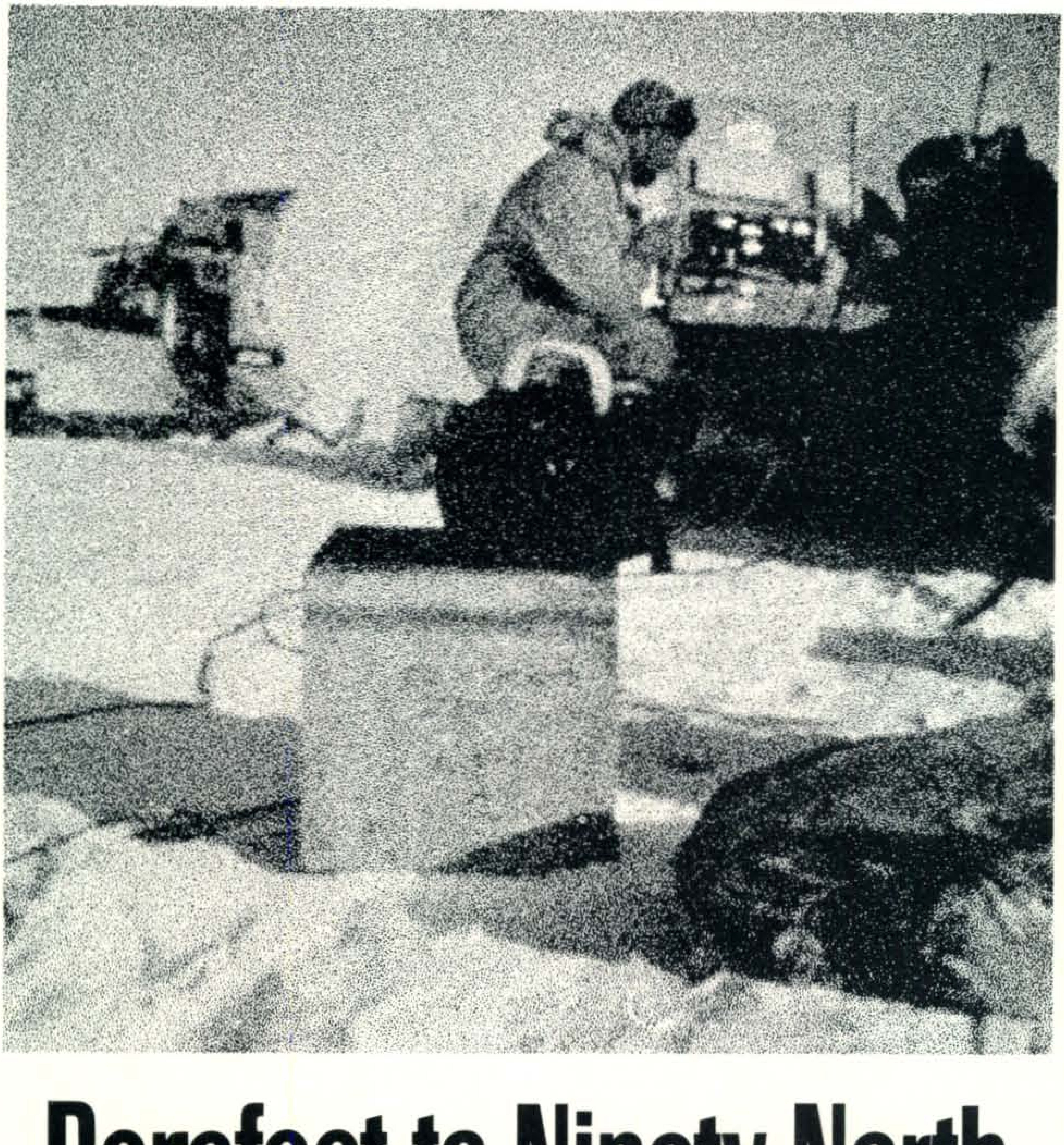
CQ

July 1968
75¢

CQ W.W. C.W. DX Contest Results: Page 34

The Radio Amateur's Journal



Barefoot to Ninety North

Four hundred seventy-five air miles—825 actual land miles—over the Arctic pack ice. Forty-four days on a frozen sea with temperatures down to 63° below. Finally: the Pole. Collins' KWM-2 furnished reliable communications every rugged mile of the Plaisted Polar Expedition. Just an example of the KWM-2's reserve performance and rugged dependability.

COLLINS

NEW FROM INTERNATIONAL

FM-2400 FREQUENCY METER

- For Mobile Or Base Station Use
- Tests Predetermined Frequencies 25 - 470 MHz
- Portable . . . Use It Anywhere

The FM-2400 is designed for testing and adjustment of mobile and base station transmitters and receivers at predetermined frequencies between 25 and 470 MHz. The FM-2400 provides an accurate standard frequency signal to which the transmitter can be compared. This same signal is applied to the associated receiver(s), thereby assuring an accurate frequency adjustment on all parts of the communications system.

Up to 24 crystals may be inserted into the meter for the selection of the frequencies required for testing of the system transmitters and receivers. The frequencies can be those of the radio frequency channels of operation, and/or of the intermediate frequencies of the receiver between 100 KHz and 100 MHz. Self contained unit. Battery operated.

FM-2400 (meter only)	**$395.00**
RF Crystals with temperature run	**$23.50** ea.
IF Crystals	
200 - 2,000 KHz	See Catalog*
2,001 - 13,000 KHz	See Catalog*

*WRITE FOR FREE CATALOG

INTERNATIONAL

CRYSTAL MFG. CO., INC.
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CQ

July, 1968 Vol. 24, No. 7

The Radio Amateur's Journal

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DEPARTMENTS

Offices: 14 Vanderventer Avenue, Port Washington, L. I., N. Y. 11050. Telephone: 516 883-6200.

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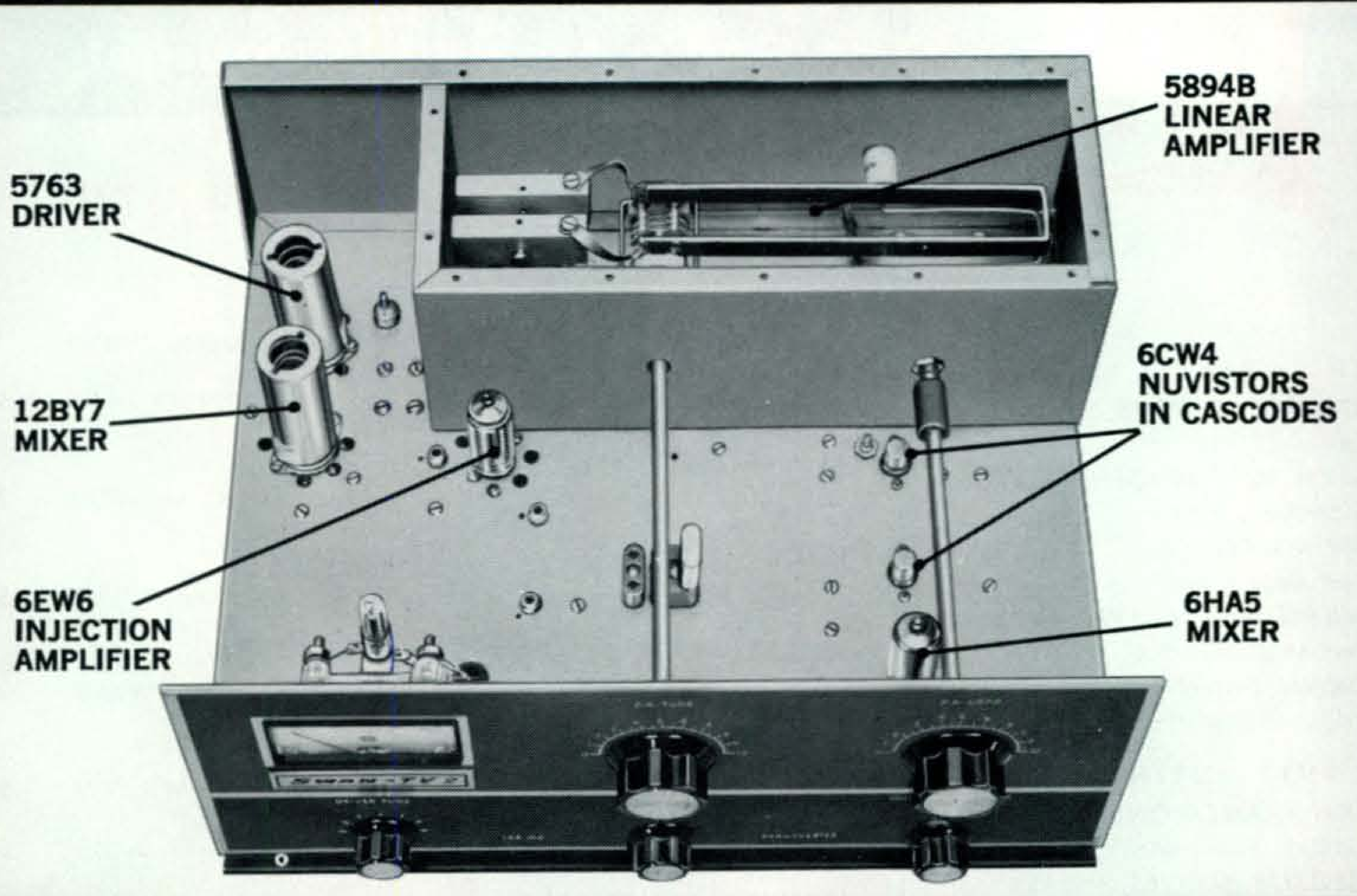
2 METER SINGLE SIDEBAND

144-148 mc 240 WATTS P.E.P. INPUT



THE NEW SWAN TV-2 TRANSVERTER

A receiving and transmitting converter for the 2 meter band, designed to operate with Swan Transceivers, models 250, 350, 350-C, 400, 500, and 500C.

SPECIFICATIONS:

14 mc intermediate frequency is standard. Thus, when operating the Transceiver from 14 to 14.5 mc, the Transverter functions from 144 to 144.5 mc. Additional crystals may be purchased and switched in for other portions of the 2 meter band, such as 144.5-145, and 145 to 145.5 mc. Three crystal positions are available.

Alternately, the TV-2 Transverter may be ordered for an I.F. in the 21, 28 **or** 50 mc bands, if desired. Of course, for use with a Swan 250 six meter transceiver, the Transverter must be ordered for 50 mc. Otherwise, the standard 14 mc I.F. is recommended since bandspread and frequency readout will then be optimum. The Transverter can easily be adjusted in the field for a different I.F. range, if required.

A 5894 B Power Amplifier provides a PEP input rating of 240 watts with voice modulation. CW input rating is 180 watts, and AM input is 75 watts.

Receiver noise figure is better than 3 db, provided by a pair of 6CW4 nuvistors in cascode.

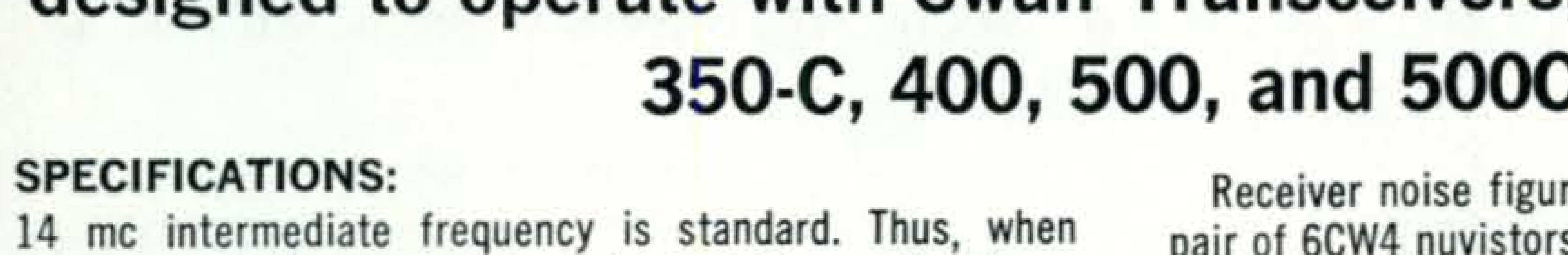
Only a Swan Transceiver and Swan AC power supply, Model 117-XC, are required. The power supply plugs into the Transverter, and the Transverter in turn plugs into the Transceiver. Internal connections automatically reduce the power input to the Transceiver to the required level.

Tube complement: 5894B Pwr. Amp., 5763 Driver, 12BY7 Transmit Mixer, 2N706 crystal osc., 6EW6 Injection Amp., 6CW4 1st rec. amp., 6CW4 2nd rec. amp. in cascode, 6HA5 rec. mixer.

The Swan TV-2 may also be operated with other transceivers when proper interconnections and voltages are provided. A separate Swan 117-XC power supply will most likely be required.

Dimensions: 13 in. wide, 5½ in. high, by 11 in. deep. Weight: 13 lbs.

$265



MODEL 250 ...... $325
MODEL 350C 420
MODEL 500C 520

MODEL 117-XC
AC POWER SUPPLY .. $105

MODEL TV-2
144 mc TRANSVERTER

SWAN
ELECTRONICS
Oceanside, California
A SUBSIDIARY OF CUBIC CORP

ZERO BIAS

It's interesting how we amateurs seem to live by a distorted and often hypocritical set of standards. I'm not about to get up on my soap box and preach; I'm too confused about what ails us to do that, but rather I'd like to share a few thoughts.

For over four years we've been surrounded by controversy stemming from the word "incentive." Someone dared to suggest that American amateurs were not as adept and knowledgeable about their medium–radio–as they might be, and that someone–ARRL–proceeded to move to rectify the situation. Four years of squabbling and disention ensued, with opinion often appearing to be evenly divided between "Yes, let's improve ourselves" and "I'm ok the way I am." Finally, last Autumn, the decision was made by FCC to adopt an incentive program of amateur licensing which would attempt to upgrade the technical status of American amateurs. The squabbles surged forward one last time and then subsided, seemingly for good.

Two months ago, a new cry was heard, this time from the new amateur radio section of EIA. The latest contention is that amateur standards in the U.S. are too high for the newcomer, and must be reduced or we will risk the demise of our hobby. Funny, isn't it, how the pendulum swings? And funny, too, how the reaction of the individual amateur has swung in the opposite direction. Only a year ago so many readers argued against the upgrading of amateur license exams, with many voicing fears that the too-high standards would stiffle the hobby. What we hear now is just the opposite. The proposal now is for reduced standards, but the public reaction is much the same. Our letters-to-the-Editor column this month gives only the scantest suggestion of the volume of similar mail we've received in the past few weeks. The average reader just won't hear of lowering the standards. Now suddenly, the code becomes important to these amateurs, and the technical examination becomes a needed weeding out device.

As I said at the start, I'm not criticizing or taking a stand. The whole thing has me a bit baffled right now, but I thought you might like to wonder along with me.

More Reading In Store

A year ago, *CQ* did a little much-needed facelifting, bringing new life to an otherwise good magazine. The addition of four-color covers, higher quality paper, and color throughout the magazine seemed to alter the attitudes of readers and authors alike, with a more aware and up-to-date feeling permeating the pages month after month.

Also at that time we hinted of better things to come, so beginning next month and continuing at least through the November issue, *CQ* will expand at the rate of eight pages a month with the goal 152 pages for November. Further growth depends on several factors: reader support, advertising support, rate of supply of articles, and most important, the number of *new* subscribers we can add to the *CQ* subscription roles as a result of publishing the most exciting magazine in amateur radio.

The advertising boys and circulation department are carrying the ball in their own areas, but the quality and quantity of editorial material in *CQ* is largely dependent upon the every day ordinary *CQ* reader who is responsible for fully *two-thirds* of the non-column text we print each month. Check a few issues. You'll notice that the great majority of authors are *not* the professional or semi-pro writers who eke out a living behind a typewriter. Most articles are written by John Q. Amateur who will probably publish a single article in his literary "career".

What we're leading up to is that in the months to come, *CQ* will be printing a great many more articles than it has before, and *they will be the best.* High editorial standards cost money. We're willing to pay, at the highest rates in the field, and if you've got something we really want, no magazine in amateur radio is going to out-bid us! That's a promise. A lot of good reading matter is going to go unpublished in *CQ* simply because good isn't going to be enough. The Best is what *CQ* represents from here on in.

73, Dick, K2MGA

See page 118 for New Reader Service

LARGE ANTENNA LOAD

BUILT FOR WIND

THE TRI-EX FREESTANDING

LM 470

(70 FEET HIGH)

This advanced state of the art tower is aerodynamically designed to reduce tower wind drag. This means you can carry more antenna than ever before. Tri-Ex engineers have made this possible by using high-strength, solid-steel rod bracing. Only at Tri-Ex do you get "W" type continuous truss bracing. Developer of the freestanding, crank-up tower, Tri-Ex prides itself on the quality of its products. More Tri-Ex crank-up towers are in use today than all other crank-up towers combined. Find out why the LM 470 tower is such an outstanding success. Write today for free literature.

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Tri-Ex TOWER CORPORATION 7182 Rasmussen Ave., Visalia, Calif. 93277

OUR READERS SAY

EIA Proposal

Editor, *CQ*:

Now that the EIA has proposed a "code free" license, I expect eventually to read that someone has proposed that literacy be eliminated as a requirement for a license, as this may be preventing many prospective hams from getting on the air. Amateur radio does not need anyone who is too lazy (or too stupid) to meet a ridiculously low code requirement of five words per minute.

I hope that the EIA will have something constructive to offer to amateur radio, but in the meantime, I must view their motives with a great deal of suspicion. Their ultimate purpose is, obviously, to make money. Now I am all in favor of this, but at the same time, I sincerely believe that amateur radio would be a lot healthier if it were less commercialized.

I would like to offer my own "radical proposal". Only homebrew equipment should be allowed on the amateur bands!

Robert V. McGraw, W2LYH
Riverhead, New York

Assistance, Please

Dear Dick:

I have been a ham radio operator for eight years, holding a General license, and a U.S. Navy Radioman for the last five and a half years. Most of the last five years have been spent in the Far East, with very little time to devote to amateur radio.

Now I am stationed at Naval Communications Station, Japan on shore duty for three years, and I would like to, once again, become active in amateur radio.

There are several military clubs in the area, but my recent experience with the club on Yokosuka Naval Base has been anything but satisfactory.

I would sincerely appreciate any information you or your readers could give me on obtaining a license from the Japanese Government and/or information concerning Japanese Radio Clubs where I could meet some of the Japanese Amateurs in my local area.

My local address is: David E. Schmaus, 1-24 Mabori-Cho, Yokosuka, Kanagaw-Ken, Japan. My Military address is: Box 67, FPO San Francisco 96662.

Any help you could give me would be sincerely appreciated.

David E. Schmaus, K9ZXI/JA
Yokosuka, Japan

With all those JA readers on the *CQ* subscription rolls, Dave should have little trouble meeting the locals.—*Ed.*

$30 Mobile Power

Editor, *CQ*:

A recent article in the February 1968 *CQ* entitled "A Mobile Power Supply for $30" tells how a 175 watt Heath MP-10 Marine Power Converter can be used in adapting a.c. transceivers for mobile use. Basically the article itself is quite good, but I must disagree with a casual comment made at the bottom of page 65, "By the way, if you need more power, two or more converters may be hooked in parallel".

It is next to impossible without the use of highly sophisticated external circuitry to keep these two converters properly synchronized. If they are not, there will be huge quantities of circulating current flowing between the converters resulting in burning out either one or both of the converters if they are not properly protected. If they are, the protection circuitry will trip immediately, preventing any output power.

Because of this I would highly advise your readers against such a procedure.

Lou Schornack, KØQAZ
Los Angeles, California

Lazier—Yet Mobile Protection

Editor, *CQ*:

I have just read with interest the article "The Lazy Man's Mobile Protector", by David J. Goodman in May *CQ*.

Other readers may be interested in knowing that anti-theft door lock knobs are on the commercial market for those not having the time or inclination to make their own.

One such source is the Warshawsky Co., 1900-24 South State Street, Chicago, Illinois 60616. Their catalog No. 313 lists these devices on pages 3 and 46.

M. A. Ellis, K1ORV
Sudbury, Mass.

Man, that's lazyiness!—*Ed.*

Navy MARS

Editor, *CQ*:

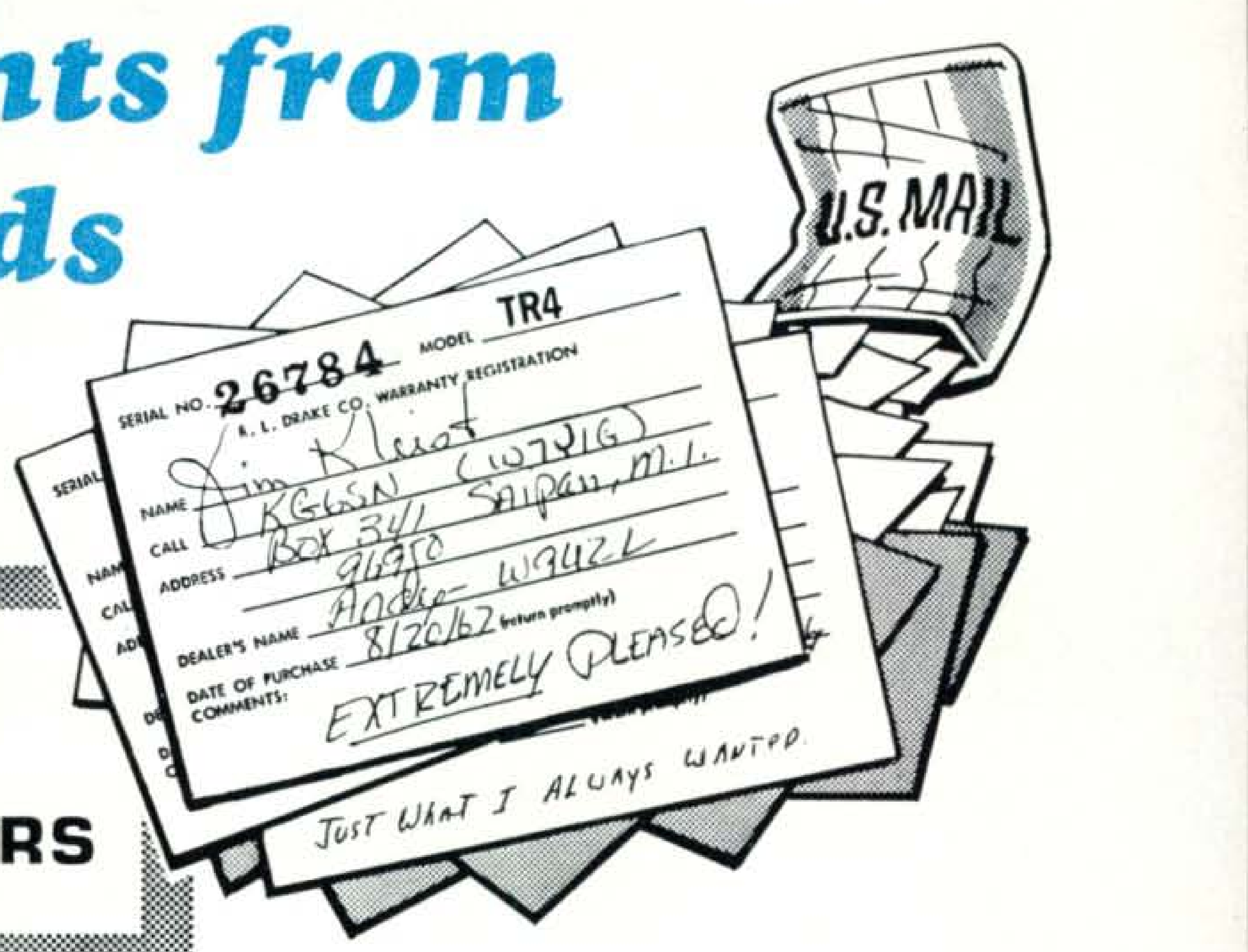
Navy MARS, for the information of possible applicants, has more member stations in this area than can be used, except for two meter stations. I think it would be advisable for any amateur who wishes to get into traffic handling to investigate all MARS branches first. Otherwise, he may find he has nothing to do.

I have been a member of Navy MARS since February, 1967 and have never been assigned to a net or even used my call sign. I joined only because I had late model equipment, full legal power and thought there was a need for stations to move what must be a great deal of traffic. After repeated requests to be assigned to a net, I was informed that Navy MARS had all the stations they could use except for two meter stations. The amateurs who are in the nets are evidently doing a very efficient and commendable job, and deserve a rousing vote of thanks. I hope the other branches of MARS are doing as well, and I am sure they are.

C. R. Ferguson, WB6DUC
Half Moon Bay, Calif.

See page 118 for New Reader Service

Some comments from warranty cards by owners of



DRAKE TR-4 SIDEBAND TRANSCEIVERS

"The TR-4 is the best rig I have ever known to be made. Glad to own one."

Dan Tangorra, WA7FWH
Tacoma, Wash.

"Finally got what I wanted!"

Ronald E. Lyons, WB2BQX
Oakhurst, N. J.

"A superb piece of equipment, no comments necessary.

C. G. Noakes, G3UHR/VO2
Labrador City, Newfoundland

"Great rig—First contact was an ON5 in Belgium."

Bill Busse, WA9TUM
Mt. Prospect, Ill.

"Best gear I have had the pleasure of working with. Receiver is exceptionally sharp and stable."

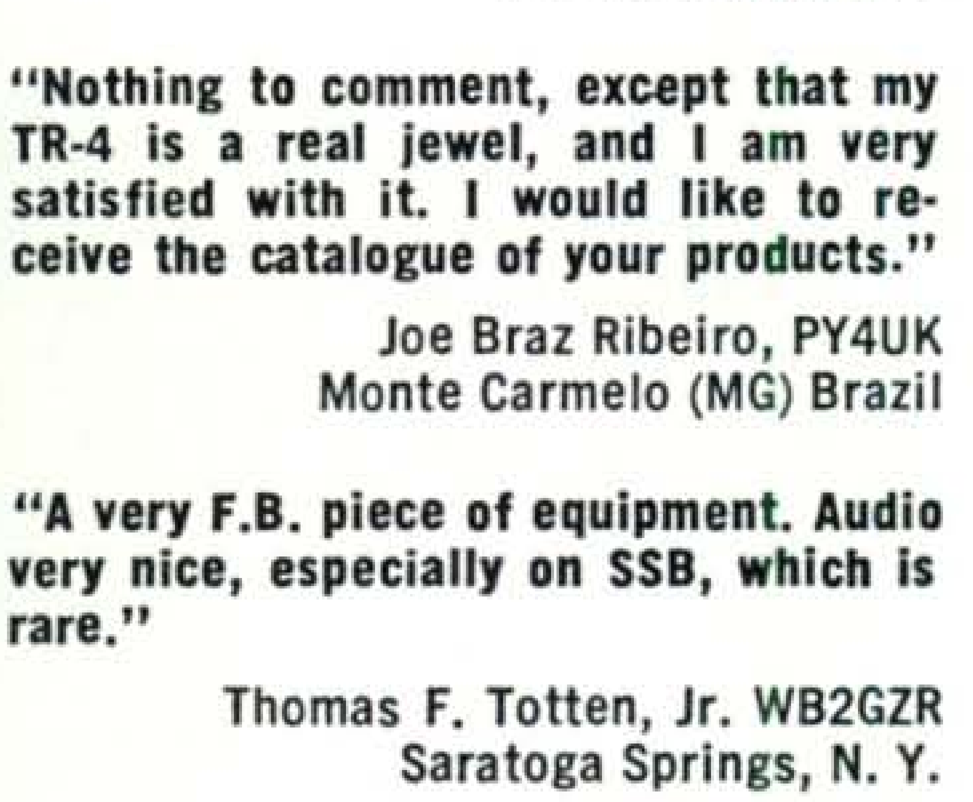
Albert V. Mitchell, WA9BUP
Jeffersonville, Ind.

"Nothing to comment, except that my TR-4 is a real jewel, and I am very satisfied with it. I would like to receive the catalogue of your products."

Joe Braz Ribeiro, PY4UK
Monte Carmelo (MG) Brazil

"A very F.B. piece of equipment. Audio very nice, especially on SSB, which is rare."

Thomas F. Totten, Jr. WB2GZR
Saratoga Springs, N. Y.



"Running it with a Mosley "Classic" beam and proves a most fine and nice transceiver. Really proud of it."

Orlando Escudero O., CE-3-OE
Santiago, Chile

"Looks good—sounds good—very well pleased with performance."

Wayne M. Sorenson, WAØETL
St. Paul, Minn.

"Have had Drake 2-B for three years. Knew that TR-4 was same Good Stuff."

Charles E. Bishop, WA8FTT
Columbus, Ohio

"Just what I always wanted."

Daniel N. Hamilton, WA4WXQ
Ashland, Va.

"Why not build a good 6 Meter SSB & AM Transceiver . . . hurry up, I'm waiting."

Harold A. Zick, WA9IPZ
Creve Coeur, Ill.

"Excellent equipment."

W. T. Newell, WB6UZU
Palm Springs, Calif.

"O.K. 100 x 100. RV-4: O.K./W-4: O.K./ L-4: O.K. Very Good!"

Franscisco Fau Campmany, TI-2-FAU
San Jose de Costa Rica

"A beautiful piece of equipment. My second piece of Drake. The first was a 2-B and this sold one friend an R-4 receiver and another a TR-4. We are Drake-minded here in town. Many thanks."

Charles E. Boschen Jr., WA4WXR
Ashland, Va.

"I'm sure this, like the other Drake equipment I have, is the finest money can buy. YOU MAY QUOTE ME ON THAT."

C. E. (Ed) Duncan, WA4BRU
Greenville, S. C.

"I'm a real happy man with it. Does a real good job of getting thru."

Jerome D. Lasher, W2RHL
Hamburg, N. Y.

"Replaces my TR-3."

D. G. Reekie, VE 6 AFS
Calgary Alberta Canada

"Finest performing gear I have ever had the pleasure of operating."

Milton C. Carter, W2TRF
Lakewood, N. J.

"PS Several months have passed . . . I now employ TR-4 as mobile unit and base station. I have logged more than 1000 contacts, many being rare DX. I am looking forward to owning a second unit to be used strictly for mobile. To date TR-4 has been trouble-free."

Milton C. Carter, W2TRF
Lakewood, N. J.

"Well pleased."

Rev. James Mohn, W3CKD
Lititz, Pa.

"I am delighted with Drake gear. This is the second of your transceivers for me. I have used a TR-3 in my car for about 2½ years — only trouble: replacing a fuse!"

Guy N. Woods, WA4KCN
Memphis, Tenn.

"Ask the ham who owns a Drake TR-4"

. . . or write for details . . .

Dept. 258 **R. L. DRAKE COMPANY** 540 Richard St., Miamisburg, Ohio 45342

See page 118 for New Reader Service

Announcements

London, England

An unusual feature of the 1968 City of London Festival, July 8th-20th, will be the amateur radio station installed and operated by the Radio Society of Great Britain. The G.P.O. has granted the use of the callsign, GB2LO. Equipment will be loaned by K. W. Electronics and will be operated by volunteers on the 10, 15, 20, 40 and 80 meter bands. Operation will be on single sideband only.

Conconully, Wisconsin

The Okanogan Valley International Hamfest will be held on July 27 and 28 at the Conconully State Park, Conconully, Wisc. Registration for hams is $1.50 and a piece of junk; XYL's $1.00. For further information contact Harlan R. Tverber, WA7DFP, P.O. Box 1420, Omak, Wash. 98841.

Evansville, Indiana

The Tri-State Amateur Radio Society's Twenty-first Annual Hamfest will be held July 21, 1968, at the 4-H Center on North 41 Highway. Advance registration $1.50 and $2.00 at the door. For details contact Jack Young, K9LAU, P.O. Box 492, Evansville, Indiana.

Chatham, Illinois

The Quad-Co. Amateur Radio Club will sponsor the 11th Annual Hamfest of the Breakfast Club on July 20 and 21 at Terry Park. All other groups are invited, giving prior notice to the hamfest committee. Mobile talk-in on 3873 kc from noon Saturday until 11:00 A.M. Sunday.

Pre-registration until July 7th is $1.00; $1.50 at the gate. Write "Hamfest" c/o Quad-Co. ARC, Inc., Box 323, Chatham, Illinois 62629.

Oak Ridge, Tennessee

The Oak Ridge Radio Operator's Club will sponsor the 18th Annual Crossville Picnic at Cumberland Mountain State Park July 20 and 21. For information, write The Oak Ridge Radio Operator's Club, Inc., P.O. Box 291, Oak Ridge, Tennessee 37830.

Terre Haute, Indiana

The Wabash Valley ARA will hold its 20th Annual VHF Picnic on Sunday, July 28, 1968, at Turkey Run State Park. One dollar registration charge at the gate only. Mobile check-in on 52.525 mc.

Navajo Celebration

To help the Navajo Indian people of Arizona and New Mexico celebrate the centennial of the signing of the treaty with the United States government and their consequent long walk back to their homeland from Ft. Sumner, K7NCR will be on the air from the site of several of the centennial celebrations. From July 4 to July 6 and again from August 30 to September 2. K7NCR will be located at Window Rock, Arizona, the capital of Navajoland. A special QSL card printed by the Navajo Tribal Printing Department will be sent to all stations contacted.

New Orleans, Louisiana

In commemoration of the celebration of the 250th anniversary of the founding of the City of New Orleans in 1718 by Jean Baptiste Le Moyne, Sieur de Bienville, the Greater New Orleans Amateur Radio Club is offering a Commemorative Certificate to any amateur who submits a log extract indicating two-way communication on any bands, in any mode, with three Metropolitan New Orleans Area amateurs during 1968. With the log, send a s.a.s.e. to the Greater New Orleans ARC, 2935 International Trade Mart Tower, 2 Canal Street, New Orleans, La. 70130.

West Paterson, N.J.

The Knight Raiders VHF Club will hold its Second Annual Hamfest on Saturday, July 20, 1968 at Weasel Drift Picnic Grove, West Paterson, N.J. from 10 A.M. until dark. Picnic tables and barbecue pits are available. No tickets, no fee. Refreshments available. Talk in station K2DEL/2 will operate on 50.4 mc and 146.898 mc. Special certificate for contacting the talk in station available. Many door prizes.

Henderson, Kentucky

The annual Hamfest of the Henderson Amateur Radio Club will be held on Sunday, July 28, 1968, rain or shine, at the Audubon Raceway. For more information, contact WA4WTE, Box 83, Henderson, Kenttucky 42420.

Phoenix, Arizona

The Amateur Radio Council of Arizona will sponsor a Hamfest in Flagstaff, Arizona on July 26, 27, and 28. The Hamfest will be held at Fort Tuthill in Coconino County Fairgrounds. There will be talk in stations for mobiles on 3878 kc and 50.34 mc. For further information write to the Amateur Radio Council of Arizona, P.O. Box 6602, Phoenix, Arizona 85005.

Paducah, Kentucky

The Paducah ARC will hold their Annual Ham Picnic at the Noble Park Community Center, Paducah, Kentucky, on July 14th. Lunch will be served. Bring along your swap material and equipment. For further information contact Don Fuller, WA4LME, 247 Seminole Drive, Paducah, Ky. 42001.

Fond Du Lac, Wisconsin

The 1968 Wisconsin Nets Association Picnic will be held July 14 at Fond Du Lac, Wisconsin in Lakeside Park. For further information contact K9GSC, Kenneth A. Ebneter, 822 Wauona Trail, Portage, Wisconsin 53901, or ask on any of the Wisconsin nets.

Greenville, Pennsylvania

A Novice Worked All States Net is being formed. The net will meet on 7.170 mc with an auxiliary frequency of 7.179 mc. Registration forms and more information can be obtained from either WN2EKW, 260 Ellen Drive, Buffalo, New York or WA3JDT, 4 Homer Street, Greenville, Pennsylvania.

See page 118 for New Reader Service

SCRATCHI

Feenix, Ariz.

Deer Hon. Ed:

By gollies, there ought to be a law against what sum peeples doing on the air these days —it's outrageous, that's what it is. I so disgusteded with things I riting you because thinking you can do something about it.

So, hon. Ed., pleese taking your feets off your Hon. Desk and paying attenshun. I'm surely you wanting to rite red-hots editorial on subject before next issue of your Hon. Mag getting pressed.

Yestiday being Sunday, Hon. Brother Itchi desiding it be nice to take ride around country-side and do a little exploring of back roads. Even have XYL-to-be, Lil, pack picnic lunch for the two of us.

So, we hedding into foothills, and having pleasant morning in Hon. Jeep. Come middle of day we picking shady spot under cupple clumps of cactus and disposing of Lil's lunch, along with cupple cups of ice-cold cactus jooce.

Taking off again after lunch, and cupple hours later sky getting black, and hevvins are opening up with granddaddy of cloudbursts. If you knowing Arizona, you knowing person doesn't keep driving on back roads in cloudburst. Every dip in road getting six feets of water in it.

So, we pulling over, and Itchi suggests we have QSO on car rig to passing time until storm being over and it safe to driving again. I turning on rig and sending out snappy two minute seek-you, and feller coming rite back.

Big surprise—he Indian feller on neerby reservayshun, he telling us. Handle is Talking Bull. We exchanging signal reports, then I telling him we in middle of 1/c desert downpour.

He coming back and saying maybe he can fixing it for us, on acct. He knowing peechy Indian chant to stopping rain. Kinda like Indian rain dance, only no dancing—he just saying words backwords. Hon. Brother Itchi getting on mike, and laffingly telling Talking

Bull he being big kidder. Homsumever, Talking Bull saying he not kidding, and he going to prove it. He asks us exactly where we are so we telling him our exact locayshun.

Next transmission Talking Bull coming on and beginning this kind of Indian chant. Reel gibberish it sounding like, Hon. Ed. Then he saying he giving countdown, and when he gets to zero, rain stopping. He starting: Twenny, nineteen, ate-teen, and so on down to three, two, one . . . and zero.

Hokendoke Hackensaki!! Just when he saying "zero", rain letting up, and in time it takes gopher to disappear in his hole, rain are stopped!! Well, both Itchi and Scratchi mighty impressed, I telling you!

We go back on air to tell him it working, and asking him more about rain-stopping chant, but he just saying something about maybe next time we not laffing at old Indian lore, and he signing off.

As we riding back to ranch, Itchi saying maybe there are something to this Indian legend, and he wanting to find out more about Talking Bull. So, when getting home, I looking up call-letters in Hon. Callbook.

Sure enough, feller are having QTH on Indian reservayshun, only name listed are not Talking Bull, but maybe he listing his American name. Funny thing, though. He Hon. Master Sgt. in U.S. Air Force!

When Itchi heering this, he saying he having friend in Air Force, so he getting on landline and calling him. He first asking cupple questshuns, then he laffing like furies. He explaning to friend what happening, then he laffing lots more.

After he hanging up, he still laffing, but he finely telling me what happening. It seeming this feller are 1/c honest-to-gracious Indian, but he also in charge of U.S. Air Force weather radar stayshun. It covering hole state of Arizona, and with this radar he can seeing where rain is falling anyplace in state.

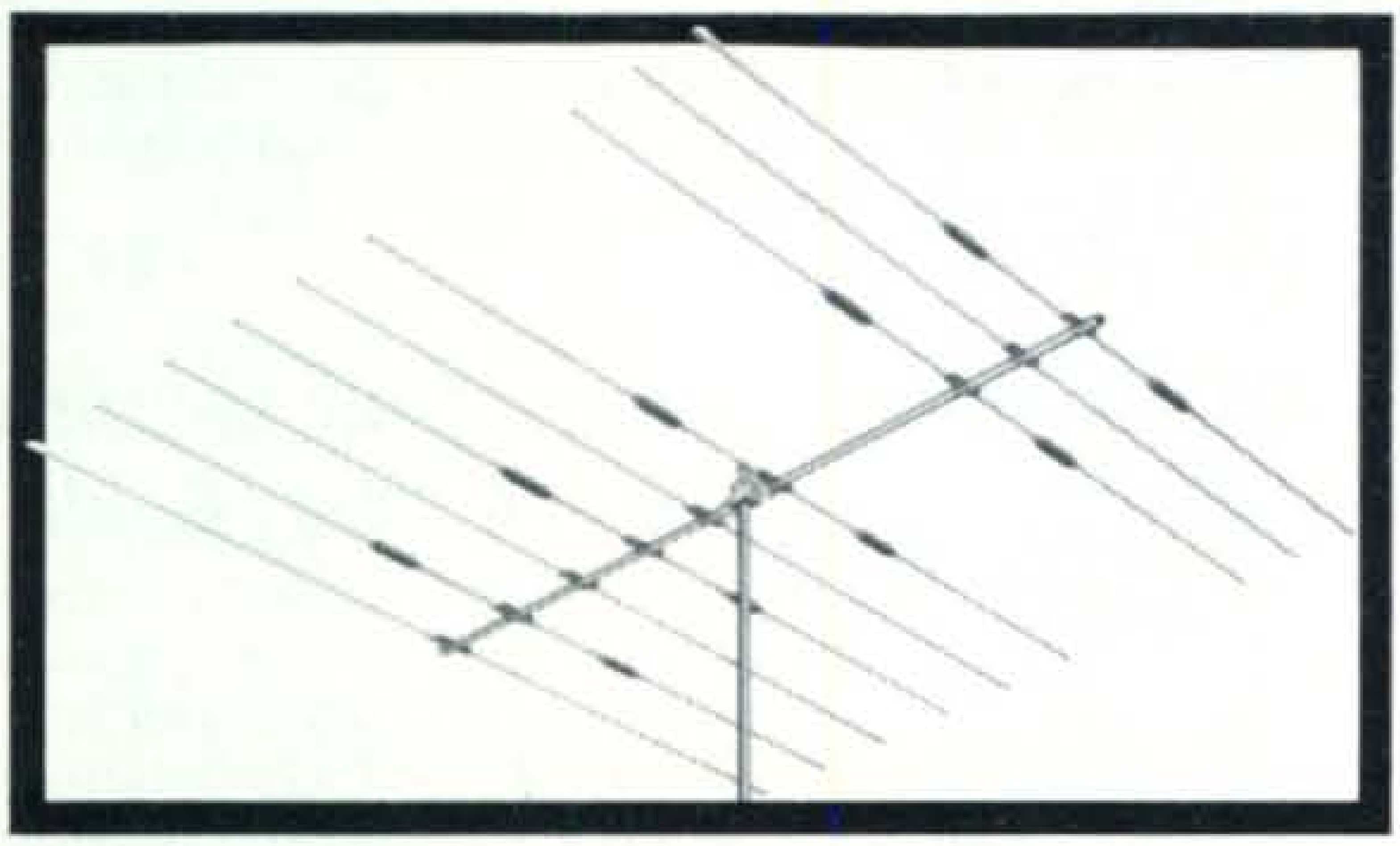
So, when he QSO'ing us, he can see rain are about to quit, so he giving us olf phoney Indian chant just as rain-storm as shown on radar are leeving us.

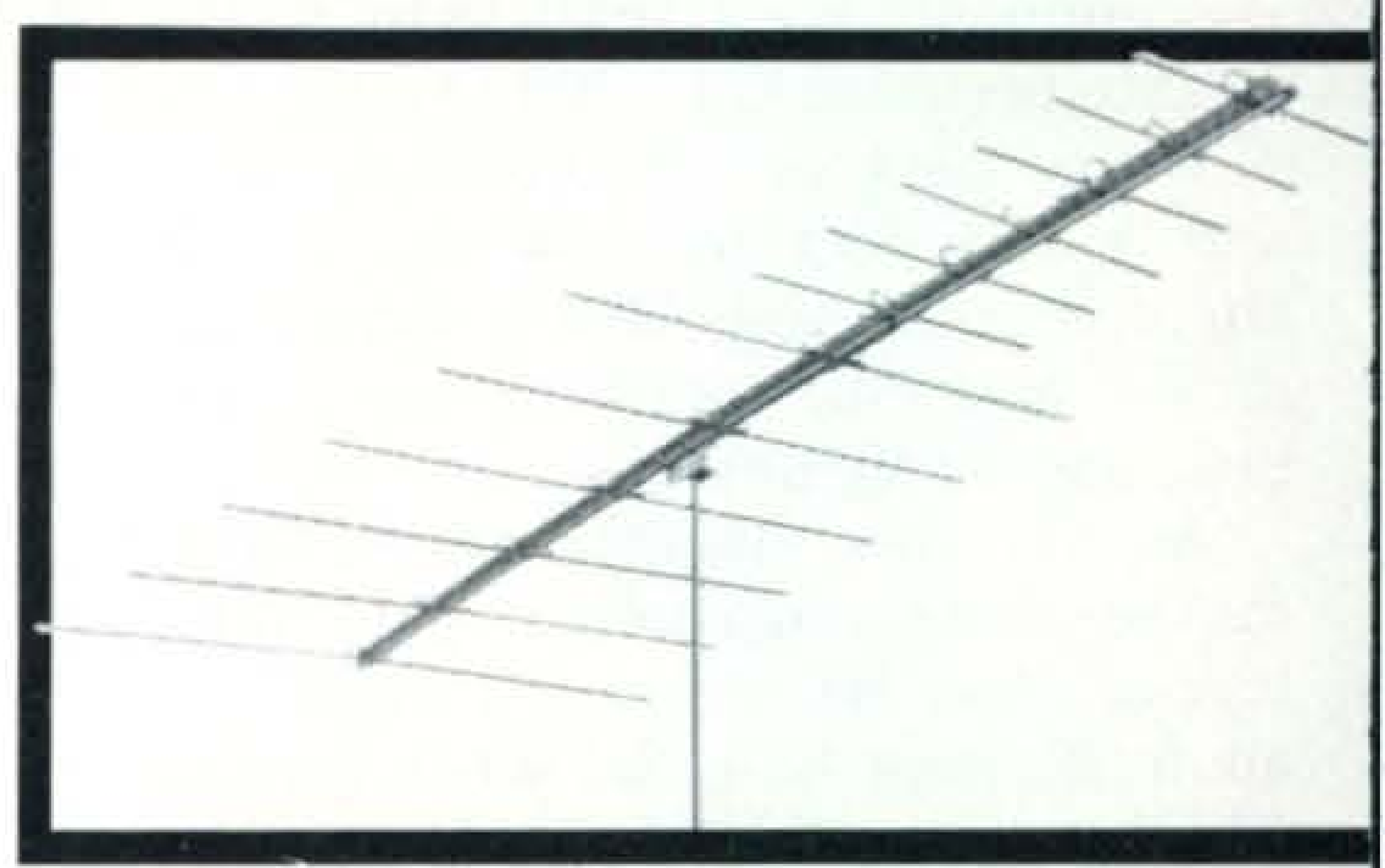
I telling you—I pretty incensed about hole thing, and I explaining to Itchi amchoors not supposed to doing things like that. Homsumever, Itchi having last word, as usual.

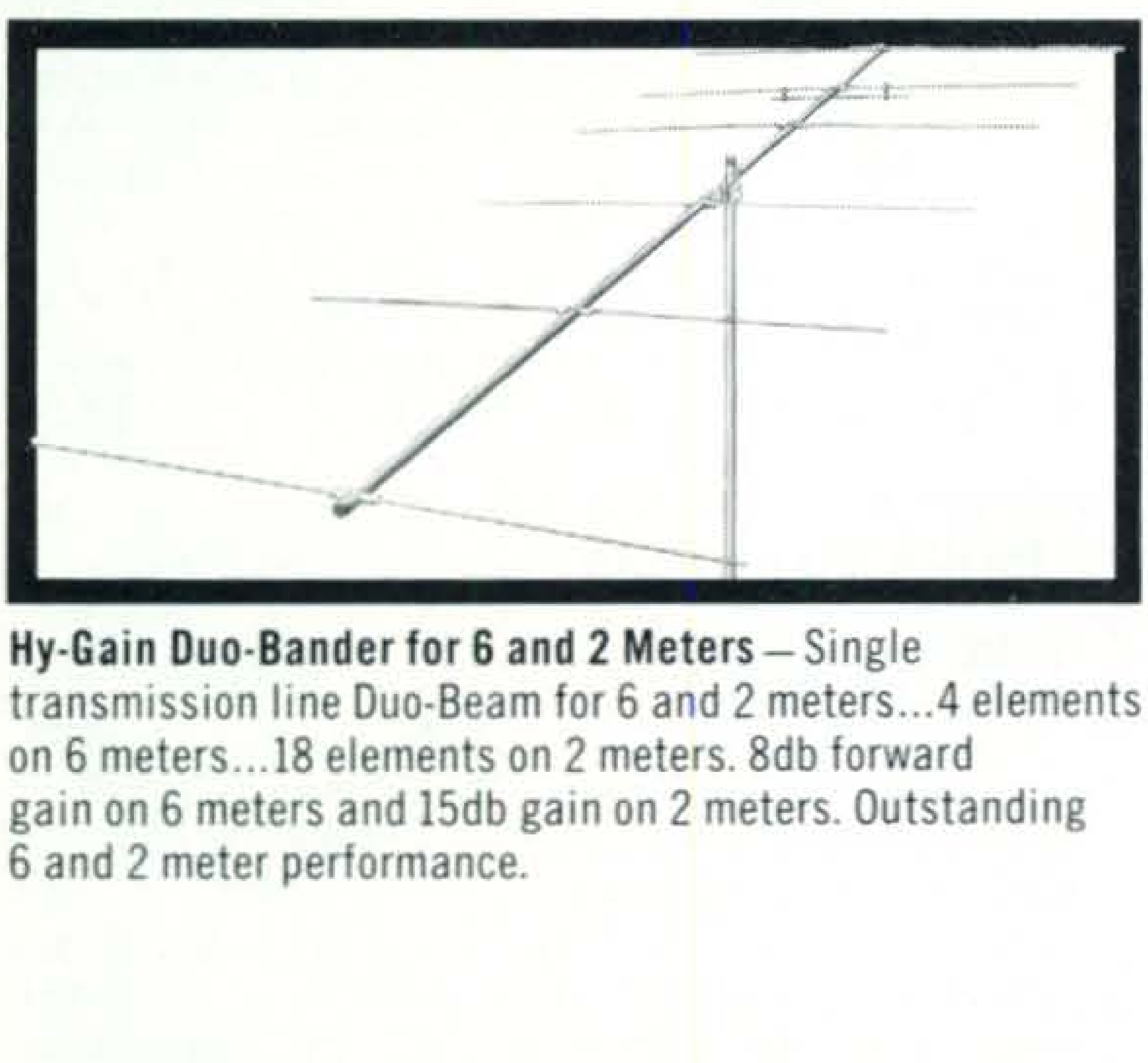
He saying with handle like Talking Bull, how I expecting to get strate story. How do you answer that? I leeving hole thing in your lap!

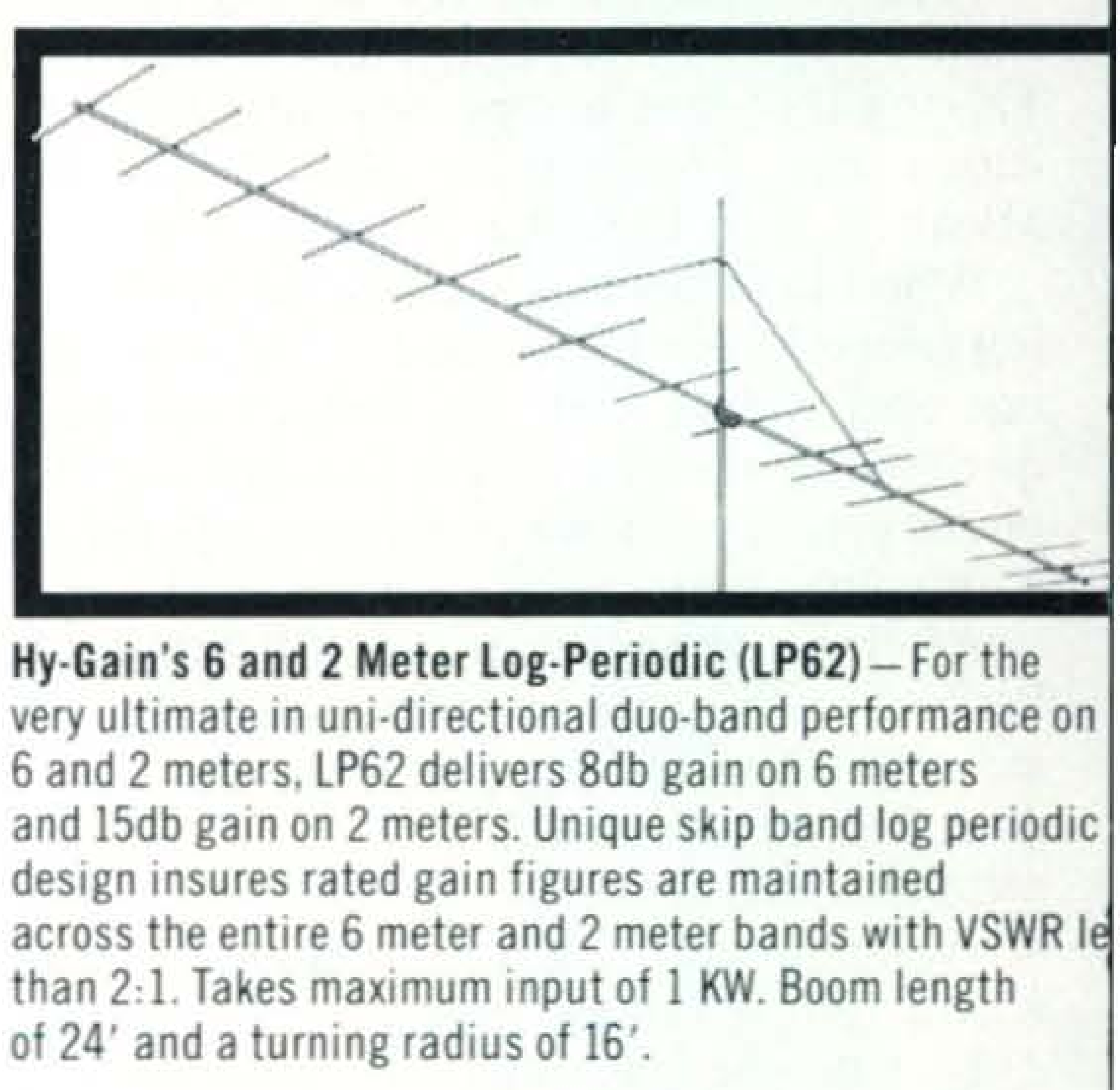
Respectively yours,
Hashafisti Scratchi

DID YOU KNOW: HY-GAIN MAKES THE BEST, THE LARGEST SELECTION OF VHF ANTENNAS AVAILABLE?









Hy-Gain Duo-Bander for 6 and 2 Meters – Single transmission line Duo-Beam for 6 and 2 meters...4 elements on 6 meters...18 elements on 2 meters. 8db forward gain on 6 meters and 15db gain on 2 meters. Outstanding 6 and 2 meter performance.

Hy-Gain's 6 and 2 Meter Log-Periodic (LP62) – For the very ultimate in uni-directional duo-band performance on 6 and 2 meters, LP62 delivers 8db gain on 6 meters and 15db gain on 2 meters. Unique skip band log periodic design insures rated gain figures are maintained across the entire 6 meter and 2 meter bands with VSWR le than 2:1. Takes maximum input of 1 KW. Boom length of 24' and a turning radius of 16'.

Hy-Gain 6 Meter Beams – All Take 1 KW Max. Power Input. VSWR At Resonance 1.5:1 or Better.

Model	Elements	db Gain	F/B Ratio	Boom Length	Turn Radius
63B	3	10	20-25db	8'	6'
64B	4	12.7	20-25db	12'	8'
66B	6	15	20-25db	24'	12'6"
611B	11	19	20-25db	47'	24'2"

Hy-Gain 2 Meter Beams – All Take 1 KW Max. Power Input.

Model	Elements	db Gain	F/B Ratio	Boom Length	Turn Radiu
23	3	9	20	3'	4'
28	8	14.5	25-30	14'	7'6
215	15	17.8	20-30	28'	14'

FOR THE MOST ADVANCED ANTENNAS UNDER THE SUN

See page 118 for New Reader Service

Hy-Gain's maximum performance beams put your signal where the action is. Not just by accident, but as the rewarding result of years of experimentation and computerized research in the most modern antenna and RF laboratory as well as exhaustive field testing.

Strategically staggered, optimum spaced elements along the boom are referenced solely to increased field strength intensity and pattern control, thus delivering tremendous increase in directional gain not attainable with close spaced beams or optimum spaced beams using linearity as the sole reference.

Exclusive Hy-Gain Beta Match—All Hy-Gain VHF Beams feature a special VHF Beta Match configuration. The unique pre-tuned Beta Match permits maximum gain and front-to-back ratio with a nominal 50 ohm feed point impedance without de-tuning any of the parasitic elements. An optimum transfer of energy thus results without sacrifice in gain or pattern control.

Coaxial Balun—All Hy-Gain VHF Beams are supplied with a coaxial balun.

Mechanical Reliability—The rugged, long life construction is available only in Hy-Gain antennas which feature heavy walled, seamless aluminum tubing. All element-to-boom clamps are machine formed of heavy gauge aluminum. All steel hardware is iridite treated to Mil-Specs for the kind of long life reliability our Government expects in equipment they buy.

Hy-Gain's 4-Element Stacked Jay-Pole for 2 Meters—4-element stacked Jay-Pole delivers 6.2 db gain. Phasing and matching harness maintains perfect parallel phase relationship and is center fed to minimize beam tilting for better low angle radiation. May be side-mounted on mast or mounted on roof saddle.

Hy-Gain Mobile Antennas for 6 and 2 Meters—For the very highest degree of mechanical reliability, while eliminating pattern distortion generally prevalent in off center mount halo's, Hy-Gain's center mount halo's are unsurpassed. They feature the exclusive Hy-Gain Beta Match to insure optimum transfer of energy.

CRG150—Vertically polarized omni-directional 55" whip with photographically etched copper base matching coil. Exclusive "Claw" mounting device easily installs in any hole 3/8" to 3/4".

HH6BK—Center mount 6 meter Halo with mast and bumper mount kit. Complete w/everything for quick installation. Perfect omni-directional pattern and excellent impedance control. Supplied with tuning rods for precise frequency adjustment.

HH2BA—Rugged center mount 2 meter Halo eliminates pattern distortion prevalent with off-center mount halos. Most efficient 2 meter halo available. Exclusive Hy-Gain Beta Match assures optimum energy transfer.

MAG150—Alnico magnet base allows quick installation. Can be removed just as easily when parking in uncertain places. No need to scrape paint...the MAG150 is capacitively grounded. Superb performance from so versatile an antenna.

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MODULATION UNLIMITED

Part I

BY FREDERIC C. DOUGHTY, *W3PHL

This two part series covers the principles and circuit techniques necessary to exceed 100% modulation without the production of undesirable side effects such as distortion and splatter. The modified final power amplifier circuit can be used for c.w., conventional a.m., d.s.b., and d.s.r.c. (double sideband reduced carrier).

This article, in part, is a review of a circuit which was described by O. G. Villard, W6QYT, in 1947[1]. At that time the circuit was proposed as a modification of an existing a.m. transmitter. The modification permits the use of audio power in excess of the amount necessary for 100% modulation. The literature has been well supplied for many years with ideas aimed toward this goal but the unique feature of the scheme advanced by Villard is that it alone offers a communications improvement with *no undesirable side effects.*

* P.O. Box 157, Valley Forge, Pennsylvania 19481.

1 Villard, O. G., "Overmodulation Splatter Suppression," *QST*, June 1947, p. 13.

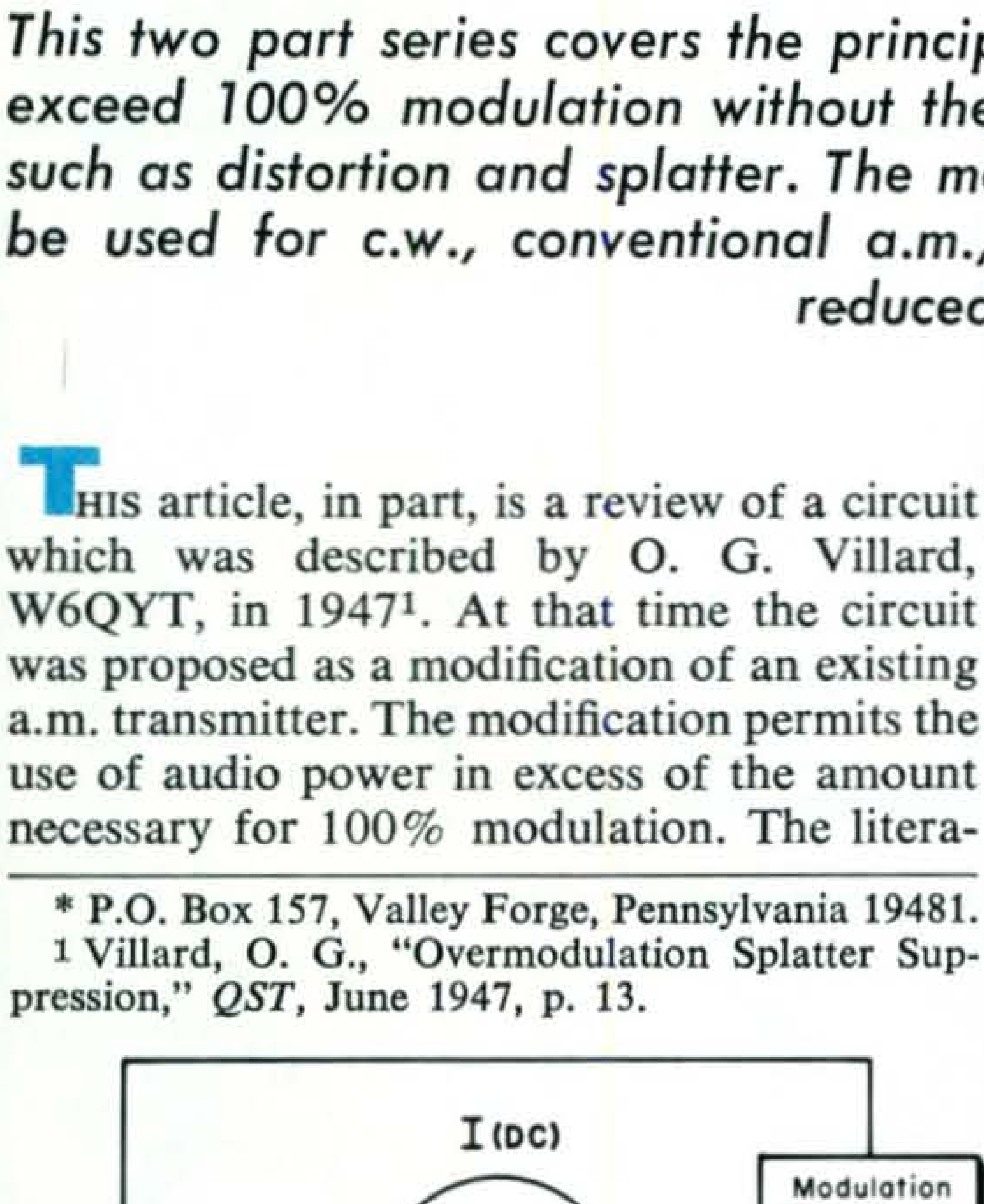

Fig. 1 (A)—D.c. current flow path in a plate modulated r.f. power amplifier. With modifications the same circuit can have an a.c. path as shown in (B).

It is required by government regulation that a transmitter shall not be modulated beyond its capability. The modulation capability of a transmitter is determined as the modulation percentage above which the modulated circuit does not reproduce the audio modulating waveform in the output r.f. envelope. Numerous factors combine to determine the modulation capability of a particular circuit. In general, for a properly designed plate-modulated Class C r.f. amplifier, the modulation capability is considered to be limited by the negative peak of modulation. Negative peak modulation in excess of 100% of a conventional plate modulated amplifier is improper in that the unidirectional vacuum tube cannot linearly respond during the period of time that the plate voltage is negative.

Increase Of Modulating Power

It is common practice to separate the circuits which are proposed to increase of modulation power of an a.m. transmitter into low level and high level groups. The low level group includes, in part, clippers, compressors and limiters. These devices are designed to improve the average modulation power either by shaping or by variable amplification of the audio waveforms. The high level group includes such circuits as negative peak clippers, loaders, and attenuators. These circuits are

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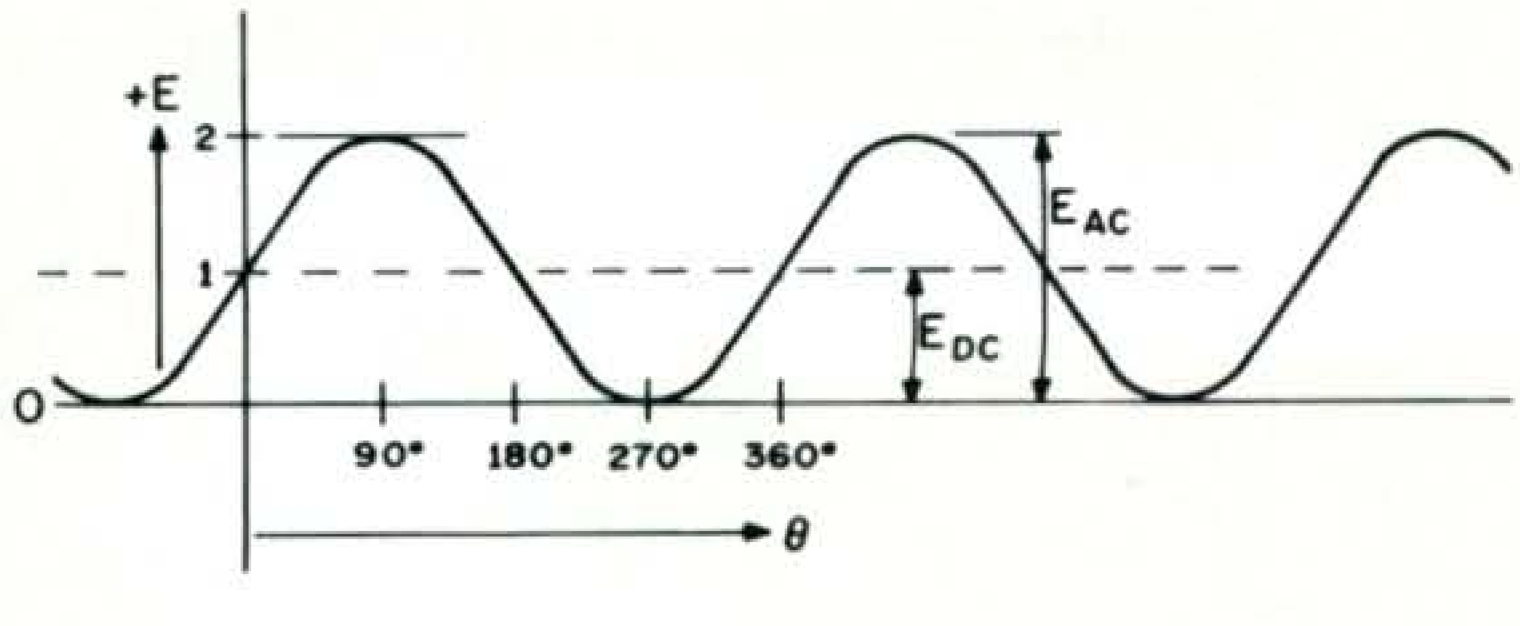
used to limit or control negative peaks of modulation to 100%, permitting positive peaks to extend beyond 100%. There are radio transmitters with circuits of one or both groups in use in all of the radio services.

Each of the above mentioned circuits, in its own way, offers an improvement in communications capability. The low-level circuits deform the original audio waveforms in some fashion. The high level circuits alter the symmetry of the a.c. modulating voltage. All of the circuits are based on intentional distortion of the original audio waveform and create undesirable side effects. This is because each one is predicated on the use of an r.f. final amplifier which is limited to 100% modulation on negative peaks.



(a)

θ	0°	90°	180°	270°	360°
Sine θ	0	1	0	-1	0

(b)

Fig. 2 (A)—A d.c. voltage modulated 100% by a sine wave. (B) The value of the sine of Θ at various angles.

The Final R.F. Amplifier

A d.c. circuit, such as a vacuum tube circuit, is one in which current is unidirectional and may vary in amplitude. An a.c. circuit is one which permits only a.c. current which also may vary in amplitude. An a.c.-d.c. circuit responds as well as both of the above circuits when subjected to the conditions pertinent to each and also to combinations of these conditions.

A conventional, properly operated, plate modulated r.f. amplifier is a d.c. circuit in which the plate current flows in one direction, in an uninterrupted continuous loop. The sequence is from ground, to r.f. final, to modulation transformer, to power supply and to ground as shown in fig. 1(A). The modification allows the same sequence and loop, and also the reverse sequence, *i.e.,* ground, to power supply, to modulation transformer, to r.f. final, to ground, as shown in fig. 1(B).

A modified transmitter may be used to generate a conventional a.m. envelope, where the carrier power is equal to two times the audio modulating power (d.c. mode); a d.s.r.c. envelope (double-sideband reduced carrier), where the carrier power is less than two times the audio modulating power (a.c.-d.c. mode), or a d.s.b. envelope wherein there is no carrier power (a.c. mode).

Improper Negative Peak Modulation

Modulation of the plate voltage of a conventional r.f. amplifier is, in part, restricted by the unidirectional operation of a vacuum tube. If the d.c. plate voltage is modulated in excess of 100% on negative peaks, the current load, which should respond to the entire modulating waveform, is interrupted during the time that the plate voltage is negative. This interruption is a distortion of the applied audio waveform and the distorted waveform cannot represent a single audio frequency. Only a perfect sine wave shape results from a single frequency. Amplitude alteration of part of a sine waveform generates other frequencies. If the instantaneous amplitudes of these other frequencies and the fundamental, in the proper phase relationship, are added at each instant of time within a cycle of the funda-

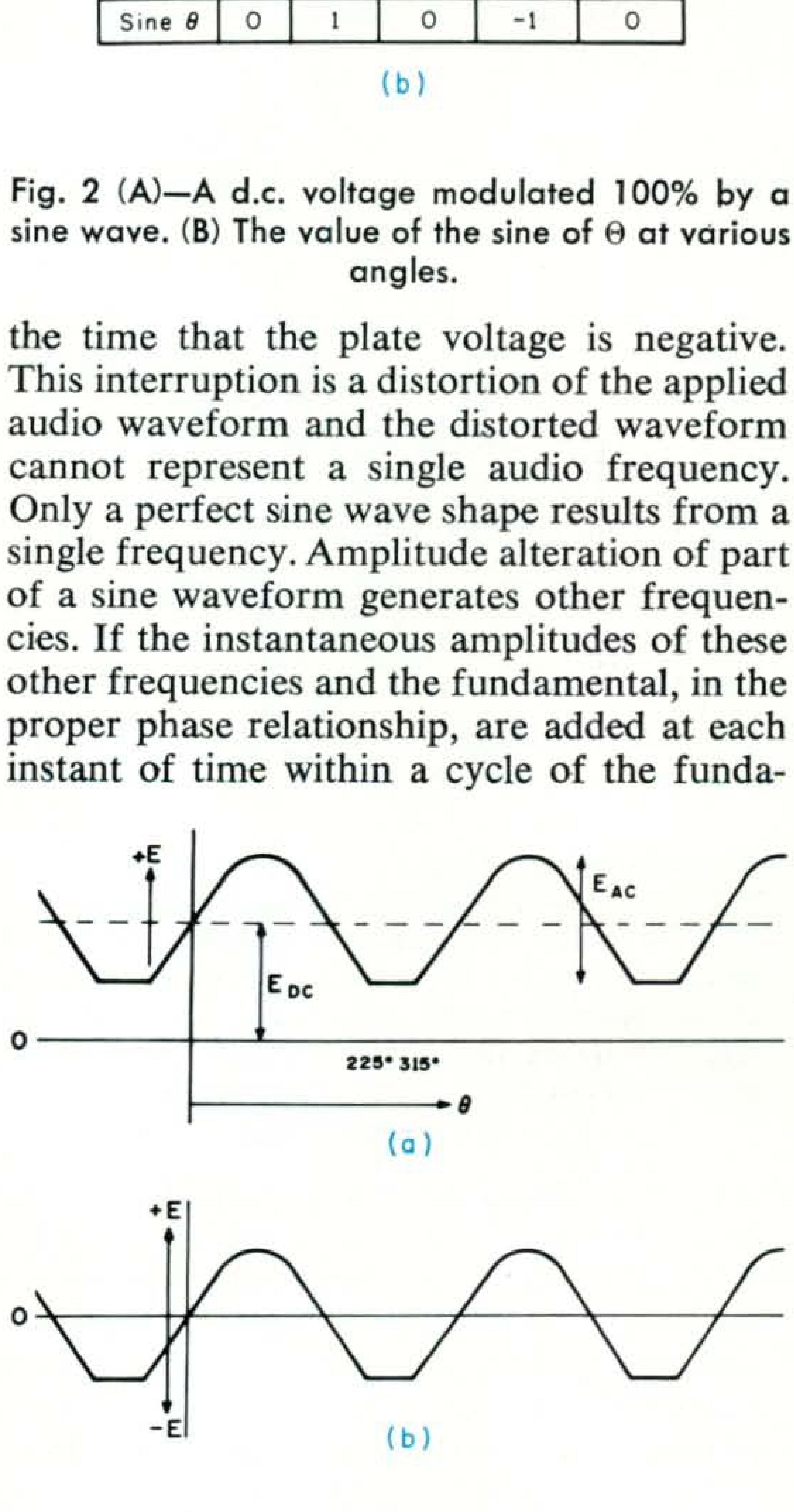


Fig. 3 (A)—A d.c. voltage modulated by the distorted wave form shown in (B). When the modulation percentage is increased, as in (C), the d.c. appears to reduce to zero volts from 225° to 315°.

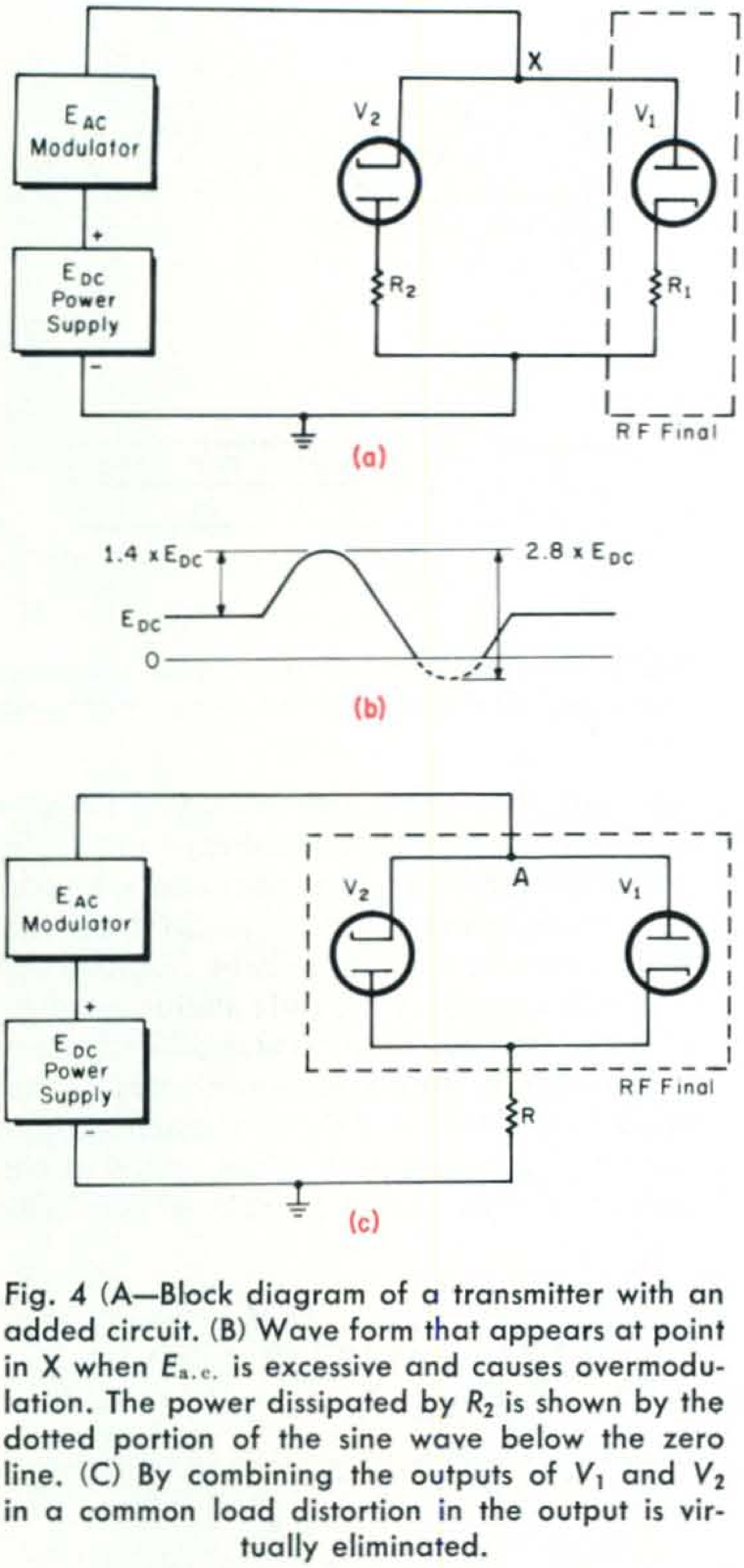


Fig. 4 (A—Block diagram of a transmitter with an added circuit. (B) Wave form that appears at point in X when $E_{a.c.}$ is excessive and causes overmodulation. The power dissipated by R_2 is shown by the dotted portion of the sine wave below the zero line. (C) By combining the outputs of V_1 and V_2 in a common load distortion in the output is virtually eliminated.

mental, a single cycle of the distorted waveform results.

Figure 2 shows a d.c. voltage continuously modulated 100% by a single frequency (a sinewave). Examination of a single cycle starts at 0° and terminates at 360°. The value of the sine at several points is also given in fig. 2. It can be seen, that throughout the entire cycle, the voltage at any instant of time is equal to $V_{d.c.}$ plus $V_{d.c.}$ times the sine of the angle at the instant of time, or:

$$V_i = V_{d.c.} + V_{d.c.} \textit{ sine } \Theta$$

The d.c. voltage, fig. 3(A), is modulated with a distorted waveform which is shown in fig. 3(B). In fig. 3(C), the percentage of modulation is increased so that the d.c. voltage *appears* to be reduced to zero during the time period from 225° to 315°. The r.f. envelope generated by the waveform of fig. 3(C) is identical to the envelope generated by a transmitter which is negative peak overmodulated during the same period. Splatter and bandwidth would cause an a.m. transmitter to *appear* to be overmodulated at *any* percentage if modulated by the audio waveform shown in fig. 3(B). This is because the audio frequencies required to generate the waveform as shown in fig. 3(A) are the same as the frequencies required for the waveform shown in fig. 3(C). Only the amplitudes of the component frequencies are changed. The formula for the waveform in fig. 2 does not apply to the waveforms in fig. 3. The formula for the waveform in fig. 3(C) must change with time or angle.

From 0 degrees to 225 degrees and from 315 degrees to 360 degrees the instantaneous voltage is calculated as indicated earlier:

$$V_i = V_{d.c.} + V_{d.c.} \textit{ sine } \Theta$$

From 225 degrees to 315 degrees V_i equals zero. Together, therefore:

$$V_i = \begin{cases} V + V \sin \Theta & 0^\circ \text{ to } 225^\circ \\ 0 & 225^\circ \text{ to } 315^\circ \\ V + V \sin \Theta & 315^\circ \text{ to } 360^\circ \end{cases}$$

It can be seen that the sine wave of a single fundamental frequency is a necessary component of the modulating waveform *and* that the components of other frequencies must be present. The addition of their respective components and the fundamental results in "zero" amplitude between 225° and 315°. These other frequencies are in the original modulating waveform, fig. 3(B), and appear as sideband frequencies in the spectrum about the carrier frequency. These "extra" sidebands are commonly called splatter.

The repeating waveform shown in fig. 3(C) can be broken down, through a Fourier analysis, to indicate what portion of the waveform is in the fundamental, second, third, fourth harmonic, *etc.* This is a complicated computation and will not be discussed here. For the waveforms in fig. 3, the power ratios of the harmonic frequencies are, if f_1 (fundamental) = 100 watts:

f_2 (second harmonic) = 3.4 watts
f_3 (third harmonic) = 0.43 watts
f_4 (fourth harmonic) = 0.1 watts

Modified Circuit

Figure 4(A) represents a transmitter with an *added circuit*. The power supply is shown as $E_{d.c.}$ and the modulator is shown as $E_{a.c.}$. Diode V_1 represents the r.f. final unidirectional vacuum tube and R_1 represents the r.f. plate load of the final. Diode V_2 and R_2 are *added* to provide the same load ($R_2 = R_1$) during a period of voltage reversal. The d.c. power (carrier) is,

$$P_{d.c.} = E_{d.c.}{}^2/R_1$$

When the peak-to-peak audio voltage equals $2E_{d.c.}$, the d.c. voltage is 100% modulated, and $P_{a.c.} = 1/2\ P_{d.c.}$. When the peak-to-peak audio voltage equals $2.8E_{d.c.}$, $P_{a.c.} = P_{d.c.}$, and the waveform at R_1 will be overmodulated as shown in fig. 4(B). Note that this is the same as the waveform that is shown in fig. 3. The audio powers dissipated by resistors R_1 and R_2 are in the ratio of the areas of the waveforms impressed on each resistor.

Half of the audio power occurs during the first half cycle and it is dissipated by R_1 alone. The second half cycle audio power is divided between R_1 and R_2 in a ratio determined by comparing the areas of the voltage waveforms impressed on each resistor. For the case shown, R_1 absorbs 84.3% and R_2 absorbs 15.7% of the second half cycle audio power.

For example, assume a condition where a 1000 watt input r.f. carrier is overmodulated by 1000 watts of audio output power, with the diode and resistor circuit added to the transmitter. The audio power to the final is equal to the first half cycle modulator power, 500 watts, plus 84.3% of the second half cycle power which equals 421.5 watts, a total of 921.5 watts. The resistor receives 78.5 watts (15.7% of 500). Without the added circuit, calculations are relatively complex because of the no-load condition on the modulator during periods of negative peak overmodulation. In addition, without the circuit, the modulation transformer will generate extreme voltage excursions during the no-load period, in that the modulator attempts to deliver power to a load of infinite impedance.

Figure 4(B) shows that the waveform which is impressed on the r.f. final *cannot* represent a single frequency. The modulating waveform is the same as the previous case as shown in fig. 3(C). If it is assumed that 921.5 watts is divided between the fundamental and the second, third and fourth harmonics, then:

$$P_{f1} + P_{f2} + P_{f3} + P_{f4} = P_t$$
$$100X + 3.4X + .43X + .1X = 921.5$$
$$103.93X = 921.5$$
$$X = 8.86$$

The powers in the fundamental and harmonics are:

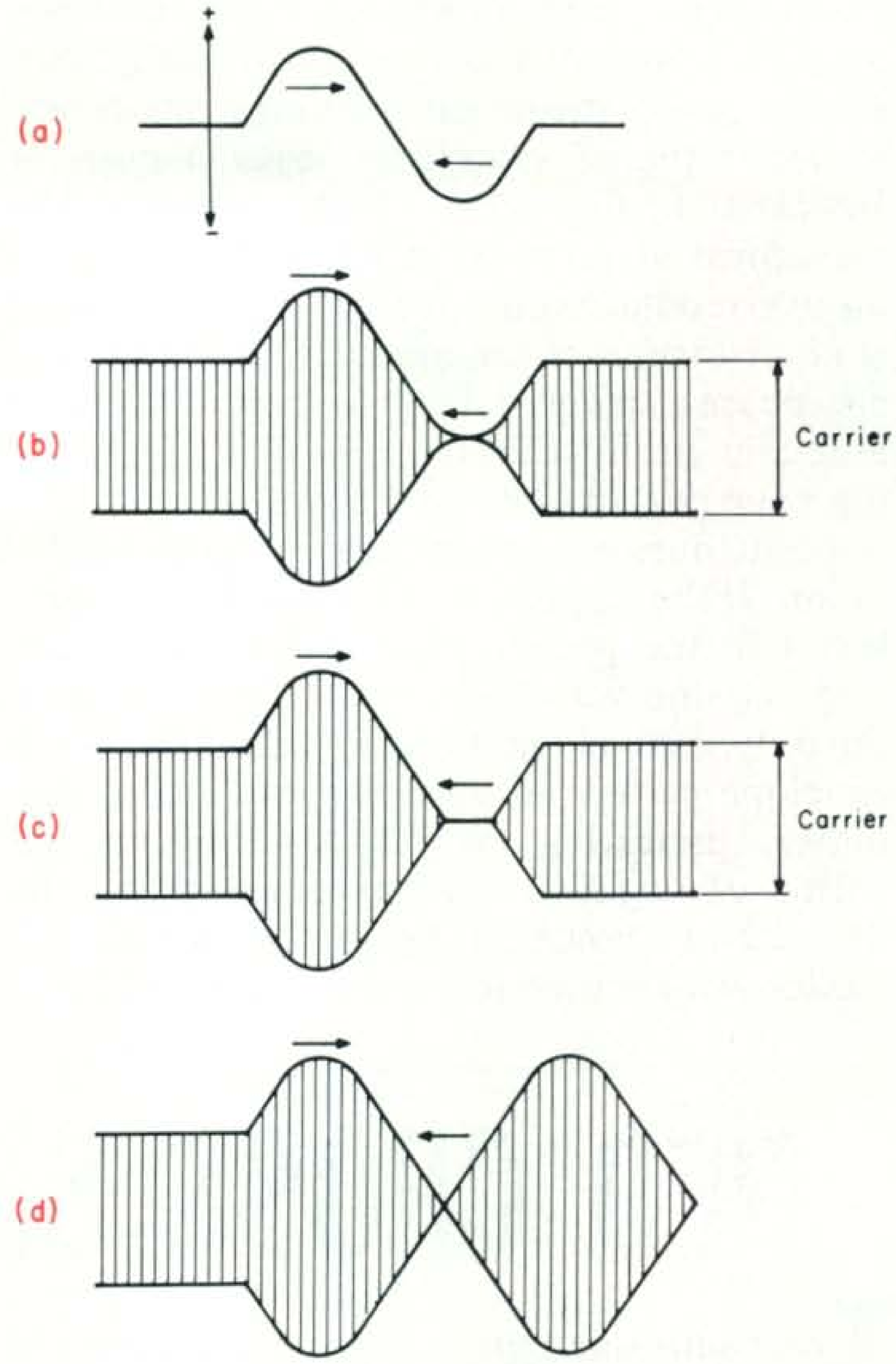


Fig. 5 (A)—The arrows indicate the phase of the two halves of the sine wave. (B) The arrows again indicate the phases of the normal modulated signal. (C) Envelope of an overmodulated transmitter.

$$f_1 = 886 \text{ watts}$$
$$f_2 = 30.1 \text{ watts}$$
$$f_3 = 3.8 \text{ watts}$$
$$f_4 = 0.9 \text{ watts}$$

The power of 886 watts at the fundamental frequency is desirable; the power of approximately 35 watts of harmonic power is illegal, and the power of 78.5 watts dissipated in resistor R_2 is wasteful. What is needed is a special circuit which will utilize the entire 1000 watts of audio output power and generate sidebands which are representative of the fundamental frequency only. The W6QYT circuit does this by properly adding the waveforms across the loads R_1 and R_2 in a common r.f. load, fig. 4(C). This r.f. addition of waveforms ensures the proper shape of the transmitted envelope but the circuit must also consider the *phases* of a sine wave.

Phase

A sine waveform indicates phase as well as shape. The arrows shown in fig. 5(A) indi-

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cate the two phases of a sine waveform. When an a.m. transmitter is modulated, the phases of the audio modulating voltage are represented in the r.f. output by phase changes as indicated in fig. 5(B). (Note arrows.) The waveform at point X in fig. 4(A) indicates an overmodulated d.c. voltage in which there is no distortion of the modulating signal. The r.f. phases, generated by a special r.f. final amplifier circuit, capable of properly responding to an overmodulated d.c. voltage, must be opposite during adjacent half cycles of modulation. If the responses of V_1 and V_2 are combined in the proper phase relationship, the original sine waveform will be generated in the output envelope. Figure 5(C) is the wave envelope pattern of an overmodulated transmitter, indicating no response during the period of negative peak overmodulation. In the circuit shown in fig. 4(C), where the diodes were shown to represent the unidirectional response of a vacuum tube to plate voltage, diode V_2 responds only during the period of negative peak overmodulation.

The r.f. amplifier tube represented by V_1, called the "normal" tube, generates a given phase during the positive peak and the opposite phase during the negative peak up to the point at which it is cut off (100%). The r.f. amplifier tube represented by diode V_2, called the "upside down tube," must generate the same phase that the normal tube was generating at the time of cutoff. The resultant waveform is shown in fig. 5(D).

The combination of the r.f. amplifier, V_1, and the upside down amplifier, V_2, in a final amplifier permits the use of audio power greater than the amount necessary for 100% modulation. A practical circuit will be shown and analyzed in Part II to be published in a subsequent issue.

[*To be continued*]

RED CROSS SERVICE AWARD

Two radio amateurs received the top awards presented at the annual Disaster Services Volunteeer Recognition Program of the Cincinnati Area Chapter of the Red Cross. Held May 9 at the Cincinnati Red Cross Building, recognition was given persons who had assisted Red Cross for one, five, ten, 15 and 25 years. Receiving the two 25-year pins were LeRoy Diselberg, W8SVU, and Paul Luhn, W8MXR. Both men received the awards for their activities through the Queen City Emergency Net (W8VND/W8VVL), emergency communications affiliate of the Cincinnati Chapter.

Also recognized for extended service was Walter Keck, Jr., W8IIO, QCEN member who received a ten-years award. Seven QCEN'ers were presented five-years service pins. They are: Jene Gaible, WA8GPQ, John Hultgren, WA8GPX, Ralph Hultgren, WA8-ELC, Joseph Phirman, WA4-HFF, Eddie Retherford, WA8GRR, Kirk Swallow, W8-QID, and James Weaver, WA8VOA.

One-year service certificates were given to Hal Blocher, Jr., Theodore Chinn, Sr., K8NJQ, John Dann, K8OGE, John Dine, WA8DFD, Walter Gibbemeyer, WA8PRR, Ronald Hasselbrook, WA8LOW, Timothy Prince, WA8TYF, Charles Southern, W8-PNK, John Wilson, WA8CKB and Burton Wolfe, WA8ULF.

QCEN has provided communications assistance in the southwestern Ohio-north central Kentucky area in every disaster involving the Red Cross since the 1937 Ohio River flood. (*Tnx WA8COA*)

LeRoy A. Dieselberg, W8SVU, right, being presented a 25-years Red Cross service pin by Walton Bachrach. Bachrach is chairman of Volunteer Services for the Cincinnati Area Chapter of the Red Cross, and former mayor of Cincinnati.

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This has resulted in a gold mine of new business for licensed service technicians. A typical mobile radio service contract pays an average of about $100 a month. It's possible for one trained technician to maintain eight to ten such mobile systems. Some men cover as many as fifteen systems, each with perhaps a dozen units.

Opportunities in Plants

And there are other exciting opportunities in the aerospace industry, electronics manufacturing, telephone companies, and plants operated by electronic automation. Inside industrial plants like these, it's the licensed technician who is always considered first for promotion and in-plant training programs. The reason is simple. Passing the Federal Government's FCC exam and getting your License is widely accepted proof that you know the fundamentals of Electronics.

So why doesn't everybody who "tinkers" with electronic components get an FCC License and start cleaning up?

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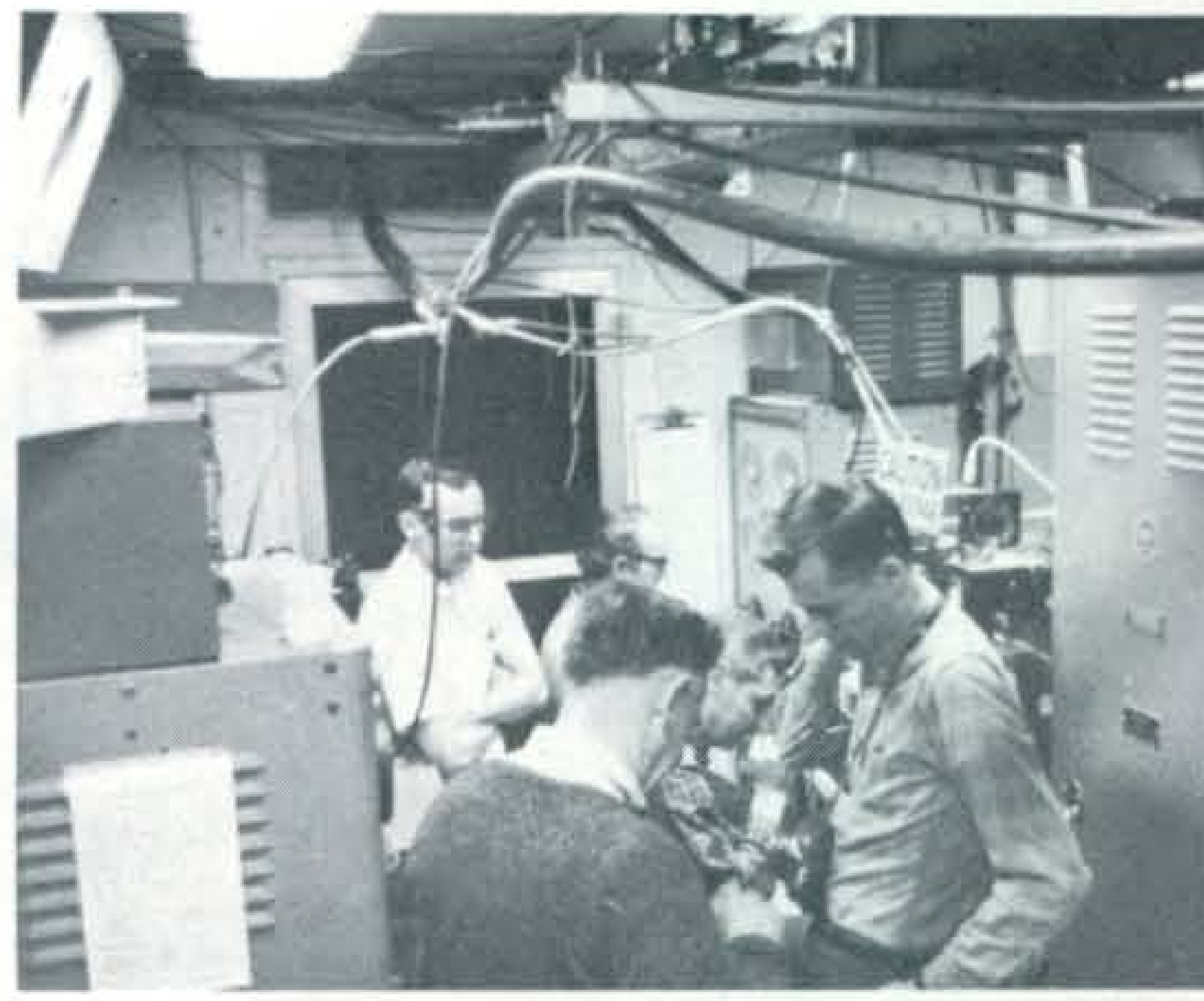
CQ-39

Cliff, W2CCY adjusting transmitter during EME test is shown in foreground. Right to Left in background is Roger Abson (no call), Dick, W2IMU, and Tony K2KII (back of head just shown).



Half of operating shack. In foreground R-L Tony K2KII, and Dick W2IMU. In Background L-R Ernest, WA4WDK (standing), Roger Abson at controls dish, and Cliff W2CCY at transmitter.

SPECIAL BULLETIN ABOUT

THE Crawford Hill VHF Club which has previously conducted successful moonbounce tests on 144 and 432 mc has done it again, this time on 1296 mc.[1] As predicted by the club months in advance on the nights of April 12 and 13 the signals of W2NFA (the present club call) were copiable by well equipped 1296 mc stations by means of the moon.

On April 12 QSO's were completed with: HB9RG at 0035-0050 z with RST 459 sent and 139 received, G3LFT at 0220-0235 z with RST 449 sent and 229 received, WB6-IOM at 0300-0325 z with RST 559 sent and 339 received. A partial QSO was also made with K6MYC at 0400-0530 z, their signals being 6 db inside the noise in a 1 kc bandpass. No other signals were heard this night.

On April 13 QSO's were again completed with: G3LTF at 0100-0120 z with RST 349 sent and 339 received, WB6IOM at 0425-0445 z with RST 559 sent and 339 received. WB6IOM tried s.s.b. transmission with very poor copy at W2NFA. Another partial QSO was made with K6MYC and K6HCP was heard using the K6MYC station. No other signals were heard.

The following comments were received by the Crawford Hill Club. OZ8EME who was operational receiving only using a 20′ dish and a TIXM103 transistor preamp reported receiving weak signals both nights with maximum S/N of +1 db in a 1 kc bandpass. G3LTF who was assisted by G3VPK, G3-ORL and R. Condon, used a 17′ dish, 4-7289's in two 180° hybrid coupled amplifiers for transmission and a paramp for receiving, noted that W2NFA's signals were 10 db above the noise in a 100 cycle bandpass. HB9RG used a 17′ dish, 7650 with 300 watts out and a paramp and was not operating the second day. WB6IOM who had the loudest signal of all used only a 10′ dish with circular feed. His transmitter consisted of 8-2C39's in a ring giving 500 watts of output. For receiving Peter used a paramp and copied W2NFA's signals 6 db above the noise in a 150 cycle filter. K6MYC reported copying very weak signals. This group used only an 8′ dish, 4-7289 amplifier and a paramp. WB6-CXF reported no signals heard. WB6CXF was a last minute group effort using a 24′ home built dish. K4QIF also reported no signals heard. Rusty used a 10′ dish and TIXM-103 for receiving. K2TKN received weak signals off the moon. The big problem at Bill's QTH and others was the low angle of the moon during the tests. At no time during the

[1] The Crawford Hill VHF Club was the first group to work VK3ATN via the moon. At that time they used the call K2MWA.

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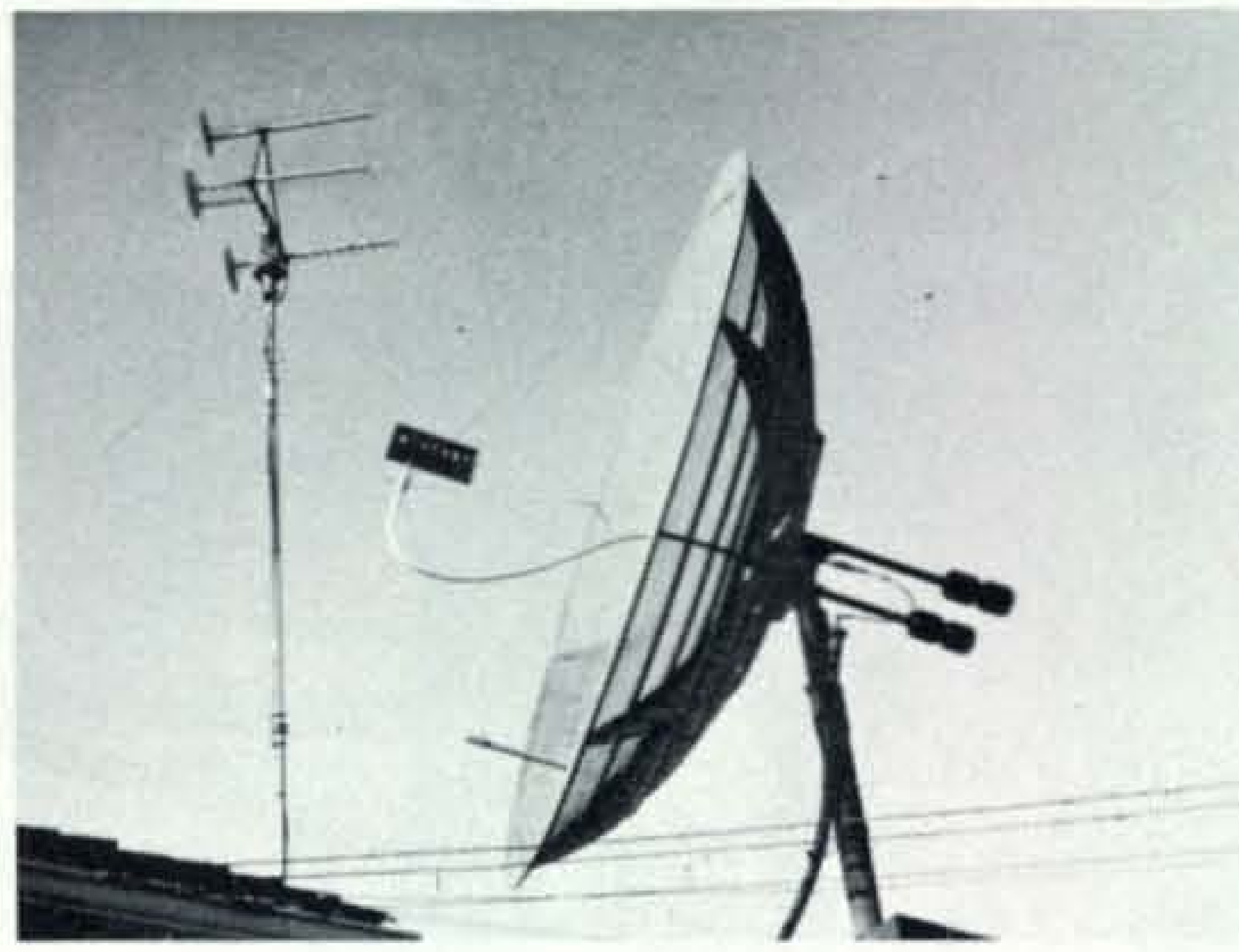
Other half of operating shack. R-L W2WVA station trustee and club president standing, Ed, W2FZY at Racal receiver, and Bill W2OJ in front of tape recorder.



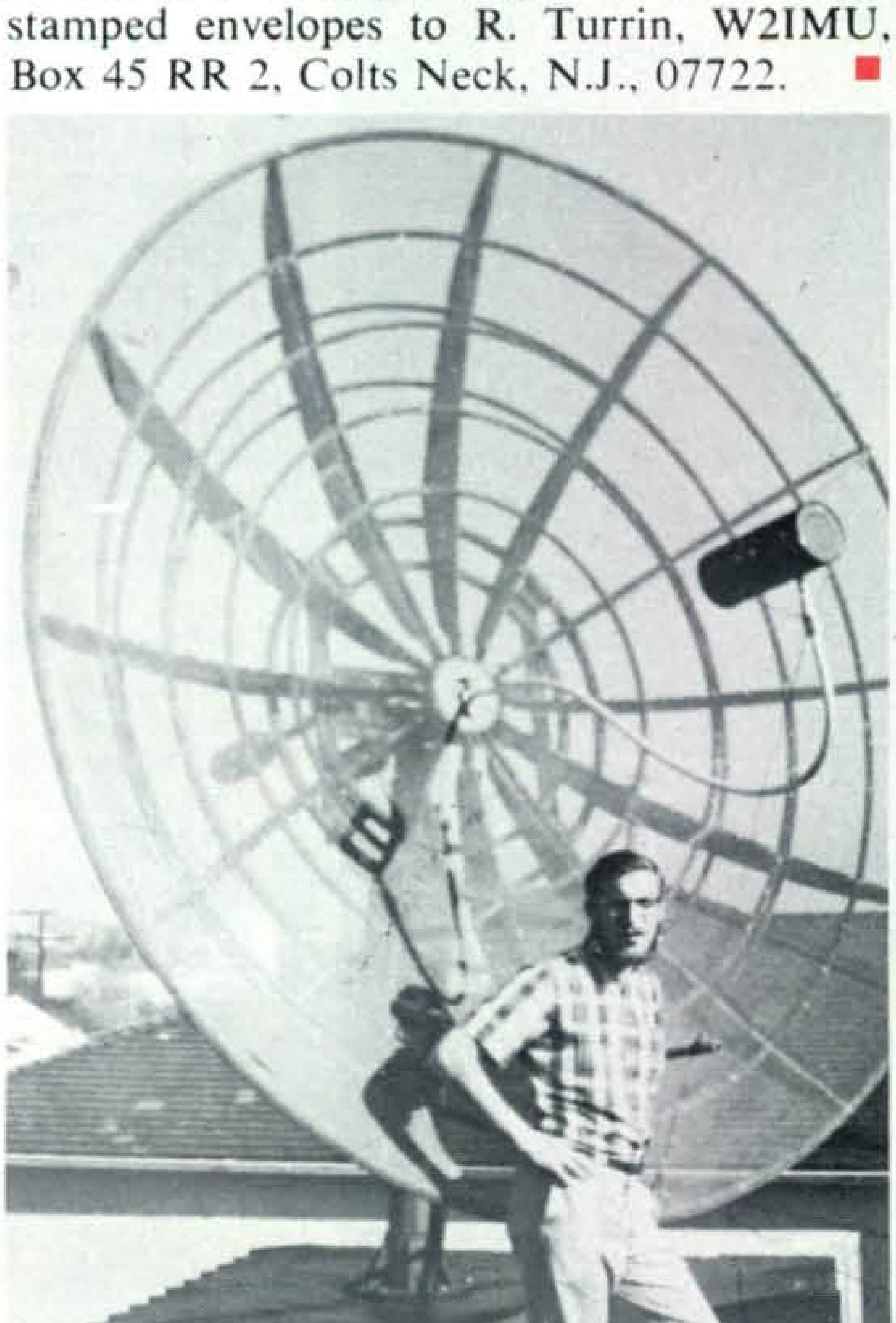
The ten foot parabolic reflector dish shown mounted on a polar mount was used by Peter Laakmann, WB6IOM, to work the Crawford Hill VHF Club, W2NFA, on April 12, 1968. Below, Peter is shown in front of the dish.

1296 MOONBOUNCE TESTS

night was the moon clear of house or trees. K2TKN used a home brew 20′ dish and KMC transistor preamp.

The W2NFA moonbounce effort was led by Dick Turrin, W2IMU. The basic exciter/receiving equipment was supplied by Cliff, W2CCY. The final amplifier which produced 300 watts out and consisted of two dual 7289 (late version of the 2C39) amplifiers coupled together by means of 90° hybrids was constructed by W2IMU from a design of W2CCY/W2CQH. The paramp used as a preamp, was mounted on the rim of the dish on a loan from K2TKN. The dish itself was 60′ in diameter and fed by a crossed dipole feed built by W2IMU. Members on hand during the tests were W2IMU, W2CCY, W2FZY, K2KII, WA4WDK, W2WVA, W2OJ, and Roger Abson.

Future moonbounce operation by W2NFA will be exclusively on 1296 mc. The next test will probably be in the Fall (Oct.-Nov.). Since most of the present activity is in the Northern Hemisphere and most stations have foreground clearance problems for low elevation moon orbits, every effort will be made to schedule the tests for a weekend with positive moon declination but not with new moon phase. Qualified stations desiring to participate in future 1296 EME tests may obtain advanced notice by sending two self addressed stamped envelopes to R. Turrin, W2IMU, Box 45 RR 2, Colts Neck, N.J., 07722. ■



Peter, WB6IOM in front of his 10′ dish.

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The Model 410C Frequency Control Unit is designed for full coverage of 80, 40, 20, 15 and 10 meters. It is intended for fixed station operation and plugs directly into Model 500C. It may also be used with Model 350C. Eight ranges, 500 kc each, 5 kc calibration.

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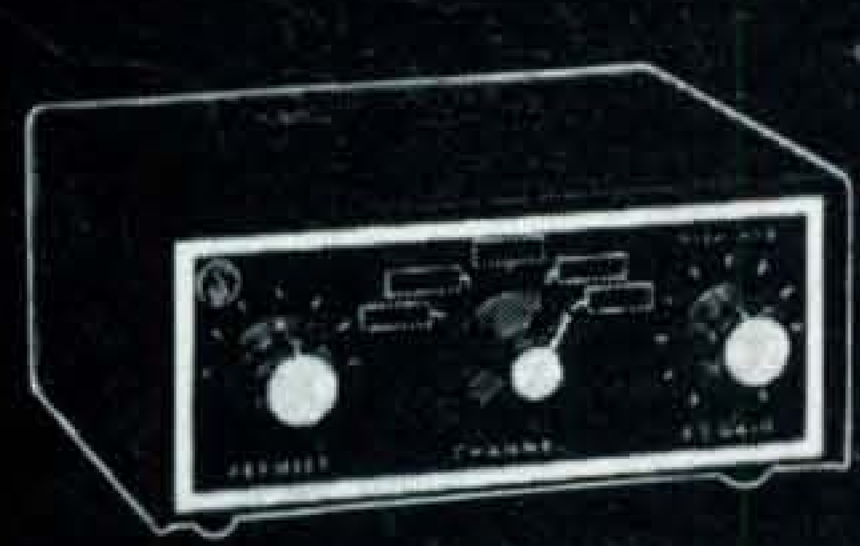

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MODEL 405X (less crystals) . . $45

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Five band, 520 watts for home station, mobile and portable operation.

The new model 500C is the latest evolutionary development of a basic well proven design philosophy. It offers greater power and additional features for even more operator enjoyment. Using a pair of the new heavy duty RCA 6LQ6 tetrodes, the final amplifier operates with increased efficiency and power output on all bands. PEP input rating of the 500C is conservatively 520 watts. Actually an average pair of 6LQ6's reach a peak input of over 570 watts before flattopping!

The 500C retains the same superior selectivity for which Swan transceivers are noted. The filter is made especially for us by C-F Networks, and with a shape factor of 1.7 and ultimate rejection of more than 100 db, it is the finest filter being offered in any transceiver today.

For the CW operator the 500C includes a built-in sidetone monitor, and by installing the Swan VOX Accessory (VX-2) you will have break in CW operation.

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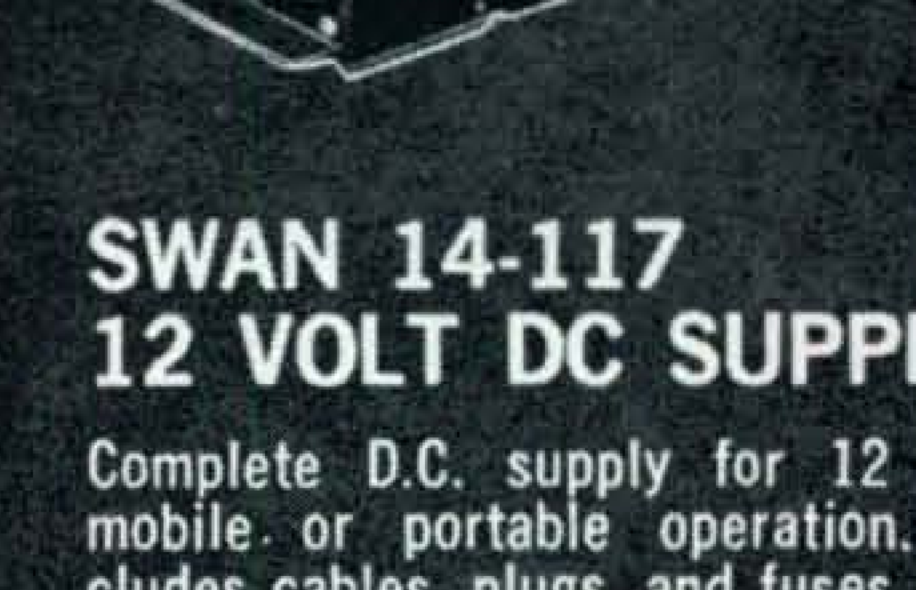

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ASK THE HAM WHO OWNS

VERTICAL ANTENNAS

Part II

BY CAPTAIN PAUL H. LEE, *W3JM

This is the second in a series of articles on a subject which has never before been treated in depth in an amateur magazine. The first chapter in last month's issue covered basic principles. This one deals with base impedances and methods of feeding and matching.

THE input (base) impedance of an ungrounded vertical antenna which is being fed against a ground plane is dependent on several factors. The one factor which has the greatest effect is of course the height of the vertical radiator. The height is usually mentioned in terms of wavelengths. In the first chapter vertical radiators of 0.25, 0.50 and 0.625 wavelengths height were discussed from the standpoint of their radiation characteristics. It is of interest, however, to plot the base impedance of vertical radiators of all heights from 0.10 through about 0.65 wavelengths height so that the variations may be noted in detail.

The second factor which affects base impedance is that of height (length) versus thickness (diameter). It is customary in texts to define this in terms of the ratio *length/diameter* (L/D). If one considers the vertical radiator being fed against a ground plane as an open-ended, unbalanced, lossy transmission line, which it actually is, it will be realized that it must have a characteristic impedance like any other transmission line. The magnitude of this characteristic impedance is determined by the conductor size and spacing. In the case of the vertical antenna (considered as a transmission line) the spacing (position of the vertical conductor relative to the ground plane) is fixed. The only factor which can then be varied, to have an effect on the characteristic impedance, is the vertical conductor's diameter. The effect on the characteristic impedance of changing diameter can be computed. Several authors treat this, but perhaps Schelkunoff[11] is one of the best references.

* 5209 Bangor Drive, Kensington, Maryland 20795.

Radiation Resistance

If this unbalanced transmission line could be terminated in its characteristic impedance at its far end, one would see the characteristic impedance when measuring at its input connection. However, it cannot be terminated. It must remain open-ended. Thus it has standing waves on it, and it radiates. When speaking of it as "lossy", this does not refer to its inherent I^2R losses. This refers to the fact that power put into it is "lost" or radiated into space. This power is represented theoretically as the power dissipated in a *radiation resistance*, R_r. For a good discussion of the concept of radiation resistance, see Laport[12]. The radiation resistance of an antenna cannot be measured. It can be computed with considerable accuracy. The radiation resistance times the square of the current at the point of reference is the radiated power. This radiated power can be determined quite closely by making field intensity measurements along

11 Schelkunoff and Friis, "*Antenna Theory and Practice*," John Wiley and Sons.

12 Laport, E. A., "*Radio Antenna Engineering*," McGraw Hill.

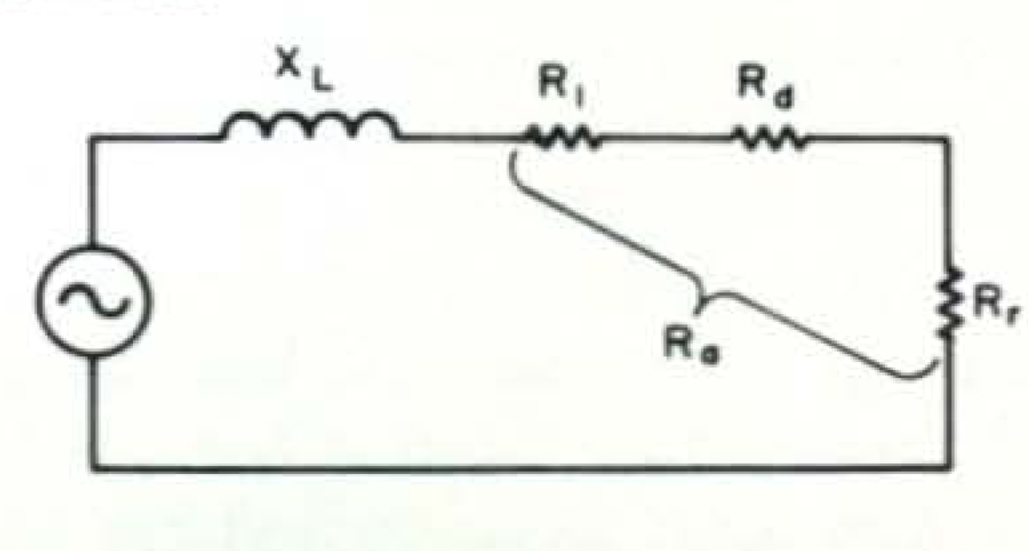
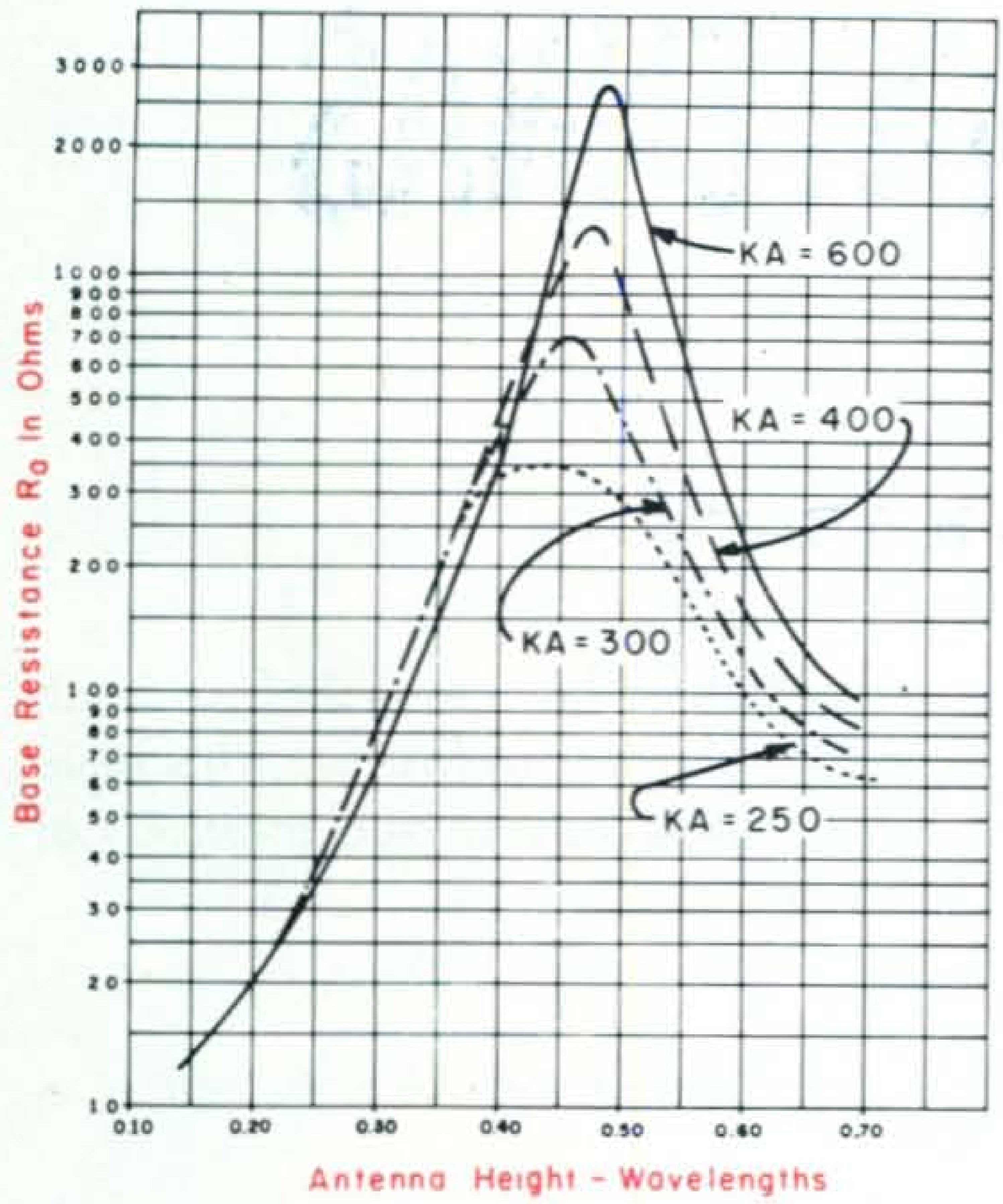
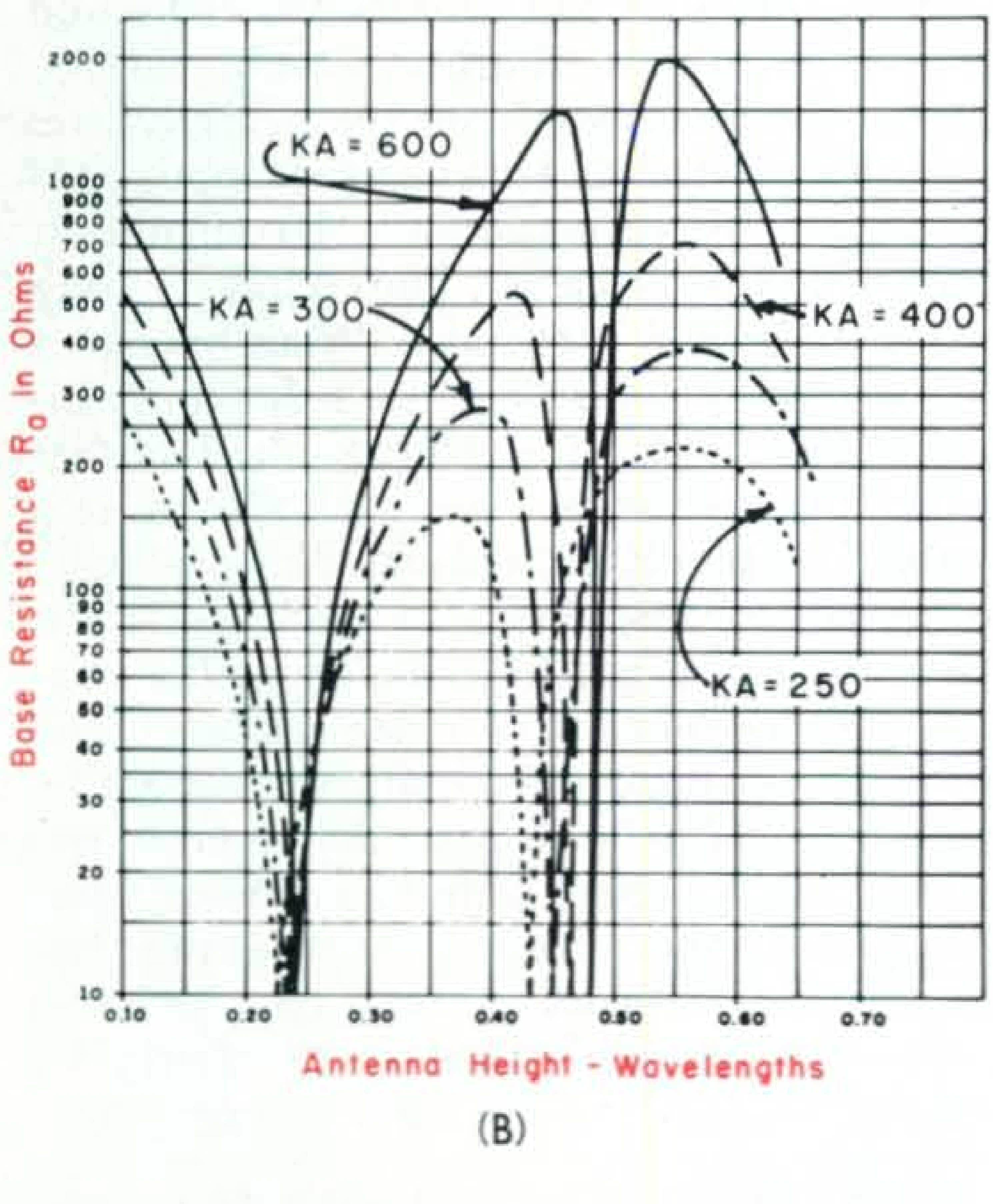


Fig. 12—Equivalent circuit of an antenna system. The total antenna resistance, R_a, is equal to the sum of R_L, R_d and R_r.



(A)



(B)

Fig. 13(A)—Vertical antenna base resistance *versus* antenna height in wavelengths for different values of characteristic impedance, K_a. (B)—The plot of the base reactance versus antenna height for the same values of K_a.

radials at varying distances out from the vertical radiator, plotting them on field intensity paper, and determining the unattenuated field intensity at one mile, as discussed earlier.

When measuring into the antenna, one sees the total antenna resistance, R_a, which is composed of several parts. This is depicted in fig. 12, which shows the equivalent series circuit of an antenna possessing some inductive reactance. These parts are the radiation resistance R_r, the ohmic loss resistances R_l and the dielectric loss R_d. In the m.f. and h.f. cases, the R_r is quite large, and it makes up most of R_a. In fact, in a well designed installation, the several loss resistances are usually neglected. However, at l.f. and v.l.f., where the vertical radiator is a small part of a wavelength, R_r is very small. In fact, at v.l.f. it is often as small as a fraction of an ohm. When this is combined with fractional ohm loss resistances, efficiency is reduced considerably. At v.l.f. it requires very special care in design, plus many model studies, to obtain an efficiency as high as 50% or so. Not so at h.f., however. We are up in the range of tens and hundreds of ohms for R_r.

The standing wave configuration on a vertical radiator will depend on its height. The base input impedance will, therefor, show variations with respect to frequency. The magnitude of the peak excursions of impedance will depend on the radiator's characteristic impedance. This fact is shown in fig. 13(A) and 13(B), which are plots of R_a and X_a, respectively. They are plotted separately for clarity. The family of curves shows the effect of varying the characteristic impedance of the radiator. Characteristic impedance is denoted by the factor K_a which can be computed from the following equation:

$$K_a = 120 \log \frac{L}{D} - 120$$

Values of K_a have been computed as follows:[11]

L/D	10	50	100	200	300	600	1000
K_a	323	516	599	682	731	814	875

By reference to fig. 13(A) and 13(B) it can be seen that a thin vertical radiator exhibits greater variations of impedance than does a thick one. (This is true of any antenna.) We make use of this fact in designing broadband antennas, which will be covered later.

Bandwidth

This brings up the subject of antenna bandwidth. The bandwidth of an antenna is dependent upon the rate of change of reactance versus the rate of change of resistance, with frequency. It may be seen that the thick antenna, the one with the lower K_a, will have a

See page 118 for New Reader Service

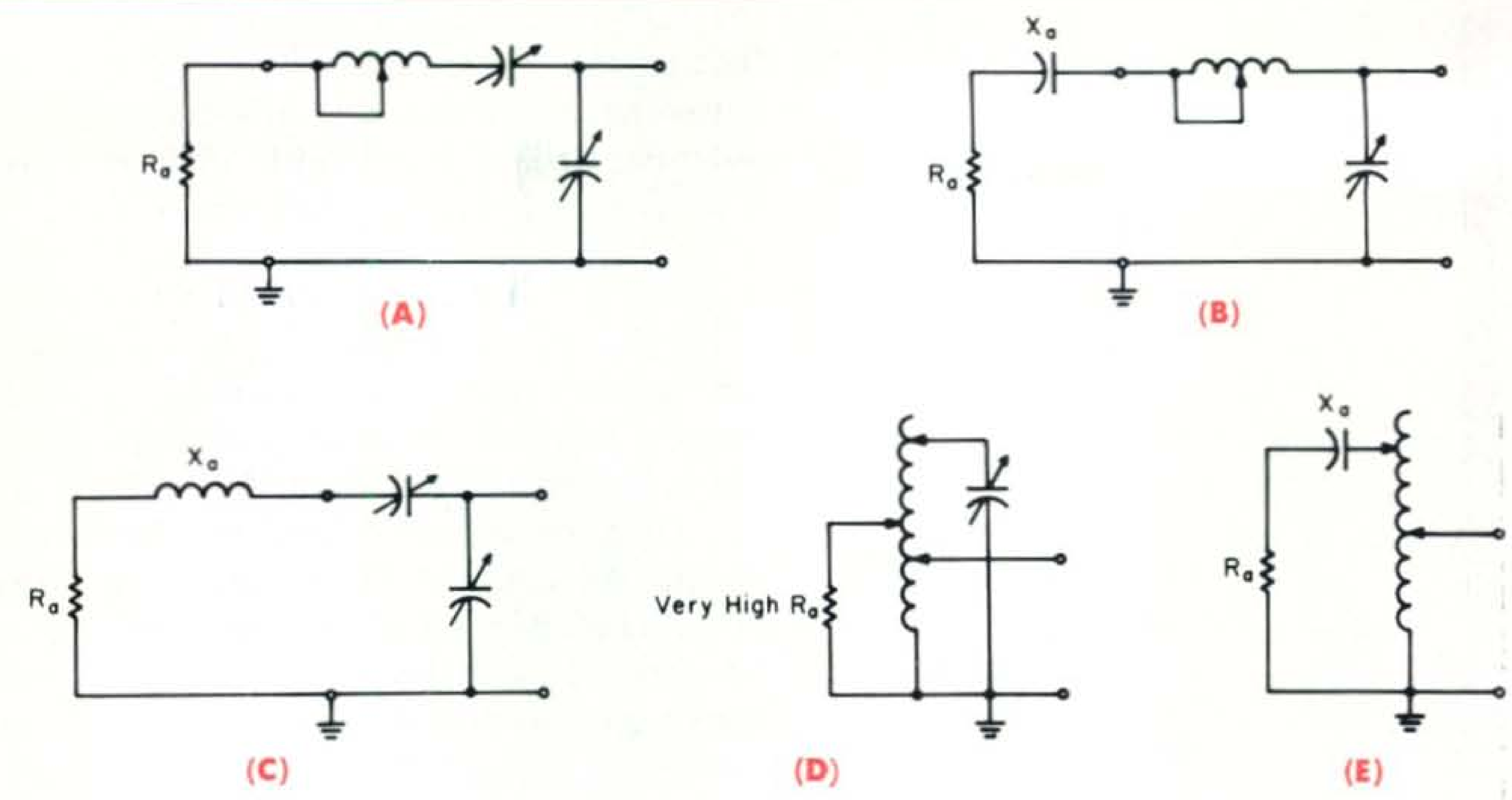


Fig. 14 (A)—Matching unit for an antenna with R_a-j X_a=R (low)-jX_c. (B)—Matching unit for a λ/4 resonant antenna with a low R_a only. (C)—Matching unit for an antenna with R_a+JX_L. (D)—Matching unit for an antenna with a very high R_a, λ/2 resonance. It is difficult to match well and should be avoided if possible. (E)—Matching unit for an antenna with a high R-jX_c (higher than coaxial line impedance).

greater inherent bandwidth than the thin one. For practical purposes, operating bandwidth is the band of frequencies centered about the tuned resonant frequency, enclosed within certain v.s.w.r. limits which depend on other factors such as transmission line capabilities, transmitter v.s.w.r. tolerance, modulation r.f. passband response requirements, *etc*. A figure which is commonly used is the bandwidth to the "3 db down" power limits. There is a very good discussion of antenna bandwidths in Laport.[12]

In the l.f. and v.l.f. cases, bandwidth restrictions can seriously limit an antenna's transmission capabilities unless special designs are adopted to increase bandwidth. These restrictions are caused by the high Q of these antennas. With very high capacitive reactance and very low resistance, the l.f. or v.l.f. antenna is a high Q device. There are special designs, which will be covered later, which improve the bandwidth of these antennas, but at the expense of efficiency. One may ask why we need greater bandwidths at l.f. and v.l.f. than heretofore. The reason is that we are gradually converting to multichannel teletype transmission systems at these frequencies, to increase our traffic handling capabilities, and such systems require greater bandwidth than the old method of single channel keyed c.w.

At m.f. and h.f. we are not worried too much about bandwidth, except that in the case of some m.f. directional arrays, the coupling and branching networks may in some cases restrict the antenna system's bandwidth, and cause loss of sideband modulation frequency response, unless special design precautions are taken. It is for this reason that the FCC requires the consulting engineer to measure and plot R_{in} and X_{in} for a directional antenna system, versus frequency. At h.f. there is no such problem. In the h.f. case bandwidth is important from the standpoint of avoiding retuning of the antenna when shifting frequency, which is very desirable in military and commercial installations.

Reference should again be made to figs. 13(A) and 13(B). Now that we have the plots of impedance versus frequency (plotted in terms of height of radiator in wavelengths), we can state the following general rules for the kind of base impedance which will exist:

Height	*Base Impedance*
Less than 0.25λ resonance.	$R - jX_C$
0.25λ resonance.	$R + jO$
0.25λ physical length.	$R + jX_L$
0.25λ resonance to 0.50λ resonance.	$R + jX_L$
0.50λ resonance.	*R (Very high) (Not recommended)*
0.50λ physical length.	$R - jX_C$ *(High)*
0.50λ physical length to 0.625λ electrical length.	$R - jX_C$

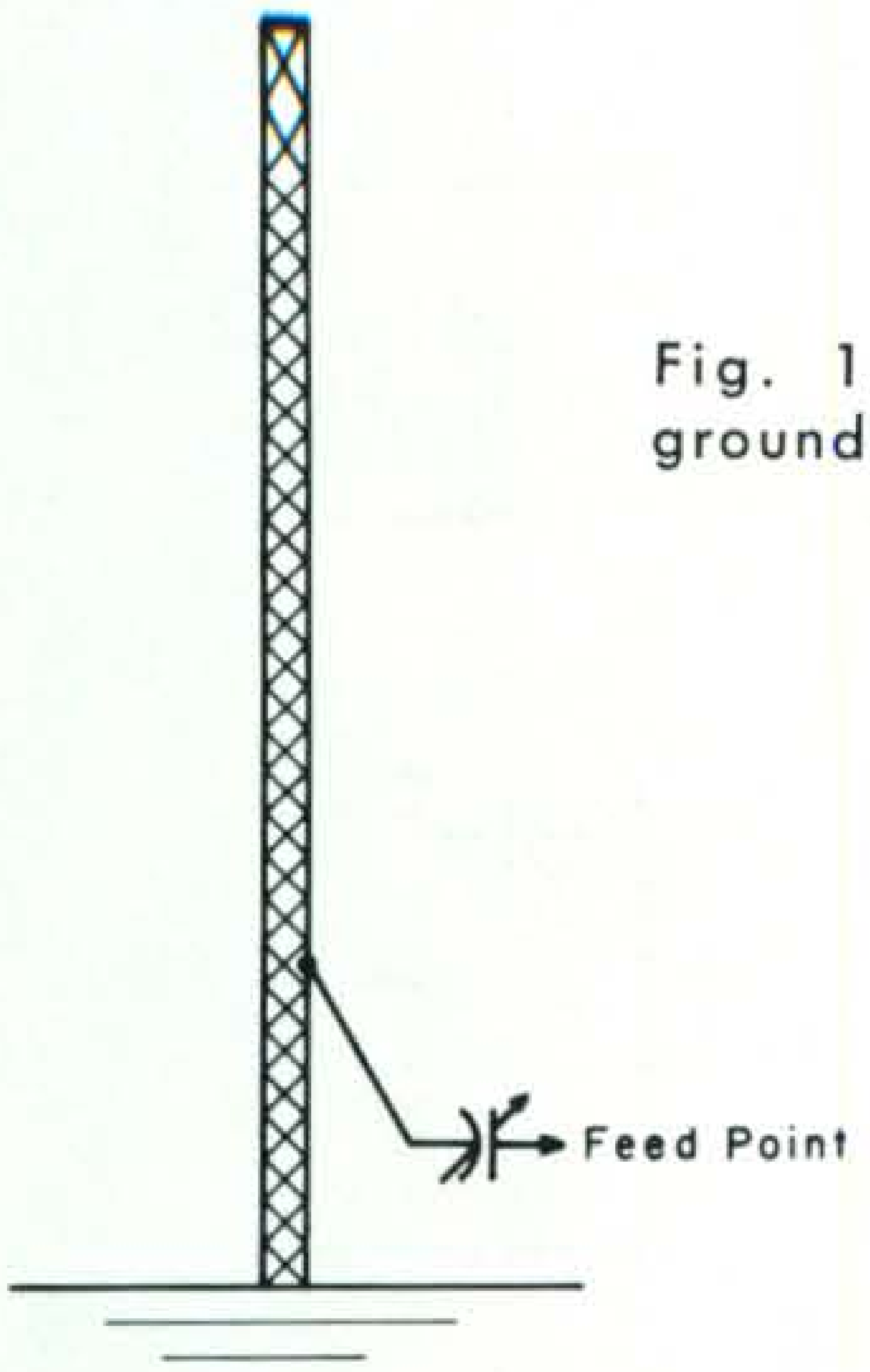


Fig. 15 — Shunt fed grounded base vertical antenna.

It will be noted that the resonant length is always less than the physical length by an amount which is inversely dependent on the *L/D* ratio.

Tuning And Matching Networks

This leads to the next topic, which is the tuning and matching networks required to resonate and match the antennas of heights shown in the preceding impedance summary, to a known source. In modern times the known source has come to be the nominal 50 ohm coaxial line, although 70 ohm line is sometimes used. The matching networks are quite simple, and are shown in figs. 14(A) through 14(E). The values of the reactances required in each case may be calculated by use of r.f. network theory as shown in Terman.[13] In general, if the antenna input reactance is $-jX_C$, inductive reactance $+jX_L$ will be required in the network to tune it, and *vice versa.* The network also simultaneously transforms the antenna input resistance into a value which matches the characteristic impedance of the transmission line.

Where an antenna is fed through a tuning and matching unit of this type, the *total antenna system reactance* must be taken into account in bandwidth computations. This total value includes not only the antenna's own input reactance versus frequency, but also the effect of the reactances in the matching unit as they vary with frequency. The computation of this is not difficult, although perhaps a bit laborious. The simplest approach is to actually tune up the matching unit with antenna attached, and then measure the matching unit's input impedance versus frequency. There are certain "tricks" with networks which can be employed to improve antenna system bandwidth and give lower v.s.w.r. over a range of frequencies.[14]

[13] Terman, F. E., *"Radio Engineering Handbook,"* McGraw Hill (first edition).

Shunt Fed Verticals

In the previous paragraph we spoke of tuning and matching a series fed, ungrounded, vertical radiator. Now let's consider the case of the grounded base, shunt fed vertical radiator. There have been several excellent articles on this subject.[15,16] The shunt fed configuration is shown in fig. 15. Simply stated, a tap is brought off the vertical radiator at a distance above ground and it is used as a feed point, having its input impedance matched to the characteristic impedance of the transmission line. In some cases it is possible by trial and error to adjust the tap's vertical position on the radiator so that the input impedance is $50 + jX_L$, thus permitting an easy match to 50 ohm line by use of only a series capacitor of equal reactance. This adjustment, however, can be quite tedious and critical, especially when hanging on the side of a tower or mast, and it is much simpler to use a matching network of proper reactance values. This type of feed has been used in many broadcast installations. It has been proven by actual full scale model studies and field intensity measurements[15] that use of this feed method is just as efficient as is series feed, and that the horizontal radiation pattern is not distorted by the presence of the sloping feed wire. By both mathematical analysis and actual radiator current meaurements[15,16] it has been shown that current distribution on the shunt fed radiator closely approaches that of a series fed radiator, and that the vertical radiation pattern is not appreciably different.

A similar arrangment, and one most often used by amateurs, is the "gamma" match or "omega" match, similar to that used on the driven element of Yagi arrays. This is shown in fig. 16. This principle was used in the feed arrangements for the Mark III and the Mark IV DX antennas which were published some time ago.[17,18] A feed rod is connected to the radiator at a suitable point some distance

[14] Lee, P. H., "Broadband 80 Meter Feed for the Mark III," *CQ*, March 1964, p. 43.

[15] Morrison, J. F., Smith, P. H., "The Shunt Excited Antenna," *Proc. of the I.R.E.*, June 1937.

[16] Badoux, P., "Current Distribution and Radiation Properties of a Shunt Excited Antenna," *Proc. of the I.R.E.*, June 1940.

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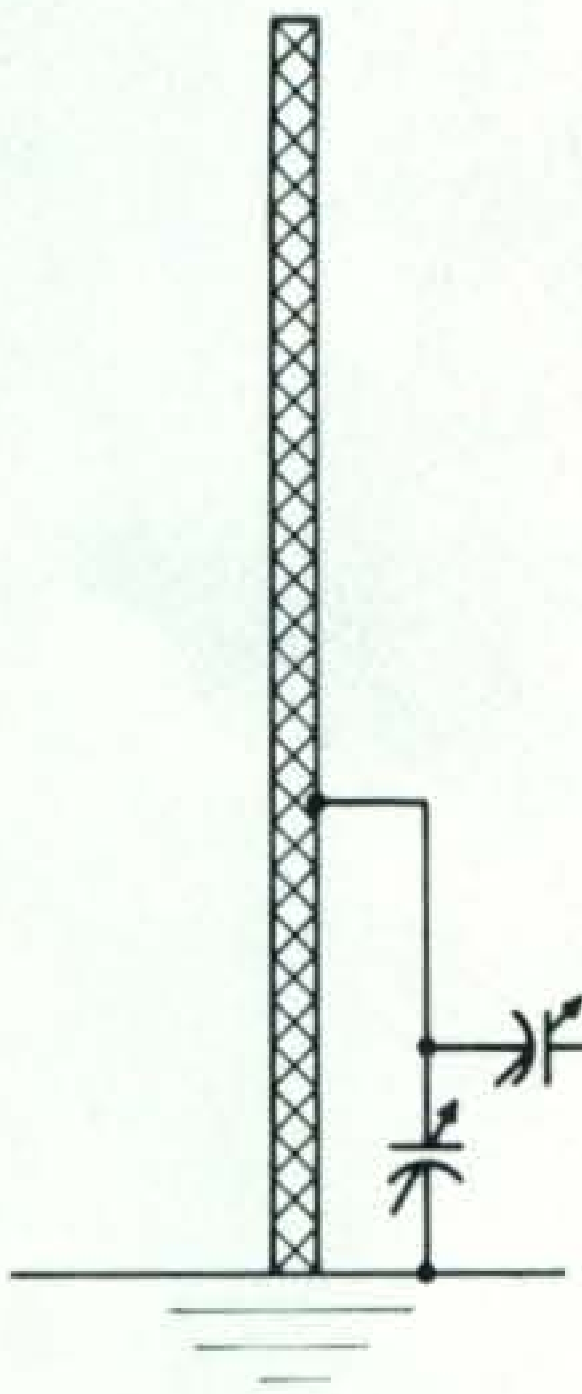


Fig. 16 — Omega fed grounded base vertical antenna.

above ground, and it is brought down the side of the radiator rigidly supported on standoff insulators. It is fed at its bottom end. It must always be considerably less than ¼ wavelength for its input impedance to be of a reasonable value. Note my experience with the 7 mc feed on the Mark IV[18]. The input impedance will always measure $R + jX_L$, because the short section of transmission line (feed rod plus the portion of radiator concerned) thus formed is less than ¼ wavelength and shorted at its top end. Matching then becomes a question of adjusting the several capacitive reactances in the matching unit. The R term of the input impedance may be quite low. The values in the Mark III and Mark IV articles[17, 18] are typical.

If the feed rod (or wire) runs all the way to the top of the vertical radiator, the whole thing becomes a folded unipole antenna and was used as a feed in the Mark IV for 2 and 4 mc.[18] This type will be discussed in detail later.

Ground Bus

There is one additional point that should be made very emphatically in connection with the shunt fed and gamma or omega fed antennas. That is that the ground bus from the tuning unit to the base of the radiator should be heavy and low loss. On the Mark IV I used a ¼″ by 1″ *aluminum* bar (to avoid use of dissimilar metals). This bus carries considerable current, especially where the R term of the feed point impedance is low. For 1 kw in the antenna (2 kw p.e.p. transmitter input), with a feed point R of 10 ohms, there would be 10 amperes current flowing in this bus (and in the feed rod as well). The capacitors in the matching unit should be large enough to withstand the voltages developed across them.

Each method of feed has certain advantages and disadvantages. The series feed has the advantage of simple matching when the antenna base impedance is capacitive, by means of a single tapped coil, as in fig. 14(E). A simple variable matching unit with a bandswitching arrangement can be built to tune a series fed radiator at several frequencies. However, unless a 3-legged self-supporting tower is used, the series fed radiator must usually be guyed because it has to be insulated from ground. Of course one may use small self-supporting whips for short verticals.

On the other hand, the grounded base radiator is quite easy to make self-supporting. Short, light weight ones can be set right in the ground itself, and tall heavy ones can be set in concrete. Very tall ones must usually be guyed. The grounded base permits other circuits to be run up the tower or mast without any special choke coils or other isolation devices. Such circuits would be tower lights, rotary beam motor control cables[18], and in some cases even the coaxial lines for v.h.f. or u.h.f. antennas can be run up a grounded vertical radiator without isolation. This latter idea has been used in several broadcast tower installations where a.m., f.m. and c.a.t.v. antennas utilize the same tower structure.[19]

Feed rod construction is simple. Even multiple feed rods are not difficult to install and adjust[17, 18] for feeding the vertical radiator on several frequency bands. Jasek's "Antenna Engineering Handbook"[20] is a veritable gold mine of information on vertical radiators (and on other types also), and especially on some of the schemes we have been discussing. It also provides an excellent source of additional references, listed at the end of each chapter.

The next installment will deal with electrically short vertical radiators, and ways of matching to them.

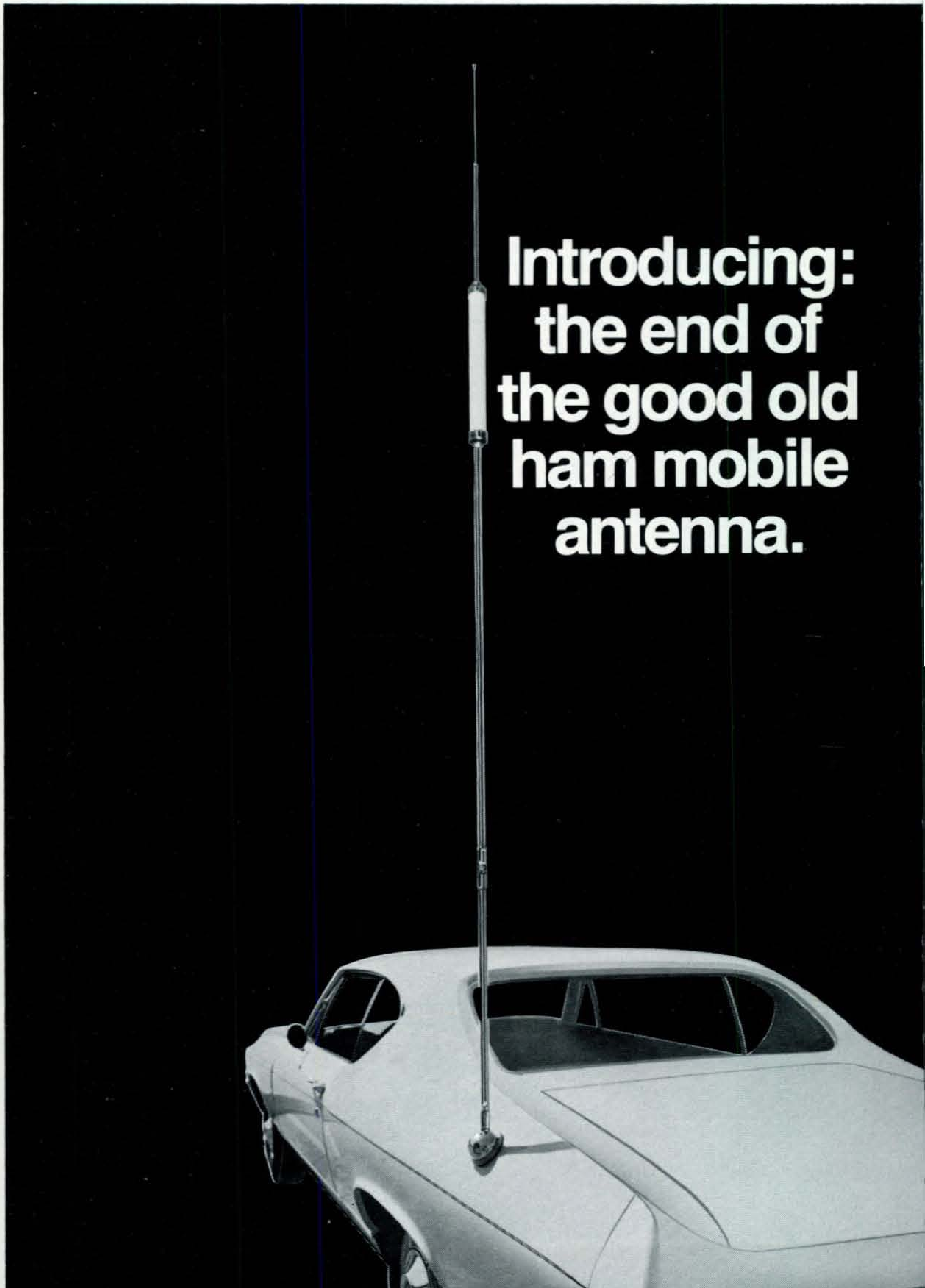
[*To be Continued*]

[17] Lee, P. H., "The Mark III DX Antenna," *CQ*, December 1962, p. 43.

[18] Lee, P. H., "The Mark IV DX Antenna," *CQ*, February 1967, p. 60.

[19] Gureckis, P. V., "A Simple Method of Isolating CATV Antennas On Standard Broadcast Towers," *Broadcast Management-Engineering*, January 1968.

[20] Jasik, H., "*Antenna Engineering Handbook*," McGraw Hill.



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Results of the
1967 CQ World Wide DX (C.W.) Contest

BY FRANK ANZALONE* W1WY

THE c.w section of the contest this year (Nov. 1967) was somewhat disappointing after the good conditions we had had for the phone section the previous month. However we still had a good one and exceeded last year's total.

Once again I will dispense quoting figures and refer you to the various charts that give this information in details. In the single band division the top scores are listed for world wide comparison. The Honorable Mention lists the top U.S.A. stations, exclusive of those that made the world high lists.

Without a doubt PY2SO's score on 28 mc was the outstanding performance of the contest. Sonia had wanted to take it easy this year but found the band open almost around the clock, so chalk up a new world record.

And that VK8UG score was made by none other than Tubby Vale of VK5NO fame of a few years ago. Conditions on 10 are sure different in the southern hemisphere.

Honors on 21 mc were evenly divided with no records being broken. However one of the Bazley family, John Jr. put G3HCT at the top of the list. Many of last year's 15 meter buffs went to 10 this year.

This was the year that we had expected to see the 14 mc band lose its hold on the single band Trophy but PY2BGL a consistent performer on 20, handily defeated his countryman PY4OD. So Manoel gets the Cup and Talma has to admire the one he won a few years ago.

Our fellows in the US made their best showing on 7 mc in spite of the low participation on that band. It will be interesting to see if 4X4RD will be able to get a Trophy out of the Israel Radio Club. Some years ago they donated one for the highest score on 40, but after the initial award we were never able to get any confirmation for later winners.

The Europeans dominated the 3.5 mc band but no outstanding scores were made. In checking the logs we found that most all of the contacts were of the local variety with very few 3 pointers listed. The 80 meter band just did not produce the multipliers this year.

A pleasant surprise was the returns on 160. Conditions were not favorable for trans-Atlantic contacts but the Europeans had a ball between themselves. However it was ZC4RB that picked up the marbles and a new world record. Rolly took advantage of all those 3 pointers north of him, altho he found it hard work and frustrating. Said he heard several W/Ks but could not raise them or TGØAA.

The all banders surpassed most of last year's scores and in many cases established new sectional records. (See page 64, Sept. 67 *CQ*).

Last year's winner, ZD8J still remains the

TROPHY WINNERS

Single Operator, All Band, World
W9IOP, Larry LeKashman Trophy
won by Katashi Nose, KH6IJ

Single Operator, All Band, Europe
W3MSK Operators Trophy
won by Vladimir Goncharsky, UB5WF

Single Operator, All Band, U.S.A.
North Jersey DX Association Trophy
won by Robert M. Knowles, K1DIR

Single Operator, Single Band (14 mc)
K2HLB, Dr. Harold Megibow
Memorial Trophy
won by Manoel R. A. de Castilho, PY2BGL

Multi-Operator, Single Transmitter
W3AOH, Dr. Anthony Susan Trophy
won by Station 4L3A
(Oprs: UA6DP, UQ2AO, UQ2CC, UQ2GA, UQ2IM, UQ2LL, UQ2MS, UQ2NX, UQ2-0371, UW6BA, George, Gunnar

Multi-Operator, Multi Transmitter
K2GL. "Buz" Reeves Trophy
won by Station PJ3CC
(Oprs: W1BIH, W1FJJ, W1TX, W3GRF, W4GF, W4KFC)

SPECIAL CQ PLAQUES

World All Band Champion
J. R. Beck, ZD8J

Club Award
Potomac Valley Radio Club

* 14 Sherwood Road, Stamford, Conn. 06905.

See page 118 for New Reader Service

world's champion and John gets the Special *CQ* Plaque for his efforts.

The World (W9IOP) Trophy however goes to that perennial contester KH6IJ. Nosey finally made it. Katashi always runs up a very high QSO total but usually does not have the multiplier to make the score stand up.

The European (W3MSK) Trophy goes to another consistent contender UB5WF. Vladimir just missed making a million but did set a new record for Europe. Now, how do we get the Cup to him? Anyone going to the Ukraine?

The U.S.A. (NJDXA) Trophy found a home at K1DIR, last year's phone winner. Bob had quite a donnybrook going with W1BPW and just did nose out Peter by having a higher Zone multiplier.

The region south of the Caucasians has become a choice area for contest operation by the USSR boys. This year a group from Latvia went on a contest expedition to Georgia, set up 4L3A, and made a new world's record to win the Multi Single (W3AOH) Trophy. To date we have not received the log of 4J7B, another group that was very active in the same area.

Another contest expedition, this one to Guatemala by K4BAI and W4YWX, set a new record for North America with TGØAA. Their biggest thrill was snagging G3RPB on 160. They would have really flipped if they had heard ZC4RB who was also calling them.

The Multi Multi Big Guns really poured it on. Many stations exceeded previous records but still didn't make the Top Six.

The PJ3CC operation, a contest expedition jointly operated by a crew of six crack c.w. men from the PVRC and the Conn. Wireless clubs, handily won the Multi Multi (K2GL) Trophy. With that kind of talent and all those 3 pointers north of them, how could they miss. And you had better believe that the log was an accurate one and that all the rules were observed. It was signed by W4GF, Bill heads the Amateur Radio division of the FCC. How about that?

And you had also better believe that Freddie did some pretty close checking of the logs of the eternal rivals, K2GL and W3MSK. With a separation of less than 10 thousand points in a 4 million score, a couple of multipliers could change the margin of victory.

The CX8CZ operation must have pooled all the resources in Uruguay as there was hardly no other activity out of there.

Additions

The 28 mc phone score of DL7BA with a total of 220,104 697 36 72 was inadvertently left out of the results last month. This puts Guenter at the top of the list for Germany.

And the c.w. log for 5R8BA, Don Miller's operation from Malagasy, was received after we had gone to press with the results. Don's score would have been listed as follows: 5R8BA A 2,614,877 2135 132 299. This would have put him at the top of the Top Ten but unfortunately it was much too late to be used.

The club competition ran more or less true to form, with the Potomac Valley gang still King of the Roost. It was their big guns that once again proved to be the deciding factor and give them their 6th plaque over the past 10 years. (W4ZM the club's president has assured me that there are no grounds to the rumor that they are out to win a plaque for each member of the club.)

This is only the second year of competition for the Rhein-Ruhr DX group and they almost pulled the upset of the contest. Walter, DJ6QT promises an even greater effort next year so the PVRC had better look to their laurels.

Both the Frankford and Northern Calif. clubs seem to lack the big multi scores to be in real competition. While with the OH-DX-Ring it's just the opposite, all chiefs and no Indians.

As for the YV5 boys, it's still a lack of c.w. men. And the North Jerseyites have once again crawled back into their cocoon after a fine comeback last year.

You will note some fine totals from groups not previously heard from so this might be a sign of things to come.

Once again we were given an assist by some of the European organizations. The Central Radio Club of Czechoslovakia sent their logs in neat packages, sorted by bands and categories, with scoring corrections by Karel Krbec. OK1ANK and Milos Prostecky, OK1MP. The DM entries were similarly treated by Klaus Voight, DM2ATL. While Jan Osowski, SP6AAT took care of the PZK entries. We are eternally grateful fellows,

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Category	Station	QSO's 1.8	QSO's 3.5	QSO's 7	QSO's 14	QSO's 21	QSO's 28	Zones 1.8	Zones 3.5	Zones 7	Zones 14	Zones 21	Zones 28	Countries 1.8	Countries 3.5	Countries 7	Countries 14	Countries 21	Countries 28
Single Operator All-Band	ZD8J		53	282	494	352	407		11	21	31	25	19		16	38	70	62	54
	KH6IJ		45	282	437	593	500		6	16	26	22	20		5	16	39	31	21
	K1DIR		31	202	185	330	176		7	26	32	30	29		13	57	76	75	61
	5H3KJ		4	106	464	383	382		4	14	24	20	24		4	31	54	47	52
	W1BPW		51	230	216	241	172		11	22	31	24	25		22	56	83	68	55
	UB5WF		283	197	235	448	186		8	16	27	22	24		38	48	70	55	46
	KA7AB		44	119	216	430	205		15	19	32	30	27		19	31	42	45	41
	KX6DB				437	544	530				31	25	29				55	32	35
	W4YHD	4	27	178	169	261	190	2	9	29	31	27	27	2	16	62	63	63	55
	G3HDA	1	68	236	272	276	190	1	10	20	26	25	22	1	35	55	65	51	36
Multi Operator Single Transmitter	4L3A		306	472	604	425	569		13	23	31	26	23		49	64	88	63	66
	TGØAA	23	119	440	739	734	560	5	8	21	30	27	25	4	9	38	64	61	43
	ZS5QU		3	38	1064	363	537		3	11	29	27	24		3	11	63	52	52
	W3WJD		26	286	316	304	226		9	30	36	30	31		16	71	107	74	73
	W3BGN	1	37	222	319	316	237	1	7	23	34	25	26	1	18	50	80	63	55
	OF2TI		57	303	438	326	172		7	22	28	27	26		33	57	64	60	56
Multi Operator Multi Transmitter	PJ3CC		191	898	1590	1553	962		7	20	29	26	28		8	46	68	64	61
	W3MSK	16	121	580	632	591	512	5	21	32	36	33	31	6	43	80	119	96	72
	K2GL	11	120	587	699	665	321	3	18	33	35	34	30	4	42	80	123	103	73
	CX8CZ	3	37	225	1020	1057	957	2	11	24	34	29	31	3	13	30	87	66	65
	OF2AM	158	383	604	862	873	437	3	12	27	36	33	31	13	49	76	101	98	78
	W4BVV	12	77	512	543	714	449	6	17	34	35	31	32	5	32	90	109	92	75

Top scores band-by-band breakdown.

United States Club Scores

Potomac Valley Radio Club	**22,896,335**
Frankford Radio Club	14,991,482
Southern California DX Club	11,060,760
Northern California DX Club	8,394,077
Golden Triangle DX Club (Fla.)	7,843,796
Northwest DX Clubs Association	5,672,962
Connecticut Wireless Association	2,799,616
Western Washington DX Club	2,525,338
North Jersey DX Association	2,445,810
Order of Boiled Owls (N.Y.)	1,907,632
Rochester DX Association (N.Y.)	1,464,790
128 DX Contest Club (Mass.)	1,409,504
Willamette Valley DX Club (Ore.)	807,956
Central Michigan A. R. C.	735,250
Poughkeepsie Radio Club (N.Y.)	729,794
West Gulf DX Club	726,275
Hamfesters Radio Club (Ill.)	636,091
Detroit A. R. Association	626,894
Suffolk County Radio Club (N.Y.)	565,020
Angel's Roost DX Club (Texas)	438,328
Southeastern DX Club	391,952
Virginia Century Club	389,310
North Alabama DX Club	318,001
Morris Radio Club (N.J.)	306,161
Florida DX Club	295,645
Utah DX Association	254,644
Ohio Valley A. R. Association	217,296
Central Iowa Radio Club	171,264
West Side A. R. C. (La.)	136,315
Miami Valley A. R. C. (Ohio)	133,399
Baton Rouge A. R. C. (La.)	114,121
Northeast DX Association	78,540
West Allis A. R. C. (Wis.)	55,540
Oak Park A. R. C. (Mich.)	34,686
QCWA DX Club (N.Y.)	26,508

Foreign Club Scores

Rhein-Ruhr DX Association	20,463,644
OH-DX-Ring-Ry. (Finland)	13,089,316
Radio Club Venezolano	11,335,475
DM-DX Club (East Germany)	3,114,955
Latvia DX Radio Club	3,084,536
E. T. A. DX Radio Club (Sweden)	2,950,243
Uruguay DX Club	2,761,816
LVOV DX Club (Ukraine)	2,186,757
Saar-Pfalz Radio Club (Germany)	2,083,742
Far East DX-Ploiters (Japan)	1,959,564
Far East Auxiliary R. C. (Japan)	1,804,439
Kiel Canal Radio Group (Germany)	1,655,500
Moscow Radio Club (USSR)	1,300,009
Lampertheim Radio Club (Germany)	1,221,854
Crimea Radio Club (USSR)	1,081,031
Tallinn A. R. C. (Estonia)	1,068,164
Venezuelan DX Club	1,039,148
Sakhalin Island A. R. C. (USSR)	977,218
Gateway A. R. C. (Germany)	889,801
SP-DX Club (Poland)	884,875
Swiss DX Club	831,656
Mashonaland A. R. C. (Rhodesia)	749,070
Calagary A. R. Assoc. (Canada)	729,985
Leningrad A. R. C. (USSR)	714,180
Leipzig Contest Team (Germany)	570,486
Kamiseya A. R. C. (Japan)	566,104
Vasteras Radioklubb (Sweden)	545,509
RAF Troodos A. R. C. (Cyprus)	543,582
Anglo American Contest Group (England)	451,605
Czechoslovakian DX Team	429,535
Nagoya DX Club (Japan)	280,210
Radio Club of Budapest (Hungary)	278,710
Waggeryds DX Club (Sweden)	248,404
Hammarbyhoejden A. R. C. (Sweden)	204,161

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Top Ten
SINGLE OPERATOR
ALL BAND

ZD8J	**1,616,673**	**UB5WF**	**999,700**
KH6IJ	**1,116,454**	KA7AB	941,227
K1DIR	**1,087,674**	KX6DB	923,841
5H3KJ	1,071,888	W4YHD	914,048
W1BPW	1,067,136	G3HDA	878,257

Top Six
MULTI-OPERATOR
SINGLE TRANSMITTER

4L3A	**3,084,536**	W3WJD	1,589,841
TGØAA	1,948,360	W3BGN	1,263,900
ZS5QU	1,615,350	OF2TI	1,076,160

Top Six
MULTI-OPERATOR
MULTI TRANSMITTER

PJ3CC	**5,527,788**	CX8CZ	3,851,645
W3MSK	4,063,920	OF2AM	3,829,375
K2GL	4,054,092	W4BVV	3,714,048

Top Scores
SINGLE OPERATOR SINGLE BAND

28 mc		7 mc	
PY2SO	532,956	4X4RD	153,716
VK8UG	320,008	OK1ZQ	109,038
9J2WR	260,190	W2LXK	91,832
OA4PF	194,732	W5WZQ	80,912
9J2BC	170,570	DJ5PA	75,897
VK9GN	149,110	W4BYB	74,304

21 mc		3.5 mc	
G3HCT	235,209	OK1ALW	39,816
W2MEL	190,334	OK3BU	32,155
PY7ACQ	184,800	SM5MX	31,222
VP2MU	168,646	DJ5DT	28,024
JAØAIF	150,147	UA9EU	27,426
SM3CNN	131,675	OH1SH	26,291

14 mc		1.8 mc	
PY2BGL	**642,400**	ZC4RB	4,335
PY4OD	592,110	PAØGMU	2,025
YV5AGD	474,978	HB9NL	1,984
VK3APJ	422,240	DL1CF	1,728
CR6AI	356,022	G3JVJ	1,700
KZ5TW	343,850	OK1IQ	1,692

U.S.A. Honorable Mention
Single Operator

All Band	W9LKJ	652,526
28 mc	K1LWI	112,320
21 mc	W3VEQ	123,114
14 mc	K9ECO	200,100
7 mc	W3DFL	65,170
3.5 mc	K2RBT	20,178
1.8 mc	W1BB/1	418

Multi-Operator

Single Tx:	W2PCJ	1,054,651
Multi Tx:	W4KXV	2,605,590

Number groups after call letters denote the following: Band (A-all); Final Score: Number of QSOs; Zones and Countries. Certificate winners are listed in **bold face**.

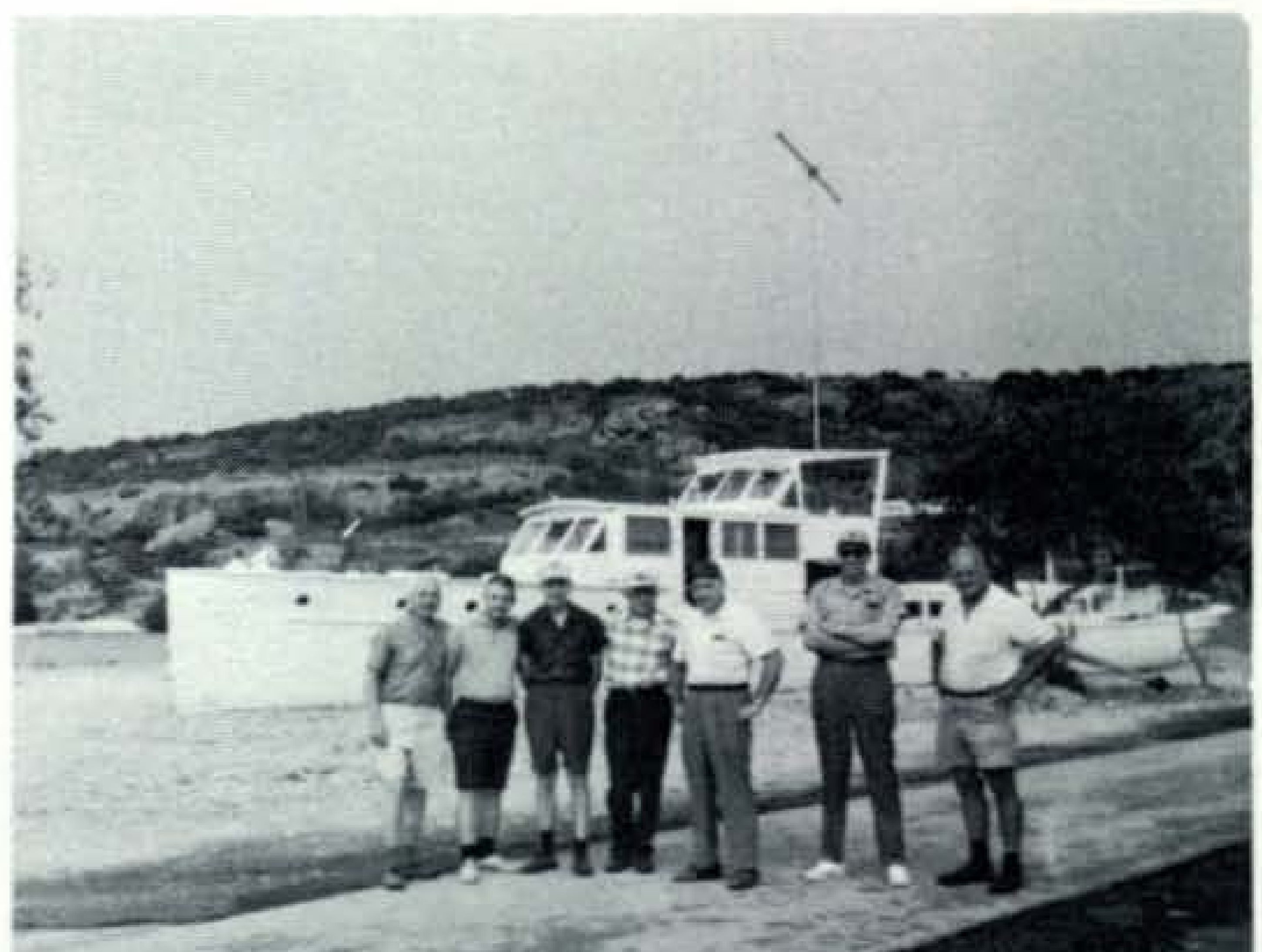
C. W. Results

SINGLE OPERATOR

North America

United States

K1DIR	**A**	**1,087,674**	**924**	**124**	**282**
W1BPW	**A**	**1,067,136**	**910**	**113**	**284**
W1JYH	"	237,943	300	98	179
W1EZD	"	218,384	319	75	157
WA1FHU	"	168,400	310	71	129
W1MX	"	138,560	306	56	114
K1LMS	"	73,130	181	51	91
W1DIT	"	67,700	153	68	103
W1ETV	"	30,912	96	45	67
WA1ANR	"	27,508	112	34	58
W1CNU	"	21,567	80	39	52
W1NIY	"	11,269	64	23	36
W1PLJ	"	7,776	54	21	33
K1LWI	**28**	**112,320**	**365**	**30**	**74**
W1BVP	"	48,420	184	30	60
K9CVO/1	"	12,354	75	20	38
WA1FCN	21	3,535	36	12	23
K1NOL	**14**	**200,062**	**513**	**34**	**100**
W1UUK	"	78,540	250	34	76
W1SWX	**3.5**	**11,908**	**80**	**17**	**35**
W1BB/1	**1.8**	**418**	**21**	**5**	**6**
W2HTI	**A**	**468,792**	**534**	**104**	**202**
K2DJD	**A**	**366,892**	**471**	**88**	**180**
W2JVU	"	308,632	473	73	150
W2HDW	"	57,120	163	38	81
WA2IZS	"	51,875	150	47	78
W2HUG	"	51,356	125	57	91
W2LV	"	46,280	127	47	83
K2DDK	"	42,150	104	55	95
K2DNL	"	36,057	119	49	70
WB2GGO	"	32,230	101	37	73
K2CPR	"	31,536	118	40	68
W2NRV	"	29,106	103	34	64
W2HL	"	21,879	77	41	58
W2JKH	"	15,326	81	44	53
W2HAE	"	14,214	70	29	40
WB2TEN	"	13,937	61	30	47
W2QDY	"	12,465	98	20	45
W2JB	"	10,442	60	14	32
WA2VSQ	"	4,391	54	23	38
W2GT	"	3,220	32	13	22
WA2OIL	"	2,026	33	21	28
WA2KSD	"	2,004	32	16	24
W2IP	"	1,134	15	12	15
W2NHH	"	990	15	7	15
WA2UJM	**28**	**96,030**	**311**	**31**	**76**
W2RDD	"	42,075	168	28	57
W2ZV	"	15,042	77	23	46
W2NEP	"	4,884	42	19	25
W2MEL	**21**	**190,334**	**567**	**31**	**87**
WA2OJD	"	120,493	407	28	73
WB2UDF	"	14,632	87	18	41
WB2WID	"	6,903	59	13	26
WN2DDR	"	28	7	3	1
W2HO	**14**	**95,571**	**269**	**35**	**88**
W2IRV	"	29,670	120	31	55
W2CKR	"	18,395	99	19	46
W2LXK	**7**	**91,832**	**303**	**31**	**73**
W2SEI	"	28,674	123	24	57
K2ISP	"	8,918	65	17	32
K2RBT	**3.5**	**20,178**	**128**	**18**	**39**
W2EQS	**1.8**	**176**	**13**	**4**	**4**
W3BES	**A**	**588,555**	**647**	**104**	**215**
W3MFW	**A**	**523,692**	**522**	**115**	**236**
W3GHS	**A**	**414,110**	**524**	**91**	**183**
K3HTZ	"	396,628	438	102	199
W3WPG	"	373,592	482	91	177
W3HHK	"	343,720	459	87	173
W3NOH	"	342,516	434	91	185
W3MSR	"	317,078	502	76	150
W3IYE	"	258,529	342	89	174
W3BIP	"	173,280	252	86	154
W3KDF	"	162,630	289	71	124
W3ISE	"	146,268	250	74	130
K3AIG	"	141,249	252	71	126
W3EQA	"	136,440	261	62	118
DL1CR/W3	"	118,737	251	55	112
W3KT	"	113,100	210	72	123
K3BNS	"	99,314	279	42	85
W3BYX	"	95,361	245	42	91
W3GRS	"	95,190	176	73	117
W3DRD	"	79,540	169	54	110
W3PN	"	75,480	178	64	106



The gang at PJ3CC took over-all top honors. L. to R.: W1TX, W1FJJ, W1BIH, W4GF, W4GRF, W4KFC, and Chet, PJ3CC.

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Vacationing VE2YU operating from his father's shack (VP2MW). Ernie put VP2MU in the Top Six on 21 mc. (Wish we could stir up more Caribbean activity.)

W3EAN	"	68,076	192	46	78
W3NNK	"	51,360	122	63	97
W3KA	"	43,452	144	37	65
WA3ATX/3	"	42,600	130	49	71
W3PVZ	"	41,515	128	40	75
W3JET	"	31,304	106	38	66
W3CGS	"	28,322	98	34	64
W3HVM	"	26,664	94	44	57
W3CAA	"	22,400	98	26	54
W3GHD	"	16,266	71	39	50
WA3GZM	"	14,720	86	18	38
W3QOR	"	12,710	56	37	45
W3CBF	"	12,606	65	22	44
W3FBE	"	12,052	66	26	39
K3EUR	"	8,700	58	16	34
W1QMM/3	"	8,580	51	28	37
WA3ENM	"	2,884	36	11	17
WA3GFN	"	2,470	29	18	20
WN3HMU	"	10	3	3	2
W3AYS	28	72,619	244	32	69
W3QQL	"	67,200	239	30	66
W3VEQ	21	123,114	413	31	71
WB2MZJ/3	"	71,760	264	26	66
W3MFJ/3	"	15,840	124	12	32
WA3HRV	"	14,573	90	20	39
W3AFM	14	90,945	224	36	105
W3KQD	"	2,688	32	14	18
W3DFL	7	65,170	233	27	71
K3CYA	"	46,410	184	25	60
W4YHD	A	914,048	829	125	261
W4ZSH	"	150,824	263	67	129
K4EZ	"	110,298	207	73	113
W4EI	"	91,690	192	64	109
W4TMR	"	75,947	165	63	110
W4MOJ	"	72,076	174	51	97
W4HOS	"	55,566	141	59	88
WA4FFW	"	32,280	97	45	75
W1AGP/4	"	31,428	107	41	67
W4WBC	"	27,720	101	36	63
W4PTR	"	20,482	75	45	53
W4DKU	"	18,480	84	28	49
WA4UXQ	"	238	7	7	7
WB4GTS	"	140	7	3	4
W4HUE	28	102,820	362	30	67
K4HXF	"	89,100	283	32	76
W4NBV	"	64,077	242	31	62
K4TRJ	"	47,872	199	29	59
W3IZI/4	"	27,288	131	26	46
K4ORQ	21	51,128	211	26	57
W4MMD	"	37,843	180	21	50
W4ZOK	"	15,960	94	19	41
W4SNU	14	106,149	301	35	88
W4PLL	"	74,018	215	35	84
W4YGY	"	61,912	203	32	77
W4BQY	"	7,434	44	26	37
KH6FON/4	"	2,128	40	12	16
W4NXE	"	1,836	17	7	12
W4KMS	"	1,100	15	11	14
WB4HFJ	"	1,050	16	12	13
W4BYB	7	74,304	269	27	69
W5JAW	A	490,500	523	106	221
W5BRR	"	334,452	422	104	178
W5BUK	"	129,430	238	86	129
K5BOC	"	125,280	264	65	115
W5CK	"	28,556	195	78	89
W5ERR	"	6,885	47	21	30
W5IOU	28	78,624	264	31	73
W5DWT	"	66,552	256	30	64
WA5CBE	"	65,000	218	32	72
WA5RQA	21	42,630	173	27	60
K8IAE/5	"	2,128	29	12	16
WN5RWU	"	1,134	22	9	9
W5KC	14	70,523	231	33	76
K5BXG	"	62,348	203	34	75
W5WZQ	7	80,912	272	30	74
W5ODJ	"	12,144	98	19	27
W5LXG	"	9,850	74	19	31
WA5IIS	"	3,060	33	14	20
W6ITA	A	627,588	747	109	189
WA6QGW	A	546,930	625	117	192
W6IBD	A	539,273	658	108	179
W6CUF	"	521,444	606	120	188
W6HJT	"	516,545	606	114	181
WA6IVN	"	419,814	523	109	172
W6WX	"	312,939	424	102	159
W6HOC	"	230,146	340	95	143
W6ERS	"	228,096	335	105	159
K6CQF	"	213,285	314	96	145
WB6KBK	"	201,552	322	90	131
W6EJJ	"	194,896	338	93	115
W6ECM	"	191,780	313	94	129
W6EOU	"	174,336	319	79	113
W6BSY	"	172,002	296	85	133
W6ISQ	"	161,400	282	81	119
W6LDA	"	153,671	277	87	116
K6HOR	"	130,144	236	80	116
K6VZA	"	129,712	261	69	107
WB6TCJ	"	125,120	319	50	77
W6JFJ	"	107,604	209	78	105
WB6LOR	"	100,740	244	55	91
W6GRX	"	86,892	207	60	96
W6NEX	"	86,720	186	68	92
K6KA	"	86,335	212	64	91
WB6HGU	"	85,410	218	61	85
WB6NWK	"	77,922	237	51	66
K6EBB	"	77,572	177	82	90
K6CYX	"	71,162	159	67	94
WA6PMK	"	56,700	196	31	69
W6DZZ	"	48,106	127	61	73
W6CNA	"	43,524	135	50	67
K6TZX	"	28,028	107	48	50
W6LDD	"	24,402	92	48	50
W6VVR	"	23,808	90	40	56
W6PLS	"	23,750	96	46	49
W6JKR	"	18,216	74	43	49
WØDAD/6	"	14,250	69	36	39
WA6UFW	"	13,110	67	32	37
W6JKJ	"	11,718	67	28	34
W6UQQ	"	7,728	55	22	26
W6EJA	"	5,439	51	18	19
WB6RTJ	"	5,198	39	21	25
K6MG	"	3,234	33	16	17
WA6JDT	"	2,822	29	15	19
W6QDE	"	1,430	23	10	12
W6TZD	28	47,970	219	27	51
VE3DXV/W6	"	39,825	193	28	47
K6YFZ	"	24,895	141	27	39
K6VFF	"	23,121	128	25	38
WA6QQI	"	15,544	94	25	33
W6PBI	"	14,742	101	25	38
K6EC	"	14,283	76	28	41
W6KHS	"	7,452	49	24	30
W6PQW	21	121,873	396	35	72
KØGJD/6	"	110,364	372	32	70
WA6GLD	"	104,535	357	32	69
W6KNE	"	85,932	326	30	63
W6ITY	"	78,442	301	31	60
WB6NWW	"	74,970	310	30	55
W6LCX	"	65,520	251	28	62
K6YRD	"	32,960	174	21	43
W6TCQ	"	17,458	105	22	36
WB6PNB	14	67,300	237	33	67
K6EVR	"	40,581	174	27	54
W6UED	"	18,036	119	23	31
WB6KIL	"	5,746	35	27	32
K6UMV	"	2,133	31	13	14
W6NKR	7	17,499	79	23	34
K6OHJ	"	13,545	105	19	26
W6ANN	"	11,609	86	19	28
K6BPR	3.5	6,336	77	16	17
W6GEN	"	4,992	71	16	16
W6SYY	"	3,192	50	14	14
W6VNJ	"	2,418	34	13	13
W7PGX	A	437,544	495	107	202
W7RVM	"	230,830	403	90	115
W7AYY	"	169,488	342	74	102
W7MVC	"	147,440	277	82	112
W7CNM	"	129,889	245	81	112
W7GHB	"	59,829	150	65	82
K7ABV/7	"	45,468	150	49	59
WA7CGR	"	42,570	156	45	54
W7QON	"	41,088	135	47	60
W7BTH	"	22,962	91	36	50
W7IUO	"	14,003	85	33	34
W7QY	"	11,766	60	33	41
W7AC	"	828	15	12	11
WN7IHF	"	336	15	9	7
W7CRT	28	12,137	79	22	31
W7EKE	21	92,288	305	32	71
W7RQN	"	73,289	305	29	54
W7PHO	"	60,235	241	33	52
K7ADL	14	91,478	296	31	75
W7DV	"	76,076	285	30	61
W7LAV	"	38,608	180	35	41
K7CHT	"	4,625	47	18	19
W7YEX	"	4,002	32	22	24
W7BCV	"	1,840	27	11	12
W7JLU	7	6,903	65	18	21
WA8LYF	A	459,192	512	107	211
WA8KPO	"	24,543	103	30	51
WA8GGN	"	16,275	73	43	50
WA8ZGC	"	14,025	70	32	43
WA8MCR	"	13,888	74	26	38
W8YGR	"	11,304	55	28	44
WA8QYK	"	2,940	25	19	23
W8WZ	28	92,768	306	31	73
W8MKE	"	39,071	151	28	61
W8JAQ	"	38,080	165	28	52
WA8TFJ	"	32,631	157	27	46
W8AJW	"	29,680	145	25	45
WA8KCX	21	108,159	395	27	66
K8HZU	"	87,450	282	32	74
W8DSO	"	4,366	42	13	24
WN8ZCC	"	2,800	31	13	22
W8BVF	14	26,709	105	30	57
W8EW	"	12,915	72	26	37
WA8CIA	"	8,142	46	18	29
W9LKJ	A	652,526	622	119	248
W9AQW	"	622,865	631	120	227
K9CUY	"	359,697	458	112	187
W9IRH	"	311,015	440	104	179
W9RQM	"	97,513	205	69	91
W9YYG	"	51,737	140	57	76
W9PJT	"	44,298	121	58	80
K9DWG	"	22,356	86	38	54
W9MUR	"	5,292	37	22	32
K9VQK	"	4,644	37	19	24
WA9NSR	"	3,696	32	23	25
W9ZSQ	"	2,006	10	8	9
W9DUB	28	71,676	252	30	69
W8CPO/9	"	6,292	44	19	33
W9ZTD	21	96,305	330	28	75
WA9AUM	"	27,918	144	21	45
WA9REC	"	11,040	69	21	39
W9AEM	"	7,611	63	16	27
K9ECO	14	200,100	476	37	108
W9SCZ	"	27,710	116	28	57
W9HUZ	3.5	3,795	49	14	19
WØVXO	A	494,816	616	123	205
WØIDW	"	120,360	243	70	107
WAØKDI	"	107,695	213	75	106
WØLBP	"	85,600	196	66	94
WØEQN	"	40,812	120	50	66
WØJYE	"	25,641	93	42	57
WØLMO	"	16,748	77	36	43
KØYIP	"	10,650	53	33	42
KØBYC	"	9,750	47	37	41
KØJPL	"	1,742	51	28	34
WAØCVS	21	93,700	331	30	70

Alaska

KL7FRY	A	538,892	1147	93	106
KL7JDO	"	130,910	642	50	45
KL7MF	"	83,622	469	30	47
KL7EWA	14	23,691	165	23	30

Bermuda

VP9BY	21	60,476	514	15	37

Canada

VO1HH	A	78,987	306	44	69
3B2AW	A	12,988	193	19	15
VE1AIH	A	122,694	344	50	93
VE1TG	28	139,026	595	28	66
VE1AE	14	13,350	99	15	35
VE2WA	A	195,720	306	88	145
VE2AYU	"	140,056	351	56	108
VE2BGJ	"	44,506	193	48	71
3C3ES	A	35,360	127	40	64
VE3IJ	"	23,040	113	33	47
VE3BMB	21	11,275	81	24	31
VE3BHS	14	105,560	344	34	82
VE3GJE	"	12,464	142	17	24
VE3BS	1.8	480	48	3	2
VE5DZ	14	816	19	8	8
VE6SX	A	28,582	199	29	33
3C6VO	"	20,511	138	26	27
VE7EH	A	290,121	703	71	102
VE7SV	"	228,636	587	78	96
3C7CE	"	31,291	156	41	42

Canal Zone

KZ5	A	103,320	615	40	42
KZ5GN	28	112,708	620	25	51
KZ5AJ	21	84,912	654	22	39
KZ5TW	14	343,850	1177	36	94

Dominican Rep.

HI8IBC	A	1,988	71	9	5

Greenland

OX3ZO	A	2,943	67	13	14

Guadeloupe

FG7TE	14	17,650	285	13	17

Mexico

XEØDUS	A	208,650	1364	39	36
XE1WS	A	205,477	618	66	87

Montserrat

VP2MU	21	168,646	860	26	60

Virgin Islands

KV4AM	A	339,522	716	99	114

AFRICA

Algeria

7XØAH	28	129,120	550	26	54

Angola

CR6AI	14	356,022	1072	30	84

Ascension Island

ZD8J	A	1,616,673	1586	107	240
ZD8HAL	21	83,216	501	17	39

Cameroun

TJ1QQ	A	405,339	660	70	143

Ghana

9G1HM	A	298,584	828	47	85

Kenya

5Z4SS	A	119,596	353	40	76

Liberia

EL2D	A	538,300	1035	59	116

Mozambique

CR7IZ	A	188,634	470	58	91

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Rwanda

9X5SA	A	7,728	55	22	26

Seychelles

VQ9B	14	120,120	403	29	75

Sierra Leone

9L1TL	21	106,260	514	22	48

South Africa

ZS2RM	A	168,590	502	45	70
ZS6DT	"	54,305	240	26	53
ZS1O	"	4,104	61	13	11
ZS2HI	14	278,256	927	30	72

Swaziland

ZD5M	A	87,399	256	44	73
ZD5X	"	79,443	237	53	64

Tanzania

5H3KJ	A	1,071,888	1339	86	188

Zambia

9J2MX	A	838,508	1234	77	159
9J2W	"	663,984	1071	70	142
9J2WR	28	260,190	877	32	73
9J2BC	"	170,570	776	24	50

ASIA

Ceylon

4S7DA	A	66,822	216	49	80
4S7NE	14	23,088	129	28	46

Cyprus

ZC4RB	1.8	4,335	86	3	14

India

VU2RM	A	130,500	359	52	93
VU2KV	"	53,196	184	65	78
VU2GW	"	41,235	202	36	51
VU2URZ	7	48	8	2	4

Iran

EP2MM	14	45,177	250	22	51
EP2BQ	3.5	11,977	110	11	32

Israel

4X4VE	28	94,340	384	29	60
4X4VF	"	13,080	148	7	23
4X4RD	7	153,716	648	22	61

Japan

JA1CWZ	A	562,010	937	87	123
JA4BJO	A	464,640	653	101	155
JA1MIN	A	354,673	598	91	118
JAØAWF	A	253,995	525	80	97
JA3LGG	"	162,261	394	71	78
JA1XLU	"	144,956	427	62	62
JA7FC	"	100,800	283	58	68
JA7CDU	"	98,558	269	64	71
JA1GTF	"	91,204	172	64	82
JA3FYC	"	75,640	238	57	65
JA7UQ	"	65,474	276	39	49
JA1PTI	"	63,444	231	54	48
JA1PIG	"	44,137	172	48	53
JAØCGJ	"	41,138	216	29	38
JA2FCR	"	41,097	143	46	57
JA2ITH	"	39,995	162	45	50
JA7CQB	"	38,340	140	53	55
JA6CLO	"	32,205	130	41	46
JA2HFB	"	30,005	135	40	45
JA2CXF	"	28,158	110	57	57
JA2AMD	"	25,536	106	42	54
JA1CYV	"	24,635	98	44	45
JA1SMA	"	23,332	126	37	40
JA2LA	"	23,144	101	46	42
JA2JKV	"	21,698	174	51	60
JA1VHO	"	20,007	105	40	41
JA1XMS	"	19,654	129	30	32
JA1IZ	"	17,010	91	32	38
JA2GRM	"	15,336	93	34	37
JA3EGC	"	15,246	91	31	35
JA1WWY	"	14,100	110	25	25
JAØBPY	"	10,692	84	26	28
JA5AVL	"	9,724	72	27	25
JA1BNW	"	9,313	67	26	35
JA3HGL	"	8,400	68	26	24
JA3DEO	"	6,674	58	24	23
JA3HLJ/3	"	6,068	97	39	37
JA5MG	"	5,412	59	20	24
JH1EDB	"	4,459	43	24	25
JA2AUV	"	3,196	34	17	17
JH1AWN	"	2,298	54	22	23
JA4FM	"	1,993	43	25	21
JA9NB	"	253	9	5	6
JAØYAK	"	18	3	3	3
JA2WB	28	72,759	329	30	49
JA3DUC	28	71,484	304	31	53
JA7ARZ	"	36,018	231	25	29
JA1EM	"	33,356	191	26	36
JA1JUQ	"	29,172	240	19	25
JA8QR	"	25,520	159	24	34
JA1SJV	"	23,230	175	21	25
JA1WRP	"	21,900	133	26	34
JA7JW	"	20,565	170	22	23
JA2IPE	"	16,362	109	24	30
JA3KM	"	14,336	94	26	32
JA8BYP	"	11,095	111	17	18
JA2JAA	"	5,480	92	10	10
JAØCIG	"	2,025	30	14	13
JA4AEZ	"	1,710	33	8	11
JAØAIF	21	150,147	622	28	55
JH1EYB	21	107,966	503	26	48
JA3GZN	"	85,976	514	24	34
JA1RQA	"	65,557	360	27	36
JA1KVT	"	65,191	342	27	40
JA2FUA	"	58,692	311	26	41
JA1PCY	"	51,548	313	23	30
JA2EPK	"	24,024	157	23	33
JA1LXE	"	23,569	177	22	29
JA3LBU	"	20,574	138	23	31
JA2BGV	"	16,497	123	21	26
JA1KYV	"	15,759	110	20	31
JA1BZM	"	12,095	103	18	23
JA3HLV	"	10,560	97	18	22
JA1XCZ	"	9,576	101	18	18
JA7COE	"	8,526	74	20	22
JA6GPR	"	7,831	76	19	22
JA5BWV	"	7,446	77	15	17
JA5BHN	"	7,141	71	18	19
JA3GMQ	"	2,945	35	15	16
JA1XRH	"	2,944	47	11	12
JA1SKE	"	2,079	26	14	19
JA3FPK	"	280	16	3	1
JA9FB	"	187	7	5	6
JAØDFJ	"	42	4	4	3
JA6AD	14	163,170	534	34	77
JA2HO	14	57,907	267	28	51
JA1NLX	"	31,080	210	25	35
JA2CPD	"	27,032	167	27	35
JA7MN	"	21,492	143	20	34
JA1CLW	"	18,550	128	25	28
JA1DFQ	"	17,120	160	17	23
JA2BVL	"	16,371	113	23	28
JA1JDF	"	11,634	111	18	24
JA2CUS	"	10,836	105	18	25
JA2FMW	"	9,635	84	21	26
JA1RJU	"	8,159	78	20	21
JA3HIG	"	5,499	56	18	21
JA1FGB	"	5,000	56	18	22
JA2KXE	"	4,488	68	16	18
JA4AQR/5	"	2,139	36	15	16
JA1ACA	"	1,972	24	15	14
JAØDJE	"	1,426	37	10	13
JA5AF	"	714	20	9	12
JAØGZ	"	168	8	7	5
JA5BJC	7	48,706	254	27	44
JA1JPJ	"	40,326	240	24	42
JA1YL	"	35,518	236	25	34
JA1LWI	"	33,366	187	25	42
JA1TBA	"	22,050	176	20	29
JA1PPW	"	17,343	145	20	27
JA1VBW	"	816	24	8	8
JA3BCT	"	396	36	6	5
JAØBOP	"	136	8	5	3
JA7XF	3.5	5,696	71	16	16
JA3IVW	"	855	20	8	7
JA3AA	1.8	216	10	4	5
KA7AB	A	941,227	1084	123	178

Korea

HL9KD	A	31,590	183	43	47

Ryukyu Islands

KR8DK	21	18,767	307	22	27

Saudi Arabia

HZ1AB	A	692,376	1281	62	142

Turkey

TA1AV	A	35,805	361	24	69
TA2BK	14	75,969	418	18	51

West Pakistan

AP5HQ	A	70,785	361	35	64

Union of Soviet Socialist Rep.

UA9JH	A	291,312	771	36	100
UWØAF	A	178,382	462	52	106
UA9UG	"	137,280	511	42	78
UWØSX	"	101,170	353	46	88
UAØLH	"	87,416	349	44	54
UAØKZB	"	73,343	474	37	34
UA9NJ	"	31,390	135	33	54
UW9PT	"	19,440	90	30	50
UAØZI	"	17,936	251	21	17
UA9FM	"	8,940	63	22	38
UA9ES	"	2,478	29	20	22
UA9MS	28	47,112	272	25	53
UA9WS	"	38,164	227	16	42
UA9SH	"	3,960	44	10	20
UA9BZ	21	52,647	314	20	49
UAØLS	21	13,508	142	20	24
UA9MM	"	12,682	148	10	24
UA9DA	14	281,312	831	31	87
UV9CU	"	237,584	727	36	88
UW9OA	"	120,189	418	30	71
UV9AB	"	95,264	342	28	76
UA9OH	14	82,517	294	33	68
UA9FV	"	61,942	247	27	67
UWØIF	14	55,440	373	26	30
UA9FN	"	51,800	270	22	52
UA9KTB	"	51,255	291	20	47
UV9OV	"	44,957	263	19	48
UA9JD	"	42,921	251	15	42
UA9OO	"	31,920	168	22	54
UA9GE	"	17,442	161	10	28
UAØTR	"	14,536	154	18	28
UAØYD	"	11,780	176	13	25
UW9CE	"	4,662	45	15	27
UAØML	"	3,808	49	17	17
UAØKCW	"	2,793	62	12	7
UAØVB	"	1,836	33	12	15
UW9CK	"	800	18	6	10
UA9EU	3.5	27,426	230	8	34
UWØFB	3.5	2,941	113	8	9

Armenia

UG6JJ	14	51,681	287	20	49
UG6EA	"	29,456	189	17	39
UG6AW	"	780	14	10	10

Azerbaijan

UD6AM	A	221,392	468	67	135
UD6BW	"	6,320	66	15	25

Georgia

UF6ACR	28	70,720	374	21	47
UF6AD	3.5	204	9	5	7

Kazakh

UL7GR	A	141,713	381	43	100
UL7XG	"	80,364	332	30	64
UL7GW	"	70,684	310	41	91
UL7IQ	"	52,851	236	24	55
UL7RL	"	4,652	55	16	20
UL7BG	14	125,048	456	28	70
UL7CG	"	64,526	322	21	56
UL7HV	"	14,070	134	13	29
UL7ND	"	7,922	102	11	23

Tadzhik

UJ8AB	A	72,254	304	27	64
UJ8AH	"	49,560	172	45	75
UJ8AC	14	39,788	284	20	38

Turkoman

UH8BO	A	71,300	268	35	65
UH8CS	"	8,526	203	13	29
UH8DI	28	2,424	53	12	12
UH8DL	14	47,804	267	26	50
UH8AH	"	16,695	132	14	39

Uzbek

UI8CD	A	188,108	500	48	100
UI8LK	"	77,367	249	37	86
UI8AI	"	62,646	236	35	71
UI8AP	21	5,445	67	11	22

EUROPE

Austria

OE5OEL	A	88,635	320	25	64
OE1LM	"	23,532	124	39	62
OE3AX	"	15,548	141	29	63
OE1WO	21	12,084	117	18	39

Belgium

ON4XG	A	331,430	645	74	156
ON8RA	"	158,594	495	59	120
ON5AX	"	146,030	424	60	110
ON5ME	"	70,928	280	48	76
ON5KD	"	32,619	161	36	47
ON5AZ	28	21,576	159	22	36
ON4CE	"	1,224	34	7	10
ON4HG	21	3,219	72	8	21
ON5TO	14	8,010	147	11	34

Bulgaria

LZ2KBA	A	130,410	604	41	120
LZ1AG	"	41,814	169	49	89
LZ1DF	"	780	39	7	13
LZ1CW	28	53,300	329	27	55
LZ1CD	21	28,152	252	22	48
LZ1BM	"	13,872	218	14	37
LZ2GS	14	2,342	66	7	20
LZ2KRS	7	6,320	101	10	30
LZ2RF	3.5	15,180	312	9	37

Czechoslovakia

OK1PD	A	625,482	834	98	253
OK3DG	A	375,912	714	83	193
OK1NR	A	307,725	705	82	192
OK1AHZ	"	257,792	540	80	173
OK1GT	"	243,542	441	72	149
OK3KAS	"	170,357	667	45	142
OK1ADM	"	168,084	262	92	184
OK1XM	"	158,672	531	55	156
OK3CCC	"	140,361	476	50	127
OK1ARN/1	"	132,430	418	52	118
OK2DB	"	125,800	388	61	124
OK2BLG	"	109,809	286	58	131
OK2LN	"	67,646	363	40	109
OK1BV	"	63,852	406	20	82
OK1ACF	"	58,653	243	52	95
OK2BHV	"	57,620	340	31	103
OK3CES	"	38,110	351	20	54
OK1AOX	"	37,730	208	34	76
OK3BT	"	25,833	195	24	85
OK1SM	"	18,948	200	15	51
OK1AOZ	"	16,473	238	11	40
OK3KNE	"	16,044	98	27	57
OK2KOO	"	11,340	86	26	44
OK2BFX	"	8,909	64	21	38
OK1US	"	8,478	69	21	33
OK2AOP	"	6,658	95	14	28
OK2BCZ	"	5,781	133	11	36
OK1ZW	"	3,690	45	15	26
OK1AOV	"	2,886	73	10	27
OK3BA	"	2,736	73	10	28
OK1AEH	"	2,560	61	9	31
OK1VU	"	1,476	18	14	15
OK3CIM	"	1,394	38	8	18
OK2BIO	"	720	16	9	15
OK2BCN	"	400	16	9	11
OK1CIJ	"	168	10	4	8
OK2QX	28	34,336	180	25	49
OK1SV	28	25,978	153	22	40
OK2BEN	"	23,247	139	22	41
OK1MP	"	21,952	136	24	40
OK1AEZ	"	12,320	80	19	36

PAØXPQ all band winner for the Netherlands. Charles was also the winner in the phone section of the contest so evidently he has his "antenna farm" in good working order.

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Group of UB5s on vacation. L. to R.—Slav Urus UB5CV, Mike, (UB5WF's son) Victor, (Also UB5WF's son and operator of UB5KMX in the phone contest) and Vlad Goncharsky UB5WF, c.w. winner of the European Trophy.

OK1AFN	"	8,987	74	17	26
OK2BNA	"	7,880	82	17	23
OK2BBI	"	5,934	48	18	25
OK1TA	"	2,750	43	10	12
OK1AKW	"	1,136	29	7	9
OK1ADH	"	774	15	9	9
OK1MS	**21**	**113,781**	**463**	**27**	**70**
OK1PG	**21**	**60,291**	**302**	**27**	**60**
OK1VB	"	55,675	277	27	58
OK1BMW	"	53,922	255	28	58
OK3KGI	"	37,114	234	24	53
OK1ABP	"	35,694	193	24	50
OK1NG	"	33,701	313	19	48
OK1ALG	"	33,338	171	25	54
OK2BIP	"	13,867	143	16	33
OK1AII	"	12,663	83	23	40
OK1RX	"	12,212	126	14	29
OK1PT	"	8,757	80	22	41
OK1WN	"	6,596	76	15	19
OK1KCD	"	4,400	53	17	23
OK1KZ	"	768	20	7	9
OK3CFL	**14**	**101,092**	**511**	**34**	**93**
OK1KPA	**14**	**65,076**	**428**	**26**	**61**
OK1UK	"	31,032	250	20	52
OK1APL	"	25,672	158	24	65
OK1ALE	"	22,594	186	23	56
OK3CDY	"	22,223	216	19	52
OK2WDC	"	12,272	188	11	41
OK1AGP	"	9,090	151	8	37
OK3JV	"	8,802	89	12	42
OK1UY	"	6,811	108	10	39
OK1SQ	"	6,191	121	10	31
OK1AID	"	2,808	58	8	31
OK1EP	"	1,452	36	8	25
OK3CEL	"	693	27	5	16
OK1NK	"	680	22	7	13
OK2BBQ	·	35	7	2	3
OK1ZQ	**7**	**109,038**	**720**	**30**	**72**
OK3CBN	"	20,746	320	14	32
OK1AHG	"	10,763	169	9	39
OK3CAN	"	6,160	101	11	29
OK3CDF	"	6,042	114	10	28
OK1KBN	"	1,218	63	4	17
OK1AAZ	"	323	17	8	11
OK1AQO	"	134	22	3	10
OK1ALW	**3.5**	**39,816**	**460**	**13**	**50**
OK3BU	**3.5**	**32,155**	**520**	**10**	**49**
OK2BHX	**3.5**	**25,284**	**505**	**12**	**37**
OK2KGE	"	21,892	335	11	41
OK3CGI	"	15,444	285	8	44
OK3BG	"	12,495	230	8	41
OK1EX	"	10,902	207	7	39
OK2HI	"	7,605	192	7	32
OK3KYU	"	7,245	203	6	29

OK1KPX	"	5,133	185	4	25
OK2BCI	"	4,521	148	7	27
OK1AWZ	"	3,916	74	8	36
OK3KEU	"	3,630	132	5	25
OK3CJI	"	3,444	128	4	24
OK3CIU	"	3,392	128	6	26
OK2BNI	"	2,444	101	4	22
OK1KSL	"	2,070	90	5	18
OK2KFP	"	1,947	66	4	29
OK2BEF	"	1,890	76	5	22
OK2BNK	"	1,820	72	4	22
OK2KNN	"	1,806	86	4	17
OK2BLJ	"	551	29	4	15
OK1AYG	"	238	17	4	10
OK1AVG	"	54	11	4	5
OK1IQ	**1.8**	**1,692**	**93**	**3**	**15**
OL5ADK	**1.8**	**1,482**	**84**	**4**	**15**
OK2ZU	**1.8**	**1,112**	**87**	**3**	**14**
OL2AGC	"	960	62	3	13
OK1AIJ	"	819	61	3	13
OK1ATP	"	734	64	3	12
OK2BNY	"	728	63	3	11
OK2BMH	"	690	44	3	12
OL6AIU	"	672	50	3	11
OLØAFQ	"	585	51	4	11
OK2BNF	"	559	52	3	10
OK2BNZ	"	546	73	3	11
OK2BOO	"	416	40	3	10
OL5AGW	"	290	40	2	8
OK1AQK	"	276	28	3	9
OL6AIV	"	264	35	3	9
OL1AFB	"	250	26	2	8
OL3AHI	"	231	27	3	8
OK1OO	"	181	22	3	8
OL2AIO	"	135	31	2	7
OL6AEP	"	100	9	3	7
OK1AVY		64	12	2	6

Denmark

OZ7BG	**A**	**479,232**	**686**	**92**	**220**
OZ1LO	"	205,440	509	66	148
OZ1QW	"	38,868	241	38	85
OZ8KB	"	27,000	143	49	76
OZ4H	"	18,174	115	33	45
OZ7G	**28**	**14,681**	**104**	**20**	**33**
OZ3JR	"	2,520	34	13	17
OZ3PO	**14**	**19,500**	**151**	**19**	**46**
OZ3Y	"	18,198	176	17	37
OZ5DP	"	14,204	188	15	38
OZ2RH	"	4,032	36	22	26
OZ7YH	**7**	**20,350**	**306**	**13**	**42**
OZ8SW	"	3,000	95	6	24
OZ7NB	"	400	19	5	11
OZ2LW	3.5	784	49	3	13

England

G3HDA	**A**	**878,257**	**1043**	**104**	**243**
G3FXB	"	412,462	657	79	192
G3DYY	"	335,753	587	80	153
G2DC	"	283,777	515	71	192
G2AJB	"	108,876	333	53	119
G3TIF	"	87,150	365	47	103
G3GGS	"	58,938	196	53	88
G8DI	"	47,082	267	35	98
G3GMK	"	46,629	238	29	70
G3NSY	"	43,470	279	29	76
G3MWZ	"	12,474	101	24	39
G3JFF	"	9,768	78	33	41
G3POI/A	**28**	**126,180**	**522**	**27**	**64**
G2BOZ	"	81,288	422	24	48
G3KMA	"	32,163	172	25	46
G2BW	"	9,630	94	18	27
G3EUE	"	8,019	98	15	18
G3WP	"	1,156	27	8	9
G3HCT	**21**	**235,209**	**886**	**30**	**81**
G3IGW	"	50,856	282	22	56
G3FKM	**14**	**148,718**	**518**	**34**	**88**
G3OXI	"	4,752	64	14	30
G3ESF	**7**	**67,340**	**587**	**19**	**55**
G3JVJ	**1.8**	**1,700**	**83**	**4**	**16**
G3NT	"	481	37	2	11

Finland

OH1PS	**A**	**314,286**	**553**	**84**	**210**
OH2YL	"	26,416	136	30	74
OF3MF	"	21,293	122	31	76
OH3MM	"	9,072	85	23	49
OF6YA	"	7,452	46	9	24
OH2YV	"	3,363	45	23	34
OH7RW	"	3,276	60	13	29
OH2BDV	"	2,624	29	15	26
OH2XK	"	2,030	20	16	19
OF6XY	"	858	39	7	15
OF2RD	"	516	17	11	14
OF2BIO	"	440	25	6	14
OH2BAC	**28**	**27,056**	**125**	**26**	**63**
OH2DP	"	8,000	57	21	43
OH5NJ	"	3,672	49	13	23
OF3SN	"	3,531	41	13	20
OH2BGD	"	960	18	9	11
OH3QT	"	940	22	8	12
OH6VP	**21**	**64,700**	**322**	**30**	**70**
OF2BDP	**21**	**52,000**	**256**	**30**	**74**
OH5WH	"	8,856	163	10	26
OH5RZ	"	7,248	90	15	33
OH2BDL	"	6,360	52	17	43
OH3KL	"	5,304	53	18	34
OF4RH	"	5,032	107	11	25
OF3LQ	"	2,888	40	13	26
OH2BEV	"	2,432	28	16	22
OH3LX/2	"	910	19	10	16
OH9RJ	"	680	30	6	14
OH2BHZ	"	396	23	4	14
OH2VZ	"	364	10	7	7
OH2UQ	**14**	**41,738**	**304**	**22**	**60**
OF2BAH	"	1,260	35	9	21
OF6WW	"	540	12	9	9
OH5UQ	**7**	**28,980**	**239**	**19**	**51**
OF9NV	"	14,337	175	14	45
OH8PE	"	6,552	140	10	29
OH1SH	**3.5**	**26,291**	**375**	**14**	**47**
OH2CK	"	6,660	128	7	38
OF3KD	"	242	18	4	10
OF3NY	**1.8**	**598**	**46**	**3**	**10**
OF6UW	"	144	20	2	6

France

F8TQ	**A**	**194,367**	**675**	**40**	**161**
F8TM	"	112,633	393	52	111
F8RU	"	56,463	167	62	115
F3AT	"	43,662	168	48	66
F9RM	"	37,318	163	40	54
F3OA	"	33,669	148	52	77
F8KY	"	30,096	288	23	53
F9BB	"	29,484	152	30	54
F5RS	"	4,455	84	13	32

Germany

DJ5BV	**A**	**644,784**	**897**	**93**	**210**
DJ4AX	**A**	**593,320**	**1004**	**83**	**197**
DJ2HH	**A**	**340,134**	**606**	**81**	**168**
DL6WD	**A**	**292,417**	**523**	**75**	**184**
DL1AM	"	210,392	420	71	150
DJ4UF	"	192,896	498	63	113
DL7BQ	"	191,000	441	67	124
DJ6QL	"	180,264	455	60	114
DJ3WU	"	159,049	426	68	141
DL8UF	"	147,840	410	55	105
DL8BS	"	132,310	350	62	140
DL7CF	"	131,433	340	56	137
DJ1OJ	"	126,027	350	68	141
DL1MD	"	121,030	321	58	124
DL1JF	"	113,163	260	69	132
DJ6SI	"	103,155	275	67	128
DL8AM	"	90,324	306	57	99
DJ4ZR	"	78,987	302	35	78
DJ4HR	"	67,636	256	44	104
DK1DB	"	64,678	215	46	100
DL3WC	"	56,950	242	48	86
DL1ES	"	56,548	271	38	96
DL3CM	"	55,728	212	49	80
DJ3BB	"	55,352	203	47	101
DL1GN	"	47,886	261	41	97
DJ9MH	"	45,696	242	34	94
DJ1FC	"	43,332	150	49	89
DL8DL	"	42,920	200	40	76
DL8AJ	"	30,591	145	39	64
DL6WE	"	29,718	139	44	83
DL7NP	"	18,568	102	32	56
DJ2EL	"	17,550	97	31	44
DL8IH	"	16,060	120	22	33
DL6BP	"	12,012	88	28	38
DL7NS	"	11,554	111	19	34
DL8FD	"	10,430	173	17	61
DL1NC	"	8,586	92	25	29
DL8AJ	"	8,175	64	28	47
DJ7BP	"	7,497	89	14	35
DL1TH	"	5,450	71	16	34
DL8IG	"	4,897	66	16	43
DJ9KP	"	4,848	50	22	26
DL6KG	"	4,550	35	23	37
DJ6QP	"	2,850	43	12	14
DL6VP	"	2,730	45	14	21
DJ1QL	"	2,304	34	14	18
DJ2XO	"	1,908	35	13	23
DL8ML	**28**	**56,502**	**280**	**26**	**47**
DJ2DR	"	48,224	207	28	60
DL9EM	"	20,790	135	23	31
DLØHM	"	18,207	110	22	41
DL6DF	"	15,606	108	18	33
DJ8IF	"	15,533	117	20	29
DJ9ON	"	12,138	94	19	32
DJ5IO	"	8,694	67	19	27
DL2JO	"	7,686	92	16	26
DJ2XP	"	4,494	44	19	23
DJ2RE	"	2,208	23	12	20
DJ5GW	"	208	9	6	7
DL8ANA	**21**	**89,534**	**439**	**28**	**61**
DJ9TQ	"	79,480	341	23	69
DL3ZA	"	69,554	338	25	58
DL8KJ	"	61,488	331	26	46
DLØFT	"	45,220	213	27	58
DL6QH	"	9,768	140	13	24
DJ9TS	"	8,155	100	12	23
DJ2BW	**14**	**179,530**	**539**	**34**	**96**
DJ2YA	"	160,821	639	31	76
DL7AV	"	58,206	280	26	83
DK2PR	"	2,914	91	6	25
DJ5PA	**7**	**75,897**	**452**	**23**	**58**
DJ6RX	**7**	**72,625**	**497**	**24**	**63**
DJ5DT	**3.5**	**28,024**	**332**	**13**	**49**
DL1CF	**1.8**	**1,728**	**110**	**3**	**13**
DL9LJ	**1.8**	**1,140**	**75**	**3**	**12**

DL4EG	**A**	**420,858**	**801**	**75**	**152**
DL5AO	**28**	**85,608**	**338**	**28**	**54**
DL4RW	**21**	**75,504**	**390**	**26**	**46**
DL5MJ	**14**	**12,122**	**126**	**14**	**34**

DM2ATD	**A**	**522,954**	**820**	**84**	**222**
DM2BTO	**A**	**85,352**	**255**	**55**	**133**
DM2AGH	"	25,273	113	44	83
DM2CHM	"	24,453	117	49	68
DM2BNI/p	"	21,449	159	24	65
DM2DEO	"	19,014	145	24	72
DM3BE	"	17,169	109	33	64
DM5ZHN	"	16,849	107	29	54
DM3XUE	"	13,286	76	36	55
DM3LOG	"	6,510	88	21	41
DM3UE	"	5,494	51	25	42
DM2BBE	"	5,347	73	16	33
DM2BDH	"	4,960	58	21	41
DM2BZN	"	4,731	31	27	30
DM3VMA	"	4,437	48	22	29
DM3WYF	"	3,772	94	9	23
DM3VCK	"	3,431	55	12	35
DM2AUA	"	2,592	49	13	35
DM4PKL	"	2,583	38	17	24
DM2BNL	"	1,860	30	13	17
DM4YEL	"	1,600	18	15	17
DM2BMG	"	1,232	22	10	12
DM2BXH	"	1,102	44	5	24
DM2AXM	"	648	18	9	18
DM2BPO	"	525	23	7	18
DM2BHG	28	1,188	16	12	15
DM3YYA	"	966	16	11	12
DM2BBK	**21**	**18,522**	**121**	**21**	**42**
DM3UEA	"	3,900	38	16	23
DM2AUO	**14**	**62,800**	**370**	**27**	**73**

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DM2CDO	"	14,650	212	10	40
DM3YK	"	3,311	39	13	30
DM2AQF	"	2,430	61	9	21
DM2AVG	"	1,550	54	5	20
DM4CF	"	1,014	29	6	20
DM2BPB	"	940	44	4	16
DM2DCH	"	391	23	3	14
DM3UFJ	**7**	**13,260**	**183**	**11**	**40**
DM4XL	"	1,584	45	7	17
DM4VBD	"	556	47	3	15
DM2BNG	"	364	30	4	10
DM5BG	"	308	35	4	10
DM2ATL	"	130	5	5	5
DM6PAO	**3.5**	**6,513**	**167**	**7**	**32**
DM4ZWL	**3.5**	**6,195**	**181**	**5**	**30**
DM3XXM	"	4,699	134	6	31
DM4UHD	"	1,953	67	6	25
DM4ZL	"	680	40	4	13
DM5ZGL	"	420	30	3	12
DM3RYA	"	336	21	3	13
DM5WGL	"	299	28	4	9
DM5GL	"	64	10	2	6

Hungary

HA8UD	**A**	**237,354**	**614**	**63**	**158**
HA1KVM	"	126,368	491	59	117
HA3GF	"	114,080	400	56	128
HA1VE	"	80,730	502	33	97
HA5DA	"	74,889	298	52	107
HA8UH	"	41,923	263	33	80
HA3MB	"	23,000	131	37	63
HA6NC	"	17,015	181	26	57
HA8UF	"	16,256	178	22	42
HA9PB	"	12,684	127	18	66
HA4YL	"	11,284	199	10	42
HA2MJ	"	2,482	44	11	19
HA9PE	"	702	23	10	16
HA1SB	**21**	**16,491**	**239**	**22**	**47**
HA5FE	**14**	**20,770**	**196**	**16**	**51**
HA2MM	**7**	**10,228**	**230**	**9**	**27**
HA7LO	"	7,440	185	8	32
HA8UO	3.5	867	51	4	13

Iceland

TF3AU	**A**	**26,400**	**174**	**26**	**49**

Ireland

EI5F	**A**	**25,452**	**152**	**30**	**71**

Italy

I1NT	**A**	**691,938**	**607**	**69**	**165**
I1ER	"	1,200	25	9	7
I1KE	**28**	**84,942**	**436**	**25**	**53**
I1AUM	21	4,544	99	10	22
I1PPI	**14**	**29,400**	**235**	**17**	**53**
I1AND	**7**	**20,900**	**316**	**13**	**42**

I. T. U.

4U1ITU	**A**	**386,973**	**844**	**67**	**152**

Luxembourg

LX1CO	**A**	**42,655**	**293**	**28**	**67**

Madeira Is.

CT3AS	**A**	**4,242**	**101**	**8**	**6**

Malta

9H1AG	**A**	**189,805**	**748**	**58**	**145**

Netherlands

PAØXPQ	**A**	**312,750**	**685**	**69**	**156**
PAØLOU	"	142,600	395	57	148
PAØVB	"	106,680	347	57	111
PAØFLX	"	61,452	278	28	80
PAØTAU	"	17,484	97	34	59
PAØJR	"	7,839	77	17	50
PAØWAC	"	4,160	59	9	11
PAØTCA	**14**	**16,146**	**260**	**12**	**27**
PAØGMU	**1.8**	**2,025**	**137**	**2**	**13**

Northern Ireland

GI3RXV	**28**	**41,800**	**324**	**18**	**32**

Norway

WØGTA/LA	**A**	**427,720**	**680**	**88**	**208**
LA6U	"	42,066	227	37	86
LA2Q	"	6,240	82	18	47
LA7NG	"	3,650	42	19	31
LA9HC	**28**	**9,990**	**68**	**21**	**33**
LA8PF	"	6,936	78	13	21
LA8GK	**14**	**7,805**	**110**	**12**	**39**
LA4YF	"	5,217	118	8	29

Poland

SP8AG	**A**	**104,357**	**420**	**46**	**127**
SP8BMF	**A**	**96,196**	**519**	**39**	**100**
SP9ZD	"	89,806	332	52	114
SP5AFL	"	84,078	337	53	120
SP9AQO	"	51,360	230	37	83
SP5YQ	"	35,425	249	23	86
SP7AOD	"	33,456	182	33	90
SP8AWP	"	27,144	191	24	80
SP5BAK	"	21,500	224	18	68
SP3BBH	"	20,584	230	16	67
SP9BPF	"	13,553	86	30	58
SP2BMM	"	9,944	80	30	58
SP3PKL	"	8,496	70	25	47
SP2IU	"	8,064	67	26	37
SP9AGS	"	7,684	105	19	49
SP5BIL	"	6,419	103	13	36
SP1AAY	"	5,311	96	12	35
SP9AVZ	"	1,638	68	8	18
SP6LK	"	513	24	5	14
SP3AIJ	**28**	**33,189**	**174**	**25**	**44**
SP8AJK	"	24,912	144	25	47
SP9ADU	"	7,128	62	18	26
SP1KCX	"	5,977	51	18	25
SP1AGE	"	3,638	40	14	20
SP5GX	"	3,468	47	15	19
SP3AOT	"	2,130	26	15	15
SP9AOX	**21**	**73,236**	**345**	**24**	**65**
SP5YC	"	67,300	255	28	72
SP9AOA	"	20,286	138	22	47
SP6AAT	"	8,757	61	22	41
SP3AUZ	"	7,680	106	11	21
SP9AQY	"	4,030	79	9	17
SP6TQ	**14**	**53,599**	**351**	**24**	**67**
SP1BHX	"	30,150	205	25	65
SP5ZA	"	21,442	185	18	53
SP4JF	"	20,150	200	17	48
SP9BNY	"	9,486	141	11	40
SP7ASZ	"	8,670	103	16	35
SP5BCT	"	7,830	116	13	32
SP9BQG	"	4,033	93	9	28
SP4AGR	"	4,030	105	8	23
SP7CDH	"	3,885	97	6	29
SP6AEG	"	2,550	54	10	20
SP9CV	"	1,288	38	6	22
SP2BMI	"	646	30	5	14
SP2PAH	**7**	**20,955**	**287**	**13**	**42**
SP8MJ	"	15,072	244	12	36
SP5ATO	"	8,084	162	8	35
SP5BMC	"	6,468	130	7	35
SP7GH	**3.5**	**25,480**	**391**	**11**	**45**
SP3BQD	"	3,496	83	7	31
SP5CJU	"	2,328	111	5	19
SP6CCJ	"	2,268	87	4	23
SP1ABV	"	2,184	89	5	19
SP6ASD	"	1,800	71	5	20
SP3HW	"	1,007	57	4	15

Portugal

CT1OI	**A**	**12,300**	**98**	**26**	**49**

Rumania

YO8AP	**A**	**268,821**	**632**	**70**	**181**
YO7DL	**A**	**149,648**	**479**	**66**	**133**
YO5DH	"	70,649	440	32	99
YO4KCE	"	70,224	362	38	94
YO9APJ	"	55,578	210	46	111
YO6AW	"	38,280	179	38	78
YO2BI	"	34,038	230	32	61
YO7VJ	"	31,008	286	20	56
YO4KBJ	"	30,485	235	22	69
YO2BA	"	22,785	145	33	60
YO8APG	"	22,100	301	15	50
YO8KBA	"	22,015	186	18	67
YO5KDL	"	19,430	125	20	47
YO2BC	"	18,200	157	20	45
YO9HP	"	12,400	160	15	46
YO5AIR	"	11,448	153	14	38
YO2AAF	"	6,660	101	19	41
YO3QO	"	4,900	92	14	36
YO7AHR	"	638	37	6	16
YO4CS	"	182	8	5	8
YO3RT	**28**	**6,615**	**74**	**17**	**28**
YO5LN	"	4,455	50	13	20
YO2BL	"	1,104	31	9	14
YO5TR	"	198	10	4	5
YO2IY	"	117	8	4	5
YO3JW	**21**	**18,603**	**241**	**12**	**41**
YO8ME	"	4,500	48	5	15
YO6WD	"	527	17	7	10
YO9HI	"	360	20	5	10
YO6DB	14	1,042	40	6	15
YO8GL	"	375	11	8	7
YO8FR	**7**	**24,998**	**320**	**12**	**46**
YO7EL	"	6,780	151	8	22
YO7AOT	"	2,300	96	7	16
YO5AT	"	2,288	86	5	17
YO3ALV	"	2,250	58	7	23
YO9IH	"	1,368	42	5	19
YO2AIS	"	644	58	4	10
YO6UN	"	432	30	4	12
YO6AAD	"	112	17	3	4
YO8DD	**3.5**	**10,752**	**254**	**7**	**35**
YO5TF	"	1,080	60	4	14

Contest expedition station TGØAA with K4BAI and W4YWX at the operating position, and TG9EP at who's QTH the operation took place. John and Paul had a successful operation on 160, worked six stations on 6 different bands and set a new record for North America.

Sardinia

ISICZQ	**A**	**107,393**	**586**	**40**	**103**

Scotland

GM3JDR	**A**	**64,030**	**386**	**32**	**63**
GM5AHS	"	23,323	217	20	63
GM5AFF	**14**	**21,206**	**302**	**11**	**35**
GM3SSB	"	11,508	211	11	31

Shetland Is.

GM3SVK	**A**	**93,118**	**333**	**56**	**135**
GM3KLA	**3.5**	**10,296**	**207**	**9**	**35**

Sicily

IT1AQ	**A**	**143,208**	**518**	**62**	**142**
IT1AGA	"	48,195	254	34	85

Spain

EA3KT	**A**	**58,190**	**306**	**29**	**81**
EA2DT	"	56,496	265	35	72
EA2CR	"	11,041	111	21	40
EA5IC	"	2,822	49	12	22
EA2HR	**28**	**2,860**	**64**	**7**	**15**

Sweden

SM4CMG	**A**	**504,738**	**694**	**99**	**252**
SMØAHQ	"	145,168	392	64	147
SM7ID	"	122,464	396	52	126
SM2COR	"	119,400	441	60	139
SM5CVH	"	78,988	251	57	125
SMØBDS	"	78,080	280	49	111
SM7QY	"	57,236	155	61	103
SM5FC	"	55,476	181	51	87
SM2BYD	"	43,632	287	30	78
SM6CUK	"	40,260	120	34	98
SMØTW	"	36,630	283	19	55
SMØKV	"	31,598	167	35	87
SM2DPS	"	28,638	166	22	64
SM5UU	"	27,540	113	39	63
SMØBUO	"	19,173	96	35	42
SM7DVF	"	7,085	70	27	38
SM7BKH	**28**	**47,802**	**201**	**26**	**67**
SM4ARQ	"	41,580	165	26	62
SM7CCU	"	32,340	159	25	52
SM5BGK	"	20,230	110	22	48
SM5BEU	"	9,975	68	20	37
SM4DPB	"	5,593	56	18	29
SM5PS	"	3,060	39	15	21
SM3CNN	**21**	**131,675**	**579**	**31**	**84**
SM5BUT	"	63,020	288	28	74
SM3CXS	"	55,328	294	26	78
SM7DBD	"	36,208	201	23	50
SM6DLY	"	21,300	161	19	41
SM4COK	"	13,275	123	17	42
SM3DNI	"	7,105	81	14	35
SM5DUT/Ø	"	3,648	29	11	27
SM7AQF	"	3,116	53	12	26
SM5BXP	"	1,014	17	10	16
SM5CEU	**14**	**107,500**	**539**	**29**	**71**
SM5CNX	"	75,012	462	24	60
SM5BOU	"	33,975	283	20	55
SM5XX	"	7,920	80	11	44
SM6JY	"	924	41	5	16
SM6DKH	**7**	**52,809**	**309**	**22**	**65**
SM5UQ	"	4,416	133	5	27
SM3EAE	"	1,088	27	3	13
SM7AJD	"	276	26	3	9
SM5MX	**3.5**	**31,222**	**382**	**14**	**53**
SMØGM	"	9,405	185	9	36
SMØCER	"	756	34	5	16

Switzerland

HB9AFG	**A**	**71,852**	**307**	**32**	**60**
HB9RX	"	52,419	166	54	119
HB9AJI	"	37,248	171	41	55
HB9AKJ	"	35,072	156	43	85
HB9AGH	"	28,500	123	41	54
HB9PQ	"	24,336	119	40	64
HB9UD	"	22,742	121	36	47
HB9DX	**21**	**45,666**	**206**	**28**	**58**
HB9ZY	**14**	**115,596**	**425**	**31**	**83**
HB9KC	**7**	**13,489**	**168**	**12**	**29**
HB9NL	**1.8**	**1,984**	**126**	**3**	**13**
HB9QA	"	1,425	94	3	12

Wales

GW3GHC	**28**	**19,916**	**170**	**18**	**34**

Yugoslavia

YU1EXY	**A**	**354,545**	**692**	**80**	**189**
YU1KO	"	53,802	327	30	92
YU3WP	"	25,900	195	28	72
YU1SF	"	25,203	209	22	71
YU2OB	**21**	**30,275**	**256**	**20**	**45**
YU3TXT	"	10,152	131	13	31
YU1BCD	**14**	**172,304**	**732**	**31**	**90**
YU2ZR	"	1,210	55	6	14
YU1NPV	**3.5**	**13,529**	**313**	**7**	**35**

Union of Soviet Socialist Rep.

Estonia

UR2EK	**28**	**2,349**	**44**	**10**	**17**
UR2FU	**14**	**48,720**	**389**	**24**	**60**

European RSFSR

UA3UJ	**A**	**419,055**	**753**	**81**	**226**
UW3HV	**A**	**232,415**	**725**	**58**	**157**
UA1ZW	"	166,216	539	50	108
UA1ZL	"	121,737	427	38	81
UA3NP	"	114,332	318	63	139
UA3KHR	"	108,944	374	56	120
UA4FR	"	84,645	375	38	97
UA3GM	"	81,702	377	37	116
UW3NE	"	73,005	227	43	111
UA3HV	"	63,373	230	43	84
UA1TQ	"	56,916	225	46	78
UA1UD	"	49,250	280	35	90

See page 118 for New Reader Service

JA4BJO was 2nd high all bander on c.w. so don't know what the microphone is doing in the picture.

UV3TP	"	41,976	214	35	71
UA3TA	"	35,568	183	36	78
UA3RO	"	32,092	159	39	74
UA3PE	"	29,840	222	21	59
UA4IW	"	25,207	166	28	61
UA4WT	A	22,114	187	30	61
UA1SW	"	20,520	140	28	62
UA3JD	"	19,345	152	21	52
UA1NR	"	17,885	132	25	48
UA3KIB	"	17,615	182	21	44
UA3WN	"	15,795	119	27	54
UW3HD	"	15,438	112	22	40
UA1UC	"	12,096	120	22	50
UA6YD	"	10,764	126	17	42
UW6AO	"	7,366	99	17	41
UA1DG	"	6,660	98	13	32
UA3IM	"	6,328	57	19	37
UW3YT	"	6,000	79	14	26
UA3MV	"	5,328	74	13	35
UW3CM	"	5,040	49	18	42
UA3WZ	"	4,770	52	14	31
UW3AB	"	4,420	105	7	27
UW3IE	"	3,634	58	16	23
UA3QV	"	2,912	44	10	22
UW3IT	"	2,760	50	13	27
UA1AJ	"	2,418	52	11	28
UV3MM	"	2,320	28	16	24
UA1BP	"	2,108	65	7	24
UV3BK	"	1,833	40	12	27
UA3VT	A	1,386	44	7	14
UA3RR	"	437	14	10	13
UV3AAM	28	38,193	208	26	61
UW3TY	"	27,020	224	21	49
UW6MA	"	21,112	221	16	40
UW4IB	"	19,516	171	23	45
UA3AZK	"	3,168	54	12	21
UA3TIB	"	1,701	29	11	16
UA3ND	"	1,590	25	12	18
UA6GX	"	832	58	4	9
UA3BK	21	17,263	176	14	47
UA1SP	"	4,836	80	11	28
UA1DI	"	2,065	37	11	24
UA1IA	14	59,373	436	22	59
UW3KBI	"	56,764	350	28	65
UW6BK	"	54,978	317	29	73
UA3RDO	"	42,687	338	22	59
UA3DF	"	27,122	232	22	49
UA1ZZ	"	24,751	242	16	37
UA3NG	"	23,936	184	18	50
UA1YY	"	19,386	160	18	36
UA6KBP	"	10,560	142	14	39
UA1KAA	"	9,143	134	12	29
UA3GO	"	2,482	42	11	23
UA1DX	3.5	10,535	218	7	36
UW3HY	"	7,855	165	7	32
UA1DH	"	7,626	166	6	35

Kaliningrad

UA2DM	A	119,964	531	40	116

Karel-Finnish

UN1AU	A	6,490	118	18	37

Latvia

UQ2IL	14	2,375	45	12	13
UQ2AB	"	1,488	31	11	13
UQ2PN	7	3,680	104	7	25

Lithuania

UP2KBA	A	129,370	499	40	130
UP2CV	"	27,552	200	28	54
UP2AV	"	9,112	111	17	50
UP2BU	28	4,032	38	19	29
UP2AR	"	2,176	28	15	17
UP2CG	21	34,020	251	20	50
UP2CT	14	41,884	405	20	54
UP2ON	7	36,504	431	17	55
UP2OX	3.5	3,540	112	6	24
UP2BL	"	2,688	107	5	19

Moldavia

UO5BM	A	18,396	179	26	58

Ukraine

UB5WF	A	999,700	1349	93	257
UT5BP	"	156,981	377	60	141
UB5LL	"	89,535	323	46	95
UB5KIX	"	50,298	330	28	73
UB5PG	"	49,914	295	32	86
UT5CC	"	40,916	269	26	80
UB5QA	"	20,720	185	21	53
UB5KYB	"	9,536	124	17	47
UB5OF	"	4,320	38	19	29
UB5UN	28	24,990	154	24	46
UY5EG	"	4,640	98	10	23
UB5OD	"	4,410	42	17	32
UB5TQ	21	44,640	364	22	58
UB5KDS	"	28,725	163	23	52
UB5DW	"	19,430	192	22	45
UB5EF	"	5,278	85	13	29
UT5WW	"	2,379	33	13	26
UB5OA	"	1,012	28	8	15
UB5CE	14	59,696	355	29	75
UT5EH	"	38,920	423	19	51
UB5EW	"	27,246	278	17	50
UT5BW	"	22,208	241	16	48
UY5AD	"	19,323	235	15	42
UB5KNF	"	7,418	95	11	31
UT5SI	"	3,658	87	9	22
UT5LE	"	3,240	58	11	19
UY5ZM	"	2,656	55	8	24
UT5LF	7	13,735	248	10	31
UT5NG	"	7,482	128	10	33
UB5VK	"	6,460	167	7	27
UB5RN	"	4,992	91	9	30
UB5TR	"	3,267	72	7	26
UB5PN	"	2,821	87	6	25
UB5WJ	3.5	23,528	398	10	43
UT5BX	"	5,670	164	8	28
UB5CV	"	4,128	111	8	24
UY5RV	"	450	29	5	10

White Russia

UC2CY	A	33,320	309	19	66
UC2AR	"	23,832	255	17	55
UC2LO	14	5,246	90	9	32

Oceania

Australia

VK2EO	A	361,675	665	71	114
VK2APK	14	167,544	549	30	74
VK2BKM	"	145,642	489	32	69
VK3AXK	A	168,120	491	53	67
VK3ABR	"	22,035	114	31	34
VK3RJ	28	9,393	107	13	18
VK3XB	21	80,106	342	29	50
VK3APJ	14	422,240	1150	35	95
VK3APN	7	28,423	221	20	29
VK3OP	"	19,044	187	17	19
VK4FH	A	50,373	237	32	41
VK4SS	28	17,440	187	15	17
VK5TC	A	164,054	507	52	59
VK5KO	"	6,930	70	19	14
VK5WC	14	15,606	111	22	29
VK6RU	A	334,268	545	79	135
VK8UG	28	320,008	1048	32	72

Fiji Islands

VR2DK	A	48,861	195	39	50

Guam

K1FNA/KG6	21	30,217	253	17	24
KØILI/KG6	7	6,403	119	11	8

Hawaii

KH6IJ	A	1,116,454	1857	90	112
KH6EBQ	"	85,629	391	41	31

Marshall Is.

KX6DB	A	923,841	1511	85	122

New Guinea (Terr.)

VK9GN	28	149,110	686	27	47

New Zealand

ZL1AJU	A	715,428	1034	87	151
ZL1AFW	"	129,570	422	49	56
ZL4BO	21	103,140	406	31	59
ZL1IL	"	95,550	431	28	47
ZL1HW	"	58,558	298	24	43

Philippines

DU1FH	A	302,434	676	63	90
DU1CE	14	80,256	433	29	54

South America

Argentina

LU6AX	A	35,112	149	36	48
LU8BAJ	"	15,168	121	29	35
LU5AQ	21	119,952	430	28	70
LU5AES	14	85,950	388	26	49
LU3FBT	"	33,608	221	23	30

Brazil

PY8EL	A	3,360	75	13	17
PY2SO	28	532,956	1319	37	101
PY2DBU	"	16,200	152	13	23
PY7ACQ	21	184,800	743	24	60
PY1BCA	"	111,972	412	29	64
PY3BVH	"	34,461	187	22	41
PY3BXS	"	4,550	61	12	14
PY1CKV	"	3,210	40	13	17
PY2BGL	14	642,400	1490	36	110
PY4OD	14	592,110	1476	35	100
PY7AKQ	"	265,190	841	30	85
PY7VKZ	"	6,885	136	9	8
PY4BLR	7	71,672	335	22	46

Chile

CE3ZK	A	271,254	840	48	58
CE2CR	"	38,702	191	38	36
CE6EZ	"	19,065	157	18	23
CE3ZW	21	47,647	310	22	31
CE2DI	14	81,872	331	31	55

Colombia

HK3ASJ	7	18,798	245	10	16

Paraguay

ZP5EC	A	5,922	48	22	25

Peru

OA4PF	28	194,732	763	28	61

Suriname

PZ1AH	A	91,931	200	70	91

Trinidad

9Y4VU	14	18,279	231	11	16

Uruguay

CX1JM	A	43,860	288	23	28
CX1OP	"	26,996	107	33	35
CX1BBV	7	3,864	61	12	11

Venezuela

YV5BKA	21	76,650	357	21	52
YV4OY	"	4,059	151	5	4
YV5AGD	14	474,978	1281	36	93
YV5BOA	"	278,856	864	30	78

MULTI-OPERATOR

Single Transmitter North America

W2PCJ	1,054,651	912	118	285

David didn't break any records but was world high on 7 mc this year. This is his brother's station 4X4RD, his home call is 4X4UH.

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WA2BLV	200.342	329	79	139
K2BMI	34,998	109	45	69
W3WJD	1,589,841	1158	136	341
W3BGN	1,263,900	1132	116	267
K3JH	704,871	815	94	195
W3MWC	659,984	674	102	232
WA6EPQ	775,012	870	121	190
W6NJU	585,504	709	114	174
K6YGS	246,468	386	90	138
WB6UDC	166,944	274	101	121
W6BIP	79,050	200	81	89
K6IPM	1,134	21	8	10
W8UM	869,862	745	132	285
K8UDJ	429,300	506	107	193
W8BQH	217,296	354	71	145
W9EXE	515,944	571	116	212
W9YT	411,616	492	114	190

United States

WØAIH	803,439	824	121	230
WØHTH	768,672	908	111	195
KØJPG	58,600	156	58	76

Alaska

KL7AIZ	28,000	204	27	29

Canada

3C2DCW	101,346	327	45	82

Guatemala

TGØAA	1,948,360	2615	116	219

Puerto Rico

KP4AXM	14,440	168	18	22

Africa

Dahomey

TY2KG	721,994	1354	59	123

Rhodesia

ZE1S	749,070	1214	82	128

South Africa

ZS5QU	1,615,350	2005	94	181

Asia

Japan

JA6YCU	505,920	730	102	153
JA6YFL	66,464	217	55	69
JA6YAF	46,228	199	41	50
JA1YUL	13,975	87	31	34
JA9YCE	8,423	146	23	21
JA4YCN	5,148	58	21	12
KA9MF	476,784	866	85	113

U.S.S.R.

Asiatic

UA9KQA	656,370	870	73	197
UA9KWA	52,054	242	22	60
UA9KHA	40,872	324	19	33
UW9KOQ	27,778	151	32	54
UA9KJA	24,530	160	19	36
UA9KFS	21,516	158	21	45
UAØKFG	977,218	1427	107	176
UAØKSB	68,442	361	42	60
UAØKBA	28,665	262	17	28
UAØKCG	21,105	188	26	19
UAØKCA	19,344	205	26	22
UAØKIA	15,948	200	18	18
UAØKKT	12,206	193	19	15

Armenia

UG6KAA	164,176	506	37	87

Azerbaijan

UD6KAB	12,099	117	11	26

Georgia

4L3A	3,084,536	2376	116	330

Kazakh

UL7KBK	101,388	327	35	84
UL7KAR	77,468	355	41	66
UL7KCB	37,758	253	18	44

Europe

Austria

OE4SZW	291,924	762	58	146

Bulgaria

LZ1KAA	155,192	706	42	110
LZ2KAF	54,740	359	32	83
LZ1KSX	49,692	386	23	59
LZ1KKR	34,888	331	19	70
LZ2KRZ	23,852	280	19	48
LZ2KIM	15,540	199	15	45
LZ1KSD	6,400	141	9	31
LZ1KSW	5,220	188	9	21
LZ2KBI	1,802	93	11	23
LZ2KEF	1,351	50	8	19
LZ1KBG	480	30	5	11

Czechoslavakia

OK1KTL	186,082	449	79	142
OK3KAG	129,967	682	28	85
OK2KJU	83,235	312	46	109
OK2KOV	60,770	446	30	73
OK2KMR	51,300	223	33	62
OK3KWK	47,197	305	30	79
OK3KGW	38,280	295	24	96
OK1KOK	23,192	209	23	81
OK1KKS	9,316	133	16	52
OK1KWR	7,316	73	24	35
OK1KHL	6,901	67	22	45

England

G3SSO	782,691	1228	87	186
G3SKY	90,440	400	38	98
G5BK	84,392	357	40	114

Faeroe Is.

OY6FRA	413,270	1347	62	159

Finland

OF2TI	1,076,160	1296	110	270
OF3AG	535,160	1132	71	182
OH1VR	241,572	430	69	177
OF3TR	198,378	638	66	148
OF2ZD	141,192	408	74	148
OF2BFJ	126,688	281	64	150
OF6AA	43,715	195	47	86

Germany

DLØAAA	555,279	938	84	187
DL2KM	474,040	880	87	193
DJ9CN	360,665	688	81	184
DJ5FK	216,216	498	70	128
DL8CM	208,392	446	79	149
DJ3YU	68,166	277	44	82
DLØER	46,308	209	41	61
DM4PL	457,776	874	88	177
DM4BO	221,244	675	67	139
DM3EN	47,838	220	38	96
DM3UN	7,194	97	16	50

Hungary

HA5KDQ	278,710	639	72	163
HA1KSA	136,136	600	52	102
HA3KNA	96,596	548	48	117
HA8KUC	49,622	455	22	64
HA9KPE	19,173	160	24	59
HA5KDI	8,060	106	20	42
HA8YUA	2,835	162	4	17

Netherlands

PI1PT	81,062	335	45	97

Norway

LA1H	625,795	1085	75	182
LA1K	392,987	1005	68	149
LA7QI	62,320	268	47	105

Poland

SPØHIL	70,272	448	37	85

Portugal

CT1EE	66,564	322	25	61

Rumania

YO3KSD	78,522	440	42	96
YO8KGC	54,634	305	36	92
YO6KAF	3,644	133	16	46

Scotland

GM3SHF	74,871	409	32	109

Sweden

SM6CKV	782,154	1123	101	241
SL5ZL	433,347	805	87	206

Crew of Multi Single station DJ5FK. L. to R.—DJ9KL, DJ5FK and DJ5WY. The boys maintained a 4 on and 8 off watch, same as used in the merchant marine.

Switzerland

HB9I	926,900	1395	90	235

Wales

GW3VPS/P	40,880	262	31	81

Yugoslavia

YU1DKL	14,472	190	16	51

U.S.S.R.

Estonia

UR2KCA	306,173	914	66	163
UR2AT	21,808	278	16	42

European

UA3KBO	793,350	996	111	276
UA1KBB	644,000	996	99	267
UA3KTV	113,126	486	35	103
UA1KUA	112,651	388	45	88
UA3KGA	57,456	263	33	93
UA1KAL	46,800	256	35	85
UA3KHA	42,745	269	25	78
UA1KUB	38,720	365	17	47
UA3KYA	38,150	224	28	81
UA1KMF	34,320	160	34	70
UA3KUS	28,644	281	36	57
UA4KSA	7,192	94	18	34
UW3KQE	945	51	7	14

Latvia

UQ2KBC	146,280	641	42	117
UQ2KCR	127,165	648	41	104
UQ2KBL	7,228	112	13	39

Ukraine

UB5KBV	194,750	692	54	136
UT5KKA	181,700	477	65	165
UB5KFF	164,920	506	65	152
UB5KCA	129,315	471	46	139
UB5KAB	113,225	440	51	124
UT5KDP	105,056	301	59	137

White Russia

UC2KMZ	15,368	169	19	49

South America

Antartica

UA1KAE	368,754	1000	36	87

Argentina

LU8DQ	439,450	875	69	101
LU4FM	92,213	394	29	54

The Operators at the Single-Transmitter Stations

CT1EE & CT1IQ.
DJ3YU & DL9RP.
DJ5FK & DJ5WY, DJ9KL.
DJ9CN & DL3BA.
DL2KM & DJ4XA, DJ9DN.
DL8CM & DL8CH, DL8FR.
DLØAAA : DJ4XG, DJ5DA, DL3BK, DL3OH.
DLØER : DK1DM, DL9FZ, DL9XY.
DM3EN : Club.
DM3UN : Club.
DM4BO : Club.
DM4PL : DM2CZL,DM3ZOL, DM4WPL.
G3SKY : G3SDD, G3UCW, G3VDZ, G3WIT.
G3SSO : G2HX, G2RT, G2HDU, G3CNW, G3FXA, G3PEO, G8FF, G8KG.
G5BK : G3LDA, G3OLN, G3TVW, G3WKH, G3WXS.
GM3SFH & GM3RNZ.
GW3VPS/P : G3MOJ, G3VPS, G8AFH.
HA1KSA : Club.
HA3KNA : HA3NA, HA3NB, HA3NC.
HA5KDQ : HA5AD, HA5DI, HA5FN, HA5-162.
HA5KDI : Club.
HA8KUC : Club.
HA8YUA : Club.
HA9KPE : Club.
HB9I : HB9ADH, HB9UB.
JA1YUL : JA1LHR, JA2CEC, JA4BYK, JA7AXG.
JA4YCN : Club.
JA6YAF : Club.
JA6YCU : JA6BXA, JA6ECF.
JA6YFL : JA6EFR, JA6ELV, JA6ESE, JA6FFK, JA6HMG.
JA9YCE : JA9BLQ, JA9BYT, JA9BYU, JA9CGK.
K2BMI & WB2UJK.
K3JH & K3JLI.
K6IPM & W6GBY.
K6YGS & W6CYX.
K8UDJ & K1ZND, K8HKM, W8TJQ, WA8LWK.
KØJPG & KØECK, KØGSV, KØIFL, KØJPL, KØYIP.
KA9MF : K3GPH, K9PVD, W3CJX, W8FCW, WØNAH, WA1DSN, WA3IBN, WB2HMF.
KL7AIZ : K7KPM, WA8QIY.
KP4AXM : K7WMA, WN9VPX.
LA1H : LA9JD, LA9OI, Joern.
LA1K : LA1EE, LA1HL, LA1NL, LA2QK, LA3JJ, LA3LJ, LA7XK.
LA7QI & LA3FG.
LU4FM : LU3FG, LU6FA, LU6FBR.
LU8DQ & LU8DLR.
LZ1KAA : Club.
LZ1KBG : Club.
LZ1KKR : Club.
LZ1KSD : Club.
LZ1KSW : Club.
LZ1KSX : Club.
LZ2KAF : Club.

Bob Snyder, WØGTA can always be expected to turn up in a contest from some distant location or other. At present he is in Norway signing LAØAD, which is quite an improvement over some of the long calls he has had to use.

LZ2KBI : Club.
LZ2KEF : Club.
LZ2KIM : Club.
LZ2KRZ : Club.
OE4SZW & OE4WBW, OE7VV.
OF2TI : OH1QP, OH2BO, OH2BCP, OH2XI, OH3PC, OH5SE, OH9RF.
OF2ZD & OH2BEM, OH2BHM, OH2VB, OH5WL.
OF3AG : OH3LG, OH3LO, OH3MK, OH3MN, OH3SM, OH3TM, OH3VJ, OH3WW, OH3YU.
OF3TR : OH1YO, OH1ZQ, OH6VC, OH7RJ, OH8RI.
OF6AA : OH6NH, OH6YA.
OHIVR & OH3YI.
OKIKHL : Club.
OKIKKS : Club.
OKIKOK : Club.
OKIKTL : Club.
OKIKWR : Club.
OK2KJU : Club.
OK2KMR : Club.
OK2KOV : OK2BJR, OK2BOB.
OK3KAG : Club.
OK3KGW : Club.
OK3KWK : Club.
OY6FRA : Club.
PIIPT : Club.
SL5ZL : Club.
SM6CKV & SM6BJI, SM6DXK.
SPØHIL : SP9APR, SP9BCB, SP9CEM.
TGØAA : K4BAI, W4YWX.
TY2KG : W6DOD, W6KG.
UAIKAE : Club.
UAIKAL : Gene, Victor.
UAIKBB : George, Wowa, Yuri D., Yuri S.
UAIKMF : UA1UG, UA1UH.
UAIKUA : Club.
UAIKUB : Club.
UA3KBO : DM2BOG, UA3-27308.
UA3KGA : Valera, Valery, Victor.
UA3KHA : Club.
UA3KTV : Ed, Tola, Vlad.
UA3KUS : Nick, Willi, Yuri.
UA3KYA : Club.
UA4KSA : Club.
UA9KFS : Club.
UA9KHA : Club.
UA9KJA : Club.
UA9KQA : Club.
UA9KWA : Club.
UAØKBA : Club.
UAØKCA : Alex, Jacob.
UAØKCG : Oleg, Sergei, Vlad.
UAØKFG : UAØEH, UAØER, UAØFM, UAØFR, UAØFK, UAØFM, UWØFP.
UAØKIA : UAØIL, UAØIX, UAØIZ.
UAØKKT : Club.
UAØKSB : UAØSE, UAØTD, Vlad.
UB5KAB : Alex, Vlad, Yura.
UB5KBV : Club.
UB5KCA : UB5AY, UB5FH, UB5-4155.
UB5KFF : Club.
UC2KMZ : Al, Oleg, Vlad.
UD6KAB : Boris, Edward, Ramiz.
UG6KAA : UG6AV, UG6WJ, UG6-6832.
UL7KAR : Club.
UL7KBK : UL7CA, UL7CJ, UL7CT, UL7-0281.
UL7KCB : Slava, Valery.
UQ2KBC : UQ2MR, UQ2MU, UQ2-22395.
UQ2KBL : Andy, Genady.
UQ2KCR : Anatoly, Artur, Gunar, Juri, Sergei.
UR2AT : Club.
UR2KCR : UR2AL, UR2AW, UR2LO.
UT5KDP : UB5-5969, UB5-5973, UB5-45017.
UT5KKA : UB5FY, UY5RR, UB5-5398, UB55587.
UW3KQE : Club.
UW9KOQ : Club.
W2PCJ & WB2CKS.
W3BGN & K3FPY, W3YUW.
W3MWC & WB2APG.
W3WJD & K3FGO, K3JCT, K3MCO, W3DQG.
W6BIP & WA6DJI.
W6NJU & W6FRZ, WB6IQI.
W8BQH & W8CXM, K8DBW.
W8UM : K2SIL, K8MFO, W8CQN, W8FAW, WB2FIT.
W9EXE & K9YOE.
W9YT : K9LBQ, K9ZMS.
WØAIH & KØIJL, KØZXE, WØLOL, WØTKX, WØYCR.
WØHTH & KØKKU, WØCDP, WAØJRW.
WA2BLV & WB2MOQ.
WA6EPQ & WA6IPY.
WB6UDC & WB6NRK.
YO3KSD : YO3AAJ, YO3AAO, YO3AAQ, YO3GU.
YO6KAF : YO6ADW, YO6EH.
YO8KGC : YO8AGZ, YO8AHA.
YUIDKL : Club.
ZEIS : ZE1AE, ZE2JD, ZE2KV, ZE3JJ, ZE3JO, ZE5JJ.
ZS5QU & ZS5DC.
3C2DCW : VE2BOW, VE2DCW.
4L3A : UA6DP, UQ2AO, UQ2CC, UQ2GA, UQ2IM, UG2LL, UQ2MS, UQ2NX, UQ2-0371, UW6BA, George, Gunar.

MULTI-OPERATOR
Multi-Transmitter

North America

W3MSK	4,063,920	2452	158	416
K2GL	4,054,092	2403	153	425
W4BVV	3,714,048	2307	155	403
W4KXV	2,605,590	1768	143	367
W4ETO	2,239,380	1655	133	335
W6RW	1,804,168	1444	150	286
W3VKD	1,342,575	1133	122	283
W7SFA	1,256,520	1175	133	237
W4ZXI	764,088	713	112	260
WA2CFG	539,460	567	107	226
WA3EPT	458,784	461	117	237
W3RRV	374,312	459	98	186
W6RGG	298,655	412	106	159
W6GQK	282,030	415	98	140
WA3EPB	145,734	247	87	127

Africa

ET3FMA	1,387,680	1476	105	231

Asia

UA9KCE	1,395,663	1571	97	242

Europe

OF2AM	3,829,375	3317	142	415
DJ6QT	2,001,660	2196	116	322
SM5BPJ	1,795,752	1795	141	368
OH1AA	1,657,350	1954	117	333
DLØKF	1,655,500	1796	126	347
LZIKPG	1,611,744	2359	117	295
UB5KKA	1,081,031	1723	109	280
UA4KPA	780,325	1537	91	252
DJ5LE	694,600	1527	90	212
OZ5DX	691,114	1169	90	224
DM7M	570,486	1252	86	203
DM7L	506,362	1186	82	199
YU3APR	386,744	891	70	198
SL6AL	361,560	747	80	196
DLØRO	181,353	487	62	121

South America

PJ3CC	5,527,788	5194	110	247
CX8CZ	3,851,645	3299	131	264
YV5RV	384,921	771	71	100

The Operators at the Multi-Transmitter Stations

CX8CZ & CX1AAC, CX1BY, CX1DZ, CX2AL, CX3BH, CX7CO, CX8BU.
DJ5LE & DJ2JE, DJ2MS, DJ8PU, DJ9KZ, DK1DO, DK1VN, DL2OM, DL3YQ, DL8RE, DL9VN.
DJ6QT & DJ1QP, DJ1VP, DJ6TK, DJ7IK, DJ8SW.
DLØKF : DJ3UL, DJ4FZ, DJ4SO, DJ5AZ, DJ7SW, DL1FL, DL2ZT, DL8PY.
DLØRO : DJ3XP, DJ8SI, DK1IZ, DK2RX, DL3VE, DL3ZI.
DM7L : DM2AQT, DM2ATL, DM3MEL, DM3ML, DM3OML, DM3UL, DM3ZUL, DM4EL, DM4YEL, DM5CL, DM5ZCL.
DM7M : DM2BFM, DM2CCM, DM2CDM, DM2CEM, DM2CFM, DM2CIM, DM2CLM, DM2DXM, DM3DBM, DM3EBM, DM3NM, DM3RM, DM3SBM, DM3SNM, DM3UNM, DM4JM, DM4ZOM.
ET3FMA : K4FMA, K9KBW, W6HOH, Bill.
K2GL & K2KUR, K2UYG, KØLFY, W1GYE, W1MDO, W2DNG, W2GLM, W2IWC, W2JAE, W2VCZ, W6KFV, Alex.
LZIKPG : LZ1BC, LZ1CC, LZ1IB.
OF2AM : OH2BBR, OH2BBM, OH2BC, OH2BCZ, OH2BH, OH2BQ, OH2BS, OH2KH, OH2QV, OH2SB.
OHIAA : Club.
OZ5DX & OZ4UN, OZ5WQ, OZ7X.
PJ3CC : W1BIH, W1FJJ, W1TX, W3GRF, W4GF, W4KFC.
SL6AL : SM6ALM, SM6ATP, SM6BBM, SM6BWD, SM6CPR, SM6CST, SM6CTQ, SM6CZZ.
SM5BPJ : SM5ARR, SM5BDY, SM5BLA, SM5BXT, SM5CZQ, SM5DRW, SM5RC.
UA4KPA : UA4PA, UA4PW, UA4PY, UA4PZ, UA4QM, UA4QP, UA4-09410.
UA9KCE : Azari, Boris, Leo, Vadim, Vlad, Valentin, Yuri.
UB5KKA : Club.
W3MSK & K3EST, W3EIS, W3FYS, W3MCG, W3MFJ, W3TMZ, W3ZKH, W9SZR.
W3RRV & W3ECR.
W3VKD & W3AOH, W3LMM, W3UHN.
W4BVV & K3NPV, K3OAE, K4VDL, W1BGD, W3BQV, W3DPJ.
W4ETO & K4HF, W4CHA, W4JDR, W4LCP, W4ZCB, WØLNE, WA4PXP, WB4DBZ.
W4KXV & K2UFT, K2VGR, K4BVD, K4PQL, K4MXF, K4WUY, WA4JFY.
W4ZXI & K4WIS, W4BJ, W4FRO, W4HOS.
W6GQK & W6SR.
W6RGG & K6ALH.
W6RW & K6UMV, K9ELT, W6BXL, W6DGH, WB6OLD, WB6TMC.
W7SFA & K7HAY, W7DL, W7DZO, W7VY.
WA2CFG & W2LWI, W2YWO.
WA3EPB & W3EVW.
WA3EPT : K3CUW, K3GJD, K4GSU/3, W3BOQ, W3WZL.
YU3APR : YU3ER, YU3EY, YU3TBM, Leon, Lojze.
YV5RV : YV1MG/1, YV5AEP, YV5AN, YV5AZG, YV5BCN, YV5BHR, YV5BOG, YV5CET, YV5CGV.

Our thanks to the following stations who sent us their chec logs: DL9BW, DM2ADC, DM2AHM, DM2AJG, DM2AMF, DM2AWF, DM2GUO, DM3NPA, DM3YPD, DM4UG, DM4ZCF, F2SQ, HA1ZH, HA5FA, HA7PM, HA8KUX, HAØLL, HAØ515, HB9IX, LZ2-193, LZ2-K-49, LZ2-C-4, OF4RH, OF6NH, OK1AKQ, OK1ALU, OK1ALU, OK1APB, OK1ASE, OK1AYY, OK1DJ, OK1KBI, OK1KPA, OK2ABU, OK2BBJ, OK2BCJ, OK2BFT, OK2BJJ, OK2KFK, OK2QX, OK3CEG, OK3CIK, OL6ADD, OZ3PO, OZ7DX, OZ7KV, PAØMIB, SP1BLE, SP2AOB, SP3BES, SP3BTS, SP4-6102, SP4-6127, SP6ARE, SP6RT, SP6XA, SP9EC, SM2DHC, SM3CJD, SM5BGK, SM5BHW, SM5BNX, SM5DUT, SM5UH, SM6CKU/mm, SM7ASN, SM7BEX, SM7DMT, VE1ARJ, VE3ATF, VE7HQ, VU2MD, W2WZ, W3CTE, W4DGJ, WA4OZM, ZL1ACW, UA3BR, UW3CY, UA4AE, UA4BB, UA4BO, UA4SG, UA4KHW, UA9MY, UA9FI, UAØTN, UB5ES, UB5FL, UB5VX, UT5BH, UT5NA, UY5UI, UL7JI, UA3-27185, W3CTE.

See page 118 for New Reader Service

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CQ Reviews:

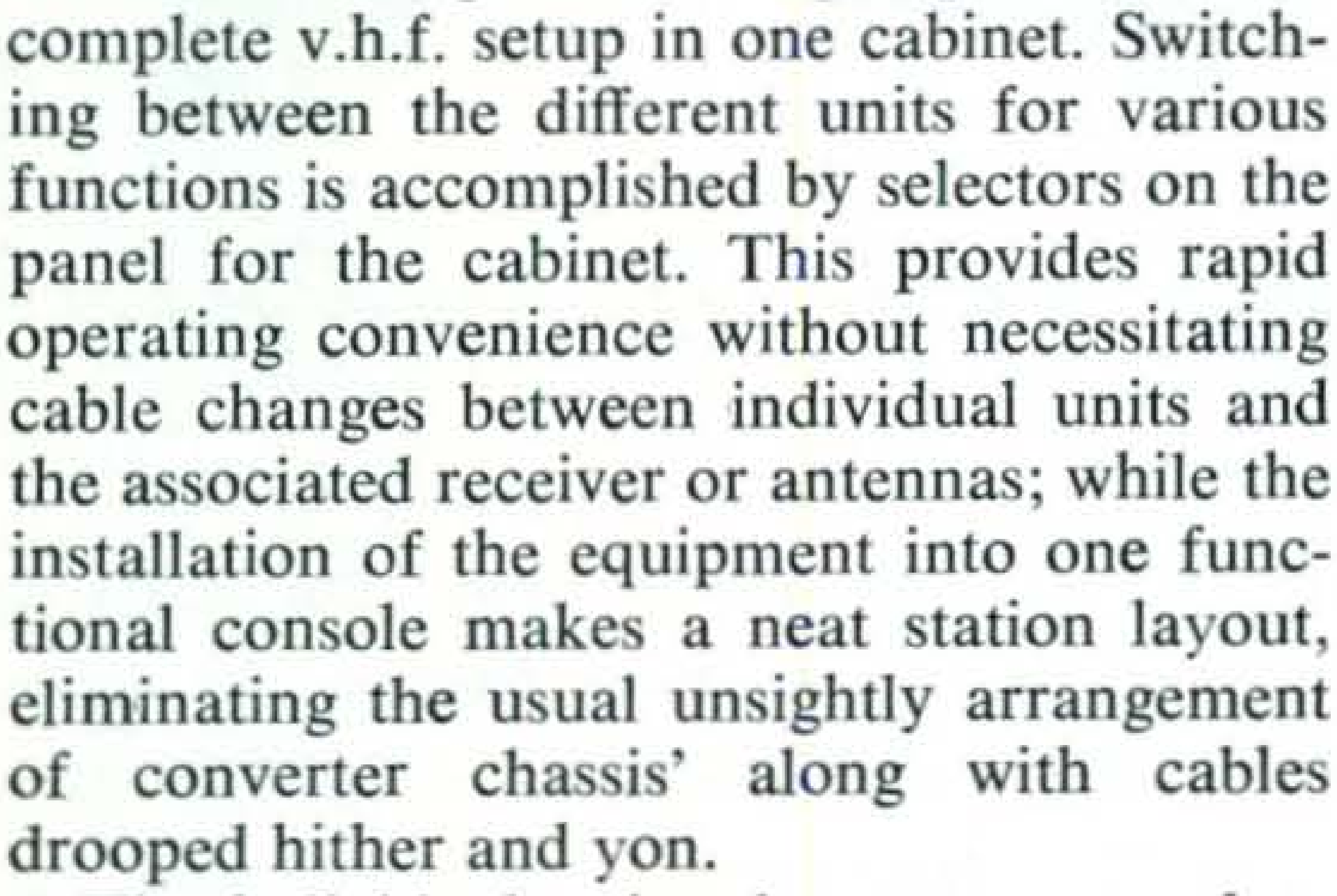
The Drake Solid-State VHF Equipment

BY WILFRED M. SCHERER,* W2AEF

THE Drake line of solid-state v.h.f. gear consists of two f.e.t. converters, the Model SC-6 for the 50 mc band, the SC-2 for the 144 mc band; the Model SCC-1 v.h.f. Crystal Calibrator and the CPS-1 Power Supply. All the units can be plugged into the Model CC-1 Console to comprise an integral package for a complete v.h.f. setup in one cabinet. Switching between the different units for various functions is accomplished by selectors on the panel for the cabinet. This provides rapid operating convenience without necessitating cable changes between individual units and the associated receiver or antennas; while the installation of the equipment into one functional console makes a neat station layout, eliminating the usual unsightly arrangement of converter chassis' along with cables drooped hither and yon.

The individual units also are arranged so in the event you are a one-band operator or do not have the console, they may be plugged into one another to form one piece of equipment.

*Technical Director, *CQ*.



The Drake Model CC V.H.F. Console

The Converters

Both converter models employ field-effect transistors in the r.f. and mixer stages for the optimum in solid-state performance with low noise, high sensitivity, minimization of overload and cross modulation.

Bandpass coupling between stages provides an essentially uniform response over the full 4 mc range for the particular band. The i.f. output is 14-18 mc for full band coverage and the output impedance is designed to match into 50 ohms. Voltage regulation with a Zener diode is provided for ensuring stability of the crystal-controlled oscillator and reverse-polarity protection is provided with a diode in the supply lead which also is filtered for r.f. to minimize stray-signal pickup.

Two crystals, selected with a slide switch, are supplied with each converter. Those for the 6-meter model provide coverage starting at 50 or 50.5 mc when used with a 14 mc and-up i.f. range. With the 2-meter model the coverage starts at 144 and 145 mc for the same i.f. range.

If the associated receiver is a ham-band-only job limited to a 500 kc spread (14-14.5 mc), continuous coverage of just the lower 1 mc portion of the 50 mc band will be available with the two crystals.

On the other hand, with the same receiver conditions, the available coverage on the 144 mc band with the supplied crystals will be 144-144.5 and 145-145.5 mc, leaving a 500 kc gap between 144.5 and 145 mc; however, the units evidently were initially intended for use with the Drake 2C and R-4B receivers (or others where an extended coverage may be had) wherein an additional receiver range of 14.5-15 mc may be obtained using accessory

See page 118 for New Reader Service

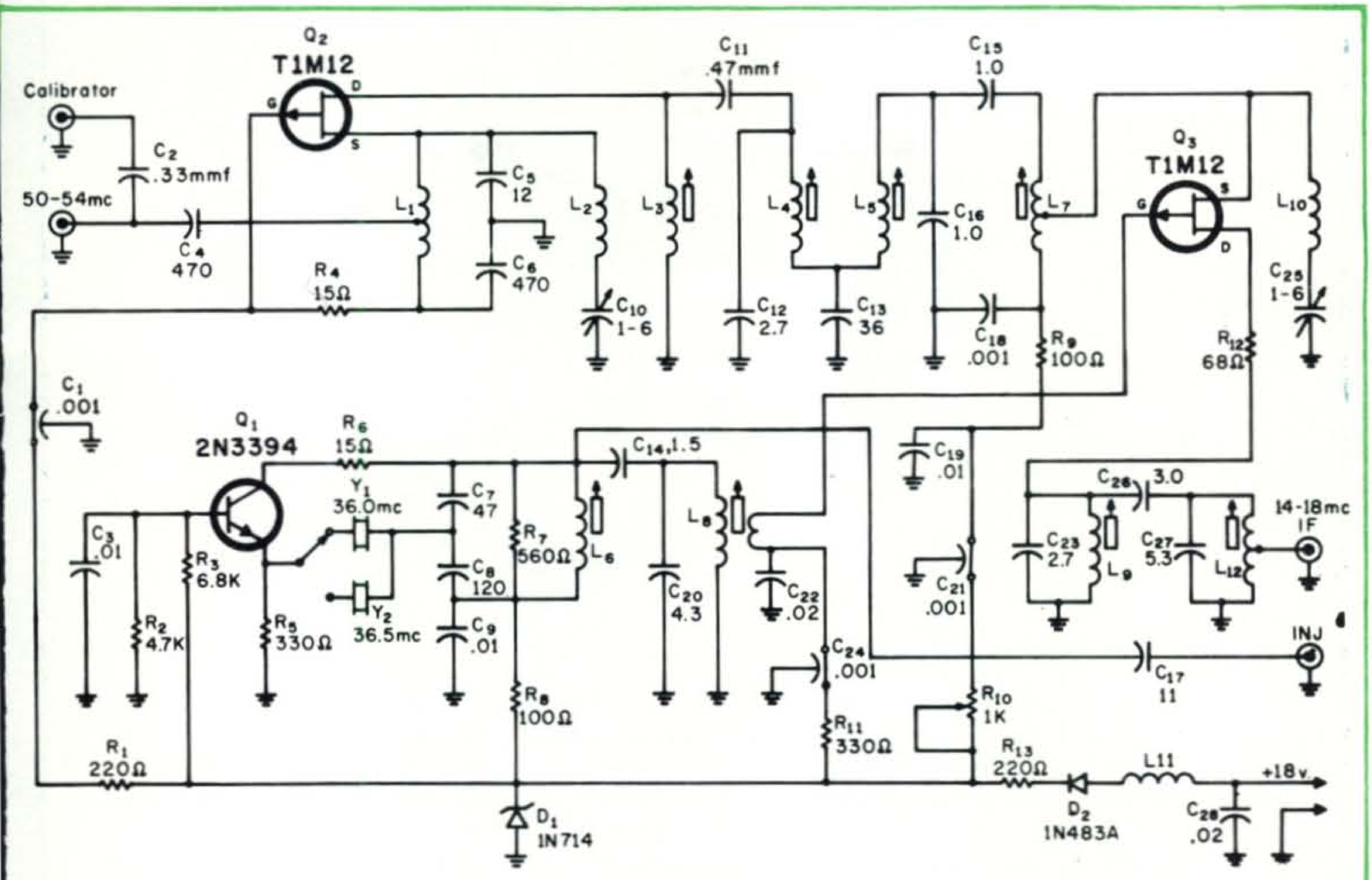


Fig. 1—Schematic diagram for the Drake SC-6 50 mc Converter. See text for details.

plug-in crystals, thus providing the needed i.f. to fill in the gap.

We suspect that this setup with the 2-meter model might have been instituted to avoid the possibility of spurious birdies when the SC-2 is used with the particular receivers.

It also might be noted that with these receivers, complete coverage of the 50 and 144 mc bands may be had by further extending their ranges with the provided auxiliary facilities, as this will furnish the tunable i.f. range as needed for such coverage with the converters.

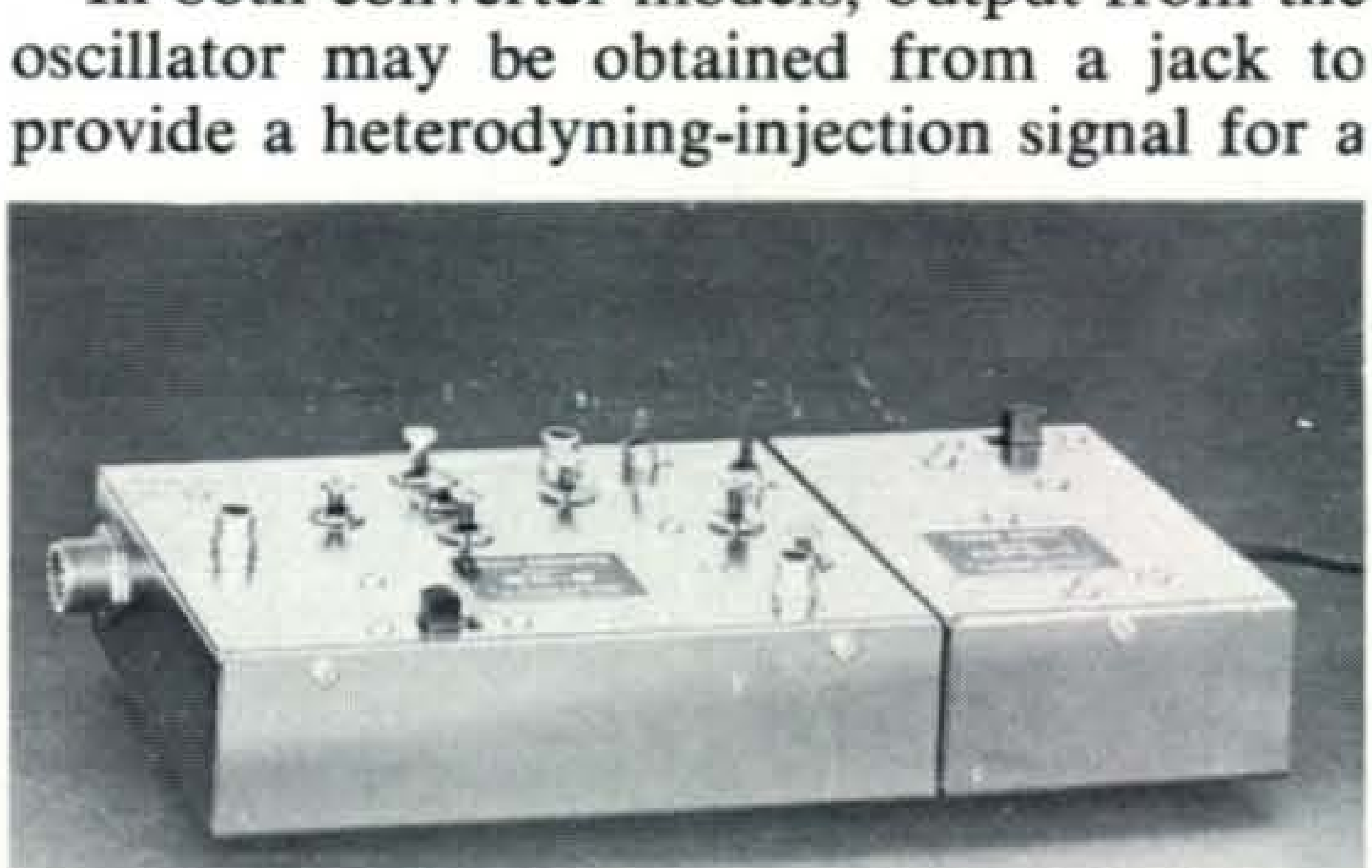
Converter Circuitry

Referring to the schematic at fig. 1, the SC-6 50 mc job employs TIM12 f.e.t.'s in grounded-gate amplifier and mixer stages with a series-resonant 36 mc crystal-controlled oscillator using a 2N3394 conventional type transistor. Bandpass coupling is utilized at the i.f. output as well as between the r.f. amplifier and mixer.

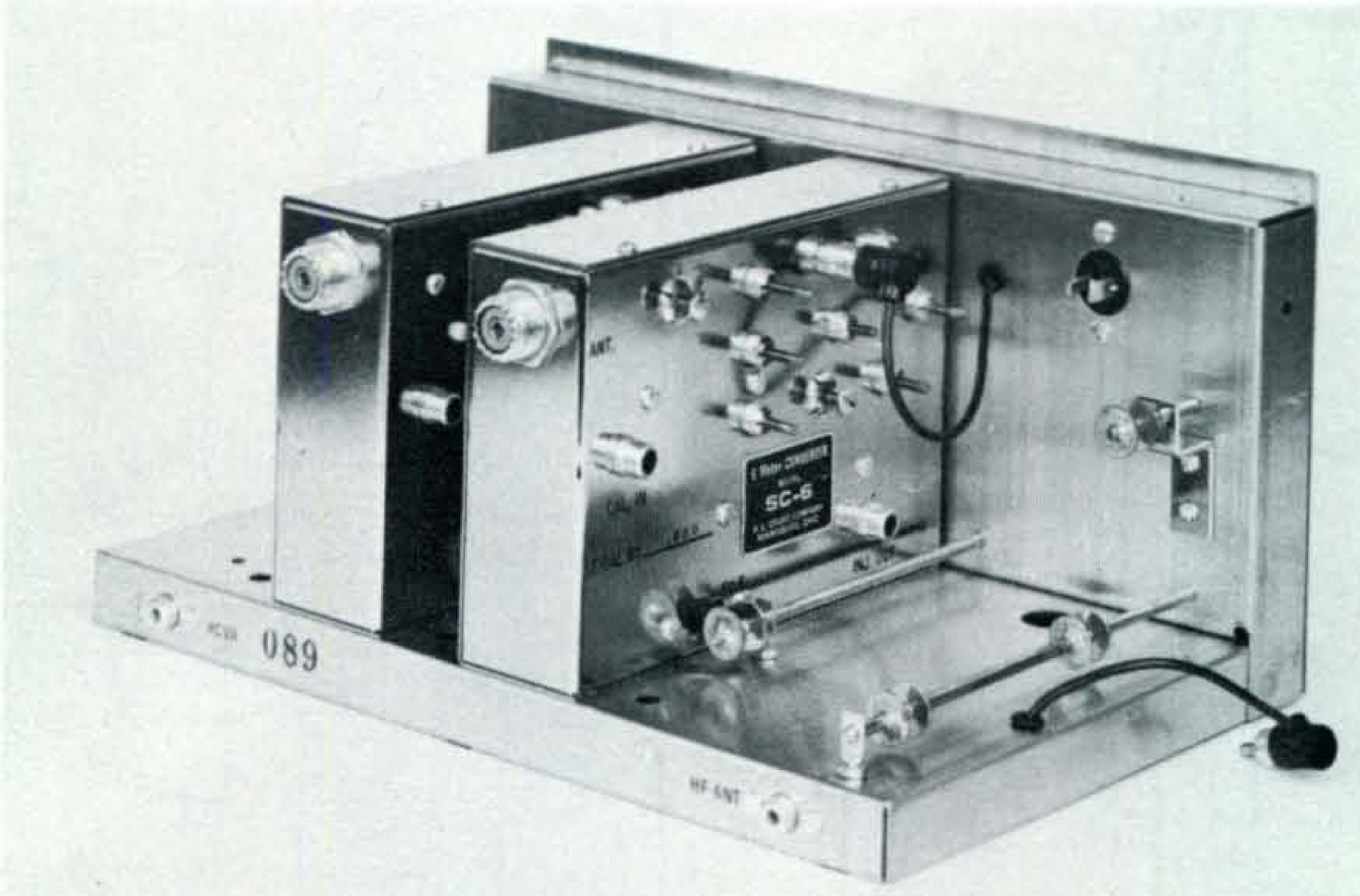
L_2-C_{10} and L_{10}-C_{25} are 57.750 mc traps used to minimize interference from Channel-2 TV stations. Where such local TV signals are exceptionally strong, interference due to intermodulation products generated by components of the TV signals near 54 mc, may be further attenuated by readjusting the L_{10}-C_{25} trap to 55.250 mc and if needed, may be accomplished without the use of a signal generator simply by rotating C_{25} one turn clockwise.

The SC-2 144 mc model employs TIS34 f.e.t.'s with grounded-source r.f. amplifier and mixer circuitry along with bandpass interstage and i.f. output configurations. A 2N3394 comprises a 43.333 mc crystal-controlled oscillator which is inductively coupled to a 2N3663 tripler that is similarly coupled to the gate of the mixer.

In both converter models, output from the oscillator may be obtained from a jack to provide a heterodyning-injection signal for a



One of the Drake converters and the power supply coupled together to form one unit.



Top-chassis view of the Drake Console with two converters installed. A third converter position is at the left end. The power supply and calibrator are coupled together (not shown) and plug in at the right. Mating connectors may be seen at the rear of the panel. One of the mechanical linkage arrangements for the slide switches is attached to the right-hand converter. It consists of a sliding rod with two discs on it that grip the slide-switch arm. The switch links for the power supply and the calibrator are resting in the foreground.

transmitting converter. There also is a jack for injecting the calibrator signal at the input to the r.f. amplifier. It is coupled through only a 0.33 mmf capacitor, thus enabling the calibrator to be left connected without affecting the r.f. input characteristics.

Construction

The converters are assembled in nickel-plated-steel chassis size 4⅛″ × 5⅞″ × 1½″ high. The antenna connector is an SO-239 u.h.f. type. Phono jacks are provided for other r.f. connections. A supply potential of 18 v.d.c. (@ 40 ma) is obtained through a two-prong Jones plug at the side of the chassis and which mates with a Jones receptacle on the power supply, allowing the two units to be ganged together without interconnecting cables. A small bracket is supplied to mechanically lock the two units together.

SCC-1 Crystal Calibrator

The SCC-1 V.H.F. Crystal Calibrator provides accurate frequency markers at 50 kc intervals up to 432 mc. It consists of a TIS34 f.e.t. 100 kc crystal oscillator that drives a 2N3394 trigger for an integrated circuit 2:1 frequency divider. High harmonic output is obtained from an i.c. harmonic generator/amplifier.

Four outputs are provided with individual phono jacks and may be simultaneously connected to separate pieces of gear. One output is peaked for 50 mc, another for 144 mc. The other two allow the calibrator signals to be fed either to a spare converter or directly to the associated receiver. Since the calibrator signals are applied at the input to the converters, frequency calibration therewith takes into consideration both the frequency of the v.h.f. converter's oscillator and the i.f. receiver setting.

The unit is built in a 3″ × 4″ × 1½″ high chassis like that of the converters. It has an on-off slide switch and at one side is an access hole to a trimmer for bringing the crystal on frequency against a standard such as WWV. On another side is a Jones plug for power and mounted on the opposite side is a Jones receptacle that is bridged across the power-input plug. This enables the calibrator to be connected between the power supply and a converter with all three units coupled together as one. Power requirements for the calibrator are 14-18 v.d.c. @ approx. 40 ma.

CPS-1 Power Supply

The power supply is built on the same size and type chassis as is the calibrator. It furnishes 17.5-15 v.d.c. @ 50-100 ma and operates from a 120 v.a.c., 60-cycle, source using a step-down transformer and silicon-

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diode rectifiers in a full-wave bridge with R/C filtering. Overload protection is provided by a 200 ma fuse in the primary circuit. Power is turned on or off with a slide switch and the d.c. output is fed to a Jones receptacle for mating to plugs on the other units as already described.

Model CC-1 Console

The Model CC-1 Console consists of a shallow copper-plated chassis with a panel mounted in a 5½" H. × 10¾" W. × 8" D. cabinet that has a black scuff-proof finish. Plugs or receptacles allow the converters, calibrator and power supply to be installed in the console when they are placed vertically and pushed in from the rear to mate with the console connectors at the back of the panel.

A unique arangement is that a mechanical linkage is slipped onto the slide-switch arms of the modules so that they may be operated from the front of the panel, as shown in the photo.

Another feature is that the units may be secured to the console chassis by screws, removed from one side of the individual units prior to installation. Corresponding holes are already provided in the console and the modules. An opening also is furnished for the trimmer-access hole on the calibrator.

Positions are provided for a 6-meter converter, a 2-meter one and a spare. A fourth position holds the power supply and the calibrator which are coupled together.

Interconnecting cables are supplied for the crystal-calibrator outputs and three additional cables for the i.f. outputs of the three converters go to a selector switch on the panel by which any one converter output may be switched to the associated receiver or which bypasses the converters and automatically connects the h.f. communications antenna directly to the receiver. Power for the individual units is likewise transferred by the switch.

Phono jacks are used at the rear for the i.f. output and the h.f. antenna. The v.h.f. antennas are connected directly to each converter, since a separate antenna normally is used for each v.h.f. band.

Operation and Performance

The converter console makes not only a clean-looking installation, but it also is most desirable from a functional standpoint, especially if you operate more than one band. Switching back and forth between each v.h.f. band or for direct operation with the receiver alone on the lower frequencies is instantaneous.

The mechanical links (operated by push-pull knobs on the panel) to the slide switches of the individual units complete the flexibility of the setup, also allowing the converter crystals to be switched or the calibrator to be turned on or off.

As to performance, the converters measured according to the related specifications which follow, except where otherwise noted in parenthesis:

SC-2—Noise Figure: Rated 2.5 db (measured 2.8 db). Image Rejection: 70 db @ 115 mc. I.F. Rejection at 14 mc: Rated 80 db (measured 95 db). Gain: 20 db.

SC-6—Noise Figure: 4.0 db. Image Rejection: Rated 75 db @ 22 mc (measured 81 db). I.F. Rejection: Rated 80 db (measured 86 db). Gain: 14 db ±. 0.5 db across band.

The sensitivity is not rated, due to possible variations according to receiver bandwidths, but readings taken with the SC-6 were as follows: 0.1 μv for 10 db S+N/N on c.w. and s.s.b. using receiver bandwidth of 2.1 kc; 0.25 μv for 10 db S+N/N on a.m. with 30% 400 c.p.s. modulation and using receiver bandwidth of 4 kc.

A sensitivity test was not made on the SC-2, but according to the noise figure, it should be slightly better than with the SC-6 under the

[*Continued on page 110*]

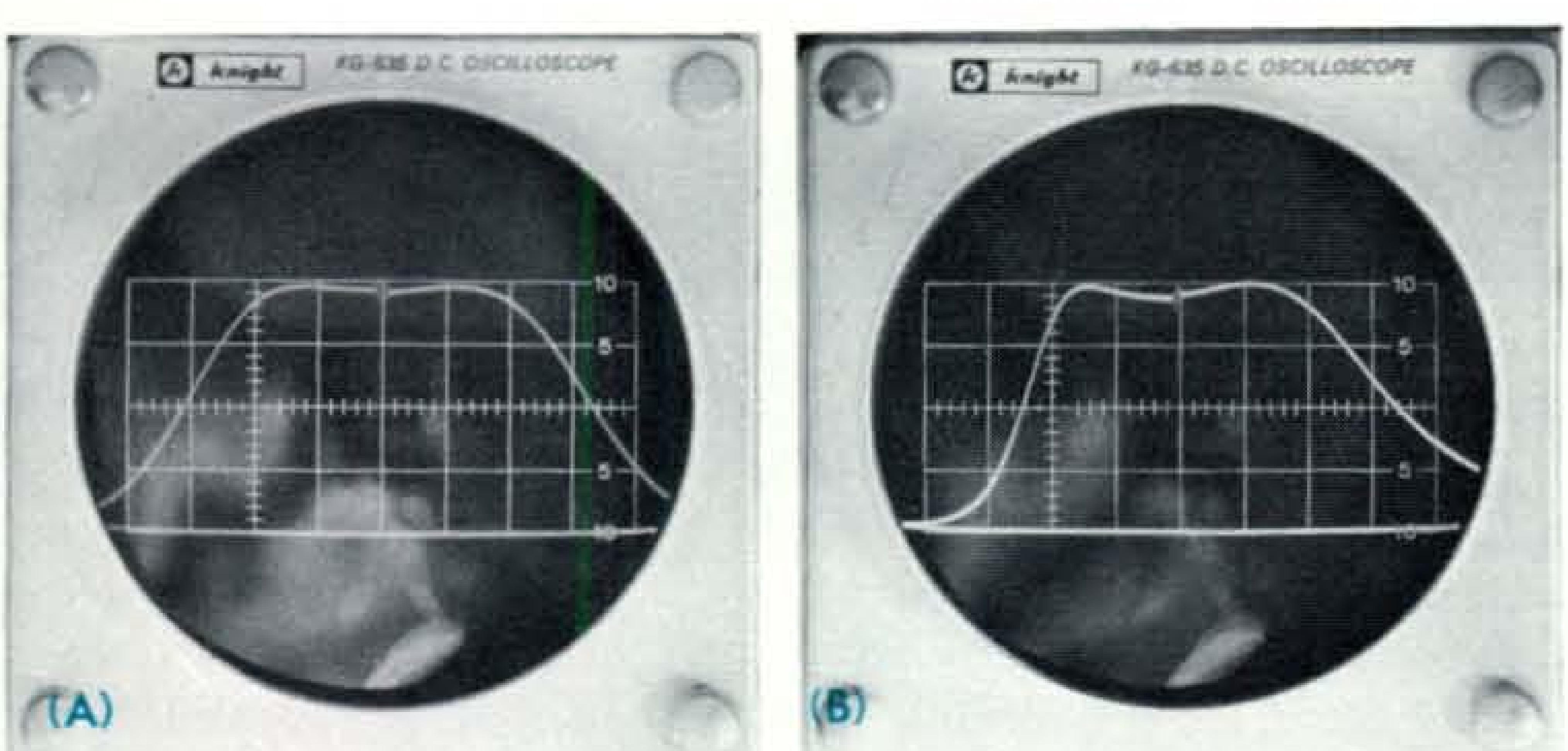

Fig. 2—Sweep-generator display on c.r.t. showing band-pass characteristics of the SC-6 at (A), the SC-2 at (B). The major horizontal-scale divisions are 1 mc apart. The vertical scale is linear with respect to voltage. The band edges and the band center (indicated by the marker pip) are less than 1 db below maximum for a response of better than ±0.5 db over the entire 4 mc bandwidth.

HOW LINEAR IS A LINEAR AMPLIFIER?

BY JOHN J. SCHULTZ, *W2EEY/1

Many terms can be used to measure the performance of s.s.b. exciters and linear amplifiers. One of the most useful terms available to measure performance is Intermodulation Distortion or i.m.d. Unfortunately, the i.m.d. is rarely given for most amateur equipment.

THE terms carrier suppression and sideband suppression are familiar to everyone who works with s.s.b. gear. The objective is to produce as great carrier and unwanted sideband suppression as possible, with −40 to −50 db for both being easily achieved with most circuits in use. However, one of the most interesting terms of measurement of the actual *linearity* of a s.s.b. transmitter or linear amplifier, Interdomulation Distortion, is rarely quoted by either manufacturers of amateur equipment or by most amateur builders. There may be good excuse for the latter group since they may not have the equipment available to measure i.m.d. while carrier and sideband suppression is relatively easily measured. However, there is no reason why manufacturers cannot quote i.m.d.; they probably don't do so because most amateurs aren't acquainted with the term.

* 40 Rossie Street, Mystic, Connecticut 06355.

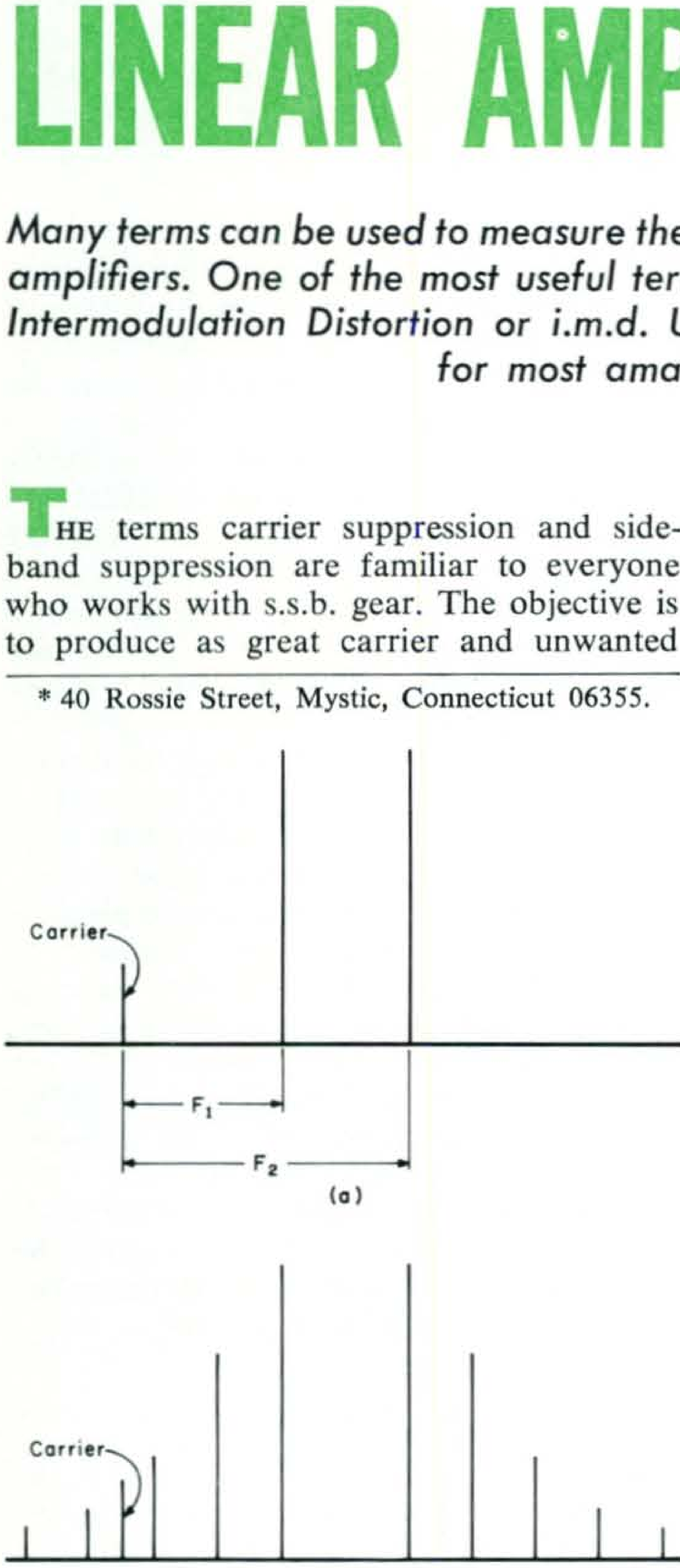

Fig. 1—Perfect linear fed two-tone signal would have output as at (A) containing only original two frequencies, each displaced from carrier by its frequency. Practical exciter or amplifier contains many more output frequencies (B).

I.m.d. is quoted very carefully for commercial and military s.s.b. equipment sales, however. The purpose of this article is to explain the importance of i.m.d. and how it can be measured. Even if one doesn't have the equipment to measure i.m.d., understanding the term is useful and provides the amateur with another important factor to be used in comparing the relative worth of different pieces of equipment.

Linearity and I.M.D.

Non-linearity in the operation of s.s.b. stages can be due to many causes: improper bias operating point, poor voltage regulation, overdrive, improper loading conditions, *etc.* No amplifier stage or linear amplifier is

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perfect and the result is that all produce some distortion to the input signal. Intermodulation distortion is a term that is used to measure the extent of this distortion or, put another way, it gives a quantitative means of knowing how linear a linear stage really is when operating at its rated power level. If a stage were perfectly linear, one would obtain an amplified output that is a exact reproduction of the input signal. A tone of 1,000 cycles/second would be reproduceed as a pure 1,000 cycle/second tone and if two tones or more of different frequencies were amplified, the output would contain only the original or input frequency tones.

In practice, however, when two or more tones of different frequencies are fed into a linear, the output contains frequencies that were not present in the input signal. These additional tones in the output are due to intermodulation distortion which is a function of the linearity of the stage. Figure 1 shows the frequency spectrum display of an ideal and a practical linear both driven from a two-tone source.

Speech, of course, is a complex waveform of multiple frequencies. High levels of i.m.d. simply create other output frequencies which serve no useful function in conveying the original desired intelligence. How much distortion can be tolerated and still not affect intelligibility is a complicated question. The human ear can accept a signal with a great deal of distortion and still process it to make it intelligible partly because our brain uses its knowledge of language to logically fill in distorted sounds or even whole words. Without this knowledge of language, far less distortion in a signal can be tolerated and still produce reasonable intelligibility. Also, under poor signal conditions, QSB, QRM, *etc.*, an amplifier with high distortion will give poorer service than one with low distortion.

Other important reasons for keeping i.m.d. low is that high distortion simply clutters up the bands with useless signals thus causing QRM and the transmitter power which is necessary to create the distortion products could more profitably be used to amplify the original input signal.

I.M.D. Levels

I.m.d. level is usually stated in terms of how far below the level of the original tone signal a spurious tone signal is measureable. Unless very unusual conditions exist, the spurious tone signal nearest the original tone

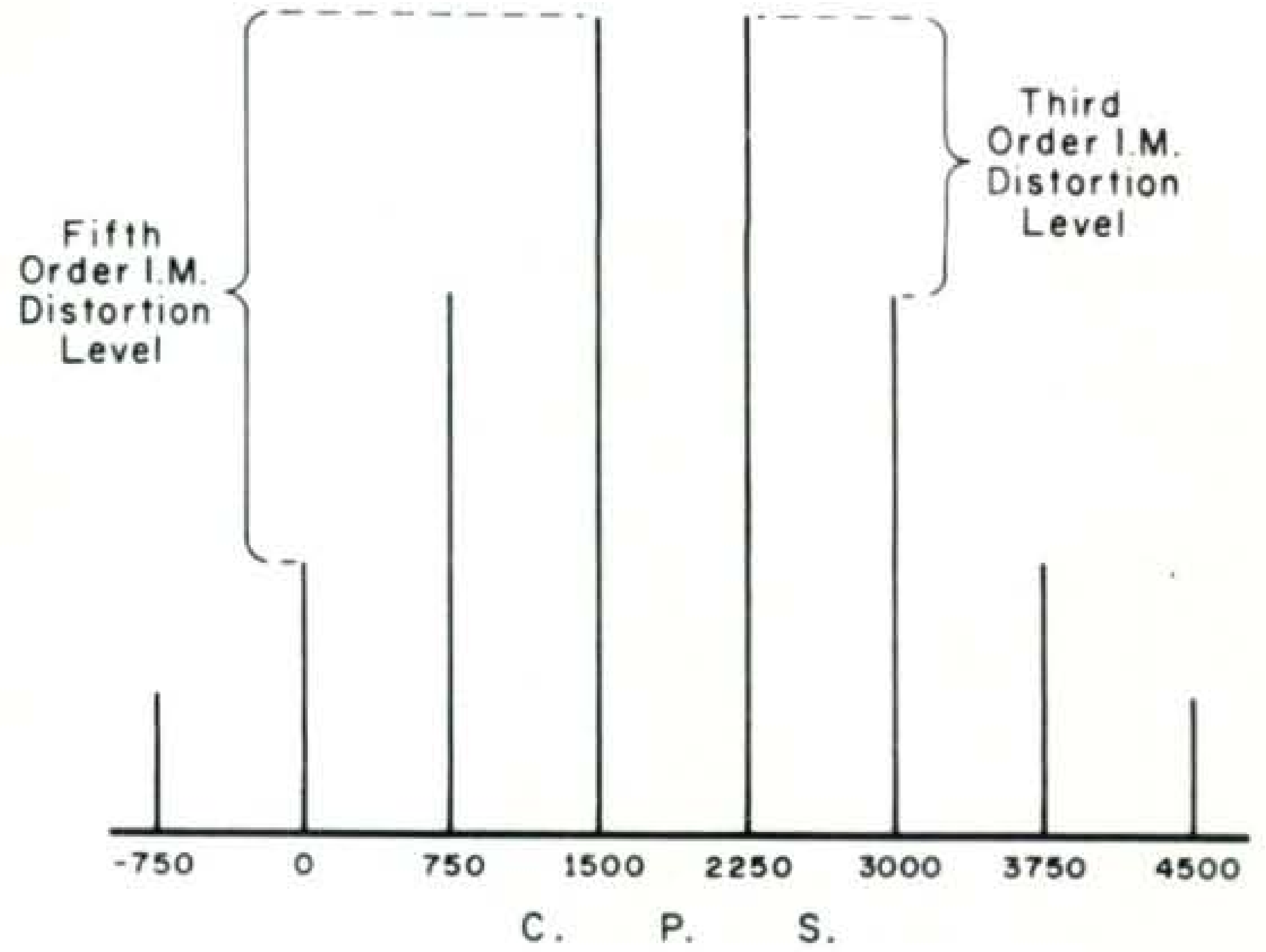

Fig. 2—Two-tone test signal of 1500 and 2250 c.p.s. produces distortion frequencies as shown. Carrier frequency is added to above frequencies to obtain r.f. output frequencies.

signal will be the greatest in amplitude while the succeeding tone signals will be progressively lower in amplitude. Therefore, i.m.d. is sometimes stated in terms of the level of the first spurious signal or sometimes in terms of the level of the first two spurious tones. The amplitude must be quoted with the amplifier operating at its rated input.

A −35 to −45 db level for the first spurious tone is considered a generally reasonable standard for most commercial and military voice communications s.s.b. exciters and amplifiers. Higher quality systems strive to reduce i.m.d. even further, with specialized military systems aiming for a −80 db or more value. Manufactured amateur equipment varies widely with some gear having a level of −20 to −25 db which is probably the lowest that should be considered acceptable. It should be noted that i.m.d. can be quoted for a single stage if desired, however, the most useful figure for an s.s.b. transmitter is the overall i.m.d. Feedback or automatic load control systems serve to reduce severe i.m.d. and the figure should also be measured with these features in operation.

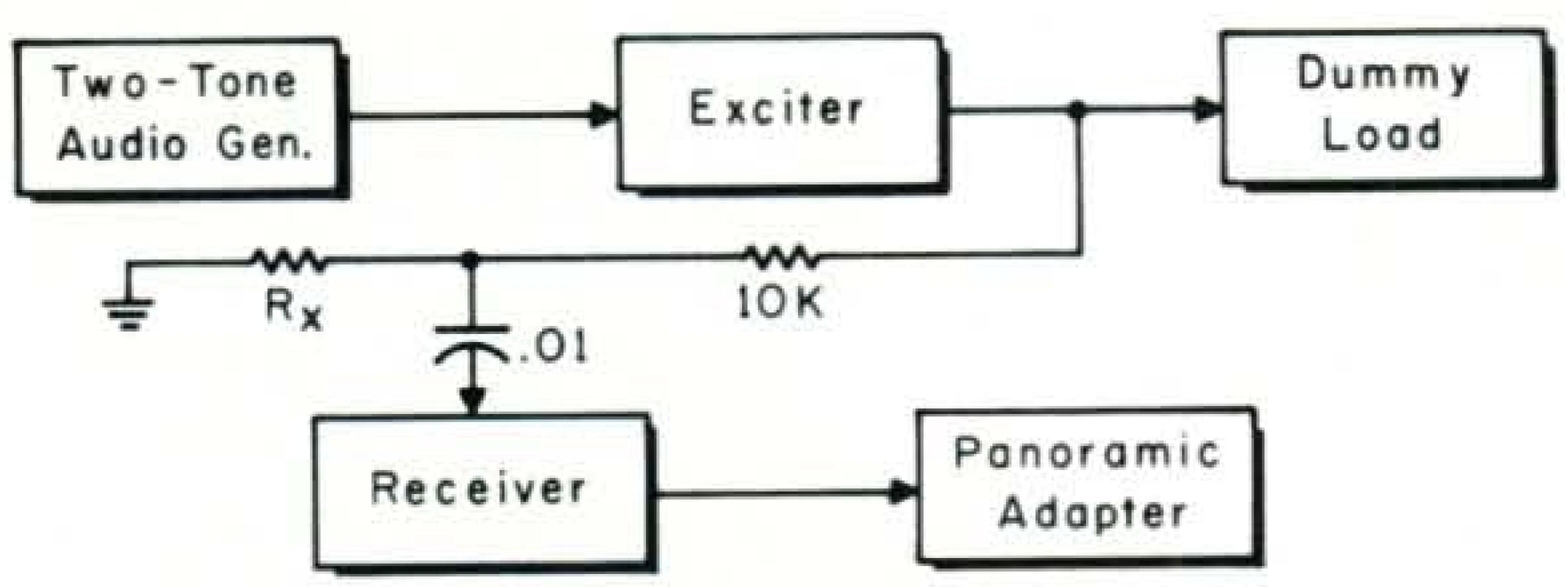

Fig. 3—I.m.d. test setup. Receiver must be isolated from exciter signal other than by direct r.f. connection shown. The value of R_x is selected to produce a signal that will not overload the receiver.

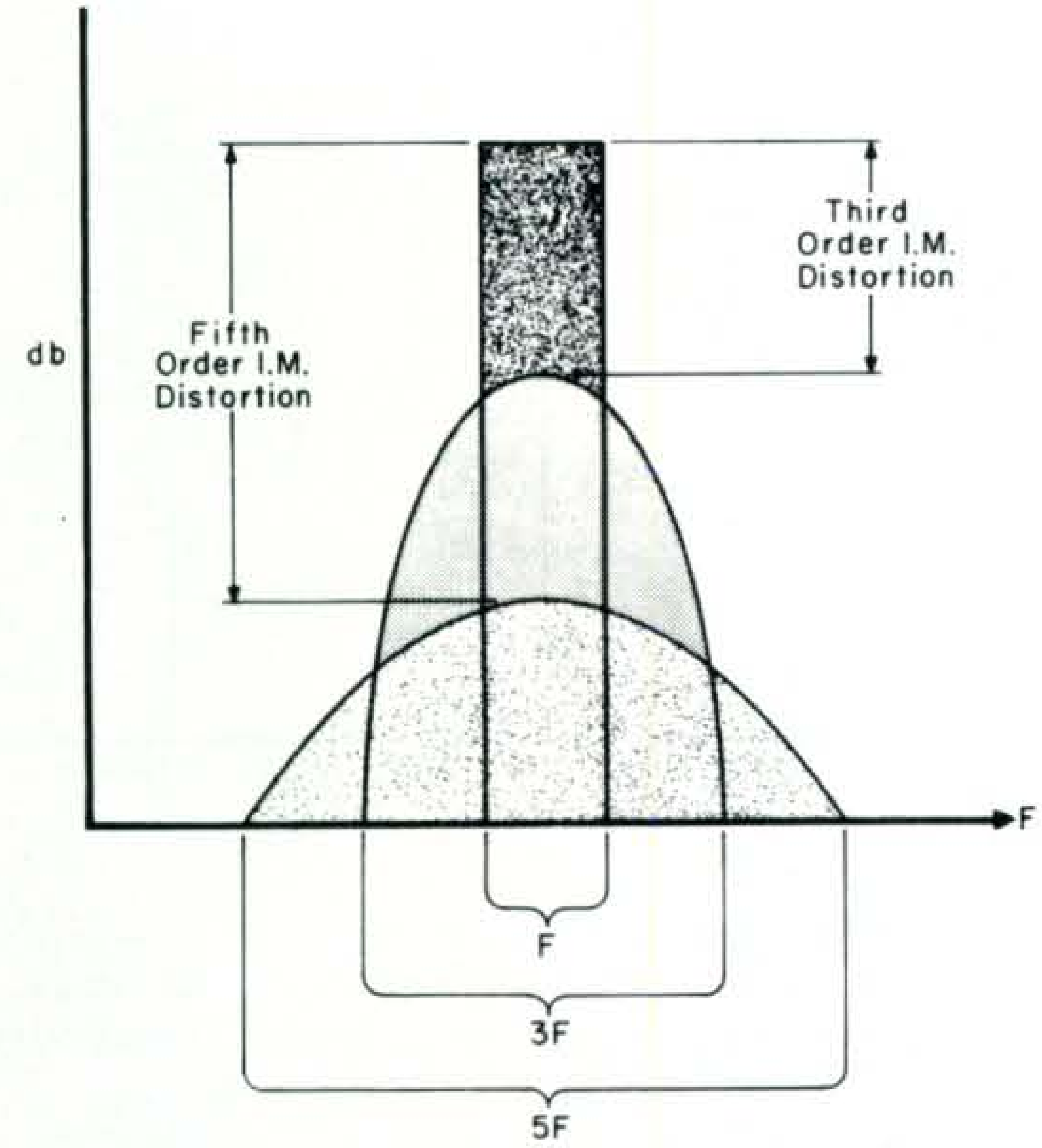

Fig. 4—Using audio bandpass limited noise signal at input, output frequency display is as shown.

Measurement of I.M.D.

In order to measure distortion signals one has to, in a sense, first create them. The standard two-tone test procedure has probably become the most accepted way to perform the measurement. One test tone is not usable since i.m.d. signals will not be created and the use of more than two tones makes for the creation of so many spurious signals that measurement of individual frequencies becomes very difficult. Any two equal amplitude test tones can be used but some frequency relationships will produce harmonics that may obscure i.m.d. signals. Therefore, two tones are usually used that have a 3 to 5 frequency ratio (1500 to 2250 c.p.s., for example). The resulting i.m.d. products are all odd order, as shown in Fig. 2. The first spurious tone, on either side of the two original tones, is the 3rd order product and is equal to twice the frequency of one tone, minus the frequency of the other tone. The next signals are the 5th order products and are equal to three times the frequency of one tone minus twice the frequency of the other tone. Generally only the 3rd and 5th order products are of interest and significance.

Figure 3 shows a test setup for measuring i.m.d. when a spectrum analyzer or receiver pandoramic adapter is available. Since the analyzer and receiver or panoramic adapter can themselves produce i.m.d. on their input signals, it is necessary to know their approximately i.m.d. level. Generally, it will be low, particularly for analyzers. However, some allowance should still be made. If the analyzer or adapter has an i.m.d. of −45 db, measurements of i.m.d. around the −40 db level can be expected to be in error by about 2 db. It is also important that there be no intercoupling between the two oscillators that produce the two-tone test signal and that each tone be of low harmonic content. An oscilloscope check should be made of the output waveform to ascertain this.

When viewing the oscilloscope display on an analyzer or panoramic adapter, other spurious displays besides i.m.d. may be seen on either side of the carrier frequency due to incidental modulation (power supply ripple, mechanical vibration, *etc.*). Since the input frequencies are known, one can calculate where to expect the i.m.d. products to appear. Also the individual audio tones can be individually switched on and off to identify their distortion products. Of course, if other spurious displays obscure the i.m.d. frequencies it may well be that other difficulties deserve attention first.

The value of the 3rd and 5th order products below the two tone level can be read directly from a calibrated display. The selectivity, sweep width and sweep speed on the display unit are varied to obtain the best pattern. One should check that different sweep speeds do not change the signal amplitude relationships. Also, the input signal should be varied to be sure that the signal relationships do not vary because of overloading the display unit.

Receiver Method

If one does not have a panoramic display unit but a well calibrated and sharply selective receiver, it can be used to tune to each of the frequencies as would be displayed on a spectrum view. The selectivity must be sharp enough to separate individual frequencies down to at least the −40 to −60 db level on the i.f. response. If the receiver "S" meter is used to measure relative single frequency strengths, its calibration must be known. Also, the measurements should be made at different input levels to preclude overload and comparative signal amplitude ratio distortion.

Another receiver method would be to use audio selectivity on the output of the receiver rather than i.f. selectivity to separate individual input frequencies. With a two-tone generator of specific frequencies, one could build audio filters to just pass the 3rd order

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i.m.d. products and, therefore, have an easy means with a receiver to check how adjustments affect i.m.d. The precautions concerning receiver overload must, of course, still be observed and the receiver operated without a.v.c. action.

Noise Measurement Method

Still another, but less frequently used, i.m.d. measurement technique tries to stimulate actual voice frequency input conditions. Instead of a two-tone test signal, a noise generator is fed through a bandpass filter (with a flat response within the voice frequency band and with sharp attenuation outside this band) and into the transmitter input. A receiver is used as a measurement device and uses three filters of identical characteristics. One filter passes only the transmitter audio bandwidth and the others pass frequencies outside the audio bandwith. The transmitter audio bandwidth filter output is used as a reference and the other filter outputs indicate the 3rd and 5th order i.m.d. levels. This method works because the noise input produces an output spectrum as shown in fig. 4. All the 3rd order distortion products will appear in a bandwidth equal to three times the transmitted noise bandwidth, 5th order products in a bandwidth equal to 5 times the noise bandwidth, etc.

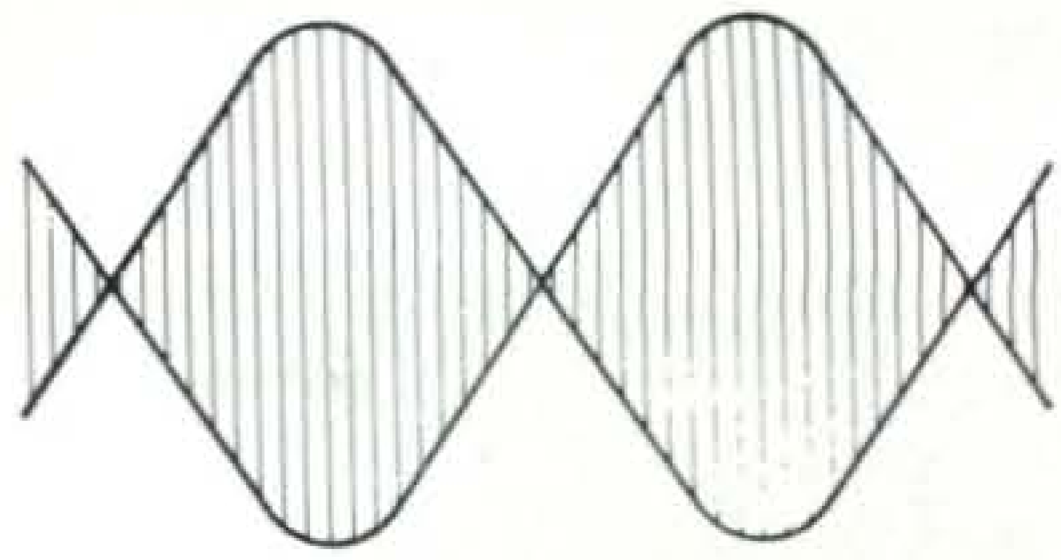

Fig. 5—Conventional twotone signal input oscilloscope display to check linearity is useful for adjustment but provides no measure of degree of nonlinearity.

Summary

It is seen that the foregoing tests, particularly the well-known two-tone test, are linearity checks. But, as was mentioned before, i.m.d. gives a quantitative measure of how linear an amplifier really is in operation. If a two-tone test is used to produce the normal oscilloscope test pattern of fig. 5, non-linearity can be noted in various ways but there is no way to express the *degree* of nonlinearity of to accurately compare different amplifiers.

Most amateurs will probably never make any i.m.d. measurements but understanding the term helps to better evaluate s.s.b. equipment. When someone next says that an amplifier is really "linear", why not ask him how linear? ■

R.S.G.B. "London Festival" Station, GB2LO

JULY 8-20, marks the dates of the 1968 City of London Festival. To help commemorate the event, the Radio Society of Great Britain will have a station (GB2LO) operating at the *Daily Mirror* Building, Holborn, London, E.C.1.

This location, within the 1.03 square miles of the City of London, is about 200 yards from the premises at 107 Hatton Garden, where some of the earliest meetings of the R.S.G.B. were held during the summer of 1913, when the group was called the London Wireless Club.

World-wide contacts are anticipated, especially one scheduled with VE3LON, the Exhibition Station callsign for the London (Ontario) "Fortnight Festival," whose theme is "The British Are Coming!"

GB2LO will be on view to the public and visitors are invited to visit.

(Tnx Sylvia Margolis)

The *Daily Mirror* Building where the R.S.G.B. station, GB2LO will be located. *(Daily Mirror photograph)*

GM3BST receives Nimbus weather satellite photo at his home in Stranraer, Scotland.

A bulletin board serves as plotting board for satellite passes.

GM3BST Rides Nimbu To US

Working with this home-brew Az-El-mounted antenna system, GM3BST regularly copies Nimbus signals.

In recognition of his state-of-the-art in receiving weather pictures from the built Nimbus weather satellite, a *CQ* au was recently treated to an 18-day tou Cape Kennedy, Washington, D.C., Los geles, San Francisco, Philadelphia and York. John B. Tuke, GM3BST of Stran Scotland, was the lucky fellow who, wit wife, was flown through the lightning courtesy of GE, and met with several Space Program officials in Washin D.C., as well as being commended sonally by Vice-President Hubert H. phrey on his achievements. Also high ing the six-city visit was his first- view of the launch of Nimbus B from denburg Air Force Base in Californ

Vice President Huber Humphrey congratu Mr. John B. Tuke of S raer, Scotland, for achievement of const ing a ground-monito station to receive wea photos transmitted Nimbus II. Looking or Mrs. Tuke and Mr. L. ley Davis, Vice-Presi and General Manage GE's Defense Prog Division. (Photos cou Dee Logan, GE).

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IMPROVED F.M. OPERATION

BY DAVID J. GOODMAN, *WA8UIT

Proper maintenance of two way f.m. equipment can improve the number of contacts in mobile operation.

Not everybody operating amateur f.m. is in the two-way radio business. (It just seems that way!) It's well known that those who do work with mobile radio as a part of their job usually have enough knowledge of commercial two-way equipment to assure that their amateur f.m. gear is in proper working order. But, what about those of us who never got closer to f.m. mobile equipment than the back seat of a taxi, until deciding to go amateur f.m.?

The truth is that f.m. two-way equipment is pretty strange to a lot of fellows; even those who have been active hams for years. The f.m. transmitters are generally easily understood, and being a comparatively simple device, they give the average ham little trouble. He can easily tell if he is getting the proper output, he can tune the transmitter, and in general, he knows what to do to make it work properly.

The Receiver

Unfortunately, the f.m. receiver is another story. Comparatively few amateurs have ever had much experience in critical receiver alignment, since no other popular amateur operating mode requires the ham to understand his receiver and to have to fiddle as intimately with its total alignment as does f.m.

The result of this situation is a transmiter that works, a receiver that doesn't and an apologizing operator. Time after time, the writer, along with other local stations, has responded to mobiles who were on their way through town, asking for a contact. Enough r.f. is heaped upon these fellows to cook a turkey, but alas, comes back the typical reply, "Sorry, Old Man, can't get your call there. We'll have to make it another time. Don't think this receiver is working quite right."

The answer to this situation is not difficult, if we consider how the receiver got sick in the first place. Most f.m. gear being operated by hams today is obsolete commercially manufactured equipment that is between 10 and 20 years old. If it's mobile equipment, the chances are good that it has been in and out of perhaps as many as 15 different vehicles and has been worked on by scores of different people. It may have come directly out of service to the ham, or it might have been obtained from another ham who used it himself. In any case, since its ancestry and health history are unknown, the safest approach is pure skepticism. "The equipment is presumed to be in as bad a condition as possible until proved otherwise," should be your motto. There is no reason to assume that those who worked on your unit left it in good order, even if it came right from commercial service, so you can be skeptical in that case, too.

We are going to discuss some of the steps to be taken to insure that a receiver is doing the job that it should be. The references are based on experiences with equipment for 2 meters f.m., but the techniques are directly applicable to 6 meter gear, as well.

Tubes

It's commonly known that close to 99% of the trouble in tube-type electronic equipment is the result of tube faults. The typical high band receiver has about 16 tubes, so it is mandatory to make sure that all the tubes are in satisfactory condition. This should be done

* 3305 DeSota Avenue, Cleveland Heights, Ohio 44118.

before ever applying power for the first time. Test every tube in a dynamic mutual conductance tube tester. Test carefully for intermittent shorts and observe the emission level. Be critical. If a tube is marginal, shows a partial or solid short, or its emission falls off, throw it away. You might end up needing six or eight new tubes. If this shocks you, remember that our objective is *a receiver that works properly*. If you are going to replace tubes with spares from your junk box, test the spares, too. Be sure that all the tube types agree with the labels on the chassis for each socket. If a late-number tube has been substituted for the original, check to see that it is a compatable substitution.

The Relay

One thing that we are going to suspect right off the bat and are not even going to give a chance to prove its innocence is that nefarious malperformer, the antenna relay. This ghastly mechanical contrivance, ridiculously simple though it be, is subject to continuous use and because it carries respectable current and voltage, it arcs, pits, attracts dirt, gets tired physically, *etc*. Because it exists under these conditions, it very often ends up doing a pretty poor job of conducting r.f. in and out of your set, by the time you become owner. Receiving losses of up to 20 db, for example, due solely to antenna relay trouble, are not at all unusual. To insure yourself against having later trouble with the relay, burnish the contacts carefully with a relay burnishing tool. If you don't have a tool, use white bond paper strips. Insert the paper between each contact and the transfer leaf, compress the leaf gently and work the paper in and out until no residue is visible when using a clean paper. Check the relay for correct overtravel in both the operated and unoperated positions. If necessary, adjust. Do this same cleaning and inspection job on the transmit-receive relay, as well. This relay contains the receiver B plus continuity contacts and often contributes to low B plus as a result of poor conductivity in these contacts. (In some sets, the antenna and power switching is combined on one relay).

Tuning And Alignment

Next, we must make sure that the receiver front end will really tune into the ham band. In the case of high band equipment, many receivers will not tune down from their intended 150 mc range to 146 mc without modification. But the unsuspecting ham, observing what he thinks is a peak when adjusting the stages of the receiver which operate at channel frequency, is, in reality, seeing the drop-off as the slug passes out of the coil, *without ever reaching resonance*. This probably accounts for more sick receivers on 2 meters f.m. than any other single cause. A grid-dip meter check of each tuned circuit that operates at channel frequency will resolve your doubts on this issue. It's usually a simple matter to add 2 mmf or so of capacity across a coil externally, where needed, to bring the can down onto the ham band.

Precise alignment of the receiver is paramount for correct operation, and it is the next step. Correct alignment of commercial f.m. two-way receivers can be bothersome without having the benefit of proper test equipment, but it is possible. In receivers having a fixed low i.f. filter, the discriminator and the i.f. chain must be tuned with a precisely accurate signal source. The BC-221 frequency meter, loosely coupled just ahead of the stage being adjusted, will do this job quite well. The BC-221 is superior to most signal generators that the average ham may have at his disposal because of its accurate dial setting capabilities and its relative freedom from drift. The signal level can be kept below saturation by adjusting the coupling. The same procedure can also be used for alignment of the high i.f. and the front end of the receiver, even on 2 meters. A rough tuning of the front end may first have to be made with a local transmitter serving as the signal source, in order to get an ample amount of signal. After this has been done, there should be sufficient sensitivity in a healthy high band receiver to allow a harmonic from the BC-221 (set at around 14.6 mc) to quiet the receiver when applied at the antenna input. For a final alignment of the front end, the frequency setting of the BC-221 should be adjusted to match the discriminator reading of a signal from a transmitter known to be on-channel, and the front end stages repeaked.

Power Supply

If the receiver is to be used in a mobile installation, the power supply must be checked as the next step. Vibrators have disappointingly short lives, so we'll want to make sure that the one that came in the set can be trusted. A partial test of its condition may be made by simply checking the receiver

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B plus with the correct battery input voltage applied to the power supply. If the resultant B plus is less than 95% of the specified value, an investigation should be made to find the cause. Vibrator replacement is the starting point, followed by filter capacitors and then rectifiers, (if the vibrator is of the interrupter type).

Preamplifiers

Let's assume that your receiver has now passed all the tests and is as sensitive as the day it left the factory. Have you done everything you can to insure good reception? No; because the day your receiver left the factory was a long time ago, and a great deal of progress has been made in the-state-of-the-art since then. At the time your receiver was made (if it's high band) the classic first r.f. amplifier tube was the 6AK5. It's a reliable tube, but it suffers from having a high noise figure. That is, because of certain structural considerations, it continuously generates noise internally. So, while it is amplifying an incoming signal, it is also amplifying its internal noise. If the incoming signal is greater than the 6AK5's internal noise, it will be amplified and detected. But, if the tube's internal noise level is greater than the signal, the noise will mask the signal and you'll never know it was there. A 6AK5 has a noise figure of about 10.5 db, at 144 mc.

In the 1950's, the introduction of the Nuvisitor was a big step in the development of low noise v.h.f. amplifiers. Nominal noise figures for Nuvistors are on the order of 2.5 db. But the last five years have really seen a breakthrough in v.h.f. amplifiers with the availability of a host of inexpensive bipolar and field effect transistors (f.e.t.'s) having noise figures of around 1.5 db at 144 mc.

A look at fig. 1 will help to understand the relationship between the noise figure of the first r.f. amplifier in a receiver, and it's sensitivity. In the pictured example, there is a given signal with strength greater than the internal noise level of an f.e.t., but below that of the noise levels of both a Nuvistor and a 6AK5. In this case, we can expect the signal to be amplified and detected if the f.e.t. is serving as our first amplifier device, but it will never be heard if a Nuvistor or a 6AK5 is used. From this, it is easy to see the vast improvement in weak signal detection that can be obtained by substituting a low noise figure f.e.t. for a 6AK5 first r.f. amplifier.

The easiest way to make this substitution

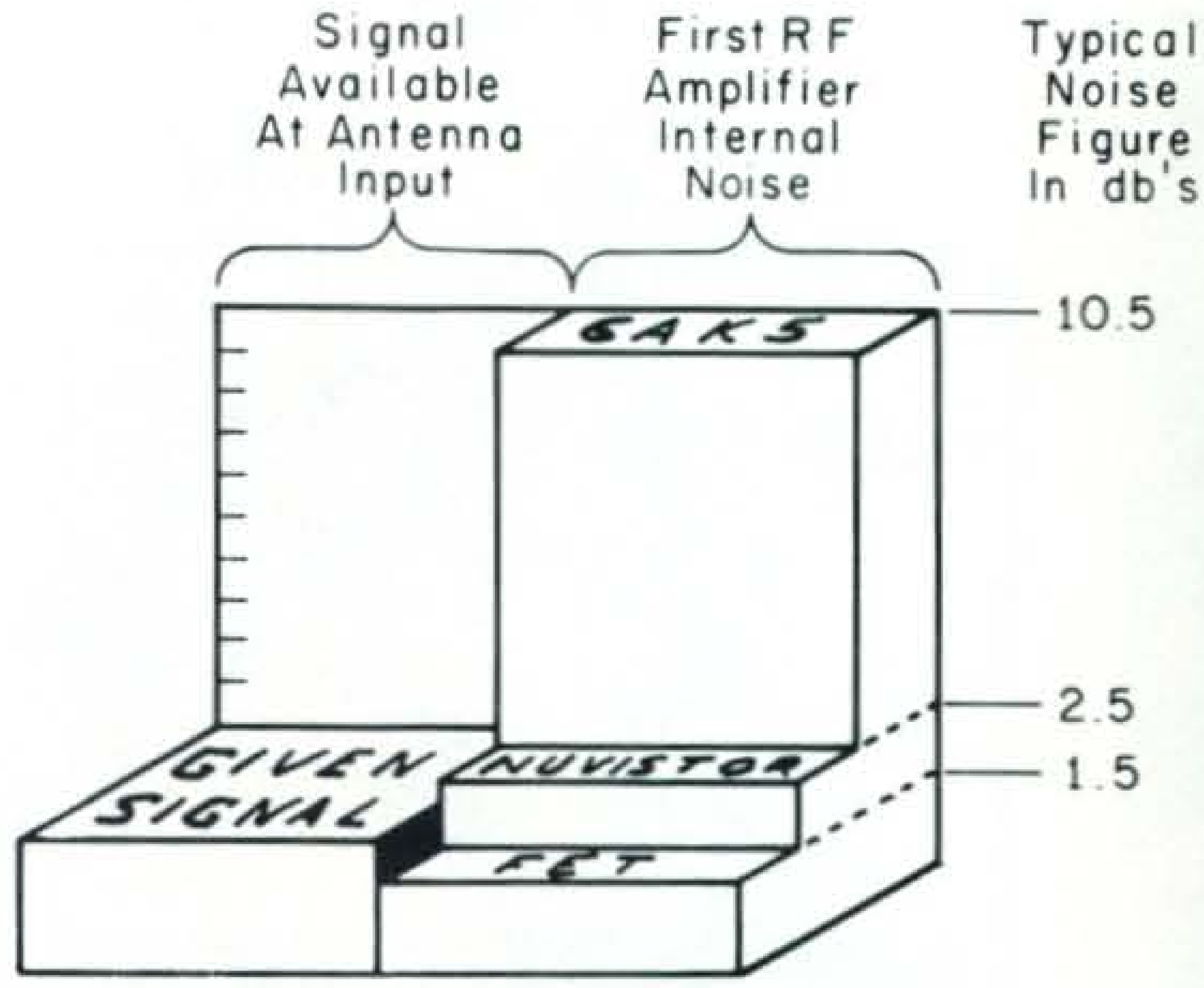

Fig. 1—Relationship between the noise figure, receiver sensitivity and the various r.f. amplifiers discussed in the text.

is to add an f.e.t. preamplifier between the antenna relay of your set and the antenna input jack on the receiver. The current literature is filled with simple f.e.t. preamp circuits for 144 mc that you can easily build. Usually, a single transistor is all that is needed, as only enough gain to overcome the noise of the original first r.f. amplifier tube (most likely a 6AK5) is required; 15 to 18 db ought to do it. If you are not a builder, such a preamp can be purchased, ready to go, for around $12.00.

Antenna Feedlines

While of interest mainly to the operators of fixed stations, perhaps a word should be said about antenna feedline, as it affects the reception of signals. For the benefit of those v.h.f.-f.m. newcomers who are refugees from the "low bands" (and there are more of these converts every day) it should be pointed out that feedline considerations that could be treated casually below 10 meters become absolutely critical at 146 mc. The two most important of these factors are directly related; attenuation and length.

The two types of 50 ohm coax that are best known to the ham are RG-8/U and RG-58/U. The published attenuation figures show that RG-8/U has a loss of 2.1 db per 100 feet at 100 mc, while RG-58/U has a loss of 4.2 db under the same conditions. A lot of operators give these figures little attention and, because they have a length of RG-58/U around, or because it's cheaper, they use, say, 100 feet of it in their 2 meter feedline. Doing so means a loss equal to more than ½ the power. Even this fact doesn't

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BY JOSEPH TARTAS, *W2YKT

SOLID STATE COUPLING METHODS

The whys and wherefore of coupling circuits in solid state i.f. amplifier design.

ABOUT seven years ago, I made a prediction in some material I was writing about TV servicing, that, "Undoubtedly transistors will eventually replace tubes in all of the TV circuits but the c.r.t. itself." Not only has this prediction come true, but at some future date, this may well be remembered, not as the Space Age, but as the *Semiconductor Age*. Each new development in the transistor line presents a different problem to the circuit designer; the bi-polar transistor, the f.e.t. and the i.c.

As the usable frequency spirals upwards, the input and output circuits must be altered to compensate for different input and output impedances. Input, output and feedback capacitances (by whatever the name) and methods of coupling to achieve the desired gain and bandpass characteristics also change.

Comparison To Vacuum Tube I.F. Circuits

The transistor has been considered as essentially a current amplifier. As an i.f. amplifier, however, its sole purpose is to provide a sufficiently high *voltage* level at the detector input. It may be regarded, except for the considerations to follow, to be similar to vacuum tube voltage amplifier circuits.

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Tubes have relatively high input *and* output impedances. Bi-polar transistors, in the more useful configurations, have *high output* impedances (although considerably lower than that of tubes) but, unfortunately, have quite low input impedances. F.e.t.'s on the other hand, have semiconductor characteristics, but with impedances higher even than vacuum tubes.

Because the transistor is basically a power amplifier, the maximum transfer of power occurs when the coupling network is matched, both to the output of one stage and input of the next stage. In addition to impedance matching, the resonant frequency of any tuned circuit connected to the transistor must be considered. The output capacity of most transistors is low, but the input capacity is often higher than those of tubes, as much as 30 mmf in some types. These capacities must be considered since they are part of the total tuning capacity across the coils in i.f. amplifiers.

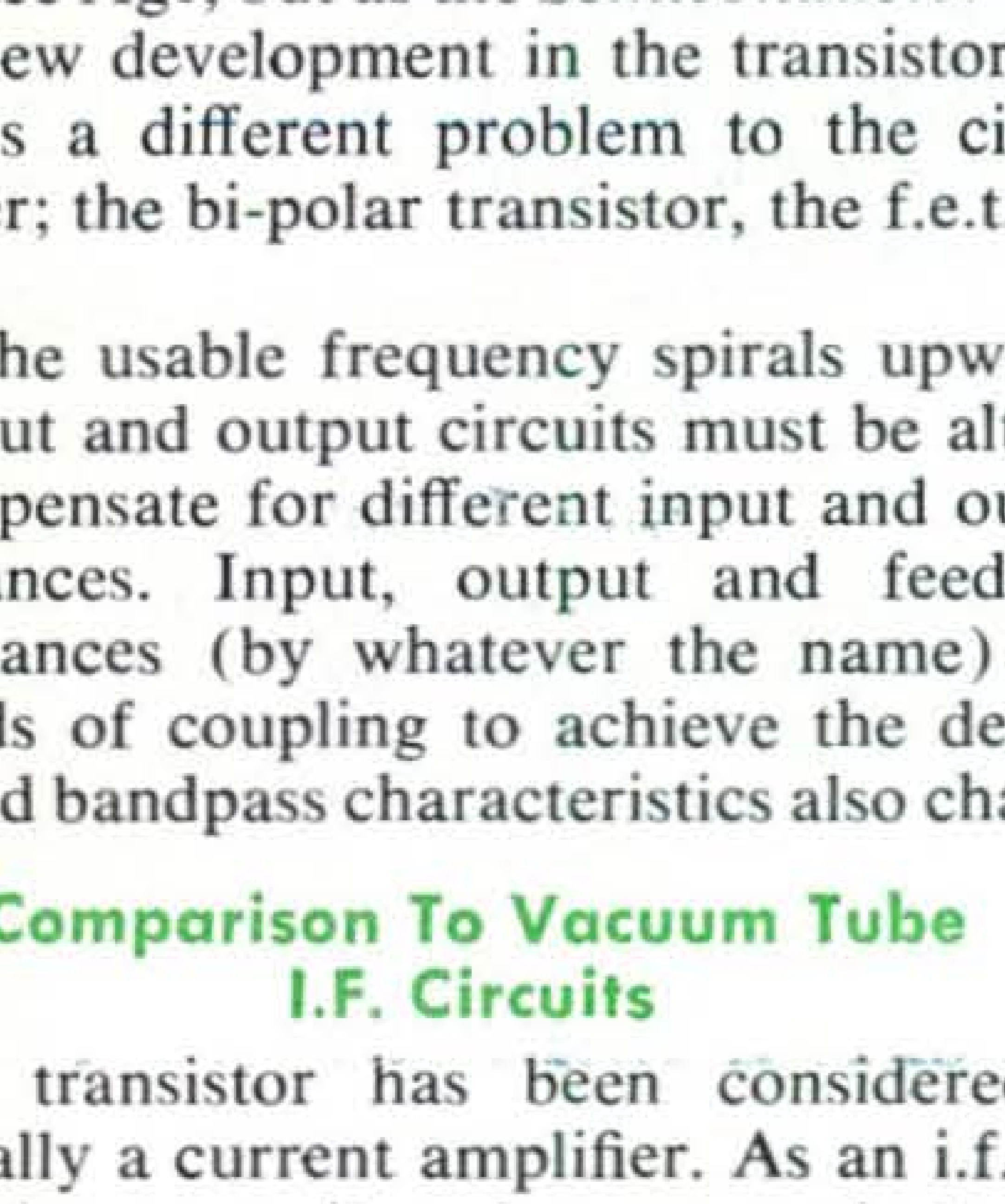

Fig. 1—Basing diagrams of most transistors are alike except for the ground lead or the extra base connection in the tetrode.

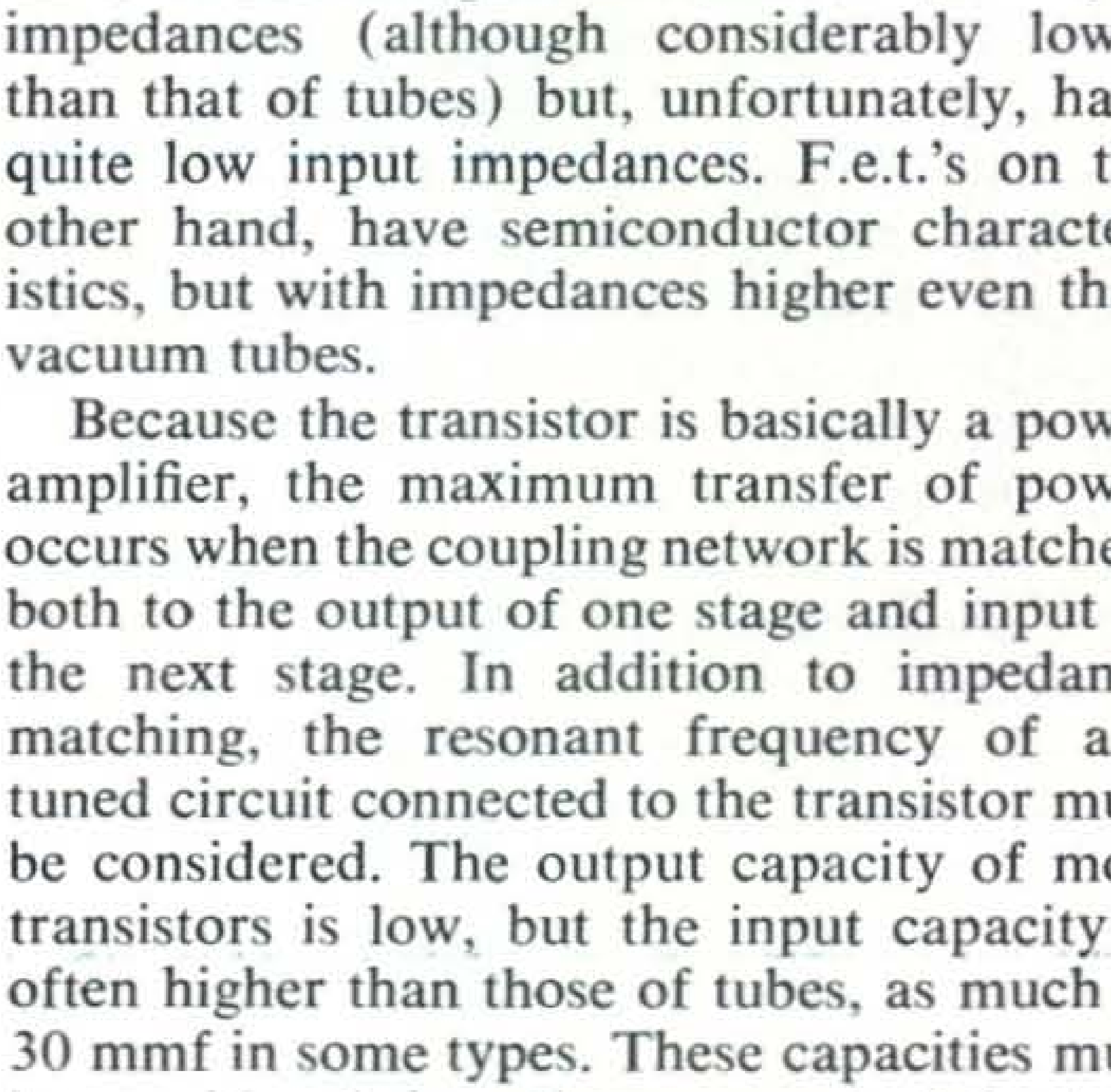

Fig. 2—Output circuit of a transistor i.f. stage. The output capacity is identified as C_o.

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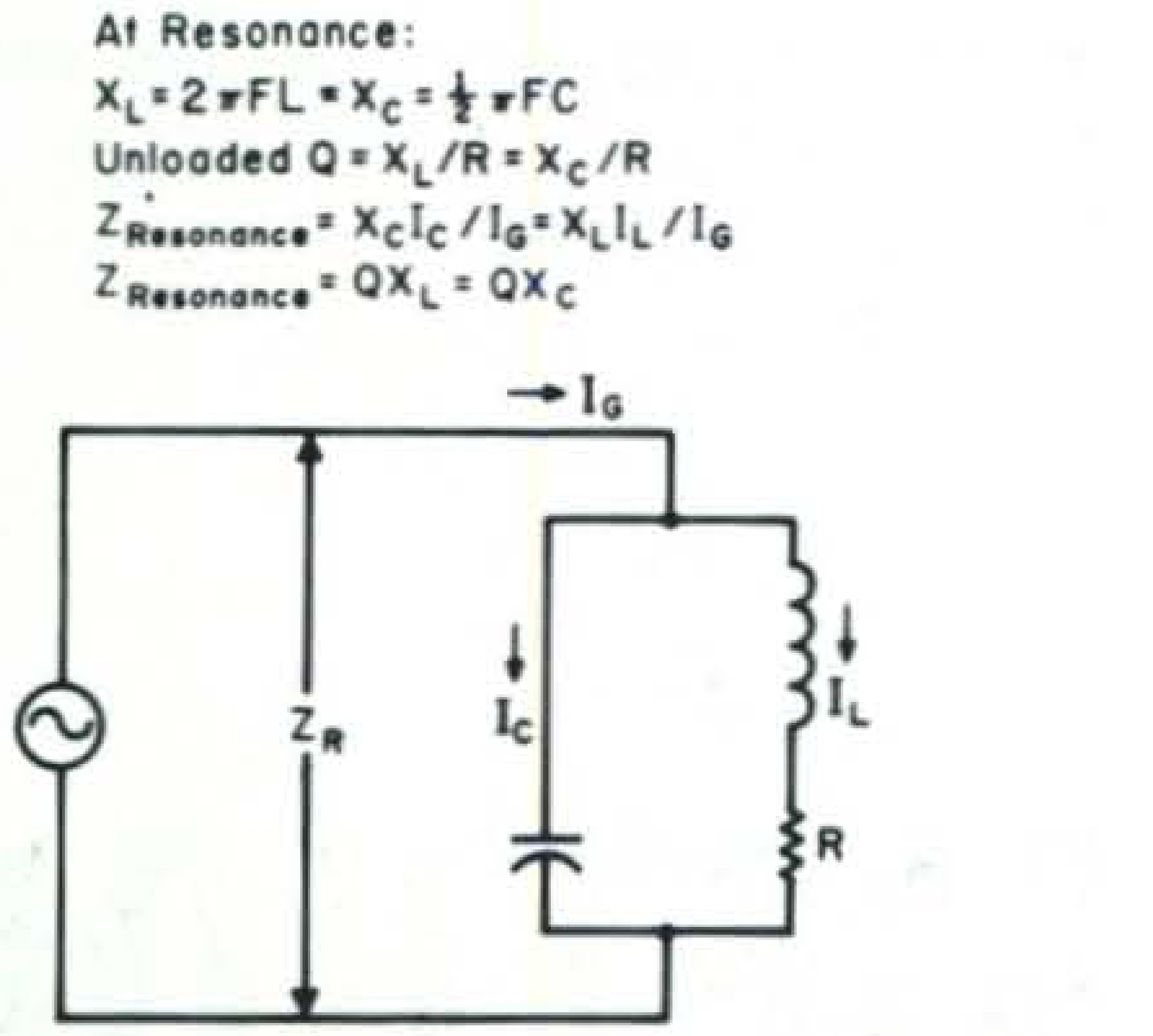

Fig. 3—A parallel tuned circuit and its various current, voltage and impedance relationships.

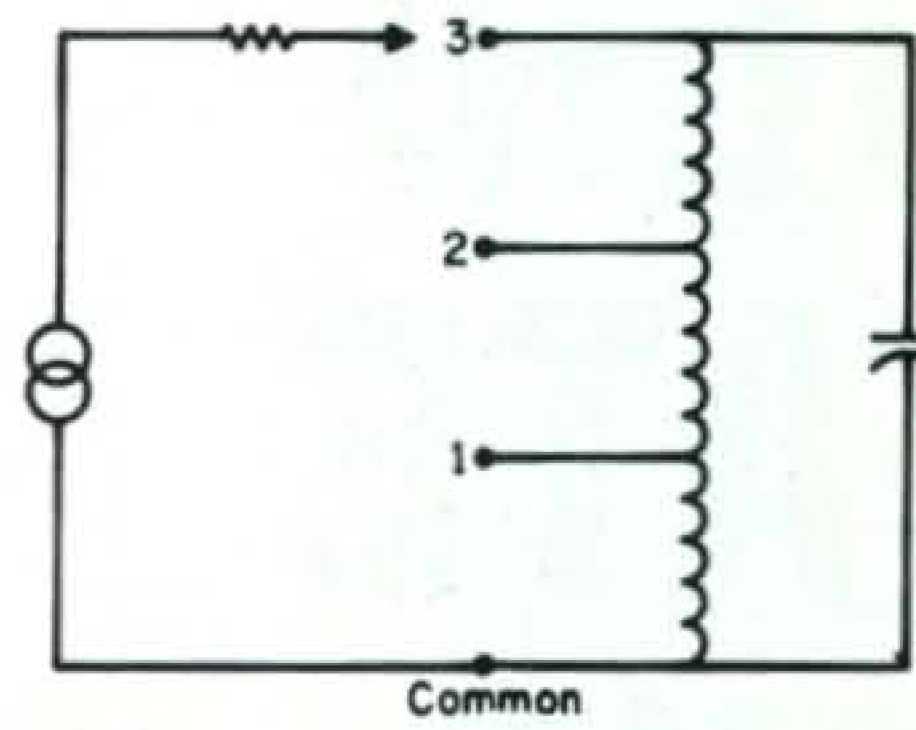

Fig. 4—Impedance matching by means of a tapped inductor. The tap impedance $= Z_R((N_T/N)^2$ where N_T is the number of turns from common and N is the total turns.

Of the three possible circuit configurations, common-base, common-emitter, and common-collector, the common-emitter circuit is almost exclusively used for i.f. circuitry. It is the common emitter circuit that produces a high voltage gain as well as the greatest power gain of the three configurations. Another advantage in using the common emitter circuit is the possibility of isolation due to the physical layout of the transistor terminals. Reference to fig. 1 shows that a shield partition may be used to completely isolate the input circuit consisting of the base circuit (which is also the collector or output circuit if another stage precedes it) and the emitter circuit, from the output, or collector circuit. In tetrode transistors the additional lead does not prevent use of the shield, but also provides a separate element for a.g.c. control that is completely isolated from the active r.f. circuit elements.

Until recently, the collector of a triode transistor was tied to the case and presented a problem in shielding. Now, many r.f./i.f. types have the case isolated from the transistor elements and it can be grounded through a fourth lead connected to the case.

Output Circuits

The output impedance of the transistor in an *L-C* tuned amplifier is sufficiently high that the tuned circuit could be represented as in fig. 2, and is essentially the same configuration as for a vacuum-tube circuit. The value of *R* would be higher than the impedance of the *L-C* circuit or omitted, depending upon the desired loading, the loading effect of the collector, and the means by which it is coupled to the following base.

Input Circuits

In order that the low impedance input of the transistor does not excessively load the tuned circuits thereby reducing the gain, some means of impedance matching must be resorted to.

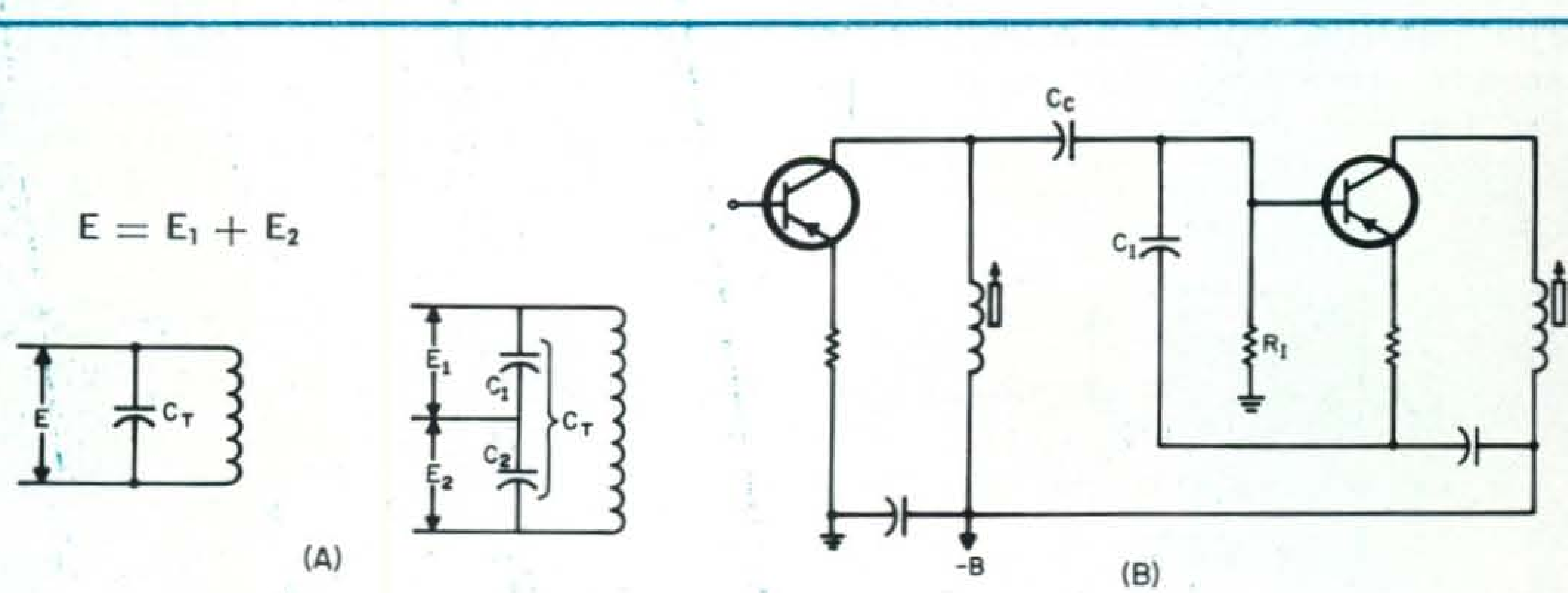

Fig. 5—(A) Impedance matching by means of a capacitive divider. (B) Typical circuit uses the coupling capacitor. C_c and the input capacity C_1 to form the impedance divider.

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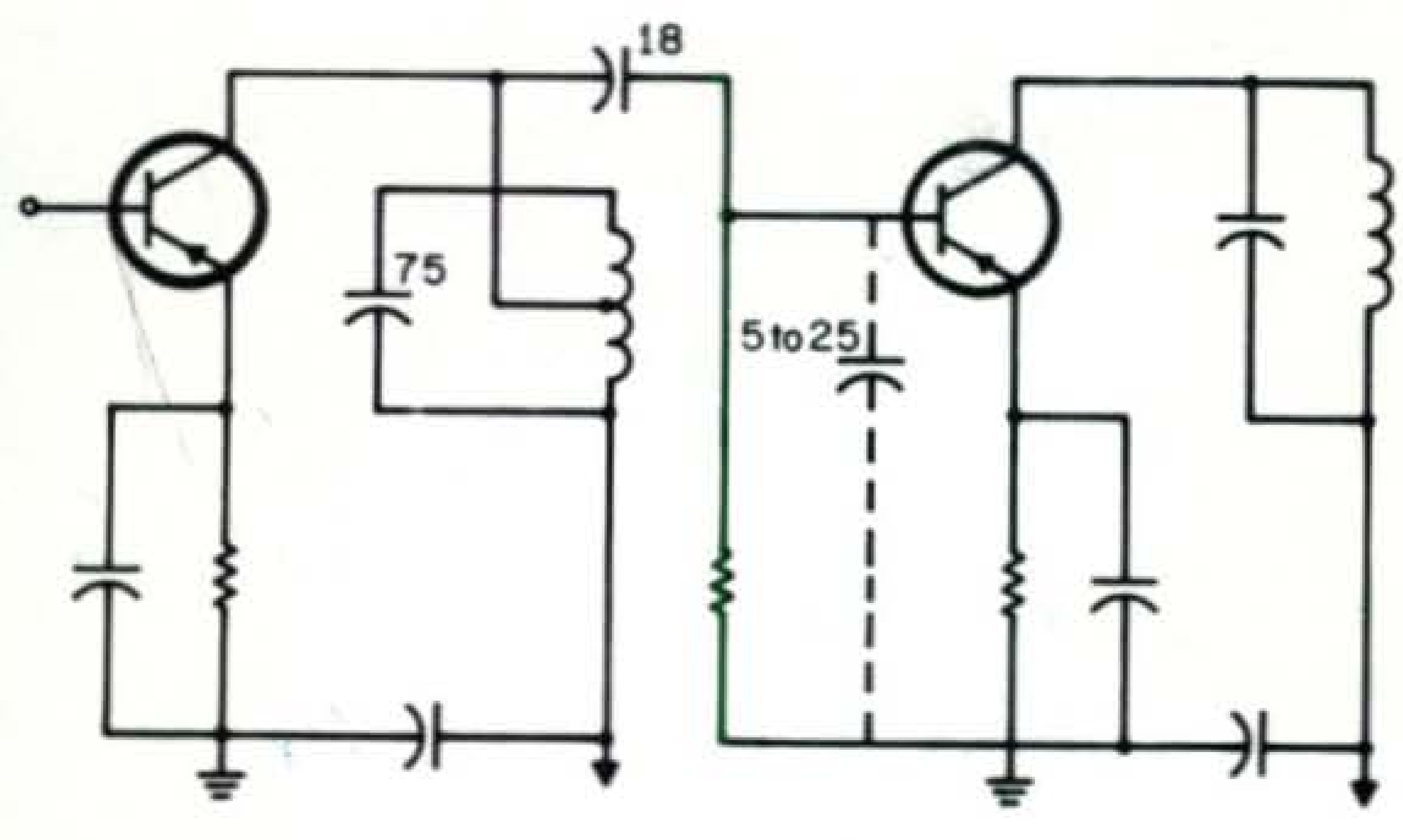


Fig. 6—Typical capacitor divider circuit and values.

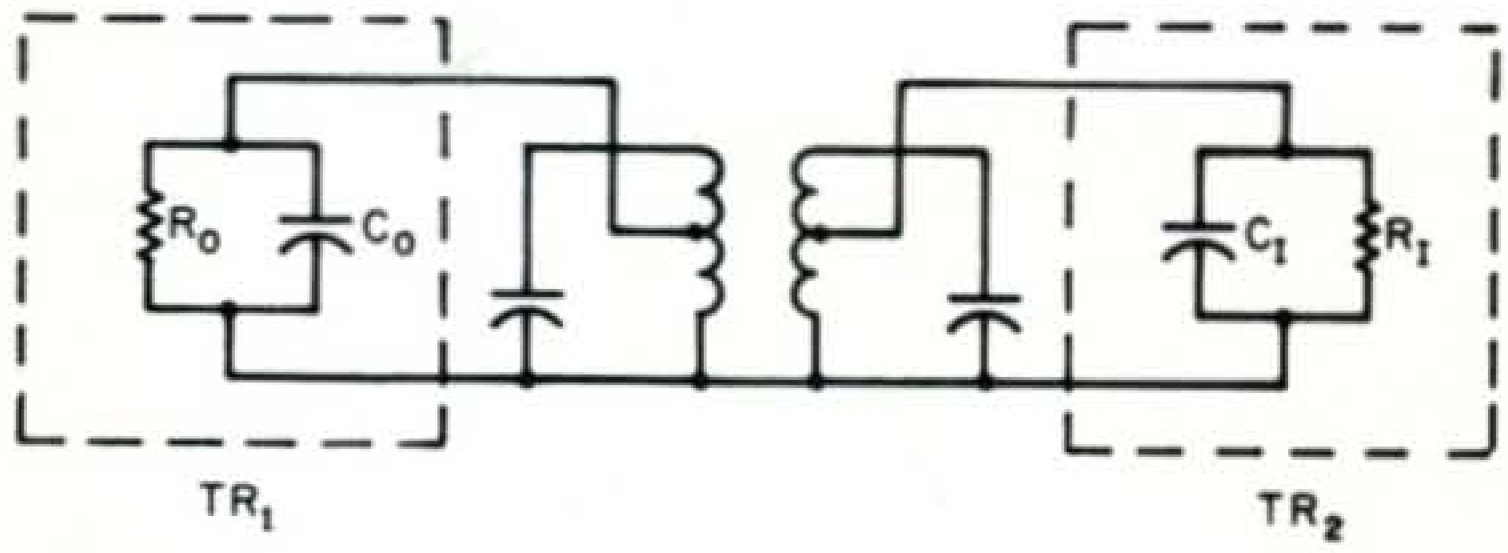


Fig. 7—Equivalent circuit of input and output matching with a tuned pair. The coupling between the two coils is discussed in the text.

There are three ways in which the proper match may be achieved. To better understand these methods, consider the various relations of the parallel tuned resonant circuit shown in fig. 3.

At resonance, the inductive and capacitive reactances are equal and the resonant impedance, Z_r, is the product of the coil Q (determining the bandwidth) and the reactance of *either* element since they are equal at resonance. The Q is the ratio of the tank current (I_L or I_c) to the total current from the generator. Since the current I divides, the ratio of the currents in each branch depends upon the ratios of reactances and resistance present in the tank circuit. If the generator is considered to have a very high impedance, then the signal may be injected between the common terminal and terminal 1, 2, or 3 in fig. 4, without affecting the resonant frequency, unloaded Q, or resonant impedance of the tuned circuit, since $Z_T = Z_1Z_2/Z_1 + Z_2$ as in parallel resistance.

Since the inductance of a coil varies as the square of the number of turns, the inductance, and hence the reactance and impedance at points 1, 2, and 3, will be one ninth, four ninths, and the total impedance respectively. Other arrangements are equally possible, *i.e.* a center tap gives one fourth the total impedance, *etc.*

The tuning capacity (where used) may be employed in a similar way to divide the total impedance, as shown in fig. 5(A). If the resultant capacity is the tuning capacity, the r.f. voltage across the tuned circuit is divided in the ratio of capacitive reactances, or the inverse of the capacity ratios, since:

$IX_{c1}/IX_{c2} = E_1/E_2$;

$$X_{c2}/X_{c1} = \frac{1}{2\pi f_{C1}} \bigg/ \frac{1}{2\pi f_{C2}} = C_2/C_1.$$

Stagger tuned i.f.'s, as found in TV circuits use the tube capacity (plus strays) as the only resonating capacity. In transistor circuits the input capacity is often much higher, but as seen in fig. 5(B), this capacity may be used as part of the impedance divider. If this capacity is too small, additional capacity may be used across the input, or the coupling capacitor that forms the other part of the divider may be made sufficiently small to give the proper division. When the tuning capacity consists mostly of a large fixed capacitor across the coil, this divider has little effect on the tuning if a small coupling value is used. See fig. 6 for typical values.

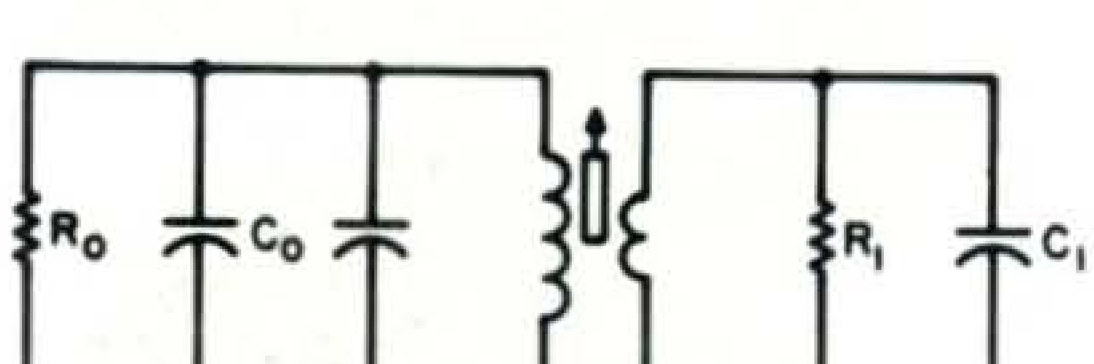
Double-Tuned Circuits

Basically, the tuning and coupling of tuned pairs are accomplished the same way as for tube circuits. The only difference in their application to transistor circuitry is in the means of loading.

Fig. 7 shows the way in which a transistor with output impedance R_o and capacitance C_o is connected by means of a tap to the primary. The secondary is connected to another transistor stage with equivalent parallel input resistance R_i and capacitance C_i. The to the fairly high value of R_o. The secondary primary tap is usually at or near the top, due tap will normally be placed well below the middle of the coil to provide the desired amount of loading, since R_i is low, compared to R_o. The coupling may consist of either capacity or mutual inductance.

Single-Tuned Transformer Coupling

An alternate method of matching a single tuned circuit to the input impedance of an-



$$\frac{N_P}{N_S} = \sqrt{\frac{Z_P}{Z_S}}$$

Fig. 8—Transformers with untuned secondaries are often used for impedance matching. The formula governing the relationship between the primary and secondary impedances is shown above.

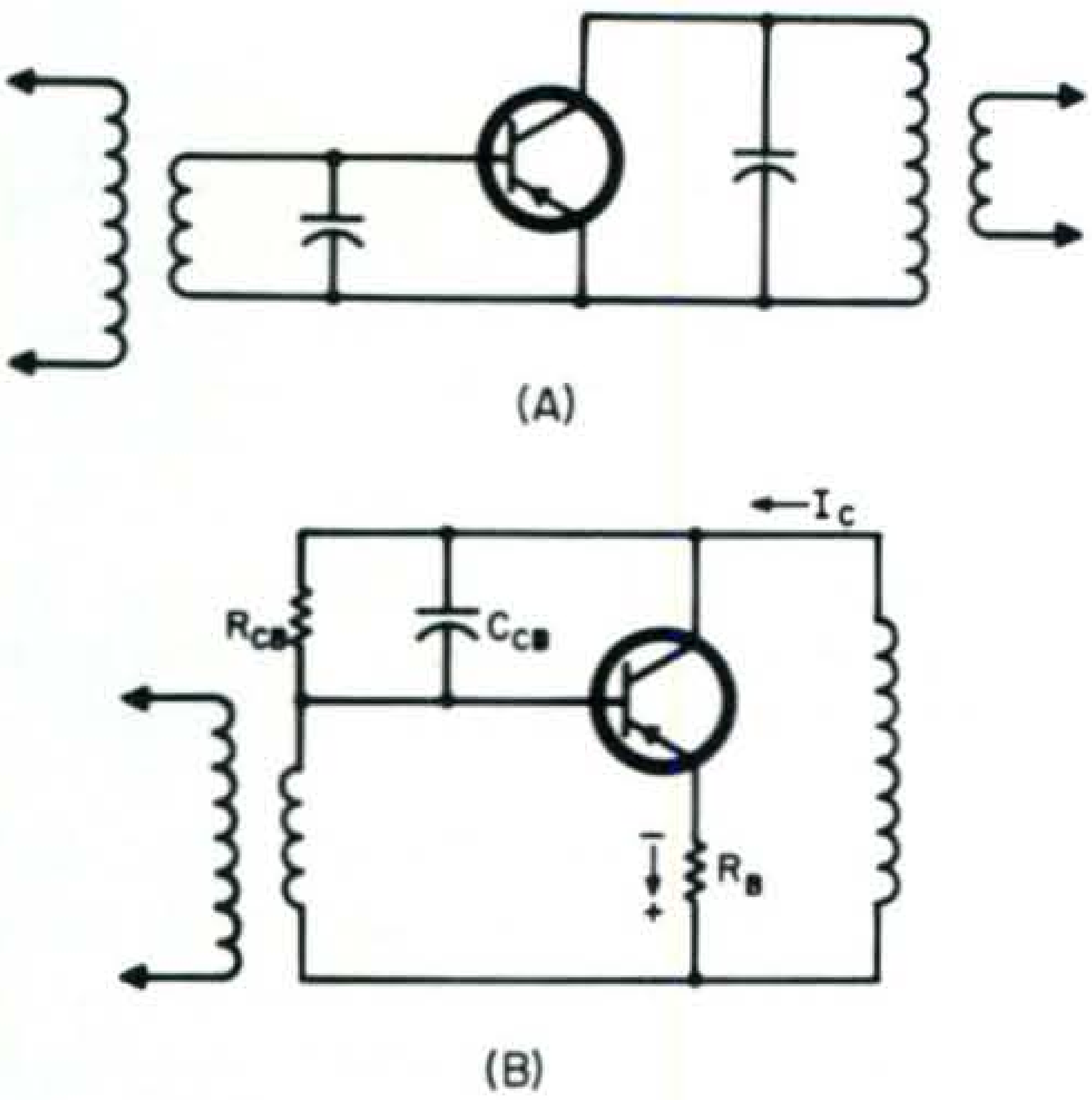


Fig. 9(A)—Simplified common emitter amplifier. (B) Common emitter equivalent high frequency circuit showing the elements that produce feedback.

other transistor is by means of transformer coupling where the secondary and primary are tightly coupled but has a step down ratio. The step down ratio of the transformer should be equal to the square root of the ratio of output to input impedance of the transistors. This, in turn, gives the number of turns for the secondary, if the number of primary turns is already known. In this case the secondary is untuned, as shown in fig. 8.

Neutralization or Unilaterialization

Unlike the vacuum tube, the transistor is not a unilateral device, *i.e.* current can flow in both directions, even though small. Because it can do this, the output voltage variations cause variations at the input of the same transistor. The result is a feedback voltage that is, unfortunately, in phase and therefore *regenerative*. If this feedback voltage is large enough, the amplifier goes into oscillation. Just as in tube amplifiers, the feedback is large at higher frequencies, and if the frequency is low enough, the feedback voltage

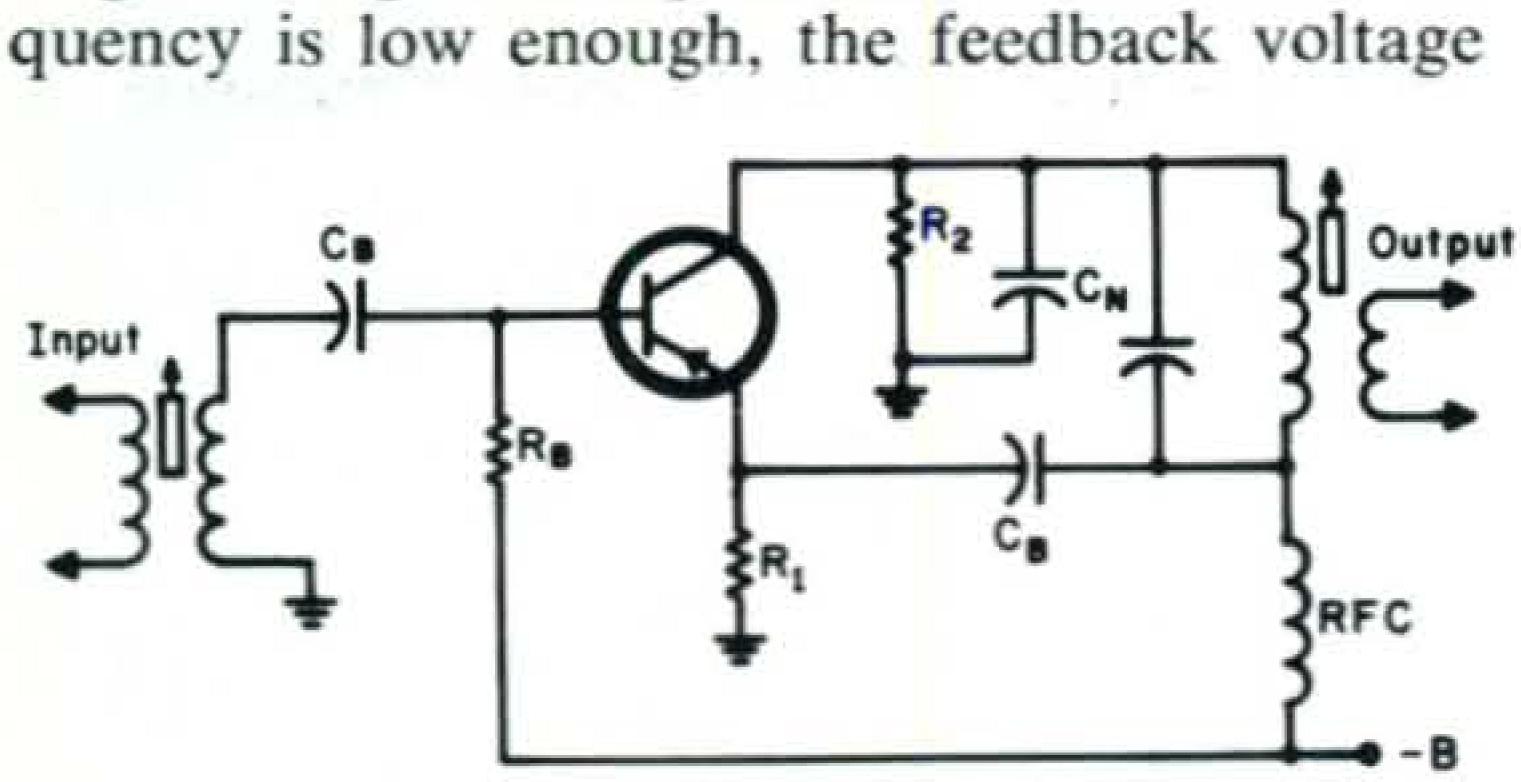


Fig. 10—Typical i.f. amplifier stage unilateralized by partial emitter degeneration. Components R_1, R_2 and C_N form the unilateralizing network.

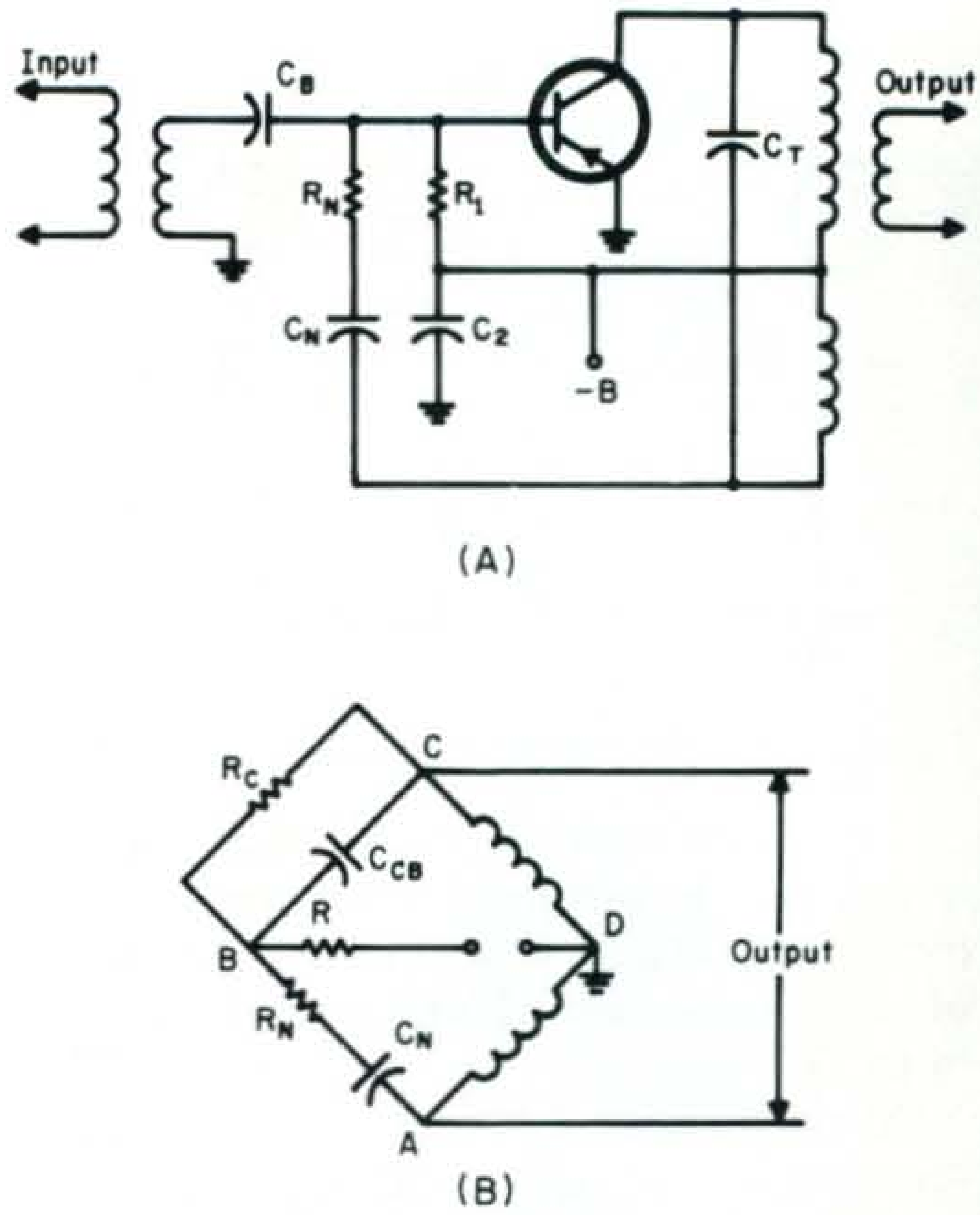


Fig. 11—(A) Bridge unilateralization and its equivalent circuit shown in (B).

is too small to be of consequence. The equivalent feedback circuit of the common emitter circuit of fig. 9(A) is shown in fig. 9(B).

The capacity of the base-collector junction, C_{BC}, is small and of little consequence at low frequencies. The resistor it shunts, R_{CB}, is very high and is of little consequence under normal operation when reverse bias is applied to the base-collector junction. As the frequency increases, the capacitive reactance decreases, until such a frequency is reached where the impedance becomes lower than the value of R_{CB} and feedback occurs. The base spreading resistance R_B, produces a positive feedback voltage due to the collector current passing through C_{BC}.

Since we are interested in the use of these circuits at reasonably high frequencies some means must be used to prevent the occurrence of regeneration and oscillation. This method is known as *unilateralization* when *all* the input changes due to feedback, *both resistive and reactive* are cancelled. If only the reactive changes are cancelled, they are said to be *neutralized*.

To those readers who are familiar with transmitter circuitry, the methods used for unilateralization and neutralization will be familiar. For reasons previously given, the common-emitter amplifier only will be discussed, although the following methods will apply equally to the common-base amplifier.

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FSK WITH VOLTAGE VARIABLE CAPACITORS

BY GEORGE R. ALLEN, *K1EUJ

A VARIABLE frequency oscillator can be adapted to frequency shift keying by mounting a small high speed relay in the v.f.o. circuit or by using one of the popular forms of the diode keyer. These circuits work well and are frequently used; however, in most cases shift adjustment must be accomplished by adjusting a small capacitor soldered directly into the v.f.o. circuit. This means that to adjust the shift of the radioteletype signal, this capacitor must be physically accessible. This presents little problem unless the capacitor is located in an awkward spot or unless you must put the transmitter back in its case. In these situations, shift adjustment can be a nuisance.

This article describes a frequency shift keying technique using a voltage-variable-capacitance diode. With this technique, shift adjustment is made by varying the voltage applied to the diode. Thus, shift adjustments need not be made at the transmitter and can be made at any position remote from the transmitter by varying a small potentiometer in a biasing circuit.

As an example of the use of this type of frequency shift keyer, this article describes the conversion of the HX-50 and the TCS transmitters to frequency shift keying by using a small variable-capacitance diode.

The Voltage-Variable-Capacitance Diode

The diode used in the circuits described in this article is a TRW IN4792A which has a nominal capacitance of 22 mmf at a reverse bias of 4 volts. It can be obtained from most large parts distributers. If TRW diodes are not available, Motorola variable-capacitance diodes may be used.

From an operational standpoint, the voltage-variable-capacitance diode is similar to the usual solid state diodes used as rectifiers and as detectors. If it is forward biased (anode positive, cathode negative) it will exhibit properties similar to a standard diode and could be used as a detector or rectifier. Upon reversing the bias, this diode will not conduct and will look like a regular diode; however, upon varying this reverse bias the special properties of this diode become apparent. With this diode, the capacitance across the diode decreases in a controlled manner as the reverse bias is increased, while with a regular diode the capacitance decreases very rapidly for a small voltage change and the capacitance change is not easy to control.

A Simple Variable Capacitance Diode Keyer

Figure 1 shows a circuit of the simplest variable-capacitance diode keyer. As the voltage V is varied, the capacitance of the diode will vary altering the resonant frequency of the v.f.o. tank. If, with some voltage V applied, a varying alternating voltage such as the output from an audio amplifier were connected to point A in the circuit, the v.f.o. could be frequency modulated.

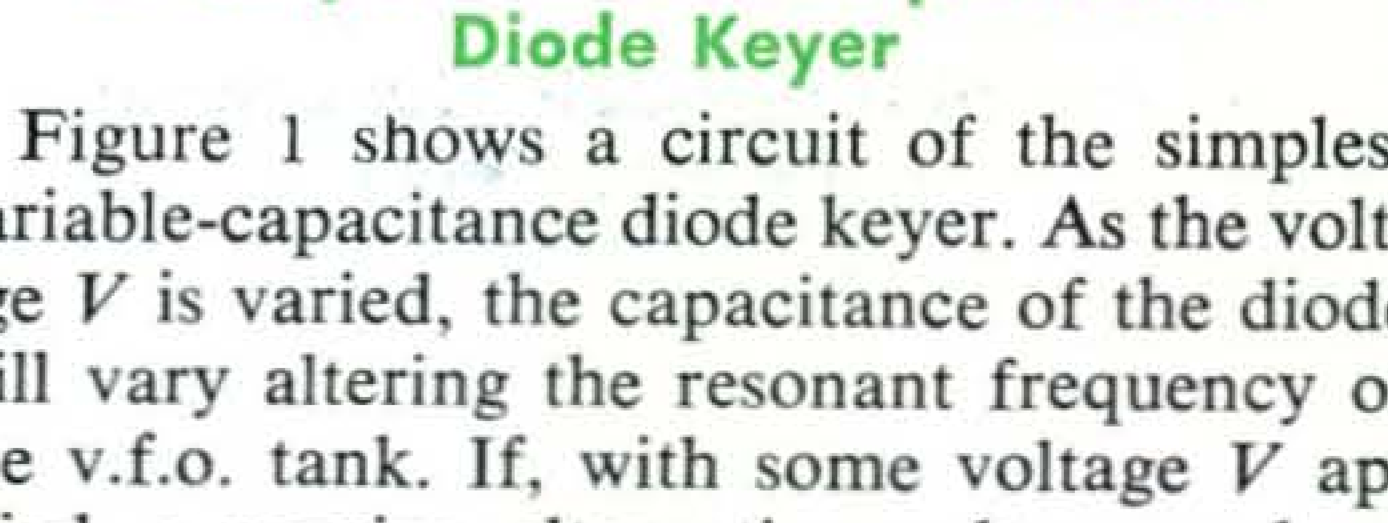

Fig. 1—Basic circuit of a v.f.o. using a voltage variable capacitance diode for frequency control.

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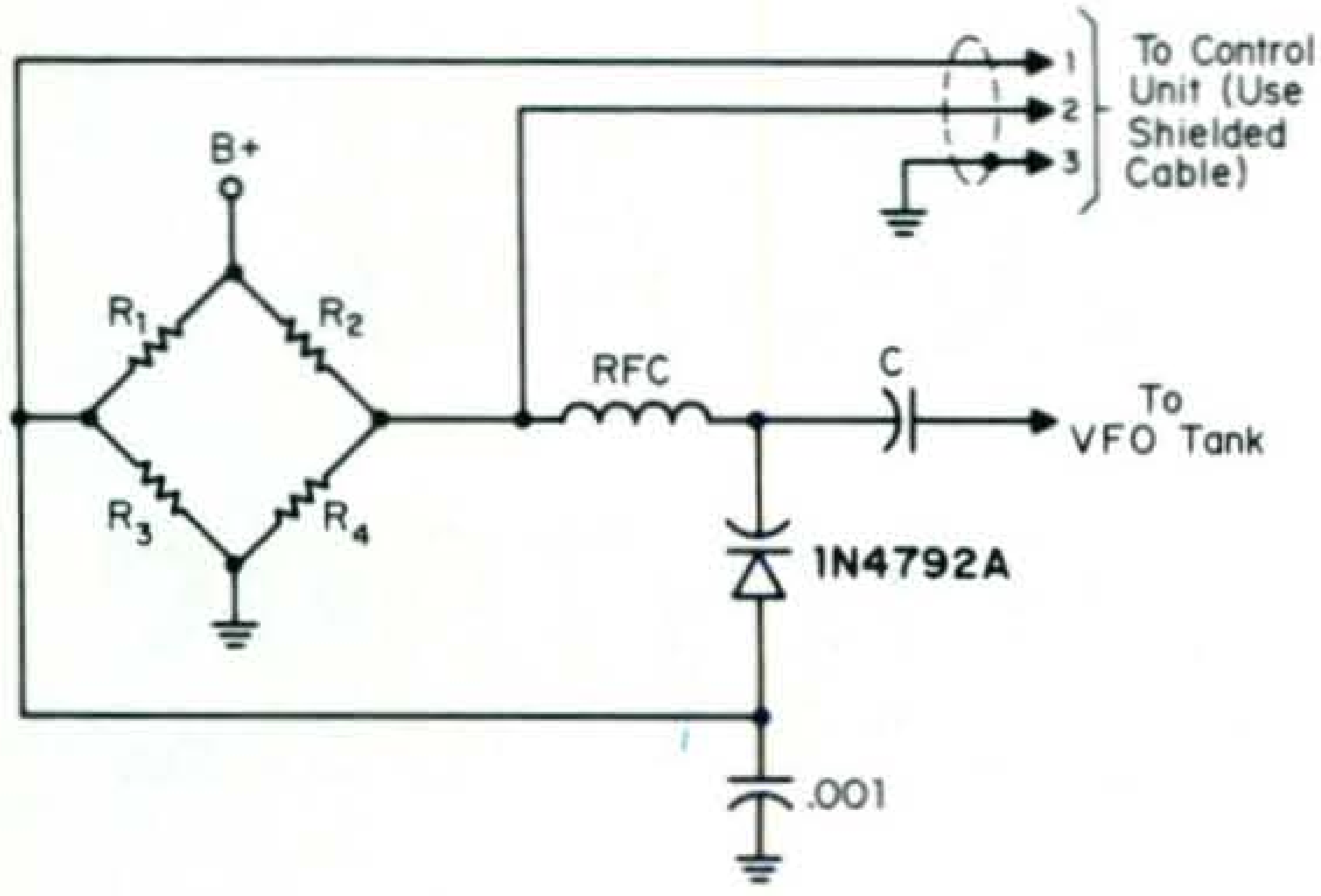

Fig. 2—Circuit of a practical keyer that can be used to frequency shift a v.f.o. With a proper control unit the keying can be reversed and the shift adjusted to any desired value. Typical component values are discussed in the text.

For frequency shift keying, a teleprinter keyboard or a polar relay could be connected to point "A". Since the teleprinter in its inactive state (a key is not depressed) shorts the circuit, the capacitance of the diode will be some value, C_o, with zero bias. When the keyboard is active (a key has been depressed) the capacitance will decrease to some value designated by C_v, where v is the voltage applied to the circuit. This net decrease in capacitance will cause an increase in frequency. Thus we have developed a simple frequency shift keyer.

Unfortunately the keyer in fig. 1 has a few disadvantages, since the way it is set up, it has no provisions for varying the shift and in addition the space is higher in frequency producing upside down keying.

A Versatile Variable Capacitance Diode F.S. Keyer

Figure 2 shows a universal variable-capacitance diode frequency shift keyer. In this case the diode is biased by a bridge circuit permitting either normal or reversed keying. Figure 3 shows the control unit for use with this keyer. This control unit may be mounted at some convenient location at the operating position and need not be mounted on or near the transmitter. The only precaution is to use shielded coaxial cable for connecting the units together and for connecting the teleprinter to the control unit.

To determine the values of resistors R_1 through R_4, the reverse voltage rating of the diode used must first be ascertained from the manufacturers literature. The diode used in this circuit, the TRW 1N4792A, has a maximum inverse voltage of 20 volts. The values of these resistors will depend on the B+ voltage and may either be calculated by ohms law or determined by trial and error. If you are not much for math and have 200 to 300 volts available then the proper resistors may be chosen by trial and error as follows. Starting with R_1, select a resistor of between 400K and 500K ohms; for R_3 start with a value of about 20K ohms. Measure the voltage at the junction of R_1-R_3 with a v.t.v.m. or high impedance voltmeter with the B+ voltage connected. If the voltage is too low, increase R_3 by a few thousand ohms and try again, if the voltage is too high, decrease R_3. When the proper voltage is obtained select R_1-R_2 and R_3-R_4. Now solder the diode into the circuit and recheck the voltages again. The voltages at the anode and the cathode of the diode should be approximately equal or the voltage at the junction of R_2-R_4 (the cathode) should be slightly higher than the voltage at R_1-R_3. If the voltages are incorrect, vary R_3 to obtain the proper voltage ratio. To obtain maximum capacitance variation, the voltage difference should be less than one volt. If the voltage difference is much greater than one volt, maximum capacitance variation will not be obtained, and if the cathode (R_2-R_3) voltage is less than the anode voltage then conduction will occur (current will flow through the diode) and possible overheating may occur. It should be noted that it is desirable to obtain maximum capacitance variation so that maximum shift variation may be obtained.

After the proper resistors have been selected, the keyer should be connected into the v.f.o. circuit. The diode should be mounted as close as possible to the v.f.o. circuit. Capacitor C should be chosen so that when the junction of R_1-R_3 is shorted to ground the frequency shift is between a kc to 1.5 kc. For a starting value for C use a small ceramic capacitor of about 20 mmf. If the shift is too large, decrease C; if it is too small, increase C. The capacitor, C must be chosen by trial and error for all practical purposes. The r.f. choke, RFC, may be a miniature 2.5 mh type; this choke is not critical at all.

Once C and all resistors have been selected and the circuit tested, the control unit may be connected to the keyer. This control unit has a switch and three sets of pots to provide adjustments for three different shifts. If three shifts are not needed, then one pot only may be used. In addition, a separate pot is included for adjustment of the shift used for identification keying. To adjust the shift,

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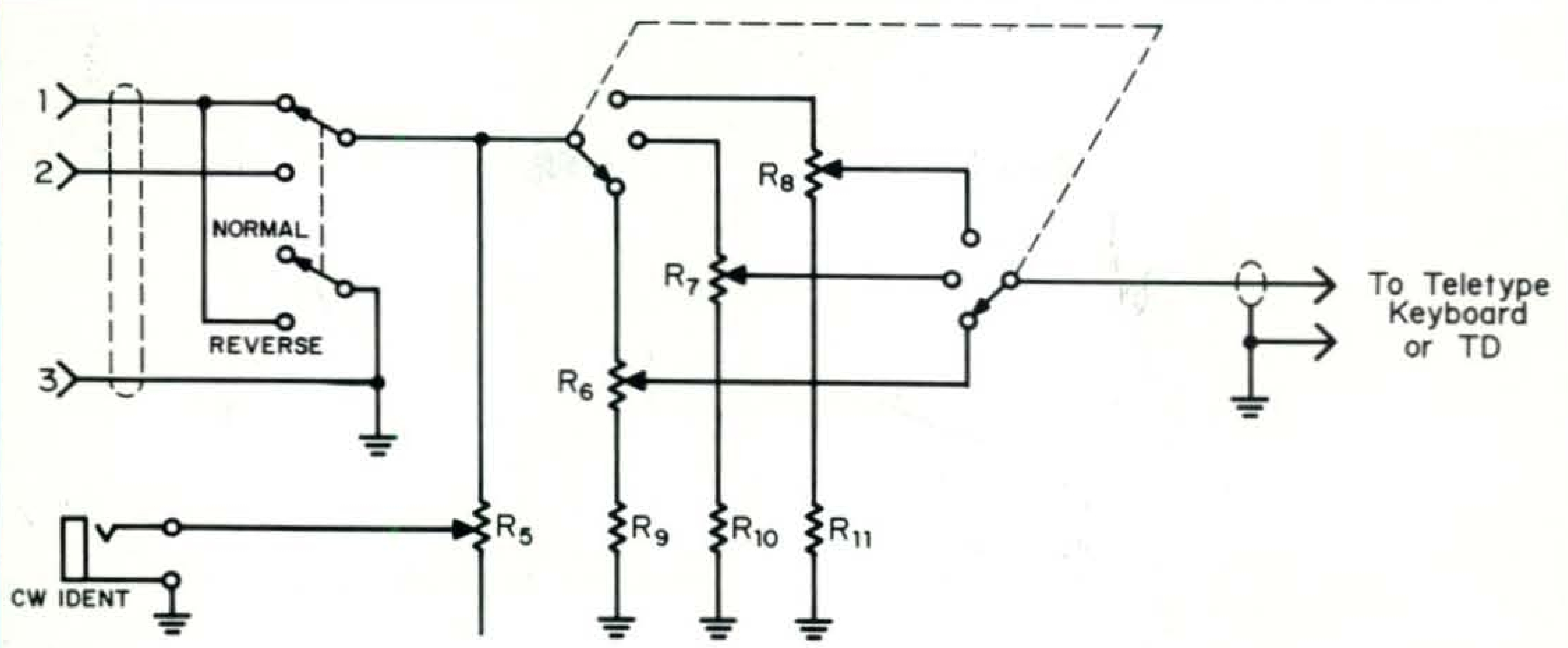

Fig. 3—Keyer control unit that may be used with the circuit of fig. 2. Potentiometers R_8, R_7 and R_6 can be set for three different values of shift. Resistors R_5, R_6, R_7 and R_8 are 250K and resistors R_9, R_{10} and R_{11} are 1 meg.

merely vary the potentiometers while operating the teleprinter until the desired shift is obtained.

Be certain to use shielded cable to connect the control unit to the keyer on the transmitter and to connect the teleprinter keyboard to the control unit. If shielded cable is not used 60 cycle voltages will be picked up on the connecting cables which will frequency modulate the carrier. If hum does occur with the shielded cable, try reversing the power line plugs on the transmitter and the teleprinter, try reversing the cable connections at the teleprinter. Also be certain that the cable is grounded to a common ground at only one end to prevent a hum loop.

Converting the HX-50

The HX-50 is one of the easiest transmitters to modify for f.s.k. since it already contains a variable-capacitance diode as an integral part of its v.f.o. circuit. This diode is used to adjust the v.f.o. frequency on upper sideband so the u.s.b. and l.s.b. frequencies are the same. Only a one wire modification and a connection jack on the back panel are needed. The way the circuit is set up the transmitter will f.s. key normally on all bands, but cannot be simply modified for reverse keying. To modify it for reverse frequency shift keying, the circuit described in fig. 2 should be used.

Figure 4 shows the modification for the HX-50. A single wire is connected to the hot end of the oscillator adjusting pot, R_{138}. This wire is connected to a new jack which must be added to the rear panel. By shorting this wire to ground through a potentiometer the output frequency is raised.

Figure 5 shows the control unit used with the HX-50. This control unit is a simplified version of that described in fig. 3. An ON-OFF switch has been included to disable the frequency shift keying provision to use the transmitter for s.s.b. If this switch is left in the ON position for s.s.b., the u.s.b. and l.s.b. frequencies won't agree. Again the shift is adjusted by varying R_{12}.

Converting the TCS

The surplus TCS transmitter is very simple to modify for frequency shift keying although it does not already have a built in variable-capacitance diode. The circuit described in fig. 2 is used with the connection to the v.f.o.

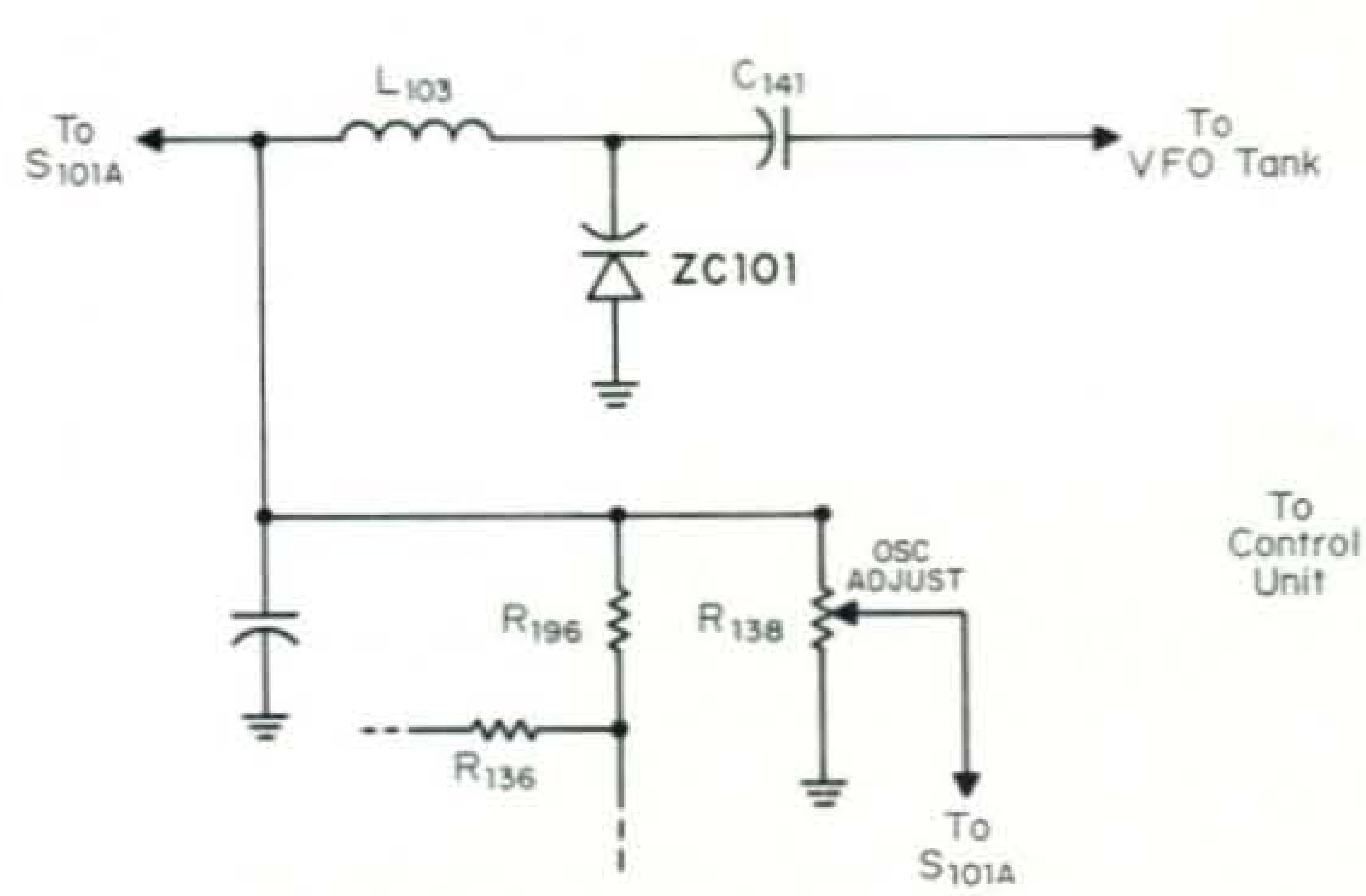

Fig. 4—Simple modification for f.s.k. operation with the HX-50. The wiring shown in color is added and the jack, J_1, is mounted on the back panel.

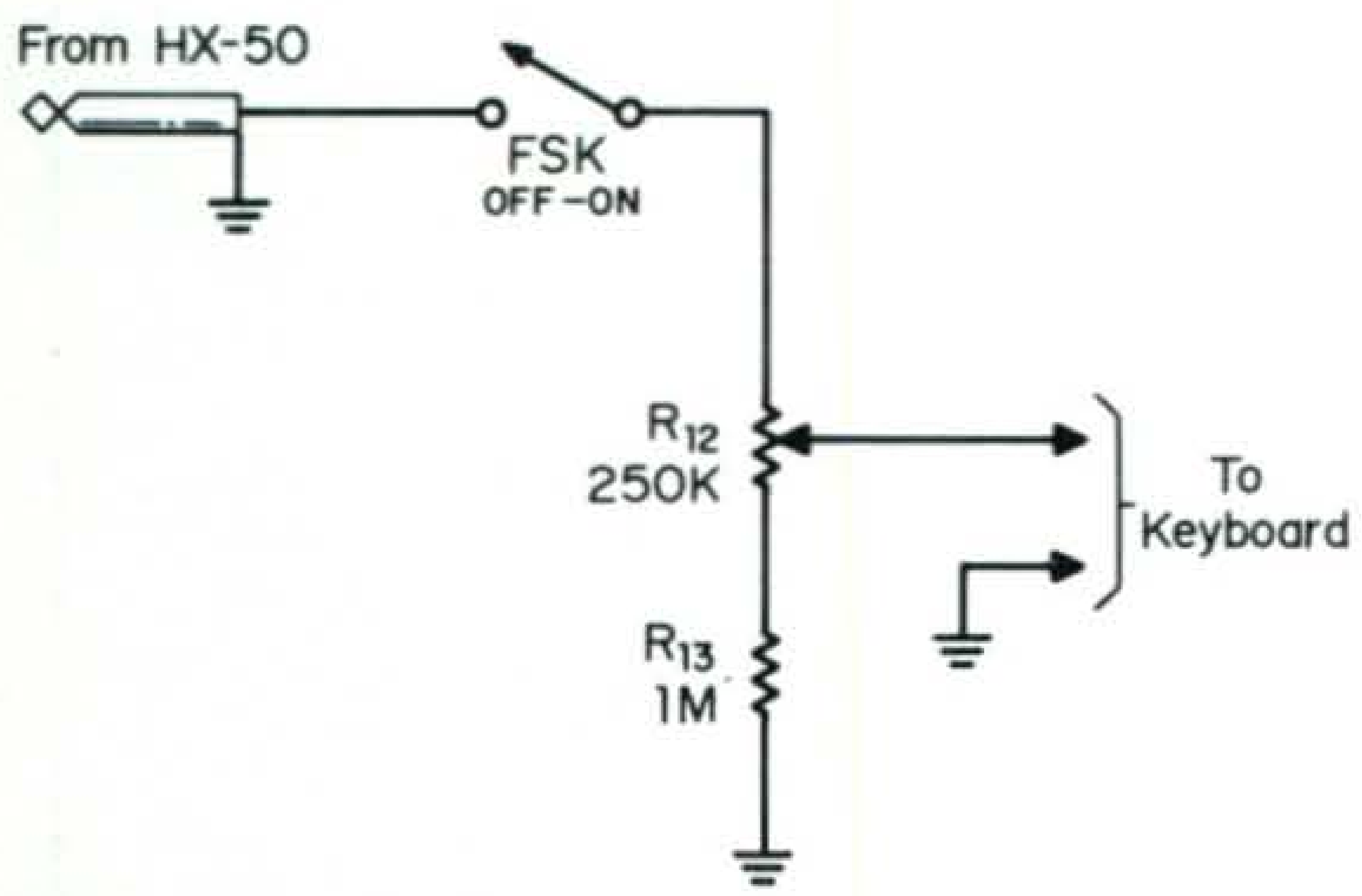

Fig. 5—Control circuit for the f.s. keyer in the HX-50 shown in fig. 4. Control R_{12} sets the shift.

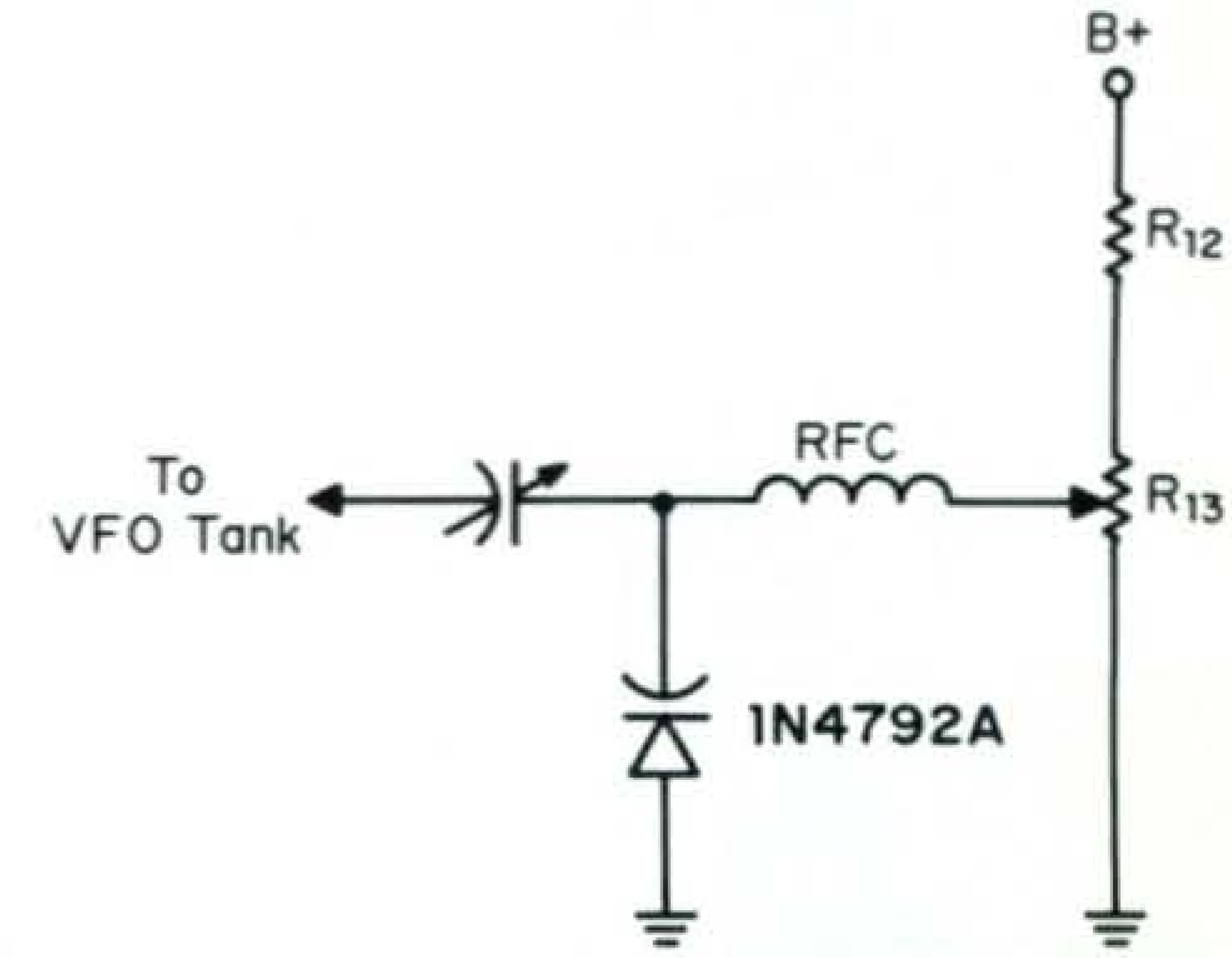

Fig. 6—Simple circuit shown above is suitable for vernier frequency control of a v.f.o. as explained in the text.

made to the cathode pin of the oscillator. The cathode of the oscillator is pin 8 of the 12A6 closest to the side of the transmitter. The value of *C* which should be used is about 100 mmf. For a B+ voltage of 200 volts R_1 and R_2 should be 470K; R_3 and R_4 should be 47K. The value of R_3 may have to be adjusted either up or down so that the voltages on the anode and cathode are approximately the same when the control unit is not connected.

Vernier Frequency Control

One problem that is very evident with some surplus v.f.o. controlled transmitters is that it is sometimes difficult to accurately zero beat a station. This presents no problems for c.w. or a.m. but for radioteletype or s.s.b it may be next to impossible to zero beat a station to within 50 cycles or so. This problem can be cured by using a variable-capacitance diode vernier frequency control. This circuit is shown in fig. 6. In this circuit, an additional diode is placed in the v.f.o. circuit. For zero beating, R_{13} is placed at mid range, the main v.f.o. is varied to place the carrier as close as possible to the desired frequency and R_{13} is varied to provide fine tuning over a kc range. Resistors R_{12} and R_{13} are chosen so that the voltage at the junction of R_{12}-R_{13} does not exceed the maximum voltage of the diode used. The capacitor *C* is adjusted so that a maximum frequency of about kc is obtained if R_{13} is shorted out.

With the information presented in this article almost any transmitter with a v.f.o. may be simply modified for f.s.k., with the shift adjustment located at any remote operating point from the transmitter.

Although this article dealt mostly with the frequency shift keying applications of the variable-capacitor diode, this diode can be used for other related applications as well. Some of these applications might be remote tuning of a receiver, crystal oscillator, wavemeter, or similar device. ■

1968 YL-OM CONTEST RESULTS

BY LOUISA B. SANDO,* W5RZJ

CONGRATULATIONS to all the top scorers in YLRL's 19th YL-OM Contest, held Feb. 24-25 (phone) and Mar. 9-10 (c.w.), and especially to Sonia Rotenberg, PY2SO, who won in both sections for the YLs. (In '67 Sonia earned second high YL score on c.w.) Congratulations also to W5WZQ, David Blaschke, who turned in the top OM c.w. score (he placed second in the '66 contest), and to K5MDX, David Thompson, who earned top OM score on phone, repeating his '65 win in this category.

YLRL V.P., Claire, W4TVT, who checked the logs, expressed her appreciation for the care taken in preparation of logs in this contest, adding that none was disqualified for illegibility. However, some logs were received

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* 4417 Eleventh St., N.W. Albuquerque, New Mexico 87107.

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a Salute to...

Mister One-Sixty

BY CHARLES M. O'BRIEN,* W2EQS

REMINISCENT and symbolic of the original low frequency pioneering trans-Atlantic experimental work carried on during the era of 1901 thru 1924 are such names as Marconi, Deloy, Schnell, Reinartz and Godley who have gone down in history.

Wireless was born in the late 1890s and its fascination instantly swept over men of all ages intent on learning the mysteries that became such a deep rooted question within them. They read with avid interest whatever small knowledge could be passed on. Nothing was known to the majority. They had to experiment with every move they made. And, the man of the day was Marconi.

Is it any wonder, then, that unequalled interest was shown upon the arrival of Marconi and his two assistants from Europe at St. John's, Newfoundland, on December 6, 1901? Six days later the Atlantic was bridged by wireless when the prearranged code letter "S" was heard. The European experimental station was at Cornwall in southewestern England 2,000 miles distant.

During the early years of wireless most amateur stations operated on frequencies covering 550 to 1500 kc and which are now known to be the broadcast band (eventually changed in later years to be 540 to 1600 kc). With rapid advancement of the art, modulation came into being and, as a result, considerable confusion and interference became inescapable. The situation was becoming not only uncontrolled but impossible. And so, the Radio Act of 1912 was passed in August of that year ordering amateurs to use frequencies of 200 meters and down. To commercial and government interests these frequencies were considered as being useless with the belief then being that the long waves were the most useful.

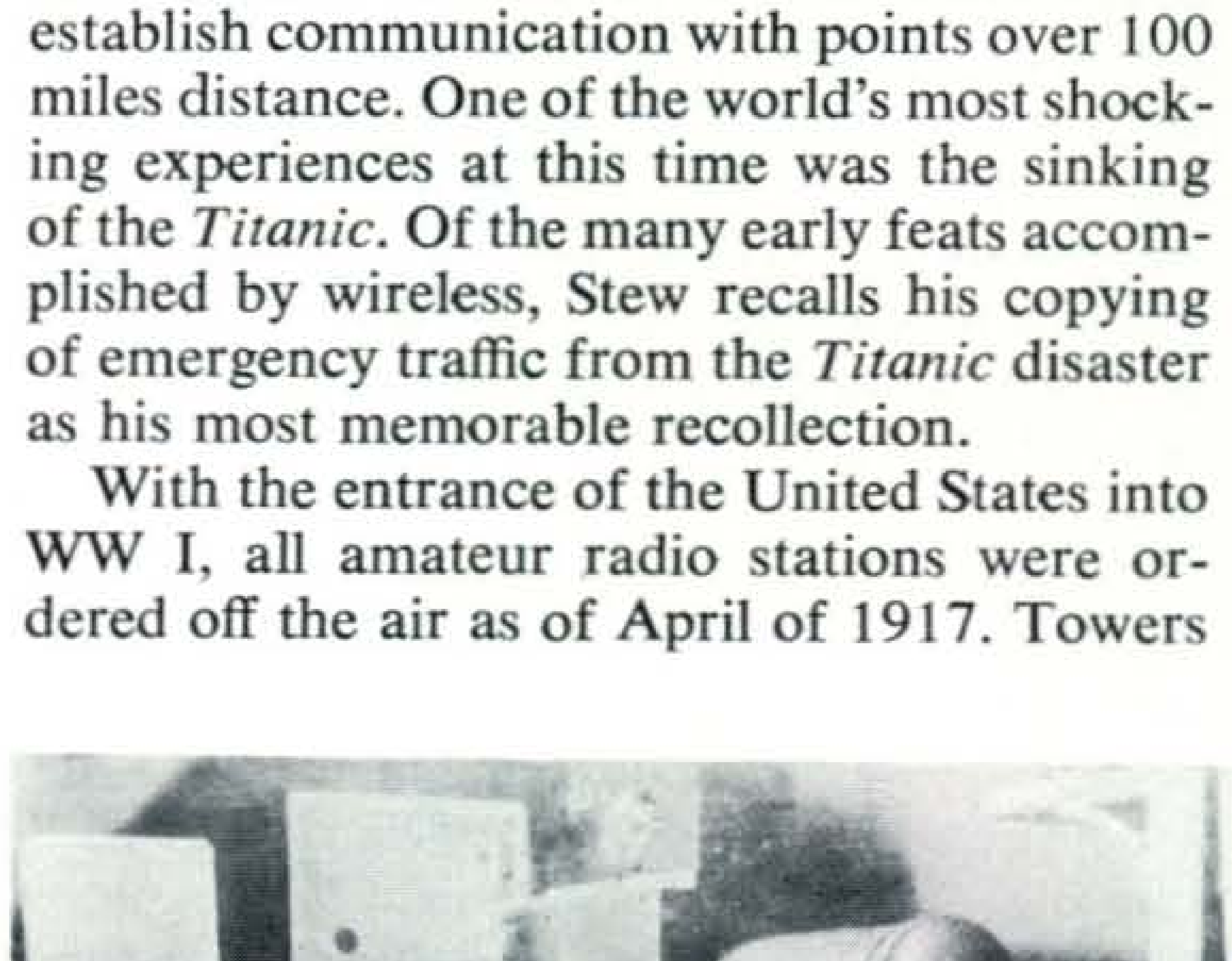
* 48 Prospect Avenue, Westwood, N.J. 07675.

As a lad of but 8, Stew Perry first went on the air in 1912 using the self assigned call of "SS" simply because it was a simple one to send as well as for others to remember but very possibly emulating the single "S" of Marconi.

Known to countless numbers now as W1BB, Stewart S. Perry is the world's foremost amateur radio operator delving into the mysteries and the potential of our lowest band of frequencies . . . 160 meters.

His first transmitter consisted of a single slider tuning coil with a crystal detector and ¼" spark coil hooked to a random 40 foot piece of wire into a nearby tree. With this type of equipment one was considered fortunate to establish communication with points over 100 miles distance. One of the world's most shocking experiences at this time was the sinking of the *Titanic*. Of the many early feats accomplished by wireless, Stew recalls his copying of emergency traffic from the *Titanic* disaster as his most memorable recollection.

With the entrance of the United States into WW I, all amateur radio stations were ordered off the air as of April of 1917. Towers



The little clock reads ten to 10 in this early (1919) view of 1BB.

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In 1921, Stew posed for this shot perhaps logging in some rare one. The trim efficient layout of the shack carries over his shipboard training.

and antennas were to be dismantled and all receiving and transmitting equipment sealed. Strangely enough it was at this time that he obtained his first official station and operators license and was assigned the call 1BB with which he is still active. However, with all amateur gear now being silenced he studied for his commercial radiotelegraph ship operator's license. As a boy of 16 he put to sea to earn money for college. Not only was it great fun, but it gave him great experience as he operated aboard coastal, trans-Atlantic and Great Lakes ships. The amateur bug was still in him, for at one time, when anchored in Boston Harbor, he tuned the ship's 5 kw spark transmitter to the amateur 200 meter band and let it go, causing quite some commotion to say the least. "What foolish things young squirts do but how pleasant to recall when one is older," he told me with a far off look in his eyes.

Needless to say that when amateurs were again permitted to return to the airwaves on September 26, 1919, he was one of the first to be back renewing old friendships and making new acquaintances. After his stint as shipboard radio operator he returned home with the desire to have that station of his as complete and commercial looking as his ability would warrant and pocketbook permit. His interest in ham radio has never lagged and today a young man's dream of years ago has finally been realized . . . 100 countries on 160.

Stew went on to college graduating in 1926 from the Massachusetts Institute of Technology and became a Registered Professional Engineer working on heavy industrial equipment for the Worthington Corporation. His knowledge has been put to use on Steam Power Plant Equipment, Diesel Engines, Gas Engines, Compressors and Pumps.

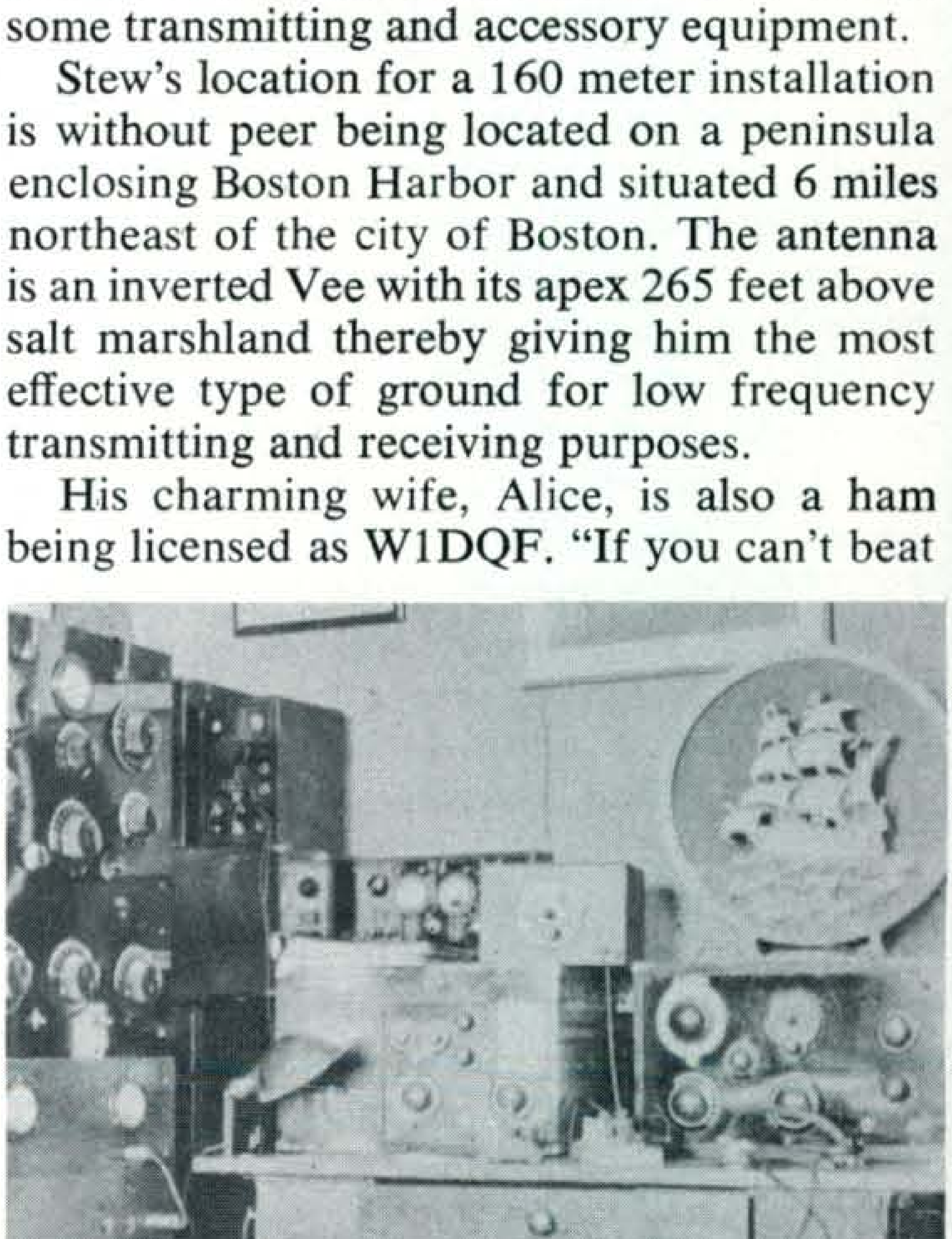
Let us return, for a moment, to those earlier days and note the changes in ham gear as more and more was learned of this mystifying hobby of amateur radio.

Going from the original spark coil, to a 1″ coil, to a 3″ coil, to a rotary gap and quenched gap rigs, W1BB had one of the very first c.w. transmitters as early as 1921; then, one of the first phone transmitters. In reminiscing, he told me of the first dance via radio ever had anywhere from a Victrola in the shack at his home in Winthrop fed into his mike to a party at the Wollaston Yacht Club in Quincy, Mass., a distance of 7 miles, where it was received and put out over the primitive P.A. system much to the delight of all as "three feature dances of the evening."

Throughout the years most of W1BB's equipment has been home brew although commercial receivers are used now as well as some transmitting and accessory equipment.

Stew's location for a 160 meter installation is without peer being located on a peninsula enclosing Boston Harbor and situated 6 miles northeast of the city of Boston. The antenna is an inverted Vee with its apex 265 feet above salt marshland thereby giving him the most effective type of ground for low frequency transmitting and receiving purposes.

His charming wife, Alice, is also a ham being licensed as W1DQF. "If you can't beat



This 1931 photo of W1BB shows the professional looking station which saw the start of the 160 Meter Trans-Atlantic Tests the following year.

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'em, join 'em." And, this is exactly what she did. Much better to be on the inside looking out than vice versa.

When Pearl Harbor was bombed December 7, 1941, amateurs were again ordered off the air by that night. For the duration of WW II, Stew was Operations Officer in the U.S. Coast Guard Auxiliary known as the Radio Sealing Unit whose duties were to go aboard all ships in Boston Harbor checking to be sure their transmitters were property tested and sealed and complying with all rules and regulations. His group would board ships from a Coast Guard launch, going up and over the side.

W1BB has always been active in amateur emergency work, too, having been ARRL's Emergency Coordinator for years in Winthrop and as RACES Communications Officer of the Civilian Defense Radio Network since its inception at the end of WW II.

During the war LORAN came into existence and was assigned spot frequencies within the 160 meter band of 1850, 1900 and 1950 kcs. This spelled doom for Top Band . . . temporarily. However, sharing arrangements were eventually worked out with the Coast Guard and approval was given for the resumption of amateur communications in April of 1949. Naturally one of the first signals heard was that of the old reliable W1BB, who, as always, has been a mainstay during the ensuing 19 years of 160 meter operation. His greatest love in amateur radio has been the 160 Meter trans-Atlantic DX Tests which, if memory serves correctly, he has been conducting ever since 1932. During these years he has stirred up tremendous activity in various countries throughout the world by getting them to try 160; yes, stations from every continent in the world. Many countries are active on 160 which are considered rare on any band including 10, 15 and 20 meters.

W1BB will be heard during the late evening/early morning hours particularly during the winter and, to a lesser degree, the summer, as well, looking for those evasive countries. Working them on such a low frequency band has given him some of the greatest thrills an amateur operator can experience. It instills within him that feeling of pioneering and accomplishment which is lacking in much of our other h.f. operations today. The Tests conducted by Stew have developed into a "Propagation Study of 160 Meter Signals" with amateurs cooperating from all over the world lending to the fund of information being compiled about communications in the 2nd region. Noise level, skip paths, weather, etc. are carefully studied, charted and recorded.

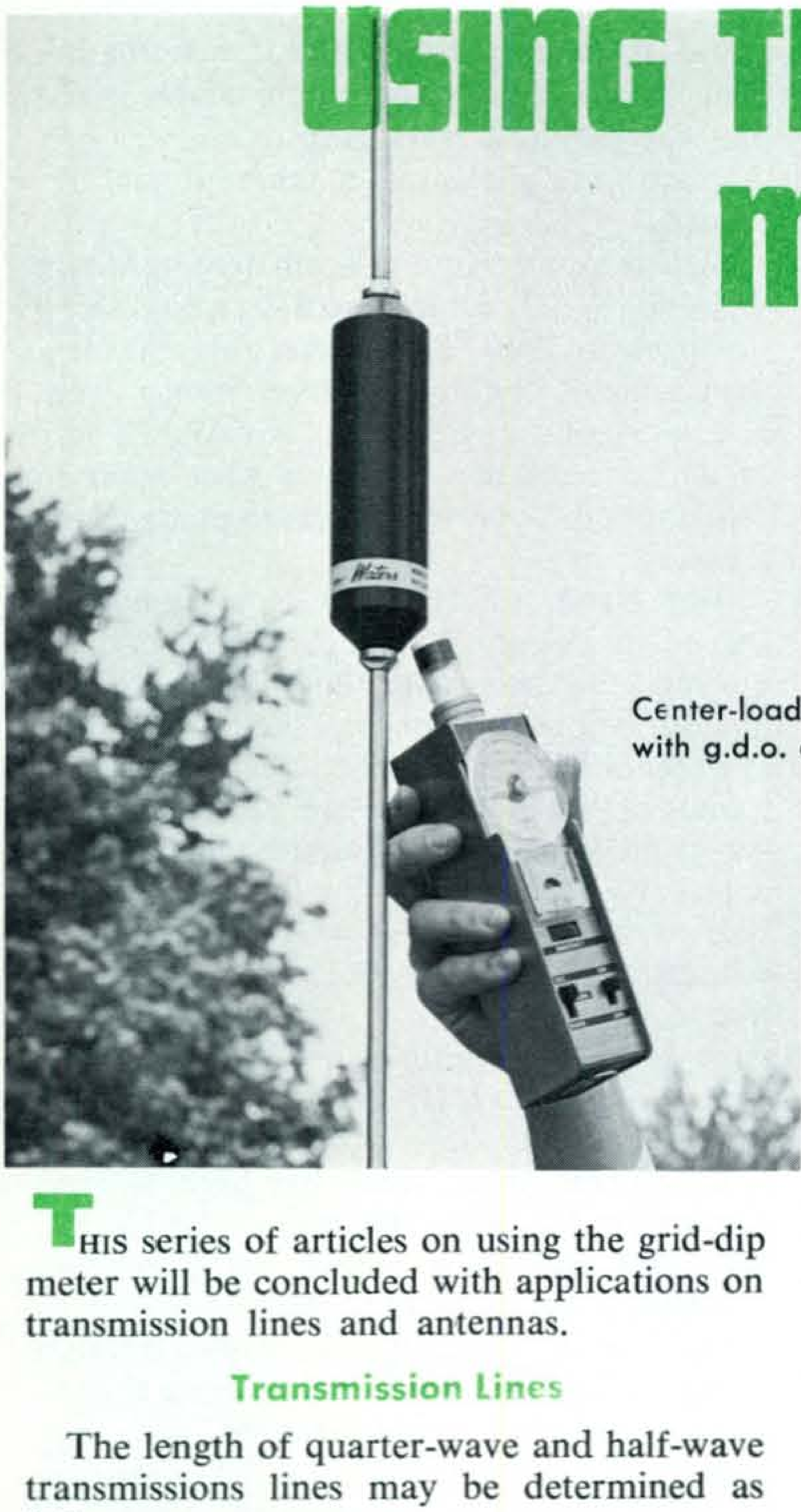
Stew is also the first U.S. amateur to obtain the 160 WAC achievement accomplishing this back in 1960. To this day there are less than a handful who can make similar claim and most of these earned their WAC only after the recent trip Stew and Alice made to Japan to introduce 160 meters to many of the JA gang.

Top Band, as 160 meters is familiarly known, is essentially a night time band requiring a darkness path. Best DX is worked an hour before or after local sunrise or sunset at either or both ends. Reflection of 160 meter signals by the ionosphere are best noted during its most turbulent condition when changing its altitude from daytime to nighttime and vice versa. During this period the signal's reflection angle varies widely. It is at this time that a far away signal arises mysteriously from what would seem to be out of nowhere. On the other hand, DX will exist when ionospheric conditions are right as long as there is a darkness path. Much has been learned concerning the peaking times of the North/South and East/West paths, polar absorption and effects of the sunspot cycle.

Stew's greatest pleasures have been through his operations on 160 . . . the personal con-

[*Continued on page 99*]

Stew and Alice Perry, she's W1DQF, at the rig in 1966.



USING THE GRID-DIP METER

Part III

WILFRED M. SCHERER, W2AEF

Center-loaded antenna resonance may be found with g.d.o. coupled to *bottom* end of loading coil.

THIS series of articles on using the grid-dip meter will be concluded with applications on transmission lines and antennas.

Transmission Lines

The length of quarter-wave and half-wave transmissions lines may be determined as follows:

Quarter-Wave Shorted Lines: Use g.d.o. coupled to open wire lines as shown at fig. 2I (in Part I) and to coax lines as at fig. 2H (in Part I). When lines are trimmed for correct length, the fittings to be eventually used for connections should be installed on the end of the line. The approximate required length of the line may initially be determined by rough calculation, taking into account the propagation constant. Additional resonant points will be found at a frequency three times that of the fundamental quarter-wave, where the line is then three-quarter waves long; or five times the frequency for a five-quarter-wave line, etc.

> A large-size 8½″ × 11″ frequency *vs.* capacitance chart for determining capacitance using a g.d.o. and a standard inductance is available from *CQ* free in return for a self-addressed and stamped #10 envelope. The chart was shown in reduced size last month on page 31.

Quarter-Wave Open Lines: For open-wire lines connect a short at one end and measure as for quarter-wave shorted lines. Due to the length of the short, the actual electrical length of the line (used as an open-line) will be slightly in error depending on the line spacing. The closer the spacing, the smaller the error.

For coax lines, place short on line and measure as quarter-wave shorted line. The short should be as direct as possible from the inner conductor to the shield to avoid errors. Fittings also should be included. Shorts should be removed after measurements are completed.

Half-Wave For open-wire or coax lines, measure for quarter-wave shorted line at *half* the calculated or desired frequency. The resonant frequency thus found must then be multiplied by 2 for a resulting half-wave shorted line.

Half-Wave Open Lines: For open-wire lines couple g.d.o. at center as shown at fig. 2J (in Part I). For coax line, short one end and measure for quarter-wave shorted line at half the calculated frequency. Resonant frequency thus found must be multiplied by 2 for correct length of the line after the short is removed; provided, the short was made direct as mentioned above.

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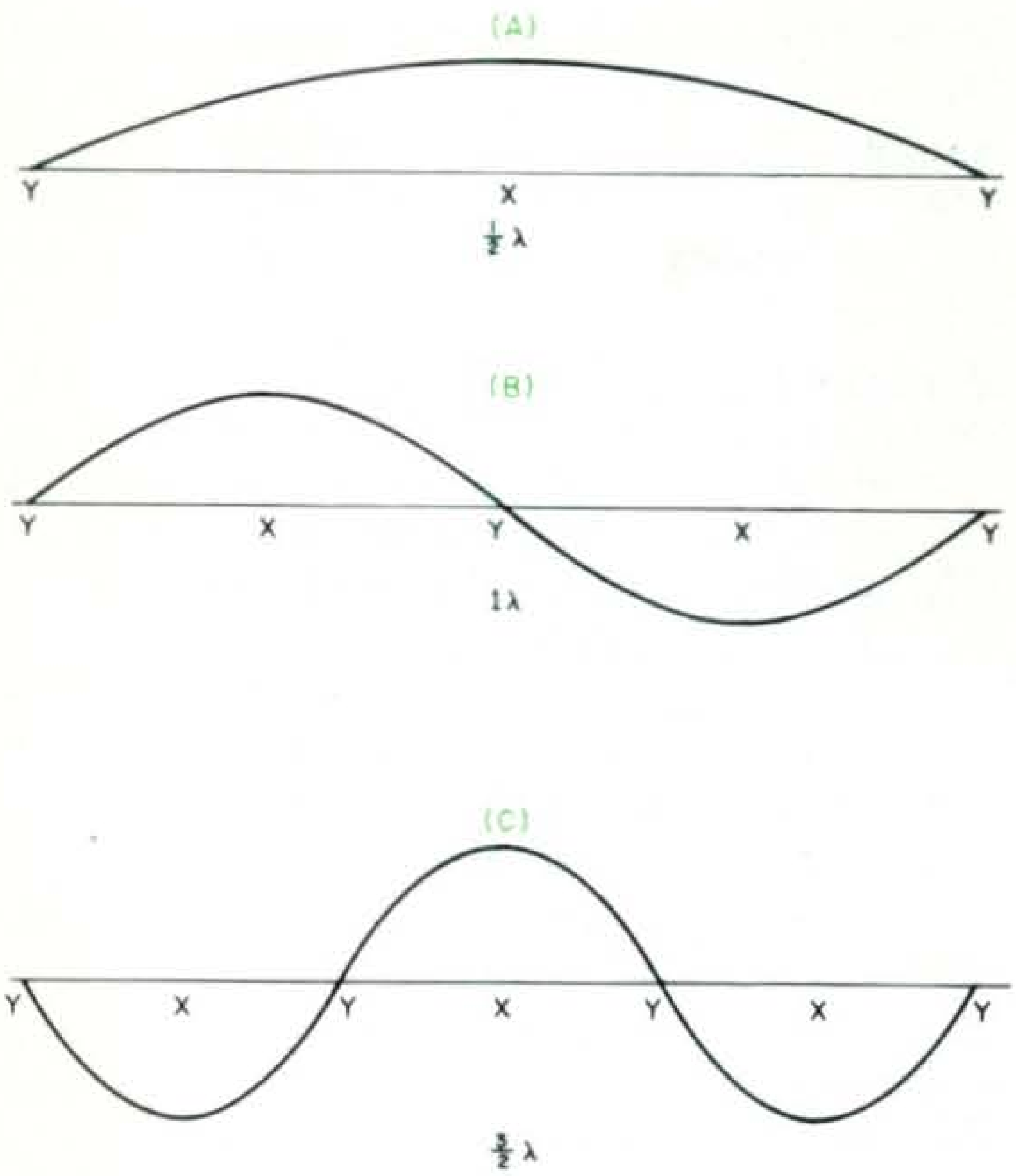


Fig. 1—Current distribution on various-length antennas. A—One-half wave. B—One full wave. C—Three half waves. The g.d.o. preferably should be inductively coupled at the low impedance points marked X. Capacitance coupling is obtained at high-impedance points Y.

Checking Standing Waves: Open-wire feed lines may be checked for the existence of standing waves by using the instrument as a diode detector. A flat line is indicated when the meter reading remains constant as the g.d.o. inductor is moved along the line. Care must be taken to maintain a uniform distance or coupling between the line and inductor. Since the g.d.o. inductor often is protected with an insulated sleeve, it may be held against the line for keeping the coupling constant.

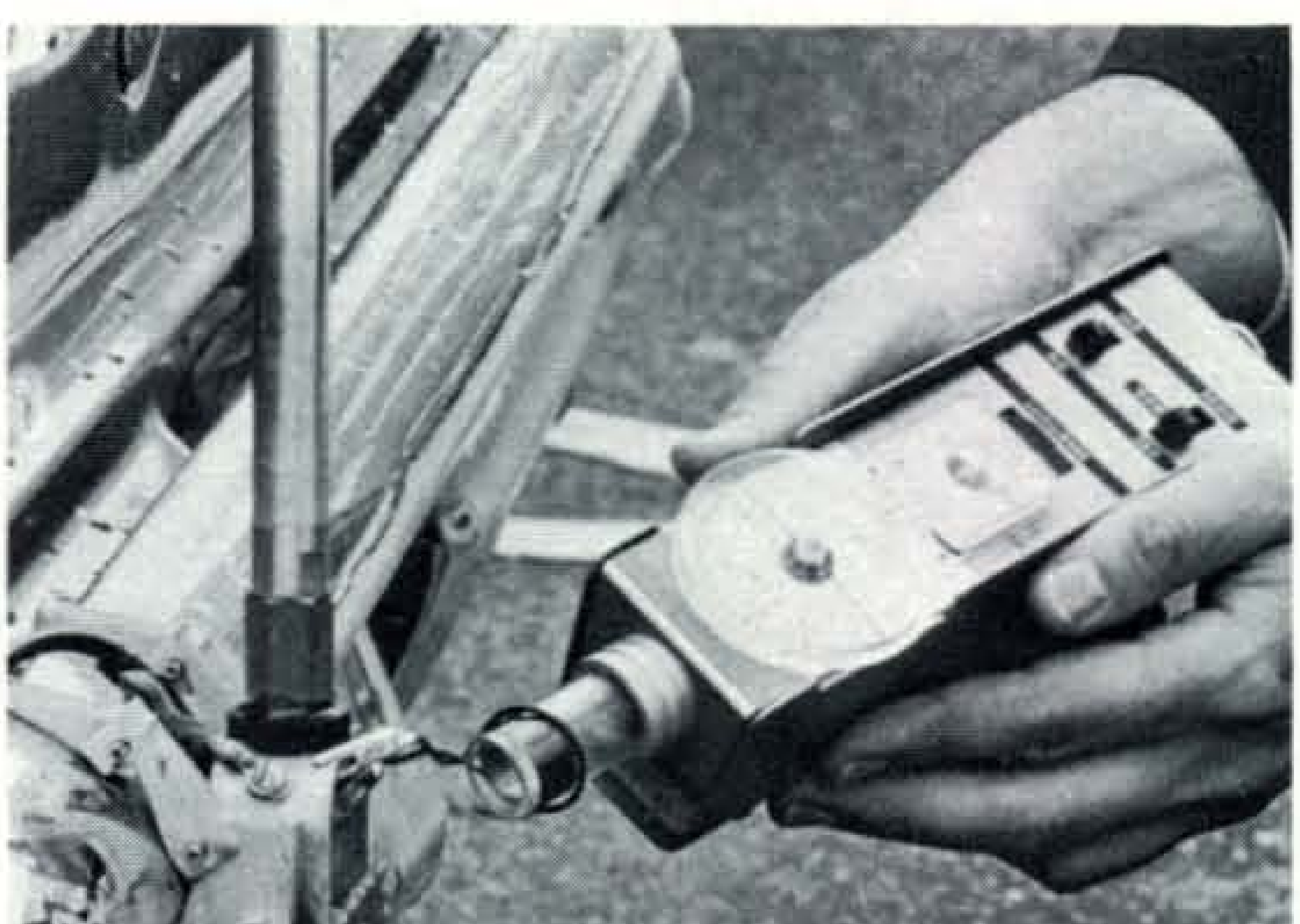
This method is like that using a neon bulb or similar device, except better accuracy can be had since the variations can be more easily seen on a meter.

Antennas: Use instrument as g.d.o. Coupling should be made at a low impedance or high current point as shown in Fig. 2F (Part I). This point, for a half wave antenna or one a number of odd half-wave lengths long, is at the center. For antennas an *even* number of half-waves long, a low impedance point will be found at a quarter wave measured from either end. Also, see fig. 1. It will be observed that a full-wave antenna will not be a half-wave at exactly half its resonant frequency. This is because the end effects are found only at the antenna ends and will be absent at other points when the antenna is a full wave or more long. Measurement should be made with the antenna placed as near as possible to its ultimate operating position. Checks on a given antenna at different heights or positions will show an amazing difference in antenna resonance.

If it is physically impossible to reach a low impedance point, a check may be made at a high-impedance or high-voltage point. See fig. 1. Capacitive coupling should be used as shown at Fig. 2G (Part I). If the high impedance point involved is one of the ends, the end effect will be altered due to the presence of the instrument and the resonant frequency of the antenna will slightly decrease. This must be taken into consideration when making measurement, *i.e.,* the reading indicated will be slightly lower than true antenna resonance (with g.d.o. away from end). This difference will be about 1 to 3% and will be encountered only when checking at the ends.

In all cases it is helpful to keep in mind the physical length in feet *vs.* electrical length (half-wave, full-wave, etc.) as calculated approximately by formula. Unlike lumped resonant circuits, antenna harmonics are detected when using the g.d.o. As previously mentioned, these harmonics will not occur at *exact* multiples of a half-wave.

When measurement is made, the feeders should be disconnected from the antennas. Unless the feeders happen to be perfectly matched or terminated, true antenna resonance will not be indicated because unmatched feeders or incorrectly terminated feeders will present either a positive or negative reactance and will, therefore, alter the electrical length.



Mobile antenna checked with g.d.o. coupled to small loop connected between antenna base and ground.

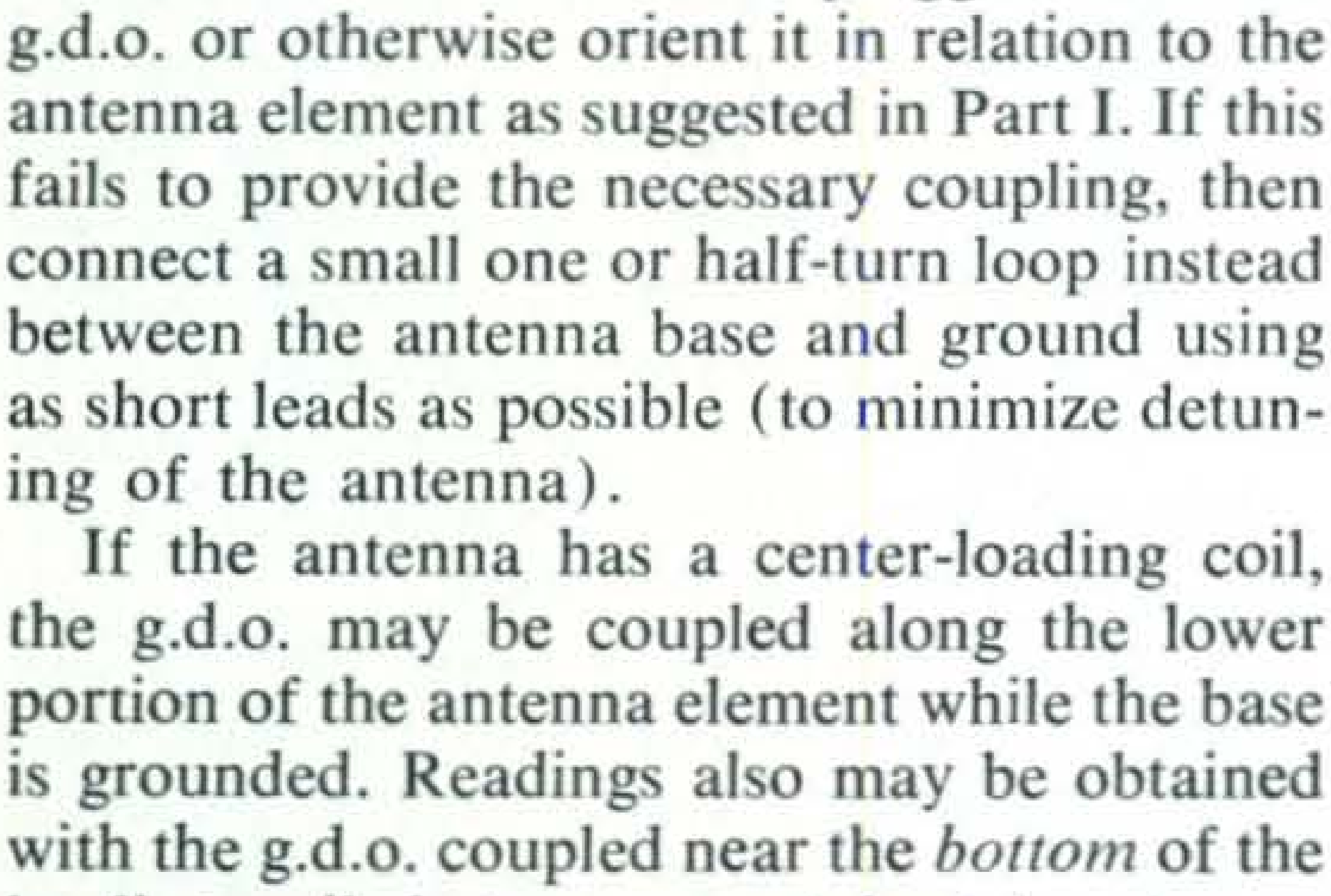
When the antenna element is of very large diameter, such as is often found in beams, sufficient coupling to the g.d.o. may not be obtained and some difficulty will be encountered in finding a reading. This condition may sometimes be relieved by jumping a foot or so of the antenna at the center with a small diameter wire and coupling to this wire.

If the antenna is to be normally used with its center open, close it with the shortest possible wire during measurement. This must be done also with the folded dipole. The short may later be removed, if required, when the feedline is connected.

Quarter-Wave Vertical Antennas: With quarter-wave vertical antennas, resonance may be found by disconnecting the transmission line, shorting the feed point to the ground system and using the g.d.o. at the base.

If adequate coupling cannot be realized for a dip indication, where possible, reverse the inductor 180° when it is plugged into the g.d.o. or otherwise orient it in relation to the antenna element as suggested in Part I. If this fails to provide the necessary coupling, then connect a small one or half-turn loop instead between the antenna base and ground using as short leads as possible (to minimize detuning of the antenna).

If the antenna has a center-loading coil, the g.d.o. may be coupled along the lower portion of the antenna element while the base is grounded. Readings also may be obtained with the g.d.o. coupled near the *bottom* of the loading coil, but care must be taken to see that body presence (particularly above the loading coil, does not detune the system. Base loading may be similarly checked while following these precautions. Unloaded antennas will exhibit a fairly broad dip and loaded antennas will produce sharper dips due to their higher *Q*.



Method of coupling g.d.o. to shorted twin lead.

Mobile Antennas: Mobile antennas usually are the quarter-wave vertical type, requiring the use of the g.d.o. as described above for such antennas.

Parasitic Beams: Tuning a parasitic beam for maximum gain or best front-to-back ratio cannot be very well done using the grid-dip meter; however, the determination of other characteristics may be helpful and can be accomplished as follows:

Parasitic beams may initially be adjusted using the g.d.o. to check the frequency of each element. The driven element should be resonated to the operaing frequency, while the directors are tuned slightly lower in frequency and the reflector slightly higher. These elements may be checked individually using the g.d.o. coupled at the center of the element. The feedline and any matching device should be disconnected and if the center of the driven element is open, temporarily place a short across this point.

Since the various elements are coupled together according to the spacing between them, several dips may be observed on any one element and may be indicative of the resonant frequency of the other elements. The most pronounced dip will be that related to the element under test. When changes are made in the length of one element, interaction may shift the resonant frequencies of the other elements. This then is a give-and-take proposition. The final result should be one that produces the most pronounced dip as possible on the driven element at the operating frequency with the least indication of dips from the other elements.

Final precise adjustment should be made, particularly if a matching system is to be employed at the antenna, by using an s.w.r. bridge or a variable-impedance bridge driven by the grid-dip meter used as a signal source with it's being coupled to the bridge through a one or two turn loop. The coupling to the instrument should be as little as possible consistent with obtaining a useable reading, otherwise the oscillator frequency may slightly shift; as a matter of fact, an occasional frequency check of the signal on a receiver will be advisable.

Trap Antennas: Trap antennas may be set up by first adjusting the individual traps for the proper resonance, before they are installed, as explained under parallel-tuned traps. After

[*Continued on page 106*]

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DX

The DX Award's Program

WAZ: Worked All Zones was the most popular award this month, with 34 new certificates authorized between April 1 and April 30. There was an unusually large crop of 2-way s.s.b. applications. In fact there were as many s.s.b. WAZ's as there were c.w.-phone WAZ's, 15 each. This was exceptional as the c.w.-phone category normally has many more applicants than either 2-way s.s.b. or phone. S.s.b. has definitely come of age. The new certificate winners were the following:

WAZ 2-Way S.S.B.: W8GGE–524, LU2CF–525, W4FPS–526, WØSFU–527, W9DNE–528, VP7NA–529, WØPAN/KH6–530, WAØKDI–531, K8IKB–532, W8ROC–533, DL3AA–534, K3HHY–535, KØBHT–536, WB6CPE–537, WA3ATP–538.

WAZ C.W.–Phone: F3CT–2409, WB2GHI–2410, W3AG–2411, WA9KQS–2412, W1RLV–2413, W4KJL–2414, DL7HC–2415, DJ4XA–2416, W9UTQ–2417, W4AQW–2418, W7YEX–2419, W1AGF–2420, K4BAI–2421, W5OBS–2422, K8ANA–2423.

WAZ Phone: WØMGI–376, W9HPS–377, DL9RE–378, W9ZTD–379.

WPX: The prefix chasers were also busy this month, with 16 new certificates authorized and 24 endorsement stickers sent out. The winners were:

WPX C.W.: K9DWG–842, W3AIZ–843, K6SDR–844, W6QFU–845, K9QVV–846, DJ4SK–847.

WPX S.S.B.: YV3KX–331, W8GGE–332, OE1KW–333, W4UF–334.

WPX Mixed: W9GFF–165, W6LDA–166.

WPX Phone: W4HA–150.

S.S.B. CONTEST WPX: F9MS–3, SM7CSN–4, SM5AD–5.

WPX Endorsement Stickers: Continent–*Europe:* SM7CSN, K3QVV. North America: W6CHY. *Africa:* PAØSNG.

Band–7 mc: YU1AG. 3.5 mc: YU1AG.

Mode–Mixed: W9GFF-700, YU1AG-600, W9ZTD-550, W4HA-550. S.S.B.: WA5LOB-500, W6LDA-350, YV3KX-350, OE1KW-350, YV4QG-300. C.W.: W4NJF-700, VK3AHQ-650, YV1AG-600, UC2AR-600, W9ZTD-400, I1ZQ-400. Phone: PAØSNG-650, W6CHY-550, W4HA-500.

The response to our April request for suggested prefixes to include on the standard list for the WPX Honor Roll has been truly gratifying. Mike, WA8GGN, sent 5 typewritten pages (single-spaced) discussing the various possible additions and deletions, and old standbys like W9WHM, W4OPM, W6TMP, W8KPL, K4DSN, K2DDK, WA1CBP, K3HGX, *et al*, also made helpful contributions. The remaining prefixes for this list will be published next month, and hopefully the special forms for application to the Honor Roll will be available shortly thereafter. Anyone wishing to receive a WPX Honor Roll application as soon as they are ready should send an s.a.s.e. to K4IIF. The business size envelope is preferred. The cut-off point is difficult to predict at this time, but if you have over 500 of the prefixes on the standard list confirmed in any of the 4 WPX categories you may be eligible.

* P.O. Box 205, Winter Haven, Florida 33880.

S.S.B. DX Awards: There were only 5 new certificates authorized during April, but as we move into May the tempo of applications is picking up. Award custodian **W8HDB** is doing an excellent job of reorganizing the files, and plans to come out with a better application blank in the near future. The S.S.B. DX Honor Roll will be a regular feature, and will list everyone with at least 250 countries confirmed. Applications and requests for information should be directed to Louise Rippe, W8HDB, 3785 Susanna Drive, Cincinnati, Ohio 45239.

The new certificate winners were:

100 Countries: G3PQF–508, K8DBW–509, OK3DG–510.

200 Countries: DL9CQ–152, K6CAZ–153.

S.S.B. DX HONOR ROLL

VK3AHO	314	WA8AJI	300	WA2IZS	293	W2LV	271
WA8AJI	312	WA2RAU	300	W2VCZ	291	G3NUG	270
W2TP	307	W4SSU	300	K1IXG	289	K8ONV	270
W2ZX	307	K6ZYG	300	K8RTW	288	G2PL	266
TI2HP	306	W4PAA	300	W1LLF	282	W6YMV	265
WØQVZ	305	I1AMU	300	W6UOU	282	G2BVN	264
K4TJL	305	W5KUC	300	W3KT	282	W3DJZ	263
W2BXA	304	KP4CL	300	W7DLR	277	G3DO	260
G3AWZ	303	G6TA	300	DL1IN	276	W6WNE	260
G8KS	303	W8EVZ	300	HB9TL	276	WA2EOQ	259
5Z4ERR	301	K2MGE	300	PZ1AX	275	PJ2AA	258
K6CTG	301	W3NKM	296	W6RKP	274	K1SHN	257
W8PQQ/		W2RGV	296	K9EAB	274	K6CAZ	254
W8BT	300	W2FXN	294	W4SSU	274	K6LGF	251
W4OPM	300	W3MAC	293	DL3RK	273	W1AOL	250

De Extra

Deliberate Interference to Contest Operations: This column has always felt that there were two sides to all questions. As a consequence it has gone to great lengths to be fair to each viewpoint. However, on this subject there is no in-between ground. The line between right and wrong is cleanly drawn with no gray area in the middle. Deliberate interference is wrong, bad wrong.

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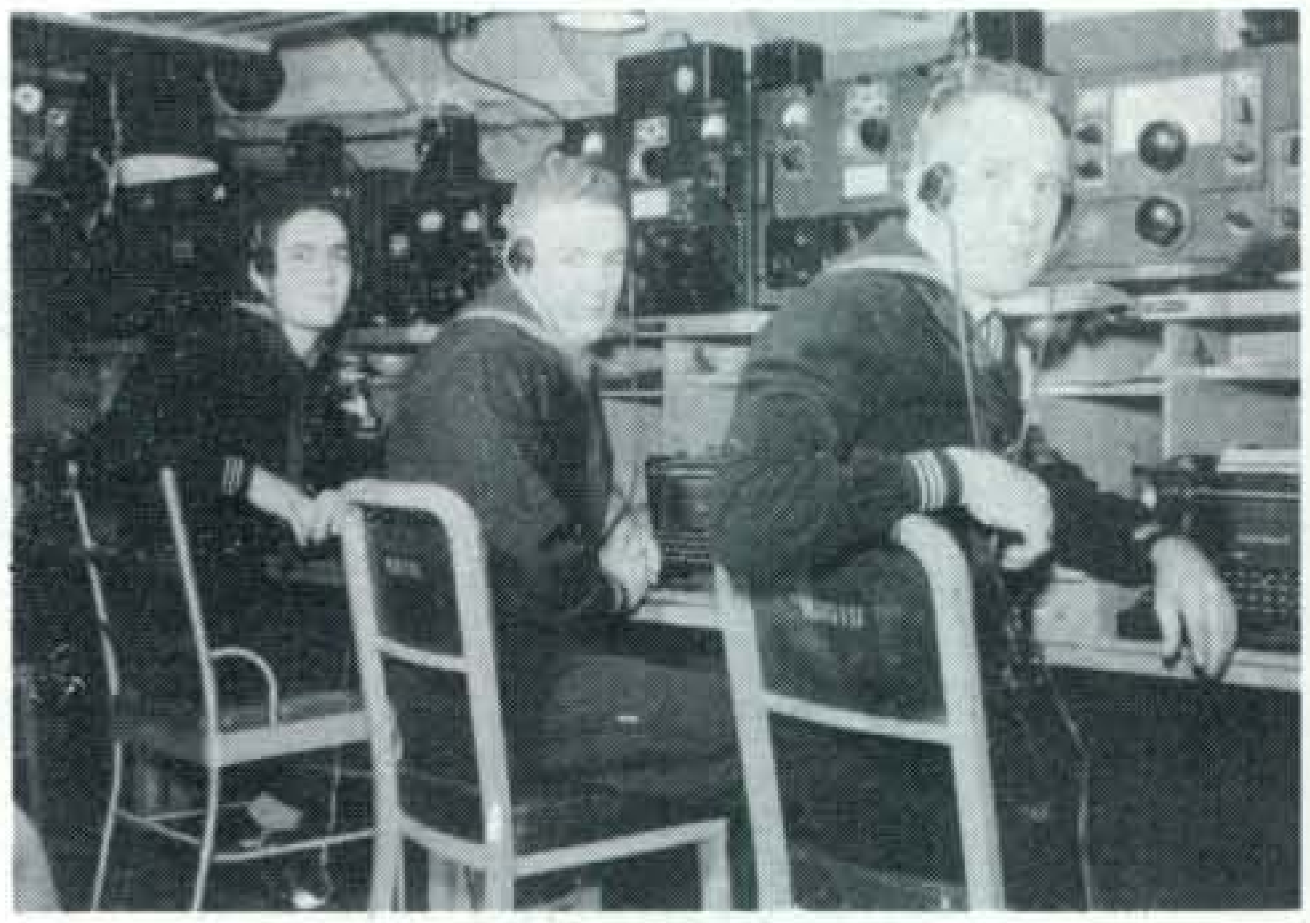

Here are "fore and after" shots of one of our real OT DXers, Ray, W2BAI, of Passaic, New Jersey. Ray was first licensed in 1928 as W2AMR and got back on the air again 3 years ago as W2BAI. He recently qualified for WAZ. On the left is Ray as he appears today, while on the right is Ray in 1943 operating in the Mediterranean Theatre as a Navy Radioman First Class.

For many years there has been a small clique of lids who have done their best to disrupt communications during DX contests, particularly on the 3.8 mc band. Phone DXing on this band has traditionally been confined to the frequencies between 3800 and 3805 kc. This is quite logical as 3800 is the lower limit of the U.S. phone band. Consequently, the DX stations, who frequently operate with very low power, can transmit between 3795 and 3800 and listen just above their own frequencies for W,K responses. This arrangement is generally quite effective, except for three weekends out of each year. These are the two weekends of the ARRL Phone DX Contest and the weekend of the *CQ* World Wide Phone DX Contest. Unfortunately, on these three weekends the loud-mouths have their field day.

In past years the stream of profanity which these characters have used in vilifying the contest entrants has been beyond belief. All one could do is shake one's head in pity that any person's mind could be that sick. Hippies to the contrary, four-letter words don't make great literature. It seemed pointless to report the matter to the FCC as it was inconceivable that anyone would say such things and then sign his own call. However, somebody must have felt differently because back about '64 or '65 an FCC monitoring station in Texas showed up for the 2nd phone weekend of the ARRL contest and things got squared away fast.

However, in this year's ARRL contest the lids were back in force, and while their language was cleaner their tactics were just as reprehensible. A difference this year from this columnist viewpoint is that he was hearing how it sounds to the stations in other countries, and it was a pretty sad thing. Yours truly was at Bahamian station VP7NA as a guest operator for about 12 hours of the contest. Shortly after midnight EST we got on 3795 kc to give the boys their 80 meter multipliers. It wasn't long before company arrived in the form of some crude, immature types who decreed that "there would be no DX contacts on 80 meter phone that night, no sir." They immediately spread out over the lower 10 kc of the band making meaningless noises in an attempt to disrupt communications. One of their favorites was the endless recitation of what they claimed were zipcode numbers. I'm sure the postoffice department didn't assign these numbers with the idea that they be used to interfere with legitimate, international communications.

After a while it became obvious that their scheme was not succeeding. Serious contesters generally have the best antennas and the loud-mouths simply couldn't cut the mustard. However, VP7NA and the other DX stations were working under different rules. In the Bahamas the power limit is 100 watts, and we were observing this limit strictly. When things began to go bad for the lids some self-appointed field general was heard to say "Go down and get that d—— VP7." Immediately two loud carriers appeared below 3800 taking out the signals from VP7NA and the other DX stations as well. VP7NA simply QSYed to 7 mc until after the children had gone to bed. However, some DX-stations threw in the towel and went QRT. One was heard to ask "Why do these crazy Americans try to break up the contest sponsored by their own national amateur radio society?" A hard question to answer isn't it!

The contest was over months ago, and this

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editor has thought long and hard about the advisability of writing this editorial. It amounts to hanging our own dirty laundry out for public view. This is generally a bad policy. However, the hour may be late so desperate measures are in order. The FCC regulations refer to the "amateurs unique ability to enhance international good will." Believe me, if we keep enhancing international good will as we do on 80 meters during DX contests there soon won't be any amateur radio around to enhance any good will, international or otherwise.

DXpedition QSLS

As of April 18, 1968, Art Altemiller, WØBN (ex-WØQKC) is the exclusive QSL Manager for all of Don Miller's operations from 1965-1968. Art's address is 8713 Charlton Lane, Affton, Mo. 63123. If s.a.s.e.'s or sufficient IRC's are sent cards will be answered by direct mail. Otherwise, they will go via the bureaus.

Re 3W8 Contacts

The following letter pertaining to the K8NHW/3W8 operation was received by W3AES and forwarded to *CQ* by WA3ATP:

"In reply to your letter dated March 6, 1968, please be advised that the South Vietnam operation by amateur radio station K8NHW does not appear to have received the necessary authorization from the South Vietnam government. Accordingly, the Commission will not permit United States amateur operators to communicate with that station.

Sincerely yours,
James E. Barr, Chief
Safety & Special Radio Services Bureau
FCC"

This letter was dated March 17, 1968. If anyone has any later information we will be glad to have it.

Here and There

CE9, South Shetland Islands: CE9AT is quite active evenings on 20 meter s.s.b. He frequently makes skeds through an m.c. (master of ceremonies), QSL to CE3ZN. *(Tnx WATTS).*

EA6ITU was on the air from April 29 to May 10, 1968 from Palma de Mallorca. Over 1000 QSO's were made on 15 and 20 meters. QSL's are in preparation and should be out by late June or early July. QSL manager, c.w., W4BV; phone, W3MR or W3ASK.

ET3, Ethiopia: ET3FMA (ex-K4FMA) likes 14215 kc s.s.b. around 0230-0300 GMT. *(Tnx LIDXA).*

F4, France: It is unlikely that there will be any F4's in the near future as the French P.T.T. has begun to issue 3-letter F6 calls, *i.e.* F6ABH. All F7's are probably off the air as these were U.S. servicemen in France. *(Tnx WA9FZQ/FØCV).*

HC8, Galapagos Islands: Rolf, HC8RS, is active on 14 mc s.s.b. from 2200-0100 GMT using a transceiver. QSL to SM5EAC. *(Tnx WATTS).*

HL9, Korea: HL9US with operators Paul (WA3EHT), Bob (WAØFIX), and Grant (WB6POH) will be very active on 15 and 20 meter c.w. and s.s.b. They will be keeping daily skeds on 14215 kc at 1130 GMT, and will be available for QSOs when these skeds have been finished. *(Tnx Tom Armstrong).*

I5, Italy: I5IJ during the *CQ* WPX fone contest was operated from Rome by Tony, I1IJ, with a special prefix for the contest only. *(Tnx I1IJ).*

JT1, Mongolia (Zone 23): The following stations have been reported active: JT1AJ 14195 kc at 1445 GMT, JT2AB 14040 kc at 1221 GMT, and JT1KAA 14057 kc at 0250 GMT. QSL via Box 639, Ulan Bator, Mongolia. *(Tnx LIDXA).*

JW7, Svalbard: JW7YF was worked on 14150 kc s.s.b. *(Tnx DX-MB).*

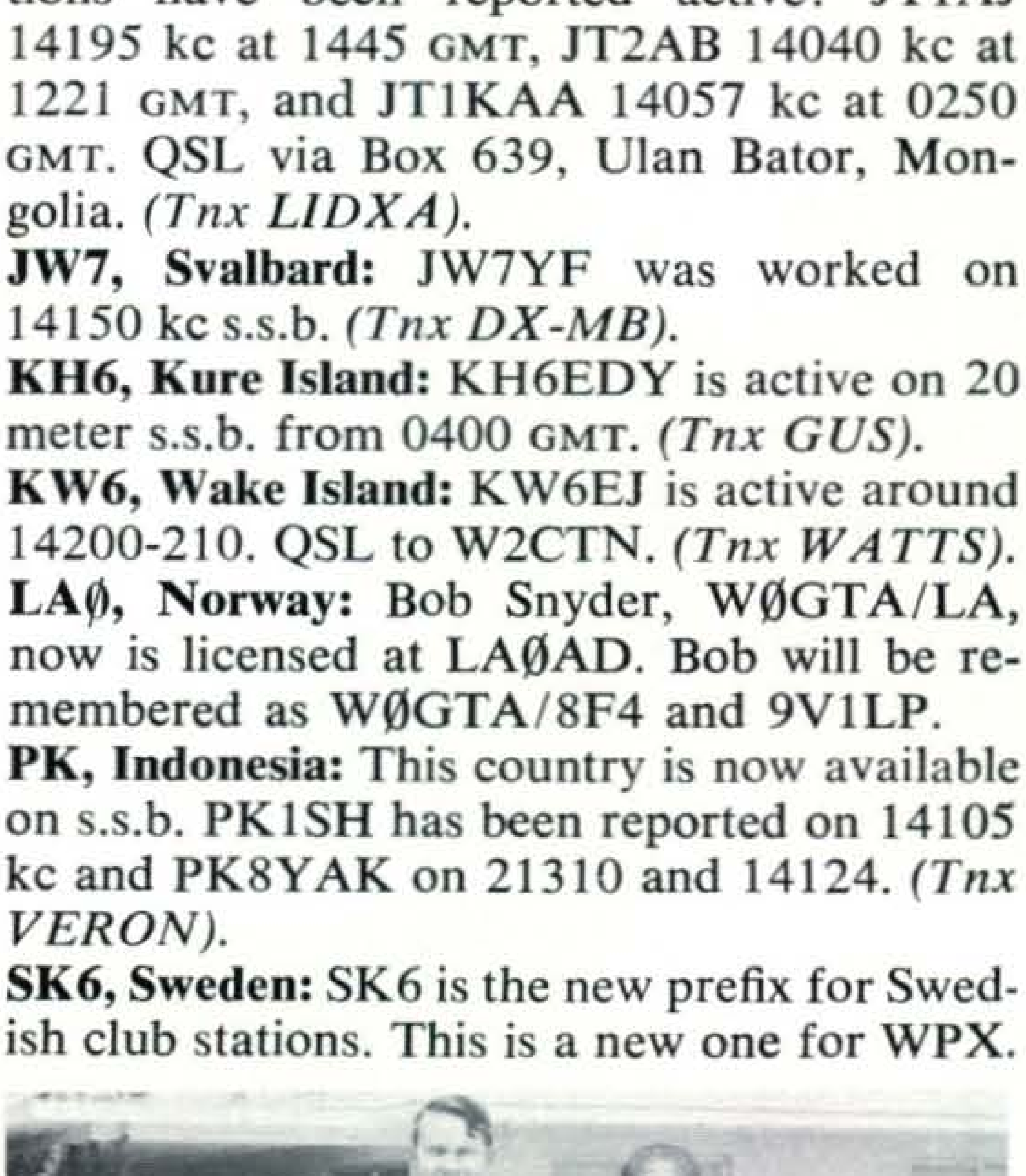
KH6, Kure Island: KH6EDY is active on 20 meter s.s.b. from 0400 GMT. *(Tnx GUS).*

KW6, Wake Island: KW6EJ is active around 14200-210. QSL to W2CTN. *(Tnx WATTS).*

LAØ, Norway: Bob Snyder, WØGTA/LA, now is licensed at LAØAD. Bob will be remembered as WØGTA/8F4 and 9V1LP.

PK, Indonesia: This country is now available on s.s.b. PK1SH has been reported on 14105 kc and PK8YAK on 21310 and 14124. *(Tnx VERON).*

SK6, Sweden: SK6 is the new prefix for Swedish club stations. This is a new one for WPX.



DX Editor K4IIF with VP7NA at the QTH of VP7NS.

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ST2, Sudan: Ibrahim, ST2SA, is still the only station making the Sudan available. He likes 14024 and 21035 kc c.w. *(Tnx VERON).*

TA, Turkey: TA1AV, TA1KT, and TA1QR are QRV on 20 meter c.w. and phone around 2100-2200 GMT. *(Tnx DX-MB).*

VK2, Lord Howe Island: VK5XK/VK2 reports that many QSLs sent were apparently destroyed in a post office fire. If yours didn't come through, send Arch another. *(Tnx VERON).*

VO2, Zone 2: VO2AC is active on 10 and 20 meter s.s.b. mostly in the Canadian band, G3UHR/VO2 is on 10 and 20 meter s.s.b., and VO2AB is on 20 meter s.s.b. between 14100 and 14200. VO2AB will be happy to go above 14200 for anyone who needs Zone 2. *(Tnx VO2AB).*

VP2, St. Vincent Island: VP2SY is on 20 meter s.s.b. between 14200 and 14220 evenings from 0040-0315 GMT. *(Tnx LIDXA).*

VR6, Pitcairn Island: VR6TC has a sked on Tuesdays at 2100 GMT on 21350 kc s.s.b. Wait until the sked is over before trying for a QSO. *(Tnx GUS).*

VS9, Maldive Islands: VS9MB is the only station now active from the Maldives. Listen around 21050 kc c.w. and 21350 kc s.s.b. *(Tnx VERON).*

XP1, Greenland: XP1AA is frequently on the air Sundays. His favorite frequency seems to be 14290 kc s.s.b. *(Tnx DX-MB).*

YA, Afghanistan: YA1ZC has been reported around 21052 kc c.w. between 1500 and 1800 GMT. QSL to Box 639, Kabul, Afghanistan. *(Tnx GUS).*

ZD7, St. Helena Island: ZD7FF was worked on 14199 kc s.s.b. at 2319 GMT. *(Tnx LIDXA).*

ZM7, Tokelaus Islands: To be activated by VE7PY during the *CQ* WW Phone DX Contest in October. *(Tnx GUS).*

ZS3, South West Africa: ZS3LU is active on c.w. near 14013-015 kc. *(Tnx VERON).*

3V8, Tunisia: 3V8TA was heard on 21152 kc at 1935 GMT. *(Tnx LIDXA).*

4A, Mexico: This prefix will be used by Mexican stations during the Olympic year and will be a new one for WPX. The station working the most 4A's will receive a gold medal, the second highest number a silver medal, and the third highest a bronze medal. For further information contact 4A2YP (XE2YP). *(Tnx GUS).*

5A3, Libya: 5A3TP has been reported from Benghazi on 14051 kc c.w. *(Tnx VERON).*

6O, Somali Republic: Bee Walton, ex-6O6BW, is now in Alaska as KL7GFN. *(Tnx GUS).*

7Z3, Saudi Arabia: 7Z3AB is on the air daily between 1200 and 1300 GMT. Preferred frequencies are 14190 kc for s.s.b. and 14035 kc for c.w. QSL via W4YDD. *(Tnx GUS).*

QSL Information

As it is almost impossible to stay up-to-date, all QSL Managers are urgently requested to notify the DX Department of all additions and deletions to their lists.

AP2MR—Via VE3ACD.
CEØAE—c/o WA5PUQ.
CEØPK—To WB6CDX.
CN8FV—Via W2GHK (D.O.T.M.), *not* via W2CTN.
CR5SP—c/o W2GHK.
CR6IK—To K3ZVM.
CR7IC—P.O. Box 135, Porto Amelia, Mozambique, East Africa.
CT1JJ—Via W6LDA, 6158 W. 74th St., Los Angeles, Calif. 90045.
CT2AA—Via WAØOMN, 1116 Hilliard Rd., St. Louis, Mo. 63122.
EA4CX—c/o WAØCEL.
EAØAH—To W4DQS.
FG7II/FS7—Via VE3EUU.
FG7TG—c/o W5BUK, 2609 Halsey Ave., New Orleans, La. 70114.
FO8BQ—To WA6WMG, 251 Lurelane St., Rialto, Calif.
FO8CA/p—Via F2RS.
G3XEM/HZ—P. K. Booth, c/o Airwork Services, Ltd., P.O. Box 2142, Jeddah, Saudi Arabia.
HBØLL—c/o WA4QVQ.
HL9US—QSOs since March 28, 1968 via T. R. Armstrong, 365 Whitten Hollow Rd., New Kensington, Pa. 15068.
HV3SJ—To WB2ETI.
HZ1AT—Via G3DYY.
I5IJ—c/o I1IJ, 10 Piazza Bologna 00162, Rome, Italy.
17RUI—To I1ZIZ, Via Gustavo Modena 13, Firenze, Italy.
I8CLC—Via I1CLC, Via Del Cappuccini 12, Firenze, Italy.
IT7GAI—c/o IT1GAI.
JT1AG—To UA1CK, Vladimir Cuploon, P.O. Box 2, GPO, Leningrad, USSR.
JW2BH—Via LA5YJ.
JX7RR—c/o LA7RO.
KG6IC—USCG Loran Station, APO San Francisco, CA 96415.
LAØAD—To W2CTN.
MP4MBC—Via G3HSR, 11 The Crescent, Milton, Weston-super-Mare, Somerset, England.
OD5EP—c/o WB2ISL.
OX3WY—To OZ2BA.
OY7S—Via VE3FYR.
PJ5MJ—c/o W2BBK, 79 Glenwood Rd., Englewood, N.J.
PJ5MM—To K9GCE.
PYØBLR—Via PY4BLR.
SK3AK—c/o SM3CZS.
UA1KAC—To WB4FJO.
VK9GN—Via K7YDO. •

[*Continued on page 112*]

Propagation

BY GEORGE JACOBS,* W3ASK

PROFESSOR M. Waldmeier, director of the Swiss Federal Observatory has recently predicted that the peak of the present sunspot cycle will occur this month (July, 1968), with a smoothed sunspot number of 110.

This is an earlier date and a somewhat lower value of peak solar intensity than had been predicted previously by Professor Waldmeier, and by other experts. For example, the Editor of this column, in January, 1968 issue of *CQ* (page 93), predicted a cycle peak of 123 to occur during November or December of this year.

It will be several more months, perhaps as long as a year, before the exact date and level of maximum solar intensity will be known with any degree of accuracy. It is certain, however, that maximum solar intensity is near at hand, if it has not already occurred!

The Swiss Federal Observatory reports a monthly sunspot number of 81 for April, 1968. This results in a smoothed sunspot number of 95, centered on October, 1967. A smoothed sunspot number of 114 is predicted for July, 1968 by the Editor of this column.

July Propagation

Both the 15 and 20 meter bands are expected to share honors for optimum DX propagation conditions during July.

Excellent world-wide openings are forecast for 15 meters throughout the daylight hours, and through the evening hours as well. Conditions are expected to peak on this band during the late afternoon and early evening hours, with excellent openings in almost all directions.

Twenty meters is expected to remain open to one area of the world or another, around-the-clock. Although DX openings should be possible at almost any hour, optimum world-wide conditions are forecast during the early evening, the hours of darkness and the sunrise period.

Some good 10 meter DX openings are expected during July, mainly on north-south paths during the afternoon hours.

During the hours of darkness, 40 meter openings are expected to many areas of the world, but seasonally high static levels may often make DX reception difficult. High static levels are also expected to result in somewhat

* 11307 Clara Street, Silver Spring, Md. 20902.

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for July 1 through Aug. 15, 1968

Days	*Forecast Rating & Quality* (4)	(3)	(2)	(1)
Above Normal: **1, 8, 13, 15, 19-20, 28-29,** 8, 12	A	A-B	B	B-C
Normal: **2, 5-6, 9-11, 14, 16, 18, 21-23, 25-27, 30,** 3-4, 6-7, 9-11, 13, 15	A-B	B	C	D
Below Normal: **3-4, 7, 12, 17, 24, 31,** 1-2, 5, 14	B-C	C-D	D	E
Disturbed: **None, None**	C-D	D-E	E	E

HOW TO USE THESE CHARTS

The following is an explanation of the symbols shown above, and instructions for the use of the *CQ* propagation predictions:

1—Enter Propagation Charts on following pages under appropriate band and distance or geographical area columns. Read predicted times of band openings at intersection of both columns.

2—Following each predicted time of band opening is a forecast rating which indicates the relative number of days the band is expected to open during each month of the forecast period. The higher the rating, the more frequent the opening, as follows: (4) band open more than 22 days each month; (3) between 14 and 22 days; (2) between 8 and 13 days; (1) less than 7 days.

On the "Short-Skip" Chart, where two numerals are shown within a single set of parenthesis, the first applies to the shorter distance for which the forecast is made, and the second to the greater distance. Note the forecast rating for later use.

3—With the forecast rating noted above, start with the numbers in parenthesis at the top of the "Last Minute Forecast" appearing above. Read down the table for a day-to-day forecast of propagation conditions in terms of Above Normal (WWV rating higher than 6); Normal (WWV rating 5-6); Below Normal (WWV rating 4); Disturbed (WWV rating less than 4). The letter symbols (A-E) describe reception conditions (signal quality, noise and fading levels) expected for each day of the month and have the following meanings: (A—excellent opening with strong, steady signals; B—good opening, moderately strong signals, little fading and noise; C—fair opening, signals, fluctuating between moderately strong and weak; D—poor opening, signals generally weak and considerable fading and noise; E—poor opening, or none at all.

4—This month's Propagation Charts are based upon a transmitter power of 75 watts c.w.; 150 watts s.s.b., or 300 watts d.s.b., into a dipole antenna one quarter-wave above ground on 160, 80 and 40 meters and a half-wave above ground on 20, 15 and 10 meters. For each 10 db increase above these reference levels, reception quality shown in the "Last Minute Forecast" will improve by one level; for each 10 db loss, reception will become poorer by one level.

5—Local Standard Time for these predictions is based on the 24-hour system.

6—These Propagation Charts are valid through Sept. 15, 1968. These Charts are prepared from basic propagation, data published monthly by the Institute For Telecommunication Sciences And Aeronomy of the U.S. Dept. of Commerce, Boulder, Colorado.

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poorer DX conditions on 80 meters, although some openings are forecast during the hours of darkness. Not many DX openings are expected on 160 meters during July, because of seasonally high level of static and solar absorption.

Check last month's column for comprehensive band-by-band DX propagation predictions for July.

Short-Skip

This month's column contains Short-Skip Charts for the period July 15-September 15, 1968. Optimum short-skip conditions on most bands are expected during July, mainly as a result of the seasonal peak expected in sporadic-E propagation. During the daylight hours considerable short-skip openings are forecast for 10 and 15 meters over distances ranging between approximately 500 and 1300 miles, with some double-hop openings extending out to 2300 miles. Frequent short-skip openings on 20 meters, ranging between 250 and 2300 miles, are expected almost around-the-clock, with conditions peaking during the late morning hours and again during the late afternoon and early evening hours.

Good daytime short-skip openings are predicted for 40 meters between distances of approximately 100 and 600 miles, with excellent nighttime openings between 250 and 2300 miles. Good 80 meter short-skip openings are forecast for the daylight hours up to distances of approximately 300 miles, with the range extending up to 2300 miles during the hours of darkness. While no 160 meter short-skip openings are expected during the daylight hours, some openings are forecast during the hours of darkness for distances up to 1300 miles. When static levels are low, 160 meter nighttime openings may extend out to approximately 2300 miles.

V.H.F. Ionospheric Openings

With a peak expected in sporadic-E propagation, frequent 6 meter short-skip openings are likely to occur during July. Most of these openings will probably fall within the 900 to 1300 mile range, but some may be as great as 2300 miles. The most likely times for these openings are a few hours before noon and again during the early evening hours, although they could take place at any time of the day or night. During many of these openings, signal levels are expected to be exceptionally strong.

Be sure to check the 2 meter band during intense 6 meter sporadic-E openings, since 2 meters may occasionally open as well. Generally, 2 meter short-skip openings take place between distances of approximately 1000 and 1300 miles.

Some v.h.f. short-skip openings resulting from auroral ionization are also expected during the month. Check the "Last Minute Forecast" appearing at the beginning of this column for periods that are predicted to be disturbed or below normal; since these are the dates that auroral v.h.f. openings are most likely to occur during July.

There is a very good possibility for some meteor-type v.h.f. ionospheric openings to take place during the last week of July, when the *Perseids* and the *Aquarids* meteor showers will take place. The *Perseids* is a major shower, and will extend into August. ■

CQ Short-Skip Propagation Chart

JULY 15 - SEPTEMBER 15, 1968

LOCAL STANDARD TIME AT PATH MID-POINT
(24-HOUR TIME SYSTEM)

Band (Meters)	*50-250 Miles*	*250-750 Miles*	*750-1300 Miles*	*1300-2300 Miles*
10	*Nil*	07-09(0-1)* 09-13(0-2)* 13-17(0-1)* 17-21(0-2)* 21-23(0-1)*	07-09(1)* 09-13(2-3)* 13-17(1-2)* 17-21(2-3)* 21-07(1)*	07-09(1-0)* 09-13(3-1)* 13-17(2-1)* 17-21(3-1)* 21-07(1-0)*
15	*Nil*	07-09(0-2)* 09-13(0-3)* 13-17(0-2)* 17-19(0-3)* 19-21(0-2)* 21-07(0-1)*	07-09(2)* 09-13(3)* 13-17(2)* 17-10(3)* 19-21(2)* 21-23(1-2)* 23-07(1)*	07-09(2) 09-13(3) 13-17(2-3) 17-19(3-4) 19-21(2-3) 21-23(2) 23-07(1)*
20	09-00(0-1)*	06-09(0-2)* 09-15(1-4)* 15-20(1-3)* 20-00(1-2)* 00-06(0-1)*	06-09(2-4) 09-15(4) 15-20(3-4) 20-00(2-4)* 00-02(1-3)* 02-06(1-2)*	06-09(4) 09-16(4-3) 16-00(4) 00-02(3) 02-06(2)
40	07-11(2-4) 11-20(3-4) 20-22(2-3) 22-00(1-2) 00-06(0-2)* 06-07(1-2)	07-09(2-4)* 09-11(4-3) 11-16(4-2) 16-18(4-3) 18-20(4) 20-22(3-4) 22-04(2-4) 04-07(2-3)	07-09(4-2) 09 11(3-1) 11-16(2-1) 16-17(3-1) 17-18(3-2) 18-20(4-3) 20-04(4) 04-05(3-4) 05-07(3)	07-17(1-0) 17-18(2-1) 18 20(3-2) 20-05(4) 05-06(3-2) 06-07(3-1)

† Hawaiian Standard Time is 5 hours *behind* EST; 4 hours *behind* CST; 3 hours *behind* MST; 2 hours *behind* PST and 10 hours *behind* GMT or Z Time. For example, when it is Noon in Honolulu, it is 17 or 5 P.M. in NYC, EST.

‡ To convert to Local Standard Time in Alaska, *subtract* 8 hours in the Pacific Standard Time Zone; 9 hours in the Yukon Zone and 10 hours in the Alaskan Standard time Zone, from the GMT times shown in the Chart. GMT is 5 hours ahead of EST; 6 hours *ahead* of CST; 7 hours ahead of MST and 8 hours ahead of PST. For example, when it is 18 GMT it is 13 or 1 P.M. EST in NYC.

* Predominantly Sporadic-E openings.

** Indicates predicted 80 Meter openings. Openings on 160 Meters are also likely to occur during those times when 80 Meters openings are shown with a forecast rating of (2) or higher.

[*Continued on page 114*]

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Q AND A

BY WILFRED M. SCHERER,* W2AEF

MANY readers have expressed a desire to see more questions and answers published; therefore, since only a given amount of space can be allotted to the Q & A Column for each issue, we'll make this month's introduction a short one to permit room for more of the requested material.

Full Value From Radio Magazines

Amateurs often comment that they cannot afford this-or-that magazine related to amateur radio, no less subscribing to all those available. Others feel that one or another publication does not contain enough articles in a particular classification or has too many other types not to the reader's liking. While these reasons may have some merit from an economical or interest standpoint, this need not otherwise be necessarily so; provided, every effort is made to get the most value out of each issue.

How can this be done? Simple—read every word from cover-to-cover, including the advertisements. Now hold on—why read a lot of stuff in which you're not interested? Again, the answer is simple—such a procedure will provide you with a storehouse of knowledge for present or future reference, stimulate your thinking, possibly lead you to other interesting areas not previously thought of or to enjoyable reading, provide material to help you to *intelligently* discuss a wide variety of subjects with fellow amateurs, keep you abreast of the latest technical and operating advances as well as amateur activities, learn about new gear, provide the germ for a new idea or two, furnish hints that may enable you to help yourself or others, let you see what the other fellow is doing whether it be construction, design, operating or accomplishments, stir up competitive spirit, provide thoughts on generating good fellowship and promoting amateur radio.

* Technical Director, *CQ*.

Even though certain type articles or features are not of particular interest to you at the moment, some day such may be the case and when you need some information on one of the subjects covered in the past, you'll remember having seen something on it around a certain time in such-and-such a magazine, thus enabling you to know about where to go for the data.

Who knows?—you may unwittingly pick up an idea or two that will be worth a whole year's subscription—less than an amount you might spend anyway for an item towards improving your operations. Also, no matter where your amateur-radio interests lie, you may find some facet of value in the other areas that will add more pleasure to the privilege of being a ham.

Yes, even the classified ads can provide interesting reading as to what is going on in the used-gear field, particularly relating to the resale value of equipment. In addition, you may run across an unlooked-for bargain or help out a friend in search for certain gear.

So, no matter which magazines you read, why not at least try the above suggestions for several months. Doing so may possibly be of greater value than even anticipated.

Decreasing Low A.F. Response With S.S.B. Transmitter

QUESTION: I use a Collins KWM-2 Transceiver, a Waters Compreamp and a Collins SM-2 dynamic microphone. My voice is quite low, so I'd like to electronically increase the h.f. response of the equipment. What circuit or component changes will do the job?

ANSWER: The best approach to your problem is to reduce the low-frequency response of the equipment with a roll-off below 1000 c.p.s. This is most easily accomplished by reducing the value of one or more interstage-coupling capacitors in the mic-amplifier lineup.

Approximate response curves for various values of C with a load resistor, R, of 1 megohm are shown at fig. 1. Which characteristic is suitable will require a little cut-and-try procedure, since the actual response of your voice is not known.

The easiest change will be at the *output* of the Compreamp. Open it up and insert the necessary size capacitor in series with the lead to the output connector. The input impedance of the KWM-2 is about 1 megohm, so the decrease in l.f. response should be close to the characteristics indicated by the related curve for the value of C. C_1 in the KWM-2 also could be altered.

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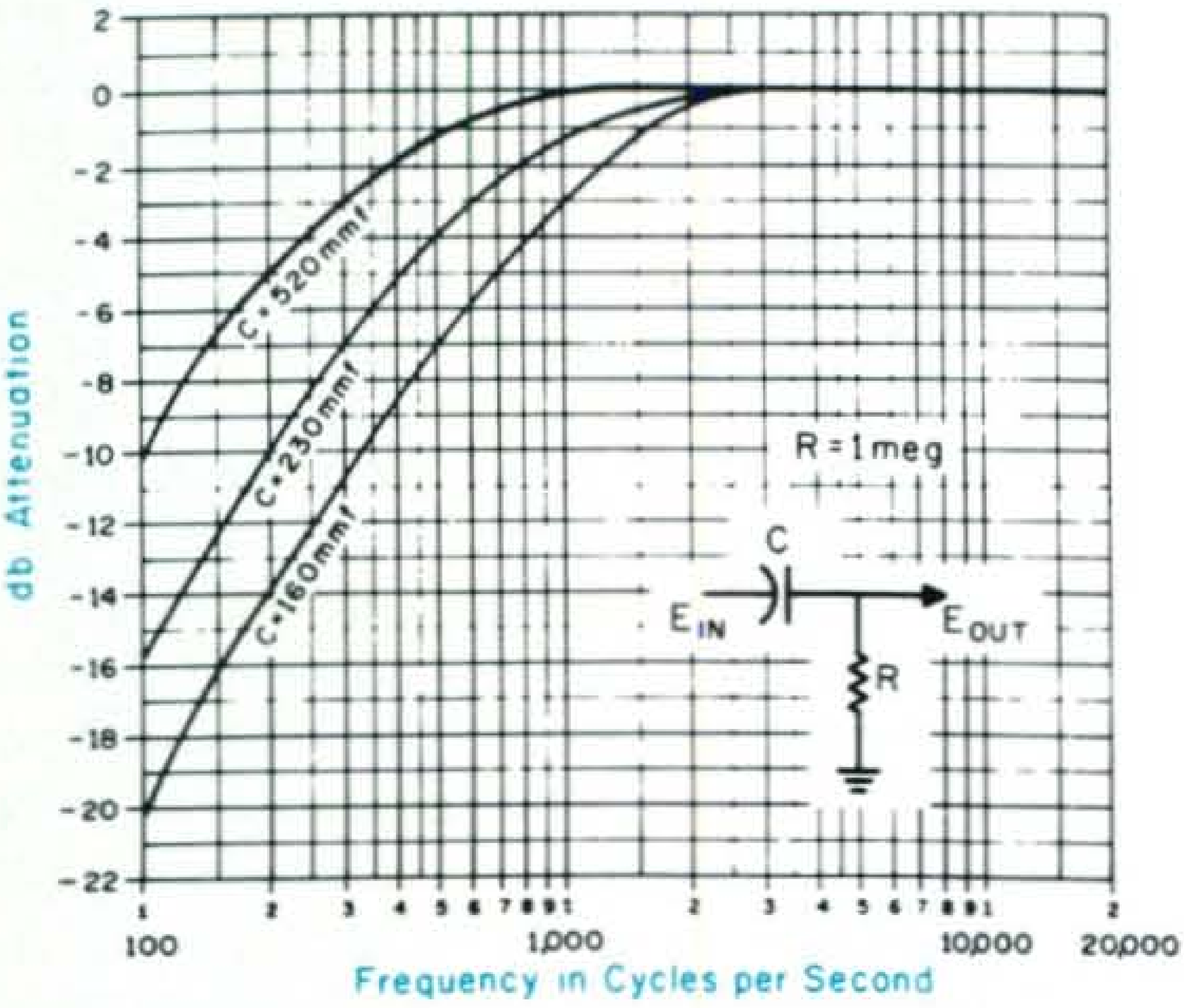


Fig. 1—Low-frequency roll-off response curves with various size a.f. interstage coupling capacitors used with 1 meg. load resistor. Other values of R and C may be substituted while maintaining indicated ratio R/X_c, where X_c is capacitive reactance @ 100 c.p.s. ($X_c = 1/2\pi fc$). A—C = 520 mmf, $R/X_c = 1/3$. B—C = 230 mmf, $R/X_c = 1/6$. C—C = 160 mmf, $R/X_c = 1/10$.

Another change might be at the input to the compreamp where the .01 mf coupling capacitor might be reduced to 500-1000 mmf. This should result in a response near that of curve A. This change will be more difficult to make, since it involves the printed-circuit board.

There are advantages and disadvantages with the changes made at different points. With the capacitor reduced at the *input* of the Compreamp, there will be less clipping of the lows (in comparison to the highs) with a given mic level and less in-band distortion; however, the output (with all frequencies clipped) may still be fairly flat.

With a small coupling capacitor at the *output* of the Compreamp, the desired roll-off will be fully maintained, but any in-band distortion due to clipping of the lower frequencies in the unit, may be accentuated. The best bet might be a compromise with a moderate roll-off at both points.

Another expedient, but more costly, would be to change the mic to an Astatic D-104. This is a crystal job which has a sharp rising characteristic that peaks near 2000 c.p.s. For this reason these mics were used considerably with a.m. transmitters where the highs usually are attenuated due to the sharp selectivity characteristics and sideband clipping of the i.f. system in the conventional communications receiver.

Swiss Quad

Queries are occasionally received concerning the Swiss Quad. For those who in the future may desire information related thereto, we suggest reference be made to the *RSGB Bulletin* for June 1964 (published by the Radio Society of Great Britain), where the design and construction of this antenna was originally described.

Heat Sink for Power Resistors

Here is a suggestion submitted by Richard Mollentine, WAØKKC, 19 Edgemere Court, Olathe, Kansas 66061:

Heat sinks for wire-wound vitreous-enamel or ceramic-insulated power resistors may be made using adjustable sliders as shown at fig. 2. The internal-contact "bump" should be removed, so the slider makes a good contact all around the insulation. A copper or aluminum sheet or bar, attached to the sliders, serves as the heat-dissipating element. Additional "sinking" may be obtained by fastening the bar to the chassis using silicon heat-sink compound. Thanks, Dick.

Heathkit HO-10 Monitorscope for 50 Kc

QUESTION: How should the Heath HO-10 Monitorscope be used with the Hallicrafter SX-117 receiver which has a last i.f. of 50.75 kc?

ANSWER: Since the vertical amplifier in the Heath HO-10 Monitorscope is designed for frequencies below 500 kc. it may be used directly with the 50.75 kc of the SX-117.

To do so, connect the Vertical input of the scope with a shielded lead through a 22 mmf capacitor to pin 3 of V_{10B}. This may be picked up at the tie point to which C_{83} also is connected. If more gain is needed, increase the scope-coupling capacitor to 50 or 100 mmf.

In order to obtain the most faithful repro-

[*Continued on page 110*]

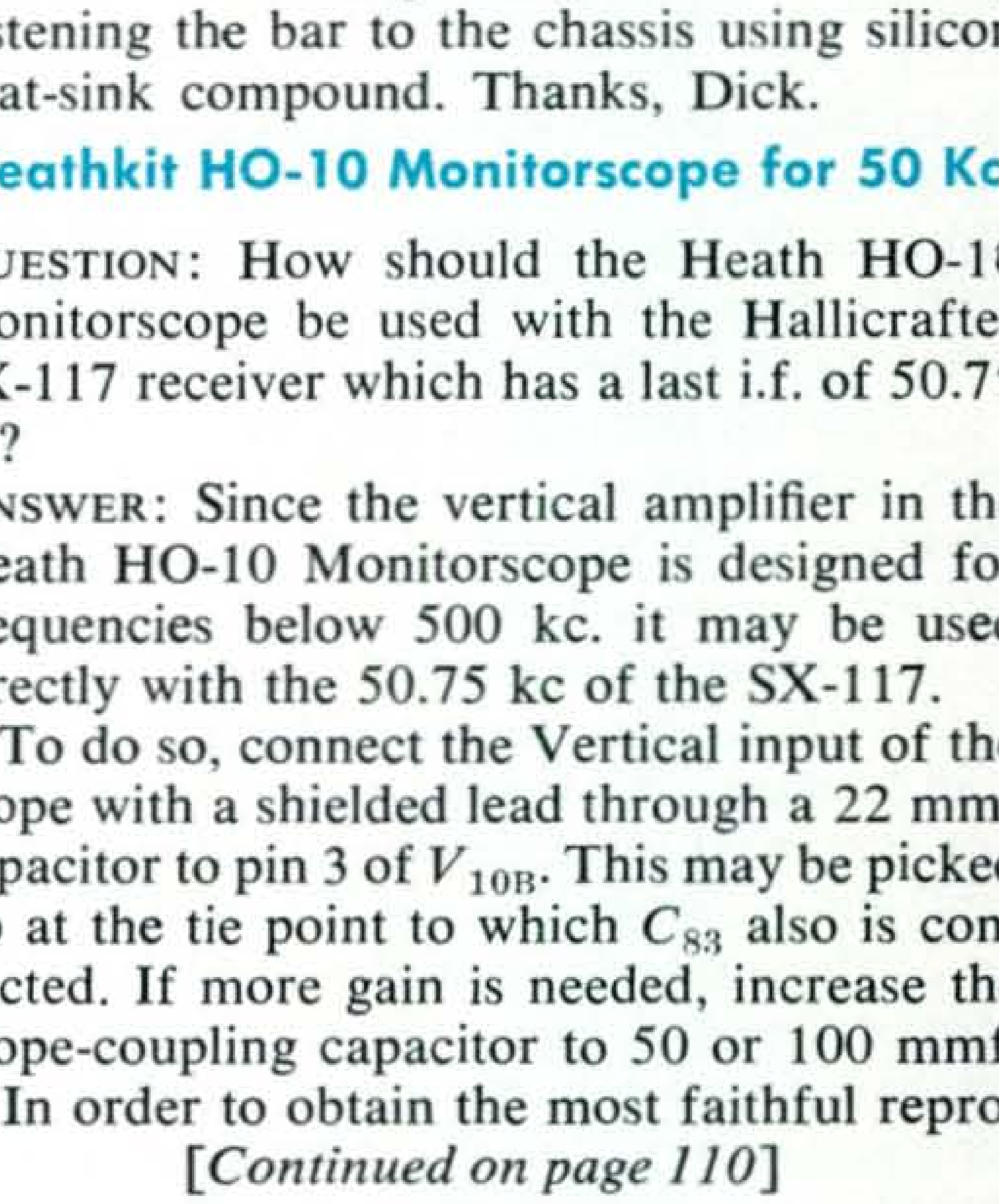
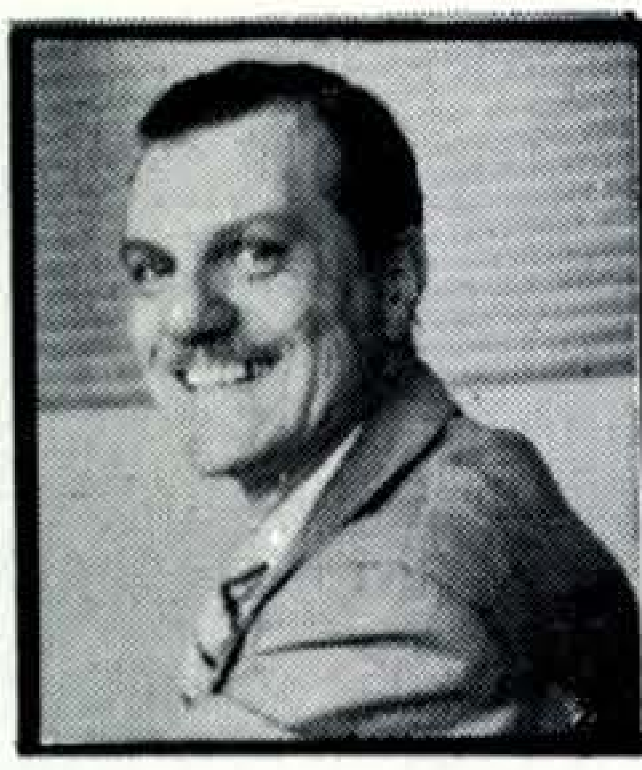


Fig. 2—Method of heat sinking large wire-wound power resistors using slider taps normally used with adjustable resistors.

See page 118 for New Reader Service



Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

July	3-5	KA Field Day
July	6-7	Venezuela Contest
July	20-21	Colombia Contest
July	27-28	County Hunters C.W. Party
August	3-4	Romania Contest
August	3-4	Maryland & D.C. QSO Party
August	10-11	DARC WAE C.W. Contest
August	10-11	LAMBRE C.W. Contest
August	24-25	QRP QSO Party
August	24-25	All Asian DX Contest
Aug. 31 - Sept. 1		LAMBRE Phone Contest
September	7-8	VU/4S7 C.W. Contest
September	14-15	VU/4S7 Phone Contest
September	14-15	DARC WAE Phone Contest
September	14-15	SAC C.W. Contest
September	21-22	SAC Phone Contest
October	5-6	C.A.R.T.G. (RTTY) Contest
October	5-6	WADM C.W. Contest
October	5-6	VK/ZL/Oceania Phone
October	12-13	VK/ZL/Oceania C.W.
October	12-13	RSGB 28 mc Phone Contest
October	16-17	YLRL Anniv. C.W. Party
October	19-20	Boy Scout Jamboree
October	**26-27**	**CQ WW DX Phone Contest**
October	26-27	RSGB 7 mc C.W. Contest
November	2-3	Okinawa (KR6) Contest
November	6-7	YLRL Anniv. Phone Party
November	9-10	OK C.W. DX Contest
November	9-10	RSGB 7 mc Phone Contest
November	9-11	ARRL SS Phone Contest
November	16-18	ARRL SS C.W. Contest
November	**23-24**	**CQ WW DX C.W. Contest**

KA Field Day

Starts: 0900 GMT Wednesday, July 3
Ends: 0900 GMT Friday, July 5

Check last month's CALENDAR and W2GT's Column for details.

Your QSL's go to: Far East Auxiliary Radio League, Box C-89, APO San Francisco 96525

Venezuela Contest

Starts: 0000 GMT Saturday, July 6
Ends: 2400 GMT Sunday, July 7

Complete details in last month's CALENDAR

Mailing deadline Sept. 15th to: Radio Club Venezolano, Independence Contest, P.O. Box 2285, Caracas, Venezuela.

* 14 Sherwood Road, Stamford, Conn. 06905.

Colombia Contest

Starts: 0000 GMT Saturday, July 20
Ends: 2400 GMT Sunday, July 21

This one also covered in last month's CALENDAR.

Logs must be in hands of the committee before September 30th. They go to: The L.C.R.A. Colombia Independence Contest, Box 584, Bogota, Colombia.

County Hunters C.W. Party

Starts: 0000 GMT Saturday, July 27
Ends: 2400 GMT Sunday, July 28

This year's party is sponsored by the South Shore A.W.A. A station may be worked once per band and may be contacted again if he moves to a different county. DX stations may be worked for QSO credit but do not count as a multiplier.

Exchange: RST report plus a progressive 3 digit QSO number starting with 001, county and state.

Scoring: Number of QSOs multiplied by number of different counties worked.

Frequencies: 3575, 7055, 14070, 21070.

Awards: Certificates to the top scorers in each state and each country, as well as the top three scorers world-wide.

Logs: Date/time in GMT, station worked, exchange sent/received, band and indicate each new multiplier as it is worked. Include a summary sheet with total claimed score, name and address in BLOCK LETTERS and other pertinent information. Also include a s.a.s.e. for copy of results.

Mailing deadline is Aug. 31st and logs go to: South Shore Amateur Wireless Assoc., 32 Elmwood Street, Valley Stream, N.Y. 11581

Maryland/District of Columbia QSO Party

Starts: 2200 GMT Saturday, August 3
Ends: 2200 GMT Sunday, August 4

This is the third MD/DC QSO Party sponsored by the Maydale A.R.C. A station may be contacted once on each band and mode.

SARL Contest Committee secretary, Aila, OH2BIN, smiling after the job of checking almost 1000 SAC contest logs has been completed. Contest Chairman, OH2XK, said the stack of logs weighed 70 lbs. Wonder what Aila's expression would have been if she had to go through 250 lbs. of paper, almost 3000 logs (our total last year)?

Separate logs are requested for each mode and each band.

Exchange: QSO Nr., RS/RST, QTH. Counties for MD/DC stations, ARRL section or country for others. (Baltimore and Wash. D.C. count as separate counties.)

Scoring: Two points for each completed QSO. MD/DC multiply total QSOs by ARRL sections and countries worked. All others use Maryland counties as their multiplier. (Max. of 25)

Frequencies: 3575, 3850, 7075, 7275, 14075, 14275, 21075, 21325. Also 50.2 and 145.2. Novices: 3735, 7175, 21110.

Awards: Certificates to top scorers in each ARRL section and country. (Total from all bands and modes.) Second and third place awards will be made in sections where participation high.

Logs: Should show date/time in GMT, station worked, RS/RST sent and received, and QTH. A summary sheet with the scoring, name and address in BLOCK LETTERS and a signed declaration that all rules and regulations have been observed.

Logs go to: Carl E. Andersen, K3JYZ, 14601 Claude Lane, Silver Spring, Maryland 20904. Mailing deadline Sept. 1st. Include s.a.s.e. if a copy of results are desired.

DARC WAE Contest

C.W.—August 10-11. **Phone**—Sept. 14-15

Starts: 0000 GMT Saturday. Ends: 2400 GMT Sunday in each instance.

This is the 14th "Worked All Europe" DX Contest sponsored by the DARC. Some minor modifications have been made to the rules of previous years, the most notable being the addition of a rest period.

All bands, 3.5 thru 28 mc, may be used, the same station may be worked once on each band for QSO and multiplier credits.

Classifications: Single operator and Multi-operator, both single and multi transmitter.

Rest Period: Only 36 hours out of the 48 hour contest period allowed for single operator stations. The 12 hours of non operation may be taken in one or two periods any time during the contest. The periods need not be equal but must total at least 12 hours and clearly shown on the log.

Exchange: The usual five or six digit serial numbers, RS/RST plus a progressive QSO number starting with 001. (Multi transmitter stations should use separate series of numbers for each band)

Points: Each QSO counts 1 point, except on 3.5 mc where it counts 2 points.

Multiplier: The multiplier for non-Europeans is determined by the number of European countries worked on each band. (See WAE list)

Europeans use the ARRL country list for their multiplier. In addition each call area in JA, PY, VE/VO, VK, W/K, ZL, ZS, UA9 & UAØ all are multipliers.

Scoring: Final score, total QSO joints plus QTC points multiplied by sum of countries from each band.

QTC-Traffic: Additional points may be realized by use of the QTC feature. A QTC is a report of a confirmed QSO that has taken place earlier and later sent back to a European station. It can only be sent from a non-European to a European. The general idea being that after a number of European stations have been worked, a list of these stations can be reported back during a QSO with another station. An additional 1 points credit can be claimed for each station reported.

a. A QTC contains the time, call and QSO number of the station being reported. ie: 1300/DJ3KR/134. This means that at 1300 GMT you worked DJ3KR and received number 134.

b. A QSO can be reported only once and not back to the originating station.

c. A maximum of 10 QTCs to a station per band is permitted. The same station may be worked several times to complete this quota. Only the original contact however has QSO point value.

d. Keep a uniform list of QTCs sent. QTC 3/7 indicates that this is the 3rd series of QTCs sent and that 7 QSOs are being reported.

Awards: There will be three power divisions for award purposes: (a) up to 200 watts input, (b) more than 200 watts, (c) newcomers licensed less than one year.

Certificates to the highest scorers in each classification in each country and country/district listed. 2nd and 3rd place awards will be given in areas of sufficient participation, and continental leaders will also be honored.

There are Trophies for both Europe and non-Europeans that are the leaders in each of the three operating categories.

A minimum of at least 4 hours of operating is required to be eligible for an award.

WAE Endorsements: Contest contacts can be used for WAE certificate endorsements providing the log of the requested station is also received.

Disqualification: Violation of the rules of the contest, or unsportsmanship conduct, or taking credit for excessive duplicate contacts will be deemed sufficient cause for disqualification.

See page 118 for New Reader Service

Logs: It is suggested you use the log sheets of the DARC or equivalent, 40 QSOs or QTCs per sheet. Use a separate sheet for each band, and a summary sheet showing the scoring and your name and address in BLOCK LETTERS. Include a s.a.e. and IRCs with your request for official log forms.

Mailing deadline is Sept. 15th for C.W. and Oct. 15th for phone. Mail logs and requests to: Walter Skudlarek, DJ6QT, An der Klostermauer 3, D-6471, Hirzenhain, West Germany.

WAE Country List

CT1, CT2, DL/DJ/DK/DM, EA, EA6, EI, F, FC, G, GC, GD, GI, GM, GM Shetland Is., GW, HA, HB, 4U1ITU, HBØ, HV, I, IS, IT, LA, LA Bear Is., JX, JW, LX, LZ, M1/9A, OE, OH, OHØ, OK, ON, OY, OZ, PA/PI, PX, SM/SL, SP, SV, SV Crete, SV Rhodes, TA Europe, TF, UA/UV/UW 1-6, UB/UT/UY, UC, UN, UO, UP, UQ, UR, UA Franz Josef Land, YO, YU, ZA, ZB2, 3A, 9H.

QRP QSO Party

Starts: 0200 GMT Saturday, August 24
Ends: 2300 GMT Sunday, August 25

The QRP A.R.C. International, with over 3000 members, announces its 7th annual QSO Party.

Members may work anyone, non-members work members only. The same station can be worked on different bands and modes for QSO points.

Exchange: QSO nr., RS/RST, ARRL section or country, QRP nr. (NM for non-members)

Scoring: One point per contact, DX 3 points. Total QSOs multiplied by ARRL sections and countries worked. There is an additional power multiplier as follows: 21-30 watts, 1.2; 11-20 watts, 1.6; 1-10 watts, 2; less than 1 watt, 3.

Frequencies: c.w. – 3540, 7040, 14065, 21040, 28040. Phone: 3855, 7260, 14260, 21300, 28540.

Awards: Certificates to the two highest scoring stations in each ARRL section and country. A special certificate to the top station in each W/K and VE call area working the most member countries. (Min. of five countries)

Logs to go: Jim Loring Jr. WA1BEB, RFD 2, Bethel, Maine 04217. Information on membership in the QRP ARC may be obtained from K7LNS.

Editor's Notes

The rules of the Romania and the All Asian contests should have been included in this month's CALENDAR. Neither one has been received at this writing. Also no word from the MARC VE/W contest usually held the last week-end of September. No information will be published unless an official announcement has been received. Past experience has proved that this policy must be maintained. And I must have it at least three months before the month of the activity.

73 for now, Frank, W1WY

1967 SAC Results

C.W.		K8HZU	1834
WA1FHU	728	WA8QIY	296
W1AYK	240	W8DWP	44
		WA8WTT	2
W1BGD/2	5040		
W2MEL	4750	W9LKI	1540
WA2QHK	876	W9HDR	740
W2NRV	510	W9AEM	264
WB2UDF	350	W9QWM	182
W2ZV	336	W9TCU	24
W2LWI	318		
W2KGN	210	WAØEMS	2205
WA2OIL	54	WØBMM	1936
		WAØKDI	1800
W3BYX	2025	KØDYM	185
K3NUM	1695	WØLMO	115
W3CBF	264		
W3QOR	44	**Phone**	
		WA2CCF	21
W4ZXI	2288		
K4BAI	1946	W3BYX	2227
W4HOS	1176	W3CBF	32
K4ELK	21		
		W4HOS	350
W5KC	1620		
W5JAW	1287	WA5ALB	189
4X4UJ/K5	100		
		WA7EVO	128
W6TZD	1404		
KØGJD/6	1248	K8HZU	342
WB6KBK	272	W8DWP	253
WA6JVD	195	W8IBX	8
WA6JDT	60	K9ECE	1312
WB6RTJ	2		
		W9KXK	550
		WA9UGI	330
		WAØEMS	671
		WØLBB	533

THE awards PROGRAM

BY ED HOPPER,* W2GT

THE July, "Story of The Month" is about John Knaak, W5OYG.

John Knaak, W5OYG

John was born October 13, 1938 in Winchester, Illinois. Shortly thereafter the family moved to Hillsboro, Kansas, where he was raised and went to school.

He is the oldest of three brothers, but the only ham in the family. A ham ticket was received in April of 1956 while he was a senior in high school, and his first call was KØEQY.

Two important events took place in July of 1960, John graduated from Kansas State Teachers College at Emporia, Kansas with a Bachelor of Science Degree in Business and one week later married "Wendy!"

For the next 6 years, the family moved seven times, moving to W5 land where John became W5OYG. In the meantime, Cheryl Ann arrived in 1962 and John Jr. in 1967. (Yes, that is John Jr. helping Dad hunt new counties).

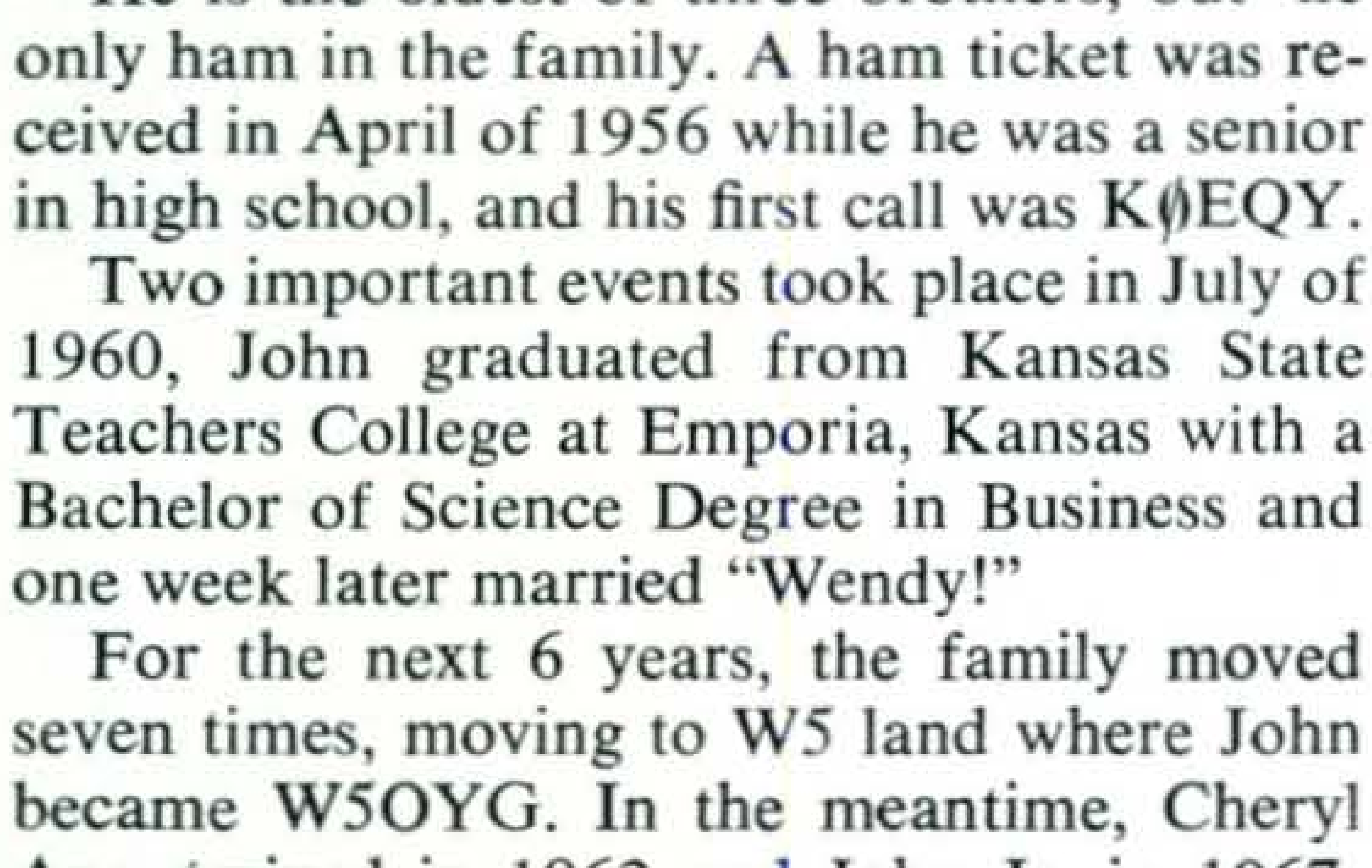
John always had a casual interest in County Hunting, exchanging QSLs with Rag Chewing contacts, but not operating any County Hunting Nets. In October 1965, the discovery of the then newly formed 75 meter County Hunter Net started John on the road to County Hunting with great determination.

By 1966, all states had been worked and confirmed on 75 sideband. In April 1966, USA-CA-500 Award #563, endorsed All 75 meters and All sideband, was received. In February 1967, USA-CA-1000 Award #110, also endorsed All 75 meters, All sideband, was earned. USA-CA-1500 Award #58, endorsed All sideband was received in March 1967. Then USA-CA-2000 Award #38, also endorsed All sideband, came in September 1967, and finally USA-CA-2500 Award #26 dated April 2, 1968, also endorsed All sideband, was received. As this is being written, John had confirmed 2573 counties on all bands and 1449 on 75 meters.

The present equipment includes a Galaxy V MK2 transceiver, 14AVQ Vertical and an assortment of dipoles.

John's occupation is Manager of a Variety Store for T. G. & Y. Stores Company in Duncan, Oklahoma. His other hobbies are fishing and golf—when time permits. He has met many of the County Hunters personally and he agrees that a finer bunch of hams

* 103 Whittman St., Rochelle Park, N.J. 07662.



John, W5OYG and John, Jr.

2nd Annual CW County Hunter's QSO Party

Starts: 0000 GMT Saturday, July 27
Ends: 2400 GMT Sunday, July 28
Sponsor
South Shore Amateur Wireless Association
116 Locust Street,
Valley Stream, N. Y. 11581
Frequencies: 3575, 7055, 14070, 21070.
See CONTEST CALENDAR
for full details.

See page 118 for New Reader Service

can not be found anywhere. John would like to publicly state that he *will* beat his good friend and County Hunting rival, Dave, W5PWG to 3000 counties.

Letters

Hank, WB2RMM, writes: "Thought this would be of interest to your readers. Have had several fine QSOs with WN7IRD, Wilberta "Willie" Longwell (XYL) of Baker, Oregon. Since she received her Novice Ticket in October, 1967, she has: Had 1,004 QSOs up to March 29; received her WAS certificate; worked all continents; worked 30 different countries; confirmed 20 countries; received her 15 w.p.m. sticker in code proficiency; 259 confirmed counties and is now a confirmed county hunter. Most of her QSOs last ½ hour and her record QSO was 2½ hours, her 1,004 QSOs do not include any contest or contest style QSOs."

Eddie, K4LSP, writes: "Please print in your column, where one may purchase the *USA-CA Record Books*. I have over 2,000 counties and would like to apply for your USA-CA Award.

Presently I have given out to the County Hunters over 2,400 counties in 40 different states, including the provinces of Canada. I travel for a living, therefore I am on the Net most every day from some different county in the south." *(USA-CA Record Books may be obtained direct from* CQ, *14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050 for $1.25. Eddie, I'm waiting for your application, Hi.)*

Don, W8IIT, writes: "This will acknowledge receipt of USA-CA-500 Award. I really am proud of this certificate and am anxious to get it framed as soon as possible. Thank you for your prompt attention in this matter.

I'd like to see more County Hunter activity on fone and CW on 7 MC. Thanks again for a super certificate—now the big push for USA-CA-1000."

Awards

The Kickapoo Council Award: This award is sponsored by the Vermilion County Amateur Radio Association of Danville, Illinois. The award is offered free for working five club members, and no confirmation is necessary, just send CGR list to the custodian. Mr. Francis Kirk, K9JLP, 911 N. Washington St., Danville, Illinois 61832. There is a hardy group of members who meet regularly on 3925 each Wednesday evening at 0330 GMT.

Kickapoo Council Award

Vancouver Sea Festival Amateur Radio Award: The 6th Annual Vancouver Sea Festival will be held July 13th to July 22nd and as the Greater Vancouver Amateur Radio Operators participate in this festival, this award is being offered in their honor. Rules are: 1. All legal Amateur Radio Operators in the world may receive this award except—(a) Countries on the Department of Transport banned country list. (b) Greater Vancouver Amateur Stations located in Vancouver City, New Westminster, Burnaby, North and West Vancouver, Surrey, Coquitlam, Richmond and Port Moody. 2. Stations in 1 (b) may qualify provided all contacts are made from a portable or mobile location not defined as Greater Vancouver. 3. The certificate is awarded on submission of the following information: (a) Date and time of contact. (b) Call sign of station worked. (c) QTH of stations worked. (d) No QSL required. 4. Ten different stations must be worked in the Greater Vancouver Area as defined in 1. (b) 5. Any legal mode of Amateur Radio Contact and any amateur Band may be used but only one contact per station. 6. There is no charge for certificate or mailing. 7. Only contacts made after Feb. 1st, 1968 will be counted. 8. Applications for this award should be sent to: Mr. Jack R. Rothwell, VE7TK, 6758 Bryant Street, Burnaby 1, Vancouver, B.C., Canada.

Vancouver Sea Festival Amateur Radio Award

Dixie 6 Meter Sideband Net Award

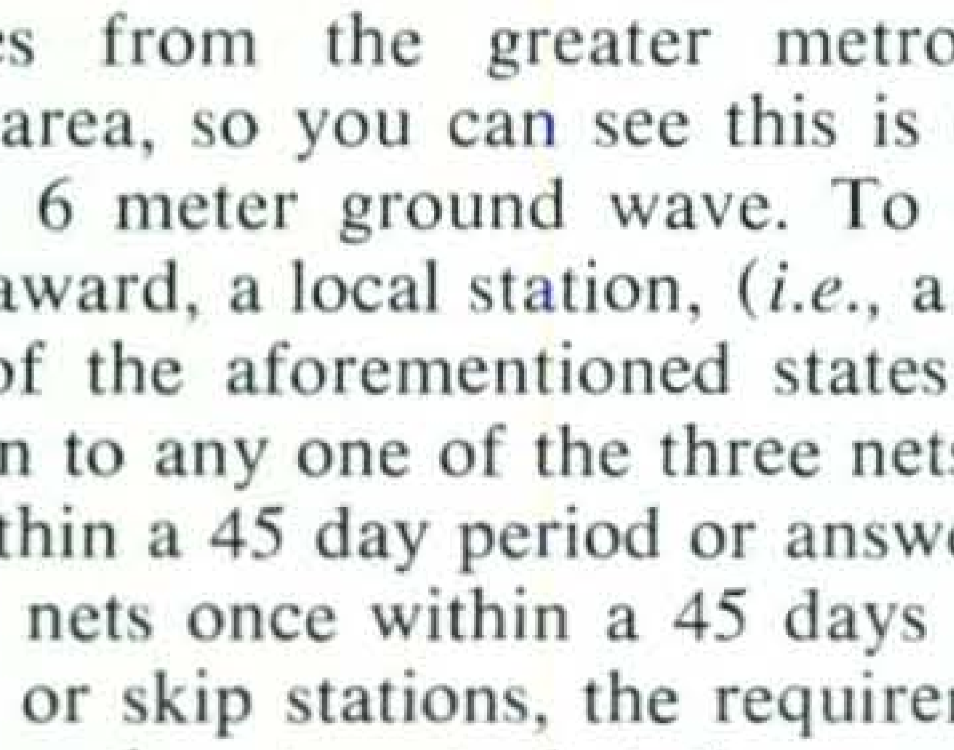
Dixie 6 Meter Sideband Net Certificate: This beautiful certificate is being issued to publicize the following Nets. The Dixie 6 Meter Sideband Net meets on a regular basis at 2100 EST on Wednesday and Sunday nights. Their affiliate net, the Atlanta Early-Bird Net meets every Sunday morning at 0830 EST. All Net activity is conducted on a frequency of 50.110 mc s.s.b. They also monitor 145.350 for cross band check-ins. There are as many as 30 members who check in on a regular basis. These stations are from the surrounding states including Tennessee, Alabama, North and South Carolina. The net originates from the greater metropolitan Atlanta area, so you can see this is quite a haul for 6 meter ground wave. To qualify for this award, a local station, (*i.e.*, a station in any of the aforementioned states) must answer in to any one of the three nets, three times within a 45 day period or answer in to all three nets once within a 45 days period. For DX or skip stations, the requirement is to work each net control station once on 6 meter sideband with no time stipulation. WA4JCI is NCS for the Sunday 0800 Net; W4BTW is NCS for the Sunday 2100 Net; and K4RZB is NCS for the Wednesday 2100 Net. There is no charge for the certificate or postage. Apply to Jim Broaddus, K4RZB, 408 Campbell Hill St., Marietta, Georgia 30060.

The Daniel Boone Award: Sponsored by the Big Thunder Amateur Radio Club of Belvidere, Illinois. Issued for stations having had contact with a minimum of 4 Boone Counties, with seals being issued for each county after the basic 4. There are 8 Boone counties in the following states: Arkansas, Illinois. Indiana, Iowa, Kentucky, Missouri, Nebraska, and West Virginia. Charge for certificate is $1.00, and seals for additional counties for sending QSL and S.A.S.E. No A.O.M.B. endorsements. Free to blind and handicapped. Swls can also qualify. Custodian: Dick Butram, K9LFA, Rt. 3, Box 306, Belvidere, Illinois 61008.

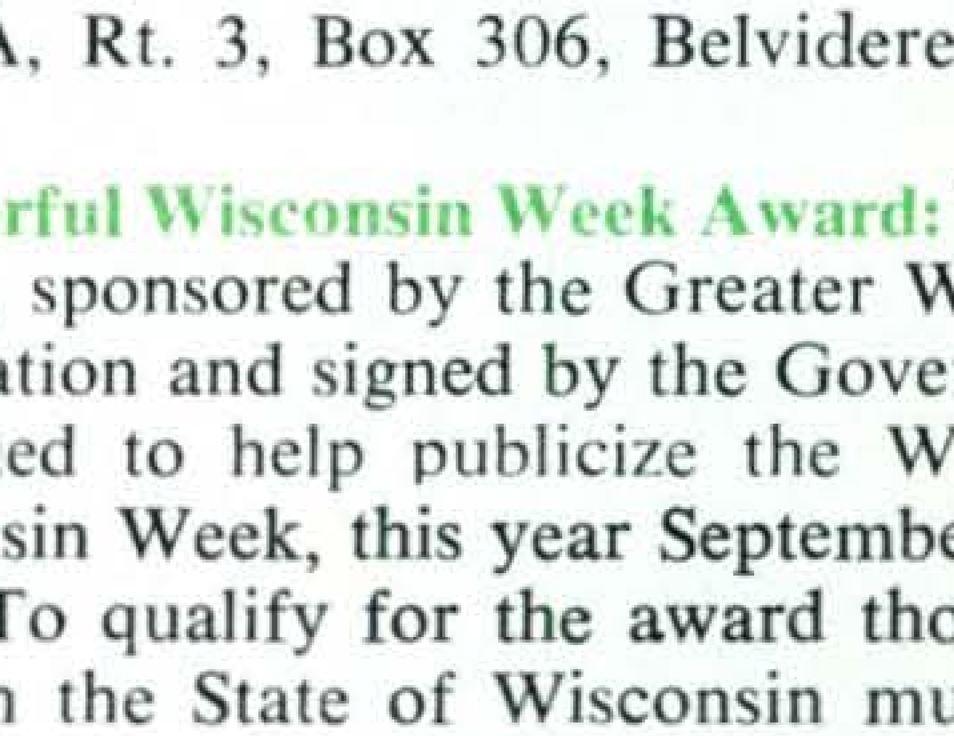
Chief Big Thunder Award: Also sponsored by the Big Thunder ARC of Belvidere, Illinois. Available to stations having confirmed contact with 3 Big Thunder ARC members after January 1, 1968. Applications have been received from 141 stations from nearly every state in the union. 4 member stations work the 75 meter county hunter nets nearly every night. Cost of award is 50¢, but free to blind and handicapped and S.w.ls can also qualify. Information and club membership will be sent upon request, S.A.S.E. will be appreciated. Custodian: Dick Butram, K9LFA, Rt. 3, Box 306, Belvidere, Illinois 61008.

Wonderful Wisconsin Week Award: This certificate, sponsored by the Greater Wisconsin Foundation and signed by the Governor will be issued to help publicize the Wonderful Wisconsin Week, this year September 17-23 1968. To qualify for the award those operators in the State of Wisconsin must make contact with at least 10 out of state amateur radio operators. Out of state operators (including all of Canada) must make contact with at least 5 Wisconsin amateur rado stations. Out of the county operators (including Alaska and Hawaii) must make contact with at least 2 Wisconsin amateur radio stations. The log information of the qualifying contacts with the names and addresses should be sent with the operations blank QSL

[*Continued on page 98*]



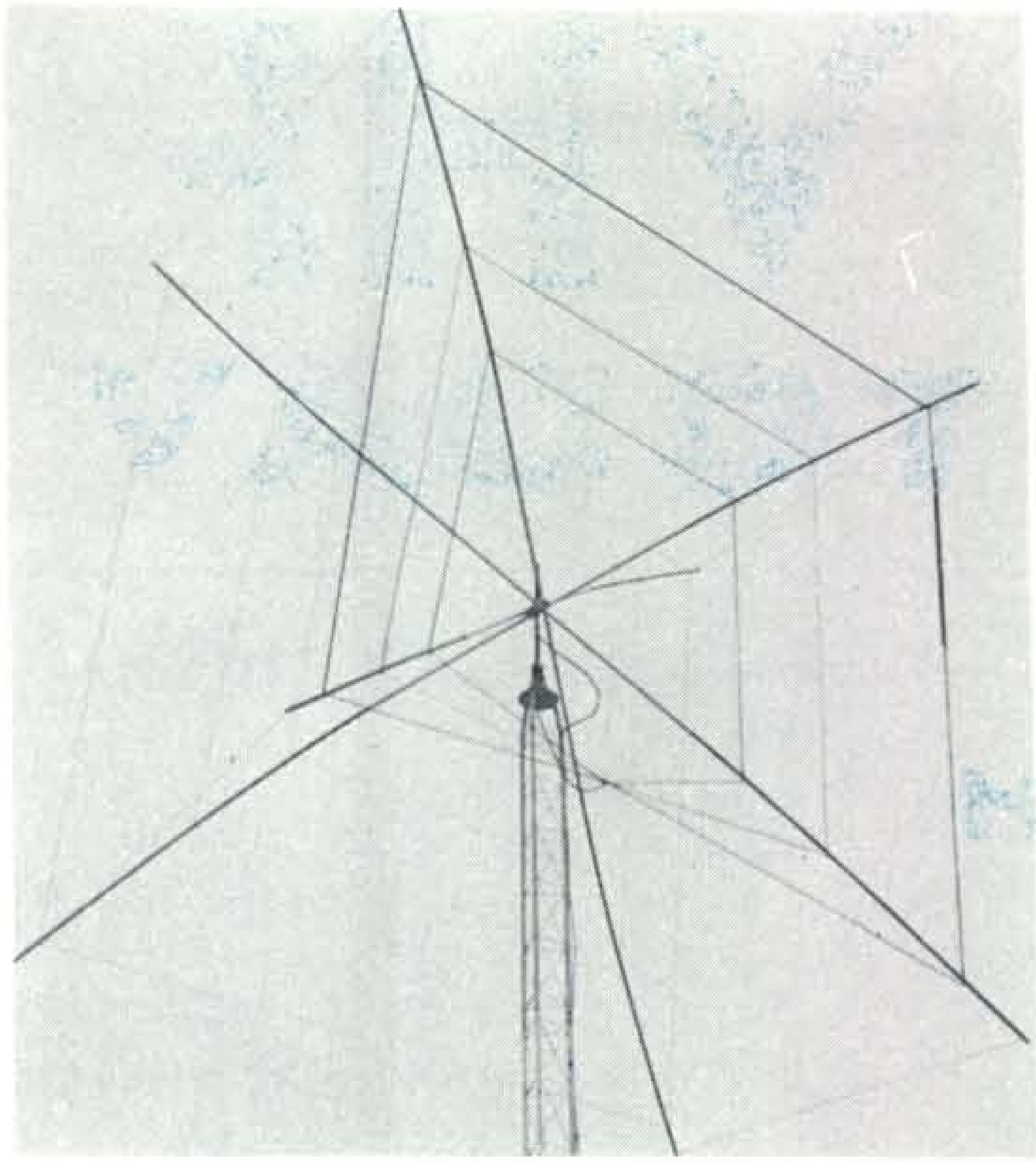
Daniel Boone Award



Chief Big Thunder Award

See page 118 for New Reader Service

Why the Reginair 321 Quad is Important to You!



Present day transceiver and transmitter designs equire an antenna match with as flat a resonant esponse as possilbe. In the olden days a typical 00 watt rig required a relay rack and 500 pounds f gear. The physical spacing and voltage parameter f the tank circuits were such that one never vorried about VSWR; indeed, that term had not et been coined! Flash over and mismatch were aughed at and tolerated.

What a difference today! In a table top box carcely 1½ cubic feet and weighing less than 50 ounds we find a modern sideband transmitter and eceiver thrown in as well. Take a good look at the omponents: fixed capacitors smaller then ½ a ostage stamp; a loading capacitor with .005 inch pacing; and transmitting tubes that are in reality 'V horizontal outputs. These, then, are what you ind. Do you wonder then why the manufacturer ells us we must operate into loads of 2.5 to 1 or etter? Do you wonder then why the factory says o tune up in less than 30 seconds? Is it a surprise o you to find that new finals are required so uickly? Good engineering tells us that at 2.5 to 1 ve have 20% of our forward power coming back to tay as circulating current and heat.

The danger comes into the picture because the verage ham can't or won't confine his operation ver that narrow spectrum where his antenna is in esonance and where his VSWR is less than 2.5 to .

Sure–new SSB designs are in the works: transeivers whose receivers will have variable electivity; whose transmitters will use better ubes; rigs that can take more guff. But can you vait that long or afford that much money?

There is an alternative now–in fact, two hoices. You can either be more mindful of the requency tolerances of your setup, or better still, ou can obtain one of our *Reginair Quads.* This is he only commercially available product that gives hree band operation with one 52 ohm feed line nd absolutely guaranteed low, low VSWR over the ntire 10, 15, and 20 meter bands.

Our new quad is constructed of 2 different dimensioned poly vinyl chloride (PVC) tubes made into a 10 foot arm with an aluminum coupler. The PVC is especially selected for temperature and mechanical stability. Hardwood stiffeners additionally are inserted within the PVC. The hub of the quad is a virtually indestructible acrylomitrile butadiene styrene (ABC) which can withstand salt water, and the atmosphere for years and years.

The quad is furnished complete with easy to understand assembly instructions, at only $89.95 FOB Harvard, Mass. Study the box score and see if this antenna isn't the answer to your operating and maintenance problems. You might even find that DXing can be fun now that you are hearing the rare one.

Forward gain over dipole	**5.9 db**
Forward gain over isotropic dipole	**8.0 db**
Front to back ration	**.25 db**
VSWR over 28-29.7 MHz; not more than	**1.5:1**
VSWR over 21-21.45 MHz; not more than	**1.5:1**
VSWR over 14-14.35 MHz; not more than	**1.5:1**
Maximum RF input	**2 kw**
Maximum mast dimension	**1¾" dia.**
Wind resistance	**.4.5 sq. ft.**
Feed line	**52 ohms**
Outside dimensions	**18'x18'x12'**
Turning radius	**.9½'**
Net weight	**35 pounds**
Shipping weight	**40 pounds**
Designed for 100 mph winds; ½ inch radial ice	
Frontal lobe	**.75°**
Standard model price (FOB Harvard)	**$89.95**

HERBERT W. GORDON COMPANY

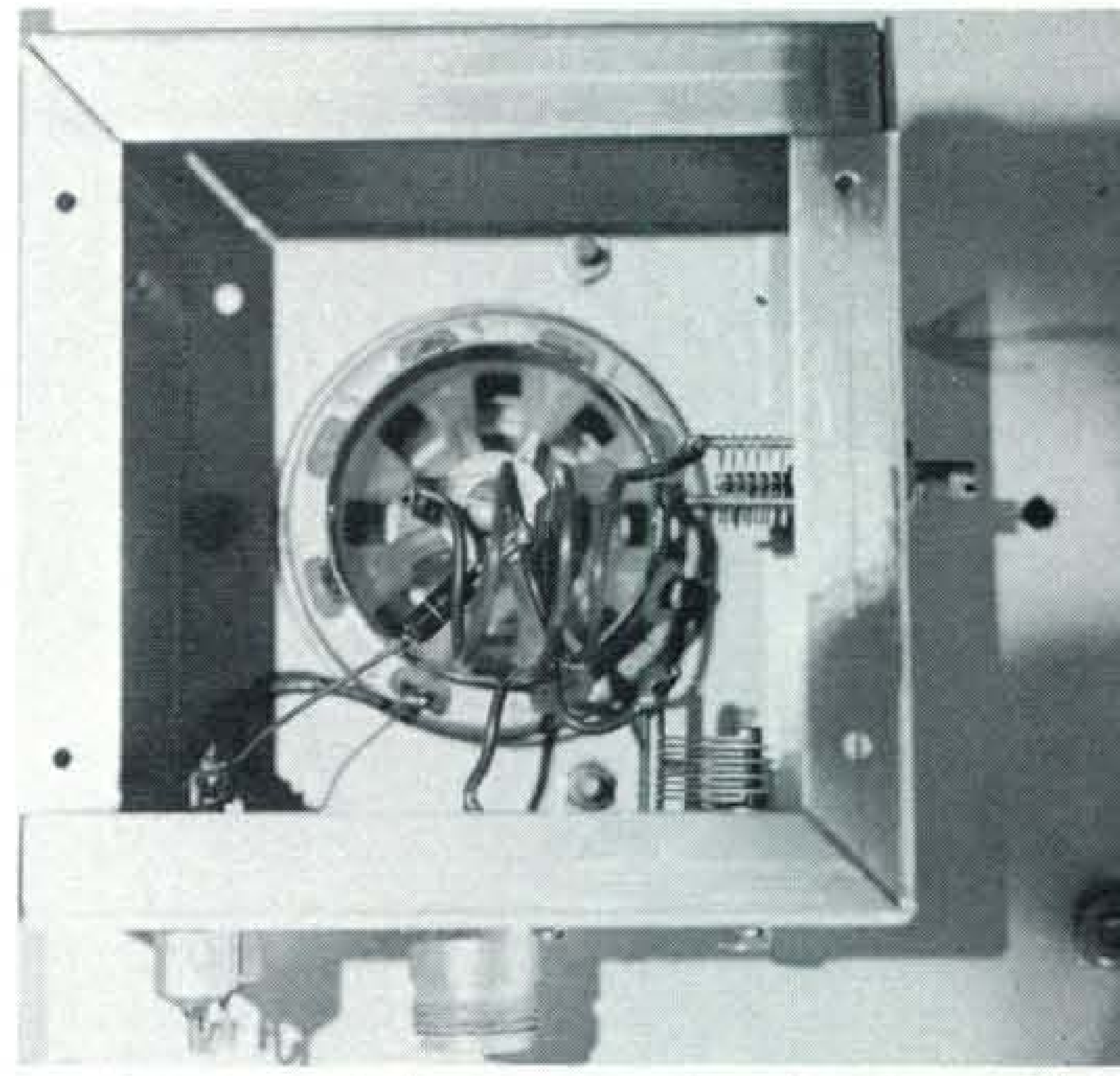
Woodchuck Hill Road, Harvard, Mass. 01451

"Helping Hams to Help Themselves"

See page 118 for New Reader Service

VHF TODAY

BY ALLEN KATZ,* K2UYH



Interior view of the input section showing grid connections. *(photo courtesy of Mark Nadir)*

How to get the most power out of an r.f. amplifier is an age old amateur puzzle. In general it is true that the more power into a given tube the more power out of that tube. R.f. Power Out = DC Power In − Power Dissipated in Heat. Efficiency = Power In/Power Out. You can usually do no better than 70% efficiency and on the v.h.f. bands you will in most cases do much worse. Thus to run 1000 watts input requires a tube with more than 300 watts of plate dissipation . . . a realistic figure is around 500 watts of plate dissipation. This is the reason at least two 4CX250's (250 watts plate dissipation each) are used in 1 kw v.h.f. amplifiers.

Suppose you have only a single 4CX250 and want to run the legal input, is there anything you can do? Back in the late 20's and 30's some amateurs ran glass bulb tubes inverted in jars of oil. The limiting condition for these tubes was envelope temperature. When plate dissipation went above a certain level, the glass envelope would become so hot that it would melt. Immersing the tube in oil allowed some of the heat at the glass envelope to be conducted away, lowering the temperature and thereby raising the plate dissipation.

The external anode tubes of today work in a similar fashion. Most of the heat developed at the plate is carried away by forcing a continous stream of air through the external anode. The more air moved through the anode, the more heat removed. The manufacturer's specifications set a minimum rate of air flow for which the plate dissipation rating holds. The 4CX250 requires 6.4 cubic peet per min. Some amateurs have shown that by forcing air at a rate in excess of the specifications that they are able to run these tubes at higher than rated dissipation. There are problems to this approach. The blower by necessity must be large and almost always creates a high noise level. Owners of such super-forced air cooled finals are usually forced to wear head phones.

A somewhat quieter approach is that of water cooling. Here water rather than air is passed through the anode. Because water ab-

* 48 Cumberland Ave., Verona, New Jersey 07462.

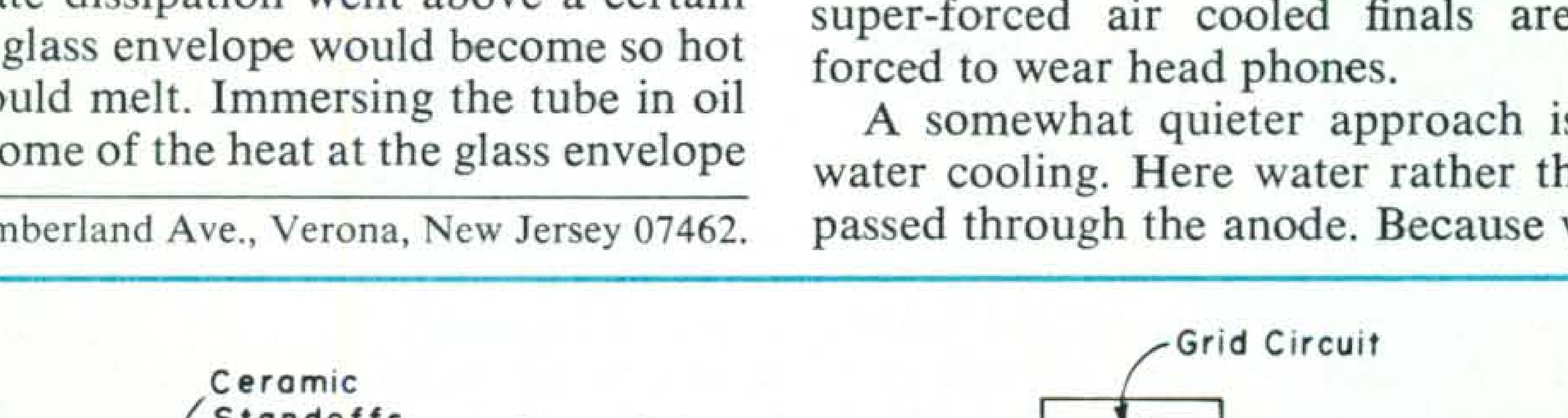


Fig. 1—Physical layout and construction details for the vapor phase amplifier operating on 220 mc.

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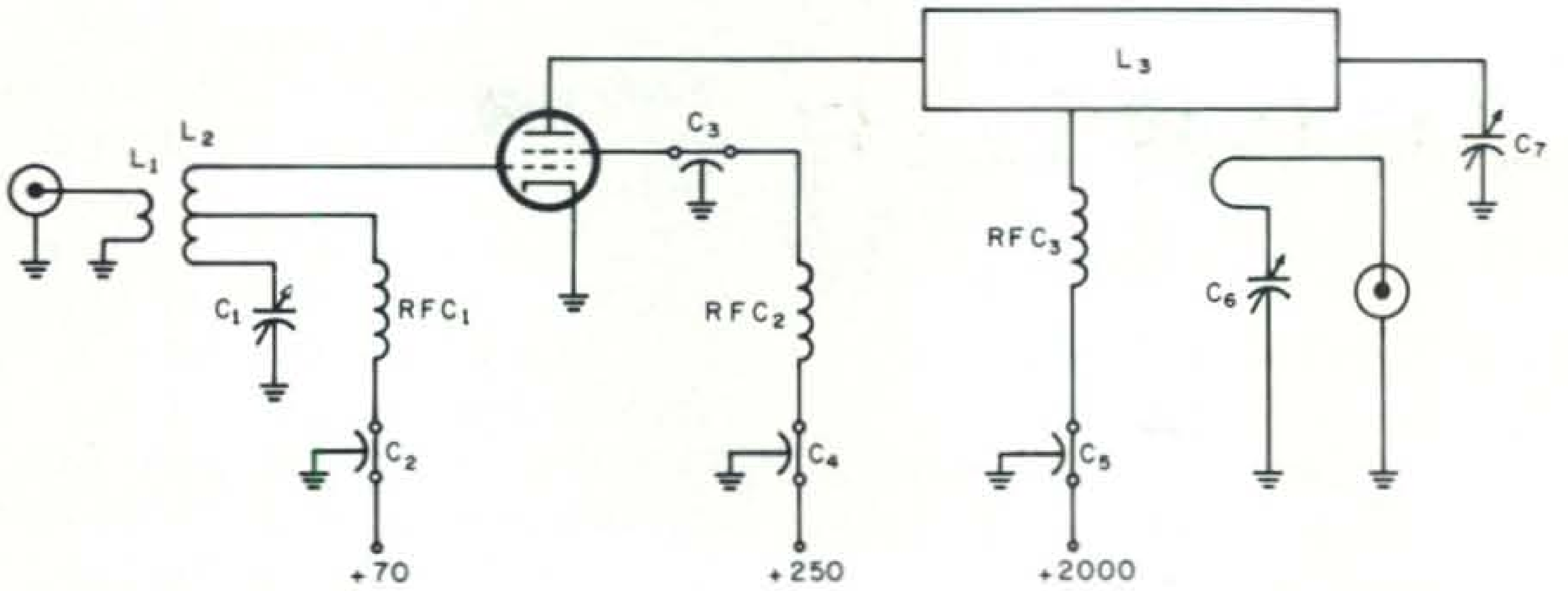


Fig. 2—The circuit diagram for the 220 mc vapor phase amplifier shown in the photographs.

C_1—15 mmf variable.
$C_{2,4,5}$—1000 mmf feed-thru.
C_3—Built in screen by-pass.
C_6—20 mmf variable.
C_7—Plate tuning capacitor. See Fig. 1.

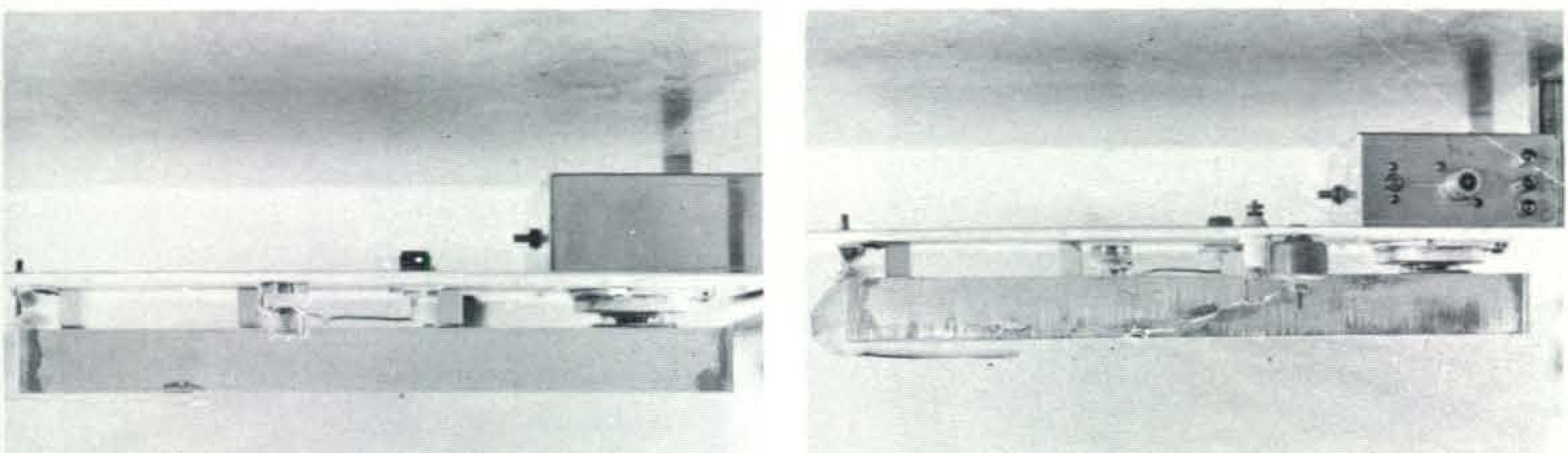
L_1—1 t. ¾″ dia. loop.
L_2—4 t. ¾″ dia.
L_3—Copper box, see text and Fig. 1.
$RFC_{1,2,3}$—Ohmite Z-220.

sorbs more heat per unit volume than air, a greatly reduced flow rate may be used. The big difficulty with water cooling is the associated plumbing.

Another technique is vapor phase cooling. This method has the ability to more than double the plate dissipation of a tube like the 4CX250 and is almost as easy to implement as normal forced air cooling. It does use water, but without the plumbing problems. The principle upon which vapor phase cooling is based is that water boils at 100 degrees C. The parameter limiting the dissipation of most external anode tubes is the seal temperature, which must not exceed 250°C for the ceramic versions as the 4CX250 and 150°C for the glass versions as the 4X150. When water is converted into steam an extraordinary amount of heat is consumed by the process. While the conversion is taking place, the temperature of the water can not rise above 100°C. As long as the anode is immersed in the boiling water, it too can not rise much above 100°C and the critical seal temperature is never reached.

The concept of using vapor phase cooling was first introduced to us about two years ago by W2CLL (x-W7PUA/2). His idea was to contain the water in a tank circut and run the tube upside down as shown in figure 1. As the tube is operated the water slowly boils away. The length of time between refills can range from several hours of continuous operation to several months, depending on how high a power level the amplifier is being operated. V.h.f. vapor cooled finals have also been constructed by W2CQH, W2CCY, and WA2-FGK. W2CCY built his amplifier with the tube positioned upright and used an O ring

[*Continued on page 96*]



Two sides of the amplifier. The plate tuning capacitor is shown on the left in both views. Output capacitor C_5 is shown in the left view and the hi-voltage feedpoint is shown in the right view. *(photo courtesy of Mark Nadir)*

SURPLUS sidelights

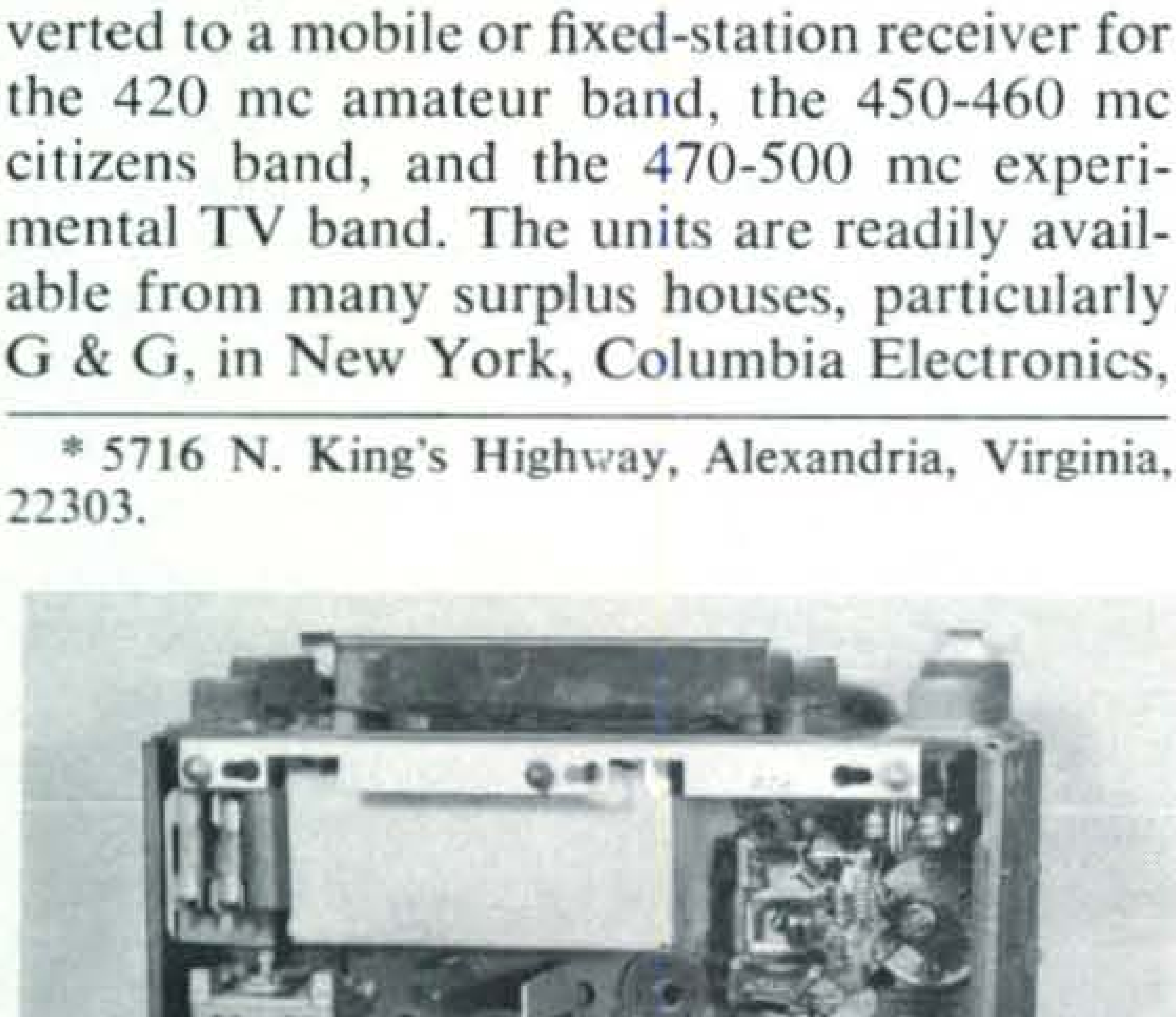
BY GORDON ELIOT WHITE*

SOMEWHERE in the vast labyrinths of the military logistics system, someone has apparently found another hoard of SCR-515 radar identification sets, squirreled away in 1942. My mail indicates that these are again appearing in surplus outlets, demanding conversion information.

By way of background, the SCR-515 is the airborne portion of an Identification, Friend or Foe system, a British idea to enable ground radar operators to determine whether scope blips were German raiders or their own Spitfires—it helped antiaircraft gunners to shoot at the right planes. Later it helped ground controllers sort out the complex air battles.

In surplus, the SCR-515 has been converted to a mobile or fixed-station receiver for the 420 mc amateur band, the 450-460 mc citizens band, and the 470-500 mc experimental TV band. The units are readily available from many surplus houses, particularly G & G, in New York, Columbia Electronics, in Los Angeles, and Fair Radio, Lima, Ohio. Prices now range around $20-$25 for a set in excellent shape, plus a few dollars for accessories such as plugs, dynamotor, mount, antennas, etc.

* 5716 N. King's Highway, Alexandria, Virginia, 22303.



The BC-645 transceiver, part of the SCR-515/ABA IFF system.

The BC-645 is the chief component of the SCR-515. Under U.S. Navy nomenclature the same set was known as ABA. The unit is designed to pick up signals from a ground radar transmitter, and if the properly-coded pulse sequence is recognized, the BC-645 transmits its own pulse train on the same frequency, creating a "bloom" on the ground 'scope. Presumably an enemy aircraft would be unable to reply properly. The same principles have been updated by the military into incredibly complex IFF systems which are an integral part of "electronic warfare." Going in another direction, civil aviation uses the principle in 'transponders" which can send aircraft identification and altitude information to traffic control radars.

Designed by General Electric for the Navy in the late 1930's, the SCR-515 system was an excellent one. Known at first as "RR" (radio recognition) in the U.S., it outdated the British IFF of the time (MK II) and as I have noted, its principle has been universally adopted for civil and military transponders since. The Army's Signal Corps Aircraft Radio Laboratory, at Wright-Patterson, Ohio, dropped its own RR designs when the SCR-515 was tested there. Unfortunately the British did not.

Though the U.S. and the British were cooperating in electronics as early as 1940, the SCR-515 became the victim of a short-sighted snafu between the allies. The British had built a bulky, slow, IFF known as MK II, and by 1941 had an updated version, MK III. The number MK IV was assigned to the SCR-515. Despite its clear disadvantages, the British tended to stick to their own design.

The argument was unresolved on December 7, 1941, but the rush to arm the nation after Pearl Harbor led to a decision to use the tried British unit, which American factories were already building for Lend-Lease. Philco was given a contract for an American version of the MK III, and the SCR-515 was stockpiled for use in case the MK III should be seriously compromised by falling intact into enemy hands.

Signal Corps officers still believe that if the SCR-515 had been adopted, those radar operators at Opana, on the west side of Oahu, would have been able to recognize the blips

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on their screen on December 7 as ene planes, rather than as an expected flight B-17's. The operators at their SCR-2 'scopes then might have been able to prev much of the Pearl Harbor damage, thou U.S. air forces probably could not have co pletely protected Hawaii.

A total of 15,000 SCR-515's were bou at a price of $2,000 apiece, plus many of SCR-532 (short range) and SCR-533 (lo range) ground radar sets used in the syste The waste was nearly $50 million, not incl ing 64 Signal Corps technicians who had j completed SCR-515 training when the de sion was made not to use it.

The set itself operates in the 470-495 me cycle band then used widely for radar, bef the advent of microwave transmitters. It h a rated range of 150 miles at 10,000 f probably a line of sight figure. Converted amateur use in the 420 mc band, it wo more likely be good for up to 15 miles ran depending upon the antenna system. Lack an r.f. amplifier in the receiver, and usin modulated oscillator without crystal cont on transmit side puts it in what Don Stor W6TNS, calls the "puttering around" cl But it is good fun for someone who wants break into the ultra-high frequency a cheaply.

Among other interesting things to be no in the SCR-515 is the self-destruct syst Antedating the sophisticated security syst of the U.S.S. Pueblo by thirty years, the I 645 contained thermite bombs which wo destroy the set to prevent its capture. Tho these have presumably been removed lo since, check for thermite capsules in the b tom of your set, just to be sure, particula if you get one in its original wrappings.

The receiver section of the BC-645 tune as low as 450 mc by adjusting the silv plated disc between the oscillator lines. mixer section will handle a 390 to 500 band, and require no changes to hit 420 To alter the oscillator, extend the tuned li by about ⅜ inch, and install a front pa tuning capacitor, soldered to the extensio A small butterfly capacitor may likewise

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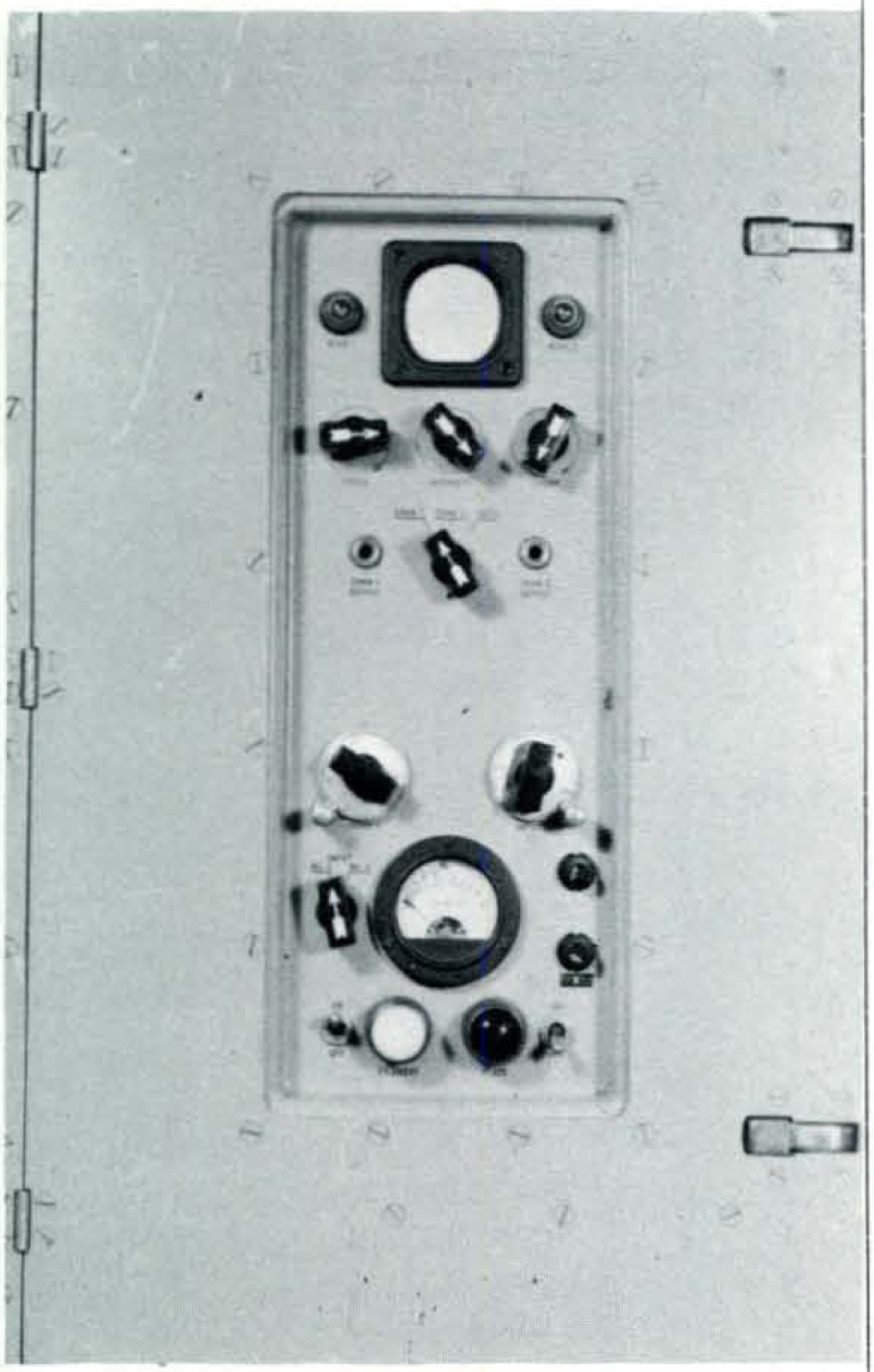

The mystery FSK unit disposed-of by the Army Security Agency.

mounted at the ends of the transmitting oscillator lines to adjust its frequency down to the 420 mc band.

For further detailed conversion dope, look up the 1956 *CQ*'s at any well-stocked public library.

Switching from the past to the present, I note that recently the armed services have been releasing quantities of once-secret security equipment, notably that used by ASA, NSA, CIA, etc. to monitor various frequencies. Apparently the transistorized material has at last begun to push tube types out. Much of this gear is secret enough that the name plates are removed when it is junked, but not so secret as to need to be smashed. Some of this is carried under nomenclature such as "AFSAV-39C", "ASAN-53" or "ASAN-54." The latter two units are teleprinter converters, similar to the common AN/FCC-3, but I have come across an interesting piece, reported to be AFSAV-35, which is apparently an RTTY converter. This battleship-built unit has an audio input, monitor scope, and audio output. It will accept AFSK RTTY signals and put out AFSK on its own tones, but obviously, from the vast amount of circuitry, it must do more than that.

I have scratched my head over this unit, but so far its secrets—and any manuals—have escaped me. If any readers have any information on it that is not still classified, I would appreciate a note from them.

The AFSAV-39C, while it seems to come from highly secret installations, is common enough to be listed in MIL Handbook 161, as ARA type gear. Identified as a "two-channel rekeyer" it is described as working with DEN-35 and the ASAN-5, whatever they may be.

I would certainly be interested in finding a source for data on this sort of gear, which apparently has real potential for amateur use, now that its secret operations are past. ■

VHF Today [*from page 89*]

to seal off the bottom of the tank and thus prevent the leakage of water. With this configuration, as the water boils away, the remaining supply stays at the base of the anode where it has the greatest effect. The photographs show a 220 mc vapor phase amplifier constructed by us. The circuit is rather conventional. The tank is made from a 12" length of S band wavegrid (although it could have been fabricated from ordinary brass stock) sealed at both ends with rectangles of copper flashing. Regular solder is used since the temperature of the tank should never go above 100°C. It is attached to an aluminum plate on which the amplifier is constructed by means of three ½" long ceramic standoffs. The above amplifier can be driven up to 1 kw input without worry. Similar results have been obtained on 432 mc and 1296 mc (300 watts input with a pair of 3CX100's).

Lose Ends

There was a 4π left out of the antenna gain formula in the May column. Also we have received questions on the construction of 200 ohm transmission line for use in stacking yagis where K-200 is unavailable. A center to center spacing of three times the wire diameter to be used will produce the desired result. Approximately 3/16" for transmission line made from #12 wire. Next month we plan to get into receiver noise theory. Until then 73 Allen Katz, K2UYH. ■

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CQ Announces
PROJECT UP-STEP

EXACTLY ONE YEAR AGO CQ changed printers—and with that change we instituted many improvements and new features in the magazine. Included in those improvements were more pages, full color covers, color inside the magazine, perfect binding, and a general improvement in the quality of paper and printing production.

WE'RE NOW READY to go ahead with phase two of our long-term plans for a better CQ. This phase will directly benefit our readers with more articles, more features, and more pages. Our present plans are to enlarge CQ in number of pages as follows: August, 128 pages; September, 136 pages; October, 144 pages; November 152 pages. What happens after that will depend on how you, our readers, respond to what we're doing.

IT'S NO SECRET that the ham radio field is getting more competitive every month, and we intend to keep CQ on top by giving our readers more good material than the other magazines. To do this we need more subscribers, especially among those readers who are buying their copies on newsstands and jobber counters. That will free the single copies for even more new potential readers.

SO HOW ABOUT JUMPING on the CQ Bandwagon with your subscription. You'll be assisting us in the bigger and better CQ that we have planned for the months ahead. And get your friends and fellow club members to subscribe as well. Remember, what comes in from subscriptions will be spent to give you more great reading.

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USA-CA [*from page 86*]

card and 25¢ to: Robert J. Draeger, Sr., WA9KNH, P. O. Box 2501, West Allis, Wisconsin 53214. Applications must be postmarked on or before November 15, 1968. A certified list is not required.

Notes

The *CW County Hunter*, a monthly bulletin devoted to c.w. County Hunting, is now being published by Dick Bentley, K2UFT and Rick Lobdell, K2VGR (both are members of the South Shore Amateur Wireless Association of Valley Stream, N.Y.). Their publication deadline is about the 25th of the month and the bulletin is in subscribers hands by the 1st of the following month. Subscription price is $1.50 per year for 12 issues by first class mail, $2.00 air mail, to the U.S., Canada and Mexico. Special rates, based upon increased mailing costs, will be available to DX stations. Please make checks or money orders payable to Thomas R. Bentley, 116 Locust Street, Valley Stream, N.Y. 11581.

As you should know, John, K3WWP who spent much time being CHN manager and also ran the 1st CW County Hunter QSO Party last year, (*swell job, John*) had to curtail such activities, so Dick, K2UFT and Rick, K2VGR have been activating the County Hunter Net on 7035 at 1600 Z on Saturdays and Sundays.

And as mentioned in April *CQ*, Bob Brown, WA9QQB and WA8LWK are trying to pep up things on 7035 Mondays through Fridays at 0230 GMT. By the time you read this, it is assumed the Net will move to 7055. Both groups can use your help and cooperation.

Many thinks to Craig Benjamin, WA4VAP for donating the U.S. Callbook, it is now on the way to Arif, AP2AR in East Pakistan.

Henry A. Doell, WB2RMM, 2015 Victor Holcomb Road, Victor, N.Y. 14564, having recently retired, would be happy to offer his services to overseas county hunters in helping them identify counties for their QSLs that fail to mention the county.

Those responsible for the huge success of the Garden State Amateur Radio Exposition that was held at the Garden State Plaza Shopping Center May 2 to 4th, sure deserve congratulations. In all my years in amateur radio, I have never seen so much publicity in non-ham periodicals. It seemed like all New

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Jersey newspapers had front page stories and other items about it for weeks. Full cooperation was had from the Air Force, Army, Navy, FCC, all radio clubs, tremendous attendance by the general public and hams, including famous moon-bouncers like VK3-ATN, KH6UK/W2UK and others including one from PAØ land and one from HB9 land. Again congratulations for a job well done and such good publicity for amateur radio.

So, what is your problem? Write and let me know—How was your month? 73, Ed., W2GT.

Mr. One Sixty [*from page 69*]

tacts with other hams and s.w.l.s, DXing, building, emergency work, making first QSOs with new hams on the air for the first time, visiting other ham stations and photographing them, trying to lend a helping hand where possible within the limits of his time and pocketbook to those needing it, and the operation and maintenance of W1BB and hosting visitors from all over the States, Canada and the world who come to pay a personal visit.

Just recently Stew retired but he continues to be as active as ever not only with his hobby but church work, Civil Defense, professional organizations, Boy Scouts, Masons, Yacht Club, as well as many and varied social activities. Stew and Alice have two sons . . . Skip and Jim . . . but neither took after them as far as amateur radio is concerned. However, Jim has made it possible for them now to be a grandmother and grandfather which is a new milestone in their very interesting and diversified lives.

One sixty is the "forgotten band" by most amateurs. They just don't realize the significance of our first and original portion of the radio spectrum and the satisfaction derived from solid short haul rag chews and the medium to long distance contacts. To many, however, a QSY to 160 is a revelation. The mysteries of these frequencies become a deep rooted addiction, and the thrills provide an awakening to new and more interesting fields to explore. There always seems to be something to look forward to on 160 which continually brings new excitement. One-sixty is a retreat from the maddening scramble of the other bands, its a band where working a G gives you a great feeling of satisfaction and accomplishment whereas working the same G on 20 meters is nothing more than working another G . . . it means practically nothing.

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Yes, 160 gives zest to hamming unequalled on any other band.

We salute you, Stew, for your untiring efforts, unselfish spirit and attitude. You have accomplished that which no one thought to be possible. You have accomplished that which will take many years for anyone else to duplicate. Heartiest congratulations from all of us. A record has been made; a milestone passed. 73. . . . . ■

YL-OM Contest Results [*from page 66*]

late, or the rules were not followed completely. Recommendations accompanying the logs will be carefully considered for future contests. And you can mark you calendars right now for the 20th YL-OM Contest: Feb. 22-23, 1969—phone; Mar. 8-9—c.w.

Top three scores in each category, and the high scores for each district or country follow:

YL PHONE

PY2SO	90,216
K8ONV	44,712
K9LUI	36,450

OM PHONE

K5MDX*	7,619
K2EIU/5*	4,444
K4MYC/4*	4,180

YL CW

PY2SO	61,380
VE3BII*	37,661
K8ONV	22,761

OM CW

W5WZQ*	4,471
K2EIU/5	4,200
W1PYM*	3,150

Top District and Country Scores

YL PHONE

W2OWL	7,065
K3WAJ	19,110
WB4BOJ*	20,440
WA5OVX	22,328
W6PQI*	13,644
K7RAM	13,702
K8ONV	44,712
K9LUI	36,450
WAØPPK*	26,163
KL7FQQ	30,640
VE4ST*	20,231
I1SGZ	2,695
CE6CC	8,178
DL3LS	21,318
PY2SO	90,216
VK3KS*	8,702
ZL2JO*	21,525
ZS5FN*	9,075
VK3KS*	19,256
ZL2JO*	5,980

YL CW

K1NEI	17,556
WA2WHE*	16,575
K3SJS*	21,525
WA4VKG*	21,525
WA5SKI	16,905
K8ONV	22,761
WA9HLY*	7,975
WAØPPK*	11,344
VE3BII*	37,661
DJ9SB	3,248
HA5KDQ	3,104
OH5RZ	3,140
OK1AZQ*	3,570
PY2SO	61,380
SP6AZY*	7,166
UA1ZX	70

OM PHONE

WA1CJR*	3,135
WA2BXK*	1,875
W3BQN*	2,231
K4MYC/4*	4,180
K5MDX*	7,619
WA6KNE	1,204
W7EOI	1,363
WA8WZG*	630
K9UCR*	3,150
WAØGZA	1,410
JH1GMZ*	2,800
LA8PF*	5
W4HSC/VO2	1,350
VE3OL*	747
ZS5FF*	5

OM CW

W1PYM*	3,150
K2DDK*	2,814
W3BQN*	1,486
K4BAI*	2,613
W5WZQ*	4,471
WB6THT*	1,415
W7CFJ	1,875
WA8RDW*	1,105
W9LNQ*	3,910
WØLRW*	2,470
VE6UP	1,333
CR7IZ	9
DJ9OZ	124
EA2HR*	70

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G3IDG*	90	OZ4H*	56
IT1AGA*	425	PZ1AH*	776
JA2EKR*	53	SP8NJ	144
LA8PF*	38	UA1ZX	70
OH3MF	263	XE1RD*	546
OK2QX*	300		

* Denotes low-power multiplier

F.M. Techniques [*from page 58*]

seem to disturb some fellows too much, as they reason that they can always think up ways to boost the transmitter power to equalize this loss. What they fail to consider, however, is that the attenuation of the feedline will eat a 4.2 db bite out of any signal being *received* by the antenna, before it ever gets to the receiver.

The 2.1 db difference in attenuation between the two types of coax is sufficient to make the difference between a readable and an unreadable signal, which, after all, is the ultimate test of desirability for any of the elements of the system. The lesson to be learned here is that when working at 100 mc and above, RG-58/U should never be used for runs of more than a few feet such as for a feedline in a mobile installation or to interconnect pieces of equipment.

Preventive Maintenance

So now you finally have a unit that receives properly and you are hearing all kinds of things you never knew were there. What's needed to keep it that way? Something called "preventive maintenance".

The technique of routine testing and inspection of electronic gear to prevent gradual performance fall-off (as well as to forestall disruptive failures) has been the accepted doctrine of all commercial and military communications organizations for decades. But for some reason, the ham laughs at the idea of this being applied to his equipment. For those amateurs who would rather troubleshoot than operate, this may be an understandable attitude. If you so desire, however, you can go a long way towards keeping your f.m. equipment in good condition simply by testing all tubes at least once every six months and keeping the relay contacts clean. Remember that if you replace a tube in a tuned stage in the receiver, you will have to repeak that stage.

This service routine is especially important in an area where a repeater station is used. Because of a favorable transmitter site and/or high power, the area is blanketed with the

[*Continued on page 104*]

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75A-3 Receiver 269
75A-4 (#3190) 425
Speaker (A1,A2,A3) 9
75S-3C Receiver 499
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32V-3 Xmtr 175
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516E-2 DC supply 75
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VOX (Galaxy 300) 12
Galaxy V Xcvr 269
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SC-35 Speaker 12
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Comm IV 6m 139
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910A 6m Xcvr 189
3-way Supply 19
Thin-Pak 19
G-76 Transceiver 99
G-77 Transmitter 45
G-77A Transmitter 59
GSB-100 Xmtr 169
GSB-101 Linear 169
6n 12v converter 19

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S-107 Receiver 59
SX-110 Receiver 99
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HT-32A Xmtr 249
HT-33B Linear 375
HT-37 Xmtr 225
HT-40 Transmitter 49
HT-41 Linear 175
HT-44 Xmtr 225
PS-150-120 AC sup 75
PS-150-12 DC sup 39
MR-150 Rack 15
P-500AC supply 75
P-500DC supply 69
SR-46 6m Xcvr 99
HA-26 2-6m VFO 34

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HQ-170AC Rec 249
HQ-180AX Rec 375
SP-600 Receiver 175

HEATHKIT
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MT-1 Transmitter 29
DX-60 Transmitter 59
DX-100B Xmtr 99
TX-1 Transmitter 115
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Well, there you have it. With a little understanding and proper care, commercial f.m. two-way equipment will give a ham years of satisfactory performance. The terrific rate of growth of this mode of operation is a good indication of the enjoyment to be had from its use. A correctly functioning receiver is the key to that potential. ■

Solid State Coupling [*from page 62*]

Figure 10 shows a typical i.f. stage using transformers with untuned secondaries for the input and output circuits. The input signal is a.c. coupled by means of the step down secondary winding, through the d.c. blocking capacitor, C_B, to the base. The transistor is forward biased by means of the resistor R_B and the supply voltage. This provides the proper bias voltage between the base and emitter. The unbypassed resistor, R_1, in the emitter provides degeneration and reduces the positive feedback produced in the base spreading resistance within the transistor structure itself. Resistor R_2, in conjunction with C_n, the neutralizing capacitor, produces an additional negative feedback due to collector current that is directed back to the emitter. The blocking capacitor C_B in the emitter circuit keeps the supply voltage off of the emitter, and the r.f. choke keeps the emitter above a.c. ground. As a result, the positive feedback is just equal to the negative feedback, and the net result is zero, or unilateralization.

Bridge Neutralization

The use of bridge neutralization for transmitter amplifiers is well known, and has been applied without difficulty to transistor amplifiers. The equivalent resistance and capacitance of the feedback circuits have already been shown in fig. 9. If these elements are made part of a bridge circuit, and other cir-

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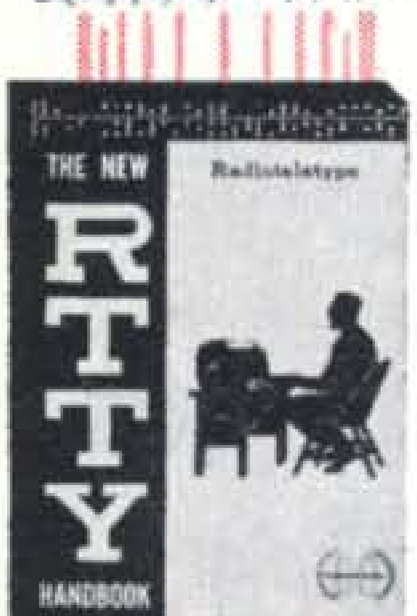

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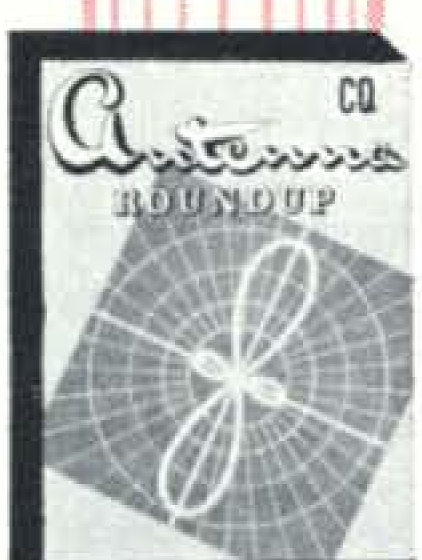

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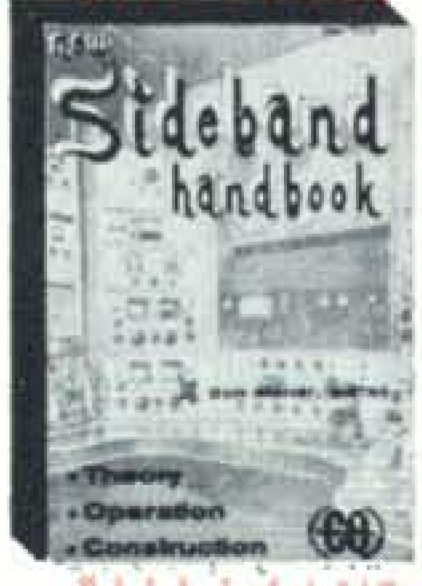

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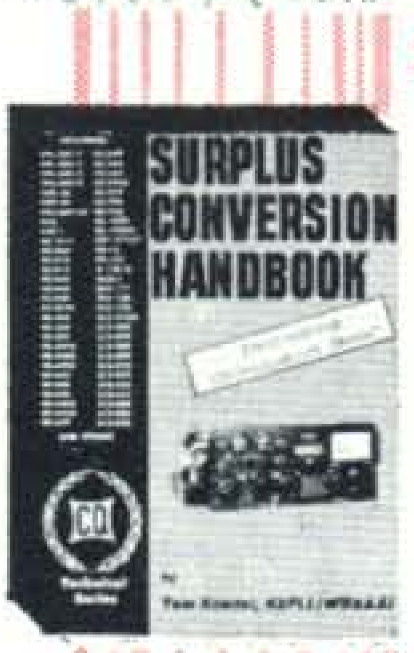

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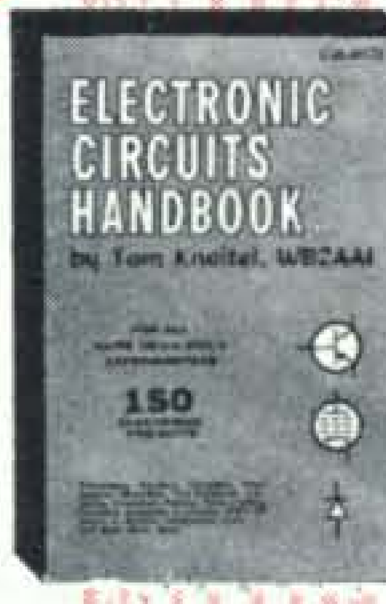

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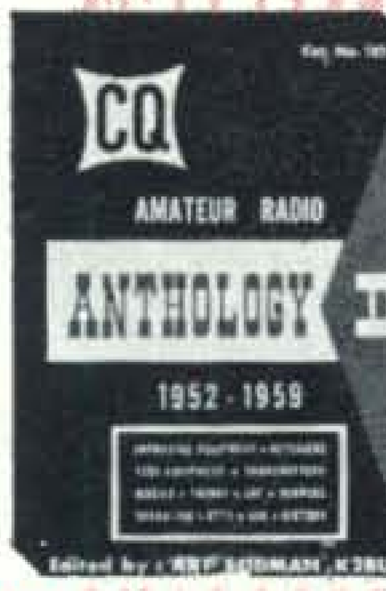

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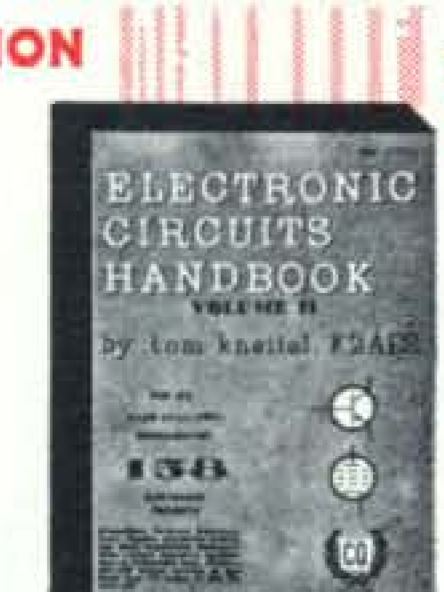

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cuit elements are used as the other arms of the bridge, the entire circuit becomes balanced (as far as the feedback voltages are concerned) and the result is unilateralization. A typical amplifier using such a bridge circuit is shown in fig. 11(A). The components that make up the bridge circuit are shown in fig. 11(B).

When the ratio of the voltages in the arms *A-B*, *B-C* equal the ratio in arms *C-D*, *D-A*, no output voltage appears between *B-D* and the bridge is balanced. Because the phase shift is also balanced, the circuit is *unilateralized*. If a capacitor alone was found to be sufficient (C_n in the bridge arm) it would be *neutralized*. ■

Grid Dipper [*from page 72*]

these have been tuned and installed in the antenna, the other elements may be adjusted to length for resonance of the entire system on the related bands using the g.d.o. as explained for antenna measurements.

Resonant Transmission Lines: Resonant transmission lines usually are associated with end-fed Zepp antennas as well as center fed types. These generally are tuned and coupled to the transmitter through either a parallel or series tuned *L/C* circuit, depending on the length of the feedline and the feedpoint. The setup may be checked for resonance at the operating frequency using the g.d.o. coupled to the circuit inductor. If resonance cannot be achieved at the desired point, changes may be made in the length of the feedlines or the tuned-circuit constants.

Un-tuned or Non-Resonant Transmission Lines: After the antenna has been adjusted to the correct length as indicated by the g.d.o., an untuned or non-resonant transmission line may be connected to it. If the antenna impedance matches that of the surge impedance for the transmission line, the g.d.o. coupled to the line with a small loop will indicate the initial antenna frequency regardless of the line length.

If such is not the case, a matching device will be needed between the antenna and the line. A match will be indicated when the adjustments are made to meet the aforesaid conditions with the g.d.o. coupled to the line.

Antenna Tuning via 300-ohm Twin Lead: When the antenna is "up in the air", it may not be physically possible to reach it for a g.d.o. measurement, but the job may be done

[*Continued on page 110*]

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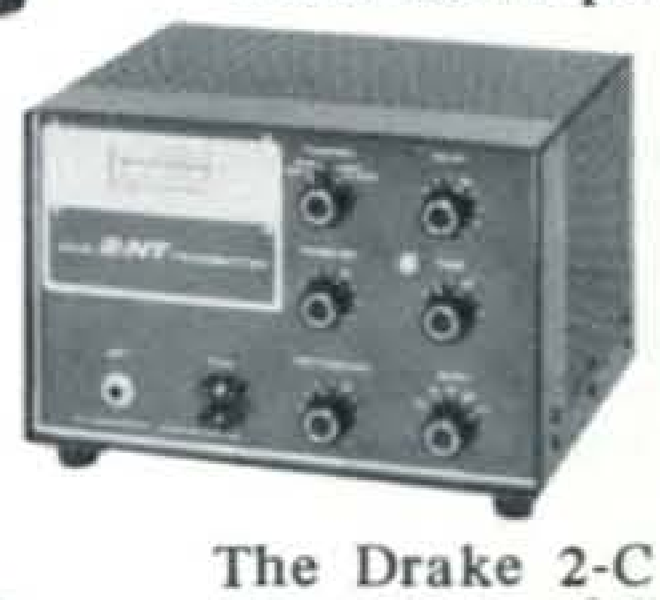

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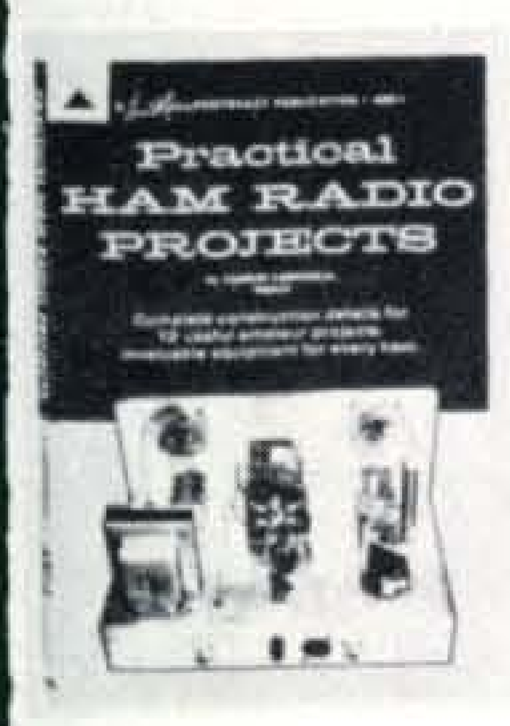

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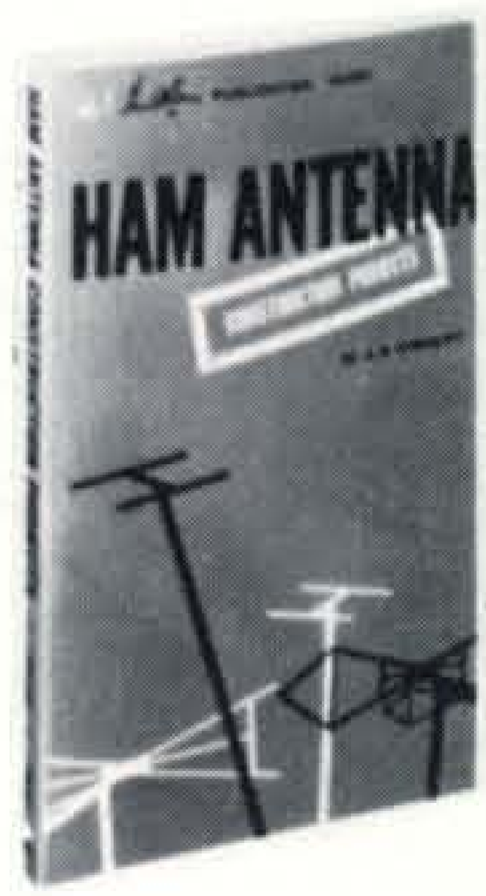

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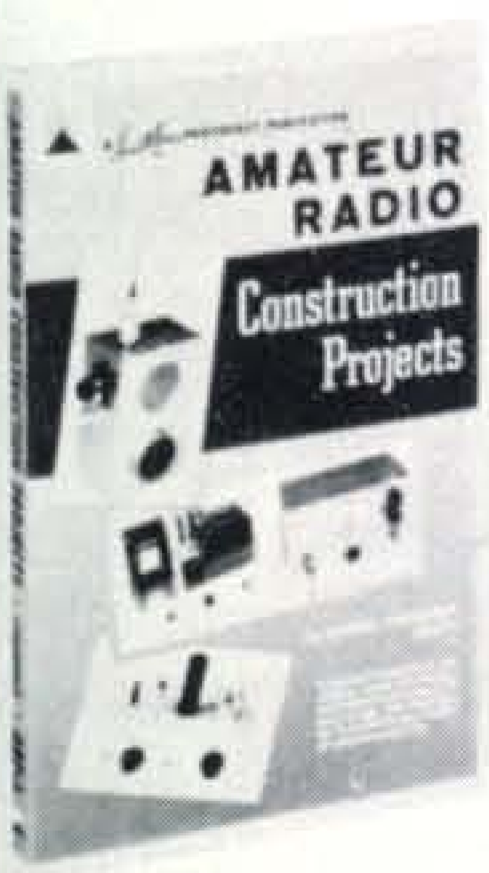

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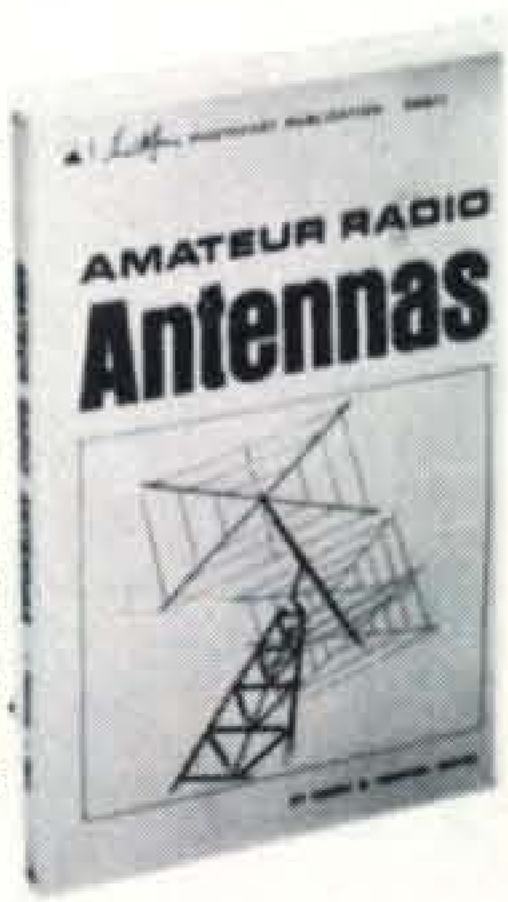

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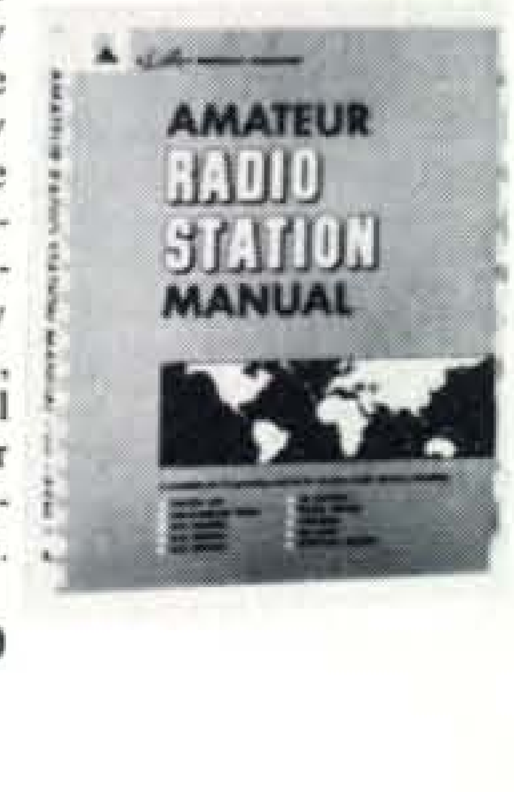

AMATEUR RADIO STATION MANUAL A complete log book designed exactly the way radio amateurs want it. Comb-bound to lie flat, it consists of 10 sections, separated by heavy index dividers, providing instant-use tabs for easy location of any section. Provides log sheets for entering complete information on all transmissions, frequently worked stations, operating records for WAS, WAC, WAZ, DX, etc. Covers special schedules, network data, prefix listings for countries all over the world. Log space permits entries for over 1,000 transmissions. 128 pages, 8½ x11".
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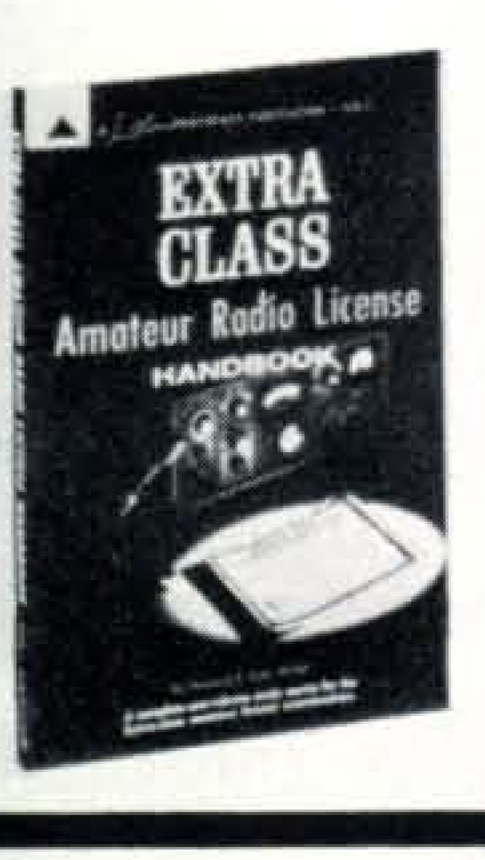

EXTRA-CLASS AMATEUR RADIO LICENSE HANDBOOK by Howard S. Pyle, W7OE. Contains the information you need to obtain your Extra-class license. Makes preparation for the "top" amateur license far easier for present holders of General-, Conditional-, or Advanced-class licenses. Covers: Requirements for the Extra-class license, building up code speed, all the advanced data you'll need to know for passing the license exam—including information on power supplies, r-f oscillators, frequency multiplication and r-f amplification, the radiating system, modulation, and advanced principles of electricity, r-f, and a-f. 160 pages, 5½ x 8½".
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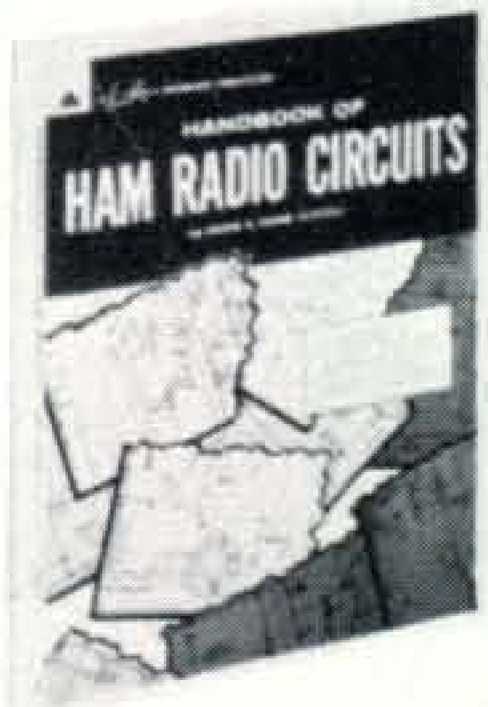

HANDBOOK OF HAM RADIO CIRCUITS by David E. Hichs. An invaluable reference on ham radio equipment and how it operates. Includes schematic diagrams, photos, and circuit descriptions for 36 of the most popular receivers, transmitters, transceivers, and linear amplifiers. Excellent for troubleshooting and modification needs as well as a guide for buying equipment. Covers single and multi-band, low-band and single-band equipment made by Collins, Clegg, Drake, EICO, Globe, Gonset, Hallicrafters, Hammarlund, Heath, Johnson, Knight, Lafayette, Mosely and National. Some are of recent design, and others are "old stand-bys." 128 pages, 8½ x11"
No. 20223 **$2.95**

See page 118 for New Reader Service

Grid Dipper [*from page 106*]

in conjunction with a half-wave length (or any multiple thereof) of 300-ohm twin lead connected to a low-impedance point at the antenna (center of a dipole).

The line itself should be cut to the proper amount by first determining its length as a multiple of a quarter wave at *half* the desired frequency as found using the g.d.o. as described for quarter-wave *shorted* lines. The short may be a small one-turn loop coupled to the g.d.o. The line will then be a multiple of a half-wave long at the desired antenna frequency and will duplicate any condition present at its far end (only at the frequency for which the line is cut).

When connected to the low-impedance point of an antenna resonant at the same frequency, the same reading therefore will be indicated by the g.d.o. If the g.d.o. dip indicates a lower frequency, the antenna is too long; if the frequency is higher, the antenna is too short. The antenna thus may be adjusted to length as needed to obtain the dip at the resonant frequency for which the twin lead was cut.

Conclusion

We have by no means included *every* possible application for the grid-dip meter; nevertheless, the information herewith presented should be adequate for most needs and also may serve as a guide line for enabling the user to employ his own ingenuity in other situations. ■

CQ Reviews: Drake [*from page 49*]

same receiver conditions.

The good bandpass characteristics of both converters are illustrated by the oscilloscope displays obtained with a sweep generator, as shown at fig. 2.

Prices for the various units are: SC-6 50 mc Converter $64.50; SC-2 144 mc Converter $69.00; CPS-1 Power Supply $12.50; SCC-1 Crystal Calibrator $24.50; CC-1 Console $24.50. These are products of R. L. Drake Company, Miamisburg, Ohio, 45342.

—*W2AEF*

Q & A [*from page 80*]

duction of the modulated r.f. waveforms, use the 5 kc bandwidth position on the SX-117. Also, tune the receiver into the center of the passband. In the case of s.s.b., this will be where the peaks appear to be the broadest.

See page 118 for New Reader Service

The s.s.b. signals will be heard slightly off frequency when this is done, but you cannot otherwise properly analyze the signal on the scope. A somewhat broader response may be obtained by connecting the scope to pin 8 of V_{10A} or pin 5 of V_9. The gain may be lower, but a better reproduction might be had.

Refer to the patterns *v.s.* bandwidth in the Monitorscope manual.

MARS Reception on Heathkit SB-300

QUESTION: I have a Heathkit SB-300 receiver which I'd like to use on MARS frequencies. I have been unable to locate any material on changing the frequency coverage, but I think it can be done by changing the heterodyning crystals. Is this correct?

ANSWER: In general you should be able to satisfactorily alter the ranges to accommodate most of the MARS frequencies by changing the heterodyning crystals and retuning their related circuits. A realignment of the preselector circuits also may be required.

The necessary crystal frequencies will be the lowest frequency for the desired range *plus* 8895 kc. For example: for 3289 kc, you'd set the receiver range for 3200-3700 kc, so you can obtain a correlated frequency reading on the dial at "089." This will require a 12,095 kc crystal (3200 + 8895). The crystal-oscillator plate and the preselector circuits may have to be realigned lower in frequency which might require a little padding.

Smaller excursions out of the ham bands will require less drastic realignment.

In the event you experience undesired birdies or spurious signals on a MARS frequency, shifting the receiver range an additional 100 kc with a different crystal frequency most likely will solve the problem.

73, Bill, W2AEF

DX [*from page 76*]

VK9KS—c/o W1YRC, 30 Rocky Crest Rd., Cumberland, R.I. 02864.
VKØIA—Via VK7Z-KJ, G. C. Johnson, 3 Inglis St. Newtown, Tasmania, Australia.
VKØJW—Via VK3UØ.
VP2MK—To W8EWS, 9500 Atherton Rd., Davison, Michigan.
VP2MU—Via VE2YU (*not* VE2BRO).
VP7NA—To K4DSN (*not* K4DNS).
VP7NF—c/o VE1ASJ, Box 41, East Riverside, Kings, N.B., Canada.
VP8s, FL, JG, & JH—E. R. Chilvers, 1 Grove Rd. Lydney, Glos., England.
VQ9JW—D.O.T.M., Box 7388, Newark, N.J. 07107
VR3DY—Ed DeYoung, Box 762, Kaunakapai, Molokai, Hawaii 96748.

See page 118 for New Reader Servic

VR6TC—Box 1, Adamsville, Pitcairn Island, South Pacific.

WØGTA/LA—To W2CTN.

W6TNS/TA—W6TNS, Box 7388, Alta Loma, Calif.

XEØVXO—Herb Schoenbohm; WØVXO/4, 2407 Melon Court, Orange Blossom Estates, Ft. Pierce, Fla.

YU3TXT—No. American contacts since Feb. 1, 1968 QSLed by WB6UJO, 9 Junipero Serra, San Rafael, Calif. 94901.

ZA7F—Via DJ9OR.

ZD9BJ—c/o GB2SM, The Science Museum, South Kensington, London SW7, England.

ZL5AA—To ZL2GX.

4A1CCP—Box 907, Mexico City, Mexico.

4Z4AG—Via WB4FJO.

5L2PL—c/o P.O. Box 1477, Monrovia, Liberia.

5N2AAU—To WA9UFV, 5417 W. Wrightwood Ave., Chicago, Ill. 60639.

5W1AR—Via W4ZXI.

6O1GB—c/o W1YRC.

7P8AR—Ulli Dehning, P.O. Box 194, Maseru, Lesotho, Southern Africa.

7Z3AB—To W4HEG.

9K2BV—Via W5GM (ex-W5EGR), 521 Monroe, N.W., Ardmore, Oklahoma 73401.

9L2SL—c/o K4MQG.

9Q5SE—To W4RNC, 8 Wilshire Drive, Asheville, N.C. 28806.

9U5CR—Via P.O. Box 1322, Bujumbura, Burundi.

73, John, K4IIF

C.W. Results [*from page 35*]

please pass the good word to some of the other organizations over there.

Andy, WB2CKS also reported a decided improvement in the USSR logs, so maybe we are getting thru to some isolated areas.

There was only a slight increase in the c.w. returns this year, a little under 6%, 1640 logs to be exact. But add this to the 1271 phone logs and we have a grand total of 2911 which should still qualify us as having the Top Contest in the world. There are 417 winners in 111 countries which is also an increase over last year, for the c.w. section.

And so we wrap up another one. I am referring to Andy Bodony WB2CKS, Fred Caposella W2IWC, Bob Entwistle W1MDO, Ben Lazarus W2JB, and Andy Malashuk W1GYE. We also had John Alline K1YRO for a short period before he wandered off to DU1FH. And Lorraine of the *CQ* office made our work much easier too.

Just mentioning names seems so inadequate when compared with the work that was involved. A few of you who have done contest work may have some idea what's involved, but believe me there's a lot more than you have ever experienced. So please forgive us if you run across an occasional error.

73 for now, Frank, W1WY

Propagation [*from page 78*]

80	06-10(4) 10-18(4-3) 18-00(4) 00-06(3-4)	07-09(4-1) 09-10(4-0) 10-16(3-0) 16-18(3-1) 18-19(4-2) 19-21(4-3) 21-06(4) 06-07(4-2)	06-07(2-1) 07-09(1-0) 09-16(0) 16-18(1-0) 18-19(2-1) 19-20(3-1) 20-21(3-2) 21-04(4) 04-06(4-3)	07-18(0) 18-19(1-0) 19-20(1) 20-21(2) 21-03(4-3) 03-04(4-2) 04-05(3-2) 05-06(3-1) 06-07(1)
160	17-18(1-0) 18-19(1) 19-21(3-2) 21-23(4-3) 23-05(4) 05-07(3-2) 07-08(1) 08-09(1-0)	18-19(1-0) 19-20(2-0) 20-21(2-1) 21-23(3-2) 23-03(4-2) 03-04(4-3) 05-07(2-1) 07-08(0-1)	20-21(1) 21-00(2-1) 00-03(2) 03-05(3-2) 05-06(1) 06-07(1-0)	20-22(1-0) 22-00(1) 00-05(2-1) 05-06(1-0)

HAWAII

OPENINGS GIVEN IN HAWAIIAN STANDARD TIME †

To:	*10 Meters*	*15 Meters*	*20 Meters*	*40/80 Meters*
Eastern USA	13-16(1)	06-09(1) 09-12(2) 12-16(3) 16-18(2) 18-20(1)	13-15(1) 15-17(2) 17-18(3) 18-22(4) 22-00(3) 00-02(2) 02-04(3) 04-06(2) 06-08(1)	18-20(1) 20-00(2) 00-02(1) 21-00(1)*
Central USA	12-14(1) 14-16(2) 16-17(1)	05-06(1) 06-12(2) 12-14(3) 14-16(4) 16-18(3) 18-20(2) 20-21(1)	06-08(2) 08-14(1) 14-16(2) 16-18(3) 18-00(4) 00-02(3) 02-04(4) 04-06(3)	20-21(1) 21-22(2) 22-01(3) 01-02(2) 02-03(1) 20-22(1)** 22-00(2)** 00-02(1)**
Western USA	10-12(1) 12-14(2) 14-18(3) 18-20(2) 20-21(1)	06-07(1) 07-08(2) 08-10(3) 10-18(4) 18-20(3) 20-22(2) 22-00(1)	05-08(4) 08-10(3) 10-13(2) 13-15(3) 15-22(4) 22-00(3) 00-05(2)	18-19(1) 19-20(2) 20-02(4) 02-04(3) 04-05(2) 05-06(1) 19-20(1)** 20-22(2)** 22-02(3)** 02-03(2)** 03-04(1)**

ALASKA

OPENINGS GIVEN IN GMT ‡

To:	*10 Meters*	*15 Meters*	*20 Meters*	*40/80 Meters*
Eastern USA	*Nil*	21-00(1) 00-02(2) 02-03(1)	12-15(1) 22-00(1) 00-02(1) 02-04(3) 04-05(2) 05-06(1)	07-10(1)
Central USA	*Nil*	20-00(1) 00-03(2) 03-05(1)	13-16(1) 22-00(1) 00-03(2) 03-06(3) 06-07(2) 07-09(1)	08-12(1)
Western USA	01-04(1)	17-22(1) 22-00(2) 00-02(3) 02-04(4) 04-05(2) 05-06(1)	13-14(1) 14-15(2) 15-19(3) 19-01(2) 01-03(3) 03-06(4) 06-08(3) 08-09(2) 09-11(1)	07-09(1) 09-12(2) 12-13(1) 09-12(1)**

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ee page 118 for New Reader Service

QST AND CQ Magazines for sale. Years '29 to present. Send SASE for list. A. Amerald, 8956 Swallow Ave, Fountain Valley, Cal, 92708

HY-GAIN 40 meter beam mod 402-B $50. Link 450 MC t-powered transceiver 5894 Final $40. Trade for Colt .45 Auto. W. Davis, 4434 Josie Ave, Lakewoo, Calif. 90713

FOR SALE: Heath SB-101 with CW filter HP-23, SB-610, SB-600 and HN-31. All are new and under warranty. Used less than a few hours. Must sell for $600. W. Bulchis, 64 Summer St, Hawthorne, N.J. 07506

FOR SALE: 1 Pr. BC611 Walkie Talkies. Now on 4,080Kc. W/manual $60. Plus transp. Waterman, 55 Lake Ave, Middletown, N.Y. 10940

SSB-33(SF) with Mount SBE mike and SB2-DCP Mobile PS $235 Perf cond. Also Two er built Apr 68 $45 with GP-11 $55. W. Thurston, 216 Cottage Rd, So Portland, Me. 04106

NAVY LM-14 Crystal Freq. Indicator with power supply and original calib. Book $50. R. Cabanillas Jr, 12620 Washington Blvd, Los Angeles, Cal. 90066

SELL: NC-173 Receiver, Good, $65. Knight T-150A transmitter, excellent at $75. Or best offer. Randolph Neal, 2802 Irwin Rd, Huntsville, Ala. 35801

1914 GERNSBACK E. I. Co., Catalogue, excellent condition. Swap for Antique radio gear. S. Samuel, 76-13 21st St, Bellerose 26, N.Y. 11426

RME-69 For sale. Manual included. One Band needs realignment, otherwise ok. Make offer. B. Mollenhauer, 186 West Ave, Pitman, N.J. 08071

WANTED: Gonset Comm 4.2 meters or other commercial 2 meter gear, state price & Condition. N. L'Heureux, 13 Libby Ave, Lewiston, Maine 04240

WANTED: Motor, 115V, 60 cy. For mite corp. TTy, P/N 2485 or 52-2477 or 521-104 or PD-82/U, FSN 6105-798-0347, D. R. Lee, 1228 Shelbourne Dr., Bethlehem, Pa. 18018

QST'S For Sale '23 to '33 incomplete '33 to date a few missing. Best offer A. Gifford, Box 313, Union Springs, N.Y. 13160

CQ & QST Magazines back to '54 for sale. Excellent cond. By volume or save $ and take all. G. Thiele, 3267 Redding Rd, Columbus, Ohio 43221

SALE: Johnson Viking I mtr w/829B final, TVI'd FB Speech clipping built-in. Just gone thru & Checked on air. 1st 10 mtr QSO w/gd plane ant. G3. $50. W. L. Lindblom, 512 Grandview Ave, Chillicothe, Mo. 64601

FOR SALE: Collins 32V-2 & 75A-2 A-1 condition, best offer. H. Rearick, 850 Washington St, Gary, Ind. 46402

FOR SALE: VHF/UHF equipment, converters, cavities, etc. Send sase for list. A. Bott, 340 South 24th St, Quincy, Ill. 62301

FOR SALE: Grimson closed circuit TV system-Camera, 21" Monitor, Sync Generator, Vidicon. Also: 17" marsan monitor. Best offer. B. Cohen, 4811 Tallahassee Ave, Rockville, Md. 20853

TELETYPE MODEL 19, complete, good condition, $100. WE-255 Polar Relay and socket $3 ppd. J. Hart, 7 Elmtree La., Huntington, N.Y. 11746

COLLINS S-LINE: 75 S-3B, 32C-3, 516F-2, SM-2. $1100. G. Grothen, 710 Arnold La, Alamogordo, N. Mex. 88310

WANTED: 110 Volt AC Power supply for Gonset Twing. Good 2 meter Transceiver with 110 volt AC Power supply. W. Luther, Rte. 2, Colfax, Washington 99111

FOR SALE: Very clean valiant, 160-10 meters. Works FB $130. R. Parson, 10726 Bordly Dr, Houston, Tx. 77042

SWAP: Model 28 ASR Teletype, Want Audio logging Recorder as used by FAA and others to monitor communications frequencies. Will answer all letters, J. Thomsen, 8280 Tennessee Ave., Clarendon Hills, Ill. 60514

FOR SALE: Pair 810's $5. Polar Relays $1.75. Cardwell PL-9027 $7. Shure 1020 Mike $3. CM-22 Comparator $25. 4ADP1 $5. H. Brown, 15 Fisher Dr., Greenville, SC. 29607

NOVICES: Sell lysco 600, 40 watt CW for $35. Sell Heath AT1, 25 Watt CW for $20. Both Excellent. Want CB rig, will trade or buy. A FOX, P.O. Box 2202, Huntsville, Tx. 77340

SONY VIDEOCORDER TV Tape recorder, 9" monitor, camera. Cost $1400 reg. $900 new! B. Heil, The Olde Music Shop, 201 North Main, Marissa, Ill.

HEATH DX-60, VFO Used to work over 200 counties & 12 countries. Grid meter needs work. $50 prepaid. C. Smith, Box 558, St. Mary's, Ga. 31558

SELL I-177B tube tester with MX949 adapter and manuals $20. Best offer. BC221AK Freq mtr w/ps. original calibration book and manual $70, best offer. R. Randall, 1263 Lakehurst Rd, Livermore, Cal. 94550

SELL: Lafayette HE-30 Receiver $40, Stromberg-Carlson Stereo Amp-New-28 watts $35. Want precision model 110 vom. I. Seidman, 735 Greens Ave Apt. 17A, Long Branch, N.J. 07740

FOR SALE: Teletype machine, page printer and keyboard; Master Mobile gear; B&W $425 filter. G. Smith, 915 Lovera Blvd, San Antonio, Tex. 78201

FOUR NEW 3" meters used with birdthruline 43 or line sections $15 each. C. Spitz, 1420 S. Randolph St, Arlington, Va. 22204

SALE: KW Bandswitch 2p11T, Steatite, $4 Viking Keyer kit $ Stereo Preamp for dual 1009 $7. All new. J. Schultz, 40 Ros St., Mystic, Conn. 06355

KWM-2 HIGH S. N. 11648 $695; 516F-2 AC PS $80; 516E-1 Hea duty 12VDC PS $119; 312B-4 Stn. Ctl. $139; GSB-101 KW Line $149. All mint. D. Burns, 4410 Reading Rd, Dayton, Ohio 454

WANTED: One or Two 4-250 or 4-400 Tubes. Will swap comma sets, Q mult., or Elmac PMR 7 recvr or cash. K. Seil, 66 Shar Dr., Rochester, N.Y. 14626

SELL: UTC GG 308 Trans., 110-220 Pri 3500-0-3500 $75. S LaDa 431 Oakland Ave., Maple Shade, N.J. 08052

FOR SALE: Vhf-152A converter 2-6-10 meters $30. Millen 908 Vhf Transmitter 2-6-10 Meter less ps/mop 100 watts $50. Ashley, Box 254, Ware Shoals, SC 29692

TRADE: 1945 CQs. Send your list for mine. Ditto SRT subchass Sell vacuum variable, low min; decade count unit. F. Schmi 405 N.W. 30 Terr., Ft. Lauderdale, Fla. 33311

WØCVU on the air since 1913. Look for me on 14275KC. Memb of OOTC and QCWA. C. Boegel, 1500 Center Pt. Rd. N.E. Ced Rapids, Iowa 52402

WANTED: USM 24A Navy Scope high-voltage transformer and/ scope for parts. Also need manual for meissner model-ex sigr shifter or will sell. A. Barry, 135 N W Dr., Patrick, AFB, F 32925

FOR SALE: Gonset GSB-100 $175. Hammarlund HQ-110 $1 Globe Highbander VHF62 $80 with VFO. Just overhauled w guarantee will ship collect. M. Bronsteins, 5 Lockwood Roselle, N.J. 07203

TRADE NCX-3, NCX-A, NCX-D, Hustler want 75S-1 or R4A or $2 T. Conley, 28 Bayberry Circle W. Liverpool, N.Y. 13088

SELL: SB300 SSB and AM Filters SBA-300-3 6 meter conver $225. HW-12 $85. C. Small, Box 71, Marcy, N.Y. 13403

FOR SALE: Homebrew Handbook Electronic keyer. W. Kornien 129 Culver St, Somerset, N.J. 08873

HUNTER BANDIT 2000C used very little. Expertly wired and cellent operating cond. $425. G. Fisher, Route 4, Solon, Io 52333

WANTED: Following back issues of 73, Oct '60 to April '61 inc sive (Except Dec '60) and Nov '61. L. Sharp, 19 Kelso Chermside, Brisband, Queensland 4032, Australia.

WANTED: Tech Manual or schematics for the TS-47/Apr; a Navy Tdn Vfo. T. Herrmann, 2327 S. East 72nd Ave, Portla Oregon 97215

SALE: Heath 10-21 scope, demod, prove, Lafayette audio gene tor $50. You pay express. W. Karl, 24 Mill St, Cooperstown, N 13326

WANTED: Prop Pitch Motor in Good working order. State con tion and price. M. Knowles, 9 Brown St, N. Billerica, Ma. 018

WANTED: Hallicrafters SX-16 SX-18 or SX-28 Cond unimporta State price 1st letter. E. Sjolander, 119 7th St, W., Ashla Wisc. 54806

FOR SALE: Bendix 500 Hertz Mechanical filter that plugs into pin miniature tube socket. This item not direct replacement Collins filter. $25. H. Hicks, 1911 Bermuda St., Shreveport, 71105

WANTED: Heath-VX-1 Voice Control unit. For sale: Heath HX-30 HA-ZO Linear 6M SSB $250. Hallicrafters SX-101-A mk III $1 J. Gysan, 53 Lothrop St, Beverly, Mass. 01915

DX-40 $35. VF-1 VFO $15. Globe HG-303 tx, needs work, $30. Falk, 5665 Bartlett St, Pittsburgh, Pa. 15217

FOR SALE: 36 Foot self supported aluminum tower with pr pitch motor. Will accept best offer. A. Zanoni, 208 Phillips A Trenton, N.J. 08638

VRC 19 FM 150-174 Mhz. Transmitter, Receiver, P.S. 6-12-2 3 Units in ease with centrol head and speaker. 30 Watts. $ W. M. Richarz, 519 Davie St, Fayetteville, N.C. 28301

ADCOM-500-12 Power New $99. KWM2 & Power $765. HW32 $ 32S1-$440. BTI-New Save or trade. F. Baker, 1 Box 546, McCon Ohio 45858

SELL: QST Complete set mint cond May 1929 through 1967 $ CQ 1947 through 1967 $60. Both for $100. W. H. Campbell, Cedar St, Wenham, Mass. 01984

FOR SALE: Spiralray, 144 mc, 25 elements $30. Mobile R Ameco TX86, HM Brew VFO, Gonset Super 6 w/stabilized Squelch & Noise limiter, console for mtg $100 w/Topaz pow supply $140, Package only. J. Horner, P.O. Box 533, Grot Conn. 06340

SELL OR Trade—Heath SB-400, $275.HRO-60 with Calibrator a all coils for 80 through 6 meters—new condition $260. Wan NCX-5 or Galaxy V Mark II. Write for list. J. Shank, 21 Terra Lane, Elizabethtown, Pa. 17022

75 M SSB Heath HW-12 with xtal calibrator. Less mike & P. $75. Will deliver 30 mile radius. R. Hutchinson, 1705 Kayw Ave, Bethleham, Pa. 18018

FOR SALE: Heath DX-60 & HG-10 VFO, large collection popu electronics magazine, wanted Nov. '60 & June '62 73 mag. Mi Hagen, Rd 2 Box 233, Brewer Rd, Waterloo, N.Y. 13165

See page 118 for New Reader Servi

INT CONDITION SX 130 sell for $115 on Swap. T. Dornback, W167 21st, Lombard, Ill. 60148.

ILWAUKEE AREA Hams-Aermotor MP-5 $240 list. 44 foot self-pporting Galvanized steel tower, disassembled, $75, L. Lawton, 04 Alta Vista Ave., Wauwatosa, Wisc. 53213

LOWATT MOBILE: Sbe 34 Transceiver $300, SBE-2LA Linear 95, SBE Inverter $195, Mount $5, Mike SBE, $14 package $680. Fruehan, 1226 Westwood Lane. Fairmont, W. Va. 26554.

LEVISION DX 6 year old DX club with new format. Pictures, ternational column, DX reports. Dues $3.50, samples $.30. orldwide, TV-FM DX Assen. F. Dombrowski, P.O. Box 5001, lwaukee, Wisc. 53204.

LE: Heath 10-21 scope, deomd, Provel LX Lafayette audio nerator. $50. You pay express. W. Karl, 24 Mill St., Coopers-wn, N.Y. 13326.

TSTANDING Like new Galaxy V mk II, AC Supply vox, galaxy 00 watt Linear. Factory cartons, checked out as perfect by C Licensed, first-class engineer. 10 spare finals. $700. W2DAP, Twisting Dr., Lake Grove, N.Y. 11755.

TIQUE TUBES Still ok one 852 and one 808 tube. Also Electro-ce mike Crystal, model 911, Rus. Sakkers, P.O. Box 218, lland, Mich. 49423.

R SALE: Heath HW-12-A 80 meter SSB Transceiver. Good con-ion. $69. A. Gerhard, 326 W 3rd St., Berwick, Pa. 18603.

LL OR Swap—Heath DX-40 xmtr. Gud shape. xtals for 80,40 & thrown in. Make offer. L. Irwin, P.O. Box 55, Weston, Ga. 832.

NTED: Collins CC-3 for 312B-5 control Antique Kennedy 110 220 receiver Heath kit "Q" Multiplier with power supply. nlein, 107 Wyoming St., Boulder City, NV. 89005.

HNSON Valiant II, Perf cond $140. Delivery locally only. W. ve, 66 Superior Rd., Bellerose, 26, New York 11426.

ANSMITTER, Eimac A-54H, five bands, $42.50. Typewriter 2.50. Transistor powr supply $16.50. Transistor heat sink 75¢. Boer, 449 Hill St., Boontown, N.J. 07005.

R SALE: Motorola 2 meter FM FMtru-5 V Dispatcher, base on -300-30 Watts Out. A. H. Carmical, 521 Fleda Rd., Memphis, Tenn. 38117.

R SALE: Heath kit Q-multiplier, Wired, new $10. Grown Antenna ator New $20. Radiart Antenna rotator, Used $10. CQ's '46 u '57. D. Scher, 11 Webster St., Irvington, N.J. 07111.

LL: HQ100 5200 speaker $125. HQ-110A used 30 hours like new 00. DX-40 a beauty $50. Globe VFO $25. J. Renault, Box 53 S, FPO New York, N.Y. 09544.

R SALE: Lafayette HB-500 CB Transceiver $80. New Hy-gain nk mounted DX CB Topper $13, Knight KG221A FM Monitor eiver $38. R. Blizzard, 146 Fortescue Rd., Newport, N.J. 08345.

NTED: Instructograph code machine in excellent cond with es and tone source. Price and condition in first letter please. Landry, 15 White Birtch Dr., Portsmouth, N.H. 03801.

L: Drake 2-C omalt/speaker, calib. 2 mo., old $265. Mint cond. tting radio. Orig Cartons, Davis, 3518 Indian Lane, Doraville, 30040.

33A LINEAR Less PI-172 tube for sale or trade or will buy e. Need 6 meter gear. L. Hoops, 1704 Glenn Dr, Ft. Worth, . 76131

NATIONS Wanted for Ham operators Radio Club of Clark Col-e. Have Club Call, W7AMD but no equipment. Will pay freight any donations. Write P.O. Box 1622, Vancouver, Wash. 98663. Donald E. Simonson, Trustee.

BCOR Royal Portable tape recorder Model EP2811-1. 3¾ & speeds. Like brand new. Cost over $200. Used only 10 hrs. ke offer. E. Colliau, 3809 Chevy Chase Dr., Flintridge, Pasa-a, Cal. 91103.

TR: Sell Globe Chief Deluxe, 90W xmtr, with three spare finals, condx, First $35 or best offer. J. Randall, 86 Fairmount Ave., tham, N.J. 07928.

SALE: Call books, Handbooks, Magazines such as CQ and er ham publications. E. Rasmussen, 164 Lowell St., Redwood , Cal. 94062.

SALE: Wheatstone oiled perf. tape, 15/32" width. P. Lemon, 4 Stony Pt. Road, Santa Rosa, Cal. 95401.

MPLETE DRAKE Station in mint cond; R4, ms4, T4X, AC 3plus re 520 SL Mic $750 or best offer. J. Heffler, 2200 Morris Ave, nx, N.Y. 10453

FOR SALE: Hammarlund HQ-170C, Heath Apache, Tx-1, Knight R-100 A with S-meter. Make offer on each or as a group. W. Newsome, P. O. Box 542, Wrens, Ga. 30833

SELLING EXCESS Equipment, xmitters, receivers, CB, test equipment, tubes, xtals etc. Send SASE for list. W. Toben, 1244 W. Schafer Dr, Tucson, Ariz. 85705

SELL OR TRADE: Hallicrafters SR-2000 2 KW PEP Transceiver & P-2000 supply, mint condition $1050, need Collins gear. D. Burns, 4410 Reading Rd, Dayton, Ohio 45420

SELL: Johnson Viking Valiant $95; Lafayette HE-30, 9 tube 550 kc to 30 mc rcvr $60. J. Wasiewicz, 4230 N.W. 10th St., Pompano Beach, Fla. 33063

WANTED: For preservation, any pre-war QSL's showing prefixes, D, EAR, ES, HAF, K4-7, KA, LY, YL, YM, ZT/ZU etc. F. Herridge, 96 George St, Basingstoke, Hampshire, England

HEAR N.Y. Area police Alarms! Bulletin #NY-1 lists more than 750 police fire, weather, and other emergency radio systems operated by city, county, state, federal agencies in New York City and surrounding areas of N.J., Westchester, and L. I. Frequencies, call signs! N.Y.C. Shown complete with 59 police stations on 28 channels. Be an informed citizen, hear tomorrow's news now! Only $1 (in cash only) from Communications Research Bureau, P.O. Box 56-A, Commack, N.Y. 11725

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WANTED: Swan 410 VFO and Drake 2B. Samkofsky, 201 Eastern Pky, Brooklyn, N.Y. 11230

HALLICRAFTERS: S-85 for sale. Exclt condx. Perfect for novice $45 or best. J. Randell, 86 Fairmount Ave, Chatham, N.J. 07928

FOR SALE: NC-270, with manual $100. Want HA-10 low freq tuner. L. Allen, 6452-A 102nd St, Ewa Beach, Hawaii 96706

SBE—for sale; NCX-3 Xcvr with XCU-27 xtal calibrator and NCX-A power sup, a $505 value for $269. Ship wt 55. Looks, works like new. J. Miller, RFD 8 Box 364, Springfield, Missouri 65804

FOR SALE: Drake R4 all extals new cond. $225. Ameco TX62 VF0621 New $125. D. Parsche, 2751 Windsor Ave, Chicago, Ill. 60625

TRADE: Johnson Viking II and 122 VFO for SB-10 with manual. H. Windle, 310 W. Palace, Hobbs, N. Mex. 88240

WANTED: Used Vibro-keyer. Sale; Hallicrafter's SX110 general coverage receiver. Make offer. J. Rutledge, Box 211, Lewisburg, Tenn. 37091

FOR SALE: 1948 issues of CQ, all 12 issues in CQ binder. Offer? H. Compton, 205 S.W. 102nd St, Seattle, Wash. 98146

WANTED: Citizen band General MC-6 transceiver. B. McGwier, P.O. Box 565, Grove Hill, Ala. 36451

FOR SALE: Radio and two-way business in sunny California. Radio doctor, J. Mayr, 818 Salem St, Chico, Calif. 95926

SELL: LM 13 Freq meter & 110VAC pwr supply, manual, calib, book, calibrating instructions & graphs, $65. W. Staudemaier, 1229 Chante Loup dr, Hendersonville, N. Carolina 28739

FOR SALE: Wheatstone perferator tape. P. Lemon, 3154 Stony Pt Rd, Santa Rosa, Ca. 95401

SELL: Galaxy V mk II w/a supp, vox, remote vfo, and rejector. New TH6DX, 70' Rohn Tower prop Pitch, Pair 4-400 GG, HW29A, Scope, Etc. J. Kreska, 2817 Lakewood Dr, Garland, Tx. 75040

2M FM & PD MON PORT. RX w/AM BCB 4 Sale. 146.6-174 MHz, STD 9V BAT, WRIST Strap, Electo-brand, $10 excellent cond. is perfect. Knight KA-25 12W/chan Amp, Metal case, $25 OK. Both for $30. ENA, 204 W Wing, Arl, Hts., Ill. 60005

WANTED: RME DB-20 preselector. State price wanted. E. Sjolander Jr, 119 7th St, W. Ashland, Wisc. 54806

SALE: S-108 $55. Mosley CM-1 $75. BC 459 $8. HT-18 Vfo $25 FOB. H. Mohr, 1005 Wyoming St, Allentown, Pa. 18103

TWO Meter Station: Clegg 22'er with original box and instructions, halo never used. Make offer. G. Skloot, 158-14 85th St, Howard Beach 14, N.Y. 11414

RTTY BACK Issues wanted; all '53 and mar '57. Cash, swap RTTY gear, or rent for duplicating. J. Sheetz, 5 Hansell Rd, Murray Hill, N.J. 07971

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Advertiser's Index

See page 118 for New Reader Service

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WANT *MORE* FOR YOUR MONEY?

Unless you're trying for inter-planetary communication, you'll get more and better DX if your beam can be elevated to its optimum height for each band.

Any beam, as it is raised to different heights above *electrical* ground, goes thru changes in impedance of as much as ±30%. Its angle of radiation likewise shifts significantly. At optimum (not necessarily highest) elevation you get best impedance match with lowest angle of radiation. This puts more of your precious RF power into the long DX path!

With an E-Z WAY Crank-up tower you can easily set your beam at the best height for maximum signals.

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73 *Bil Harrison* W2AVA

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FREIGHT PAID to any of 48 USA.

TYPE	ANTENNA HEIGHTS	*WIND LOAD	HAM NET
HD†	26 to 60 Ft.	14.0	$838.50
STD†	26 to 60 Ft.	11.0	596.50
HD	32 to 52 Ft.	28.8	571.50
STD	30 to 51 Ft.	12.0	438.00
HD	27 to 42 Ft.	33.5	503.50
STD	25 to 41 Ft.	12.0	320.00

*Antenna sq. ft. for 50 MPH winds, full up; 100 MPH when down.
†Three section; others two.

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page 118 for New Reader Service

GOTHAM'S AMAZING ANTENNA BREAKTHRU!!

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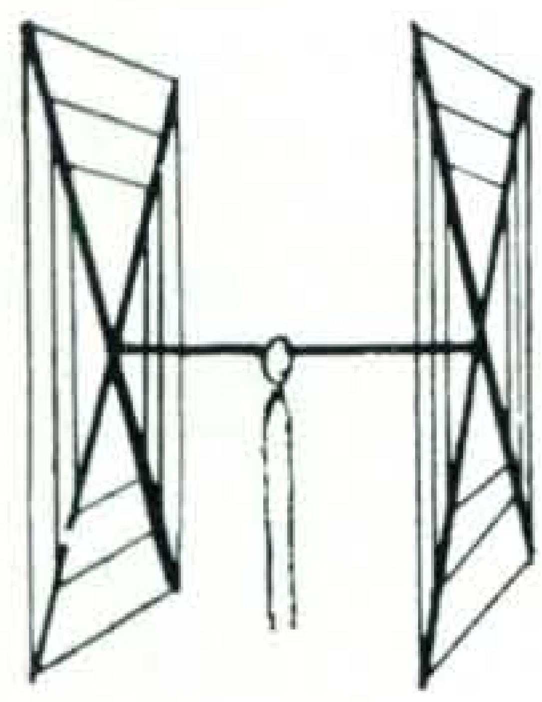
QUADS

Worked 42 countries in two weeks with my Gotham Quad and only 75 watts... W3



CUBICAL QUAD ANTENNAS — these two element beams have a full wavelength driven element and a reflector; the gain is equal to that of a three element beam and the directivity appears to us to be exceptional! ALL METAL (except the insulators) — absolutely no bamboo. Complete with boom, aluminum alloy spreaders; sturdy, universal-type beam mount: uses single 52 ohm coaxial feed; no stubs or matching devices needed; full instruction for the simple one-man assembly and installation are included; this is a fool-proof beam that always works with exceptional results. The cubical quad is the antenna used by the DX champs, and it will do a wonderful job for you!

10/15/20 CUBICAL QUAD SPECIFICATIONS

Antenna Designation: 10/15/20 Quad
Number of Elements: Two. A full wavelength driven element and reflector for each band.
Freq. Covered: 14-14.4 Mc. 21-21.45 Mc. 28-29.7 Mc.
Shipping Weight: 28 lbs. Net Weight: 25 lbs.
Dimensions: About 16′ square.
Power Rating: 5 KW.
Operation Mode: All
SWR: 1.05:1 at resonance
Gain: 8.1 db. over isotropic
F/B Ratio: A minimum of 17 db. F/B
Boom: 10′ long x 1¼″ O.D.; 18 gauge steel; double plated; gold color
Beam Mount: Square aluminum alloy plate incorporating four steel U-bolt assemblies. Will easily support 100 lbs. Universal polarization.

Radiating Elements: Steel wire, tempered and plated, .064″ diameter.

X Frameworks: Each framework consists of two 12′ sections of 1″ OD aluminum 'hi-strength' (Revere) tubing, with telescoping ⅞″ tubing and short section of dowel. Plated hose clamps tighten down on telescoping sections.

Radiator Terminals: Cinch-Jones two-terminal fittings

Feedline (not furnished); 52 ohm coaxial cable

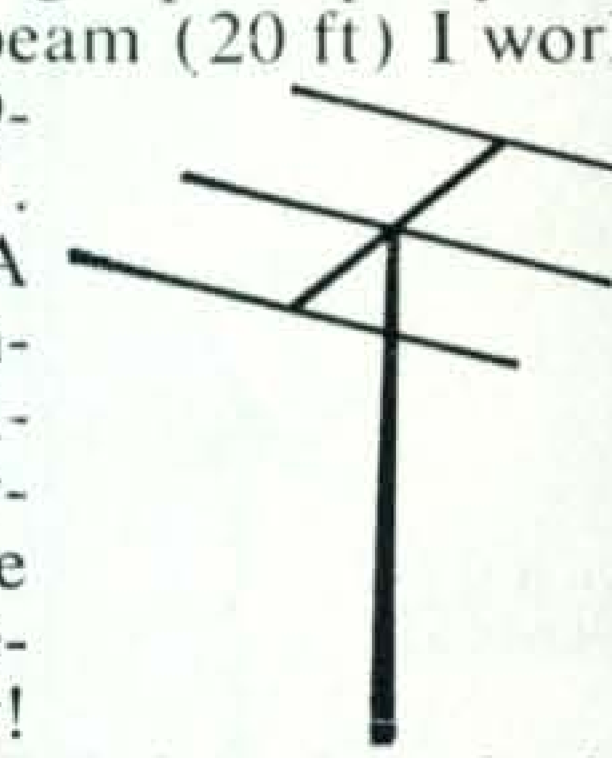
Now check these startling prices—note that they are *much lower* than even the bamboo-type:

10-15-20 CUBICAL QUAD	$35.00
10-15 CUBICAL QUAD	30.00
15-20 CUBICAL QUAD	32.00
TWENTY METER CUBICAL QUAD	25.00
FIFTEEN METER CUBICAL QUAD	24.00
TEN METER CUBICAL QUAD	23.00

(all use single coax feedline)

BEAMS

The first morning I put up my 3 e ment Gotham beam (20 ft) I work YO4CT, ON5LW, SP9-ADQ, and 4U1ITU. THAT ANTENNA WORKS! WN4DYN



Compare the performance, value, and price of the following beams and you will see that this offer is unprecedented in radio history! Each beam is brand new; full size (36′ of tubi for *each* 20 meter element, for instance); a solutely complete including a boom and all har ware; uses a single 52 or 72 ohm coaxial fee line; the SWR is 1:1; easily handles 5 KW; ⅞ and 1″ alumnium alloy tubing is employed f maximum strength and low wind loading; beams are adjustable to any frequency in t band.

2 EL 20	$16	4 EL 10	$1
3 EL 20	22*	7 EL 10	3
4 EL 20	32*	4 EL 6	1
2 EL 15	12	8 EL 6	2
3 EL 15	16	12 EL 2	2
4 EL 15	25*	*20′ boom	
5 EL 15	28*		

ALL-BAND VERTICALS

"All band vertical!" asked one skept "Twenty meters is murder these days. Let's s you make a contact on twenty meter phone w low power!" So K4KXR switched to twen using a V80 antenna and 35 watts AM. Here a small portion of the stations he worke VE3FAZ, TI2FGS, W5KYJ, W1WOZ, W ODH, WA3DJT, WB2FCB, W2YHH, VE FOB, WA8CZE, K1SYB, K2RDJ, K1MV K8HGY, K3UTL, W8QJC, WA2LVE, YS MAM, WA8ATS, K2PGS, W2QJP, W4JV K2PSK, WA8CGA, WB2KWY, W2IWJ, VE KT, Moral: It's the antenna that counts!

FLASH! Switched to 15 c.w. and worked KZ 1KN, KZ5OWN, HC1LC, PY5ASN, FG7X XE2I, KP4AQL, SM5BGK, G2AOB, YV CLK, OZ4H, and over a thousand other statio

V40 vertical for 40, 20, 15, 10, 6 meters	$14.
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See page 118 for New Reader Servi

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80-40 Meter SSB Transceiver

HAM NET... 159^{95}

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Includes: 1 ea.: Duo-Bander 84, DC384 Power Supply, one Bandspanner Antenna, BDYF Mount, 350C mic, Mic Plug, PL 259 Plug, UG176/U Reducer and 25′ RG58/U coax Cable. All supply cables are included.

ORDER: ZZMA103 package. $279.95 ($14 monthly)

OR...

A Complete 80-40 Meter FIXED STATION PACKAGE!

Includes 1 ea.: Duo-Bander 84, AC48 250 watt supply, 80/40 Duo-Doublet Antenna kit, 350 mic., Mic. Plug, PL259 Plug, UG-176/U Reducer and 100 ft. RG58/U coax cable.

ORDER: ZZMA104 Package. $205.00 ($10 monthly)

ORDER: ZZMA105 Package. $235.00 (Same as above with 400 watt AC supply) ($12 monthly).

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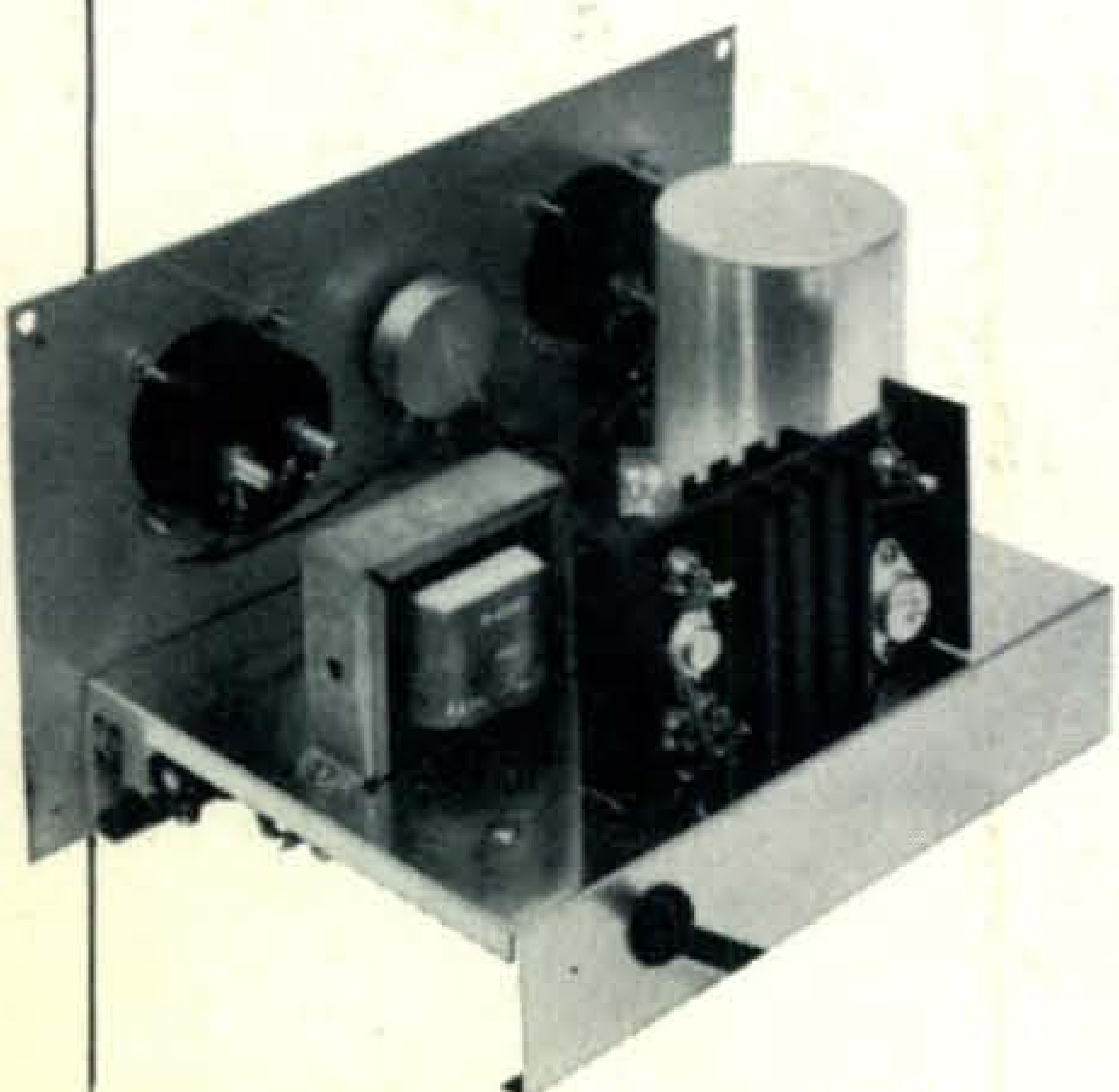

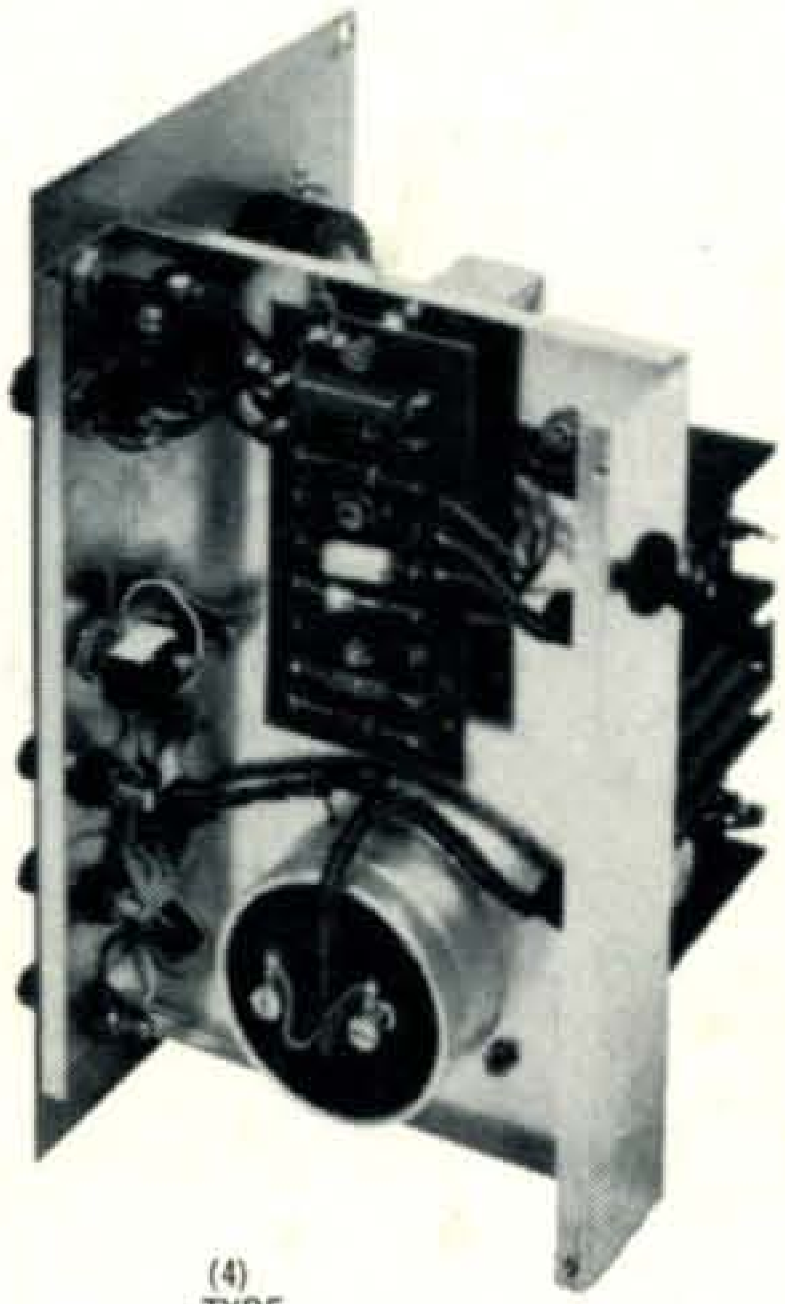

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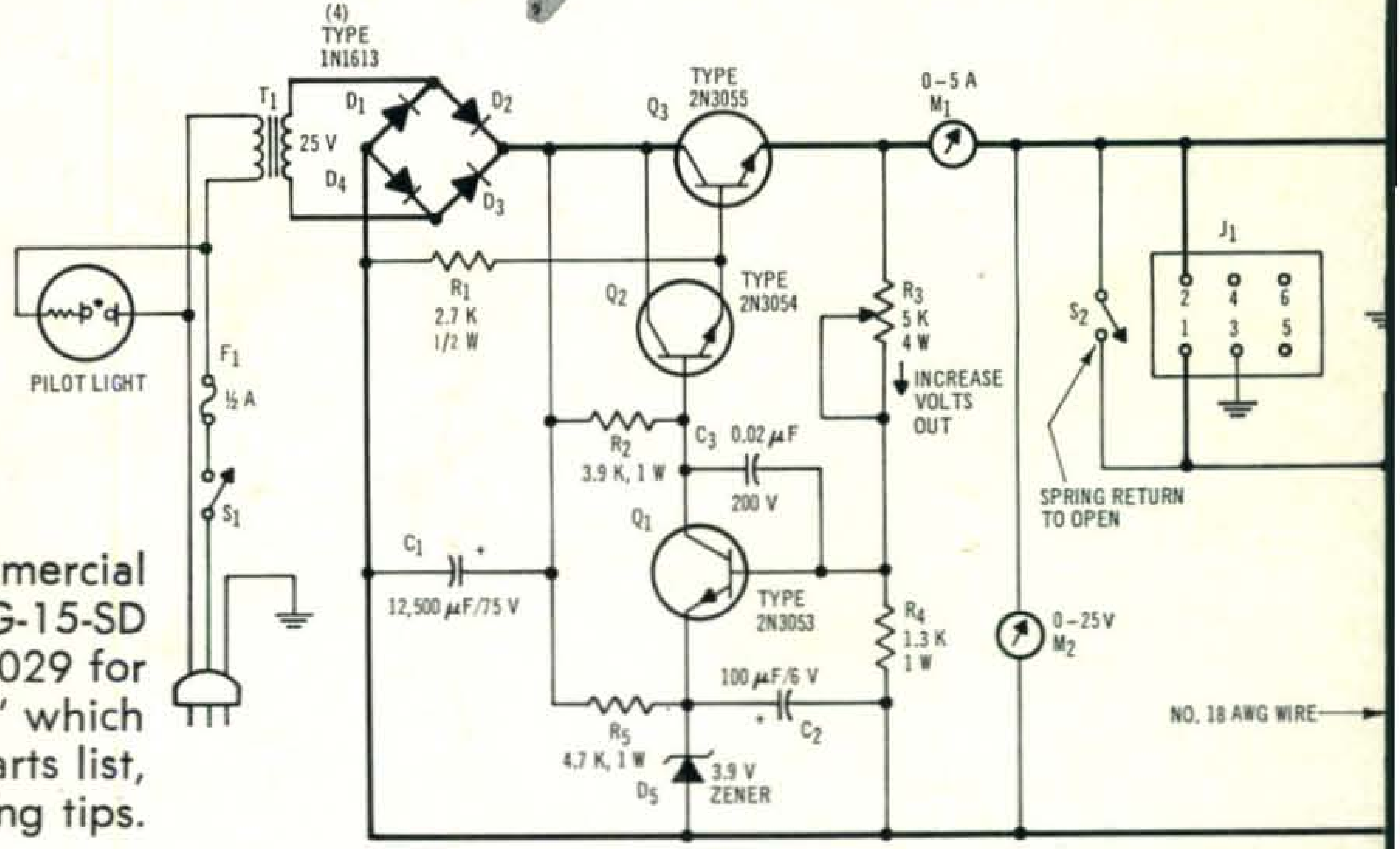

Write RCA, Commercial Engineering, Section G-15-SD Harrison, N.J. 07029 for June '67 "Ham Tips" which includes full parts list, schematic and building tips.

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