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CQ

June 1961

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The Radio Amateur's Journal

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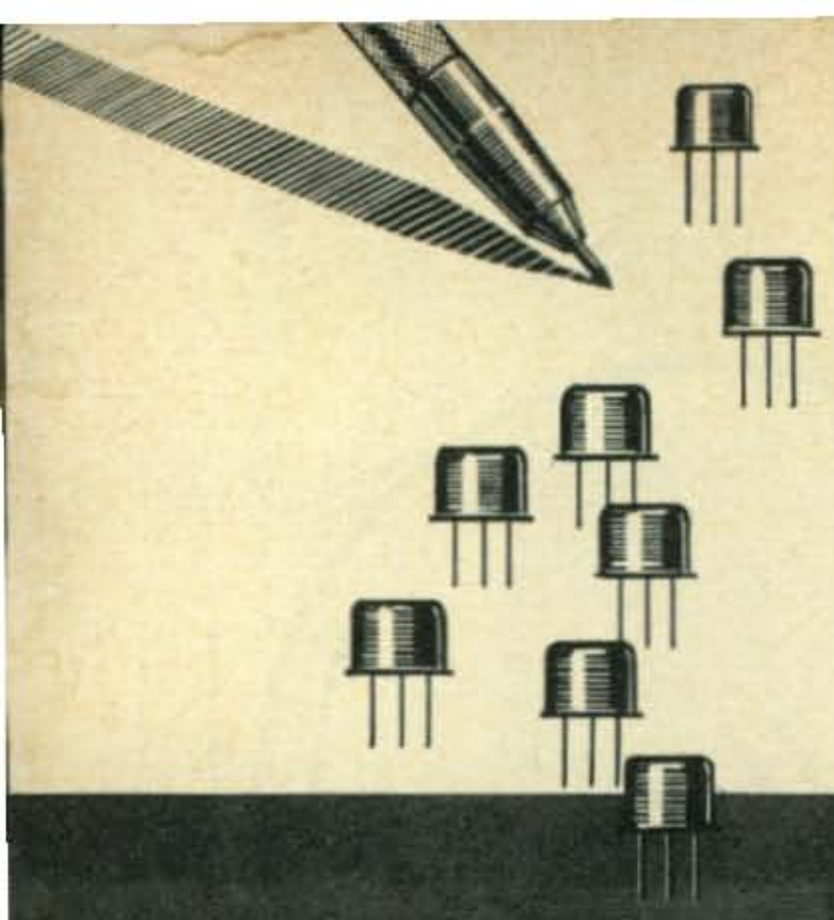

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For further information, check number 4, on page 126

CQ The Radio Amateur's Journal

VOL. 17, No. 6 JUNE 1961

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TABLE OF CONTENTS

S.S.B., A.M. and C.W. 80 Through 6 Meters
John D'Angelo, K1AFT 26

Driving The Class AB1 Linear Amplifier Through L-Networks
R. H. Griffith, W2ZUC 34

Break-in Without Pain ..... *E. L. Raub, W1RAN* 36

Adjustment of the RTTY Polar Relay
W. E. Nichols, W6VVF 38

Improving The Heath AR-3 ..... *Robert M. Voss, W2HTN* 41

The Sunspot Story; Cycle 19; The Declining Years, Part III, Conclusion
George Jacobs, W3ASK and Stanley Leinwoll 44

A Stacked Rhombic Array for 1296 Mc.
Frederick W. Brown, W6HPH 54

Results VK/ZL Contest 1960 55

The 3-400Z and 3-1000Z for Amateur Service
William I. Orr, W6SAI 56

Another Keying System ..... *E. H. Marriner, W6BLZ* 59

El Paso Roadblock ..... *Ross A. Sheldon, K5UCH* 60

Results of the 1960 *CQ* World-Wide DX C.W. Contest
Frank Anzalone, W1WY 62

CQ Reviews: The Hamboards T-2 Converter 100

DEPARTMENTS

Announcements	16	QSL Contest	18
DX	69	RTTY	82
Ham Clinic	75	Semiconductors	92
Ham Shop	118	Sideband	78
Letters	12	Space Communications	95
Novice	88	V.H.F.	84
Propagation	72	YL	98

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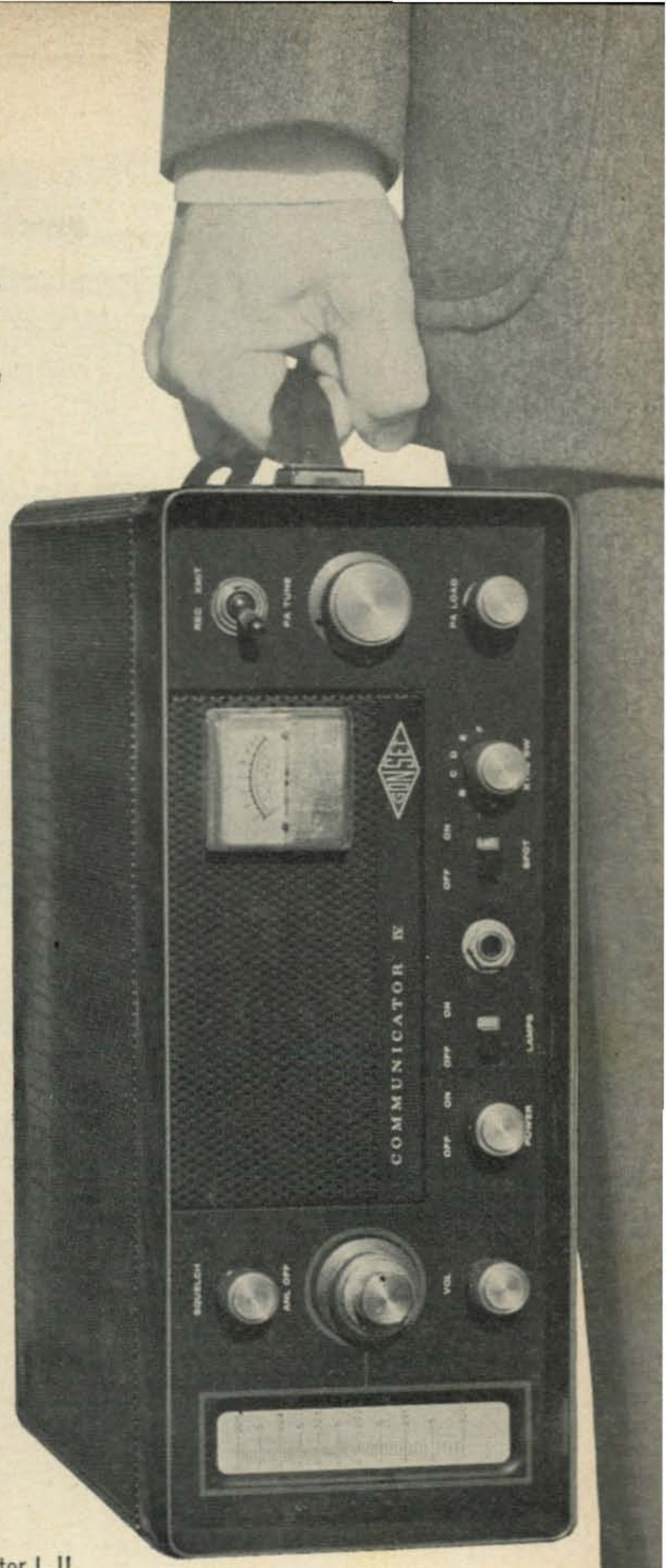

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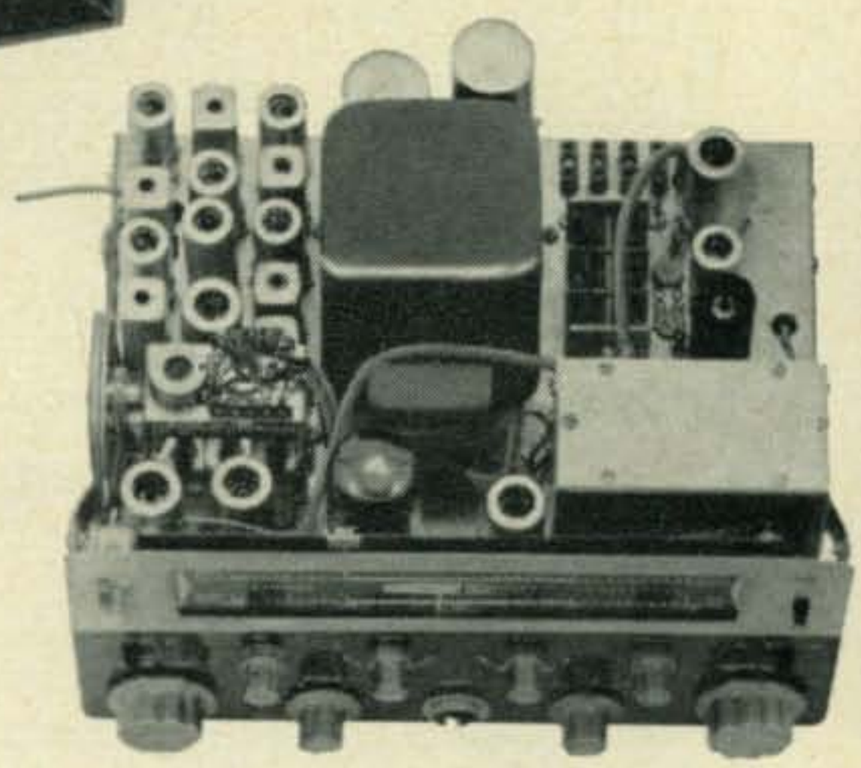

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Letters..... to the Editor

Calling Frequency; Pro & Con

Editor, *CQ:*

Your idea about a national calling frequency with a silent period twice each hour is just easily answered by one word: Baloney.

Have you ever listened to a pile up? Well multiply a pile up by one thousand and you have the result of a national calling frequency.

There is not the least bit of use in comparing 500 kc and your crack pot idea, since there is no basis for comparison as any marine operator knows.

If a calling frequency idea were made obligatory with two hourly silent periods all the I.B.M. machines east of the Mississippi couldn't punch out tickets to keep up with the hams stepping out of line.

The whole idea is about as educative as a military ham post sending traffic by voice. Did you ever take time to listen to that kind of baloney?

Samuel A. Wight, KH6EQ
133-A Judd St.
Honolulu, 17, Oahu, Hawaii

Editor, *CQ:*

I hail the step forward you have proposed in your April editorial—a national calling frequency for radio amateurs. As you so aptly point out, this same technique has been in use for many years by the commercial operators. However, not just on 500 kc, but also on 2182 and 8364 kc, and on 121.5 and 243 mc.

When everyone was using crystal control, it was fairly easy to ascertain whether one of your particular friends was on the air . . . you merely checked his crystal frequency. But in this day of variable frequency oscillators, you may never happen to hear an old friend even though he might have been on the same band at the same time. Having a national calling frequency might alleviate this problem to some extent.

Robert H. Wright, W1RMH
18 Pine St.
Concord, New Hampshire

Modulation and Audio Power

Editor, *CQ:*

The article "Modulation, Audio Power and Readability" in the March *CQ* was interesting but did not quite cover the subject from a communication stand point.

Since we do not do much communicating with the sinewave audio that the formulas call for, let us consider the usual voice wave. If the transmitter is set so that the random peaks on the "hard" sounds reach 100% modulation, the average modulation will be about 30%. This 30% modulation is a rather low figure and a lot of transmitter capacity is going to waste and the "talk power" is not what it should or could be. Uncontrolled, the average modulation cannot be increased as the peaks will cause over-modulation and unwanted adjacent-channel splatter. To increase the "talk power", commercial radiotelephones, the V.O.A. and some hams use speech compressors and clippers. In s.s.b. transmitters, a.l.c. circuits can be used for the same effect. Ten to 12 db of compression or clipping can be used with a minimum of distortion and will give a worthwhile increase in "talk power". The average modulation will now be in the order of 60% with the peaks held at 100% and the adjacent-channel splatter under control.

Just a little plug for more use of a.g.c. and a.l.c. when modulation and readability are mentioned.

Wayne W. Cooper, K4ZZV, ex HR2WC
9302 N.W. 2nd Place
Miami 50, Florida

← For further information, check number 9, on page 126

For further information, check number 10, on page 126

Zero Bandwidth

Editor, *CQ:*

After reading the article, "Zero Bandwidth Modulation" (April, *CQ*), I was completely bewildered. Technically, the article showed original thought; grammatically, the article was well-written; even the writer's offer to answer queries was most pleasing: but, Dear Editor, how does one communicate with the author, Shorza Gitchagoome? Is Hiawatha his QSL manager? Are I R C's acceptable in the Iroquois Nation? And lastly, dear sir, is this mode of modulation adaptable to conditions which exist when operating birch bark canoes as maritime mobile?

Alvin Liftig, K1IXG
1125 New Britain Ave.
West Hartford 10, Conn.

Editor, *CQ:*

I was very interested in your article on sweep modulation in the April, 1961, *CQ*. It seems to me to be an excellent way to reduce QRM on our bands, but the author's method seems to me to be very cumbersome. Through considerable experimentation, I have devised several simpler ways of accomplishing the same result.

Essentially, what he is doing is varying the amplitude of the received carrier at an audio rate. This can, of course, be done as he describes, but there is a simpler method. All one needs to do is to put a variable resistor in the antenna lead, and vary the resistance at an audio rate. I first tried this with an old volume control, but was unable to change the resistance fast enough. (I did, however, manage to send c.w.) Then I got the idea of using an old carbon mike for the resistor. This worked, but had the disadvantage that the mike was hot with r.f. To combat this disheartening drawback, I link coupled the mike to the antenna coupler. This final arrangement works so well and is so simple, that I think I'll patent it. In looking for a clever name, I finally hit upon "loop" modulation. You'll hear more of this in the future.

My loop modulator is OK for low power, but I had trouble in applying it to higher powered rigs. (The mike burned up.) The ideal variable resistor would be a tube, since it is easily controlled, so I connected a tube in shunt to ground from the h.v. lead of the power supply. I used a choke on the supply side of the lead, since it seemed to help. Now I have no more trouble with r.f., and my modulation is very strong. I have decided to call this system "Heising" modulation. This is a corruption of the German "heiss", meaning "hot". I chose this name because it's really hot stuff.

I am now working on a system which will not only act as a resistor in series with the power lead, but also as a generator, increasing the power output *above* that of the resting carrier. This is a definite advantage over the "sweep modulation" system. What I will do is put one winding of a transformer in series with the plate lead, and drive the other winding with a pair of tubes. Since these will operate in class B, I will call this "class B", or maybe "plate" modulation. I predict that once it is perfected, this system will win general acceptance among amateurs everywhere.

I wish to make very clear that these are all simply extensions of the method developed in the article on sweep modulation. The end result is precisely the same, and I do not claim any credit for the basic theory there developed.

I enjoy your magazine very much, especially these articles on new developments.

Sandy and John Hassler
1319 Laramie St.
Manhattan, Kans.

P.S.—I intend to invent f.m., n.f.m., p.m., d.s.b., and s.s.b. in the near future. Will keep you informed.

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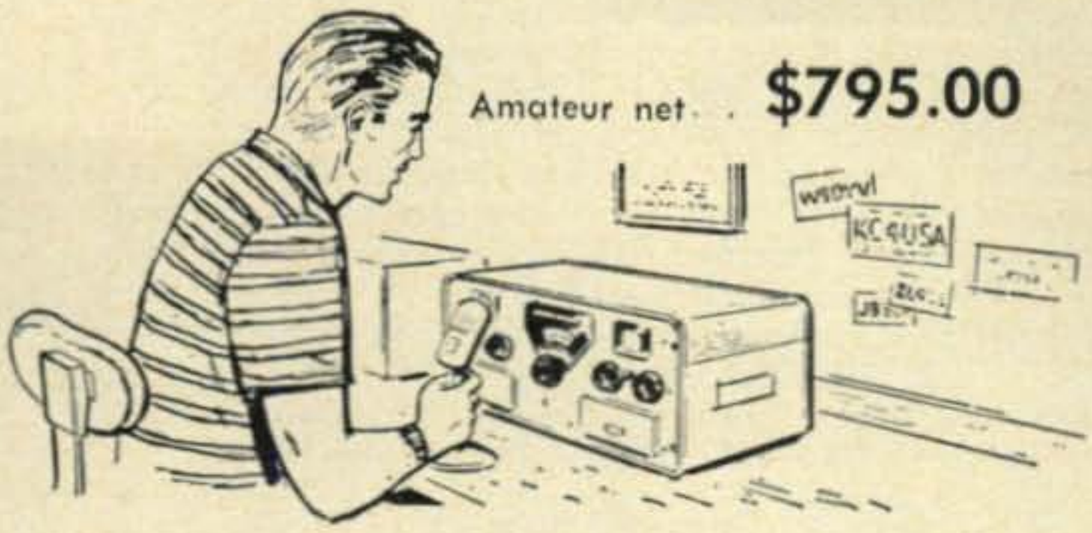

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Rome, New York

The Rome Radio Club is sponsoring their annual Family Day, which will be held on Sunday, June 4th at Becks Grove, in Rome, New York. The program includes dinner, prizes and fun for the children and XYL's. Registration is $4.00 before May 20th and $4.50 at the gate. Pre-registration for children 5 to 12 is $1.25 and $1.50 at the gate. The QTH of the Rome Radio Club is Box 721, Rome, N. Y.

Penn-York Hamfest Assn.

The third annual Penn-York Hamfest is planned for June 3rd at the Ingersoll-Rand Employees Hall, Athens, Pa., starting at 12 noon. A fine assortment of prizes will be given including National and Hallicrafters equipment. Pre-registration can be made by writing to the Ticket Committee, Penn-York Hamfest Assn., Box 301, Corning, N. Y. All tickets will be picked up at the door.

Ohio V.h.f. Picnic

The Sixth Annual Picnic, sponsored by the Northeast Ohio V.h.f. Group will be held on Sunday June 18, at Sunset Park, Rt 619, west of Alliance Ohio, starting at 12:00. There will be prizes for hams, XYL's, and mobile check ins on six meters. Special features will be the mystery manhunt and a Swap Shop. Bring your lunch! Refreshments are available on the grounds. Registration is $2.00 per family. Write or call Robert Morehead, K8WUP, 581 Lincoln St., Barberton, Ohio, PL 3-8368.

California

On Sunday, June 4th at the Victory-Vanowen Park in North Hollywood, California, the San Fernando Valley Radio Club will hold its fifth annual Hamfest. Among the features of this event will be hidden transmitter hunts on two and six meters, free refreshments, games for the children and other activities of general interest to hams. The main attraction will be a drawing for a Gonset GSB-100 s.s.b. transmitter together with dozens of other prizes. Admission is by donation of $1.00 and is open to the public. No pre-registration is necessary and everyone will share equally in the fun and prizes.

Utah

The Ogden Amateur Radio Club assisted by the Salt Lake Club is sponsoring this year's Rocky Mountain Division ARRL Convention to be held June 16, 17 and 18th at the Ben Lomond Hotel, Ogden, Utah. The FCC, Armed Forces, OCDM, MARS and other activities will be represented and will have speakers on the program. Several special interest meetings are also being scheduled together with activities for the XYL's and YL's. Inquiries regarding the convention and requests for hotel reservations can be addressed to Capt. L. B. Blaylock, USN Ret., K7OIP Municipal Building, Ogden, Utah, or Col. J. H. Samson, USA Ret., W7OCX 3618 Mt. Ogden Dr., Ogden, Utah.

Pennsylvania

June 17th is the date set for the Uniontown A.R.C. Gabfest. The 12th Annual event will take place on the club grounds, on the Old Pittsburgh Road, just off Route 51, two miles north of Uniontown, Pa. Refreshments will be available and there will be a drawing for prizes. The club can be found by writing to P. O. Box 849, Uniontown, Pa.

Ohio

The Northeast Ohio V.h.f. Group will hold its annual picnic on June 18th at the Sunset Park, on route 619, near Alliance, Ohio. A large attendance is expected and the gang promises a big turn out of v.h.f. enthusiasts. K8NZU and K8CHE are taking care of the prizes but will no doubt help you out with tickets and info. The address is 347 Wall Street, Ravenna, Ohio.

[*Continued on page 103*]

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"Thanks for putting such a **BEAUTIFUL RECEIVER** on the market."
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** These unsolicited comments are from the world's toughest critics—active amateurs. Review for yourself the fine performance of the new RME 6900 at your nearby RME distributor today, or write to:*

RME Electro-Voice®

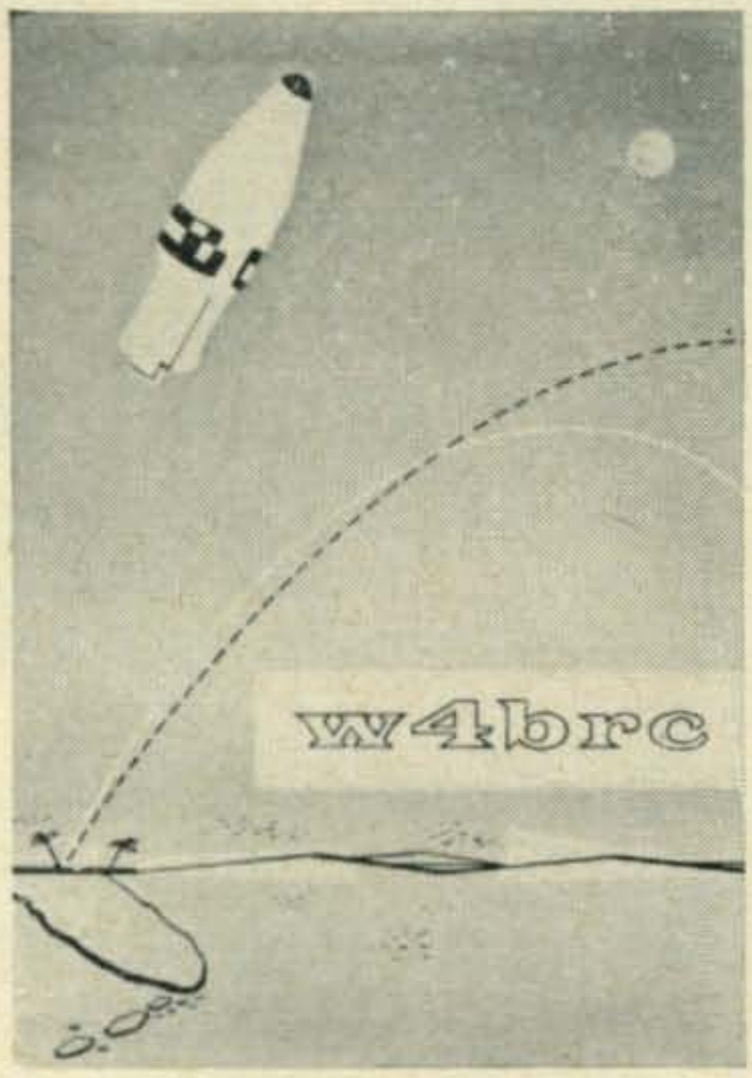
RME Division, ELECTRO-VOICE, INC.
Dept 618G, Buchanan, Michigan

For further information, check number 12, on page 126

QSL contest

This month's winner is M. F. Williams, W4BRC who hails from Indialantic, Florida. His card measures a rather large 4⅞ by 6⅞ and features only two colors, black and blue. A free one year subscription has been entered for him.

Dozens of beautifully done cards are received each week, but unfortunately many cannot be reproduced properly due to technical problems. Some of the very fine cards received recently are listed below. K1KPS, K2IVJ, W2NKB, K3GGD, W3JQE, W5CEN, W6ONE, K7OQR, W8HKT, K8QOJ, K9OEC, WØALG, KØTHI, DJ3CP, EP1AD, F3JW, HK1FN, JA3SQ, SM6AGG, XE2VE, YV5AID, and ZS6HG. ■



Runners Up

"Business end" of the HX-500 showing the parallel-connected RCA-6146's "raring to go".

HAMMARLUND HX-500

...uses RCA-6146's

Hammarlund's new 10-80 meter HX-500 transmitter

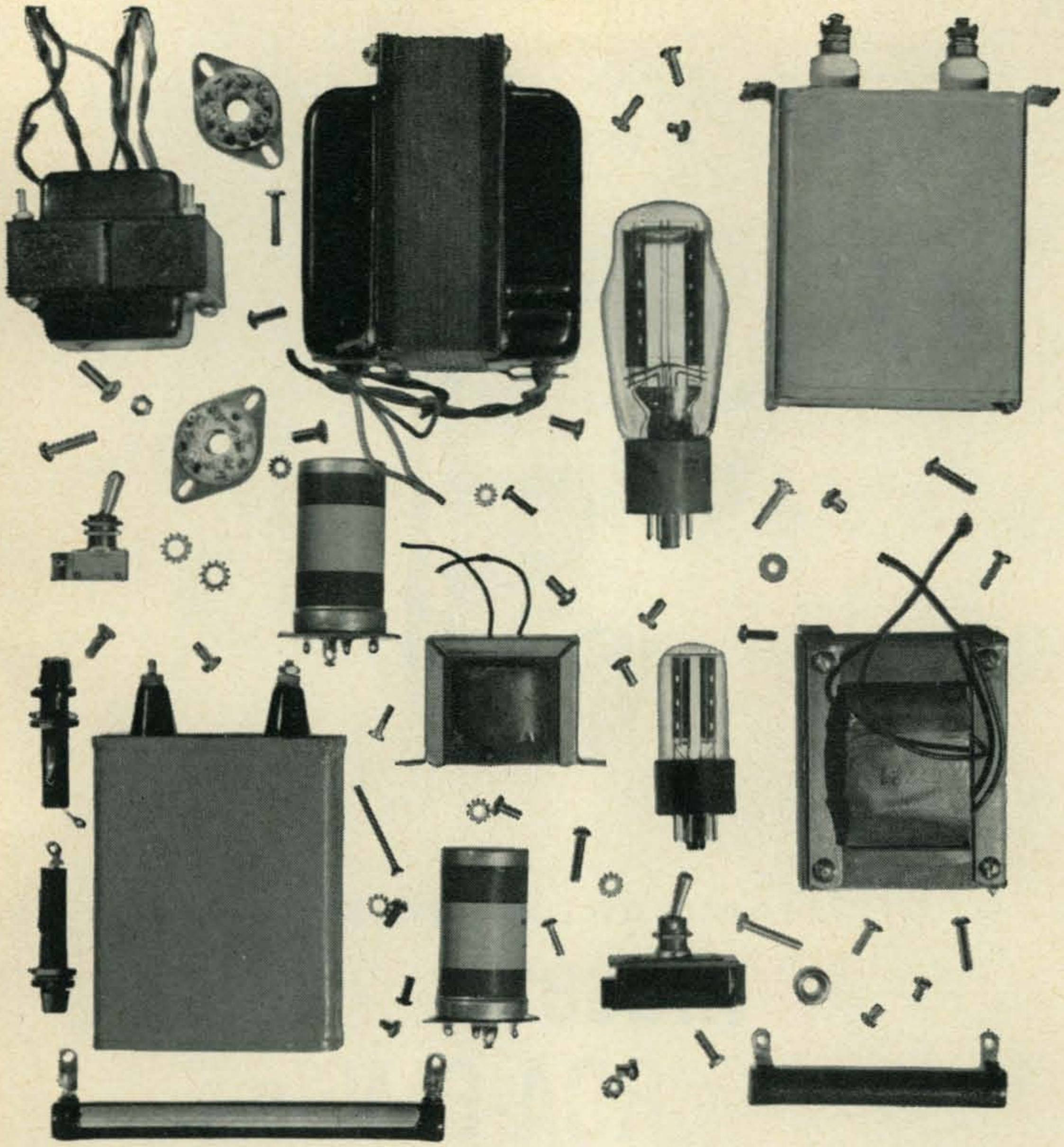
Well-known in amateur radio for more than a generation, Hammarlund again makes transmitter history. This time it's the 100-watt HX-500, advance-designed for virtually every mode of operation in use today—SSB, DSB, CW, FM, FSK for RTTY. We are pleased to point out that Hammarlund designers specified a pair of RCA-6146 beam power tubes for the final.

Today more rigs use RCA-6146 beam power tubes than any other power type or brand. They are conservatively rated, have tremendous reserve of cathode emission, deliver full power output at relatively low plate voltage—and they are economical.

RCA Tubes for amateurs, and information on their use, are available at RCA Industrial Tube Distributors everywhere.

Electron Tube Division, Harrison, N. J.

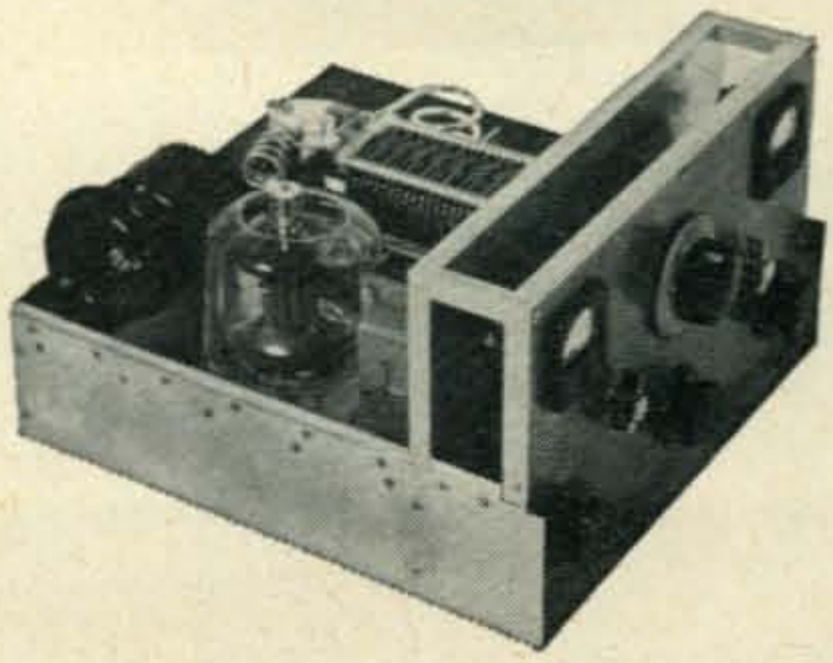
The Most Trusted Name in Electronics
RADIO CORPORATION OF AMERICA



YOU'LL PART WITH ALL THESE PARTS

when your transmitter is built with a new Eimac zero-bias triode.

Look to the right and you'll see an amazingly simple transmitter. Look closely and you'll also see the secret behind its simplicity: Eimac's new 3-400Z zero-bias triode. This one tube eliminates *both* screen grid and bias power supplies. (And all the parts you see on the page!) Designed for grounded grid service, it's rated at 400 watts plate dissipation and a 3-1000Z version is rated at 1KW. Product distortion figures for each: better than —35db below maximum output! For more data write: Amateur Services Dept., Eitel-McCullough, Inc., San Carlos, Calif.

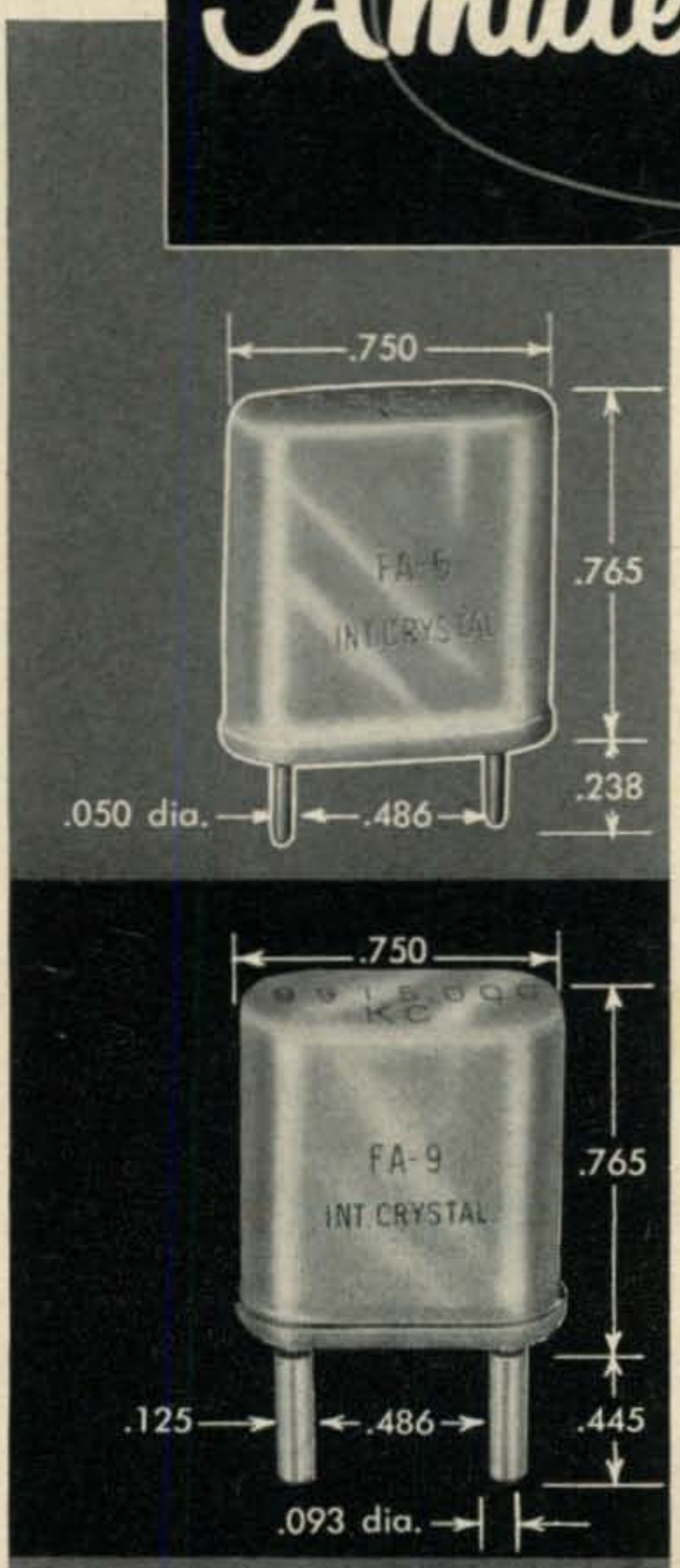


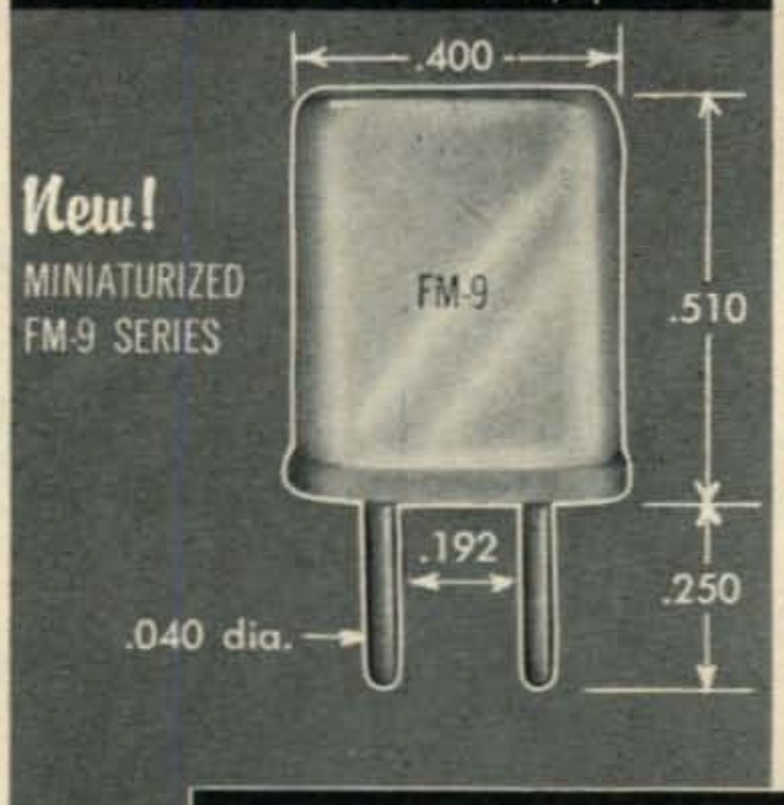
Eimac®

For further information, check number 14, on page 126

Amateur Crystals

1000 KC to 137 MC - .01% TOLERANCE





Wire mounted, plated crystals for use by amateurs and experimenters where tolerances of .01% are permissible and wide-range temperatures are not encountered.

Just any crystal in any oscillator will NOT combine to produce spot frequencies. These crystals are designed to operate into a 32 mmf load on their fundamental between 1000 kc and 15000 kc. Overtone crystals operate at anti-resonance on 3rd mode and series resonance on 5th and 7th mode crystals.

- **HOLDERS:** Metal, hermetically sealed. FA-5 and FA-9 are HC/6U pin type while the FM-9 is an HC/18U pin type.
- **FREQUENCIES** (Specify crystal type and frequency when ordering.)

	FA-5 and FA-9	Price	FM-9	Price
Fundamental	1000 - 1499 kc	$ 5.75	Not available	
	1500 - 1799 kc	$ 4.95	Not available	
	1800 - 1999 kc	$ 4.40	Not available	
	2000 - 9999 kc	$ 3.30	8000 - 9999.999 kc	$ 5.00
	10000 - 14999 kc	$ 4.40	10000 - 15000 kc	$ 5.50
	15000 - 20000 kc	$ 5.50	15001 - 19999.999 kc	$ 6.50
Overtone (3rd)	10 - 14.99 mc	$ 4.40	Not available	
	15 - 29.99 mc	$ 3.30	20 - 39.99 mc	$ 5.00
	30 - 59.99 mc	$ 4.40	40 - 59.99 mc	$ 5.50
Overtone (5th)	60 - 75.99 mc	$ 4.95	60 - 89.99 mc	$ 6.50
	76 - 99.99 mc	$ 7.15	90 - 100 mc	$ 8.50
	Not available		101 - 110 mc	$10.00
Overtone (7th)	100 - 137 mc	$ 9.35	Not available	

Overtone crystals are calibrated on their overtone frequency. They are valuable for receiver-converter applications and are NORMALLY NOT UTILIZED IN TRANSMITTERS, since only a small amount of power is available under stable operating conditions.

- **CALIBRATION TOLERANCE:** ± .01% of nominal at 30° C.
- **TEMPERATURE RANGE:** −40° to +70° C. ± .01% of frequency at 30° C.
- **DRIVE LEVEL:** Recommended, maximum 3 milliwatts for overtones; up to 80 milliwatts for fundamentals, depending on frequency.

ONE DAY PROCESSING . . .

Orders for less than five crystals will be processed and shipped in one day. Orders received on Monday through Thursdays will be shipped on the day following. Orders received on Friday will be shipped the following Monday.

WRITE FOR 1961 CATALOG FREE!

INTERNATIONAL CRYSTAL MFG. CO., INC.

18 NORTH LEE • OKLAHOMA CITY, OKLA.

For further information, check number 15, on page 126

For further information, check number 16, on page 126

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FOUR BEAM PENTODES FOR S.S.B.

What are your plans for single-sideband? Going to build a new rig or just up-date the one you now have? Either way, you'll find a Penta beam pentode to do the job . . . from less than 200 watts input right on up to the legal limit. Both amateurs and equipment manufacturers have learned that for minimum distortion, better linearity, and greater output, Penta pentodes are superior—not just in theory, but in actual, on-the-air operation.

The key to the superior performance of the 75-watt PL-177A, the 125-watt PL-4E27A, the 400-watt PL-175A, and the 1000-watt PL-172, is the suppressor grid. The longer plate voltage swing which can be obtained at a given screen voltage is the direct result of the electron beaming due to use of the suppressor, and leads to increased efficiency and output.

If you're buying a new transmitter or amplifier rather than building, look for Penta tubes in the equipment you buy.

Write for data sheets for any or all of these well designed, rugged Penta pentodes. Ask, also, for your free copy of "Transmitting Tubes for Linear Amplifier Service," which explains in detail why pentodes are your logical choice for single-sideband use.

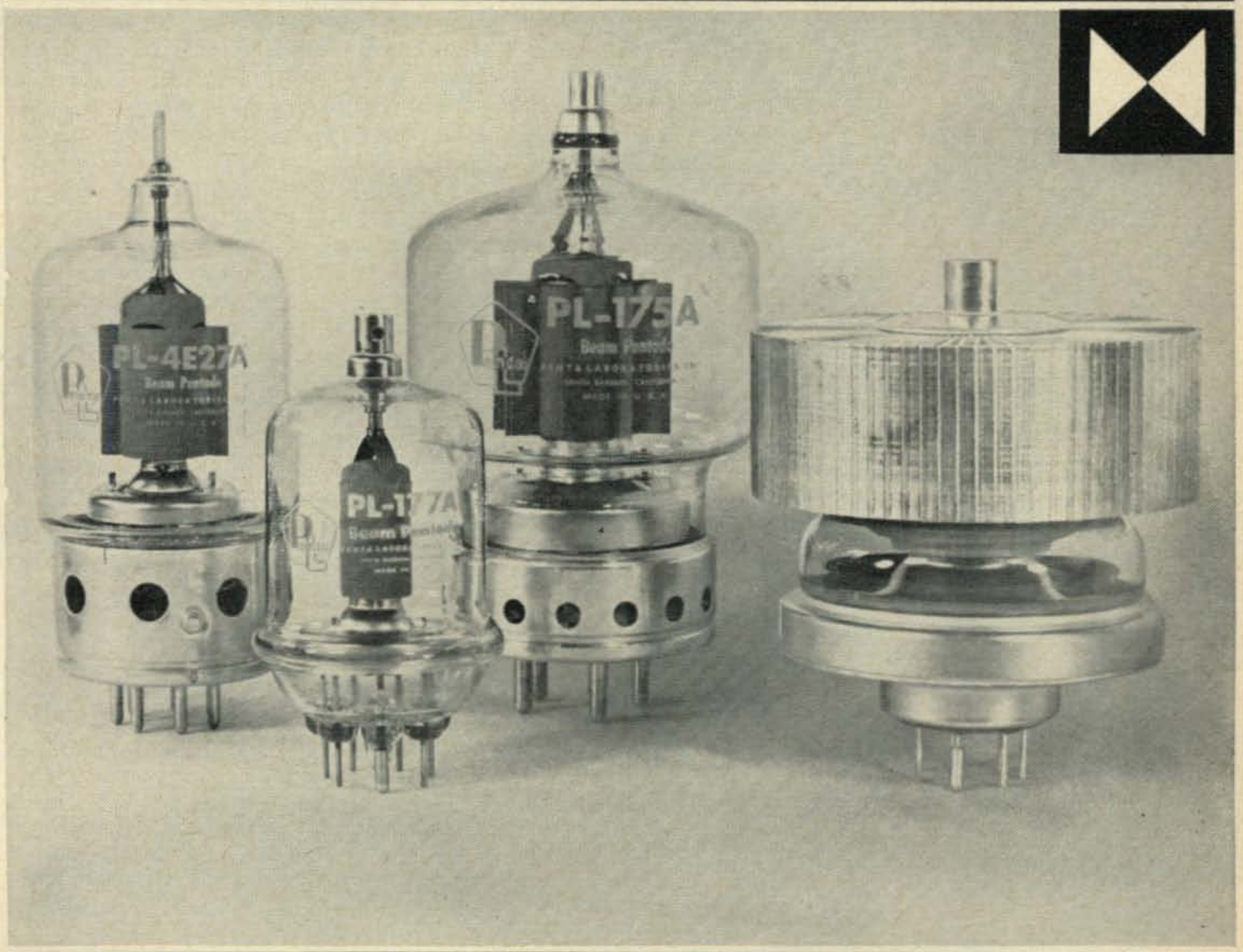
RATINGS

Type	FILAMENT Voltage (Volts)	FILAMENT Current (Amps)	Max. Plate Dissipation (Watts)	USEFUL OUTPUT* CLASS-AB, LINEAR AMPLIFIER Plate voltage in volts 1000	1500	2000	2500	3000
PL-177A	6.0	3.3	75	96W	140W	210W	—	—
PL-4E27A	5.0	7.5	125	—	—	220W	280W	—
PL-175A	5.0	14.5	400	—	—	445W	570W	680W
PL-172	6.0	7.8	1000	—	—	1040W	1260W	1590W

*Actual power output delivered to load from typical amplifier.

PENTA LABORATORIES, INC.

312 North Nopal Street
Santa Barbara, California



For further information, check number 18, on page 126

"INVADER"

EXTENSIVELY FIELD

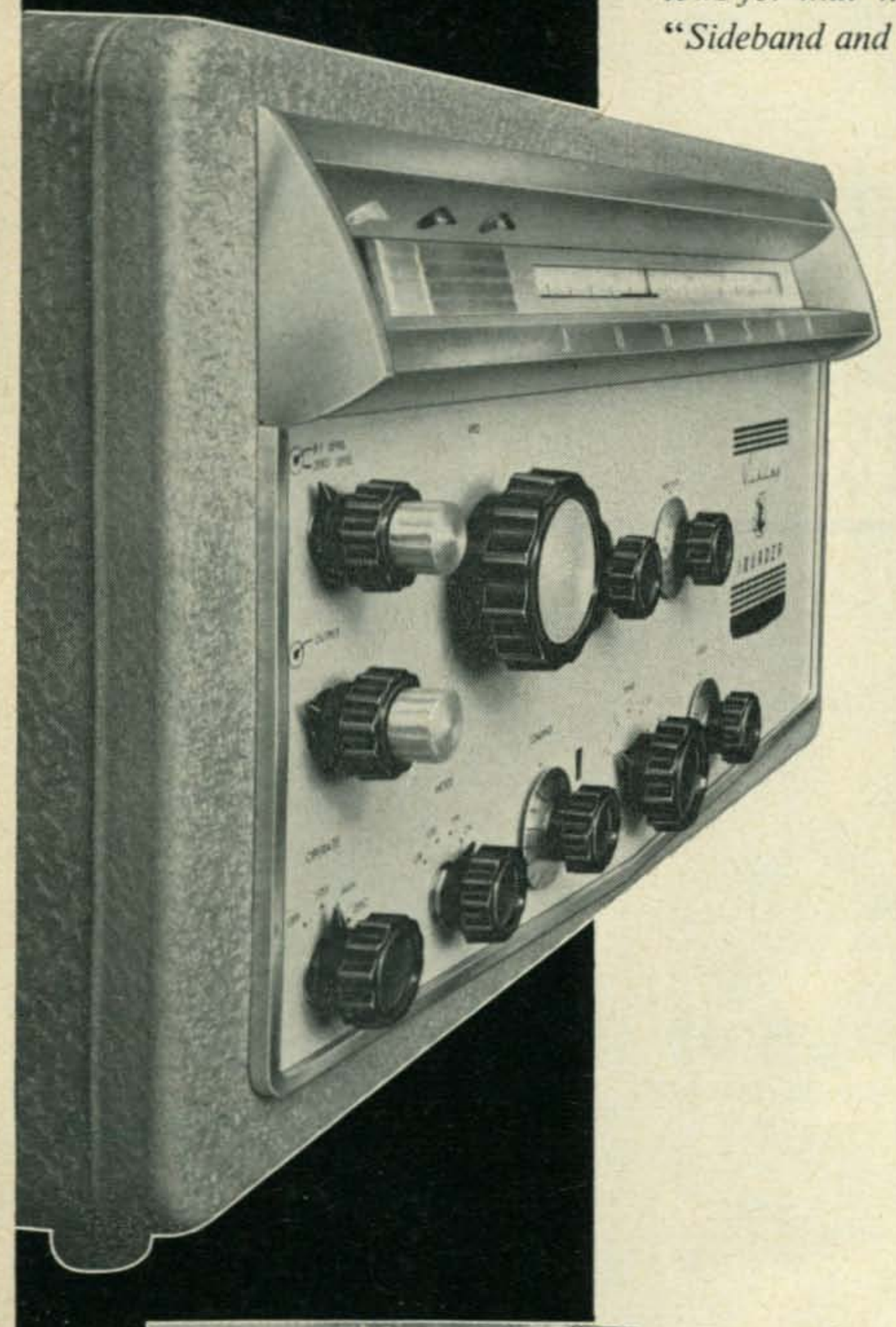
here are typical reports:

"Sideband never sounded so good!"

"Excellent penetration and an outstanding signal!"

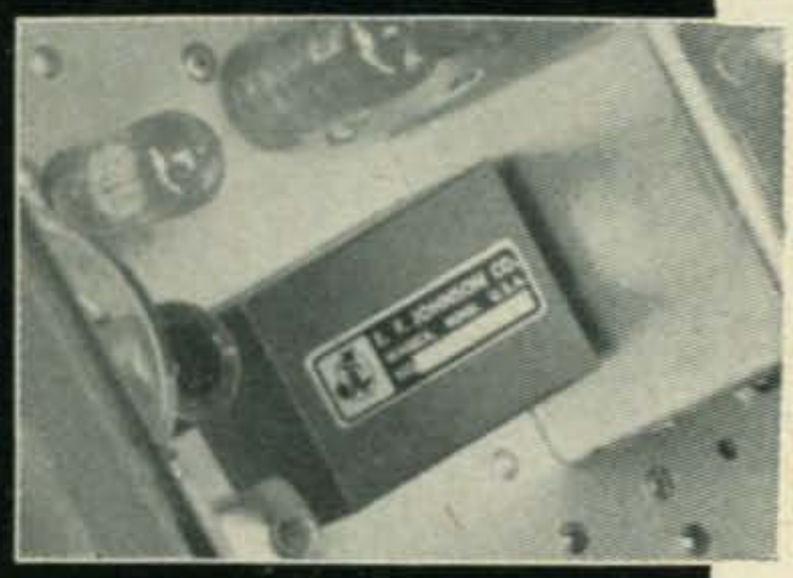
"Full-fidelity voice reproduction—picks up the lows for that 'natural' sound for the first time!"

"Sideband and carrier suppression is tops!"



Here's the transmitter with the sharp, penetrating signal you've been waiting for—plus *more* exclusive operating and convenience features than any other SSB Transmitter on the market today! A classic of modern communication equipment design, the "Invader" offers instant bandswitching coverage 80 through 10 meters—no extra crystals to buy—no retuning necessary—delivers a solid 200 watts CW input; 200 watts SSB input; 90 watts input on AM! Unwanted sideband suppression is 60 db or better! Built-in VFO is differentially compensated. Exclusive RF controlled audio AGC and ALC (limiter type) provide greater average speech power—high gain push-to-talk audio system has plenty of reserve gain for either crystal or dynamic microphones. VOX and anti-trip circuits are extremely smooth in operation—built-in anti-trip matching transformer—adjustable VOX time delay circuit. Mixer-type shaped keying is crisp, sharp—click and chirp free. Single knob wide range pi-network output circuit—fully TVI suppressed. Blocking and operating bias for noise-free T-R switch operation.

Cat. No. 240-302-2—Wired and tested with tubes, crystals and crystal filter. **Amateur Net ....** **$619.50**



superior to phasing-type units . . . obsoletes all other filter types!

EXCLUSIVE—Now, for the first time, not only **better** audio fidelity—but balanced audio response in a filter-type transmitter. The only equipment on the market using a specially developed high frequency, symmetrical, multi-section band-pass crystal filter for more than 60 db sideband suppression—more than 55 db carrier suppression! Select either upper or lower sideband instantly with a front panel "mode" switch.

the finest SSB signal on the air!

TESTED BY DOZENS OF UNBIASED AMATEURS!

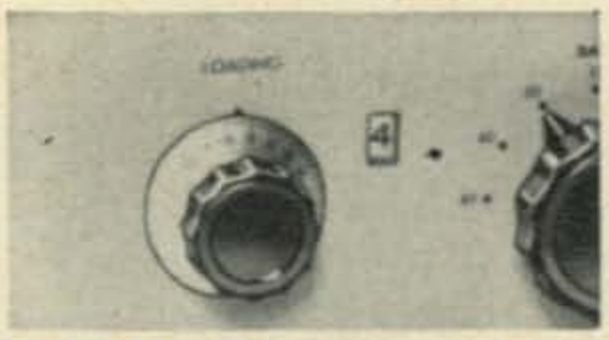
A BOLD STATEMENT FROM E. F. JOHNSON CO.

The sophisticated engineering and styling of the "Invader" is *unmatched* by other equipment within the amateur field—*bar none!*

Long recognized as the "first choice among the nation's amateurs" . . . Viking transmitters achieved popularity in a solid and healthy way. Known the country over as the line that gives you excellent engineering and performance, outstanding dollar value and more features at a popular price . . . the Viking line now achieves a new pinnacle with the introduction of the "Invader" and the "Invader-2000". We feel that the creative and imaginative engineering in the "Invader" sets aside "old fashioned" ideas that a unit is good simply on merit of the manufacturer's name alone! It has to perform—and nothing outperforms the "Invader!"

EXCLUSIVE—When converted to the Invader-2000—the only maximum legal power table-top unit available! (Remote power supply can be placed in any convenient location.)

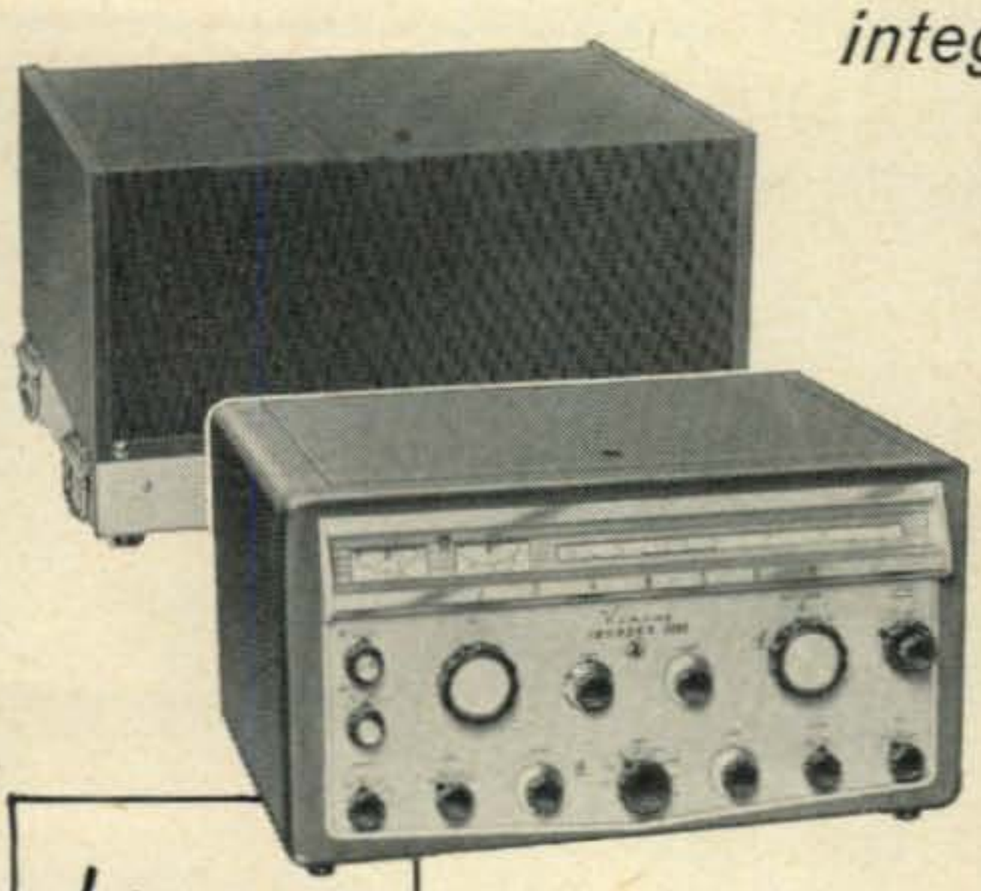
EXCLUSIVE—The only transmitter with both limiter ALC and audio AGC for an **extra** sharp signal! Reduces overdriving and flat-topping—increases average audio level for greater penetration and the **best** signal anywhere!



EXCLUSIVE—Single-knob wide range output circuit makes it possible to load into just about any conceivable type of antenna!

EXCLUSIVE—Full-time VFO heater element keeps VFO at operating temperature, even with the equipment turned off! No warm-up drift—rock-solid stability!

add hi-power conversion overnight for an integrated 2000 watt desk-top transmitter!



HI-POWER CONVERSION—Take the features and performance of your "Invader" . . . add the power and flexibility of this unique Viking "Hi-Power Conversion" system . . . and you're "on the air" with the "Invader-2000". Completely wired and tested—includes everything you need—no soldering necessary—complete the entire conversion in one evening!

Cat. No. 240-303-2 . . . Amateur Net $619.50

INVADER-2000—All the fine features of the "Invader", plus the added power and flexibility of an integral linear amplifier and remote controlled power supply completely wired and tested. Rated a solid 2000 watts P. E. P. (twice average DC) input on SSB; 1000 watts CW; and 800 watts input AM! Wide range output circuit (40 to 600 ohms, adjustable.) Final amplifier provides exceptionally uniform "Q". With multi-section power supply, tubes and crystals.

Cat. No. 240-304-2 . . . Amateur Net $1229.00

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8-PAGE BROCHURE . . .

Yours on request . . . complete specifications and photographs on the "Invader" and the "Invader-2000"!

FIRST CHOICE AMONG THE NATION'S AMATEURS

Viking®

E. F. JOHNSON COMPANY • WASECA, MINNESOTA.

For further information, check number 19, on page 126

S.S.B., A.M. and C.W.

80 Through 6 Meters

John D'Angelo, K1AFT
412 Bryant Street,
Malden, Mass.

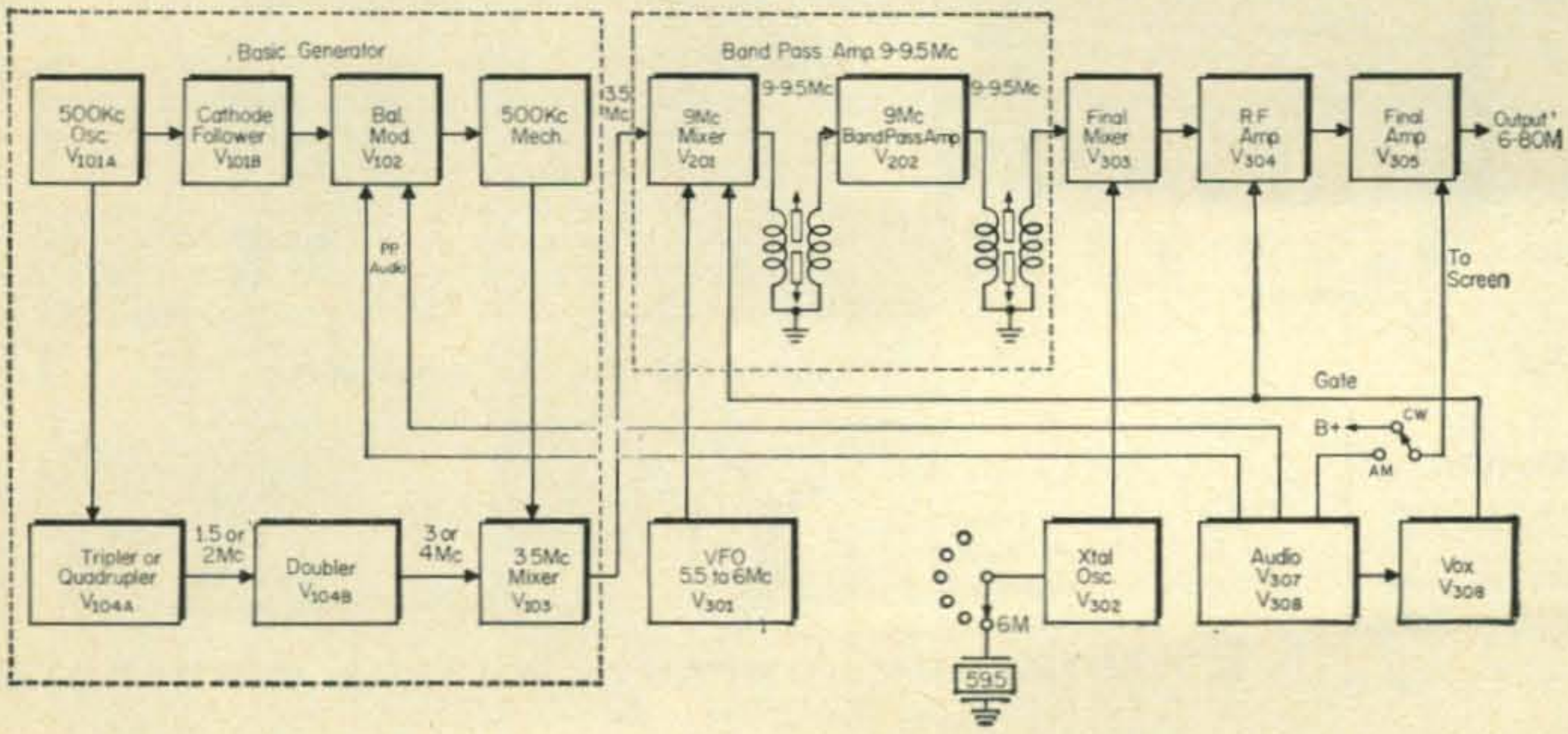
Here is a single sideband exciter featuring the amateur bands, 80 through 6 meters, completely bandswitched. In addition, a.m. by screen modulation as well as c.w. are included. The large slide rule dial coupled with a v.f.o. tuning rate of only 5 kc per knob rotation assures easy and pleasurable QSY. A monitor scope and a clean front panel give the unit a commercial appearance.

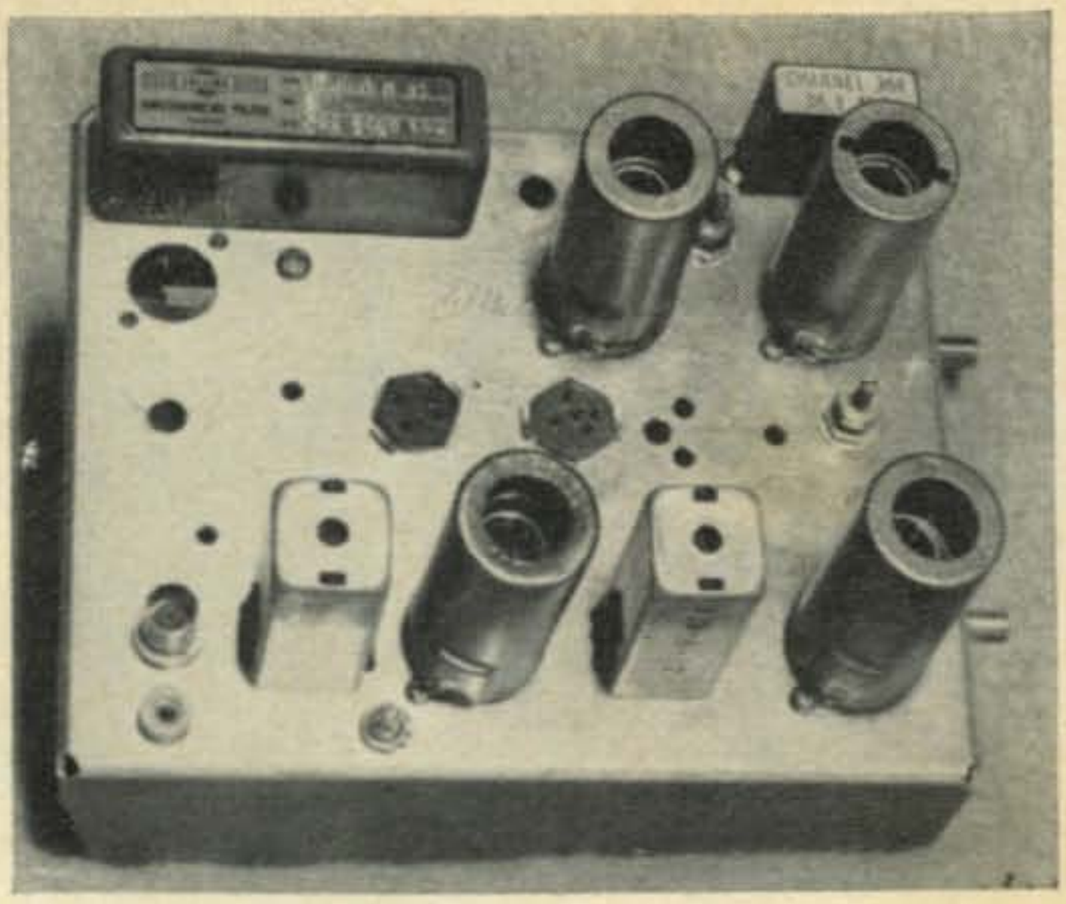
WHEN this project was undertaken about a year ago some of the goals were: (1) to build a sideband exciter incorporating the best features of commercial units yet be simple to construct in a reasonably well equipped amateur workshop. (2) To hold the cost down by using surplus parts wherever possible, and (3) To design for reliability and ease of operation. Most of these goals were achieved and the many flattering reports received during the past months of operation indicate that the hours spent on this unit were not wasted.

Circuit Description

Looking at the block diagram, fig. 1, we see that the basic sideband signal is generated at 500 kc by means of a 12AU7 balanced modulator, V_{102}, followed by a Collins mechanical filter. The 500 kc oscillator, V_{101}, is crystal controlled and, in addition to the balanced modulator, it also feeds a multiplier chain, V_{104}. The tuned circuits in the multiplier are selected by the mode switch so that in the LOWER SIDEBAND position the multiplier output is 4 mc, while in the UPPER SIDEBAND position the output is 3 mc. The multiplier output is mixed with the 500 kc filter output in V_{103}, a 12AT7 balanced modulator. The mixer output is fixed 3.5 mc upper or lower sideband signal. This system allows sideband selection withour carrier shift and results

Fig. 1—Block diagram of the sideband exciter that covers 80 through 6 meters and has a power output of 20 to 25 watts.





Top view of the basic sideband generator. Along the top edge from left to right are the Collins mechanical filter, V_{102}, L_{101}, V_{101} and crystal Y_{101}. Along the lower edge from left to right are J_{101} and TP_{101}, T_{102}, V_{103}, T_{101} and V_{104}. The miniature Amphenol connectors P_{101} and J_{101} can be seen at the center of the chassis. Below V_{101} can be seen L_{102} while potentiometer R_{102} can be seen between T_{102} and V_{103}. The two controls on the front edge are CARRIER BALANCE (top) and FUNCTION.

in the saving of two precision crystals[1].

Potentiometer R_1 is the CARRIER BALANCE control as is indicated in the schematics. Potentiometer R_2 is a miniature unit added to balance out any residual carrier passed by the multipliers.

The v.f.o., V_{301}, a high capacity Colpitts oscillator, tunes the range of 5.5 to 6 mc. A Pentagrid mixer V_{201}, combines the v.f.o. output and the 3.5 mc signal from the basic generator to produce a new frequency in the 9 to 9.5 mc range. A stage of amplification, V_{202}, and two double tuned i.f. transformers follow the mixer.

The response of the band pass amplifier is such that the unwanted products and the various harmonics of the mixed frequencies are greatly attenuated. As a result a very clean signal in the 9 to 9.5 mc range is supplied to the final mixer. This signal is heterodyned with the output of a crystal controlled oscillator running on the high side of the desired band. The final mixer is a 6AU8 tube, V_{303}, and cathode coupling is used because of its relative freedom from overload.

The resultant signal, now on the desired frequency is amplified by V_{304}, a 12BY7, which drives the 6146 final, V_{305} which is operated AB_1. The output power is approximately 30 watts.

When the mode switch is placed in the CALIBRATE position the 500 kc balanced modulator is unbalanced, the audio is biased out and a CALIBRATE LEVEL pot is inserted in the keyed mixer bias so that the exciter output can be adjusted to a suitable value for zero beating.

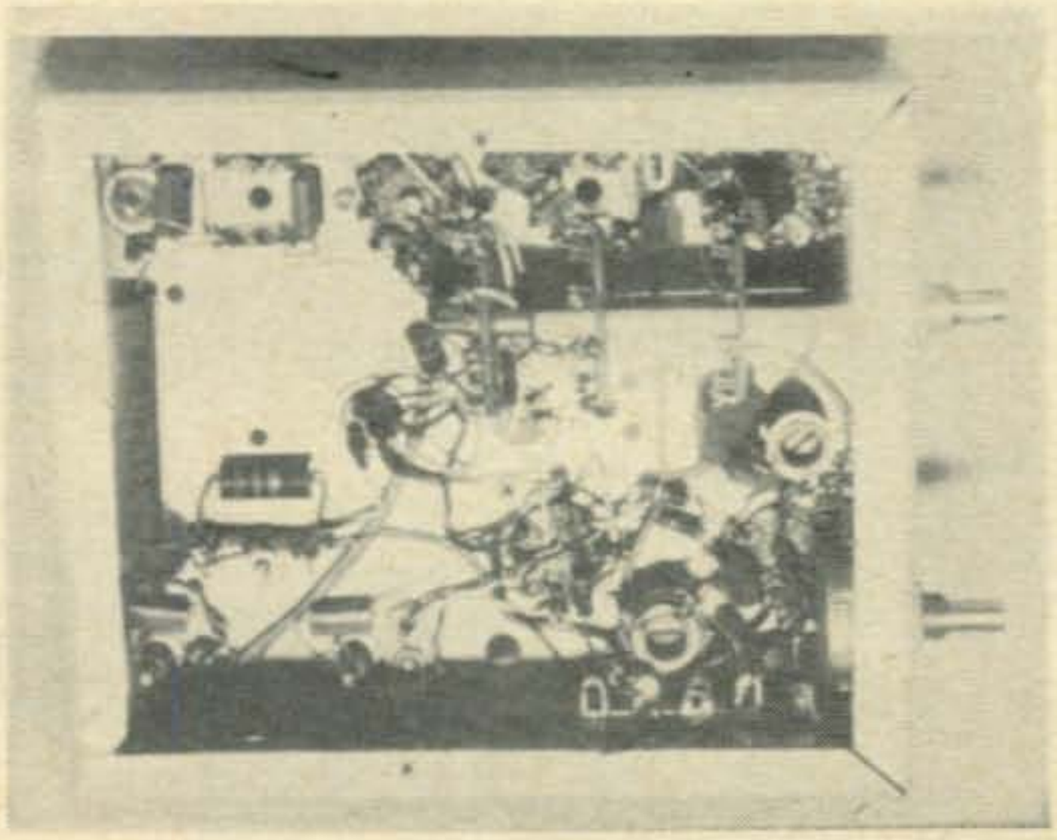
In the a.m. position the 500 kc modulator is again unbalanced to let the carrier through and an audio signal is fed to the screen of the 6146 final amplifier. The audio is transformer coupled to the screen for good modulation capabilities and adjustment of the audio and carrier level is no problem with the aid of the built in scope. In the CW position the audio is biased out and the second and third mixers are keyed with fixed bias. Transmit-receive is accomplished by keying the mixers and final bias.

Construction Details

The exciter is built on an aluminum chassis 15½ × 10½ × 2 inches, and is housed in a National Company NC-188 cabinet. The aluminum front panel is 16⅝ × 10 × ⅛ inches. These chassis and the others were fabricated from 1/16 inch sheet aluminum. This, however, is not recommended unless you have access to a sheet metal shop. Chassis of approximately the same dimensions are available commercially at most distributors.

Before any wiring is started, the main chassis layout should be completed, the front panel and dial assembly installed and enough room al-

[1] Bigler, George K., "A Sideband Package," *QST*, June 1958.



Bottom view of the basic sideband generator unit. Two small crystal sockets are used to mount the Collins mechanical filter in the lower left hand corner. Note the placement of coils L_{101} and L_{102}.

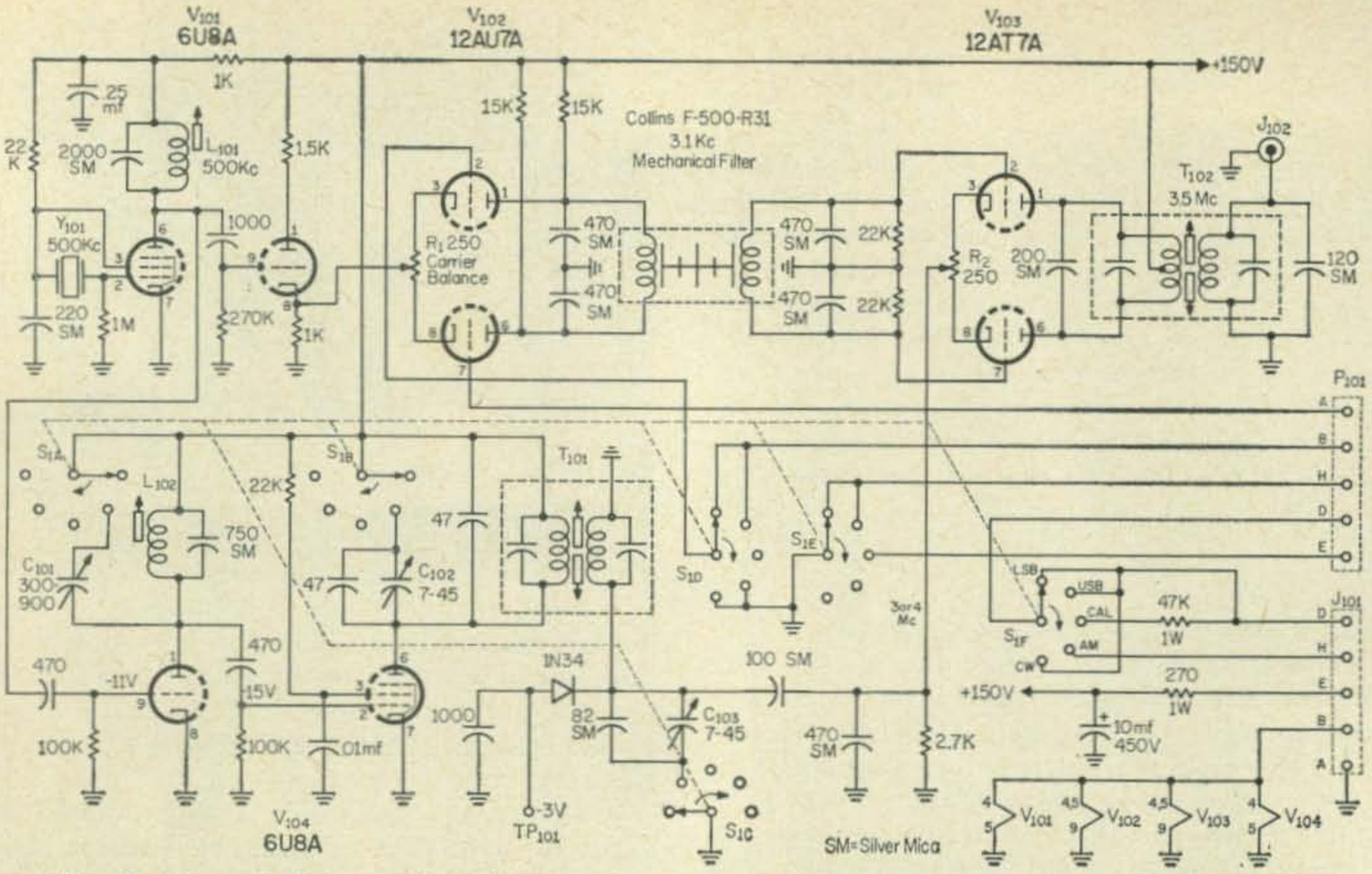


Fig. 2—Schematic diagram of the basic sideband generator unit. See photos on page 27 for parts placement information. T_{101} is a standard 4.5 mc discriminator transformer with the coupling capacitor from primary to secondary C.T. removed. All unmarked resistors are ½ watt. All capacitors are in mmf unless otherwise specified.

lowed for easy removal of the basic generator subassembly. (Remember that the mode switch and balance pot are mounted on the Basic Generator chassis and their shafts project through the front panel.)

Basic Generator—The basic generator is built on a chassis 6 × 5 × 2 inches as shown in photographs (page 27). When wiring this unit care should be taken to isolate the output of the mechanical filter from the 500 kc oscillator signal. The filter output is at a very low level while the oscillator level is several volts and coupling would produce carrier leakage. The circuit of the basic generator is shown in fig. 2. Make the length of the connecting cables long enough to reach when the subassembly is off the chassis.

Band Pass Amplifier—This subassembly is built on a 2 × 3 × 3 inch chassis which is mounted to the rear of the v.f.o. The i.f. cans, T_{201} and T_{202}, are standard 10.7 mc units whose band width is increased by the addition of 5 mmf capacitors from plate to grid. This increases the primary to secondary coupling and widens the band pass to about 600 kc.

The i.f. cans may be mounted by strapping them to the sidewall of the chassis. Appropriately positioned holes on the top and bottom plates permit access to the adjustment slugs. The wiring diagram is shown in fig. 3, the main diagram.

C_{301}—V.f.o. trimmer 2.5-3.0 mmf Hammarlund MAC-30.
C_{302}—V.f.o. tuning 10-100 mmf transmitting variable.
C_{303}—V.f.o. temp. compensator 3.5-27 mmf differential capacitor Johnson 167-32.
C_{304}—Neutralizing capacitor 1.5-7 mmf Erie TS-A.
C_{305}—Grid tuning capacitor 2.5-30 mmf Hammarlund MAC-30. Use insulated extension and ground capacitor with shoulder washers.
C_{306}—Neutralizing capacitor 1.5-7 mmf Erie TS-A.
C_{307}—Final tuning capacitor 17-335 mmf National STH-335.
CR_1—150 PIV @ 100 ma
CR_2—Texas Instrument IN2071, 600 V PIV @ 750 ma
J_{301}—Miniature 5 pin connector Amphenol 126-011.
J_{302}—Chassis mounting BNC connector.
J_{303}—Mike connector Amphenol 75 PC 1M.
J_{304}—Closed circuit phone jack.
K_{301}—VOX relay 4 pole d.t. 15K coil.
L_{301}—7.5 turns B&W 3011 Miniductor 1" dia. 16 t.p.i.
L_{302}—L_{319}—See coil table.
L_{320}—7 turns #12 tinned 1" dia. Tap at 3 turns from plate.
L_{321}—Airdux 1212D6 23 turns 12 t.p.i., 8 turns 6 t.p.i. Tapped as shown in fig. 3.
M_1—0-100 ma meter. Triplet 327T.
P_{301}—Miniature 5 pin plug Amphenol 126-010.
S_{301}—5 pole 6 position rotary switch Centralab 2022.
S_{302}—2 pole 6 position rotary switch Centralab 2002.
S_{303}—S.p.s.t. switch on a.f. gain control.
T_{201}, T_{202}—10.7 mc i.f. transformers. Primaries and secondaries shunted as shown. Miller #1463.
T_{301}—Bias transformer (6.3 v. fil. transformer reverse connected) Stancor P-6465.
T_{302}—Power transformer 700 v. ct. 200 ma Triad R-20A.
T_{303}—Universal output transformer UTC R-38.
T_{304}—Microphone to grid transformer 1:15 turns ratio Triad A-3X.
Y_{301}—59.5 mc International Crystal FA-5.
Y_{302}—38.0 mc International Crystal FA-5.
Y_{303}—30.5 mc International Crystal FA-5.
Y_{304}—23.5 mc International Crystal FA-5.
Y_{305}—16.5 mc International Crystal FA-5.
Y_{306}—13.0 mc International Crystal FA-5.

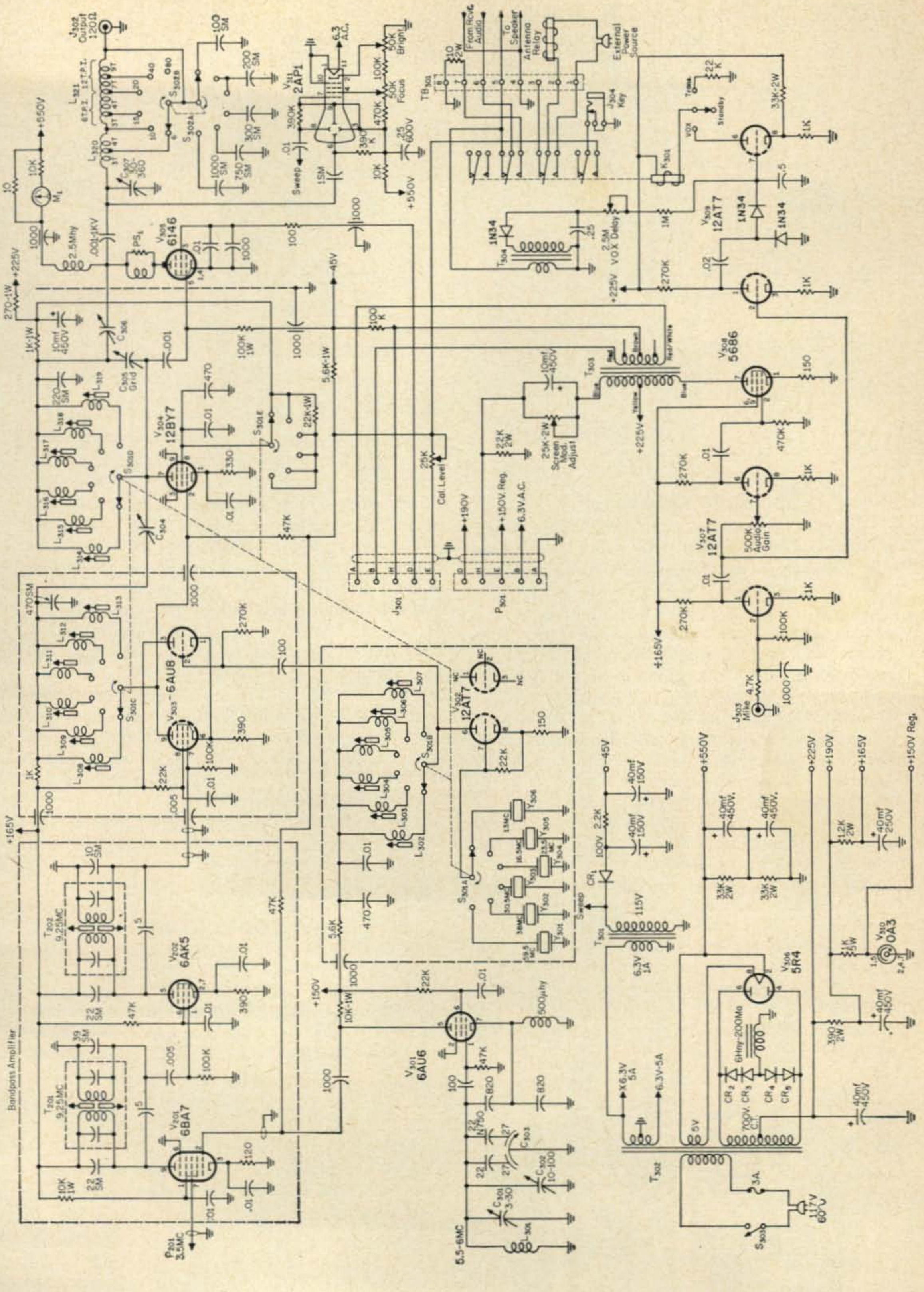


Fig. 3—Main diagram of the s.s.b., a.m., and cw. transmitter covering 80 to 6 meters. The bandpass amplifier is built as a small separate unit and mounted on the main chassis. The basic generator shown in Figure 2 connects to J_{301}, and P_{301} on the main chassis. All resistors are ½ watt unless otherwise indicated. All decimal value capacitors are in mf; all others are in mmf unless otherwise indicated.

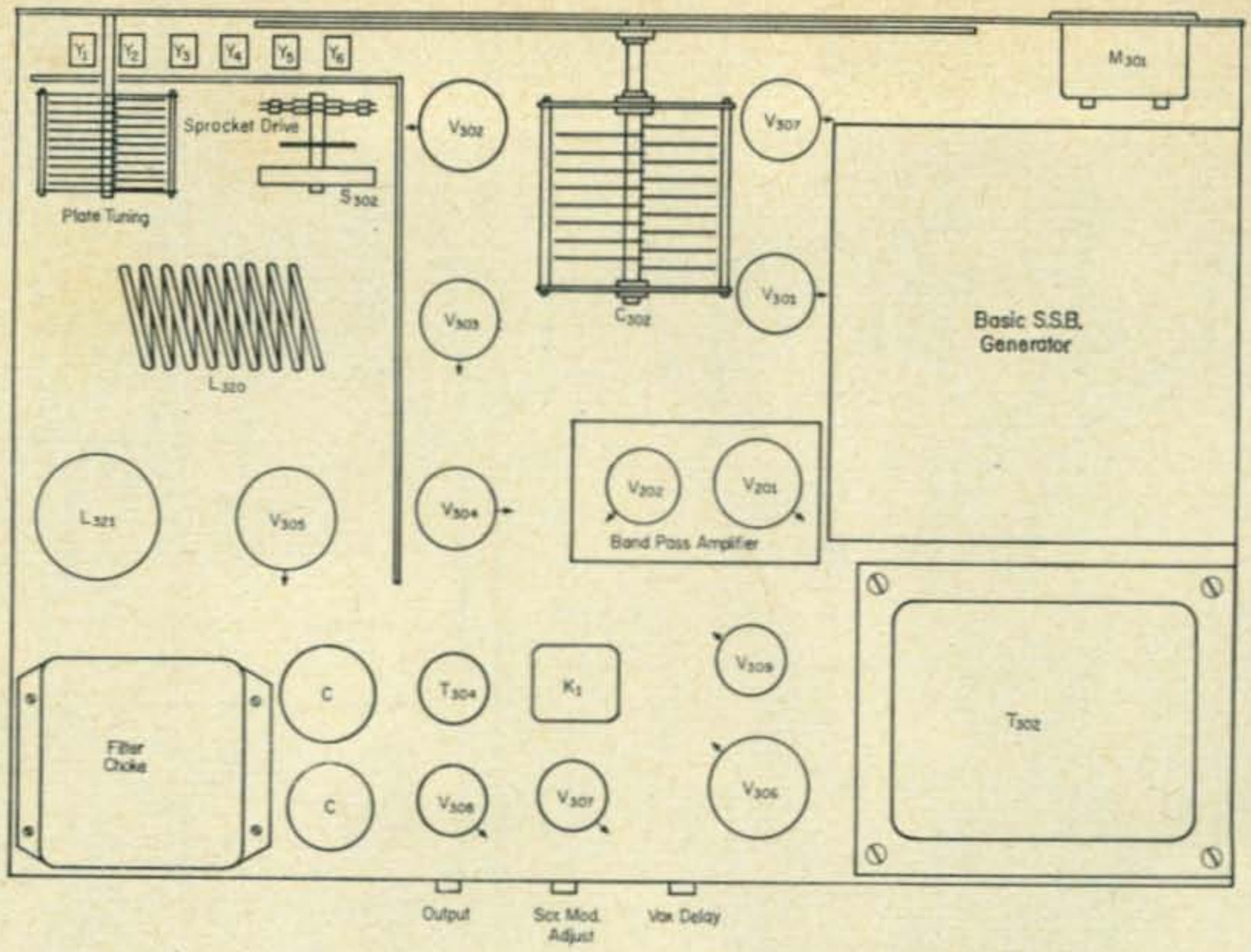


Fig. 4—Main chassis layout of the s.s.b., a.m., and c.w. transmitter. Arrows on tubes indicate socket key way positions. Not shown is the 2AP1 scope tube.

Main Chassis

The main chassis layout is shown in fig. 4 and the various photographs. No exact dimensions are given since the layout will vary somewhat with the components used.

The front panel should be mounted on the chassis and mated with the cabinet to assure proper fit. Next, the dial assembly should be mounted on the front panel with the flywheel just clearing the top of the chassis. The Basic Generator chassis should then be fitted into place before proceeding with the mounting of the power supply components behind it. Make sure that the generator subassembly can be removed easily for alignment and servicing.

V.F.O.—The v.f.o. tuning capacitor (10-100 mmf) is mounted on a bracket to the rear of the dial as shown in the illustrations. The measurements are shown in fig. 5A. A flexible coupling is used between the dial and capacitor to accomodate a reasonable amount of misalignment. The v.f.o. components are mounted on the main chassis below the bracket. When wiring the v.f.o. take the usual precautions; mount all the parts securely and use short stiff wires for stability. A special mounting base for the v.f.o. coil is shown in fig. 5B.

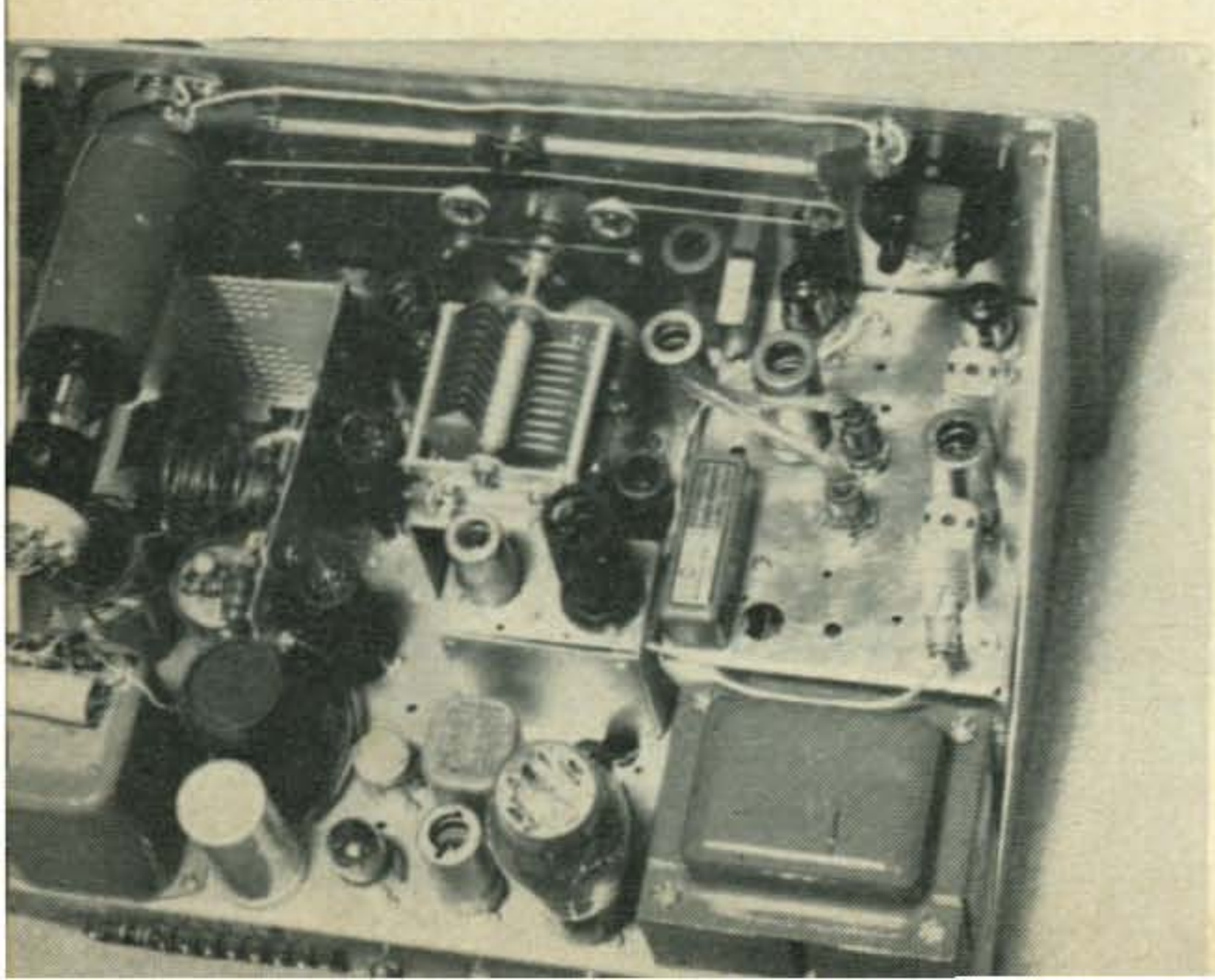
Bandswitch—The bandswitch controls two sets of wafers, one below and the other above the chassis with chain and sprocket drive used to couple the two shafts. The crystal oscillator, mixer, and driver coils are mounted on two brackets which also support the switch wafers. Mount the brackets in place and check the mechanical alignment of the switch shaft before mounting and wiring the coils. The coils are not to be mounted or wired until all the other circuits are wired and voltages are available. Then they are to be mounted, wired and adjusted as directed in the alignment section. It is difficult to reach the bottom coils after the top ones are in place.

The section of the bandswitch above the chassis. $S_{302_A, B}$, are located in the front area of 6146 cage as shown in fig. 4.

Testing and Alignment

After the wiring except for the coils on the bandswitch has been completed, several basic tests must be made.

Power Supply—Make the routine resistance measurements from all the B+ lines to ground to check against the possibilities of shorts. If the resistances check out, fire up with the 6146 out



Top view of the sideband exciter. Layout of components and subchassis may be compared to fig. 4.

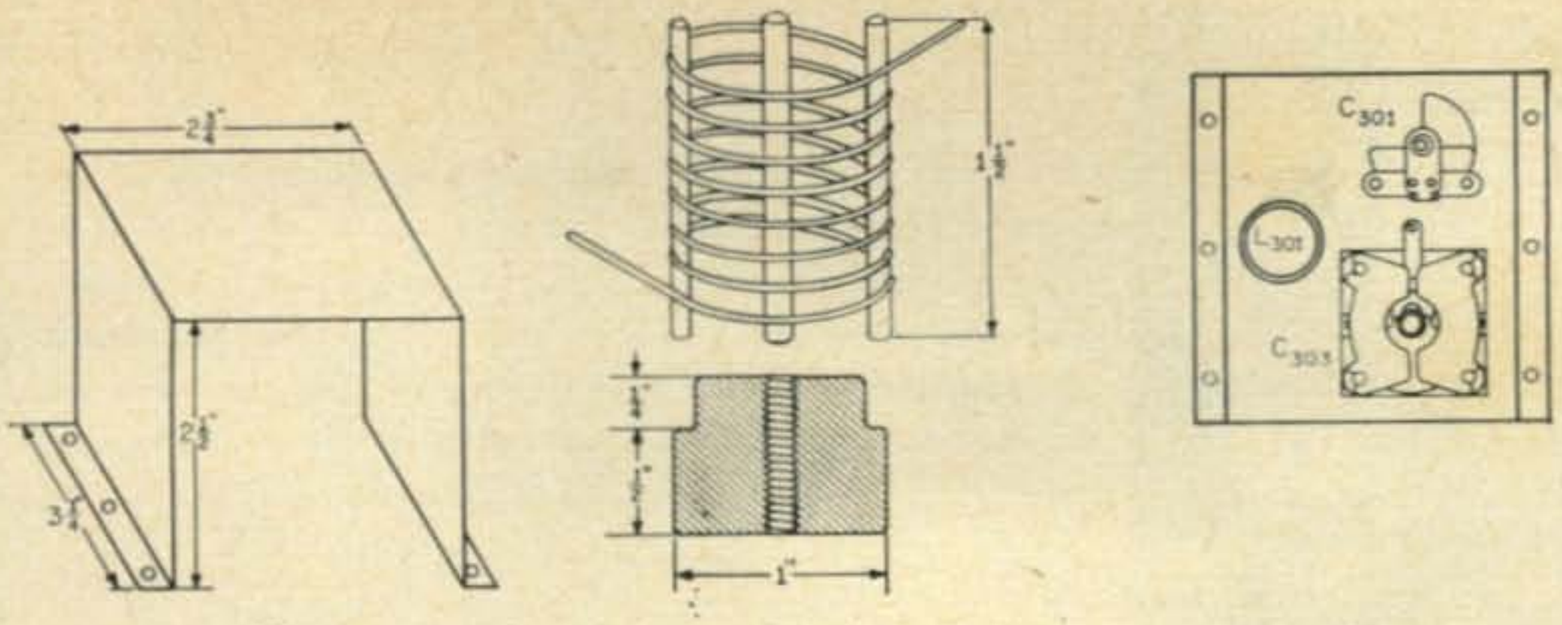


Fig. 5—(A) V.F.O. capacitor mounting bracket (B) V.F.O. coil mounting base is made from a ¾" section of 1" polystyrene dowel. (C) Layout of the v.f.o. compartment.

of the circuit. The voltages should be close to those marked in fig. 3 but somewhat higher due to the reduced load.

Audio Amplifier—An audio signal is applied to the microphone input jack and the signal is then traced through with a scope. Observe each check point (plates-grids) for appropriate gain and distortion levels. The final test, of course, will be the audio quality when on the air.

Basic Generator—Connect P_{101} and J_{101} and proceed to check the signal chain as follows.

Adjust the 500 kc oscillator tuning, L_{101}, by placing a v.t.v.m. d.c. probe on pin 9 of V_{104}. Adjust L_{101} for slightly less than maximum voltage. The voltage here should be about —11 volts. Next, connect the probe to V_{104}, pin 2. Place the mode switch to LOWER SIDEBAND position and tune L_{102} slug for maximum voltage at 2 mc. Check this frequency with a grid dip meter. The voltage here should be about —15 volts. Move the probe to Test Point 101 and tune T_{101} primary and secondary winding for maximum voltage at 4 mc. Check the frequency with a grid dip meter. The voltage here should be about —3 volts.

Place the mode switch in the UPPER SIDEBAND position and place the v.t.v.m. probe on V_{104}, pin 2. Tune C_{101}/L_{102} to 1.5 mc. Check the frequency with the grid dip meter. The voltage here should be about —15 volts. Move the v.t.v.m. probe to TP-$_{101}$ then tune C_{102} and C_{103} to 3 mc. Check this frequency with the grid dip meter. The voltage here should be about —3 volts. Turn the mode switch to the CALIBRATE position (this unbalances the modulator) and connect either a receiver or a high frequency scope to J_{102} and tune T_{102} to 3.5 mc. Use a 15 mmf capacitor in series with the lead to J_{102}. The tuning of the subassembly will have to be rechecked later on when the 500 kc crystal is brought to the exact frequency.

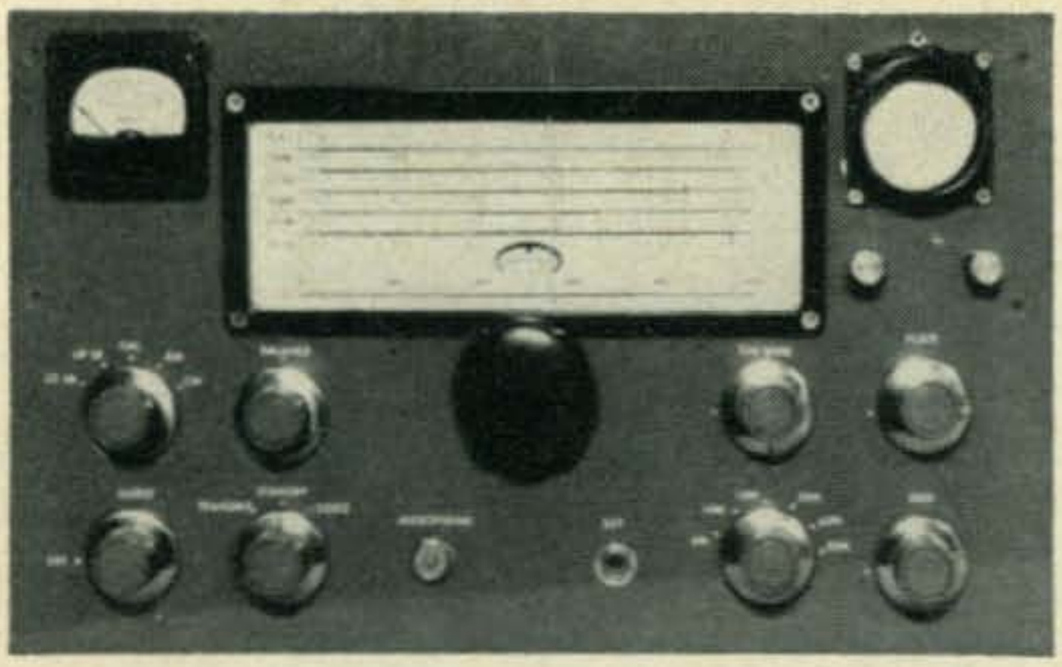
Band Pass Amplifier—For those that have access to laboratory instruments the band pass amplifier can easily be tuned on the bench with the aid of auxiliary power supply and signal generator. It was found that a grid dipper can be used very effectively as a signal generator as follows: place a 2 turn loop around the grid dipper coil and connect the loop through a suitable length of a twisted pair to P_{201}. Set the grid dipper frequency to 9.25 mc with the aid of a general coverage receiver. Connect a multimeter to the grid return of V_{202} (20,000 ohms per volt) and then load the secondary of T_{201} with a 1000 ohm resistor and peak the primary. Move the 1000 ohm load to the primary of T_{201} and tune the secondary. Check the bandwidth of T_{201} (the meter should show a peak at 9.5 mc and 9.0 mc with a dip at 9.25 mc). Make sure the 1000 ohm resistor is removed for the bandwidth test. If the bandwidth is too wide decrease the coupling between the primary and secondary windings by reducing the size of the coupling capacitor (5mmf on the schematic). If the response shows a single peak reverse the connection to one of the windings. Repeat the tuning and bandwidth check for T_{202} and then check the overall response of the band pass amplifier. You will notice that the overall response is more narrow than the individual bandwidths and the 3 db points will fall at 9.0 and 9.5 mc.

V.F.O. and Crystal Oscillator—Check the v.f.o. frequency with a general coverage receiver. It should tune the range of 5.5 to 6.0 mc. Set the mode switch to c.w., the operation switch to TRANSMIT and connect the r.f. probe of the v.t.v.m. to V_{303}, pin 7. Tune the v.f.o. across its range. The meter should show the response of the band pass amplifier. Leave the v.f.o. in the middle of its range. Set the band switch to 6 meters and connect a 1 meg resistor to pin 2, V_{303}, and the v.t.v.m. d.c. probe to this resistor. (The series 1 meg resistor is used to avoid loading of the tuned circuits by the probe capacity.) Disconnect the B+ voltage from V_{303}, then install and tune the crystal oscillator 6 meter coil. Switch to 10 meters, install and tune the 10

COIL TABLE

Coil	*Band*	*Freq. Mc.*	*Turns*	*Gauge*	*Slug**	
L_{302}	6	59.5	8	24	Green	
L_{303}	10	38.0	10	30	Green	Crystal
L_{304}	15	30.5	14	30	Green	Osc.
L_{305}	20	23.5	17	30	Red	Coils
L_{306}	40	16.5	24	30	Red	
L_{307}	80	13.0	35	30	Red	
L_{308}	6		6½	18	White	
L_{309}	10		10	30	Green	
L_{310}	15		14	30	Green	Mixer
L_{311}	20		23	30	Red	Coils
L_{312}	40		50	30	Red	
L_{313}	80		100	18	Yellow	
L_{314}	6		6½	30	White	
L_{315}	10		10	30	Green	
L_{316}	15		14	30	Green	Drive
L_{317}	20		23	30	Red	Coils
L_{318}	40		50	30	Red	
L_{319}	80		100	30	Yellow	

*All coil forms CTC LS-6



Front view of the sideband exciter. The meter in the upper left corner is connected in the 6146 B+ feed and the scope in the right corner is permanently connected across the r.f. output to permit constant monitoring of the signal. The two controls below the scope are INTENSITY and FOCUS. The tuning dial is made by Eddystone.

meter coil and so on until the crystal oscillator is operative on all bands. In tuning this oscillator you will notice that the output increases slowly then drops sharply. The slug should be left at the point just below maximum output from the oscillator. The drive voltages for the various bands, as read on the v.t.v.m. are as follows: 6m —9v; 10m —12v; 15m —12v; 20m —12v; 40m —14v; 80 —12v. Turn the band switch through the various bands a few times to make sure the crystal oscillator starts reliably every time. Reconnect B+ to V_{303}.

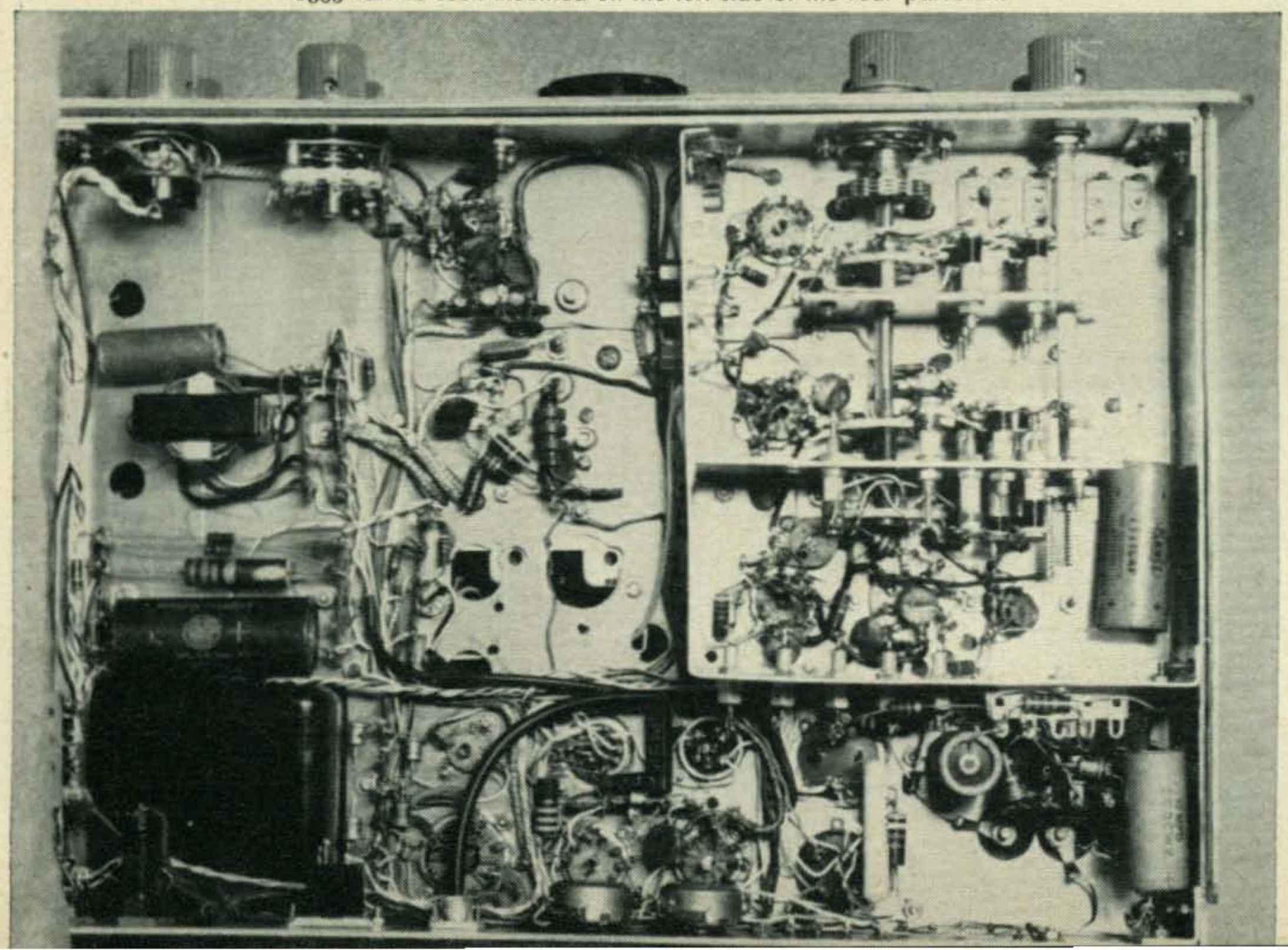
Mixer—Disconnect B+ from the 12BY7 driver tube V_{304}, and connect the one meg resistor to the grid, pin 2. Connect the v.t.v.m. to this resistor and, starting from the 6 meter position, install and tune the mixer coils. The drive voltage as read on the v.t.v.m. will be as follows: 6m —1.1v; 10 —2v; 15m —1.8; 20m —1.7v; 40m —2.5v; 80m —2.1v.

At this point the final frequency can be checked with a good amateur receiver and the v.f.o. set accurately by means of the trimmer capacitor. Connect a pick up loop to the antenna terminal of the receiver and tune the receiver to the sideband generator signal. A clean c.w. note should be heard. Adjust the v.f.o. trimmer capacitor so that the band edges are covered with a slight overlap. Remember that only a 500 kc segment of any one band can be covered with the high frequency crystals specified on the schematic.

Driver—Reconnect B+ to the 12BY7 driver and disconnect the screen and plate voltages from the 6146 final. Disconnect the bias from the 100K resistor on the 6146 grid and connect the v.t.v.m. to the bottom of this resistor. Proceed to install and tune the driver coils. Tune for maximum v.t.v.m. indication.

When tuning the driver coils the 3-30 mmf grid tuning capacitor, C_{305}, should be centered on its capacity range on all bands except 6 and 10 meters. On these two bands the capacitor should be set close to minimum and the coils tuned to 50.5 and 29 mc respectively to obtain a more reasonable L/C ratio.

Bottom view of the complete s.s.b. transmitter. The large shielded enclosure at the upper right contains the 9 mc mixer and exciter stages. The multi-gang rotary switch is S_{301}. Note the mounting of slug tuned coils L_{302}-L_{319} on the two aluminum partitions supporting S_{301}. Final grid tuning capacitor C_{305} can be seen mounted on the left side of the rear partition.



If, while tuning the driver coils, the voltage suddenly increases it means that the stage is regenerative and the neutralizing capacitor CN_1 should be adjusted. The d.c. voltage as read by the v.t.v.m. attached to the 100K resistor will vary from band to band but it should always be higher than 50 volts to assure adequate drive to the 6146 final.

Final—Reconnect the bias voltage to the 100K resistor. Check the neutralization of the final amplifier by tuning the final to the proper frequency while drive is being applied and with the grid dip meter coupled to the plate tank adjust the neutralizing capacitor CN_2 for minimum r.f. feedthrough.

Reconnect the B+ leads to the 6146 plate and screen. Connect a dummy load to the antenna terminal and check the unit in the c.w. mode. The built in scope will be of great assistance in the further tuning of the unit.

Adjusting the 500 kc Crystal—At this point the 500 kc crystal can be set accurately on the slope of the mechanical filter. As purchased this crystal has a frequency of about 501.3 kc. while the mechanical filter slope is around 503.2 kc. Grinding the crystals' top edge (this is a plated crystal) will easily move the frequency up a few kc's. Connect an audio oscillator to the microphone input, keeping the level to about 100 mv so the audio channel will not overload. Turn the MODE switch to upper sideband and observe the scope presentation. Set the carrier balance control for minimum carrier, also adjust the 250 ohm balance pot on the cathode of V_{103} for minimum carrier.

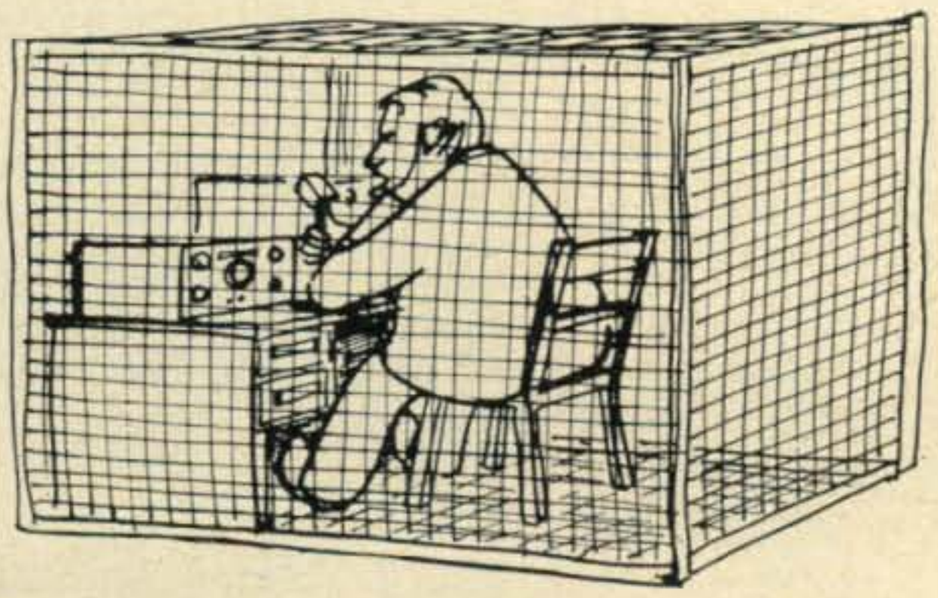
Carefully open the crystal holder and grind the top edge of the crystal with fine emery paper. Be careful not to break the crystal leads for once *these* leads are broken, the crystal is useless. Grind the crystal slowly until the audio from the generator shows up on the scope. This should occur only when the audio frequency is above about 200 c.p.s. Tune the audio generator through the audio range, the output of the exciter as seen on the scope should be fairly flat between 300 cycles and 3.3 kc while it should drop rapidly below about 250 cycles. The signal as seen on the scope should be a continuous wave. Any ripple or envelope is carrier leakage. If the crystal is ground too far and the audio does not show on the scope until the generator is tuned, let us say, to about 600 c.p.s. the crystals frequency can be lowered slightly by rubbing some soft solder or pencil along the edges. After the 500 kc oscillator is set properly on the filter slope, the basic generator tuning should be rechecked.

Calibrating The Dial—Check the band edges with a good amateur receiver and if necessary adjust the v.f.o. trimmer capacitor. Once the bands are centered on the dial you can start marking the 100 kc divisions. A 100 kc crystal calibrator is very handy for this operation. It is necessary to mark only one band since these divisions fall on the same spot on the dial for all bands. After the 100 kc divisions are marked, the dial plate can be pulled out and the work completed on the bench. The space between two marks can be divided by ten to obtain 10 kc calibration points. Lettering can be completed using a good template and the finished product will reflect any extra care that is given to this operation. The front panel lettering was done with decals, which give excellent results and are easy to apply.

Overall Check—The unit should be checked thoroughly for proper operation on all the bands and on all modes. This is best done with an audio generator while the exciter output is connected to a dummy load.

Place the mode switch to LOWER SIDEBAND, the operation switch to TRANSMIT, and the CARRIER BALANCE pot fully clockwise. Then tune the final grid and plate capacitors while watching the scope. Balance out the carrier and then connect a 1000 cycle audio signal to the microphone input. Advance the audio gain for ¾ in. deflection on the scope. The scope presentation should be a c.w. signal with very little envelope modulation. Turn the carrier balance and observe the two-tone pattern for any distortion. Now switch to the C.W. position and check the keying characteristics. Again the scope will show any distortion in the r.f. waveshape. The a.m. carrier level should be adjusted by means of the 25K pot (screen modulation adjust) provided for this purpose. The proper procedure for this adjustment is to tune the exciter in the C.W. position then switch to A.M. and adjust the 25K pot for a carrier amplitude equal to ½ the c.w. level as observed on the scope. This control need not be readjusted when switching from band to band. Small variations in carrier amplitude can be compensated for with the grid tuning capacitor. The 6146 final amplifier has a very good screen modulation characteristic especially when operated AB_1 and nearly 100% modulation can be obtained with little distortion.

The signal specifications as measured with the receiver S-Meter (NC-300) are as follows: carrier suppression . . . 45 db below full output; unwanted sideband and spurious products . . . 35 db below full output; hum and noise . . . 40 db below carrier; power output . . . 20 to 25 watts into a 120 ohm dummy load. (The 120 ohm output impedance was chosen because this value gives the right voltage to drive the grids of a pair of 4X150's in the linear amplifier.) ■



"—and even now there's a trace on channel two."

Driving The Class AB1 Linear Amplifier Through L-Networks

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Garden City, N. Y.

The L-network, as used here, provides a simple, efficient and easily adjustable method to furnish relatively high grid driving voltage from a low-impedance coaxial line. This is accomplished without the complications involved in switching links as used in conventional parallel tuned tanks, and with the added advantage that neutralization of a high power tetrode is not needed.

SEVERAL different methods can be used to obtain the required grid driving voltage for the grounded cathode AB1 amplifier. The passive grid circuit of fig. 1 is certainly the simplest:

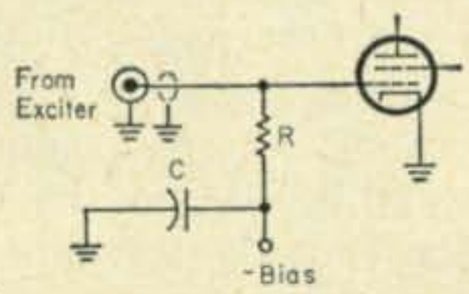

Fig. 1—Simple input circuit used to match the exciter to the linear amplifier. The value of *R* should match the coax impedance.

The value of *R* is made equal to the Z_o of the coaxial transmission line (usually 52 or 75 ohms). This works well if a fairly high driving power is available. Table 1 lists the approximate driving voltage and power needed for several popular tubes.

TABLE I

Tube	*Bias*	*Peak R.F. Driving Voltage*	*Watts Drive Power* 52Ω	75Ω
4-125A	—100	100	192	133
4-250A	—110	110	233	161
4X250B	—50	50	48	33
PL172	—110	110	233	161
4CX1000A	—55	55	58	40
813	—95	95	174	120
7094	—50	50	48	33

As the table shows, the power requirement is excessive when the r.f. driving voltage required is above 50 volts or so.

Immediately, we begin to think of increasing *R*, because it is obviously possible to get the same peak voltage with less power when *R* is larger. When *R* equals 100 ohms, for instance, the peak power required to drive an 813, in this circuit, drops to 81 watts. This is an improvement over the 156 watts required when *R* equals 52 ohms but still inconveniently great. However, another thing has happened. The coax from the exciter now sees a load of 100 ohms instead of 52 or 75 ohms, and with RG-58/U cable the s.w.r. is practically 2 to 1. By itself this is not particularly important, because with the line lengths that would ordinarily be used, the losses in unmatched coax would be too small to worry about, even if the s.w.r. were as high as 5 to 1 or greater.

The line input impedance, however, will be found to vary over a wide range when changing bands so that the exciter has to deliver power to a load which is reactive as well as resistive. The reactive component can be "tuned out" by adjusting the controls in the exciter plate circuit; but the resistive component remaining is likely to be either considerably greater or smaller than the value for which the exciter output was designed, and it may not be possible to adjust the coupling as desired.

What is needed is some sort of r.f. transformer at the amplifier grid which would allow the use of a much larger value for *R* while maintaining a reasonably good match for 52 ohm coax input. If this transformer could be broad enough to eliminate the need for a tuning control across an amateur band, so much the better. The *L*-network is exactly right for the job. It is easy to determine the correct component values and very simple to build and adjust.

Figure 2 shows the basic circuit of the *L*-net configuration used:

Here R_{in} = input impedance
R_g = grid loading resistor
L = series inductance
C = shunt capacitance

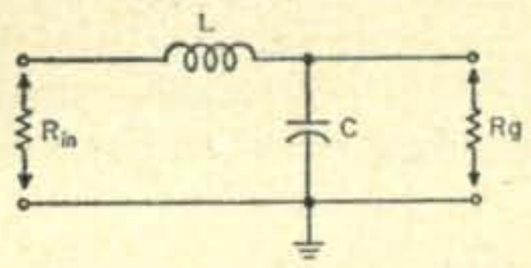

Fig. 2—Basic circuit of the *L*-network used to couple the exciter to the linear amplifier. This circuit requires less driving power than fig. 1.

Note that R_{in} is not an actual resistor. It is the equivalent input impedance for the network. To match RG-58/U, R_{in} is set to 52 ohms. The component R_g is a resistor which must be non-inductive and capable of dissipating moderate power. The component C includes the input capacitance of the tube and socket and stray wiring capacity.

The fundamental equations for the *L-net* are given in any handbook, and are:

$$R_g = R_{in}(Q^2+1) \quad \ldots\ldots (1)$$
$$R_g = QX_c \quad \ldots\ldots (2)$$
$$X_1 = QR_{in} \quad \ldots\ldots (3)$$

Where Q = operating Q of the network
X_c = reactance at operating frequency of total capacitance C
X_1 = reactance of series inductance L

The value of R_1 has been set at 52 ohms. Now either Q or R_g may be selected. Assuming $R_g = 1000$, a readily obtainable value;

from (1)

$$1000 = 52\ (Q^2 + 1)$$
$$Q = \sqrt{18.23}$$
$$Q = 4.27$$

from (2)

$$1000 = 4.27\ X_C$$
$$X_C = 234 \text{ ohms}$$

from (3)

$$X_L = 4.27\ (52)$$
$$X_L = 222 \text{ ohms}$$

Table II lists the values for C and L for different frequencies:

TABLE II

F, mc	X_c	C mmf	X_L	L μh
3.9	234	174	222	9.0
7.2	234	95	222	4.9
14.2	234	48	222	2.5
21.3	234	32	222	1.7
28.7	234	24	222	1.2

On 10 meters, the capacitance needed is small enough so that the tube input capacity plus stray capacity may exceed the calculated value. If so, use of a smaller value resistor for R_g will result in a lowered Q and a larger required value for C. On the lower bands there should be no trouble getting the minimum C down to the amount tabulated.

The frequency response is very broad. With a Q of less than 5, the voltage across C varies less than 10% over the entire 7, 14, or 21 mc band. It drops only slightly at the high end of 10 meters and the low end of 80 c.w. when peaked at the tabulated frequencies. The match to RG-58/U is excellent. The reflectometer shows zero reflected power on 75, 40, 20 and 15 meters. On 10 meters, the reading was 90 μa reflected for 500 μa forward current. This amount of mismatch is quite tolerable, although it could have been improved by lowering R.

The power dissipated in R_g is very much less than in the passive grid circuit. For the 4-250A, peak power is now $\frac{(110)^2}{1000} = 12$ watts

For the 813, it would be $\frac{(90)^2}{1000} = 8$ watts

This is very different from the original conditions.

The final amplifier at W2ZUC was rebuilt along these lines. It is a single 4-250A having a conventional pi-net plate tank. A bandswitching grid circuit was constructed per fig. 3.

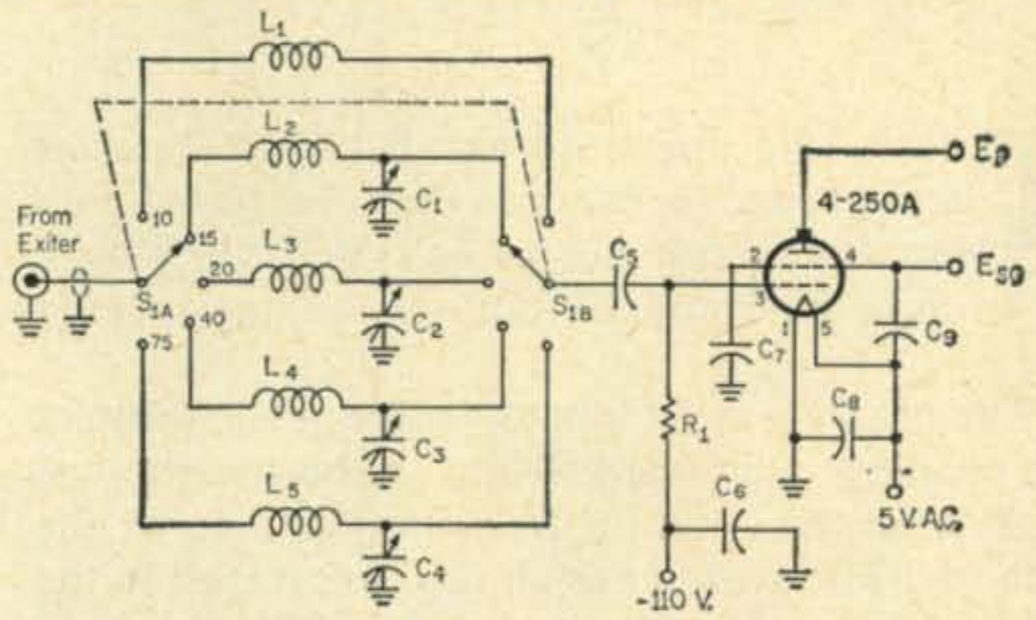

Fig. 3—Bandswitched input circuit for 52 ohm coax. The method used to tune the ten meter position is described in the text.

C_1, C_2—3-30 mmf compression trimmer
C_3—12-120 mmf compression trimmer
C_4—20-180 mmf compression trimmer
C_5, C_6, C_8—.01 mf disc ceramic
C_7, C_9—.002 mf, 3000 v disc ceramic
R_1—1000 ohms, 10 watts, non-inductive
S_1—2 section 6 position (5 used) ceramic switch
L_1—7t of B&W 3011
L_2—11t of B&W 3011
L_3—16t of B&W 3011
L_4—20t of B&W 3012
L_5—28t of B&W 3012

No trimmer is used with the 10 meter coil. Instead, 1½" of extra lead length is left on it at the grid end of the switch. Then, with the amplifier filament on, but with screen and plate voltages removed, the exciter is tuned up on 28.7 mc. Connect the exciter to the input and adjust it until a little grid current is observed. The coil is then checked with a brass slug and an iron slug alternately, while bending the extra lead length, until either slug causes a reduction in grid current. Drive should be reduced as the circuit comes to resonance to avoid the extra loading caused by too heavy a flow of grid current.

The lower band coils are cut to length according to the ARRL *Lightning Calculator* and then checked with the g.d.o. and 2% ceramic capacitors. Tune up of these in the amplifier is done with the trimmers.

There is no convenient method to neutralize the amplifier; however, it was thought that the very low grid impedance that appears in this circuit would result in good stability. The impedance seen by the grid is the parallel combina-

[*Continued on page 117*]

Break-in Without Pain

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Here is a foolproof mechanical method of break-in for the c.w. man. While keying the transmitter, W1RAN also keys his receiver gain with an outboard attachment on the bug.

THE traffic men started it; Tom Puckett brought the problem to the foreground with his all-electronic break-in system[1], and most of us have been on the outside looking in ever since.

The problem isn't difficult to define: 1) Protect the receiver from overloading by the transmitter; 2) Protect the operator from overloading by the receiver. T-R switch design has progressed to the point where the first requirement is handled passably, though unfortunately, there still isn't one with the noise figure of a coax relay!

If we accept the shortcomings of electronic T-R switches, then it appears that we need only to find a way to key the receiver's gain, or mute it completely, without producing clicks and noise. Handbooks and magazines have described schemes using vacuum tubes, negative supplies, and other encumbrances too involved to be attractive.

As the problem is actually one of sequential switching, (in order: receiver off—transmitter on —transmitter off—receiver on), it would seem that perhaps a well placed contact or two might negate a chassis full of electronics.

[1]Puckett, T.H., "Break-in with One Antenna", *QST*, March, 1954, p. 35

Receiver Keying

Receiver-keying contacts added to an old and t-rusty Speed-X are shown in the photograph. They come into play just an instant before the usual transmitter-keying contact 'makes.' They return to normal just after the key opens.

A Collins 75A-2 receiver's a.v.c. circuit was modified the least bit to afford external keying of the receiver gain by these contacts. Figure 1 shows the modified circuit. First trial of this kind

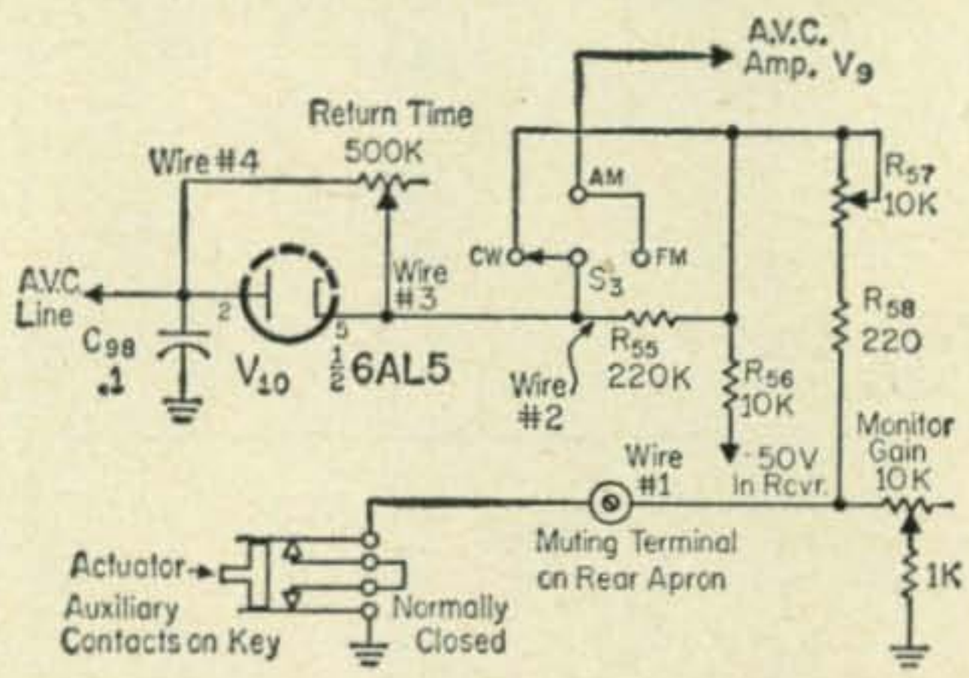
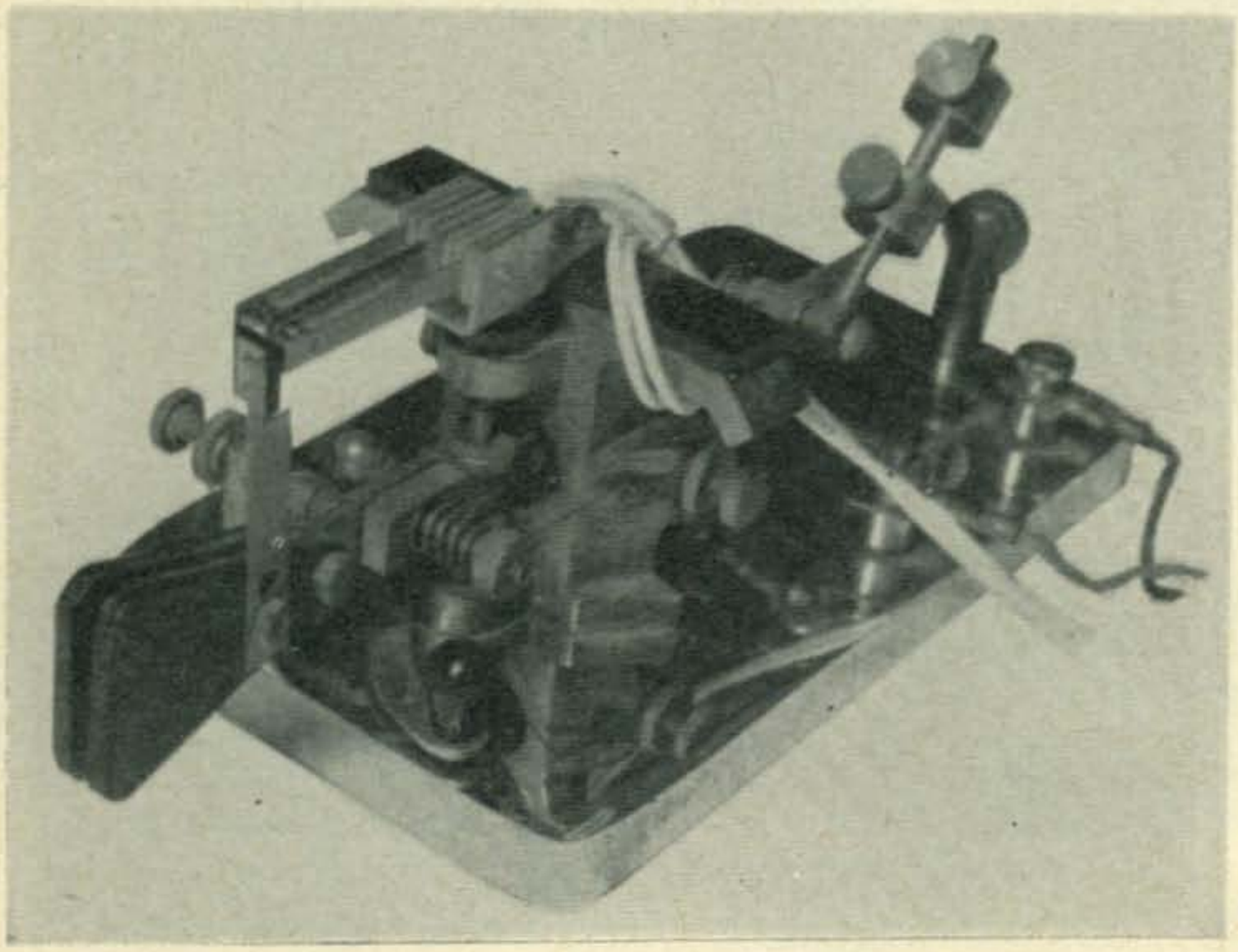


Fig. 1—Circuit modifications made to the 75A-2 for break-in. Components not assigned symbol numbers are added to the receiver.



Key showing the auxiliary contacts and the paddle extension.

of thing showed the receiver gain to return so fast that the last few cycles of a transmitted character would come through and knock the operator's ears off. The diode and 500K potentiometer provide a means of controlling this sensitivity return time[2]. The diode used is one half of V_{10}, a 6AL5 in the 75A-2 receiver. In early models it was unused. Later, it was somewhat unnecessarily employed in the audio muting circuit. It can safely be stolen for our application, in either case.

Modification of The 75A-2

1—Locate R_{58} in shielded compartment under receiver chassis. One end is grounded. Disconnect lead from other end. Mount a small terminal strip with a 4-40 machine screw through the hole used to secure the cable clamp. Mount a substitute 220 ohm resistor on this strip to replace R_{58} left in place. Route a lead from R_{58} to 10K MONITOR GAIN control. Connect 1000 ohms between the control's wiper and ground.

2—Disconnect two green wires from S_3 (arm); tie together, tape and let float.

3—Disconnect R_{55} from C_{98}. Run wire #2 (fig. 1) from free end of R_{55} to S_3 (arm) and then to V_{10}, pin 5.

4—Brings out wires #3 and #4 from V_{10} and attach to 500K RETURN TIME potentiometer.

5—Connect V_{10}, pin 2 to a.v.c. line, C_{98}.

6—Disconnect existing lead to mute terminal. Tape and let float. Route a lead from there to the monitor gain control.

Adjustment

Adjustment is simple. Set the MONITOR GAIN control to the desired level. Spin the RETURN TIME control until the keyed "tails" just disappear. The circuit is smooth, absolutely clickless, and works right off the bat.

The photograph of the receiver shows the two pots mounted on an L bracket on pillars behind the p.t.o. The mounting holes are those originally intended for the n.b.f.m. adapter, and there would be nothing to prevent returning the receiver to its original condition should resale require this.

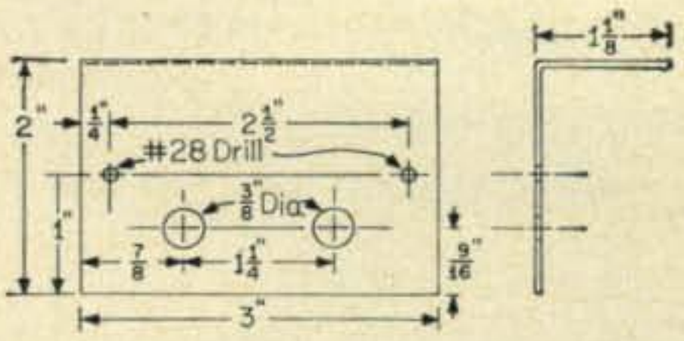
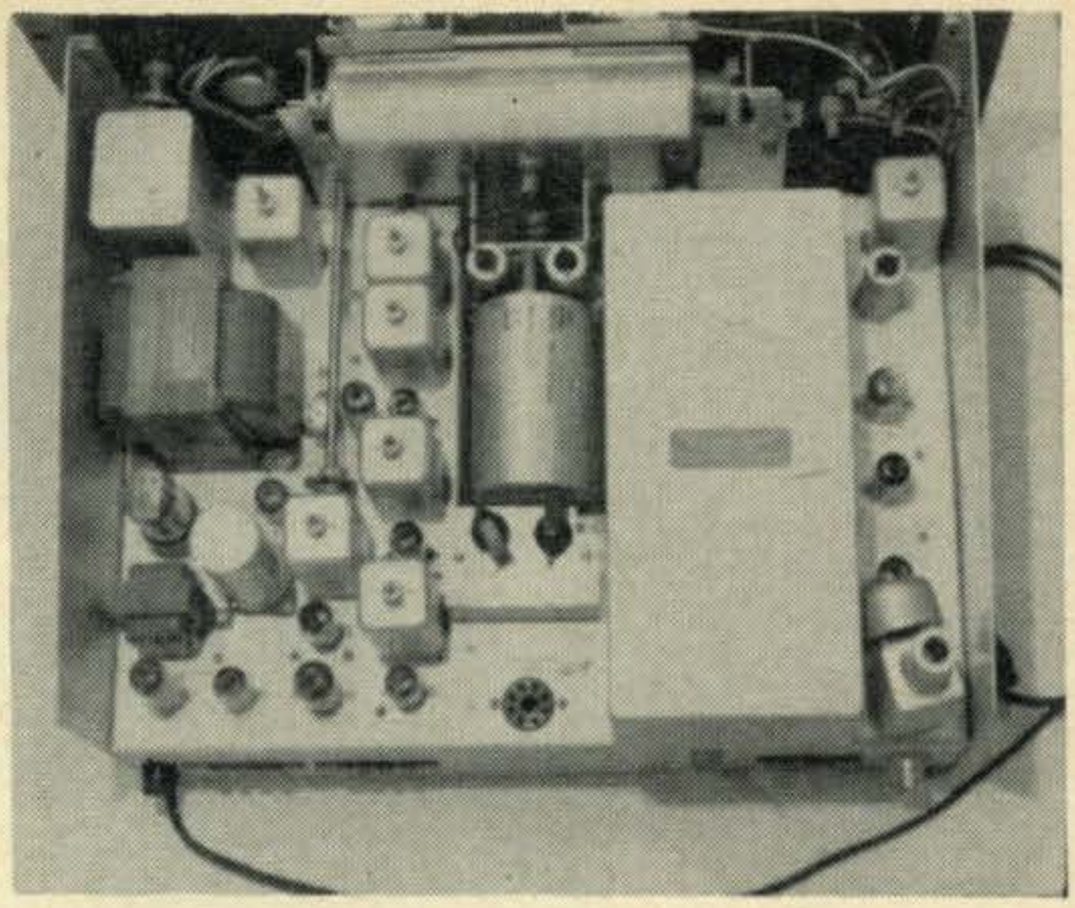


Fig. 2—Bracket for mounting the RETURN TIME and MONITOR GAIN controls behind the p.t.o. in the 75A-2. The bracket is supported by two spacers 1 1/16" long with the screws passed through holes designed to accommodate the n.b.f.m. adaptor.

[2]Radarmen call it "Sensitivity Time Control"; Sonarmen call it "Time Variable Gain"

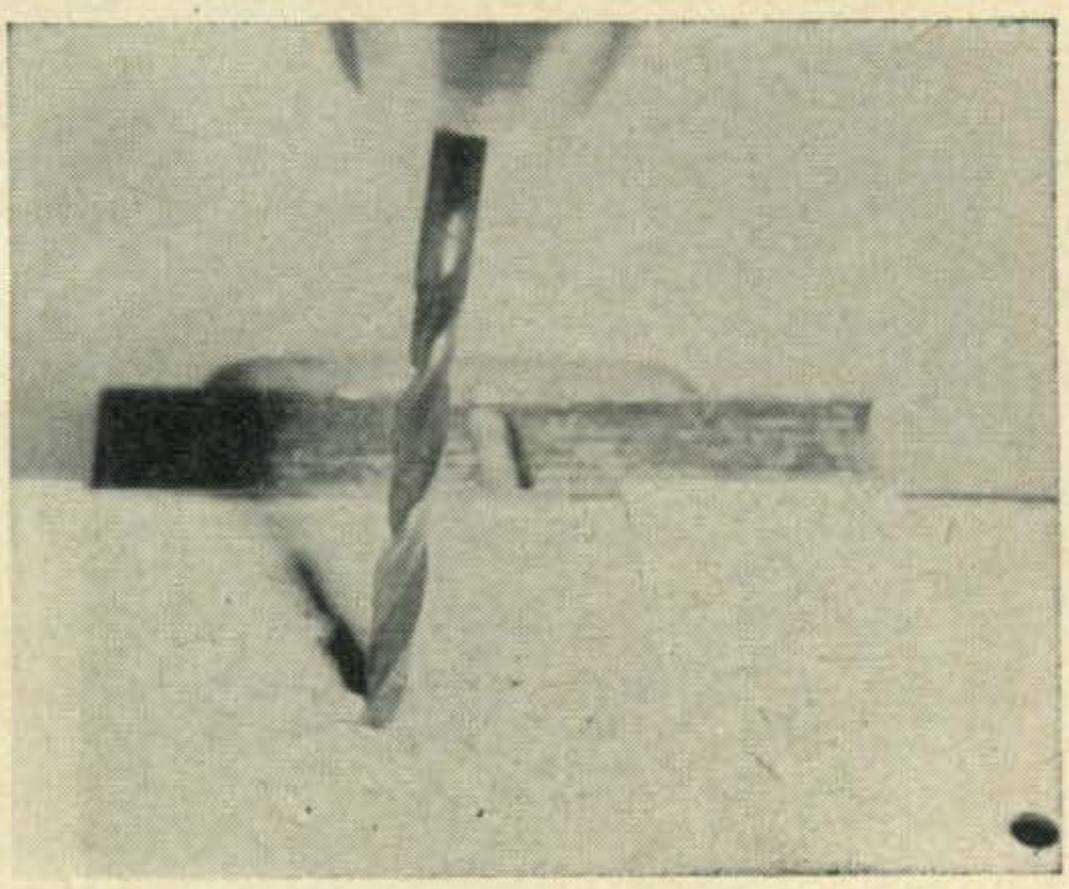


The two new controls may be seen mounted on the bracket behind the p.t.o.

A few suggestions: a) If one-band operation is usual, the MONITOR GAIN control may be mounted as shown. If all-band work is the practice, it is wiser to place it in a more accessible spot. b) Keep the auxiliary contacts lightweight to the point of being flimsy and the actuator arm stiff, and the action will be positive and effortless. c) It would be quite possible to employ the "back contact" of a keying relay for this purpose. Note however, my placement of auxiliary contacts will hold the receiver gain down throughout a string of dots, eliminating annoying between-dot bursts from the receiver.

The receiver conversion circuitry is the work of David B. Hallock, KØAZJ, one of Collins' bright young engineers, and this article appears at his suggestion. ■

Ham Hint



Cardboard Aids Drilling Holes

When you have to drill a hole accurately in the chassis of a transmitter, radio, TV, or hi-fi, you can keep the drill from creeping by taping some cardboard to the chassis as shown. This is better than banging the chassis with a hammer and punch for the shock could seriously damage vibration sensitive components and tubes.

ADJUSTMENT OF THE RTTY POLAR RELAY

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W6VVF explains the intricacies and pitfalls of adjusting the 215 and 255 polar relays without a special test setup; all you need is a volt-ohmmeter and a few hand tools.

DURING the process of "De-Bugging" a test set for measuring bias distortion and, finding that one of my 255 relays came no where near being within the proper bias range, it became distressingly apparent that correct adjustment of these relays is not the simple thing that many an amateur genius believes it to be! However, in spite of the fact that adjustment of these relays *is* an involved operation, there actually is an easy way to do it.

Most of us do not have bias test equipment—yet we faithfully check our transmitting frequencies, s.w.r., plate current, and antenna coupling for maximum output of r.f. but seldom do we consider the fact that we may be imposing a burden on the other fellow trying to print our biased signals! How then, without access to a good bias test set can we be sure that the polar relay, when used in the transmitting circuit, is not biasing the mark or space pulse? This article will tell you how to accurately adjust your relay using only a volt-ohmmeter and some very simple tools. The details of the procedure given below came to me as a result of a conference with a field telegraph engineer concerning this problem. He had more confidence in his method than he did in the shop product!

Because relays are more sensitive receiving units than are printer magnets they generally are used with fixed station equipment to allow greater operating distances between machines. This arrangement applies more to land line operation than in our radio mode where audio signals from the receiver are converted into mark-space pulses and fed directly to the printer magnets from the keyer tube of a terminal unit. Some of us, however, use a polar relay in the terminal unit to repeat to the printer magnets, the mark-space impulses. Those who follow this procedure are just plain lucky that the small arcs across the relay contacts, in passing even 20 mils, do not seriously garble the signals through fortuitious distortion that enters the receiver in spite of good filtering.

Relay Types

The more common polar relays are the Western Electric Co. type 215 and 255. Each of the two windings of the 215 relay has 85 ohms resistance and is designed for 60 mils of signaling current only—we say again, 60 mils only! The windings of the 255 relay are 136 ohms each and can be used on 20 to 60 mils of signaling current and even less than 20 when bias current is properly proportioned. The 255 relay has large knurled pole piece locknuts which make it easier to adjust the pole pieces, and its contacts are of later design and better materials. The stationary contacts used now are convex while the armature contacts are flat. Needless to say, the less current these contacts have to pass the longer the contact life. Scrubbing contacts with files to remove burns is a sure way to throw bias into the relay unless special readjustment techniques are followed.

When a 215 or a 255 relay is used as the line relay, or as we use them more often in the transmitting circuit in neutral operation, we must supply, locally, 30 mils of "steady" current in the bias winding in a direction to cause the armature to be held against the spacing contact. Sixty mils of current is passed through the line winding in a marking direction. When the marking pulse is transmitted, the magnetic field induced by the 60 mil line current in the line winding overcomes the magnetic field induced by

the 30 mils of locally supplied current in the bias winding. This causes the armature to move to the marking contact under the influence of an effective force of 30 mils through the line winding (60 minus 30). When a spacing impulse is transmitted, there is no current flow in the line winding and the armature is moved to the spacing contact by the 30 mils of current in the bias winding.

Now if the contact adjustment is too close or too wide or the two contacts are unequally spaced with respect to the armature, mark or space bias distortion is the result. If the pole pieces are out of adjustment and exert too much pull on one side of the armature, serious mark or space bias is developed. The balanced magnetic push-pull effect on the armature by these pole pieces is directly related to the magnetomotive forces of the line and bias winding currents and insure quick and positive armature reaction to changes in line current values under pulsing conditions. These, then, are very critical adjustments.

Adjustment Procedure

Here is how you can adjust a 255 relay without special test equipment other than a simple volt-ohmmeter and achieve a result that is as accurate, if not more so than when using a distortion test set.

Tools Required

The following tools are required when adjusting the relays:

1-Non-magnetic adjusting tool such as the Western Electric 212, or equivalent, to turn the capstan adjusting screws. This tool is a tapered rod about 3 inches long with the end bent at a 45° angle.

1-Hardwood spuger such as the Western Electric KS-6320.

1-Feeler gauge, .004", the shorter the better.

1-Western Electric 265C burnishing tool, or the equivalent.

1-Volt-ohmmeter with 2 foot long test leads.

1-Bottle of carbon tetrachloride.

Procedure

1) First, and this is very important, remove all metal tools and objects from the immediate vicinity of the relay where you are going to work. Do not try to adjust the relay on your operating table close to a receiver, transmitter or other large piece of gear. The two foot test leads will keep the volt-ohmmeter away from the relay. These objects exert a strong magnetic influence on the relay. To demonstrate this fact, after you complete the adjustments, observe the armature move when the relay is pushed close to any object that has a magnetic field; it will move to one side which would have made your adjustment incorrect!

2) Dip a burnisher in carbon tet and pass it through the contacts to clean them. Do not touch the blade of the burnisher with your fingers; they are oily!

3) Loosen the knurled lock nuts and back out the pole pieces as far as they will go.

4) Back out the contact screws on both sides of the armature for a distance of at least ⅛ inch from the armature contacts.

5) Now look down the long axis of the armature toward the hole in the coil head from which the armature protrudes, and sight by eye to see that it is centered perfectly. If not centered, adjust the coil until the centering is correct. The coil is held in place by several small screws and don't forget to tighten them again if you have loosened them for adjusting the coil.

6) Insert the .004" gauge in between the two leaves of the armature spring so that the gauge floats free from the rest of the relay. This spreads

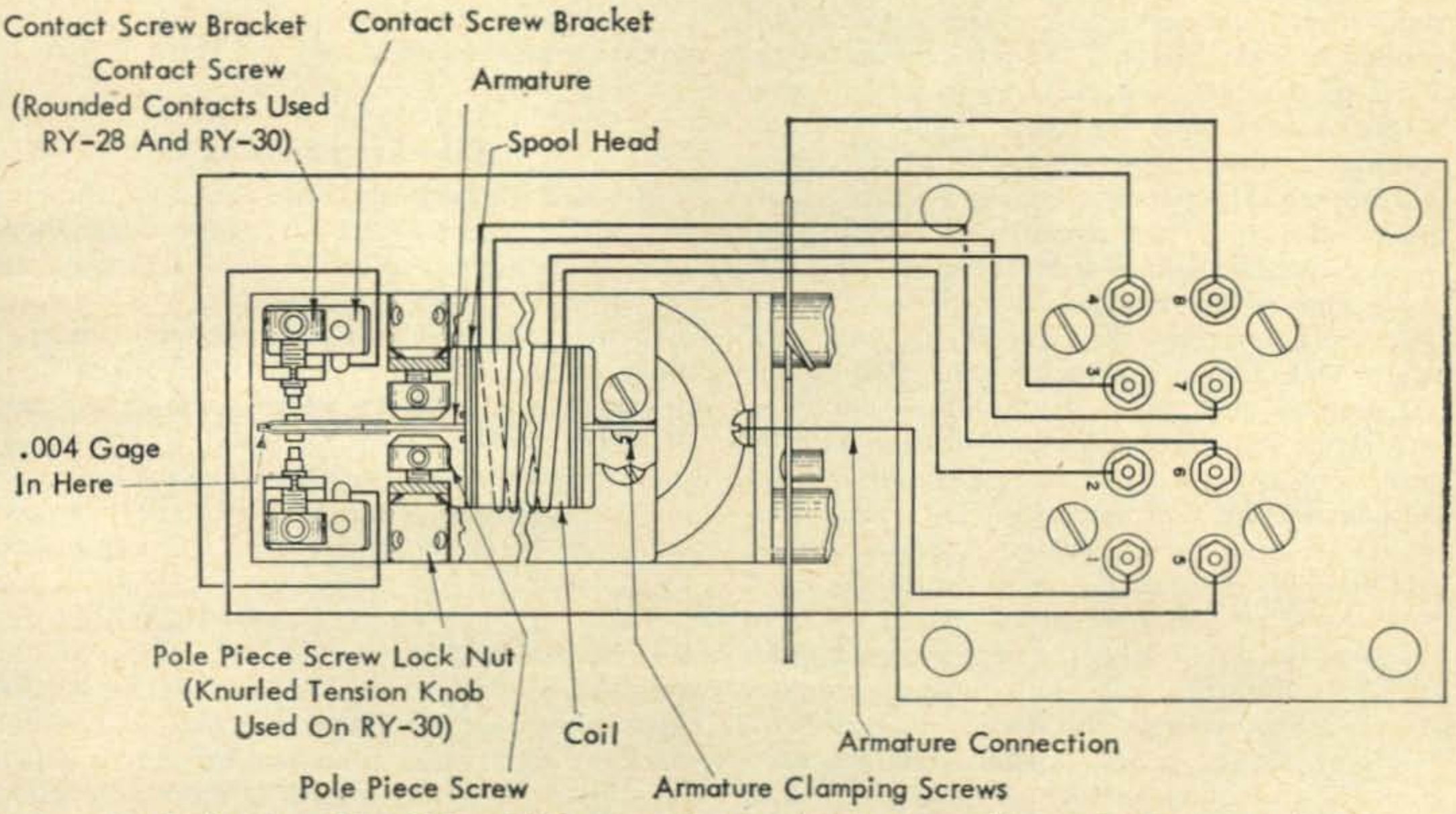
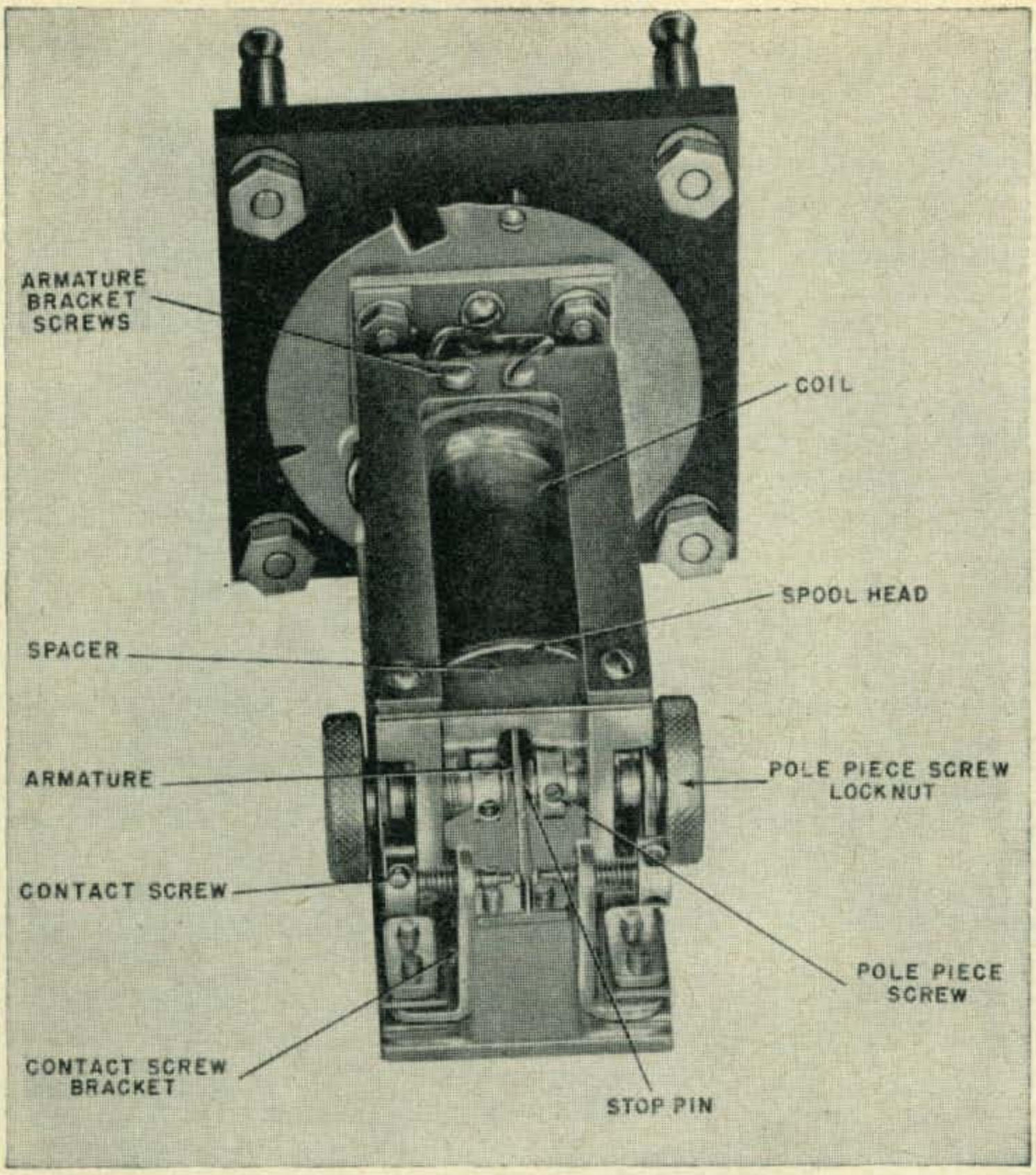


Fig. 1—Drawing of the 215 and 255 polar relay showing the base wiring and adjustment points.



Photograph of the polar relay and plug in base showing the contact assembly and adjustment points. The shield, removed for the photo, should be in place when the relay is in operation to reduce the effects of stray magnetic fields.

the leaves carrying the contacts .002″ in both directions, that is, right and left.

7) Connect one lead from the volt-ohmmeter to terminal no. 1 on the rear of the relay and connect the other lead to the right hand contact bracket carrying the right contact screw. Turn in the right contact screw with the non-magnetic tool until the meter just indicates circuit continuity. Back off the contact screw just enough to break the circuit. Remove the lead from the right contact bracket and connect it to the left contact bracket carrying the left contact screw. Turn in the left contact screw with the non-magnetic tool until the meter again indicates continuity; then back off until the circuit is just broken. Do not touch these contact screws again once they are correctly adjusted! Now remove the .004″ gauge from the armature.

8) Tighten the knurled lock nuts slightly to hold the pole pieces slip-tight during their final adjustment. Leave the meter connected to the left contact and, using the non-magnetic tool, turn in the right pole piece until it mechanically pushes the armature over against the left contact as indicated by the meter showing circuit continuity. Do not turn the pole piece more than just enough to make the meter show contact!! Now back off the pole piece exactly ½ turn (¼ turn for a 215 relay). There are four holes in the capstan so you can easily judge the amount of turn. Now change the meter connection to the right contact screw. Again, using the non-magnetic tool, turn in the left pole piece until its magnetic force moves the armature over against the right hand contact as indicated by the meter and again, do not turn the pole piece more than just enough to make electrical contact shown by the meter! Now back out the left pole piece exactly ½ turn (¼ turn for a 215 relay). Note here again that the left hand pole piece was moved in until its magnetomotive force moved the armature, not by mechanical force as when you adjusted the right pole piece to move the armature.

9) Finally, hold the pole pieces stationary with the non-magnetic tool and securely tighten the lock nuts.

Checking Results

If you have performed the above adjustments carefully, and observed the precautions about stray magnetic influences affecting the relay, the armature will now float between the contacts and the meter will show that neither contact is made to the armature. To further check your fitness as a polar relay adjuster, touch the side of the armature with the spudger lightly—it should stick to the contact to which the armature is pushed—either direction under the balanced influence of the pole pieces and will again float when free.

This relay, if it meets the above requirements will be adjusted accurately and will have the absolute minimum of contact bias. It is also advisable to use a relay with a metal cover for shielding from stray magnetic influences which can impose a steady bias condition on a good relay. ■

Improving The Heath AR-3

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New York 25, N. Y.

Small a.c.-d.c. type amateur receivers are excellent for the beginning amateur and short wave listener, but anybody who has listened to their performance on the ham bands, and compared it to that of receivers in the $150-$200 price bracket, knows that they leave much to be desired. Presented here are several modifications made on the Heath AR-3 that improved both selectivity and sensitivity. The changes are not restricted to this one receiver but, as explained, can be applied to any similar unit.

HAVING recently come into possession of a Heathkit AR-3 receiver, I decided to determine how far one could improve it, doing just about everything possible on one chassis. Actually, the AR-3 is not an a.c.-d.c. receiver, but we might classify it as an a.c.-d.c. "type" because of its tube line-up in the early stages. (12BE6-12BA6-12AV6) although it benefits from the higher plate voltages and the isolation of power transformer operation.

R.F. Amplifier

The first improvement usually made on any receiver is generally an attempt to increase its sensitivity by the addition of an r.f. stage. Since the receiver has a tuning capacitor with only two sections, we cannot use a conventional tuned r.f. stage (fig. 1), which requires a third section. The logical approach would seem to be the addition of an untuned r.f. stage ahead of the tuned mixer (fig. 2). However, it has been stated before[1] that one can achieve the same increase in sensitivity with much less loss of selectivity by using the arrangement shown in fig. 3; tuning the input to the r.f. stage and using untuned impedance coupling to the mixer.

My first attempt at an r.f. stage used a 12BA6 with a.v.c. applied both to it, the mixer and the i.f. amplifiers. Although this resulted in an improvement, it was not nearly as great as I had hoped for. While measuring voltages in an attempt to find something amiss, I realized that the residual a.v.c. was preventing the stage from amplifying at its greatest potential. Although delayed a.v.c. would have been the most elegant solution to this problem, I decided simply to remove all a.v.c. from the r.f. stage. I later found

[1]Thomas, J. H.; "Souping Up That Old Receiver"; *Radio-Electronics;* May 1960; pp. 106-108.

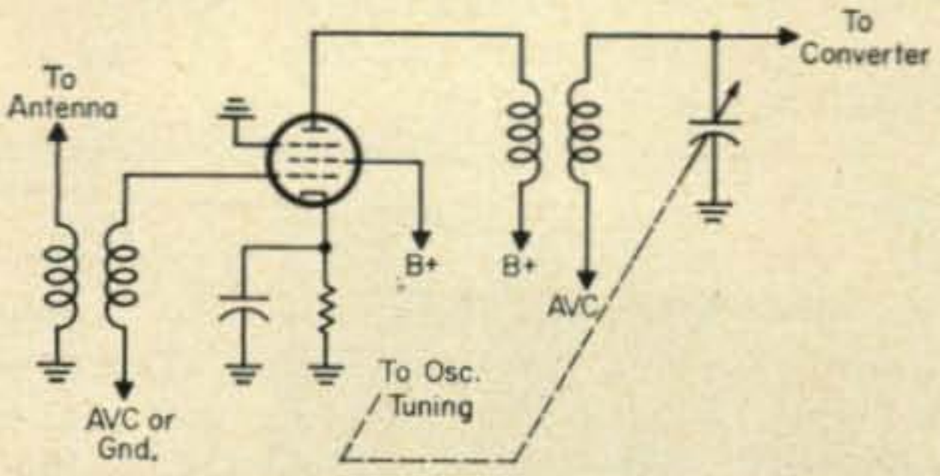

Fig. 1—Conventional r.f. stage which requires a 3 gang tuning capacitor not available in the AR-3.

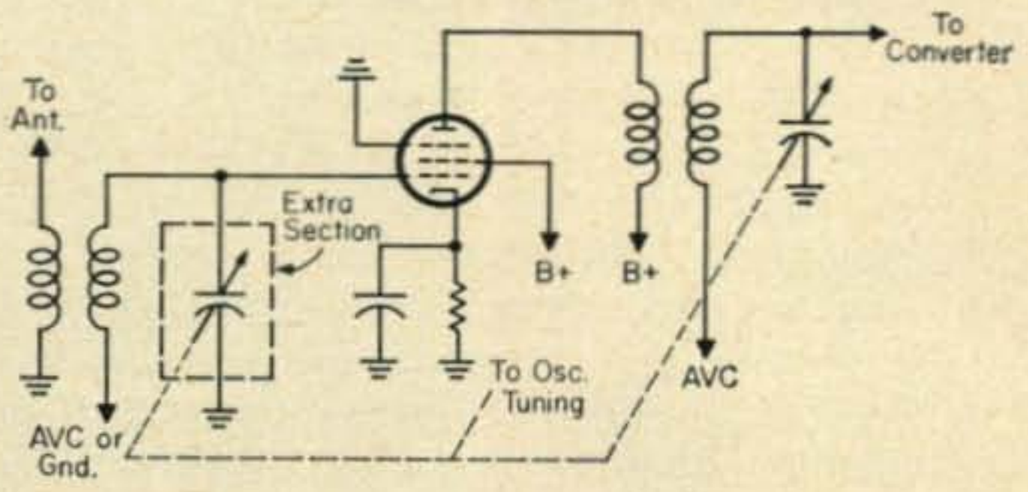

Fig. 2—An untuned r.f. amplifier that provides little benefit from the stand point of selectivity or sensitivity.

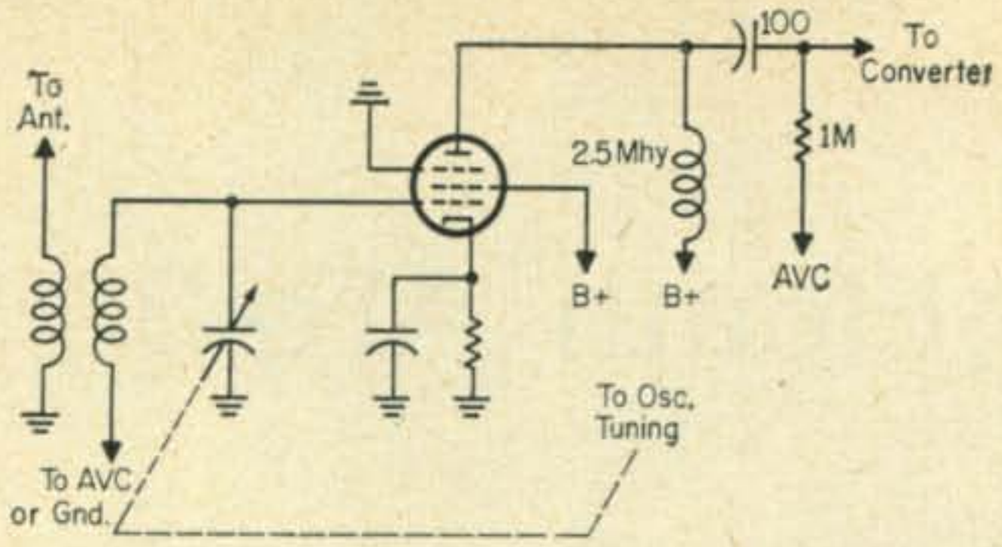

Fig. 3—Tuning the r.f. input and impedance coupling to the mixer provides a satisfactory compromise circuit.

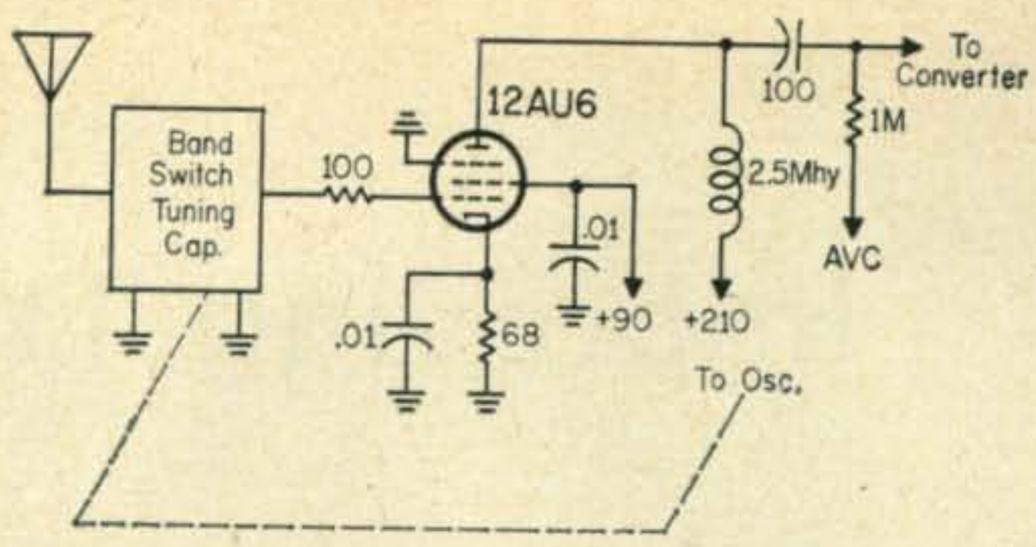

Fig. 4—Final form of the r.f. amplifier.

that substitution of a sharp cutoff pentode, a 12AU6, and the use of a very small cathode resistor also increased gain. The r.f. stage, in its final form, is shown in fig. 4.

Remove the a.v.c. from the r.f. amplifier and feed it to the mixer grid through the one megohm resistor as shown in fig. 5. Capacitor C_9 is mounted on the bandswitch and when removed has to be replaced because of lead length.

I.F. Amplifier

The next modification was made to improve the selectivity. The *Q* multiplier, frequently used with the AR-3, provides very great selectivity, but there are times, particularly when it is used to null a signal, when it is desirable to have more selectivity in the receiver itself than the AR-3 provides. The logical addition was another i.f. stage. The chassis, however, was very crowded, and there was absolutely no place to mount the extra tube, without taking something out.

The 5Y3 socket, situated in precisely the right place for the new tube, was tempting. My decision was to remove the rectifier tube, use semi-conductor rectifiers instead, and thereby free the socket for the new i.f. tube, a 12SK7.

Another change must be mentioned at this time; because of the extra tubes, the filament winding of the power transformer was somewhat overloaded. Since the 5 volt winding was now free, I decided to change the output tube from a 12V6 to a 5V6, and operate its filament from what was formerly the rectifier winding. The 5V6 actually requires only 4.7 volts, which, fortunately, is exactly what the winding delivered.

Rotate the socket 180 degrees, because of the basing arrangement of the 12SK7. The new i.f. transformer is mounted between the 12BE6 and the 12SK7. The 12SK7 is now the first i.f. stage and the 12BA6 becomes the second.

The new i.f. transormer used is a Miller 12C1, 455 kc input. The unit may be mounted in a 1⅛" hole made with a chassis punch and secured with the special mounting plate provided.

The *Q*-multiplier input remains where it was, which means that it is fed by the primary of the second rather than the first i.f. transformer. The *Q*-multiplier operation is, if anything, better.

The bypass capacitor is removed from the cathode of the 12BA6 in order to increase stability, and, since both i.f. stages are manually gain controlled, the arm of the gain control is bypassed to prevent coupling between the stages. I found it necessary to add a resistor (between the rectifiers and the filter capacitor), and to change the value of several other resistors because of the load of the additional tubes.

Two additional changes were made to increase the flexibility of the receiver: I added a jack on the rear panel to provide for the measurement of the a.v.c. for the S-metering purposes.

Since no meter amplifier is included in the AR-3 it is necessary to connect a v.t.v.m. to the S-meter jack. Also, a shorting jack enables remote control of standby-receive functions, such as that provided by a transmitter-controlled antenna relay. When the plug is removed, phone-standby-c.w. operation is controlled manually by the switch on the front panel. Removing the 5V6 from the circuit does not cause a great increase in the B+ voltage.

The completed receiver, shown schematically in fig. 5, stands up well as far as sensitivity and selectivity are concerned, when compared to receivers in the $150-$200 class. Image rejection leaves something to be desired, but a series-parallel wave trap completely removed interference which a local broadcast station was causing in the 80 meter band. The wave trap passes enough signal for useful broadcast band reception. It is broadly tuned, and may not be needed in all areas.

A.C.-D.C. Receivers

If you are attempting a conversion on an a.c.-d.c. receiver, make the following changes in the tube lineup: change the 50 volt output tube (50B5, 50C5, or 50L6GT) to its 35 volt equivalent, providing sufficient extra voltage for the 12AU6 filament. Change the i.f. amplifier to a 6 volt 150 ma tube with the same base connections, (12BA6 becomes 6BJ6, 12SK7 becomes 6SS7) and use the same tube for the new i.f. amplifier.

If you are really interested, you might want to experiment with double conversion (try beating the second i.f. to 50kc.), a grounded grid or other low noise input circuit, or a self-contained S-meter (measuring plate current in one of the i.f. stages). However, the conversions described here are, by themselves, sufficient to provide a much improved and very usable receiver. ■

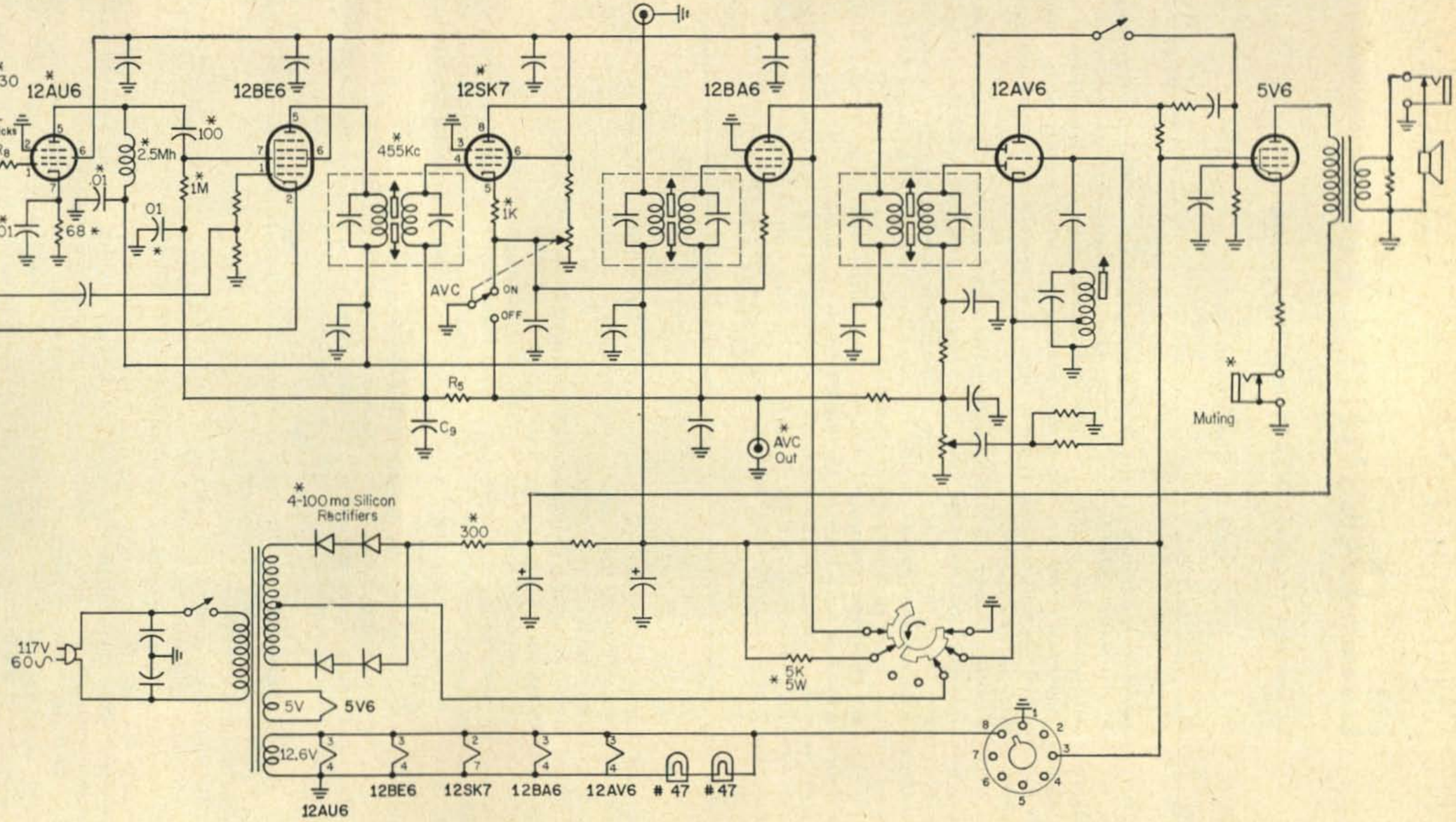

Fig. 5—Diagram of the modified Heath AR-3 receiver. All new components to be added are marked with an asterisk. Note that the 5V6 cathode bypass capacitor has been removed and a muting jack added. The Ferri Loopsticks are optional and were added only to eliminate BC interference on the 80 meter band.

The Sunspot Story; Cycle 19 The Declining Years

By George Jacobs*, W3ASK and Stanley Leinwoll†

Part III, Conclusion

The sunspot cycle is a reliable index of the ionosphere's capability for reflecting shortwave, or high frequency, radio signals. In Part II of this special three-part report, which appeared last month, the authors pointed out that the present sunspot cycle is declining steadily towards a minimum which they predict will occur during early 1965. They also underscored indications that solar activity may remain at a relatively low level for the remainder of the century.

Such a state of nature would have very serious implications for shortwave radio communications in general, and amateur radio in particular. In this, the final installment of this timely report, the authors discuss what propagation conditions are expected to be like on the various amateur bands during the next five years, and perhaps for the remainder of the century as sunspot activity declines.

While the authors point out pessimistically that the consistently good DX openings experienced during the last four years on the higher frequency bands (6, 10, 15 and 20 meters) may soon be a thing of the past, they conclude on an optimistic note by showing that propagation conditions are expected to improve on the lower frequency bands (40,80 and 160 meters) during the upcoming period of low sunspot activity.

IN THE first installment of this report, the critical frequency was defined as the *highest frequency* at which an echo is returned when a pulse of radio energy is transmitted vertically upward towards the ionosphere.

Although the critical frequency is a very important quantity for determining characteristics of the ionosphere, such a vertically transmitted wave returns to earth close to the transmitting station and is of little value for communication purposes. To traverse the great distances required for world-wide radio communications, the signal must leave the earth and enter the ionosphere at an *oblique*, or *slant* angle.

The proper slant, or *radiation angle*, and frequency for efficient long-distance transmission depends upon the height and intensity of ionization of the reflecting layer, and the distance between the transmitter and receiver.

The process involved in the propagation of a radio wave through the ionosphere is very complex, and beyond the scope of this report. Fortunately, however, a relatively simple relationship has been found to exist between the critical frequency measured at vertical incidence, the height of the ionosphere at which reflection takes place, and the optimum radiation angle and frequency required for long-distance transmission. This relationship is expressed by the following equation:

$$f = \frac{f_o}{\sin a} = f_o \csc a \quad \ldots\ldots (2)$$

where:

f_o is the critical frequency; f is the signal frequency for oblique transmission; and a is the radiation angle for oblique transmission

The mathematics expressed in equation 2 is shown pictorially in fig. 18.

Using geometrical relationships shown in fig. 18, equation 2 can be modified as follows to permit an even more direct solution for the optimum frequency required for long-distance transmission:

$$f = f_o \sqrt{\frac{D^2}{4h^2} + 1} \quad \ldots\ldots (3)$$

where:

f_o is the critical frequency; f is the signal frequency that will give optimum long-distance transmission over a path length of D; and h is the height at which ionospheric reflection takes place. (D and h must be given in the same units, either miles or kilometers).

The significance of equations 2 and 3 is, that given the critical frequency and height of the ionosphere, and knowing the distance between the transmitting and receiving locations, it is

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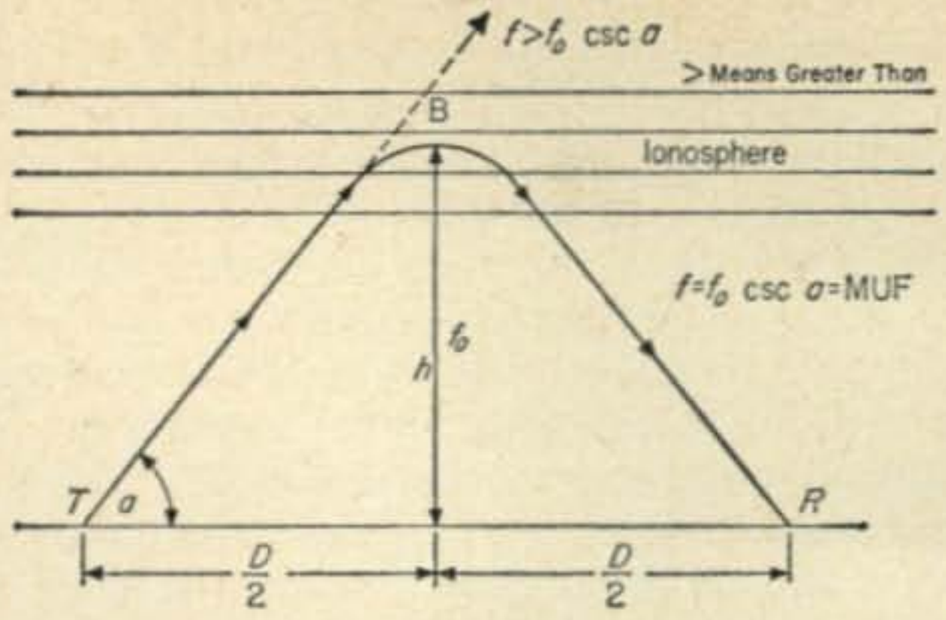

Fig. 18—Illustrative example of MUF calculations:
Given:
h = 200 miles (height of reflection at B)
D = 1000 miles (path length from T to R)
f_o = 5 mc (critical frequency measured at vertical incidence)
Then: (From equations 2 and 3, see text)
MUF = 13.3 mc
Radiation Angle (σ) = 22 degrees.
Illustration not drawn to scale.

possible to determine the best frequency to use for the transmission. This frequency, f in equations 2 and 3, is called the *Maximum Usable Frequency*, or MUF.

For a radio wave to be reflected between two distant points via the ionosphere, its frequency must be equal to, or less than the MUF. As the operating frequency is raised towards the MUF, the signal will be received with increasing signal strength. When the frequency *exceeds* the MUF, ionization at the point of reflection will not be strong enough to bend the wave back to earth at the receiving location, and it will continue on through the ionosphere into space. To insure satisfactory communications between two distant points, the operating frequency must be as near to the MUF as possible, but should never exceed it.

MUF Calculation

Since the MUF is related directly to the critical frequency, its value is a function of the intensity of ionization in the earth's upper atmosphere. For a given transmission path, the MUF follows the same diurnal, seasonal, geographical and cyclical variations as the critical frequency. During periods of high solar activity MUF values are considerably higher (on the order of two to three times) than during periods of low sunspot activity.

It should be noted at this point that the amount of power radiated does not enter into the determination of the MUF. The ionosphere either returns or does not return a radio wave depending entirely upon the frequency of the wave and the degree of ionization. This applies to the normal case of a truly reflected wave and does not apply to the case of "scatter" reflections from the ionosphere that may occur under certain abnormal conditions, or when powers on the order of hundreds of kilowatts are radiated. Under these last two conditions, radiated power will enter into the determination of the MUF, but these are conditions that are not generally encountered in amateur radio communications.

Because the MUF is such an important quantity in radio communications, relatively straightforward graphical methods have been devised for calculating its values for transmission paths of any distance, without the necessity for resorting to mathematics.

Contour charts containing world-wide values of predicted critical frequencies, MUF values calculated for a standard distance of 4000 kilometers (2400 miles), and appropriate graphs for determining from these values the MUF for any distance, are published monthly by the Central Radio Propagation Laboratory of the National Bureau of Standards.[16]. Instructions for using CRPL's contour charts, and typical illustrative examples, can be found in *Shortwave Propagation* by Stanley Leinwoll[17], one of the co-authors of this report.

Ionospheric Absorption

So far we have discussed the characteristics of the ionosphere as a reflector of radio waves. Ionization, however, not only bends a radio wave, it causes energy to be absorbed from it as well. Ionospheric absorption is one of the main reasons the signal strength of a radio wave is reduced as is passes through the ionosphere.

As a radio wave enters the ionosphere, it imparts energy to the ions that exist in this electrified region. The ions are set into motion by the transfer of energy, and thus convey the radio wave through the ionized region. While moving through the ionosphere, ions vibrating in rhythm with the radio wave collide with much larger gas molecules which are also present in this region. As a result of such collisions, the ions lose some of the energy imparted to them by the radio wave. In effect, this lost energy is not propagated, and the amount of energy in the radio wave when it emerges from the ionosphere is less than when it entered, resulting in decreased signal strength.

Exactly how much energy is lost as the radio wave propagates through the ionosphere depends on the number of collisions per second between ions and molecules of gas. This quantity, in turn, depends on the radio wave's frequency, as well as the number of ions and molecules present. As the wave frequency increases, the wavelength decreases[18], and the number of collisions between ions and gas molecules also decrease. The *higher* the frequency, the *less* the absorption.

The amount of ionospheric absorption varies inversely as the square of the wave frequency. If the wave frequency is doubled, ionospheric absorption will decrease by a factor of four. For example, the absorption on 28 mc (10 meter

[16]*Basic Radio Propagation Predictions, CRPL Series D*, published monthly by the Central Radio Propagation Laboratory, NBS, Boulder, Colorado.
[17]Leinwoll, S., *Shortwave Propagation*, J. F. Rider pub., New York; 1959.
[18]Frequency (expressed in kilocycles) and wavelength (expressed in meters) are related by the following:

$$Frequency = \frac{300{,}000}{Wavelength}$$

band) is one-fourth the intensity of the absorption found on 14 mc (20 meter band). When both bands are open at the same time, it will require considerably more power on 20 meters to equal the strength of the 10 meter transmission over the same path. This accounts for the strong signals often possible on the 10 and 6 meter bands, when using relatively low power.

Since the MUF is the highest frequency that can be used on a circuit, and since ionospheric absorption decreases rapidly with an increase in frequency, this type of absorption is *minimum* near the MUF.

Ionospheric absorption depends upon the intensity of ionization in the earth's upper atmosphere. The level of absorption varies greatly throughout the day, season of the year, and geographically, being proportional to the angle that the sun makes with respect to the earth. Absorption is much more intense in equatorial regions, where the sun is more directly overhead, than in the temperate latitudes, and is generally greater during the summer months than in winter.

While absorption takes place in each of the ionospheric layers, it is strongest in the lowest, or *D* layer, where it varies from extremely low values during the hours of darkness to very high values which peak shortly after noon.

As we might expect, the absorption of high frequency radio waves as they pass through the ionosphere varies throughout the solar cycle. During the years of low sunspot count, when ionization is at a minimum, ionospheric absorption is also at a minimum.

Signal strength measurements made during the past two sunspot cycles show that during the daylight hours, ionospheric absorption is between approximately 3 and 10 db *less* during periods of low solar activity than at the cycle's peak. The reduction in absorption on the 10 and 15 meter bands is nearer the 3 db figure; the reduction on 20 and 40 meters is nearer 6 db, and the reduction on the 80 and 160 meter bands is approximately 10 db.

During the hours of darkness, when ionospheric absorption normally drops to very low values, there is a reduction of between approximately 3 and 6 db as the sunspot cycle declines from maximum to minimum activity, with the greatest reduction taking place in the lower frequency bands.

The reduction in ionospheric absorption as the solar cycle declines is very significant, for it means that during the coming years of low solar activity the absorption that contributes most to weakening signals will be reduced materially. Consequently, the signal strength of radio waves that will be reflected by the weakened ionosphere during the next several years should be *noticeably stronger* than signals have been during the past four years of high solar activity, especially on the 40, 80 and 160 meter bands.

The LUF

The *Lowest Usable High Frequency*, or LUF, is the *lowest* frequency that can be used for satisfactory communication over a particular path at a particular time. The LUF is defined as the frequency at which the received signal strength is *equal* to the *minimum* signal strength required for satisfactory reception.

The strength of the received signal depends upon the power of the transmitter, the gain and directivity of the transmitting and receiving antennas, the path length, and absorption losses.

The minimum level of signal intensity required for satisfactory reception depends upon the noise level at the receiving location and the type of modulation transmitted. Atmospheric noise, or static, is generally the predominant type of noise that the signal must overcome. For satisfactory reception, a manual c.w. signal requires a signal-to-noise ratio of about 3:1, speech grade quality s.s.b., with 10 db carrier suppression and 3 kc bandwidth, requres a ratio of about 7:1; while speech quality d.s.b., with 6 kc bandwidth, requires a signal-to-noise ratio of at least 15:1.

At frequencies *below* the LUF, satisfactory reception will not be possible since the received signal will be lost in the prevailing noise level. As the operating frequency is raised *above* the LUF, the signal-to-noise ratio improves. Optimum conditions occur at the MUF, where both the signal-to-noise ratio and the propagation reliability are maximum.

Unlike the MUF, which is dependent entirely upon ionospheric characteristics, the LUF can be controlled to some degree by adjustments in the effective radiated power, or by changes in the type of modulation transmitted. As a general rule of thumb, the LUF can be *lowered* approximately two megacycles for each 10 db *increase* in effective radiated power, and vice versa.

The LUF is somewhat more difficult to determine than the MUF, since it depends upon so many variables. Graphical techniques for calculating the LUF appear in *Ionospheric Radio Propagation, NBS Circular 462*, which is available from the Supt. of Documents, Government Printing Office, Washington 25, D.C., for $1.25.

Since ionospheric absorption decreases between approximately 3 and 10 db as the solar cycle declines, the LUF for any particular circuit is expected to be somewhat lower during the coming years of low solar activity than during the recent period of peak sunspot count.

Circuit Analysis Curves

Between the MUF and the LUF there is a range of frequencies over which radio communications can be maintained on a particular circuit. The upper limit of this range (the MUF) is determined by the ionization density at the point of reflection, while the lower limit (the LUF) is determined by ionospheric absorption along the path, and noise conditions at the receiving terminal. It is of great operational importance to know both these limits as well as the intervening range of useful frequencies. Such data, plotted conveniently in graphical form, are often referred to as circuit, or propagation analysis curves.

Figure 19, a typical circuit analysis curve, represents data for the circuit between the east coast of the U.S.A. and western Europe for a winter period of low solar activity (December, 1954). From this example, it is possible to see at a glance what bands are expected to be open at any time of day. For example, fifteen meter openings are shown between 9 A.M. and 12 noon EST, while forty meter openings are shown between 3 and 8 P.M. EST, etc. The circuit analysis shown in fig. 19 is based on an effective radiated c.w. power of 250 watts.[19]

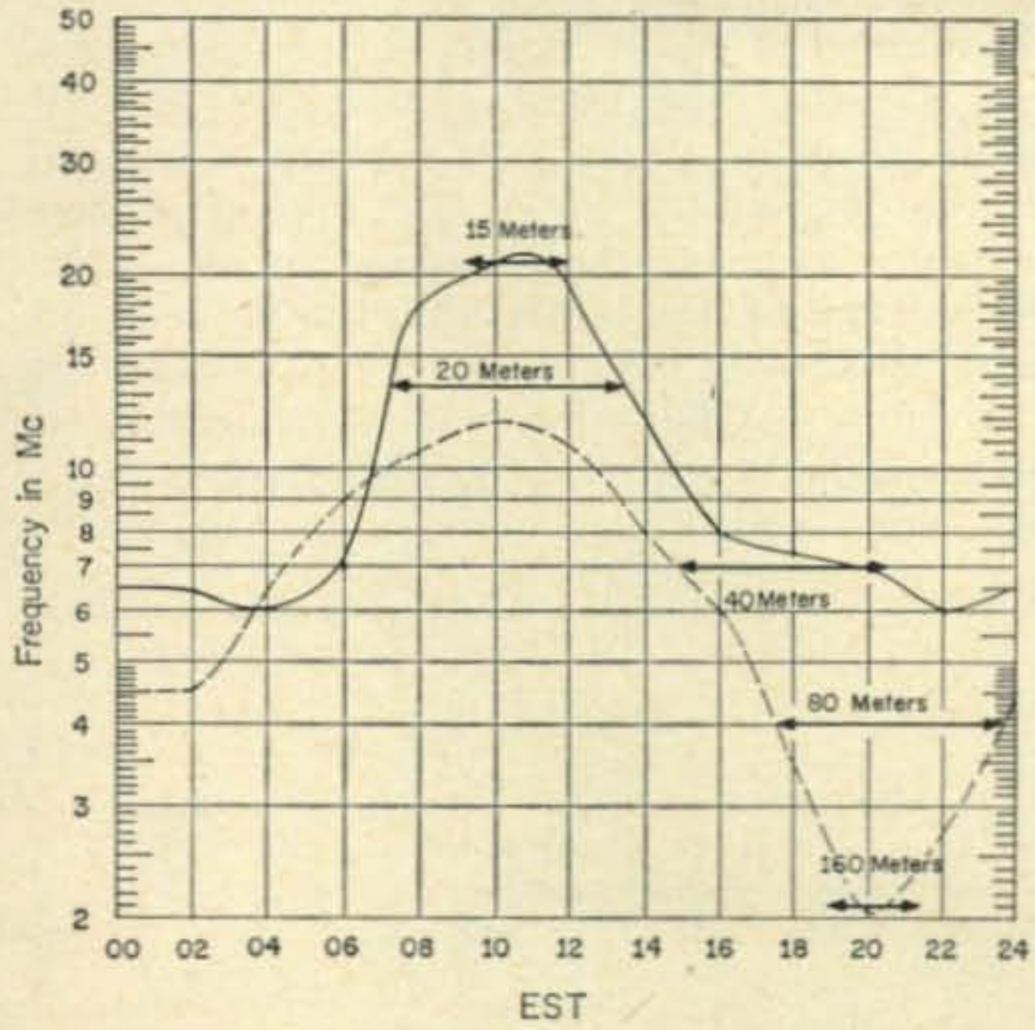

Fig. 19—Circuit analysis curve east coast U.S.A. to western Europe; low sunspot activity (SSN 10); winter season December, 1954. Solid line is MUF, dashed line is LUF. LUF based on 250 watts of c.w. effective radiated power.

During periods of time when the LUF *exceeds* the MUF, "blackout" conditions occur, and it becomes very difficult, if not impossible, to maintain communications on the circuit. In fig. 19, blackouts occur between 4 and 7 A.M. and 1 and 3 P.M. EST.

Propagation forecasts appearing monthly in *CQ*'s PROPAGATION column are based upon the evaluation of nearly 100 different circuit analysis curves of the type shown in fig. 19. The propagation study appearing later in this report is based on nearly 250 such curves.

It can be seen from fig. 19 that unless we are familiar with ionospheric conditions, the chances of maintaining effective radio communications are very slim, since haphazard selection of an operating band can easily result in the signal either penetrating the ionosphere and being lost in space, or being completely lost in the noise level. On the other hand, proper band selection based on propagation data will result in reflection of the signal between transmitter and receiver with a minimum loss of energy.

The ability to maintain efficient long distance

[19] Effective radiated power, or ERP, is defined as the power supplied to the antenna multiplied by the gain of the antenna in a given direction, relative to the gain of a dipole antenna a half-wavelength above ground.

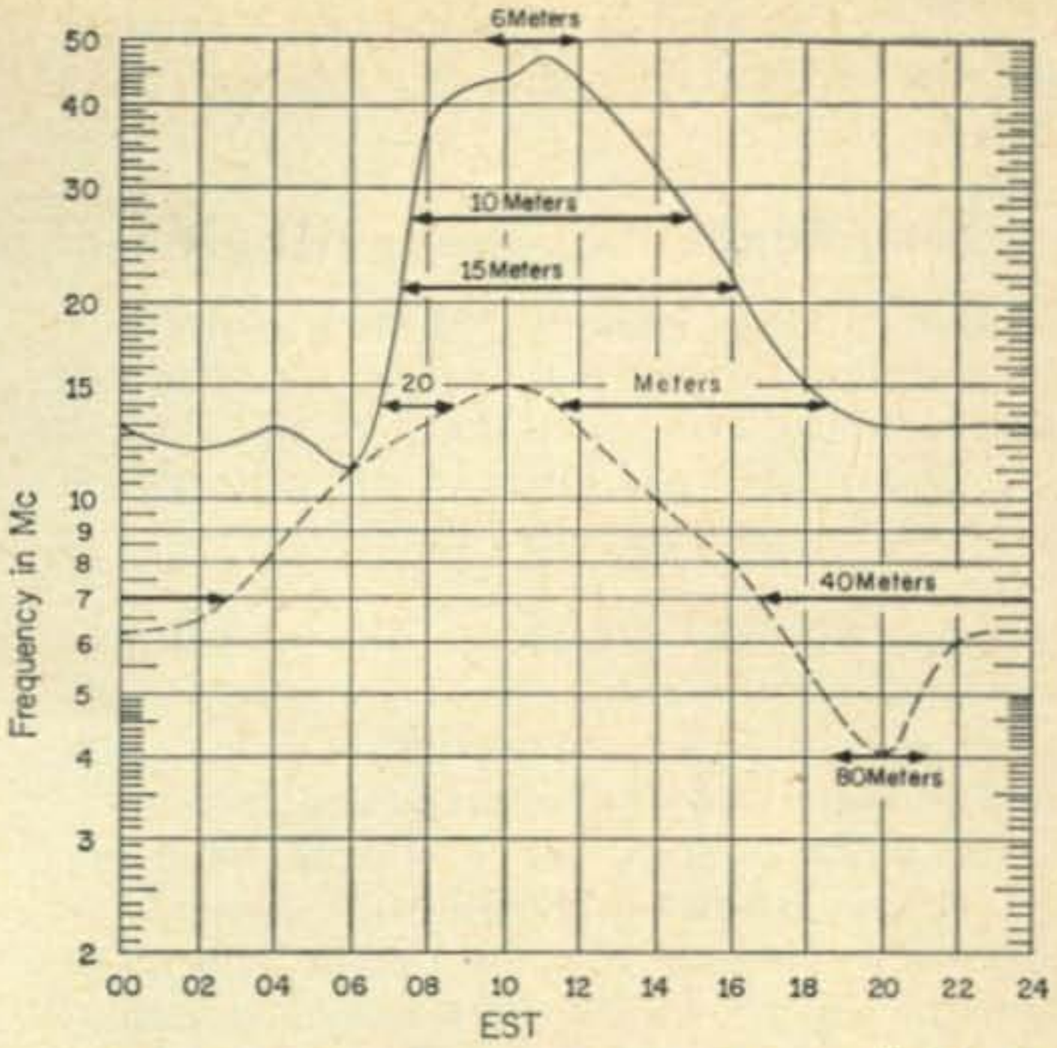

Fig. 20—Circuit analysis curve east coast U.S.A. to western Europe, high sunspot activity (SSN 180); winter season, December 1958. Solid line is MUF, dashed line is LUF. LUF based on 250 watts of c.w. effective radiated power.

shortwave communications depends to a great extent on the ability to predict far enough in advance, what conditions in the ionosphere will be, so that adequate plans can be made. Such long range propagation studies, of the type appearing in this report, are made possible because of the close relationship that is known to exist between ionospheric conditions and smoothed sunspot numbers. This relationship has been discussed in considerable detail in the first two installments of this report. An example of the close correlation that was observed between MUFs and smoothed sunspot numbers during the rising years of the present solar cycle is shown in fig. 21 on page 51.

Present trends in ionospheric conditions (MUFs and LUFs) can be projected for the remainder of the present sunspot cycle in much the same manner as smoothed sunspot numbers have been predicted for the remainder of the cycle. Using the predicted sunspot numbers as a basis (see Table 3, page 41, May *CQ*), it is possible to match MUF and LUF data observed during previous cycles with the corresponding predicted sunspot number. Figures 19 and 20 are examples of propagation data observed on the path between the eastern U.S.A. and western Europe during the winter months of previous periods of high and low solar activity. The propagation study in this report is based on similar projections and correlations for more than 50 other circuits. In addition, the necessity for taking into account seasonal propagation variations brings the total number of circuit analysis curves used in this report to nearly 250.

Space limitations do not permit the publication of each circuit analysis curve used in preparing this report. Pertinent data from these curves has, however, been summarized in tabular form, and propagation conditions expected to occur during the coming years of low solar acti-

vity will be discussed in relation to each amateur band in which ionospheric propagation takes place.

Long Range Propagation Study

A typical long range propagation study takes into account the four seasons of the year for both the upper and lower limits of the sunspot cycle. From this basic information, propagation conditions for any phase of the solar cycle can be deduced.

Figures 19 and 20 depict winter seasonal conditions for the extremes of sunspot activity on the eastern U.S.A. to western Europe path. Based on these, and similar circuit analysis curves for the other seasons, the following table has been devised showing the *average number of hours* each amateur band is usable daily. The tabulation clearly shows the seasonal variations in the average number of hours that each band is usable, as well as the drastic change between periods of high and low sunspot activity.

Table 5 shows that the number of hours that blackout conditions occur on the eastern U.S.A. —western Europe path *doubles* as the solar cycle declines. Table 6 shows that the total number of hours all bands are open on this circuit shrinks by *nearly half* between maximum and minimum periods of solar activity.

To give greater validity to the results found for the eastern U.S.A.—western Europe path. this propagation study also includes a similar analysis of the following paths between the U.S.A. and nine other areas of the world:

1. Eastern U.S.A.—Australasia
2. Eastern U.S.A.—South & Central Africa
3. Eastern U.S.A.—Central Asia
4. Central U.S.A.—Central Asia
5. Central U.S.A.—South America
6. Western U.S.A.—Australasia
7. Western U.S.A.—Western Europe
8. Western U.S.A.—Far East
9. Western U.S.A.—South & Central Asia

Table 6 shows that as the sunspot numbers decline, the number of openings on the higher frequency bands (6, 10, 15 and 20 meters) decreases sharply. For example, at the minimum of the sunspot cycle both the 6 and 10 meter bands are not expected to open at all on the eastern U.S.A.—western Europe path, and the 15 meter band will open less than one-tenth the number of hours it did during the recent sunspot peak. The number of hours that 40 meters opens on this circuit remains about the same throughout the solar cycle, but signals will be strongest during the minimum of the cycle. The number of hours that both the 80 and 160 meter bands open increases as the cycle declines.

In Table 6, the totals for the information appearing in Table 5 are presented for a more convenient comparison.

TABLE 5

The number of hours each amateur band is usable daily (falls between the MUF and LUF) during the four seasons of the year; a comparison between high and low sunspot activity for the eastern U.S.A.-western Europe path.

High Solar Activity (SSN 150)

	Band (Meters)							Black-
Season	160	80	40	20	15	10	6	out
Winter	0	2	9	11	9	7	2	4
Spring	0	1	6	13	12	6	0	4
Summer	0	0	2	12	8	1	0	7
Fall	0	1	6	13	12	6	0	4
Total	0	4	23	49	41	20	2	19

Low Solar Activity (SSN 10)

	Band (Meters)							Black-
Season	160	80	40	20	15	10	6	out
Winter	2	6	5	6	3	0	0	9
Spring	1	3	7	11	0	0	0	7
Summer	0	1	3	6	0	0	0	14
Fall	1	3	7	11	0	0	0	7
Total	4	13	22	34	3	0	0	37

TABLE 6

The total amount of time (average daily totals for the four seasons) that each amateur band is usable: a comparison between high and low solar actitvity for the eastern U.S.A.–western Europe path.

Band (Meters)	*Total Hours Usable* SSN 150	*Total Hours Usable*[20] SSN 10
6	2	0
10	20	0
15	41	3
20	49	34
40	23	22
80	4	13
160	0	4
Total	139	76

Although the statistics vary somewhat for each circuit, openings on the 6, 10, 15 and 20 meter bands decrease considerably, while openings on 40, 80 and 160 meters increase somewhat, as the sunspot cycle declines towards a minimum.

From the data appearing in Tables 5, 6 and 7, the following general conclusions can be drawn concerning propagation conditions on the amateur bands between 6 and 160 meters during the next five years or so, as the present sunspot cycle declines.

a. The total number of hours that all bands on a particular circuit remain open ("Total Usable"

[20] The average daily number of hours an amateur band is expected to open on a particular circuit serves as an index for a particular season. For example, in Table 5, the 40 meter band is expected to open for 5 hours a day during the winter season of low solar activity. This index, taken for each of the four seasons and totalled, becomes the "Total Hours Usable" column in Table 6. The "Total Hours Usable" is significant only as a convenient index for making comparisons. In Table 7 the "Total Hours Usable" for each band is totalled to give an overall "Total Usable" index.

TABLE 7

The total amount of time (average daily totals for the four seasons) that each amateur band is usable; a comparison between high and low sunspot activity for paths between the U.S.A. and nine areas of the world.

Circuits	*Band (Meters)* 160	80	40	20	15	10	6	Total Usable[20]	Blackout
1. Eastern U.S.A.—Australasia									
Sunspot High	0	3	7	31	23	25	0	89	44
Sunspot Low	3	5	15	9	7	0	0	39	72
2. Eastern U.S.A.—South & Central Africa									
Sunspot High	0	0	9	27	25	39	0	100	33
Sunspot Low	3	9	14	12	13	2	0	53	59
3. Eastern U.S.A.—Central Asia									
Sunspot High	0	0	0	13	13	2	0	28	74
Sunspot Low	0	0	2	6	0	0	0	8	88
4. Central U.S.A.—Central Asia									
Sunspot High	0	0	0	14	13	1	0	28	81
Sunspot Low	0	0	2	8	0	0	0	10	87
5. Central U.S.A.—South America									
Sunspot High	0	14	22	45	67	47	5	190	10
Sunspot Low	6	20	26	22	30	9	0	113	21
6. Western U.S.A.—Australasia									
Sunspot High	0	4	6	26	28	35	2	101	26
Sunspot Low	4	9	16	9	15	3	0	56	55
7. Western U.S.A.—Western Europe									
Sunspot High	0	0	1	12	20	3	0	36	67
Sunspot Low	0	1	3	8	1	0	0	13	84
8. Western U.S.A.—Far East									
Sunspot High	0	5	11	30	46	22	2	116	20
Sunspot Low	1	7	19	17	13	0	0	57	51
9. Western U.S.A.—South & Central Asia									
Sunspot High	0	0	2	17	31	27	1	78	34
Sunspot Low	0	3	9	10	13	1	0	36	63

column in Tables 6 and 7) drops considerably as the cycle declines. The reduction varies from 40 to 64% for the ten representative circuits considered in this study; the average reduction being 54%. This means that on the average, the amount of spectrum between 6 and 160 meters that will open for ionospheric propagation during the coming period of low solar activity (from about mid-1962 to 1967) will be *less than half* of the amount usable during the recent period of high sunspot numbers (from about 1957-1960).

b. For the ten representative circuits considered, the average amount of time that *no amateur band* opens on a particular circuit rises by slightly more than one and a half times as the cycle goes from maximum to minimum. On many circuits the number of blackout hours more than doubles (see "Blackout" column in Tables 5 and 7).

c. As the solar cycle declines towards a minimum, there is a shift in emphasis from the higher to the lower frequency bands. During periods of high solar activity the 10, 15 and 20 meter bands open most frequently, while during periods of low sunspot activity the bands opening most frequently are 20, 40 and 80 meters. The 6 meter band, which opened to many areas of the world during the two most recent peaks in solar activity, will not open at all for regular ionospheric propagation during periods of low solar activity. Except for circuits in a north-to-south direction, 10 meters is not expected to open very often as the sunspot numbers dwindle. On the other hand, 160 meters, which rarely opens for DX when the sunspot count is high, is expected to open to many areas of the world during low periods of solar activity. A more detailed band-by-band account of propagation conditions expected during the coming period of low sunspot activity is given later in this report.

Although this report deals with the bands allocated to amateur radio, the general conclusions given above apply equally well to the various other radio services (aeronautical, broadcasting, fixed, mobile, etc.). The drastic reduction in usable high frequency spectrum space expected during the next five years, and possibly longer, is expected to create very serious problems in the field of international telecommunications as all of the world's high frequency communication circuits (which are still increasing at a rapid rate) must be squeezed into less than half the spectrum that was available during the past few years of high solar activity.[21]

Abnormal Ionospheric Variations

Ultraviolet radiation from the sun is believed to be responsible for the formation of the regular electrified layers of the ionosphere. Normal ionospheric variations have been discussed at length in Part I of this report. To review briefly, these consist of *daily variations*, which result from the twenty-four hour rotation of the earth about its axis, *seasonal variations*, which result from the earth's relative angular position and distance with respect to the sun, and the *sunspot cycle variations*, which result from the approximate 11 year variation in sunspot activity seen on the face of the sun.

These variations are regular, and fairly predictable. In addition to these, however, there often occur short-term variations in the ionosphere which cannot be explained by known solar relationships, and which result in *abnormal* ionospheric behavior. Among these abnormal phenomena are the occurrence of ionospheric disturbances, auroral displays, and sporadic-*E* clouds.

While the causes of these phenomena are not clearly understood, it is believed that they are dependent upon abnormal bursts of ultraviolet energy, X-rays, cosmic rays and corpuscular radiation from the sun, and meteors, to name a few. It is necessary to study the solar cycle influence on these abnormal variations in the ionosphere which also play an important part in the propagation of a shortwave signal.

Ionospheric Disturbances

Ionospheric disturbances fall into two general categories—the ionospheric storm, and the sudden ionospheric disturbance, or SID. The former may either develop gradually or commence

[21] Jacobs, G. & Martin, E. T., "The Dwindling High Frequency Spectrum," 1961 International Convention of the *Institute of Radio Engineers*, N.Y.C.

suddenly, and may continue from one or two days to almost a week. The SID, on the other hand, usually commences suddenly, and lasts from about twenty minutes to an hour or two, but rarely longer. Both types of disturbances are similar in that they disrupt communications by causing a drastic increase in ionospheric absorption, and a severe decrease in the ionosphere's capability to reflect shortwave radio signals.

SIDs are believed to be produced by solar flares which are usually associated with large sunspot groups. Flares are tremendous explosions which take place from time to time on the surface of the sun. They occur suddenly, and emit vast quantities of ultraviolet energy, X-rays and cosmic radiation at the speed of light, and subatomic particles, called corpuscles, at much slower velocities. Much of this abnormally high radiation reaches the *D* level of the ionosphere, where it forms a blanket of intense absorption, resulting in a fade-out of signals in the shortwave part of the spectrum. Since SIDs are caused mainly by excessive ultraviolet radiation from the sun, they influence only those transmission paths either completely or partially in the *daylight* areas of the world. Sometimes SIDs are so intense, background noise disappears as well as all shortwave signals. Since absorption affects the lower frequencies most adversely, these are the first to fade out as the SID commences, and the last to return to normal once the flare responsible for the SID burns out.

While SIDs occur almost daily during the years of peak sunspot activity, many months may pass before one occurs as the cycle approaches a minimum.

In addition to radiation which travels at the speed of light, solar flares emit subatomic particles called corpuscles. These travel much more slowly, and reach the ionosphere from one to four days after the flare has occurred. If the bombardment of the ionosphere by these corpuscles is intense enough, the effects on both the magnetic field of the earth and the stability of the ionosphere result in severe magnetic and *ionospheric storms*.

The high-energy particles contained in the corpuscular radiation saturate the ionosphere, considerably increasing ionospheric absorption. This results in a corresponding reduction in signal strength. The radiation also causes severe turbulence in the ionosphere, reducing the ionization density of the layers so that waves which are normally reflected begin to penetrate the weakened ionosphere, and do not return to earth.

During ionospheric storms, the highest frequency which the *F*-layer will reflect may be reduced by as much as 50% below normal, and excessive fading may also occur. Although the *F* layer is primarily affected, severe storms cause similar behavior in the *E* region as well. Under extreme conditions, the combination of a weaker ionosphere and increased absorption results in a radio blackout, during which time long distance shortwave communication may become impossible to many areas of the world, especially on circuits passing near the earth's magnetic poles.

The onset of an ionospheric storm is usually detected in both the daylight and darkness areas of the world at the same time. The storm generally begins simultaneously in the northern and southern extremities of the earth, expanding into the temperate zones as the severity of the storm increases.

Ionospheric storms may occur as much as 100 hours a month during periods of maximum sunspot activity, while during periods of low sunspot numbers they occur about half as often.

Aurora

Corpuscular radiation from the sun, responsible for producing the ionospheric storm, bombards the atoms and molecules of the gases present in the rarified atmosphere at the extremities of the earth, causing them to ignite, forming an aurora.

Of all natural phenomena, auroras are probably the most breathtaking and spectacular. Called variously "Aurora", "Northern or Southern Lights", or "Aurora Borealis"; they arc across the night time sky as weird, yellowish-green, dancing ribbons and violently throbbing rays, or as great draperies folding and unfolding. Some of the rarer displays may also contain shades of red and purple. They occur at *E* level height in the ionosphere, about 60 miles above the earth's surface, and can be seen obliquely from the ground for distances up to about 600 miles from the zenith point.

Observations made over the past 100 years, and intensified during the recent International Geophysical Year, have defined areas of the world where auroras occur most frequently. The zones of maximum occurrence, where auroras are seen on approximately 250 nights a year, are belts about 23 degrees wide centered about the northern and southern geomagnetic poles. In the northern hemisphere, the zone arcs across northern Alaska, central Canada, the southern tips of Greenland and Iceland, the northern tip of Norway, and the northern coast of European Russia and Siberia.

Auroras are seen less frequently as one proceeds south of this zone. In the northern areas of the United States mainland, auroras are seen between 10 and 40 nights a year, while in southern states, several years may pass before an aurora is seen.

Auroras play havoc with shortwave communications. The excessive ionization which causes auroras also cause severe absorption. As a result, auroras act like a screen, shielding shortwave transmissions from passing through. For this reason, trans-polar communication from the United States is extremely difficult and unreliable. The presence of auroral effects on propagation can frequently be detected by the presence of an unique fading component, consisting of a low frequency "flutter" of from 100 to 1000 cycle per second which the aurora superimposes

on the carrier. During intense auroral displays, this fading component is generally strong enough to render the signal unintelligible.

There is a very close relationship between ionospheric storms and the occurrence of auroras. During periods of ionospheric storminess, the zones in which auroral effects are most pronounced expand and move southward. The more severe the storm, the further south the affected area. During the great storm of November 12, 1960, an aurora could be seen as far south as Cuba, with the result that shortwave communication throughout the entire northern hemisphere was virtually blacked-out.

While shortwave communications may be disrupted during auroral displays, v.h.f. propagation often *improves* during these periods. The ionization associated with auroras is often intense enough to reflect 10, 6 and 2 meter signals over distances up to about 1300 miles during times when such propagation is not normally possible.

Since auroras are produced by solar flares, they occur most often during periods of maximum sunspot activity, when flares are most numerous. In temperate latitudes, they occur most frequently two or three years after the peak in solar activity has been reached. Thereafter, they taper off gradually to a minimum that coincides with the minimum of the sunspot cycle. Auroral activity, which has been high during the past four years, is now declining steadily.

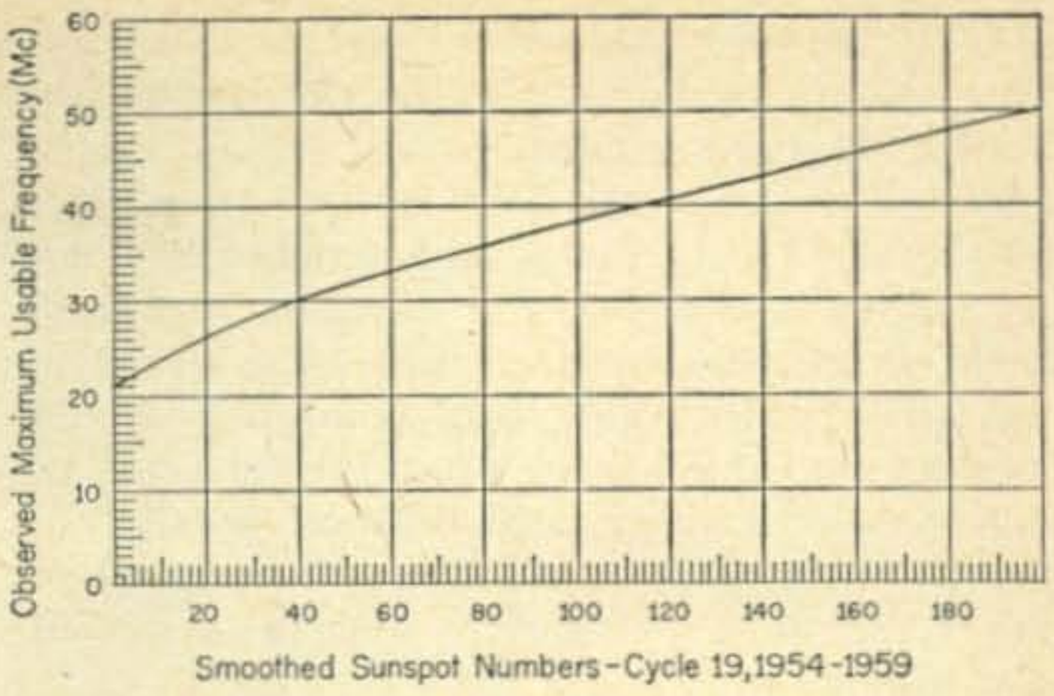

Fig. 21 — Correlation between noontime MUFs and smoothed sunspot numbers on a trans-continental U.S.A. circuit. Values plotted are based upon median December readings measured during 1954-1959.

Sporadic-E, Meteors & Trans-equatorial Scatter

The irregular formation of a thin, but often intense layer of ionization at *E*-layer height in the ionosphere has been discussed in Part I of this report. Sporadic-*E* ionization is of considerable practical importance to radio amateurs since it will often support communications, up to distances of about 1400 miles, on frequencies considerably higher than those being reflected by the regular layers. Sporadic-*E* propagation is often possible on frequencies as high as 60 mc, and on occasion as high as 145 mc. Although it may occur at any time throughout the year, sporadic-*E* propagation peaks during the daylight hours of the summer months when the layer may reflect 10 meter signals as often as 30% of the time, and 6 meter signals as often as 5% of the time.

The sunspot cycle influence on sporadic-*E* propagation is not yet fully established. If the cycle has any influence at all, it appears as if sporadic-*E* ionization may occur somewhat less often during periods of high sunspot activity, but that the intensity of ionization is greater, and higher frequencies are reflected than during periods of low solar activity.

Meteors, or shooting-stars as they are often called, are particles of mineral and metallic matter which are continually entering the earth's atmosphere from outer space. It has been computed that hundreds of millions of meteors, most of them microscopic in size, enter the atmosphere every 24 hours. This figure increases manyfold during certain times of the year, when meteor showers occur. Travelling at velocities of up to 50 miles per second, meteors quickly burn up upon entering the atmosphere.

As a meteor enters the atmosphere, the intense heat generated by friction with the upper air causes it to leave an ionized trail behind it as it burns some 30 to 100 miles above the earth's surface. Ionization produced by meteor trails is often intense enough to reflect v.h.f. signals over distances of several hundred miles. This type of propagation usually occurs in bursts which last from several seconds to a minute or so. Ionization from meteors is also believed to play an important part in the formation of the sporadic-*E* layer, and may also contribute to the existence of the regular layers of the ionosphere during the hours of darkness.

The formation of meteors and their entrance into the earth's atmosphere are not related to sunspots. The solar cycle, therefore, has no influence on this type of propagation.

During 1947, radio amateurs using the 6 meter band discovered a new mode of abnormal propagation, now referred to as *trans-equatorial scatter*. Working across the magnetic equator, it was found that the 6 meter band often opened from the U.S.A. to Argentina and other areas of South America during the evening hours when propagation by normal means was considered to be impossible. Dozens of such openings took place between 1947 and 1950.

During the recent International Geophysical Year (July 1957 to December 1958), hundreds of radio amateurs throughout the world participated in a scientific research program designed to learn more about trans-equatorial propagation. The program was coordinated by the American Radio Relay League. During this period thousands of 6 meter openings were reported, and the characteristics of trans-equatorial scatter propagation were better defined. This type of propagation takes place in all

parts of the world, on paths that cross the magnetic equator in a more or less north-south direction. It occurs during the evening hours, peaking between 9 and 10 P.M., and takes place most often during the period between September and April. From the I.G.Y. results, and from further research carried on since by other scientists, it appears that trans-equatorial scatter propagation occurs most often during years of high sunspot activity, and falls off greatly, or does not take place at all, during the portion of the 11-year solar cycle when sunspot activity is at a minimum.

As the solar cycle declines, therefore, there should be a considerable reduction in the occurrence of ionospheric disturbances, auroras, and trans-equatorial scatter propagation. On the other hand, the solar cycle should have little, if any, influence on sporadic-*E* propagation, and none at all on propagation by means of meteor ionization.

Band-By-Band Summary

The following is a band-by-band summary of ionospheric propagation conditions expected during the coming minimum of the sunspot cycle. Although many of the effects have already been felt, the full impact of minimum conditions is not expected until late 1962, and is expected to last through early 1967, with conditions at their worst between 1963 and 1966. If, as discussed in the second installment of this report, sunspot activity remains at a relatively low level for the next three sunspot cycles, many of the effects may last for the remainder of the century.

6 Meters

THE regular ionospheric layers will not be strong enough to support 6 meter propagation during the period of low solar activity. The world-wide DX openings of a few years ago are a thing of the past, and no DX openings are expected until sunspot activity rises again, and this might not be until the end of the present century.

Short-skip openings up to about 1400 miles should continue to be possible as a result of sporadic-*E* propagation. These openings are most likely to occur during the summer months, or at times when auroral displays take place. Propagation by means of meteor ionization should also be possible, especially during August and December when the major showers take place. Openings of this type occur, however, in bursts of a few seconds, and over relatively short distances.

10 Meters

ALTHOUGH the picture in this band is not as bleak as it is on 6 meters, it is not encouraging. Gradually the openings we've been used to during the plush years will almost entirely disappear. By 1963, except for an occasional opening on more-or-less north-south paths (to South America, and perhaps Australia), it is unlikely that any DX will be heard on this band. What DX does manage to come through, is expected for very limited periods during the late fall, winter and early spring months.

Sporadic-*E* openings up to distances of about 1400 miles should be quite numerous during the summer months (occurring up to about 30% of the time). Short-skip openings may occur during other seasons of the year, especially when auroral displays take place.

15 Meters

Summer: During the years of maximum sunspot activity this band was optimum for summertime DX from about noon through the early evening hours. On some circuits the band remained open during most of the nighttime hours as well. During the period of low sunspot activity few, if any, trans-oceanic openings (to Europe, the Far East, etc.) are expected. Somewhat more frequent openings should occur to Central and South America, but only for a few hours during the daytime. Short-skip sporadic-*E* openings from several hundred to about 1400 miles in distance should occur relatively frequently, especially during the daytime hours.

Winter: Although DX propagation will be greatly reduced, occasional trans-oceanic openings should take place, with somewhat more frequent openings in a north-south direction. Openings will occur during the daytime hours, and may be of rather short duration. Short-skip openings between approximately 1500 and 2400 miles should be possible fairly regularly during the afternoon hours. Once the sun sets, signals propagated by the regular layers of the ionosphere should disappear entirely.

Fall & Spring: Fairly frequent daytime openings to Latin America, and some to Africa and Australasia should be possible. Few, if any, trans-oceanic openings are likely to take place during these seasons. Some daytime short-skip openings should be possible for short periods of time.

20 Meters

DURING the recent period of high solar activity, the 20 meter band was the optimum DX band during the hours of *darkness*. The band would usually open during the late afternoon hours, and remain open to most areas of the world until dawn. During the coming period of minimum sunspot activity, 20 meters is expected to be the optimum band for DX during the *daytime* hours, and very little, if any, regular ionospheric propagation is expected to take place during the hours of darkness.

Summer: The band should remain open from shortly after sunrise to shortly after sunset. During this time fairly frequent openings to many areas of the world should be possible. Frequent short-skip openings over distances from a few hundred to approximately 2000 miles should also be possible during the afternoon hours.

Winter: Good world-wide DX conditions to many areas of the world should be possible during the hours of daylight. Openings to most areas of the world will, however, be of rather short duration, on the order of an hour or so. During some openings signal levels may be exceptionally strong, about as strong as 10 and 15 meter openings were during sunspot maximum. Short-skip openings between approximately 500 and 2000 miles should also be possible during most of the daylight period. Once the sun sets, however, signals propagated by the normal layers of the ionosphere should disappear rapidly.

Fall & Spring: Fairly good DX to some areas of the world is expected during the daylight and early evening hours. Signals will be weaker than during the winter months, but the band should remain open to DX areas for longer periods of time. Fairly frequent short-skip openings should be possible during

most of the daylight period over distances ranging between approximately 900 and 2000 miles.

40 Meters

WHILE 40 meters opened fairly frequently for DX during the evening hours of sunspot maximum, signals were usually weak and erratic because of the high absorption. As the solar cycle declines, absorption on 40 meters decreases by more than 6 db, signals become noticeably stronger, and the band opens to more areas of the world. During the minimum period of solar activity, 40 meters often should be the best DX band during the hours of darkness. It is expected to behave much like 20 meters did during the hours of darkness of the sunspot maximum period. It should be reliable for world-wide DX almost every night of the year, during the hours when most amateurs find it most convenient to operate.

Summer: Although static levels are at their highest values of the year, the band is expected to open to Europe, the Far East, Latin America and other areas of the world from a few hours after sundown until dawn. During the hours of darkness short-skip openings should be possible up to distances between approximately 1000 and 2300 miles. During the hours of daylight, intense ionospheric absorption is expected to limit openings to distances between approximately 200 and 500 miles.

Winter: The band should begin to open for DX during the late afternoon hours, and remain open to one part of the world or another until dawn. During this period, openings should be possible to most areas of the world, often with exceptionally strong signals. During the nighttime hours, consistent short-skip openings should be possible between distances of approximately 1300 and 2300 miles. During the daylight hours, intense absorption should limit openings to between approximately 150 and 750 miles.

Spring & Fall: Fairly good DX to most areas of the world is expected during the nighttime hours, with signals often quite strong. Frequent short-skip openings between approximately 1200 and 2300 miles should also be possible. During the daytime hours propagation is expected to be limited to distances between approximately 200 and 600 miles.

80 Meters

DURING the coming period of low solar activity 80 meters is expected to behave much the same as 40 meters did during the recent period of high sunspot activity. The band should open to many areas of the world during the hours of darkness, and signals will often be quite strong.

Summer: Although the band should be quite noisy, some DX openings are expected during the hours of darkness. Frequent short-skip openings should also occur during the hours of darkness up to distances of approximately 2000 miles. Intense absorption is expected to limit daytime openings to distances of about 150 miles or so.

Winter: With static levels at their lowest seasonal values, the band is expected to open for DX to many areas of the world during the hours of darkness. At times, signal levels may be exceptionally strong. Frequent short-skip openings during the evening hours should be possible between distances of approximately 300 and 2300 miles. During the daytime hours, short-skip openings up to distances of about 250 miles should be possible.

Spring & Fall: Fairly good DX openings are expected to many areas of the world during the hours of darkness. Short-skip openings between distances of approximately 250 and 2300 miles should also take place during the nighttime hours. Intense ionospheric absorption is expected to limit daytime propagation to distances of about 200 miles.

Working all continents on 80 meters is no longer uncommon. Recently, W1BU, the Rhodedendron Swamp Radio Society, turned the trick on 75 meter s.s.b. in something less than three hours. Less experienced operators have recently made WAC on 80 meter c.w. during a weekend. As the sunspot cycle declines, this feat is expected to become easier to accomplish.

160 Meters

THE 160 meter band undergoes considerable change as the solar cycle declines from maximum to minimum. During the recent solar cycle peak, 160 meters rarely opened for ionospheric propagation beyond a thousand miles or so. When it did, the band was usually very noisy, and signals weak and erratic. As the solar cycle declines, absorption decreases (up to 10 db), and conditions on 160 meters improve considerable. This improvement is already noticeable on the band.

The great improvement that takes place on this band as solar activity decreases is underscored by the recent announcement that W8GDQ of Wellington, Ohio has become the second station in history to Work All Continents on 160 meters. This was accomplished on March 3, 1961 when Wilkie worked ZC4AK in Cyprus for his first Asian contact. In 1953, almost at the minimum of the last sunspot cycle, Stew Perry, W1BB, was awarded the first WAC on 160 meters.

Conditions on 160 meters are expected to continue to improve. Conditions on this band during the period of low solar activity should be as-good-as, or somewhat better than they were on 80 meters during the recent sunspot maximum. During the hours of darkness, the band should open to many areas of the world. During the late fall, winter and early spring months signals may at times be remarkably strong. During the daylight hours intense ionospheric absorption is expected to limit propagation to groundwave distances of several miles during the summer months, and skywave distances up to about 150 miles during the other seasons.

With an improvement in 160 meter propagation conditions already noticeable, activity on this band has picked up considerably throughout the world. It is estimated that amateurs from nearly fifty countries, comprising all continents, are now active on this band. In the years of low solar activity ahead, it is almost certain that WAC, and even DXCC, will no longer be uncommon on 160 meters.

Summary

The present sunspot cycle, the 19th observed since accurate records have been kept, reached a record breaking peak during March, 1958. Since then, sunspot activity has been declining . . . slowly at first, but now more rapidly. This decline is expected to continue gradually until the present cycle reaches its minimum value, which is predicted to occur sometime during early 1965. There are indications, although considerably less reliable, that the present cycle may be followed by three very low cycles, and

[*Continued on page 104*]

A Stacked Rhombic Array for 1296 Mc

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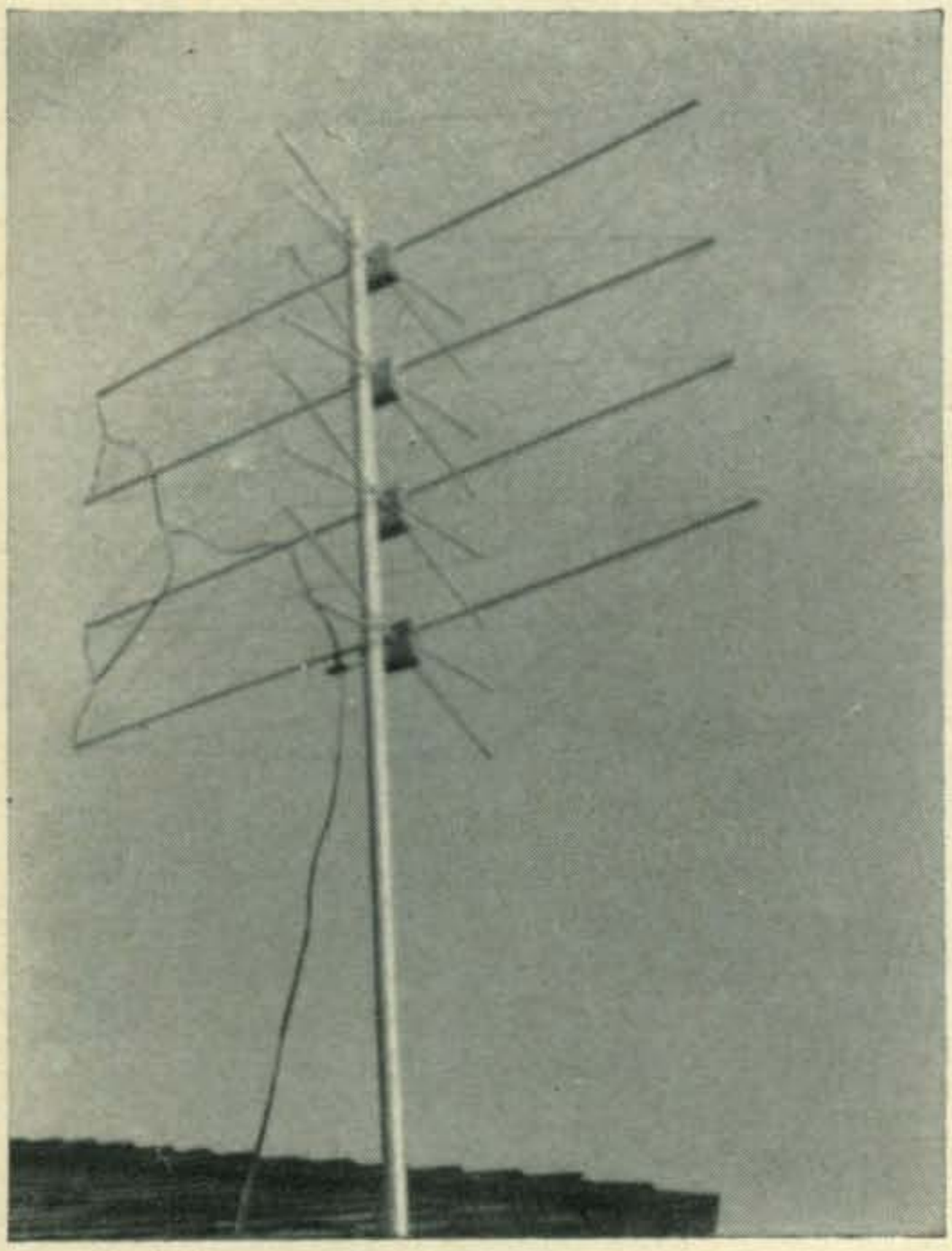
Ease of construction and low wind resistance are essentially the advantages derived from this high gain 1296 mc stacked array.

At 1296 mc, a wavelength is so small that practically any form of antenna becomes feasible and a multitude of types have been developed that could be used. The main problem is to choose the most practical form. From the amateur viewpoint, the most desirable characteristics of a 24 cm antenna would be: (1) high gain, (2) low wind resistance, (3) low cost, (4) light weight, (5) ease of construction, (6) "loose" dimensional tolerances, (7) small over-all size. Obviously, some of these requirements are mutually conflicting; for instance, the requirement for high gain usually conflicts with all of the others. By far the most popular communications antenna in the microwave region is the parabolic dish, but in terms of the above requirements it is not a particularly high performance antenna.

Most antenna types may be placed in one of two categories; the aperture type, or the end-fire type. Examples of the aperture type antenna are the dish, the horn, the bedspring array, etc. The end-fire class may be represented by such forms as the Yagi, the Polyrod antenna, the Cigar antenna, etc. The Rhombic, along with the V is somewhat unique in that it finds a home in neither category, but is kind of a hybrid between the two. The H-plane (vertical plane for a horizontal rhombic) directivity is achieved entirely by end-fire means, whereas the E-plane beamwidth is determined by a combination of end-fire and broadside directivity. For this reason, a typical rhombic will have an H-plane beamwidth about twice as great as in the E-plane. In the case of a horizontally polarized rhombic, this is just the opposite of the desired pattern since only that power confined to within a few degrees of the horizon is useful. Power radiated at a large angle with respect to horizontal is wasted into outer space or into the ground nearby. At the same time, a narrow azimuthal beam has the disadvantage of less angular coverage (fewer people will hear your CQ and conversely). Of course, reducing beamwidth is the only way we can increase gain (assuming small minor lobes), and for the above reasons, it would be much wiser to reduce the beamwidth in the vertical plane. This is readily done by stacking vertically. In the case of rhombics, the spacing between bays need not be large because of the broad H-plane lobe to start with.

The stacked rhombic in action at W6HPH.



This array consists of 4 identical rhombics, each patterned after the antenna described by Triolo.[1] The gain of each is about 13.5 db and four, stacked, gives about 19.5 db, nearly as much as a four foot dish (with considerably less wind resistance). Front-to-back ratio is about 5 db, and may be increased to at least 12 db by terminating each rhombic with a 620 ohm, ½ watt carbon resistor. The termination does not affect the gain however, since it merely absorbs the power that would otherwise be radiated to the rear. QRM is not a problem on the u.h.f. bands, so it is just as well to leave the array unterminated, and theoretically this results in a slightly lower antenna noise temperature.

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[1]Triolo, F. J., "A Novel Antenna For Mobile Radio Relay Operation in the UHF Range." 1958 IRE *National Convention Record,* Part 1. pp 183-192.

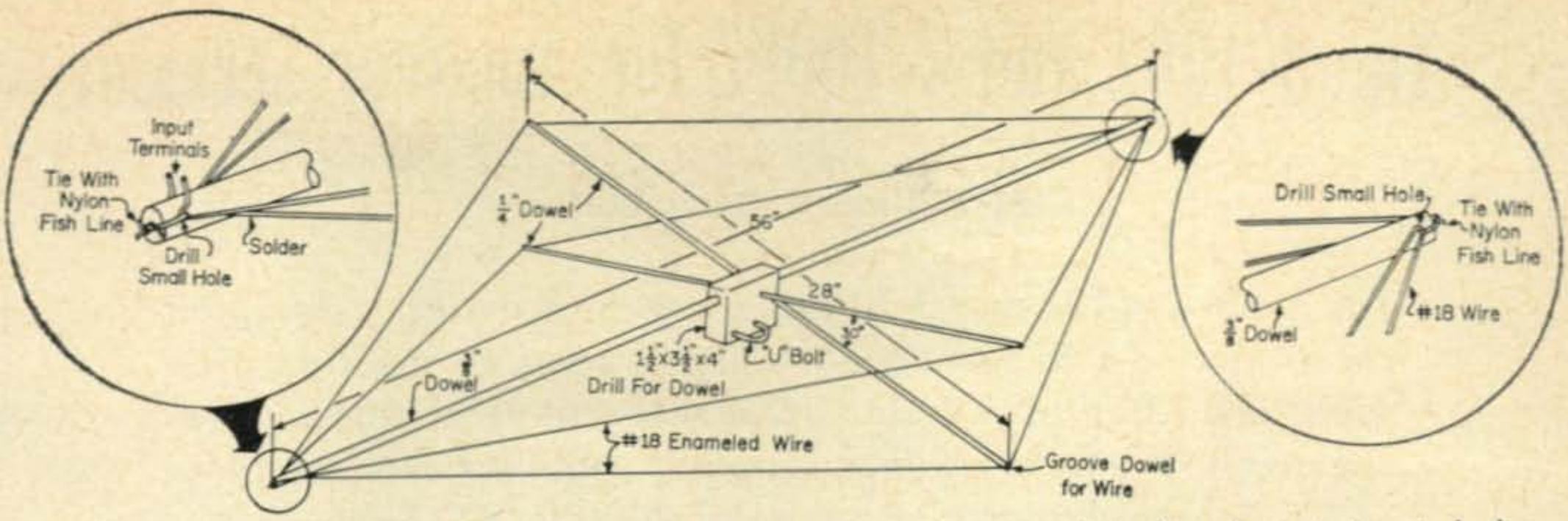

Fig. 1—Construction details for a 1296 mc rhombic. Pictured is one of the four bays to be stacked vertically.

Construction

Dimensions and necessary construction data for each rhombic are given in fig. 1. The block in the center is a piece of 2×4 drilled to take the dowel supporting members. Try to select dowel with a straight grain to minimize warpage. All wooden parts should be given two coats of premium quality house paint (any color) to protect them from the weather. The cost per rhombic, neglecting the U-bolt is about 30 cents.

The spacing between bays is 12 inches. Correct phasing is insured by feeding pairs as in fig. 2. The phasing harness may be made of 300 ohm ribbon. Matching is achieved by wrapping the twinlead transmission line with a small piece of aluminum foil near the point where it connects to the phasing harness. This is the simplest, quickest, and probably the most efficient way to match a u.h.f. antenna. Both the position and length of the foil section must be adjusted for minimum s.w.r. After the correct adjustment is found, the foil is wrapped with masking tape and doped with house paint to make it water tight.

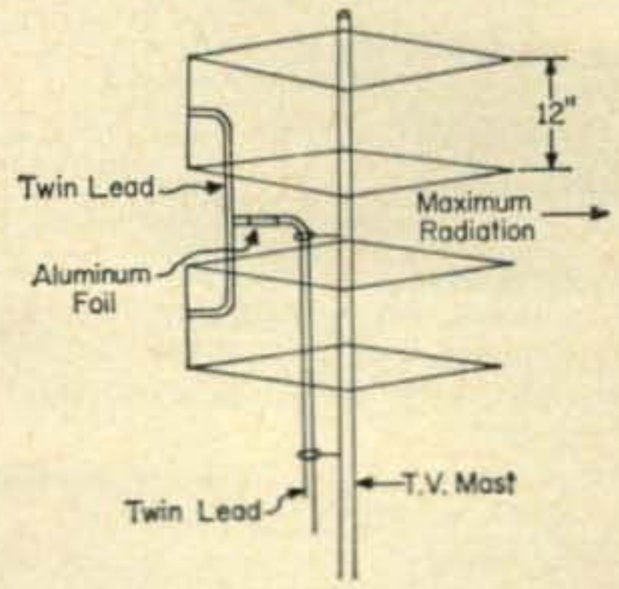

Fig. 2—Method of stacking and phasing the rhombics. The aluminum foil wrap on the feedline is adjusted for a proper match.

Transmission Lines

A word is in order about transmission lines at this frequency. Twinlead or open wire line is recommended, unless some very low-loss coax is available. Even ordinary dime store twinlead has much lower attenuation than RG-8/U. The radiation losses are negligible and are independent of the length.[2] Also, most antennas have balanced temminals which are more adaptable to parallel wire line. A balun is needed at the station end of course, and a half wave coax balun at 432 mc will work fine as a 3/2 wave balun at 1296 mc.

This array, being extremely broad-band, will show some gain (about 9 db) at 432 mc. Results on 1296 have been highly rewarding, measurements indicate the gain to be at least 19.5 db, and on-the-air reports confirm this. ■

[2]Skilling, *Electric Transmission Lines*, McGraw-Hill, pp 329.

RESULTS VK/ZL CONTEST 1960

C.W. WINNERS

No. America		So. America		Europe	
W1GYE	495	HK7ZT	176	DL1FF	2054
W2EQS	2639	CE3AG	1575	EA3CY	72
W3RNY	45	YV3AS	240	F2MA	221
W4FIJ	3535	Asia		G4CP	1176
W5KC	4104	JA1VX	4824	HB9MO	392
W6LDD	5120	BV1US	216	IT1AGA	32
W7IMA	2720	MP4BCV	126	OE1RZ	768
W8JIN	4176	VS9ADL	72	OZ7OMR	40
W9WNV	3344	XZ2TH	400	OK1LM	624
WØBMM	336	UAØAG	310	PAØTAU	108
KL7ALZ	792	Oceania		OH5RU	152
VE3BWY	779	FK8AH	1675	ON4LX	352
KP4CC	390	KØSLD/		LA8GF	15
TI2CMF	96	KW6	5670	SP6FZ	640
XE1PJ	424	VR1B	4294	SM5LL	1000
Africa		ZK1AR	836	SVØWZ	9
FA8RJ	210	KH6DMW	616	UB5KAB	1430
				UR2BU	9
				UA1DZ	1440

PHONE WINNERS

No. America		Europe		Asia	
W1WY	15	DL3LL	511	JA3AA	72
W4SIB	162	EA3JE	250	BV1US	184
K5KBH	2176	G5HZ	128	OD5CT	84
K6RTC	520	CT1EY	216	9M2DQ	2250
W8JIN	480	OE1RZ	55	UAØKIA	28
K9ECE	96	OH5SM	230	Oceania	
VE3DDI	96	SM5ACC	90	KH6DLD	611
VE6TF	15	UR2BU	112	KØSLD/	
TG9CP	560	Africa		KW6	1200
TI2CMF	10	ZS6NE	338	ZK1AR	630
				So. America	
				YV1EE	126

VK/ZL LEADERS

C.W.			Phone		
VK5NO	14,045	ZL1AH	13,535	VK5MS	13,790
VK2GW	12,495	ZL1AIX	11,705	VK5NQ	7450
VK9XK	9815	ZL1AJU	11,240	VK9NT	3880
VK2ADE	9490	ZL1APM	10,960	ZL1AIX	11,755
VK3DQ	8415	ZL1HS	10,365	ZL1KG	8540
VK7SM	6505	ZL2AWJ	10,275	ZL1AH	6350

The 3-400Z and 3-1000Z for Amateur Service

By William I. Orr*, W6SAI

The Eimac 3-400Z and 3-1000Z are zero bias triodes designed for grounded grid service in the high frequency spectrum. The tubes are rated at 400 and 1000 watts plate dissipation, respectively. No external bias supply is required over the plate potential operating range of 2000 to 3000 volts.

THE 3-400Z and 3-1000Z tubes are especially suited for single sideband operation in the amateur service. Costly and bulky screen and bias supplies are not required. The tubes are small and rugged, and are designed to fit into modern, compact transmitter design. Best of all, the 3-400Z and the 3-1000Z provide *improved* linearity and a reduction of bothersome intermodulation products when operated in an approved circuit.

The 3-400Z is rated to 1000 watts p.e.p. input, and the 3-1000Z is rated to 2000 watts p.e.p. input. These ratings are established at moderate plate potentials, and result in third-and high-order product distortion figures better than —35 decibels below maximum output!

Preliminary operating data for these tubes is given in Table I, and suggested circuits are shown in fig. 1 and fig. 3.

Circuitry for the 3-400Z

A simple operational circuit for the 3-400Z is shown in fig. 1. The input circuit comprises a high-C tank (L_1C_1), with excitation applied at a point which matches a 52 ohm driving source. The coil is bifilar wound, with the filament voltage applied to the tube via the coil. The grid of the tube is at ground potential for both d.c. and r.f. The plate circuit consists of a pi-network ($C_5L_2C_6$) with the output voltage monitored by a simple diode voltmeter.

The Cathode Circuit

Capacitors C_3 and C_4 form part of the cathode tuned circuit and comparatively high valves of r.f. current flow through them. The specified capacitors are satisfactory for the 3-400Z tube in continuous service, and will serve for the 3-1000Z in intermittent duty. These two capacitors should be grounded to a common point at the rotor of capacitor C_1. Capacitor C_2 carries the full excitation current and should be a transmitting type, as specified.

Filament coil L_1 is made of a section of ¼ inch diameter copper tubing with a length of #12 insulated wire passed through the center hole. Heavy conductors are soldered to each end of the coil to serve as filament circuit leads. After the correct position of the excitation tap has been found, it may be soldered in position.

It is necessary to use some form of tuned circuit at this point and to *resist* the temptation to substitute untuned filament chokes. Use of the latter by themselves will result in degradation of linearity to a marked degree, and will make the amplifier more difficult to drive properly.

Circuit Details

Plate meter M_1 is placed in the B-minus lead to the amplifier in order to register plate current instead of cathode current (a combination of

TABLE I

Preliminary Operating Data for 3-400Z and 3-1000Z

3-400Z

Filament: 5 volts @ 14.5 amperes
Socket: Eimac SK-410 with SK-416 chimney
Cooling: Radiation and forced air
Maximum Operating Temperatures: Base, 200°C; Plate seal, 225°C
Typical Operation for minimum distortion products with 1 kw p.e.p. input

D.c. Plate voltage	2500 volts
Zero signal plate current	73 ma
Single tone d.c. plate current	400 ma
Single tone d.c. grid current	142 ma
Two tone d.c. plate current	274 ma
Two tone d.c. grid current	82 ma
Useful power output (p.e.p.)	560 watts
Resonant load resistance	3450 ohms
Intermodulation products—Typically more than —35 decibels below p.e.p. level	

3-1000Z

Filament: 7.5 volts @ 21.3 amperes
Socket: Eimac SK-510 with SK-516 chimney
Cooling: Radiation and forced air
Maximum Operating Temperatures: Base, 200°C; Plate Seal, 225°C
Typical operation for minimum distortion products with 2 kw p.e.p. input

D.c. plate voltage	2500 volts
Zero signal d.c. plate current	162 ma
Single tone d.c. plate current	800 ma
Single tone d.c. grid current	254 ma
Two tone d.c. plate current	550 ma
Two tone d.c. grid current	147 ma
Useful power output (p.e.p.)	1050 watts
Resonant load resistance	1700 ohms
Intermodulation products—Typically more than — 35 decibels below p.e.p. level	

*Manager, Amateur Service Department, Eitel-McCullough, Inc., San Carlos, California.

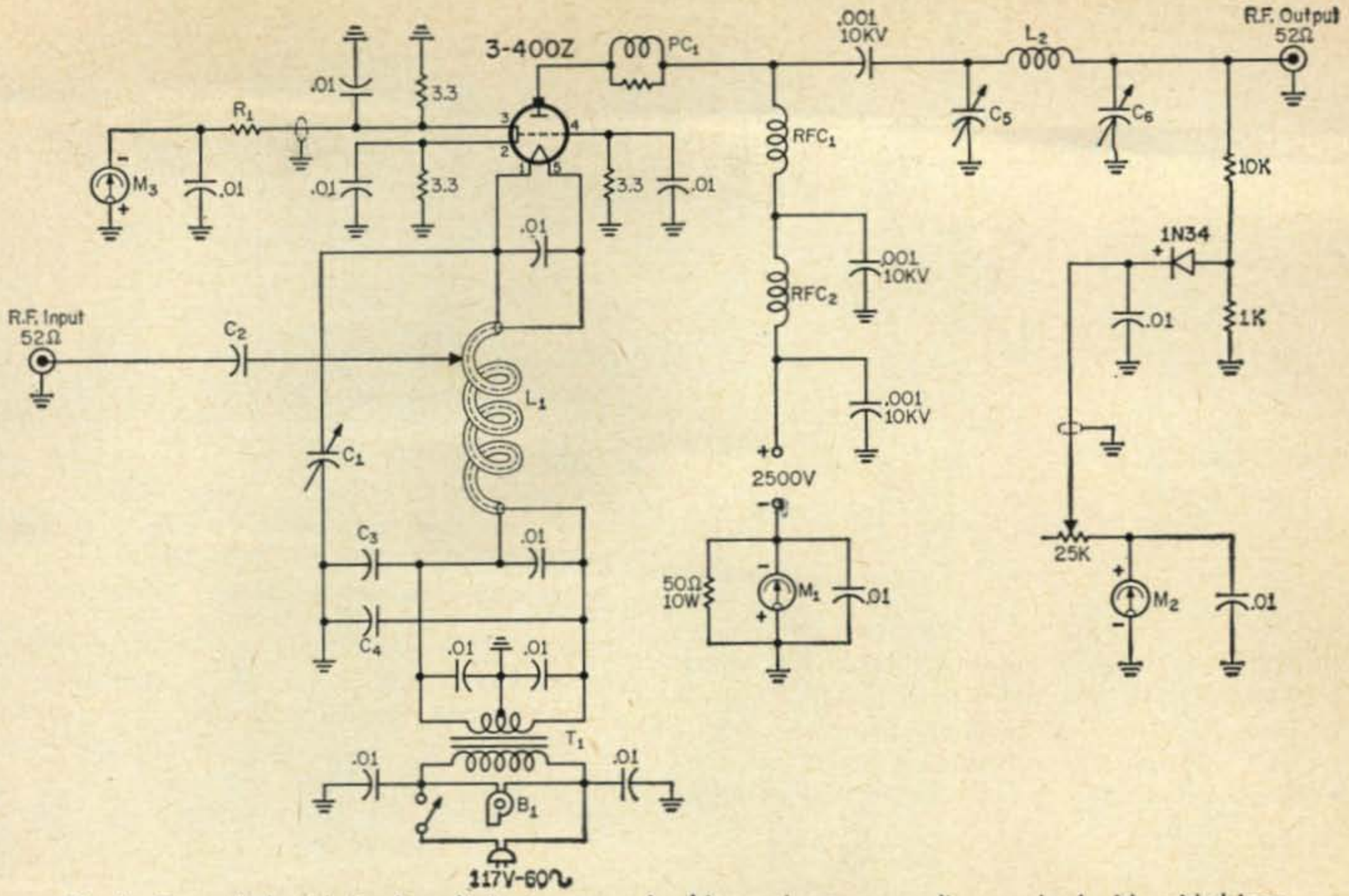

Fig. 1—Grounded grid circuitry eliminates expensive bias and screen supplies required with grid driven circuitry. Good tube linearity, plus use of tuned cathode circuit results in low distortion, high power side-band amplifier.

C_1—1000 mmf three gang b.c. variable, with sections connected in parallel. (J. W. Miller #2113).

C_2—.01 mf, mica. 1200 volt. Aeorvox type 1446.

C_3, C_4—.01 mf, mica. 500 volt. Aerovox type CM-30B-103.

C_5—3500 volt rating. Effective tuning capacity: 2.5 mmf per meter.

C_6—500 volt rating. Effective tuning capacity: 25 mmf per meter.

L_1—See text. Resonates to operating frequency with C_1 setting of approximately 13 mmf per meter. Approximate dimensions are: 80 meters, 10 turns, 1⅝" i.d., 3¼" long, tap 6 turns from ground. 40 meters, 6 turns, as above, 2" long, tap 3½ turns from ground. 20 meters, 4 turns, as above, 1¼" long, tap 2 turns from ground. 15 meters, 3 turns, as above, 1" long, tap 2 turns from ground. 10 meters, 1 turn, as above, tap ½ turn from ground. Make of ¼ inch copper tubing, threaded with #12 insulated wire.

L_2—Make of ¼ inch copper tubing, 3" i.d. To resonate to frequency with settings of C_5 and C_6 as specified above.

M_1—0-750 ma.

M_2—0-1 ma.

M_3—0-1 ma.

R_1—Internal resistance of meter M_3 plus R_1 totals 550 ohms. Meter reads 0-500 ma, full scale.

T_1—5 volts at 14.5 amperes. Chicago type F-516.

RFC_1—H.f. choke. B&W type 800.

RFC_2—V.h.f. choke. Ohmite Z-144.

PC_1—Three 100 ohm, 2 watt composition resistors in parallel; shunt coil is 3 turns, 1" diameter, length of resistors.

B_1—115 volt blower. Minimum of 15 cubic feet per minute. Ripley #82, or equivalent.

grid and plate current). The negative return of the power supply, therefore, should be "floating" as shown in fig. 2.

Since a great deal of power is produced in a small package, the new low cost Eimac air system socket and a blower are used with these tubes in order to maintain the envelope and seals at a low temperature. An alternative arrangement may be two separate blowers, one directed at the envelope of the tube, and the other at the bottom of the tube socket.

Amplifier Construction and Adjustment

In order to complement the excellent internal shielding of the grounded grid tubes it is necessary to isolate the input and output circuits. The cathode circuit should be placed below the metal chassis, enclosed in a metal box. Plate circuit components should be mounted above the chassis. As a TVI preventive measure, the complete amplifier should be enclosed within a metal shield made of perforated material. The grid terminals are bypassed to ground by means of three .01mf ceramic capacitors mounted (one at each socket terminal) by the shortest possible leads. Also placed at each grid terminal is a 3.3 ohm, 1 watt composition resistor. These resistors "de-Q" the capacitors and provide a short, direct ground return for the r.f. and d.c. currents in the grid circuit. Meter M_3 measures the slight voltage drop across the resistors and is calibrated in terms of grid current for tuning purposes.

Before the amplifier is adjusted, the filament voltage at the tube socket should be checked to ensure that excessive voltage drop does not exist in the tuned circuit. Approximate setting for the

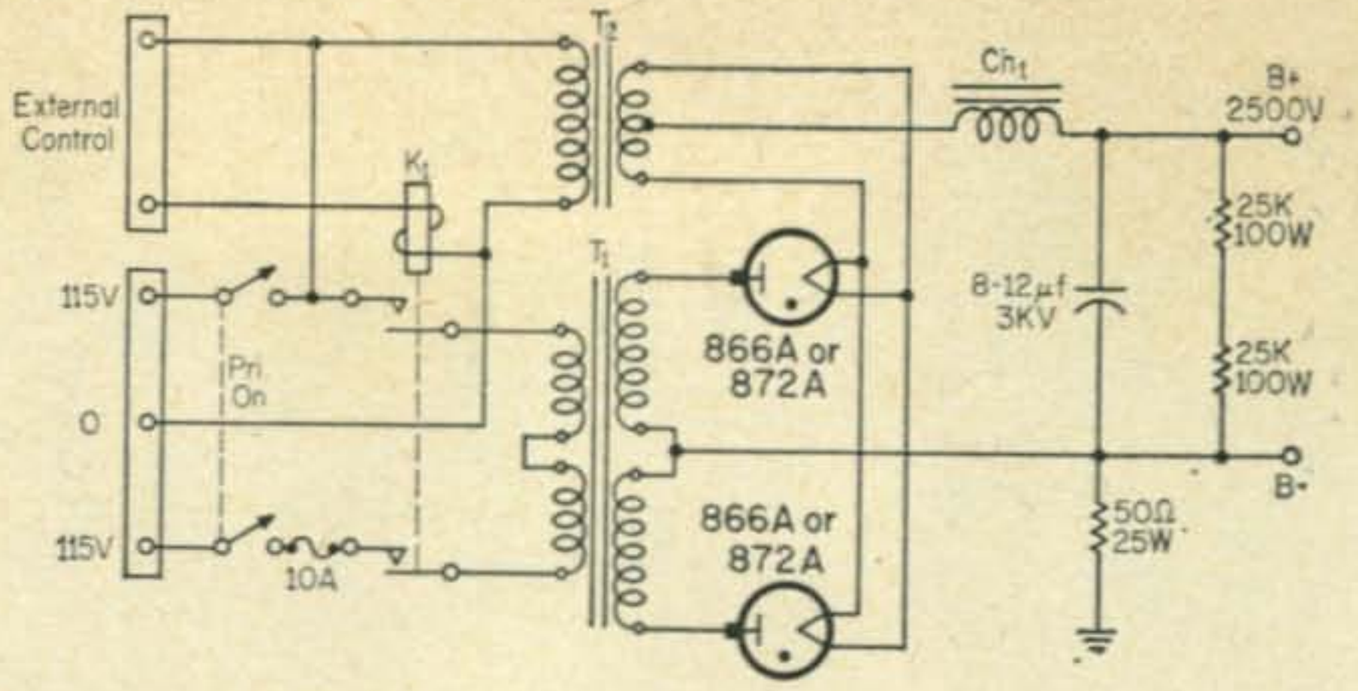

Fig. 2—A suitable power supply to be used with the amplifier described. 866A rectifier tubes may be used with the 3-400Z. Use 872A rectifier tubes for the 3-1000Z. Xenon-type 3B28 may be substituted for the 866A and the 4B32 for the 872A.

CH_1—10 Henries @ 500 ma. Resistance 40 ohms. Chicago #R-105.

K_1—D.p.s.t. relay. Potter & Brumfield PR7AY, with 115 volt a.c. coil.

T_1—2900-0-2900 volts @ 500 ma, CCS. 115-230 volt primary. 1600 va capacity. Chicago #P-2126.

T_2—For 866A tubes: 2.5 volts @ 10 amp. 9 kv insulation Chicago #F-210H. For 872A tubes: 5 volts @ 15 amp. 10 kv insulation. Chicago #F-520HB.

tap of L_1 is given in fig. 1. The exact point may *be found* by loading the amplifier to full input and varying tap placement until maximum grid current is obtained at the same setting of capacitor C_1 that provides minimum s.w.r. on the exciter coaxial line. At incorrect tap settings, minimum s.w.r. figure and maximum grid current settings of capacitor C_1 do not coincide.

When properly loaded and tuned, grid current runs about ⅓ the value of plate current. Plate loading and tuning and the excitation level adjustments should be conducted to adhere closely to this ratio of grid/plate current. After the amplifier is loaded to maximum input in this fashion, the pi-network should then be overcoupled (C_6 reduced in capacitance) slightly until the r.f. output measured on M_2 drops about 3%. This will approximate a condition of maximum linearity. *Do not* apply full excitation to the tube without plate voltage and proper loading as grid dissipation will be exceeded.

In sideband service, for voice waveforms, the indicated plate current measured on M_1 will be approximately one-half the peak d.c. plate current. One kilowatt p.e.p. input to the 3-400Z, for example, may be achieved on voice by plate current meter peaks of 200 ma at a plate potential of 2500 volts.

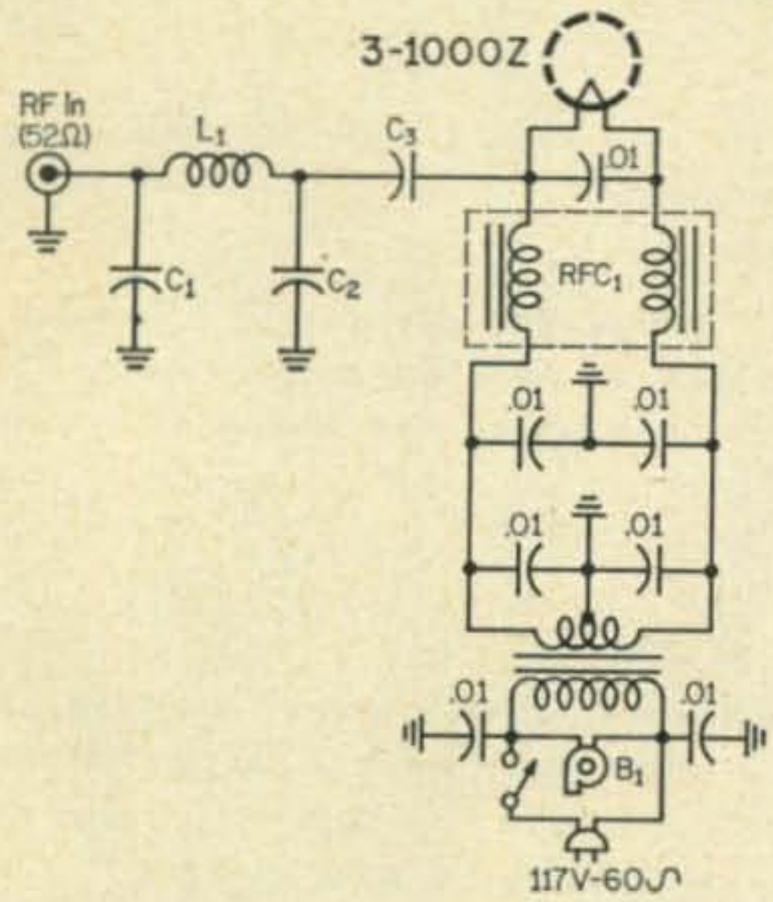

Fig. 3—Diagram of a suitable pi-network input circuit for the 3-1000Z. The network may be adjusted by shorting capacitor C_2 and trimming inductor L_1 until L_1C_1 resonates to the center of the band in operation, or by making C_2 variable and adjusting for maximum grid drive. An alternative arrangement is to eliminate the bifilar filament choke and substitute a low-capacity filament transformer. (7.4 volts at 21.3 amperes). A suitable transformer is made by Transformer Technicians, Inc., 2608 No. Cicero Ave., Chicago, Ill. (Type #TTI-4173).

C_1—1250 volt, transmitting-type mica capacitor. Aerovox type 1446 or 1651-L. Two capacitors may be connected in parallel to obtain odd values of capacitance.

80 meters: 1000 mmf — 15 meters: 150 mmf
40 meters: 450 mmf — 10 meters: 100 mmf
20 meters: 220 mmf

C_2—Same as C_1. Capacitance as follows:

80 meters: 900 mmf — 15 meters: 90 mmf
40 meters: 375 mmf — 10 meters: 30 mmf
20 meters: 150 mmf

C_3—Same as C_1. 0.02 mfd.

L_1—May be made of B&W Miniductor coil stock, as follows:

80 meters: 2.5 μh 15 turns, 1" diameter, 8 turns per inch. (B&W #3014).
40 meters: 1.1 μh 8 turns, same as above.
20 meters: 0.55 μh 7 turns, ¾" diameter, 8 turns per inch. (B&W #3010).
15 meters: 0.37 μh 6 turns, same as above.
10 meters: 0.3 μh 6 turns, ½ " diameter, 8 turns per inch. (B&W #3002).

B_1—115 volt, 60 cycle blower. Ripley #81. 45 cubic feet per minute.

RFC_1—30 ampere bifilar filament choke. B&W FC-30.

Notes on the 3-1000Z Tube

The circuit of fig. 1 may be used for the 3-1000Z. However, the higher filament current of this tube requires that a heavier bifilar coil be used, having a length of #10 insulated wire for the center conductor. Also, as the input impedance of this tube is close to 52 ohms, the

[*Continued on page 124*]

ANOTHER KEYING SYSTEM

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La Jolla, California

The author describes a rather simple keying system, capable of not only electronically keying the final amplifier but also controlling the v.f.o., receiver, etc. in proper sequence to provide for semi-break-in operation.

BECAUSE of the intense interest shown by c.w. men in previous keying articles [1, 2, 3] I would like to present still another method of semi-break-in which uses more simplified circuitry. In this circuit a diode replaces a tube in the delay circuit and fewer components are required.

The system shown in fig. 1 performs two functions. First it uses the 6BX7 to key the final of the transmitter and second it employs the 6C4 to control K_1 which can perform a variety of auxiliary functions.

Operation

When the key is depressed several things happen. First, the blocking bias is removed from the control grids of the 6BX7. This voltage is from 90 to 100 volts as set by R_1. The decay time of the 6BX7 grid voltage determines the keying characteristics.and may be controlled by varying the value of C_2. Second, the grid voltage on the 6C4 is also removed when the key is depressed. The tube conducts heavily thus closing the relay. Control R_4 can be adjusted initially so the rated relay current flows under key down conditions.

The length of time the relay is held closed after the key is released is determined by C_1, a 6 mf capacitor and the setting of R_2. Control R_2 can be adjusted from a fast break-in to a 2 second delay. Capacitor C_1 discharges through the IN315 and R_2 only when the key is depressed. This path provides a short time constant and therefore a rapid discharge occurs.

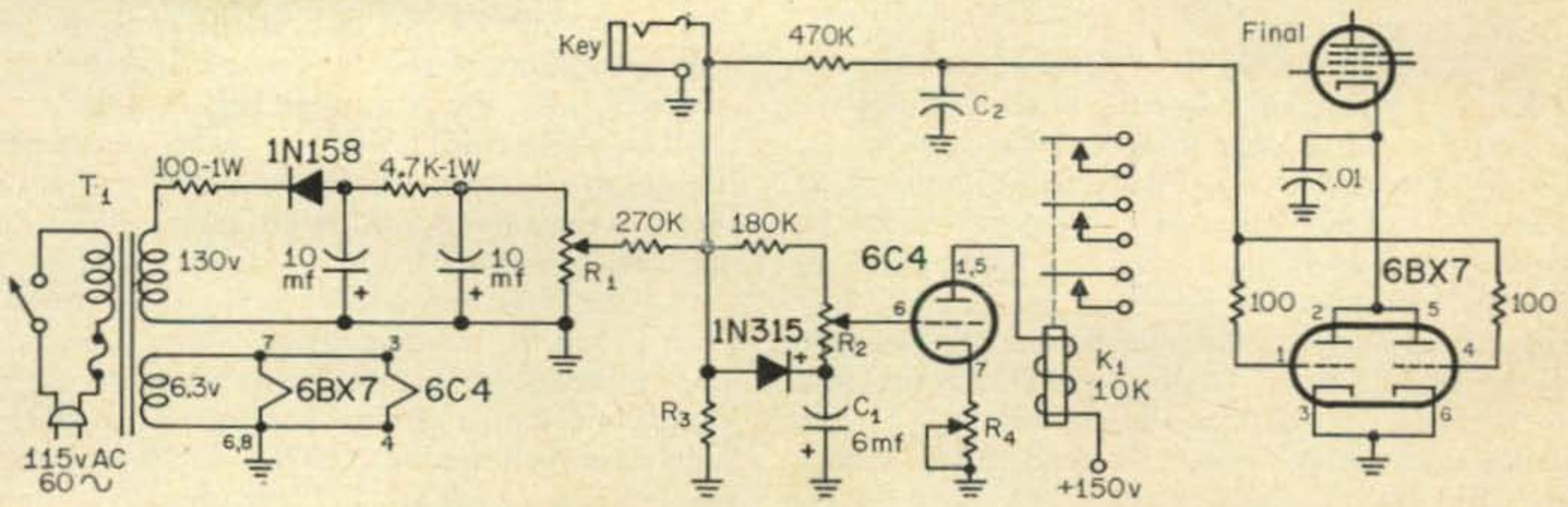
When the key is released C_1 must recharge through R_1, R_2 and R_3 and the long time constant prevents the relay from being released too quickly. How quickly K_1 is released is determined by the setting of R_2. The closer the arm of R_2 is to C_1, the longer it will hold in on key up condition.

Applications

When the relay is closed, the contacts can be used to either cut off the plate supply to the receiver, or cut in an external r.f. gain control on the receiver so that the audio can be monitored at a reduced volume. Another contact can be used to operate an antenna relay, which has auxiliary contacts which in turn can operate another relay to turn the v.f.o. screen supply on and off. I will not go into this as it has been fully described in other articles. The basic idea of this system is that the v.f.o. is on during a group of words and not keyed with each letter, but goes off during a pause in the sending. During monitoring, the audio level is reduced and the v.f.o. is not heard; only the final.

This system of keying solves all of the problems and I feel it is much better than the heterodyne method with its complex mixing and the added possibility of improper tuning on spurious signals. ■

Fig. 1—Schematic of delayed break in system. All resistors are ½ watt unless otherwise specified.



C_1—6 mf metallic or oil.
C_2—.001 to .005 mf adjustable for keying characteristics.
R_1—50K 2 watt potentiometer.
R_2—250K 2 watt potentiometer.
R_3—180K ½ watt.
R_4—0-500 ohm 2 watt potentiometer.
T_1—150 volts at 20 ma.
Note: A 200 ohm resistor in series with a 1 mf capacitor may be put across the key for spark suppression.

El Paso Roadblock

Ross A. Sheldon, K5UCH
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El Paso, Texas

Most amateur service to the public is provided during natural disasters. Amateurs, however, can often help avert man made tragedies. The carnage on the roads on holiday weekends can be cut down and local amateur groups can be effective in helping. Here is the story of how the El Paso hams helped the local gendarmes cut the traffic toll to zero.

EVER hear hams complain: "We can help the local officials—but they don't appreciate us?"

It's true. They don't! Because it's our own fault. We don't sell ourselves; we don't *show* them what we can do.

Let's face it OM's. Police cars nowadays have radios in them. If there is an emergency, who gets called out first? The police, naturally. And with their two-way radios—who needs an amateur? (Fact is, that very word—"amateur"—puts two strikes on us right there, among the "professionals.")

Oh sure, in case of tornado, or flood, or twenty feet of snow, or hurricane, or most any other catastrophy, a widespread communications knockout gives the mobile and portable hams an opportunity to serve their community. But how often have these things hit *your* community? Fortunately, not often. In most cases, never.

The regular police, fire and medical services can take care of things for ten years before something happens where hams would be needed for ten hours or less.

So, what to do?

Regular police and sheriff's departments have organized reserve units in many cities and towns. Usually these reserve units are search and rescue teams of various sorts. A child gets lost in the woods or drowns in a river or lake requiring divers or dragnets to hunt for the body. Every policeman, fireman and sheriff's deputy assigned to the search means that much less protection for citizens elsewhere in the community. This is where the reserves come in. And this is where the hams should come in.

The reserve units have little communications equipment. Many have none! Some use private cars. Others, such as the El Paso Sheriff's Reserve, use personally owned jeeps suitably painted and equipped—out of the member's own pocket. (They receive no pay and no expense money. Just volunteer citizens on call to help their neighbors.)

Coordination

Ever try to coordinate a widely scattered search team in the desert, mountains, woods or what-have-you? Sometimes a search party has to hunt for a search party!! And how about sending back to town for a doctor, a wrecker, a man with a cutting torch or hydraulic jack, or maybe for more food or water, or some blankets? How about asking for a better description or more detailed information of a traffic accident and getting the answer *right now* because the search has halted and searchers are waiting for the answer; or pass the word to everyone the search is over?

Even if a police or county sheriff's cruiser with radio was available, did you ever try to cover a wide area on ground wave using *one* band—particularly a high frequency? El Paso County, at the westernmost tip of Texas, on the Mexican border, contains a city at one end (El Paso) and desert and mountains over the rest. The mountains block the line-of-sight high frequencies, and the mountain-top thunderstorms clobber the static sensitive lower frequencies. It's no wonder the single frequency police and sheriff departments find dead spots, plus a limited distance from town to mobile unit. By the time a fast highway cruiser gets close enough to town to talk to the dispatcher, it could, in a few more minutes, be in town using a telephone. The multi-band ham mobiles have no problem here. With two fixed stations on 75 and 10 meters the mobiles can reach town from anywhere in the county simply by changing bands.

The Problem

But here is the problem. How do you get the reserve units to call you in an emergency? By letting them know you're alive; by joining them

in training exercises and letting them see the advantage of having free communications, real *communications!* Some cast eyes at the Citizen's Band, then discover the hard way that five or ten miles is the most they can get out of it, and with worse dead spot problems than the police encountered.

What kind of training exercises? The long holiday weekends with their staggering highway death rate gave El Paso amateurs an idea. How about, they said to the sheriff's reserve, setting up highway roadblocks to slow down motorists, and have a mobile amateur at each one? A fixed station in town can relay, by land line, to the dispatchers office. Accidents or serious speeding incidents would get immediate attention from the regular police and sheriff deputies at the edge of town.

The first tryouts were on Memorial Day and the Fourth of July. The results startled the sheriff and police departments. Despite dire predictions by the safety council, El Paso County had *no accidents* while these roadblocks functioned! Reason? The sight of the uniformed reservists with their jeeps, and the "unmarked cars" with radios in use, caused motorists to become suddenly cautious—and they lived! Wherever they looked they saw the roadblocks. One ham slowed traffic all by himself while working on his rig. The motorists thought the power-supply which he had set on the hood was radar!

Another dividend for the motoring public was their unusually prudent driving, which resulted in no traffic tickets being issued on the highway! In fact, once the regular sheriff deputies saw the result of the "show of force" by the reserves and amateurs they abandoned their own traffic surveillance and went about other routine duties of patrol in the residential areas of the county.

More Problems

There *were* problems of course. Due to the problem of two groups of people working together for the first time, messages "got lost." Fixed station locations were not always wisely chosen to allow coverage of the area in which the mobiles were operating. Roadblocks were set up in "blind spots" where the mobile couldn't tie in with the frequency in use on that particular highway. Many mobiles didn't show up, or were very late. Deputies who had seen too many TV versions of the crisp "10-4" police transmissions were disturbed at the casual manner with which the amateurs passed messages. One group of deputies couldn't understand why the fixed station couldn't hear the mobile because the mobile could hear him! (The n.c.s. was running a thousand watts to the mobile's forty!) One new amateur got "mike fright" until another ham operated his rig for the first transmission! (He later gave yeoman service and was one of the last to QRT). Complicating the "cockpit troubles" was an afternoon thunderstorm on the Fourth of July which tore up 75 meters. It was a very successful venture as the two groups

Cars assembled at a strategic road point. The sight of official cars and tall whip antennas slows traffic down to the legal limits. The car on the left is that of K5UCH and the one alongside the jeep is W5TVO's.

learned of each other's problems (and learned a little about their own!)

Suggested Procedures

For other amateurs interested in helping their sheriff's reserve, the El Paso gang offer the following suggestions:

1. Avoid publicity! Stay in the background and plug the sheriff's reserve. They are amateurs too, and boosting them with the public will make them more willing to work with you. Grabbing the headlines yourself will only make them prefer to "go it alone." (Some reserve units will insist on learning about the Citizens Band the hard way.)

2. Let the deputies deal with the public. You stay quietly in the car and talk to the mike. Your job is communicating, not playing policeman.

3. Check the field pattern of all your fixed stations. Know what frequencies you require to cover various locations. Avoid having an n.c.s. deep in the city making it difficult to read the mobiles. Remember the effect of summer static on the low frequencies and winter skip on the high.

4. Keep the individual who complicates matters, out of the picture. The "do-it-my-way, or, I-will-go-home type is apt to add friction at a time when static is causing enough trouble. A particular nuisance during this type of operation is the ham who can't see "working with the cops to trap honest citizens", and thinks accident prevention is some kind of game, where the speeder and the drunk driver should be given a sporting chance to get away. Maybe a tour of a local hospital emergency room on a Saturday night would cure him. The sight of what's left of an eight year old girl brought in on a rubber sheet might give him other thoughts as to the importance of the game being played.

5. Plan to use both high and low bands in case conditions suddenly change.

6. Have a deputy at the n.c.s. to handle phone calls to the dispatcher. They know each other and they will expedite traffic matters efficiently.

7. The amateur coordinater should be on the road with his rig checking the roadblocks. Some problems are not apparent until you see them.

[*Continued on page 116*]

Results of the 1960 *CQ* World-Wide DX C.W. Contest

By Frank Anzalone, W1WY
Chairman, CQ Contest Committee

THANKS to the response from overseas stations we are happy to report a record breaking number of logs, 1000 and 1 to be exact, from 107 different countries. This an increase of over 160 entries as compared to last year, and 9 additional countries. This in spite of the fact that returns from this country were considerably lower in the mid-west. However this was more than made up by the usual activity in Europe plus a tremendous effort by the boys over in Japan and the radio clubs of the USSR. For the latter it paid off, two of the Trophies going to the land of the Sputnik.

It should be no surprise to see Vladimir Semenov, UA9DN at the top of the pack. He is no newcomer to our contest and his all out effort almost equalled last year's all time high score made by Maj. Glenn Luse, CN8JX. Congratulations Vlad, the Larry LeKashman, W9IOP Trophy is yours.

Once again Josef Plzak, 7G1A last year's Trophy winner was in the runner-up position. Josef also broke a million, mainly because of his record 1,497 contacts.

At first glance we thought the two year lay-off had given Katashi Nose, KH6IJ the necessary energy to push him to the top but a few corrections in his arithmetic showed it was only an illusion. "Nosey" had to settle for third.

Not far behind in the 4th spot is A. E. Dowdeswell, ST2AR, a call that merits watching in future contests.

A couple of more Africans, VQ4DT and ZD2JKO are in the fifth and sixth spot respectively. Both Henning Overgaard and Michael Dransfield placed in the Top Ten in the Phone contest, with 4DT winning the Trophy.

This year's 4X4 representative is Hanan H. Hirsch, 4X4MB, who placed seventh.

And over in the Ukraine, UB5FJ and UB5WF were at it again, with Anatoly once more showing his heels to Vladimir.

T. D'Angelo Drummond, PY4OD—Second world high on 14 mc.

The only US entry to make the magic group is James H. Ahlgren, W4YHD, who usually goes in for single band competition.

Say, how about that boy Ricardo Sierra Jr., CX2CO. He went and did it again! Another Trophy, this one donated by John Ryan, W7KVU, for making the highest score on a single band. This one also on 14 mc, matching the one he won in the Phone contest. Ricky's 370,139 points and 1,032 contacts is a new record for a single band. Man, that's really knocking 'em off.

Mention must also be made of Talma D'Angelo Drummond, PY4OD with the second highest score, also on 14 mc.

As a matter of fact, practically all the high single-band scores were made on 20, and all continents were well represented.

In this country, Vic Clark, W4KFC, (who else) was the leader and only single band station to work over 100 countries. While Alan Emerald K6EIV was the only one to work all 40 Zones.

Next in popularity was 21 mc but the activity was somewhat reduced on this band. European openings only lasted a few hours and after that you really had to dig for a few contacts.

Gunter Heinzen, DL6EN is the top man and Al Stobbe, W2WZ is still the big gun on this side of the pond. Yours truly took a crack at this band but found the competition a bit tough. Hi!

Some of the fellows were out to prove that 10 was still alive and they proved their point. A look at the scores will show the top group all within shouting distance of each other but the scores of course are much lower than previous years. Pickings are growing slimmer and you really have to move fast as the band openings don't last long.

If you had a beam or a full gallon it was possible to run up a good score on 40. Bob Martinez, K2DGT had both and again is top man on the Totem pole. Bob was working Europeans while the sun was still high on the horizon. And he worked JA1FL and JA1YL the long way around at 4:30 in the afternoon, most unusual on 7 mc from the East coast.

Missing however was W3BVN's consistent 40 meter signal, but Jake Schott, W8FGX, is still putting out a potent signal in the mid-west and Haywood Perry, W4DHZ, also did a fine job which his 2 element mini-beam.

The Europeans made good use of 40 locally and ran up good totals on that band. As did the West coast boys with their pipe line to Japan.

Once again 80 was strictly a European band with Wes Wysocki, SP2DX an old hand at contests, leading the pack by a narrow margin. Over here, VE1ZZ, VE3AGX and W9PNE were the only ones to show any kind of a score.

As for 160 we have come to the conclusion that

the Top Band does not open up this early in the season. However some of the multiplier seekers used it for what it was worth.

Over in the Multi-Operator, Single Transmitter division, which is increasing with popularity, especially among the club stations in some of the European countries, the entries were double those of last year. One of the more active areas was the Ukraine and a couple of operators of the Stalino Radio Club, Alfred Barkov and Leo Yailenko put UB5KAB up at the top to win the Tony Susen, W3AOH Trophy for their club. That makes two for the boys of the USSR.

Improving their score and position over last year was LZ1KBA, headed by Dimiter Petrov and two other operators of the Sofia Radio Club, Stefan and Spas. The whole station was loaded on a truck and moved to a quiet mountain location and in spite of adverse weather and inferior antennas, the boys took the second spot. Wait 'til next year.

A surprise 3rd was a West Coast entry, W6GHM/6, who did so well as a single in the Phone contest. Evidently Stew Fason moved the rig to another location and got Pete Wolf, W6FUF to give him a hand.

Warren Mallory, W7PGS — Runner-up for all band honors. That's a full gallon he's keying.

Another club group, 4 operators from the Baku Radio Club took the 4th spot with UD6KAB, while Tubby and Jeff Vale at VQ5NQ, proved that it can be done from "Down Under."

The boys over at Hot Ziggety ONE American Boy, found conditions rough and finished out of the money.

The "Big Guns", Multi-Operator, Multi-Transmitter stations, were practically the same group as in last year's brawl. However the order of finish is changed around a bit and this year Tony Susen and his gang at W3AOH lead the pack by a narrow margin to win the Buzz Reeves, K2GL Trophy. It was only by virtue of a bigger multiplier that they were able to nose out a new group from The Potomac Valley Radio Club. The gang at W3MSK really gave W3AOH a run for their Trophy.

The crew at UB5KBB, Power House of the Ukraine. Front Row: UT5CC, UB5LN, UB5LK, UB5KCD. Back row: UB5CI, Chief Op.; UB5DP, UB5LV and UB5LM.

The gang at W3MSK — Front row: W3MSK himself, W3JTC, W6HOH/3. Back row: W3MCG, W3PZW, W3FYS.

Again in 3rd place was UB5KBB of the Kharkov Radio Club. The boys would have had a much higher score but they got a bit careless and duplicated too many contacts.

Hardi Ludwig and his crew at DJ3JZ, last year's Trophy winner, found the loss on the higher bands too great and had to settle for the 4th spot. Better luck next year Hardi.

It seems the whole membership of the East Bohemian Radio Club was pounding brass at OK1KKS. They did manage to beat out W6KW for the 5th spot. Roger Mace and the boys could not overcome their locational west coast handicap.

The Potomac Valley Radio Club finally made it and won the *CQ* Plaque. However it was only made possible by the addition of a new "Big Gun" W3MSK, that was the clincher. This should make Lenny Chertok, Vic Clark and the rest very happy.

They were closely pressed by the German DX Team, last year's winner. We breathed a sigh of relief when the scores were tabulated and the GDXT fell short a few thousand points. Their secretary would have been on the spot had their score been higher. Since he did not send up a list of their participating members and their scores, we would have had no other alternative but to disqualify their score. We *insist* that clubs who are in contention for the Plaque observe this rule.

The North Jersey bunch made their usual fine team effort but lacked the big clincher.

We know that Southern California can do much better but they just can't seem to get rolling the past few years.

U. S. A. Club Scores

Potomac Valley Radio Club	**2,861,618**
North Jersey DX Assn.	2,147,037
Southern California DX Club	2,061,954
Northeastern DX Club	1,061,429
Hamfesters Radio Club (Ill.)	445,831
Ohio Valley Amateur Radio Assn.	368,068
El Ray Club (Mass.)	196,524
Maui Amateur Radio Club (Hawaii)	127,413
West Gulf DX Club	102,204
Frankford Radio Club (Penna.)	66,304
Niles Michigan Amateur Radio Club	58,163
Detroit Amateur Radio Assn. (Mich.)	55,257
QCWA-New York Chapter	52,365
Northern California DX Club	47,115
Palo Alto Radio Club	26,001
Four Lakes Radio Club	13,851
Houston Texas Radio Club	9,882
Order of Boiled Owls (New York)	8,313
Connecticut Wireless Assn.	5,307
Southeastern DX Club	3,846
Florida DX Club	2,992
Bronx High School Radio Club	651
Columbus Amateur Radio Club (Ohio)	518

Foreign Club Scores

German DX Team (DARC)	2,823,019
Uruguay DX Club (RCU)	1,074,316
Radio Club of Kharkov (Ukraine)	1,026,457
Sofia City Radio Club (Bulgaria)	879,450
East Bohemia Radio Club (CAV)	766,824
Radio Club of Bucharest (Roumania)	198,504
Far East DX Ploiters (Japan)	197,559
Turun Radioamatoorit (Finland)	181,792
Japan DX Radio Club (JARL)	175,577
Central Radio Club Praha (CAV)	157,606
Lucerne DX Division (USKA)	148,891
Radio Club Timsoara (Roumania)	148,632
Radio Club of Tartu (Estonia)	135,301
Kuibyshev Radio Club (USSR)	105,408
Radio Club Stalino (Ukraine)	102,879
Radio Club of Tallinn (Estonia)	101,183
Bremerhaven Radio Club (Germany)	75,774
Radio Club Gyor (Hungary)	69,708
Gdansk Radio Club (PZK)	47,991
Krakowski Radio Club (PZK)	46,580
Radio Club of Maribor (SRJ)	43,164
Radio Club of Kaluga (USSR)	35,682
Radio Club Varna (Bulgaria)	33,488
Liga Colombiana de Radio Aficionados	32,172
Shizuoka Amateur Radio Club (SARC)	24,408
Stockholm Amateur Radio Club (SRA)	23,920
Polskizwiazek-Rzeszow (PZK)	21,481
Lodzki Radio Klub (PZK)	17,019
Radio Club Sverdlovsk (USSR)	17,010
Sapporo Amateur Radio Club (Japan)	14,135
Toko Radio Club (Japan)	11,843
Opolski Radio Club (PZK)	11,781
Stalin Radio Club (Roumania)	10,730
Radio Club of Rousse (Bulgaria)	10,528
Sliven Radio Club (Bulgaria)	8,692
Isahaya Radio Club (Japan)	7,614
Radio Club of VilJandi (Estonia)	6,965
Radio Club of Papuk-Osijek (SRJ)	6,255
Radio Club of Galati (Roumania)	6,000
Linhopings Radio Amoter (Sweden)	5,324
Radio Club Braila (Roumania)	4,680
Kagoshima Club (Japan)	4,360
Radio Club of Warsaw (PZK)	4,255
Nagano Amateur Radio Club (Japan)	2,784
Pozna Radio Club (PZK)	1,742
Siemens Radio Club (Germany)	1,680

DJ3JZ l. to r. DL9CI at key, DJ1BZ, DL1CR, DL3AO, DJ3JZ himself, DJ1BP and DJ4LI.

Des Vahl, ZS7M—A rare one that confined his operation to 14 mc.

The Northeastern DX Association made a good showing for their first real effort. They certainly have the membership to be a top contender.

A surprise was the score turned in by the Uruguay DX Club, a new organization with limited membership.

By plan and coincidence, four DXpeditions showed up at choice spots. FL9 from French Somaliland, HKØHCA from San Andres, LX3AH from Luxembourg and ZS6IF/9 from Bechaunaland.

You will note we omitted the power column in the listing of the results. This had to be done to overcome a printing problem that has been plaguing us. Since it has no bearing on the final score that item was the most expendable.

The usual generous distribution of certificates will soon be in the mail. Sometimes I think we are a little too generous, especially in large areas like Canada, Australia and, for that matter certain areas in this country. The returns as compared to the known activity is disappointing to say the least. What's the answer?

Well, that's about it for this one. Was that a sigh of relief? Emphatically yes, chorus Andy Malashuk W1GYE, Mac McIntire W2BO and Ben Lazarus W2JB. Andy is going back to rebuilding his final, Mac is planning a western trip and Ben can go back to dreaming about that vacation up in the Adirondacks. Me? I'm starting to plan for the next one, after a short vacation to Nassau, that is.

73 for now, Frank, W1WY

Top Ten

ALL BAND—SINGLE OPERATOR

UA9DN . . . 1,114,695

7G1A	1,041,755	ZD2JKO	564,134
KH6IJ	894,615	4X4MB	539,090
ST2AR	810,650	UB5FJ	517,920
VQ4DT	666,600	W4YHD	513,720
		UB5WF	463,556

Top Five

MULTI-OPERATOR SINGLE TRANSMITTER

UB5KAB . . . 637,980

LZ1KBA	520,416	UD6KAB	350,217
W6GHM/6	400,425	VK5NQ	296,185

Top Five

MULTI-OPERATOR MULTI-TRANSMITTER

W3AOH . . . 1,049,104

W3MSK	1,024,373	DJ3JZ	864,930
UB5KBB	960,960	OK1KKS	766,824

Continental Leaders

SINGLE BAND

28 Mc

4X4LC	41,635
W3LSG	39,440
G4CP	35,760
CX9AJ	31,488

21 Mc

DL6EN	80,353
PY4GA	62,136
W2WZ	60,610
ZS6APQ	53,380
KH6DVG	40,138
UA9DT	39,655

3.5 Mc

SP2DX	14,940
VE1ZZ	3,128

14 Mc

CX2CO	**370,139**
4X4FA	184,460
ZS2HI	157,311
W4KFC	147,852
KH6DLF	143,070
OK1LM	73,357

7 Mc

K2DGT	92,700
4X4DH	63,318
DM2ABL	29,491
FA8RJ	5,928
VK4XW	3,660

1.8 Mc

OK1WT	473

U.S.A. Runners-up

All Band	W3GRF	446,208
28 Mc	W8WZ	36,000
21 Mc	W3MFJ	58,330
14 Mc	K6EIV	99,912
7 Mc	W8FGX	66,240
3.5 Mc	W9PNE	1,034

Number groups after call letters denote the following: Band, final score, number of QSOs zones, and countries. Certificate winners are indicated in **bold face.**

SINGLE OPERATOR

North America

United States

W1BIH	**A**	**197,224**	**272**	**96**	**181**
K1JTC	**A**	**196,524**	**342**	**71**	**135**
W1FZ	"	127,853	230	73	124
K1MEM	"	16,310	92	28	42
W1IKB	"	10,773	67	25	38
K1PNN	"	8,280	53	27	42
W1QMM	"	6,900	44	26	34
W1FXT	"	5,307	38	25	36
K1KPS/1					
	"	3,402	39	18	24
W10JR	**28**	**22,010**	**128**	**20**	**42**
W1BPW	"	1,794	27	12	14
W1WY	**21**	**50,654**	**212**	**26**	**60**
K1DAT	"	15,190	91	22	40
W1GYE	**14**	**46,852**	**159**	**33**	**73**
K1NHR	"	5,356	42	20	32
K2DCA	**A**	**284,125**	**387**	**96**	**179**
W2EQS	**A**	**272,076**	**366**	**99**	**188**
W2BXA	**A**	**270,216**	**409**	**84**	**159**
W2AGW	"	209,703	301	88	159
W2JT	"	145,536	276	67	125
W2OBX	"	116,237	110	49	75
W2JVU	"	114,950	249	61	114
K2UVU	"	96,455	195	79	112
WA2OJD	"	93,264	204	69	105
W2LV	"	92,520	218	67	113
W2TQC	"	91,964	192	66	117
K2BZT	"	80,550	169	70	109
K2GHM	"	80,524	171	67	97
W2DEW	"	76,670	176	67	103
K2BSM	"	48,822	139	31	63
W2DGW	"	43,569	125	57	84
W2LAX	"	33,189	119	46	65
K2DSW	"	11,072	62	23	41
W2TP	"	9,322	53	22	37
W2FBS	"	8,580	48	26	40
W2BOK	"	5,512	40	22	31
W2GKE	"	4,150	40	22	28
W2GT	"	3,552	30	23	25
WA2DES					
	"	3,120	33	16	24
W2HMJ	"	2,720	26	19	21
W2QKJ	"	2,623	23	20	23
WA2IEK					
	"	2,301	26	18	21
K2YOR	"	1,958	31	8	14
W2JB	"	1,711	23	11	18
K2OFD	"	651	17	10	11
WA2JAM					
	"	180	10	8	7
K2HWL					
	28	**25,406**	**118**	**25**	**53**
W2PTI	"	15,730	90	23	42
K2UVV	"	1,638	29	9	12
W2WZ	**21**	**60,610**	**233**	**29**	**66**
W2CYS	"	58,032	200	30	74
W2HAQ	"	27,636	115	26	58
W2YTH	"	24,949	138	16	45
W2GZZ	"	16,835	92	26	39
W2LPE	**14**	**74,370**	**240**	**34**	**77**
W2GUM					
	14	**67,378**	**210**	**36**	**82**
K2JGG	"	30,780	120	32	63
W2PCJ	"	30,300	115	29	71
W2SUC	"	22,386	95	27	55
W2AZS	"	8,313	55	19	32
W2UGM	"	8,190	52	25	40
K2UYG	"	6,954	51	22	35
W2PKM	"	2,516	24	16	21
K2QHL	"	1,000	29	16	24
K2DGT	**7**	**92,700**	**337**	**31**	**72**
W3GRF	**A**	**446,208**	**497**	**114**	**222**
W3MSR	**A**	**141,484**	**254**	**87**	**130**
W3KTW	"	44,888	133	48	76
W3WV	"	28,574	109	39	52
W3IPO	"	21,658	88	34	57
W3ADZ	"	18,080	91	33	47
W3MCG	"	4,407	40	16	23
W3KYF	"	3,498	38	24	29
K3KMO	"	3,136	33	21	28
K3AIG	"	2,324	31	12	16
W3LSG	**28**	**39,440**	**178**	**25**	**55**
W3AYS	"	14,628	114	22	47
W3QQL	"	8,946	53	21	42
W3QZ	"	7,497	57	20	31
W3HWE	"	432	15	8	8
W3MFJ					
	21	**58,330**	**219**	**28**	**67**
W3OCU	"	48,224	197	27	61
W3TLN	"	34,943	156	27	56
W3KFQ					
	14	**79,230**	**248**	**33**	**81**
W3JTC	"	74,752	208	37	91
W3ZBG	"	47,840	153	35	80
W3BYX	"	37,525	153	31	64
W3EIS					
	3.5	**578**	**24**	**8**	**9**
W4YHD	**A**	**513,720**	**524**	**124**	**236**
W4KXV	"	139,612	262	83	126
W4AZK	"	78,010	199	49	96
W4RIM	"	1,508	19	12	17
W4RVW					
	28	**14,457**	**83**	**21**	**40**
W4PLL	"	14,213	91	21	40
K4YUD	"	3,081	32	17	22
W4EEO	"	1,800	20	13	17
K4ZWR	"	1,708	24	12	16
W4KPB	"	630	12	9	12
W4JAT	**21**	**49,098**	**191**	**27**	**71**
K4SXR	"	10,710	91	21	42
K4BQU	"	9,130	67	21	34
W4IEH	"	2,992	30	7	17
W4QAR	"	325	5	5	5
W4KFC					
	14	**147,852**	**362**	**37**	**109**
W4LVV	"	46,690	151	35	80
W4BQY	"	35,616	126	36	70
W4OM	"	16,037	81	27	52
W4QVJ	"	2,074	23	15	19
W4HOS/4					
	"	84	4	3	4
W4DHZ	**7**	**41,850**	**181**	**28**	**62**
W4OSD	"	6,732	49	19	32
W5BRR	**A**	**106,863**	**216**	**81**	**118**
W5ZD	"	94,073	238	60	91
W5WZQ	"	89,075	195	73	102
W5BUK	"	59,679	142	73	98
W5LJT	"	6,104	47	23	33
W5LGG	**28**	**30,294**	**137**	**27**	**54**
K5UYF	21	252	9	5	7
W5KC	**14**	**33,250**	**131**	**32**	**63**
K5DGI	"	30,452	121	33	59
W5PM	"	9,882	62	24	30
W5BOS	"	8,322	64	22	35
W5EJT	"	4,025	41	14	21
W6IBD	**A**	**281,060**	**413**	**108**	**152**
K6CTV	**A**	**184,338**	**361**	**78**	**120**
K6RTK	"	64,196	77	42	42
K6BWX	"	43,329	162	46	55
W6UQQ	"	34,454	118	46	61
K6IEC	"	34,006	121	45	53
W6EKZ	"	29,190	96	46	59
W6WX	"	26,001	91	48	59
W6YC	"	20,097	98	42	45
W6QDE	"	3,555	32	20	25
W6QBH	"	2,015	23	13	18
W6AM	"	216	6	6	6
W6BSY	**21**	**11,682**	**79**	**25**	**34**
W6BIL	"	1,728	22	15	17
K6EIV	**14**	**99,912**	**273**	**40**	**98**
K6VTQ	"	85,426	260	37	84
K6UFX	"	7,605	66	20	25
K6JC	"	4,875	43	16	23
W6ID	"	4,410	35	24	28
W6VRJ	"	2,296	41	13	15
W6PQW	**7**	**20,923**	**153**	**22**	**27**
W6NZW					
	3.5	**308**	**15**	**7**	**7**
W7VY	**A**	**212,553**	**360**	**82**	**127**
W7PGS	"	145,110	269	86	124
W7BTH	"	5,940	39	25	30
W7ENA	"	4,485	42	18	21
W7ZVY	"	644	21	12	11
W7OSR	"	212	16	10	7
K7BJN	**28**	**6,396**	**65**	**16**	**23**
W7AHX					
	21	**6,815**	**57**	**19**	**28**
K7AOZ	"	3,885	52	16	21
W7POU	"	1,210	26	11	11
W7YGN					
	14	**68,572**	**194**	**39**	**85**
W7CAR	"	6,600	54	17	27

K7ADL	"	1,375	23	11	14
W7PLI	"	1,352	20	12	14
W7DLR	"	364	10	6	7
W7JLU	**7**	**7,200**	**96**	**14**	**16**
W8JIN	**A**	**368,068**	**417**	**116**	**218**
W8EV	"	46,112	137	45	86
W8KC	"	8,305	60	23	32
W8WZ	**28**	**36,000**	**165**	**25**	**55**
K8HTM	"	1,325	25	12	13
W8UPN	**21**	**48,776**	**201**	**28**	**63**
W8FGX	**7**	**66,240**	**231**	**28**	**68**
W8IBX	**3.5**	**518**	**38**	**6**	**8**
W9WNV	**A**	**445,831**	**428**	**136**	**261**
W9HT	"	30,250	103	56	69
W9MBF	"	13,851	69	33	48
W9CLH	"	13,760	66	36	50
W9PWM	"	936	18	14	15
W9YSX	**21**	**46,233**	**176**	**29**	**70**
W9ZTD	"	37,980	162	28	62
K9CUY	**14**	**21,837**	**107**	**33**	**54**
K9ZEL	"	20,080	97	30	50
W9PNE	**3.5**	**1,034**	**29**	**10**	**12**
WØBTD	**A**	**62,264**	**152**	**73**	**99**
WØMCX	"	35,179	120	55	72
WØDAE	"	31,239	119	53	64

Alaska

KL7KG	**A**	**91,455**	**526**	**46**	**59**
KL7AMH/KL7	"	37,520	330	33	37
W4ARH/KL7	**14**	**8,326**	**74**	**18**	**28**

Bahamas

VP7NT	**A**	**67,311**	**750**	**37**	**44**
VP7BP	"	3,828	169	13	9

Bermuda

VP9BO	**A**	**12,496**	**263**	**24**	**20**

Canada

VE1EK	**21**	**5,425**	**64**	**11**	**24**
VE1DB	14	1,104	22	10	14
VE1ZZ	**3.5**	**3,128**	**55**	**6**	**17**
VE2YU	**A**	**88,704**	**196**	**76**	**116**
VE2AKF	"	120	11	6	4
VE2IL	28	130	10	5	5
VE3BOG	**A**	**46,652**	**250**	**47**	**60**
VE3BMB	"	13,884	104	39	39
VE3ES	**14**	**10,292**	**70**	**26**	**36**
VE3JZ	"	7,535	79	21	34
VE3AGX	**3.5**	**1,440**	**61**	**9**	**11**
VE6HG	**A**	**4,343**	**53**	**22**	**21**
VE6TP	**14**	**5,244**	**42**	**19**	**27**
VE7EH	**A**	**106,536**	**442**	**59**	**79**
VE8SA	**14**	**10,485**	**124**	**19**	**26**

Canal Zone

KZ5TD	**A**	**51,847**	**199**	**58**	**81**
KZ5LC	**14**	**6,713**	**55**	**20**	**29**

Greenland

OX3NK	**A**	**4,199**	**235**	**9**	**8**
OX3UD	"	710	67	6	4

Mexico

XE1PJ	**A**	**5,040**	**91**	**22**	**20**
XE1H	"	4,746	220	12	9

Nicaragua

YN4AB	**14**	**3,304**	**88**	**12**	**16**

Puerto Rico

KP4AOO	**14**	**51,440**	**500**	**25**	**55**
KP4ANJ	**7**	**1,760**	**57**	**9**	**13**

Africa

Algeria

FA3DU	**A**	**8,330**	**80**	**11**	**24**
FA9VJ	14	1,804	56	5	6
FA8RJ	**7**	**5,928**	**47**	**15**	**37**

Bechaunaland

ZS6IF/9	**A**	**52,536**	**274**	**30**	**36**

Cape Verde

CR4AX	**14**	**12,735**	**138**	**14**	**18**

Congo, Republic of

SM5KV/9Q5	**14**	**29,463**	**179**	**21**	**40**

Guinea, Republic of

7G1A	**A**	**1,041,755**	**1497**	**69**	**166**

Kenya

VQ4DT	**A**	**666,600**	**873**	**83**	**181**

Liberia

EL4A	**A**	**267,444**	**680**	**51**	**87**

Libya

5A3TR	**A**	**333,882**	**669**	**45**	**117**

Mozambique

CR7LU	**A**	**26,370**	**113**	**39**	**51**

Nigeria

ZD2JKO	**A**	**564,134**	**753**	**74**	**180**

Portuguese Guinea

CR5AE	**A**	**14,560**	**79**	**26**	**39**

Reunion Island

FR7ZD	**A**	**52,644**	**200**	**39**	**68**

Rhodesia (Northern)

VQ2CZ	**A**	**282,931**	**528**	**67**	**120**
VQ2EW	"	114,240	299	55	81

Rhodesia (Southern)

ZE1JN	**A**	**125,292**	**406**	**42**	**64**
ZE8JO	**14**	**51,405**	**260**	**26**	**43**

South Africa

ZS6IW	**A**	**437,418**	**873**	**57**	**114**
ZS1O	"	6,612	69	20	18
ZS6APQ	**21**	**53,380**	**270**	**21**	**47**
ZS6DZ	"	3,105	69	8	7
ZS2HI	**14**	**157,311**	**547**	**30**	**69**
ZS6AJO	"	23,880	202	15	25

Sudan

ST2AR	**A**	**810,650**	**917**	**82**	**288**

Swaziland

ZS7M	**14**	**25,752**	**154**	**22**	**36**

Asia

Bahrain Island

MP4BCV	**A**	**32,900**	**168**	**49**	**81**

Burma

XZ2TH	**A**	**101,760**	**334**	**45**	**83**

Cyprus

ZC4AK	**A**	**74,664**	**250**	**35**	**67**
ZC4CT	"	68,694	225	28	79

India

VU2RM	**A**	**158,175**	**343**	**76**	**109**
VU2XG	"	84,320	235	42	94
VU2BK	"	35,432	144	31	55
VU2NR	**14**	**82,340**	**328**	**31**	**61**
VU2AJ	"	29,394	170	27	42
VU2CK	"	20,894	150	25	37

Iran

EP1AD	**A**	**98,552**	**278**	**41**	**88**

Israel

4X4MB	**A**	**539,090**	**823**	**62**	**173**
4X4FS	"	245,700	459	55	140
4X4JO	"	73,280	295	20	60
4X4LC	**28**	**41,635**	**265**	**18**	**37**
4X4FA	**14**	**184,460**	**587**	**31**	**84**
4X4DH	**7**	**63,318**	**364**	**15**	**46**

Japan

JA1VX	**A**	**239,921**	**457**	**81**	**106**
JA7AD	**A**	**62,469**	**236**	**41**	**58**
JA2XW	**A**	**54,450**	**220**	**41**	**58**
JA1FAT	"	38,610	194	36	42
JA7KY	"	34,668	170	37	44
JA1BTH	"	25,610	148	30	35
JA2WB	"	24,408	146	34	38
JAØAQ	"	20,519	122	33	38
JA1EC	"	11,725	75	31	36
JA1CBZ	"	9,900	77	24	26
JA9BE	"	9,128	71	26	30
JA5AF	"	8,046	66	24	30
JA4AQR	"	4,370	41	23	23
JA1CPM	"	4,181	45	19	18
JAØAC	"	2,784	40	17	15
JA5MU	"	1,848	36	11	10
JA1DSI	"	1,851	42	20	19
JA8XF	"	1,792	31	16	12
JA4EE	"	1,148	21	13	15
JA1BCP	"	546	14	10	11
JA1BK	**28**	**22,464**	**157**	**22**	**30**
JA3EK	**28**	**19,764**	**135**	**22**	**32**
JA1BWA	**28**	**18,500**	**135**	**21**	**29**
JA1BLC	"	12,120	116	16	24
JA3KM	"	6,125	63	16	19
JA1EM	"	5,508	60	15	19
JA1BZV	"	5,247	53	14	19
JA1BUN	"	4,704	54	15	17
JA7JU	"	4,260	52	15	15
JA2CG	"	4,224	48	15	17
JA9CQ	"	3,564	40	14	19
JA3APY	"	1,694	27	10	12
JA2AIT	"	1,054	24	8	9
JA6PN	"	946	16	11	11
JA3RQ	"	860	17	9	11
JA3ATP	"	798	14	10	9
JA3CE	"	768	14	11	13
JA8AAC	"	546	16	6	8
JA1BLZ	"	252	8	5	7
JA1AAT	"	36	4	2	1
JA3AA	**21**	**7,160**	**69**	**18**	**22**
JA5JS	"	2,208	36	11	13
JA2JW	**14**	**81,180**	**342**	**32**	**58**
JA2DN	**14**	**48,544**	**241**	**27**	**47**
JA5FQ	"	33,603	188	28	41
JA1CJN	"	33,465	190	24	35
JA1AR	"	17,523	126	23	36
JA7WB	14	11,070	99	20	25
JA1BKV	"	10,208	101	18	26
JA7BN	"	9,880	98	18	22
JA3ZP	"	9,016	87	19	27
JA7EZ	"	7,614	70	20	27
JA6ZV	"	4,360	50	17	23
JA8GR	"	414	12	9	9
JA1ACA	"	216	10	6	6
JA1YL	**7**	**17,328**	**123**	**22**	**35**
JA8FC	**7**	**14,135**	**116**	**24**	**31**
JA8LN	**7**	**11,952**	**107**	**21**	**27**
JA1GV	"	8,712	82	21	23
JA1LR	"	5,472	64	17	19
JA1CWZ	"	3,960	51	16	20
JA3BEK	"	3,596	53	16	15
JA1CZG	"	3,104	44	16	16
JA7XF	"	2,132	41	13	13
JA3BGF	"	2,100	44	10	10
JA4YC	"	2,068	43	11	11
JA1CID	"	1,800	33	12	13
JA3CAF	"	1,600	30	13	12
JA6AKU	"	1,584	35	11	13
JA7AKC	"	1,440	28	12	12
JA1DUH	"	1,219	22	11	12
JA7VJ	"	1,140	27	10	10
JA1CUM	"	792	26	9	9
JA7AKQ	"	624	22	8	8
JA7AFN	"	510	25	6	4
JA1CXC	"	425	18	9	8
JA1FOR	"	297	19	6	5
JA6AKV	"	180	7	5	3
JA8JC	"	28	7	2	2
JA9NB	"	16	2	2	2
JA1BTG	3.5	228	8	6	6
KA2JL	**A**	**135,660**	**371**	**54**	**79**
KA2RJ	**14**	**10,373**	**96**	**17**	**24**

Lebanon

OD5CT	**A**	**205,326**	**400**	**54**	**129**
OD5LX	"	190,784	392	47	129

Oman

VS9OA	**A**	**107,060**	**286**	**37**	**88**

Ryukuyu Island

KR6JM	**A**	**131,651**	**322**	**72**	**97**
KR6LJ	"	116,224	383	62	66

Taiwan

BV1US	**14**	**6,984**	**94**	**15**	**21**

U.S.S.R.

Asiatic

UA9DN	**A**	**1,114,695**	**1146**	**93**	**266**
UAØAG	"	70,902	319	35	66
UAØKSB	"	37,671	232	34	53
UAØEH	**"**	**35,934**	**248**	**20**	**33**
UA9VX	"	275	15	5	6
UA9BZ	**28**	**3,266**	**57**	**7**	**16**
UA9DT	**21**	**39,655**	**187**	**22**	**55**
UAØSO	"	9,600	76	14	34
UAØBP	**14**	**172,674**	**582**	**33**	**73**
UA9DM	"	17,010	124	15	39
UA9OB	"	15,290	112	20	35
UAØRD	"	7,714	92	17	21
UAØAH	"	5,050	77	15	10
UAØKZB	"	4,158	90	10	12

Georgia

UF6FB	**A**	**304,764**	**524**	**65**	**153**

Kazakh

UL7LE	**A**	**17,340**	**143**	**18**	**33**
UL7KAD	14	5,312	68	9	23

Tadzhik

UJ8AG	**14**	**126,920**	**496**	**25**	**70**

Europe

Aland Island

OHØNE	**A**	**5,192**	**92**	**14**	**30**
OHØNF	"	2,607	75	11	22

Austria

OE1RZ	**A**	**243,908**	**372**	**91**	**190**
OE3NH	"	36,414	144	41	61
OE3WB	**14**	**5,226**	**115**	**8**	**31**
OE1WO	"	3,528	85	9	27

Belgium

ON4CE	A	4,230	63	18	29
ON4WE	**14**	**12,921**	**151**	**18**	**41**

Bulgaria

LZ2KKZ	**A**	**33,488**	**284**	**24**	**68**
LZ1KDA	"	13,632	174	16	48
LZ1WD	**28**	**17,700**	**153**	**19**	**41**
LZ2KLR	**14**	**3,876**	**91**	**7**	**27**
LZ2KBA	**7**	**23,260**	**305**	**14**	**44**
LZ1KGZ	"	16,250	231	14	36
LZ2KSB	"	8,299	158	8	35
LZ1KBG	"	3,712	104	8	24

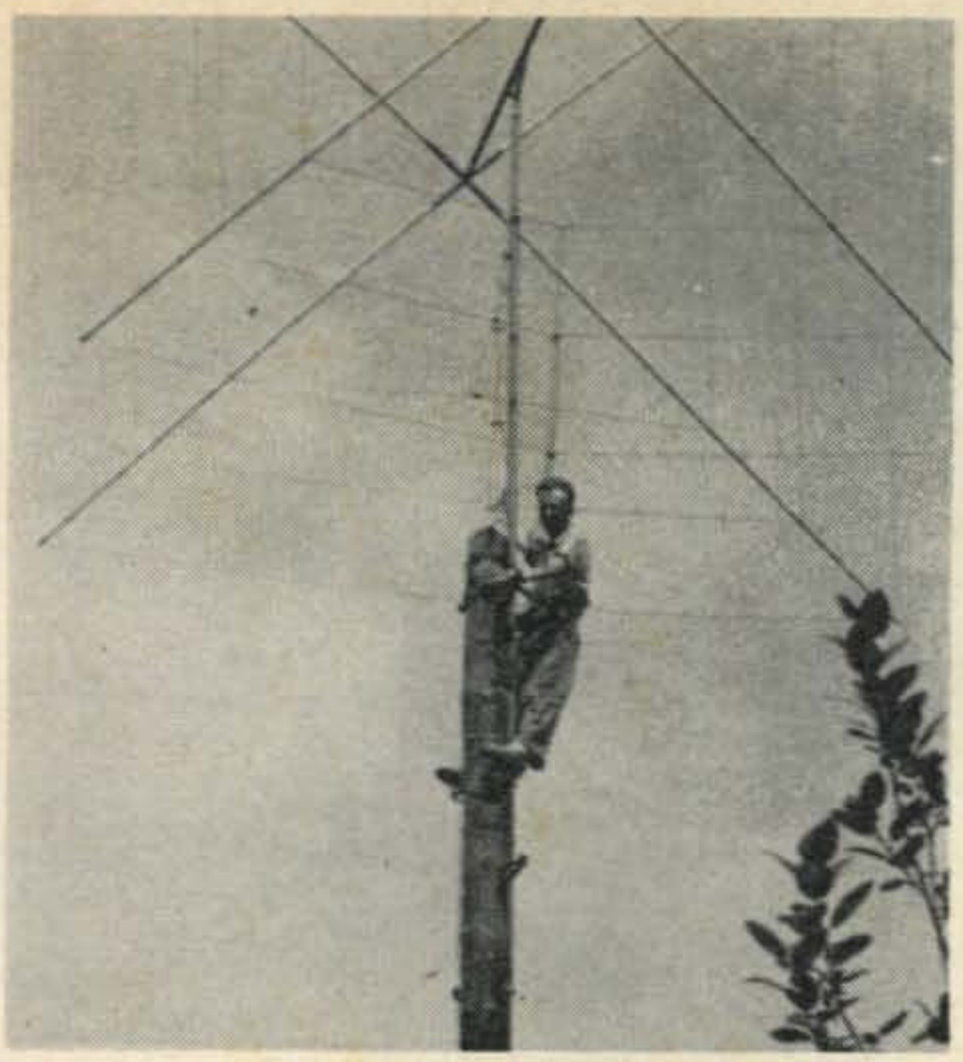
Crete

SVØWZ	**A**	**18,954**	**192**	**20**	**61**

Czechoslovakia

OK3EA	**A**	**141,900**	**376**	**59**	**156**
OK2QR	**A**	**101,516**	**515**	**36**	**128**
OK1JX	"	92,040	352	48	129
OK1AMS	"	41,293	215	41	78
OK1AEH	"	40,158	243	30	108
OK1MG	"	39,754	174	41	98
OK1KWR	"	35,733	201	36	93
OK3FQ	"	32,574	175	36	86
OK1RX	"	31,605	198	28	77
OK1GO	"	22,110	132	33	77
OK3KGW	"	17,175	154	24	51
OK2LN	"	15,903	134	26	67

John Thompson, W1BIH—Last year's Trophy winner and New England's leading contestant, concentrating on a weak one.



Gunter Heinzen, DL6EN—Making final adjustments to his tri-band quad which made him world high man on 21 mc.

OH7NF	7	7,728	142	11	35
OH2DW	"	2,465	79	7	20
OH6RC	"	1,200	31	7	23
OH2CD	"	90	13	3	6
France					
F9MS	A	221,850	664	49	125
F3ML	"	63,983	340	34	75
F9BB	"	18,576	143	21	34
F2PO	"	16,600	132	27	56
F8IN	"	2,150	50	6	19
F2AS	"	376	20	6	11
F8VO	28	600	20	6	6
F8SQ	21	10,131	132	11	22
Germany					
DJ3KR	A	299,904	532	82	182
DL7AA	A	171,430	336	71	146
DJ2IB	A	167,535	370	68	151
DL7DF	"	134,750	258	72	173
DL7BQ	"	96,000	294	51	109
DJ4DN	"	83,720	253	61	121
DL6WD	"	81,549	305	39	78
DL7EN	"	72,924	206	61	116
DJ4EJ	"	53,375	248	36	89
DJ4SO	"	49,140	262	37	98
DJ2SK	"	33,792	159	39	89
DJ5BV	"	31,097	211	31	90
DLØOS	"	25,953	169	31	92
DL7BK	"	25,403	98	45	88
DL1GN	"	24,961	196	27	82
DL9KP	"	21,280	117	29	47
DM2BEL	"	21,112	196	23	68
DL7CF	"	18,810	134	27	63
DM2ABE	"	16,458	206	20	58
DL1XS	"	15,456	92	32	54
DJ2IV	"	14,823	102	31	50
DL9OL	"	14,329	82	32	57
DL8CM	"	12,775	89	29	44
DJ3YU	"	11,508	102	30	54
DL8DL	"	8,360	109	21	55
DM2ACM	"	6,468	60	23	43
DJ1UE	"	5,525	68	17	48
DL1YB	"	4,779	52	21	38
DJ2SL	"	4,575	57	23	38
DL1YA	"	4,224	42	20	24
DL9RP	"	3,286	33	17	19
DL1EA	"	1,680	29	10	11
DL3BP	"	1,274	42	10	16
DM2BDN	"	390	30	4	11
DM3XFC	"	221	19	4	9
DJ5QK	"	96	10	4	8
DL6MK	28	19,437	121	20	37
DJ4OP	"	13,884	105	21	31
DL6DF	"	6,623	69	16	21
DL6EN	21	80,353	327	31	60
DL7BA	"	74,865	290	29	64
DL3TW	"	16,324	116	18	35
DL3WT	"	7,749	87	13	28
DJ5VQ	"	6,711	70	16	31
DJ5FZ	"	4,917	55	14	19
DJ5IH	"	2,825	48	9	16
DL7IP	"	800	24	8	8
DM2AHM	"	705	17	9	6
DJ2MN	14	48,348	263	31	71
DJ3WU	"	2,720	86	6	26
DL9OW	"	700	34	5	15
DM2ABL	7	29,491	277	19	58
DL1JW	"	27,667	276	17	56
DJ5KN	"	3,332	91	7	27
DJ2XP	"	1,953	68	4	27
DJ2RE	"	1,710	27	10	20
DL7JF	"	850	48	4	13
DJ3WE	3.5	13,770	267	8	37
DJ2DT	"	760	42	4	15
DL1ES	"	740	32	7	21
DM3YCM	"	578	37	4	13
DL4BU	7	25,254	330	15	46
Gibraltar					
ZB2AD	A	71,298	314	32	70
Greece					
SVØWI	A	343,938	785	77	189
SV0WQ	"	63,873	355	35	106
Hungary					
HA1KSA	A	69,708	253	48	109
HA7PZ	A	42,300	340	26	74
HA8KCU	"	19,920	168	31	49
HA8CF	"	15,100	255	24	51
HA5AW	"	12,090	152	15	62
HA5BI	"	9,398	79	26	48
HA1SB	"	4,047	71	17	40
HA9OS	"	3,772	74	17	24
HA5FO	"	3,139	85	18	25
HA5FY	"	3,080	67	13	27
HA6NC	"	1,596	56	11	17
HA6KNB	"	1,568	54	9	19
HA4KYB	"	703	41	5	14
HA4YB	"	104	13	3	5
HA8WS	7	6,771	165	7	30
Iceland					
TF3AB	A	20,033	146	20	47
Italy					
I1TEB	A	20,610	133	30	60
Jan Mayen Island					
LA1NG/P	A	7,958	113	15	31
Netherlands					
PAØTAU	A	230,307	450	68	163
PAØLOU	"	162,214	424	60	161
PAØYN	"	16,147	115	25	42
PAØPFW	"	6,576	90	17	31
PAØPAN	"	713	29	7	16
PAØATY	14	21,483	203	19	44
PAØSNG	"	7,896	134	11	36
PAØVV	"	2,220	60	7	23
PAØJAL	"	1,568	40	7	21
PAØWAC	"	629	19	8	9
PAØNIC	7	10,824	194	10	34
PAØVB	3.5	12,212	251	8	35
PAØLV	"	11,382	249	6	36
PAØTA	"	940	49	4	16
Northern Ireland					
GI3AXI	28	14,040	139	12	27
Norway					
LA5HE	A	66,341	273	46	117
LA6U	"	18,414	127	26	67
LA2OG	"	7,904	95	19	57
LA2Q	"	7,645	96	14	41
Poland					
SP8FZ	A	128,336	314	62	146
SP6YC	"	108,853	267	58	141
SP9KAD	"	16,654	113	34	55
SP6AAT	"	12,948	127	20	58
SP3HD	"	10,788	191	18	44
SP7WZ	"	2,214	45	12	29
SP9KY	28	2,349	27	18	17
SP3AK	"	1,742	24	12	14
SP9DH	"	1,386	25	9	13
SP9RF	21	11,934	106	22	32
SP6BZ	"	4,932	76	12	24
SP4JF	14	34,120	268	23	57
SP9ADU	"	11,580	143	16	44
SP8AG	"	10,640	209	13	27
SP2GS	"	5,852	125	11	27
SP2OY	"	2,352	68	7	21
SP8KAF	7	21,285	287	14	41
SP7JX	"	17,019	228	14	47
SP6PT	"	11,781	201	10	41
SP2CO	"	6,960	131	9	39
SP9DT	"	3,772	65	9	32
SP2RS	"	3,230	70	9	29
SP9YP	"	1,254	67	6	13
SP6KA	"	680	14	7	13
SP2IU	"	320	12	5	11
SP5AHZ	"	195	15	4	9
SP2DX	3.5	14,940	308	7	38
SP2BK	"	10,906	264	9	32
SP8MJ	"	5,616	153	6	30
SP5AGU	"	4,060	146	5	23
SP9EU	"	2,880	103	5	25
SP6UK	"	2,175	76	4	25
Roumania					
Y09CG	A	37,986	336	20	58
Y03RK	"	18,144	177	20	61
Y06KBA	"	10,730	115	18	56
Y02BU	"	10,296	94	27	39
OK3KFE	"	10,855	133	19	46
OK2YU	"	9,730	124	16	54
OK1KNL	"	2,016	50	9	27
OK1KIV	"	1,760	56	12	20
OK3DG	28	5,904	53	17	24
OK1BMW	21	31,200	168	24	56
OK1VB	"	18,972	113	25	43
OK3KGI	"	13,995	155	18	27
OK1KUR	"	3,795	56	13	20
OK1LK	"	3,720	45	16	24
OK1AAA	"	608	16	8	8
OK1LM	14	73,357	349	30	79
OK3KMS	"	41,988	344	21	62
OK3UI	"	28,428	289	16	53
OK2KGZ	"	22,464	208	19	53
OK1TW	"	19,247	165	17	54
OK1KKJ	"	15,984	226	14	40
OK3IR	"	11,832	153	12	46
OK1NK	"	4,788	96	12	30
OK1AVT	"	3,745	84	7	28
OK1PC	"	817	41	5	19
OK1WY	"	798	40	4	15
OK1NW	7	6,594	136	9	33
OK2KMR	"	3,060	68	7	29
OK1OO	"	589	14	6	14
OK2KBR	3.5	13,860	307	8	34
OK1IK	3.5	10,062	246	6	37
OK3JR	"	6,633	197	5	28
OK3KJH	"	6,156	206	7	29
OK2KGV	"	5,957	164	6	31
OK1AWJ	"	5,363	158	6	31
OK1PG	"	3,648	124	5	26
OK3KKF	"	3,270	106	5	25
OK2BBJ	"	3,204	142	5	23
OK2KOJ	"	2,828	107	5	23
OK3KES	"	2,387	80	5	26
OK3CCC	"	2,225	89	4	21
OK3CCA	"	1,098	86	4	14
OK1WT	1.8	473	49	3	8
OK3EE	"	352	33	3	8
OK1ADS	"	104	18	3	5
Denmark					
OZ2NU	A	57,784	303	34	98
OZ4RT	"	22,540	186	24	74
OZ9N	21	1,742	31	14	12
OZ3CF	14	9,001	143	11	40
OZ8KB	"	42	3	3	3
OZ3GW	7	840	23	7	17
England					
G3FPQ	A	410,176	606	84	188
G3FXB	"	328,656	546	72	174
G2DC	"	168,432	332	70	172
G3NFT	"	47,344	250	25	63
G3MPR	"	31,395	190	30	75
G3FTQ	"	29,400	177	29	76
G3JKY	"	28,767	124	34	95
G3KHT	"	19,190	130	31	64
G3MWZ	"	5,253	76	17	34
G4CP	28	35,760	231	19	41
G5RP	"	17,238	131	17	34
G3KKP	"	15,168	128	17	31
G3EUE	"	2,625	42	9	16
G3EYN	21	37,453	238	20	47
G2AJB	14	10,608	131	13	38
G8DI	"	6,683	133	10	31
G3WP	"	2,257	43	10	27
G3LET	7	23,433	183	19	54
G3ISX	"	2,635	72	6	25
Finland					
OH1TN	A	95,418	343	55	131
OH5QN	A	62,626	227	51	122
OH2ZL	"	38,367	179	39	108
OH2FS	"	27,025	181	28	87
OH9PF	"	25,704	130	35	84
OH6AA	"	24,717	224	33	77
OH1VA	"	21,669	220	26	67
OH7NW	"	19,404	129	31	68
OH3NM	"	10,336	107	19	57
OH2BZ	"	9,576	71	25	51
OH5SG	"	8,280	95	20	52
OH3AD	"	6,188	83	19	49
OH2FT	"	2,622	40	19	38
OH9QB	"	1,914	37	11	22
OH3NY	"	1,728	28	11	21
OH3TD	"	1,020	31	11	19
OH2CP	"	850	53	4	13
OH3VG	"	380	20	7	12
OH2RD	"	340	15	8	12
OH6UD	"	235	17	6	9
OH3VX	"	48	10	3	6
OH3SG	28	2,802	34	12	24
OH2QV	21	7,800	88	18	34
OH3WL	"	924	42	5	16
OH8RA	"	760	9	5	8
OH2MQ	14	33,176	294	24	64
OH2PM	"	22,557	235	18	55
OH5NJ	"	21,600	152	23	52
OH3TE	"	20,898	141	24	57
OH2QO	"	10,659	144	16	40
OH3PX	"	3,395	85	7	28
OH9PA	"	646	26	8	11
OH5PG	"	140	11	4	6

YO3ZR	"	10,230	119	16	46
YO2BQ	"	8468	120	16	42
YO6AW	"	8,588	92	23	53
YO5AF	"	1,856	54	9	23
YO3FD	**14**	**44,714**	**410**	**20**	**59**
YO3FN	"	14,535	195	13	44
YO3LM	"	1,075	25	11	14
YO3AC	**7**	**28,842**	**322**	**15**	**51**
YO5LJ	"	8,464	154	11	35
YO3RN	"	6,653	113	8	25
YO6XB	"	2,790	62	8	23
YO9IG	"	2,108	48	9	22
YO2CX	"	1,344	44	7	17
YO2FV	"	546	37	4	10
YO8ME	"	518	38	4	10
YO4ZJ	"	425	24	6	11
YO2BB	"	240	16	3	9
YO8DD					
	3.5	**3,600**	**119**	**5**	**25**

Sicily

IT1AGA	**A**	**51,876**	**252**	**32**	**100**
IT1TAI	**7**	**6,132**	**89**	**10**	**32**

Spain

EA1GZ	**A**	**23,400**	**181**	**28**	**62**
EA7GF	"	2,120	36	14	26
EA3IH	**28**	**20,088**	**169**	**19**	**35**
EA3KI	"	672	22	7	9
EA5FU	**14**	**19,440**	**162**	**11**	**29**
EA1CS	7	912	48	4	15

Sweden

SM5BLA	**A**	**131,182**	**449**	**56**	**158**
SM7QY	**A**	**36,156**	**141**	**41**	**90**
SM5XX	"	9,063	93	18	39
SM2ABX					
	"	7,480	124	15	40
SM7EH	"	4,895	53	19	36
SM5UQ	"	4,655	93	11	38
SM5BDY					
	"	2,444	52	12	35
SM7MS	"	2,360	24	16	24
SM5AEV					
	"	216	15	10	14
SM5UU	"	102	12	9	12
SM5LL	**28**	**6,615**	**62**	**16**	**33**
SM5VY	"	2,992	37	12	22
SM5AJU					
	21	**15,860**	**125**	**22**	**43**
SM5BFE					
	"	5,700	47	18	32
SM5AJR	"	5,324	67	14	30
SM2COL					
	"	4,495	113	9	22
SM5AQI	"	2,584	51	10	24
SM7TV	"	819	31	7	14
SM5ATK					
	14	**27,468**	**228**	**20**	**43**
SM5TW					
	"	**18,300**	**155**	**21**	**59**
SM5AHW					
	"	15,860	150	18	47
SM5AHL					
	"	15,630	149	18	52
SM7AMV					
	"	10,192	158	14	38
SM6ARH					
	"	6,946	117	12	34
SM5BEU					
	"	6,344	81	15	37
SM5BAS					
	"	3,034	58	10	27
SM7AIL	"	2,604	70	8	23
SM4TU	"	1,296	44	7	17
SM5AFN					
	"	225	13	4	11
SM5BP	"	198	8	5	6
SM3AGD					
	7	**11,102**	**119**	**17**	**44**
SM3BEI	**7**	**5,895**	**112**	**10**	**35**
SM5CAK					
	"	4,026	114	9	24
SM5CCE					
	"	3,636	84	10	26
SM6CWP					
	"	3,067	98	5	26
SM5CMP					
	"	2,164	74	7	21
SM5BOU					
	"	1,568	38	7	25
SM6CMR					
	"	1,536	49	6	26
SM3CNN					
	"	1,482	61	6	26
SM5CGN					
	"	1,247	44	5	24
SM6BWQ					
	"	1,150	46	5	20
SM6MZT					
	"	736	29	6	17
SM6CJK					
	"	726	32	5	17
SM3CGR					
	"	558	32	4	14
SM6CCO					
	"	558	33	4	14
SM3CCM					
	"	130	11	4	9
SM3VE					
	3.5	**6,965**	**210**	**5**	**30**
SM3AF	"	1,235	66	3	16
SM6JY	"	1,225	50	4	21
SM3SV	"	792	49	3	15
SM5CZK					
	"	595	36	3	14

Switzerland

HB9MO	**A**	**137,124**	**321**	**73**	**161**
HB9ZY	"	79,605	275	47	98
HB9UD	"	31,833	170	38	93
HB9JG	"	25,839	127	33	54
HB9QA	"	11,767	192	9	32
HB9DX					
	21	**20,500**	**159**	**14**	**36**
HB9NL	"	3,996	61	9	18

Wales

GW3JI	**A**	**85,118**	**391**	**36**	**110**

Yugoslavia

YU3OS	**A**	**94,990**	**451**	**42**	**119**
YU3ZW	"	5,264	64	16	40
YU1AG	**14**	**41,096**	**314**	**24**	**64**
YU1SF	"	7,344	130	8	40
YU3YW	7	405	29	4	11

U.S.S.R.

European

UA3FG	**A**	**127,846**	**408**	**57**	**137**
UA3LI	"	91,800	432	35	118
UA1NA	"	89,527	291	55	126
UA4IF	"	79,968	307	49	98
UA1KBA					
	"	28,700	231	32	68
UA3YR	"	19,552	196	34	70
UA3FT	"	12,180	145	20	40
UA3RO	"	10,125	91	21	54
UA3GO	"	1,456	35	6	22
UA3GH	"	986	24	12	17
UA4PA	**14**	**50,372**	**281**	**29**	**69**
UA3RM	"	12,546	168	14	37
UA3MC	"	1,702	38	11	26
UA3WX	"	1,333	69	9	18
UA3AT	"	836	27	7	15
UA3IZ	7	1,500	52	6	19
UA3KET					
	"	806	27	8	18
UA1CE	"	544	32	4	13

Estonia

UR2AO	**A**	**137,034**	**451**	**59**	**148**
UR2AT	"	101,304	438	48	120
UR2BU	"	8,436	71	25	49
UR2DX	**7**	**7,399**	**132**	**9**	**40**

Latvia

UQ2AS	**A**	**113,740**	**427**	**47**	**141**
UQ2AN	"	59,764	297	38	96

Moldavia

UO5AA	**A**	**61,824**	**304**	**44**	**94**
UO5SA	**14**	**10,700**	**166**	**13**	**37**

Ukraine

UB5FJ	**A**	**517,920**	**988**	**89**	**243**
UB5WF	"	463,556	889	80	209
UB5JC	"	3,597	84	12	21
UT5AE	"	104	13	3	5

White Russia

UC2WP	**A**	**25,600**	**206**	**29**	**71**
UC2AR	**14**	**7,301**	**96**	**14**	**35**

Oceania

Australia

VK2GW	**A**	**326,696**	**593**	**76**	**118**
VK2APK					
	14	**55,944**	**282**	**28**	**44**
VK3ADB					
	A	**45,360**	**214**	**34**	**36**
VK3YD	**14**	**5,800**	**60**	**17**	**23**
VK3TL	"	5,616	78	13	13
VK3APV					
	"	5,460	67	14	14
VK3XB	"	5,148	58	15	18
VK4SD	14	5,680	52	18	22
VK4XW	**7**	**3,660**	**68**	**10**	**10**
VK5JT	**A**	**12,628**	**102**	**23**	**21**
VK5MF	"	5,920	58	21	19
VK5RX					
	14	**9,780**	**76**	**17**	**28**
VK5LD	7	720	15	7	9
VK6RU	**A**	**260,678**	**486**	**73**	**114**
VK7SM	**A**	**58,236**	**235**	**41**	**51**
VK7KA					
	14	**13,912**	**110**	**21**	**26**

Cook Islands

ZK1BS	**A**	**161,025**	**475**	**54**	**59**

Fiji Islands

VR2DK	**14**	**24,332**	**195**	**21**	**27**

Hawaiian Islands

KH6IJ	**A**	**894,615**	**1419**	**92**	**123**
KH6DVG					
	21	**40,138**	**234**	**25**	**36**
KH6DLF					
	14	**143,070**	**549**	**34**	**61**
KH6DMO					
	"	54,492	355	23	34
KH6CXY					
	"	19,035	154	20	25

Midway Island

KM6BV	**A**	**45,674**	**384**	**16**	**25**

New Caledonia

FK8AH	**A**	**122,322**	**405**	**61**	**53**

New Guinea

VK9XK	**A**	**127,595**	**335**	**64**	**87**

New Zealand

ZL2AWJ					
	A	**224,245**	**468**	**62**	**87**
ZL1NG	"	149,055	536	48	47
ZL3US	"	47,696	204	41	47
ZL1AFW					
	"	29,448	151	37	35
ZL2AYJ					
	14	**71,315**	**305**	**30**	**55**

Niue Island

ZK2AD	**14**	**7,280**	**94**	**14**	**12**

Philippine Islands

DU7SV	**A**	**29,750**	**212**	**25**	**25**

Wake Island

KW6DG	**A**	**412,594**	**836**	**81**	**101**

South America

Argentina

LU5DDF					
	A	**54,945**	**201**	**45**	**54**
LU7AU	"	48,867	196	41	50
LU5AQ	**14**	**59,136**	**261**	**29**	**48**

Brazil

PY1ADA	**A**	**421,544**	**783**	**76**	**108**
PY1FM	"	1,230	43	7	3
PY4GA	**21**	**62,136**	**307**	**24**	**48**
PY4OD	**14**	**224,316**	**618**	**35**	**89**
PY2BZD	"	5,024	61	15	17
PY4ADC	7	936	25	6	7

Chile

CE1AD	**A**	**164,800**	**550**	**42**	**61**
CE3LV	**21**	**14,013**	**178**	**13**	**14**
CE3AG	"	5,400	78	12	12

Colombia

HK7ZT	**A**	**29,316**	**236**	**22**	**20**
HK3AH	"	12,789	156	14	15
HK1HV					
	14	**32,172**	**261**	**20**	**22**

Paraguay

ZP9AY	**A**	**121,000**	**472**	**43**	**45**
ZP5JP	**21**	**34,802**	**191**	**24**	**39**

Uruguay

CX7CO	**A**	**153,036**	**491**	**51**	**66**
CX1FB	"	65,700	300	36	39
CX9AJ	**28**	**31,488**	**259**	**16**	**25**
CX2CO	**14**	**370,139**	**1032**	**34**	**87**
CX10P	7	425	11	5	5

Venezuela

YV5AGD	**A**	**32,712**	**105**	**49**	**67**
YV5BJ	"	3,610	64	10	9
YV5AK	**14**	**72,657**	**306**	**27**	**54**

MULTI-OPERATOR
Single Transmitter

North America

United States

K1DIR	...	**31,460**	**126**	**55**	**66**
		(K1DIR, K1CLT, K1HVV)			
W2HZY	..	**97,495**	**189**	**81**	**104**
		(W2HZY, W2OST)			
W4NUC	..	**69,440**	**208**	**38**	**86**
		(W3AFM, W4AO, W4FFV)			
K4IGZ	...	42,336	137	47	79
		(K3CCJ, W4DEC)			
K4TEA	...	3,846	39	15	32
		(K4TEA, K4TKM)			
W5AZB	...	**70,300**	**181**	**58**	**90**
		(W5AZB, W5OSW, W5TH)			
K5UKR	..	13,452	84	36	40
		(K5UKR, K5SEK, K5UKQ)			
W6GHM/6		**400,425**	**515**	**114**	**167**
		(W6GHM/6, W6FUF)			
W6ILP	...	143,260	289	75	115
		(W6ILP, W6DFY)			
WA6HQR	.	81,056	209	65	84
		(WA6HQR, W4CTL)			

Canada

VE4JB	...	**31,380**	**360**	**37**	**33**
		(VE4JB, VE4MF)			

San Andres Islands

HKØHCA	.	11,220	170	13	9
		(YN1CAA, HKØAI)			

Africa

Eritrea

ET2US	...	**34,928**	**166**	**24**	**50**
		(W4DMS, K8SNA)			

French Morocco

CN8JR	...	**171,756**	**490**	**34**	**83**
		(CN8JR, CN8HX)			

Asia

Japan

JA1HD	...	1,980	39	10	8

Saudi Arabia

HZ1AB	...	**277,100**	**642**	**44**	**119**
		(WA6CAD, W4PEC, K4WTG)			

U.S.S.R.

Armenia

UG6KAA		**178,312**	**500**	**34**	**90**
		(Club Station)			

Asiatic Russia

UAØKAR		**195,075**	**509**	**41**	**94**
		(Club Station)			
UA9KOG	..	126,288	389	53	91
		(Club Station)			
UAØKJA	.	95,760	388	64	80
		(Club Station)			
UAØKAE	.	95,390	427	32	57
		(Club Station)			
UAØKID	.	70,090	524	23	30
		(Club Station)			
UA9KGA	.	29,028	214	36	87
		(Club Station)			

Azerbaijan

UD6KAB		**350,217**	**694**	**56**	**133**
		(Club Station)			

Georgia

UF6KAF	.	**87,168**	**320**	**25**	**71**
		(Club Station)			

Kirghiz

UM8KAA		**111,572**	**416**	**31**	**75**
		(Club Station)			

Turkoman

UH8KAA		**147,312**	**167**	**40**	**84**
		(Club Station)			

Uizbek

UI8KAA	..	**81,028**	**325**	**28**	**66**

Europe

Belgium

ON4EC	...	**110,292**	**497**	**41**	**115**
		(ON4EC, ON4BU)			

Bulgaria

LZ1KBA	..	**520,416**	**867**	**84**	**204**
		(Club Station)			
LZ1KSZ	..	287,416	636	79	217
		(Club Station)			
LZ1KSP	..	212,280	614	62	170
		(Club Station)			
LZ1KBD	..	97,800	455	41	122
		(Club Station)			
LZ2KSK	..	18,755	278	14	41
		(Club Station)			
LZ1KDP	..	15,282	222	14	40
		(Club Station)			
LZ1KDM	.	13,360	221	10	30
		(Club Station)			

[Continued on page 124]

DX DX DX DX DX DX DX DX

URBAN LE JEUNE, JR., W2DEC
BOX 35, HAZLET, NEW JERSEY

The following certificates were issued during the period between March 12th, 1961 and April 12th, 1961:

WAZ

1516	ZE6JY	D. G. Shephard
1517	K5JZY	Jim Hambright
1518	KH6BXU	Robert E. Thornton
1519	GM3CIX	L J. McDougall
1520	G3CEG	B. King
1521	W8GB	C. A. Moline
1522	DL3BL	Walter Hullenhagen
1523	HB9PA	Rudolf Staehr
1524	SP2AP	Alfons S. Strzelecki

CW WPX

167	WØDVZ	Dave Carpenter
168	W9GFF	Bud Frohardt

PHONE WPX

25	XE1AE	Fernando L. Vallarta A.
26	K9EAB	Cliff Corne

SSB WPX

56	W1EQ	George R. Caron
57	W9WIO	Jim Zvolanek
58	VE6TF	L. Tuckey
59	K4PUS	Jim M. Hoots, Jr.

Letters

The following letter from KØGEN describes the operation of 6W8CB/MM:

"6W8CB/MM, formerly FF8CB/MM is the radio station of the adventurous twenty-nine foot long, ten foot wide, *Danae II*, on its trip around the world which will take another three to four years.

"Their story of adventure is very interesting, in that they built their small yacht themselves in Dakar, Senigal, now their home port, hence their 6W8 call, even though they are French. They lived on their yacht for a year to accustom themselves, and find out their absolute necessities. They sailed from Dakar and took 23½ days to reach Martinique, F.W.I. It was entirely by sail and they did not use their engine. They had planned on eating a lot of fish, but only caught one very small one on the whole trip.

"Their transmitter is home brew, 50 watts (a.m. only) rig, with a Geloso v.f.o., to a vertical antenna. Their receiver is a BC-312 Telefunken.

"They plan on being in the West Indies visiting the various islands for most of this year and will sail toward the Panama Canal in December in order to catch the season of few storms for their Pacific crossing.

"Claude is an Electrical Engineer and Claudine has been a school teacher. He speaks only French while she uses French, Spanish and English. She feels that her English is very poor, but we think it quite good. At times while visiting with her she would resort to a Spanish word or two when she could not think of it in English, as we know a smattering of Spanish.

"I am sure that the amateurs throughout the world will check in on them and be of aid to them wherever they might go on their travels, in that very small craft."

Don, W6AM, received the following letter from HM1AJ, and I wonder if some of the gang would like to lend a hand to KARL.

"As you have read in *QST*, we have succeeded to get the ham licenses in the last August and there are 19 ham stations here in Korea. They are: HM1AA thru HM1AN, HM2AO, HM1AP, HM4AQ, HM9A/p and HMØHQ. HM9A/p and HMØHQ are the club stations of the Korean Amateur Radio League, Inc. Headquarters. Now, HMØHQ is the fixed HQ station and HM9A/p is the portable station for the expedition, emergency and exhibition.

"Now, the purpose of this letter is to ask you some help for these HQ stations. Unfortunately, we could not prepare rigs of these stations yet, because all members of KARL are too poor to set up the stations in their HQ. That is, we have only call signs of HQ stations and we have to borrow the transmitters and antennas and receivers, when we need the special operation.

"Dear OM, can you help us by sending small

This fine looking husband and wife team is Gudny, LA3AH, and Lief, LA4Y. Their transmitter is home brew 50 watts on all bands. *(Tnx Helge Blucher)*

The newly installed I1AFS in operation. Their first CQ netted a UA3 in Moscow.

equipment for the HQ stations? We need not the high power rig, because our a.c. power line is very poor. We think about 50-80 watts rig on all band shall be most convenient for HMØHQ and about 30-50 watts portable rig for HM9A/p. We would be very happy, if you can send us the transmitters and receivers for the HMØHQ and HM9A/p. I think you can send us them from your used equipment that you don't use at present.

"HM9A/p will be operated at the Dokdo Islands which are located about 140 miles East of Korea and there are no men except about a dozen policemen who are protecting the Island. However, there are many difficulties for this operation plan, such as the strong wind in the East Sea, financial problem and the rig of HM9A/p and HMØHQ. HMØHQ also should be operated to make continuous contact with HM9A/p. The licenses for the both stations are issued on the frequencies of 7-144 mc bands c.w. phone, f.m. and s.s.b. However, they are mostly operated on 17, 14, 50 mc with c.w. and a.m. signals.

"I am very sorry for asking this of you but I believe you can understand our difficult condition and I hope to hear from you as soon as possible.

Vy best 73,
Cho Dong-In, HM13J
Miadong 559-8, Seoul, Korea

It looks as though Tore, LA8LG, has just snagged a good one from his Oslo QTH. Does anyone know the make of the receiver? You're right . . . it's a Lorentz. *(Tnx Helge Blucher)*

"P.S. My rig is homemade 2E26 single transmitter with 15 watts input on 7, 14 and 50 mc band and receiver is homemade 10 tubes super. Antenna is folded dipole constructed with 300 ohms TV feeder." (Tnx NCDXC)

FC Corsica: DL9PF and DL7AH will operate from Corsica this summer. This is the same team that operated as PX1PF last summer.

FQ8 Gabon Republic: FQ8AL is the only active station from this new country. Look for him on 21 mc phone. (Tnx *DXer*)

HBØ Lichenstein: There is a good chance that all HB9 stations operating portable in Lichtenstein in the future will use HBØ prefixes. HB9AA would be HBØAA. (Tnx *DXer*)

Meet Art, G3MDW, a handicapped ham who operates his rig right in his own "Candy Cabin" Variety store. A Panda Cub 25 watt transmitter with a S-640 receiver does a fine job with a Mosley Tribander. A long wire is used on 160. You fellows with a "sweet tooth" should surely get acquainted. *(Tnx W1BB)*

HKØ Malpelo Island: HKØTU was recently activated for three days by W9EVI and company. W4EEE was the first contact from land. It should count as a new country. QSL via Swani Radio Club, Harvard, Illinois.

HV1 Vatican City: The following letter from Dom, HV1CN, will explain the recent delays in receipt of HV1CN QSL's.

"Dear OM: As you are no doubt aware, HV1CN has not been able to send out QSL cards for a long time. This has been a situation beyond my control and that of my QSL manager, Max Meyers, W2BIB. However, the situation has now been rectified. During the past week, we have mailed out almost 2000 cards which were supplied through the kindness of Mr. Bill Halligan, Sr. of Hallicrafters. This should take care of all the cards which we owe to this date.

"In order to handle promptly all future QSL requests, we are inaugurating a new QSL system at HV1CN. Henceforth, I shall mail by air to W2BIB every week a duplicate of the station log of HV1CN. Max will then send out to the bur-

This neat station belongs to Per, SM7CKJ, the DX Editor of the SSA QTC. *(Tnx K6BX)*

eaus via air mail, cards for all contacts made from HB1CN. These cards will be stamped by Max with a facsimile of my signature which I have sent to him.

"With the great demand for cards from HV1CN, this is the only practicable way I can see of handling the situation.

I would appreciate your conveying to your readers my regrets for the long delay in getting out the long overdue cards, and to assure them that in the future all QSL cards will be on the way to the various bureaus within days after contacts are made."

Sincerely 73,
Domenico Petti (HV1CN)"

Look for HV1CN on twenty s.s.b. about 1600-1900 GMT on Saturdays.

KH6 Kure Island: There is good news for the fellows that missed KH6ECD during his recent trips. A license test has been given to one of the Loran techs and he is now awaiting his call. It will not be KH6ECD. The gear is there; all that is needed is an antenna. He is looking for phone patch outlets. (tnx WGDXC)

KL7 Pribilofs: KL7AGX is reported active from Pribilofs Island near Alaska. There have been operations from this Island in the past but to my knowledge none have been submitted for DXCC credit. When measured from the mainland, Pribilofs is just over 250 miles, which is the minimum required for separate country status. So don't pass up KL7AGX. He is QRV on 14 mc.

KS4 Swan Island: A group of W4 hams are planning an expedition to Swan Island in July. All bands phone and c.w. will be used.

PK Indonesia: Lest there be any doubts, the following is from Cliff, W8OLJ:—"I have never operated /PK ashore—regardless of the rumors. The Indonesian Government will not allow it."

VK9 Norfolk Island: VK2ANB is now operating from Norfolk Island as VK9GP. (Tnx WGDXC)

VP8 South Georgia: VP8EL, who has operated on 14 mc c.w. is located in South Georgia. Does anyone know the present QTH of VP8BK/LA1RC?

VQ8 Chagos Island: VQ9HB will be operating from Chagos as VQ8HBC by the time you read this. He will QRT around the end of June.

UA1 Franz Josef Land: UA1KED is operating from Alexander Island which should be close enough to Franz Josef Land to count for DXCC. In a letter from RAEM, Ernst advises that the operators from this station will not return until August at which time QSL's will be sent.

Hel, DL1QT, who is finishing up 2½ years in TA land will shortly be on with a new 100V/75S-1 combination. Despite all possible effort Hel could not get operating permission in Turkey. *(Tnx K6BX)*

3A2 Monaco: DL4PI and DL4FX will operate from Monaco in June using a KWM-2. (Tnx *DXer*)

5N2 Niger Republic: G3JKO will be returning to 5N2JKO about the time you read this. You might remember him as ZD2JKO. (Tnx *DXer*)

60 Somali Republic: 6O2RS went QRT in March and is now G3LOE. (Tnx Andy Rugg)

160 Meters

W8GDQ, Willie Waite, of Wellington, Ohio, is to be ocngratulated on making WAC on 160 meters—clinching it by QSOing ZC4AK for Asia, after painstaking schedules over a period

[*Continued on page 102*]

The 22nd meeting of the CLRC in Tokyo with visiting firemen KA2USA left front and KA2NK right front. Fifth from the right, middle row is JA1BWA, the secretary of the club who supplied this picture.

PROPAGATION

George Jacobs, W3ASK
11307 Clara St., Silver Spring, Md.

LAST MINUTE FORECAST

The forecast indices for the month of June, shown in the Propagation Charts following the predicted times of openings, are expected to be related to day-to-day propagation conditions in the following manner:

Forecast Indices	Above Normal Days June 12-15, 26-28	Normal Days June 1-5, 10-11, 16-21, 25, 29-30	Below Normal Days June 6, 9, 22-24	Distributed Days June 7-8
(1)	C	D-E	E	E
(2)	B	C-D	E	E
(3)	A	B-C	D-E	E
(4)	A	A	B-C	C-D

Where:

A—Excellent circuit with strong steady signals.

B—Good circuit, moderately strong signals, with some fading and noise.

C—Fair circuit, signals fluctuating between moderately strong and weak, with moderate fading and noise.

D—Poor circuit, signals weak, with considerable fading and very high noise level.

E—Circuit not possible.

General Conditions

10 Meters: Sharp increase in short skip openings up to distances of approximately 1300 miles as the occurrence of sporadic-E propagation reaches a seasonal peak. Very few DX openings expected.

15 Meters: Sharp increase in short skip openings between approximately 750 and 1300 miles due to sporadic-E propagation. A few DX openings expected to some areas of the world during the afternoon and early evening hours.

20 Meters: This is expected to be the best band for short skip openings between distances of approximately 400 and 2300 miles during the daylight and early evening hours. On some occasions the band is expected to remain open throughout the night hours for short skip openings. DX openings to many areas of the world are expected to peak during the late afternoon and evening hours. A second peak should occur for an hour or so after sunrise.

40 Meters: Optimum band for short skip openings up to about 400 miles during the hours of daylight and up to approximately 2300 miles during the hours of darkness. Fairly good DX openings expected to many areas of the world during the hours of darkness despite seasonally high static levels.

80 Meters: Best band for openings up to about 200 miles during the daylight hours. During the hours of darkness fairly good short skip openings are expected up to approximately 2300 miles. DX openings to some areas of the world are also expected during the hours of darkness, especially when static levels may be lower than usual.

160 Meters: Seasonally higher static levels are expected to reduce the number of openings on 160 meters as compared to the winter and spring months. During the hours of darkness fairly regular openings are expected out to about 2000 miles. A few DX openings considerably beyond this distance are expected, especially when static levels are lower than usual. DX openings have a tendency to peak on this band just before sunrise. During the daylight hours intense solar absorption is expected to limit openings to groundwave distances of less than 50 miles.

This month's Propagation Charts contain band opening predictions for short skip circuits up to 2300 miles, and for circuits between the mainland and the states of Hawaii and Alaska. DX predictions for June were contained in Charts appearing in last month's column.

Sporadic-E

Sporadic-E propagation peaks during the months of June and July. Based on previous observations made throughout the United States, 10 meter openings resulting from sporadic-E

CQ SHORT-SKIP PROPAGATION CHART

JUNE AND JULY, 1961

LOCAL STANDARD TIME

BAND (METERS)	50-250 Miles	250-750 Miles	750-1300 Miles	1300-2300 Miles
10	NIL	9 A - 5 P (0-1)	6 A - 9 A (0-1) 9 A - 1 P (1-3) 1 P - 5 P (1-2) 5 P - 6 A (0-1)	6 A - 9 A (1-0) 9 A - 1 P (3-0) 1 P - 5 P (2-0) 5 P - 8 P (1) 8 P - 6 A (1-0)
15	NIL	6 A - 9 A (0-2) 9 A - 4 P (0-3) 4 P - 8 P (0-2) 8 P - 6 A (0-1)	6 A - 9 A (2) 9 A - 4 P (3) 4 P - 8 P (2) 8 P - 6 A (1)	6 A - 9 A (2-1) 9 A - 2 P (3-1) 2 P - 4 P (3-2) 4 P - 8 P (2) 8 P - 6 A (1-0)
20	NIL	4 A - 9 A (1-2) 9 A - 4 P (1-4) 4 P - 10P (1-3) 10P - 4 A (1-2)	4 A - 9 A (2) 9 A - 4 P (4) 4 P - 10P (3-4) 10P - 4 A (2)	5 A - 8 A (2-3) 8 A - 9 A (2) 9 A - 3 P (4-2) 3 P - 4 P (4-3) 5 P - 10P (4) 10P - 1 A (2) 1 A - 5 A (2-1)
40	7 A - 11A (1-2) 11A - 5 P (2-3) 5 P - 9 P (3-4) 9 P - 12M(1-2) 12M- 7 A (0-1)	7 A - 8 A (2) 8 A - 2 P (3-1) 2 P - 5 P (3-2) 5 P - 9 P (4) 9 P - 12M(2-4) 12M- 3 A (1-2) 3 A - 6 A (1) 6 A - 7 A (1-2)	7 A - 8 A (2-1) 8 A - 2 P (1-0) 2 P - 5 P (2-1) 5 P - 8 P (4-2) 8 P - 12M(4) 12M- 3 A (2-4) 3 A - 5 A (1-3) 5 A - 7 A (2)	7 A - 8 A (1-0) 8 A - 2 P (0) 2 P - 6 P (1-0) 6 P - 8 P (2-1) 8 P - 9 P (4-2) 9 P - 2 A (4-3) 2 A - 3 A (4-2) 3 A - 5 A (3-2) 5 A - 7 A (2-1)
80	7 A - 10A (4) 10A - 4 P (4-3) 4 P - 7 P (4-2) 7 P - 9 P (4-3) 9 P - 7 A (4)	7 A - 8 A (4-1) 8 A - 4 P (3-0) 4 P - 7 P (2-1) 7 P - 9 P (3) 9 P - 4 A (4) 4 A - 6 A (4-3) 6 A - 7 A (4-2)	7 A - 8 A (1-0) 8 A - 4 P (0) 4 P - 7 P (1-0) 7 P - 9 P (3-1) 9 P - 11P (4-3) 11P - 2 A (4) 2 A - 4 A (4-3) 4 A - 6 A (3-1) 6 A - 7 A (2-0)	6 A - 7 P (0) 7 P - 9 P (1-0) 9 P - 11P(3-2) 11P - 2 A (4-3) 2 A - 4 A(3-2) 4 A -6 A (1)
160	8 P - 10P (4-1) 10P - 12M(4-3) 12M- 3 A (4) 3 A - 5 A (4-3) 5 A - 7 A (4-1) 7 A - 9 A (3-0) 9 A - 6 P (2-0) 6 P - 8 P (3-1)	8 P - 10P (2-1) 10P - 12M(3-2) 12M- 3 A (4-3) 3 A - 5 A (3-2) 5 A - 7 A (1-0) 7 A - 6 P (0) 6 P - 8 P (1-0)	8 P - 10P (1-0) 10P - 12M(2-1) 12M- 2 A (4-3) 2 A - 3 A (4-2) 3 A - 5 A (2-1) 5 A - 8 P (0)	5 A - 10P (0) 10P - 12M(1) 12M- 2 A (3-2) 2 A - 3 A (2-1) 3 A - 5 A (1)

ALASKA

Openings in Alaskan Standard Time**

TO:	15 Meters	20 Meters	40 Meters	80/160 Meters**
Eastern USA	4 P - 7 P (1)	2 A - 6 A (1) 5 P - 7 P (1) 7 P - 9 P (2) 9 P - 11P (1)	NIL	NIL
Central USA	5 P - 9 P (1)	2 A - 6 A (1) 5 P - 7 P (1) 7 P - 9 P (2) 9 P - 11P (1)	NIL	NIL
Western USA	6 P - 8 P (1) 8 P - 9 P (2) 9 P - 11P(1)	7 A - 3 P (1) 3 P - 6 P (2) 6 P - 10P(3) 10P - 12M(2) 12M-2 A (1)	1 A - 5 A (1)	NIL

**There are four different time zones in Alaska. This Chart is based on standard time in the zone from Skagway to 141 degrees west longitude. Time in this area is equivalent to:

Eastern Standard Time minus four hours;
Central Standard Time minus three hours;
Mountain Standard Time minus two hours;
Pacific Standard Time minus one hour.

HAWAII

Openings in Hawaiian Standard Time *

TO:	10/15 Meters*	20 Meters	40 Meters	80/160 Meters**
Eastern USA	2 P - 5 P (1)* 7 A - 2 P (1) 2 P - 5 P (2) 5 P - 7 P (1)	3 P - 5 P (2) 5 P - 8 P (4) 8 P - 10P(3) 10P - 2 A(2) 2 A - 4 A(3) 4 A - 6 A(2) 6 A - 3 P (1)	7 P - 9 P (1) 9 P - 11P(2) 11P - 1 A(1)	8 P - 9 P (1) 9 P - 11P (2) 11P - 12M(1) 9 P - 11P (1)**
Central USA	4 P - 7 P (1)* 8 A - 12N(1) 12N- 4 P (2) 4 P - 7 P (3) 7 P- 9 P (1)	3 P - 5 P (2) 5 P - 8 P (4) 8 P - 11P(3) 11P - 3 A(2) 3 A - 6 A (3) 6 A - 8 A(2) 8 A - 3 P (1)	7 P - 9 P (1) 9 P - 1 A (3) 1 A - 2 A(2) 2 A - 4 A(1)	8 P - 9 P (1) 9 P - 1 A(2) 1 A - 2 A(1) 9 P - 12M(1)**

HAWAII (con'd.)

Openings in Hawaiian Standard Time *

TO:	10/15 Meters*	20 Meters	40 Meters	80/160 Meters**
Western USA	11A - 4 P (1)* 4 P - 7 P (2)* 7 P - 8 P (1)* 7 A - 9 A(1) 9 A - 11A(2) 11A - 3 P (3) 3 P - 6 P (4) 6 P - 7 P (2) 7 P - 9 P (1)	2 P - 5 P (3) 5 P - 9 P (4) 9 P - 12M(3) 12M- 4 A (2) 4 A - 6 A(3) 6 A - 8 A (4) 8 A - 10A(3) 10A - 2 P (2)	6 P - 7 P (1) 7 P - 8 P (2) 8 P - 2 A(4) 2 A - 4 A(2) 4 A - 6 A (1)	7 P - 8 P (1) 8 P - 9 P (2) 9 P - 1 A(3) 1 A - 2 A(2) 2 A - 5 A (1) 8 P - 9 P (1)** 9 P - 12M(2)** 12M-2 A (1)**

* Hawaiian Standard Time is equivalent to:

Eastern Standard Time minus five hours;
Central Standard Time minus four hours;
Mountain Standard Time minus three hours;
Pacific Standard Time minus two hours.

FORECAST INDICES

Circuits Forecast To Open:

(1) Less than 7 days during each month of forecast period.

(2) Between 8 and 13 days during each month of forecast period.

(3) Between 14 and 22 days during each month of forecast period.

(4) For more than 22 days during each month of forecast period.

Where two forecast indices are shown within a parenthesis, the first applies to the forecast for the shorter distance range, and the second to the forecast for the longer distance.

A - A.M. P - P. M. N - Noon M - Midnight

See the "Last Minute Forecast" at the beginning of the column for the relationship between the Forecast Indices and the day-to-day propagation conditions expected during the month of June, 1961.

*Indicates times for expected 10 meter openings from Hawaii to other areas of the United States.

**Indicates times for expected 160 meter openings from Hawaii and Alaska to other areas of the United States.

The CQ Short-Skip Propagation Charts are based upon a CW effective radiated power of 75 watts from a half-wave dipole antenna, a half-wave above ground. The Charts are valid through July 31, 1961. These forecasts are based upon basic propagation data published by the Central Radio Propagation Laboratory of the National Bureau of Standards, Boulder, Colorado.

propagation should occur for approximately 30% of the time during these months, while six meter openings should occur for about 5% of the time. While sporadic-*E* openings can occur at any hour of the day or night, they most often occur between 8 A.M. and 2 P.M. local time.

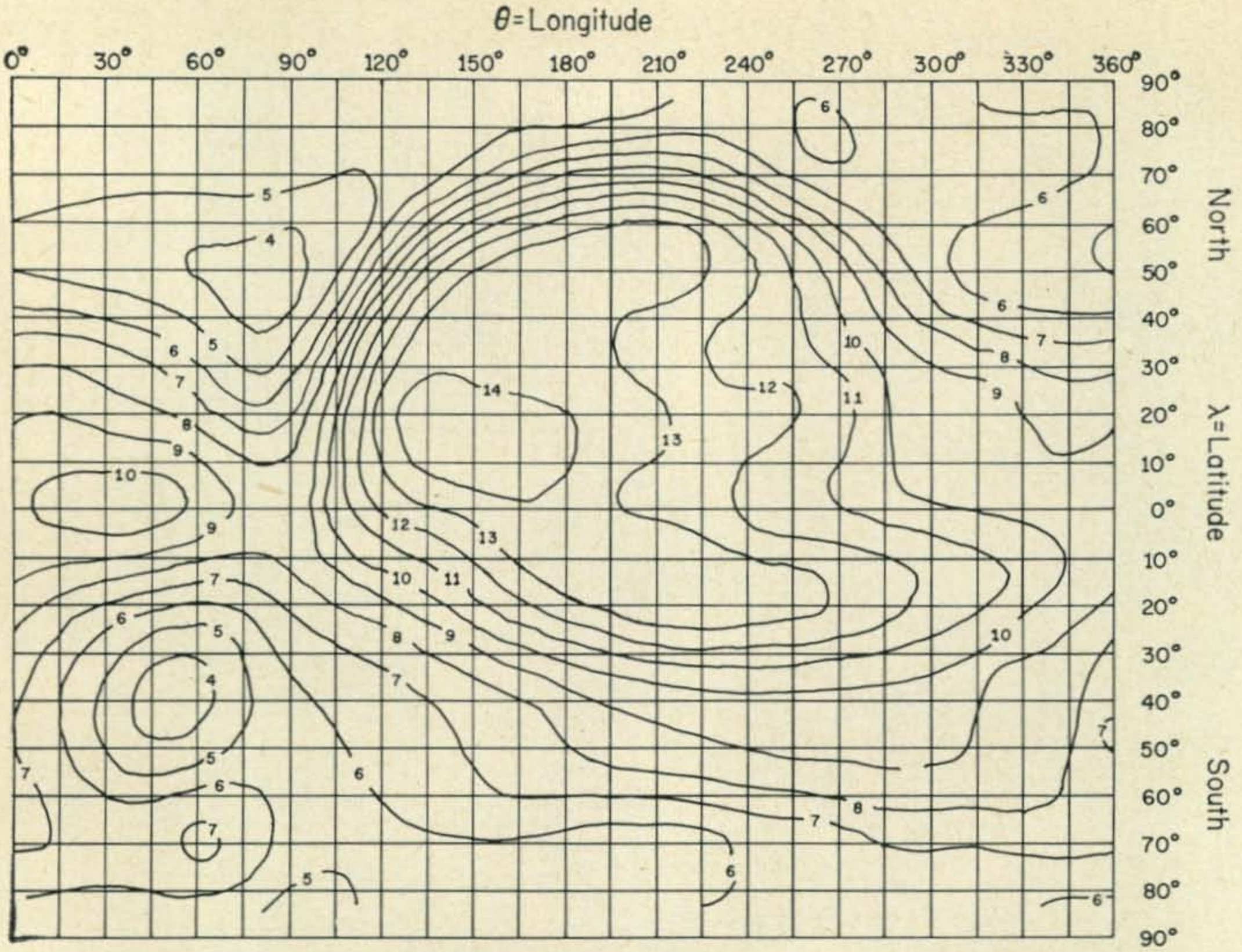
Here's a tip that's worked out very well during the past years for determining when 6 meters would open as a result of sporadic-*E* propagation. The geometry of sporadic-*E* propagation is such that as the skip distance *decreases* on 10 and 15 meters, the *highest* frequency that will be reflected by the sporadic-*E* cloud is *increasing*. When stations are heard less than 500 miles away on 10 meters, or about 400 miles on 15 meters, the chances are very good that 6 meters will open in the same general direction, with stations being heard from about 1200 miles away.

Computer Propagation Predictions

The Central Radio Propagation Laboratory of the National Bureau of Standards announced recently that is has successfully applied computer methods to the preparation of world maps used for predicting high frequency radio propagation conditions.[1]

These contour maps, based upon ionospheric

[1] Jones, W. B. and Gallet, R. M., "Ionospheric Mapping by Numerical Methods", *Telecommunication Journal*, No. 12, Dec. 1960.



World map of F2 layer critical frequency contours constructed by means of electronic digital computer techniques devised by the Central Radio Propagation Laboratory of the National Bureau of Standards. The data shown on the map is for midnight GMT, December 1957. Mapping ionospheric contours by computer methods is expected to increase the accuracy of high frequency radio propagation predictions.

data collected from ionospheric sounding stations throughout the world, have been issued monthly by CRPL for nearly twenty years.[2] Until recent success with computer methods, these maps had been constructed by hand, with points being plotted manually. With the rapid increase in the number of ionospheric sounding stations throughout the world, from a few dozen to more than 100 during the past few years, manual construction of the ionospheric maps became increasingly slow and tedious.

After five years of research, CRPL scientists worked out methods for utilizing electronic computers for plotting the ionospheric contours more rapidly and more accurately than can be done manually. The new maps of the ionosphere, produced by an electronic digital computer installed recently at CRPL's Boulder Colorado headquarters, are expected to be published monthly beginning later this year.

Construction of more accurate ionospheric contour maps should be of considerable interest to readers of this column, since the Propagation Charts appearing in this column are derived from the basic maps published by CRPL. The greater accuracy expected from the computer-constructed ionospheric contour maps should result in a corresponding increase in the accuracy of the predictions that will appear in this column in the future.

[2] *Basic Radio Propagation Predictions, CRPL Series D,* published monthly by the Central Radio Propagation Laboratory, NBS, Boulder, Colorado.

Sunspot Cycle

The Zurich Solar Observatory reports a monthly sunspot number of 51 for March 1961. This results in a 12 month smoothed sunspot number of 97 centered on September 1960.

A smoothed sunspot number of 74 is predicted for June 1961 as the present sunspot cycle continues to decline. For those who can remember, the present level of solar activity is about the same as occurred during the summers of 1940 and 1951. Propagation conditions this summer should be much the same as they were during both those years.

Sunspot Story

Check the Table of Contents of this month's *CQ* for the third and final installment of "The Sunspot Story; Cycle 19; The Declining Years."

After discussing some additional high frequency propagation parameters that are influenced by the solar cycle, the concluding installment of this special three part report by Jacobs and Leinwoll contains a band-by-band forecast of what propagation conditions will be like during the next five years of declining solar activity.

Don't miss the final installment of this special report which should be of interest to all radio amateurs.

73, George

CHARLES J. SCHAUERS, W6QLV/4
CQ, 300 WEST 43RD ST., NEW YORK 36, N. Y.

ham clinic

Taking Care of Your Recorder

Last month we covered the use and choice of tape recorders. This month, we will cover *some* aspects of trouble-shooting and maintenance of the units which most hams buy.

Like any other electro-mechanical device, the tape recorder needs periodic maintenance if it is to perform at top efficiency.

Lubrication

One of the things either "over-done" or not done at all (when required) is lubrication. Some manufacturers use sealed motors in their recorders which (technically) never require *user* lubrication. On the other hand, some recorders do contain motors that need lubrication; if over or under-lubricated, damage can result.

Lubrication instructions should be carefully followed. If a special type of grease or oil is called for, *use them!* This is important!

When lubricating any mechanical portion of your recorder, be careful that you do not inadvertently put grease or oil on rubber drive belts, capstans, pressure rollers, tape guides, etc. If you do, immediately clean the affected parts with a good harmless solvent and wipe them *thoroughly* dry with a good soft lintless cloth.

When possible, always lubricate moving parts when they are moving. If this is not done, the "start up" can throw grease and oil where it is not needed.

Be careful that oil is fed slowly into its cup or input hole. More tape recorders have been damaged by over lubrication than by any other cause.

If a motor begins running too hot, first check the lubrication.

Mechanical Adjustment

Seldom will the average home-type tape recorder need special mechanical adjustment, unless the controls have been roughly handled, forced or operated incorrectly.

Spring tensions should not be disturbed. If a spring seems defective, don't try to tighten it up by making it shorter—it should be replaced. Remember that the part upon which it is exerting pressure can and does wear too . . . perhaps it may need replacement instead of the spring.

Head position is important and should be checked when the head is cleaned. Usually however, the head(s) is mounted with a couple of screws—check these for tightness, unless the instruction book indicates otherwise.

If slippage of certain wheels seems apparent, check them for excessive edge lubrication before you look into possible mechanical trouble such as loose shaft set-screws etc.

When major mechanical mal-functioning is evident, it is best to take the recorder to an authorized service dealer—he has the experience and tools to do the required repairs and/or adjustments correctly.

Trouble-shooting

Vacuum tubes are the greatest source of tape recorder trouble and should be suspected first when the recorder output is low, the sound is distorted, there is poor erase action, hum, or no recording.

The amplifier used in *any* recorder is treated as is any other a.f. amplifier as far as trouble-shooting is concerned. Whenever possible however, always make *exact* replacements of resistors, condensers or any other part which may play a major role in shaping frequency response.

Here are a few trouble-shooting tips to help you localize and cure the *usual* troubles encountered in tape recorders:

No Recording—check all input devices (microphone etc.). Try a different input channel; check the recording head as well as its input connections. Check RECORD-LISTEN (reproduce) switches for position and proper operation—clean all wiping contacts. Check tape and head contact as well as head positioning. Check amplifier output into head. Check for defective gain controls. Check all tubes.

No Reproduction—check all tubes. Check head and amplifier input; check amplifier speaker and its connections. Check head positioning and gain controls. Run known well recorded tape through machine. Check for open monitoring jack (headphones). Check reproduce switch connections.

No or Bad Erasure—check bias oscillator tube, erase coil and tape positioning.

Hum—check for defective tubes (especially

the rectifier); check for a bad filter capacitor and/or shorted filter reactors; poor input device grounding; open socket grid connections and exterior hum pickup.

Distortion—check amplifier, head, and input devices, tape ride; and whether or not you plugged your input device into its correct jack (high or low impedance). Think: did you record too heavily—too much gain? Distortion is best checked by introducing a good sine wave signal at different frequencies, *i.e.*, 40—14,000 cycles or so to the input of the recorder and with a scope check the amplifier output; then record and check the recording with the same scope. For more accurate distortion measurements, a square wave input can be used. Improper recording is the greatest cause of distortion.

Wow and Flutter—check head positioning, correct tape "ride through" (sticking or uneven travel); check the tape take-up mechanism and reel drag. (Note that these two troubles are hard to find without special equipment.) Of course wow and flutter can be heard in a finished recording if bad enough. On the other hand, there may be just enough of each introduced to defy quick "ear detection." If the recorder is used to reproduce a *pure* sine wave for checking purposes, the scope will show distortion of that wave which may be undesirable if accurate measurement is desired.

Treat recording heads *gently!* When cleaning them with a good head cleaner use a soft lintless cloth, never use a screwdriver within the cloth, it may be magnetized and give you a lot of trouble. Generally, when a recorder is taken to a good repair shop, each head is demagnetized as a routine matter. A head that is magnetized above a certain level will also introduce distortion.

Magnetic Tape

Taking care of your tapes is another matter. They should not be stacked one on top of the other. Remember, you are handling magnetized tapes! One tape can magnetically "influence" another! Of course it would take a long time for any tape to affect another when they are contained in the usual cardboard container. But to be safe, store your tapes so that they do not come in contact with each other.

If a tape breaks it is relatively easy to splice when the commercial splicing devices are used. But a broken tape usually means rough handling!

Every manufacturer of recording tape likes to say that his tape is absolutely the best; but take it from me, the differences in the lower priced tapes are so small they need not be considered. On the other hand, there is a fine difference between the higher priced tapes, but to detect it, an elaborate lab setup is required. No manufacturer can honestly tell you that one can "hear the difference" using the same recorder . . . it cannot be done!

Surplus tape? Anything that is surplus has been superseded by something better. Stick to the well known brands and you can't go wrong.

The trouble-shooting of transistor recorders is similar to that for tube sets but a lot more difficult. More transistors are "cooked" by putting batteries in tape recorders backwards than for any other reason. The same precautions taken when servicing transistor radios must be used when working around transistor recorders. A friend of mine not too long ago found this out the hard way. Using an ohmmeter containing a 22½ volt battery he proceeded to check out a few circuits in the TR recorder and wound up replacing 3 transistors!

Whether you own an inexpensive or expensive recorder and use it around the hamshack, I know that you're having a lot of fun many hams are missing. It is the recording of the rare things that makes owning one very worthwhile. Happy recording!

On Surplus

Now that Ken Greyson, W2HDM has ceased writing the monthly SURPLUS column, many of the letters relative to surplus that would normally come to him now come to HAM CLINIC. To be frank with you fine readers, our surplus file is mighty thin and we are hard put to answer the questions we receive.

We can tell you where to find *original* surplus technical information, schematics etc., but we have little or no modification information except that which has already appeared in *CQ*. For this, we can only give you the proper references.

Although we have modified and used many items of surplus gear, we are not the surplus experts that Ken is. So to be fair to you and to ourselves, we must request that you confine your questions on surplus to already published material or queries relative to schematic sources etc.

For those of you looking for diagrams, instruction books etc., we know of no place better to obtain them than at Bill Slep Surplus Co., P. O. Box 178, Ellenton, Florida. If any readers can suggest anyone else who has a wide range of technical information on surplus gear at a reasonable price, please send us the address with full info and we will publish it here.

Due to the lack of space we cannot publish individual requests for surplus information as was Ken's policy.

Please Help!

When you write HAM CLINIC be sure to include a *self-addressed stamped envelope* . . . this is only fair. Surely you can spare a stamp and envelope if the information you seek is worthwhile. Help us to help you—remember the stamp and envelope!

On CB Equipment

HAM CLINIC receives many letters from hams concerning their CB equipment . . . fine! However, if a non-ham writes in, his answer is given "5th priority." Our technical file on CB equipment is growing and as time goes on, we will be

in a better position to help the CB boys. Note to manufacturers: send HAM CLINIC your instruction books, schematics and service notes, we can use them to help out your ham customers as well as you. If you will do this, we will be glad to send you the letters we receive on your equipment (with names deleted of course). Here's a chance to improve *your* product.

Confidential

All letters to this column are treated with respect and held in confidence. No letter goes unanswered unless you forgot (as many do) to include you return QTH. Full credit for technical items is always given the writer. After letters are answered they are destroyed . . . we do not have enough file space for them. So when writing again about your original query it must be restated. Do not expect us to remember your correspondence as one ham did whom we recently met at a ham gathering. "Say I'm the guy who wrote you concerning the NC-183. Remember me?" We were sorry to say *no*, but we have received many, many letters on this particular set relative to modifications etc.

For a quick answer, confine your letter to one question.

Observation

When our Editor, Arne, is kind enough to pass on to me for possible publication in the column certain, short items or incomplete articles, you can bet I give them close attention. But in all too many cases recently, the material received has either appeared before or is not clear enough for a re-write. If it is at all possible to "save" the piece received, I do so.

Observed—many hams do not feel that small items are worth much trouble . . . and how wrong they are! It is the little tid-bit of information . . . the unusual approach . . . the unique, that is of major interest.

Advice—typewrite your copy when possible (double-spaced). Make sure your photographs are glossy and clear. Draw your diagrams with a pencil or pen, but make them readable. Write your material as if you were writing a personal letter to a fellow ham. Be informal, but accurate.

Questions

HQ-170—"When I first purchased my Hammarlund HQ-170 receiver it worked beautifully. Then about three months later it started to drift. I checked it all over carefully but could not determine the cause. Any suggestions?"

First of all, remember that component aging *does* have an effect on frequency stability. Although manufacturers try to obtain "aged" components they are not always successful, and they do everything they possibly can to keep drift down. Then too, sometimes parts of "guaranteed" tolerance are not exactly what they should be.

If your receiver has a serial number of 1913 or less, Hammarlund has a modification kit which will definitely improve the stability of the high frequency oscillator. The cost of the complete modification of the high frequency oscillator circuit, involving all new oscillator coils, a new oscillator rack and band change switch, plus all new trimmers, re-inspection and complete alignment and test will be $25.00 plus shipping charges to and from the factory at Mars Hill, N.C.

If you are an expert technician and have good test equipment you can obtain the kit with schematic (not pictorial) and a new instruction manual, for $12.50 plus shipping charges.

Before you ship your receiver to the factory you must obtain return authorization forms. Personally, I'd ship the set, and then I could be certain that the work was done properly.

Diode Rectifiers—"Is it necessary to use matched silicon diodes in a bridge rectifier circuit? Also, do you have any tips in using these?"

It is always a good practice to use diodes acting in tandem that have similar characteristics; especially similar front to back resistance ratios and power rating. You can see what would happen if you used diodes having large different FBRR, sooner or later you would have a replacement problem. Equalizing with resistors is not a good solution. But to protect diodes some resistance in series with each one should be used. The manufacturer will generally supply the values of resistance best used with his products. Suggest you write to the "ham's friend" International Rectifier Corp., El Segundo, Calif. for full info on the use of silicon diodes as rectifiers. They have a book for $1.50 that is a "dilly."

Parasitic Choke—"What caused the parasitic choke in my final amplifier (813) to burn up? My final tank is a pi circuit."

When a parasitic choke literally burns up it means that you're having final tank coupling difficulty, *i.e.*, bad impedance match to your antenna and/or a very high s.w.r. This business about reflected power is no choke, . . . er joke. The old 32V's popped parasitic chokes anytime an 80 meter doublet was used on 10 meters. A pi network does not guarantee full load into anything it is coupled to . . . that is a myth!

Mobile Noise—"I have a rig in my Volkswagon and the only noise I get is from the wheels. I checked this by turning off the motor and coasting; when I stopped, the noise stopped. What gives? What's the cure?"

Deflate your tires, then introduce some graphite powder into them. Fill them back up to normal pressure—bet your noise has disappeared! See my article: Noise Elimination, May 1958, *CQ*. It covers noise in the VW and other sports cars.

NC-270 Receiver—"I accidently pushed my NC-270 off the edge of the operating desk onto a rug covered floor. There apparently wasn't any damage, but now I am experiencing dial slippage. What happened, and what can I do to correct the slipping?"

Although the drive mechanism on the 270 is adjusted at the factory for smooth effortless op-

[*Continued on page 114*]

sideband sideband sideband

SIDEBAND

Irv and Dorothy Strauber, K2HEA/K2MGE
12 Elm Street, Lynbrook, New York

SSB DX HONOR ROLL

TI2HP	232	W5IYU	180
W6UOU	229	W2FXN	177
W8EAP	225	MP4BBW	177
W8PQQ	220	K6ZXW	177
VQ4ERR	218	K4TJL	175
PY4TK	211	W5KFT	175
W7VEU	210	W2LV	174
WØQVZ	208	K2FW	171
W6PXH	205	K6LGF	170
W6RKP	205	KØCTL	162
K2MGE	204	4X4DK	161
HB9TL	203	K2JFV	158
W3NKM	202	W3LMA	155
W6WNE	201	PZ1AX	154
W2JXH	200	WØUUV	154
K9EAB	200	W1LLF	153
W6BAF	188	XE1AE	152
W5AFX	187	W2NUT	152
ZL3IA	186	K8RTW	151
VK3AHO	185	W2YBO	150
WØCVU	185	W2QKJ	150
W4OPM	183	W6VUW	140
W2VZV	182	K6MLS	140
ON4DM	181	W6EKZ	138
W2ZX	180	K2TDI	134

CQ SSB CERTIFICATES AND STICKERS

Worked 50

K6UJV K9WUR
ST2AR K9VYL
G3NUG KØDNI

Worked 75

G3NUG K3AMC
W3AYD W8USP
G8KS W5KC

Worked 100

DJ3CP K1IDW
OE1RZ W3ATV
G3FKM SM5DW
G3NUG W2WJS
OZ7FG W1LLF
XE1CV

Worked 125

W1ORV W1LLF
WØPGI G2BVN
K2JFV W2VCZ
K6HFZ W4UWC

Worked 150

W2QKJ K2JFV
XE1AE W1LLF
W2NUT

Worked 175

W4OPM

Worked 200

W6WNE W6RKP

Re: Grounded Grid

In our April column we printed a letter from Wayne, K4ZZV/HR2WC, outlining an easy way to add a.l.c. to your sideband rig. In spite of our giving Wayne a new call, he has once again come up with a lively discussion which is reprinted below.

"About a year or so ago I decided to redesign and rebuild my s.s.b. linear amplifier from its original 1 kw p.e.p. input to this talked about but few can explain 2 kw p.e.p. input. A grounded-grid circuit was decided upon because there are certain simplifications and straight forward operation to this class of circuit. It may not be quite as simple though as some hams seem to think, judging from the articles on grounded-grid amplifiers that I have seen published. It takes a little more than a tube and a tank circuit for a low distortion, stable grounded grid amplifier. The one point that is little stressed is a proper cathode input circuit; of course there have been articles on how to wind filament chokes and low capacity filament transformers or where to buy them. This however only solves one problem and there the matter generally rested.

"The simplification that I had in my amplifier was the use of a pair of cathode type tubes with an average input impedance of about 60 ohms. No filament chokes, no special transformer and no matching of impedance. In the first stages of modification I connected a 1 amp r.f. choke from the cathode to ground. If the plate choke has to carry an ampere or so on peaks, the d.c. cathode return has to carry that, plus the grid(s) current too. The amplifier did a very good job of fundamental frequency oscillating. The r.f. voltages were going back down the line to the driver tank circuit looking for a return path to ground. A possible solution could have been to have had a quarter-wave line but for quick band change it is rather unhandy to change coupling lines too. Some commercial amateur band grounded-grid amplifiers apparently cure their instability by neutralization but there are a few more problems that this won't cure. According to Terman, the grounded-grid circuit is self-neutralized which is one reason that I used the circuit.

"I consulted with Stu, W2ZE, who has been running a ground-grid amplifier for a few years, and he suggested a very high-*C* parallel tank circuit shunt from the cathode to ground. This is also shown in some tube application data on Penta Lab. tubes. The data gave 400 mmf for the 20 meter band but I took Stu's suggestion and made it 2000 mmf. The coil is three turns of #18 wire about a half inch in diameter and spaced for the center of the phone band. The *LC* ratio works out nicely as a similar coil can be used on all bands with 1000 mmf for 15 meters, 500 mmf for 10 meters, etc. Mounted right on a band change switch section, it makes a very compact arrangement. The heavy loading on this tank circuit broadens it out so the whole band is covered without readjustment. Where tubes are used whose input impedance does not match the line, a pi-network is then required. The Collins 30S-1 and 30L-1 are ex-

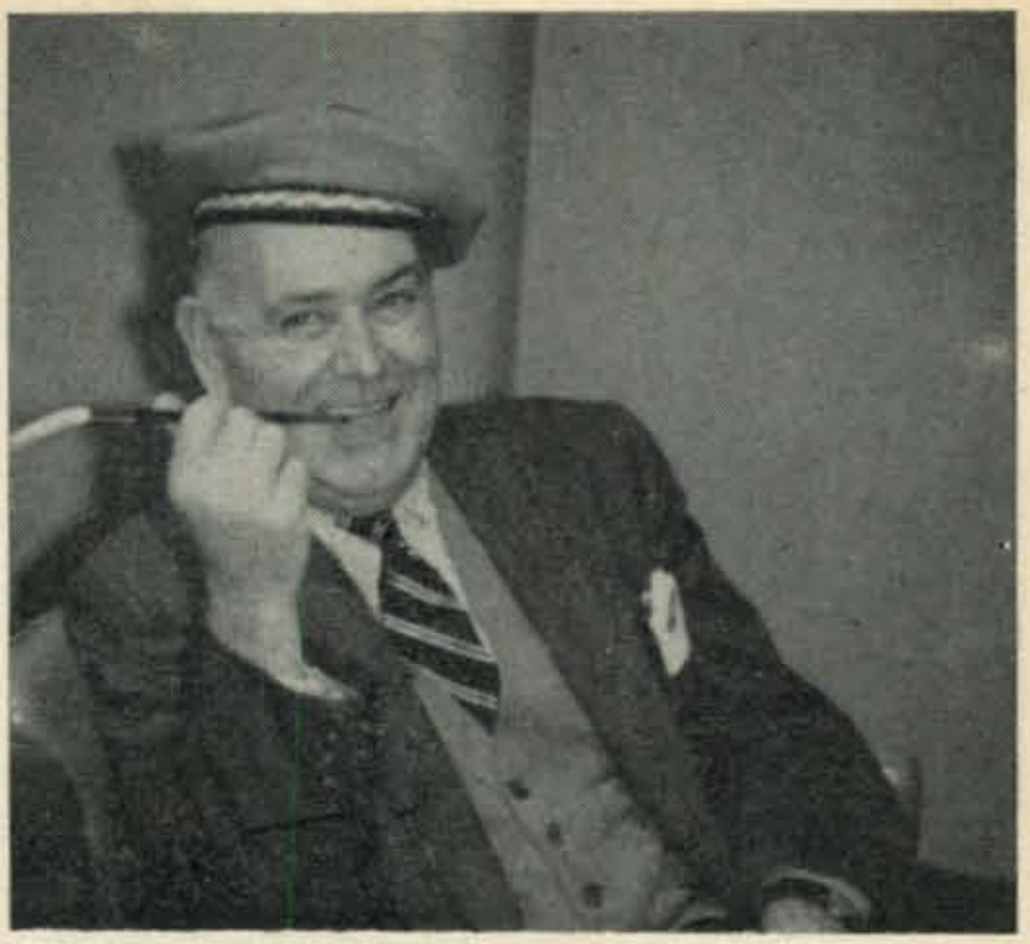
amples of well designed grounded-grid amplifiers using this circuitry. The amplifier is now completely stable and there is no reaction on the driver amplifier. No neutralization was necessary and none is required on a grounded-grid amplifier. In many cases the tendency toward self-oscillation is masked by using blocking bias on the tubes. Some years ago I used zero-bias tubes in a tank-circuit type of grounded-grid amplifier. Removing the blocking bias, and with an antenna relay in the circuit, that removed the load on stand-by helping things along, I was surprised at the beautiful oscillator I had!

"The more obvious reactions in the grounded grid amplifier are not the only reason for using a hi-*C* tank or pi-network between the cathode and ground. As Stu pointed out, the hi-*C* shunt tank is necessary to give a good "fly wheel" power regulation to the drive voltage and cathode current. Bill Orr of Eimac, told me at the recent S.S.B. Dinner that such a shunt tank was very important in order to tie down all the circulating r.f. currents; harmonics especially. Gene Senti of Collins said their tests showed such an input circuit gave a marked decrease in distortion products. The r.f. feeding-back into the driver amplifier increases the distortion of that stage which in turn gets amplified by the final amplifier. Where the final amplifier and driver are built as a unit, only one pi-network between them is necessary as the proper circuit *Q* and impedance matching can be designed for this application and is done in commercial transmitters."

10th Annual N.Y. Sideband Dinner

The 10th Annual Single Sideband Hamfest-Banquet, sponsored by the SSBARA in New York City on March 21, was one of the high spots of the year for sidebanders. Not only was the newest and best in sideband gear displayed, but the program was the best yet. A full day of viewing equipment, meeting old friends and making new ones, was topped off by a terrific dinner. Stan, WA2GFV, Program Chairman, provided some wonderful Broadway talent with Frank Fontaine, TV's "John L. C. Sivoneeay,"

Dieter, DJ3CP, shown at his fine sideband station in Butzbach, Germany, who is now boasting the addition of a "Worked 100" Certificate.



Just to prove he looks just as dapper as he sounds, here's a photo of Mac, W2NSA, relaxing at the N.Y. Sideband Hamfest.

and Calypso singer, Steve De Pass, who entertained the dinner guests.

Bing, W2CMM, SSBARA President, introduced the Dinner Committee: Irv, W21VW; Mike, WA2BLH; Mort, W2KR; Art, W2CYK; Stan, WA2GFV; Ron, W2SUC; Kitty, K2TEX; Dorothy, K2MGE; Irv, K2HEA; Harry, W2JXH; and Jim, W2JVO.

Jonathan, W2WK, Award Committee Chairman, presented the "Sidebander of the Year" Award, a beautifully engraved plaque, to Dorothy, K2MGE, who was chosen by the members of the SSBARA to receive the first of these annual awards.

Bill Leonard, W2SKE, was presented with a cup by Irv, K2HEA, in recognition of his winning the members' division of the SSBARA WAS Contest run in conjunction with *CQ*.

Mort, W2KR, presented the lucky winners with their prizes, and Butch, KØDWC, drew the ticket that made Gene, K2AJY, of Niagara Falls, New York, the delighted winner of the main prize—a KWM-2 in a suitcase with power supply.

As usual, this event attracted thousands of sidebanders from all over the country and many parts of the world, all of whom agreed this was the best Sideband Dinner ever.

Use and Abuse of Phone Patching

Much grumbling has been heard recently about the use and abuse of phone patching. Phone patching is a service that we hams can perform in emergencies; a service that we can perform to link members of a family separated by vast distances (we are very much in sympathy with our servicemen in remote corners of the world whose morale can be boosted by a patch) with Americans away from home, in countries which have traffic agreements with the U.S., who want to assure themselves of the health and safety of the folks at home. In these instances, a phone patch performs a useful func-

Tom, W5FMO, well known as Louisiana S.C.M., and Bert, W4MF, Chairman of the Delta Division Convention, as they greeted guests at the Chattanooga event.

tion. However, we take issue with the use of amateur freq. to handle traffic that belongs on the proper MARS frequencies; with the phone patch pest who breaks up a contact whenever and wherever he hears you request a patch; with the selfish ham who ignores such things as local calling areas and runs your phone bills up way over your budget. We could go on but we're sure that you've heard them!

We wonder about this—"I've been trying to get into Elm City for three days with *urgent* traffic!" If the traffic were urgent, why wasn't the phone used? Or a telegram?

Must the ham bands resound with "This is W----, running phone patch traffic. A clear frequency would be appreciated?" This is a reasonable request and every ham tries to steer clear of the frequency. But, when you tune over the band and hear this clarion call every few kcs, it's remarkable that tempers are not shorter than they are

When it is necessary to run a patch, for a good and sufficient reason, remember that the patch must be properly adjusted. Too many of the patches we have heard have been horribly overmodulated and broad as a barn door. This does nothing to alleviate the resentment imposed by the use of excessive phone patching.

In the interests of consideration and fair play, ask yourself "Is this patch really necessary" before you interrupt the pleasure of another's operating!

1961 A.R.R.L. Delta Division Convention

"We-all" had a real fine time in the land of the Magnolia Blossom and the Delta Division from April 7 to April 9. The convention, hosted by the Frye A.R.C., at the Read House in Chattanooga, was a great success and lived up to its advance publicity. Jamming the exhibit space to overflowing, hundreds of Delta hams turned dials, switched switches and peered into the innards of shining new equipment. Teeing off the technical forums were Harold Vance, K2FF, of RCA who spoke on "Single Sideband Fundamentals" and *CQ*'s SIDEBAND column editors who spoke on "Sideband Equipment and Operation.

Guests at the Banquet were temporarily disappointed to learn that the scheduled speaker, Dr. Wernher von Braun, was unable to appear but they soon perked up when Capt. Slattery of Redstone Arsenal presented a most fascinating talk illustrated by color slides on some of our best known missiles.

Undoubtedly the happiest couple at the Convention (besides ourselves) were the Arceneaux's—Arcy, K5SGK, and Mabel, K5SGJ—whose ticket number was the one chosen for the grand prize, a complete s.s.b. station.

Our congratualtions to Bert, W4MF, General Convention Chairman; Charles, W4TDZ; Joyce, K4QNI; Bill, K4IOP; George, K4AV; Charlie, K4ICH; J. D., W4JVM; Jack, W4HOI; Dale, K4CLT; Thelma, K4TSD; Ward, W4QT; Lewis, K4TNE, and Stan, K4HVF, who worked and worked and worked to make the Convention the success that it was.

Another highlight of our trip down South was the generous hospitality extended by Buck, W4TO, and his charming XYL, Elizabeth. The Joyners made us feel most welcome in Atlanta. Wallace, K4TJL, arranged a very enjoyable luncheon at which we were joined by Bob, W4MCM, Lee, K4RPK, and of course Buck, W4TO. Needless to say, we had quite a lively, interesting session with these outstanding Southern DXers.

Sideband Around the World

How nice to meet Larry, SVØWV, on the air again after many months between contacts. Last time we spoke to Larry, in the true spirit of amateur radio service, he was trying to locate a special medicine for a gravely ill woman in Athens. It was good to learn from this last contact that he had been successful . . . Joe, EI8P, has a delightful method for QRM-free QSOs without breakers—he carries on his conversations via Air Mailed tape recordings . . . Some-

Another popular Mr. and Mrs. couple on sideband—Betty, K4BZE, and Blaine, W4BNF, Pres. and Sec'ty respectively of the Atlanta Radio Club.

one has been pirating the call of John, CR9AH, for c.w. operation after 2100 GMT; spread the word that it isn't John! . . . LA1LG/P has been operating from Jan Mayen on s.s.b. but conditions have not favored many contacts with the U.S.A. . . . Jim, VS4JT, is now in the U.K. but should be leaving shortly to return to Sarawak . . . Only 216 stations were worked by Gamboa as CT1GA in Lisbon but with Adriano, CT1IP now on s.s.b., we're sure many more of you have added Portugal to your lists . . . Tony, SVØWT, reactivated sideband activity from Crete after several years of s.s.b. silence from that island and, despite his low power, has been making a lot of operators happy with a new country . . . New activity also from Faeroes Island with OY8RJ now being heard . . . According to Scotty, KØDQI, Bob, K3HVN, has received permission from both the Javanese and FCC authorities to operate as PK1SX starting in June for fourteen months. Arrangements have been made for Bob's wife to handle his QSLs from their home QTH. We're keeping our fingers crossed that all goes as planned!

Philip, EL6E, provided a most interesting contact. He is a Canadian with the Order of Holy Cross and has been in Liberia for six months. Philip mentioned that EL6F will also be joining us soon and another contact mentioned that we should look for activity from Aden as VS9APH is building up an SB-10 . . . "J.C.," LU1DAB, switches his call to LUØDAB when he goes mobiling with his KWM-2 on his cattle ranch 250 miles southwest of Buenos Aires and what a nice signal he puts out on an otherwise dead 10 meters on a Sunday afternoon! . . . Hearty congratulations to the group who operated from Malpelo Island as HKØTU. From what we heard, the operation proceeded very smoothly despite the rarity of the country and the fact that this would be the only time it would be represented by amateur operation . . . Many eyebrows were probably raised at hearing the call GI6YM/A but a chat with operators Bill and Cedric clarified that the "A" means "alternative" and that they were operating from a holiday scientific exhibition in the YMCA in Belfast—and, we might add, putting on a wonderful demonstration of sideband.

Lee, K4RPK, and Bob, W4MCM, two of Atlanta's top sideband DXers.

So this is how it's done? With Brazilian soda pop? Jaime, PY2CK, and Art, PY4TK, divulge the secret of their success as two of Brazil's top DX men. Art, of course, was the first PY to achieve CQ's "Worked 200" Certificate for sideband.

Band Hopping

Bill, W2SKE, and his lovely wife, Cappy, left during mid-April to accompany Henry Cabot Lodge on a 10 week tour of Africa. The ex-Ambassador to the U.N. visited the African continent on behalf of the Institute of Internation Education and his visit was filmed for a CBS TV news program with Bill doing the narrating. The Leonard's itinerary included Tunis, Kenya, Egypt, and Rome from all of which Bill hoped to operate on s.s.b. . . . George, WA2IZE, submitted ample proof to substantiate his claim that he is "the old timer with the new call"; George was 9BTL in Minneapolis from 1922-1927 . . . Harry, WA2LYT, had a pleasant experience with a neighbor recently. Seems that Harry was getting into the chap's hi-fi outfit when the volume was turned down. But, after checking with the volume up and not being able to hear Harry, the neighbor was delighted to learn that he had a built-in short-wave receiver to pick up Harry's interesting comments. "Who needs hi-fi?", he asked . . . Peter, ex-TG9PS, is now in Boston. We hope his s.s.b. rig, which was detained in customs, is now in Peter's shack and on the air . . . Art, W4DKJ, was elected President of the Florida Sidebanders who meet on 3940 every Sunday afternoon at 2200 GMT. Congratulations, Art, we know you'll be a splendid President.

Bill, WA6LDV, (ex-W7GIS, W2UBE) who heads up the Electronics Dept. of The Rand Corp. in Santa Monica, had a most interesting experience, thanks to s.s.b. While testing for b.c.i., a pleasant YL voice broke in to say that she was hearing Bill just fine—turned out to be Frankie, EL2AB, the same gal Bill had been trying to contact for six months! . . . Bob, W3ATV, was the first station in Delaware to get on sideband and that was back in 1950. It wasn't until last year that Bob decided to concentrate on DXing and within the space of 12 months, he received his first 102 confirmations. Bob's primary interest is in designing and building equipment rather than operating. The rig he has been using for the past two years is a 28-tube transceiver comparable to a KWM-2 but using a pair of 4X-250B's in place of a pair of 6146's. We'll have to get a photo of Bob and his station and show you what some good homebrew equipment looks like! . . . The Western Sideband

[*Continued on page 106*]

RTTY

BYRON KRETZMAN, KØWMR
108 WEST TERESA DRIVE
WEST ST. PAUL 18, MINNESOTA

When we described the Twin City TU, an RTTY converter and terminal unit, in the March 1961 RTTY column, reference was made to an unfilled octal socket. This we said was for the future addition of autostart. What is this "autostart" business? Many fellow hams, not as yet on RTTY but curious about it, ask this same question. Let's see if we can answer it.

Autostart

Autostart is one of the most fascinating aspects of amateur radioteletype. It is used on v.h.f., usually in metropolitan areas and their populous suburbs, and a.f.s.k. is the mode. Instead of the more common random-frequency operating, RTTY nets stick to one net frequency, on the high ends of the bands where they won't bother the DX-chasers; and, where *they* won't be bothered by QRM. This, of course, makes it very convenient to use crystal-controlled receivers as well as transmitters. Early RTTY nets on v.h.f. used the war surplus SCR-522 a.m. sets. Modern nets are now using commercial surplus police-type f.m. sets, with tremendously extended range as compared to the older a.m. sets. The "squelch" feature of these sets makes possible the completely noiseless monitoring of a channel, as their audio amplifiers are completely cut off in the absence of a carrier.

With the above described radio system available, it becomes a fairly simple matter to monitor these RTTY channels with our receiving machines completely controlled, including the starting and stopping of the motors, by any RTTY station transmitting on the channel. This, we would like to emphasize, can be a completely unattended receiving operation. We don't have to be in the shack to receive a message on RTTY!

There are in general use two basic systems of autostart, both of which are compatible if we pay attention to time. The first is a continuous monitoring system. Receiver and TU are turned on and are in an operating condition at all times. The machine motor is turned on and off by the received signal. An RTTY signal on the channel *at any time* will be copied.

The second system utilizes a time clock arrangement that turns on the radio receiver and the TU only at certain times. The RTTY signal controls the machine motor just the same way as in the first system. In its most simple form this system uses a commercial sign or light control which turns on the receiver and TU at a preset time, say 6 P.M., and turns them off at another preset time, say 11 P.M. In its most sophisticated form this system consists of a more complicated clock arrangement with time delay and control relays. This arrangement turns on the radio receiver and TU at certain specified "clock times," usually on the hour at preselected hours. If no RTTY signal is heard during a monitor period of about 1½ minutes, receiver and TU are shut down until the next clock time. If an RTTY signal *is* heard, the motor of the machine is started and the signal is copied. The time delay circuits keep the receiver and TU on as long as the channel is active, and the motor of the machine is started and stopped by the stations transmitting on the channel. The receiver and TU shut down *only* after 1½ minutes pass after the *last* transmission on the channel.

Both of the above autostart systems are controlled by the reception of the 2125 cycle *mark* tone. In other words, random noise, 'phone signals, etc., on the channel must *not* be allowed to start the motor of the machine. These are the practical considerations in the fool proof operation of an autostart system, and they are met by designing the system so that a steady *mark* tone of about 5 seconds is required to start the motor. An absence of *mark* or a steady *space* signal of about 1 to 2 seconds should shut down the motor.

At this point we would like everyone who contemplates autostart operation to carefully consider the safety of unattended operation of equipment. The cardinal rule is, **fuse everything!** And, we mean fuse it intelligently. Use the lowest ampere rating that you can. Use "slow-blow" type fuses only in the machine motor circuit. Even the electric clock timers that you use should be separately fused. Just one other thing: if you intend to use the continuous monitor system, make sure that the power transformers in your receiver and in your TU are sufficiently oversize to permit continuous operation without undue heating. A power transformer should never be too hot to handle. The RTTYer planning autostart operation should have absolutely no qualms if he follows the above cardinal rule and suggestions.

Autostart for the Twin City TU

Figure 1 shows the schematic diagram of the autostart circuit as applied to the Twin City TU; however, it can be utilized with almost any

RTTY converter. A 6SQ7 tube was used because that was in the junk box. Almost any high mu triode will work. There is nothing new about this circuit. Originally, in slightly different form, it was used by W6AEE and it appeared in *CQ* back about 1953.

Fixed cathode bias is obtained from the simple voltage divider. This bias is high enough to cut off the plate current of the tube. When a steady *mark* is received, the d.c. voltage developed across the *mark* diode load resistor, being of opposite polarity in respect to the cathode of the 6SQ7, lowers the effective bias on the grid to the point where the tube draws plate current, thereby closing the relay in its plate circuit. The combination of the 10 megohm series resistor and the 2 mf capacitor makes it necessary for the *mark* diode load voltage to be there for about 5 to 6 seconds before the tube conducts. When the *mark* diode voltage disappears, the charge on the 2 mf capacitor leaks off through the 3.9 megohm resistor. The cut off bias from the voltage divider then takes over, and the plate relay drops out. This takes about 1 to 3 seconds.

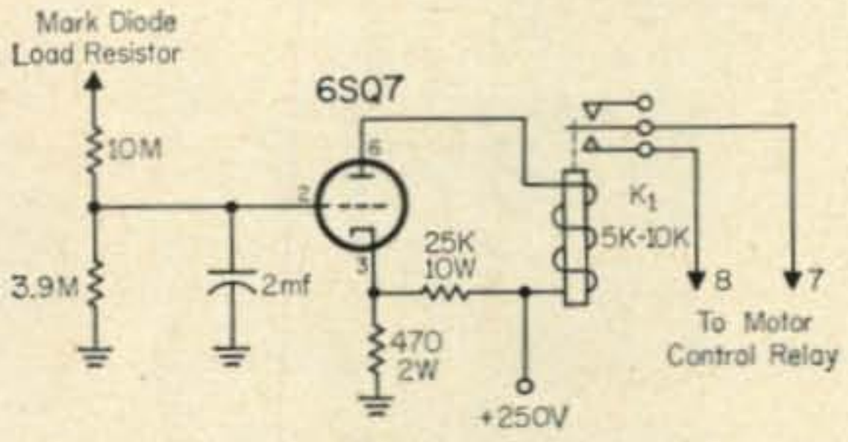


Fig. 1—Autostart Circuit for the Twin City TU.

The relay K_1 is a 5000 ohm Argonne AR-21, used because of its small size; however, the more rugged Sigma Type 4-F is to be preferred. Surplus plate relays of up to 10,000 ohms should also work. Do not, under any circumstances, attempt to directly control the a.c. motor circuit with the small contacts usually found on these sensitive plate circuit relays. Another relay, with larger contacts, should be used to actually turn on the motor. This larger relay, of course, would be actuated by the autostart relay in the TU.

National Federation

The combined societies of MARTS, Inc. and the Florida RTTY Society is undertaking a task which we feel will bind all RTTYers in a united group. They feel, and have felt, that RTTY is not represented well enough with the FCC. They feel quite strongly that the dual identification rule should be eliminated for RTTY, and that an organized Federation of Amateur Radioteletype Societies would present a strong front to petition the FCC in this matter and other matters pertaining to RTTY.

MARTS, Inc. and the Florida RTTY Society would like to hear from all RTTY groups across the country. All comments in this matter should be sent either to D. L. McMullen WØATM, Secretary MARTS, Inc., 1404 So. Spring Street, Independence, Mo.; or to Fred DeMotte, W4RWM, Box 6047, Daytona Beach, Florida.

WØZB, Les Benson, St. Louis, Mo.

On the Bauds

W4BKJ of Decatur and W4NTK of Swainsboro represent Georgia on 40. W4HMN of Raleigh and W4TLA of Rocky Point represent North Carolina on 80. W4RWM has a Model 15 for sale. K5SKG is not in KP4 but QRT.

K6MTX of San Jose, California, has requested the ARRL Pacific Division director to "take the necessary action" to accomplish the elimination of the dual identification requirement. W6GFI is on 20 from Brentwood, California. W7EJD has a Model 26 with table for sale. W7EQU of Spokane, Washington, is on with a Model 19 and a W2JAV TU.

W8BPY of Chesterland, Ohio, is on 6 and 2. K8DNY is /8 from Charleston, West Virginia. W8SEY of Kalamazoo, Michigan is on 80. The Elkhart, Indiana, High School Radio Club is on with a Model 14, 650 watts, and the Twin City TU, according to W9FQN and K9IXS. K9DOK, also of Elkhart, has a 15 on 2. W9ZFA is another Elkhart RTTYer. K9HIH of Downers Grove, Illinois, has a Model 19 and is on 2. W9ZGC is on 80 from South Bend, Indiana.

KØSPF is on 40. WØWOM of St. Paul, Minnesota, operates 52.6, 53.64, and 146.95, all f.m. channels. WØLFH of Algona, Iowa, is building the Twin City TU. WØUYC of St. Louis, Mo., is on 80. KØBER is on 40 from Kansas City, Kansas, with tape gear.

KM6BU is now on 20 and 40. ZS1FD worked PAØFB.

Filters

W6CQK, 1307 Alameda, Redwood City, California, can now supply the tuned-up channel filters and the band-pass input filter (April *CQ*) for the Twin City TU. Jack can also supply the 255A polar relay, all balanced and with a socket, for only $3.25 postpaid. Drop Jack a postcard for his list of available filters.

73, Byron, KØWMR

VHF

BOB BROWN, K2ZSQ
67 RUSSELL AVENUE
RAHWAY, NEW JERSEY

50mc. 144mc. 220mc. 420mc. and above

Time sure does fly by! Here it is June already and we're still trying to get all the equipment repaired and antennas up for the big DX season ahead. Yes, I said DX season! Well, at least for the 6 meter men. June is the month that usually marks the evident beginning of our Sporadic-*E* openings on 50 mc, and, judging by W3ASK's PROPAGATION column and the expected improved conditions on 10 meters, we're not the slightest bit pessimistic about more excitement on our favorite v.h.f. band! The approaching Sporadic-*E* season has always intrigued me, and I imagine that most 6 meter operators look forward to this time of the year when contacts can be made over a path of roughly 1,500 miles or so. This phenomena has both puzzled and pleased amateurs for years and we still have a lot to learn about it. But for the meantime, let's enjoy it! In brief, a quick definition of Sporadic-*E* skip—In the region of the *E* layer of our atmosphere, at approximately 30 to 70 miles in altitude, clouds of very high ionization are frequently formed. These clouds (sometimes visible, notes W8BPY) are capable of reflecting v.h.f. signals. It is thought that there is some correlation between aurora and *E* layer propagation, but this is not as yet definitely known. This cloud layer may be spotty, reflecting signals from a small area or on occasion reaching continental proportions (double-hop). Propagation by Sporadic-*E* is thought to be limited to (at the highest) 144 mc and lower, however 144 mc transmissions in excess of 1000 miles lead to some question regarding the upper limit. Only in the last few years have any kind of Sporadic-*E* 144 mc work been possible at all. Minimum distance utilizing this mode of propagation seems to be about 600 miles and maximum for single hop is about 1500 miles. Well, that's a quick summation, and should give you a basic understanding of what to expect. Listen for me around 50.140 mc on openings!

Flash!

VKØVK, a close personal friend whose home call is VK2VK, is operating as VKØ from Wilkes Land, Antarctica. During a sked QSO with him the other night (h.f., not v.h.f.), he mentioned that he has finished making an automatic keyer and will be operating it using 100 watts to a beam aimed on the States on 6 meters! VKØVK will be the call used. He will run the keyer on 10 minute intervals, six times during each 24 hour period. This should go on for months. Anyone hearing his signals is urgently requested to send a card to both K2ZSQ and K2QXG giving the date and time. Exact QRG is not known as he does not know as yet what crystals he will have available. Thanks to Lauren L. McMaster, K2QXG, P. O. Box 206, Brightwaters, New York, for this scoop.

Certificates

Bald Eagle V.H.F. Award–Carl McDaniel, W3HCW, sends us a sample of their fine certificate with the following requirements:

1. Stations in the local area contact and QSL with at least *eight* stations operating portable or mobile from atop the Bald Eagle Mountain in North Central Pennsylvania.
2. Stations outside the local Williamsport area contact and QSL with *five* stations operating portable or mobile from atop the Bald Eagle Mountain in North Central Pennsylvania.
3. QSL's must be received by the Bald Eagle V.H.F. Society before the membership certificate will be issued.
4. Contacts must have been made after January 1, 1961.
5. Contacts may be on any single band or any mixture of bands 50 mc and up.
6. Send a log extract listing the date, time, frequency, and the name of each station worked to: W3JEZ
   680 Campbell Street
   Williamsport, Pennsylvania

Kansas City V.H.F. Club Award–No detailed information on this certificate, but anyone interested is urged to write to:

Kansas City V.H.F. Club
P. O. Box 973
Kansas City 41, Missouri

From what we can deduce, this three-color certificate is offered to those who have shown proof of working five or more members of the club.

Clubs and Societies

Microwave Society of Long Beach—Jim Halicus, WA6HYJ, writes us that this club meets on the second Wednesday of each month at 8:00 P.M. PST. The location is the Belmont Shore Public Library, East Second Street and Bayshore Drive, Long Beach, California. All interested parties are urged to attend. The purpose of this society is to stimulate interest in the v.h.f., u.h.f. and microwave bands.

V.H.F. Mobile Club of Detroit—Here's a real promising group that is associated with the Michigan 6 Meter Club (membership 120!). For further details contact Rodney R. Dryo, K8SGL, 37145 Glichrist, Wayne, Michigan.

The Crossband Communications Club of New York, Inc. has rapidly grown into the most active v.h.f. group in the New York City area. Originally formed by 2 and 6 meter enthusiasts from Brooklyn and Queens, the club now has an active membership of almost three dozen members, all active on the v.h.f. bands, and from several counties.

The club meets the first and third Thursday of each month at the Woodhaven Democratic Club, 87-13 87th Street, Queens, New York. There's always a turnout of at least 20 members, and these sessions are devoted to technical discussions, social events, and regular club business.

The "Crossbanders" are now awarding a certificate to any amateur who has worked and QSL'd at least ten members, with additional awards in the works for working extra members beyond ten. In order to qualify for this certificate, you must make individual contacts with ten or more members and exchange QSL's. Contacts made during contests or round-table QSO's including more than one member don't count. V.h.f. fans are urged to climb on 6 or 2 meters and call "CQ Crossbanders," and then duck.

A roster of club members is listed for the convenience of any amateurs who are interested in obtaining this handsome certificate . . . W2AZC, LDC, ZRA; K2APL, BIE, GB, IGK, JZW, LDC, MVT, UMM, VBS, VNR, VZA, ZKE, ZXN; WA2BHL, BKO, CGX, CZH, CZI, EAZ, GHM, IQJ, KXK, LRO, LSL, MAT, MUR, NOH; WV2MYA.

Kansas City V.H.F. Clubs: This one is presently composed of 123 members, all operating on frequencies above 50 mc. Listed below are a few of their activities which they'll be only too glad to further explain upon request . . .

1. Regular nets, weekly.
   a. Sunday evening, 2100 hours CST 145.3 mc
   b. Monday evening, 2100 CST 51.3 mc
2. Monthly eyeball meetings.
   a. 1930 hours CST, Lykins Community Center, 4114 E. 7th, Kansas City, Missouri. This meeting is held the first Tuesday of each month.
3. Annual meetings
   a. Picnic, held each spring
   b. Field Day
4. Other activities
   a. Radio Bingo, played on Monday night nets
   b. Traveling awards
      1.) Courtesy award, for the person who extends outstanding courtesy for the month.
      2.) Boner award, for the person who makes the biggest goof of the month.

Anyone winning either award three times gets to keep it.

c. Refreshments, which are purchased with money from a kitty which the members contribute to voluntarily, are served at the monthly meeting.

d. Operation Rollerskate, an activity in which the club collects money and buys toys for orphans at Christmas time.

e. The club also issues a certificate to any ham who works five or more members and whose home QTH is 50 miles or more from Kansas City, Missouri.

The address for correspondence is:

Kansas City V.H.F. Club
P. O. Box 973
Kansas City 41, Missouri

Kings County AREC Traffic and Emergency Net—This club meets every Wednesday evening at 2030 local time on a frequency of 50.4 mc.

Kings County AREC, RACES, and CD NET—Meets every Wednesday evening at 2030 local time on 50.4 mc.

Brooklyn V.H.F. Association—Meets every Saturday afternoon at 1400 local time in New York. For further details write to Bill Pasternak, WA2HVK, 1525 West 8 Street, Brooklyn 4, New York.

The St. Louis 432 mc group: (left to right) Lane P. Jackson, KØKJX, Charlie Andrew, WØVOM, Gene Hall, K9RIG, Bill Hollander, WØAAS, and Charles Courtney, KØJHW, in WØVOM's shack. *(Photo by KØKJX)*

V.H.F. Man of the Month

This month **Carl Scheideler, W2AZL,** earns our high seat of honor for his tremendous contributions to the art of v.h.f. amateur work. I'm sure you're all familiar with Carl's now famous "W2AZL 417A 2 Meter Converter." His contribution in the form of this one article hit the v.h.f. fraternity like a shot in the arm. How many serious 144 mc enthusiasts do you know who aren't using them? W2AZL has become synonomous with high "states worked" on 144 mc, and we must admit that 29 confirmed states surely represents a lot of real hard work. We've personally had the pleasure of visiting Carl at his Plainfield, New Jersey, residence, and must confess that every time we leave, we take to mind how little we know about v.h.f.! W2AZL, a real pioneer in this field of v.h.f. experimentation, constantly amazes us with his fantastic talent of continually coming up with some new piece of gear right in time with the age and applicable to the 144 mc enthusiast. Any tribute we can pay to him would fall far short of his true deservedness. If there were only more like him!

A. E. Pendl, OE6AP, at his contest operating position. He set the first meteor reflection record in Europe, and is now active on 70 mc, 144 mc, 432 mc and 1296 mc!

Greater Pittsburgh V.H.F. Hamorama!

The Greater Pittsburgh V.H.F. Society, Inc., is throwing a real big one this year exclusively for us v.h.f.'ers. The First Annual Greater Pittsburgh V.H.F. Hamorama is to be held on Sunday, June 18, 1961, from 11 A.M. to 5 P.M. at the Museum Building, South Park Fairgrounds, near Pittsburgh, Pennsylvania. This will be a convention type of Hamfest, complete with indoor and outdoor activities. Although the main theme of this HAMORAMA is v.h.f. operation, they will be offering events of a diversified nature to interest all who attend regardless of their likes as to modes of operation. There will be prizes in excess of $1,800.00 total valuation awarded to the lucky winners.

The registration fee will be only $1.50 in advance and $2.00 at the door. XYL's and children are admitted free if accompanied by an attending amateur.

Also in conjunction with this affair there will be a V.H.F. Hamorama Six Meter Contest to be held on June 10 and 11 coincident with the ARRL June V.H.F. QSO Party. The rules will be the same, and the time duration the same, with the following exceptions: To be eligible for the contest, a contestant must have a Hamorama registration ticket and fulfill the following rules:

You must work 10 Greater Pittsburgh V.H.F. Society members and make a minimum total of twenty (20) or more contacts. GPVHFS members will count as three extra points each. Anyone is eligible to enter the contest providing the rules are followed. At the completion of the contest, the logs together with the registration ticket number are to be sent to W3ZUQ, Jerry Smurphat, Powers Run Road, Pittsburgh 38, Pennsylvania. The logs are to be in the same form as the ARRL contest forms.

There will be two sets of three prizes each to be awarded. The first set of three prizes will consist of 3 beautiful trophies to be awarded to the highest scorers. The second set of three prizes will consist of ham equipment totaling a value of $100.00. In order to be fair to those with poor locations and yet encourage a big turnout, these prizes will be awarded on a chance basis. All those who submit a proper log and who have registered by June 18, will have their calls put on a stub which will be drawn at the Hamorama. The winners need not be present. "By having our contest coincide with the ARRL Contest we hope to get more activity out of our group and from those in adjacent areas," adds K3CJY.

Tickets are available from Sidney Lippman, K3CJY, Hamorama Chairman, 1208 Linden Street, Cheswick, Pennsylvania.

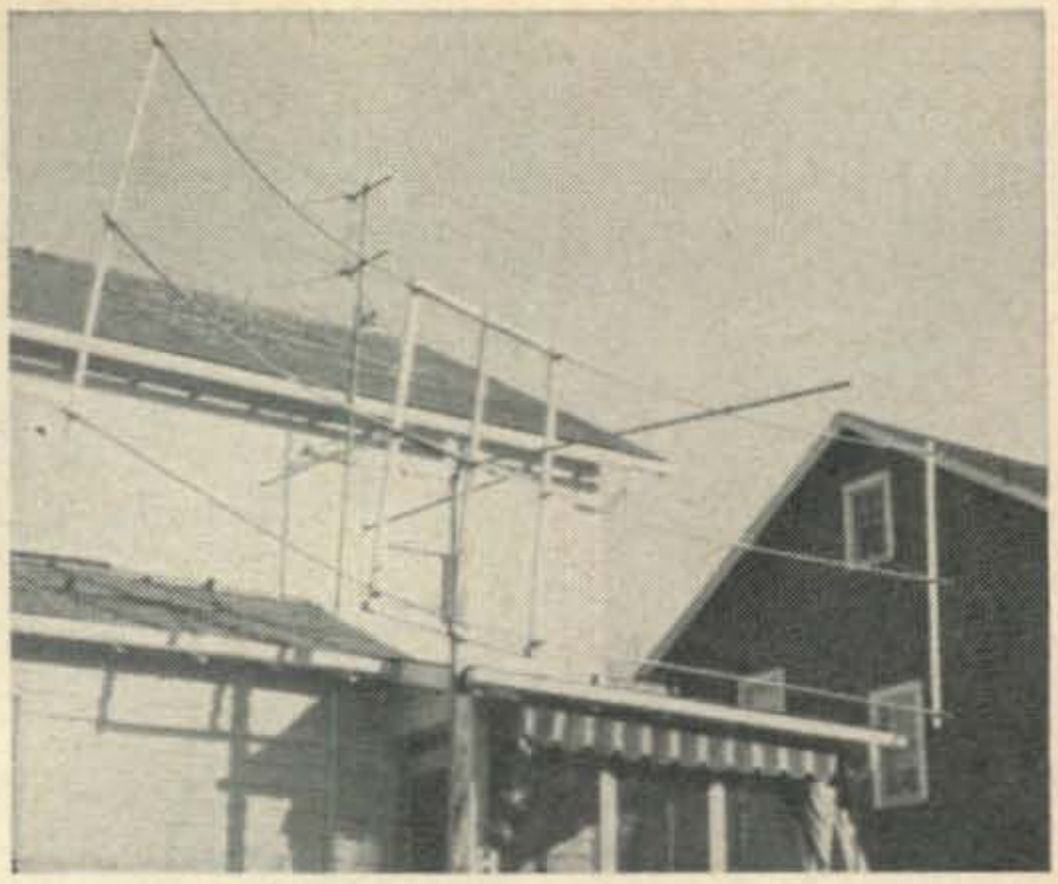
Sid adds that the organization "meets on the second Sunday of every month at the East Liberty YMCA, Pittsburgh, Pennsylvania. We meet on the air every Monday Evening on 50.4 mc at 1900 local standard time and on 145.15 mc every Wednesday at 2000 local standard time. We also give a beautiful certificate for working six of our members on either 6 or 2 meters."

Walt Taylor, K2MLT, and his XYL inside Walt's newly constructed exclusive v.h.f. ham shack cabin at Hammondsport, New York.

Two Meter and Down Club

This one just came in and didn't get it in the clubs and societies listing, but is well worthy of

note. The Two Meter and Down Club is still going strong after *nearly 15 years* of uninterrupted activity. The 1961 officers are as follows: President, W6GUE, Vice President, W6WKO, Secretary, W6MMU, Treasurer, W6IHK. This club meets on the third Friday of every month at the club's newly built facility near 83rd and Lincoln Blvd., in Los Angeles, California. The project for 1961 will be to carry on work started last year; namely, finishing the construction of a moonbounce station. So far the building has been put up, the dish mounted on its rotator, the parametric amplifier is working, the frequency stabilization buried in the ground, and the driver unit put into place. The only big link missing is the final amplifier, plus, "a lot of hard detail work," comments Don Goshay, W6MMU.



Here's a shot of K2UYH's 1296 mc moonbounce parabola mounted in position on his Verona, New Jersey, QTH.

Mailbag

Laramie, Wyoming — Paul Sandels, K7EMO, comes through for us this month with . . .

"Thanks for my 50 mc CCC #1025! No skip openings out here lately. I went up on the mountain 7 miles east of here on the 25th of March (8,700 feet!) and worked 24 50 mc stations in or near Denver, Colorado. This is a distance of about 120 miles. Two of the fellows down there were using Heathkit Sixers. My equipment was a modified Viking Challenger transmitter, NC-270 receiver and a 5 element beam. Power was an army surplus 110 v.a.c. gasoline engine power supply. I plan to do it again soon!" *Well, Paul, keep us informed on your DX'peditions. Who knows? Maybe we'll work you yet on some Sporadic E double-hop this summer!*

Webster Groves 19, Missouri—One of the boys who made the long trip up to Syracuse last fall, Lane Jackson, 'KØKJX, sends us plenty of news from Missouri and 'St. Louis this month . . .

"Vernon, WØKIQ, has moved from Jefferson City to 'Chamois, Missouri, which is still 110 miles from St. Louis, but he continues to deliver a good S7 to S9 signal in QSO's with KØJNH (St. Louis, County).

"The St. Louis area has some activity on 432 mc with WØVOM, W9IFA (Carrollton, Illinois), K9AAJ (Quincy, Illinois), and W9AAG (Woodhull, Illinois). Already on the air are WØAAS, KØKJX, KØJHW, K9RLG, and WØWEG, who is building a transmitter and a converter. Please send a tape or write KØKJX if you are on 432 mc and wish to exchange technical and operating data. I'll forward the tapes on to others who wish them.

"In March about 50 RACES members from all over Missouri gathered in Jefferson City for a one day meeting to discuss plans for the C D alert, "Opal 1961" and it turned out to be a miniature v.h.f. gabfest! Very few 2 or 6 meter stations work across the state, mainly because of low power and small beams. Had a talk with Del, WØATM, and Bob, WØEZM, both of Independence there in Jefferson City and find that there are many active 6 meter boys in the Kansas City area. (I received my first call, 9AXJ, when my QTH was Independence many years ago. The "W" wasn't added until later and, yes, Kansas City was W9 land in 1924).

"Talked to a new YL on 6 meters, Golda, KØVPH, of Arnold, Missouri, last week. She has been active on 80 meter c.w. for some time and was surprised to find so much activity on six, even with her Sixer. Maybe it's her voice." *Could well be, Lane! Many thanks for news—Keep it coming!*

Bettendorf, Iowa—Hubert Testroet, KØPWS, writes . . .

"Since the advent of the Heath Sixer, the six meter activity has increased considerably here in the Quad City area. The mobile activity has benefitted most. Although with all the increased activity on the band more contacts had been expected, it seems that the ground wave contacts have suffered due to the reduced power being used by the new stations on the band.

"During the past year I have been able to increase my 6 meter Worked All States list to 44 by confirming North Dakota. Have a grand total of 7 states on 2 meters. I'm sorry to say that the 2 meter stations are few and far between in this area." *Well, don't get discouraged! The v.h.f. population is growing by leaps and bounds, and don't be too surprised if the 'ole 144 mc segment becomes quite active in the next few years!*

Elizabeth, New Jersey — Rich Panzer, K2TWZ, drops along a quick line to let us know that the Union County New Jersey 6 meter AREC Net is now active on Saturday mornings at 1030 EST on 50.25 mc. He is Net Control Station. Rich is also kept busy with his studies at Fairleigh Dickenson University. Keep up the good work, Rich.

Collierville, Tennessee — Paul, W4HHK, sent along a note through the club bulletin of the Mid-South V.H.F. Association, *The V.H.F. Signal Report* . . .

"Some of the local gang ought to start making plans to build a 432 mc converter to feed that old TV set. A number of surplus inconoscope TV cameras have been purchased by some of the boys . . . and if all show up on 432, there'll be TV QRM galore! First camera checked out made a fairly good picture, about 400 lines resolution. 'See you' on 432 mc may take on a new meaning!" *Sure hope so, Paul. Just where did you get those cameras?!*

Syracure, New York—The chairman of last years Syracuse V.H.F. Roundup, Charlie Sellwood, W2RHQ, writes . . .

"Sending this note along to you to tell you about the aurora of March 5th. You'll probably get a lot of mail concerning it. Although it probably won't go down as a terrific DX session, it certainly was one of the greatest for activity.

"I logged all the calls I heard from 6 P.M. when I was alerted 'till 10:06 P.M. EST when I pulled the switch. Heard better than 100 stations and the funny part was

[*Continued on page 106*]

The 432 mc station at WØVOM. The 432 mc Centimeg converter is on the back wall to the left of the power receptacle, on the shelf above the table is the s.w.r. meter, modulator, 2 meter crystal exciter, and tripler and 432 mc final with cover off. Antenna is a 32 element array. *(Photo by KØKJX)*

Novice

by **DONALD L. STONER, W6TNS**
P.O. Box 137, Ontario, Calif.

The simplest form of radio tube contains two electrodes—a *cathode*, and a *plate*. This type of tube is called a *diode*. In the diode, *positive* voltage is supplied to the plate from a suitable power source. The cathode is always negative with respect to the plate. When a positive voltage is applied to the plate, electrons will flow from the cathode to the plate and return to the cathode through the external plate power supply circuit. If a negative voltage is applied to the plate (with respect to the cathode), the free electrons in the space surrounding the cathode will be forced back to the cathode and no plate current can flow. Thus, a diode permits the electrons to flow from its cathode to its plate, but never from plate to cathode. When an alternating voltage is applied to the plate, the plate will alternately become positive and negative. Plate current (due to the flow of electrons) will flow only during the time when the plate is positive and since it flows only in one direction, it is said to be *rectified*.

Diode rectifiers are employed in receivers and transmitters to convert a.c. to d.c. for supplying the plate, screen, and grid bias voltages for the other vacuum tubes. They are also used as detectors or demodulators in receivers. Rectifiers were discussed during the past few months and detectors are to be discussed in detail later on.

The invention of the *triode*, or three-element tube, was one of the most important steps in modern electronics. Up to 1907, the diode was the only electron tube used in the primitive wireless communication systems of that time. In that year, DeForest disclosed his third element, an electrode which was added to the diode and so formed the triode. Not only did it modify the diode, but it opened a new era in communications. DeForest's third element made present-day radio, in all its forms, a practical reality.

A triode contains a grid, a cathode, and a plate. The grid is usually an open coil or mesh of fine wire and is placed between the cathode and the plate. The turns of wire in the grid are spaced far enough apart so that the passage of electrons from the cathode to the plate is virtually unobstructed. The number of electrons that pass through the tube constitute the *plate current flow*. If the grid is made more negative than the cathode, some of the electrons emitted by the cathode will be repelled by the grid and, therefore, will not reach the plate. Thus the plate current is reduced accordingly. You can see that as the grid voltage is made increasingly negative, fewer and fewer electrons will reach the plate. Eventually, the grid is made negative enough with respect to the cathode, no electrons will reach the plate and plate current will cease to flow (or be cut off) entirely. The point at which plate current ceases to flow is called *cut-off*, and the negative grid voltage required to stop the plate current is called the cut-off voltage.

Going in the opposite direction from cut-off, plate current will increase as you make the grid less negative. When the voltage on the grid becomes zero, it will have no effect on the passage of electrons to the plate. If the grid is made positive with respect to the cathode, it will "speed up" the flow of electrons and actually increase plate current over the diode condition. However, a point will be reached where not all of these electrons will go to the plate. The grid itself will act as a plate and a current, called *grid current*, will flow. Since this "starves" the plate of electrons, grid current flow is not normally desired. If the grid is made positive enough, it will attract the majority of electrons since it is closer to the cathode than the plate.

This is a very important point. Because of the proximity to the cathode, a comparatively small change in the voltage on the grid has the same effect on electron flow as a much larger change in the plate voltage. It is this feature that gives the triode its chief property—*amplification*.

Here is how amplification is achieved. A small alternating voltage applied to the grid causes comparatively large variations in plate current. As we have seen, these variations will follow the change in grid voltage almost exactly. If a resistor, called a *load resistor*, is plated in series with the plate current path, the varying plate current will develop a voltage across the resistor (remember that $E = I$ times R). The alternations in voltage developed across this resistor will have a frequency equal to the a.c. voltage applied to the grid. However, the magnitude of the voltage across the load resistor will be much greater than that of the voltage applied to the grid. Since the voltage appearing in the output (across the load) is greater than the voltage applied to the grid, it is said to be *amplified*.

Characteristic Curves

The behavior of a triode is best described by means of curves, called *characteristic curves.* These curves are obtained by keeping one of three quantities (grid voltage, plate voltage or plate current) constant and observing the relationship between the other two. By plotting curves with the constant quantity varied in fixed steps, we obtain a *family* of curves. Fig. 1 shows a family of E_g (grid voltage) versus I_p (plate

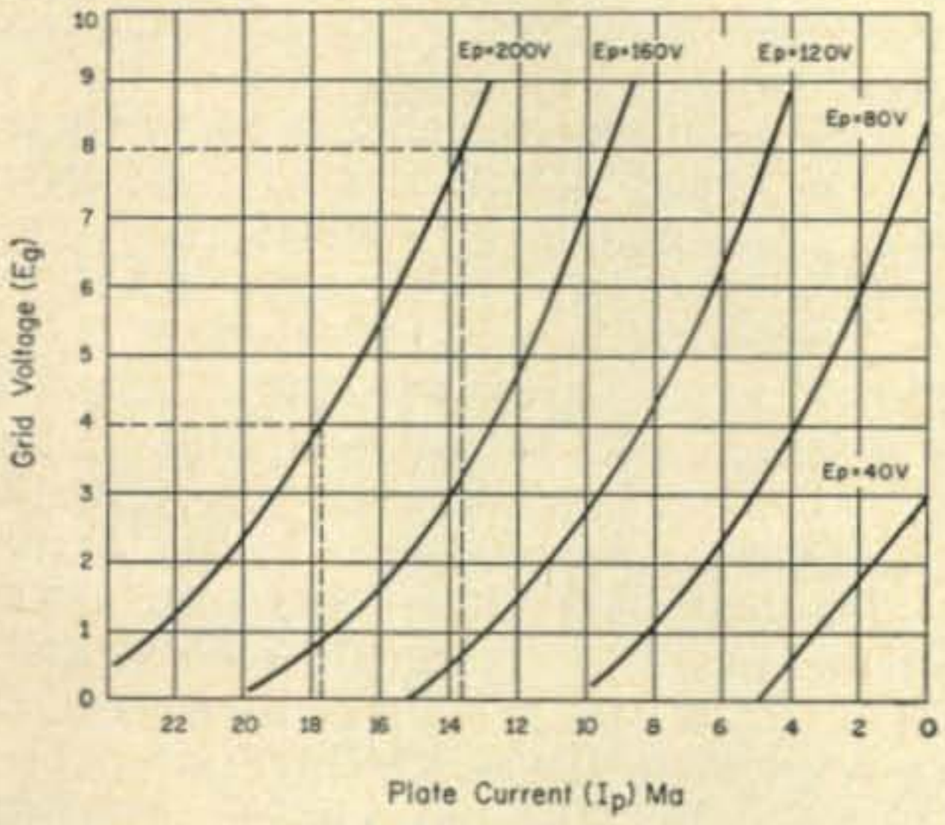


Fig. 1—The E_g versus I_p curve for a typical triode.

current) curves with the plate voltage held constant at various points. Since any of the three quantities may be kept constant, there are altogether three families of curves.

The three families are shown in fig. 1, fig. 2 and fig. 3. The E_p-I_p curves are obtained by holding the grid voltage (E_g) constant and plotting the plate voltage (E_p) against the plate current (I_p). The third family, fig. 3, the E_p-E_g curves, result from keeping the plate current

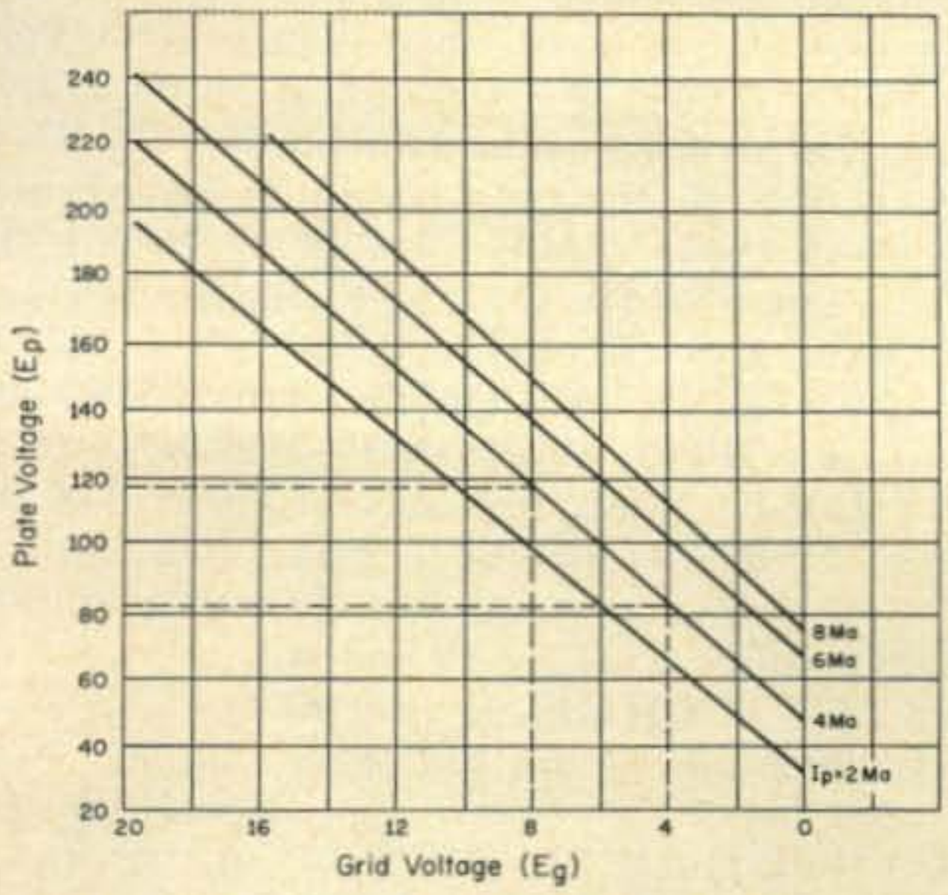


Fig. 2—The E_p versus E_g characteristics of a typical triode.

constant and plotting the grid voltage (E_g) against the plate voltage. The most commonly used curves are the E_p-I_p family. You can find these curves in almost any tube manual.

Curves of the type shown are called *static curves,* since they are obtained by using d.c. voltages under nonoperating conditions. Characteristic curves obtained under operating conditions are called *dynamic curves.* Dynamic curves are useful only when circuit elements are operated under the same conditions that the curves were obtained. Static curves, although obtained under nonoperating conditions, will give you considerable information relative to the tube when operated under dynamic conditions.

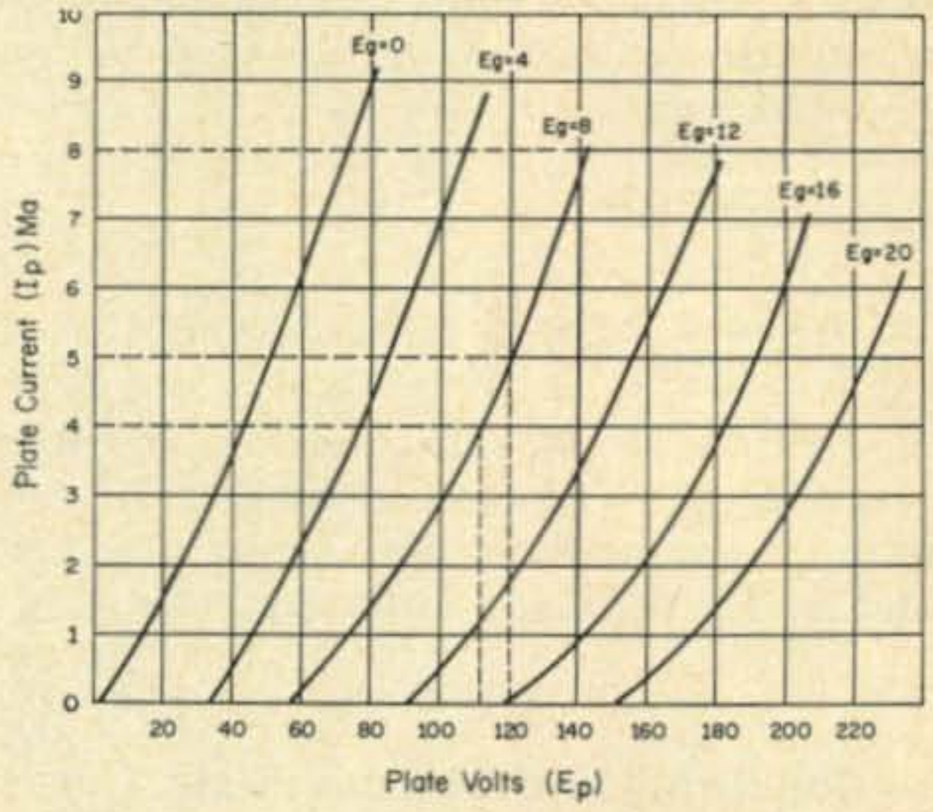


Fig. 3—The E_p-I_p curves for a triode provides much information about the operation of the tube, as explained in the text.

Amplification Factor

Here's a term you have probably all heard. We know a tube amplifies, but how much? Earlier I told you that a small change in grid voltage would cause a large change in plate current. Further, I said that it would take a much larger change in plate voltage to effect the same change in plate current. The ratio of the plate voltage change required for a given change in plate current compared to the change in grid voltage which will produce the same change in plate current is called the *amplification factor.* It is commonly expressed by the Greek letter μ (mu) and expressed mathematically is:

$$\mu = \frac{\Delta E_p}{\Delta E_g} \text{ (when } I_p \text{ is constant)}$$

(Δ means a change in)

In triodes, the amplification factor varies from 3 to about 100.

Plate Resistance

The ratio of a small change in plate voltage to the change in plate current it produces when the grid voltage is constant is called the dynamic or a.c. plate resistance of a tube and is represented by R_p. The formula for plate resistance is:

$$R_p = \frac{\Delta E_p}{\Delta I_p} \text{ (when } E_g \text{ is constant)}$$

Plate resistance is important in determining the performance of a tube in a given circuit since it forms a voltage divider with the load resistance. This divides the voltage across the tube in a ratio depending on the value of the plate and load resistance. The larger the load

resistance with respect to the plate resistance, the smaller the ratio and the greater the amplification of the circuit. Any decrease in this ratio results in an increase in amplification; any increase results in a decrease in the amplification.

Transconductance

Another important tube constant is called transconductance and is represented by *gm*. Transconductance tells how much plate current change is caused by a small change in grid voltage. The formula for this constant is:

$$gm = \frac{\Delta I_p}{\Delta E_g} \text{ (when } E_p \text{ is constant)}$$

The unit of transconductance is the *mho*. Transconductance bears a mathematical relationship to the amplification factor and plate resistance. Thus it can also be expressed as:

$$\mu = gm\, R_p$$

Tube Constants and Characteristic Curves

The characteristic curves can be mighty useful tools when you know how to use them. The tube constants μ, R_p and gm may be determined with reasonable accuracy from E_p-I_p curves. To understand how they can be used in this manner, refer to fig. 1, fig. 2 and fig. 3. On these curves, note that when E_g changes from —4 to —8 volts (with I_p remaining at 4 ma) E_p changes from 82 to 119 volts. Thus:

$$\mu = \frac{119 - 82}{8 - 4} = \frac{37}{4} = 9\tfrac{1}{4}$$

According to the tube manual, the amplification factor for the tube for which the curves were drawn is 9. Thus, for practical purposes, the curves provide values which give reasonably correct results. In general the answer you obtain will vary somewhat, depending upon the value of E_g and I_p, and how closely you interpret the intersects.

By assuming a value for E_g and then comparing the change in E_p with the change in I_p you can approximate R_p. For example, assume E_g is equal to —8 volts. When I_p changes from 4 ma to 5 ma, E_p changes from 116 to 121 volts. Therefore:

$$R_p = \frac{121 - 116}{.005 - .004} = \frac{5}{.001} = 5000 \text{ ohms}$$

Mathematically, the ratio expressed by the plate resistance is the slope of the curve at a particular point. On the same curve or on different curves, it has different values at different points. In other words, plate resistance depends, to some extent, on the conditions under which the curcuit is operating.

When finding the *gm* using the same E_p-I_p curves illustrated previously, assume that E_p is equal to some typical value, say 200 volts. Thus you can find that when E_g changes from —4 to —8 volts, I_p changes from 13.6 to 17.6 ma according to fig. 1. Therefore, by substituting in the equation for transconductance:

$$gm = \frac{.0176 - .0136}{8 - 4} = \frac{.004}{4} = .001 \text{ mhos or } 1000 \text{ micromhos}$$

Who's DX?

Bill Zaehring, W4TEW, Lot 5A, Brown's Trailer Park, Sumter, South Carolina, recently returned from a short trip to Kingston, Jamaica. On Feb. 21, 1961 he managed to copy the following stations on 80 c.w. through heavy QRM: WV2PYO (589), KN4BIY (589), KN4NJO (589), KN4NMM (599), KN4NUG (599), KN4NZG (599), KN4ZUY (579), KN5FQN (579), KN5GYI (569), KN8WDD (589), KN9BDF (559), KN9YFI (589), KNØZFY (579). Many thanks for the report, Bill.

Keith Lamonica, WA6CYT/G reports receiving the following Novices on 15 meters: March 26, 1700-1900 GMT: KN1ONZ, ORB, QXK, WV2JBK, LIS, NPF, NXS, PHY, PXN, KN3, AXH, LOZ, MHH, MTC, MWA, KN4ACW, NUJ, WVX, WV6NDJ/4, KN7LOY, KN8AUH, URR, KN9YTX, ZFK. March 30, 1730-1930 GMT: KN1ONZ, PXB, QGC, QLE, RHS, WV2LOW, NLY, QMC, KN3MWG, KN4CHH, NXV, WN4AGX, AJY, KN5FSM, HWL, WV6KVO, NQF, NTP, NYZ, OPM, OYT, PSY, QHU, KN8UDM, WLX, KN9ZWR (?), KNØFQY, GHF.

We haven't heard from Sven Elfving, Solgardsgatan 15, Orhskoldsvik, Sweden, who is SWL SM3-3104. Sven says: "I recently logged on 3.7 mc, March 4th, WV2MTW-0415Z, 569, KN1NYY, 57/89 often peaking 589! I have heard him 4-5 times on 80 c.w. with v.f.b. signals. KN1ONB also logged and KN1QYZ, KN1OPX both 579 on peaks at 04-05 GMT. Many 559 signals also heard from WV2's, KN1, KN4's. On 40 meters I recently logged also KN4NKJ, 0825 GMT, 7160, 559, WV6LVP, 0850, 7184, 339! His QTH? ? Really a nice catch for me. Also KN3NGZ, 579, 0914 GMT, KN3MOD, 1016 GMT, 569, KN1PRS, 559 1021 GMT, KN1PPQ, 1022 GMT, 339, KN8VUT, 1131 GMT. Note the unusual times for 40 meters." Sven would like to make skeds especially for Novice contacts and their club station SL3ZO will be working 80 and 40 c.w.

Mike, K8OOK/DL, in Furth, Germany, reports reception of the following stations: Feb. 25, WV2MJF-569, March 5, KN1OBQ-579, QKQ-589, QLE-579, WV2JLI-579, KN4NIJ-569, KN8TAL-569, KN9DKU-579, WYV/4-578. These stations were logged on 15 meters. By now Mike should have his DL4 license and be active on all c.w. bands with a 75 watt home brew rig and NC-122 receiver. He will be on the lookout for Novices—"I remember how it was when I was a Novice," says Mike.

Dan Dolan, K5SDY/G, 48th TRANSRON, Box 1989, APO 179, N. Y., N. Y. winds the DX news up this month. Dan received the following

Rick Hunt, KN5FWQ, sports a pretty big hat. He's probably thinking of that beautiful quad and tower in the back yard.

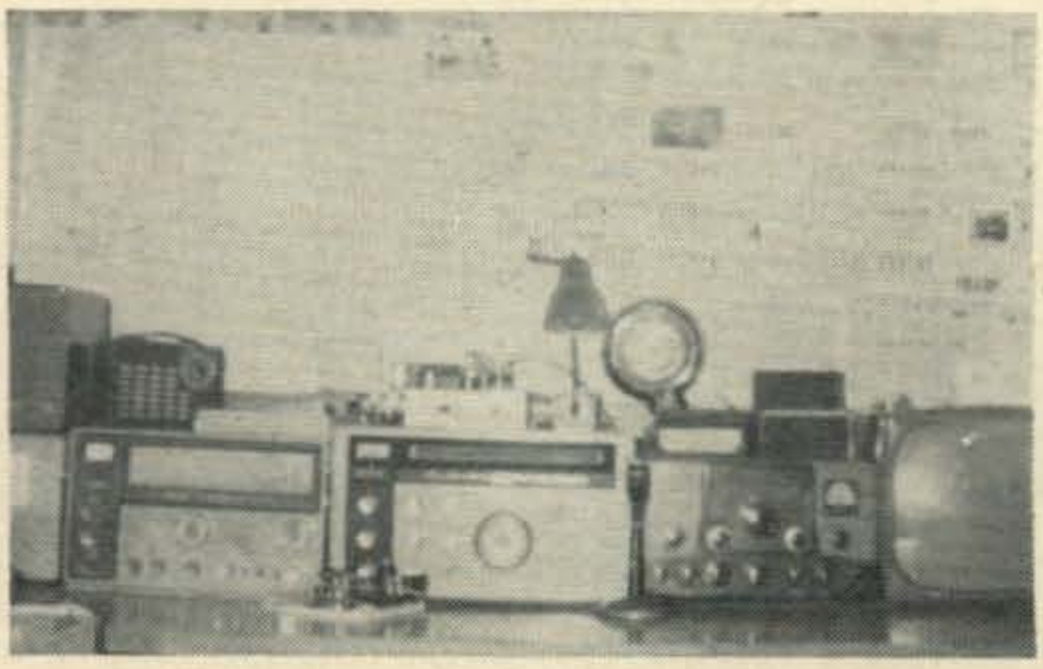
stations on 15 and will confirm reception to those interested. He would appreciate stamps or IRC's, however. Dec. 29, 1960, KN1NZF, OXG, WV2DHG, KN3MTC, KN4YRD, FST, Dec. 31, 1960, WV2OCX, KN4SZM, Feb. 28, KN1-PHQ, QFC, March 2, KN3NYI, March 12, KN-4VAY, KNØFOJ, March 19, KN1PSK, March 23, KN1OJQ, QBX, WV2OCW, QMC, KN3-MKZ, OKA, KN4NNM, NQM, NSY, YPV, WN4AIF, KN5BYS, FOF, FZA, March 24, KN1OGA, PCY, RCA, WV2LYQ, PHY, PMK, PPD, PXN, KN3MWA, NLC, OKO, KN4-NNP, NSL, NXV, WA4ADV, WV6NLT, PSY, KN8TRF, KN9CDM, DKU, ZAW, ZFK, March 26, WV2LJY, MJA, NYX, OBF, PXN, QVH, RDJ, KN3MNP, KN4AEW, NEE, KN-5BCJ, KN8ZDP, KN9ZAM, KNØFWO, March 28, KN4ZVI, KN5HWL.

Help Wanted

Rod Ayotte, 1065 Pine Road, Alpena, Mich., writes to inform us of a new radio club starting in that city which will be giving code and theory classes. Rod would also like to hear from others regarding how they can best serve the newcomer.

The following fellows would appreciate assistance in earning their Novice license:
W4—John S. Garst, Rt. 1, Box 110, Marks, Miss.
W5—Earl N. Oster, Jr., 3465 Cecil Dr., Beaumont, Texas; George C. Line, P. O. Box 1057, Gage, New Mexico

Ron Conley, KN7LTV, likes to work the locals on 40 and stay up late at night to ragchew on 40.



W7—Bruce G. Thompson, 226 East 11th, Port Angeles, Wash. GE 7-6134.

Letters

Bradley Norman, 4640 Portland Ave., So., Minneapolis 7, Minn., is an almost Novice and kicks things off this month. Brad is set up with a DX-40 transmitter and National HRO 60 receiver and hopes to add a Gonset G-63 and Hornet triband beam, plus an all band vertical, by the time you read this. He goes on to say that he became interested in ham radio after picking up a copy of *CQ* and reading the NOVICE column.

Peter Joseph, WV2OMR, 261 Prince Ave., Freeport, L. I., N. Y., enjoys reading the NOVICE column, but asks "when's my call gonna be in Who's DX?" Pete goes after them with an Eico 720 and an S-85 puller inner. WAS stands at 43/41 and DX includes DJ3, G3, VE2, 3, WL7 and WP4 with a 15 meter dipole. Pete will sked anyone needing New York and would like skeds with Nev., Wyo., Ariz., Hawaii, Ver., N. Mexico, Maine and Kentucky.

Larry Stark, P. O. Box 162, Winfield, Illinois, is KN9ARZ now, but hope to shed the "N" by

Meet J. Hawley Landry, KN5DYD, who operates 40 and 15 and has some mighty impressive wallpaper to show for his efforts.

the time you read this. Larry is trying for a WAS on 80 c.w. only but it is currently slowed down to a 13/11 because of only one xtal, 3713 kc.

Ron Conley, KN7LTV, 811 Palmer, Miles City, Montana, should also be going "General" about now. He is 14 and has a rather elaborate antenna farm consisting of an 80 meter dipole, two 40 meter dipoles, a 20 meter longwire, a 15 meter dipole and a 15 meter home brew beam. An impressive WAS stands at 49/48 with only New Mexico needed to fill in for a full house. Needless to say he would like to make a sked with someone! Ron's impressive shack is also shown for your edification.

Rick Hunt, KN5FWQ, Box 122, Pettus, Texas, sends a big howdy-do to readers of the NOVICE column. Rick is 16, a member of the Beeville ARC and a sophomore in high school. So far Rick can brag about a WAS of 35/30 and DX including VK3, VE3, KZ5 and KH6. Take a gander at Rick's Stetson in the snapshot.

J. Hawley Landry, KN5DYD, P. O. Box 164, Plaquemine, La., has an impressive collection of wallpaper, attesting to many contacts. A 40

[*Continued on page 117*]

by DONALD L. STONER, W6TNS
P.O. Box 137, Ontario, Calif.

semiconductors

Most amateurs regretted the loss of the 11 meter band. However, as a result of this action, we are reaping rewards of a rather unexpected nature. Considerable equipment has become available for the Citizens Radio Service, most of which is suitable for conversion to other amateur frequencies.

Of particular interest is the so-called "second-generation" equipment which uses transistors exclusively in the transmitting section. Transistorized receivers have been around for some time, and of course, present no particular design problems. High power transistor transmitters are quite another matter, however.

Demands from Citizens Band equipment manufacturers have brought about rapid advancements in r.f. power amplifier device technology. Although suitable devices have been available for some time, it is only large demands, and therefore mass production, which brings about substantial price reductions. As this is being written a minor revolution is taking place in the semiconductor industry to develop circuits and devices for low-cost CB transmitters.

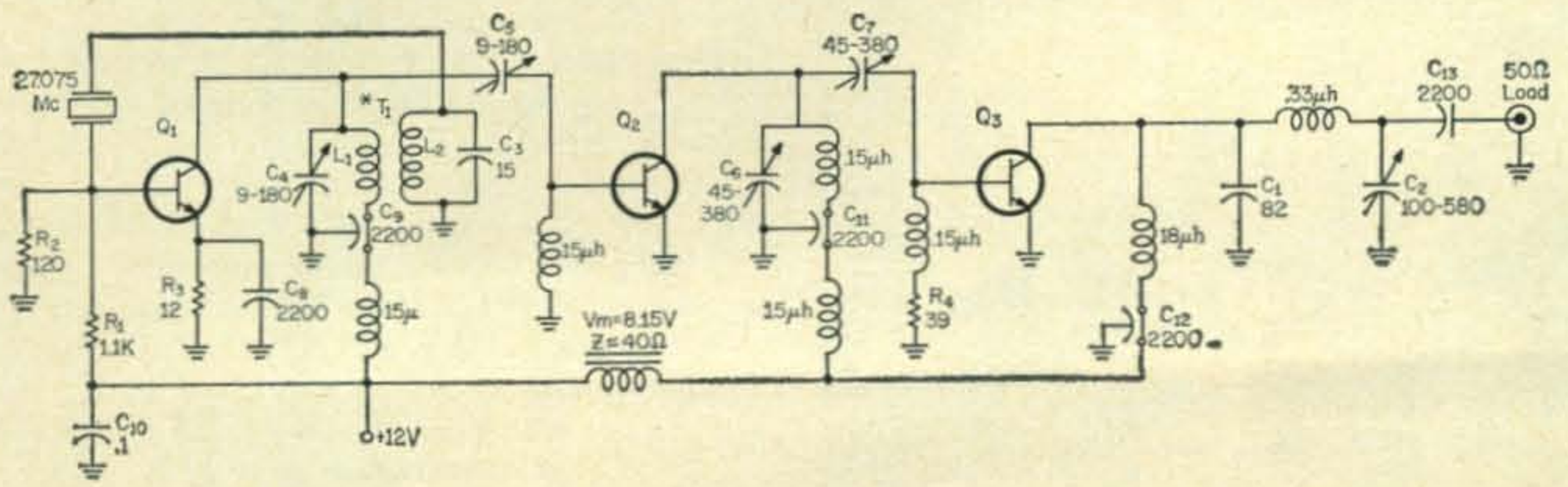
One such circuit has been developed by Don Hall's application group at Texas Instruments, Inc., Dallas, Texas and is shown in fig. 1. This three-stage, 12 volt crystal controlled transmitter is designed to give one-watt or more output at 27 mc. The circuit, with the values given, should work on the 10 meter amateur band with little or no reduction in output. Note that n.p.n. silicon mesa transistors are used throughout. The driver stage is modulated, along with the final to provide upward modulation.

At first glance, the oscillator may seem unconventional. If the crystal were connected from collector to base, the output impedance of Q_1 would load the tank coil and prevent the circuit from oscillating due to insufficient feedback. To provide suitable feedback amplitude the TI circuit is designed to develop a voltage and impedance step-up. The close coupling of L_1 and L_2 (they are bifilar wound), and their turns ratio, produces the impedance step-up. This is roughly analogous to tapping the collector down the tank coil and connecting the crystal to the top end. However, the TI system provides correct impedance matching without the necessity of fussing with coil taps. Note that no coil taps are used in either circuit. Resistors R_1 and R_2 provide forward bias for Q_1, while R_3 stabilizes the base-emitter diode. Capacitors C_9 and C_{10}, along with the r.f. choke prevent r.f. from reaching the other stages. R.f. energy is coupled from a low impedance point in the circuit to the driver through capacitor C_5, which serves to match the two stages. Capacitor C_5, in conjunction with the capacity of Q_2's base-emitter diode, forms a voltage and impedance divider. Again, this system is used to avoid coil taps. The operation of a capacitive divider is identical to an inductive divider, which is exactly what a tapped coil is.

Transistor Q_2 is a buffer and driver/amplifier. The choke connected between base and emitter provides a d.c. return path. No stabilization is required since the stage operates between class B and C. Further, the external base-emitter path contains no resistance, which minimizes thermal runaway. The collector of Q_2 is resonated at the signal frequency with the 0.15 μh coil and capacitor C_6.

Capacitor C_7 forms another capacitive divider which matches the collector of Q_2 to the base of Q_3. Like Q_2, stage Q_3 has no forward bias applied and the signal bias is obtained by

Fig. 1—Schematic of a transistorized transmitter designed at Texas Instruments capable of producing one watt output at 28 mc. Transistors are grade-outs and are described in the text.



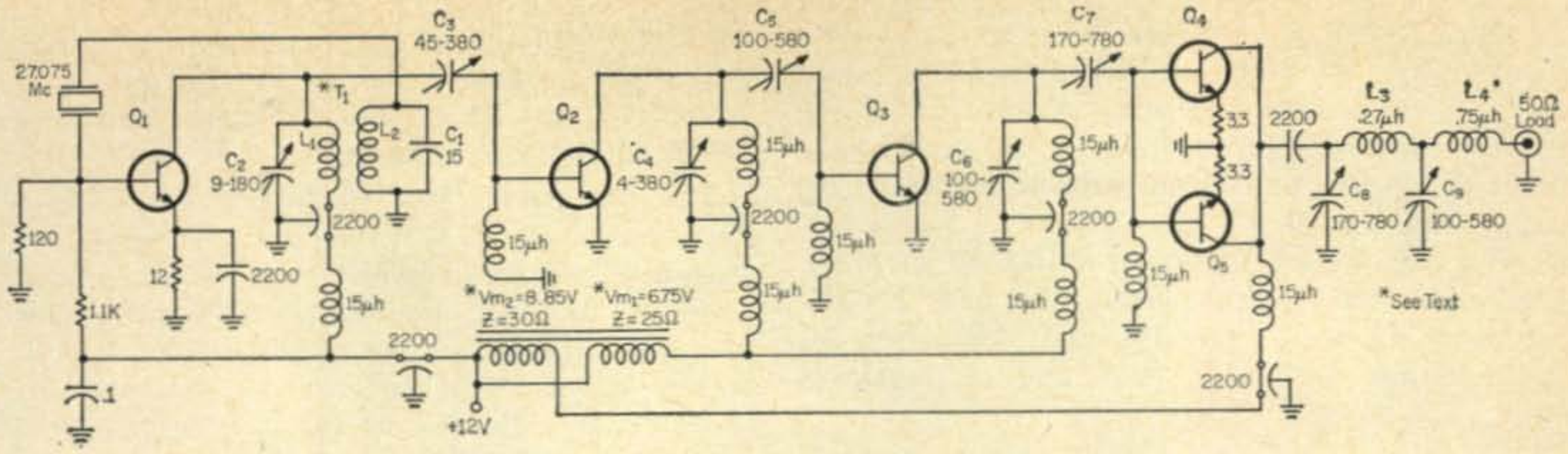


Fig. 2—Diagram of a transmitter similar in circuit to that shown in fig. 1. In this unit, however, an additional power amplifier stage using 2 power transistors in parallel is employed to produce 2 watts output at 10 meters

rectification in the base-emitter junction. Whenever a positive cycle of r.f. appears at the base of Q_3, the base-emitter diode conducts and current flows through R_4. This action creates a negative bias across R_4, which drives the transistor deep into the class C region. The choke in series with R_4 prevents the 39 ohm resistor from appearing as a load to the driving stage. The output of Q_3 is coupled to the antenna through a pi-network consisting of C_1, C_2 and the 0.33 μh inductance.

It is difficult, if not impossible, to modulate a transistor power amplifier stage 100% unless several tricks are resorted to. The saturation resistance and V_{ce} are both factors in this problem. To modulate 100% it is usually necessary to apply a portion of the modulation voltage to the driver and in some extreme cases, even the oscillator. Referring to fig. 1, you will see that 8.15 volts r.m.s., from a 40 ohm source, is applied to both the power amplifier and the driver stage.

The resistors in this transmitter are TI carbon film units. Capacitors C_1 and C_3 are Dur-Mica and the variable capacitors are ARCO type 46 or equivalent. All coils are Delevan type 1537. Transformer T_1 (L_1 and L_2) is closewound on a $\frac{9}{32}$" o.d. form. L_1 is 4¼ turns of #23 wire and L_2 is 7¾ turns of the same wire. L_1 is bifilar wound at the low potential end of L_2.

To tune the transmitter, adjust C_4 and C_5 until the oscillator starts. Alternately adjust C_2, C_4, C_5, C_6 and C_7 for maximum power out. Finally, increase C_2 for one-watt power output.

Fig. 2 is the schematic of a 12 volt, two-watt crystal controlled Citizen's Band transmitter. The final stage, which has been added to fig 1, uses two transistors in parallel, with emitter resistors to balance the power handled by each transistor. The buffer and driver stages are modulated along with the final to produce upward modulation. This circuit differs little from fig. 1, except for the elimination of the pi-network at the output of Q_3. This is replaced by a coil, resonating capacitors C_7 and C_8 and now resembles the network between Q_2 and Q_3. Note that the bogey value for C_7 is much larger than C_5 since it looks into a much lower impedance. The output of the parallel Q_4-Q_5 stage is also quite low. If this low output impedance, plus the antenna impedance, were placed across the pi-network, the operating Q would be much too low for adequate harmonic suppression. In cases such as this, a double pi (or two L-networks) is usually employed. This system steps up the collector impedance to some intermediate value (the junction of L_3, L_4 and C_9) and the second L section steps this impedance back down to that of the transmission line. This technique is quite common and is used extensively in the Collins transmitter line.

This circuit also differs from the preceding one, in that two modulation windings are used to provide different audio levels. A 6.75 volt signal is fed to the drivers from a 25 ohm source. The final stage is modulated by 8.85 volts from a 30 ohm winding.

Coil L_3 is 5¼ turns of Air Dux #508 and L_4 is 7 turns of Air Dux #516.

The transistors used in these two circuits are grade-outs from other types and will probably not be available through regular Texas Instruments distribution channels. Equipment manufacturers and experimenters can obtain valuable assistance, in obtaining these devices by contacting their local TI representative. If you are unable to obtain information on these devices, a note addressed to the writer will find its way to the proper persons.

100 mc Class C Amplifier

Although not particularly applicable to the Citizen's Band and 10 meters, v.h.f. fans will be interested in the new Motorola 2N707 silicon n.p.n. double-diffused epitaxial mesa transistor and its application to high frequency equipment. In the epitaxial growth process, semiconductor material in vaporized form is used to grow a thin epitaxial layer on a polished wafer of the parent material, under controlled conditions of time, temperature and pressure. With the epitaxial film laid down, subsequent production of the mesa is basically the same as with non-epitaxial processes. The complete epitaxial device offers several advantages; higher voltage breakdown, lower collector capacitance, and much lower collector saturation resistance, making the epitaxial mesa an outstanding v.h.f. device.

The 2N707 is rated as follows; V_{cb}- +56 volts, V_{eb}- +4 volts, I_j- +175°C, P_a- 1 watt, I_{cbo}- 0.005 μamps. and C_{ob}- 4 mmf. The device is capable of producing a typical power output of 300 mw at 100 mc with an efficiency of approximately 38%.

Fig. 3 is the schematic for a 100 mc, class C, common-base amplifier using the new 2N707 epitaxial transistor. The 180 mmf. capacitor, in conjunction with the base emitter capacity

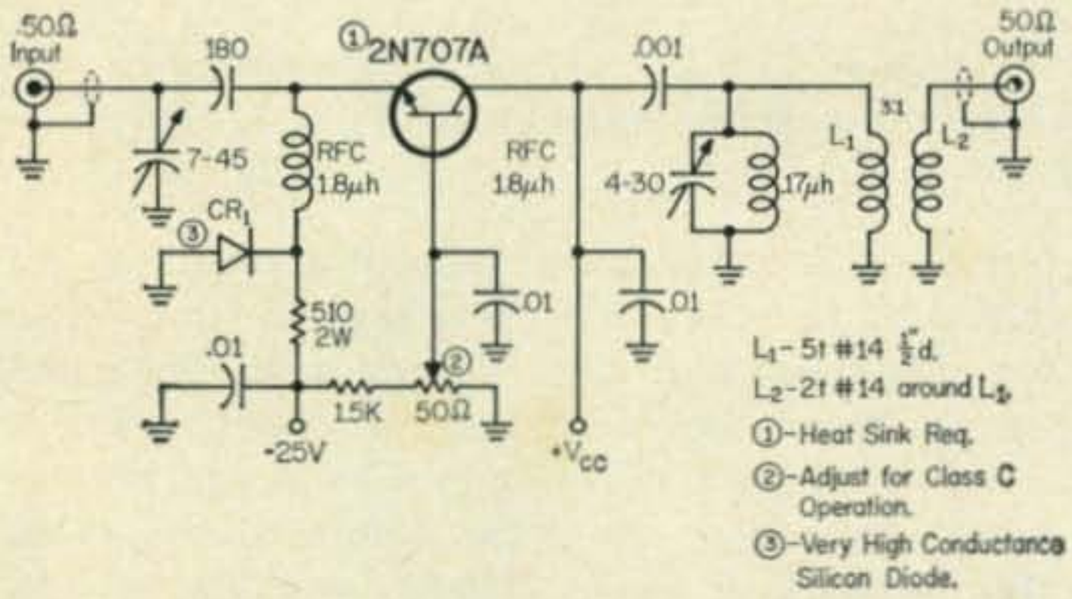


Fig. 3—Schematic diagram of a 100 mc. class C amplifier using the new Motorola 2N707 epitaxial mesa transistor.

forms a voltage divider to match the very low emitter impedance to the 50 ohm source. An ingenious stabilization circuit is used to insure a fixed operating point. Note that the supply passes through the 510 ohm resistor and the high conductance silicon diode. The forward voltage drop across the depletion region provides a stabilized potential of approximately 0.6 volts. The base potentiometer can then be set for class C operation. A large portion of the negative half cycle will have to appear at the emitter before the stage conducts. The output circuit is quite conventional. The 4-30 mmf capacitor resonates the collector inductances at the signal frequency and the r.f. energy is link coupled to the load.

Semiconductor News

General Electric Co. has made available a brochure on potted rectifier assemblies. Information on these devices (publication ECG 487), and the items to follow, may be obtained by writing GE, Rectifier Components Department, Auburn, N. Y. GE recently announced that they are making controlled rectifiers for the inertial guidance system of the Air Force Minuteman missile. News from the transistor section includes a group of eight silicon mesa transistor designed for medium power and r.f. applications. Types 2N497 through 2N498 and 2N657 are described in bulletins ECG 528 and 538 which may be obtained from GE, Kelley Bldg., Liverpool, N. Y. Of interest to v.h.f. fans is a group of new germanium tunnel diodes which operate up to 4600 mc in strip-line circuits. The devices are priced between $20 and $30 to OEM's.

If you are interested in the production techniques of making semiconductors, the latest issue of Hoffman's *SPAN* has a very interesting article on producing mesa's by the photolithography system. Also included in the issue is a progress report on Solar Power.

The Feb./Mar. issue of *International Rectifier News* contains a valuable engineering discussion of voltage drop and power loss in silicon rectifiers. International has announced a new line of gridded silicon solar cells with 13% conversion efficiencies. The gridding technique affords better collection of the current from the active cell area. Just announced is a new series of 250 mw zener diodes available from 3.3 to 30 volts, which are described in bulletin XSR-261. For more information, write International Rectifier, El Segundo, California.

Looking for tiny air-variable capacitors for use on printed circuit boards? The E. F. Johnson Co. is marketing their "U" and "UB" series of single section and butterfly capacitors which measure $\frac{7}{16}$" × $\frac{29}{64}$". For further information, drop a line to E. F. Johnson Co., Waseca, Minnesota.

Philco Corporation, Lansdale, Penna., showed many new and interesting devices at the IRE show. They included a microelectronic transistor diode logic circuit packaged in a TO-5 can, the new 2N779A MADT which has a V_{sat} of 0.085 and can switch in 52 nsec at 10 ma, a 100 mc counter using the 2N769 MADT and many types of fail-safe transistor test equipment. Amateurs and experimenters will be interested in *"Transistor Guide for Communications Circuit Designers"* which is a capsule course on the design of transistorized equipment. You can obtain a copy by writing Lansdale (see above) and requesting a copy of Application Lab Report #701.

Sylvania Electric has announced the world's fastest switching transistor, an epitaxial type number 2N783 and 2N784. The device has a maximum turn-on time of 16 nsec and turn-off of 30 nsec for a total switching time of only 46 nsec. The devices are priced at $22.50 in single quantities. Also included in the expanding epitaxial line are the 2N1958 and 2N1959, two watt units which can handle 500 ma and switch in 105 nsec. These devices, which are also useful in class C applications, are priced at $19.50 and $21.00 respectively. Of interest to high frequency bugs, are the new 10 kmc Sylvania tunnel diodes, which have about three-times the frequency range of previously announced TD units.

Texas Instruments, Dallas, Texas, is marketing an interesting line of high frequency germanium power transistors. The 2N1907 series has an h_{fe} of 50 at 5 amperes, a power dissipation of 150 watts and are guaranteed to 10 mc. These devices were used in the marine transmitter featured in the April column. By the way, in that article, the original TI formula for load resistance was in error. It should have been "P_o= the power required from both transistors." Thus P_o= 3.5 ohms. 73, de Don, W6TNS

Space Communications

GEORGE JACOBS, W3ASK
11307 CLARA STREET
SILVER SPRING, MARYLAND

Orbital Scatter Communications

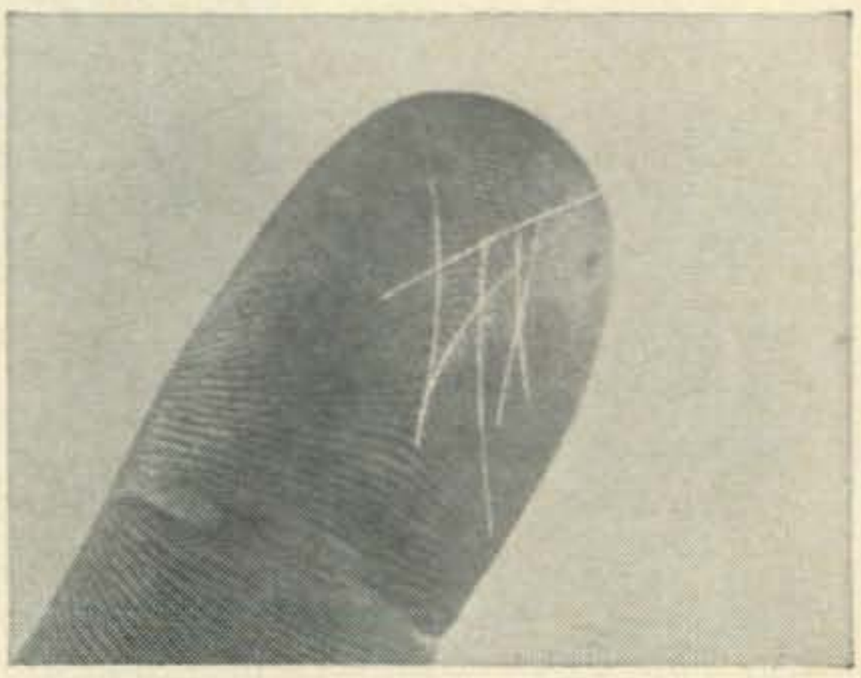
A new and unique concept for global space communications, which if successful could make possible world-wide DX on the v.h.f. and u.h.f. amateur bands, was announced recently by the Massachusetts Institute of Technology.

Given the name *orbital scatter* by MIT scientists, the new technique would utilize the reflective properties of a belt comprised of millions of metallic fibers, or dipoles, placed in orbit several thousand miles above the earth. Each dipole element would be about ½ inch long and one-third the diameter of the human hair.

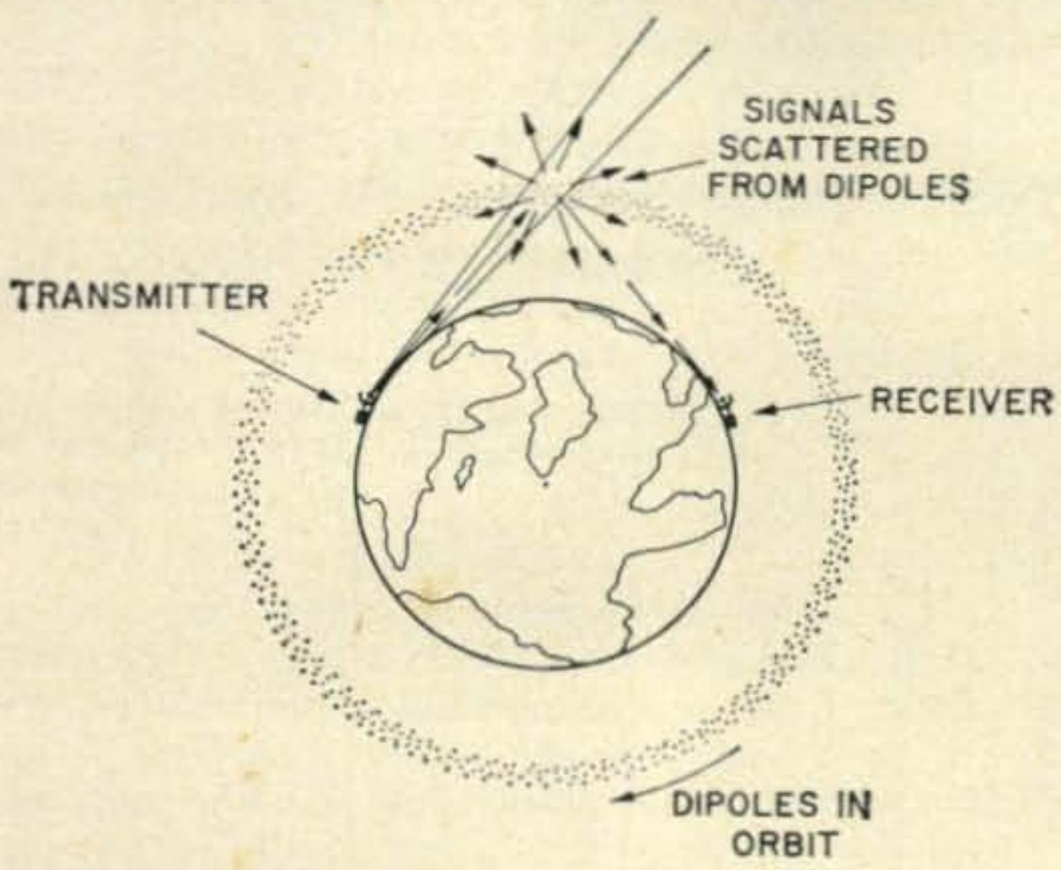
Radio waves transmitted to the belt would be scattered back to earth in much the same manner as h.f. radio waves are presently reflected by the ionosphere. MIT scientists believe that the reflecting surface presented by the metallic dipoles would be considerably more reliable than the ionosphere which undergoes daily, seasonal and solar cycle changes and is subject to blackouts.

Although the orbital scatter concept is still in the theoretical stage, plans are being made to test the theory in the near future. According to MIT, a cylindrical container into which the small dipoles have been packaged will be rocketed into space. When the proper orbit has been attained, the container will be ejected from the carrier rocket. A dispensing mechanism will then release the fibers gradually from the container, over a period of a day.

If the present theory is correct, it is estimated that within one to two months after being placed into orbit the dipoles will spread to form a continuous belt around the earth. In a completed belt each dipole would be separated on the average by about 1000 feet, according to MIT calculations. With two such belts, one east-west over the equator and one north-south over the poles, communications should be possible between practically any two points on earth.



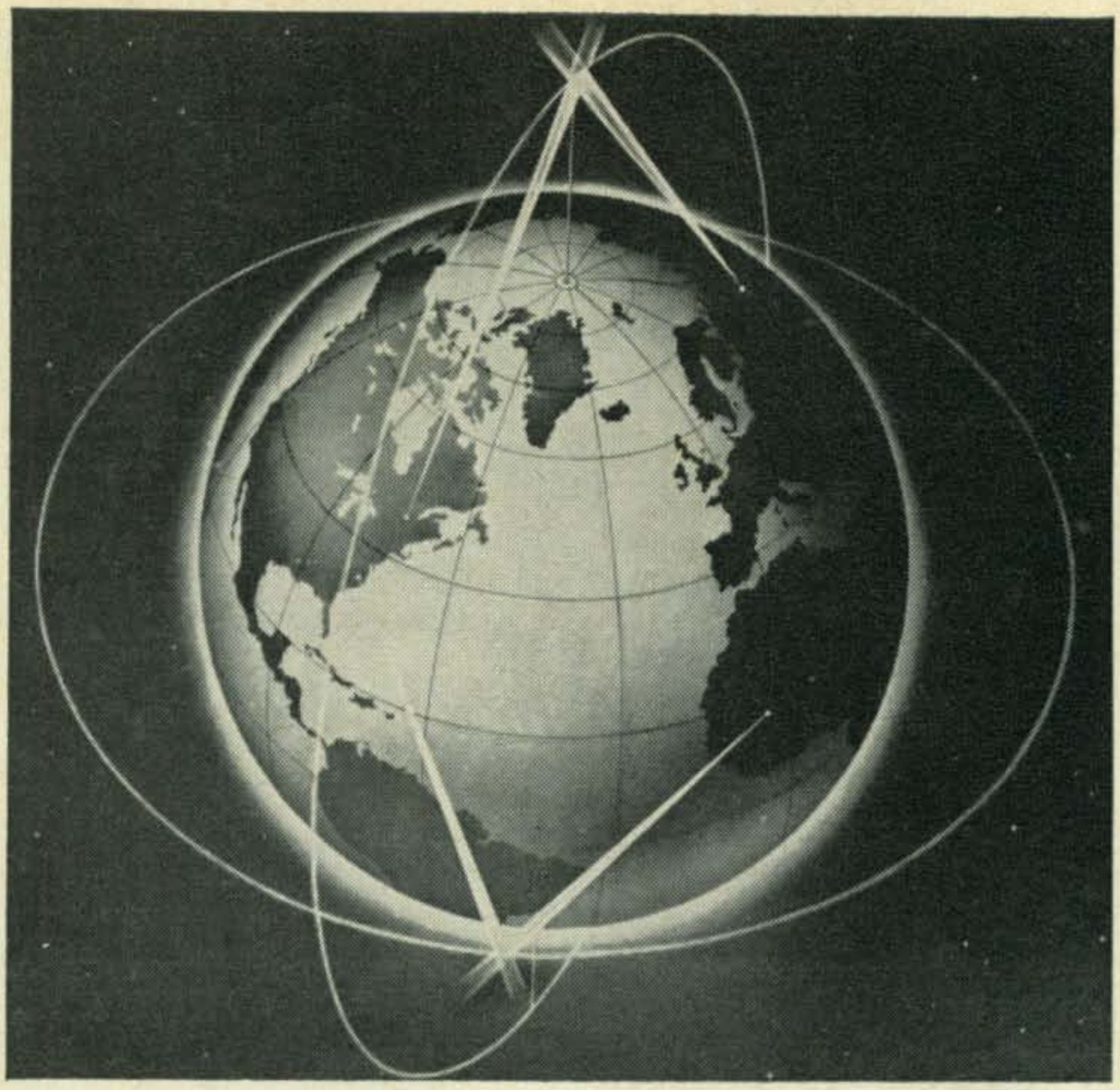
Tiny metallic "dipole" fibers will be placed in orbit to relay radio messages over very long distances, in "orbital scatter" communication system being developed by the M.I.T. Lincoln Laboratory. In orbital belts, individual fibers will be hundreds of feet apart.



Tuned dipoles in orbit would be used for v.h.f. and u.h.f. world-wide communications in much the same manner that the ionosphere reflects h.f. radio waves. The dipoles would be widely dispersed along an orbit some 40,000 miles in circumference.

The lifetime of the belt will vary from a matter of months to years, depending on the altitude and inclination of the orbit together with the dipole design. As the belt nears the end of its useful life, the dipoles will be dissipated harmlessly in the atmosphere. MIT plans to use dipoles with a relatively short lifetime during the initial experiments.

Some concern has been expressed in other areas of the scientific community that ringing the earth with belts of metallic material might block the passage of signals employed in other important space projects, or prevent certain telescopic and radar observations from being made of the sun, other planets and the universe in general. MIT scientists are convinced by theoretical considerations, however, that the dipoles in orbit will have negligible adverse effects on other space communication systems, and on the various types of astronomical observations; optical, radio or radar.



Two "orbital scatter" belts (one east-west over the equator and one north-south over the poles) could make it possible to relay radio messages between practically any two points on earth. According to M.I.T. scientists this would open the v.h.f. and u.h.f part of the spectrum for more reliable long-distance radio communication than is now possible with h.f. systems.

Advantages of Orbital Scatter

Orbital scatter appears to offer a number of advantages in long-distance radio communications. Only two rockets would be required to provide world-wide coverage with two reflecting belts. Since the dipole belt will be relatively stationary in space, communication between any points on earth becomes a relatively straightforward problem in geometry. Transmitting and receiving antennas on the ground can be aimed at the point of reflection with far greater accuracy than is possible when depending on the ionosphere for reflection. This also eliminates the need for costly, complex high-speed tracking equipment that is required for communication by either moonbounce or satellite reflection.

The electronic and physical characteristics of the dipole belt are such that a very wide range of frequencies extending from the upper v.h.f. part of the spectrum to beyond u.h.f. can be reflected with a relatively high degree of efficiency. This is many times the frequency reflecting capacity of the ionosphere.

Considerably less power would be required for orbital scatter communications than is required for moonbounce or satellite reflection. Rough calculations indicate that communications over a distance of several thousand miles might be possible on the 1296 mc amateur band using transmitters, receivers and antennas available to many amateurs today.

If MIT's theory about orbital scatter proves to be correct, much of the DX now taking place on the h.f. bands may also take place on some of the v.h.f. and u.h.f. bands in the future.

Full scale technical development of the orbital scatter technique is being carried out at the Lincoln Laboratory of MIT under the leadership of W. E. Morrow, Jr. Although no target date has been announced for launching the metallic dipoles, experiments are being prepared at MIT for testing the feasibility of the technique in the near future. As soon as the successful launching is announced, check the v.h.f. and u.h.f. bands for unusual reception; you may be surprised to hear stations rolling in from thousands of miles away!

Office For Satellite Scatter Coordination

Word has also been received from MIT concerning the formation of an *Office for Satellite Scatter Coordination* (OSSC). This office has been formed to coordinate research and other activities among radio amateurs interested in satellite scatter communications.

Created with the help of MIT's Department of Electrical Engineering, the Director of the OSSC is Raphael Soifer, K2QBW. Ray, together with K3JTE, made amateur radio history last year when they completed what is believed to be the first QSO ever to have taken place as a result of radio waves being scattered from an orbiting satellite. In the words of K2QBW, the OSSC hopes to:

> ". . . establish frequency channels for satellite scatter research; provide a means for disseminating findings among fellow experimenters; act as an information bureau through which any news which might develop out of radio amateur satellite scatter research can reach the outside world; publish bulletins from time to time with information of interest to these in the satellite scatter field; maintain lists of amateurs involved in satellite scatter research together with some pertinent information as to their equipment, times of operation and other activities; and with the

assistance of MIT's scientific staff, to supply technical information and advice in overcoming technical obstacles that might be encountered, and filling in where knowledge falls short."

The first bulletin received from the OSSC proposes the use of 21.010, 28.010 and 50.010 mc as frequencies to be used for satellite scatter communication experiments, and also contains very useful information about satellite orbit prediction charts as well as a list of radio amateurs who are willing to maintain satellite scatter communication schedules. More information about OSSC can be obtained directly from Raphael Soifer, K2QBW, P.O. Box 308, Cooper Station, New York 3, N.Y. (after September 15, 1961, OSSC correspondence should be addressed to OSSC, Room 10-206, Massachusetts Institute Of Technology, 77 Massachusetts Avenue, Cambridge 39, Mass.).

There is a real need for such an organization as OSSC, and its formation gives radio amateurs interested in the field of satellite scatter communications the opportunity to coordinate their activities through a centralized organization having real know-how in this challenging new field.

Project OSCAR

Slowly, but surely Project OSCAR, amateur radio's hoped-for contribution to space communications, nears reality.

The three pound satellite, containing a 100 milliwatt transmitter operating in the amateur 2 meter band, was test flown in an airplane over the San Francisco Bay area during April. FCC granted special authorization for flight testing the transmitter, and no call sign was necessary.

It is understood that OSCAR's beacon transmitter was received loud and clear over a relatively wide area, and that the transmitter and payload are now both ready for their ultimate destination—an orbit in space several hundred miles above the earth.

How soon the OSCAR satellite will be launched is still uncertain. It is hoped that it will be placed in orbit in the not-too-distant future, piggy-back with one of America's planned satellite programs. Unfortunately, however, nothing definite can be reported at this time, although there are some optimistic signs that the launching date might not be very far off.

Also very encouraging has been the tremendous interest Project OSCAR has stirred in amateur radio, and other scientific circles in the United States, and in many other countries of the world. A very large number of radio amateurs have volunteered their services to the Project OSCAR Association as a result of the articles appearing in this column during December and February. During February, almost the entire weight of America's amateur radio community was thrown behind the project when the American Radio Relay League announced its support of Project OSCAR. Project OSCAR is now truly a space project of, by and for radio amateurs throughout the world.

Since launch circumstances are such that a blast-off date for Project OSCAR might have to be announced with very litte notice, be sure to check W1AW's transmissions for the latest official information concerning the project.

Satellite Voices

A large number of requests have been received during the past few months asking if recordings were available of the various types of transmissions that have been received from the many satellites placed into orbit.

After considerable detective work, a source for such recordings has been found. Elmo Melton, WØAEQ has available a 5 inch, 600 foot reel of 1½ mil tenzar or equivalent magnetic tape containing recordings of more than *fifty* different signals received from *twenty-five* or more earth satellites. The recordings are made at a tape speed of 3¾ inches per second.

The first recording on the tape is a transmission from the first Sputnik launched on October 4, 1957. The tape also contains, in chronological order, samples of signals received from almost all of the satellites launched successfully through December 5, 1960.

Among the more interesting samples are those received from Pioneer V at a distance of more than a million miles in space, telemetry signals from Russia's Lunik just before it landed on the moon, the "last words" of Sputnik III just before its fiery destruction in the dense atmosphere of the earth, President Eisenhower's historic Christmas Message relayed to the world from the Atlas-Score satellite, more recent messages bounced off the Echo balloon satellite, and the odd voice of Vanguard I which can't be hushed, and might continue to transmit for hundreds of years.

The sample recordings are authentic, exactly as received by WØAEQ on his special receiving setup. Copies of the tape are available directly from Elmo at $5.95 each, postpaid. His address is Elmo Melton, 2901 East Meyer Blvd., Kansas City 32, Missouri. Also available is a standard 45 r.p.m. vinylflex record containing 14 samples of transmissions received from most of the satellites launched between 1957 and late 1959. The price of the record is $1.45 each, postpaid.

Moon Map

Thanks to Carl Schultz, WA2IMG, for an excellent map of the moon. Measuring nearly 3 feet by 3 feet, it is one of the most detailed I have ever seen. Clearly identified on the map are over 750 names of mountains, craters, seas, lakes, etc. In addition, the map is carefully indexed, and contains a comprehensive fact sheet giving information about the moon that would be hard to find in a single place elsewhere. Besides being educational, the map makes a wonderful wall decoration for the shack or den.

Copies of the moon map can be obtained directly from Carl at 32 Sky View Drive, Cohoes, N.Y., for a buck each, postpaid.

73, George, W3ASK

YL

BY LOUISA B. SANDO, W5RZJ
4417 ELEVENTH ST. N.W.
ALBUQUERQUE, N. M.

WAC-RTTY

In the last issue we got as far as congratulating Mary Schultz, K6OWQ, for earning the WAC-RTTY award, the first YL to do so; now more details. Because of the scarcity of RTTY stations throughout the world it took four years of constant plugging for Mary to make her contacts with the six continental areas. She submitted these QSLs: ZL1WB, CN8FQ, W9GRW, KA8RA, CE3AGI, G3CQE. She has worked 14 countries on RTTY, such as TG9, KR6, VK, ZK1, OA5, YV5, VO1, and was one of the two stations worked on RTTY by the Socorro Is. DX-pedition, XE4B, in '59.

K6OWQ, Mary Schultz, is the first YL to earn WAC-RTTY. She also holds WAZ and DXCC and many other certificates. Mary's OM is W6CG. Her set-up is an HT32-HT33A; 75A-4 receiver, W3DZZ tri-band beam. For RTTY she uses a Model 19 printer, Model 14 re-perforator, and 14 tape distributor.

According to the RTTY Society of Southern Calif, which issues the award, there are quite a number of YLs active on RTTY, and doing a fine job. They hope more YLs will become interested, especially since most are "at home" at a keyboard and teletype machines can now be obtained from the various RTTY societies around the country for less than $100.

Flying Hams' Club

K6BX is sponsoring the new "Flying Hams' Club" for all Hams who have the hobby of flying. It is open to any person of any country who can produce reasonable proof that he or she has at any time whatever, even though not concurrently, held both an amateur radio license and an aviation pilot's license. Clif would especially like to hear from any YL Hams who fly. FHC has an awards program with achievement certificates available.

K6BX also brings us up to date on these YL CHC'ers: Lucia, CR7LU, was the second YL to earn over 50 achievement awards. Number one was K5BNQ, Doris. KØIKL, Joy, was the first YL to win QCWA's new award. K2UKQ, Kay, who beat out all other DX'ers to win HTH25 number one, also won number one HTH50. K5BGT, Chic (see below), was first YL to win WUN-1 award. Tnx, Clif, and congrats to all these YLs who "stay in the news"!

DX'er

A postscript to the DX section in this column in April *CQ*: In addition to her other many many DX awards, K5BGT, Chic Tilley, has earned DUF-IV (for working all French countries on the six continents). With it Chic received a silver medal with bar bearing her call. Very lovely Chic comments, and she is the only YL in the U.S. to have received it. Her USSR contacts now number over 150 and she has added UD6, UG6, UH8 and JT1 to complete her contacts with all USSR countries. Chic has been "working her way" around the world, attempting to pick up the certificates from each continent that represents having worked that continent, like WAP for Oceania, ADXA for Asia, WAE for Europe, AAA for Africa and WAA for the Americas, etc. Chic has worked them all.

Pictured at the annual dinner of the Washington Chapter of the Quarter-Century Wireless Assn. are members W3AKB, Fran; W3CDQ, Liz, and K4LMB, Ethel. Liz is secretary of the chapter. She recently received a 40-year pin for government service, having worked all 40 years at the National Bureau of Standards. Ethel also is with NBS and Fran is with the Navy's BuShips. *(Photo by W4CVO)*

Members of GABS, YL club at Brownfield, Tex. L. to r., front row: W5EZZ, Alma; Betty Hall; K5BJV Frances. Standing: K5LSO, Irene; Inez Brown; K5-FBM, Viola; K5MBS, Gladys, and Patsy Bourland.

With the Clubs

Our apologies to the YL clubs for being tardy in reporting club news—we just haven't had space.

WRONE officers for the current year: Pres., W1HOY, Helen; V.P., K1ADY, Mary; sec.-treas., W1ZJS, Dee; membership & net chm, K1IJV, Jean; hospitality chm., K1ICW, Mary. Numbering over 130 members in the six N.E. states, WRONE holds informal luncheon meetings the first Sat. of each month at the Abner Wheeler House, Rt. 9, Framingham, Mass. The annual spring luncheon was held this year at the Publick House, Sturbridge, Mass., May 6. High scorers in the WRONE Week contest were K1EAV, Belle; K1EKO, Edie, and W1ZEN, Onie.

Officers of WHOOT for 1961 are: Pres., W5WLO, Grace; V.P., K5PLC, Jean; treas., K5GBX, Bernell; sec., K5MTF, Estelle. Members of WHOOT provided communications for the 6th annual Civitan Women's Open Golf Tournament held in Dallas Apr. 13-16.

Current officers of BAYLARC include Pres., WA6JGR, Eleanore; V.P., W6QYL, Martha; treas., K6CUV, Lee; sec., K6ZCR, Claire. The club has over 60 members. Congrats to member K6ZCR who has made BPL for many months.

WØMRJ, May, sends news of The Missouri Magpies, a YL club organized at St. Louis in Sept. '59. They meet the 2nd Thurs. of the month at members' homes and have been following "*A Course in Radio Fundamentals.*" So far they have built a transformerless power supply and oscillator and also a power supply with transformer. They bought all the parts and are buying their own tools. "You should see us trying to drill holes, strip and solder wire, etc.," adds May, "but we're having a lot of fun." Her OM, WØMCX, stands by to help if they get into difficulties. May is president of the club; KØMAS, Libby, is V.P.; KØOSC, Pauline, sec., and Lora, ex-KNØRSF, is treas. Other members are KNØBJK, Charle, and Mary Speer, ex-Novice. Recently they had discussion and practice to help members get Tech. or General licenses.

The Camelia Capital Chirps installed these officers for '61: Pres., K6ENL, Aleta; V.P., K6DLL, Marsha; sec.-treas., K6HHD, Jan; P/C and editor of newsletter, K6ENK, Wanda.

GABS, which stands for Gals at Brownfield (Texas), became an organized club in May 1960. Current officers are: Pres., K5BJV, Frances; V.P. Inez Brown; sec.-treas., K5LSO, Irene; P/C, Betty Halls. The GABS will be sponsoring the 7th annual get-together of the Texas YL Round-Up Net in Nov. and chairmen for this are K5FBM, Viola, and K5MBS, Gladys, with finances to be handled by W5EZZ, Alma, and Patsy Bourland.

Sixteen members of the Los Angeles YLRC entertained VK1YL, Denise Robertson, at luncheon at the Miramar Hotel in Santa Monica in early March. Denise's OM is VK1ATR, and with their two small sons they had just arrived from Canberra, Australia, en route to Long Island where VK1ATR will be doing research at the Brookhaven National Labs. for about a year. . . . The L.A. YLRC has published a '60-61 Yearbook listing over 80 members and 6 adopted DX YLs.

[*Continued on page 108*]

Of the Los Angeles YLRC's 15 presidents, 11 were present at the club's 9th annual Valentine Day banquet. L. to r., front row, with year elected: W6JZA ('58), K6BUS ('59), W6PJU ('54), W6CBA ('50), W6UHA ('48). Back row: W6QOG ('55), W6DXI ('57), W6CEE ('51), W6QGX ('56), K6ANG ('60), W6WSV ('46).

CQ Reviews:

The Hamboards T-2 Converter

NORMALLY, it's our practice in reviewing a manufacturer's commercial product to bypass superlatives and stick strictly to objective discussion of the unit under consideration, but in the case of this brand new 2 meter converter, we must really do the unit justice and call it top notch.

The T-2 is a completely transistorized affair of modern, compact design employing the Philco series of v.h.f. transistors. The overtone oscillator uses a 2N1744 with another 2N1744 doubling to provide local oscillator injection to the 2N1743 mixer. The r.f. amplifier is a 2N1742 in a standard base driven circuit while the cathode follower i.f. amplifier uses a 2N1726. See fig. 1.

A 5 db noise figure is indicated in the spec' sheets and comparisons with several "low noise" tube type converters indicate that this figure may be conservative.

Several features contribute to making the T-2 almost a custom built job, since the buyer has a choice of several options. Naturally, any i.f. between 1 and 30 mc is available but the unit is available also with a choice of several types of input and output connectors and can be purchased with several variations in cabinets. In a standard cabinet, the T-2 measures only 5½ × 3 × 2⅛. The unit is available in either kit form or fully wired and aligned.

One of the inherent features of the T-2 is extreme stability resulting from the mercury battery power source. A rather unique feature is a 1N48 diode connected in series with the positive leg of the battery cable, protecting the transistors from burnout due to reverse polarity; simple enough, yet a very worthwhile addition.

We honestly believe that this item will find a most enthusiastic reception among v.h.f. enthusiasts in all categories, especially the mobileers. ■

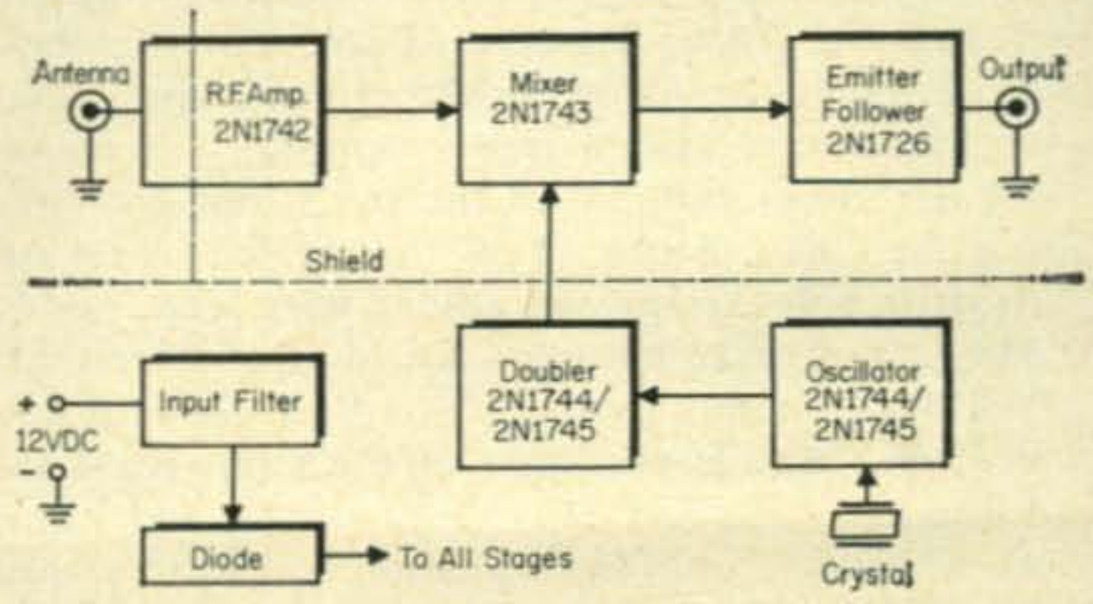
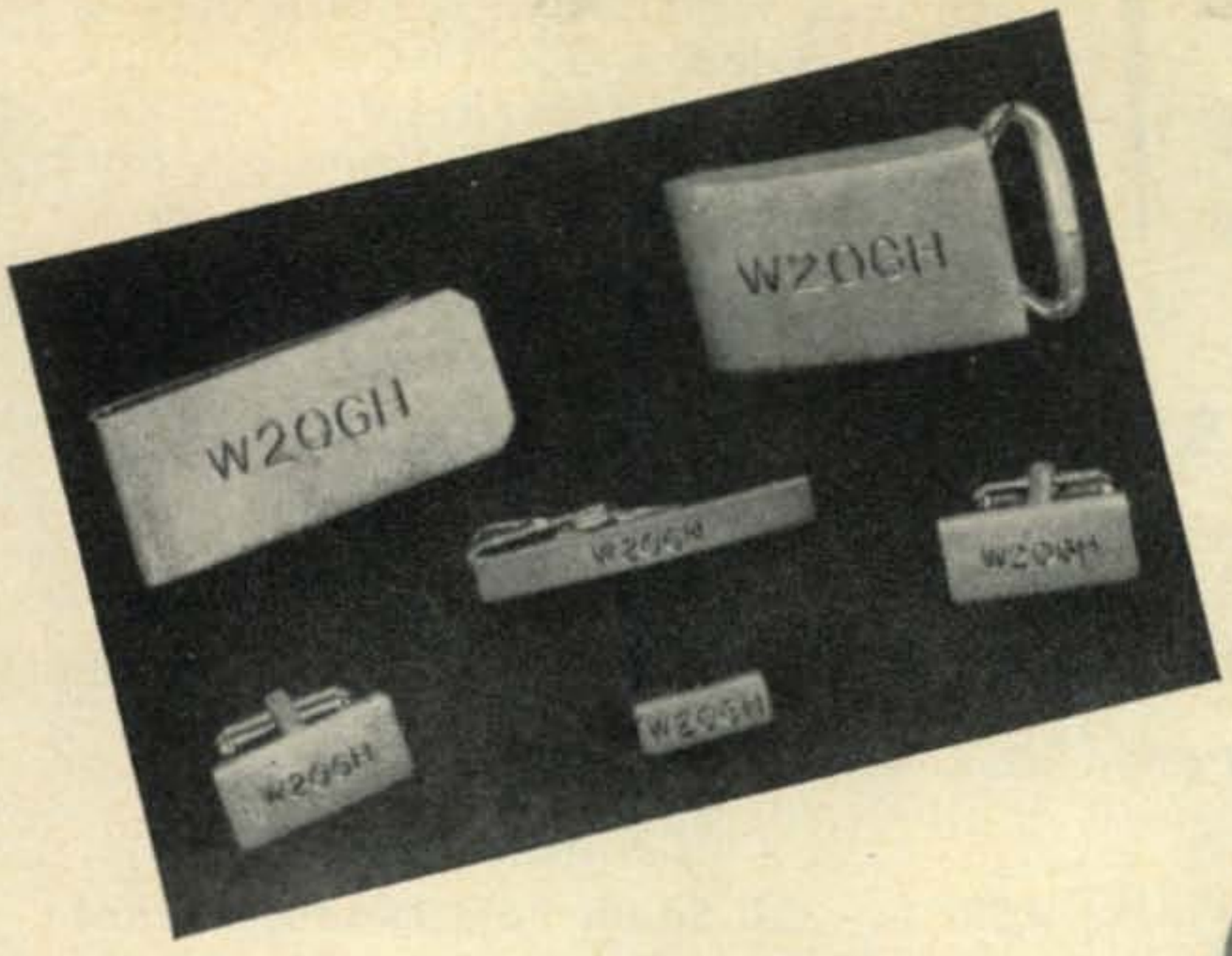


Fig. 1—Block diagram of the T-2 converter.

CUSTOM STYLED GIFTS



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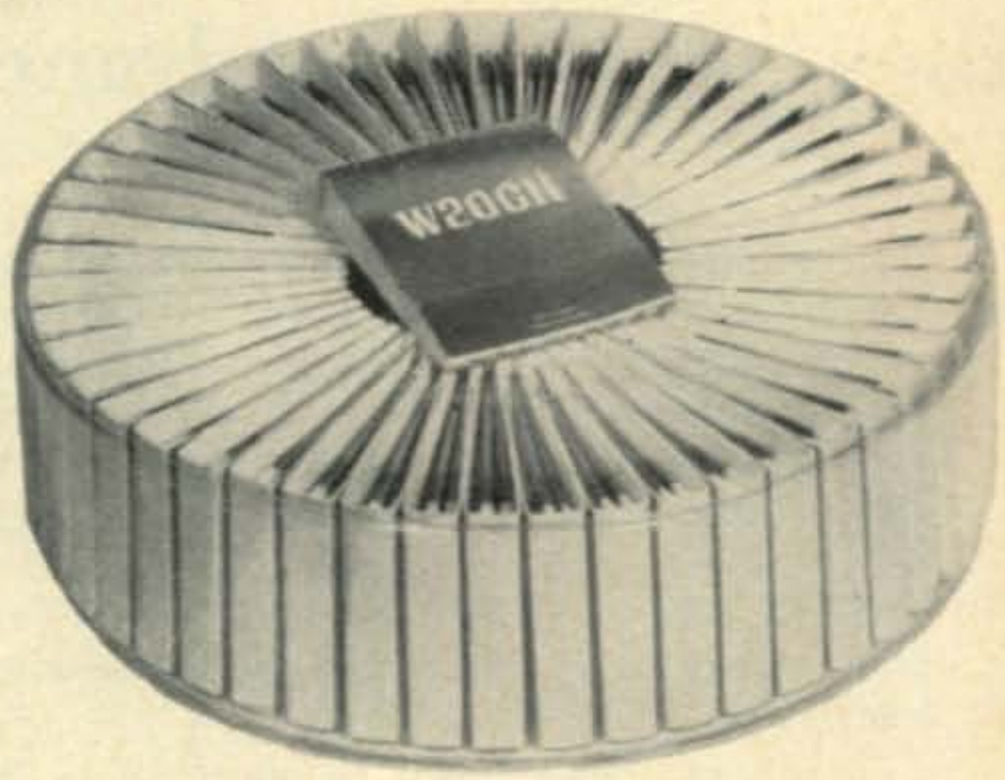
Buckle	3.50*	Lapel Pin	2.50*



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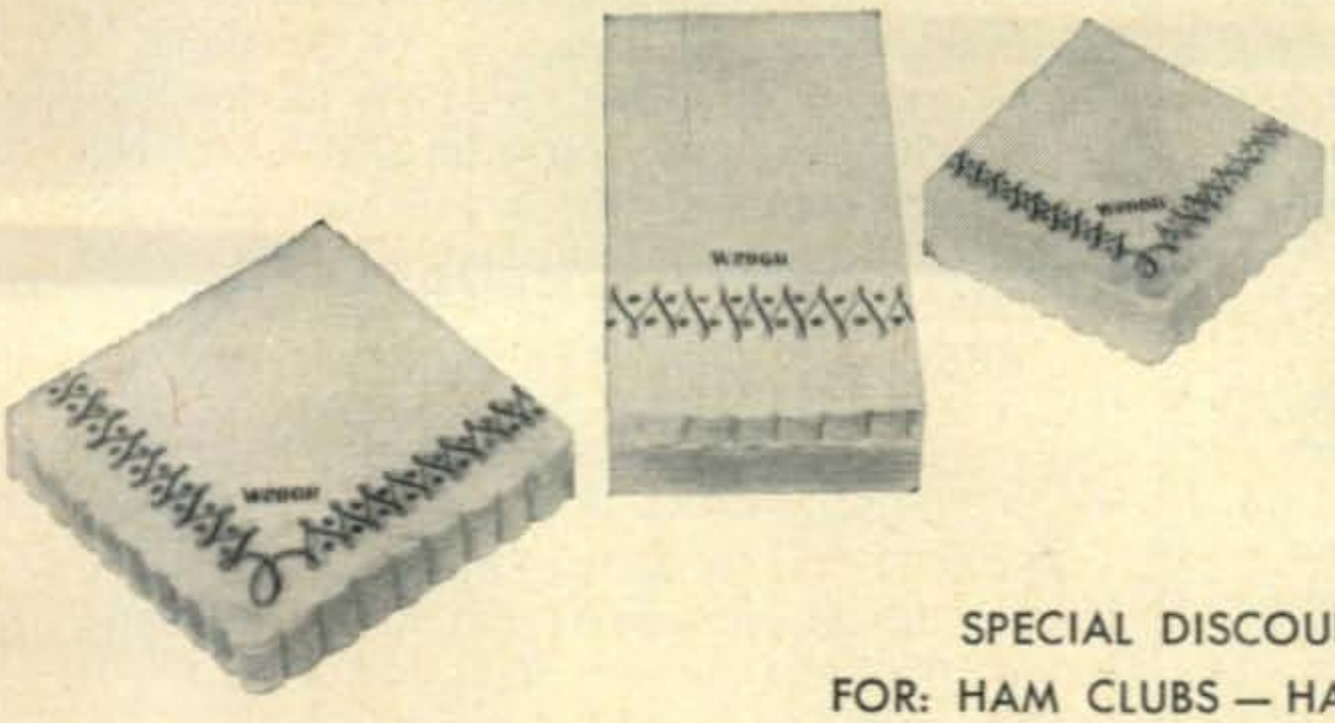

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Add 10% Federal Excise Tax to all jewelry. New York City residents add 3% Sales Tax.

DX [*from page 71*]

of months. This was March 3rd 1961 at 0417 GMT when Willie peaked to 579 in Cyprus, and Steve/ZC4AK says—"Willie was about the best stateside signal I have heard yet—peaking during his CQ at 0413, within 5 minutes of Sunrise time"—Compliments should also go to Steve, ZC4AK who made all this possible—and also Cyprus/Asian QSOs for a number of other W stations this season for his patience, perseverance and skill in working on 160.

This is the second WAC on 160, W1BB making the first in 1953. Other W's working ZC4AK include W1PPN, W1ME, W1BB/1 and W2KQT.

OH hams now have 160 meters with maximum power of 10 watts; they lost 50 kc on 7 mc, however.

Certificates

ASPI . . . All South Pole Islands Award

For working and confirming 20 different South Pole area islands since the year 1945. Must have at least 10 different islands. No more than 5 stations from any one island. 25-50-75-100 stickers available. Also *All-c.w. All-15* stickers. After 1st 20, no limit on amount from any one island.

1. Balleny	6. Heard	11. Orkney
2. Bouvet	7. Kerguelan	12. Peter
3. Crozet	8. Macquarie	13. Sandwich
4. Falkland	9. Marion	14. Shetland
5. Georgia	10. /MM	15. St. Paul

Fee—50¢. Note: If you want QSL's returned by certified mail add 50¢; if you want them returned via Registered, add 50¢. KC4USG good for /MM. Marion is ZS2MI. FB8XX is Kerguelen. FB8ZZ is St. Paul. Apply to: W4ML—Tom Stuart, 212 Jakeman Street, Bayside, Virginia.

LHRC Award

ZS1ACD, the custodian of the Lions Head Radio Club Award reports that many certificates in the initial mailing were damaged in transit. If anyone receiving one of these damaged uertificates will drop a note to Max, he will see to it that a new certificate is sent out at no charge.

QTH Listings

W6BAF is not the QSL manager for 6O2AB but is manager for ZE5JJ, VQ2AB, VS1JV and FB8CJ.

DL5 as well as DL4 calls have been issued ot U. S. personnel in Germany and QSL's may go via their new bureau which is DL4 and DL5 QSL Bureau, c/o DL4VJ Base MARS Station, APO 130, N. Y., N. Y.

ex-AP2F via VE3BWY
FF4AH P. O. Box 100, Agboville, Ivory Coast
FF4AK Box 1813, Abidjan, Ivory Coast
FF4AL via W3KVQ for QSO's after March 1st
HH2OT via KØGZN
KV4CI Pat Miller, P. O. Box 872, (Box 1853 also given) St. Thomas, U. S. Virgin Islands, U.S.A.
ex-MP4DAA now 5A3CAA Box 263, Benghazi, Libya
MP4's QAQ, TAI and BDD via W2JXH
OHØNE I. Dahlbom, Mariegat 36, Mariehamn
SM5BUG/9Q5 SSA, Enskede 7, Sweden
SP5PO A. Gandzyk, Irysiwa 2, Warsaw 25, Poland
SV1AB via W4HUE, ex W2BYB 4108 Southwest 5th St., Ft. Lauderdale, Fla.
UM8KAA W. Milko, Dziorszynskiego 86m2, Frunze, U.S.S.R.

ANNOUNCEMENTS [*from page 16*]

Kentucky-Virginia

The Breaks Annual Hamfest will be held Sunday, June 11th at the Breaks Interstate Park near Elkhorn City, Kentucky and Haysi, Virginia, 20 miles south of Pikesville, Kentucky on highway 80. This event is considered to be one of the largest in that part of the country and fun and enjoyment can be expected by all. K4BGQ is handling the incidentals via Box 129, Pikeville, Kentucky.

Vermont

The Burlington Amateur Radio Club Inc. extends a warm welcome this year to all those who can make their Hamfest June 17th and 18th at the Green Mountains in Vermont. Registration includes a two hour ferry boat ride across Lake Champlain and early registrants will receive a handsome call pin free. Send early reservations and money ($3.00) to W1OJO c/o Burlington A.R.C. Box 684, Burlington, Vt. Three-fifty will be charged at the gate.

Michigan

The Oakland County A. R. Society is celebrating the Greater Pontiac Centennial Celebration during the week of June 17-24 by sponsoring a contest which will be rewarded by a certificate of achievement. Contestants must work five members stations in the area. Logs and an s.a.s.e. should be forwarded to W8RBU at 261 Draper Avenue, Pontiac, Mich.

COBRA Award

The City Of Baltimore Radio Association has inaugurated an award which requires the applicant to work 25 stations in the Baltimore Metropolitan area with at least 10 QSO's being made with members of the Association. Space does not permit a complete rundown of the requirements. We suggest you contact W3LE at 7704 Old Hartford Rd., Baltimore 14, Md., or Clif Evans, K6BX, Box 385, Bonita, Calif., who lists almost all awards in his *Directory of Certificates and Awards.*

"You say I'm the strongest mobile you've heard . . .?" Mr. Bob Carter, W7INP, Phoenix, Arizona, in his tiny Renault Dauphine car with his traveling antenna in place (Telrex "Christmas Tree"), on his way to the Phoenix Convention in May.

VKØVK via K2QXG
ex-VU2GI via VE3BWY
VP4TP Capt. Colin Fraser, Box 40, Port of Spain, Trinidad, BWI
VP6ZX via W9JFJ
ex-VS6BJ now G3KVU
VS9APH Phil Hudson, Royal Air Force, c/o Sergeants Mess, Khormaksar, British Forces Post Office, England
W3ZA/EP via W2JXH
XW8AM via W2JXH
ex-ZD1AW Alf Wilson, 1A Hamel Drive, Belfast 6, No. Ireland
ZK2AD via W9GFF
4S7EC Box 907, Colombo, Ceylon
ex-5A5TO now PAØETO, Fred Vitringa, Banstraat 2, The Hague, Holland
5N2PJB via W7VEU
6O1MT P. O. Box 397, Mogadiscio, Somalia Republic
6W8AF P. O. Box 7, Rufisque, Senegal
6W8BQ/SG P. O. Box 90, Dakar, Senegal
6W8CB/MM via KØGZN
6W8CY Box 971, Dakar, Senegal
ex-9M2EB now G3IJU

That's it for this month. Have a good summer.

73, Urb, W2DEC

Sunspots [*from page 53*]

that solar activity may remain at relatively low levels for the remainder of the century.

The decline in the present solar cycle, together with a related decline in the intensity of ionization in the earth's upper atmosphere, is responsible for the poorer propagation conditions presently observed on 6, 10, 15 and 20 meters. Conditions will continue to become poorer on these bands as solar activity declines.

Although the outlook is not bright, it is certainly not bleak either. Because of decreased ionospheric absorption that accompanies lower sunspot activity, propagation conditions are expected to improve considerably on the 40, 80 and 160 meter bands. This improvement has already been noted during the hours of darkness, and conditions will continue to improve steadily on these bands as solar activity declines.

Finalé

One might say after reading this report that we have painted a rather pessimistic picture. Nature has wiped out the 6 and 10 meter bands, perhaps for the remainder of the century, and has reduced 15 and 20 meters to rather lean daytime bands. Even the ray of optimism concerning the improvement in conditions on 40, 80 and 160 meters might be called unwarranted by some readers because of the terrific QRM that would be caused if all the amateurs on the h.f. bands today were to try to squeeze into these three remaining bands.

We feel that the declining sunspot cycle once again places amateur radio on the threshold of action. We can either lean back and let nature get the best of us, or we can press forward and experiment with new techniques that might overcome the difficulties. Moonbounce, satellite reflection, orbital scatter communications, Project OSCAR, or some yet unexplored method or technique, might hold the key that may permit amateur radio to hurdle new communication frontiers without dependence on the ionosphere or the solar cycle. It is in this spirit that we look upon the declining sunspot cycle as a challenge to amateur radio, and this report is furnished, not as a "forecast of gloom," but as a stimulant to action. ■

For further information, check number 24, on page 126

Sideband [*from page 81*]

Association re-elected W6ZHH as President; W6ECP as Vice President; and K6AM as Secretary-Treasurer. WA6BKG and W6TSQ were elected as Directors of the group. Their 1961 Annual Convention will convene the last week-end of September at the Vandenberg Inn-Hotel in Santa Maria . . . Chuck, WØCVU, advised us that Ernie, WØSYF, is writing a book on s.s.b. which will be on the market soon. This book should be most informative since Ernie was one of the pioneer designers of s.s.b. amateur gear . . . It was wonderful to hear again from Ed, K7CIK/8, who had paid us a visit while enroute to Turkey several years ago. Ed is now back in the States at Wurtsmith AFB in Michigan.

Just learned that Bannie, W4CE, is now retired from the Navy and is living in South Carolina where he is enjoying lots of fishing and hamming.

With conditions becoming worse due to the sunspot cycle low, and Summertime lull, we'll be looking forward to hearing from more of you through the mail. Please keep us posted.

73, Irv and Dorothy

V.H.F. [*from page 87*]

that 50% of them were calls I had not heard on 144 mc before . . .

"Looking for DX, I only worked about a dozen stations. These were from Virginia to Indiana. Here's a list which should be of interest to all 2 meter men: *W1's,* REZ, PZA, BCN, BFW, SBM, PJW, TJW, AEP, HUD, AJA, AJR; *K1's,* CRN, CRQ/8, CXX, AOX; *W2's,* QMK, KDX, SJX, HUX, ADD, IGX, LWI, RCK, AZL, NCF, QMK, ESX, VJN; *WA2's,* BAH, EKM, MNK, DHS, GSC; *K2's,* KJI, EQI, GVI, LMG; *W3's,* TEV, TCR, RUE, LZD, ARW, LST, MFT, SSC, BYF, SFY; *K3's,* KPT, BFA; *W4's,* MKJ, RFR, FJ, GSH, LTU; *K4EUS; W8's,* TTQ, BAX, BKI, MVM, AQ, YOX, GGH, WNM, DX, CKK, CYY, EJP, KAY; K8PBA; *W9's,* EUU, OIT, UIF, EGH, BOZ, ZSC, QXP, GIR; *WØAXU; VE2DZ, VE2AX; VE3's,* HW, BPR, AIU, EGV, BVC, and CUG.

"The boys that don't work c.w. are sure missing some fun! There is just nothing on the lower frequencies that can compare to aurora.

"On the Syracuse V.H.F. Club, we are working on a little club project with some cash rewards. We are building some little one tube rigs for 220 mc. It was described in *CQ* some time ago. This was selected because it was simple and therefore all the fellows in the club could participate." *Sounds like a lot of fun, Charlie! Let us know how the gang makes out on those little 220 mc rigs! Agree with you on that 144 mc aurora—Just nothing like it. Noticed a lot of very familiar 2 meter calls in that list. Good luck on future openings!*

Madison Heights, Michigan—Richard Medynski, K8PEJ, emits with . . .

"Just got some new equipment . . . a Seneca VHF-1, RME 152A converter, and an HQ-129X receiver!

"Good ground wave opening on April 4. Worked K2ZYX, and K8MMM, heard W8UMF and W8ESZ, all at Grand Haven, Michigan, about 200 miles away. Copied all signals S9! Have got 102 confirmed contacts with Ohio. Ohio is about 55 miles away, and I'm always looking for new stations. Am usually on Tuesday nights between 10 to 12 P.M. local standard time." *Real fine, Dick! Sounds like you're all set and a'rarin' to go with all that new gear! Keep us posted.*

2 Meter Nuvistor Pre-Amplifier!

Got a short note from K8GEM, of Gem Electronics, RR #3, Springfield, Ohio, that the labs are now in production with a 2 meter nuvistor (6CW4) pre-amplifier. But the most amazing thing is the price . . . only $3.50 postpaid! This is a new addition to the recent line of equipment now in production at Gem. You'll remember last month's 2 meter converter announcement (also nuvistor). We'll keep you informed as more products are released.

Thirty

Again, we wrap up Ye Olde VHF Columne for another month. Next month we'd like to hear from you. And how about some technical info? Any little items you have available . . . converter designs, preamps, etc. Just a few lines and a schematic will do. May we hear from you.

73, Bob Brown, K2ZSQ

YL [*from page 99*]

The following officers of the NYC YLRL were re-elected for '61: Pres., W2EUL, Amy; V.P., WA2DBG, Helen; treas., W2EEO, Madeline; sec., K2DPN, Dot. YLs in the New York area had some FB publicity in the N.Y. *World Telegram & Sun* in Feb. entitled "A World Wide Sewing Circle."

The Portland Roses are getting things lined up for the big convention to be held in Portland in '62. The Roses will be hostesses for the ladies' activities. Officers of the club are: Pres., K7BII, Mary; V.P. and treas., W7ZMN, Phyllis; sec., W7RVM, Helen; publicity and activities chm, W7NOK, Pat.

Nets

A note from K9TUD, Mary, calls the attention of all Wisconsin YLs. They are invited to join a new Wis. YL net at 0900 CST on Wed. at 3840. If YLs outside of Wisconsin can copy the net, they are invited to join.

New officers of the Loaded Clothesline YL Net are: Pres. & NCS, KØGAS, Connie; V.P. & ANCS, K5ECP, Helen; secy., KØGIC, Dot; treas., W5YSJ, Jennie; P/C, KØEPE, Marte.

The Apricot Net (Mon. 8 P.M. 51 Mc.) had some FB publicity in an article by W8BAH in the *Cleveland Plain Dealer*. NCS is K8ONA, Eunice, and among the over 50 members are these YLs—K8VMV, IEZ, TOK, NQD and VMY.

The Floridora YLs have one or more nets for most every day of the week: Mon. 0900, 7225, W4IUR mgr.; Tues. 0900, 7215, s.s.b., W4UF mgr.; Tues. 1000, 50.330, no mgr.; Wed. 0900, 7185, c.w.-Novice, K4RDX mgr.; Thurs. 2000, 50.300, K4ANR mgr.; Thurs. 2000, 50.330, W4LPR mgr.; Sun. 0900, 7225, K4UIZ mgr.

[*Continued on page 114*]

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Visitors & inquiries invited.

For further information, check number 30, on page 126

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WIDBM's newly written TVI book (2nd edition) covers all aspects of curing TVI from both the Ham's viewpoint and that of the TV viewer or the TV serviceman. It includes 2- and 6-meter TVI as well as Citizen's Band. Industrial, Medical and Utility TVI. Profusely illustrated with diagrams, photos, charts, tables and FCC regulations pertaining to radio and television interference. Price $1.75 postpaid, USA, $2.00 Foreign.

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SEE PAGES 104 & 105 APRIL 1961
FOR COMPLETE DESCRIPTION
SOMETHING NEW IS COMING
SEE PAGE 110 THIS ISSUE

YL [*from page 108*]

Book Reviews

Building Up Your Ham Shack is the latest book off the press by Howard ("YB") Pyle, W7OE. Published by Howard W. Sams & Co., 128 pages, well illustrated, price $2.50. Not only does it explain how to assemble a first Ham station and how to choose and install equipment, but it also guides in the choice of advanced equipment if one wants to gradually upgrade his station.

The Many Names of Lee Lu is the latest book by Helen Cloutier, W8GJX. Illustrated by Don Elmi, it was published by Albert Whitman & Co., price $2.25 (cloth bound). For children, it is the story of Lee Lu, a Chinese boy, who came to America, and his concern as to what name the American children would call him, and his teacher, and his joy in her choice.

33, W5RZJ

Ham Clinic [*from page 77*]

eration, rough handling either in the hamshack or in shipment will cause mis-adjustment. Merely re-engage the pinch to the drive disc and your slippage will disappear. First make sure that the pointer is not binding at the cabinet top. If you cannot seem to stop the slippage by re-engaging the pinch to the drive disc, then remove the main tuning knob and counterweight. Remove the retaining ring. Then with a ½" *Spin-Tite* wrench, loosen the pinch drive bushing. With the bushing loosened, further engage the pinch assembly into the main tuning disc to obtain proper drive without slipping. Tighten the pinch drive bushing and re-assemble the main tuning knob. The operation should be correct. If this operation did not work, then loosen the four variable capacitor mounting nuts. Engage the drive disc into the pinch mechanism by moving the capacitor . . . *be careful of the wiring!* Tighten the four nuts and you're back in business.

RCA Modulation—Anyone have any information on so-called RCA "ampli-phase" modulation? If you do, how about sending us the complete info if you do *not* want it returned.

Tip of The Month

Thanks and 75 to W5GFK for his very simple put practical Tip of The Month.

He writes: "those who have ever tried to adjust the input to the audio phasing network of an s.s.b. exciter are quite familiar with the fact that the input pot can readily be adjusted for excellent sideband suppression on either the upper or lower sideband . . . but not both. The setting for either sideband is a compromise at best. With the help of Doc Dawson, W5KFI and some experimentation, we finally settled the matter by using two pots and switched these for upper and lower sideband operation . . . giving us optimum adjustment. With a Tektronix scope, equal sideband suppression measurement was in the order of 45 to 55 db with the SB-10." See fig. 1 for the simple modification.

ARMCHAIR PHOTOGRAPHER

In this hectic era of space stations and amphibious autos, far be it from us to criticize progress. And yet, we shake our cranium a bit sadly, and we reminisce a bit remorsefully to the days not so long ago when we hadn't yet traded our souls for do-it-yourself kits. And looking back, we remember when the pioneer of the do-it-yourself phaze was the died-in-the-wool ham who built and serviced his own station.

Even so, we must force a faint smile as we remember that even the true-blue old timer occasionally referred to *CQ* to solve a tricky problem or refresh his memory on a technical point.

Mind you, we're not opposed to progress. We just realize that there are so many new phases of our hobby being developed today that *CQ* has become a second right arm to its regular readers. And those hams who only occasionally happen to browse through a copy of *CQ*... oh, well! Some hams still like to do things the hard way.

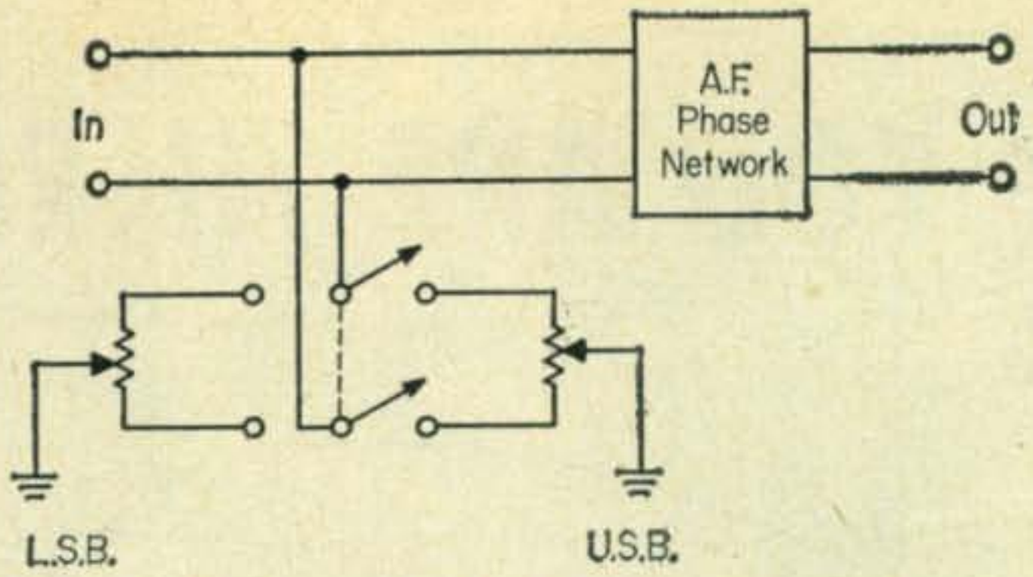

Fig. 1—Simple method of obtaining equal optimum sideband suppression for both upper and lower sideband with phasing type exciters.

Thirty

With the birds singing, the flowers in bloom and the young ham's fancy turning toward more than ham radio, we sign off for this beautiful month. So until next month then, thank you for reading HAM CLINIC and helping us to help others with their problems. 72 to our friends across the sea and 73 and 75 to brother hams everywhere.

Chuck, W6QLV/4

El Paso Roadblock *[from page 61]*

Both amateurs and deputies tend to pour out their troubles when they meet "on location." You may learn a lot that way, and can pour oil on troubled waters.

8. If you have an amateur with a rig in his plane, (as does El Paso) get him airborne with binocular carrying passengers. Accidents and incidents beyond the view of stationary roadblocks are quickly seen. Then too, sometimes a ground chase is impractical when the car makes a sudden turn up a side road or alley. The airborne plane can cope with this.

9. To avoid burning gas and overheating the engine to keep the battery charged, arrange for a filling station to supply charged batteries which the sheriff's jeeps can transport to the roadblocks.

10. Local "ladies auxiliary" type organizations could bring free sandwiches and drinks to the men on location. In El Paso County the local Red Cross did this.

11. Be sure each volunteer has the phone numbers of the n.c.s., police, fire and sheriff departments just in case he loses radio contact. Be sure the sheriff's department dispatcher has been given the phone number of the n.c.s. and location of roadblocks the n.c.s. is covering. Each station, mobile and fixed, should have a map of the area.

12. Establish the net early. Mobiles should clear traffic with the n.c.s., and they and the deputies should meet at a prearranged spot enroute to the roadblocks.

Labor Day will be the next operation of the El Paso County Highway Safety Net. *Check* with your local officials and join in keeping your holiday death toll down. The Sheriff's Reserve sent ours clear down to zero. ■

Novice [*from page 91*]

meter dipole and a 40 meter doublet have provided him with a WAS of 38/38, plus VE3.

Remember Tom's (KR6ZT) report that KN7INE was the strongest Novice heard on Okinawa? Tom wondered what he was using. Bob Gates, Jr., now K7INE, 10617 S.E. 199th Renton, Wash., writes to tell us how he produces the rock crushing signal. His antenna is a two element cubical quad about 50 feet up and rotated by a TR-2. For receiving Bob uses an HQ-170 and the transmitter a Heath DX-40. Bob continues, "As for DX, I don't think the Novice should overlook the foreign fone boys on 15. I worked almost 20 countries c.w./fone that way, including a couple of rarities (VR2 and VK9). And also of special importance, when calling DX don't call too long as they will get tired and tune on. Believe me, I know. I learned the hard way. The big thing which applies to all DX'ers is *listen*. All this CQ DX'ing won't get you anywhere. Call 'em when you hear em."

Let's close with an ex-Novice who turned out to be a real DX hound. Charlie, K4WIH, 527 King Ave., Orlando, Fla., is only 14 but racked up a WAS of 50/48 (still needs those confirmations from Ariz., and Idaho—come on fellows, let's kick through). In addition Charlie brags about an impressive list of DX including XEØ, VE, YV5, PY2, YN6, TI2, HC1, HK7, KZ5, VP9, CR4, CO2, CP4, KV4, CR5, ZS6, SU3, G3, DL7, OZ7, ON4 and many, many more. All this, yet, with a DX35 and an old Navy receiver!

73, De Don, W6TNS

L-Networks [*from page 35*]

tion of 1000 ohms of resistance and 234 ohms of capacitive reactance. Thus, the grid to ground impedance is small and always capacitive; hence, the energy fed back by the grid to plate capacitance of the tube is, in effect, bypassed to ground. Operation has been checked on all bands, and it is perfectly stable. The amplifier has been tested thoroughly with no load whatever, running 2500 plate volts, 650 screen volts, and approximately 110 volts bias to allow 100 ma plate current, and no oscillation has appeared.

Both screen terminals are bypassed with .002 mf 3000 volt ceramics; one to the hot side of the filament and the other to the ground filament lug. Note that one side of the filament is actually grounded. This is contrary to ordinary transmitter wiring practice, but was suggested by Eimac and in several previous versions of 4-250A amplifiers definitely helped to eliminate v.h.f. parasitics.

This circuit does not appear to be suited to drive a Class AB2 or B amplifier. The low *Q* series tank does not have sufficient flywheel to push the peak r.f. voltage on up when the tube draws any amount of grid current. However, no particularly bad effects have been observed on the scope two-tone test from slight excursions into the grid current region. The usual precautions against overdriving are advised. ■

Ham Shop

Rates for the HAM SHOP are 5¢ per word for advertising which, in our opinion is obviously of a non-commercial nature. A charge of 25¢ per word is made to all commercial advertisers or business organizations.

Your copy should be preferably typewritten, double spaced on one side of the page only.

We do not bill for advertising in the HAM SHOP. Full remittance *must* accompany all orders.

Closing date is the 20th of the 2nd month preceding date of publication.

We reserve the right to reject advertising which we feel is not of an amateur radio nature.

Because the advertisers and equipment contained in the HAM SHOP have not been investigated, the publishers of *CQ* cannot vouch for the merchandise listed therein.

GIANT CALL SIGNS: Large extra bold print. Worded with your CALL and Amateur Radio on 11" x 7" cards. Surrounded with bright red splash. Attractive Decorative. Three for $1.00 Post Paid. Call Signs, P.O. Box 933, Aurora, Illinois.

KWM-2, Collins 516F-2 AC power supply, both in mint condition in original cellophane containers and cartons, operated 3 hours, Collins conversion bulletins; $1000; Lt. Fred L. Capossela, NRTD, TAGSUSA, Fort Harrison, Indiana.

If you held a two-way contact 40 or more years ago, you should join the Old Old Timer's Club. This is the Granddaddy of all Radio Clubs. Once a member, always a member because initiation fee covers life time dues. Write Sec.-Treas., W2EG, Earl C. Williams, 507 Wayside Road, Neptune, N. J.

TOROIDS: Uncased 88 mhy like new. Dollar each. Five $4.00 PP. DePaul, 309 South Ashton, Millbrae, Calif.

BEGINNERS: Code bothering you? Now learned in one hour. New Method. Quick approach towards your ham ticket. Used in Armed Services, Ham Radio, Scouting. Ketchum's One Hour Code Course $1.00 postpaid. MONEY BACK GUARANTEED—O. Ketchum, 10125 Flaro Vista, Bellflower, California.

WANTED: Teletype printers, perforators, reperforators, transmitter-distributors, test equipment: Model #14, #15, #19, #26, #28, GRC, TT, TGC, GGC, etc. All types Collins receivers, 51J, R-388, R-390, 75A, etc. Cash, or trade for NEW amateur equipment. Write Tom, W1AFN, Alltronics-Howard Co., Box 19, Boston 1, Mass. (RIchmond 2-0048).

WANTED: Military and Commercial laboratory test and measuring equipment. Electronicraft. Box 399, Mount Kisco, N.Y.

"The VHF Amateur"—At last a magazine for VHF'ers! Don't miss a single issue! Send $2.00 for year or $1.00 for six big issues . . . 67 Russell, Rahway, N.J.

Interrogation: Applications are now being accepted for Election into our Research and Administration staff. The function of the organization is non-profit in nature, and will work under contributions and grants. The purpose of the organization is Research in Extra-Terrestrial phenomena; i.e. Radio Astronomy, Propogation, Scatter, etc. If you are seriously interested and would like more information write: Radiometric Research, Ltd., P.O. Box 4335-Annex, Las Vegas, Nevada.

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Collins 75S-1 $385., 51J-3 $675., 51J-2 $495., 75A-2 $295. SP-600 $495., HQ-150 $175., HQ-160 $295., Valiant $299., Ranger $210., Teletype machines; R-390/URR. Alltronics-Howard Co., Box 19, Boston 1, Mass. (RIchmond 2-0048).

ATTENTION Mobileers! Leece-Neville 6 volt 100 amp system, $50; 12 volt 50 amp system $50; 12 volt 60 amp system $60; 12 volt $100 amp system $100. Guaranteed no ex-police car units. Herbert A. Zimmermann, Jr. K2PAT, 115 Willow St., Brooklyn 1, N.Y. Tel. DIckens 2-9121 or JAckson 2-2857.

For Sale: TV Cameras, Teletype, Panadapters, Transmitting Tubes, Transistors, SSB gear. Write for list. Spera Electronics, 37-10 33 Street, L.I.C., N.Y. STilwell 6-2199.

ONE THIN DIME brings 50 page eye-popping war surplus electronics catalog. Fabulous bargains. Meshna, Lynn, Mass.

FOR COLLINS in Detroit area it's Michigan Ham Headquarters. Also large selection of tradeins on display. M. N. Duffy Ham & Electronics, 2040 Grand River, Detroit 26, Michigan. WO 3-2270.

CASH for surplus tech manuals—W4FXQ, Box 2513, Norfolk, Va.

WANTED: World War I French L-3 Amplifier, Mu-Rad receivers and R.F. Transformers for electrical test. Buy, borrow, trade. Also UV206, UV208 tubes. Grote Reber, Research-Cottrell, Bound Brook, New Jersey.

QSL's, SWL's. That are different, colored, embossed card stock and "Kromekote." Samples 10¢. Turner, K8AIA, Box 953, Hamilton, Ohio.

C. Fritz for better QSL's! Samples 10¢. P.O. Box 1684, Scottsdale, Arizona.

QSL's-SWL's, samples 10¢. Malgo Press, 1937 Glendale Avenue, Toledo 14, Ohio.

QSL's. SWL's XYL-OM's. (Sample assortment approximately 9¾¢). Covering designing, planning, printing, arranging, mailing, eye-catching, comic, sedate, fantabuous, DX-attracting, protoypal, snazzy, unparagoned cards. (Wow!) Rogers, KØAAB, 1200 Marshall Ave., St. Paul 4, Minnesota.

QSL's—"Brownie" W3CJI, 3110 Lehigh, Allentown, Pa. Samples, 10¢, with catalogue, 25¢.

QSL's-SWL's: 100 2-color glossy $3.00; 100 QSO file cards $1.00; Sample 10¢. Rusprint, Box 7507, Kansas City 16, Missouri.

QSL's four colors glossy stock forty design send $5 for 200 and get surprise of your life. 48 hour service satisfaction guaranteed, Constantine Press, Bladensburg, Md.

QSL's. Samples 15¢. Sims, 3227 Missouri Ave., St. Louis 18, Mo.

GLOSSY 3-color QLS cards 100—$4.50. Free sampler. Rutgers Vari-Typing Service, 7 Fairfield Road, New Brunswick, N.J.

QSL's?? SWL's?? Largest Variety samples 20¢ (refundable). "Religious" QSL samples (with bible verses) 10¢. Sackers, W8DED, Holland, Michigan.

FREE SAMPLES QSL JAKETS to preserve and display your QSL cards. QSL JAKETS, 917 Pima, West Covina, California.

Outstanding QSL's . . . Dime . . . Filmcrafters, Martins Ferry, Ohio.

Photo-QSL's Free Samples A&D Studios, 2030 S. Prairie Ave., Pueblo, Colorado.

QSL's 100 glossy 4 color $3.70 Postpaid. Samples 10¢, or send 25¢ for large assortment and free "Danger, High Voltage" sign. Dick, W8VXK, Rt. 1, Gladwin, Michigan.

New TV Tubes—6198 or 5527—$50.$$. W1BYX, Box 122, Rockville, Conn.

USED: Heath DX-100 excellent condition $180.00. Will ship anywhere in USA PP. Knox Electronic Supply, 67 N. Cherry St., Galesburg, Illinois.

WANTED: Instructions for APR-5A receiver. Barker, West Drive, North Haven, Sag Harbor, N. Y.

CRYSTALS: 1900 thru 8700 kilocycles FT243 holders. 5 for $2.00. SSB FT-241A crystals. 15 for $2.00. Limited channels. Send stamp for 12 page crystal catalog. Quacker Electronics, Plymouth, Penna.

Lysco 600, serial #1396. Transmitter is in excellent condition and features built-in V.F.O., low pass filter, line filter, and grid block keying for chirpless CW. Price is $65. Anyone have the following? Write and state price. (1) 4-250 mmf vacuum variable condenser at 5 or 10 Kv. (2) 800 cps mechanical filter (F-455C-08) for Collins 75A-3. Write K8GGX, 16101 Judson Drive, Cleveland, Ohio. Phone SK 1-0048.

Need cash for radio equipment? Sell your old Electric Toy Trains to Edward Wichmann, New Lenox Station, Lenox, Mass.

FOR SALE: SX-99, $110.00; Globe Scout 680A, $75.00; Viking II, factory wired, with audio similar to DX-100, $195.00; Viking VFO $25.00; RME 4350A, used less than five hours, with speaker and new set guarantee $195.00; (2) BC-659's converted to six meters, $20.00 each. All A-1 condition and FOB. Satisfaction guaranteed. Will trade. Paul Sturpe, 228 E. Church, Orville, Ohio.

USED but you wouldn't know it if we didn't tell you. B&W 51 SB $198.00. We will ship it anywhere. PP. Knox Electronic Supply, Inc., 67 N. Cherry St., Galesburg, Illinois.

WANTED: 75A-4 or 75A-3 Collins Receiver. Will pay cash. Would prefer mechanical filters. Walter Taylor, K2MLT, R.D. #2, Hammondsport, N. Y.

MM2 Analyzer, used 10 hours. $120.00. Warranty. K6RPZ, 3211 Quandt Road, Lafayette, California.

Subraco 125W transmitter, Meissner signal shifter, Alpha Modulation Scope, Antenna Tuner, Extras. $235.00. W2-ZNC, 53 East 38 St., Paterson, N. J.

Model 15 teletype, sync motor, pulling magnets, new table $175.00 or trade for good clean 20A. Kilowatt modulator with power supply, UTC components $50.00; W2JAV converter with rack mount $40.00; new Eico grid dipper $30.00; 4-250 tube 20 hrs use $20.00; 4-400 10 hrs use $30.00; PR 4-65 $10.00 each; 8 ft. deluxe bud enclosed rack $40.00; 6 ft. rack $20.00; 6800 volt c.t. xfmr 2 amp. $30.00; AXT2 xmtr converted to 432 mcs with spare 8025's $25.00. Certified check or money order and shipped collect. W9UBF, 2112 W. 12th St., Anderson, Ind.

RTTY Operators: 2050 to 3050 CPS input filters, $12. Mark and space filter $20. Laursen Electronic Sales, Box 205, Lees Summit, Mo.

WANTED: EICO 720 or Heathkit DX-60 80-10 meter transmitter or equal, kit or built. Offer fine archery equipment, aluminum arrows. Weber, 6416 71st, Middle Village, N. Y. 79.

SUPERPOWER: Unused Thordarson plate transformer, 6000 vct. or 3500 vct. at .750 amps. Matching chokes, filament transformers; DX-40, VF-1, etc. Cleaning house. Send stamped envelope for list. Brian Desind, K3GBT, 3317 Hillsmere Road, Baltimore, Maryland.

NEW NOVICE TRANSMITTER, the 50-watt Davidson "ECHO", model DP-110, smashes all price precedents: kit—$29.50; wired—$42.50. Write for brochure: Davidson Products, Box 733-A, New Canaan, Connecticut.

SX-99, AR-2, AM-FM receiver, auto radio. DX-35, AT-1, VFO, Q-Multiplier, VTVM's, signal generator. Homebrew equipment, tubes, meters, mikes, parts. Priced cheap, offers considered. Will swap. Send for complete list. Steve Pinion, K4JRE, Route 2, Bedford, Va.

DX-100 OWNERS: Increase your power output by 50%. Run 240 watts AM—300 watts CW or SSB. Additional 6146 installed in final and all modifications made to increase grid drive and audio. We furnish complete kit of parts and step by step instructions for only $19.95. Order or write for details. Similar kit also available for the TX-1 Apache. W4KUV—W4NZS Best Radio & TV Service, 610 N. Madison Avenue, Goldsboro, North Carolina.

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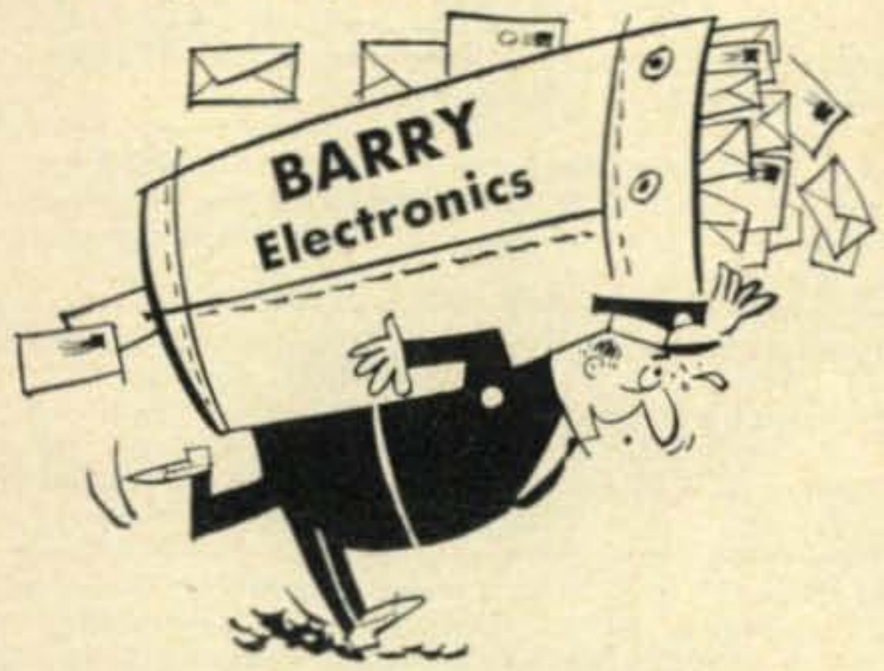

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Price: **$129.50**

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NC270 with NTS—3 Matching Speaker—
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BC221 Frequency Meter. With Internal Modulation and orig. calibration book. Lab tested—excellent condition. $99.00.

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TV6/U Bendix Electrometer Tube Tester: Checks 5889, 5886, 5803, 5800, 5799, etc. Brand New. With Book $55.00.

UTC Choke: 6 Hy. @ 500 Ma. (27 Ohms) $8.95.

UTC Choke: 6 Hy. @ 1 Amp. (33 Ohms) $13.95.

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RCA CRV-59AAC TV Xmtr/Camera with 1846 Iconoscope. $95.00.

RCA Precision 500 KC Crystal Oscillator: Accuracy 0.0012%. Contains Precision 500 KC xtal oven. 5840 tube. Herm. sld. Mounts on standard 7 pin miniature socket. Requires 6.3 VAC or DC, 75 100 V.D.C. W/schematic. $3.75.

Xmtg Variable Capacitor: Approx. 20 to 750 Mmfd @ 4,000 V.D.C. Capacitor enclosed in ingenious oil-bath, allowing high-voltage and small size. Overall dimensions: 6¼" L x 3⅛" H x 3⅛" W. $11.95.

Compact 125 Watt Modulation Xfmr: Pri: 10,000 Ohms Plate-to-Plate. Sec: 4550 Ohms (Has screen winding. 3300 Ohms). Open frame, epoxy impregnated. Winding insulation to ground; 5000 Volts Peak. Orig. designed for PP 4-65A's. Dimensions: 3⅛" H x 3½" W x 3¼" D. Wt: 3 lbs. $6.95.

Eimac JAN Tube type 4-65A's @ $10.00.

Plate Transformer: Pri: 115 VAC @ 60 CPS, with taps. Sec: 3200 VCT @ approx. 300 Ma. Overall Dimensions: 8½" H x 4⅝" W x 8" D. Wt: 27 lbs. Mfd. by RCA. $10.50.

Hughes Swinging Choke: 20 Hy. @ 50 Ma. D.C./3.5 Hy. @ 250 Ma. D.C. 75 Ohms D.C. Resistance. Herm. sld. Ceramic insulators. Wt: 5½ lbs Overall Height: 4⅝". 3½" W x 3" D. $1.95.

RCA Mica Capacitor: 4,000 Mmfd. 3000 V. Peak. $1.95.

RCA PLATE Xfmrs: 1220 V.C.T. @ 360 Ma. Pri: 115 V. w/taps. 60 CPS. Herm. sld. $4.95.

RCA Plate Xfmrs: Pri: 115 VAC @ 60 CPS. Sec: 905 V.C.T. @ 360 Ma. Herm. sealed $3.95.

Variable Capacitor: Dual 215/215 Mmfd. .125 spacing (4500 V.). $7.75.

Merit Choke: 10 Hy @ 250 Ma. #C-3182. $2.95.

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#213 Sockets for 304TL & 304TH. $1.15 each.

Cathode Ray Tube Shield (for tube type 2BP1). $2.95.

Cornell-Dublier 4 Mfd @ 4000 VDC Oil Capacitor. $9.95 (3 for $27.00).

UTC Type S-32 Swinging Choke: 5/25 Hy/225 Ma/120 Ohms. $4.90.

Filter Choke: 8 Hy. @ 200 Ma. (90 Ohms D.C. Resistance) Herm. sld. $1.75.

World Globe, 12" Diam. Beaut. colors. Topography is raised above surface of actual globe. $19.95.

Barry Electronics Corp., 512 Broadway, N.Y.C. 12, N.Y.
(Minimum order this ad/$2.00) **(C-6)**

☐ Enc. is money order or check and my order.

☐ Send copy of Winter-Spring 1961 "Greensheet" catalog.

Name ..... Title

Company .....

Address .....

City ..... State

For further information, check number 43, on page 126

ORDER YOUR COLLINS 500 WATT LINEAR FROM C & G NOW.

The new compact 30L-1 500 watt linear is the same size as the famous Collins KWM-2, and has a self-contained power supply. Its price is quite reasonable, too—$520. Order the Collins 30L-1 now for early delivery!

C & G ELECTRONICS

Northwestern headquarters for Collins

2502 Jefferson Avenue, Tacoma 2, Wash.
2221 3rd Avenue, Seattle 1, Wash.

For further information, check number 44, on page 126

WANT 2-meter Gonset II Linear. Lorenson, Box 42, Hillsdale, N. Y.

TEKTRONIX OSCILLOSCOPE—Brand new model 310, light, portable, operates on 115/230v. 50-800 cycle line. Vertical freq. response dc-4 mc. Complete with 10 meg. probe, adapter, green filter and instruction manual. $525 or best offer. Rullman, K7MSH, 3065 S.W. 123rd Ave., Beaverton, Oregon. MI 4-9731.

HIGHLY EFFECTIVE home-study review for FCC commercial phone exams. Free literature. Wallace Cook, Box 10634, Jackson 9, Miss.

Used Teletype Machine!!! One used teletype writer in excellent condition, complete with metal stand. Ship wt. 150 lbs. plus freight. Only $175.00. Daniel D. Jensen, Route #2, Tomah 3, Wis.

"Communications, Teletype, unusual surplus bargains. Free flyer, MDC, 923 W. Schiller, Phila. 40."

75A-4, serial 2519, perfect, calibration is "on the nose." $549.00; KWM-1 DC supply, $150.00; Mounting Tray, $40.00. W8WGA. Phone CR 70409.

For Sale: Transistor power converter 6-12 v.d.c. to 250 v.d.c./150 ma $19.95 kit; 0-1 ma meter with volts scale $3.25; 0-100 r.f. ma meter $3.95; Vitamin Q tubular capacitors—most sizes 25¢; A-B pots—many sizes 45¢; Microswitches—normally closed 25¢; normally open 35¢; all new, send for list WA6HQJ 4086 Hillcrest Drive, Los Angeles 8, Calif.

Tech Manuals, New Original Maintenance Books, APA-10 $5.00, APA-38 $8.00, APN-1 $6.50, APN-4 $8.00, APN-9 $10.00, APR-1 $7.50, APR-4 $7.50, APX-6 $8.50, ARC-1 $10.00, ARC-2 $8.50, ARC-5 VHF $8.50, ARC-27 $8.50, ARR-2 $7.50, ARR-5 $8.50, ARR-7 $8.50, ARR-15, $10.00, ART-13 $12.50, BC-224—BC-348 (Specify Model) $8.50, BC-375 $7.50, SCR-274N Command Sets $8.50, SCR-522 $10.00, ARN-5 $7.50, ARN-6 $8.50, ARN-7 $8.50, URC-4 $8.00, TS, TM, RTTY Manuals in Stock, Send Requirements, Free Catalog With 5000 Items, Bill Slep Company, Drawer 178CQ, Ellenton, Florida.

Sell SP600-JX Hammarlund. First Cashiers check for $325. gets it. Will ship express. K4ECI 233 Murray Hill Road, Fayetteville, N.C.

6 Meter Tecraft Transmitter 12VDC Transistorized power supply, receiver, halo antenna, all $110.00. 12VDC transistor mobile power supply, 450-225VDC at 150MA—$30.00. New tubes: two 7094—$12.00 ea. Two 6146—$2.50 ea. PL177 —$5.00. Others. Cleaning House. WA2FKZ P.O. Box 571, Hewitt, N.Y.

For Sale: Excellent SB-10, $80; HQ-140-XA, $170; "A" Slicer, $35. John D. Mininger, K9DMC, 1624 S. 8th St. Goshen, Indiana.

Garage Door Operators $59.95. Rugged chain drive automatic units. Highest quality. Free literature. DEMSCO, Inc., Sebring 22, Ohio.

Wanted: High and low capacity variable vacuum condensers and rotary inductor for pi-network final. F. Price, 4620 N. Magnolia, Chicago 40, Ill.

For Sale: Improved Heath Six Meter Transceiver. $26.00. Robert W. Mark, 823 Church St., Hawley, Pa.

Collins 30S-1 Linear Bargain; can't be told from new; 4CX1000A just checked OK by Eimac. Sacrifice for $1095 if sold before I leave for Mexico. Can ship in original packing FOB Chicago. R. Yeager, 1455 Wilson, Chicago 40, Ill.

CQ Magazines, Complete file 1949 through 1960, with indexes, plus 5 issues 1946, 5 issues 1947 and 8 issues 1948. Entire lot $75; General Radio Experimenter, complete indexed file 1929 through 1960, $25 R/9 Magazine Aug. 1934 and combined issue R/9 and Radio Magazine Jan. 1936, collector's items, both $10; Radio Magazine 1936 through 1939, less three issues $20. Shipment extra. Lester Harlow, W4CVO, 5901 Paul Street, Alexandria, Virginia. HUnter 1-9360.

For Sale: Hammarlund HQ-110C Receiver—6 months old—in carton with manual—$195.00. Tecraft 2 meter converter —$37.00. Hy-Gain #103B 10 meter beam, new, in unopened carton—$24.00. Two Taco 2 meter 10 element beams in unopened cartons with balun—$22.00. 1 #730 Eico modulator with cover, new condition—$38.00. L. H. Anderson, K4PQX, 1602 Edgerton St., Goldsboro, N.C.

Collins 75A-4 in excellent condition. $495 cash. C. R. Armour, WØWMV, 1205 Olive, Carthage, Mo.

Sell! Heath Mohawk RX-1! Factory aligned! $1.99. K5-HXO, 109 Main, Elk City, Okla.

For Sale: SX-88 with speaker, $350; Valiant, $325. Excellent condition. James Spencer, 1102 Grand, Laramie, Wyoming.

For Sale: Heath VFO $15; Bud VFO $10; Heath AT-1 as is—$15; 10 mtr beam—$10, Gotham 80-6 vert—$10; Johnson 4kw TR switch—$18; old DuKone tape recorder—$20; B&K picture tube rejuvenator—$35. Cash only—no trades—Jon Wood; 6010 Nall; Mission, Kansas.

Heathkit MR-1 mobile receiver with matching speaker. Wired and tested. Brand new, never used. $125. Roy Durso, 35 Dayton St., Westbury, L.I., N.Y., ED. 3-7294.

Sell—Trade:—3 new vibrapacks 12v.-275, 300, 325v./90 ma. $9 each. 3 homebrew (commercial looking) 40, 75 meter 15 watt mobile transmitters, complete $35 each. Supplies:—750v./250 ma.-6.3v. $18. 600v./250 ma.—6.3v. $10. 1200v./250 ma. $20. Nyalclad and enameled copper wire #22 and #25, II lb. spools $10 each. 500 watt autotransformer, 100-110-120-130V. taps $8. 350 watt isolation transformer $8. 15 modulation transformers (unused) from

BC-375 transmitters, $2.50 each. 28v. at 7 amps. D.C. supply, $20. 40 watt plate modulator $18. 3" 0-1 (Marion) milliameter $5. Dual vibrator vibrapack 6v.-400v./120ma. $7. Superior 20 amp. variac model 136 $25. Set of new 175 watt modulation and driver transformers, $12. 150 watt set $10.40 watt set $7. New 304TL $12. Push to talk mobile carbon mike $4. Converted BC-457, combination VFO-exciter-xmitter, built in supply $20. Everything in clean excellent like new condition. Stan—W8QKU, 2748 Meade, Detroit 12, Mich.

Tell your novice friends that H & H has bargains in small transmitters; Globe Chiefs and Scouts, Knight fifty watters, Heath, Johnson and others at low, low prices. H & H Electronic Supply, 506 kishwaukee St., Rockford, Ill.

Surplus Bargains—Command Receivers BC-453, $13.95; BC454, $10.00; BC-455 New, $13.00; T-19/ARC-5, 3-4mc, $10.00; SCR-522 Transceiver, $19.50; BC-348 Receiver, $79.00; ART-13 Transmitter, $39.00. Send for new catalog. HI-MU Electronics Sales Company, 133 Hamilton Street, New Haven, Connecticut.

Wanted: R-388/URR receivers, any condition. Electronicraft, Box 399, Mt. Kisco, New York.

Sell: Eimac A54H Xmtr $60; James Vibrator Supply 6 or 12 volts $18, Johnson T-R Switch $22, K9MWM, 733 Oak Street, South Milwaukee, Wisconsin.

Sell: HQ-170, $260. Viking I, PTT, 6M, etc., $150. Johnson phone patch, $16. Jack Myers, W5KKB, 443 Centenary Drive, Baton Rouge 8, Louisiana.

College Bound: Must sell for tuition; Heath GC-1A "Mohican" performs like a dream. Best offer over $100. 100th brand new in box, two-meter converter, 80 meter mobile converter, six-volt dynamotor, 600 volts 225 ma; 80 meter mobile whip base, coil spring; best offer. K5QOM, Box—60A, Boyle, Miss.

WANTED: TELETYPE TG-7, Models 14, 15, 19, 26, 28, printers & reperforators: Rcvrs & xmtrs: AN/GRC-3 & higher, RT-66, -67, -68; Collins 51J, 17L3, -4, 18S-2, R-388, -390, -391: ARN-14 and -30; APR-9, -10, ARC-21, -27, -34; APS-10, -31, -33, -42, etc., and TEST EQP'T, TS or AN/URM. We pay freight. Amber Industrial Corp., 75 Varick St., New York 13, N. Y.

HRO-60 with calibrator all bands original carton and booklet mint condition $350. Phone HI 3-0803. H. Webb, 125 Ocean Ave., Jersey City, N. J.

College student wishes summer employment in Radio-Television field. Second Radiotelephone, Amateur licenses. Willing to travel. David Elliott, 136 Morris Pkwy. Valley Stream, N. Y. VA 5-7402.

100V approx. 40 hrs TT $495. New in factory sealed crate $595. NEED CASH have to sell one. K9CNG, Vandalia, Illinois.

NICE NOVICE XMTR—Heath AT-1 plus matching AC-1 coupler and 3 Novice Xtals. F.O.B. first $24. gets it. K1OMJ, 47 Prospect Street, Taunton, Mass.

FOR SALE: Heath DX-40 Xmtr, National NC-109 rcvr w/spkr, Heath Balun Coil set, Heath reflected power meter, Dow-Key coax relay, Bud Low-pass filter, Johnson Speed-X Auto. Key Crystal Mic., and Bud 100kc crystal calib. Excellent condition and $200 takes all. J. Fuhr, W3FHZ, 33 Hilltop Road, Levittown, Penna.

For further information, check number 47, on page 126

S. A. R. L.

The Saskatchewan Amateur Radio League welcomes all visiting radio amateurs and their families to Saskatchewan the land of wheat and holiday fun. If mobiling, the net frequency is 3780 and net meets at 1830 daily, but call in any time! 1961 Hamfest is June 30, July 1 and 2 at the well known Prince Albert National Park. If you are planning to visit our fair country let us know at the SARL, Box 801, Saskatoon, Saskatchewan, Canada . . . drive carefully and keep your fingers out of the HV . . .

3-400Z, 3-1000Z [*from page 58*]

filament tap point for C_2 occurs near to the top (filament end) of the coil. Adjustment of the tap-point may not be required.

It may be somewhat easier from a mechanical point of view to substitute a pi-network input circuit for the parallel *LC* circuit, as shown in fig. 3. Untuned filament chokes are used to supply filament voltage to the tube, and a simple fixed tuned pi-network circuit is employed to couple the exciter to the filament circuit of the 3-1000Z. The transformation ratio of the network is 1:1, matching the line to the tube, yet providing the *Q* necessary for proper circuit operation. The pi-network circuit and filament choke may be used for the 3-400Z tube, if desired. ■

C.W. Results [*from page 68*]

LZ2KBI	12,096	211	9	33	(Club Station)
LZ2KAG	10,528	186	9	38	(Club Station)
LZ1KDZ	8,692	190	8	33	(Club Station)
LZ2KST	6,000	132	9	31	(Club Station)
LZ1KLB	1,116	132	4	14	(Club Station)
Czechoslovakia					
OK3KAB	172,556	341	75	166	(Club Station)
OK3KAG	50,840	347	31	93	(Club Station)
OK3KAS	45,430	295	27	91	(Club Station)
OK1KSO	24,024	212	23	68	(Club Station)
OK2KHD	17,840	182	21	59	(Club Station)
OK1KCU	15,170	133	23	59	(Club Station)
OK1KCI	1,001	77	3	10	(Club Station)
England					
G3OHM	11,259	123	26	55	
Finland					
OH2AA	95,475	342	55	146	(OH2KH, 042KK, OH2LP)
OH9AB	2,480	58	13	27	(OH9NZ, OH90Q)
Germany					
DL3YQ	61,468	235	45	82	(DL3YO, DJ2JE, DJ5LE)
DM3BB	46,217	366	30	83	(3 Operators)
DM2ATL	44,516	291	32	92	(2 Operators)
DM3BM	42,003	242	47	76	(6 Operators)

Roumania

YO3KAA	198,504	602	59	157
	(Club Station)			
YO2KAB	142,044	588	40	93
	(Club Station)			
YO2KBB	6,588	92	17	37
	(Club Station)			
YO4KAK	4,680	99	11	25
	(YO4WA, YO4AH)			
YO6KAF	1,428	51	8	20
	(Club Station)			
YO4KBJ	6,000	121	8	32
	(YO4CS, YO4ZL)			

Sweden

SL2ZA	15,844	187	20	48
	(SM2BGG, SM2ALT, SM2BJS)			
SM6CCA	1,104	46	5	18
	(SM6CCA, SM6CMU)			

Yugoslavia

YU3BUV	43,164	272	32	77
	(Club Station)			
YU2HNO	6,255	95	11	34
	(Club Station)			

U.S.S.R.

European

UA3KWA	233,760	640	67	186
	(Club Station)			
UA3KMB	46,860	224	36	96
	(Club Station)			
UA4KHW	29,953	225	23	54
	(Club Station)			
UA6KAE	29,280	212	27	53
	(Club Station)			
UA3KUA	24,831	229	26	67
	(Club Station)			
UA3KIB	22,134	168	19	74
	(Club Station)			
UA6KTB	13,570	241	11	24
	(Club Station)			
UA3KYA	9,900	111	19	47
	(Club Station)			
UA3KAM	5,047	74	14	35
	(Club Station)			

Estonia

UR2KAE	71,526	421	35	96
	(Club Station)			
UR2KAW	67,158	454	35	91
	(Club Station)			
UR2KAH	6,965	183	8	27
	(Club Station)			
UR2KAG	1,770	65	7	23
	(Club Station)			

Latvia

UQ2KAA	48,372	410	32	83
	(Club Station)			

Moldavia

UO5KAA	147,562	696	47	131
	(Club Station)			

Ukraine

UB5KAB	637,980	968	101	271
	(Club Station)			
UB5KED	182,380	570	62	158
	(Club Station)			
UB5KAG	125,685	434	50	139
	(Club Station)			
UB5KBA	70,680	329	38	114
	(Club Station)			
UB5KEF	45,617	298	31	90
	(Club Station)			
UB5KDS	9,936	77	25	47
	(Club Station)			
UB5EF	8,848	120	14	42
	(Club Station)			

White Russia

UC2KAB	196,253	611	64	163

Oceania

Australia

VK5NQ	296,185	566	67	118
	(VK5NQ, VK5NO)			

MULTI-OPERATOR

Multi-Transmitter

North America

W3AOH	1,049,104	820	141	323
	(W3AOH, W3LMM, W3MVQ, W3QJJ, W3UHN, W3VKD, W3WGH, K3DKD)			
W3MSK	1,024,373	883	132	295
	(W3PZW, W3KZQ, W3MCG, W3FYS, W6HOH/3, W3MSK)			
W6RW	725,139	814	111	210
	(W6RW, K6EWL, K6KII, W6YMD, W6KFV)			
K6EVR	391,770	544	99	171
	(W6GFE, W6UED, K6EVR)			

Asia

UAØKKB	157,460	486	58	81
	(Club Station)			
UAØKYA	29,328	220	34	44
	(Club Station)			

Europe

OK1KKS	766,824	1309	100	259
	(Club Station)			
OK2KFK	60,060	312	39	104
	(Club Station)			
G3JUL	7,458	111	16	50
	(G3JUL, G3LOV, GM3HOM)			
OH1AA	181,792	454	66	181
	(Club Station)			
DJ3JZ	864,930	1245	98	232
	(DJ3JZ, DL1CR, DJ1BP, DL3AO, DL9CI, DJ1BZ, DJ4LI)			
UA3KAA	250,776	903	53	163
	(Club Station)			
UA4KYA	249,964	671	66	181
	(Club Station)			
UB5KBB	960,960	1460	110	310
	(Club Station)			

Our thanks to the following Stations for sending us their Logs for checking purposes.

W1MD	G3KKP	OK1EV	OK3KGI	SM5BHW
W2FXN	HB9IX	OK1KIY	OK3KGQ	SM5BKO
W1UQP	JAIAJA	OK1TJ	OK3KHE	SM5BPJ
W5ARJ	JA1LN	OK1WD	OK3KII	SM6CU
K6OHJ	JA8FO	OK1ZW	OK3ZM	TI2DN
W8HA	LA2B	OK2UZ	OY7ML	VK3GE
K9GTK	LA3SG	OK3AL	PAØLY	YV5FK
CX2BT	LA6CF/M	OK3CAT	SM3CJD	ZE3JJ
DM1066/M	OK1AW	OK3DG	SM3QA	ZE4JS
DM3LF	OK1AAA	OK3EE	SM3API/5	ZL3IS
F8DF	OK1AAZ	OK3KDH	SM3BAA/5	ZS6IX
FL9	OK1AWJ	OK3KIC	SM4CIP	

ADVERTISING INDEX

ACF Industries, Inc. 16
Allied Radio Corporation 128
Alltronics-Howard Company 125
Amateur Electronic Supply 111
Amateur Radio Exchange 122

Barker & Williamson Incorporated 108
Barry Electronics Corporation 121
Beam Radio Enterprises 125
Brown Electronic Inc. 114
Burstein-Applebee Company 116

C & G Electronics Company 121
Central Electronics Incorporated 15
Clegg Laboratories 102
Cleveland Institute of Electronics 14
Collins Radio Company ..... Cover II
Communications Equipment Company 125
Communication Products Company, Inc. 4
Cush Craft 124
Cowan Publishing Corp.
CQ's Ham Mart 113
CQ Ham Shop 118, 119, 120, 121, 122, 123, 124
CQ Subscription 115
CQ YL 115
CQ-VHF for the Radio Amateur 110

Dow-Key Company, Incorporated 116-124

E-Z Way Towers, Incorporated 117
Eddystone-Br. Radio, Elect. Limited 122
EICO 13
Eimac-Eitel-McCullough, Inc. 20
Electrophysics Corporation 106
Electro-Voice 17
Empire State Electronics 119

Finney Company (The) 18

Gonset Company 5
Greenlee Tool Company 119

Hallicrafters Company 2
Hammarlund Manufacturing Company 6
Hamboards 124
Harris Radio Supply Corp. 102
Harvey Radio Company, Incorporated 105
Heath Company 9, 10, 11
Henry Radio Stores 107
Hewlett Sales 101
Hornet Antenna Products Company 22
House of Antennas (The) 126
Hy-Gain Antenna Products 103, 118, 123

Instructograph Company 125
International Crystal Manufacturing Co. 21

J. M. Enterprises 126
Johnson, E. F. Company 24-25

Lafayette Radio 109
Lampkin Laboratories, Incorporated 125

McCoy Electronics Company 7
Millen, James Manufacturing Co., Inc. 12
Mosley Electronics, Incorporated 8

National Radio Company, Incorporated ..... Cover III

P & H Electronics 106
Palmer, Joe 118
Pennwood Numechron Company 124
Penta Laboratories, Inc. 23
Petersen Radio Company, Incorporated 1
Picon-ite 120

Radio Amateur's Bookshelf 112
RCA (Tube division) ..... Cover IV, 19
R W Electronics Electronics 120

S.A.R.L. 124
Shure Brothers, Incorporated 22
Skylane Products 120
Space Electronics Corporation 125

TAB 127
Technical Manuals Company 110
Telrex, Incorporated 115
Texas Crystals 104

U. S. Crystals, Inc. 117

VHF for the Radio Amateur 110
Vibroplex Company, Incorporated 108

Western Radio Company 120
World Radio Laboratories, Inc. 100

ALLIED saves you $60.00 on this famous NATIONAL

NC-66 PORTABLE RECEIVER and RDF-66 DIRECTION FINDER.....!

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Allied passes tremendous savings on to you! Receiver is the versatile, popular 3-way portable NC-66. Use it anywhere—on AC, DC or self-contained batteries. Tunes 150 to 400 kc and 500 kc to 23 mc in 5 ranges. Covers longwave, shortwave and standard broadcast bands. Built-in 5" PM speaker; ferrite loop for BC, whip antenna for SW. Size, 9¾ x 12¼ x 10". RDF-66 Direction Finder is an accurate navigation aid for pleasure craft, etc. Has built-in meter; one-null indication; 7 x 8½ x 10"; powered by the NC-66. Both units can be yours for far less than the original price of the receiver alone! Less battery. Shpg. wt., 25 lbs.

77 SX 984. NC-66 and RDF-66.
SALE PRICE.....**$79.90**
80 J 616. Battery for NC-66. Wt. 6½ lbs. **$ 5.57**

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☐ 80 J 616 Battery for NC-66

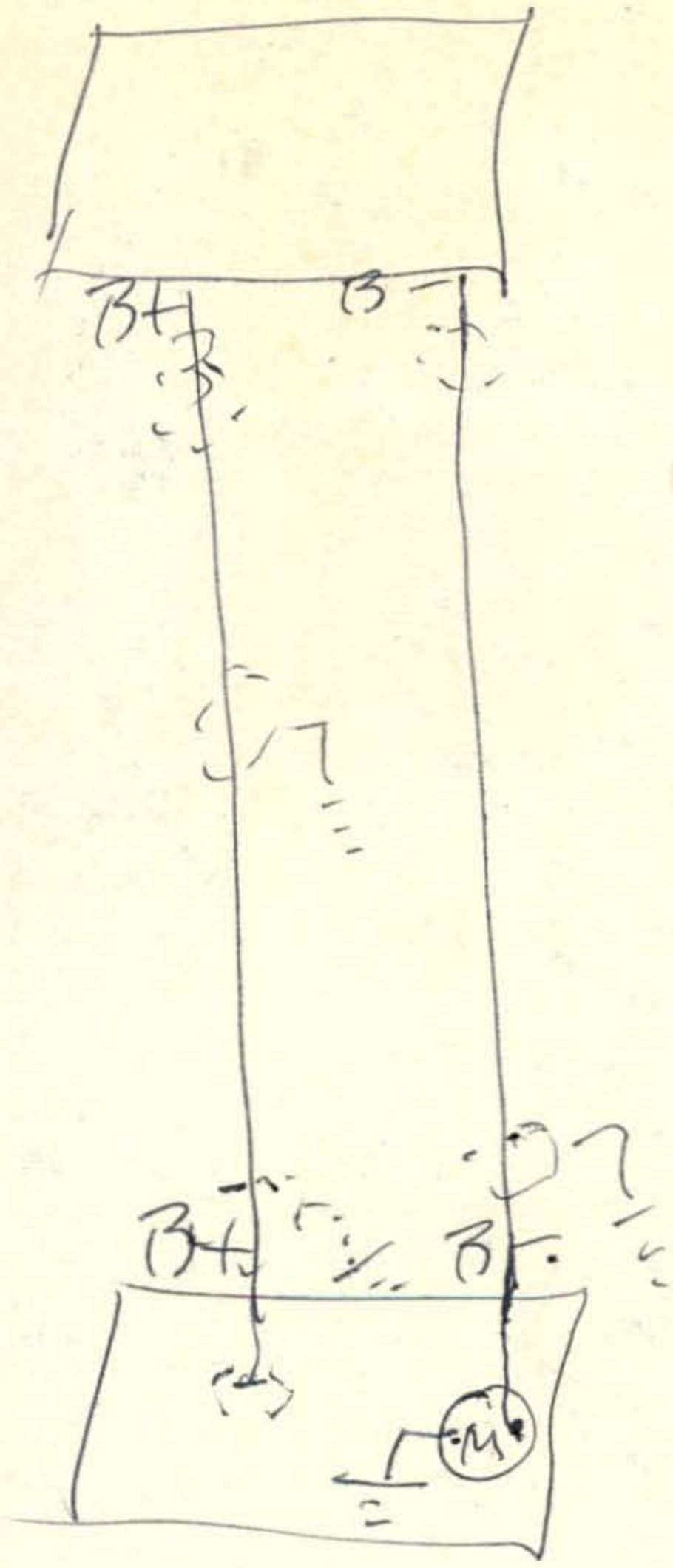
$.....enclosed

Name_____
Print

Address_____

City_____ Zone____ State_____

For further information, check number 49, on page 126



2 BANDSPREADS

Calibrated foreign broadcast bands, calibrated amateur bands, either at the mere flick of National's exclusive Dial Selector. Double-conversion in a general coverage receiver at only $199.50. True variable selectivity with National's patented "Ferrite Filter" to provide clear, readable AM, CW, and SSB reception. Sensitivity —better than 1 microvolt. Five bands—540 kc to 30 mc.

Latest addition to National's "Cosmic Blue" series. "Flip-Foot" equipped for effortless operation.

See it, and tune it for yourself.

NATIONAL RADIO COMPANY, INC.

MELROSE 76, MASS.

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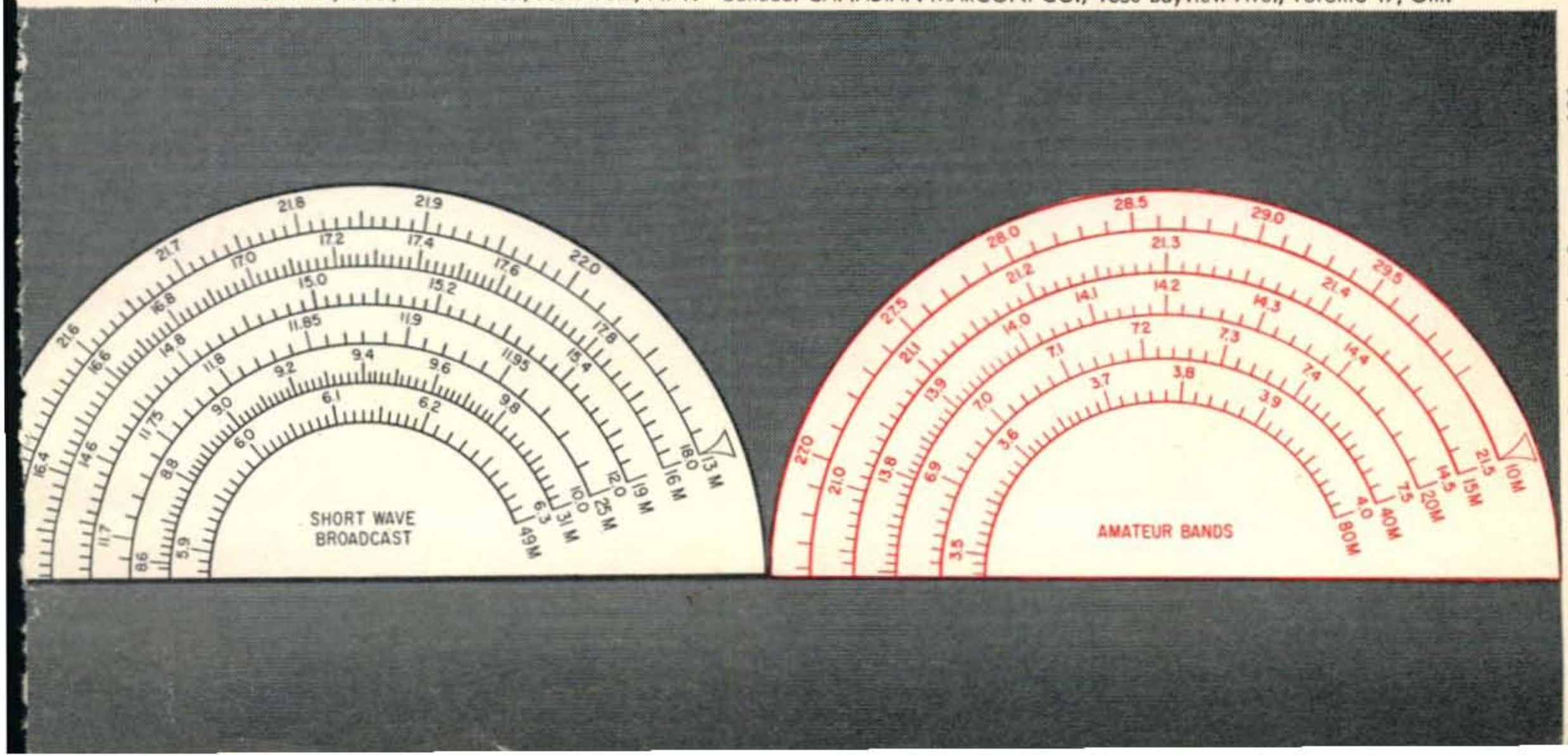
THE ALL NEW NC-190

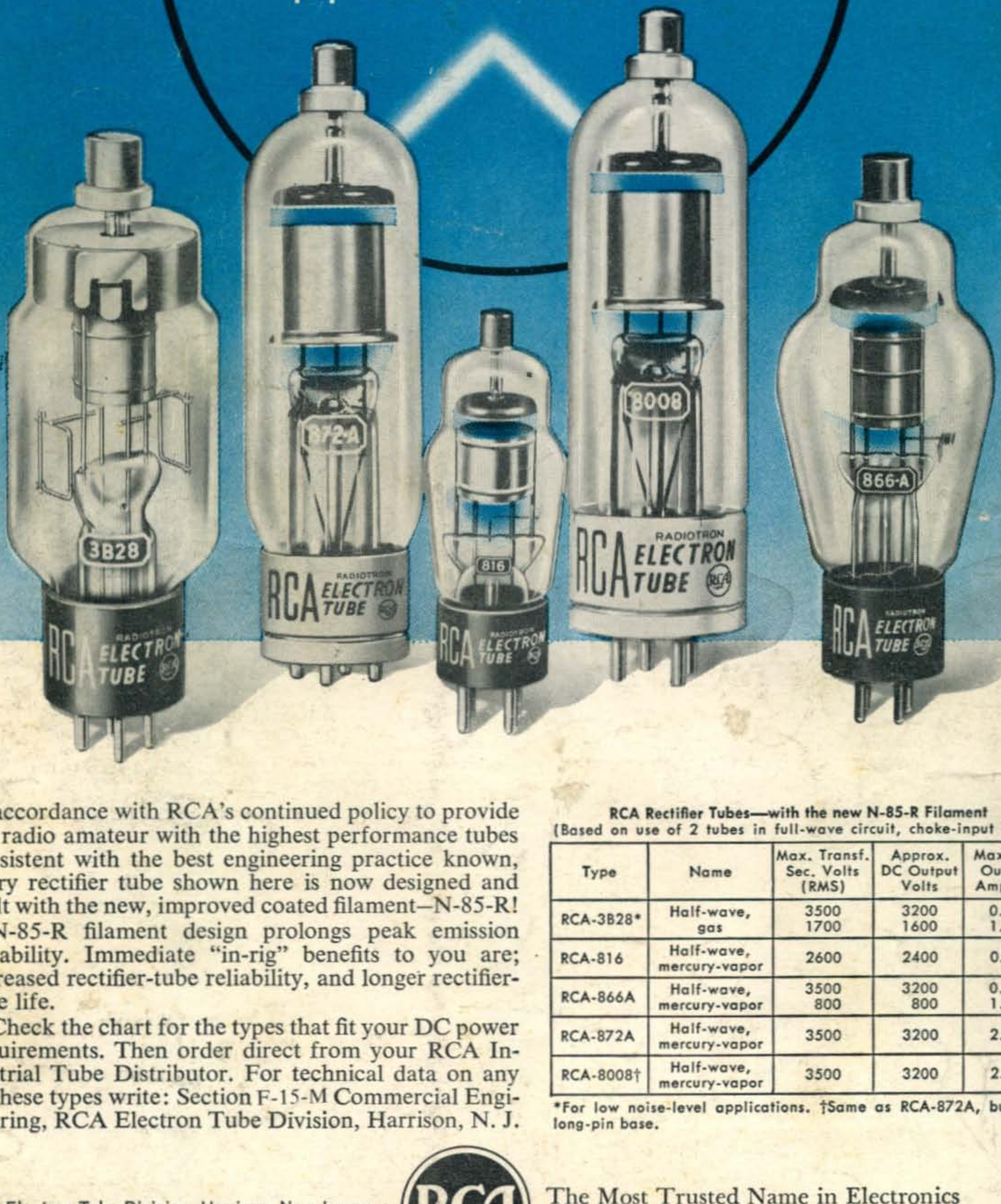
Export: AD AURIEMA, INC., 85 Broad St., New York, N. Y. Canada: CANADIAN MARCONI CO., 1830 Bayview Ave., Toronto 17, Ont.



For further information, check number 2, on page 126

NEW
N-85-R FILAMENT

adds even longer life to these popular RCA Rectifier Tubes



In accordance with RCA's continued policy to provide the radio amateur with the highest performance tubes consistent with the best engineering practice known, every rectifier tube shown here is now designed and built with the new, improved coated filament—N-85-R!

N-85-R filament design prolongs peak emission capability. Immediate "in-rig" benefits to you are; increased rectifier-tube reliability, and longer rectifier-tube life.

Check the chart for the types that fit your DC power requirements. Then order direct from your RCA Industrial Tube Distributor. For technical data on any of these types write: Section F-15-M Commercial Engineering, RCA Electron Tube Division, Harrison, N. J.

RCA Rectifier Tubes—with the new N-85-R Filament
(Based on use of 2 tubes in full-wave circuit, choke-input filte

Type	Name	Max. Transf. Sec. Volts (RMS)	Approx. DC Output Volts	Max. DC Output Ampere
RCA-3B28*	Half-wave, gas	3500 1700	3200 1600	0.5 1.0
RCA-816	Half-wave, mercury-vapor	2600	2400	0.25
RCA-866A	Half-wave, mercury-vapor	3500 800	3200 800	0.5 1.0
RCA-872A	Half-wave, mercury-vapor	3500	3200	2.5
RCA-8008†	Half-wave, mercury-vapor	3500	3200	2.5

*For low noise-level applications. †Same as RCA-872A, but h
long-pin base.

RCA Electron Tube Division, Harrison, New Jersey

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RADIO CORPORATION OF AMERICA