operate like an air condenser of low capacity, the beam passing between the plates and being deflected by any charge appearing on them. One set of deflecting plates can be used alone, the result being a single-scale device such as a voltmeter. In this case, the unused plates should be shorted. By measuring the shift in spot position on the luminous screen, after it has been calibrated, the peak voltage applied to the plates can be measured whether it is a.c., d.c., or r.f. The greatest use of the tube, however, is derived from the fact that there is also another set of deflecting plates located at right angles to the first set. This permits measuring two different voltages—or currents—at the same time, in the form of a "plot" on the screen, just as a curve is plotted in rectangular co-ordinates. Tube characteristic curves, resonance curves, and many other types of phenomena can be seen in this way when the proper connections are made.

If a charge collects on the deflecting plates, the beam may be deflected. In order to maintain the free plates at essentially the d.c. voltage of the anode, most scopes have resistors of one to ten megohms between the free plates and the anode—that is, across each pair of plates. Many uses of the equipment involve a connection that places a lower d.c. resistance circuit across the plates in which case the deflecting plate resistors are unnecessary, but they cost only a few cents and usually do no harm. They are shown as R_6 and R_7 in figure 2. Their value should be as low as the external circuit will permit. If the pattern creeps on the screen, it may indicate that the beam current is too high for the resistors used, in which case the spot intensity can be reduced. The resistor across the horizontal deflecting plates can be a potentiometer, which is often useful in adjusting the voltage on these plates, particularly if a 60-cycle a.c. sweep is used.

Building A Simple Scope

With this background, we can proceed with the construction of an oscilloscope. The haywire model pictured in figure 4 will serve to illustrate the utter simplicity of the basic circuit, used with an external power supply. In

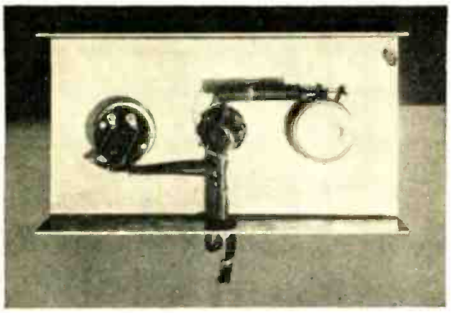


Figure 6. There isn't much hidden under the chassis of this simple scope.

this case, we have shown a pattern that is a straight line with its ends apparently turned up. This was obtained by putting 60-cycle a.c. on the horizontal deflecting plates, and hooking the free vertical deflecting plate to the rectifier filament. The anode was already connected to the filter output, so the voltage on the vertical deflecting plates represents that developed across the filter choke in the receiver power supply. At the peak of each half cycle, current flows through the choke to recharge the filter condenser, causing the rise at the ends of the horizontal sweep. Actually, the horizontal lines are not quite superimposed, but are slightly tilted. The pattern would have been clearer if it had been made the object of the photograph and in sharp focus.

The same equipment was used in the mounted job of figure 5. The socket is one of the older Amphenol models that is held to the mounting plate by a spring. The tube can be turned in the mounting by filing off the small projection in the plate, or the plate can be thrown away and the socket mounted in the hole without it, using the spring but no bolts. The recent sockets have a moulded construction which would make tube adjustment difficult, but apparently the old model is not out of production.

The switch appearing on the back of the Centralab potentiometer in figure 6 was not used in this model but was obtained so that it can be used later if the simple scope should grow into a complicated one. The deflecting plate leads were not cabled with the power leads, because in some r.f. applications, low capacity is desirable. The power leads end in a plug which can be connected to an old receiver power supply.

So far, no difficulty has been experienced from the absence of shielding around the tube. Used in this way, the tube is sensitive to electrostatic fields unless it has a metal shield around it; and to electromagnetic fields which can be eliminated by changing the angle of the tube with respect to the field, by shielding with iron or steel, or by removing the scope to a point some distance from the disturbing field. Such fields can be detected by turning on all the apparatus that will be running during the measurements, but with the deflecting plate leads of the tube disconnected from the apparatus to be tested, and preferably shorted. If the spot moves as the other equipment is turned on, then there may be some difficulty of this sort. A somewhat more accurate way to make this test is to put an alternating current first on one set of plates and then on the other.

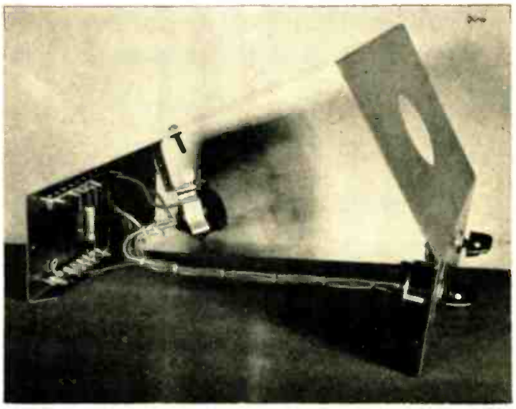


Figure 7. The de luxe model.

If the line widens out into an ellipse in either case, there is a disturbing field present.

The cost of this equipment, exclusive of the tube which can be obtained for $4.00 for the one-inch and $7.50 for the two-inch, is only $1.37 if the parts (listed under figure 1) are purchased at mail-order prices. A few cents must be added for knobs if they are not available, and for a metal chassis such as the one shown in figures 5 and 6 if the sheet metal is not lying around.

A De Luxe Model

A completely shielded de luxe model chassis of the no-stoop, no-squat, no-squint type can be made at a local sheet metal shop for one or two dollars. One style is shown in figures 7 and 8, built from the plans of figure 9. It is arranged so that a two-inch tube can be used, with an Amphenol C-R socket and bracket adjusted so that the tube screen just fits against the hole in the panel to support the screen end of the tube.

When the one-inch tube is used, the screen is behind the panel if mounted in the same place, and the chassis acts as a light hood, making it possible to use a very weak trace on the screen in daylight, but difficult to make any measurements with a transparent scale placed on the tube screen.

A Warning

There are one or two points of caution which should be mentioned. The voltages used on C-R tubes are comparable with those in transmitters. Five or six hundred volts is unlikely to be fatal to the user but is enough to cause a jerk that may knock that new C-R tube right on the floor.

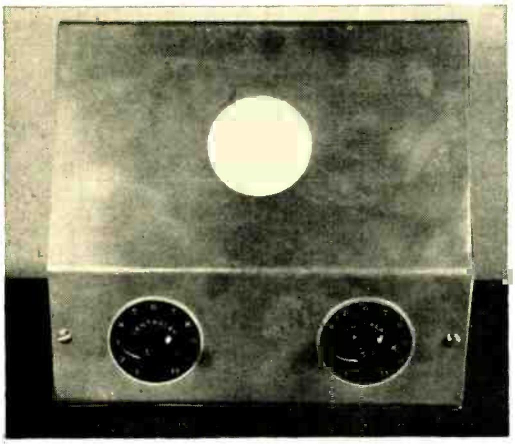
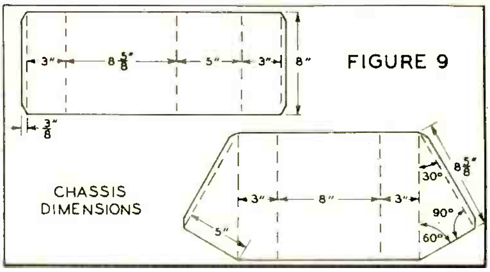


Figure 8. The de luxe model.



Plans for building the de luxe model.

The second thing is in regard to the spot intensity. This should be adjusted to the lowest that will give a suitable image on the screen. If the spot stands still, or moves slowly such as at the point of a trapezoidal modulation pattern, strong spot intensity may cause a temporary loss of screen sensitivity at that point or permanently destroy the active screen material. Allowing a horizontal line to remain on the screen for long periods will eventually cause the spot to be dim when crossing that part of the screen.

If a stronger spot is desired momentarily in order to shorten the exposure time when photographing a pattern, a resistor can be arranged to shunt the intensity control for a fraction of a second during the exposure. This is less likely to damage the screen than if the intensity were turned up and back down for the operation.

In a future issue, we shall discuss measurements that can be made with the basic oscilloscope, and describe auxiliary apparatus.

Something for Nothing . . .

Occasionally, amateur radio has an opportunity to get something for almost nothing.

Because the volume of the soft sounds in voice transmission largely determines the understandability of a weak phone signal, volume limiting and compression devices which have recently come into use in speech amplifiers enable us to increase the volume of the weak parts of voice about 4 db without as quickly running into the modulation limits of a transmitter. Two excellent methods of accomplishing this have been shown in recent issues of RADIO.

Stacking one antenna above another will increase useful low-angle radiation at the expense of only the wasted high-angle power. Also, while for some time it was felt that antenna gain is determined by the space required by the antenna, the close-spacing idea as used in the W8JK flat-top beam and other antennas derived from Brown's studies has brought increased gain in less space.

The improved gain in the flat-top beam, which is a close-spaced end-fire array, has been

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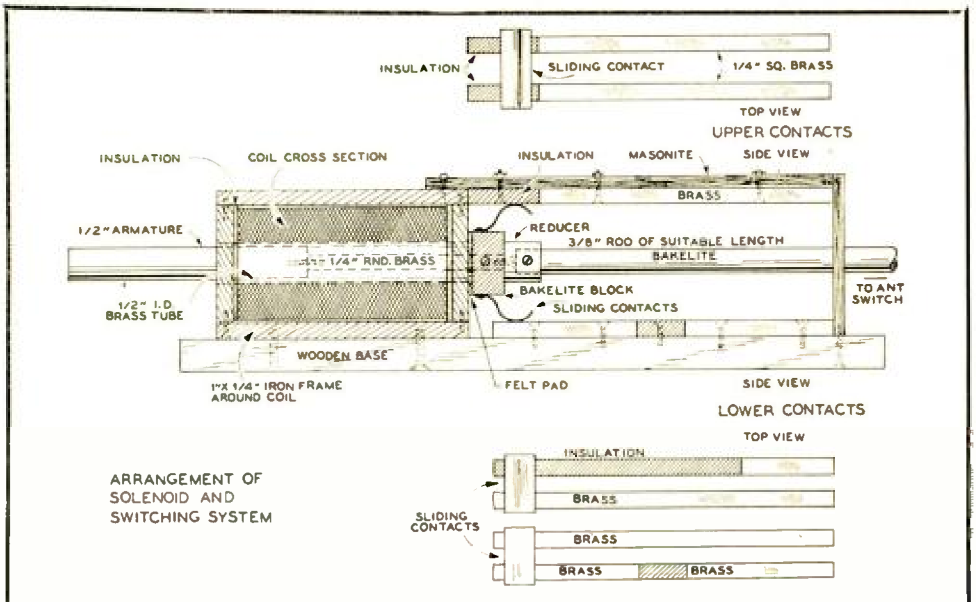

FIGURE 1

Solenoid-Type RELAY CONSTRUCTION

By E. R. JOHNS,* W7BTH

In modern station design it is becoming more and more common to see relays accomplishing the job of feeder switching and transmitter control. In the interests of improved and simplified operation relays are being used to accomplish many of the jobs that were previously switched by hand. However, multi-contact relays are expensive and an increasing number of amateurs are resorting to "roll your own" methods to obtain the desired relays. Heretofore, most of the home-constructed relays have been of the closed magnetic circuit or "clapper" type. The solenoid type of contactor has been more or less neglected. But it is also well suited to the job.

To accomplish the dual job of feeder switching and transmitter control in this station a solenoid-type relay has been constructed. It is comparatively simple in design, accomplishes its assigned jobs with no difficulty, and can be duplicated, with variations perhaps to suit it to individual needs, by any amateur with a mechanical turn of mind.

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Construction

The heart of the system is, of course, the solenoid. The coil is 3¼" long by 1¾" in diameter and is wound on a ½" inside diameter brass tube. The two end flanges can be made of fiber, bakelite or tempered masonite. The form is then wound full of no. 20 d.c.c. wire.

The moving armature is a piece of ½" iron shafting (it must be enough smaller than the inside diameter of the brass tube in the center of the coil so that it will slide freely) 3¾" long and tapped in one end. A piece of ¼" diameter brass shafting 4½" long and a ⅜" to ¼" reducer in series make up the balance of the moving system. These various parts are fastened together with short lengths of 6-32 brass stud. The various junctions are indicated in the layout diagram. The piece of ¼" shaft is tapped at both ends, and the ½" iron shaft and the reducer are tapped at one end. The best method of joining the various sections is to screw a 1" 6-32 machine screw into one of the ends until it is tight, then cut off the head of the screw and screw the two sections to be joined together until they are tight.

Then, as can be seen in figure 1, there is a bakelite or fibre block 2"x1"x½" mounted upon the end of the ¼" brass rod and just below the ⅜" to ¼" reducer. It is upon this block that the sliders that turn on and off the plate transformers and control the action of the relay are mounted. These sliders are fastened to the bakelite block and contact the 1/4" square brass strips that go to make the switch circuit. The positioning of the contacts is shown in figure 1. Figure 2 shows the method of connecting these contacts so that the movable bar in the solenoid coil will throw to one position when the start button or key is pressed and will return to its original position when the stop button is operated. A three-wire cable is run from the control position to the solenoid contactor.

The coil of the solenoid is enclosed by strap iron, 1"x1/4", on two sides and both ends. The two end pieces of iron have holes large enough to pass the *outside* diameter of the 1/2" i.d. brass tubing. The iron frame around the coil is bolted together and is used as the mounting for the other parts of the contactor as set of two contacts is mounted on the upper

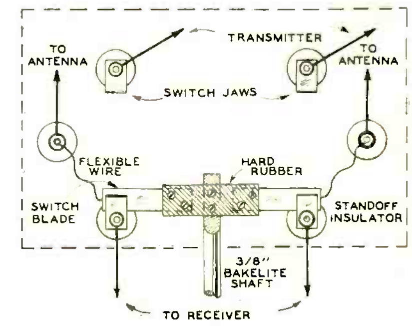


FIGURE 3

side of the solenoid from the set of four contacts that are mounted upon the baseboard.

The Power-Control Contacts

Mounted upon the wood base that holds the entire assembly are the contacts that control the power to the transformers and the solenoid. Four brass strips are used, two for controlling the motion of the switch and two for controlling the transformer primaries. As can be seen from the center drawing of figure 1, the sliding contacts that are mounted upon the movable bakelite block merely short these various brass bars together to complete the circuit. This is also the case with the "upper contacts" as labelled in the drawing. These latter contacts are used to control the primaries of the intermediate and low-power plate transformers. This

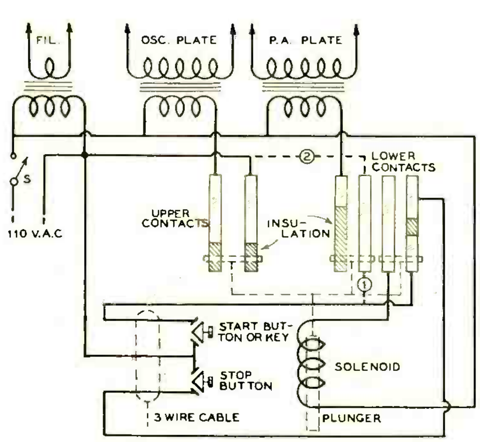


FIGURE 2

The bakelite block that carries the sliders is drilled and tapped on one side to take a set screw to hold it to the 1/4" shaft extension of the armature. Also, the brass reducer has a set screw to secure the 3/8" bakelite shaft from the antenna change-over switch to it.

The Change-Over Switch

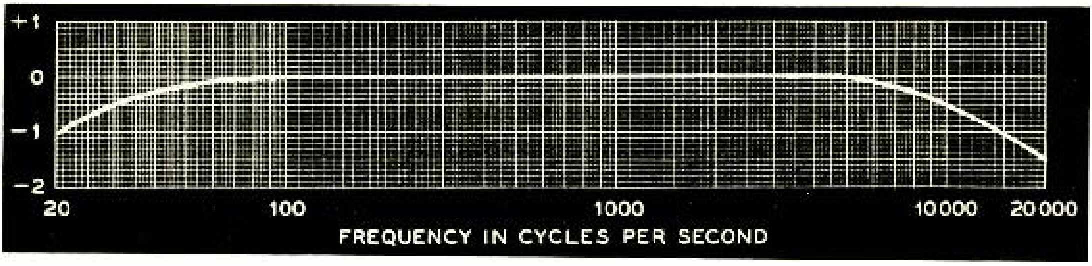
The antenna change-over switch is quite simple, consisting mainly of six standoff insulators, four with switch jaws on them and two with flexible leads going to the movable arms as in figure 3. The 3/8" bakelite rod connecting the a.c. portion of the switch to the antenna change-over portion can be any length convenient up to a couple of feet or so. Also, the switch can be single pole or three pole instead of two pole. Incidentally, a piece of felt under the movable bakelite block at the solenoid will help materially in quieting the contactor on the return stroke.

On the antenna end of the shaft the switch arms can be mounted by filing the 3/8" shaft flat for about 2" and drilling for two bolts to hold a hard rubber or bakelite separator for the switch arms. These arms can be made from 1/16" by 1/2" copper strip and should be mounted so as to make good contact with the jaws at either end of the throw.

The switching arrangement can, of course, be modified in almost any way to make it more suitable to different installations.

Texas, the largest state in the Union, is 212 times larger than Rhode Island, the smallest state. There are 1642 hams in Texas; 292 in Rhode Island.

BEAT-FREQUENCY AUDIO OSCILLATOR



By H. W. ANDERSON,* W6CCG

An oscillator capable of delivering outputs of low harmonic content over a wide frequency range is a useful instrument to communications engineers, experimenters and advanced amateurs. With such an instrument and a variable attenuator, frequency response curves can be made on transmitters, audio amplifiers and program lines. The addition of an oscilloscope makes possible distortion and modulation measurements.

The best method of generating such an output is through the use of two oscillators, one with a fixed frequency and the other being varied so that the beat difference may be detected and amplified. Such an arrangement makes it possible to get a continuously variable frequency over a wide range. The four basic requirements of such an audio oscillator are low harmonic content, good frequency stability, uniform frequency response and low noise level.

The first point of low harmonic content is governed primarily by circuit design, and in the oscillator discussed was held to a low value through the use of unusual oscillator circuits, balanced demodulators, push-pull amplifiers and adequate filters in both the oscillator and detector circuits.

Good frequency stability is found to be dependent on temperature variations and supply line voltage fluctuations. The greatest changes are due to variations in temperature between the oscillator coils. By careful placement of tubes and resistors it is possible to make both oscillators drift uniformly.

A common mistake is the suggestion to make the fixed oscillator crystal-controlled. This only aggravates the condition as it is impossible to make the variable oscillator so that it won't drift. The best method is to make both oscillators as identical as possible, so that both will be affected equally by ambient temperature changes and supply voltage fluctuations. Uniform frequency response is almost entirely dependent on the design of the demodulator and audio circuits.

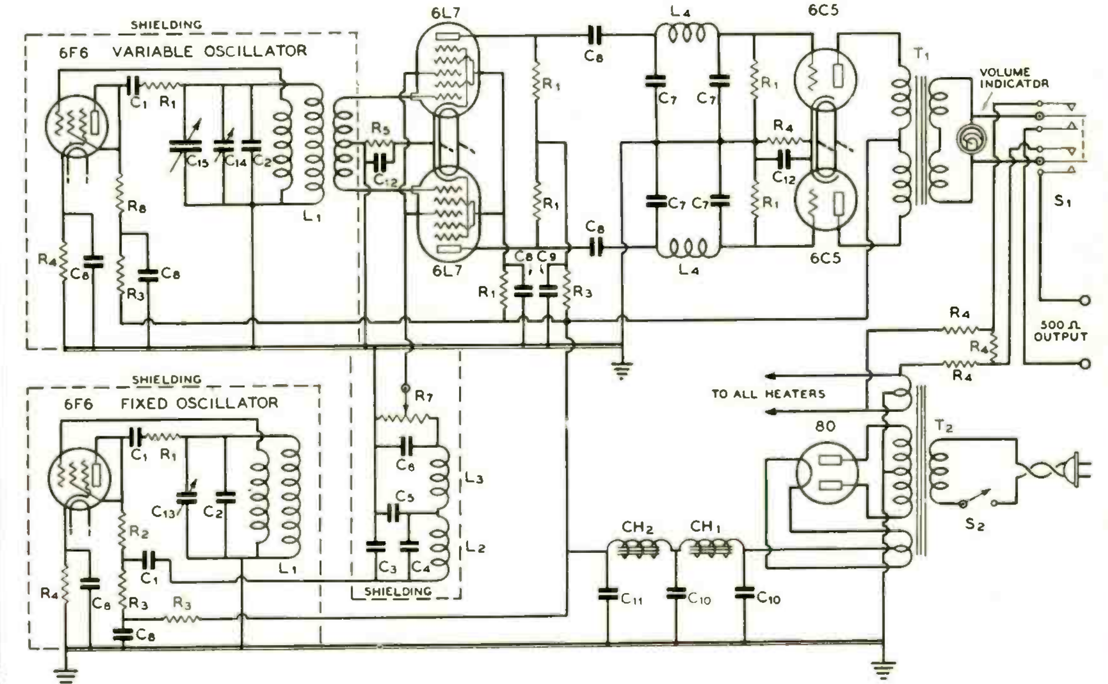
Low noise level is accomplished through adequate filtering and careful shielding.

A point that hasn't been touched upon but which is of vital interest is the cost. The parts for this oscillator cost approximately $60.00, which is about the cost of a three-inch oscilloscope. This should appeal to the broadcast engineer or amateur who has to operate on a rigid budget. As a matter of fact, this cost can be reduced by about one third if a less expensive tuning condenser is used and if less expensive padding condensers and other parts are employed. As the unit now stands, the very best type of part has been used in each position.

The Stabilized Oscillators

The oscillators are of the resistance-stabilized type. This circuit employs a minimum number of parts. The fixed oscillator operates at 130 kilocycles and the variable oscillator operates from about 109 kc. to 130 kc. It is well not to operate at too low a frequency as there will be too great a percentage difference of the fundamental frequencies when the beat frequency is high. This means the circuits of

*c/o Radio Station KFAC, Los Angeles, Calif.



C_1—.006-μfd. fixed mica
C_2—.002-μfd. fixed mica
C_3—.0005-μfd. fixed mica
C_4—.00037-μfd. fixed mica
C_5—.00129-μfd. mica (.001 and .00025 in par.)
C_6—.00078-μfd. mica (.0005 and .00025 in par.)
C_7—.00005-μfd. fixed mica
C_8—0.1-μfd. 400-volt tubular
C_9—1.0-μfd. 400-volt paper
C_{10}—8-μfd. 450-volt electrolytic
C_{11}—16-μfd. 450-volt electrolytic
C_{12}—25-μfd. 25-volt electrolytic
C_{13}—10-μμfd. midget variable
C_{14}—50-μμfd. midget variable
C_{15}—900-μμfd. variable
R_1—50,000 ohms, 1 watt
R_2—20,000 ohms, 1 watt
R_3—10,000 ohms, 1 watt
R_4—500 ohms, 1 watt
R_5—1000 ohms, 1 watt
R_6—30,000 ohms, 2 watts
R_7—1000-ohm tapered potentiometer
L_1—750-microhenry inductance (see text)
L_2—1.00-millihenry (see text)
L_3—1.59-millihenry (see text)
L_4—250-millihenry inductance
T_1—P.p. 6C5-to-500 ohm line output transformer
T_2—25-cycle power transformer. 700 v. c.t., 75 ma.; 5 v. 2 a.; 6.3 v. 2.4 a.
$CH_{1,2}$—50-hy. 65-ma. filter chokes
S_1—Calibration check switch
S_2—A.c. line switch.

the two oscillators are not operating under identical conditions and one will drift in frequency faster than the other, causing frequency instability. On the other hand, use of too high a frequency leads to frequency instability since a small percentage change in the oscillator frequency becomes a large change in the beat frequency.

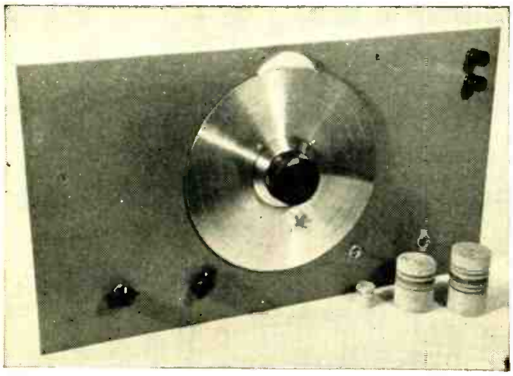
The 130-kc. frequency was chosen so that commercially available variable and fixed condensers could be used. A General Radio 505G condenser, whose capacity is 0.002 μfd., is used for the fixed value. This condenser is unusually free from capacity changes due to age and temperature. Since this oscillator has been completed, the Cornell-Dubilier Company has announced the production of a condenser made by silver plating mica which has a low temperature coefficient and might well be used for the fixed value.

The Special Variable Condenser

The variable condenser is a General Radio model 539X. This condenser is designed specifically for beat-frequency oscillators and has plates shaped to spread the low frequencies out well. From one thousand cycles up the frequency change is approximately linear. Any variable condenser used for a beat frequency oscillator should be of sturdy mechanical construction to retain correct calibration.

Coil Design

The coils used in any oscillator should have as high a Q as possible. In the resistance-stabilized type this is especially true as it allows a larger value of resistance to be used in the feedback circuit. Close coupling between the grid and plate coils is also very desirable. To get this condition a slotted coil form was de-



Front view of the unit showing the large dial (unengraved). Three of the unwound coil forms are also shown in front of the panel.

cided upon. The forms are made of maple wood one and one-half inches outside diameter. One each of the unwound oscillator-coil forms along with one of the r.f. choke forms can be seen in one of the photographs. The slot for the plate coil is in the center of the coil structure and has a minimum diameter of one-half inch and width of one-quarter inch. This slot is filled with 187 turns of no. 20-38 Litz wire. The inductance of this winding is 750 microhenrys. A slot one-eighth inch wide is cut on each side of the plate coil to the same depth as the plate coil. This slot should be as close to the plate coil as possible. The writer found that a sixteenth of an inch was as close as it was possible to make it and still retain enough mechanical strength in the form so that it would not collapse when the winding was put on. Best operation is secured from the oscillator when a unity turns ratio exists between the plate and grid coils. Ninety turns of 20-38 Litz was wound in each slot. Three slots are all that are necessary for the fixed oscillator.

The variable oscillator has two additional slots, one on each side of the grid windings. These slots are three-eighths of an inch deep and one-eighth wide. They are closely coupled to the other coils. Each slot contains 25 turns of 20-38 Litz. These are wound in opposite directions so that the inner ends of both coils can be tied together and grounded, keeping the input circuit to the demodulators balanced. It is quite possible that the Q of these coils would still be high enough if no. 24 d.s.c. wire were substituted for the Litz. But since the Litz was available, it was used in this case.

After the coils are wound, they are boiled in a mixture of 50 per cent rosin and 50 per cent beeswax. This locks the windings firmly in place and seals the coils against moisture. This mixture is used, as beeswax alone has too low a melting point, and rosin is too thick to impregnate thoroughly the coils. The coils are mounted on small bakelite plates 2¾ inches square which carry the terminals.

These terminal plates are the same size as the bases of the coil shields which are 2¾ inches in diameter and 3¾ inches long. The coils should be mounted closely together so that both will experience the same temperature changes. The most desirable place is under the chassis so that the heat from the tubes and power transformer will rise away from the coils. Plenty of air space around the coil shields acts as a low pass filter to temperature changes and causes the oscillators to drift slowly and uniformly. In the writer's oscillator the coils are mounted under the variable condenser and the tubes and power transformers are as close to the edge of the chassis as possible, thus keeping the heat producing elements as far as possible from the coils. It may seem that too much stress is being laid on keeping heat from the coils, but a simple experiment showed the necessity of this. Laying a soldering iron on one coil shield will cause a frequency drift of approximately 10 cycles in the first minute and after that the frequency changes very rapidly.

The next important thing that affects frequency stability is mechanical rigidity of all parts of the oscillator circuit. For this reason the chassis is constructed of 16-gauge cold-rolled steel. All wiring in the tuned circuits is made of rigid bus bar. The oscillators are mounted side by side on the chassis but well shielded from each other. The resistors are all one-watt insulated type except the plate resistor of the variable oscillator which is two watts.

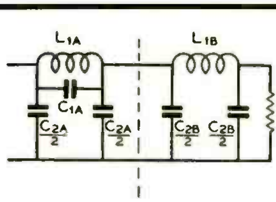
The Oscillator Tubes

This circuit operates best with tubes of medium low mu (5 to 10) and high mutual conductance. A 6F6 pentode, strapped for triode operation, has a mu of 7 and mutual conductance of 2700. Metal tubes were used throughout as they are thoroughly shielded. The value of feed-back resistance can be determined from the formula $R = R_L\ (\mu-1) - R_p$. Or, the value of this resistance can be raised until oscillations cease and then it should be reduced in resistance until the point is found where the oscillator always starts promptly. This value should be not less than 5 times the plate resistance. In the writer's oscillator this value was 50,000 ohms. Cathode bias is required with this type of circuit; the tube operates with slightly less bias than a class-A amplifier. As the crest of the excitation voltage exceeds the grid bias, the losses in the feed-back circuit rise and prevent the grid from going greatly positive. This in conjunction with the low L/C ratio leads to a sinusoidal output. The 130-kc. output of the oscillators was studied on an oscilloscope and the waveform was found to be excellent.

Filter Circuits

The output of the fixed oscillator is filtered before demodulation to prevent the generation of spurious beat notes. This is quite necessary; as an example: the tenth harmonic of one oscillator might combine with eleventh harmonic of the other to cause a beat note to be superimposed on the output frequency. Such effects cause a tone to start at a high audio frequency, go to zero and rise again until they cannot be heard with a rotation of only a few degrees on the dial. These spurious whistles are called "birdies" and are easily removed by proper filters.

The filter is composed of two sections, one M derived and one prototype. The M derived has its frequency of maximum attenuation at 260 kc. which is the second harmonic of the fixed oscillator. This gives a value of .639 for M. This filter is terminated by the output control which is a 1,000-ohm tapered potentiometer. The filters are designed from the conventional equations.



M Derived

$$L_K = \frac{1000}{3.14 \times 2 \times 10^5} = .00159 \text{ hy.}$$

$$C_K = \frac{1}{3.14 \times 2 \times 10^5 \times 10^3} = .159 \times 10^{-8}$$

$$M = \sqrt{1 - \left(\frac{2 \times 10^5}{26 \times 10^4}\right)^2} = 0.639$$

$$L_{1A} = .639 \times 0.00159 = 0.001 \text{ hy.}$$

$$C_{1A} = \frac{1 - (.639)^2}{4 \times .639} = 0.000368\ \mu\text{fd.}$$

$$\frac{C_{2A}}{2} = .639 \times 159 \times 10^{-8} = 0.0005\ \mu\text{fd.}$$

$$R = 1000\ \Omega$$

K Type

$$L_{1B} = 1.59 \text{ mh.}$$

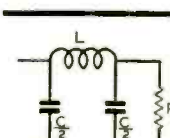
$$\frac{C_{2B}}{2} = .00078\ \mu\text{fd.}$$

Since the capacities called for in this filter are of odd values, combinations of two condensers are required to get the correct value. The .00129 is composed of a .001 and .00025 in parallel. The .00758 is a .0005 and .00025 in parallel. The other two values are stock ones, that is .00037 and a .0005 μfd. The chokes are made from three-quarters inch dowel with a slot one-quarter inch deep and 3/16-inch wide wound with 400 turns of no. 10-40 Litz for the 1 mh. The 1.6 mh. is wound with 500 turns in a slot ⅜ inches wide and one-quarter inch deep.

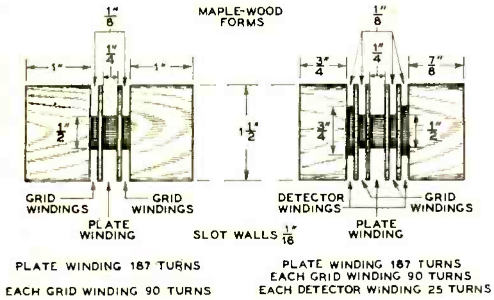
The 6L7 Demodulator Tubes

The output of the variable oscillator is fed to the number one grids of the 676 demodulator tubes 180 degrees out-of-phase. The output of the filtered fixed oscillator is fed to the number three grids in-phase. This gives electron coupling without tendency to interlock. The cathode bias and screen voltage was varied for minimum distortion.

A radio frequency filter is inserted in the plate circuits of the demodulator tubes to remove any possibility of the carrier frequencies appearing on the grids of the audio stage and causing distortion and high noise level. This is a prototype filter with a cut off frequency of 64 kc. This rather high cut off frequency is due to the fact that air core chokes larger than 250 mh. are not commonly available except in transmitting sizes.



Design of the demodulator plate circuit filters.



Method of making the coil forms for the variable and fixed oscillators.

$$L = 250 \text{ mh.}$$

$$\frac{C}{2} = 50 \ \mu\mu\text{fd.}$$

$$R = 50{,}000 \ \Omega$$

$$L = \frac{5 \times 10^4}{3.14 \times 63{,}800} = 0.250 \text{ hy.}$$

$$\frac{C_K}{2} = \frac{1}{3.14 \times 5 \times 10^4 \times 638 \times 10^2 \times 2} = .00005 \ \mu\text{fd.}$$

This filter is terminated by the grid leaks of the output tube. The values of the leaks are 50,000 Ω. This is a rather high-impedance circuit and the inductances are apt to pick up hum so they should be well shielded. A small shield normally covers this unit but it has been left off in the photograph so that construction may be seen.

The Output Stage

The output stage consists of a pair of 6C5 metal tubes operating into a push-pull plate to multi-line output transformer. Care should be exercised in selecting the transformer as this determines the frequency characteristic of the oscillator to a large degree. However, almost any first-line transformer may be used. The particular transformer used in this case is down 1 decibel at 20 cycles and 1 decibel at 20,000 cycles according to the manufacturer's published curve. The output of the beat oscillator is down 1 db at 20 cycles, and 1.5 db at 20,000 cycles which follows the transformer characteristic very closely. Undoubtedly the additional droop at the high end is due to stray capacitances in the wiring and tubes.

The oscillator was designed for low audio outputs and the 6C5 tubes will deliver a zero level signal (.006 milliwatts) with about 0.2 of one per cent distortion. Anyone wishing larger outputs can add another stage or probably a pair of 6F6 tubes strapped as triodes in the output stage would increase the power capabilities materially. Since most oscillators work into an attenuator, it would seem desirable not to raise the output to more than 0 level—hence, the small tubes which make the power supply smaller and keep down the amount of heat generated in the oscillator.

Power Supply

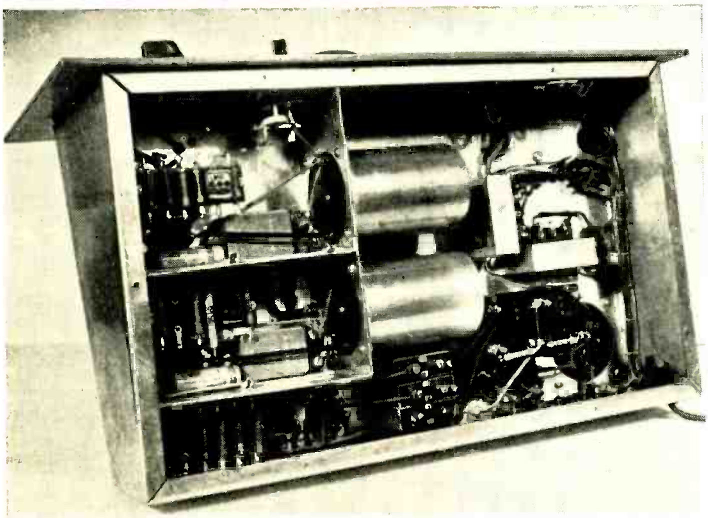
The power supply is quite conventional, using a full-wave rectifier and a two-stage filter. Although operation is on 60 cycles, a 25-cycle transformer is used to keep the stray field down and avoid large temperature rises. Most of our present day transformers work the iron at too high a flux density and the copper at too low a cross sectional area for the current carried. In this case, although the total drain from the "B" pack is less than 30 ma., a 100-ma. transformer is used. The filter is a two-section unit with condenser input. It was found that a reduction of 10 db in the overall noise level could be accomplished by changing from choke to condenser input. Also by changing from 20-henry chokes originally used to 50-henry chokes, the overall noise level was decreased another 8 db. Thirty-two μfds. of capacity are used in the filter circuit, 8 μfds. across the input, 8 μfds. between chokes and 16 across the output. No current is wasted to heat a bleeder resistor.

Calibration Check

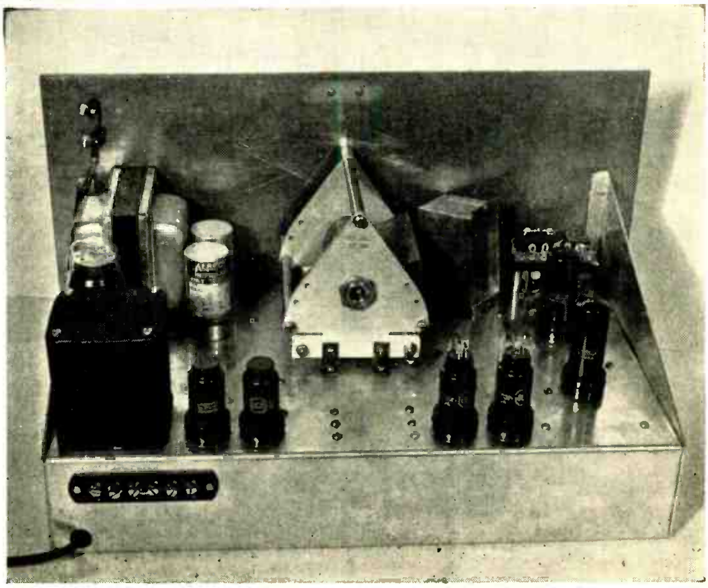
The calibration is checked by comparing the output of the oscillator with the power line frequency. As the line frequency is maintained very accurately, this is a quite accurate means of checking. This checking voltage is obtained from a voltage divider across the 6.3-volt filament winding by operating the double pole double throw switch in the output circuit. To calibrate, the main dial is set to the power line frequency after the oscillator has warmed up for about ten minutes. The output control is advanced so that the output meter (external in this case) reads about half scale and then the output switch is thrown to the calibrate position. Now, by adjusting the calibrate condenser, a beat will be indicated on the output meter by the meter hand swinging back and forth. Careful adjustment will make it possible to set the calibrate condenser so that the line frequency and oscillator output are in zero beat. This operation can also be accomplished at multiples of the line frequency. However, the amplitude of the meter oscillation becomes correspondingly smaller as the frequency is increased.

The calibrating condenser mounted on the front panel is a MC20X Hammarlund 20 μμfd. This is normally a three-plate condenser. One stator plate should be removed to reduce the capacity; otherwise it is rather critical to adjust.

A 50-μμfd. condenser is mounted on the chassis in the variable frequency oscillator shield. This is adjusted after the oscillator is completed so that the calibrated condenser on the front panel will be half in mesh with normal room temperature. This condenser also takes care of the differences of the oscillator inductances, as it is practically impossible to adjust the inductances so that zero beat of the two oscillators will occur within the range of small calibrating condenser C on the front panel when the 900-μμfd. variable is set to zero. Taking off one turn from an inductance will change the frequency several hundred cycles. A slight movement of oscillator wiring will shift the frequency 10 or 15 cycles, indicating the need for rigid wiring and rigid chassis con-



● Bottom view of apparatus. To the left can be seen the shielded partitions for the variable and fixed oscillators. The round shield cans for the two inductances are in the center with their leads entering their respective oscillator compartments.



● Top rear view. Power supply on the left, main tuning condenser in the center and the fixed oscillator plate circuit filter (with shield can removed) in the right rear (next to the panel).

struction. The chassis is made of 16-gauge body steel, cadmium plated. All partitions are spot welded in. A lip was folded over on the bottom of the chassis so a cover could be fastened on. The chassis was made 17 inches wide so it could be mounted in a standard rack if desired. For this reason terminals were mounted on the rear of the chassis as well as on the front panel. For broadcast or studio operation the incorporation of a pair of double jacks to accommodate patch cords would be desirable. Due to the large frequency range covered a large dial should be used. A nice dial can be made by using one of the popular planetary movement dials and mounting a piece of 1/16" dural 8 inches in diameter with a hole cut out in the center so that the dural disc can be fastened over the top of the old dial engraving. The new dial can then have the frequencies engraved on it for direct reading. Before engraving a nice finish can be given the dial with a little steel wool and oil while revolving the dial in a lathe. The dial shown in the photograph has not had the calibration engraved upon it as yet.

Calibration

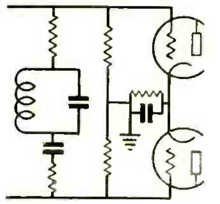
The calibration of the completed unit may be accomplished in any one of a number of different ways; the actual method is mainly dependent upon the ingenuity of the constructor. Of course the easiest method of calibration is to compare directly the output of this oscillator to a standard one that has already been calibrated. Such already calibrated units can often be found at one of the local broadcast stations, the telephone company office, a motion picture studio, a local theatre, a college physics laboratory, etc. The main thing is to know someone at the place of residence of the calibrated oscillator so that you will be allowed to calibrate yours. That is often the most difficult part of the calibration!

Then, of course, it is quite possible to calibrate accurately the unit without the use of another calibrated oscillator. The oscillator as it stands will cover a range of 10 cycles to 21,400 cycles, and as many points as possible should be obtained within this range. Now there is at least one source of standard frequency available to almost everyone: a.c. line frequency, 50 or 60 cycles. Then, there are the 1000-cycle and 440-cycle standard frequency transmissions of the Bureau of Standards on WWV; each of these may be used to establish a number of calibration points. And, as has been mentioned in recent issues of RADIO, it is often possible, in large cities served by the Bell System, to obtain a 1000-cycle test tone by dialing some special number.

Performance

The performance of this oscillator compares very favorably with the commercial models offered at from three to five times the cost of this unit. The noise and distortion were measured on a General Radio 732 distortion meter. The harmonic content at 400 cycles is less than two-tenths of one per cent. A close inspection of all the other frequencies on an oscilloscope showed excellent waveform. A study of the harmonic distortion on a General Radio wave analyzer is to be made in the near future.

In making the frequency runs an interesting fact was discovered. It was found that copper oxide rectifier meters have a very decided droop at the high end. A frequency run with a thermocouple on one of these units disclosed that it was down 0.5 db at 10,000, 0.8 at 15,000 and 1 db at 20,000 cycles. Other meters have been found to be off as much as 1.6 db at 20,000 cycles. For this reason no V.I. is built into the oscillator. Instead, the V.I. will be mounted in the gain set with a transfer switch to change it from the output of the oscillator to the output of the amplifier under test. By using it in this manner the error in frequency response will be cancelled, as the input to the amplifier will be reduced by the same amount the amplifier output is reduced due to the meter error.



The final frequency run on the oscillator showed that it was down 1 db at 20 cycles and 1.5 db at 20,000 cycles without any equalizing. For those who want a flat frequency characteristic, an equalizer can be connected from grid to grid of the 6C5 tubes using the above circuit.

Values for this circuit will be dependent on the oscillator characteristic. Generally, it is desirable to tune the parallel resonant circuit somewhat higher than the highest output frequency of the oscillator to get a slope in the equalizer complementary to the slope in the falling characteristic of the oscillator. At the low frequency end the response is corrected through the use of a series condenser whose

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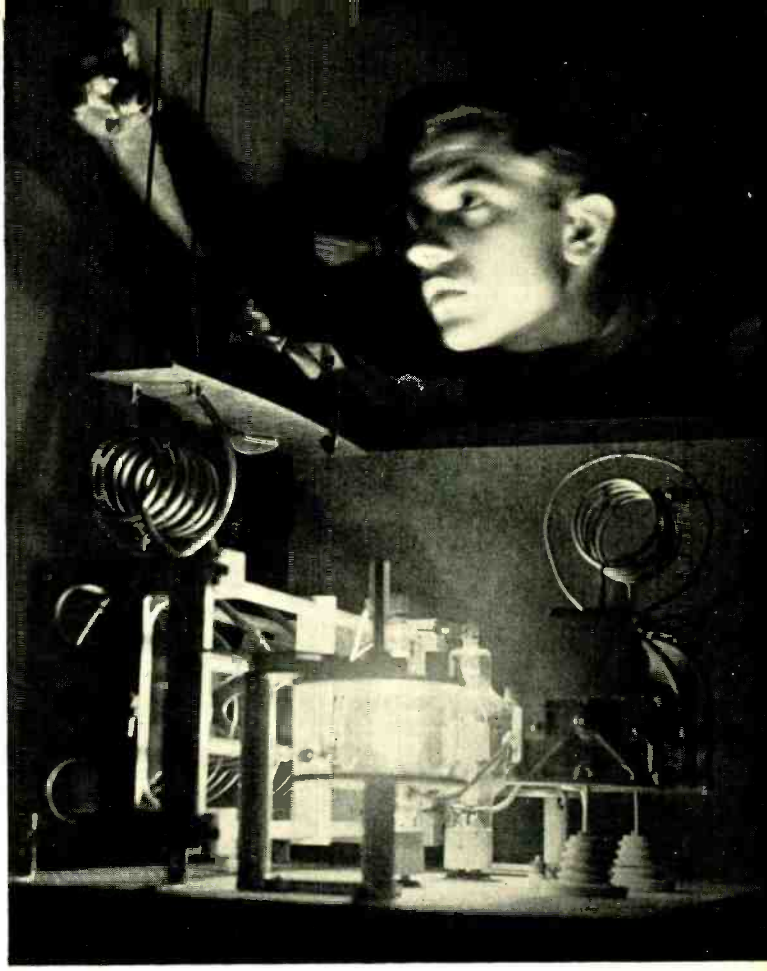


THE BIG MOMENT
With the new rotary beam installed, and a couple of C clamps holding "temporarily" the antenna coupling, W6OJK holds up a neon bulb with his right hand and carefully "puts her on the nose" with his left, all set to get on 10 with his kilowatt.

— W6NIT

DEPARTMENTS

- **Dx**
- **Postscripts and Announcements**
- **56 Megacycles**
- **Yarn of the Month**
- **Calls Heard**
- **Book Reviews**
- **Open Forum** *(See front of book)*

"WAZ" HONOR ROLL

	Zones	Countries
ON4AU	40	148
G2ZQ	40	139
G6WY	39	138
W6CXW	39	138
W6CUH	39	138
W6ADP	39	137
W8CRA	39	135
W4CBY	39	133
W2GWE	39	129
W6GRL	39	128
W8OSL	39	125
W6HX	39	123
W2CYS	39	117
W6FZL	39	112
ON4FE	39	110
W6FZY	39	109
XE1BT	39	90
G6VP	39	
W8BTI	39	
W7BB	39	
W3ANH	39	
W4DHZ	39	
W8BKP	38	138
W1BUX	38	130
W2GTZ	38	130
W1ZB	38	129
W2BHW	38	126
G5BJ	38	120
W8DFH	38	119
W1CC	38	116
W6AM	38	115
W8HWE	38	112
W5BB	38	110
W2AAL	38	109
W2GT	38	108
W6GRX	38	107
W9ADN	38	106
W2GW	38	104
W3DDM	38	104
W9UQT	38	103
W9PST	38	103
W9ALV	38	102
W3EVW	38	102
W9KG	38	101
W8LEC	38	100
W8AU	38	100
VE4RO	38	85
W9VDQ	38	79
G6RB	38	
W9TJ	38	
G5YH	38	
W4AJX	38	
W6KIP	37	128
W7AMX	37	122
W6QD	37	122
W6GAL	37	121
W5VV	37	121
W6DOB	37	118
W2HHF	37	115
W8ZY	37	114
W8DWV	37	114
G2LB	37	111
W3EVT	37	110
W6LYM	37	108
W2GVZ	37	107
W9PTC	37	103
W8BOX	37	102
W6FKZ	37	101
W8KPB	37	100
W9AJA	37	99
W3EXB	37	98
ZL2CI	37	97
W8OQF	37	97
W6VB	37	97
W6JBO	37	97
ON4FT	37	96
W8EUY	37	95
W7BYW	37	93
W5CUJ	37	93
W3AYS	37	92
VK2AE	37	90
G6GH	37	89
W6GCB	37	81
W9UBB	37	77
W2BSR	37	
G6NJ	37	
W2DTB	37	
W3EMM	37	
LY1J	37	
W4AH	37	
W9AFN	36	105
VK3EO	36	101
W6BAM	36	100
W1AQT	36	100
W8LZK	36	99
ON4EY	36	97
ON4VU	36	96
ZL1HY	36	95
W9KA	36	92
W6KWA	36	92
W9PK	36	92
LU7AZ	36	92
W5ENE	36	91
W8MTY	36	86
G2UX	36	83
W6GCX	36	76
W6ITH	36	78
W9CWW	36	71
W2BJ	36	71
W8KKG	36	
W9ARL	36	
W3EDP	36	
W2OA	36	
W6KBD	36	
U1AD	36	
W2BJ	35	105
W3GAU	35	104
W6TI	35	66
W8CJJ	35	98
W2BXA	35	98
W9RCQ	35	97
W9EF	35	94
ON4FQ	35	92
W1GDY	35	89
W8AAT	35	87
W6MHH	35	82
W7AYO	35	81
G6QX	35	75
K6AKP	35	63
W6NHC	35	
W2AIW	35	
W3BBB	35	
W2IOP	35	
W8BSF	34	94
VK2AS	34	94
W6EPZ	34	93
W8HGA	34	93
W3TR	34	92
G2IO	34	90
W2IYO	34	88
G2QT	34	88
VE2EE	34	88
W6HEW	34	86
W6GHU	34	83
VK2TF	34	81
W6JMR	34	81
ON4SS	34	80
VK2TI	34	75
W8JK	34	74
W4ELQ	34	74
W6LHN	34	71
VK2VN	34	63
W3EGO	34	
W2FAR	34	
W8CNZ	34	
W1RY	33	92
W8DOD	33	91
W4IO	33	91
OK1AW	33	90
W2BMX	33	90
W5KC	33	88
W3RT	33	86
W6LEE	33	85
W9LQ	33	84
W2WC	33	83
W6LCF	33	78
VE4LX	33	69
OK2HX	33	66
VK2RA	33	65
W8LDR	33	
K6JPD	33	
W6LDJ	33	
W9LBB	33	
W5AFX	33	
ON4TA	33	
G6CL	33	
SU1WM	32	105
VK2VQ	32	99
W5ASG	32	90
W6DIO	32	90
G6YR	32	85
W6CEM	32	84
W9FLH	32	80
ON4NC	32	79
W8QDU	32	79
W6MVQ	32	76
W9PGS	32	77
W3CIC	32	75
W6AX	32	74
W3GAP	32	70
W6KZL	32	67
W9DEI	32	66
ZU1T	32	65
W6KRM	32	62
W6KQK	32	61
W8HYC	32	
W8BTK	32	
W4MR	31	92
W6DRE	31	86
W8FJN	31	85
W6GNZ	31	84
W9LW	31	82
W1APU	31	81
W1BGC	31	78
GI6TK	31	76
W6NNR	31	74
W6OFC	31	62
VK2VA	31	62
VK2EG	31	60
W6IES	31	57
K6CGK	31	54
W6LCA	31	51
W3DCG	31	
W6HXU	31	
I1TKM	31	
VK2QL	31	
W9YGC	31	
W3KT	30	81
W4DCZ	30	80
W3UVA	30	76
W3CDG	30	78
W1APA	30	75
W2HVM	30	74
W3GMS	30	72
W4DMB	30	71
W4DTR	30	68
W8MPD	30	66
W6OEG	30	61
W9VLQ	30	58
W6KEV	30	58
W8PHD	30	57
W8DPY	30	53
W6JJA	30	
W8MAH	30	
W7AVL	30	
W8DED	30	
W9IWE	30	
W3EMA	30	

PHONE

KA1ME	35	79
W6ITH	33	67
W6CQI	32	70
W6OCH	31	69
W6LLQ	31	68
W6AM	31	
W4AH	31	
W6NNR	30	68
W6MLG	30	68
W4DSY	30	
W6EJC	29	64
W9NLP	29	60
W9YGC	29	
W9QI	28	72
W3EMM	28	
VE2EE	27	56
W3FAM	27	55
W9ARA	27	53
W9TIZ	27	47
W9BBU	27	45
W2HUQ	27	
W5DBD	27	
G5ZJ	26	77
W2IXY	26	75
W2IKV	26	52
W6FTU	26	51
W6BGH	26	
W8LAC	25	64
W8JK	25	47
W6GAL	25	45
W7BVO	25	37
W6LEE	25	34
VK2ABG	25	
W3SI	25	
G8MX	24	53
W1BLO	24	50
W2IUV	24	41
W6LYM	24	38
W9NLP	24	
VE5OT	24	
W6NLS	23	45
W6GRX	23	43
W9ORL	23	38
W6MVQ	23	31
W7ALZ	23	27
W7ESK	23	
W6AAR	23	
W6OI	23	
W8QDU	22	47
W9RBI	22	44
W7AO	22	
XE1BT	22	
W2HCE	21	55
W8RL	21	49
W5ASG	21	42
W6GCT	21	30
W6MVK	21	22
G6DT	21	53
W1HKK	21	51
G6BW	21	50
W7BJS	21	25
W6HX	21	32
YV5AK	20	45
W3AKX	20	32
W6NCW	20	21
W1COJ	20	
W4BMR	20	

If you have worked 30 or more zones and are ready to produce confirmation on demand, send in your score of zones and official countries on a post-card.

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

DX

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, Calif.

During the past month dx has restored itself to normal. By that I mean that everyone has more or less recovered from the siege of the contests, has taken the little "vacation" from dx that follow such brawls, and now is back on the air with a vengeance. For example, W6CXW and his bride are in their new house. They moved 200 feet from the old QRA, and Henry is busy getting things back on the air, as well as watching his avocado crop. Then there is W8CRA who is back knocking off a new country now and then, after changing yl's . . . we hear the new one is a blonde. W1ZB is a loyal follower of the "more countries or bust" movement. W5VV, Wilmer Allison, was asked, just after the contest, what he was using in the final. W5VV answered, still groggy, "A couple of tennis rackets in push-pull." W2BJ is having parasitics in his final, so he thinks he'll go on phone. W7AMX says he worked VR6AY without using his mike. K4KD working overtime to get his 30 zones . . . even ol' Fat Benning, W4CBY, is punching the key again and wafting his voice across the ether. This is only a mild idea of the activity that is springing up again, as there are hundreds of other dx men equally as effective as the few mentioned above. In fact, you just get on there any night around 0800 g.m.t. and listen to 'em call VR4AD and VK9DM.

While we're talking about VR4AD I might mention to those who have not heard him, he is in British Solomon Islands, and comes in around 14,300 with a T9X signal. Usually on the air from 0800 G.m.t. until 1100 G.m.t. He will QSL and his QRA is as printed in the call book. In New Guinea there are three of them active. VK9DM T6 14,410 kc., VK9VG T9X 14,100 kc., and VK9BW T6 14,375 kc. The mailing addresses for the above are as follows:

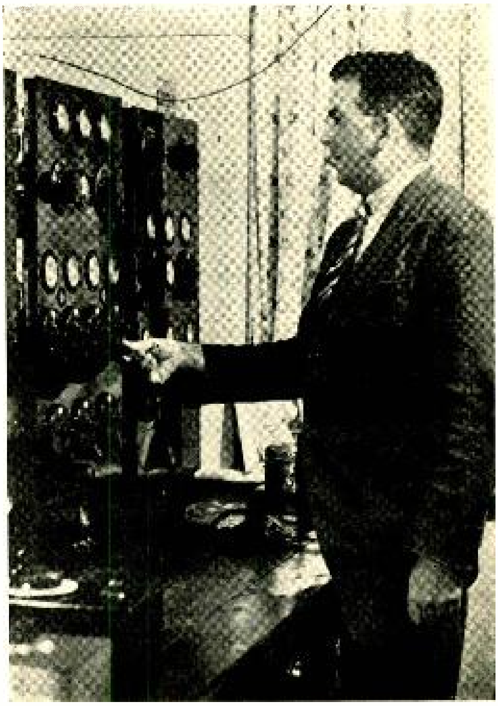
VK9DM, D. Mitchell, Roamer, New Guinea.

VK9VG, V. Gilchrist, Bulolo Power House, Bulolo, New Guinea.

VK9BW, Bill Holland, Wau Post Office, Wau, New Guinea.

Thanks to W6KIP for the above as he seems to have a private line into VK9. Another one that KIP slipped in for good measure is ZD2H 14,360 T9, who is Art Tomlinson, G2QN. Address: Posts and Telegraphs, Lagos, Nigeria. Alex also worked XU4GW who is supposed to be in the interior of China. Naturally we are all holding our breath to find out if he turns out to be just outside of zone 23 . . . or just inside. KIP won't get a good night's sleep until the card arrives—he doesn't sleep much anyway so it doesn't make much difference. If any of you want to dig for XU4GW—he is T9 on 14,095 kc. W6KIP has 37 zones and 128 countries at present.

W3AYS adds one, XU8RL, and now has 37 and 92. W3TR takes on VR2FF making him 34 and 91. W2GVZ worked YV2CU for country no. 107, and W3KT breaks into the roll with 30 zones and 80 countries . . . VR4AD did the trick. W8DWV has 37 and 114 with VS7RF and XU2BM helping him out . . . plus his new receiver. W3EVW hooked three stations giving him three new zones, U9MF, OQ5AE and FI8AC, bringing him to 38 and 102. W7ALZ on 14-Mc. phone wrote in bewailing the fact that he couldn't get VR6AY to come back to him. Three days later I received another card from W7ALZ saying he had spoken too soon as he landed Pitcairn shortly after mailing the first card, and now Frank has 23 zones and 27 countries on phone. Speaking of phone, W6NNR, Guy Dennis, worked YR5AA for his 30th zone and 66th country . . . and of all things Guy has slipped in a few c.w. crystals and is back on c.w. after a long layoff . . . yes, he still knows the code. Art Bean, W7AMX, adds VR6AY, K6NVJ, HR7WC and K6BAZ now making 123 countries. Art says he may have to put his "mike" in his antenna in order to raise TG9AA who has been coming in on 14,380 kc. around 0900 G.m.t. Another one that W7AMX worked was CR6PG who is supposed to be in Angola. There have been quite a few of the gang that have worked him on the West Coast but most of them seem to think he is a BL. If anyone knows anything about this guy, let's have it so we can spread the "glad tidings" if any.



A. D. Gay of G6NF. G6NF is manager of the calibration section of the R.S.G.B.

Left to right: W8ZY, W6CXW, W6FZY, W6GRX, W9AWP. Taken while W8ZY and W9AWP were on a trip to southern California.

LU7AZ did himself a little good by getting FI8AC and VR4AD for new zones. This makes him 36 zones and 92 countries. Just for good measure LU7AZ tosses in a WAC in 59 minutes. W6TI ups his to 35 and 66 by working VQ8AA on 13,995 kc. T7. As long as I've started on the W6's I may as well finish them up, so here goes . . . W6ONQ hooks ZD2H and wonders if he is OK, to which I'll say with envy . . . "plenty good". Why the heck didn't I get him. W6CQI, who is fortunate to have a couple of rhombics as well as other skywires, joins the phone section of the zone list with 32 zones and 70 countries. W6OCH adds two countries on phone, GI2CC and VP1AB, making 65 total. And while in the midst of the phone men I see that W6EJC in Sacramento has 29 and 64. W6MVQ spent all of his Easter vacation chasing VR6AY and finally got him, also nabbed his first European on phone. His total for both c.w. and phone is 31 and 72, and for phone only is 23 and 30. W6NLS is on 10 meters only and has been doing some swell work. He has 23 zones and 45 countries just on 28-Mc. phone, both ways. On April 3rd John worked SV1CA in Athens, Greece, which is probably the first W6-SV QSO on 10-meter phone. Well, here's another "part time" phone operator, Norol Evans, W6LYM, who swears by his 24 and 38 . . . and his combined total looks something like 37 and 108.

GI6TK

Frank Robb, GI6TK, has 31 zones and 76 countries. Frank tells about the time he was selling tickets at a dance given by the Radio Society of North Ireland. While stationed at the door selling tickets to any that may wish to come in, a very nice chap appeared on the scene and in good American accent said he would like to come to the dance. Frank sold him a ticket and a little later in the evening he started to have a chat with him. To his amazement the American said he was Claude Hannibal, W5EEZ, whose home QRA is now in Los Angeles. W5EEZ is the sparks on the *West Gambo* trading between Belfast and New Orleans. Another recent visitor to GI6TK was W3BBF, who was on a Greek ship. Frank says that in case any other hams come to Belfast they are sure to be welcomed at GI6YM which is the Belfast YMCA Radio Club. GI6TK uses a different rig on each band. A single T20 is used in the final of each rig, with about 20 to 30 watts input.

"Looking Over the Band"

Maybe it should have said "looking over the gang", but anyway K4KD wants everyone to know there is someone else signing his call and if any of you work K4KD to be sure you check thoroughly on him. It appears that "Ma" Mayer has been getting a flock of cards from fellows whom he has never worked. These cards have been turned over to the F.C.C. field inspector and will be very useful in tracking the guy. K4KD recalls the night he and K4RJ delivered W8IGQ back to the yacht Yankee after a visit. K4RJ suggested to Mayer, on the way home, that they stay up and try and snag a U9. but K4KD says "ND I'm going to bed." He did and K4RJ promptly works the U9 . . . now Mayer wonders, "What price sleep." A line from SU1WM which reads in part: "I see there is not a single SU station listed in the zone list, and in order to give them a start I am writing to say that I have 32 zones and 105 countries. All of this on c.w. in two and a half years. I shall be away in G for a holiday until the end of September but all my mail is being forwarded to 28, Park Road, Blackpool, England." G2IO ups his zones, by getting OQ5AE, to 34 and 90. W4DMB breaks into the column with his 30th zone, KA1AP; he also has 71 countries. Rig uses a pair of 35T's with a 4-section 8JK beam. W7AOL has changed locations which seems OK and has changed his rig from a 45 to a T20 . . . 25 watts input. A few of 'em worked with this QRP include VR6AY, VR4AD, HK5JD, FI8AC, TF2C, VK9VG, etc. According to W3GHB, our friend ZS1AH is leaving South Africa for home in England very soon. ZS1AH is Capt. Thorpe and he is retiring from active duty. We all shall miss the signal of ZS1AH but hope that he will pick up where he left off, with a G call. W3GHB just had a birthday, the 17th, and is getting those zones pretty fast . . . has 28 and 64 right now.

A word from G6QX, Bob Jardine, tells us that he has arrived in NYC and that he didn't have to chew a lemon crossing the pond. Anyway, we welcome Bob to W and I'm sure that some of you will have the pleasure of meeting him while here. He expects to be in USA for about two months, but will get no farther west than Chicago . . . darn it. Maybe some of you fellows can convince him to "Go west OM and see where California kw's are more important than oranges."

W6CMU tells one about a guy bootlegging a ham's call and another fellow gets on the air and hi-jacks this same call . . . and now guy no. 1 is sore as a boil because he has had "his" call copped when it wasn't his in the first place. Gee, this ham radio is getting tough . . . you can't even steal someone's call anymore, and be safe.

ZS3F, South West Africa

A great many of the boys have wondered what sort of a station ZS3F has. In a recent letter he gives quite a good description, although no photo is available. Here's from Jerry's letter: "In November, 1936, this station was born, and started off with a homebuilt receiver of 3 valves. Xmitter was a 71A mopa into a zepp antenna. Later this was changed to pushpull 30's into pushpull 71A tubes. In December, 1936, a better outfit was put up, using a 6A6 osc/dblr into a 6A6 p.a. with the grids and plates tied together. This was modulated by a 6A6 in p.p. driven by a 38 tube. This was fine, providing the batteries driving the 400-volt Genemoto lasted the entire QSO. No dx was tried with this rig on phone but on c.w. it worked well. In May, 1937, this rig was sold and I began on the present one, while still living in the d.c. section of town. In September a new QRA was established in the a.c. section; the xmitter was then tried on its initial test. Hey Presto, FB phone. Only one electrolytic condenser went. Rig was composed of the Jones three-band exciter using 6L6's and a 35T final with 50 watts input. Antenna an o.c.f. Hertz. Tried a 20-meter crystal but would not function well, when doubling to 10 so I stayed on 20 meters.

"Well, that's up to date, and at present the station is off the air as most of the parts were utilized by ZS3G in geting on the air. Trouble was experienced in getting QSL cards printed until now, and it looks like an impossible task in catching up. A log book containing many QSO's was destroyed by fire and I regret to say that all those who contacted me between December 1st and January 24th of this year, will have to work me again. I feel worse about this than you do, fellows, but all those whom I worked in the SARRL contest will receive cards ok. Before I sold my receiver I put up a single section 8JK and did it work. In two morning tests I received two R8, six R9, and two R9 plus reports. The antenna is being changed to a rotary job. About SWL's . . . please have mercy, I have no secretary, and the PO tells me I might have to rent a box if the cards keep coming in at this rate. Hereafter no SWL cards will be answered if unaccompanied by 9 cents in IRC. Visitors here have included scorpions, spiders, and ferocious rats . . . in the contest I parked under a mosquito net. No snakes yet but anticipated."

73

JERRY, ZS3F.

By the time you fellows read this Jerry will have his new receiver and will be back on the air. ZS3F is about the only active station in South West Africa and we hope that he will continue to be, as it means a new country for anyone who works him for the first time.

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Ham Humor

These surely cannot be passed up although they have little to do with dx. Thanks to W6KW for the general thought of the following humor:

W8BTI was working on his transmitter. W8ZY was helping. BTI turning to ZY says, "Karl take hold of the other end of that wire will ya?"

W8ZY: "OK."

W8BTI: "Feel anything?"

W8ZY: "No."

W8BTI: "Well, then, don't touch the other wire, its got 5,000 volts on it."

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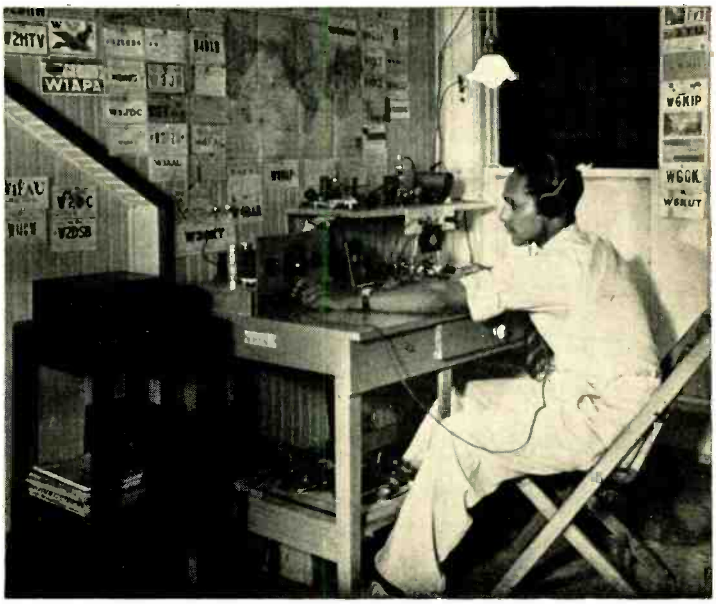
W6HX says there was no official winner in the recent Hollywood Diaper Derby. All the fathers who participated wound up a little behind.



VP7NT BAHAMAS

Operator is Harold Worth and received his ticket on February 19th. He is giving many fellows a new country. The rig consists of a 6N7 crystal oscillator and doubler, into a T20 final with 37 watts input. Receiver is a homemade Super Gainer; in fact Hal built the whole outfit himself. His chief interest is dx so possibly the famine on VP7 contacts is over. The antenna VP7NT uses is a Hertz and the frequencies used mostly are 3,655, 7,145, 7,202, 14,290 and 14,404. His complete QRA is Harold Worth, Box 471, Nassau, Bahamas.

W8AU: "A woman is just a rag, a bone and a hank of hair."

His xyl: "And a Ham is just a brag, a groan and a tank of air."

•

W6MLG: "You know there's a lot of electricity in my hair."

W6NNR: "There should be. It's connected to a dry cell."

•

More of This and That

W1AQT has not been idle as he has gone after a few new ones and landed them, PJ3CO, G8MF, ZS3F, etc., making 36 and 100. W4DIQ has been having a lot of fun getting his 35T on all bands, which he finally did. Keys in the primary of the whole rig, and hopes that R.I. hasn't heard the signal. He finally licked it though and now has accumulated 26 zones and 72 countries. A new one to the phone list is Capt. Ben Wallich, G6BW, with 21 zones and 50 countries . . . all raised and worked on phone. Nice going.

For those who have worked VR6AY, he is in zone no. 32, which is the same as ZL. As far as I know, there are no phone stations coming through from zones 16, 17, 18 and 19. W4CEN would like to know if anyone knows something further about AR8MO, ZM2G, ZC6AQ, ZP2AC . . . how about cards for them?

W8LAP worked something signing K9P and wonders if anyone knows more about him. The only thing I know about him is that he was probably on Dog Island of the Canine group. This makes another one to the ever increasing list of the so-called BL's, phonies or what have you. With B4UP, and his shadow B4IP, T4TWO, HCAC, HRO, and more recently PRO, and a guy signing L, we have a collection.

W7BVO has been doing some nice work on fone and sends in his list for 25 zones and 37 countries. This is the best figure in the phone section for a W7. W7BVO has worked them all on phone both ways, never having been on c.w. since 1932. He says the idea is that a good phone can work any place that c.w. will. It probably will, but not with the same consistency as c.w. W7BVO uses a pair of HK-354C tubes with a "competent kilowatt". On April 26th and 27th, in the space of 2 hours and 45 minutes Rollie worked 13 Europeans, 10 of them giving him R8 reports. W8PQK has been using his 100TH to good advantage by working more than 42 countries so far including YV5AD, I1TKM, OK1LN, CN8AV, HK2CC, OK1BC, HR4AF, ZS1AH, etc. W8BKP has been spending a lot of his time on 28-Mc. phone (tsk) and has nabbed a few new ones from doing so. BKP now has 138 countries, and made WAC on 10 phone in two weeks.

W4EPT has been doing quite well for himself lately by hooking ZS6CN, FM8AD, PJ1R, YN1AA, YR5CF, ZE1JG and others. He also says that every time a W9 sends out a CQ dx he's right smack on top of a dx station calling W4EPT. Hey, don't pick on those poor W9's, they have a tough time . . . they're dx for anybody, even W4's. W1APU is up to 31 and 81 now . . . thanks to TF5C. W8BOX goes to 37 and 102 and W4IO claims 33 and 91, also 4IO wants to know if anyone can dig in and get some info on OODVN back in 1928 . . . his QRA.

W9RBI picked up a zone on phone and now makes the list with 20 zones and 40 countries. W4CBY gives the low-down on the Atlanta gang: W4EF travels and not on much, W4YC on 10 and 20 phone, W4DVF just got his Asian for WAC, W4DQT on phone, and W4DOC and W4CFJ are playing with 10-meter phone, and W4EEV is doing very well on 10 phone. As for Fat himself he has 39 zones and 133 countries . . . another one waiting for zone no. 23.

G6YR is a new one to our fold and we hope he keeps it up. He has 32 zones and 85 countries. A feat worthy of mention—a short time ago G6YR worked ZS1AN on 7, 14 and 28 Mc. within 70 minutes. Just stop and think this over . . . those three bands really overlapping inside of 1 hour and 10 minutes. Here's another G to the rescue, this time G6DT with 21 zones and 53 countries on phone. All were worked on 14 Mc. with 50 watts input. Rob uses two 8JK beams which play a very important part in getting these elusive birds. What's this, still another one . . . G8MX adds a new zone and country by hooking XZ2EZ . . . yes, on phone . . . and now this gives him 24 and 53. G8MX remarks about the morning of April 22nd when the W6's poured in on phone. He worked W6CQI, W6FJC, W6DUW, W6AQO and W6OSY in rapid succession. G8MX is now doing quite a bit on c.w. so he should be in that list before long.

From G6WY's column in the *"T. & R. Bulletin"* we grab the following . . . G2TR was the first Great Britain-Pitcairn contact, on March 28th 0730 G.m.t. G2TR uses 25 watts. G6QS was the first G ever worked from Fiji, VR2FF being the station . . . on 14 Mc. EP5SO was a first contact for G2PL. He is ex-G5SO operating in the Persian Gulf. VE5LD and VE5ACS are in zone 2 but 5ACS is returning to Nova Scotia in July. VE5LD, however, looks to be anchored on King Williams Land. Cards for either of these may be sent safely to VE5AAD. VO6J, who is VE2JQ when at home, is still at Sandgirt Lake, Labrador, but has been off the air due to generator breakdown. Cards for VO6J should go to VE2JQ and cards for VO6D to VE2JK. By looking through the columns I notice the boys in G have their troubles with phoney stations. It's interesting to see, too, that many of them are entirely different than those reported by W stations, which means that they are more less localized. Just a few birds with a distorted sense of humor. To go on with the *T. & R.*: PJ3CO is ex-PA0XX and PX1B is ex-PX1A . . . must be genuine as he sends cards. I1IR worked POPI who claimed to be on board the S. S. Spinach, and now I1IR wants to know if Popeye QSL's. Oh my, will it never cease!!! Before leaving the *T. & R.* it is interesting to note that I. B. Clark, 2BIB, started a little discussion through publishing a few paragraphs on "Continuously Variable C.C. Oscillator". This is right in line with an article in May RADIO by Leigh Norton,

[*Continued on Page 91*]

POSTSCRIPTS...

and Announcements

CONVENTIONS—HAMFESTS

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A.R.R.L. Convention

The A.R.R.L Board of Directors has just designated Labor Day weekend, September 3, 4, and 5 in Chicago for the 1938 National A.R.R.L. Convention under the sponsorship of the Chicago Area Radio Club Council.

Spencer, Iowa

Amateurs in the vicinity of Clay county, Iowa, will have their second annual "hamfest-gabfest" on June 12, on the grounds of the Clay County fair being held in Spencer. They will have a booth at the fair. W9REH, W9TTO, W9UOW, W9SRR, W9VDL, W9YBD, W9TGV, and W9OC are in charge.

Fox River Valley

Fox River Valley Affiliated Radio clubs will hold their sixth annual convention at Round Lake, Wis., June 26. This organization is comprised of the memberships of Fond Du Lac Amateur Radio club, Appleton Radio amateurs, and Sheboygan Radio Amateurs club.

Cranbrook, B. C., Canada

When the East Kootenay Amateur Radio association gives its hamfest on Sept. 3, 4 and 5 in Cranbrook, B. C., radiomen will have a chance to visit the famous Kimberley lead, zinc, and silver mine and the various lakes and beaches in the vicinity. The hamfest is being held simultaneously with Cranbrook's fortieth anniversary celebration. Mrs. K. R. Barber, VE5SI, is chairman.

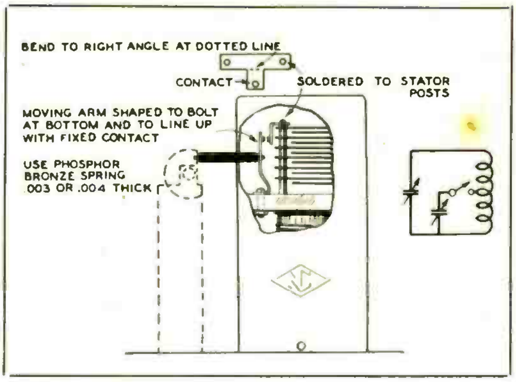
Wisconsin

Rock River Radio club will hold its annual hamfest in Fireman's park, Waterloo, Wis., on July 24. Reservations and complete information may be obtained from Lester Miller, W9OFL, 275 S. Madison St., Waupun, Wis.

Indiana

Eastern Illinois Amateur Radio league will

[*Continued on Page 95*]



RE "OBTAINING FLEXIBILITY AT LOW COST"

The fixed-tune tanks used in the exciter described by Harold Christensen in his article "Obtaining Flexibility at Low Cost" in the March issue of RADIO, brought forth several inquiries as to more detail on the contact arrangement. As the FXT tanks shown in the photo have been changed by the manufacturer in their internal arrangement, the accompanying sketch shows the method of making the contacts in the new type. The only difference between the old and the new type tanks lies in the fact that they have simply turned the assembly carrying the condensers upside down and made the necessary changes required for mounting in the new position.

•

PHONEY PICKED UP

As a result of some quick thinking and clever action on the part of W8BKM, the phoney self-styled subscription agent for RADIO that has picked up many a dishonest dollar at eastern hamfests by offering a "bargain special" has been apprehended and according to latest reports is cooling his heels behind some heavy shielding. The amazing part of the whole thing is the fact that he managed to get away with his racket as long as he did, because RADIO issued several warnings regarding the man and in spite of them he continued to solicit subscriptions under the same name.

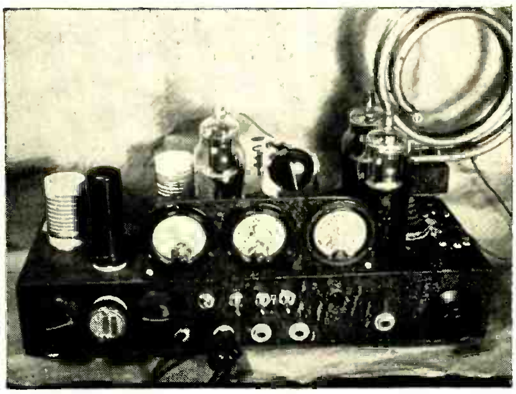
•

FLEXTAL CORRECTION

In the "Flextal" exciter diagram (May issue), the auxiliary filter condenser, if used, should be connected to the tap supplying the low frequency oscillator, and not to the crystal oscillator tap as shown. The data pertaining to the condenser is correct in the text.

56 MC....

By E. H. CONKLIN*



W8IPD'S 56 Mc. Crystal-Controlled Transmitter

According to Don Knock's radio pages in the Sydney (Australia) *Bulletin,* at 11 a.m. on March 19, ZL3AJ heard U.S.A. stations on 56 Mc. The calls heard were not given.

Dick Sampson, W6OFU, wrote us from Gallup, New Mexico, on April 5 saying that from 8:30 to 8:43 p.m., an unidentified W5 was coming in R0 to R7, on about 57,800 kc. He was talking to another W5, signing, "In the middle of Texas." At that frequency, and because he had asked, "What end of the band are the ZL's and VK's on?" the fundamental was probably in the ten-meter band. This is the first hint of summer 500-1200 mile dx to reach us.

Second Report

The second report was received via W8CVQ who says that W8NZ heard W2XAF on 51 Mc., R9 at 10:45 to 11:00 p.m. on April 8. The signal was slowly fading in and out. W8CVQ, who is in Kalamazoo, Michigan, says that his 56-Mc. signals have been getting into Grand Rapids for the first time.

Toward the end of the Australian summer, on March 13, VK2NO received a telegram from VK2GU to the effect that Mt. Stromlo reported unusual ionosphere conditions, and that long-distance communication should be possible on the ultra-short waves. He promptly got on five meters with the antenna aimed northeast and southwest. Two weak stations were heard to reply on phone calling VK2NO, but they were not identified due to their being of the modulated oscillator variety.

New Layer in Arizona

Clyde Criswell, on the Mission Ranch, Phoenix, Arizona, says that he has been informed that the state is unique in having a layer of nitrous oxide gas about 100 miles up, which may have some effect on radio waves. Perhaps we had better send Clyde up there to investigate. Also, he points out that some low-power mountain work was done by W6KKQ, W6LKK, W6POS, W6KVE, W6IUQ, W6KMM and W6KFC early in April. Signals were received at 40 miles with good strength. The last 40-Mc. dx signals passed out April 2 as against April 20 in 1937, but on April 19 this year, ten-meter signals from the north and south of Arizona were heard on a 200-mile skip.

Buffalo-Toronto QSO

After a lot of hard work, VE3ADO is putting a husky signal into Buffalo and W8RV is returning one to Toronto with interest, a distance of about 55 miles. At first, they picked each other up at about 6:15 p.m. and maintained contact until 7:30. Each succeeding night it lasted longer, now until after 9:00 p.m. It is a dream come true for them.

New Transmitter

A new transmitter at W8IPD starts with a 6L6 40-meter crystal and doubler stage, uses an 807 quadrupler to "five," with a pair of 807's running straight through in the final. It runs 60 watts input with a comfortable 50 per cent efficiency. It's all built on a 7x17 chassis. Who says 56-Mc. crystal control is hard? The new receiver is full of acorn tubes in the front end. We hope that Ely will be successful in the summer dx.

*Associate Editor, RADIO.

More From Florida

Tom Herrin, W4AKA, says that the five-meter gang is active on the Florida west coast, and that the Clearwater Radio Club, W4EQK, will have a 200-watt crystal controlled transmitter going in May. They plan to run the transmitter on code and phone quite a bit, and to try to stir up 56-Mc. interest in that territory. Tom says that there ought to be some good u.h.f. super-hets manufactured by somebody, inasmuch as the R.C.A. and W.E. 40-Mc. receivers work quite well.

A U.H.F. Rhombic

R.C.A. has given us the design data on the 7½-meter rhombic antenna used to receive the 42- and 45-Mc. transatlantic television signals last winter:

Height above ground	45 feet
Length per leg	400 feet
Length of shorter diagonal (width)	130 feet
Surge impedance, approximately	700 ohms
Surge impedance of transmission line, approximately	460 ohms
Overall effective height of antenna system	20 m.
Wire size	14 B&S

Provision was made to vary the length of the diagonals.

This was designed for signals arriving at the low angle of 7½ degrees which was the measured angle for the television signals from England. The antenna should prove to be excellently designed for 28 and 56 Mc. Somewhat smaller dimensions would probably be satisfactory on "five," though a rhombic antenna for this frequency should be arranged strictly for low-angle reception. For average work, ordinary half-wave elements—whether horizontal or vertical—stacked above one another and fed in phase, should produce satisfactory gain without excessive directivity.

International Field Day

O. H. Mills, W8NED, reports an international five-meter field day on Sunday, May 1, sponsored by the Presque Isle five-meter club of Erie, Pa. The purpose was to set up an international five-meter relay network extending from Toronto, Ontario, to Pittsburgh. The network proved successful and a message originating in Toronto by VE3ADO was relayed through to Pittsburgh via VE3ADO, W8RV, W8GBK, W8GU, W8QKI, W8DEP, W8QQG, W8KOL, W8GCI, W8KG, W8BDG, W8VO, W8QXV, W8CIR, W8NED. Also, W8CIR took his mobile transmitter to Negro Mountain, Maryland, and originated a message there which got through to VE3ADO. Then W8EUO went mobile and originated a message at Wellsburg, West Virginia. The fellows are happy over the way the field day turned out and plan to have a bigger and better relay net test in the near future. Chances certainly seem improved for a Chicago-New York-New England relay.

W8RV at Buffalo, New York, has been heard several times around Pittsburgh and Aliquippa, Pa.

A letter from Bryan Groom gives more dope about his 56-Mc. station, GM6RG, and transatlantic reports he has received:

"W1KTF copied me at 10:04 a.m. E.s.t. on February 18th when I was calling on c.w. and using an automatic sender. He was able to tell me what was on the tape of the sender. The report was QSA 3/5 R4/5.

"When W2JCY and W2KTF heard me, I was operating on 28 and 56 Mc. simultaneously, but I stopped and changed to c.w. only on 56 Mc., in case any doubt should be cast on any contact which might materialize. W2JCY copied me solid for forty minutes, so I believe, during my dual transmission.

"I can give you no dope on other reports as I took no note of them as I was not given any other information than that I had been heard. I like to be able to check up on such statements!

"The transmitter uses 500/1000 watts c.c. on 57,016 kc. The frequency will be changed shortly as the transmitter is being changed to use a 28-Mc. crystal. Antennas are rhombic with nine wavelengths on a leg, and also a vertical array of four half waves in phase with four reflectors and twelve directors, rotatable. I have a similar array for 28 Mc. but it is horizontally arranged. Separate transmitters are used for 7, 14, 28, and 56 Mc., remotely controlled from the house about 300 yards away, as also is the rotation of the 28-Mc. beam. Phone or c.w. on any of these bands."

On April 5th, W6OFU (who is located at present in Gallup, New Mexico) heard a W5 phone on 57,800 kc. fading badly from R7 to R0. He was talking to another W5 and was heard asking, "What end of the band are the ZL's and VK's on?" Although fading prevented

[*Continued on Page 86*]

YARN *of the* MONTH

A Sunday in the Life of a Ham

(Dedicated with Vy 73 to the Ham Down the Street.)

9:00 a.m.—Folks leave for the day and Ham is alone. Aimlessly paces floor in his room. Stops and views visage in mirror. Makes weekly mental note to get hair cut sure next Saturday. Resumes walking, watching b.c.l. set out of corner of eye. After great mental wrestling, says, "Aw, well, guess I'll go out'na shack."

Unlocks door of shack noting key turns very hard as usual. Makes mental note to oil sometime. Shoves master switch which turns on all lights, filaments in transmitter and receiver, soldering iron and much miscellaneous equipment scattered along and under work bench. Clicks switch putting plate voltage on receiver. Indulges in idle cogitation anent desire for broadcast coils. Aimlessly opens various well-filled drawers in operating desk. Spies very battered coil which gets careful investigation. Receives brilliant idea and rummages around until he finds ancient variable condenser that might be 250 μμfd. Emits joyful grunt, and opens top of receiver. With the aid of tattered test leads, makes "b.c.l. set" by clipping coil and condenser onto grid of first detector and onto b.f.o. switch on front panel. Tunes condenser avidly. B.c.l. set operates very unstably and with high distortion. Stations seem infrequent and play no Benny Goodman records.

Decides to heck with b.c.l. and in process of experimentation discovers that by putting 40-meter coil in oscillator and 80 coil in detector can tune 30-meter commercials. For best reception 80-meter coil must be mounted with judicious use of rubber bands to exert starboard pressure. Resurrects battered mill from under bench and copies a Mex commercial. Success—50%.

10:00 a.m.—Turns off receiver deciding that all Mex commercials stand on their heads and send left handed. Leans back too heavily in chair, breaking back out. Fixes chair with hammer, shingle nails and muttered imprecations. In melee unknowingly knocks soldering iron from tin can rest.

Decides to tune up rig as W9 last night only gave him 5 and 8. Emphatically decides for umpteenth time to buy some 6-watt car lights as Xmas tree lights, especially blue ones, highly unsatisfactory. Pulls ½-inch arc from final tank. Fire comes through pet r.f. pencil and burns finger. Sucks finger and smells something else burning. Dives madly into rig thinking transformer he traded pair of anemic 210's for had finally given up ghost. Transformer sings merrily and only red hot. Finds soldering iron, which is sending up fair sized smudge, and replaces on tin can. Decides he was going to tear up flooring anyway to put in new switching system. Turns off rig.

11:00 a.m.—Ham discovers that action picture of World's Greatest Risqué Dancer has slipped down behind operating desk. Rescues picture and retacks to wall. Scratches out title and substitutes call of Ham Down the Street. Fills out five QSL's, depositing them with twenty-five more in desk drawer to await financial opulence.

Finds old European recording of Ray Noble and places upon turn table. Winds crank industriously amid great groaning and thumping of spring. Finds amplifier and plugs output into bench panel after deciphering maze of wiring. Plugs pickup into input of amplifier, and clicks switch. Panel light on amplifier fails to glow; remembers burning it out when tuning up buffer stage last week. Notes dandy hum in speaker; puts pickup on record and spins turn table with finger. Record gives off faint squeaks and scratches, while speaker emits loud hum as before. Manipulates gain control frantically with no effect. Remembers remov-

By PAUL B. STILLMAN, W6MSE

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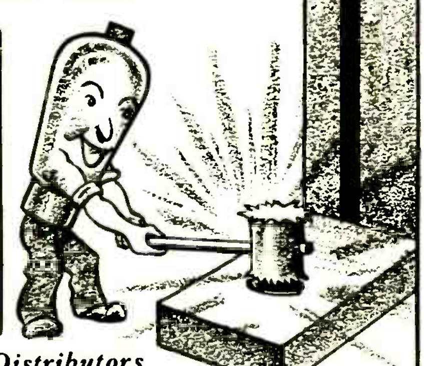

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TAYLOR TUBES, INC., 2341 WABANSIA AVE., CHICAGO, ILLINOIS ing various resistors to experiment with 6L6 oscillator, and hunts feverishly for resistors. Decides Ham Down the Street swiped them yesterday. Gets down bottle of resistors and RMA color chart.

12:00 noon—Starts putting resistors back in bottle, deciding he didn't want to hear Ray Noble anyway. Departs for house to eat lunch and QSO YL on land line. YL very touchy about being stood up last night when the dx was rolling in. Ham explains at length to no avail, mentally deciding to give up radio for umpteenth time. YL hangs up with loud bang. Ham decides to stick to radio and replaces receiver. Rubs ear and sits moodily by phone.

1:00 p.m. — Revives drooping spirits with can of beer and retires to shack. Takes pencil and, standing on chair, marks, "What are you looking up here for?" on ceiling. Admires ingenuity and handicraft for five minutes from various angles. Decides he's gone the Ham Down the Street one better. Finds old copper tubing tank coil and decides to go on 20 c.w. by doubling in final. After much calculation discovers frequency will land in fone band. Makes mental note to write to Radio's Open Forum anent outrageous width of 20-meter fone band.

Cuts coil down and haywires it in final. Tube develops definite sunset glow, while r.f. has gone down until flame hardly burns finger. Ham decides it's self-excited, but what the heck? Calls CQ till he's black in the face, then decides the QRM situation on 20 is terrific. Puts rig back on 40.

2:00 p.m.—Ham finds license manual and makes up mind for umpteenth time to pass class A and go on 75 fone. Fills in all the O's with pencil for three pages and then decides the dx situation on 75 is terrible, and anyway he'd better stick to c.w. Pulls open desk drawer to replace manual and finds resistors from amplifier. Solders resistors back in after filing residue from soldering iron and retinning it. Soldering tip is now so short it's easier to use shank. Amplifier again plays with former brilliance. Remembers Ham Down the Street has two new Benny Goodman recordings, and departs with formidable 2000-volt 1-μfd. filter, and trading gleam in eye.

3:00 p.m.—Reappears at shack with two new B. G. recordings, minus 2000-v. 1-μfd. filter and trading gleam. Seems fairly exhausted. Cranks up gain on amplifier until QSL's on wall begin to vibrate, and plays B. G. recordings incessantly.

4:00 p.m.—Puts amplifier back under work bench making mental note to trade B. G.'s for two Ambrose. Resurrects dusty dim doorbell ringer from under bench and mounts on wall with display caption reading, "Ring Only In Case Of Fire." Gets brilliant idea and upsets shack hunting for Ford spark coil. Finds coil in obscure corner under two tanned cat skins, the remains of an ancient b.c.l. set, and a very defunct "B" battery. Hooks up coil, running wires with great cunning. Touches ringer with some trepidation. Jolt seems very satisfactory. Shakes arm vigorously and hears folks arriving. Greets family and asks when supper will be ready. Folks have stopped at drive-in on way home. Rereads funny papers in bad frame of mind.

5:00 p.m.—Eats dinner and evolves scheme for making records sound European by putting extra pickup on record and making synthetic room echo. Starts for shack with vague idea of going on air. Folks take firm stand about wanting air for Charlie McCarthy and Jack Benny. Decides to QSY to YL's house and affect reconciliation. Departs whistling, "Sweet Someone," interspersed with CQ's.

A Midget 90 Cm. Transceiver

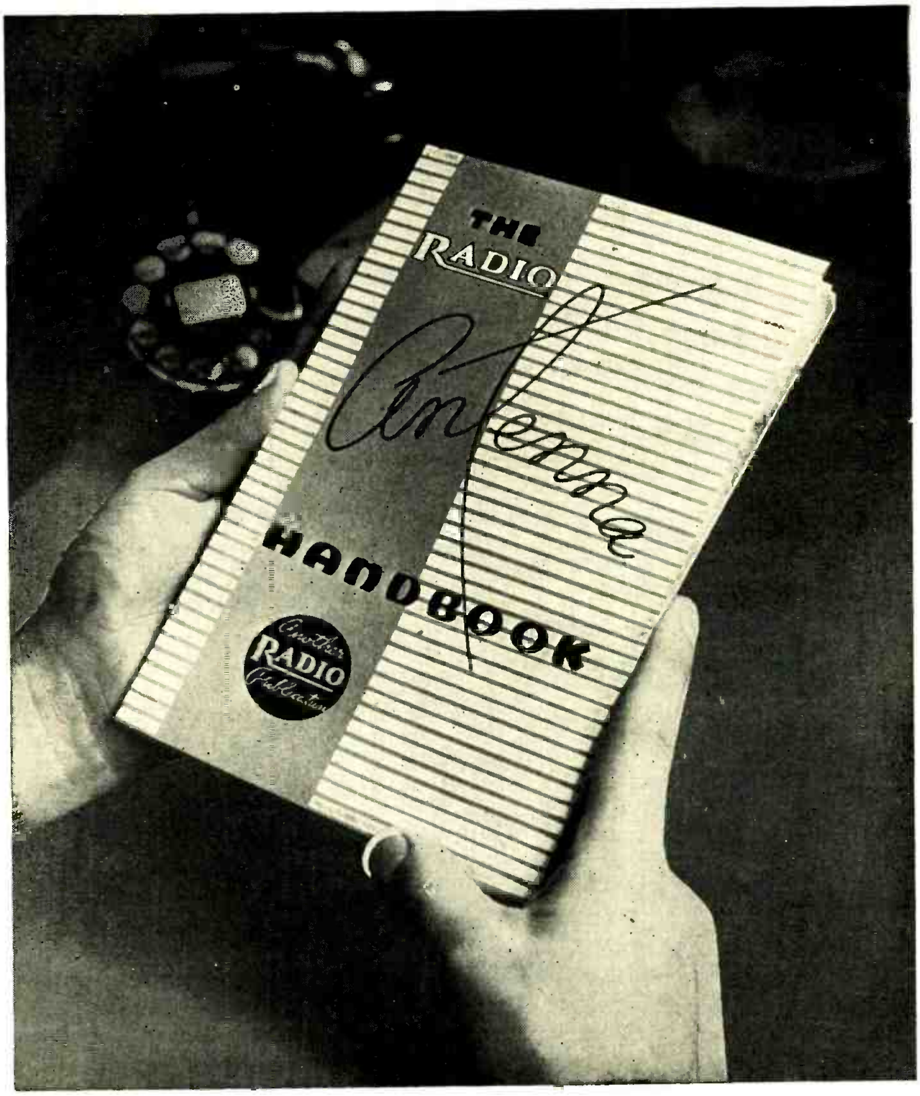
[*Continued from Page 37*]

In actual operation, we have so far covered a distance of six miles. This has been between two hills which are not high but are in an optical line. Reports as to signal strength were R7 over this distance. It is a definite fact that greater distances *can* and *are* going to be achieved. It was found that the signal strength increased from one to two R's when the receiver was raised over a full wavelength above ground. Reliable communication can be expected so long as the two points of communication are theoretically visible. All our results have been obtained *without* the use of directive antennas. It is hard to tell just what distances may be had with good beam antennas. And they can be made highly directive in a small space on this frequency.

A vote of thanks goes to George H. Schmitz whose ready assistance and splendid cooperation greatly facilitated the building and testing of the outfits.

If anyone wishes additional information please write to the author, enclosing a self-addressed, stamped envelope.

The 1938 "Radio" Antenna Handbook



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Eric W. Trebilcock, BERS-195,
Darwin, North Australia
(January, 1938)

(7 Mc. phone)

CR7AU.

(14 Mc. phone)

CO2JV; FI8AC; K4DDH; KA1BH; KA1JR; KA1ME; PK2AY; ZE1JA; ZE1JR; VK4HN.

(7 Mc.)

CR6AF; CR7AU; CR7BB; CR7BC; CT1LZ; F3EL; F3LR. **G**—2CV; 2IT; 2PL; 5AN; 5UY; 5XC; 6KP; 6RG; 8FF; 8IX; 8QC; 8RL HA5C; HB9BB; J2OV; K6MOJ; K6OCL; K6ORA; K6PEJ; LX1AS; LX1MX; OE3AH; ON4AA; ON4BO; ON4BW; ON4DKW; ON4IW; ON4SG; OZ5C; PK3WI; PY2DN; SP1HH; SP1FB; SU1LWM; U1BC; U1BQ; U1BQU1VI; U2NE; U2AG; U3BC; U3VB; U3BX; U43EA; UX5KS; VP5KS; VP2tg; **ZS**—1BE; 1BG; 1CX; EY; 4Z; 4AM; 5AQ; 6BC; 6EJ; 6EQ. ZT1A; ZT1A; ZT2U; ZT6AV; ZT6F; ZT6U; ZU1Z; ZU2H; ZU5U.

(14 Mc.)

W—1CLX; 1IED; 1KN; 1MX; 1SZ; 2ARB; 2AXT; 2DF; 2DVA; 2CTC; 2GRG; 2HMJ; 2IFZ; 8JOZ; 2UK; 3EMM; 3ENX; 3EVW; 4PCV; 4DOC; 4EBU; 4MR; 5DGB; 8DFH; 8OQU; 9ARL; 9PWF; 9UPH; CM2JV; CO2JJ; I7AA; J2NF; J3GW; J5CV; K5AA; K6MBT; KA1AF; KA7EF; OK2CC; PK3WI; PY1DI; ST6KR; UK8IA; VE3FB; VQ4CRT; VS7AA; VS7JW; VS7RP; VU2FV; XU8AL;XU9W; YV5AK; ZE1JG; ZL1AR; ZL1MR; ZL2SF; ZL3DQ.

●

Eric Trebilcock, BERS-195 Telegraph Station,
Powell Creek, (NT) Via Adelaide (SA),
North Australia
(Note new address)
(February, 1938)

(14 Mc. phone)

CE1AH; CE1AN; CE1BE; FI8AC; G2NA; K6BNR; K6MTE; KA1BH; KA1MG; KA1MH; KA1YL; PK2WL; PK2WI; XZ2EZ; ZE1JR; ZS6AJ.

(7 Mc.)

W—2BHD; 2KSL; 3CAQ; 3EVT; 3FHA; 3HEM; 4DKH; 4TK; 5EID; 5FVN; 6VDQ; 6CV; 6DNG; 6GRF; 6GXV; 6LNS; 6MFY; 6POI; 7AVL; 7DXZ; 7CJO; 7EHH; 7FZP; 8IAT; 8KXP; 8KZM; 9FLI; 9HEL; 9JXR; 9PRU. GHFF; HK5JD; K4FAI; K6MOJ; K6NFU; K6OWQ; K6PDQ; K6PKJ; KA1SL; LA1Z; OH5OA; ON4NW; PY2DN; SM5YV; SP1BA; SU1BA; SU1NH; U6WB; VU2FV; XU3YK; ZL3JD; ZT6Y.

(14 Mc.)

W6LYM; CM5RY; CN8MA; CR7AC; CR10ZS; D4TKP; EI5F; F8RP; FA8AX; FB8AA; FI8AC; FR8VX; G8FC; GI5NJ; GM6RV; HA1P; HB9AY; HC1JW; I1MH; I7AA; K4CVV; K5AN; K6PAH; KA4LH; OA4R; OK2PN; ON4JB; PA0TY; PK1TM; PY1DI; SM7TF; SV1AZ; U9AW; UK8IA; VE3WA; VK4YL; VK7KV; VK4KC; VP1AL; VP1AL; VP2AT; VP3TEST; VP6LN; VQ4CHS; VJ8AJ; VR2FF; VS100; VS6AH; VS7RP; VU7FY; XU8MR; XZ2DY; ZB1H; ZE1JF; ZL2FA; ZS2Z.

●

Donald W. Morgan, 15 Grange Road,
Kenton, Middx., England
(February, 1938)

(14 Mc.)

W—1BFA; 1CH; 1CPS; 1DZE; 1DX; 1ICA; 1JVS; 2CYU; 2HCM; 2HKW; 2HUB; 2KLV; 2KUD; 3EMM; 3EVW; 3RT; 3TR; 8JMP; 8LYQ; 8OPB;8YU; 9MCD. CN8AR; CR7AU. **D**—3FAF; 3SPF; 3YM; 4ANC; 4ATT; 4BEE; 4SNP; 4SQK; 4SZK; 4TAB; 4YTM; 4YUM... EI2M; EI5F; EI9G; F3EG; F8GK; FA8JO; FA8ZZ. **HA**—1Z; 2B; 2J; 2N; 3B; 3J; 3P; 5F; 5Z; 7D; 7P; 8D; 9R. HB9AI; HB9CH; HB9J; HB9XB... **I**—1IE; 1IK; 1IR; 1IS; 1IY; 1KNX; 1LS; 1LT; 1LM; 1ZB; 1ZZ. LA4K; LA5S;LA6N; LA7I; LA7U; LA7W; LA7Z; LA8B; LY1J; OE1J; OE1EK; OE1JB; OH1NV; OH2NM; OH2OT; OH3NP; OH6NG. **OK**—1AM; 1CS; 1EE; 1EX; 1JA; 1KW; 1RW; 1RX; 1SZ; 1WK; 2AK; 2AO; 2BE; 2HB; 2HK; 2HV; 2HX; 2LO; 2MM; 2PN; 2SI; 3TW: **OZ**—1S; 4B; 4P; 5B; 5R; 5XY; 5Z; 7FK; 7K; 7K; 7T; 7U; 7UU. PA0KV; PY2AR. **SM**—4XX; 5OF; 5OU; 5PI; 5UG; 5UP; 5WZ; 5YU; 6AB; 6PA; 6PI; 6PO; 6UG; 6UP; 6VX;6YG; 7CT; 6YT. **SP**—1AR; 1AT; 1DP; 1FA; 1FM; 1HH; 1IE; 1JA;1JB; 1LM; 1MD; 1MR. SU1DX; SU1GT; SU1SW; U1BC; U1BN; UK8IA; VE1EK; VE1HK; VP1HK; VP2AT; YM2AA; YR5AA; YV1AG.

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Bob Everard, "Oakdene" Lower Sheering Rd.,
Sawbridgeworth, Herts, England
(February, 1938)

(14 Mc. phone)

CN8AF; CN8AM; CN8AR; CR7MF; CT2AB; CT2BC; FA3HC; FA3JY; FA2QV; FB8AD; FB8AF; FI8AC; FR8VX; FT4AR; FT4AU; HH2B; K4DDH; K4FAY; K6KMB;K6AQE; KA1BH; KA1HS; KA1ME; KA7MX; JK1ZZ; PK3GD; PK4AU; PY6AB; PY6AI; PY7GA; SU1RD; SU2TW; SU2TW; T6AM; T6AN; VP6MR; VQ4KTB; VS2AK; VU2CQ; XZ2EZ; YR5TI; YV1AC; YV4AB; YV5AA; YV5ABY; YV5AK; ZB1E; ZB1L; ZE1JA; ZE1JR; ZS1AX; ZS1AX; ZS1K; ZS2N; ZS3F; ZT1M; ZT1R; ZT2Q; ZU5Z; ZU6N; ZU6P.

(28 Mc. phone)

W—1ADE; 1AEP; 1AKZ; 1ANA; 1APU; 1ARB; 1AWO; 1BBX; 1BJE;1BOK; 1BOO; 1BQQ;1BSA; 1BVL; 1BWY; 1CAA; 1CAV; 1CJN; 1CKV; 1CND;1COO; 1DAY; 1DBB; 1DDE; 1DLJ; 1DQK; 1ELO; 1ELR; 1ETO; 1EUG; 1EWY; 1EYS; 1FMQ; 1FZA; 1GDY; 1GKJ; 1GWK; 1GZL; 1HJP; 1HRS; 1HVS; 1HWH; 1HXU; 1HYJ; 1IAV; 1IDV; 1IGD; 1IIQ; 1IKS; 1IPV; 1IVG; 1IYE; 1JQN; 1JIE; 1JIL; 1JNX; 1JOS; 1JPM; 1JQT; 1JRN;1JTG; 1JUJ; 1JVU; 1JZR; 1KC; 1KFC; 1KJJ; 1KKF; 1KKL; 1KNB; 1KPP; 1KQG; 1KQM; 1WD; 1ME; 1SE; 1TW; 1WU; 1WV; 2AHX; 2ALK; 2ALP; 2AMJ; 2AMM; 2AOG; 2BAA; 2BHY; 2BXA; 2BYB; 2BYD; 2CDG; 2CIW; 2CKG; 2CSN; 2CYQ; 2DFM; 2DH; 2DMJ; 2DRY; 2DTE; 2DVV; 2DTX; 2EKG; 2EXI; 2FGB; 2FGD; 2GIL; 2GWK; 2GAH; 2GFH; 2GHO; 2GMR; 2GUM; 2GUX; 2HHM; 2HJU; 2HPZ; 2HXO; 2HYJ; 2IDE; 2IFL; 2IIA; 2ISY; 2ITA; 2IVA; 2IZK; 2JAV; 2JCY; 2JIH; 2JLR; 2JOQ; 2JQX; 2JSO; 2JVC; 2JXI; 2JXS; 2JZQ; 2KAK; 2KB; 2KGY; 2KHR; 2KKQ; 2KQP; 2KXJ; 2MB; 3AEG; 3AIR; 3AKE; 3AKX; 3ANH; 3ASH; 3ASJ; 3BIW; 3BZJ, 3CAD; 3CBT; 3CIJ; 3CKT; 3CRY; 3EOZ; 3EVQ; 3FAR; 3FEA; 3FLG; 3FLZ; 3FTR; 3FVO; 3FXU; 3FZE; 3GGC; 3GHS; 3GIS; 3GIZ; 3GQS; 3GSV; 3GTL; 3GWM; 3GXO; 3GZN; 3HDA; 4AHH; 4AUS; 4AUU; 4AZB; 4BQI; 4CFJ; 4CLK; 4CPB; 4CWF; 4CWR; 4DCK; 4DDM; 4DEK; 4DOF; 4DRZ; 4DXM; 4ECF; 4EEK; 4EDD; 4EDQ; 4EDW; 4EEB; 4EEV; 4EFN; 4EGT; 4EJE; 4EKI; 4EMF; 4EOA; 4EOZ; 4EPZ; 4EPX; 4EQJ; 4EWX; 4EWY; 4EYH; 4FS; 4FT; 4GB; 4HK; 4OQ; 4PD; 4ZF; 5AHJ; 5AXQ; 5BAT; 5BEN; 5BSK;5CHG; 5ECT; 5EEL;5 EGU; 5EHM; 5ETR; 4FCM; 5FDE; 5GKZ; 5GPX; 5GQ; 6AM; 6CKR; 6CUU; 6ERT; 6GCX; 6GUQ; 6IWS; 6JXF; 6KG; 6LWB; 6MPS; 6NAP; 6NLS; 6NWU; 6OTE; 6OZH; 6PBD; 6RVO; 7BEE; 7EMP; 7GGG; 8AAH; 8ABC; 8AFG; 8AIY; 8ALT; 8ANO; 8BTO; 8BVP; 8BCU; 8CDH; 8CHQ; 8CIR; 8CJF; 8CJM; 8CJQ; 8CLS; 8CNA; 8CPC; 8CUE; 8CUY; 8DST; 8DSU; 8EBS; 8EPM; 8EUK; 8FXC; 8GGG; 8HHH; 8HHZ; 8HSP; 8IAU; 8IWG; 8JAH; 8JFC; 8JLW; 8JVI; 8KCI; 8KYY; 8LAC;8LGJ; 8LGO; 8LWA; 8MAP; 8MID; 8MLS; 8MNM; 8MSK; 8MYF; 8MZE; 8NBR; 8NDL; 8NGJ;8 NHQ; 8NKS; 8NSO; 8NXF; 8NYU; 8NZU; 8ODE; 8OE; 8OJM; 8OTK; 8PDP; 8PG; 8PK; 8PKQ; 8QBO; 8QGZ; 8QMF; 8QOV; 8QQT; 8QVB; 8QVV; 8QWB; 8QXT; 8QYC; 8RAE; 8RCO; 8REU; 8RJX; 9AEQ; 9AGO; 9ARK; 9ARN; 9AVS; 9BBU; 9BHT; 9BAF; 9GPL; 9BTO; 9CGO; 9CHI; 9CSI; 9DUU; 9DWU; 9EOZ; 9EW; 9EYM; 9FAA; 9FEY; 9GGY; 9GPC; 9GWQ; 9HDZ; 9JJK; 9JOL; 9JRY; 9JRZ; 9KQE; 9LKI; 9LZP; 9OFL; 9PQH; 9PUY; 9PZI;

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

9QI; 9QNA; 9QPQ; 9REG; 9RGT; 9RRX; 9RYM; 9SJV; 9SVV; 9TVV; 9TII; 9TIO; 9TMP; 9TTB; 9TYJ; 9UKW; 9USU; 9UUR; 9UXA;9UYD; 9VFB; 9VRC; 9VXL; 9WAH; 9WAL; 9WBW; 9WFG; 9WLW; 9WNQ; 9WOA; 9WOR; 9WYS; 9YDI; 9YLO; 9YWN; 9YYM; 9ZHB; 9ZNA. CN8AV; CO7CX; CO8RQ; CT1ZA; FA3JC; G5NH; G5SA; G5VT; G5ZG; G6WU; G8FZ; HI2P; HI7G; K4DDH; K4EIL; K4EJG; K4EMG; K4ENT; K4EPO; K4EZR; K4FAY; LU7AG; NY2AE; SV1CA; SV1ME; TG9AA; TG9AA; TI2FG. **VE**—1AP; 1BB; 1BR; 1CO; 1DR; 2CA; 2HG; 2ID; 2KX; 2MX; 2NH; 3AGS; 3AIB; 3ANF; 3AQ; 3LB; 3SY; 3TB; 4AW; 4CP; 4OK; 4SN. VP 6YB; VP9R; VU2CA; XE1GE; YV6AL; ZE1JJ; ZE1JR; ZS6AJ; ZT6T; ZU6P.

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R. L. Weber, W6JOH, 1256 Hawthorne, Alameda, Calif.
(Feb. 22 to March 13)

(7 Mc.)

VK2BY; XU3LK; ZU7BB; XU8HM; XU9CF.

(14 Mc. phone)

CO2QQ; KA1ME.

(14 Mc.)

W1OXTB; CE3BC; CE4AD; CM2AZ; CM8PW; CM2RZ; CM2RZ; CM2WD; CM7LR; CM8MC; CT1PC; CX1CG; CX2AJ; F8AI; FA8BG; FY8AA; HC1JW; HH4AS; J2JJ; J8CF; K7DNL; K7FZD; LU1EP; LU2EG; LU3EV; LU5AN; LU6DG; LU7AZ; OA4Q;OH5NG; OH5OD; ON4CD; OZ2M; PA0AZ; PK1MF; PY2AP; PY2JT; SM5UL; TI2FG; U1CO; U2NE; U9AV; U9AW. **VK**—2BR; 2DI; 2GU; 2HZ; 2MT; 2PV; 2PA; 2VN; 3HK; 4JU; 4SD; 4UR; 5WR; 7QZ. VP3TE; VP7NC; VP9L;VR6A; ZB1H. **ZL**—1BT; 1CK; 1HY; 1MQ; 2CI; 2FA; 2FR; 2LA; 2QM;3 GR; 4BP; 4BS; 4CS. ZS2AL; ZS5BH; ZZ2A; ZZ2J.

(28 Mc.)

G6HB; G6WY; J3FJ; K5AN; K6BHL; K7PQ; LU7AZ; ON4FE; PY3BP; TI2FG; VKADE; VK3IW; ZL1GX; ZL1MR; ZL4DQ; ZL4FK.

●

R. Martin, 24 Rue Sacretelle, Paris
(Heard during the A.R.R.L. Contest)

(14 Mc. phone)

W—1ADM; 1AXA; 1BEQ; 1BIL; 1BZC; 1CGT; 1CJY; 1CND; 1COI; 1COJ; 1CRW; 1CCW; 1DET; 1DIC; 1DWW; 1FDK; 1FMP; 1FMT; 1GUX; 1HKK; 1IED; 1IGR; 1JCX; 1JFG; 1JIC; 1KKP; 1NW; 1TW; 1WI; 2AMM; 2AZ; 2BBI; 2BLV; 2BRV; 2BWR; 2BZ; 2CIF; 2CQL; 2CWC; 2EIW; 2EJG; 2MM; 2EOA; 2ETI; 2GDU; 2GIZ; 2GO; 2GPI; 2GUX; 2HEM; 2HFS; 2HNA; 2HS; 2IKD; 2IKV; 2IUV; 2IXY; 2JI; 2JLZ; 2JMJ; 2JT; 2JV; 2KIU; 2KXH; 2OJ; 2VK; 2XCM; 2ZC; 2ZRP; 3ABP; 3ALI; 3ANZ; 3ASG; 3BD; 3BFH; 3BMA; 3BQO; 3CHS; 3CIU; 3CMY; 3CRG; 3CWW; 3DLL; 3EMM; 3EOZ; 3EW; 3EWW; 3FJU; 3KY; 3LN; 3MD; 3MV; 3PC; 4AGB; 4AH; 4ARW; 4AZK; 4BJV; 4BMR; 4BPG; 4BRD; 4BYY; 4CYU; 4OAA; 4DIA; 4DMI; 4DSY; 4EHG; 4HX; 4OC; 4QUAH; 4TJ; 4TO; 4YC; 5AMX; 5BMZ; 5DNV; 5EB; 5EWW; 5FIV; 5YF; 6AM; 6OQU; 6GIH; 6GRL; 8AAJ; 8BDO; 8BIS; 8CMA; 8CRP; 8GII; 8GLC; 8GLY; 8IGD; 8IRK; 8MVY; 8MXQ; 8NJP; 8NXQ; 8PAA; 8QGW; 8RGB; 8RED; 8YX; 9ARL; 9CGY; 9DLL; 9DNP; 9DKU; 9ELL; 9ENX; 9GIZ; 9NNO; 9GNQP;9VXZ; 9GYC. CO2EG; CO2JJ; CO2JV; CO2WM; FI8AC; HC1FG; HC1JW; HK2LDC; LU1DA; LU5AN; LU8HF; PY1GJ; PY2ET; PY3BP; PY4BU; PY4DI; PY5AN; PY6AB. **VE**—1AH; 1CX; 1EL; 1ET; 2AB; 2AQ; 2AW; 2BO; 2BV; 2CC; 2CP; 2CX; 2DZ; 2EE; 2GT; 2HG; 2JK; 2KB; 2MQ; 2MW; 2WE; 3ABZ; 3AEX; 3GV; 3HF; 3HY; 3JY; 3JW; 3KL; 3MB; 3NB; 3QL; 3WV;4HB; 4SS; 5ID. VK2GU; VK2XU; VK4VD; VO1D; VO6B; VR6AY; XE1GK; YV4AY; YV5AK; YV5AZ; YV5HH.

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F. Kostelecky, OKRP173, Mlada Boleslav 834, Czechoslovakia
(Feb. 12 - March 13)

(28 Mc.)

W—1AFR; 1AOL; 1BDG;1BUL; 1BUX; 1COI; 1DBE; 1DZE; 1ELR; 1EXB; 1EZL; 1GBO; 1HVC; 1ICI; 1IVO; 1JHM; 1KQF; 1SZ; 1TK; 1WV; 2AIH; 2AYS; 2BHM; 2BQK; 2BSK; 2BXA; 2CBO; 2CUQ, 2DAG; 2DOZ; 2DTB; 2HGV; 2JME; 2TP; 2UK; 3AXU; 3AYS; 3BEN; 3BYF; 3DUK; 3EXB; 3EYY; 3GEH; 3GIH; 3HIL; 3KT; 4AZB; 4CBY; 4CQG; 4DMB; 4DOC; 4MR; 8ACY; 8ANO; 8BFF; 8BKP; 8BKX; 8BTI; 8CUY; 8CVB; 8EBR; 8FMX; 8GFD; 8HGW; 8IIL; 8IQS; 8JJY; 8KHS; 8LDA; 8LYQ; 8LZK; 8MSK; 8MVG; 8NK; BNLB; BNSS; 9HLF; 9IXO; 9NEU; 9NST; 9RBI; 9NZA. CN8AV; CN8MI; CT1JU; CT1AB; FA8IH; FB8AA; FR8VX; LU3DH; LU7AZ; SU3TW; U9ML; VE1AP; VE1AU; VE2KS; VE3QD; VE3HP; VE3EP; VUSCQ; VU2FV.

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Nicholas Woytan, 309 South Wilbur Avenue Syracuse, N. Y.
(November to April 5)
(14 Mc. phone)

CN8AM; CN8AU; CN8AV; CN8MU; CT1AY; CT1DA; CT1PA; CT1QG; CT1QH; CT2DC; CX2AK; EA9AH; EI2L; EI4L; EI6G. **F**—3CP; 3GR; 3HZ; 3KH; 3OO; 8AM; 8BU; 8BU; 8DL; 8GR;

[*Continued on Page 85*]

NEW BOOKS AND REVIEWS of CATALOGS

(Books submitted to the Review Editor will be carefully considered for review in these columns, but without obligation. Those considered suitable to its field will also be reviewed in Radio Digest.)

HOW TO PASS RADIO LICENSE EXAMINATIONS, by Charles E. Drew. 1938 Edition, published by John Wiley & Sons, Inc., New York, N. Y. 201 pages, 9¾" by 6¾".

A completely revised edition of an earlier book bearing the same title. It is written in question and answer form and completely covers all the subjects upon which answers will be required in the government examinations for commercial radiotelegraph and radiotelephone licenses. One section is devoted to the radiotelegraph classes of licenses, another to the radiotelephone classes first and second, another to the third class radiotelephone, one to radio communications abbreviations and the last to the legends of the radiotelegraph and radiotelephone transmitters shown in the earlier sections.

The requirements for each class of license are completely covered under the individual head devoted to that class. The book should prove of great assistance to persons interested in obtaining a commercial license and to those interested in improving the class of license which they now hold.

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"When You Can Measure," a 32-page brochure recently published by the General Electric Company, tells in brief the contributions of G.E. engineers to the art of measurement. This very attractive, beautifully-printed publication describes in pictures and in words the story of how instruments are designed, constructed and tested in the G.E. "House of Magic."

Since measurement, in its final form, depends upon comparison with some carefully chosen standard, a section of the booklet is given over to a description of the company's standards of voltage, resistance, time and temperature.

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National Radio Institute has prepared, after the suggestion of the Philco Radio and Television Corporation, a special course in radio theory and practice for servicemen. Since many amateurs are also radio servicemen, this announcement may be of interest to them.

A booklet has been prepared, "How to Make and Keep Radio Servicing Profitable," which outlines the course. Copies have been mailed by Philco to all members of the Radio Manufacturer's Service. Servicemen-amateurs who are not listed in the files of the R.M.S. may obtain a copy of the booklet by writing to National Radio Institute, 16th and U Streets N.W., Washington, D.C.

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Catalog 71, the Spring, 1938, catalog of the Wholesale Radio Service Co. has just been released. The brochure should prove of great value to the out-of-town ham as the products of a very large number of manufacturers are listed in some detail. There is a section devoted to broadcast receivers, both home and auto sets; one to transmitting equipment, another to b.c.l. replacement parts, and quite a large section devoted to public address amplifying equipment.

(See page 79 for additional information on new books.)

What's Happening to "Ten"?

[*Continued from Page 29*]

Feb. 16	230	13,500	41,600
Feb. 23	240	13,200	39,000
Mar. 2	240	13,400	40,200
Mar. 9	215	13,000	38,000
Mar. 16	220	13,300	38,300
Mar. 23*	530	6,700	17,000
Mar. 30	275	12,500	37,000
Apr. 6	280	12,000	33,000
Apr. 13	300	12,700	34,900
Apr. 20	390	9,800	23,700
Apr. 27	340	8,900	24,000

*Ionosphere storm in progress.

The above table indicates rather well how the F_2 layer becomes useless for 28-Mc. transmission in an east-west direction. For the last four or five years, a very few transatlantic signals have been heard or worked in the summer, but South Americans in the afternoon and, beginning in July or August, Australians have been worked with reasonably stable signals at both ends. These signals follow paths that change rapidly in latitude, and may encounter a favorable F layer before crossing the equator. Being winter in the southern hemisphere, conditions there are likely to be favorable. Of course, if the first hop at our end of the path is via a sporadic E layer reflection, there is greater chance of the signal getting far enough south before it is necessary to have an F layer reflection.

Here in the U.S., the summer brings periods of rather good signal strengths over distances

[*Continued on Page 87*]

 (Continued from Page 6)

must have a license to transmit before some unkind person catches up with him.

4. After investing his weekly allowance of two bits (lucky Aubrey) in a book of questions and answers on how to pass the license exams, little Aubrey make five or six trips to the RI's office, makes 100% on the questions but flops code test. He can't miss the questions; he has them all memorized just like his lessons in school. He has no idea why a tube oscillates, but the "answer" is in the book.

5. Then one day our little Aubrey learns of a radio club that gives code practice and lo and behold, our own little Aubrey takes advantage of this great opportunity. For 25c a week he not only gets free code instruction but a doughnut and a cup of coffee—he really is too young to drink.

After about six months of intense drilling he now can, or hopes he can, receive 13 w.p.m. The great day arrives. He knows he can answer all questions as per license manual, and sure enough he manages somehow to copy 13 per. Now our little Aubrey possesses an amateur radio license which entitles him to all the privileges of an honest-to-goodness ham.

6. And now our little Aubrey is on five meters again, calling CQ and signing his very own call from the United States Government, with all the rights and privileges of a ham that knows at least something of what he is doing.

7. But as time passes our Aubrey grows tired of the unintelligible yelping and screeching of five meters; he takes a shot at 40 and 20 because he hears a lot about dx on these bands.

Lest we forget, little Aubrey spent all his time on the air developing his vocal cords and was barely able on the day of his exam to pass the code test of 13 w.p.m. So here we have one more lid on 20 and 40 because he hears there's gold in them thar hills. Ah, me.

Now for a change of scenery:

Old Timer or honest-to-goodness amateur rises up in the wee small hours or stays up till the crack of dawn to try and snare that elusive "J" or whatever he needs for w.a.c. or zone 19 and lo and behold our little Aubrey is right there with his self-excited 45 in an f.b. QSO with his friend (in the same code class with him) four blocks away. Key clicks and hash from little Aubrey and his friend clutter up the whole 20 or 40 band and Old Timer once more reaches for the now almost defunct bottle of Old Crow which has helped out before in cases of this kind.

Old Timer, realizing he is licked, prepares to lay his weary and numbed head down to rest when the sun is well up, only to be informed by the x.y.l. that he can't stay up all night and work that dx fellow and expect to sleep all day in this house as there is work to be done. Ah, me! Amen.

Now back to little Aubrey of the humid ears, whose fist no one could make out even if his nose was clean. He has had a f.b. rag chew (so he says) with his friend four blocks away which lasted all night and part of the morning with a total investment of about $10.00 for xmtr. and recvr. (papa pays the electric bill), while Old Timer sits back with T200's in the final, RME69 and all the fixin's waiting for little Aubrey and his friend to QRT so's he can hear something besides key clicks and hash.

Ah, me—this is great stuff. The last of the Old Crow, I mean.

I firmly believe that constructive criticism is always of great value. There's the criticism; now who will do the construction work? The W.P.A.?? We now pause for station identification.

C. CHESTER STEPHEN, JR., W3CM.

P. S. Junior says little Aubrey came over to play with him and wants to know if I worked any dx last night. Will the orchestra please play "Hold That Tiger"?

Separate Phone CW Exams

Dartmouth, N. S., Canada.

Sirs:

I have just read with great interest Mr. Poland's letter in "Open Forum" of January, 1938. With memories of Wellar and Link in my mind, I hasten to reply. To commence, I most heartily agree with these gentlemen on the subject of the stiff technical exam for phone men. This would, very obviously, train the phone men in their own field.

I have my amateur operator's license but no call or station license to date. You probably know that here in Canada these two licenses may be obtained separately. I had no object in obtaining a station license because I was, or am, unprepared, from a financial standpoint, to put a high-class *phone* rig on the air, and I have no intention of operating either a c.w. rig or any of these hogging, splashing T1 phone signals that one hears on the air.

It is my firm belief that licenses should be divided into the two classes—phone and c.w. For the phone men, a strictly technical exam with a license to use phone *only*. For the c.w. men, a good c.w. and operating practice exam with a moderate technical exam. These c.w. men would operate on c.w. only. For the group which operates phone and c.w., both licenses would have to be procured. That is my opinion. Any objections? As friend Poland states, what on earth is the use of learning something to forget immediately after the exam? I have been spending the last few months steadily forgetting all the code I ever knew—which was just enough to pass the federal examination.

Like my predecessors Wellar and Poland, my technical knowledge traces back several years, and it is only in very recent times that I learned enough of the infernal dit-dahs to take the test.

I disagree with Mr. Poland on one point, however. He states that the technical end of the exam should be the same for phone or c.w. There a correction is necessary. No modulation or speech knowledge should enter the thoughts of the c.w. men, but it most certainly should for the phone men. The same thing applies to things like key click filters, etc.

Another disagreement with friend Poland: item three of his "rules and regulations"—directional arrays. Very nice. Mr. Poland should live on the north side of a house on the north side of a hill nearer the north pole, and without enough money to construct one of these motor-driven arrays. Up here we can't put nice pulleys with boat wheels on or though the walls. Although I've never tried it, I can imagine a CQ beamed at Little Falls, in some tiny isolated part of a nice, sandy desert, or anything just as deserted. It just wouldn't work out!

On the whole, I think that apart from our little exam problem, the bands are quite OK. The QRM adds to the excitement of a QSO.

A. M. Croft

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South Gate, Calif.

Sirs:

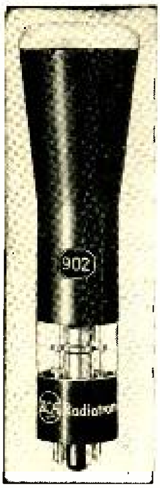
In January, 1938, Radio there is a very interesting article by Mr. H. O. Poland of Wilkinsburg, Pa., re code as a necessary part of amateur examinations and a license to put a transmitter on the air.

It is just too bad that the federal government requires that an applicant be able to send and receive code at 13 w.p.m. Perhaps if Mr. Poland understood why the government has been so lenient with amateurs, so free both in the frequencies they can work on and the power they are allowed to use, he might not object to our country's demanding that every applicant be able to send and receive the international Morse code at 13 w.p.m.

Up to 1910 there were no federal laws controlling radio communications; not until 1912 did congress pass a law covering amateur work. At that time radio telegraph was the only form used, and not until 1927 did congress enact the law which was the basis of present legislation.

During that time (1912 to 1927), we had been a party to the World War, and our government recognized the great help the amateurs had been in supplying our forces with a reservoir of radio operators. By 1925, although de-

[*Continued on Page 88*]



NEW TUBES
on the Market

1851 TELEVISION AMPLIFIER PENTODE

An interesting looking new tube has just been released by RCA for use in television amplification equipment. Those amateurs who are interested in television research will undoubtedly be quite interested, but the unusual characteristics of the tube make it sufficiently different to be of interest to all amateurs interested in u.h.f. work.

The tube is especially designed for use as a u.h.f. amplifier in stages which must pass wide bands of frequencies. It is also well suited for use as a video amplifier and as an impedance transformer. Its application in all these services is discussed, along with suitable circuits, in the pamphlet that accompanies the tube.

The tentative characteristics and ratings are as follows:

Heater voltage	6.3 volts
Heater current	0.45 amperes
Direct interelectrode capacitances:	
Grid-to-plate	0.02 $\mu\mu$fd.
Input	11.5 $\mu\mu$fd.
Output	5.2 $\mu\mu$fd.

Envelope—Slightly larger than the 6J7 with a lead through the top.

Base—Standard small octal.

Maximum Ratings and Typical Operating Conditions

Plate voltage (max.)	300 volts
Screen voltage (max.)	150 volts
Screen supply voltage (max.)	300 volts

Typical Operation

	*Condition I**	*Condition II***
Plate voltage	300	300 volts
Suppressor voltage	0	0 volts
Screen-supply voltage	150	300 volts
Screen series resistor		60,000 ohms
Cathode-bias resistor (min.)	160	160 ohms
Amplification factor (approx.)	6750	6750
Plate resistance (approx.)	0.75	0.75 megohm
Plate current	10	10 ma.
Screen current	2.5	2.5 ma.

**Condition I* with fixed screen supply gives sharp cut-off characteristic.

***Condition II* with series screen resistor gives an extended cut-off characteristic for applications where gain is controlled by grid bias.

As can immediately be seen by scanning the characteristics given above, the 1851 is ideally suited for use as the first amplifier stage in high-frequency pre-selectors, converters and superheterodynes. The extremely high transconductance coupled with the almost unheard-of μ of 6750, and both these found in an adequately-shielded h.f. pentode—it will be difficult to restrain the receiving-equipment designers as well as the television-equipment engineers from whipping out the slip-stick and leaping to the drafting table. The only probable fly-in-the-ointment will be the price—this has not, as yet, been made generally known. We can only hope for the best on this count.

RCA has also announced that they now are manufacturing the 6S7. There is nothing particularly exciting about this one, it is practically identical to the 6K7 except for its filament drain. The 6S7 draws 0.15 ampere at 6.3 volts, the 6K7 draws 0.3 amperes at the same heater voltage.

THE RCA-902

In line with popular demand, RCA is now manufacturing an inexpensive 2" cathode-ray tube for use where the now-common 1" 913 would be too small or incapable of giving enough detail. The tube is practically interchangeable with the smaller tube as far as basing and voltage requirements are concerned. However, the new tube is considerably longer

(7 7/16" overall) and is capable of taking somewhat more anode voltage where the occasion demands.

Due to the greater distance between the electron gun and the fluorescent screen, the 902 is considerably more sensitive than the 913 at the same anode voltage, and still somewhat more sensitive than the smaller tube when the full rated voltage of 600 volts is applied to the anodes.

The screen is coated with "phosphor no. 1" as the fluorescent material, thus giving a medium-persistence image of a greenish hue. The beam is deflected electrostatically in both planes by two pairs of deflecting plates the same as the 913 and the 906 of common usage.

While the anode ratings of the 913 are 250 to 500 volts, those of the 902 are 400 to 600 volts. If a 913 is to be replaced by one of the larger 902's, it is important that the anode voltage be 400 or more. The heater requirements are the same for both tubes: 6.3 volts at 0.6 amperes.

The RCA-902 is most excellently suited for use in the larger of the two oscilloscopes described by Jay Boyd in the April RADIO ("Let's See—Two excellent 'scopes that are easy to build," p. 52).

●

Book Reviews

P. R. Mallory & Co. has just released the second edition of its large radio service encyclopedia. Because of the favorable reception accorded the first edition, the second edition has been made more than 50 per cent bigger, containing 335 large pages of fine-print text and tables.

While designed primarily to help service men—and the first 157 pages would be of little interest to anyone else—the last half of the book contains valuable miscellaneous information which in itself should be well worth to amateurs and experimenters the price of $3.00. Amateurs attempting to repair their own factory-built communications receivers will find the book of great assistance.

●

The Bliley Electric Co. has published an interesting and informative booklet devoted to the theory and practical operation of all types of quartz crystals: filter type, frequency standard, and frequency control. Operating data, including all recommended circuits as well as suggestions for physical arrangement, will be found in its 32 pages. The booklet is not just a catalog, contains much valuable information of use to amateurs. A nominal price of 10c has been placed on the booklet to cover cost of publishing.

The Flat-Top Beam

[*Continued from Page 18*]

top beams. Whitmer's method[6] was used. This method enables one to measure, by means of the matching stub dimensions, the resistance at the current node in the vicinity of the point where the feeders connect to the antenna. By considering the stub to be a Q-bar system, the bottom-of-the-stub resistance at the short location with the short removed is then obtained. The stubs used were all of the "600-ohm" type.

In contrast to the low impedance at the current loop points in flat-top beam antennas, the impedance at the current nodes is extremely high. This makes the insulation at these points very important. This is particularly the case with flat-tops of few sections and small spacing, such as the single-section type with eighth-wave spacing. Wider spacing up to about 0.6 wavelength reduces the impedance at the current nodes and increases it at the current loops.

Feed Systems and Adjustment

The flat-top beams may be fed in a number of ways. Three practical methods will be outlined. One method is to use zepp feed. Good insulation and at least 6-inch spacing should be used on a zepp feed line connected to a flat-top beam. With series tuning at the transmitter, the feeders are made an odd multiple of one-quarter wavelength long, approximately. This applies to all of the flat-tops except the single-section center-fed type which requires zepp feeders an integral multiple of one-half wavelength long, approximately. All tuning of the antenna system is done at the transmitter. Generally, it is not advisable to use a zepp line which is more than a wavelength or two long with these antennas.

Another very practical system makes use of a shorted stub and matched-impedance transmission line. The antenna is shock-excited and the shorting wire is adjusted up or down the stub until maximum current through it is obtained. During this process, a sensitive r.f. meter or flash-light bulb can be used in series with the short as a current indicator. In RADIO for April[7], Smith described an effective method for exciting the antenna during this process by terminating the transmission line in a loop of several turns and coupling this loop to the shorting bar.

The stubs should be approximately a quarter-wave long or an odd multiple of this length for all of the flat-tops except the single-section center-fed type. This type requires a stub which is approximately one-half or one wavelength long. After the short has been located, the transmission line is connected above the short and adjusted up or down until the standing waves on the transmission line are a minimum. In case the standing waves cannot be reduced to a low enough value by this procedure, a small readjustment of the shorting wire position is sometimes helpful. Approximate lengths of stubs and distances for connection of a 600-ohm line above the short for 2-section flat-tops are listed in the table. With fewer sections the distance of the line above the short is smaller, and for more sections, greater. These stub dimensions are only approximate and are

[6] "Impedance Measurements With a Matching Stub", Robert M. Whitmer, RADIO, November, 1937, p. 51.

[7] "The Bi-Square Directable Array", W. W. Smith, RADIO, April, 1938, p. 38.

intended to serve merely as a guide in making the first settings in the tuning-up process.

A third method of feeding flat-top beams is to use an unshorted matching stub and some type of matched impedance transmission line. First, the stub is tuned by adjusting the short as described above. This resonates the antenna system. The short is then removed and the transmission line connected at the same point. It is important that the stubs used be of the "600-ohm" type (number 12 wire spaced 6 inches). The so-called "low-impedance" cables of 60 to 75 ohms characteristic impedance will then give a fairly good match when connected to the bottom of the stub of the following types of flat-tops: 2-section type with 0.20 or 0.25 wave spacing, 3- and 4-section types with 0.15 wave spacing, and the 4-section type with 0.125 wave spacing. Other types of flat-tops can also be fed with low-impedance cable in the same way, but undesirable standing waves are apt to be present on the cable. However, Seeley[8] has pointed out that a twisted-pair line, one wavelength long, when mismatched as much as 2 or 3 to 1, may still have a fair efficiency on 14 Mc. Data on attenuation of various types of "low-impedance" line were given in *Electronics*[9] for April.

In order to feed flat-tops not mentioned in the above list with low-impedance cable and obtain a fairly good match, another method can be employed. This requires an additional Q-section, the stub being considered as one of these sections. Suppose we wish to feed a 2-section flat-top having eighth-wave spacing with 70-ohm cable. The bottom-of-the-stub impedance for this antenna is about 20 ohms. Therefore, a Q-section between the stub and cable is required having a characteristic impedance which is the geometric mean of 20 and 70 ohms. This is about 37 ohms. Such a Q-section might be built with two 70-ohm lines in parallel. This same arrangement can be used with a 2-section flat-top having 0.15-wave spacing. In connecting the cables in parallel it is, of course, important that the same wires are joined at each end of the Q-section. That is, if the "tracer" wires of each cable are connected together at one end of the matching section, the two "tracer" wires should likewise be connected together at the other end. Due to the lower speed of propagation over such cable, the length of the "Q" should be considerably shorter than a free space quarter-wavelength. As much as 40 per cent shortening is necessary in some cases, as shown by Hawkins.[10]

Such double-Q arrangements have been used

[8] "Match and Mismatch", S. W. Seeley, *QST*, November, 1937, p. 80.

[9] "Measurement of H-F Lines", Ballantine Laboratories, *Electronics*, April, 1938, p. 27, fig. 2.

[10] "How Long Is a Quarter Wavelength?" J. N. A. Hawkins, *QST*, Nov., 1937, p. 32.

to feed a couple of flat-top beams at W8JK. In one case the antenna was a 14-Mc. 3-section end-fed flat-top with eighth-wavelength spacing. The shorting wire on the quarter-wave stub was removed and a piece of common parallel molded-rubber lamp cord about 12 feet long inserted. This cord acted as a Q-section, the other end being connected to a 600-ohm line. The bottom-of-the-stub impedance of this antenna is roughly 30 ohms and the characteristic impedance of the lamp cord approximately 120 ohms.

In another case a 14-Mc. single-section center-fed flat-top of one-eighth wave spacing was fed in a similar fashion. However, the Q-section between the bottom of the stub and the 600-ohm line consisted, in this case, of about 10 feet 6 inches of 72-ohm twisted-pair cable.

Although these double-Q arrangements may be convenient in some installations, the efficiency of the low-impedance rubber-insulated Q-sections is probably not very high.

If a transmission line matched to a flat-top beam stub by a low-impedance Q-section as described above is found to have bad standing waves, improvement may sometimes be obtained by changing the position at which the "Q" connects to the stub a few inches one way or the other.

In tuning up a flat-top beam it is often of assistance to have a current indicator, such as a flash-light bulb, at a current maximum point in one of the flat-top wires. In this way it is possible to judge the relative amounts of power actually reaching the antenna with different tuning adjustments. Due to the large currents in a flat-top beam, the bulb needs to be shunted across only a relatively small length of antenna. For a constant power input, the currents increase as the spacing is decreased, but the gain varies as shown in figure 1. It is, of course, very important in all cases that the antenna and feeder systems be well insulated from the transmitter high voltage.

Improperly adjusted beam antennas can give peculiar results. Capacity coupling at the transmitter may cause the flat-top and feeders to radiate together as a Marconi against ground. A discussion of some causes and cures for such effects was given by Conklin in RADIO for January.[11]

Which Type?

The eight types of flat-top beams shown in figure 2 can all be used with either 0.125 or 0.15 wavelength spacing. The 1- and 2-section types can be used also with 0.20 or 0.25 wave spacing.

The number of sections used is a matter of choice. On the one hand, this number may be determined by the space available, or, on the other hand, by the gain or coverage desired. The overall length of a 14-Mc. 2-section center-fed flat-top is about 62 feet and a 4-section about 112 feet. The overall lengths of the corresponding end-fed types are a few feet less.

Both the center and end-fed flat-tops may be used horizontally. The center-fed horizontal flat-top is generally preferred because of its symmetry. However, if end-feed is used with a horizontal flat-top, it is possible to apply the directivity switching system described in RADIO for January, 1938.[12] The flat-top beams can also be turned on end and operated vertically. For vertical operation, the end-fed types may be more convenient, feeding from the lower end.

[11] "Why Some Beams Don't Work", E. H. Conklin, RADIO, Jan., 1938, p. 121.

[12] "Optional End-Fire Directivity With the Flat Top Beam", R. R. Sprole and J. D. Kraus, RADIO, Jan., 1938, p. 85.

There is little to choose with respect to gain between the flat-tops with 0.125 and 0.15 wave spacing. The smaller spacing can be used where wider spreaders would be inconvenient. Also, in the longer flat-tops of 3 or 4 sections, the 0.125-wave spacing makes for a less bulky array. For arrays which have been erected using eighth-wave spacing and which work satisfactorily, there would be no point in increasing the spacing. The chief advantage of 0.15-wave spacing is that there is somewhat more impedance at the bottom of the stub. If the 0.15-wave spacing is convenient, it is preferable for this reason.

The 0.20- and 0.25-wavelength spacings can be used to good advantage with 1- and 2-section flat-tops. These spacings are particularly recommended for the single-section type, where convenient. At a very slight sacrifice in gain, these spacings provide a much higher impedance at the bottom of the stub. More sections give this higher stub impedance without employing these wider spacings, so that there is no advantage in using more than 0.15-wave spacing on 3- or 4-section flat-tops. Hence, dimensions suitable for these combinations are omitted from the table.

Zepp feed or feed with a 600-ohm matched-impedance transmission line and shorted stub can be used on all of the flat-top beams. Or a 600-ohm line can be used to feed an unshorted stub by means of an extra Q-section as has been described. Low-impedance cable (approximately 70 ohms) can be connected directly to the bottom of the stub (at the point where the shorting bar was connected to resonate the array) of a number of flat-tops. These were listed earlier in the article under the section on "Feed Systems." Other types may be fed with low-impedance cable by using additional Q-sections of the proper impedance.

Harmonic Operation

The foregoing remarks apply to flat-top beams operated on their fundamental frequency. All of the antennas described can also be used on their harmonic frequencies. On the second harmonic the spacing will be twice as great, measured in wavelengths. Thus, in general, the impedance at the bottom of the stub will be considerably greater than on the fundamental. The stub, of course, must be readjusted in length for the harmonic frequency. One can often use a flat-top beam to advantage on a number of bands. An ingenious method of switching matching stubs for multi-band operation was described by Willoughby in RADIO for February.[13]

All of the antennas have a bidirectional horizontal pattern broadside to the antenna on their fundamental frequency. The single-section cen-

[13] "Matching Stubs With Remote Switching", B. K. Willoughby, RADIO, Feb., 1938, p. 23.

ter-fed type has this pattern on both its fundamental frequency and second harmonic. The other types have 4 main lobes of radiation on the second and higher harmonics.

Construction

Figure 3 shows the type of construction suggested for the center and end-fed flat-top beams. In the center-fed type the feeders come up from below and connect on at the center spreader. The cross-overs between extra sections use one vertical feeder-spreader insulator fastened vertically at the middle of the long wooden or bamboo spreader. The use of good insulators, especially at voltage maximum points, is particularly recommended. Also it is advisable to use the fewest number of paralleled insulators in the cross-over consistent with good construction. Between sections only one insulator is necessary and at the center cross-over of a center-fed flat-top only two are required.

Wood strips 1 x 1 inch square make satisfactory spreaders. Slightly heavier pieces may be required for spacings of more than 12 feet.

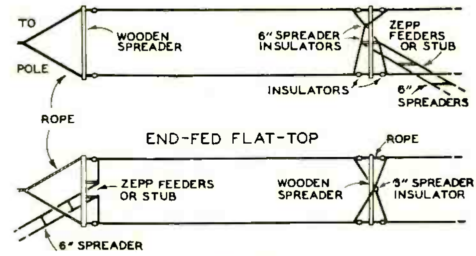


FIGURE 3

Suggested constructions for center and end-fed flat-top beams. The antennas are shown in top view.

Bamboo poles also make good, light spreaders. The use of rope supports at each end is recommended. By making the rope yoke long, the strain on the spreaders at each end is reduced and a lighter type of spreader may be used.

Height and Coverage

The vertical angle of radiation from a flat-top beam is largely dependent on the height above ground.[14] The greater the height, the lower the angle of the lowest lobe. For dx communication on 14 Mc. a height of three-quarters to one wavelength seems worth while. However, for short-skip contacts on 14 Mc. somewhat less height is often desirable.

The 2-section type of flat-top beam has a substantial gain on its fundamental frequency over an angle of about 60 degrees in each direction broadside to the antenna. Thus, stations in directions well off the center line of the beam can be worked readily. The coverage of the single-section type is a bit more than the 2-section, whereas the 3- and 4-section types have somewhat less coverage but higher gain. The horizontal radiation patterns for both 1- and 2-section flat-top beams have been given previously.[15] If the flat-top is working properly and the feed line not radiating appreciably, the signal off the ends of the antennas will be extremely small.

Acknowledgment

The writer is much indebted to Robert M. Whitmer, of the Department of Physics at Pur-

[14] "The Effect of Average Ground on Antenna Radiation", E. H. Conklin, RADIO, March, 1938, p. 36.

[15] "Rotary Flat-Top Beam Antennas", J. D. Kraus, RADIO, December, 1937, p. 16. Also see references 2 and 3.

due University, for his interest and suggestions.

Appendix

Brown's equation (50), which applies to the case of two similar parallel antennas with equal currents, is of the form,

$$\text{Gain} = \frac{\sqrt{2}\cos\left(\frac{\alpha}{2} - \pi d \cos\phi\right)}{\sqrt{1 + \frac{R_m}{R_{oo}}\cos\alpha}}$$

Where,

α = phase angle of the currents in the two antennas.

d = spacing of the antennas in wavelengths.

ϕ = angle in plane at right angles to the antennas, in which direction the gain is measured. This angle is zero in the plane containing the antennas.

R_m = mutual resistance of the antennas.

R_{oo} = self resistance of each antenna.

The computation of the data for figure 1 applies specifically to the broadside gain of a flat-top beam where $\alpha = 180°$, $\phi = 0°$, and d is the variable. The gain is the ratio of the field strength of the two parallel antennas to the field strength of one of the antennas when fed with the same power as the pair.

F.C.C. and Emergency Communication

[*Continued from Page 23*]

life and property. It is the desire of the Commission to cooperate in every way possible in making maximum use of radio facilities for assistance in the stricken area. The Commission will give immediate attention to all requests for emergency operation under the provisions of Rule 23."

Calls Heard

[*Continued from Page 73*]

8JI; 8JQ; 8KI; 8MG; BPU; 8QD; 8UE;8XN; 8XT; 8ZC. FA3QV; FA3HC. **G**—2AI; 2AK; 2DV; 2HK; 2MF; 2PU; 2QT; 3FA; 5BJ; 5BM; 5DT; 5KI; 5KH; 5LU; 5ML; 5NI; 5QI; 5QN; 5YV; 5ZG; 6AG; 6BW; 6BX; 6BY; 6DL; 6JF; 6KL; 6LL; 6LK; 6ML; 6VX; 6WV; 6WX; 6XR; 8BX; 8FX; 8GX; 8IK; 8KZ; 8MA; 8MF; 8QH; 8WF; GI2CC; GM2UU; GM6WD; GM8MN; GM2DI; HC1ET; HC1JB; HC1SE; HB9BL; HK1DG; HK3LDC; HR5C; K4DDH; K4EJF; K4ENY; F4FAY; K4SA; K6NZQ; K6OQE; LA1F; LU1QA; LU5CZ; LU7AG; LU7BK; LU9BV; OA4AL; ON4PA; ON4SS; OQ5AA; OX2QY; PY2AP; PY3BP; PA0EO; PA0FB; PA0MZ; PA0UN; SM7YA; SU1CH; SV1KE; VO1I; VO1X; VO2Z; VO6D. **VP**—2AT; 2AB; 2DA; 3BG; 3THE; 4GA; 4TH; 6MR; 6TR; 6YB; 9G; GL; GR; YN1OP. **YV**—1AG; 1AP; 1AQ; 4AA; 4AB; 4ABG; 5AA; 5AD; 5AK; 5AN; 5AZ; 5ABF; 5ABG; 5ABY. ZS2X; ZS2F; ZS5M; ZS6DW.

(14 Mc. c.w.)

CN8AJ; CT3AN; CX1CC; F8AM; F8PR; F8RC; G2MA; G5KA; G5KT; G6FB; G8AI; G8DT; G8NH; GM6RV; K4BU; K4DTH; K4EZR; K4RJ; K5AA; K5AC; K5AG; K5AY; K6BNR; LU3EV; OM4DZ; ON4IF; ON4NW; ON4UU; OZ7UU; PY1DC; PY2ET; SM7UC; VO1M; VO4Y; VO6J; VP2CD; YV5AA.

•

Dr. Tng. Mario Lantangeli, I1ER, Milano, Italy (January-March)

(14 Mc.)

W—1ADM; 1AFB; 1AOP; 1BVL; 1CGQ; 1CHL; 1CVA; 1DIA; 1DIL; 1EJT; 1FTR; 1GVV; 1IGZ; 1IYJ; 1KIV; 1JAF; 1LZ; 1ME; 1SZ; 2AGW; 2AHC; 2AXZ; 2BNX; 2BO; 2BYB; 2CJM; 2CO; 2CYI; 2CYN; 2CYS; 2DKF; 2FKE; 2FSN; 2GIV; 2HFP; 2HUQ; 2IKV; 2IUD; 2KEH; 2KEZ; 2KJY; 2JXH; 2SJD; 2ZA; 3AM (PHONE) 3APJ; 3BIW; 3CBV; 3CDQ; 3CHE; 3CVA; 3DDM; 3DIU; 3ELV; 3EMM; 3ETA; 3EXF;3FAX; 3FMA; 3FQP;

3FRE; 3FRY; 3FXV; 3FYK; 3GAG; 3GFN; 3GGT; 3GKZ; 3GTL; 3GUF; 3GZH; 3GZV; 3HIL; 3KGN; 3PC; 3WU; 3ZX; 4AH; 4BMH; 4BMR; 4BYU; 4BYY; 4CBY; 4CDG; 4CDY; 4DY; 4EIY; 4HK; 4|UF; 4QZ; 4TP; 4YC; 5BRR; 5DNV; 5FRL; 5VC; 6BYB; 6DIO; 6DVI; 6KRI; 6JBO; 6MHH; 6MR; 6NIK; 6ONQ; 6OS; 6TIL; 7DSZ; 76ZL; 7FFA; 7FUL; 8AAU; 8APD; 8AQT; 8DZC; 8ERA; 8FHO; 8FYM; 8GFD; 8GUF; 8HRD; 8ICL; 8LED; 8LIR; 8LYQ; 8MJF; 8NJP; 8OIV; 8OKC; 8OSL; 8PCU; 8PQK; 8PTD; 8PUD; 8PZZ; 8QUL; 8RNQ; 9ABN; 9BMM; 9CUH; 9DCE; 9EOC; 9ETP; 9FJB; 9HDO; 9HKZ; 9ICO; 9KCZ; 9KG; 9KGU; 9NHW; 9NST; 9OG; 9OVU; 9PTW; 9PXZ; 9SH*; 9TH; 9TKK; 9UIT; 9UM; PUS; 96DD; 9YWQ; 9ZKV. CE5AU; FB8AB; HC1JW; HP1A; K5AN; LU3DH; LU7AD; LU7AZ; LU9BV; PY1AZ; PY1EB; PY2RK; VE3YH;VK2ADE; VK2NY; VK4RY; VP2LA. **ZL**—1BE; 1BR; 1BT; 1CK; 1CV; 1DI; 1LFT; 1GX; 1HQ; 1HY; 1IY; 1KE; 1KR; 1JI; 1LJ; 1LM; 1LW; 1MQ; 1MR; 1PQ; 2AZ; 2BI; 2CW; 2EW; 2FA; 2IW; 2LA; 2LB; 2NM; 2SM; 3GR; 3KG; 3KM; 3KR; 3ZX; 4AC; 4AP; 4DQ; 4FK; 4FW. ZS5AZ; ZS5DY.

(28 Mc.)

W—1ANA; 1AS; 1AVK; 1BGT; 1BJB; 1DBE; 1DF; 1DZE; -EKT; 1ELR; 1ETD; 1GBO; 1HOU; 1HXU; 1IBZ; 1IZY; 1KH; 1KPP; 1JPB; 1TW; 1ZB; 2ANT; 2AOG; 2BQK; 2BXU; 2CBO; 2CKO; 2CKY; 2COM; 2DNG; 2DTB; 2GMM; 2GQK; 2GUM; 2HGU; 2JME; 2JOA; 2TP; 2VH; 3ATR; 3AYS; 3BES; 3BZJ; 3EPV; 3EXB; 3FG; 3FGL; 3FGW; 3GIH; 3GTL; 3KGN; 3KT; 3PC; 4AH; 4BBP; 4CDE; 4CDX; 4DRZ; 4ECI; 4FEH; 4IO; 4MR; 5ENE; 6CXW; 8BAP; 8BKP; 8BTI; 8BWB; 8BYE; 8CVB; 8DYE; 8EBR; 8GHW; 8KYY; 8JIN; 8JLK; 8LAC; 8LIR; 8LYQ; 8MSK; 8MG; BNK; 8NJP; 8NLB; 8OE; 8OKC; 8OQF;8QDU; 8QQE; 9ARL; 9CCI; 9DQU; 9FS; 9GRE; 9FG; 9LBD; 9PS; 9RRT; 9SWQ; 9TH; 9UNIT; 9VDY; 9VTZ: CT1JU; LU3DH; LU3DH; SUTW; VE1AU; VE1DG; ZS1AH; ZS6U.

56 Megacycles

[*Continued from Page 67*]

identification of the call, he signed, "In the middle of Texas." Time, 8:43 p.m.

While this is obviously a 28 Mc. harmonic, it gives evidence of another good summer of 56 Mc. dx awaiting those who are ready for it. Read about the work last summer, reviewed in the July and October, 1937, issues of RADIO.

A Useful Phenomenon?

For the past year, British experimenters on 28 and 56 Mc., as well as a few in this country, have mentioned the "hiss level" sometimes heard to be unusually loud. The British have mentioned this as a sign of intense solar activity which may cause unsettled conditions. It was heard by G6DH on March 21 after the 28-Mc. band had been very active, after which the band suffered until the 27th when dx signals again rose in volume.

In past years, 28-Mc. transatlantic communication has practically ceased during the summer months, to be replaced with short-skip communication in the U.S. This summer, G2XC plans to keep regular schedules with G8MH every Monday at 21:30 to 21:45 G.m.t., and with W9WSY every Saturday and Sunday at 20:00 and 22:00 G.m.t.

We Want Reports!

We can't hope to acknowledge every letter on 56-Mc. subjects, but we think that real dx on "five" is important enough to receive publicity so that we can find out all we can during the current part of the sunspot cycle, and not forget all about it as was mostly done on 28 Mc. about ten years ago after international dx had been worked. We promise to do our best to bring you the news, but we shall need reports from all of you! Last year we wrote hundreds of letters trying to dig out the dope, and did publish some four hundred cases of 56-Mc. dx reception or QSO's at distances beyond 500 miles. If you learn that someone else has done some good work on "five," let us know so we can chase it down. Send us a picture now and then if it is newsworthy and suitable for reproduction, and don't fail to let us know of any apparatus developments or unusually successful construction.

W5EHM Gets Into W8 on 56 Mc.

On May 9, W8RMX of Glassport, Pa., a suburb of Pittsburgh, reported hearing W5EHM on five meters calling CQ FIVE DX. This was at 4:26 p.m. Eastern daylight time. W5EHM faded out before finishing the call. At first, he was QSA5 R8.

W8NSY of Pittsburgh also heard W5EHM at the same time.

FLASH

TELEGRAM:

MIAMI, FLORIDA, MAY 15, 1938

E. H. CONKLIN
ASSOCIATE EDITOR OF "RADIO"
51/2 N. MAIN STREET
WHEATON, ILLINOIS

FIRST SCHEDULED TEST TODAY WITH NEW YORK ON FIVE METERS BETWEEN ONE AND TWO P.M. E.S.T. WAS VERY SUCCESSFUL. BAND WAS OPEN FOR TWO HOURS WITH EXTREMELY LOUD SIGNALS COMING IN. FOLLOWING STATIONS WORKED WITH MOST OF THEM R8 TO 9 SIGNALS: W1EYM, W2JCY, W2CUV CALL W2BHD W2HWX W8CIR W8YUT. FOLLOWING CALLS HEARD RUNNING FROM R6 TO 9 IN REPORTS: W1EYM W1IXT W2CUV W2JCY W2AMJ W2HWX W2GZC W2ISY W3CMA W3HKN W3GMV W3GGC W3FOM W3GOK W3EZM W8CIR W8NED. THE ABOVE CALLS WERE ALL ON PHONE ONLY ONE BEING ON CW. CW STATIONS ON BAND. QRM WAS TERRIFIC. WE WERE UNABLE TO LOG ALL STATIONS. WILL WRITE DETAILED REPORT TOMORROW OR TUESDAY. BEST REGARDS.

H. H. ROBINSON, W4EDD

What's Happening to "Ten"?

[Continued from Page 74]

of 500 to 1200 miles or so, because of sporadic E and scattered G layer reflections. By that time, however, many of the "fair weather" friends of the ten-meter band usually have deserted it, while those who can hop down there easily for a few QSO's when the band is open, have the pleasure of working on nearly a "cleared channel" basis.

Open Forum

[Continued from Page 77]

velopments had been made in radiotelephony, it was radio c.w. operators that the government would need if we ever entered another conflict; hence, it was made imperative that each applicant learn the code, and in this manner we would be assured of men who knew how to telegraph should the necessity ever arise for radio operators in another war.

To further this, the army and the navy today cooperate with amateurs, getting them acquainted with their procedure, and believe it or not, Mr. Poland, their activities center on dots and dashes, not on whistles and phonograph records. So I must say again, it's too bad that you and I *must* know the code before we can get a license.

Enough of that. I see that he advocates an annual fee be charged for transmitters. Fine—I have often thought that would be the thing to do. But I go further than either Mr. Poland or Mr. Link. I suggest that a basic fee of about 50c for the first 50 watts of c.w. be charged, then add $1.00 per year for each 50 watts of power above 50.

Now suppose each c.w. station occupies 250 cycles in the spectrum. Then for each 1000 cycles of the amateur spectrum, you would have 4 x 50c or $2.00 as the minimum. If you had 50 watts and occupied the space of 6000 cycles with a 50-watt phone, you would take up the room for 24 c.w. stations, so we would charge a basic $12.00 per year for its occupancy. If you had high fidelity and occupied 20,000 cycles, you would pay $40.00 per year for a 50-watt phone. So you see the government would be receiving just as much from one phone station occupying 20,000 cycles of the band as 80 c.w. stations occupying the same space. This, to my mind, is the only fair and equitable way to charge a fee, using as a base both power and space occupied in the band. I would like to hear more about this.

Roy Wheadon, W6KTY

Southington, Conn.

Sirs:

Will you kindly tell me why a class A license is required for phone operation in the 80-meter band? Also why is our 20-meter c.w. band split wide open!

Listen in on the phones any night. If the 160-meter phones don't, on the average, sound better operated than the 80-meter phones, there's something wrong with my receiver. Also, look at the tremendous number of signals on 160. Granted there is more room in kc., but there are proportionately more fellows. Also, you'll never see one or two groups of high power phones on 160 more or less monopolizing the band. As for harmonics and overmodulation, except for a few, give me 160 any day. Yet the 80 meter boys are supposed to be the tops in phone men!

Why doesn't the F.C.C. realize that with the present development of the art and the increased general higher operating ability of the amateur, class A is just an anachronism? Simply something to obstruct a lot of amateurs interested in phone and at the present time serving no worth-while purpose. I'd say the same for 20 meters; however, the boys in those bands will now howl to heaven if they read this. If you analyze their howls, it will reveal a selfish motive. Freedom of gun for those there—although it's bad enough. But what right has any amateur to any frequency? A traveler on the highway never gets the sole right to use a particular part of the road.

Also, tell me why the c.w. boys are offered as sacrifices to the 20-meter phones? The present set-up makes two bands of c.w. where there logically and rightfully should be only one. Why not put the phones at one or the other end and have done with this foolishness? Foreign phones, overmodulation, broad carriers are steadily encroaching on the 20-meter c.w. boys. Put the phones at one end!

In summary, let's get these worn out restrictions removed. Anyone not operating his station—c.w. or phone—in accordance with established amateur standards should be warned. We want ham radio to progress—but it can't do it in a strait jacket.

Kurtz A. Fichthorn, W1BGJ.

Something for Nothing

[*Continued from Page 49*]

attributed almost entirely to the fact that the current in one wire induces a current in the other, so that the total current flow is greater than it would be without interaction between the wires.

Hansen and Woodyard, in a paper published in the March issue of the I.R.E. *Proceedings*, have pointed out a new principle in directional antenna design. The aim in such an array is to arrange matters such that the total power radiated is a minimum while maintaining the intensity radiated in some direction or direction constant. This is another way of saying that the antenna should direct the greatest power in the desired direction out of a constant total of power radiated. In the usual end-fire array, the spacing and the current in each antenna are arranged so that the signal received at a distant point is the sum of the power from each radiator in the antenna, all arriving in phase. The simplest example of this type is two half-wave-length wires spaced one-half wavelength and fed 180-degrees out-of-phase. However, the resulting pattern has a broad nose, suggesting that much of the total power radiated goes out in directions differing somewhat from the most favored one. The broadside array produces a somewhat sharper pattern.

Now if the antennas in an end-fire array are spaced and fed so that the waves going in the direction of maximum transmission are not strictly in phase, it is possible to increase the gain. This can be shown mathematically. The result is a sharpening of the common broad-nosed pattern. A plot of the radiation from the W8JK array, in a plane perpendicular to the wires, shows this effect. This further explains why the close-spaced arrangement in the flat-top beam gives more gain than ordinarily would be expected, considering the small amount of space necessary. It has been found that in the long end-fire array under consideration in the study, adjusted phase relationships resulted in a power requirement of only 55% to produce the same signal as with the ordinary phasing equal to the spacing of the wires. This means nearly a 3 db improvement over the former practice!

The best adjustment worked out to have one more half wave of current along the array than the number of half wavelengths contained in the array length. The flat-top beam is spaced ⅛ wavelength while the wires are fed current ½ wavelength out-of-phase (180 degrees) or, in other words, there are ⅜ of a wavelength of current along the array in excess of its physical length (⅛ wavelength). This suggests that both a reflector and a director, each spaced about 1/10 wavelength from the antenna, might be used with the Roberts or the General Rotary types.

Amateurs will do well to take into consideration these two totally different but very effective methods of increasing station *efficiency* before worrying about increasing station power.

*"Peak Compression Applied to the Speech Amplifier," Ray L. Dawley, W6DHG (page 11, November, 1937, RADIO); "Automatic Modulation Control", L. C. Waller, W2BRO (page 21, March, 1938, RADIO).

Beginner's Exciter-Transmitter

[*Continued from Page 44*]

operate as a doubler. The plate current should dip to about 36 ma. at resonance with no load coupled to the doubler output circuit.

7.0-Mc. Band

For operation on 40 meters with a 40-meter crystal, coil no. 3 may be used in the 809 plate circuit and coil no. 2 in the oscillator. With the oscillator tank practically clear in, it will operate on 40 and the 809 will operate as an amplifier on this band. Or an 80-meter crystal may be substituted for the 40-meter one and the operation will be almost exactly the same. The 809 will dip to about 15 ma. at resonance with no external load.

It will be possible to operate on 40 with a 160-meter crystal should one be available whose harmonic will hit the band. In this case coil no. 4 would be used in the oscillator plate circuit and the oscillator would be tuned to 80 meters. The 809 would operate as a doubler in this case.

3.5-Mc. Band

For operation on 80 with an 80-meter crystal, coil no. 4 would be used in the 809 plate circuit. Coil no. 3 would be used in the oscillator. Under these conditions the amplifier would dip to about 15 ma. at resonance, no load. Also, a 160-meter crystal could be plugged into the oscillator crystal socket and operation would be essentially the same.

Summary of Operation

First, in summarizing the operation of the unit, it should be said that each of the coils is capable of operating on two different bands in the oscillator circuit, and that the same coil is capable of operating on the higher frequency of these two bands when operating in the amplifier plate circuit. Thus coil no. 1 will operate on 20 or 10 in the oscillator and on 10 in the amplifier. No. 2: 40 or 20 in the oscillator and 20 in the amplifier. No. 3: 80 or 40 in the oscillator and 40 in the amplifier. No. 4: 160 or 80 in the oscillator and 80 in the 809 amplifier.

Incidentally, a 60-turn close-wound coil of no. 22 enameled wire could be made for use in the plate circuit of the 809 amplifier for operation with the output of 160 meters.

Crystals

Any type of 80-meter crystal may be employed, so long as it is known to have good activity, as the crystal current will run quite low with an 80-meter crystal in the oscillator. However, when a 40-meter crystal is used, the crystal current will run around 100 ma. under certain conditions of tuning. For this reason, *only an AT cut or B-5 type 40-meter crystal should be used.* These two types will safely stand over 100-ma. crystal current and have very low drift.

It is advisable to use as large a condenser at C_4 as possible in order to keep the crystal current down. If made too large, however, the harmonic output of the oscillator will suffer. With mechanical layouts similar to that illustrated, 250 μμfd. will be found to be a good compromise between harmonic output, crystal current, and stability.

The Power Supply

The power supply should be capable of delivering 600 volts under a 200-ma. load and have good regulation. A 125-watt plate power transformer delivering from 700 to 725 volts r.m.s. each side of center tap may be used in conjunction with an 83 rectifier and choke input filter. A single section filter consisting of a 200-ma. swinging choke and 600-volt *oil-filled* condenser of 4 to 8 μfd. "aft" will provide sufficient filtering for c.w. work. The voltage divider on the oscillator and "resting current" on the 809 will act as a bleeder and keep the voltage from going much over 600 volts with the key up. Two of the inexpensive tubular, can-type 600-volt oil-filled condensers in the 4-μfd. size can be used in parallel to get 8 μfd. if a smoother note is desired.

Tuning Precaution

When tuning up any transmitter using a regenerative crystal oscillator, it is strongly advisable to make use of a monitor to make sure that the transmitted wave is crystal controlled. A well-shielded receiver can sometimes be used as a monitor if the antenna post is grounded. After tuning up as described, it should be possible to tune the 6L6 oscillator condenser a few degrees either way with no more than a few cycles change in the pitch of the note as heard in the monitor, and the signal should be stable and clean. If this check indicates that the 6L6 is self-oscillating, the fixed condenser C_4 should be replaced with one slightly larger in value, but no larger than necessary to discourage self-oscillation.

Dx

[*Continued from Page 64*]

W6CEM, on the "Flextal Exciter", a simplified conversion exciter.

Here's this QRP guy again, W8DPY. Now he's using a folded antenna in his attic about 15 feet above the ground and measuring 9 by 24 feet. Walt says it is simple and can be put up in ten minutes. It is bidirectional and can be rotated. He is still using 8 watts into a 6L6 driven by an 802 e.c., and with this he has worked CR6AC, CN1AA, U9ML, J8CD, J2JJ, VR6AY, W10XAB and G8MF. Gosh . . . 8 watts. Keat Crockett, W9KG, claims he is plenty busy and has not had time to work much lately, only VU2DR, U9AG, W10XAB, U6WB, XU8LS, YV2CU, VP9R, YU7AY, CT1KH, SV1RX, and several others . . . you know, just locals. In a whisper Keat sneaks in the remark that he has been doing quite well on 28-Mc. phone. Shhhh! don't tell a soul. W8OSL has been having a session with new antennas but finally settled on a s.w.f. Hertz. Jul now has 39 zones and 125 countries. W5VV gets a few new countries making his count up to 37 and 121.

J3FJ on 56 Mc.

For those interested in going after 5-meter dx, J3FJ will be on daily 0200-0210 and 0900-0910 G.m.t. sending "56 J3FJ, 56 J3FJ", etc. Frequency 56,800 kc. and uses a pair of 100TH's in p.p.

ON4FT is still after 'em and now puts his down as 37 and 96. W3DDM reports for the first time and has 38 zones and 104 countries. He had one busy morning on April 30th when he worked six new countries. After schooling in this country W3DDM expects to be XU6DDM, and he is going to China. At present a friend of his is the room-mate of XU6LN at Lingnan University. W2HHF is also punching the old key to the tune of 115 countries at the present time . . . 37 zones. Some of the better ones are ZD2H, LX1AS, ZB1U, VS7MB, K6BAZ, G8MF, K7CHP and others. W5KC has boosted his to 33 and 88. W2WC with 33 zones and 88 countries is a new one to the flock.

K6CGK has slipped over a new stunt . . . he is on 56 Mc. Not being content with 5 bands he doubled again and lit on 5 meters. The point I was to bring up, however, is that he has received a heard card from England on his 5-meter signal. Leave it to K6CGK.

HR7WC says if you want a QSL card to send yours, and with it a self-addressed stamped envelope to W5ENE. Only W5ENE is handling cards to HR7WC so this is your chance. HR7WC is T9X on 14,405 kc. W8LZK was the first W contact for VQ2JF 14,036 kc. His QRA is C. F. Jones, Box 9, Luanshya, Northern Rhodesia. This was confirmed by ZS6DM. W8LZK says that VU2GJ wants a sked with South America for his WAC. Mac has hooked up with a number of good ones bringing his standing up to 36 and 99. W3CDG is all tickled since changing over to a 250TH because he christened it by working VR4AD and enabling him to get 30 zones and 78 countries.

Eric Trebilcock, BERS 195, is here again. In March Eric logged 323 different stations, all dx, on 7 Mc. in 35 countries. About half of them were W stations. This should show that 40 isn't so dead after all. He has now heard 39 zones and 143 countries, with 28 zones on phone. His records for HAC on c.w. is 6 minutes, and HAC on phone is 6 hours 25 minutes. For January, February and March Eric has logged 103 countries . . . during March he made 2,500 log entries involving 1,524 individual stations. That's really writing 'em down. He doesn't agree with the official country list . . . but oh, that's a long story . . . anyway, Eric, you should live in W for a while. He writes about the night he was listening to the trio K6BAZ, W6CUH and W6QD cooking up the "Islands Network" involving K6BAZ, K6DSF, K6NVJ, K6GNW and K6HCO. The "roundtable" QSO went off fine except we couldn't get K6HCO. This didn't matter as K6GNW was in the Phoenix Group although on a different island from HCO. Again for your information K6BAZ, Howland, is on 7,190, K6DSF, Baker Island 7,080 kc., K6GNW Enderbury Island 7,190, and K6NVJ 7,185 on Jarvis Island. Baker is not counted as a country but Jarvis is on the list as is Phoenix Islands.

W7BJS in Afton, Wyoming, had never gone in for much dx until he read about the 8JK beam in December RADIO. Now he has 21 zones and 25 countries on phone using a single 35T with never more than 95 watts input. His beam is of the 30-foot type on top of a 40-foot pole, rotary of course. Immediately he contacted ZU5M and VK4JU, and this was the first time he had ever heard these continents on phone. This just illustrates what a good antenna

Taken by Frank Robb, GI6TK, at his QRA. Reading left to right. GI5OV, xyl of G8KP, and G8KP.

will do. W6KQK breaks loose and now has 32 zones and 61 countries, the rig being T20's with 100 watts. KA7EF on Negros Island in the Philippines does not count separately from KA.

Here's a letter that I think I'll let you in on . . . . it is short and snappy, and should draw a laugh out of you. It is from W4DGG, Alva H. Clark:

"Dear OM:

Speaking of "handles" (DX column of Feb. RADIO), I think that I'll have to go fone to solve the problem here. The "handle" here is "Alva" and plenty of QSLs come to me addressed "Miss Alva". Some have gone so far as to ask me for a picture. Most of these come from W's but I have one from SM5UO saying that I was his first W yl and a few days ago one arrives from YV5AK addressed "Miss". He says he has 44 countries on phone, 24 on c.w., and 22 loves; if he should send in cards to prove the loves, one of the loves doesn't count. Hi. Here is hoping that my voice doesn't sound too much like a yl's on the air, for I would hate to have some OM proposing to me."

Very 73,
(Mr.) Alva H. Clark, W4DCG

What do you think of that one? He might have to do a little fone work just to let the boys know what kind of a 'gal' he is.

Once again I'm taking the easy way out and copying a letter which gave me quite a few snickers.

Hope you're in a snickering mood . . . . if you're not, better take a walk for three minutes. This is from W8AQT:

"Dear Herb:

The first night I cranked up my old 500-watt power leak on 40 I found out that there was more fun than just hunting dx. And here is why, for here is the next door neighbor's story as he told it to me over the telephone after he had worked himself up to a stage that he was almost ready for the padded cell.

His Story

'My wife and I went to bed and I was sure that I had turned off the light, but I noticed the light was going on and off. Then I thought I had forgotten to turn off the lights so I got up and turned the switch again, but the light came on bright. I thought I had a short in the wires so I dashed down stairs to the basement and pulled the main switch. When I came back up stairs all of the lights in the house were going on and off.

'My wife and I thought the house was haunted, for you know we have only been here for two weeks. Just then all the lights went off and I figured everything was OK again. (I had stood by). But in about five minutes they came back on so I called up the Light company and told them that I had a short in my lights and they said to pull my main switch, and they would send out a service man to fix them.

'I told him that I had just pulled the switch, but the lights still went off and on. He told me to go to bed . . . . that I was drunk . . . . and you know I don't drink. (How do I know he doesn't drink?)

'Well, then I saw you out on the porch and I heard you say to the fellows that were leaving to come back again some night and we will try for some more dx. Then I knew what was wrong with my lights because I had seen you put up a new aerial today, and my friends told me radio waves would do that. I am going to the light company and make the fellow apologize to me.'

"So you see I had a lot of fun on 40 the first night besides chasing dx.

73,

W8AQT."

Well, look who's here. KA1ME of all people, and here is a guy who is topping all of the phone section with zones and the number of countries. 35 zones and 79 countries. All of us know how he pours in and if it is about the same in other parts of the world, I wouldn't be surprised to see a couple more zones added to his list in the near future. W8MTY has been having "hill trouble" in Pittsburgh; he had never hooked an Asian until he put up a full wave Johnson Q around the first of February. Now he has 12 Asian contacts to his credit. He slips in that he increased his power to a kw on his 250th's. Sam has 35 zones and 86 countries. W3TR thought it was a just a good dream . . . but no, he really worked VQ2FJ and is he happy? Don't even ask . . . he puts it this way, "I've been in ham radio since 1922 but the thrills never wear off." I, too, could stand a thrill . . . especially if VQ2FJ was on the other end. W3TR now has 34 and 92. W2GWE broke loose the other night all over the high end of the 20-meter band. Pete says he's temperature controlled on 14.399.872 kc. There is a good marker for you. We hope his oven continues to work. W2GWE stands at 39 zones and 129 countries. W2BHW works some new ones in VR6AY, VR4AD, K6BAZ, VQ2FJ putting Lindy up to 38 and 126.

More on 56 Mc.

May 13th or 14th were pretty good days for a few of the 5-meter hounds. Around 6.25 p.m. p.s.t. W6MKS and W6DNS hooked up with W7AQJ in Vancouver, Washington. W7AQJ was on fone and the W6's were on ICW. W6IOJ also got W7AQJ. MKS and DNS are in San Diego which makes it quite a haul. They said the W7 had also contacted a K7 on 5.

VS2AK, T. A. Dineen, 15 Seavoy Rd., Kuala Lumpur, Malay States, is leaving some time in June for England, to be gone about six months. His address in England is not yet definite, but he will try to contact his old friends from some station over there. He'll be on 10- and 20-meter phone. Any further information we receive will be passed on to you.

I must mention the recent DX Roundup held in Wilmington, California. Every three months or so, the dx men of southern California stage a big meeting of their own. It more or less resembles a hamfest, except that everything at the "Roundup" is of interest to the dx man . . . and is purposely planned that way. For example, we had 175 of the best dx men in W6 at this one held April 30th. If there were room to print their calls you would know every one of them as one of the consistent dx men in W6. Someone just about hit it on the head when he said that he bet the total power of the 175 dxers gathered there, would be over 300 kw. That doesn't sound the way it should especially to the F.C.C. but it was all in fun . . . or was it??? We had as guest speaker, W6DQD, who used to be at the key of VS8AA, Bahrein Island . . . remember? Then there was ex-NY1AB (now W6GCX) and G5SA all the way from London. Jack McCullough demonstrated too much power into a pair of 35T's . . . arcs were 8 inches long, W6CUH gave a few pointers on new amplifier design, and W4DHZ talked on an antenna for the dx man. Everyone got home in time to get the deuce from his xyl. They tell me the power company is against too many meetings of this kind. The line voltage goes up all around Southern Calif.

Things around W6QD have been just so-so. After seeing all of you fellows scooping up the new zones and countries I wonder what the heck I'm doing here if you notice on the list I am still sitting at 37 zones . . . everyone else seems to breeze by me like I have a quarantine sign out. When I think of it it seems silly to think I haven't hooked anyone in Zone 2 or Zone 21. Everyone else around here has done it with ease. Maybe I didn't get a personal introduction to the right guy. If any of you know of a good way to obtain a formal introduction to anybody in these zones, spring it because I haven't got the combination yet. Everytime I start laying for some fellow in Zone 2 or 21 I hear he has either moved or is rebuilding. Mebbe By Goodman's dx expedition is not such a bad idea after all. I really shouldn't kick as something is bound to happen some day.

Before I forget it I want to express my thanks to the gang for helping me get all those W9's last month. There have been a lot of the fellows arranging skeds with nines for me . . . it is surely thoughtful of them as with such cooperation as that, a guy can't miss. A quickie . . . I hope you get it. Two baseball teams were playing. One team was plenty lousy. An irate and disgusted fan yells, "Put in 'another nine' ". With one like that I had better fade out. See you next month.

Here are some frequencies that may help get a few new ones for you. Remember, these are guaranteed to be accurate as they are more a general average of those reported by you fellows. No effort was made to list the more common dx stations as most of the gang desire the frequencies of the "hard-to-get" variety.

CR7AK	14080	VP3TEST	14450
CT2BC	14340	VP7NT	14370-14405
EQ4AC	14375	VP7NC	14410
FM8AD	3520	VQ2FJ	14030
FR8VX	14410-28600	VQ2JC	14100
FY8AA	14375-14450	VQ4CRO	14090
GI2CC	14140 fone	VR1FF	7190
J2LL	14030	VR4AD	14300
J9CA	14005	VR6AY	14360
K6TE	14300	VS1AF	14060
K6BAZ	7190	VS6AO	14300
K6GNW	7190	VS6AG	29000 fone & c.w.
K6NVJ	7185		
K6DSF	7080	VS6AF	28600 fone
LX1AS	14405	VS7RF	14320
OY7A	14275	VS7MB	14399-14060
PJ3CO	14265	VS7RP	14255
PK6AJ	14105	VU2AN	14060
PK7FF	14280	VU2JP	14320
PZ1AB	14450	VU2AU	14085
TG9AA	14380 fone	XU4GW	14095
U6SE	14410	XZ2DY	14095
U6WB	14390	YT4AS	14405
U8ID	14030	YT7TJ	14430
UK8IA	14460	YU7LX	14280
VK4HN	14285 Papua	YV2CU	14405
VK9DM	14400-14380	ZB1U	14300
VK9VG	14100	ZD2H	14260
VK9BW	14375		
VP1AB	14130 fone	ZD7H	14400
VP2LA	14020	ZU9AB	28200

A Beat-Frequency Audio Oscillator

[*Continued from Page 58*]

impedance rises at the proper rate to decrease the loading on the 6C5 grids. The proper condenser and resistors are essentially a cut and try proposition since the resistors affect both the high and low end simultaneously. The resistors will be somewhere between 50,000 and 100,000 ohms and the capacity between 0.1 and 1.0 microfarad.

A small degree of high frequency equalization can be made by connecting a small condenser, around .01 μfd., across the 500-ohm output winding. Generally not more than a half a db can be realized this way.

The final noise level measured on the G. R. noise meter was 61 db below 6 milliwatts. This measurement was made with the oscillators adjusted to zero beat so that the noise level is an overall measurement including the oscillators. This low noise level is due to adequate filtering and shielding. The output transformer has a combination permalloy and copper shield which in conjunction with 25-cycle power transformer allows the two to be mounted in close proximity. The use of the resistance-stabilized oscillators makes it unnecessary to use a power pack with voltage regulation as the frequency is essentially independent of plate voltage changes. It takes the oscillators about 10 minutes to settle down from a cold start. After this time the oscillator drifts less than 3 cycles per hour. If the oscillator is allowed to operate for an hour and then the two oscillator tubes change the frequency, the frequency will again be unstable for a period of approximately 10 minutes, thus indicating that the tube elements have to be thoroughly heated to insure stable operation.

Postscripts and Announcements

[*Continued from Page 65*]

hold its annual field day and picnic at Turkey Run park, Indiana, July 17. This event has been held in conjunction with the Wabash Valley Radio league on this date for the past 3 years. Last year's attendance was about 300. Five hundred are expected this year. Further information may be had by writing W9VUH or W9UNS.

Grand Rapids, Mich.

Tenth annual hamfest of the Grand Rapids Amateur Radio club is scheduled for June 12 on the U.S. Army rifle range in Grand Rapids. Among events scheduled for the day is an indoor baseball game between phone and c.w. men. Those on the committee are Harvey K. Dodge, W8GRP; George White, W8FM, and E. W. Eggebrecht, W8OAH.

1938 HAMMARLUND MANUAL

The 1938 edition of the "Hammarlund Short Wave Manual" contains much interesting material for the short wave experimenter. Included in its 32 pages are a number of one-, two-, and three-tube a.c. and battery type short wave receivers; short wave converter; two-stage preselector, an ultra-high frequency superheterodyne and complete power supply data. For the amateur, there is a three-stage modern crystal controlled transmitter and also an up-to-date five-meter transmitter with appropriate receivers and power supplies for the ham.

Four pages are devoted to the short wave listener and include a large short wave station list, tuning hints for operating short wave receivers, and information as to how to obtain verification cards. Profusely illustrated, the book contains over 50 diagrams and photographs. Price, $.10.

Advertising Index

Ace Products Co. 84
Allied Radio Corp. 90
Astatic Microphone Laboratory, Inc. 82
Bliley Electric Co. 75
Bud Radio, Inc. 83
Burstein-Applebee Co. 88
Centralab 73
Decker Mfg. Co. 95
Eitel-McCullough, Inc. .... Inside Front Cover
The Hallicrafters, Inc. 7
Heintz & Kaufman, Ltd. 81
P. R. Mallory & Co., Inc. 77
Moore, Ken 95
Ohmite Mfg. Co. 79
Pacific Radio School 92
RADIO ANTENNA HANDBOOK 71
Radio Amateur Call Book, Inc. 87
RADIO DIGEST .... 6, Inside Back Cover
RADIO HANDBOOK 5
RCA Mfg. Co., Inc. .... Outside Back Cover
RADIO NOISE REDUCTION HANDBOOK 8
Radio-Television Supply Co. 89
E. M. Sargent Co. 93
Solar Mfg. Corp. 80
Taylor Tubes, Inc. 69
Thordarson Electric Mfg. Co. 3
Trimm Radio Mfg. Co. 85
Wholesale Radio Service Co., Inc. 76

LAMENT OF A RETIRED 210

I'm just a little vacuum tube,
And not so very old;
I'll oscillate on any band,
I'm worth my weight in gold.

My OM's very nice to me
When he goes on the air;
Only once I jibbed on him,
Boy—, can that man swear.

He uses me quite often,
Morning, noon and night;
He fears that I might soften,
He needn't—I'm all right.

I used to work on 80,
I liked the job quite well;
I drew 'bout 30 watts,
My note was clear's a bell.

Then he pushed me down to 20;
I danced to beat the band;
And when he saw the way I worked;
He said that I was grand.

I won him a certificate,
The coveted W A C;
He stroked me very gently,
He's justly proud of me.

But he put me back on 80,
My holidays were o'er;
I sighed and longed for 20,
Quoth my master, "Nevermore."

Here I am at my old task
Of keeping up the skeds;
10 and 20 are for newer tubes,
They're too fast for us old ten's.

—W6OFD, AC8JS.

W3HCE joins the ranks of the fellows with *no-brake crystals.* He reports that when his entire xmitter is shut down, the crystal just coasts right along, oscillating merrily along until the heater of the crystal stage has thoroughly cooled down.

The Worldwide Authority
Take "Radio"

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 usually may be substituted without materially affecting the performance of the unit.

BRODERSON MIDGET RECEIVER

C_1—Hammarlund MEX
C_2—Hammarlund HF15 variable
C_3—Hammarlund HF100 variable
Coil form—Hammarlund CF-4
Pilot bracket—Yaxley 310
Filter condenser—Cornell-Dubilier Dwarf 8-8 μfd.
Resistors—Centralab
R_3—Centralab 72-103
Phone jack and line switch—Bud

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JONES 222 RECEIVER

C_1—Hammarlund MEX
C_2, C_3—Rebuilt Hammarlund MCD-35-MX
C_4—Bud 323 condenser
C_5—Bud 905 condenser
By-pass and tubulars—Cornell-Dubilier
C_{14}—Cornell-Dubilier triple 8 in can
Coil forms—Bud
Sockets—Hammarlund
Audio transformer and choke—Stancor
Power transformer—Stancor P2751
IF transformers—Miller 612W or Meissner
Chassis—Bud 1190
Cabinet—Bud 1189
Shaft couplings—Hammarlund
R_3—Yaxley K control
R_7—Centralab 72-117
R_{10}—Yaxley B control
R_{16}—Yaxley O control with switch

●

NEWCOMER'S 809 TRANSMITTER

R_1—Aerovox Corp.
R_2, R_3 R_4 R_5—Ohmite Mfg. Co.
C_1, C_2, C_3, C_4, C_6, C_7—Solar Mfg. Corp.
C_5—Hammarlund "Star" 140
C_9—Hammarlund MCD-100-M
RFC—Hammarlund CHX
809 Coil socket—Hammarlund S-5
Coil forms—Hammarlund XP-53
J_1, J_2—Mallory-Yaxley "Junior" type

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BEAT-FREQUENCY AUDIO OSCILLATOR

All mica condensers—Aerovox
Paper condensers—Cornell-Dubilier
C_2—General Radio 505G fixed
C_{15}—General Radio 539X variable
C_{12}—Aerovox PR-25 25 μfd.
C_{10}, C_{11}—Aerovox 8-8 μfd. 450-volt 2GLS
T_1—Inca TF29 or UTC LS-51
T_2—Inca C65 (25 cy.) or UTC VR-2 (25 cy.)
L_4—Hammarlund RFC-250
C_{14}—Hammarlund MC-20-S
C_{13}—Hammarlund APC-50
R_7—Yaxley B control

The Marketplace

(a) Commercial rate: 10c per word, cash with order; minimum, $1.00. Capitals: 13c per word. For consecutive advertising, 15% discount for 3d, 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 therefor. Rates and conditions are subject to change without notice.

PHOTOS WANTED FOR "RADIO"

Nothing enhances a magazine as much as good photographs of interesting and varied subject matter. Unfortunately, photographically interesting radio items are rare, though they do exist. We keep a weather eye peeled for them around here, but must depend upon you for likely items from your neck of the woods.

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Acceptable snapshots average a $2.50 payment; some run to $5.00; $1.00 is minimum.

•

Pictures which tell a story are especially good. Radio scenery and apparatus are in order. Many "personality shots" can be used as well as some larger portraits of prominent radio personalities.

YOUR ADDRESS

Is your address correct in our files for all near future issues? If you move, notify us *in advance* as we cannot replace copies sent to your old address; under U. S. postal laws these will be destroyed unless you have left forwarding postage with the postmaster (5c in U. S. A. for normal issues.).

Notice must *reach* us by the 5th of the month preceding date of issue with which new address is to become effective.

RADIO, LTD., 7460 Beverly Blvd., Los Angeles.

Effective with the .... issue my mailing address for "RADIO" is:

NAME..

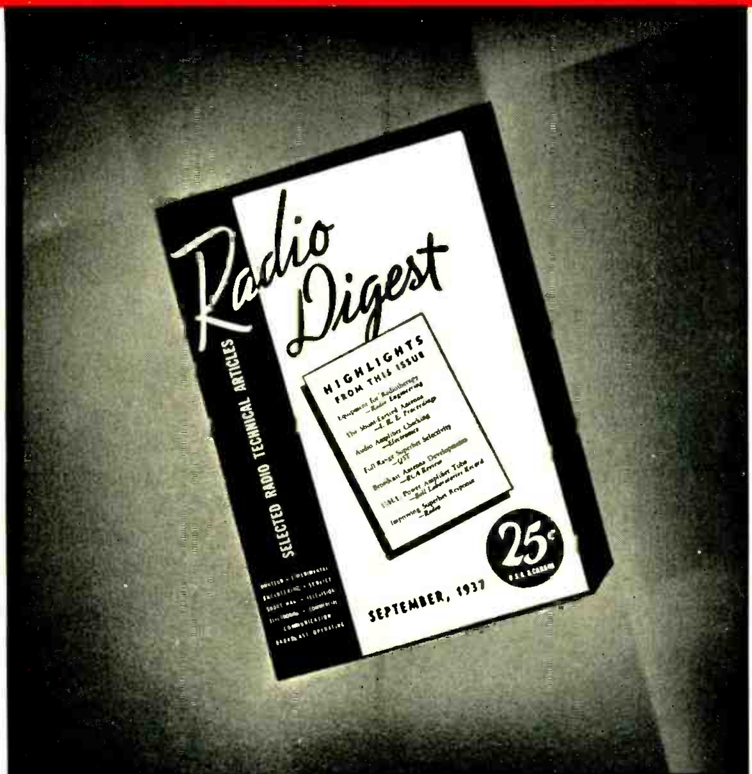
ADDRESS..

CITY.................................... STATE....................

My old address was:

ADDRESS..

CITY.................................... STATE....................



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