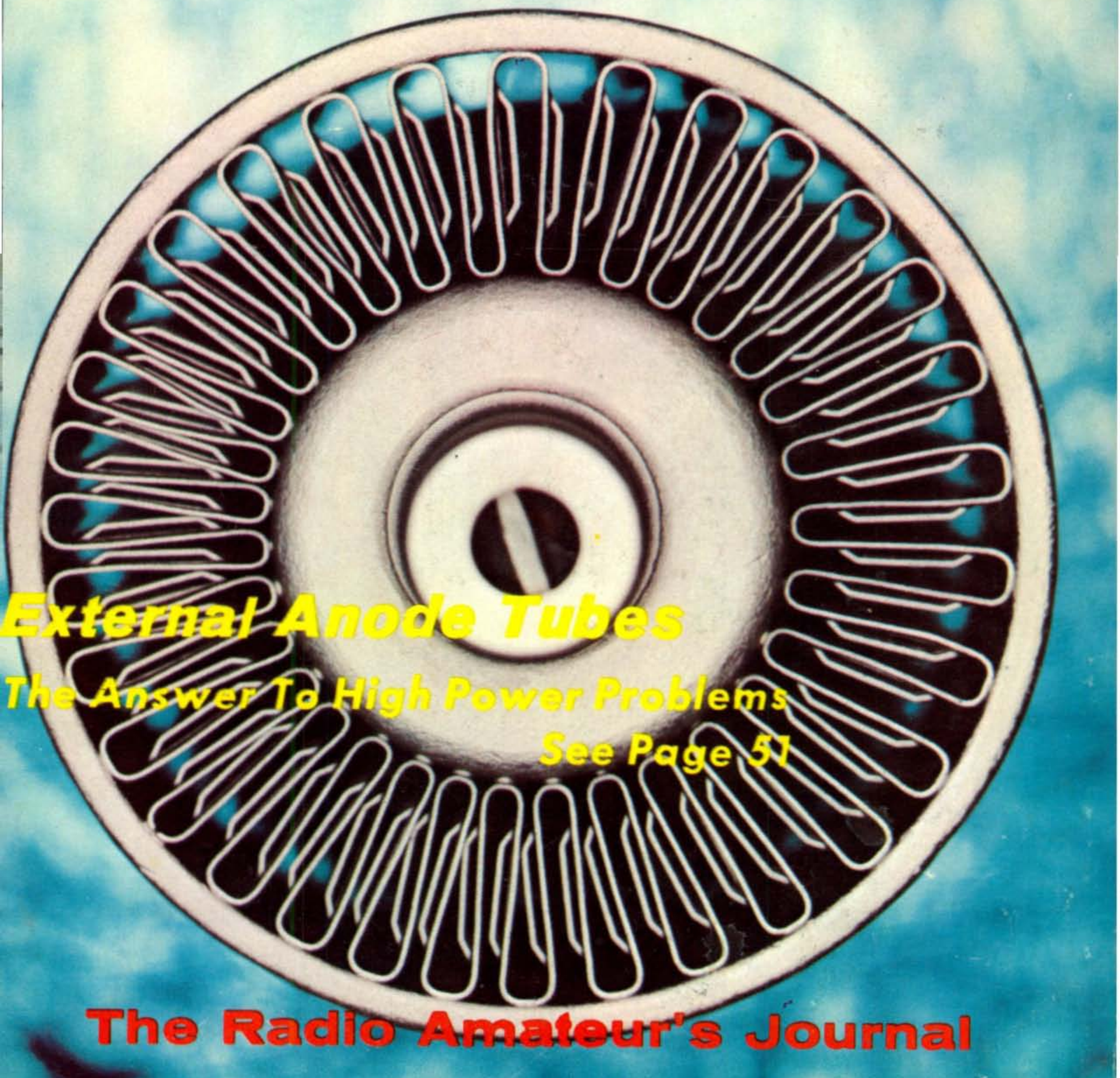
CQ

ICD

June 1968

75¢



External Anode Tubes

The Answer To High Power Problems

See Page 51

The Radio Amateur's Journal

SUITCASE SYSTEM

Slide a PM-2 Power Supply on the back of your KWM-2 and put them into a CC-2 Carrying Case. Slip the 30L-1 Linear Amplifier into another CC-2 and you're DXpedited. Plug in the antenna, microphone, and three patch cords and you are on the air—anywhere—with a Collins quality kilowatt system.

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The Model 6000 Modular Frequency Meter will measure frequencies 10 KHz to 600 MHz with .000125% accuracy. Special plug-in modules allow the instrument to be used as an audio frequency meter from 500 Hz to 20 KHz full scale and in addition to be used as a dc voltmeter (10,000 ohms/volt).

The wide variety of plug-in oscillator accessories and range modules makes the Model 6000 adaptable to a number of jobs in the field and in the laboratory. Portable, battery operated with rechargeable batteries.

Model 6000 with 601A charger, less plug-in modules.....$195.00

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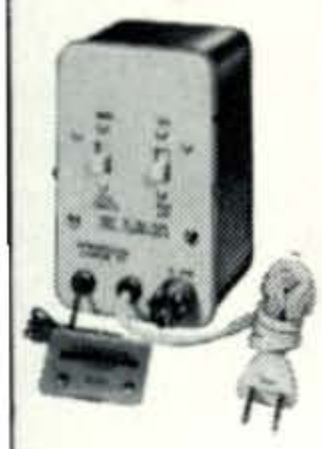

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Special Modules
Audio Frequency $45.00
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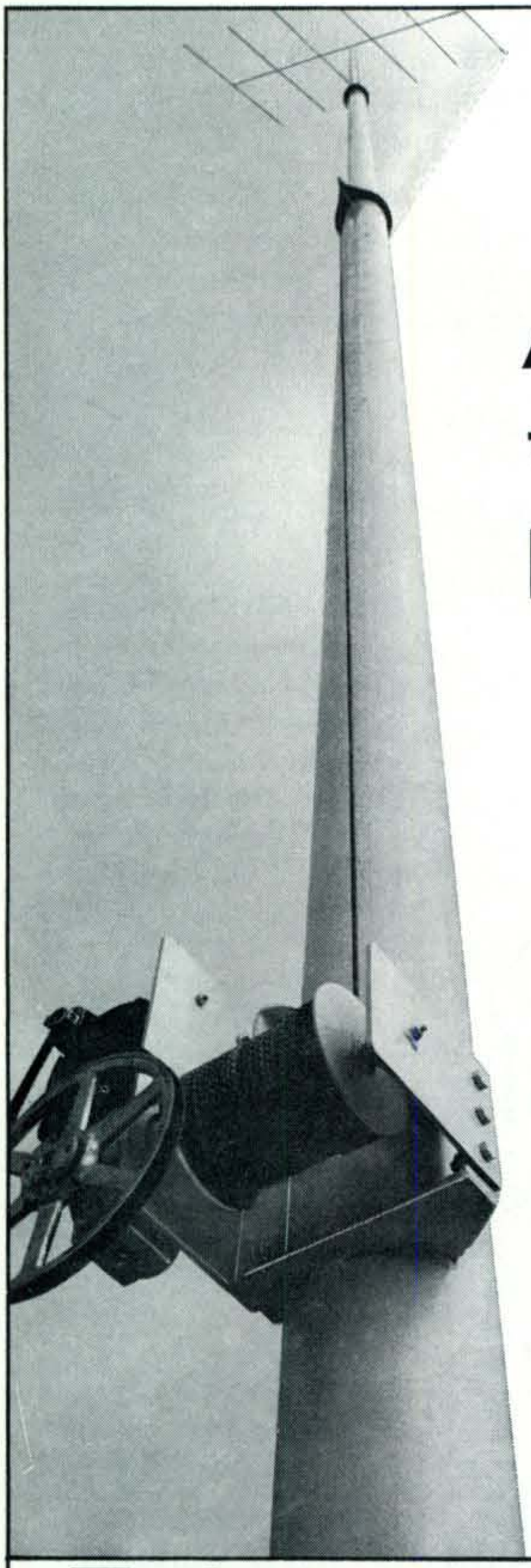
See page 126 for New Reader Service



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TM 370

Holds 30 sq. ft. of antenna in 60 mph wind.

Telescopes to 70 feet up

Nested at 27-ft., it can be quickly run up to its full 70-ft. for instant use. The TM 370 Sky Needle is the only Tri-Ex telescoping *tubular* mast specifically designed for amateur antennas. Absolutely freestanding, the TM 370 will support a full 30 sq. ft. of antenna in a 60 mph wind. Only the best high-strength steel, welded by certified welders, is used in the tower's construction. Each section is fully galvanized—inside and out—*after* fabrication for all-weather use. Single crank up and down operation is assured by the extra heavy-duty worm-geared, self-locking safety winch and galvanized aircraft-type cable. No special crane is needed to erect the Sky Needle because of its tilting hinged base. A ladder and work-platform is available as accessories. Tri-Ex offers immediate delivery. No shiping charges inside continental U.S.A. Write now for free brochure.

Tri-Ex TOWER CORPORATION

7182 RASMUSSEN AVE., VISALIA, CALIF. 93277

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JUNE, 1968 VOL. 24, No. 6

CQ The Radio Amateur's Journal

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DEPARTMENTS

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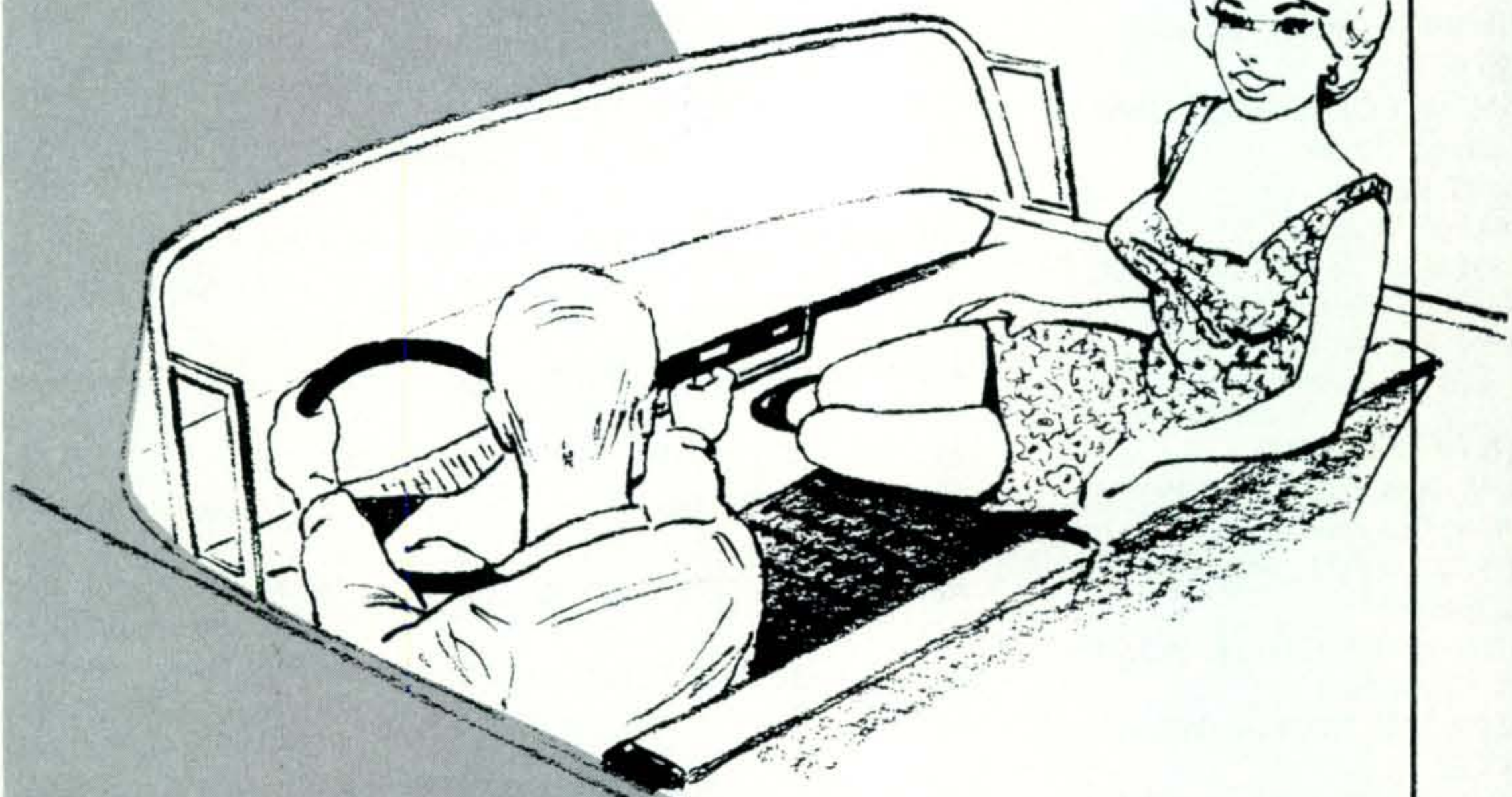

...to change bands?

Band-Adder, installed in a jiffy on most mobile antennas adds the 10, 15 and 20 meter bands — without tuning or switching. Get all the use out of your new 5-Band transceiver. Order from your Waters distributor or send check for $19.95 to factory. We'll ship the same day.

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See page 126 for New Reader Service

ZERO BIAS

We've been editorializing for the past few months in favor of legislation granting aliens in the U.S. the right to hold amateur licenses during the years prior to their becoming citizens. Last month we were able to report some progress towards that end, and this month we report still more.

On April 24, 1968, Congressman Theodore R. Kupferman of New York introduced H.R. 16764, a Bill designed exactly to meet the demands of the situation first described in *CQ* for January 1968. H.R. 16764 is now under study by the House Committee on Interstate and Foreign Commerce, West Virginia Congressman Harley Staggers, Chairman. Whether or not the Bill gets out of committee depends, to a great degree, upon the support and interest demonstrated to Chairman Staggers by the public. This means amateurs throughout the U.S.

Our means of demonstrating the needed support are not new to amateurs. We've gone this route before, with S.2361, the 1961 Senate Bill which led the way to Reciprocal Licensing. In 1961 and early 1962, hundreds of letters were written and dozens of telegrams sent in support of S.2361.

S.2361 never quite made it through the Senate, the legislative process being such a slow and laborious one, but in February 1963, S.920 was introduced, replacing S.2361, and went on to become the law of the land.

The same thing can happen wtih H.R. 16764, but it means letters, and plenty of them. We urge all interested and public spirited amateurs to write a letter of support for the Bill to their own Congresmen, and to Committee Chairman Staggers. We also will welcome similar letters to *CQ* which will in turn be forwarded to the most productive quarters.

In addition, we sincerely urge ARRL members to implore their Division Directors to lobby for similar support from ARRL. Several Directors have already expressed their enthusiasm for the project, and we're sure that more will, when approached. As in State and National politics, in urgent times, partisan politics must be set aside. And so it should be in amateur radio.

EIA On The Move

At the Dayton Hamvention held recently, the Electronic Industries Association Amateur Radio Section held a meeting to discuss, among other things, ways in which the organization can further promote the development of Ham Radio. Several highly original and constructive programs are under way, all of which are being financed by participating member manufacturers.

It was brought up that the Association would do well to work in local areas in conjunction with local Amateur Radio Clubs, and *CQ* was asked to provide EIA with an up-to-date list of such clubs. In checking our list, which has been compiled over a period of years, we find that we have less than half of the known-active clubs included. We'd like to update that list immediately to make it available to EIA for their excellent projects. In this direction we need *your* help.

If you belong to an amateur radio club, we would like the name and mailing address of the club, and if possible, the name of the president or secretary. Please don't assume that your club is already on our mailing list or that someone else is going to send us the information. If we get more than one letter or card duplicating the name of a specific club, we'll remove the duplicate names.

Send the information on a post card or letter to EIA Ham Club List, c/o *CQ*, 14 Vanderventer Ave., Port Washington, N.Y. 11050. We need this list quickly, please.

Our Cover

This month's cover is a close-up photo of one of the latest external anode transmitting tubes, the RCA 8122, now in use in several commercially-built amateur transmitters. On page 51 of this issue begins an article intended to assist the amateur to utilize this family of tubes in medium and high-power transmitting situations. Our thanks to RCA for their photo assistance.

See page 126 for New Reader Service

NOW! A SUPER THUNDERBIRD!

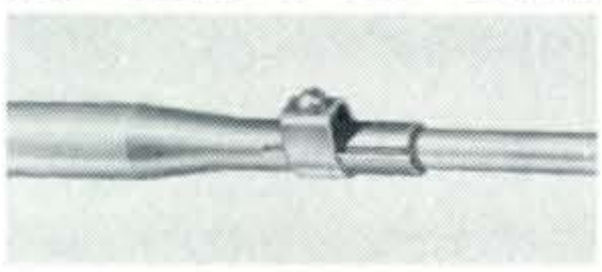
ALL NEW 6-ELEMENT SUPER THUNDERBIRD TH6DXX

The new Super Thunderbird TH6DXX offers the ultimate in tribander performance, with mechanical and electrical specifications unsurpassed for 10, 15 and 20 meters. This newest of Hy-Gain's amateur antennas is superb on DX and other long haul contacts, and gives peak performance on each band whether you're working phone or CW. Check the many features at right; you'll see why you should be using the new Super Thunderbird!

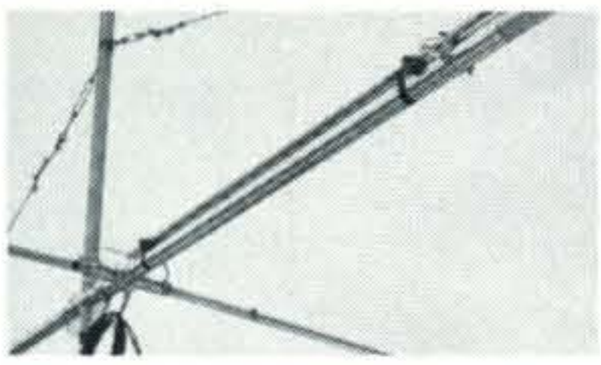
PLUS THESE OTHER GREAT THUNDERBIRDS

- New, improved 3-element Thunderbird—Model TH3MK3.
- Fabulous, 3-element Thunderbird Jr.—Model TH3JR.
- Popular 2-element Thunderbird—Model TH2MK3.

Tilt-head, universal boom-to-mast bracket—all new, cast aluminum bracket accommodates masts from 1¼" x 2½". Allows easy tilting for installation, maintenance and tuning, provides mast feed-thru for beam stacking.



Taper swaged, slotted tubing—new tubing on all elements allows easy adjustment and re-adjustment. Taper swaged to permit larger diameter tubing where it counts! And, less wind loading. Full circumference compression clamps are mech. and elec. superior to self-tapping sheet metal screws.



Hy-Gain Beta Match—Advanced design from company that invented the Beta Match, achieves balanced input, optimum matching on all 3 bands, and provides DC ground to eliminate precipitation static.

OUTSTANDING HY-GAIN FEATURES

- Tilt-head, universal boom-to-mas bracket (see details at left).
- Taper swaged, slotted tubing wit full circumference compressio clamps (see details at left).
- Hy-Gain's exclusive Beta Matc (see details at left).
- New, improved "Hy-Q" traps. separate traps for each band.
- Up to 9.5 db forward gain.
- 25 db front-to-back ratio.
- SWR less than 1.5:1 on all banc
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GOING STRONG!

The latest evolutionary development of the Classic Model 350

The new SWAN 350-C 5 band, 520 Watt SSB-AM-CW TRANSCEIVER

The introduction of the new model 350-C at no increase in price over the popular 350 is a real triumph of value engineering.

Power rating of the 350-C is the same as the Deluxe Model 500-C, which is 520 watts P.E.P. input on single sideband, 360 watts CW input, 125 watts AM input. A pair of rugged, blast-rated 6LQ6 tubes handle this input with ease. Selectivity is provided by the same superb crystal lattice filter used in the 500-C, with skirt selectivity and ultimate rejection superior to any other filter being used in amateur equipment today. Audio quality has the same degree of fidelity which Swan has stressed from the very first single band transceivers.

The 350-C is designed to operate automatically on the normally used sideband with extended frequency coverage of all five bands, 10 through 80 meters. The high frequency crystal lattice filter is common to transmit and receive circuits. Bandwidth is 2.7 KC. Audio bandbass is essentially flat from 300 to 3000 cycles. Sideband suppression is greater than 50 db; carrier suppression is greater than 60 db. Grid block CW Keying is provided with offset frequency. The VFO is transistorized, temperature and voltage stabilized. Receiver sensitivity is better than .5 μv for 10 db signal-plus noise to noise ratio. Velvet smooth dual-ratio tuning is featured, as in all Swan Transceivers. Basically the difference between the 350-C and the 500-C is in the deletion of optional features which are not essential to communication. These include such things as crystal calibration, sideband selector, CW sidetone, automatic noise limiter, automatic level control, etc. For the operator who desires these features, we are proud to recommend the deluxe model 500-C. However for powerful and reliable communications without all extras, we now offer the new 350-C, and we are confident that you will rate it a truly exceptional value. **$420**

ACCESSORIES

117XC Matching AC supply with speaker.....$105
14-117 12VDC Mobile Supply.....$130

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SWAN SPEAKS YOUR LANGUAGE
ASK THE HAM WHO OWNS ONE

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NARA Replies

Dear Mr. Ross:

In your March issue you mention NARA and our opposition to the incentive regulations. It is the band reductions for general class licentiates which is of course the big problem. You are right that amateur radio has been torn apart over this issue for several years. I am not certain that the way to solve this and future issues is to give in to the ARRL. The two party political system has worked reasonably well in the USA and I think that amateur radio needs another organization to help create a sensible balance of power.

When we speak of something for the "Good of amateur radio," what do we mean? Are we to encourage more to join the hobby or to discourage people so that we can reduce band crowding? Will harder exams create a better breed of operators or will it penalize those who do not have the time to memorize, or do not have the time or money to go to cities where they can take the exam. Will the new rules make the bad operators more courteous? Will they take the illegal highpower rigs off the air who hog the bands?

Our equipment has grown so sophisticated that few dare to build or work on their own equipment as your Grumbles points out, and anyone who can who can memorize can pass the theory exams without really knowing what it is all about.

NARA's nationwide survey has revealed that those who are getting clobbered by the new rules are nearly all against them. Those that would gain advantages at the expense of the others are nearly all for them.

It is quite common for unions or associations to go to employers or legislatures to ask for increased privileges. This is probably the first time in history that an organization has asked to have its members privileges reduced. It is hard to believe that the ARRL which has the majority of its members as Generals or Conditionals really was expressing the wish of the majority of its members when they advocated the present rules and cut down their members rights.

NARA's plans are not completely formulated but they will be presented to the membership for approval and our plans are coming from the membership.

Some of our members would like to see high power rigs off the air, especially the illegal power jobs. Many would like to see even a reduction of current power levels. Some would like to see better policing of the amateurs. Some have advocated a licensing system similar to the one in Japan. Others think that if the new changes would stop with those going into effect this November that things wouldn't be too bad. We are welcoming all constructive criticism!

Richard M. Smith, K7GOM
St. Helens, Oregon

DX's Contribution

Editor, *CQ*:

I certainly agree with K4IIF, when he states in his DX column in the April issue, that various facets of DX'ing contribute to justifying the granting of frequency space to radio amateurs. However, I don't think John emphasized enough that it is not DX "operating" alone that makes this contribution but DX'ing in the sense of equipment advancement, gaining of knowledge of propagation mechanisms and, to a lesser extent, operator techniques. Sheer patience and long hours of knob spinning may be the means necessary to really score high in the DX world but in and of itself, this does not advance the state of amateur radio or justify its existence. If, on the other hand, one tries to learn something during these hours that is reflected in even some minor circuit improvement, antenna development or bit of propagation knowledge, the whole world of radio can benefit.

John Schultz, W2EEY/1
Mystic, Conn.

Our Gang

Dear Dick:

I would like to take this opportunity to publicly praise Mr. Frank Anzalone, W1WY, *CQ*'s CONTEST CALENDAR Editor for his sustained performance in keeping individuals, radio clubs, DX'ers and DX-peditions well informed, not only through his very popular column, but through his personal efforts via the amateur radio bands and the mail. I also wish to commend Frank, as the *CQ* Contest Committee Chairman, and his committee, for their untiring efforts on our behalf in providing the contest world with the final results at the earliest possible date. I'm sure all contest minded amateurs throughout the world will agree that these hams, and their clerical staff, are truly the unsung heroes of the *CQ* World-Wide DX and *CQ* WPX/SSB Contests and are deserving of a special award.

Thank you . . . . . from one of the many.

Bernie Welch, DL4FS
Rhein-Main Air Base, Germany

Editor, *CQ*:

I am a short wave listener and have been so for a little over three years. I would like to take this opportunity to thank you and the people of your magazine for the fine information they publish each month.

I would especially like to thank John A. Attaway, K4IIF and Ed Hopper, W2GT. Through the efforts of these two gentlemen, I have been able to log and verify several countries and qualify for various awards. I would not have known of any of these had they not been mentioned in the DX and Awards Program columns.

Even though your magazine is written primarily for the amateur radio operators, I personally consider it to be invaluable to the s.w.l. who wants to add to his list of countries logged or who is an avid award-hunter.

Again, thank you. Looking forward to the next issue of *CQ*, I remain,

Gary S. Ligon
Cliffside, North Carolina

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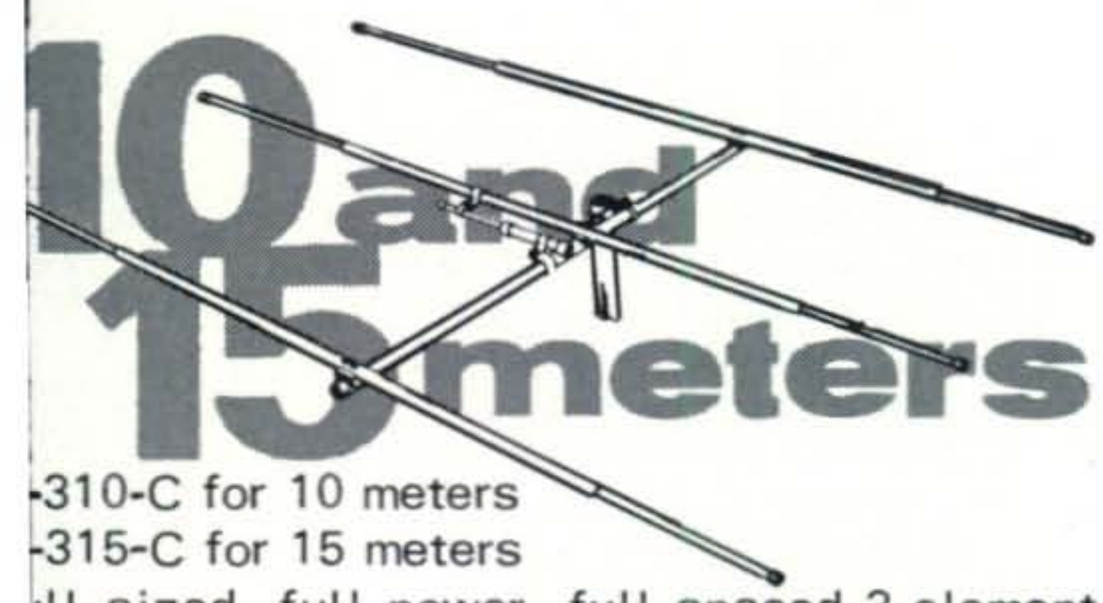
When hams discuss 'OPTIMUM SPACING' in single band beams . . .

. . . . . *The subject turns to* **Mosley**

mateurs punch through the QRM on 20 meters ith Mosley's A-203-C, an optimum spaced 0 meter antenna designed for full power. he outstanding, maximum gain performance xcells most four to six element arrays. This lean-line rugged beam incorporates a spe- al type of element design that rtually eliminates element utter and boom vibration. Wide paced; gamma matched for 52 ohm ne with a boom length of 24 feet and ements of 37 feet. Turning radius is 22 feet. ssembled weight — 40 lbs.

20 meters



10 and 15 meters

-310-C for 10 meters
-315-C for 15 meters
ll sized, full power, full spaced 3-element rays. 100% rustproof all stainless steel rdware; low SWR over entire bandwidth; ax. Gain; Gamma matched for 52 ohm line.

40 meters

S-402 for 40 meters
Top signal and unexcelled forward gain - a 2-element optimum spaced beam. 100% weatherproof. Low SWR. Heavy duty construction. Link coupling results in excellent match over full bandwidth.

For detailed specifications and performance data, write Dept 157A.

Mosley Electronics, Inc. 4610 N. Lindbergh Blvd., Bridgeton, Mo. 63042

Announcements

The annual Central Kansas Amateur Radio Club Hamfest will be held Sunday, June 9th, at the Salina County 4-H Building, Salina, Kansas. For more information contact Darwin L. Gray, WAØJFC, 315 South Connecticut, Salina, Kansas 67401.

Monterrey, Mexico

The National Convention of Liga Mexicana De Radioexperimentadores, A.R.C. will take place on May 30 and 31 and June 1 at the City of Monterrey. Being so close to the United States, the convention welcomes American amateurs who may, at the same time, obtain temporary licenses allowing them to operate while in Mexico. For further information contact Anthony Pita, XE1CCP, President, Apartado Postal 11, Tlalnepantla, Edo. de Mexico.

Rome, New York

The Rome Radio Club presents its 15th consecutive Ham Family Day on Sunday, June 9 at Beck's Grove, ten miles west of Rome, N. Y. Features include technical talks, mobile judging and c.w. contest. Registration starts at 12 noon with dinner at 5:00 P.M. Advance adult registrations $4.50, at the gate $5.00. Kids under 12–$1.75. Kids under 6 free. Send reservations to Rome Radio Club, Box 721, Rome, N. Y. 13440.

Ottawa, Illinois

The Starved Rock Radio Club will hold their annual SRRC Hamfest at the LaSalle County 4-H Home and Picnic Area southwest of Ottawa, Ill. on June 2nd. The Club suggests registration in advance at $1.50 or at the gate at $2.00. Deadline for advance registration is May 25. For further details, write W9QLZ, George E. Keith, Secretary, RFD #1, Box 171, Oglesby, Illinois 61348.

Chadron, Nebraska

The Pine Ridge A.R.C. of Chadron, Nebraska will hold their annual Hamfest on June 2nd at Chadron State Park, Chadron, Nebr. Complete details are available from Mrs. Marie Gorr, WAØPSN, Secy., Pine Ridge A.R.C., Star Route 1, Box 117, Chadron, Nebr. 69337.

Atlanta, Georgia

The Atlanta Radio Club will hold its annual Hamfest, June 15 and 16 and the North DeKalb Shopping Center. For further information contact John M. Fearon, W4WKP, 4165 Club Drive, N.E., Atlanta, Ga. 30319.

Winfield, Pennsylvania

The West Branch Amateur Radio Association and the Milton Radio Club will sponsor the Penn-Central Hamfest on Sunday, June 9th at the Union Township Volunteer Fireman grounds, Rt. 15, Winfield, Pa. Registration at gate–$2.00, family included. For information contact: Harvey C. Folimer, Jr., WA3BZO, 800 Upper Market St., Milton, Pa. 17897.

St. Louis County, Missouri

The Suburban Radio Club of St. Louis County, Mo., will have its third annual hamfest on Sunday, June 30th at the Creve Coeur Lake Memorial Park, St. Louis County, Mo. Advance registration $1.00 from KØAHD, WØMUX or WØJUY.

Ontario, Canada

The Essex County V.H.F. Society will award an annual trophy to the highest VHF/UHF Field Day score in North America, from completed logs submitted to the Society, post-marked no later than July 31st, 1968. ARRL rules apply in all respects, as applicable. Mailing address: Essex County VHF Society, Box 1137, Essex, Ontario, Canada.

Sidney, Montana

The Hi Sky Amateur Radio Club of Sidney, Montana, will hold the Eastern Montana Ham Picnic at the Richland County Fairgrounds Commercial Building, Father's Day, Sunday, June 16, 1968.

Webster City, Iowa

Once again, as in prior years, Hamilton County will be playing host to many hams at the "Iowa 160 Meter Picnic" to be held in Webster City, Iowa, on June 16, 1968, at Briggs Woods Park. For further information, write: Hamilton County Amateur Radio Association, c/o Jerry A. Wells WAØFXT (Vice Pres.), 936 Bank Street, Webster City, Iowa 50595.

Detroit, Michigan

The Detroit Mike and Key Amateur Radio Club is going to hold its First Operating Marathon. The operating marathon will be for a period of 48 hours beginning June 1, 0001 GMT, to June 2, 2400 GMT.

The requirements for non-member stations will be for these stations to work 5 DMKC members and send an extract of their log along with a large self addressed envelope to: Frank Johnson, K8VCT, 3736 Taylor, Detroit, Michigan 48206. A certificate will be awarded upon verification of log extract. Member stations that will be active will be: K8DNX, W8DYX, W8HXY, K8HZU, K8GHZ, W8IHD, WA8ITU, W8KVE, W8LMQ, W8MZS, WA8ROY, W8QON, W8TKE, WA8VBT, K8VCT, K8WRA and WA9JFU/8. The frequencies to be used are: 3820, 3920, 7250, 7265, 14285, 14300, 21400 and 21410 kc.

Dixson, Illinois

The Rock River Radio Club will hold their Second Annual Hamfest June 16, 1968, at the Lee County 4-H Center. A cordial invitation is extended to all hams. CBers, electronic hobbyists, and commercial exhibitors. Hours from 9:00 A.M. to 5:00 P.M. Advance ticket donation $1.00; $1.50 at the door. For additional information and advance tickets, contact Chuck Randal, W9LDU, 1414 Ann Avenue, Dixon, Illinois 61021.

Weston, West Virginia

On June 29 and 30, the West Virginia State Radio Convention will hold its tenth annual convention at Jackson's Mill, Weston, West Virginia.

Huntington, West Virginia

The Tri-State Amateur Radio Association of Huntington, West Virginia has announced its sixth annual Hamfest, to be held on June 2, 1968, at Camden Park in Huntington, West Virginia.

See page 126 for New Reader Service

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Feenix, Ariz.

Deer Hon. Ed:

I hope you are feeling good, on acct. I not much so, but I figyouring I feeling much better if unloading my recent misery on you, which is OK if you feeling good, if you follow me.

Yesterday was one of those days that shouldn't have been. Like Hon. February 30, it shouldn't be on anybuddy's calendar.

Day started out reel normal-like. Getting up early like at 10 ayem, having lite breakfast (only six eggs), then relaxing in Hon. Shack.

Are about to turn on Arizona Kilowhat ether-blaster when I remembering I wanting to toon-up my antenna. Starting to search for field-strength meter, and managing to locate it in less than half an hour—which is almost a record.

Turning on rig to check if FS meter are working. Getting no indicayshun. Rapping it smartly with knuckles and getting no result except brewsed knuckle. Desiding better take it to work bench to check it.

Work bench kinda messy, but cleering it off with handy 2 by 4 in no times. Reaching for screwdriver, discovering it somewhere in pile of junk on floor where I just cleering off bench. Finding it, then finding I needing Phillips head instead. Ten minutes later, finding one on floor and proceeding to open FS meter.

Reaching for ohmmeter. Remembering it being on top of bench before I cleering it off. Looking for ohmmeter on floor and finding it. Most of it, anyway.

Discovering meter not broken. That being big relief, on acct. it are present to me from my Hon. Grate Uncle from Sockitoome.

Locating clip leeds few minutes later, clipping them together, but ohmmeter not reed-

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ing upscale. Or downscale either. Evidently batteries are dead.

Grabbing keys to Hon. Jeep, yelling to Hon. Brother Itchi I being back in time for dinner, and taking off for drug-store like wounded bird.

Are barreling along like sixties when all of sudden Hon. Jeep acting like elephant what stumbling over big log. Kaloomp, kaloomp. Hokendoké!! Hon. Ed., I are out of gas. Jeep's gas tank are drier than desert in middle of dust storm. This hole day are starting to turn into nitemayor.

So, hoofing it along hot pavement cupple miles until finding gas stayshun. Getting gallon of gas, walking wearily back to Jeep, driving to gas stayshun, and filling up gas tank.

Then I discovering not having credit card. Fellow amchoor borrowing it last week. Paying cash for gas, and driving to fellow amchoor's house to get credit card.

When I getting there, he in middle of rag chew with some feller in Brazil who living on rubber plantayshun. Sure sounding like it, as signal are bouncing all over band.

When we signing, he asking me to call Hon. Seek-You. Doing it, and we hooking up with some guy who amchoor comedian. He having millyun jokes, and we having grate rag chew for hour or so.

Finely desiding better buy batteries, so dashing to neerby Joe's Triple-Dip Hunky-Dory Ice Cream and Used Magazine parlor. About to pay for batteries when discovering spending all my bux on gas. Joe wouldn't give credit to John D. Moneybags, so dashing back to ranch to getting more dinero.

Brother Itchi, a little grumpy by now, yelling that my dinner are getting cold on the sink, so quick-like grabbing bite to eat, then out to neerby drug store. Getting battteries and back to Hon. Shack.

Trying to put batteries in ohmmeter, and finding buying wrong size. Hon. Ed., at this point Scratchi feel like crying. I not even sure now why I wanting batteries, or what I had planned to do when I had them. Not only that, I leeving credit card at friends house.

Just looking for envelope to mailing this letter and not finding any. It's okay, Hon. Ed., I probably haven't got a stamp to mail it with anyway. Just forget the hole thing.

Respectively yours,
Hashafisti Scratchi

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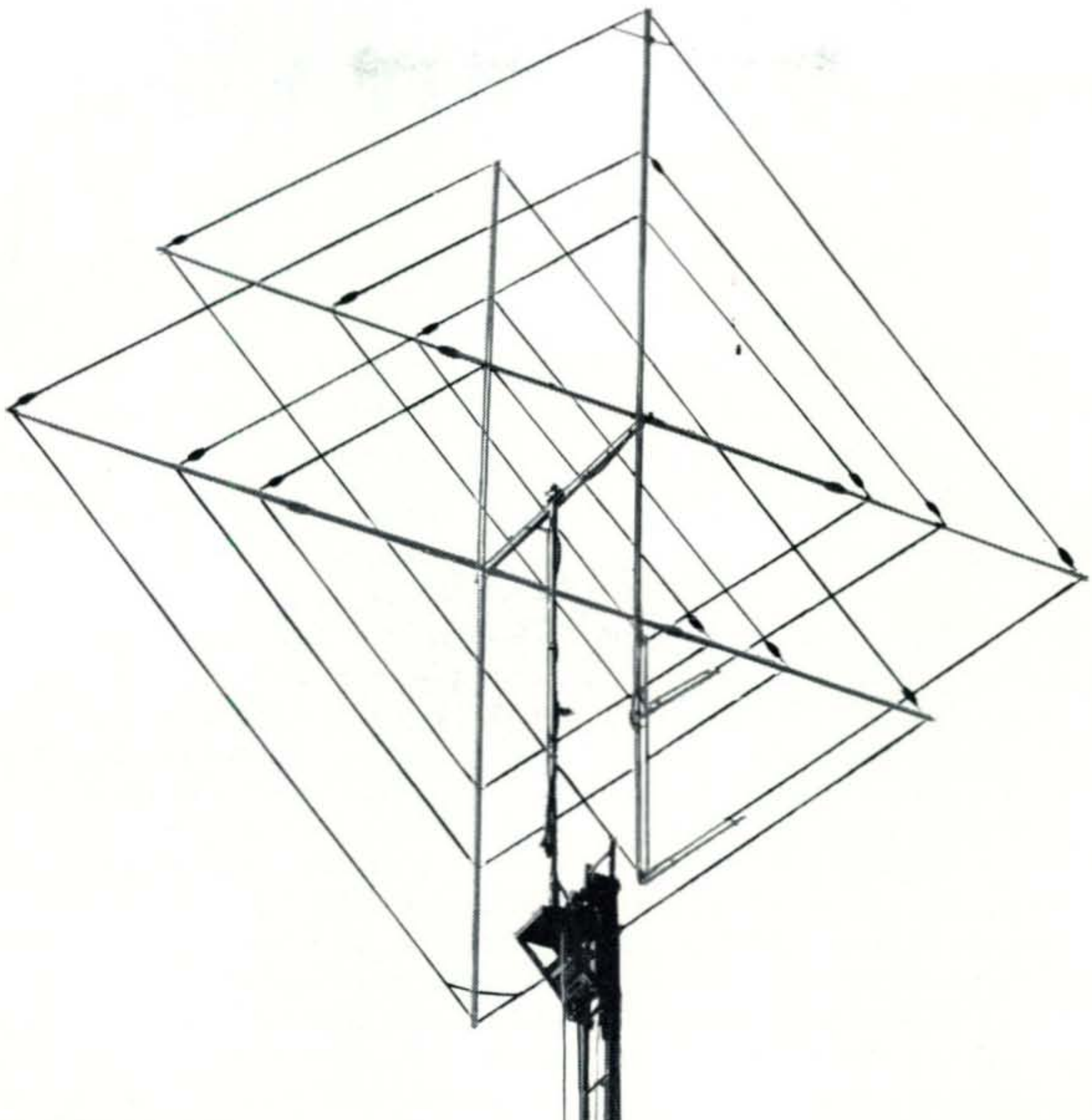

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VERTICAL ANTENNAS

Part I

BY CAPTAIN PAUL H. LEE, *W3JM (ex-W3JHR)

This is the first of a series of articles on the subject of vertical antennas which will be published in this magazine during the next year. Basic principles are presented in this chapter. Subsequent chapters will cover feed methods, arrays, stacked verticals, broadband types and physical design factors.

IN spite of the fact that there have been many articles written on vertical antennas, including several by myself[1,2,3,4,5], there are, no doubt, many amateurs to whom their operation is a bit mysterious. There are some amateurs who emphatically and categorically state that verticals are no good without really knowing what they are talking about. But please, I am not trying to sell vertical antennas to the exclusion of other types; I am just trying to spread a bit of knowledge, and we can stand having a bit spread around in amateur radio these days.

For many years I have found the field of antenna design, in conjunction with propagation study, to be a very fascinating one in which to work, both in naval communications and in civilian consulting radio engineering. Now back in uniform, on active duty in the Navy Department, Washington, D. C., I have much to do with shipboard antenna problems as head of an office which is directing an extensive program of fleet communications improvement. At our service in this endeavor we have the output of years of experience in our naval electronics laboratories and many interesting and valuable contributions from commercial industry. Antenna design is one of the most important factors in the planning of any communications system. In this business one cannot afford to tolerate an "NIH" (Not Invented Here) attitude, nor to say that something is no good. An open mind is the mark of an intelligent man. In this series of articles I plan to discuss many aspects of vertical antennas, from some basic theory right on through actual designs, practical configurations, advantages and disadvantages and results to be expected.

Fundamentally, a vertical antenna is nothing but a horizontal antenna turned up on end. Let us go one step further and rule out the vertical dipole at some distance above earth for practical reasons, and consider the case of the vertical antenna fed at its base against a ground system. For purposes of analysis, this can be considered as a dipole whose lower half has been cut off and replaced by a ground plane. For some purposes the concept of a mirror image (imaginary lower half below ground) is useful. One can say quite truthfully that the total power radiated in free space by a dipole (either vertical

* 5209 Bangor Drive, Kensington, Maryland 20795.

1 Lee, P. H., "Four Band DX Antenna," *CQ*, Nov. 1953, p. 20.

2 Lee, P. H., "Mark II Four Band DX Antenna," *CQ*, July 1960, p. 28.

3 Lee, P. H., "Optimum Antenna Design For DX Communications," *CQ*, Nov. 1962, p. 49.

4 Lee, P. H., "Mark III DX Antenna," *CQ*, Dec. 1962, p. 43.

5 Lee, P. H. "Mark IV DX Antenna," *CQ*, Feb. 1967, p. 60.

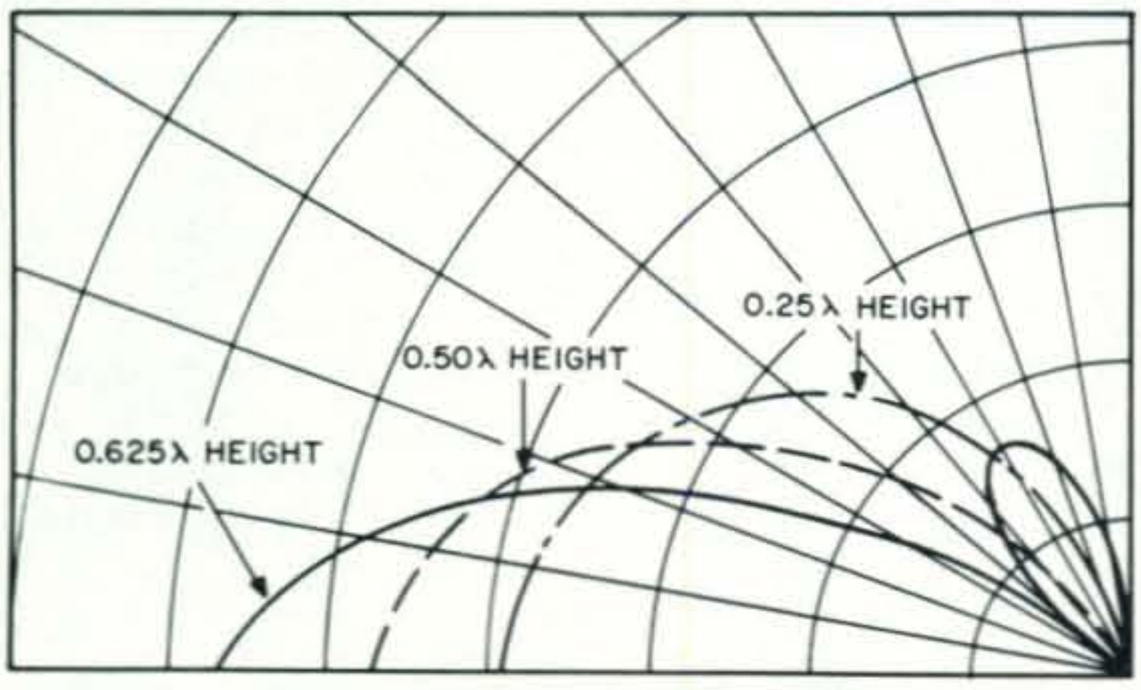

Fig. 1—The theoretical vertical radiation patterns for vertical antennas of ¼, ½ and ⅝ wavelengths in height.

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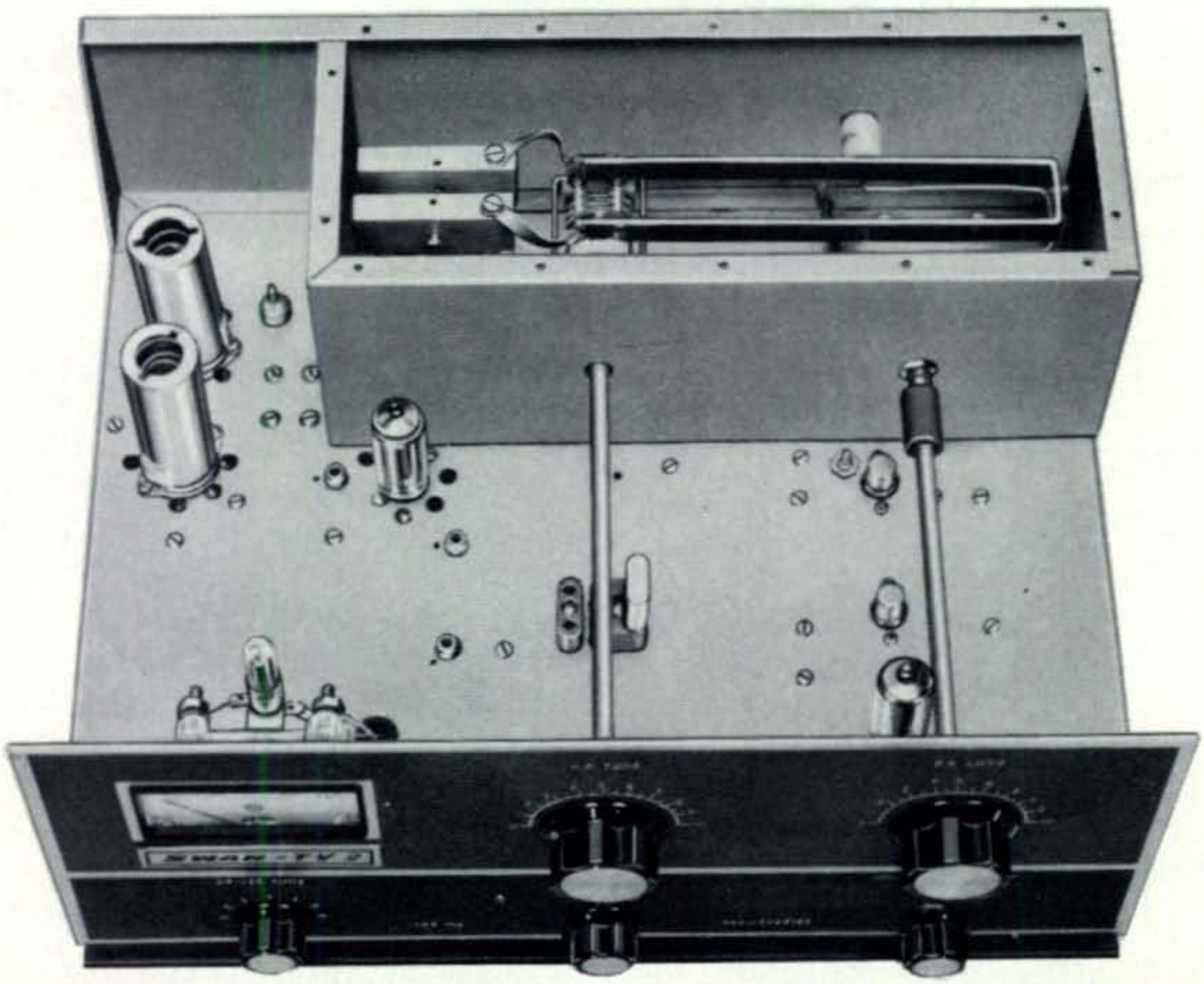

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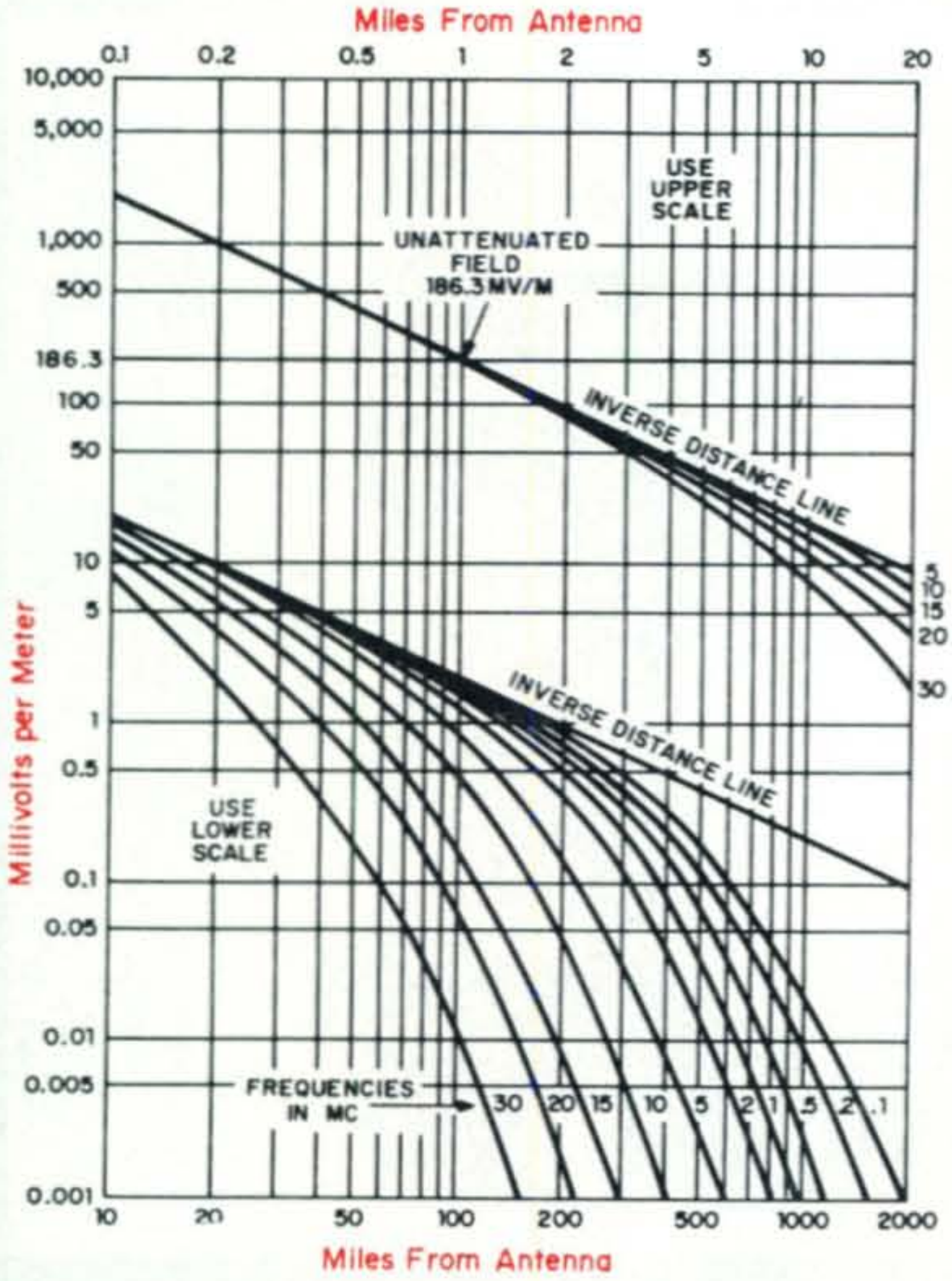

Fig. 2—A plot of ground wave field intensity versus distance from the antenna for various frequencies over sea water based on a radiated power of 1 kw.

or horizontal) has now been concentrated in the upper hemisphere only. Thus it is commonly said that, considering only the upper hemisphere, the radiation from the ground based vertical is 3 db above that from a free space dipole. This is true in one special case, and that is the case of a perfect ground plane with no loss. No such thing exists in actual practice. It can be closely approximated by sea water, or by an extensive copper screen. However, in these two cases there will still be some loss, although minimal. The loss will depend to some extent on frequency. Model studies have shown that for sea water or a large copper ground screen, the vertical radiation pattern of a ground based vertical antenna closely approaches that of the theoretical case.

Vertical Radiation Patterns

What are theoretical vertical patterns of ground based antennas of various heights? They are shown here in figs. 1(A) through 1 (C). It will be noted that as antenna height increases, the ground wave or low angle lobe increases until it reaches a maximum at 5/8 wavelength height. As this height is exceeded, the low angle lobe shrinks very fast, the high angle lobe increases rapidly, and the antenna becomes useless for communications where low angle radiation is required.

Some authors have discussed at length the effect of ground reflections on the vertical pattern, and have stated that all low angle radiation is either absorbed or reflected out of phase, thus making verticals useless for low angle communications. The example invariably used to prove this is one in which the vertical is a dipole, suspended in the air some distance above earth. The center of the dipole is considered to be the theoretical center of radiation. How one is to feed this antenna from a practical standpoint is never mentioned. However this antenna does lend itself very well to a mathematical analysis which can be done by hand or by computer, which shows that ground reflections do occur, and that the vertical pattern has zones of cancellation and reinforcement of radiation, as one would expect. There is an excellent discussion of this in one of the references[6] which is obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C. at a cost of $1.25. However, this antenna is hardly a practical configuration. It is an entirely different case from that of the practical, base fed vertical whose ground system is a part of the actual radiating system. For an analysis of this type, consider the theoretical center of radiation to be at earth level, and that the ground system is a part of the antenna system, a lossy part to be sure, but still an inseparable part of it. (The vertical dipole mentioned above has no ground system, nor any connection with earth. That point is always overlooked.)

Ground Attenuation

Ground is lossy. Loss increases with frequency. Ground wave radiation thus decreases with frequency. Figure 2 is a plot of ground wave versus distance for various frequencies, over sea water where ε is 80 and σ is 5 mhos per meter. Figure 3 is a similar plot over "good ground", where ε is 15 and σ is 10 mmhos per meter. Figure 4 is the same plot over "poor ground," where ε is 5 and σ is 1 mmho per meter. (ε is the dielectric constant, and σ is the conductivity.) From these plots it can be seen that at l.f. and m.f. ground losses are fairly reasonable. This is why the FCC considers that the vertical radiation patterns closely approach theoretical at frequencies in the m.f. broadcast band. In

[6] "Siting Criterea For HF Communication Centers," *National Bureau of Standards Technical Note 139.*

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past consulting work for broadcast clients before the FCC many skywave patterns have been computed based on this premise, and it might be added that there are literally thousands of actual skywave measurements on file which show this premise to be realistic. Skywave interference ratios between co-channel stations are computed on this basis. Ground wave coverage and directional patterns are similarly based. More will be said about that later.

It can be seen that at frequencies of interest to amateurs, 2, 4, 7, 14, 21 and 28 mc, ground wave attenuation over earth increases greatly with frequency. Thus from a ground based antenna, the ground wave will be quite strong within two or three miles, but will rapidly attenuate as distance increases, until it finally becomes useless. There is no such thing at h.f. as 50 to 100 mile ground wave coverage, as occurs in the m.f. broadcast band. Because of these ground losses the vertical pattern from a vertical antenna at h.f. will show considerable "suck-in" at low angles, as shown in fig. 5. The exact patterns will depend on frequency, with more suck-in and loss at higher frequencies.

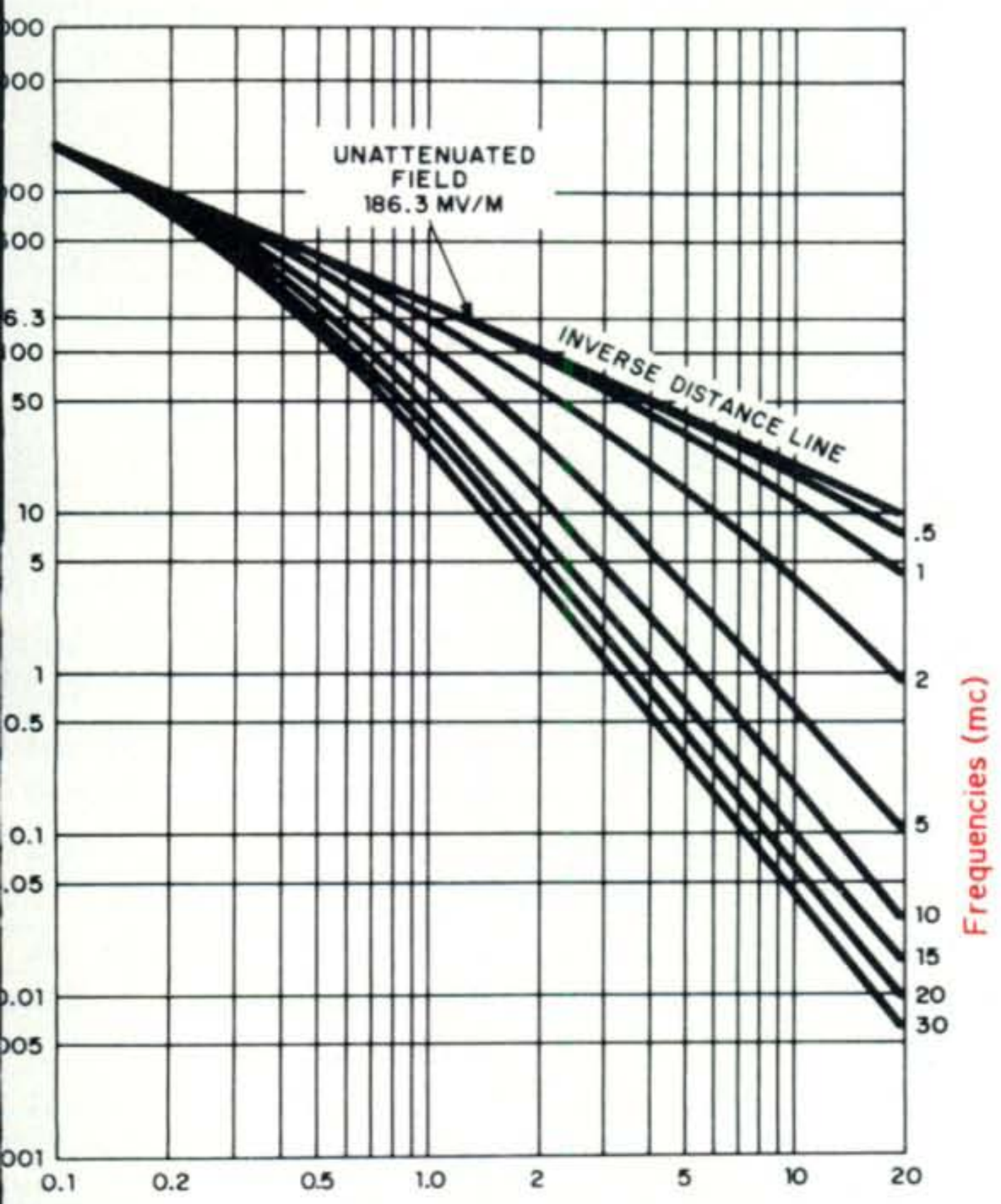

Fig. 3—A plot of ground wave field intensity versus distance from the antenna for various frequencies over "good ground" where $\varepsilon = 15$ and $\sigma = 10$ millimhos per meter, based on a radiated power of 1 kw.

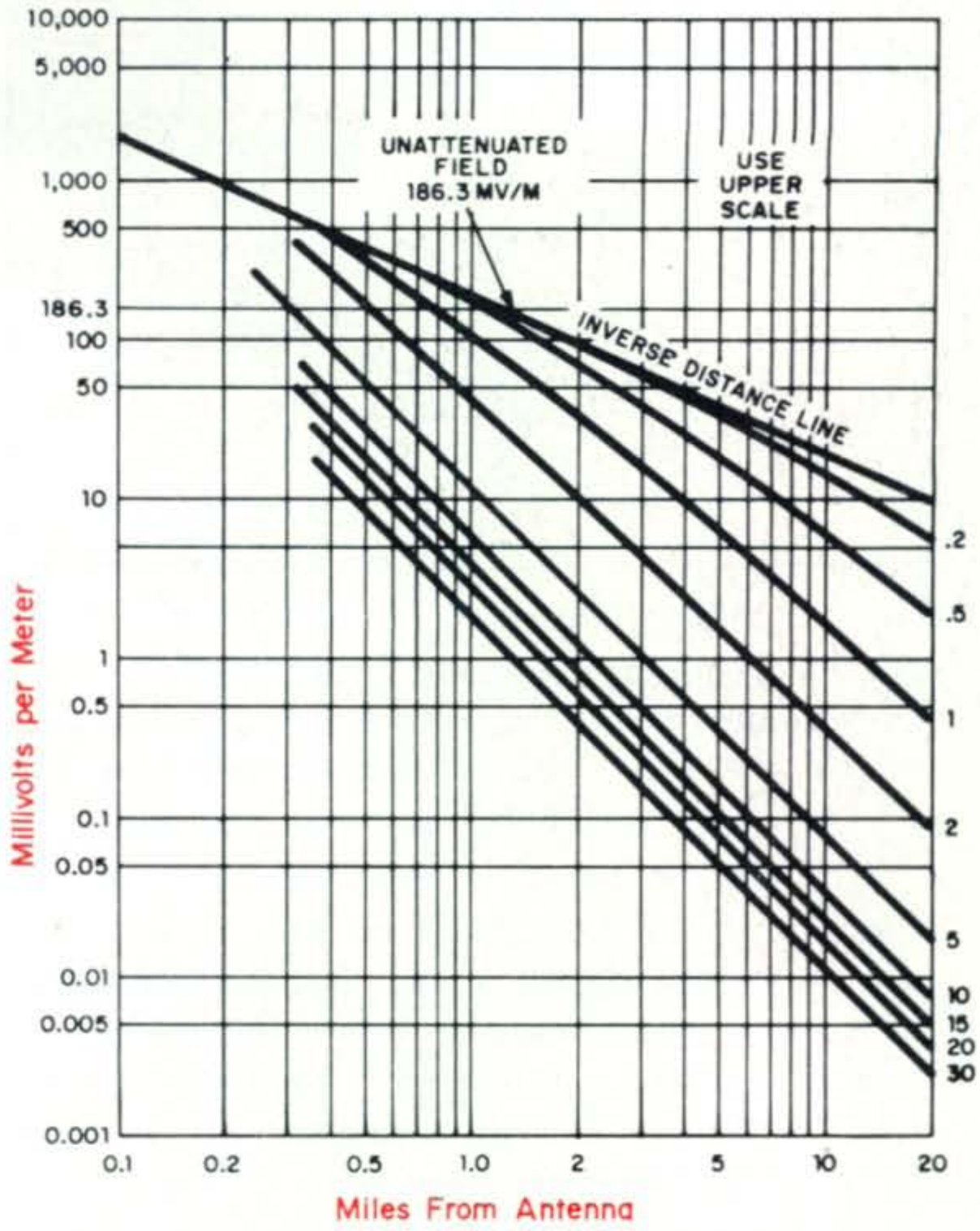

Fig. 4—A plot of ground wave field intensity versus distance from the antenna for various frequencies over "poor ground" where $\varepsilon = 5$ and $\sigma = 1$ millimhos per meter, based on a radiated power of 1 kw.

Thus it is apparent that it behooves the amateur who uses a vertical antenna to install as good a ground system as possible to minimize the losses. He who lives on the ocean beach or other body of water is indeed fortunate, for his local ground losses will be much less than those of the poor soul on a city lot surrounded by buildings, trees, etc.

The vertical radiator with ground system is thus more efficient at the lower amateur frequencies, such as 2, 4 and 7 mc. It is simply a matter of losses. The vertical radiator with counterpoise or metal ground plane is therefor used at higher frequencies. One does not see v.h.f. or u.h.f antennas sitting on the ground, with buried ground planes. However, buried ground systems are used up through 28 mc with good success. More will be said about ground systems and their effect on radiation efficiency later.

Gain

Meanwhile, let's talk about the subject of "gain." What is antenna gain? We hear it mentioned many times on the air, and see it quoted (or misquoted) in advertisements. To have gain, one must start with something and

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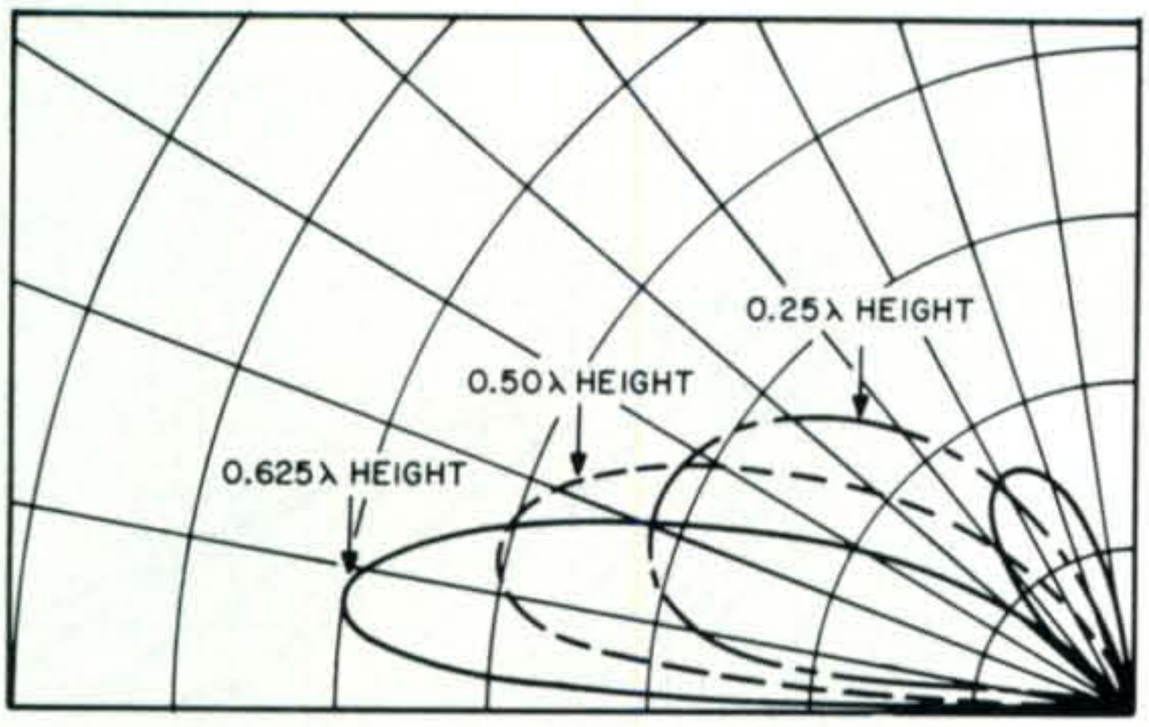

SUCK-IN OF VERTICAL PATTERN

Fig. 5—Ground losses cause "suck in" of the vertical radiation pattern of the vertical antenna. The effects are shown above for antennas of various wavelengths.

then compare something else to it. What is the start, in antenna work? What is the basis of comparison? What is this "isotropic" antenna we hear about — so many db above isotropic? An isotropic antenna is a theoretical zero length point source. It can never exist. However, it is used as a theoretical and mathematical basis for comparison. In reality, what else could one use? The isotropic antenna is one which radiates equally in all directions. For a given power input, it will produce a certain radiated field intensity at a given distance from it, in all directions. A plot of its radiation pattern is a perfect spherical surface, with the point source at the center of the sphere. Every *practical* antenna, which must have finite length, thickness, and distance from earth, will produce a pattern which is not constant in all directions. Thus the practical antenna is said to possess gain (or loss) in certain directions when compared to the isotropic antenna. *Gain is meaningful only when referred to a specific path or direction.* Directional gain is defined as the ratio of the power that must be radiated by

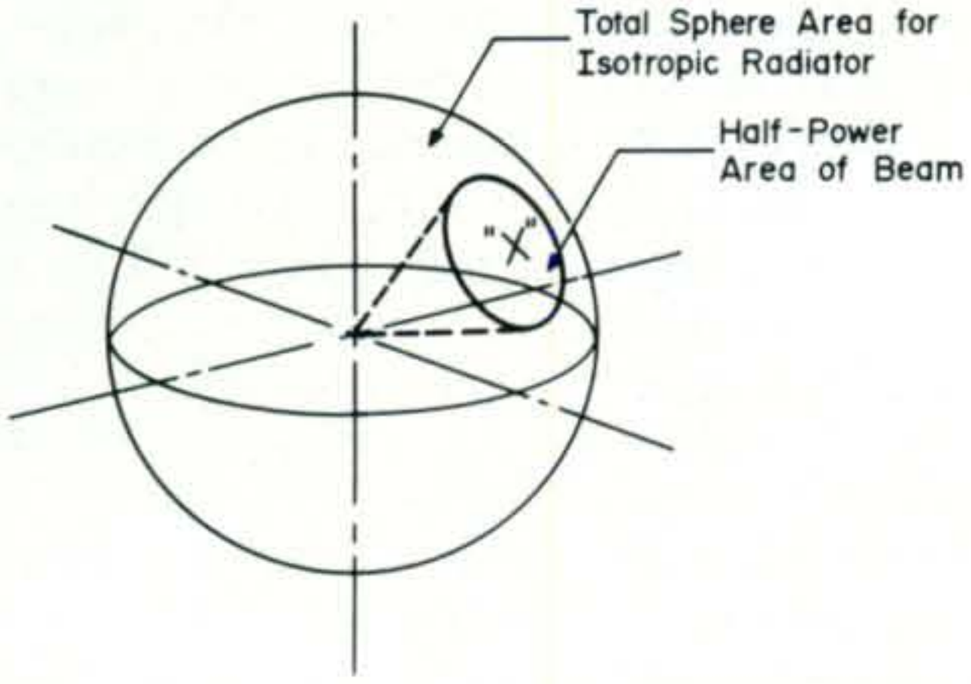

Fig. 6—Comparison of radiation pattern of an isotropic versus a directional antenna.

an isotropic antenna to the power being radiated by the test antenna under consideration, to develop equal field intensities from the two antennas in a certain direction. Consider that the isotropic spreads power over the entire spherical surface. The directional antenna, on the other hand, concentrates power in a certain area of the sphere's surface. This concept is shown in fig. 6. Thus for equal field intensities at point "X" within the area illuminated by the beam, the power in the isotropic must be considerably greater than that in the test directional antenna. This power ratio between the two is equal to the gain of the directional antenna. It can be seen that there is an inverse relationship between gain and areas illuminated, for a certain fixed power. There is a simple method of computing the gain of a directional antenna.[7] The number of "square degrees" area in the surface of a sphere has been computed to be 41253. Keeping in mind the relationships mentioned above, divide this number by the number of "square degrees" in the beam of the directional antenna between the half-power points, and the result will be a close approximation of the power gain of the directional antenna, in the direction of the beam. Consider the 3 element horizontal Yagi antenna, whose beam width is about 60 degrees in the horizontal plane,[8] and about 30 degrees in the vertical plane, for a height above earth of ½ wavelength. The approximate area within the half-power limits is 1800 square degrees.

$$\text{Power gain} = \frac{41253}{1800} = 22.9,$$

or 13.60 db above isotropic

Note that I said *above isotropic*, the theoretical antenna which cannot exist. Sometimes, without much thought, the horizontal dipole is used as a reference. But this can be very confusing, because its radiation varies with direction, both in the horizontal and the vertical planes, and with distance above earth. Thus, a manufacturer can easily confuse an amateur by saying simply that his beam has so much gain in db. Gain with reference to what? To isotropic? To a dipole? In what direction? At what vertical angle? At what height above earth? The "gain above isotropic" figure is always more impressive to the reader, because in the direction of its main lobe the dipole has several db gain with refer-

[7] Terman and Pettit, *"Electronic Measurements,"* Second Edition p. 436.

[8] Kraus, J. D., "Antennas," *McGraw-Hill*, p. 321.

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The 15 transistor, 18 diode, 3 tube circuit is powered by a built-in 120/240 VAC supply. Circuit board construction averages 20 hours. It's all housed in a low-profile Heath gray-green aluminum cabinet measuring 14⅛" W x 6⅛" H x 8½" D with everything in place. A ceramic PTT mic. and a gimbal bracket for mobile mounting are included.

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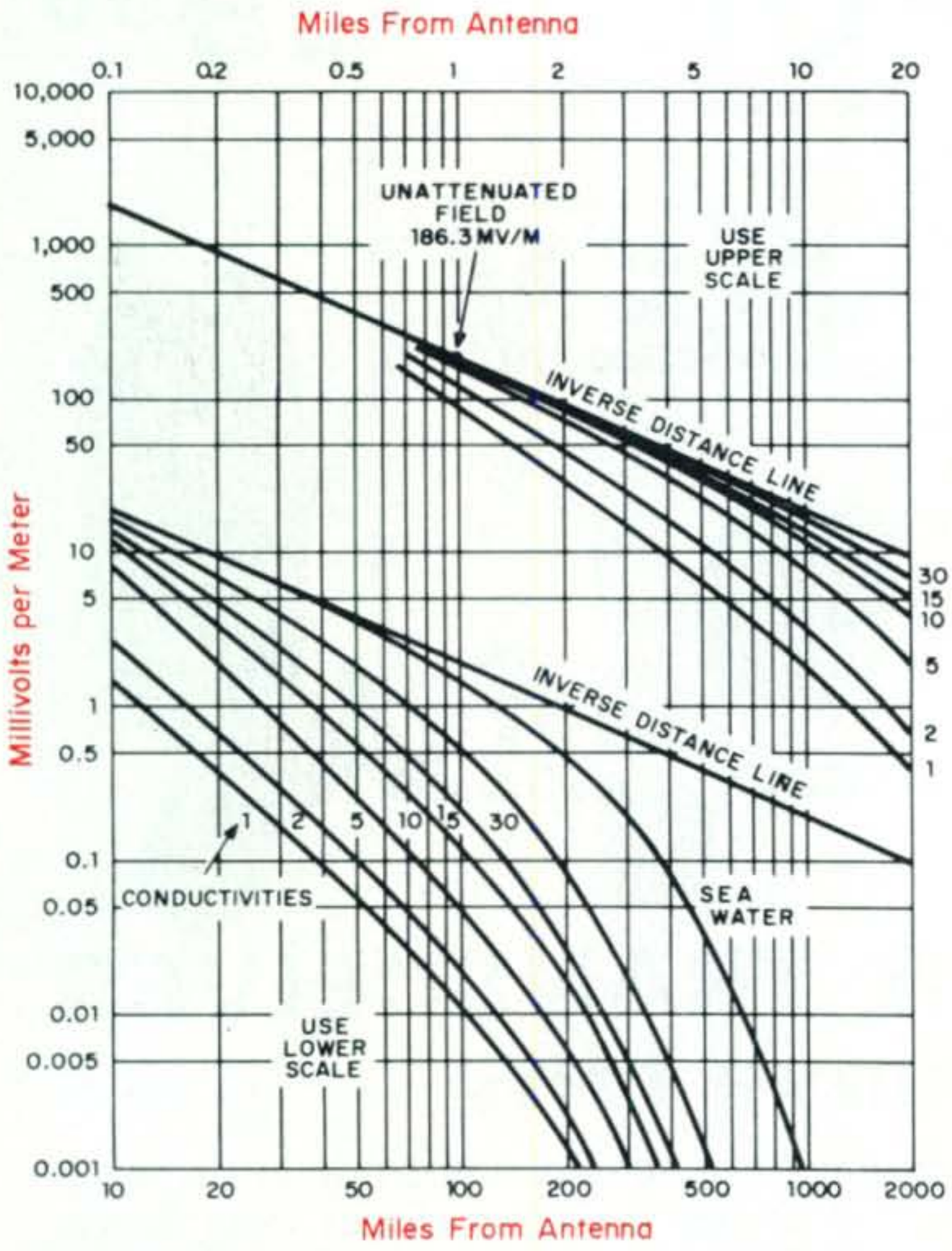

Fig. 7—A plot of ground wave field intensity versus distance from the antenna for 970 to 1030 kc. The unattenuated field is 186.3 mv/m at one mile for a radiated power of 1 kw. The dielectric constant ε is 15 and the conductivities σ are shown in millimhos/meter.

ence to isotropic. Thus gain figures quoted by manufacturers have to be considered with care, with special attention to the fine print. Don't be fooled by gain figures; ask the question, "Gain with reference to what?" You may be surprised at the answer. Some beams, especially miniature ones, have little gain above a dipole, possessing only *directional discrimination*.

We might be inquisitive, not to prove anything but to simply find the answer, and compute the gain of a 5/8 wave vertical antenna.

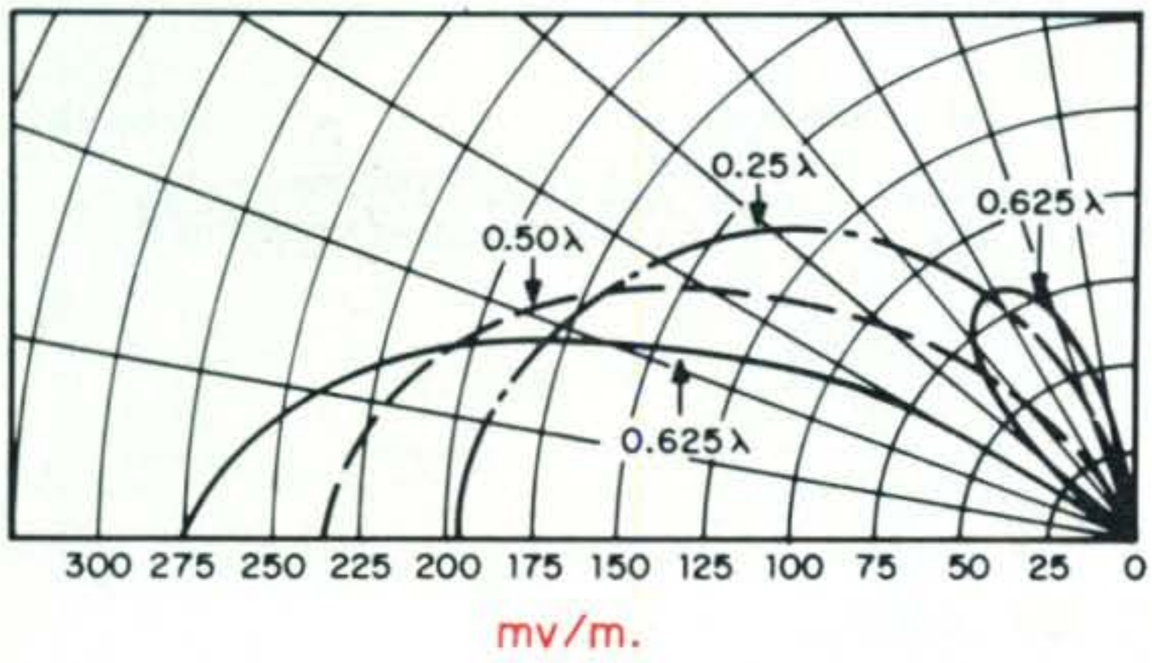

Fig. 8—Theoretical vertical patterns for antennas of 0.25, 0.5 and 0.625 λ heights.

We must decide on a reference, which by rights should be isotropic. The vertical beamwidth to be expected is about 15 degrees. Since the horizontal spread is a full 360 degrees, the approximate number of square degrees is 5400.

$$\text{Power gain} = \frac{41253}{5400} = 7.63$$

or 8.84 db above istropic

Note that I again said *above isotropic*, the theoretical antenna which cannot exist. Thus by computing the gains of individual antennas with reference to isotropic, their gains relative to each other may be determined. The above computations show a relative gain of 4.76 db for the Yagi over the 5/8 wave vertical, but *in different main lobe directions*. The lobe from the 5/8 wave vertical is lower than that from the Yagi.

Gain is meaningful only when considered with reference to a particular communications path and set of propagation conditions. This factor can never be overlooked. A simple illustration will suffice. Antennas designed for the tropical broadcasting bands to produce skywave coverage over a certain Latin American country or two usually are horizontal dipoles at a low height above ground, thus producing only high angle skywave lobes. They are useless for long distance communications. They are designed that way intentionally, to restrict coverage. Thus, one cannot say that one antenna is no good, or that another is the perfect answer. Each type has its own specific application, designed to fit certain systems requirements.

There is another way of determining the efficiency of a vertical antenna. As a basis of evaluation in this case, it has become standard practice throughout the years to use the "unattenuated field intensity at one mile" as the reference for field intensity measurements. This figure is the basis for all plots such as those in figs. 2, 3, 4 and 7. It is a figure of merit which can be accurately determined by a carefully made series of field intensity measurements, taken along a number of radials (usually at least 8) and out to considerable distance from the antenna. Each set of radial measurements is then plotted in a field intensity plot such as that in fig. 7. From knowledge of the ground conductivity in the area (shown in fig. 11) the plotted curve can be fitted against one of those in fig. 7, and the actual unattenuated field being radiated can be determined. The curves of fig. 7 show field intensity versus distance for various ground

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conductivities, with the *standard unattenuated field of 186.3 mv/m at a mile for one kilowatt radiated power*. Figure 7 is an adaptation of one of a series of such figures from the FCC rules for various frequencies in the m.f. broadcast band. It is used merely as a convenient example. Similar curves can be plotted for frequencies in the h.f. range.[9] As may be seen, figs. 2, 3 and 4 are a partial plot of such. There is a direct relationship between them and fig. 7.

One may ask the origin of the "186.3 mv/m at one mile" as a standard of vertical antenna efficiency. This figure is the unattenuated field at one mile for a theoretical zero-height point source current element on a ground plane. The derivation of this figure is given in one of the references.[10] The table below shows the relationship between the zero height point source current element and the isotropic. The current element is, of course, something which cannot exist in practice.

Type	Pattern	mv/m at 1Mile (1 kw)	Power Gain	DB Gain
Isotropic	⊙	107.6	1	0
Half Isotropic		152.1	2	3.01
Current Element		186.3	3	4.77

Practical antennas have finite height. Figure 8 shows the vertical patterns which can be computed for antennas of various heights. It may be seen that this figure is the same as fig. 1, but plotted with field intensity values. The theoretical unattenuated field at one mile along the horizontal plane may be read for each. They are as follows:

Height of antenna	*Unattenuated field at One Mile (1 kw)*
0.25 (¼)λ	196 mv/m
0.50 (½)λ	236 mv/m
0.625 (⅝)λ	276 mv/m

Thus it may be seen that the 0.625 (⅝) wave antenna produces the greatest ground wave field, and the lowest main lobe. Figure 8 is taken directly from the FCC rules. The values

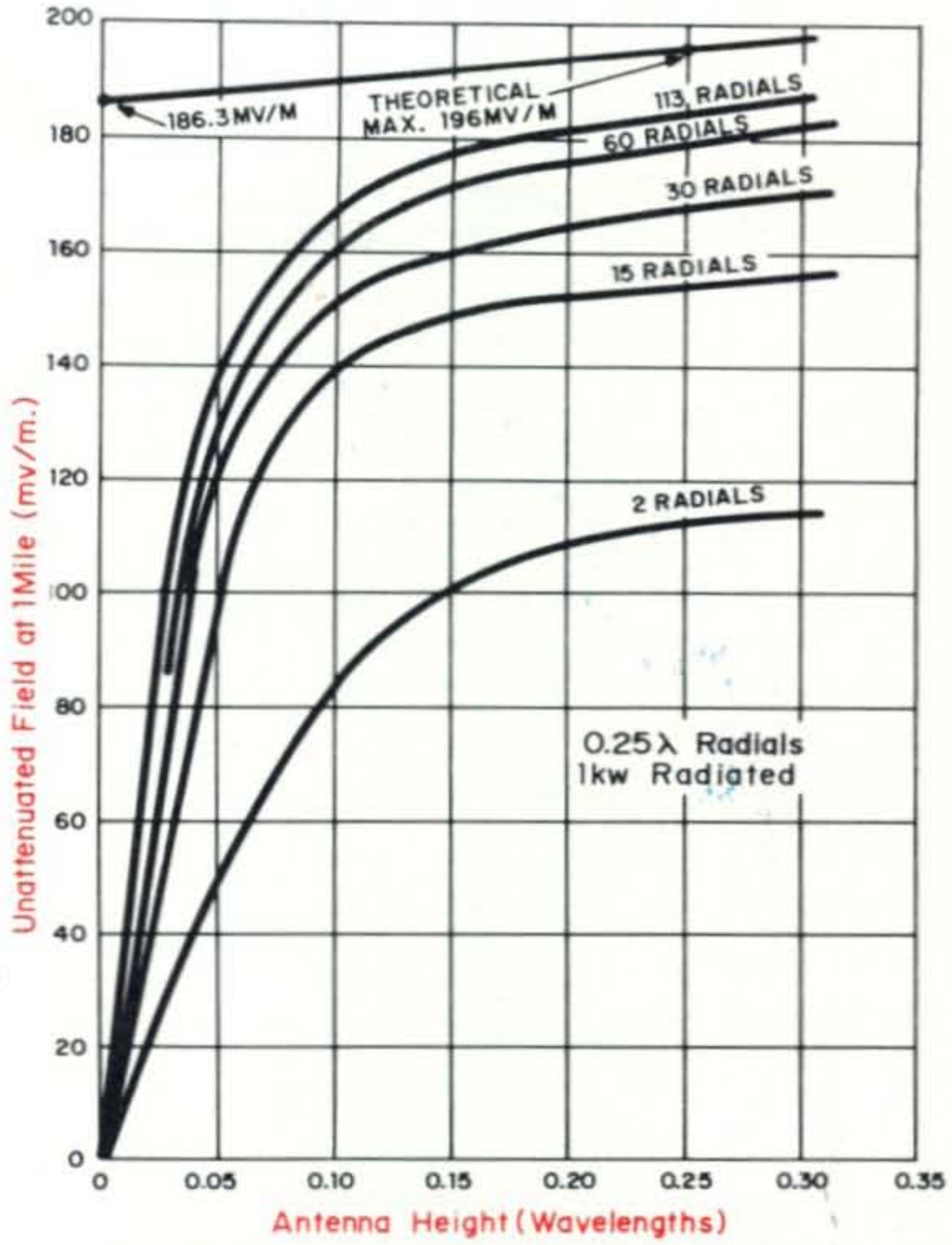

Fig. 9—Effect on the unattenuated field at one mile by changing the number of radials.

shown are theoretical maximums. Antennas with adequate ground planes and low losses will closely approach these values, as will be seen shortly.

The Ground System

This leads to the next item of my discussion, which is the ground system. There have been several good articles published in past years on the subject of ground systems and their effect on antenna efficiency and other parameters. One of the best, which we in the business consider to be the "bible", is by G. H. Brown.[10] It was based on an extensive experimental program of actual field measurements by RCA Laboratories. It covers such factors as numbers and lengths of radials, depth of burial, ground currents, losses, radiation resistance, and other factors. The development of the figure of 186.3 mv/m is shown. Figure 9, based on this reference, shows a factor of interest to amateurs, which is the effect of changing the number of radials of a fixed length. Figure 10 shows another such factor, the effect of varying the length of the radials, for certain fixed numbers of radials (15 and 113). A study of these figures shows that radiation efficiency is greatest for a large number of long radials, but it can be seen that the curves flatten off and that there is an area of diminishing returns where the percent

[9] Norton, K. A., "Calculation of Ground Wave Field Intensity Over a Finitely Conducting Spherical Earth," *Proc. of I.R.E.*, Dec. 1941, p. 632.

[10] Brown, G. H., et al, "Ground Systems As A Factor In Antenna Efficiency," *Proc. of I.R.E.*, June 1957, p. 735.

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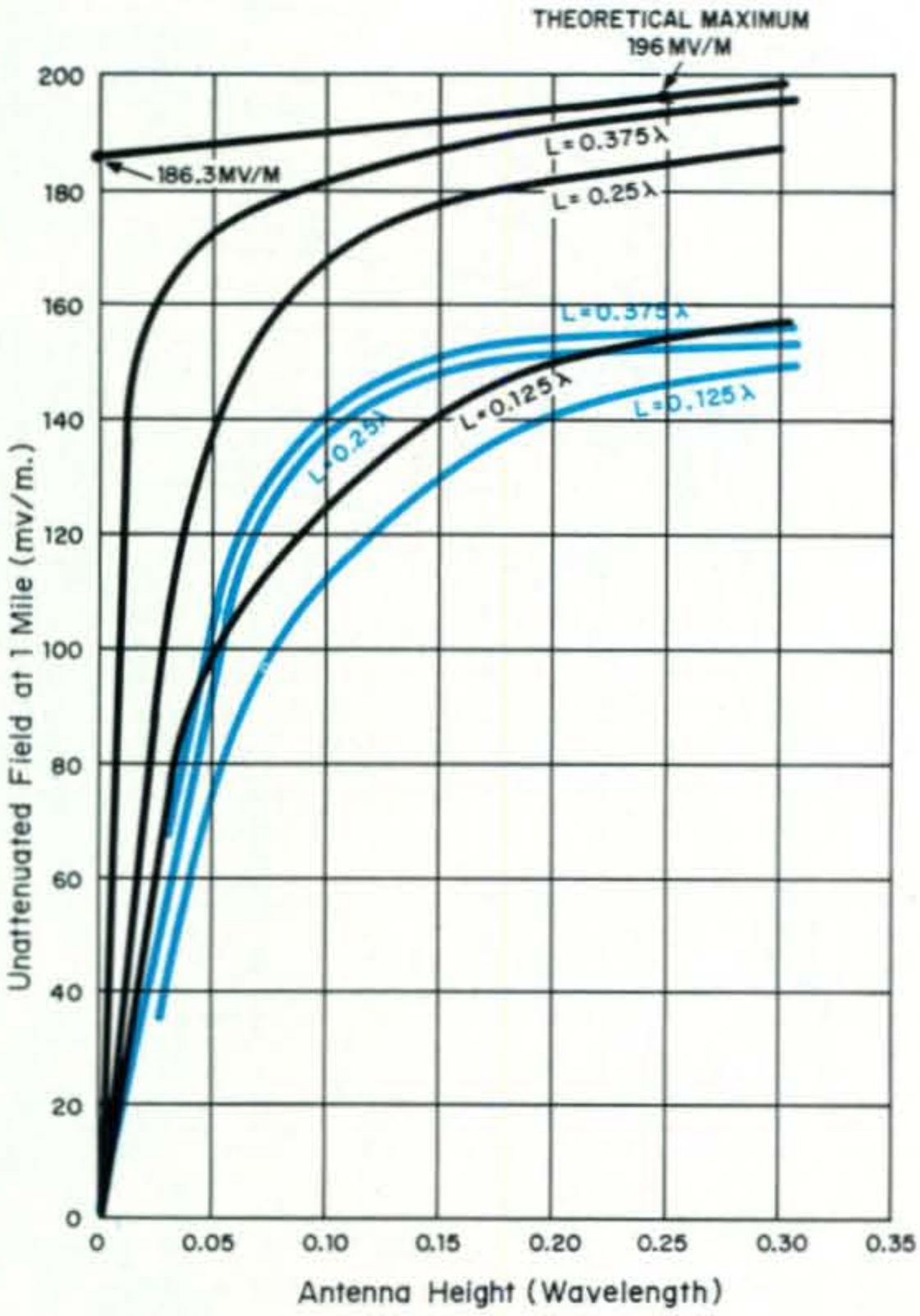

Fig. 10—Effect upon the unattenuated field strength at one mile by varying the length of the radials. The radial lengths, L, are specified in wavelengths. Black curves are for 113 radials and the colored curves are for 15 radials.

increase in efficiency is not really worth the added cost of copper in the ground. FCC rules require that broadcasters use at least 120 radials ¼ wave long. Many stations better this. For the average amateur, 16 is a reasonable and economical number. Doubling the number will not double the radiation efficiency.

It should next be realized that the unattenuated field determined by measurements is the "starting out" radiation from an antenna of given height. It is less than the theoretical field by an amount which is determined by the losses in the ground system, as shown in figs. 9 and 10. It is also affected by losses in the antenna itself, and by the presence of buildings, wires, and other absorptive elements in the vicinity of the antenna. This is especially true at h.f., where losses in the immediate vicinity may be quite high, as some of those objects approach an appreciable size in terms of wavelength. He who has a good, clear site is fortunate. Then, as the signal proceeds further from the antenna along the surface of the earth, it is attenuated even more by ground losses, causing the considerable suck-in of the low angle radiation, especially at the higher frequencies.

Figure 11 is included for those who are interested in knowing something about

[*Continued on page 120*]

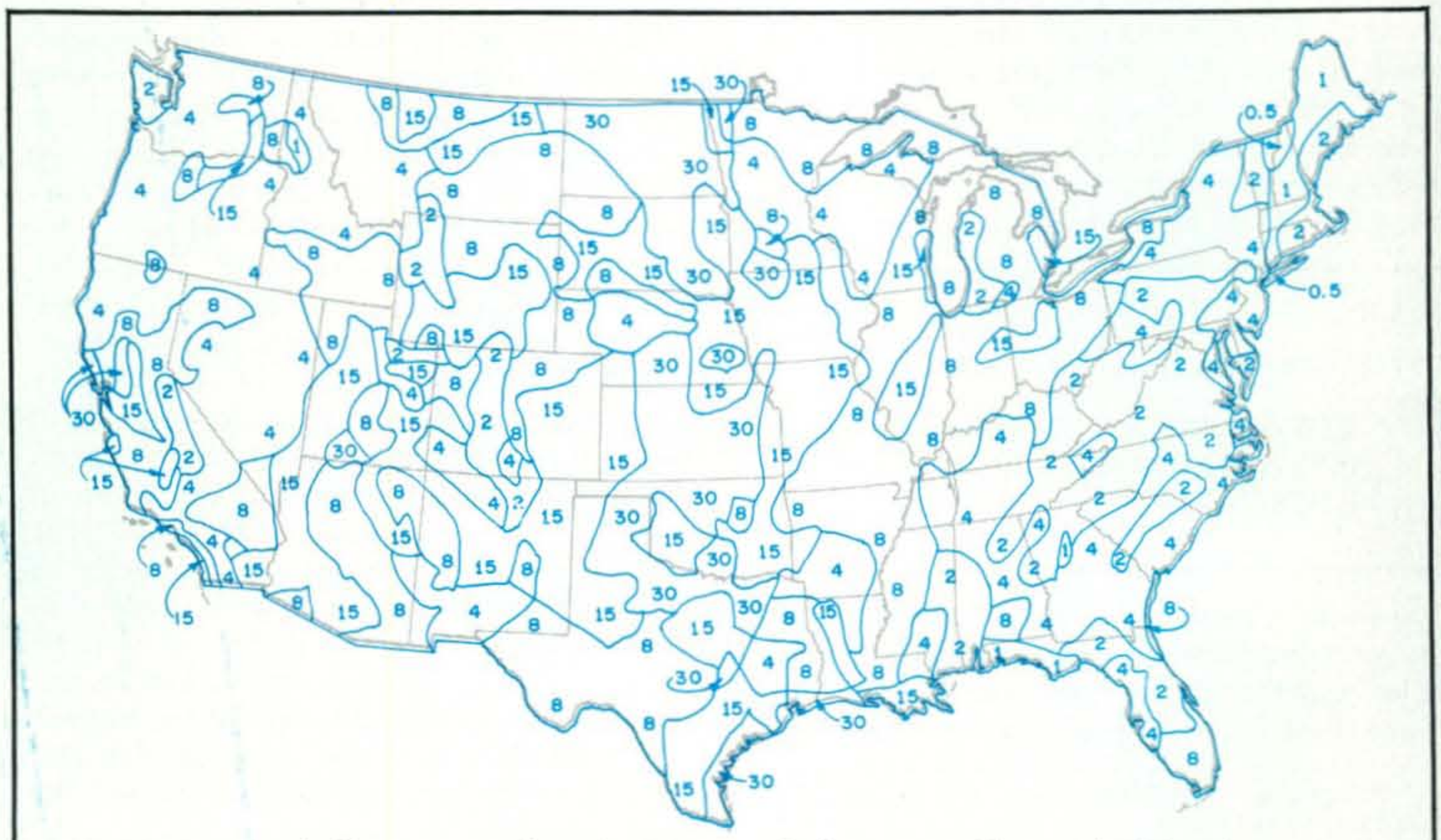

Fig. 11—Estimated effective ground conductivity in the United States. The numbers represent estimated effective ground conductivity in millimhos/meter. The conductivity of sea water, while not shown, is assumed to be 5000 millimhos/meter.

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STUMPED FOR A HOUSING?

BY HOWARD S. PYLE, *W7OE

YOU'VE just completed 'bread-boarding' a pet project; you've given it the 'smoke test' and it's measured up. Fine; now you're all set to tear it down and arrange the components in more professional form on a neatly lettered panel and house the finished product in a suitable enclosure. Again fine . . . in fact, commendable . . . but, you can't find a cabinet of the right size, shape or whatever in any of your catalogs, which will contain the business and yet fit into the scheme of things in your shack! What to do? You don't want to knock together a wooden box . . . they went out with the Ark! You're not such a good metal worker and don't have a bending brake and other sheet metal tools so fabricating a decent looking metal cabinet is a bit out of line. Park your frustration though; there *is* an 'out' and a good one too!

Ever hear of 'aluminum extrusions' and complementary fittings? Well, maybe vaguely but with little interest at the time. Wake up that latent interest now and do a little digging. You'll find that 'extrusion' is just a fancy name for square metal tubing! These are readily available in several sizes, either plain or with a variety of 'fins', which lend themselves admirably to quickly and easily built framework construction for almost anything you want to house from a small accessory item to a kilowatt transmitter!

Currently, we know of only one source for such material although there are possibly others. We procured all of ours from factory stock carried in scores of cities by representatives and distributors of the Amco Engineering Co., 7333 W. Ainslie Street, Chicago, Ill. 60656. After reading the following paragraphs and examining the accompanying photos, if we've planted the germ of an idea in your noggin, write a postcard to Amco and ask for their latest catalog of aluminum extrusions for electronics systems. They will include a list of their representatives who stock this material; no doubt there is one right in your own area!

We found the ¾" × ¾" cross section extrusion to be just the ticket for building enclosures for receivers, transmitters and various sundry items of ham equipment. They are easily cut to length for your project with a common hack-saw and with the many aluminum corner, hinge, 'T' and odd-ball castings also offered by Amco, you can assemble a beautiful enclosure in practically nothing flat! Not a hole to drill or a screw to use; assembly is accomplished simply by use of sturdy spring locking clips furnished with each casting, which are inserted in the extrusion and pushed firmly into place, completely concealing them!

You can build not only equipment enclosures but the framework for a complete operating desk or console with either straight front or sloping to accommodate equipment panels. Casters are also available for pieces

* 3434 74th Ave., S.E. Mercer Island, Wash., 98040.

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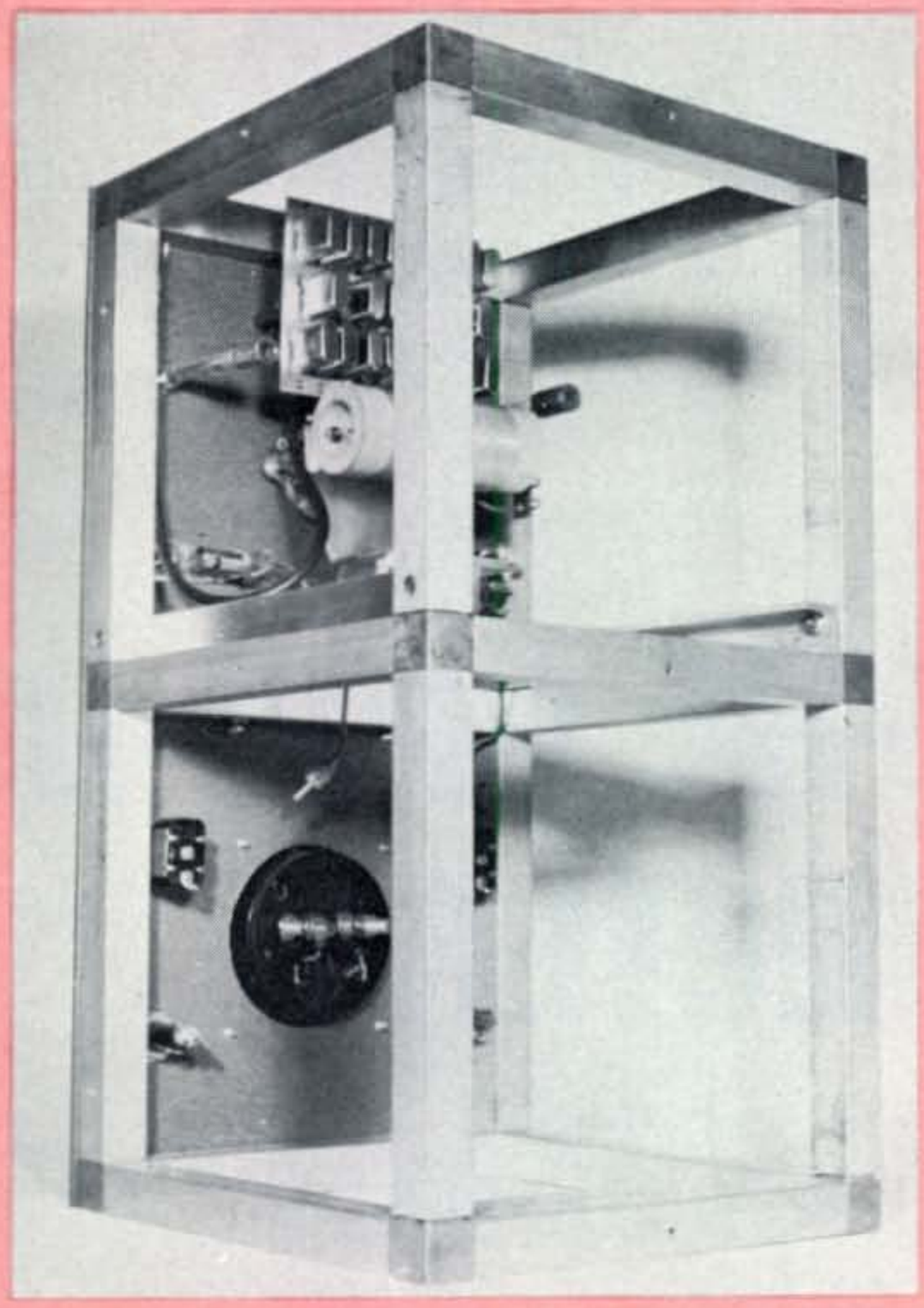
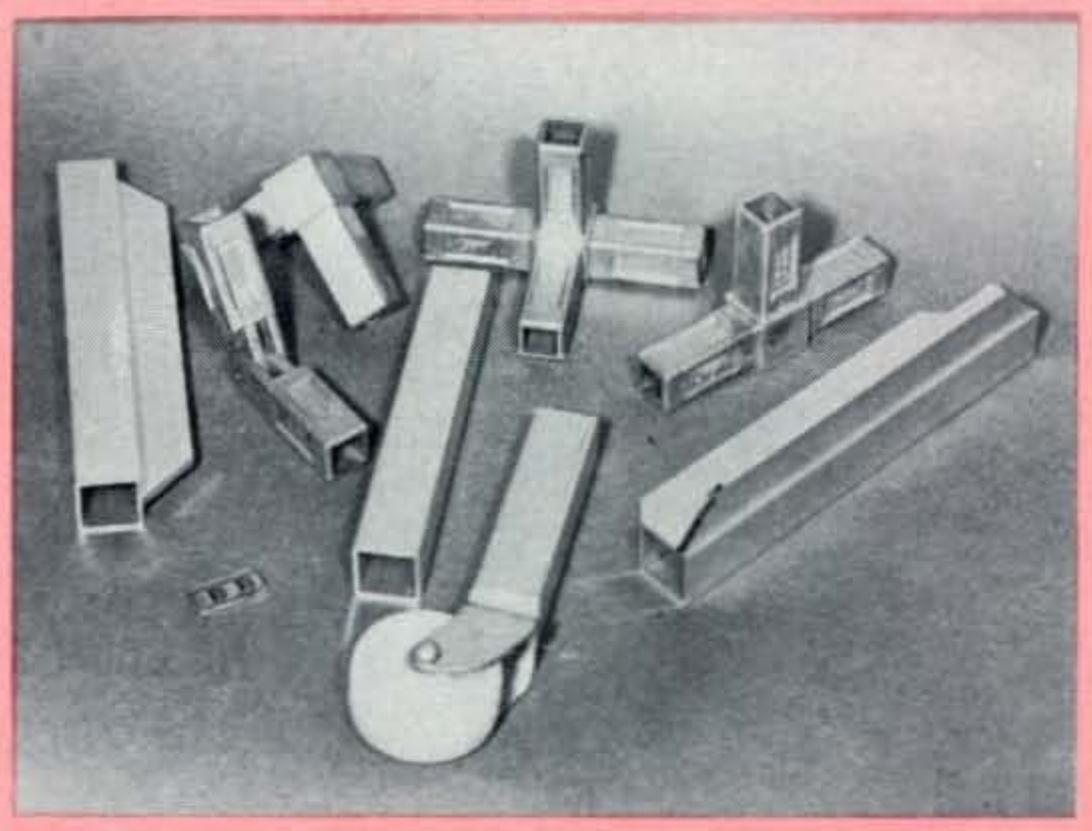
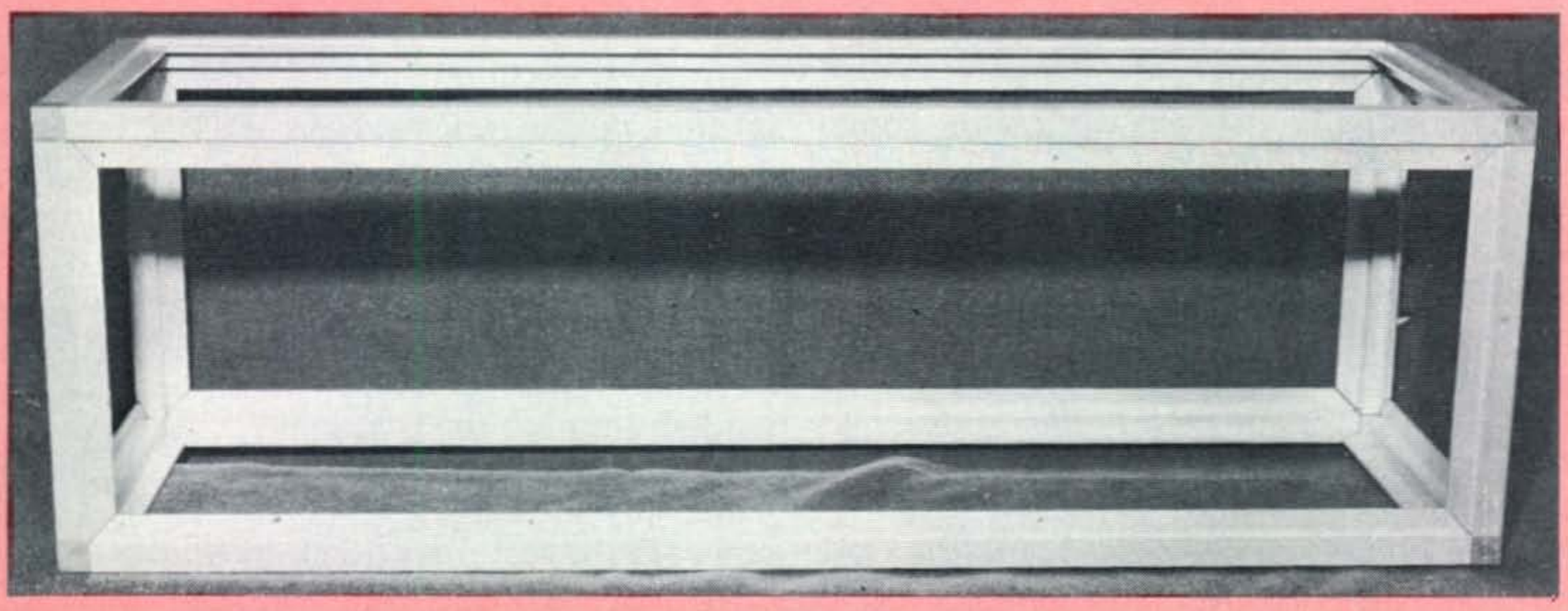




The photo on the left shows a partially completed multi-channel transmitter in an extruded aluminum rack frame. Below, a horizontal housing is shown waiting for that certain project. Above are some of the many extrusions and castings available in AMCO aluminum.



which you may want to push around. In other words, it's the most versatile method we've seen for easy construction of sturdy, light weight housings.

You can cover the sides, top, bottom and ends with solid sheets of Masonite or aluminum or, if you prefer, and particularly for equipment requiring ventilation, screen or hardware cloth or better still, sheets of perforated aluminum. These latter are available at most hardware and building supply stores in a variety of patterns and designs. We found one simulating an old-fashioned cane chair seat to be particularly attractive!

That's it; if you're stumped for an attractive, rigid but light weight frame for your equipment housing, desk or console, Amco aluminum extrusions and accessory fittings are your answer. Don't take our word for it but send for the catalog and find out for yourself! ■

Back Issues

Back issues of *CQ* are available from our Circulation Department. Issues in the current year sell for face value (.75) and all others in stock are one dollar each, postpaid. If the issue is no longer in stock, photo copies of specific articles are available at one dollar each. Preferably, the entire issue will be sent.

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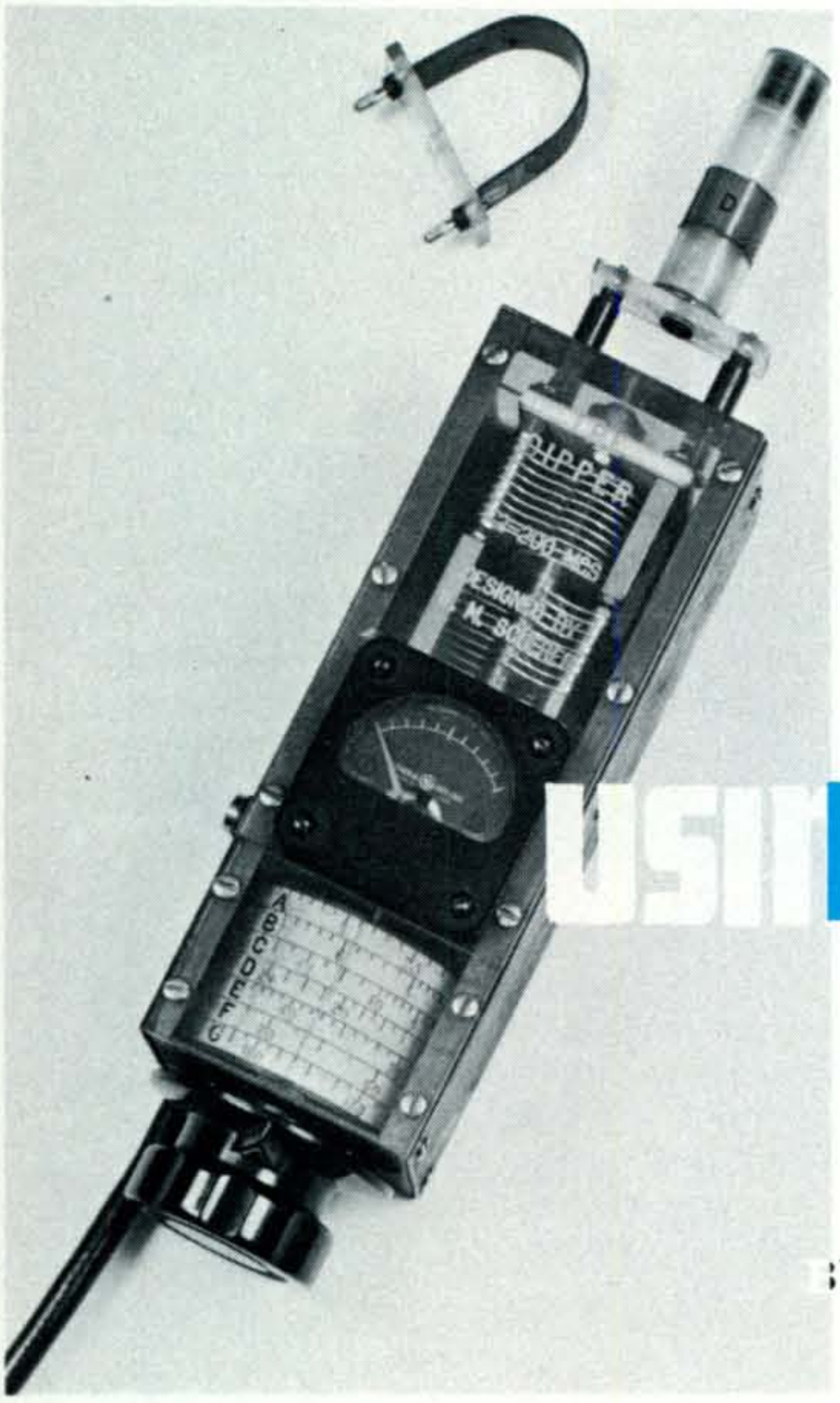

Part II of this short series presents "How To" information on using the ubiquitous G.D.O. around the ham shack.

USING THE GRID-DIP METER

Part II

BY WILFRED M. SCHERER,* W2AEF

BEFORE continuing with a discussion on the applications of the grid-dip meter, some procedures, not mentioned previously, will be taken up.

When the g.d.o. is to be coupled to large-diameter inductors made with heavy conductors such as tubing, it may be necessary to position the g.d.o. inductor inside the end of the test inductor and next to the inside edge of the conductors.

In applications where the instrument is used as an oscillating detector, due to the circuit loading when the tube then functions as a diode, the meter response will be relatively broad. The frequency calibration also will shift slightly to a lower-frequency dial reading than with g.d.o. operation.

Besides producing a response in headphones, the meter will tend to kick upward with the signal as it is tuned in during operation as an oscillating detector. Both the meter and headphone response will be extremely sharp, necessitating slow and careful tuning.

Applications

Neutralization: Remove *plate* power from the transmitter. Using the instrument as a g.d.o., couple it to the driver of the stage to be neutralized and tune it for a dip. Leave the instrument set with the meter deflected at the bottom of the resonant dip and adjust the neutralizing control so that tuning the plate tank of the neutralized stage through resonance has no reaction on the deflected meter reading. Each time the neutralizing setting has been changed, a new resonant dip may have to be first located, before the check is made by tuning the p.a. tank.

Another method is to remove plate power from only the stage to be neutralized. Apply power to the driver stages and with the instrument used as a diode detector tuned to the operating frequency, couple it to the amplifier tank and check for an indication of r.f. Adjust the neutralizing control until no or a minimum indication of r.f., is observed according to the detector meter reading.

Parasitic Oscillations: Use instrument as either a diode or an oscillating detector coupled to the unstable circuit to find the frequency of the oscillations. It may be observed that during such searching with diode detection, that the meter reads at the high-frequency end of the range, regardless of which instrument inductor is in place. This is due to the very low C at this point which with the diode loading lowers the Q and broadens the response. It is particularly noticeable with v.h.f. parasitics. The looked-

*Technical Director, *CQ*.

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for frequency is not indicated, unless the meter reading peaks somewhere in the range.

When the parasitic frequency has been determined, remove power from the equipment and using the instrument as a g.d.o. to locate circuits or components, such as r.f. chokes, wiring, etc. that are resonant at the parasitic frequency. Steps taken to alter such resonances may cure the oscillations.

One cause of parasitics may be cavity resonance produced by the chassis on which the equipment is built. This usually can be found by the g.d.o. function with coupling made in one corner of the chassis interior. Detuning the chassis by means of a bar or partition shield inside the chassis has been found to cure such difficulties.

Parasitics may occur even in receivers as may be evidenced by birdies (other than oscillation due to instability at the operating frequency) as a circuit is tuned. We had one case where a check with the grid-dip meter as a detector indicated that the oscillations did not take place at the operating frequency, eliminating the possibility of r.f. feedback, but rather occured at a very high frequency. This was due to the capacitance of the antenna trimmer and the inductance of its connecting lead to the bandswitch that produced resonance at the high frequency (as learned with the g.d.o.) that introduced the parasitic oscillations. A change in the lead length corrected the difficulty.

Parallel-Resonant Traps: Use instrument as a g.d.o. Traps usually are best pretuned or checked prior to installation in a circuit or with at least one circuit lead disconnected, since under some conditions wiring or other elements involved in the associated circuit may introduce additional shunt capacitance or inductance and produce a resonance indication other than that of the trap itself or prevent a dip indication at the actual resonant frequency of the trap alone.

If the circuit "strays" and their Q are small in comparison with the trap values, chances are that they will not seriously affect the dip readings, in which case checks made with the trap installed will be approximately correct.

Final precise adjustment should be made by applying power to the circuit and tuning the trap for the desired effect under actual operating conditions.

Series-Resonant Traps: Use g.d.o. in similar procedure as with parallel-resonant traps, but where resonance is to be checked prior to installation, the trap must be first connected as a parallel circuit. At high frequencies or where the trap inductance is low, the lead making the parallel connection should be a short heavy conductor to keep its inductance low and leads to be used for installation connections also must be included with this setup.

Harmonics: Harmonics may be checked using the instrument as either a diode or oscillating detector coupled to the tank circuits or other elements of interest. Except where such harmonics are relatively strong, indications may not be found with the grid-dip meter, particularly energy produced by stray radiation from the equipment that may cause TVI; but in any case, where a particular harmonic is known to create trouble, the cause of its production due to faults in the transmitter often may be tracked down using the g.d.o. to locate circuit resonances that could encourage harmonic production.

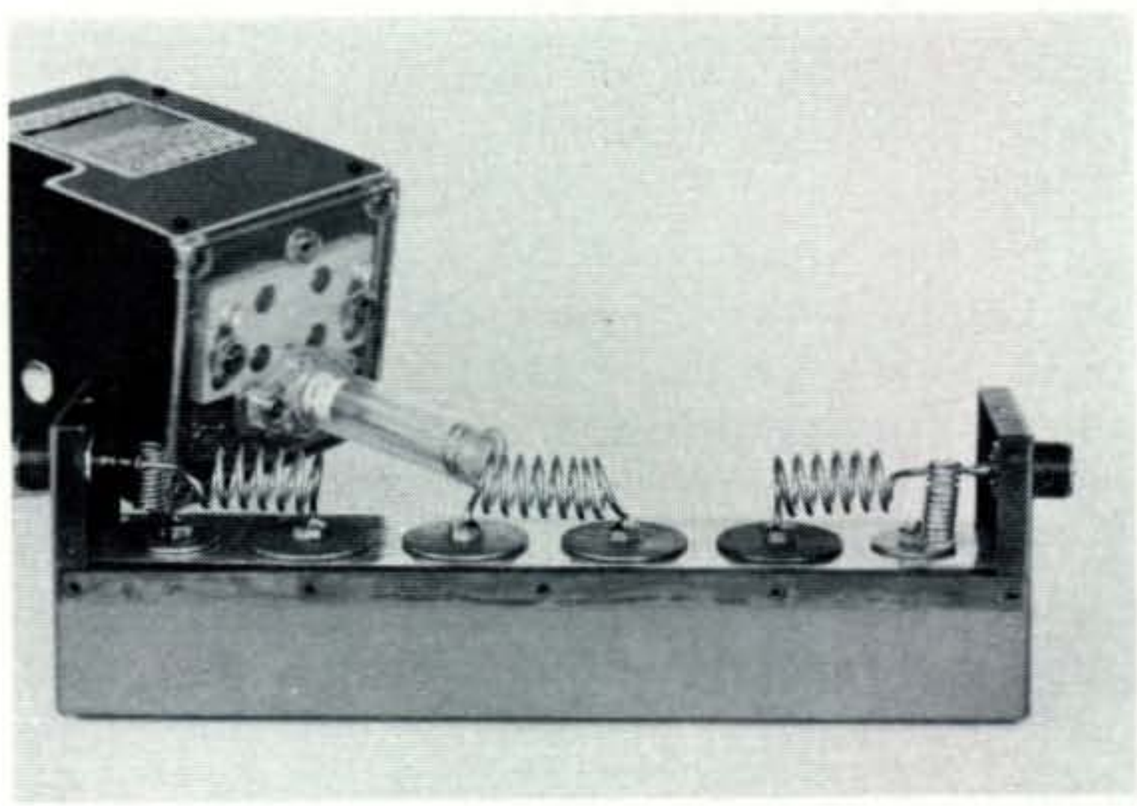
Low-, high-, and band-pass r.f. filters may be checked using the g.d.o.

For a single low- or high-pass constant-K Pi-section, disconnect it from associated circuitry. Use of the g.d.o. coupled to the inductor (for a low pass filter) or *one* of the inductors (for a high pass filter) will indicate the cutoff frequency.

For a single low-, or high-pass constant-K T-section filter, short-circuit the input and output. Follow a similar procedure as above.

For multi-section filters using constant-K and M-derived sections, the cutoff frequency may be found with the g.d.o. coupled to an "untuned" series inductor (in a low pass filter) or a similar shunt inductor (in a high pass filter) at one of the mid sections.

If the capacitive and inductive values are known or designated for a particular section,



G.d.o. coupled to center section of low-pass filter for determining filter cutoff frequency.

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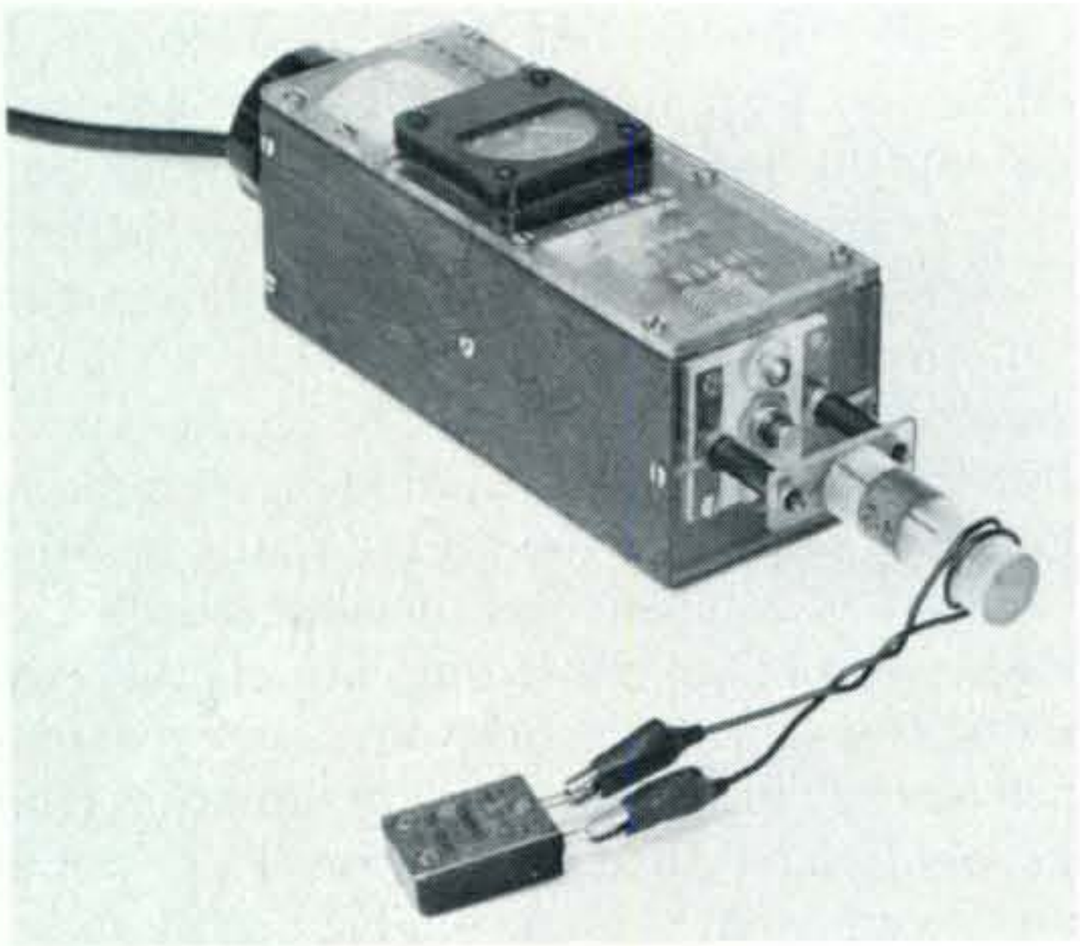

G.d.o. coupled with loop attached to crystal-holder pins for checking overtone activity of crystal.

the g.d.o. may be helpful for checking the proper resonant frequency thereat as predetermined by calculation or the use of an L/C resonance chart or nomograph. This can be particularly helpful during filter construction, as illustrated on page 16 in *CQ* for March, 1967.

Checking Crystals: Plug crystal into grip-dip meter in place of the instrument inductor. This may require the use of a jig or short leads equipped with clips or banana plugs. Use the instrument in the oscillate mode. Rotate the tuning capacitor until grid current is indicated, the value of which at a given capacitor setting for various crystals will indicate the relative activity of the crystals. Oscillation is best obtained near a low-capacitance setting (toward h.f. end of scale).

This also is necessary when the crystal frequency is to be determined by checking the oscillator signal with a calibrated receiver, since most crystals are rated for a load capacitance of about 33 mmf.

Crystals also may be checked for activity and *approximate* frequency by making a one or two-turn loop around the g.d.o. inductor with a short lead the ends of which may be clipped to the pins of the crystal holder. The g.d.o. will indicate a sharp dip when tuned through the crystal frequency (with the appropriate inductor in use). This is useful for overtone crystals with which the overtone frequencies also will be indicated. The fundamental and overtones of many other crystals also will be found.

In some cases the dip may occur at two slightly different frequencies, depending on whether or not the g.d.o. is tuned starting above or below the crystal frequency. In such cases split the difference between the two readings.

This method is handy for use where even the range in which the crystal frequency falls is not known. After this has been determined, a much more accurate frequency check may be had by plugging the crystal directly into the g.d.o. and checking the signal with a receiver as described above.

Field Strength Meter: Use instrument as a diode detector with a short antenna connected to one inductor terminal or to a one or two turn loop wound around the inductor with the other end of the loop grounded to the instrument case. The frequency calibration might thereby be altered somewhat, but for this application the requirement is only to tune for a maximum meter reading. This is indicative of the signal strength.

R. F. Chokes: The *parallel* resonances of r.f. chokes may be checked using the g.d.o. coupled to the choke with both its leads open.

The *series* resonance is similarly checked, but with the leads of the choke connected together.

Where the choke is the single solenoid type, it may be better to check it while it is installed in the place where it is to be used. The end nearer ground may be connected, but the "hot" end should be left floating.

Self Resonance of Inductors: This actually is the same proposition as r.f. chokes and may be treated as such, but there are some additional aspects which sometimes crop up. These involve a tuned circuit where the inductor is tapped for operation on different ranges.

Self resonances in the unused, and sometimes in the used, portion of the inductor may introduce adverse effects on the operation of the equipment, such as signal suckout, parasitics, instability, harmonics, etc. This may occur either if the unused turns are shorted or left open. Using the g.d.o. for checking such resonances can be helpful in tracking down difficulties.

Quantitative Measurements

A number of quantitative measurements may be made with the grid-dip meter as follows:

Capacitance Measurement: Use the g.d.o. to find the resonant frequency with the unknown capacitance connected across an inductance

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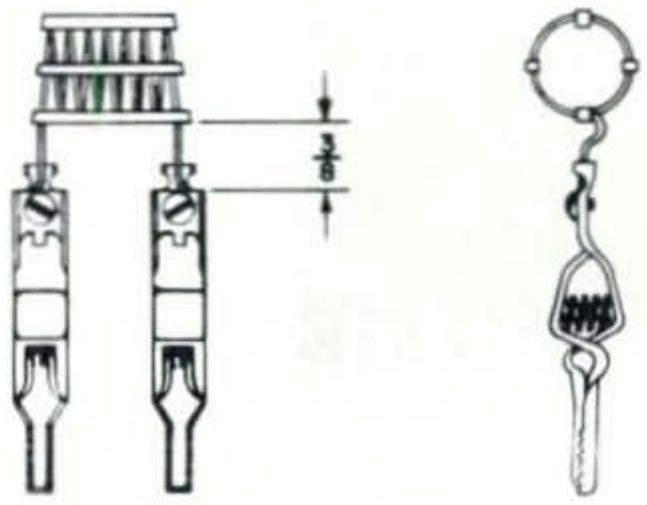

Fig. 1—Test inductor standard for determining capacitance when used in conjunction with a grid dip meter and either a calibration chart (fig. 2) or the formula described in the text.

of known value. The capacitance then may be found from $C_X = \frac{1}{4\pi^2 f^2 L}$ where f is the resonant frequency in megacycles, L is the inductance in micro-henries, C is the capacitance in micro-farads. If known, the distributed capacitance of the inductor should be subtracted from the result. Many manufacturers of grid-dip meters specify the values of the inductors for the instrument or provide a calibration chart for utilizing the instrument inductors to determine the capacitance *vs.* resonant frequency with each one. A small jig or short leads equipped with clips may be set up for connecting the capacitor to an inductor.

A do-it-yourself expedient that can easily be set up and one which we've found more handy and convenient, is one individual test-inductor standard made up of 7 turns of a B & W #3002 Miniductor equipped with alligator clips as shown at fig. 1.

This one inductor will permit a continuous frequency coverage of 2.4—80 mc to be used for capacitance measurements of 10 mmf to .01 mf as indicated by the calibration chart at fig. 2.

The distributed capacitance of the inductor is very low, and thus will introduce a negligible error, leaving the accuracy primarily up to the g.d.o. calibration.

This inductor also exhibits a very high Q, often making it possible to obtain a measurement on a capacitor actually installed in a circuit. In any case, the inductor should be clipped on as near the capacitor body as possible in order to avoid additional inductance from the capacitor leads.

Inductance Measurement: This will be limited to r.f. inductors. Connect a capacitor of known value across the inductor (using as short leads as possible) and use the g.d.o. to

[*Continued on page 107*]

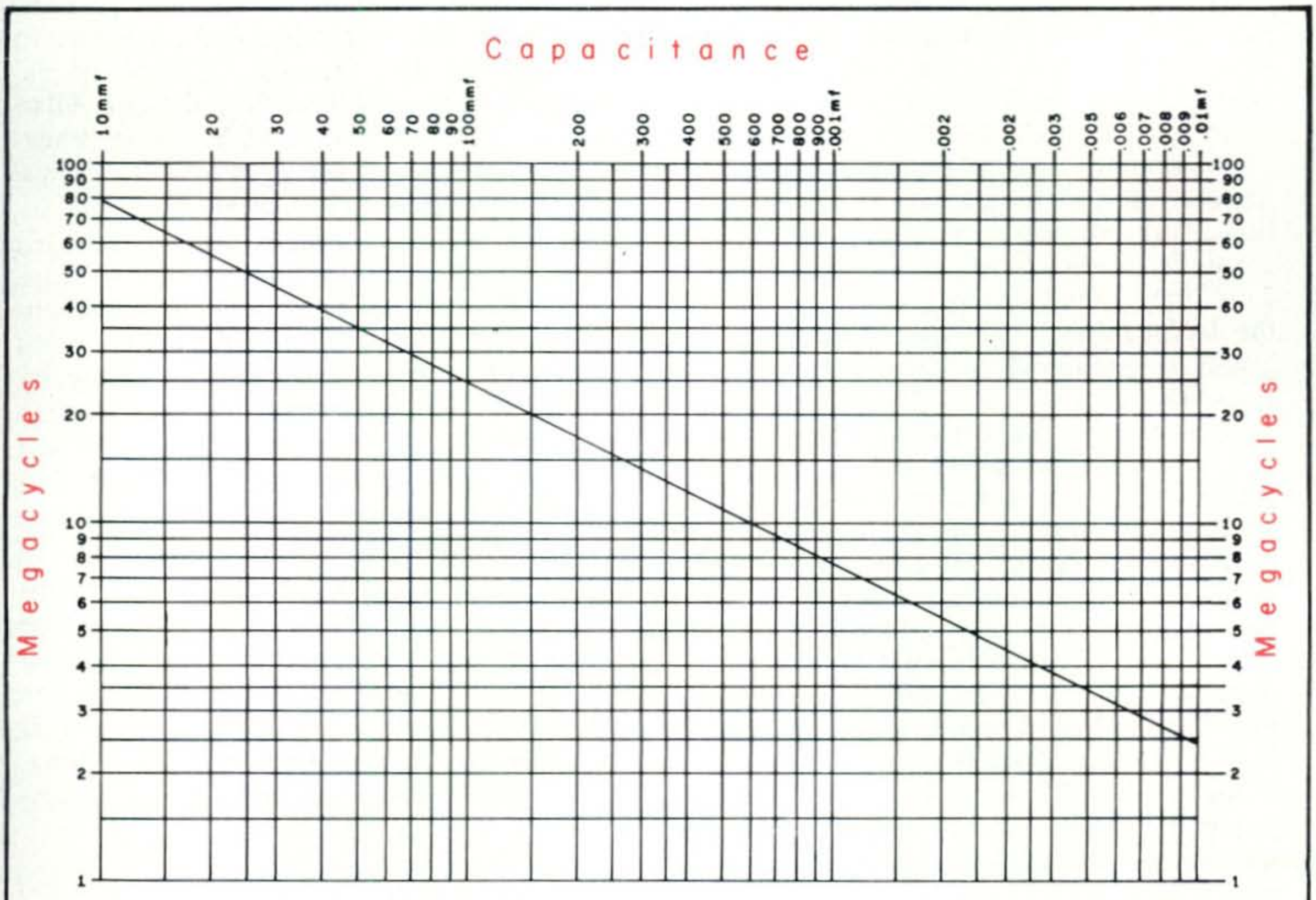

Fig. 2—Calibration chart for capacitance measurements with the g.d.o. using the clip-on inductor described at fig. 1. Accuracy depends on g.d.o. calibration and self-inductance of capacitor. Distributed capacitance of the inductor is about 1.5 mmf.

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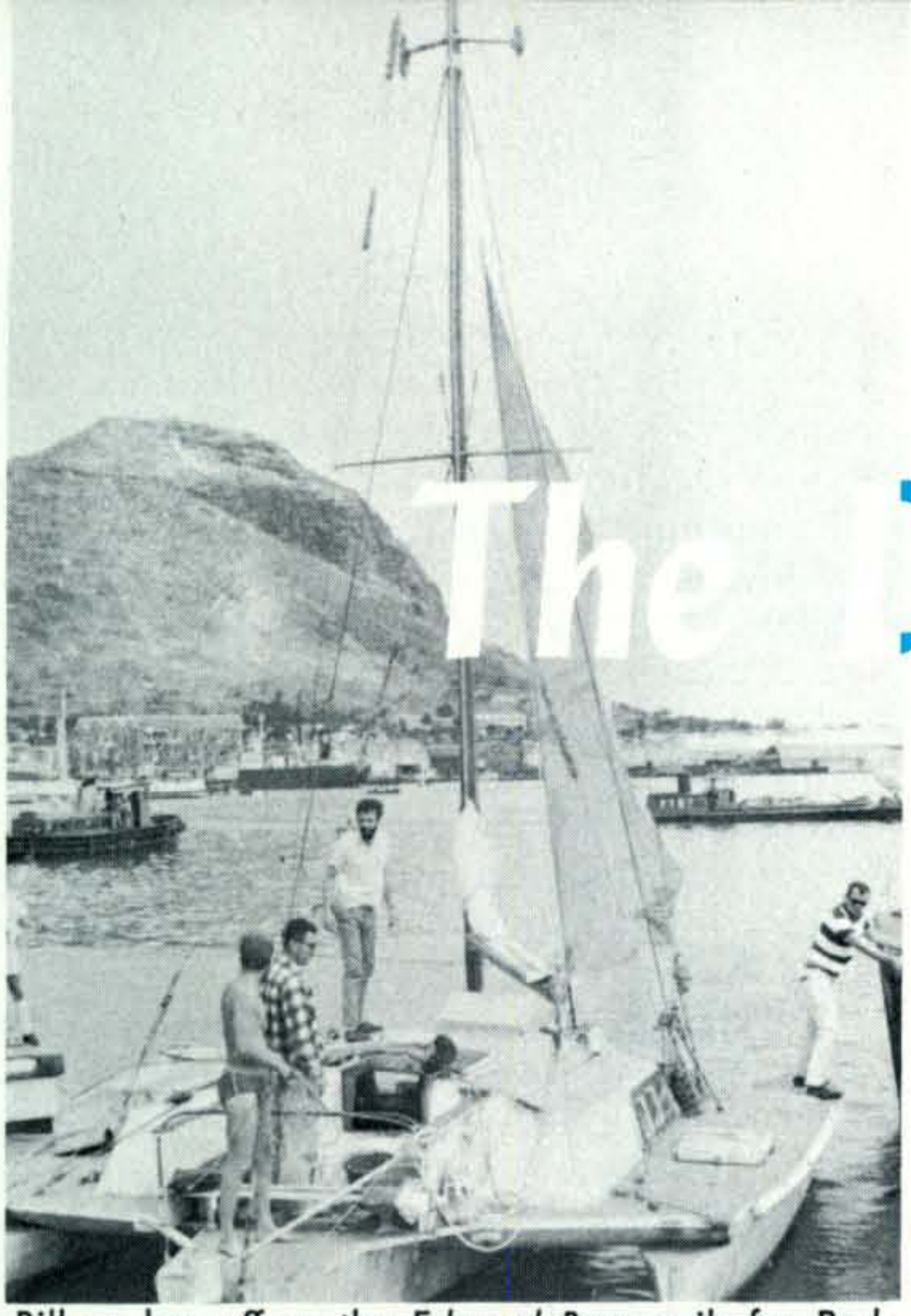
The DXpedition

Part VI — Better Late Than Never

BY DON MILLER,* W9WNV



Bill pushes off as the *Edward Bear* sails for Rodrigues from Port Louis, Mauritius.

FOR almost the entire, uneventful, four-hour flight from Johannesburg I had been deep in thought, reviewing the DXpedition's past 30 months—how and why it began, where it had taken us, and what the future held in store. As the 707 approached our destination I recalled the rejoiceful moment of exhaltation when, after months of luckless despair during which I had all but given up hope, my Mauritius license, VQ8CB was granted. That was more than half a year before, in Mombasa, Kenya. A few weeks later the DXpedition would be abruptly and flagrantly interrupted, perhaps never again to resume or recover.

Rodrigues and St. Brandon were two cardinal reasons for bringing the DXpedition into the Indian Ocean in the first place. But our dreams had been all but shattered. If there were no other reason for attempting to complete the DXpedition, no matter how great the obstacles nor foreboding the circumstance, the thought of that VQ8 ticket and those who made it possible provided more than enough inspiration. It wasn't merely the realization that VQ8CB held the key to two of the rarest DX Countries remaining; neither was it the defiant attacks upon the DXpedition by the world's most powerful amateur group; although these factors played a role in the decision to continue, I can accurately state that the DXpedition was completed, in fact, as the final payment of a debt of gratitude to the DX fraternity, and especially to men such as Roy Stevens, G2BVN, of the Radio Society of Great Britain and Allan Foster, VQ8AX (GM3OXA), who transformed the remote hope of a Mauritius amateur radio callsign into reality.

As the huge jet gradually leaned starboard I was treated to my first glimpse of Mauritius, its brown, stubby volcanic peaks barely reaching into the clouds, its colorful shallow coral reefs, and its small sister islands protuding like green dots above the surface of the deep blue Indian Ocean. The past six months had been an entanglement of frustration and sweat but somehow, as we approached that runway, the past seemingly dissolved into a most satisfying realization that our dreams and hopes would, after all, come true. As we descended I realized a certain confidence that we would, in fact, succeed in carrying the DXpedition through to its final objectives. It was late in the afternoon on Wednesday, August 2nd. We had, at last, landed in Mauritius!

Old Friends in a New Land

Having expected to meet only Bill, WA6SBO, who arrived two day searlier from

* c/o *CQ*, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.

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Nairobi, what a welcome surprise it was to find none other than Lincoln Jack Astley, skipper of the *Edward Bear*, which had transported the DXpedition on its previous voyage a year before! Except for the presence of Marjorie, his petite, exotic companion, Jack hadn't changed one bit. We rushed through the usual customs and immigration formalities and drove off in Bill's "rent-a-jalopy" ($1.00 per day with free mileage so long as it ran) toward Curepipe, some 15 miles distant, to meet Steve Gibbs, VQ8CC. Driving halfway across the Island (Curepipe is located midway between the airport and the capital city of Port Louis on the opposite shore), Jack and Bill proceeded to enlighten me on the local "facts of life." This soon-to-become independent island country proved a far cry from its sister colony of the Seychelles, a thousand miles to the north, where the DXpedition was based a year earlier. The Seychelles had presented a sparse, largely uneducated population, undeveloped land, and genuine remoteness and isolation, having no airport and rather inefficient and undependable communications with the outside world. Mauritius, however, although roughly five times the Seychelles' area (740 square miles vs. 152), is inhabited by nearly twenty times the Seychelles' population (750,000 vs. 40,000)! Like the Seychellois, the majority of Mauritian s are Indian, the minority Creole and European; like the Seychelles, sugar is the principal and practically sole export; and, although the official language of both countries is, of course, English, French still predominates, both in language and general influence (both island groups were first settled by the French, later becoming British Colonies). Creole, Hindu, Chinese, and English are also spoken. I would guess that 100% of the literate population has a working knowledge of French; less than half speak any English at all. Despite the similarities, Mauritius resembles a typical African mainland country much more than it resembles primitive and remote Seychelles.

Poor Timing

Like arrivals at many of our previous locations, we had come to Mauritius at a most inopportune moment, and uncertain period of turmoil, unrest, and confusion which was likely to cast some shadow of doubt on our immediate plans. First, the new crisis in the Middle East had closed the Suez Canal; all ocean-going vessels normally crossing the Mediterranean in either direction were forced to divert around the entire African continent (having the same effect as closing the Panama Canal in this hemisphere), and Port Louis, Mauritius suddenly found itself one of the world's busiest ports. Barely equipped for the unexpected surge of marine activity, the administration and port authorities were already working overtime to handle the rush. A double row of freighters lined Port Louis harbor, dozens more waiting at the entrance.

As if the resulting turmoil weren't enough, the most important event in Mauritian history was to occur four days after our arrival. August 7th wa selection day; not the ordinary annual political affair, but an election whose only issue was independence. Mauritians were about to make their historic decision to sever their cord with Great Britain and seek status as an independent nation. The contest was between the underdog Mauritian (Blue) Party, which preached the advantages of England's protection and a presently successful economy, and the Independence (Red) Party which, catering to the majority Indian population, promised that independence would bring job, money, and security to every Mauritian and that all the world's powers would support Mauritius financially if she wished. The campaigns seemed to be staged more on an ethnic basis than on the issue at hand; most of the poorer population readily accepted the dream of a rich, independent society. Time will tell.

As we approached Steve's QTH we agreed that the present marine and political turmoils could well prove a major setback to the DXpedition, especially since neither Bill nor Larry had yet been granted amateur licenses, since many of our visas, clearances, and paperwork were not yet in hand, and because the Director of Telecommunications was in Europe on Holiday and most government officials were already working overtime. We all shared the unspoken concern that the DXpedition would need a helping hand to get off the ground. Steve Gibbs more than fulfilled that role.

Steven Gibbs

The DXpedition's course had brought me into contact with many of the world's most prominent amateurs on all the continents—renowned technical experts, well-known DXers, editors and publishers, and various amateur society and telecommunications officials. Many had helped or advised the expedition;

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their acquaintances were more intimate than superficial. Many had made their contribution toward amateur radio; some, many times over. A few had invested far more time and effort in the amateur service than any possible personal reward or recognition. Such an individual was Steven Gibbs, VQ8CC. His callsigns and activity from G3MBS, GM3MBS, ZC4AK, 5A3CJ, or MP4BEQ may not be familiar to some reading this article; either may VQ8CC, although this is doubtful if you are at all active on the DX bands. But the imprint of his love of amateur radio, devotion to the service, and profound moral commitment to work to improve and promote amateur radio wherever he has travelled and wherever his travels take him in the future, is destined to enrich and radiate the progress of amateur radio throughout the world.

Steven Gibbs, VQ8CC. Presently stationed with International Aeradio in Mauritius, Steve has contributed greatly to the progress of amateur radio throughout Africa and the Middle East.

During his tour with the RAF through 1961, Steve's operating transformed Cyprus Club Station, ZC4AK, into one of the best known DX callsigns on the h.f. bands in that era. His historic 160 meter Asia-North American QSO's with W1BB, W8GDQ (to complete 160 meter WAC), and others on the top band will probably be remembered longer than his thousands of c.w. contacts on the higher frequencies.

Steve joined International Aeradio, Ltd., in Libya for two years, operating at 5A3CJ from Benghazi before his 1964 stint on Bahrein as MP4BEQ. Perhaps his most frustrating experience was a 1965-66 tour of duty in Kenya —20 months without an amateur ticket!

Attending a government communications training course at Denver, Colorado late that year, Steve welcomed even the non-rare status of his reciprocal callsign, G3MBS/WØ. His Stateside visit afforded Steve the opportunity for an introduction to some of his American DX colleagues and to DXing, American style.

Perhaps Steve's greatest amateur accomplishment is that of instigating the first Indian Ocean amateur radio society. As Secretary of the Mauritius Amateur Radio Society (MARS), Steve has spearheaded the development of a full-fledged, organized association bound to markedly improve the status of amateur radio in the African area.

Introductions and Preparations

Larry Page, WB2DHF, had been waiting with Jack in Mauritius for almost two months. While Bill and I tried to sort out the ARRL mess and reorganize the DXpedition in the States, Jack and Larry had sailed from the Seychelles, covering the thousand miles in the midst of poor weather conditions in less than a week. The trimaran required a good deal of maintenance, already initiated by the time we arrived in Mauritius.

Larry had arranged an early meeting with Commander Audrey Booker, Port Captain, Harbor Master, and Director of Marine for Mauritius. Steve had similarly arranged a get-together with Paul Caboche, VQ8AD; a staunch pioneer of amateur radio in the Indian Ocean, Paul, along with Leny Mazery (ex-5Z4GT) conducted the first real DXpedition (in the modern day sense) to the Chagos in 1937! Paul is QSL Manager for Mauritius and current president of MARS.

Thanks to the generosity of the Long Island DX Association, the DXpedition and LIDXA jointly donated a Swan transceiver to Paul for DX and DXpedition use in the Indian Ocean. Herbert St. Lambert, VQ8BZ has already taken the unit to Rodrigues (VQ8BZR) and accomplished several hundred QSO's. The rig remains in Paul's custody between trips, enabling VQ8AD to be heard on 20 meter s.s.b. after 30 years of c.w. and a.m.!

Prognosis for an early departure for Rodrigues and St. Brandon depended upon getting the gear through customs, testing and repairing the equipment, obtaining Bill's callsign, and Larry's and Jack's preparing the *Edward Bear* for the voyages. She needed some major carpentry, sanding and several coats of paint, scraping and anti-fouling paint for the hulls, replacement of some rigging, minor sail repairs, welding, fresh provisions, re-storage and offloading, and a general "spring cleaning." Only through major efforts by Jack and

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Larry, and the kind cooperation from Steve, Paul, and Captain Booker, was the DXpedition completed at all.

Soon after arrival we learned that a local tug, *Le Corsaire*, would be departing for Rodrigues on August 9th, but our gear wasn't likely to arrive by that date and Bill hadn't yet obtained any definite commitment on his license. Since Bill had grave misgivings about sailing aboard the *Bear* in its present condition, an opinion I didn't share, it was a shame to have to pass up the opportunity for a free "luxury cruise" to Rodrigues. I should point out that Bill, aboard his own slightly-larger trimaran, has just been through a rather horrifying experience (see February, 1968 *CQ*, *The DXpedition*, page 62). Moreover, I had already sailed in the same general area aboard *Bear* and knew, first hand, that both ship and skipper performed superbly under the same overloaded conditions under which we'd be sailing.

It soon became obvious that the gear, ship, and licensing problems would drag on for a while. Steve volunteered use of one room of his apartment for testing and packing the gear, and the services of his house-girl, Edmone Christophe, probably the finest cook we encountered during the entire DXpedition. Captain Booker secured a room for Bill and me at the Merchant Seamen's Club, located quite close to *Bear*'s mooring.

Up to a bit of mischief on election eve, Bill, Larry, and I cautiously approached the trimaran at a time when we knew Jack and Marjorie to be quietly reading(?) inside. Removing a huge, three-foot quadruple-fold of about a thousand Chinese firecrackers of every imaginable variety from his jacket, Bill handed me one end. Crouching, we laid them on a concrete pier alongside the *Bear*, just alongside the cabin. Larry lit the fatal match and in a split second we had retreated to the roar of hundreds of explosions that illuminated the tiny ship and echoed across the harbor for a full three minutes. After a brief moment of silence there was a noisy scuffle, followed by a loud barrage of fascinating New Zealand slang (Kiwi and Yankee slang use different vocabulary—same meaning). We needed no further encouragement to retreat to the safety of a nearby-by shack, returning to town when Jack calmed down.

In the morning we returned to find our Skipper in a rather non-receptive mood. At first, Jack related, he rather enjoyed the excitement. Then, suddenly, he remembered

Captain Astley explains some of the fine points of sailing to Don.

that all sails, currently under repair, were lying on deck alongside the explosives. As he dashed on deck to the rescue, Jack stepped clean through the open starboard hatch, severely bruising his right leg in the process; this is what evoked the beautiful vocabulary the night before. But he was too late; some of the flying crackers landed among the folds of sail and burned gaping holes in the bellies of the terrylene mainsail and working jib. We had nearly crippled our Captain and seriously curtailed our departure! Whereas it wasn't the last of mischief on the DXpedition, we had serious second thoughts about further shenanigans!

Checking Gear and Provisions

Having decided to sail first to Rodrigues, the more difficult of the two voyages since its entire 400 mile course would have to be directly into the teeth of the potent southeast trade winds and a strong current, we sought some arrangements whereby Steve could join us. It would have been difficult, at best, for five human beings to live on that tiny boat for any length of time. Moreover, Steve informed us that his obtaining leave would be out of the question for at least the next couple of weeks. It seemed that Steve was already an integral part of the team, however, and we shared the hopes that somehow Steve could participate in at least one of the operations before we departed the area. As luck would have it, those hopes were realized.

Our gear, which was supposed to have arrived on August 5th, joined us on the 11th, all 34 cartons. Perhaps it was for the better, for elections took place on the 7th, Mauritius selected independence, and some degree of unrest and commotion followed. By the time our equipment arrived the atmosphere had settled and we survived Her Majesty's Cus-

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toms with a minimum of delay and only a 0.50 rupee ($0.11) fee!

Because of the delay, Bill was able to operate in DARC's WAE c.w. Contest on August 12th and 13th with some success (VQ8CB/A). This provided an excellent opportunity for testing the gear. One of my Waters Codax Keyers needed a new input transistor, and Steve installed the closest replacement type he could locate. Unfortunately, its rating was not exactly the same as the original, the result being an electronic keyer incapable of less than 20 w.p.m.! Being the older and more worn of the two units, I decided to continue to use it as much as possible, reserving the new *Codax* for 40 and 80 meter operation, where QRS predominates.

One s.w.r. meter needed minor repairs; once again Steve volunteered. While Bill checked out the Collins and Galaxy gear for the contest, I reconstructed our antennas for portable operation, using the same procedure as on previous trips. Of the assortment of *Hy-Gain* antennas shipped, we decided to take only one beam, the TH-3 tribander, for 10, 15, and 20 meter operation, and a combination 40-and-80 meter dipole. At all but a few aluminum element junctions I replaced the Hy-Gain indentation clamps with adjustable, screw-type hose clamps. By longitudinally slitting the end of each outer sleeve, these junctions provided a rapid assembly and disassembly system. In 30 minutes the entire array and telescoping mast could be assembled to full size or reduced to a neat, 7-foot, lightweight bundle of tubing.

The choice of a tribander was a wise one, since all three bands were to provide worthwhile openings into each continental area. The efficiency of the Hy-Gain traps was remarkable; even at low heights and on a reduced 14-foot boom I noticed no appreciable loss of performance when compared with Hy-Gain's full-sized 3-element 20 meter beam (203 BA, 16-foot boom) used on previous Indian Ocean trips when we were limited to 20 meter operation. The sturdy, less flexible aluminum elements proved ideal during the gale winds of an anticyclone, and the traps seemed unaffected by salt air or salt water, even when accidentally doused.

We decided to leave one of our two AR-22 rotators, the 3-element 15 meter and 4-element 20 meter beams (153BA and 204BA) with Steve for the time being, as the *Edward Bear* was already heavily overloaded. In a couple of hours Steve had erected the 14 mc array, finding the gain of 4 elements on 20 meters to his liking.

Bill resigned from the WAE Contest a little early on Sunday. Jack reported that *Bear* might be ready to sail in three days. The gear had been thoroughly checked out and was in perfect condition. Despite the uncertainty of Bill's own callsign, and his obvious second thoughts about *Bear*'s safety, we temporarily agreed to a Wednesday, August 6th departure for Rodrigues. Bill didn't really decide to accompany the voyage until Tuesday night, and even then I knew it was only with grave misgivings and reluctance. I knew his feelings were sincere. Unlike myself, Bill had an XYL and three children to consider.

Financial and Medical Problems

On Tuesday morning Jack confronted me with the most enormous provisions bill I had ever seen! Charges for our "normal," conservative supplies—canned goods, fresh fruits and vegetables, kerosene and gasoline, and dry goods—amounted to a figure many times what I had anticipated, and I might point out that I had grown rather accustomed to "stocking up" for long voyages in remote areas. One would have thought the four of us could survive for over a year for this amount of money, yet Jack and Larry bought barely enough to sustain us for two months! (We had followed the time-honored procedure of doubling the expected sailing time to allow for becoming lost or disabled). There was obviously no choice. Our already-meager budget suffered a serious setback!

On Tuesday I mailed to *CQ* the final material for the *DX Handbook*. I'm happy to

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Edward Bear sails out of Port Louis Harbor, bound for Rodrigues, dwarfed by ocean liners in the background. Freighters and tankers were lined up at Mauritius, which suddenly found itself as a major port with the closing of the Suez during the Middle East crisis.

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A SIMPLE 10 METER QUAD

BY ED MARRINER, *W6BLZ

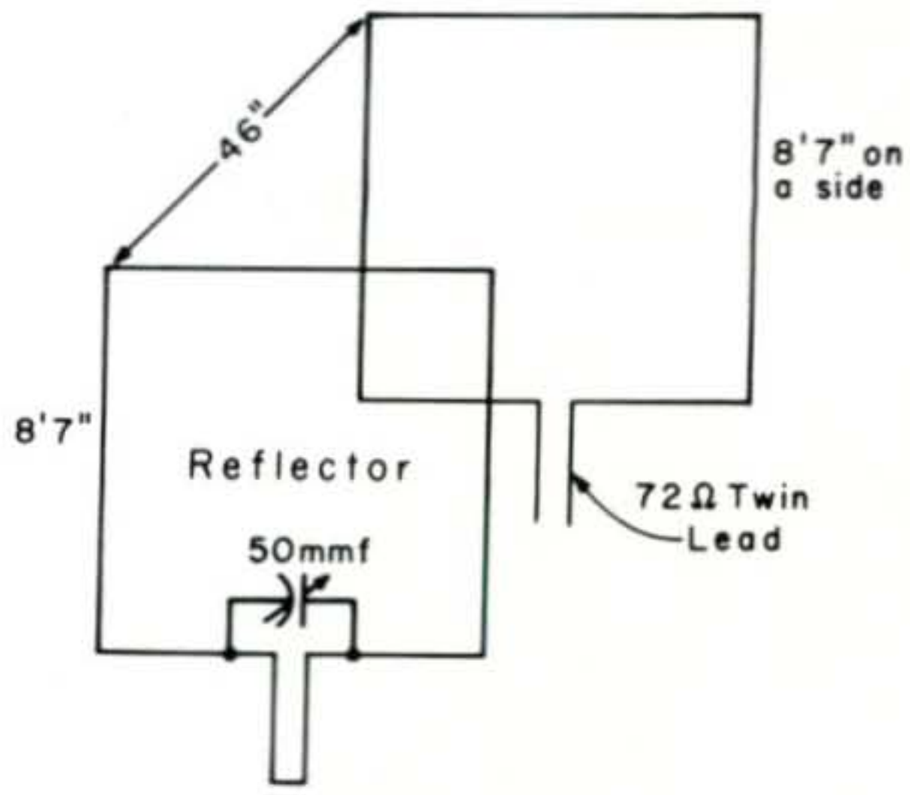


Fig. 2—Dimensions of the 10 meter quad antenna. The reflector stub is 10" long, 3" wide and made from #14 enameled as is the rest of the antenna.

QUAD antennas have been built using many configurations and materials. The use of bamboo poles for the Quad arms has probably been the most popular, although, they do have many disadvantages. The bamboo eventually splits and comes apart despite any method of protection. As a result of this problem, tapered fiber glass arms have become a popular construction material, but they are generally only available for the 20 meter beams.

A search was made for new ways to construct Quad antennas which would hold together. Nuplaglass rod seemed like a logical choice and the rod comes in almost any diameter. It was decided to give the ⅜ inch diameter rod a try, and the results were very satisfactory. The rod could be cut easily with a saw and drilled with a twist drill. When the wire was strung there was an outward bowing effect which held the element wire tight.

Construction

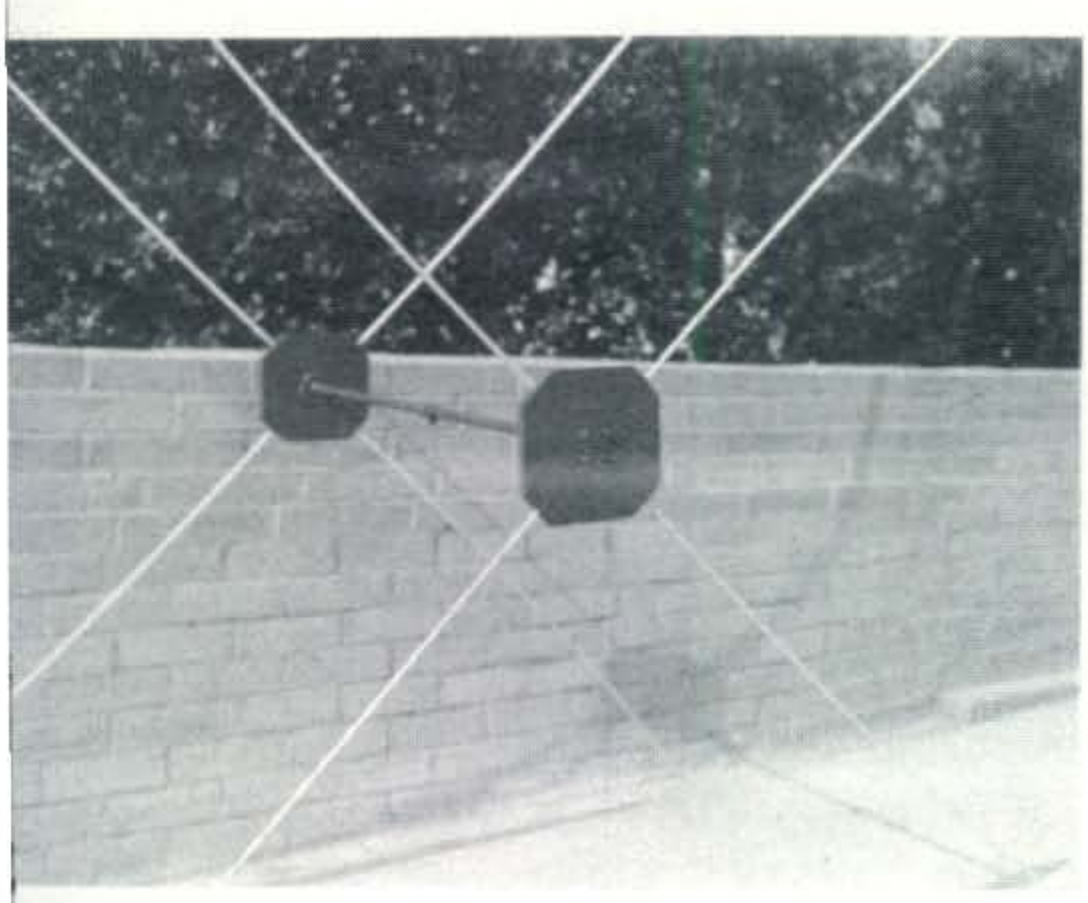
Before starting you will have to order 8 pieces of ⅜ inch diameter by 7′ Nuplaglass rod from the New Plastic Corporation, Structural Plastics Division, 1017-27 North Sycamore, Los Angeles, Calif. 90038. Next a quick trip to the hardware store for a ½ inch "T", two ½ inch pipe flanges and two pieces of two foot galvanized ½ inch pipe. At the lumber yard pick up two pieces of waterproof ¾ inch thick plywood one foot square and cut the corners off. (See fig. 1.)

With a ⅜ inch drill, sink a hole at the four corners to a depth of four inches. Now apply a gob of Armstrong cement to the ends of the rods and insert them into the holes; let them set overnight.

Once the rods are set in the wood square, measure out 6′7″ from the exact center of the board toward the ends of the rods and drill a hole for stringing the wire. This dis-

[*Continued on page 114*]

* 528 Colima Street, La Jolla, California 92037.



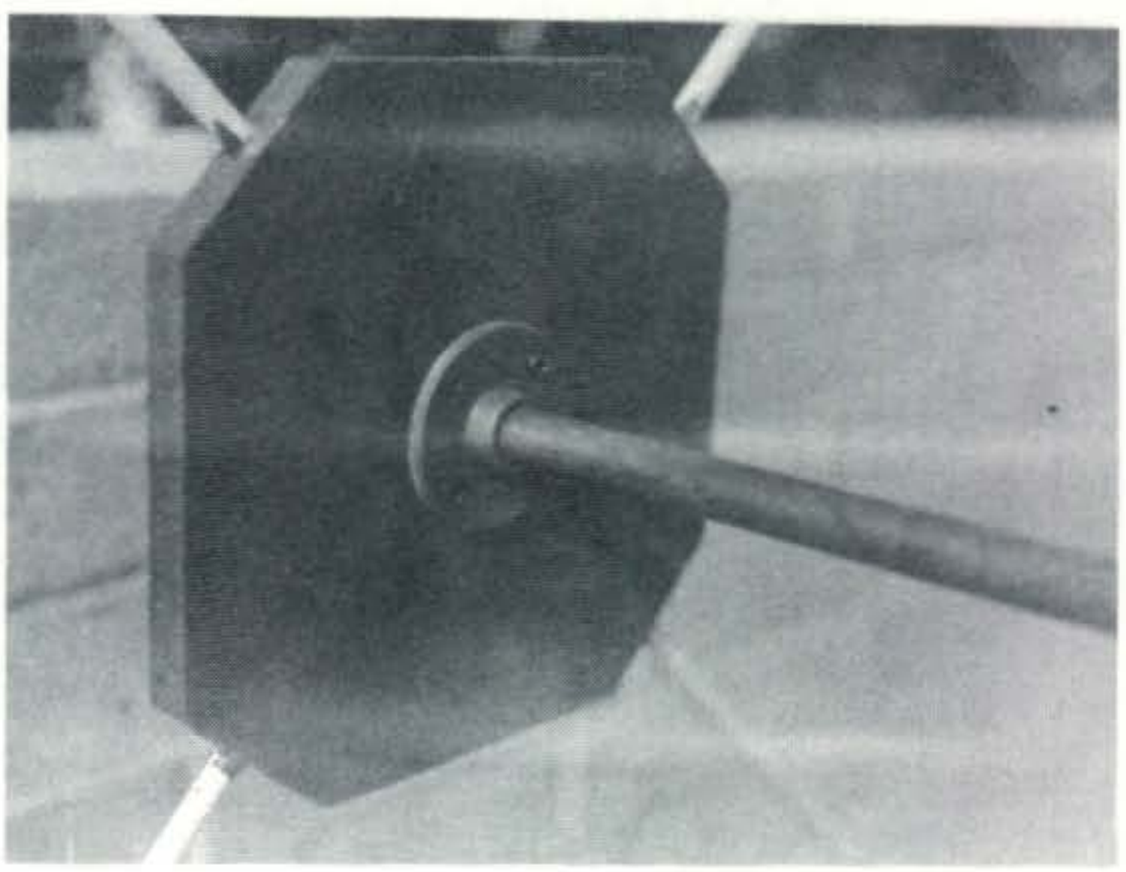


Fig. 1—Overall view (left) of the assembled 10 meter quad structure using Nuplaglass rods. On the right is a close up showing how the rods are inserted in the board and the mounting of the flange.

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If you can't swing a beam, maybe you should swing with one of these.

These are the trap verticals that go along on just about every DX-pedition. It's because they're the best antennas under the sun for hams that are short on swinging room or cash.

The 14AVQ (10 thru 40 meters) and the 18AVQ (10 thru 80 meters) from Hy-Gain are the ONLY high efficiency-high Q trap verticals made.

Others claim to have an advantage in uniform mediocrity across all bands which is the result of low Q-high loss traps.

Hy-Gain developed "Hy-Q" low loss traps are each electronically tuned to precise frequency to give true resonance on each band. Some other traps are tuned mechanically.

Hy-Gain traps take maximum legal power continuously while others melt under less stress.

You get low VSWR on all bands with the ability to adjust and readjust for peak performance at any specific frequency.

Hy-Gain verticals develop an extremely low-angle radiation pattern, so you get a powerful signal for the long hauls.

And they're the only verticals at DC ground. So you get practically no static or lightning problems.

You can phase two 14AVQs or two 18AVQs and get the signal directivity of a beam without the bother or worry of a tower or rotor.

Constructed of high-grade heat-treated, heavy wall aluminum and iridite treated hardware, there's no worry about rust and deterioration common with cadmium plated steel. Taper swaged tubing reduces wind loading and puts extra strength where it's needed. No top loading gimmicks to hang up in the wind.

Get down to the best distributor under the sun (he stocks all Hy-Gain products) and get swinging on the 14AVQ or 18AVQ.

14AVQ & 18AVQ from Hy-Gain

HY-GAIN ELECTRONICS CORPORATION
N.E. Hwy. 6 at Stevens Creek
Lincoln, Nebraska 68501

FOR THE MOST ADVANCED ANTENNAS UNDER THE SUN

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Results of the 1967 CQ World Wide DX (Phone) Contest

BY FRANK ANZALONE,* W1WY

WE had another good one this year (Oct. 1967). Again the "all time records" will have to be up-dated and new champions crowned.

No object would be served in quoting figures, the various charts in this report give this information in details. You will note that we have made some additions and modifications and hope that you will find them more informative.

In the single band division the top scores are now listed in groups of six on each band. Since this is a world wide competition we feel it's proper that comparisons are made on a world wide basis.

It's interesting to note that the 10 meter band high scores are dominated by South Americans, with our friend "Jaycee" still the champ on that band. LU1DAB exceeded his last year's world record by a wide margin. Also note W2BXA's score. Nice going Ben.

On 15 it was the Europeans that had a monopoly on the high scores. DL6EN maintained his position at the top of the heap and Gunter has a new world's record.

The entries from the 20 meter boys was definitely lower than previous years. Still this was the band that produced the highest scores and the Trophy winner, G5AAM, Bob Lane, remember him? In 1965 he did it at F7BL, this year he again topped all the single banders from the other side of the Channel. So Stew Meyer can be our ambassador and present his own Trophy on his next trip to England.

However YV5BIG's record still stands. Raul sat this one out and let his friend YV5AXT have a crack at it, but Tony didn't quite make it.

In spite of the fact that both 40 and 80 were below par this year, K2GXI made a new world high on 40, and in doing so Bob also beat out his perennial rival W3PHL. However both had better watch out for G3NLY in the future.

The two 80 meter hot shots YV5BTS and ON4UN did not make an appearance this year. The scores on that band were below normal, so the all time record remains intact.

Many have asked, "Why 160?" especially on phone. Well, it does produce some activity and its certainly quite a challenge. Its fitting that the new record was made by Jan, a 160 buff of long standing.

As for the all banders any superlatives would be futile. Breaking a million was common place, 19 contestants did the trick, most of them Europeans. We haven't gotten around to figure how many records were broken (that's Freddies job) but it will be interesting to see the new All-Time Records list. (Or you can check last year's list, page 65, Sept. '67).

The VK2ADY/9's score was a typical Don Miller performance. This year Don outdid

*Chairman, Contest Committee.

TROPHY WINNERS

Single Operator, All Band, World
W2SKE, Bill Leonard Trophy
won by Don Miller, VK2ADY/9

Single Operator, All Band, Europe
W4BVV Operators Trophy
won by Michael Bazley, G3HDA

Single Operator, All Band, U.S.A.
Potomac Valley Radio Club Trophy
won by Doug Gaines, W4AXE

Single Operator, Single Band (14 mc)
W2GHK, Stuart Meyer Trophy
won by Bob Lane, G5AAM

Multi-Operator, Single Transmitter
W6YY, John Knight Trophy
won by Station I4GAD
(Oprs. I1AUM, I1BXN, I1GAD, I1LCK, I1TAE)

Multi-Operator, Multi Transmitter
Radio Club Venezolano Trophy
won by Station OF5SM
(Oprs: OH2BCP, OH2BO, OH2BR, OH2ER, OH2HN, OH2TH, OH2WI, OH3PC, OH5NQ, OH5NW, OH5SE, OH5SM, OH5TM)

SPECIAL CQ PLAQUES

World Champion
Multi-Operator, Multi Transmitter
Station OF2AM, OH DX Ring
(Oprs: OH2BBM, OH2BBR, OH2BC, OH2BCZ, OH2BH, OH2BQ, OH2BS, OH2KH, OH2QV, OH2SB)

European All Band Champion
Walter Skudlarek, DJ6QT

Outstanding Performance
James E. Rumble, VK6RU

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Single Operator—All Band

Station	QSO's						Zones						Countries					
	1.8	3.8	7	14	21	28	1.8	3.8	7	14	21	28	1.8	3.8	7	14	21	28
VK2ADY/9		29	118	949	1084	1130		15	25	38	38	37		20	37	110	104	113
DJ6QT		109	130	452	646	629		9	16	32	29	33		35	48	99	69	64
VK6RU		8	47	518	148	952		4	16	34	23	32		6	18	94	37	71
G3HDA		66	124	764	506	185		8	14	33	29	24		30	43	84	68	40
DJ2QZ		112	140	320	568	501		13	9	33	27	29		41	38	73	54	53
DJ5BV		63	68	274	547	569		8	11	28	28	27		33	39	70	54	53
W4AXE		38	78	416	299	253		13	19	34	33	28		17	36	83	82	68
YU3LB		79	132	651	714	104		7	10	34	26	21		30	35	78	56	28
WØGTA/LA		85	77	448	397	490		5	9	27	28	28		23	30	73	50	41
ZL1KG	1	5	62	330	513	476	1	3	14	34	29	27	1	2	18	77	63	42

Multi-Operator—Single Transmitter

I4GAD		67	80	616	716	1093		6	10	31	33	34		26	35	80	65	70
CX3BH	3	6	25	583	809	923	2	4	13	31	32	26	3	6	15	75	63	57
SM2BJI		53	139	754	680	360		8	20	35	28	33		30	45	88	60	60
YV5ANF	1	23	83	827	820	248	1	7	17	36	25	24	1	10	33	106	75	59
DJ7IK		29	54	689	659	481		5	9	35	30	35		21	26	100	57	63
UA3KBO		89	189	355	869	494		7	15	34	25	27		26	43	79	52	45

Multi-Operator—Multi-Transmitter

OF2AM	3	330	467	2256	1850	1142	2	10	28	39	36	36	3	43	68	141	104	89
OF5SM	7	264	489	1635	1747	1316	2	12	23	39	37	36	3	45	65	134	102	99
4M5A	2	187	369	1568	1619	1288	1	11	18	37	36	31	2	24	51	127	102	87
K2GL	3	80	201	1017	886	858	2	15	26	39	37	35	3	32	65	136	121	103
W3TM2	2	71	237	739	820	706	2	15	28	37	37	36	1	25	63	121	120	106
CE6CA		35	126	982	1032	1269		7	21	38	32	28		7	26	105	79	58

Top scores band-by-band breakdown.

himself, but as he explained it, everything was in his favor. A rare location, a good antenna farm, adequate a.c. power for a change, good propagation conditions and a full 48 hour operating schedule. He averaged 70 QSO's per hour, dropping as low as 25 per on 40 and 80 and rising to 200 on the other bands. This may have been Don's last DX phone contest from a rare location.

Since DJ6QT was a winner last year, Walter is not eligible for the W4BVV Trophy, but he will be awarded a special *CQ* Plaque. The Trophy goes to G3HDA. Congratulations Michael, that's the first time one of our Trophies has been won by a station in the British Isles.

This year the Committee voted to give an additional award. A plaque to the station, who in our opinion, contributed the most in the contest. I'm sure all will agree that Jim's activity from VK6RU was a most welcome signal from rare Zone 29, and deserving of this award.

Incidently the UA boys want to remind all of us that the 80 meter phone band for the USSR extends only from 3600 to 3650 kc.

And let's not overlook W4AXE's new record for the USA and North America. That's the first time the million mark has been broken on phone in the USA. Nice going Doug.

A nice surprise was the score submitted by CE6CA. The boys of the Radio Club Temuco spent a month setting up an antenna farm just for the contest. They found the going on 40 and 80 pretty tough that far south.

The single transmitter multies were topped by a well known group of I1 phone men. This is also a first for Italy, which goes to prove that it can be done.

CX2CO teamed up with a group at CX3BH but didn't quite make it. Nice try Ricardo.

Also disappointing was the fact that we never did receive 4L7A's log. Seems it got lost before it even got to Moscow. Too bad, as UP2NV claimed that they had made a score of better than 2.7 million.

Last year it was OH5SM's log that got lost. It's a shame to see so much effort go down the drain. We sometimes wonder how many other logs are lost in the mail.

Maybe the Hong Kong gang didn't make the Top Six but VS6AJ sure gave it a go. In spite of typhoon Dinah, long wires that would not load and spiders as big as saucers in the shack.

The battle of the Big Guns was a dilly. The new Champs, the boys of the OH DX Ring. The Venezolano crew was unable to activitate YV9AA this year and hurriedly set up 4M5A at what they considered an inferior

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Top Ten
ALL BAND SINGLE OPERATOR

VK2ADY/9	**5,045,115**	DJ5BV	1,408,914
DJ6QT	**2,270,224**	**W4AXE**	**1,301,776**
VK6RU	**1,627,095**	YU3LB	1,284,075
G3HDA	**1,567,346**	WØGTA/LA	1,247,544
DJ2QZ	1,529,210	ZL1KG	1,241,823

Top Six
MULTI-OPERATOR SINGLE TRANSMITTER

I4GAD	**2,764,320**	SM2BJI	2,168,089
CX3BH	2,225,235	DJ7IK	1,933,956
YV5ANF	2,198,126	UA3KBO	1,676,750

Top Six
MULTI-OPERATOR MULTI-TRANSMITTER

OF2AM	**9,259,941**	K2GL	5,414,252
OF5SM	**7,738,911**	W3TMZ	4,355,670
4M5A	7,468,117	CE6CA	4,003,584

Top Scores
SINGLE OPERATOR SINGLE BAND

28 mc

LU1DAB	501,828
YV1LA	450,007
OA8V	416,928
W2BXA	309,844
VK9GN	291,194
G2BOZ	280,675

21 mc

DL6EN	503,034
ON5KY	418,999
SM3CNN	386,816
4X4TP	375,354
HB9ZY	372,922
PAØLX	332,326

14 mc

G5AAM	**824,344**
CR6BX	698,640
YV5AXT	638,748
SM4CMG	420,210
KP4AST	400,928
KZ5TW	391,230

7 mc

K2GXI	60,204
G3NLY	58,982
W3PHL	52,955
JA2BTV	46,620
DJ3BW	46,566
SM5EAC	23,694

3.8 mc

OK1WGW	17,236
4X4AS	16,380
SM4GZ	15,950
K2RBT	11,040
GM3RFR	7,913
EP2BQ	6,272

1.8 mc

DL9KRA	486
VE3BS	400
DL5KS	56
W8GDQ	36

U.S.A. Honorable Mention
Single Operator

All Band	W6ITA	987,012
28 mc	W8OCT	229,233
21 mc	W1HQV	216,543
14 mc	K8YBU	360,160
7 mc	W8GDQ	21,616
3.8 mc	WA8ROJ	3,996

Multi Operator

Single Trans.	WA6ZQU	1,451,219
Multi-Trans.	W4ETO	2,274,540

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.**

Phone Results

SINGLE OPERATOR

North America

United States

1HVV	**A**	**445,048**	**614**	**101**	**191**
1OBT	"	370,747	526	85	162
1OKG	"	217,557	374	67	140
A1IHN	"	201,292	391	59	123
1JYH	"	68,911	176	48	89
1PCD	"	16,650	86	40	71
1PLJ	"	7,200	62	15	25
A1EDR	"	4,961	43	16	25
1QPJ	"	1,083	20	8	11
1IMP	**28**	**205,625**	**564**	**33**	**92**
1LWI	"	114,330	352	30	81
1NWE	"	86,112	321	29	63
1KNQ	"	65,704	266	26	60
1YRO	"	53,900	196	33	65
1DEP	"	48,218	213	27	51
1AJQ	"	46,225	186	29	60
1BIH	"	35,722	120	32	74
1WY	"	22,594	103	27	52
1FNP	"	16,714	95	21	40
1YRG	"	2,686	27	13	21
1HQV	**21**	**216,543**	**572**	**33**	**98**
1RIL	"	193,600	611	31	79
1SHN	"	62,040	249	28	60
1ZDI	"	14,210	98	15	34
WA2SFP	**A**	**964,934**	**894**	**115**	**264**
K2ISP	**A**	**666,824**	**707**	**105**	**223**
K2DJD	"	343,958	516	75	154
W2BHK	"	340,224	465	85	171
W2JVU	"	340,170	511	63	167
W2ZTV	"	307,692	432	82	170
K2SUX	"	306,161	519	63	148
WB2QHY	"	180,707	417	54	103
W2SHC	"	147,168	301	59	109
W2QDY	"	126,864	304	52	92
WA2YFB	"	118,088	286	53	94
W2LEJ	"	107,580	243	59	104
W2CME	"	89,827	209	51	98
W2MXN	"	89,516	190	55	106
WB2WID	"	83,326	223	42	80
W2SNI	"	83,160	217	48	84
W2DEW	"	72,369	170	61	92
W2JKH	"	65,514	157	44	78
W2QKJ	"	64,512	159	43	101
K2PZF	"	44,548	132	56	92
W2HO	"	39,338	154	29	60
W2TP	"	33,990	180	32	71
K2CPR	"	30,128	102	43	69
WB2HZH	"	26,912	82	43	73
WB2UZU	"	23,788	108	27	49
K2OEA	"	14,616	82	21	42
W2GT	"	3,610	34	16	22
W2JB	"	3,472	38	12	19
WB2UUD	"	1,344	29	14	18
W2BXA	**28**	**309,844**	**751**	**35**	**107**
WA2UJM	"	213,070	561	34	96
W2DKM	"	74,772	282	29	64
WB2VAE	"	73,284	271	30	63
WB2PCF	"	49,329	214	25	56
W2STM	"	34,222	166	24	47
WA2IZS	"	28,038	118	31	55
W2ZV	"	10,878	83	18	31
W2KIT	**21**	**181,566**	**500**	**35**	**91**
WB2YEM	"	133,857	443	31	76
WB2NXL	"	132,750	387	32	86

W2LEJ is located in the heart ot Manhattan (NYC) proving that it can be done from a restricted area even though Dick was not a winner.

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WB2YJS	"	48,960	212	25	55
WB2AEL	"	32,562	140	27	54
WA2WVL	"	13,912	100	17	30
W2IP	"	1,428	23	7	14
W2EYB	**14**	**28,800**	**106**	**27**	**69**
W2IUV	"	20,808	101	23	49
WA2BZV	"	8,214	81	11	26
WA2BPH	"	2,652	36	9	17
W2CKR	"	845	22	5	13
K2GXI	**7**	**60,204**	**254**	**27**	**60**
K2RBT	**3.8**	**11,040**	**92**	**15**	**33**
W2ZPO	"	5,301	66	10	21
W3WJD	**A**	**840,926**	**805**	**115**	**247**
W3BES	**A**	**537,250**	**620**	**98**	**209**
K3HTZ	"	324,562	489	82	157
W3HHK	"	256,677	444	72	129
W3GHS	"	221,656	380	78	128
K3AIG	"	181,546	340	76	119
W3WPG	"	160,034	344	51	110
W3KT	"	146,025	307	59	106
W3AXW	"	133,200	250	77	123
W3GRS	"	129,710	211	77	141
K3CHP	"	112,608	366	46	90
W3FYS	"	111,074	247	56	102
W3IYE	"	103,512	233	59	93
W3KDF	"	101,184	249	48	88
W3HVM	"	81,593	208	51	88
W3GRF	"	70,770	230	48	77
W3PN	"	49,407	133	45	84
W3DRD	"	47,710	134	52	78
K3MCO	"	44,940	146	40	69
W3INH	"	41,715	135	34	69
W2AGM/3	"	36,354	160	34	49
W3CAA	"	30,458	109	33	64
W3JPT	"	18,762	139	34	60
WA3AUS	"	18,216	97	22	44
W3GHD	"	17,556	76	44	40
W3NOH	"	12,870	84	24	41
W3CBF	"	8,316	64	12	32
W3CGS	"	6,705	61	14	31
W3KQD	"	5,396	50	10	28
W3EQA	"	4,158	42	15	18
W3TLN	**28**	**190,920**	**547**	**35**	**85**
W3ZPO	"	94,710	328	32	78
W3VEQ	**21**	**159,965**	**480**	**31**	**84**
W3BWZ	"	140,400	422	33	84
W3AYD	"	16,302	103	20	37
WA3HRV	"	688	17	6	10
WA3FGS	**14**	**102,592**	**324**	**32**	**80**
W3PHL	**7**	**52,955**	**223**	**26**	**63**
W4AXE	**A**	**1,301,776**	**1094**	**127**	**286**
W4BVV	**A**	**982,647**	**927**	**122**	**247**
K4CG	"	465,868	576	94	195
W4KFC	"	448,678	593	87	176
W4NBV	"	425,432	527	99	185
W4YDD	"	394,496	555	92	164
K4EZ	"	289,654	422	94	157
W4MMD	"	178,189	368	59	108
W4EI	"	165,300	333	58	116
W4OPM	"	164,736	302	62	130
W4YWV	"	132,102	264	63	116
W2GHK/4	"	114,126	253	60	93
WA4VIY	"	112,266	266	57	105
W4HOS	"	110,340	228	62	118
W4ZNI	"	104,632	225	54	110
W4GRG	"	57,233	165	42	79
WA4VKG	"	53,382	152	44	79
W4PEW	"	52,767	180	45	72
W4DS	"	50,400	140	59	85
W4PTR	"	49,896	140	51	75
WA4FFW	"	42,750	123	52	73
W4LRN	"	38,280	112	49	83
W6IBU/4	"	29,388	118	37	56
WA4UFW	"	27,900	109	35	55
W4DKU	"	18,518	72	41	53
W4HA	"	9,338	61	25	33
W4NJF	"	6,392	45	16	31
W4GF	"	926	29	5	16
K4VYN	**28**	**193,550**	**524**	**35**	**95**
K4HXF	"	120,042	365	33	81
W4EEU	"	100,217	290	32	87
K4QWX	"	86,200	297	32	68
W4HUE	"	85,884	290	32	70
W4BAI	"	80,200	277	30	70
W3IZI/4	"	45,436	211	27	47
W3MDI/4	"	44,712	195	25	56
WB4DJQ	"	34,194	150	29	53
WA4WFQ	"	32,193	151	26	47
W4KMS	"	7,803	52	20	31
W4DQD	"	5,328	55	13	23
WB4ESE	"	209	7	5	6
WA4LMD	**21**	**136,612**	**399**	**33**	**86**
W4FRO	**21**	**129,739**	**329**	**36**	**101**
K4CGC	"	114,359	350	33	86
W4NQM	"	115,150	431	28	70
W4CYC	"	103,114	327	32	77
WA4UXU	"	83,605	251	32	83
W4DRW	"	69,258	259	29	68
K4YMQ	"	50,962	221	24	59
K4FDQ	"	19,944	112	27	45
WB4AMT	"	4,320	48	12	20
WA4WAO	**14**	**75,936**	**238**	**32**	**80**
W4CZS	"	19,740	104	20	50
W4BQY	"	18,810	75	32	58
W4JVU	"	18,354	100	22	47
WB4EKI	"	8,740	75	18	28
W4IF	"	7,849	61	19	28
W4BYB	**7**	**16,705**	**95**	**20**	**45**
WA5ALB	**A**	**438,328**	**553**	**105**	**188**
W5NMA	"	363,408	492	99	169
W5JAW	"	284,080	381	88	180
K5AGI	"	173,436	328	69	125
W5JWM	"	150,410	301	59	119
WA5SDV	"	87,204	219	68	88
WA5LGO	"	71,967	183	62	87
WA5AER	"	60,572	252	30	54
K5MLN	"	43,550	119	52	82
W5WBU	"	42,700	128	52	70
WA5DAJ	"	40,640	118	48	79
WA5CER	"	7,205	48	26	29
WA5BFB	**28**	**166,668**	**454**	**34**	**95**
W5IOU	"	114,121	338	33	86
W5TKB	"	84,132	271	31	77
K5IIN	"	83,952	297	30	69
K5TGJ	"	15,288	72	26	52
W5BVD	"	9,614	70	15	31
W5LXX	"	2,052	54	14	24
W5MSG	"	117	5	5	4
W5EQT	**21**	**117,593**	**406**	**32**	**75**
WA5RQA	"	59,241	232	29	62
W5DQV	"	58,968	259	27	51
W5CJV	"	31,540	161	24	52
K5TCG	"	5,006	53	11	22
K5BXG	**14**	**86,160**	**261**	**35**	**85**
W5NOP	"	72,964	275	35	81
W5KC	"	53,340	188	32	72
W5ODJ	**7**	**3,708**	**40**	**15**	**21**
W6ITA	**A**	**987,012**	**1,043**	**109**	**224**
K6SEN	**A**	**632,090**	**834**	**95**	**187**
WA6IVN	**A**	**475,416**	**590**	**99**	**180**
W6NJU	"	421,889	502	108	191
W6QJW	"	283,619	465	74	143
K6SDR	"	282,693	427	96	145
W6LDA	"	267,007	387	97	150
W6VNH	"	266,960	407	91	144
W6WX	"	218,105	322	93	148
W6SRF	"	213,840	356	84	132
K6CQF	"	195,953	312	90	143
K6YRD	"	178,500	370	71	104
K6SSJ	"	151,493	276	70	127
W6KNH	"	138,502	270	70	112
W6ZKM	"	134,904	283	66	102
W6JKJ	"	124,254	253	76	101
W6DZZ	"	118,272	215	73	119
WA6AHF	"	118,080	232	72	108
K4EID/6	"	116,816	276	57	92
WB6ZGJ	"	115,395	275	57	90
W6LDD	"	113,520	227	73	99
W6ERS	"	106,190	194	86	119
W6BSY	"	94,340	198	72	106
W6CUF	"	90,133	197	72	101
W6VVR	"	86,978	199	66	91
W6NTQ	"	86,254	236	44	78
W6OHU	"	83,876	210	57	75
WB6KRW/6	"	79,867	198	57	89
K6PIH	"	70,620	220	46	64
W6EJJ	"	61,513	164	59	78
W6QBY	"	61,061	229	30	61
W6UQQ	"	43,104	161	37	61
W6PLS	"	35,200	129	41	59
WA6AUD	"	32,580	124	36	54
W6CDJ	"	24,448	102	34	53
K6HOR	"	21,280	100	31	45
WØDAD/6	"	13,660	126	39	50
WA6IVM	"	13,350	90	24	26
WB6KIL	"	13,040	64	38	42
K6VFF	"	9,900	70	21	29
W6BIP	"	5,250	48	22	28
WB6TOJ	"	3,820	80	14	20
K6MG	"	3,132	37	14	15
W6NKR	"	1,537	20	13	16
WB6ROR		1,408	32	9	7
K6ERV	**28**	**158,002**	**449**	**33**	**85**
W6YAW	"	102,120	327	31	80
WA6GLD	"	69,465	212	31	82
K6VOI	"	56,330	234	28	58
K6YFZ	"	42,000	185	28	52
W6ISQ	"	38,622	165	26	56
W6KJS	"	24,309	119	30	43
WA6OWM	"	19,814	139	23	34
W6OJW	"	17,880	103	23	37
W6VUW	"	8,978	49	26	41
WA6QQI	"	8,030	52	22	33
K6KA	"	7,344	49	24	48
WB6RNS	"	2,460	30	14	16
K6ICS	"	2,369	43	10	13
WA6EKL	**21**	**205,296**	**696**	**31**	**81**
WB6LED	"	153,930	500	33	72
KØGJD/6	"	150,804	440	34	84
W6PQW	"	132,582	407	33	81
K6SVL	"	89,775	329	32	63
WA6YMX	"	89,760	324	32	64
WB6FGT	"	88,920	327	30	65
K6YNB	"	83,226	295	33	64
WB6NWW	"	76,050	296	29	61
W6LCX	"	62,791	280	28	63
WB6FCR	"	42,228	225	26	42
WB6OOP	"	37,064	154	29	53
W6HJA	"	28,960	126	26	54
K6UJW	**14**	**87,376**	**239**	**37**	**90**
K6YRA	"	80,504	259	35	81
WB6PNB	"	40,313	159	33	58
W6EUF	"	37,904	145	33	59
W6UED	"	10,251	70	20	31
W6CFG	"	6,533	51	19	28
K6JAH	"	2,340	32	13	17
K6BPR	**3.8**	**2,856**	**57**	**13**	**15**
W6GEN	"	532	18	10	9
W7EPA	**A**	**563,409**	**682**	**109**	**188**
W7DQM	"	302,778	540	89	154
W7EOI	"	183,162	350	68	110
WA7EVO	"	160,836	366	60	96
W7MVC	"	113,040	223	68	112
W7CNM	"	111,162	222	79	112
W7CMO	"	55,100	140	45	65
W7YG	"	39,576	141	41	61
W7GHB	"	23,028	96	49	65
W7QON	"	22,185	91	35	52
K7CVL	"	4,998	35	17	32
W7QY	"	3,030	35	14	16
W7BTH	"	2,730	32	10	20
W7WLL	"	1,700	44	14	11
W7AZG	**28**	**115,020**	**370**	**32**	**76**
K7PXI	"	77,450	273	30	64
W7MX	"	46,563	196	29	54
W7DQM	"	35,868	150	29	55
W7EKM	"	34,162	162	27	47
W7CRT	"	19,328	110	23	41
W7AYY	"	18,560	114	19	39
W7ZOH	"	14,945	89	21	40
W7PJL	**21**	**100,415**	**358**	**30**	**65**
W7DQM	"	38,364	191	23	46
K1IEM/7	"	30,128	182	22	34
W7GUV	**14**	**37,048**	**150**	**29**	**59**
W7SGN	"	31,772	118	32	62
W7OEV	"	14,742	86	26	37
W7YEX	"	14,430	76	26	39
W7REX	"	1,274	17	11	15
K7CHT	"	1,152	22	7	11
W7BCV	"	229	12	5	8
W8TWA/8	**A**	**305,928**	**425**	**91**	**161**
W8WPC	"	147,266	324	56	101
W3TBF/8	"	122,639	269	57	106
WA8MCR	"	119,511	276	50	97
K8OVK	"	107,200	249	58	102
W8DQL	"	34,686	122	31	51
W8KC	"	32,676	135	26	58
W8KYY	"	31,510	228	40	75
W8YGR	"	24,024	82	40	64
K8IKH	"	23,058	234	19	42
W8HYV	"	18,062	150	40	77
WA8GGN	"	15,664	72	41	47
W8TWJ	"	3,864	32	19	23
W8OCT	**28**	**229,233**	**612**	**34**	**95**
W8UM	"	164,488	487	32	84
K8WIJ	"	133,840	414	32	80
WA8RSL	"	95,188	312	32	74
WA8PJZ	"	62,318	244	28	58
K8GVK	"	56,602	212	29	62
W8WEJ	"	43,624	201	29	53
W8QDH	"	39,783	82	28	61
W8PCS	"	25,795	117	27	50
W8DWP	"	17,018	100	21	42
K8HZU	**21**	**171,125**	**477**	**31**	**94**
W8RXY	"	114,570	339	36	78
W8CVH	"	76,908	259	32	70
WA8LTX	"	25,872	159	18	38
WA8TKM	"	4,275	35	18	27
K8YBU	**14**	**360,160**	**796**	**38**	**122**
W8BVF	"	41,736	152	30	64
WA8GPX	"	8,892	63	21	31
WA8SWV	"	5,265	50	14	25
K8EUR	**7**	**21,616**	**145**	**19**	**37**
WA8ROJ	**3.8**	**3,996**	**64**	**11**	**16**
W8GDQ	**1.8**	**36**	**4**	**3**	**3**
W9EWC	**A**	**619,229**	**732**	**104**	**195**
W9LKJ	"	563,784	633	105	207
W9IRH	"	366,776	532	91	163
K9CUY	"	110,142	231	62	112
WA9RQY	"	107,598	238	55	103
K9ZJV	"	81,966	250	42	72
WA9UGI	"	61,228	175	51	77
K9IDQ	"	29,003	118	42	55
W9MUR	"	12,567	66	26	45
K9DWG	"	9,942	66	18	34
K9VQK	"	8,201	53	24	35
WA9NSR	"	7,018	49	23	35
W9DUB	**28**	**177,480**	**515**	**33**	**87**
W9LKI	"	130,980	404	32	79
K9ECE	"	114,290	361	31	75
W9HHA	"	105,621	351	29	80
W9GIL	"	100,916	410	33	84
K9QFR	"	90,042	375	27	69
W9QEE	"	75,348	302	26	59
WA9NME	"	59,514	229	29	69
WA9OTH	"	44,772	205	25	57
WA9HHH	"	42,413	182	27	59
WA9TEQ	"	19,764	114	19	41
WA9TUM	"	15,934	92	21	41
W8CPO/9	"	8,100	48	24	36
WA9SXJ	**21**	**142,020**	**421**	**31**	**71**
W9DRL	"	20,832	116	21	41
W9CRN	"	8,732	78	19	36
K9ECO	**14**	**245,106**	**561**	**38**	**111**
W9ZTD	"	45,990	182	30	66
WA9CYV	"	15,180	86	21	36
W9WKU	"	12,600	65	30	41
W9RBI	"	6,600	40	27	36
WAØKDI	**A**	**248,844**	**378**	**87**	**141**
KØCVA	"	190,211	330	70	132
WAØOAI	"	171,264	270	84	132
WØJYW	"	126,852	240	71	112
WØEQN	"	60,495	203	49	69
KØJPL	"	9,315	49	26	36
WØLBB	**28**	**100,837**	**355**	**31**	**71**
WAØGCP	"	90,792	320	30	69

JA1JAN was No. 2 among the JA all-banders. Kunito is well known in the DX and contest circles.

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WØBDD	"	83,594	303	30	68
KØGVG	"	66,928	250	30	64
WAØOTE	"	61,946	233	30	64
WAØKXZ	"	32,361	164	23	46
KØRNZ	"	28,124	134	26	53
WAØBGQ	"	20,367	98	28	45
WØLBP	"	5,549	61	12	19
WAØLJM	"	1,300	22	11	14
WAØLJN	"	576	12	6	12
WØVXO	**21**	**97,278**	**396**	**28**	**65**
KØIFL	"	72,716	264	31	67
WØLBS	"	63,856	211	32	72
WAØMOJ	"	17,940	126	19	33
KØYIP	"	10,282	70	20	33
WØRDF	"	495	12	7	8
WØIYH	**14**	**113,708**	**300**	**37**	**94**
WØSEA	"	40,092	188	23	55

Alaska

KL7FRY	**A**	**487,296**	**1125**	**83**	**109**
KL7MF	"	183,491	1079	34	43
KL7EFX	**14**	**28,860**	**137**	**24**	**50**

Barbados

VP6AL	**14**	**29,325**	**262**	**19**	**32**

Canada

VO1HI	**A**	**359,832**	**920**	**60**	**128**
VO1AW	"	37,525	163	31	64
VO1AQ	**14**	**93,240**	**393**	**29**	**76**
VO2AB	**14**	**12,648**	**140**	**17**	**34**
3B2AW	"	696	43	4	4
VE1TG	**14**	**303,150**	**842**	**34**	**107**
VE2AYU	**A**	**183,073**	**362**	**61**	**126**
VE2WA	"	12,285	67	27	43
VE2AIO	**28**	**110,220**	**358**	**32**	**78**
VE2AFC	**21**	**78,108**	**292**	**28**	**64**
VE2WY	**14**	**114,030**	**350**	**37**	**89**
VE2AMW	"	79,500	308	27	73
VE2DCX	"	38,313	174	25	56
VE3ELA	**A**	**117,068**	**280**	**45**	**103**
3C3ES	"	96,640	265	40	88
VE3CEZ	"	51,435	143	52	75
VE3CYF	"	42,848	132	37	66
VE3ESN	"	16,660	83	22	48
3CEFX	"	3,564	48	18	18
3C3DIB	**28**	**108,576**	**424**	**28**	**68**
VE3BMB	**21**	**90,944**	**340**	**29**	**69**
VE3MR	**14**	**192,717**	**560**	**35**	**98**
VE3CBG	"	173,763	493	34	95
VE3BSJ	"	96,768	330	32	80
VE3DLC	"	62,580	248	33	72
VE3BS	**1.8**	**400**	**51**	**2**	**2**
VE4SD	**A**	**196,845**	**532**	**59**	**106**
VE4TT	"	41,772	135	47	71
VE4SK	"	13,165	108	26	56
VE6TP	**A**	**359,544**	**655**	**67**	**141**
VE6AGV	"	119,190	342	56	81
VE6AJJ	"	34,008	123	38	66
VE6AKV	"	19,286	99	32	39
3C6AB	"	19,266	92	29	49
VE6ABM	"	15,254	102	19	39
VE6MC	"	7,336	50	24	32
3C6VO	"	2,158	35	13	13
VE6ATH	"	1,537	21	12	17
VE6TK	"	1,175	21	12	13
VE6NW	**21**	**29,185**	**162**	**21**	**44**
VE6AO	**14**	**129,835**	**469**	**33**	**82**
VE6AQL	"	104,451	356	31	80
VE6ABR	"	91,635	277	31	89
VE6PL	"	89,748	323	31	77
3C6KV	"	54,530	223	27	66
VE6GN	"	49,628	235	29	55
3C6IN	"	39,690	159	30	60
VE6VK	"	19,491	96	22	51
VE6AKO	"	5,950	62	10	24
VE6VV	"	5,510	50	17	21
3C7AHD	**A**	**921,452**	**1334**	**95**	**197**
VE7EH	"	263,471	625	62	107
VE7AHG	"	178,485	409	57	106
VE7QC	"	4,400	42	15	25
VE7BW	**14**	**244,055**	**778**	**38**	**95**
VE7GI	"	129,198	408	36	86
3C7NW	"	42,676	167	30	64
VE7MD	"	3,069	35	10	21
3C7CE	**7**	**1,547**	**58**	**7**	**6**
VE8MB	**A**	**214,731**	**1081**	**49**	**50**
3C8BB	**A**	**206,883**	**472**	**64**	**117**
3C8RX	**14**	**361,390**	**975**	**34**	**108**

Canal Zone

KZ5TW	**14**	**391,230**	**1231**	**37**	**101**

Costa Rica

TI4JP	**14**	**277,200**	**720**	**35**	**105**

Greenland

OX3DM	**14**	**21,840**	**143**	**22**	**38**
OX3PZ	"	4,732	68	6	20

Guatemala

TG8RH	**A**	**13,230**	**139**	**24**	**25**
TG8IA	**28**	**8,215**	**121**	**12**	**19**

Honduras

HR2GK	**A**	**326,566**	**815**	**68**	**120**
HRIKAS	**14**	**345,554**	**1011**	**34**	**105**

Jamaica

6Y5CB	**14**	**32,306**	**239**	**16**	**42**

Mexico

XE2YP	**14**	**161,245**	**583**	**34**	**85**
XE1HS	"	6,612	74	14	24
XE1AE	"	4,961	46	14	27

Panama

HP1JC	**A**	**266,585**	**647**	**73**	**112**

Puerto Rico

WA4MMO/KP4	**A**	**118,800**	**699**	**36**	**44**
KP4CLB	**21**	**48,681**	**245**	**24**	**57**
KP4AST	**14**	**400,928**	**1288**	**31**	**105**
KP4CL	**14**	**370,986**	**1384**	**31**	**90**

Virgin Island

KV4AM	**A**	**69,620**	**280**	**52**	**66**

AFRICA

Algeria

7XØAH	**28**	**141,024**	**441**	**31**	**82**

Angola

CR6DX	**28**	**190,872**	**659**	**29**	**70**
CR6BX	**14**	**698,640**	**1450**	**39**	**125**

Ascension Island

ZD8HAL	**A**	**290,780**	**708**	**54**	**86**
ZD8CC	**21**	**21,420**	**151**	**20**	**31**

Congo Republic

TN8AA	**A**	**153,669**	**320**	**64**	**117**

Ethiopia

ET3REL	**A**	**619,014**	**930**	**76**	**150**

Ghana

9G1KT	**14**	**29,815**	**126**	**30**	**59**

Kenya

5Z4KX	**A**	**209,684**	**584**	**44**	**80**
5Z4KN	**A**	**207,168**	**407**	**83**	**125**
5Z4KL	**28**	**98,256**	**189**	**30**	**62**

Morocco

CN8FV	**A**	**371,085**	**687**	**50**	**123**

Nigeria

5N2ABF	**A**	**168,428**	**355**	**58**	**106**

St. Helena

ZD7DI	**28**	**151,335**	**550**	**28**	**67**

Spanish Morocco

EA9AQ	**A**	**11,284**	**77**	**19**	**33**

South Africa

ZS5JM	**A**	**866,115**	**1047**	**98**	**187**
ZS5FF	"	500,940	834	83	124
ZS5UW	**28**	**138,756**	**507**	**30**	**63**

Tanzania

5H3KJ	**A**	**597,462**	**879**	**82**	**175**

ASIA

Ceylon

4S7PB	**A**	**38,735**	**127**	**48**	**79**

Cyprus

ZC4RB	**A**	**967,483**	**1175**	**80**	**201**
ZC4CN	**28**	**68,060**	**328**	**28**	**54**

India

VU2DKZ	**A**	**560,038**	**955**	**64**	**150**

Iran

EP2GI	**28**	**140,192**	**464**	**30**	**74**
EP2BQ	**3.8**	**6,272**	**69**	**6**	**26**

Israel

4X4HF	**28**	**101,235**	**403**	**26**	**59**
4X4CJ	"	72,756	299	28	58
4X4TP	**21**	**375,354**	**1019**	**33**	**93**
4X4AS	**3.8**	**16,380**	**133**	**8**	**34**

Japan

JA3UI	**A**	**666,168**	**928**	**83**	**163**
JA1JAN	**A**	**633,928**	**915**	**87**	**152**
JA1MIN	"	530,934	848	79	135
JA6BZI	"	517,374	766	85	149
JA1CIB	"	332,992	617	57	119
JA3RQ	"	320,150	583	69	121
JA7JM	"	231,516	450	67	109
JA3LGG	"	138,450	371	51	79
JA6ATY	"	103,292	295	46	78
JA7FC	"	64,460	208	47	63
JA3DJ	"	49,282	210	35	47
JA7KE	"	45,477	182	42	51
JA3MKL	"	39,424	176	37	40
JA2HO	"	36,464	125	41	65
JA7JH	"	35,845	120	51	56
JA7CDV	"	35,640	145	37	51
JA7UQ	"	25,678	132	35	39
JA1AG	"	21,630	75	40	65
JAØAWF	"	16,946	93	34	40
JA3CF	"	11,470	63	30	32
JA1AAT	"	6,650	50	22	28
JA4AQR/5	"	4,066	44	18	20
JA2LA	"	3,686	35	19	19
JA6GLK	"	2,805	31	16	17
JA4DZ	"	2,275	25	17	18
JA1BNW	"	2,244	22	15	19
JA2HFB	"	615	16	12	13
JA3EGE	**28**	**190,008**	**745**	**32**	**55**
JA1MHV	**28**	**187,256**	**713**	**32**	**57**
JA5BJC	"	143,225	574	33	52
JA6QT	"	122,460	533	27	51
JA3DGC	"	116,130	501	29	50
JA8CKC	"	93,513	440	29	44
JH1AJT	"	92,732	428	25	48
JA1JUQ	"	76,544	506	19	33
JA6YCU	"	69,952	379	25	39
JA6EFR	"	48,960	262	28	36
JA7ERJ	"	47,664	332	20	28
JA2BVZ	"	46,020	263	26	33
JH1GMZ	"	44,700	257	24	36
JA6AFL	"	28,944	187	22	30
JA2GRM	"	28,202	174	23	36
JA2CG	"	19,208	132	21	29
JA1NSJ	"	17,924	159	18	18
JA3CXN	"	17,760	150	17	23
JA1JNM	"	15,340	104	20	32
JA1SJV	"	12,980	88	22	33
JA2JAA	"	11,640	127	11	19
JA2BDR	"	10,000	90	15	25
JA1X1	"	9,840	86	17	23
JA3GRO	"	7,000	62	17	23
JA7ACV	"	5,474	59	16	18
JA1BAR	"	5,148	46	19	20
JA1YL	"	5,031	48	18	21
JA6FFK	"	5,031	46	18	21
JA7DBG	"	1,388	40	9	8
JA3LVA	**21**	**286,200**	**1070**	**28**	**62**
JA3FDA	**21**	**208,104**	**896**	**25**	**53**
JA2CWX	"	194,109	706	29	60
JA1PCY	"	143,605	637	26	51
JA1OCA	"	142,373	627	26	51
JA1NUH	"	134,575	529	26	59
JA4FK	"	102,240	492	26	45
JA1DDZ	"	87,033	444	24	43
JA1JXU	"	84,754	466	22	40
JA1FRE	"	60,102	324	20	43
JA6DHE	"	52,650	279	22	43
JA1IZZ	"	43,462	242	24	38
JA1XYK	"	36,180	228	20	34
JA6ECM	"	27,144	162	21	37
JA2FTJ	"	26,970	151	24	38
JA2AXG	"	21,000	131	22	28
JA4EMC	"	10,192	68	21	35
JA2BGV	"	6,192	52	18	25
JA7BZU	"	4,851	53	14	19
JA2ADH	"	4,063	83	8	9
JA2FUP	"	3,696	41	15	18
JA1VZM	"	3,366	36	16	17
JA1PVJ	"	2,560	31	15	17
JH1CPU	"	1,824	30	11	13
JA4ERX	"	1,395	45	14	17
JH1CNK	"	1,130	39	6	4
JH1APK	"	1,056	17	11	13
JA4FJD	"	493	11	8	9
JA8NU	**14**	**186,865**	**494**	**35**	**98**
JA6AD	**14**	**146,280**	**374**	**38**	**100**
JA7MA	"	35,432	123	34	69
JA9AG	"	24,140	102	33	52
JA2ACC	"	23,104	124	30	46
JA8QA	"	19,440	92	31	49
JA3DWT	"	16,900	97	26	39
JA4BEX	"	8,428	62	22	27
JA8SW	"	8,415	52	15	30
JA2AMD	"	5,152	41	18	28
JA8BBM	"	2,175	25	14	15
JA7OP	"	1,392	25	10	14
JA4FM	"	925	15	13	12
JA3NPL	"	384	10	7	9
JA2BTV	**7.**	**46,620**	**196**	**29**	**55**
JA3EGW	"	3,078	41	12	15
JA1LWI	"	1,280	24	10	10
JA1DMX	3.8	240	9	5	5
JA3AJB	"	168	9	4	4
KA2DJ	**28**	**87,561**	**440**	**26**	**43**
KA2FL	**21**	**31,038**	**259**	**17**	**25**

Korea

HL9KA	**A**	**247,270**	**576**	**63**	**95**
HL9TS	**28**	**111,860**	**588**	**27**	**43**
HL9TM	**14**	**30,001**	**249**	**23**	**38**

Laos

XW8AX	**A**	**766,117**	**1051**	**91**	**180**

Lebanon

OD5EN	**A**	**154,455**	**491**	**28**	**77**

Malaysia

9M2PO	**A**	**289,852**	**575**	**83**	**150**

Pakistan (West)

AP2MR	**14**	**36,480**	**149**	**30**	**66**

Ryukyu Is.

KR6TAB	**28**	**61,446**	**337**	**29**	**48**
KR6LS	**14**	**105,433**	**404**	**35**	**78**

Saudi Arabia

HZ1AB	**A**	**98,987**	**419**	**20**	**59**

U.S.S.R.

Asiatic

UW9CC	**A**	**445,260**	**786**	**59**	**146**
UA9EU	"	409,248	665	59	165
UAØEH	"	155,976	639	59	75
UV9PP	**28**	**97,152**	**580**	**20**	**53**
UV9AB	"	17,160	107	21	39
UA9BE	**21**	**40,448**	**240**	**16**	**48**
UA9WJ	"	25,866	179	15	39
UW9WR	"	15,660	153	9	27
UA9WS	"	1,440	22	7	17
UAØKAP	**14**	**108,700**	**567**	**27**	**46**
UA9HW	"	7,250	61	21	29
UWØAA	"	4,930	59	12	17
UW9WC	"	3,999	52	11	20

Azerbaijan

UD6BV	**A**	**149,694**	**423**	**36**	**86**

Georgia

UF6FE	**A**	**318,136**	**597**	**56**	**126**
UF6ACR	**28**	**147,033**	**589**	**30**	**63**

This year the returns from Canada were more in keeping with the potentials of that country. We like to believe that Gene Krehbiel, VE6TP was in no small way responsible for this activity.

See page 126 for New Reader Service

The CE6CA multi-multi operation was quite a project.

UF6UB	21	2,800	29	11	24
UF6AS	14	13,596	110	11	33
Kazakh					
UL7JA	A	359,100	702	56	134
UL7LA	14	93,366	390	27	64
UL7YD	"	11,178	84	18	36
Turkoman					
UH8BO	14	23,729	154	20	41
Uzbek					
UI8AG	14	54,747	265	26	53

EUROPE

Aland Islands					
OHØNI	A	262,404	769	67	155
Austria					
OE6FWG	A	33,800	162	38	62
OE8AY	"	17,487	131	24	63
OE1JHA	"	3,132	52	14	22
OE4SZW	14	72,880	466	22	58
OE1WO	7	10,416	159	12	44
Belgium					
ON4FJ	A	131,722	376	49	85
ON4XG	28	124,956	491	30	59
ON5KY	21	418,999	1237	34	85
ON4IZ	21	366,168	1146	33	81
ON5EB	"	38,836	201	25	51
ON8CG	"	37,012	200	25	51
ON5GA	14	224,213	763	33	88
Bulgaria					
LZ1BZ	14	125,742	640	34	80
LZ1KSA	7	4,576	137	5	27
Crete					
SVØWL	14	186,219	823	33	88
Czechoslovakia					
OK1AHZ	A	134,845	426	53	128
OK3EA	"	47,128	275	33	104
OK2DB	"	26,599	187	26	41
OK3CCC	"	4,187	79	13	40
OK2BEN	28	44,094	500	13	16
OK1MP	"	26,775	138	28	47
OK2ABU	21	65,962	415	17	42
OK3CEN	"	11,952	132	18	30
OK2RZ	"	2,464	64	9	17
OK3KGI	"	1,386	51	7	15
OK3KHE	14	19,200	258	17	43
OK3BU	7	21,514	257	14	48
OK1WGW	3.8	17,236	327	10	48
OK2QX	"	6,025	137	8	33
Denmark					
OZ3SK	A	929,160	1069	107	241
OZ6OX	"	255,840	570	62	102
OZ5JT	"	190,098	421	62	115
OZ1RH	"	120,792	355	55	113
OZ6HW	"	71,550	398	24	66
OZ7DX	"	20,636	142	22	45
OZ4FA	28	260,760	864	34	72
OZ3Y	"	82,416	292	36	65
OZ7BG	"	72,912	300	29	55
OZ5DX	"	6,840	76	15	15
OZ3GW	"	4,536	40	19	23
OZ4WR	"	592	13	8	8
OZ2KT	21	89,551	421	27	50
OZ3KE	"	60,928	357	23	45
OZ7SS	"	2,159	46	9	8
OZ8BZ	14	73,320	408	29	75
OZ9CR	"	27,392	284	17	47
OZ6RG	"	9,592	168	10	34
OZ2CE	"	6,545	84	14	41
OZ7KV	"	4,860	40	20	34
OZ3FU	"	3,741	67	12	31
OZ5JR	3.8	81	9	2	7
England					
G3HDA	A	1,567,346	1645	108	265
G3KZQ	A	1,031,985	1296	87	198
G3UXF	"	507,424	1123	62	95
G3DYY	"	372,548	678	83	151
G2AJB	"	75,624	274	42	95
G3MWZ	"	33,558	180	32	70
G3JFY	"	10,800	79	25	25
G2BOZ	28	280,675	960	32	77
G3KMA	"	107,695	448	29	56
G3ESF	"	63,144	316	29	43
G3LSF	21	322,800	993	35	85
G3FKM	21	302,763	918	36	93
G3VZD	"	73,260	274	31	68
G5YC	14	109,038	1069	28	74
G3OXL	"	42,528	266	28	68
G3NLY	7	58,982	410	19	58
G5HZ	"	23,980	220	15	40
G5AAM	14	824,344	1634	39	144
Faroe Islands					
OY4OV	A	38,789	371	20	59
OY7ML	A	9,774	77	22	32
Finland					
OH7PI	A	944,218	1412	85	172
OF2UB	"	274,703	515	66	155
OF3SN	"	213,908	516	63	149
OH5UQ	"	108,031	372	46	115
OH2BEV	"	24,805	138	43	78
OH2XK	"	1,400	19	16	19
OH2BZ	28	164,800	592	31	69
OH2BAD	"	138,947	516	33	70
OF2AD/6	"	53,274	281	28	50
OH2BAC	"	42,581	200	28	51
OF3NY	"	26,259	135	31	46
OH6VE	"	14,950	91	23	42
OF2XE	"	6,642	61	17	24
OH2BR	"	580	11	9	11
OH5TN	21	56,550	328	24	51
OF2TJ	14	253,234	1015	30	76
OF5VT	"	15,510	116	19	47
OH2VS	"	5,424	69	16	32
OF3QA	7	17,554	201	19	48
France					
F3KW	A	981,063	1823	69	114
F8GV	"	240,454	430	68	150
F8CS	"	175,490	376	74	131
F9RM	"	74,834	220	55	87
F5FV	"	58,619	289	29	44
F3KT	"	27,360	224	22	35
F8RU	"	21,945	89	47	58
F2VX	"	7,670	130	22	37
F3II	"	6,870	81	15	15
F8TM	"	572	19	10	16
F5AN	14	10,716	100	15	32
Germany					
DJ6QT	A	2,270,254	1966	119	315
DJ2QZ	A	1,529,210	1641	111	257
DJ5BV	A	1,408,914	1521	102	249
DJ8FC	A	1,172,622	1292	105	222
DJ6UO	A	1,150,560	1452	89	193
DJ1ZN	"	508,725	734	88	197
DJ9LI	"	451,656	838	63	141
DJ2GG	"	388,000	750	69	125
DL7BQ	"	365,650	655	77	129
DJ1FC	"	364,021	797	60	101
DJ7CP	"	340,200	733	54	114
DL3DW	"	232,646	475	69	109
DJ4AX	"	222,144	469	67	111
DJ6QP	"	215,080	430	68	122
DJ1XP	"	210,438	432	73	170
DJ2HH	"	186,732	385	69	120
DL8TG	"	177,332	390	64	108
DL7HZ	"	175,784	418	60	86
DL6WE	"	147,393	402	51	108
DJ9IA	"	127,008	342	56	133
DJ1OJ	"	123,808	308	70	142
DJ6TK	"	121,320	289	57	123
DL9HC	"	95,540	306	51	119
DL6KG	"	90,125	218	66	109
DJ2UU	"	88,270	248	56	138
DL8BS	"	87,450	171	46	113
DJ4IZA	"	86,774	260	50	101
DJ3BB	"	85,320	240	59	121
DL2JO	"	85,008	241	58	126
DJ2SL	"	77,488	180	69	98
DL1MD	"	75,075	214	56	87
DJ8FF	"	69,576	235	46	110
DL2AA	"	68,487	234	40	77
DL7GQ	"	64,386	193	45	102
DK1NF	"	56,769	183	53	74
DL1AM	"	48,300	164	53	97
DJ4HH	"	42,189	143	41	82
DJ6QS	"	39,634	168	37	96
DJ8YQ	"	39,088	137	45	67
DJ9ZB	"	32,770	154	37	76
DJ5IH	"	32,310	160	28	62
DK1HV	"	26,607	196	20	29
DJ7PB	"	23,452	140	27	55
DJ5HN	"	19,716	100	39	54
DJ6QL	"	19,350	114	31	59
DL8DL	"	18,990	165	22	68
DL1KN	"	14,580	85	29	31
DJ6SI	"	11,840	89	20	54
DJ2XO	"	6,496	54	22	36
DJ5ZE	"	4,002	35	21	25
DJ1IP	"	3,672	61	17	34
DL1HH	"	3,375	31	20	25
DL6VP	"	783	17	11	16
DJ8IF	28	153,244	639	32	59
DJ4PU	"	71,102	333	30	43
DL6HW	"	60,864	330	23	41
DL1KS	"	60,431	241	33	56
DJ2QH	"	42,560	199	31	45
DL7LJ	"	37,737	207	25	28
DL7DI	"	27,117	134	26	43
DJ4UF	"	20,349	57	23	34
DL7FP	"	16,335	103	24	31
DL9VS	"	16,148	128	19	25
DLØAG	"	7,152	152	13	16
DLØHM	"	6,995	70	15	20
DL6EN	21	503,034	1462	36	82
DJ1LP	21	481,664	1292	31	91
DJ9TQ	"	237,216	851	30	66
DJ2DR	"	160,293	506	36	83
DL8PC	"	70,200	305	28	62
DL6AX	"	4,557	60	14	17
DJ3GI	14	289,396	760	36	106
DJ1SX	"	171,450	626	33	94
DL8RH	"	45,084	260	28	74
DJ1RJ	"	44,329	223	26	71
DJ3KQ	"	30,456	220	22	50
DL2DM	"	255	13	5	10
DJ3BW	7	46,566	336	19	59
DL7AD	"	11,343	132	14	43
DK1FW	3.8	6,120	133	8	37
DK2JX	"	4,428	117	7	29
DK1QC	"	432	27	2	14
DL9KRA	1.8	486	57	2	7
DL4EG	A	543,884	1032	63	125
DL5LR	"	473,888	776	73	163
DL4HJ	28	177,002	644	32	62
DL4FS	"	127,688	530	31	57
DL5LB	14	62,084	297	23	60
DL4QC	"	30,384	243	19	53
DL4AQ	"	3,774	65	10	24
DL4FJ	"	1,458	34	9	18
DL4RO	7	17,640	217	14	46
DL5KS	1.8	56	8	2	5
DM2ATD	A	262,254	502	75	143
DM2BEA	"	23,328	181	21	60
DM4WPL	21	103,163	520	26	45
Greece					
SVØWP	A	162,122	781	29	74
SVØWEE	"	114,840	403	57	108
Hungary					
HA5DU	A	107,919	363	61	128
HG2KRD	28	139,728	592	30	52
HA5FE	14	40,670	348	22	61
HA5BY	"	4,680	113	9	30
HA5DD	"	2,564	58	10	24
Iceland					
TF3EA	A	164,200	385	62	138
Italy					
IIBAF	A	1,239,672	1393	99	230
IIFLD	A	1,129,058	1457	92	189
I1NU	"	850,816	1128	89	200
I1ASH	"	18,515	132	32	53
IIZSQ	28	20,104	129	24	32
I1AUM	"	17,118	139	20	24
IIMOL	14	79,184	364	30	68
I. T. U.					
4U1ITU	A	433,570	872	63	128
Luxembourg					
LX1BW	A	102,000	415	49	121
Monaco					
3A2EE	A	7,080	76	21	39
Netherlands					
PAØXPQ	A	723,246	963	95	203
PAØDEC	"	197,561	432	53	114
PAØUC	"	124,684	326	56	90
PAØHSJ	"	49,875	243	30	65
PAØVB	"	35,065	178	37	68
PAØXKB	28	80,109	353	29	52
PAØLOU	"	26,460	165	24	30
PAØLX	21	332,326	921	35	92
PAØQT	"	51,224	246	26	50
PAØEEM	14	243,846	775	33	105
PAØGG	"	5,310	78	12	33
PAØHTR	3.8	4,309	133	4	27
Norway					
WØGTA/LA	A	1,247,544	1497	97	217
LA8NK	A	207,350	567	46	87
LA9HC	"	55,660	180	44	71
LA9UI	"	41,800	194	34	61
LA2TA	"	30,536	174	33	55
LA6U	"	23,085	119	28	67
LA7NG	"	14,606	142	18	49
LA8EJ	"	3,627	54	13	18
LA4LG	28	26,790	200	16	31
LA4ZB	"	11,440	91	21	23
LA8RI	"	7,208	83	15	21
LA5YJ	14	90,576	410	31	80
LA3UF	"	31,164	222	22	62
LA8GK	"	16,362	205	15	39
LA7VK	"	1,464	51	8	16
Poland					
SP8AJK	A	465,566	680	104	245
SP8AWP	"	8,260	121	14	45
SP6AAT	21	20,614	161	23	31
SP5AKG	14	127,323	412	38	103
SP9QS	"	3,420	48	10	35
SP9BZM	"	1,260	60	4	17
SP9KDE	"	36	6	2	4
SP2BSX	3.8	1,044	58	9	14
SP5CJU	"	486	26	4	14
Portugal					
CT1LN	A	354,110	872	49	121
CT1PK	14	106,920	513	28	60
CT1EE	"	81,744	294	29	75
Romania					
YO3ZM	A	61,100	414	27	67
YO3JU	"	7,920	114	14	41
Scotland					
GM3BCL	A	302,267	596	62	141
GM3JDR	"	99,553	414	32	81
GM5AGM	"	7,930	111	16	49
GM3KGT	21	119,988	760	20	46
GM5AHS	14	16,587	203	17	40
GM3SSB	14	14,364	141	17	40
GM3VNN	"	5,502	103	10	32
Shetland Is.					
GM3SVK	A	424,480	815	71	153
GM3RFR	3.8	7,913	159	9	32
Sicily					
IT1TAI	28	7,728	58	22	26
Spain					
EA2EL	14	152,285	646	25	70
Sweden					
SM5CEU	A	1,021,276	1409	86	176
SM3BIZ	A	815,085	1087	91	216
SMØTG	"	497,112	924	73	158
SM2BTQ	"	151,859	422	51	130
SM2CTY	"	90,308	173	78	136
SMØBUO	"	62,370	221	46	59
SMØCER	"	53,392	232	42	100
SM7ID	"	51,168	234	41	82
SM2COP	"	43,384	234	30	38
SM5ZZ	"	38,570	158	39	56
SM5CVH	"	33,174	147	37	77
SM5BOE	"	25,850	140	38	76
SM5DUI	"	10,664	60	27	35
SMØBDS	"	5,500	64	19	31
SM2CAA	"	4,845	54	21	30
SM2CSA	"	4,687	47	17	26
SM6AEK	28	273,544	812	35	89
SM2BHX	28	236,844	819	35	73
SMØAJU	28	156,294	476	34	80
SM7BKH	"	147,840	459	36	74
SM4ARQ	"	75,460	235	33	77
SM5RK	"	70,320	492	20	28

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SM5BGK	"	31,169	131	25	46
SM7CCU	"	20,772	120	24	40
SM5BPJ	"	9,656	55	24	44
SM2COR	"	864	21	7	9
SM3CNN	**21**	**386,816**	**1145**	**38**	**90**
SM7DMN	"	83,293	432	24	49
SM5API	"	19,834	211	16	31
SM4DPB	"	5,084	72	12	29
SM4CMG	**14**	**420,210**	**1066**	**39**	**122**
SM7CRW	"	191,125	773	35	90
SM7CSN	"	119,286	481	35	106
SM5AD	"	103,040	429	31	84
SM6CKS	"	62,730	275	27	75
SM5FC	"	40,320	261	25	59
SM2CXU	"	26,622	152	28	59
SM5AUP	"	9,180	91	16	38
SMØCXM	"	6,104	70	14	42
SM5BNX	"	1,176	25	10	14
SM5EAC	**7.**	**23,694**	**215**	**15**	**51**
SM5API	"	17,600	213	14	50
SM5CAK	"	2,360	59	7	13
SM4GZ	**3.8**	**15,950**	**241**	**12**	**43**

Switzerland

HB9ADD	**A**	**210,424**	**421**	**78**	**154**
HB9UD	"	144,976	403	52	84
HB9AKJ	"	66,120	251	50	102
HB9RX	"	30,576	136	37	67
HB9QA	"	88	11	3	5
HB9IX	**28**	**69,180**	**402**	**23**	**37**
HB9DX	"	25,916	147	24	38
HB9ZY	**21**	**372,922**	**1111**	**34**	**87**

Wales

GW3SFC	**14**	**19,368**	**142**	**23**	**49**
GW3NNF	**7**	**14,025**	**241**	**10**	**41**

Yugoslavia

YU3LB	**A**	**1,284,075**	**1680**	**98**	**227**
YU7LAF	**21**	**18,709**	**195**	**16**	**37**
YU1BCD	**14**	**59,904**	**284**	**26**	**70**

U.S.S.R.

Estonia

UR2GZ	**A**	**10,494**	**114**	**19**	**48**
UR2IV	**28**	**9,374**	**80**	**17**	**26**
UR2CW	**21**	**84,600**	**494**	**23**	**52**
UR2AR	**14**	**618,797**	**1598**	**37**	**112**
UR2AO	**7**	**11,934**	**170**	**12**	**42**
UR2MS	"	1,794	68	5	21
UR2OP	**3.8**	**6,055**	**162**	**7**	**28**
UR2EK	"	5,280	159	5	27

European

W3VT	**A**	**754,298**	**1186**	**81**	**181**
A3DR	"	316,938	693	67	135
A3DB	"	103,138	384	43	96
AITT	"	59,280	266	36	68
AICS	"	25,806	172	22	47
V3MM	"	8,326	88	16	30
A3TN	"	4,644	95	14	29
W3NE	"	2,448	36	13	23
V3TQ	"	1,426	38	8	23
A3KUS	"	1,326	31	12	22
A1KBB	**28**	**108,158**	**500**	**33**	**49**
A6NF	"	60,907	378	27	50
A1DJ	"	58,381	338	28	57
A3TU	"	7,280	68	16	24
W4IB	"	6,705	87	16	29
A3ANN	"	4,352	102	13	19
A4PDN	"	2,168	74	6	17
V3TP	**21**	**23,808**	**206**	**20**	**42**
W3IN	"	14,883	225	13	28
A4PW	**14**	**124,500**	**440**	**36**	**89**
A3BK	"	53,418	342	22	65
A6XG	"	40,530	273	21	49
A3WZ	"	1,820	51	7	19
A1DI	"	1,116	27	7	11
A1GO	**3.8**	**544**	**35**	**4**	**13**
W3DH	"	540	27	5	13

Latvia

Q2FK	**A**	**7,056**	**108**	**16**	**33**
Q2KBZ	"	1,344	50	8	20

Lithuania

P2CV	**A**	**12,744**	**185**	**14**	**40**
P2KTU	"	8,058	132	17	34
P20K	**14**	**132,301**	**635**	**33**	**78**
P2KBA	"	2,821	76	8	23
P2BA	**3.8**	**4,719**	**137**	**6**	**27**
P2NBG	"	3,410	106	5	26

Ukraine

UB5KMX	**A**	**1,146,868**	**1378**	**102**	**224**
UB5DEB	28	1,280	58	6	10
UB5FG	**21**	**87,261**	**615**	**24**	**63**
UB5SJ	**14**	**38,016**	**190**	**27**	**72**
UB5OD	"	20,064	149	23	53
UB5SR	"	18,780	170	16	44
UT5LE	"	3,534	44	12	26
UB5ND	"	266	7	7	7
UB5KLD	**3.8**	**3,608**	**69**	**4**	**20**

White Russia

UC2DN	**28**	**3,610**	**49**	**17**	**21**
UC2BF	**14**	**22,387**	**160**	**18**	**43**
UC2WX	"	1,798	56	7	22

OCEANIA

Australia

VK2APK	**14**	**231,684**	**634**	**34**	**95**
VK2AND	"	4,920	32	18	23
VK3KS	"	69	5	4	5
VK3XB	**21**	**53,179**	**264**	**26**	**45**
VK3ABA	"	19,362	158	16	26
VK3SM	"	6,996	33	22	22
VK4FH	**A**	**107,749**	**343**	**45**	**62**
VK4UC	**14**	**31,476**	**141**	**29**	**57**
VK4DO	"	3,584	40	15	17
VK5FO	**A**	**43,382**	**149**	**47**	**62**
VK5MF	**28**	**54,320**	**72**	**26**	**44**
VK5EF	"	18,017	144	18	25
VK5LC	"	10,422	69	22	31
VK5WC	**14**	**6,106**	**55**	**17**	**26**
VK6RU	**A**	**1,627,095**	**1673**	**109**	**226**
VK6XX	**28**	**278,844**	**828**	**34**	**80**
VK8UG	**28**	**19,380**	**122**	**25**	**35**

Cocos-Keeling Is.

VK2ADY/9	**A**	**5,045,115**	**3310**	**153**	**384**

Fiji Islands

VR2DK	**A**	**108,540**	**294**	**58**	**76**
VR2FM	**14**	**3,960**	**69**	**11**	**13**

Guam

KG6ALY	**A**	**801,500**	**1259**	**87**	**142**
KØILI/KG6	**21**	**188,324**	**733**	**30**	**59**
KG6AQG	**14**	**226,168**	**593**	**35**	**101**

Hawaii

KH6IJ	**A**	**1,199,600**	**2029**	**82**	**118**
KH6GGJ	"	135,141	450	48	56
KH6BZF	**28**	**122,472**	**762**	**22**	**32**

Marshall Is.

KX6FB	**A**	**70,950**	**292**	**34**	**52**
KX6FJ	"	10,304	63	31	33

New Zealand

ZL1KG	**A**	**1,241,823**	**1387**	**108**	**203**
ZL1TB	"	2,537	40	19	24
ZL1HW	**28**	**84,955**	**448**	**25**	**40**
ZL3AB	"	55,265	531	14	21
ZL1AGO	**21**	**34,884**	**219**	**21**	**36**
ZL1AXB	**14**	**281,840**	**930**	**33**	**71**

Philippines

DU1FH	**A**	**860,456**	**1311**	**86**	**150**

Terr. of New Guinea

VK9GN	**28**	**291,194**	**1035**	**34**	**63**
VK9KS	**14**	**29,727**	**143**	**27**	**54**

South America

Argentina

LU8FP	**A**	**180,096**	**380**	**57**	**111**
LU2FAO	"	**150,084**	**418**	**57**	**75**
LU1DAB	**28**	**501,828**	**1375**	**34**	**90**
LU5AQ	**21**	**27,631**	**153**	**22**	**41**
LU8FAO	**14**	**134,638**	**402**	**34**	**84**

Bolivia

CP5ED	**28**	**25,251**	**158**	**25**	**32**

Brazil

PY7ACQ	**A**	**1,093,540**	**1275**	**95**	**197**
PY2PC	"	684,040	789	90	190
PY1NBF	"	556,444	826	86	152
PY2ASO	"	125,622	328	46	80
PY2EAD	"	90,684	232	44	88
PY2GE	"	66,196	188	53	81
PY3BAD	"	58,050	237	34	52
PY2AQQ	"	40,685	138	46	57
PY2DBU	"	14,768	75	26	45
PY1CAD	**28**	**42,080**	**186**	**25**	**55**
PY1BAR	"	7,446	78	15	19
PY5EG	**21**	**155,641**	**536**	**27**	**74**
PY1ATG	"	142,600	532	30	62
PY3APH	"	15,132	71	29	49
PY2DCA	"	14,700	145	13	22
PY4OD	**14**	**341,055**	**819**	**37**	**106**
PY7GV	"	285,439	860	33	88
PY3BXW	"	204,525	544	37	98
PY7LAK	**7**	**15,228**	**114**	**16**	**31**
PY4BLR	"	2,350	37	13	12

Chile

CE1FC	**14**	**133,322**	**455**	**33**	**74**
CE8CP	"	46,440	197	28	58

Colombia

HK5BDS	**14**	**52,050**	**371**	**21**	**54**
HK4EB	"	33,669	98	35	94

Equador

HC1TH	**A**	**1,023,378**	**1852**	**66**	**125**
HC5NW	**14**	**263,418**	**726**	**38**	**91**

Guyana

8R1G	**A**	**481,656**	**857**	**72**	**116**

Peru

OA4JR	**A**	**485,326**	**753**	**78**	**149**
OA8V	**28**	**416,928**	**1101**	**36**	**93**
OA6BG/8	"	7,548	85	11	13
OA4BS	**14**	**77,220**	**284**	**32**	**67**

Suriname

PZ1CK	**A**	**37,558**	**152**	**39**	**50**

Trinidad

9Y4VT	**14**	**151,008**	**656**	**24**	**54**

Uruguay

CX9CO	**A**	**350,108**	**586**	**79**	**139**
CX2CN	**28**	**186,095**	**693**	**28**	**63**
CX9AAY	**7**	**378**	**19**	**7**	**9**

Venezuela

YV1LA	**28**	**450,007**	**1560**	**30**	**73**
YV1FV	"	174,492	800	23	51
YV1SA	**21**	**134,320**	**504**	**27**	**65**
YV5AXT	**14**	**638,748**	**1693**	**34**	**98**
YV7AV	"	67,473	310	24	57
YV4UA	"	39,270	204	23	47
YV1EL	"	13,727	87	17	36

MULTI-OPERATOR
Single Transmitter
North America

U.S.A.

WA1DCE	105,186	282	54	87
K1UHA	61,845	212	34	71
WB2ZCK/S	**596,570**	**609**	**112**	**226**
WB2FON	539,100	631	96	204
W2FZJ	472,472	572	94	192
WB2OIV	441,664	577	90	178
WB2HZG	101,188	223	59	105
W3BGN	**1,390,350**	**1271**	**114**	**276**
W3MVB	522,936	685	81	188
W3MWC	445,212	605	79	170
K3BNS	438,250	570	85	165
K3JYZ	212,256	381	66	132
W3OK	76,636	228	41	78
K4ZYP	**277,632**	**422**	**78**	**163**
K5FIQ	**68,701**	**227**	**36**	**67**
WA6ZQU	**1,451,219**	**1264**	**126**	**275**
WA6IPY	830,725	878	116	213
K6OHJ	702,900	703	125	230
WB6NRK	212,925	459	73	94
WB6NWK/6	181,259	341	70	121
W6RGG	111,860	231	65	105
W6GQK	17,812	82	27	46
K7JLF/7	**93,808**	**237**	**56**	**87**
K8DOC	**828,468**	**843**	**111**	**213**
K8UDJ	594,808	687	91	207
WA8OSE	272,835	411	79	156
W9BGX	**670,397**	**636**	**116**	**255**
W9EXE	649,288	808	88	205
W9ZRX	575,011	651	106	201
K9YHB	500,280	663	86	178
W9HHX	264,872	420	82	144
WA9IBT	240,525	386	80	145
WA9LMY	179,124	354	63	114
WAØEMS	**609,768**	**666**	**111**	**213**
WAØCJU	292,404	439	81	155
WAØCPX	227,955	413	73	122
WAØNOJ	141,678	330	58	95
WAØNLP	107,756	252	62	96
WAØNZD	40,908	165	34	50

Canada

VE3FHO	**1,100,528**	**1191**	**97**	**241**
3C3CTX	300,501	541	57	136
VE6ADX	**234,195**	**480**	**72**	**123**

Mexico

XE1WS	**1,050,036**	**1864**	**83**	**171**

Virgin Is.

K4IIF/KV4	**865,100**	**1904**	**83**	**128**

AFRICA

Angola

CR6YY	**175,650**	**427**	**58**	**92**

Ethiopia

ET3JBP	**942,152**	**1292**	**69**	**179**

Ghana

9G1KG	**900,726**	**1493**	**71**	**143**

ASIA

Cyprus

ZC4MO	**543,582**	**926**	**64**	**143**

Hong Kong

VS6AJ	**1,032,447**	**1391**	**102**	**197**

Japan

JA3YBF	**120,148**	**422**	**37**	**61**
JA1YNX	27,840	126	32	48
KA9MF	**1,244,910**	**1680**	**86**	**169**
KA2KS	556,104	1058	65	123

U.S.S.R.

UA9KQA	**156,612**	**356**	**48**	**106**

Europe

Bulgaria

LZ1KIAA	**6,390**	**123**	**13**	**32**

Denmark

OZ6PK	**6,072**	**184**	**6**	**27**

England

G3WYX	**828,180**	**1160**	**81**	**177**
G6LF/P	473,084	885	68	134
G3VYG/A	451,605	804	81	150
G3IAR	361,250	697	76	174

France

F8LC	**293,136**	**652**	**69**	**117**
F9JS	28,336	131	37	51

Finland

OF1VR	**273,953**	**568**	**81**	**196**
OF3TR	118,161	497	44	127

Germany

DJ7IK	**1,933,956**	**1912**	**114**	**267**
DJ3YL	**1,525,984**	**1651**	**108**	**236**
DLØWW	1,221,854	1356	102	256
DL8KJ	1,000,593	1252	97	200
DLØIB	898,998	1200	94	175

Iris and Lloyd Colvin found our contest one of the most interesting and challenging events in their *Yasme* World Wide DX-pedition. Their phone operation from 9G1KG was second high for Africa. *(Photo by EL2AW)*

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The crew at club station KA9MF, top multi-operator, single transmitter station for Asia. L to R: Front row—W8FCW, WA1DSN, WØNMH. Back row—FA3IBN, K9PVD, W3CJX, WB2HMF and S. Bassett (no call, must have been included for decorative purposes. How about that set of handle-bars). The other asset at the station was a TH6-DX on a 170 ft tower. (*U. S. Army photo*)

DJØPH	814,103	1214	83	194
DL8RM	769,920	1145	82	158
DLØJD	484,567	901	66	125
DLØHN	194,256	509	60	84
DLØDF	13,930	173	14	56
DL4RM	**288,225**	**781**	**46**	**89**
DL5YZ	188,783	596	51	130
Italy				
I4GAD	**2,764,820**	**2572**	**114**	**276**
I1DFD	643,650	1342	63	112
Luxembourg				
K7HTZ/LX	174,832	559	57	139
Netherlands				
PAØSNG	**1,230,250**	**1350**	**106**	**264**
Sweden				
SM2BJI	**2,168,089**	**1986**	**124**	**283**
SM5AZU	346,833	588	80	187
SL3ZV	229,140	532	64	107
SL7ZJ	57,276	268	47	82
SL2ZI	27,650	159	31	48
Wales				
GW3NWV	**951,080**	**1496**	**75**	**161**
European U.S.S.R.				
UA3KBO	**1,676,750**	**1996**	**108**	**245**
UA3KND	304,523	693	78	171
UA3KOB	25,060	224	20	50
UA3KAG	21,700	146	21	49
UA3KHR	18,480	149	26	62
Latvia				
UQ2KFG	**636,256**	**1274**	**67**	**169**
Lithuania				
UP2KCB	**7,047**	**114**	**12**	**35**
Ukraine				
UB5KKB	**123,390**	**397**	**41**	**94**

Oceania

Christmas Is.				
VK9XI	**52,272**	**181**	**42**	**66**
Guam				
KG6AAY	**1,523,396**	**1813**	**106**	**181**

South America

Uruguay				
CX3BH	**2,225,235**	**2349**	**108**	**219**
Venezuela				
YV5ANF	**2,198,126**	**2002**	**110**	**284**
YV1AJ	1,039,148	1567	82	144

The Operators at the Single Transmitter Stations

CR6YY : Maria & Jose Silva.
CX3BH & CX1BY, CX2CO, CX7CO.
DJ3YL & DJ2YA.
DJ7IK & DJ6MD, DJ6TS.
DJØPH & DJ9YA, DL8PG.
DL4RM : DL4GO, DL4HR, DL4SD, DL4WQ, DL5MH.
DL5YZ : Club.
DL8KJ & DJ1QP.
DL8RM & DJ1RN, DJ6WO, DJ9YG, DL3LU, DL8RK, DL8RL.
DLØDF : DJ9JV, DL3UP, DL6QV, DL9YP.
DLØHN : DJ4DI, DJ4LN, DJ4UD, DJ6KT, DJ9EV, DJ9EW, DL2LZ, DL9DH, DL9JI, DL9TS.
DLØIB : DJ9XG, DL6DZ.
DLØJD : DK2HY, DK2IA, DJ1CY, DJ1XI, DJ9VE, DL3AH.
DLØWW : DC6FF, DJ1YP, DJ3GR, DJ40Q, DJ4XN, DJ6DU, DJ9VS, DJØRM, DL2LW, DL2UU, DL3ZA, DL6NK.
ET3JBP : K4FMA, W5QHD, W6HOH, WB4BWU.
F8LC & F2SI, F5PR.
F9JS & F9IE.
G3IAR & G3RYV.
G3VYG/A & G3VZT, G5AFS, G5AHE.
G3WYX & G3HTA, G3RUV, G3RUX, G3TJW.
G6LF/6 : G3CLP, G3KVG, G3PXL, G3VDV, G3VOT.
GW3NWV & GW3DIX.
I1DFD : K2MWH, W7DGP, KL7DML.
I4GAD : I1AUM, I1BXN, I1GAD, I1LCK, I1TAE.
JA1YNX : JA1WPF, JA1WRF, JA8CDE, JH1BYP, JH1CMW.
JA3YBF : JA3EBT, JA3FGJ, JA3FQD, JA3KAO, JA4BOI, JA4CIG.
K1UHA : WA1EDM, WA1FTG, WA1FVN, WA1HHO.
K3BNS & KØWEU.
K3JYZ & K3LCH.
K5FIQ : K4FTY, WA5QZG.
K6OHJ & W6BHY.
K7JLF/7 & K7KPQ.
K8DOC & K8DVV, K8YWG.
K8UDJ & K8BGZ, K8MFO.
K9YHB : K9RHY, WA9EJD.
KA2KS : Club.
KA9MF : K9VPD, W3CJX, W8FCW, WØNMH, WA1DSN, WA3IBN, WA5QNI, WB2HMF Sam.
KG6AAY : K1OTI, K6KII, W7IIZ, WØQQG, WA1HZD, WA2RXH, WA8DXG, Dick.
K4IIF/KV4 & WA4RFB.
K7HTZ/LX & WA6ZCA, WB2CGM.
LZ1KAA : Club.
OF1VR : OH1UR, OH1VR.
OF3TR : OH1YO, OH5VF, OH6VC, OH7RJ.
OZ6PK & OZ3FD, DJ7XZ.
PAØSNG & PAØGMU, PAØHBO.
SL2ZI : SM2DPS, SM2DQS.
SL3ZV : SM3DGU, SM3DYU, SM4-3894.
SL7ZJ : SM7DIE, SM7DQC.
SM2BJI & SM6CAS, SM6VR.
SM5AZU & SMØATN, SMØBGM, SMØMC.
UA3KAG : Club.
UA3KBO : DM2BOG, UA3-27308.
UA3KHR : Club.
UA3KND : Club.
UA3KOB : Nick, Oleg, Vic.
UA9KQA : UA9RR, UA9RQ, UA9RY.
UB5KKA : Club.
UP2KCB : Club.
UQ2KFG : George, Vic.
VE3FHO & VE3GCO.
VE6ADX & VE6SB, VE6TF, VE6XJ.
VK9XI & Judy, Mac, Norm.
VS6AJ & K6IHO, W5UHK, VS6FZ, Mrs.VS6AJ, Dieter, Peter, Sig.
WA1DCE : K1RSC, W1YJD, WA1COH, WA1EAH, WA1HXH.
W2FZJ & G2NKR, K2YWE.
WB2CKS & W2PCJ.
WB2FON & WB2AJJ, WB2FOV, WB2YYI.
WB2HZG & WB2ERE.
WB2OIV & WB2DLB, WB2IUC.
W3BGN & K3FGO.
W3OK : K3MAZ, K3QDV, WA3ATK, WA3BQX, WA3CXM, WA3GUI.
W3MVB & W1ARR, WA3FHB.
W3MWC & K3JLI.
W6GQK & W6SR.
W6RGG & K6ALH.
WA6IPY & WA6EPQ.
WA6ZQU & K6VZA, W6ITY, WA6SBO, WB6EFA, WB6LFR, WB6SHL.
WB6NRK & WB6UDC.
WB6NWK/6 & WB6HGU, WB6VFJ.
WA8OSE & WA8GKW.
W9BGX : K4HNA, W9ICE.
W9EXE & K9YOE.
W9HHX : WA9IYU, WB2TTK.
W9ZRX & W9VNE.
WA9IBT & WA9NXH.
WA9LMY & WA9NNH.
WAØCJU : KØEKG, KØHAP, KØUYN, WØISJ, WØISJ, WØIVZ.
WAØCPX & KØBLY, & KØBLY, WAØCPY.
WAØEMS : WAØPFU.
WAØNLP : K7BOY, KØEOK, KØKZD, WØGHY, WØTLX, WAØBHD.
WAØNOJ & WAØMMP, WAØMPS.
WAØNZD : W6YHD, WA6WFZ, WBZRUR.
XE1WS & XE1BJ.
YV1AJ : YV1BP, YV1HD, YV1PP, YV1QF, YV1TS.
YV5ANF & YV5ANE, YV5CIY.
ZC4MO : Club.
3C3CTX & G3RFD.
9G1KG : W6KG, W6DOD.

MULTI-OPERATOR Multi-Transmitter North America

K2GL	**5,414,252**	**3045**	**154**	**460**
W3TMZ	**4,355,670**	**2575**	**155**	**436**
W4ETO	**2,274,540**	**1588**	**136**	**365**
W7SFA	**953,712**	**993**	**115**	**218**
W6UMI	**679,239**	**765**	**111**	**210**
W8NGO	**629,894**	**701**	**96**	**211**
W1UOP	**585,920**	**683**	**107**	**213**
WØLOL	**516,780**	**608**	**101**	**196**
WB2PWU	414,686	541	95	178
W8LN/8	290,385	434	83	156
WB6CPE	160,362	322	70	107
W3EVW	125,788	277	59	105

Europe

OF2AM	**9,259,941**	**6048**	**151**	**448**
OF5SM	**7,738,911**	**5458**	**149**	**448**
OF1AA	2,824,860	2847	124	321
OF1AD	2,194,519	2395	120	241
DL3BA	**1,968,624**	**1933**	**115**	**257**
GB2SM	**1,929,272**	**2281**	**99**	**250**
UA1KBW	**1,569,451**	**2011**	**87**	**212**
SM6BGG	**1,428,420**	**1592**	**109**	**249**
OK1KDC	**401,893**	**722**	**75**	**196**
OF3AG	375,912	979	70	137
OF6AA	70,884	308	43	89

South America

4M5A	**7,468,117**	**5033**	**134**	**393**
CE6CA	**4,003,584**	**3444**	**126**	**275**

The Operators at the Multi-Transmitter Stations

CE6CA : CE6CC, CE6DP, CE6EF, CE6EQ, CE6EW, CE6EZ, CE6FQ, KØSQX.
DL3BA & DJ9CN, DL2VQ, DL4AK, DL4BM, DL4CZ, DL4RW, DL5LU, DL5ML.
GB2SM : Club.
K2GL & K2KUR, K2TXC, K2UYG, KØLFY, W1GYE, W1MDO, W2DNG, W2GLM, W2IWC, W2JAE, W2SKE, W2VCZ, W6KFV, Alex.
OF1AA : OH1NK, OH1NM, OH1SS, OH1SY, OH1YW.
OF1AD : OH1QP, OH1SH, OH1VT, OH1XB, OH2KK, OH2PM.
OF2AM : OH2BBM, OH2BBR, OH2BC, OH2BCZ, OH2BH, OH2BQ, OH2BS, OH2KH, OH2QV, OH2SB.
OF3AG : OH3SM, OH3TM, OH3WW, OH3YI, OH3ZG.
OF5SM & OH2BCP, OH2BO, OH2BR, OH2ER, OH2HN, OH2TH, OH2WI, OH3PC, OH5NQ, OH5NW, OH5SE, OH5TM.
OF6AA : OH6QP, OH6WG, OH6WI.
OK1KDC : OK1ADM, OK1ADP.
SM6BGG & SM6CKV, SM6DLL, SM6DXK.
UA1KBW : Alex, Vadim, Valery.
W1UOP & K1UDP, W1ORV, W1LHZ, W1UMC, W1ZW.
W3TMZ & K3EST, K3NPV, W3AZD, W3BQV, W3ZKH, W9SZR, WA3FUM.
W3EVW & WA3EPB.
W4ETO & K4HF, W4FWG, W4LCP, W4QBK, WØLNE, WA4PXP.
W6UMI & VE3DXV, WA6TQK, WB6KIG.
W7SFA & K7HAX, W6VUW, W7DL, W7NLB.
W86GO & K8LSG, K8YEI, W8CLR, W8ONA.
W8LN/8 & WA8NWV, WA8OGB, WA8RYW.
WØLOL & WØPAN.
WB2PWU & WB2PMP.
WB6CPE : WB6NTZ, WB6SAZ, WB6VLM.
4M5A & YV5AEC, YV5AGD, YV5AIP, YV5BBU, YV5BNW YV5BOA, YV5BPG, YV5BPJ, YV5BQV, YV5BTS, YV5CDK.

Our thanks to the following stations who sent us their check logs W1BVP/mm, W2EGI, W2WZ, W3AKG, WA4OEI, W5FFW, WA5BNG/m, W6JZG, K7NNJ, W7FCD, W7MSI, WAØKKR/KG6, CO8RA, DJØPN, DLØAAA, DM-2401/L, HA2KRB, KX6EN, JA3ADW, LA1QL, LA1ZI, LA9CE, OD5FC, OE1WO, OH2MA, OK1NH, PY2CQ, SM5CAK, SM5AEZ, SM6, CZV, SM7BTN, SM7DBD, SMØDZL, YS1O, YU3-RS-743, VE7PY, ZS2AA, DM2AMH, SM5RK, SM7ASN.

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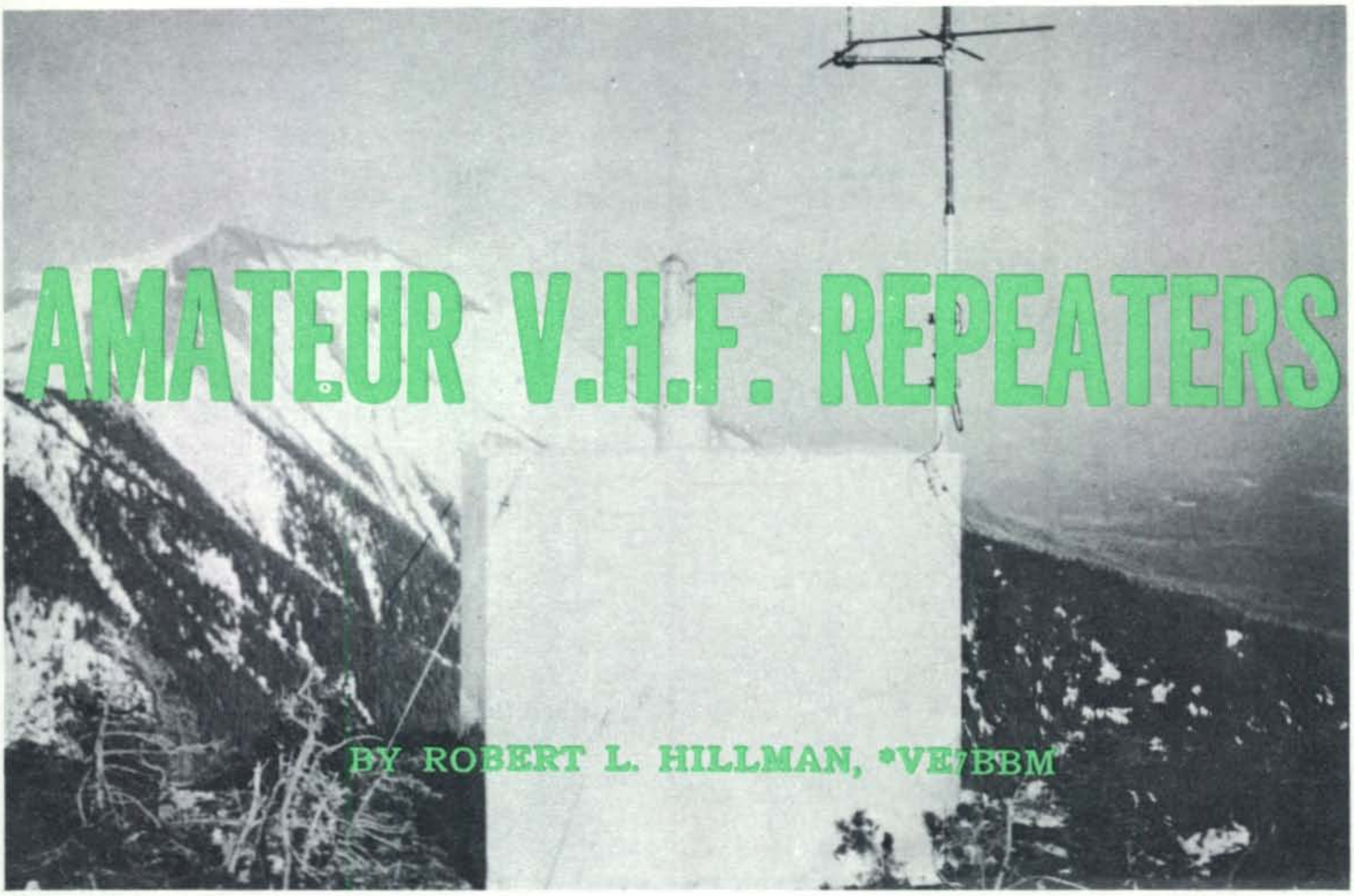
AMATEUR V.H.F. REPEATERS



BY ROBERT L. HILLMAN, *VE7BBM

With the widespread use of six and two meter f.m., many amateurs are now considering repeater stations. Considering the extrmely low cost of used "wideband" (±15 kc deviation) equipment this is not surprising. Repeaters have been in use for years in commercial v.h.f. f.m. service and they are a common tool for increasing the coverage and the reliability for such systems.

A repeater simply receives a signal on one frequency and retransmits it on a second frequency. These frequencies are generally within the same amateur band and must be separated by 400 kc or more. Figure 1 shows a block diagram of the basic system. The only requirement of such operation that usually causes concern to amateurs is the close operating proximity of the receiver and transmitter since they both function at the same time. Problems such as desensitization and intermodulation distortion can usually be solved by using separate antennas for the receiver and transmitter. Since all mobile f.m. work is vertically polarized, adequate isolation can usually be provided by mounting ground planes on the same mast and separating them vertically as far as practical. In some cases, it becomes necessary to use cavities (tuned circuits) in receiver and/or transmitter antenna feeds.

To serve its main purpose of increased coverage, a repeater is usually located high atop a local mountain or hillside. As an analogy, a repeater gives the mobiles the same results as if they were located at such an advantageous location.

Typical System

A typical system could be developed around an existing two meter f.m. channel presently in use. If there is a local net on 146.76 mc and a repeater is desired it is only necessary to pick a frequency for the repeater input. The repeater would then transmit on 146.76 mc. This is the simplest way to incorporate a repeater into a v.h.f. system and it involves adding an extra transmit channel on the mobiles and base stations. The receivers would remain single frequency on 146.76 mc.

In choosing the additional frequency (repeater receiver) several factors should be kept in mind. Foremost, the repeater input and output frequencies should be kept at least 400

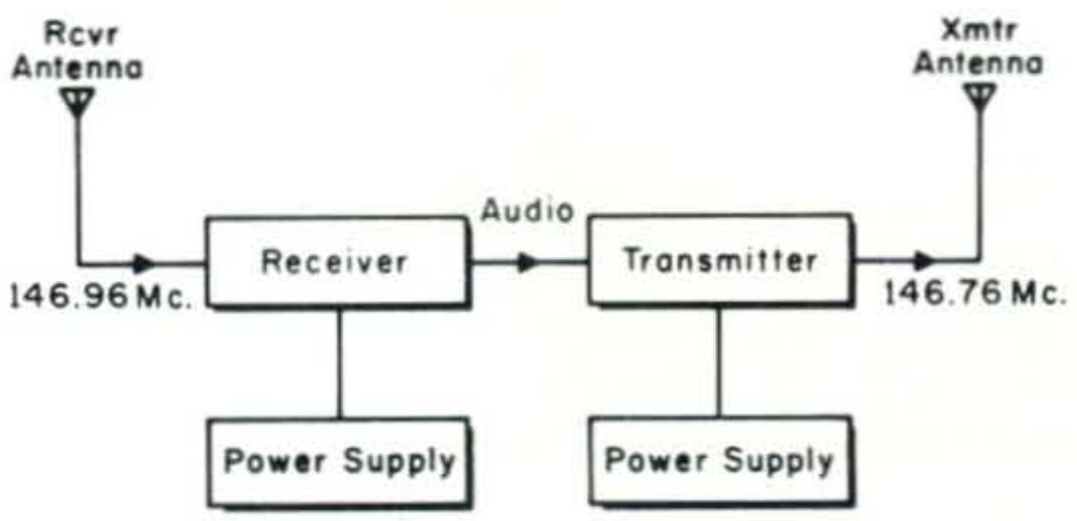


Fig. 1—Block diagram of a basic f.m. repeater system.

* 562 Ballantree Road, West Vancouver, B.C., Canada.

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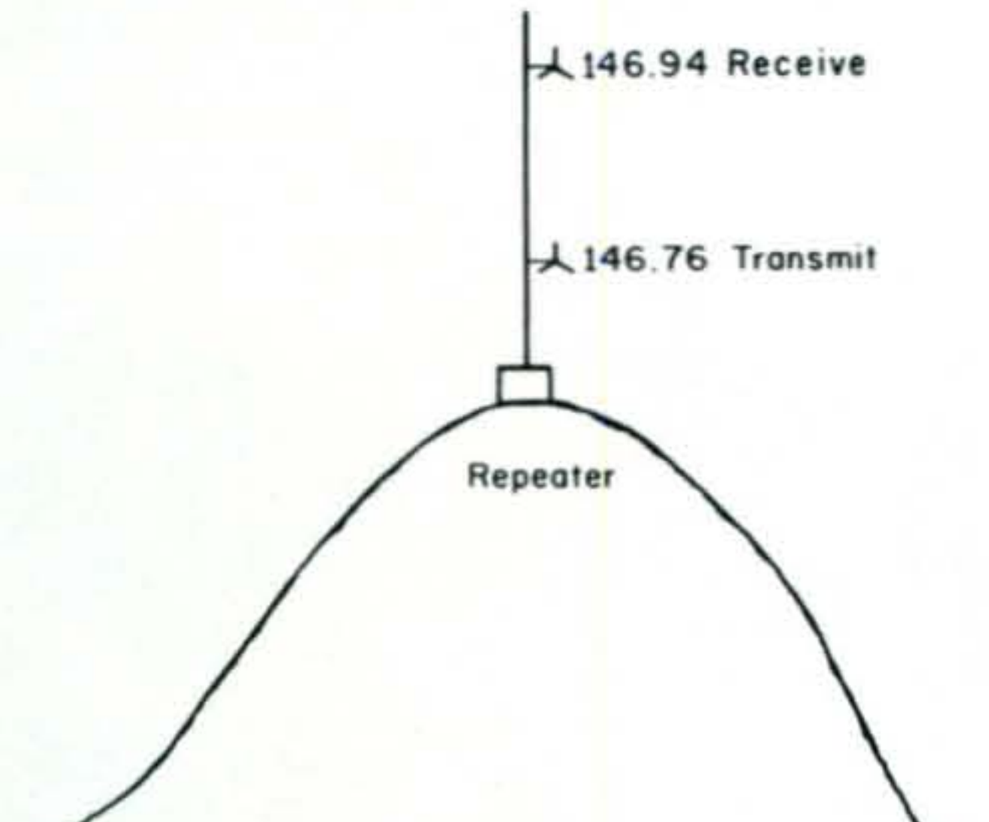

		F_1	F_2
Mobiles and Base Stations	Rcvr.	146.76mc	
	Xmtr.	146.76mc	146.94mc

Fig. 2—Repeater location sketch and a typical frequency system.

kc apart but this is an absolute minimum. The closer the spacing the greater the problems of desensitization, *etc*. Secondly, the mobile and base stations are generally only capable of frequency separations in the order of 0.4% without seriously degrading their performance. In this case, the two transmit channels in the mobiles and base stations should be spaced no greater than approximately 900 kc.

The system described will enable mobiles and base stations to communicate station to station on 146.76 mc. This provides for catastrophic failure of the repeater and enables mobiles and base stations to talk among themselves when they do not require the additional coverage the repeater provides. It should be obvious that if a station then activates the repeater he will be heard by these mobiles. This can be advantageous where a station out of range as far as mobile to mobile contact is concerned wishes to break. It is a simple matter, when one wishes to use the repeater to switch the transmit frequency and talk. Most commercial v.h.f. equipment is adaptable to two or more frequencies and this becomes a simple matter of switch selection at a mobile control head. The frequency plan is shown in fig. 2.

It is important for the basic purpose of the repeater to be properly assessed. Experience has shown that nearly all repeater installations have their differences. It is paramount that considerable thought be given to the establishment of some set of arbitrary design parameters. If the main purpose of the repeater is to extend coverage in a large metropolitan area to as many amateurs as possible, a high central location and omnidirectional antennas would seem most practical. However, local topography may shift the design to the choice of a nearby mountain and a cardoid antenna pattern. Similarly, if the main purpose of the repeater is to link amateurs in two separated communities and/or provide coverage along the connecting highway, directional antennas and a site midway along the route may prove best. The repeater must be designed and executed to perform the job expected of it. It should include the needs of everyday use and those of emergencies.

Repeater Construction

The actual construction of a suitable repeater will differ due to the equipment available for modification. It has been found that most commercial v.h.f. f.m. equipment can be converted to a suitable repeater if it meets the following basic requirements;

a) *Separate receiver and transmitter chassis.*

b) *Service*—Power supplies in particular should be rated for CCS (Continuous Commercial Service) and should be separate.

c) *Modulation*—The transmitter should have some means of limiting the maximum deviation to ±15 kc. Motorola calls it I.D.C. (Instantaneous Deviation Control). You will find that most equipment will meet these requirements but that Motorola, RCA and GE seem most popular. This is due in part to the availability of manuals and replacement parts.

The equipment should be checked out as a unit before conversion is attempted. This will save considerable time and effort later. Aside from the obvious power supply requirements, there are only two main steps in the construction of a repeater. First, means must be provided to activate the push-to-talk circuitry of the transmitter when a carrier appears at the repeater receiver. This requirement is commonly fulfilled by using a circuit called a carrier operated relay. (C.O.R.) The other requirement is the transfer of audio from the receiver to the modulation circuitry of the transmitter at the proper level. The operation and relevant circuitry are described in the following paragraphs. The block diagram of fig. 3 shows the general stage by stage layout.

The C.O.R. is simply a circuit consisting of a relay connected in the plate circuit of a tube. (See fig. 4.) The grid is usually connected either to the noise rectifier or an i.f. tube (usually the last one before the limiters). The presence of a signal in the receiver will

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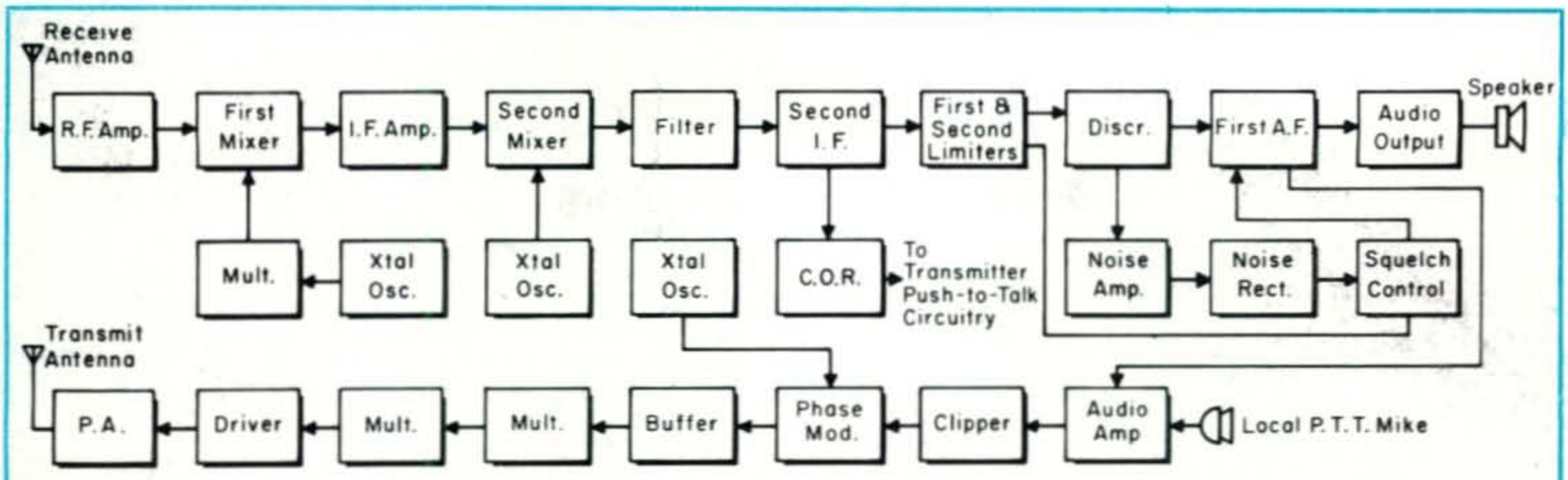

Fig. 3—Block diagram of an f.m. receiver and transmitter interconnected for repeater operation.

cause the relay to close. The delay capacitor is to allow the transmitter to remain keyed 1 or 2 seconds after the carrier disappears from the receiver. With this arrangement, momentary loss of the received signal will not cause the repeater transmitter to immediately go off the air. This will preclude the possibility of the transmitter continuously keying itself off and on as a mobile transmitting into the repeater travels through dead spots. This delay will be of great assistance to anyone attempting to net his receiver "on channel," as he can key his transmitter momentarily and then observe the receiver discriminator reading since the repeater transmitter will remain on for several seconds.

The second requirement in the construction of a repeater system is a means of transferring the received audio to the modulator stages of the transmitter. This audio should be adjustable and it is called the "repeat level." If you examine the circuitry of both the receiver and the transmitter chassis you will see that it is possible to remove the audio from the receiver at the stage preceding the output stage. This will give approximately the right level to drive the audio stages in the transmitter. Such a modification, which works nicely with the Motorola 43G series, is shown in fig. 5.

Bench Check

At this stage, presuming that the technical prerequisites have been met, you will probably be ready to bench check the repeater. To properly evaluate the units you will need professional quality test equipment, consisting of a v.h.f. signal generator with a calibrated attenuator, a deviation meter, and a Thruline or Inline wattmeter. The individual units should be fully checked out first. The transmitter should be on frequency, develop rated output into the antenna and deviation set to limit it to ±15 kcs as per the manufacturer's manual. The receiver should be set on frequency and checked for rated sensitivity.

Probably the only parameters above that will puzzle most amateurs are the measurements of transmitter deviation and receiver sensitivity. For transmitter deviation it will be necessary to either modulate the transmitter by the microphone or by injecting a 1000 c.ps. tone into the microphone circuity. The deviation meter should then be set up accordingly.

Receiver sensitivity may be measured by connecting an a.c. voltmeter to the receiver audio output and the signal generator at the antenna terminals. The signal generator output should be set at zero and the audio adjusted on the receiver to give a suitable reading on the a.c. voltmeter. The signal generator output should now be increased to a level necessary to reduce the a.c. reading by 20 db. (10-1 voltage ratio, remember?) This is commonly called the 20 db quieting test.

These tests completed, it should now be

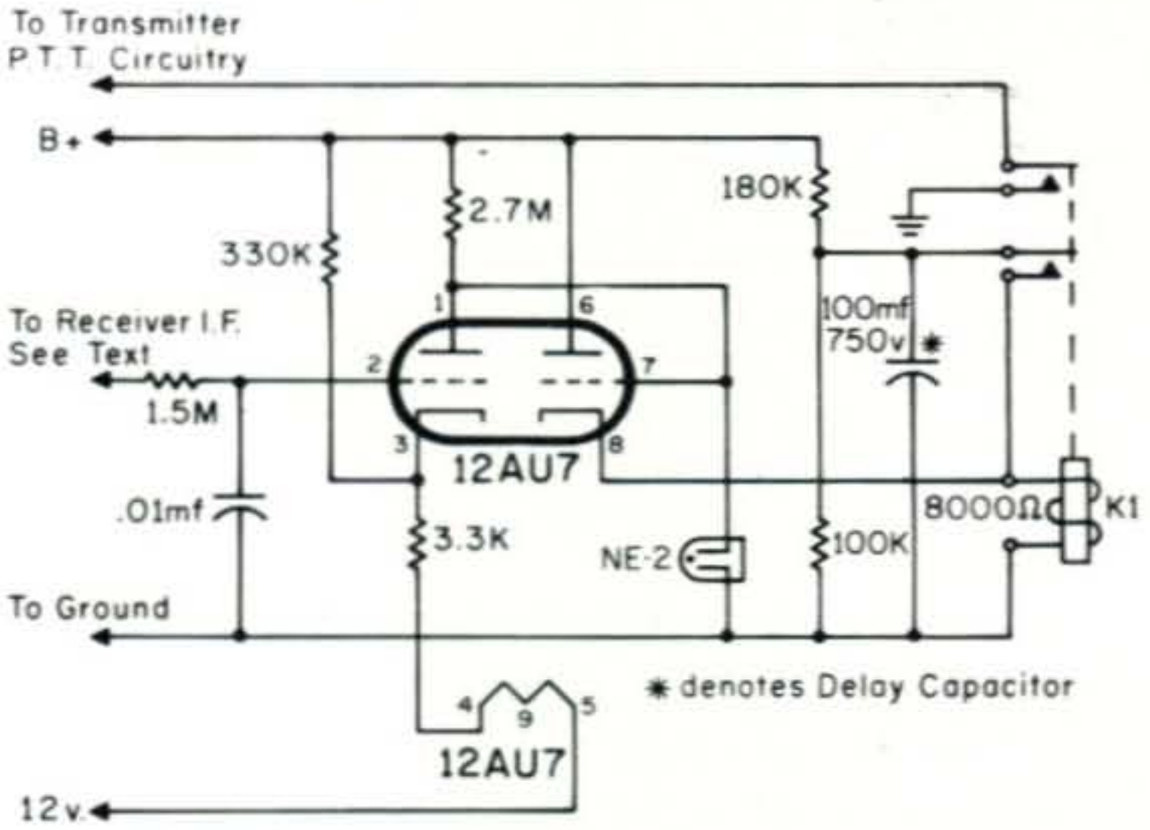

Fig. 4—Circuit of a carrier operated relay stage. One set of relay contacts connects to the p.t.t. circuit of the transmitter. The second set of relay contacts connects the delay capacitor into the circuit. Varying the value of this capacitor changes the hold time of the relay.

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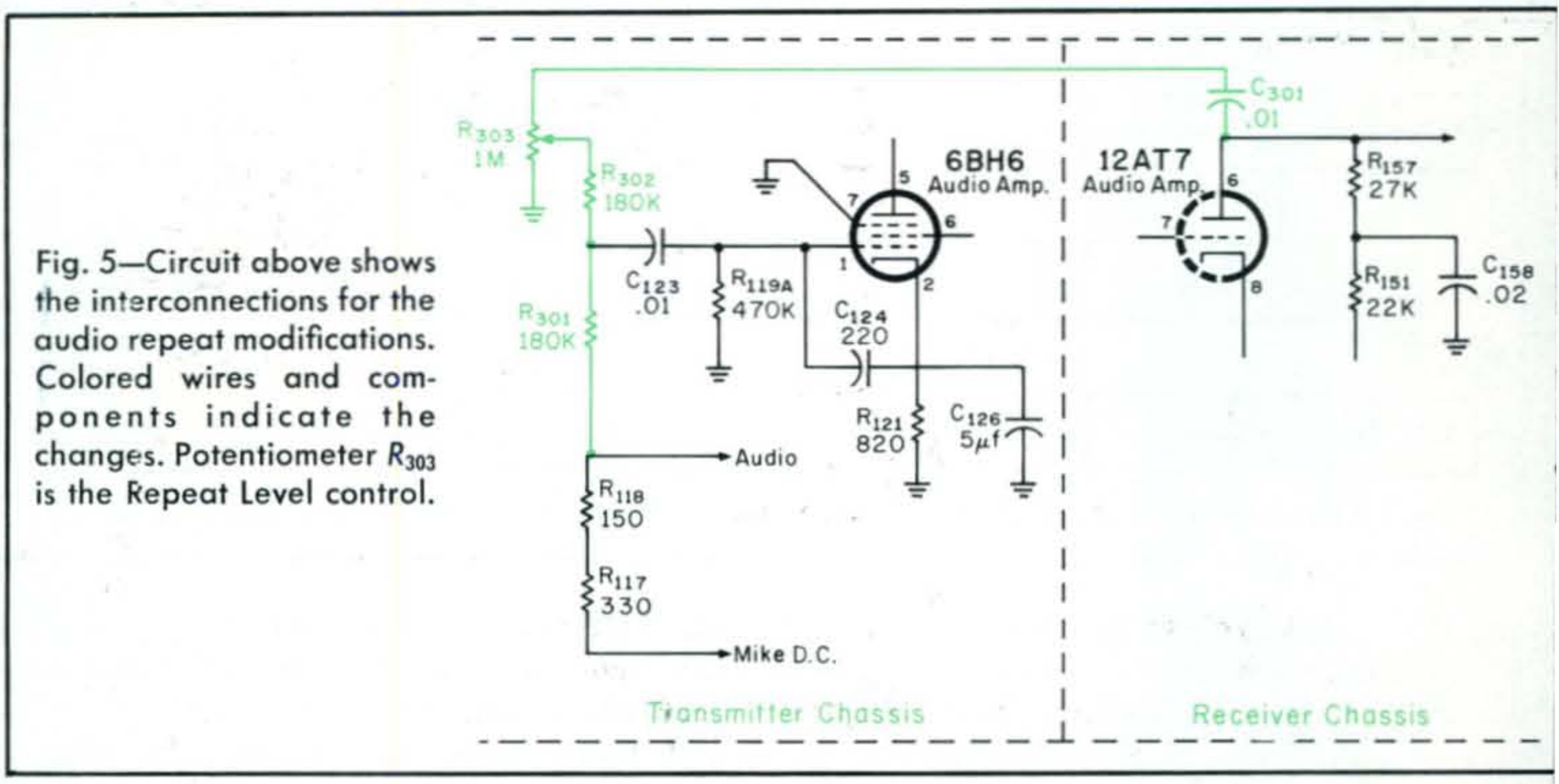

Fig. 5—Circuit above shows the interconnections for the audio repeat modifications. Colored wires and components indicate the changes. Potentiometer R_{303} is the Repeat Level control.

possible to begin testing the units as a repeater. You will need separate antennas or dummy loads, preferably antennas if cavities are not going to be used. Separate the antennas vertically as far as possible, to provide the most isolation between the receiver and transmitter. The transmitter should be fed into its antennas and keyed, the receive audio line should be disconnected from the transmitter audio stages. With this done, receiver sensitivity should once again be checked. If sensitivity is impaired with the transmitter on, you are experiencing desensitization and the cure is greater antenna and feed-line separation, or the use of a rejection cavity in the receiver line tuned to the transmitter frequency.

The audio repeat level may now be set. The idea here is that the repeater receiver, when hearing a ±15 kcs signal should cause the repeater transmitter to deviate ±15 kcs but no more. This must be checked through a range of inputs, though a signal deviating, say ±5 kcs should not cause the transmitter to deviate ±15 kcs. The transmitter will not always deviate the same as the received signal, due to nonlinearity and other equipment vagaries.

Site Selection

The selection of an effective site is paramount to the realization of the maximum performance of a v.h.f. repeater system. Many factors will predicate the choice of a site for a repeater system.

Basically, the site must satisfy the general coverage requirements. Since cost is often a factor in amateur work, compromises must have to be made. The following requirements will have to be met;

A) **Power**—Remote sites won't generally have a.c.

B) **Shelter**—Should offer freedom from vandalism; preferably a building or shack.

C) **Height**—Should be well above the surrounding terrain.

D) **Antenna Support**—Should be located beside the building and of necessary height for vertical antenna separation if cavity resonators are not used.

E) **Accessibility**—Maintenance will be required so site should be accessible by vehicle

F) **Cost**—If an existing structure is used rent may have to be paid, or if a building must be provided the cost will have to be absorbed somehow.

Of course, prospective sites can always be checked by field tests by operating a mobile at the proposed location. In this way, practical observations can be made to assess the coverage and performance aspects of a particular site.

Conclusion

V.h.f. f.m. communication is possibly the best means for reliably covering a large metropolitan area. For the amateur it is without a doubt the most economical way to provide reliable communications. A properly developed repeater system will provide good reliable communications over several thousand square miles. Such a system would make an ideal club project and provide an excellent emergency radio service for the public. Considering the cost, this form of communication is an excellent way for everyone to occupy part of six and two meters and justify our exclusive use of these frequencies. ■

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EXTERNAL-ANODE TUBES AND THE RADIO AMATEUR

BY LEE AURICK, *K3QAX/W2QEX

The cover photograph of the November 1967 issue of CQ showed one of the new external-anode, ceramic-metal power tubes, and many of its parts. This article encourages you to make use of these tubes by discussing what they are, and showing how you may benefit from their unique advantages.

EXTERNAL-anode tubes have been available o the amateur for more than a dozen years. Despite this fact, amateurs who build their wn equipment have been slow to accept the nany advantages they offer.

Today, many manufacturers are designing uch tubes into equipment intended for ama- eur use. If the economics and performance f external-anode tubes are so appealing to ost- and performance-minded professionals, hy haven't "roll-your-own" amateurs taken o these tubes more readily?

The answer, or answers, may perhaps be ound in a reluctance to change from the amiliar "bottles" the amateur has known for nany years; the seeming complexity of soc- eting and cooling the new tubes; and a lack f familiarity with the many advantages that ccompany these tubes.

Some Old Problems

If you ask any ham who has tried to build v.h.f. or u.h.f. rig with a glass tube what ne of his most critical problems has been, e'll tell you, "Coupling. You just can't couple o the plate in an efficient manner." And if ou can't couple efficiently, you can't get all he power you want out of the tube. Tank ircuit leads are understandably small above 0 mc, and the task of coupling to internal- node tubes causes tank circuit inductances o all but vanish. Because the output capaci- tances of these tubes are also generally higher, the tank requirements are further compli- cated.

Although the coupling problem is almost

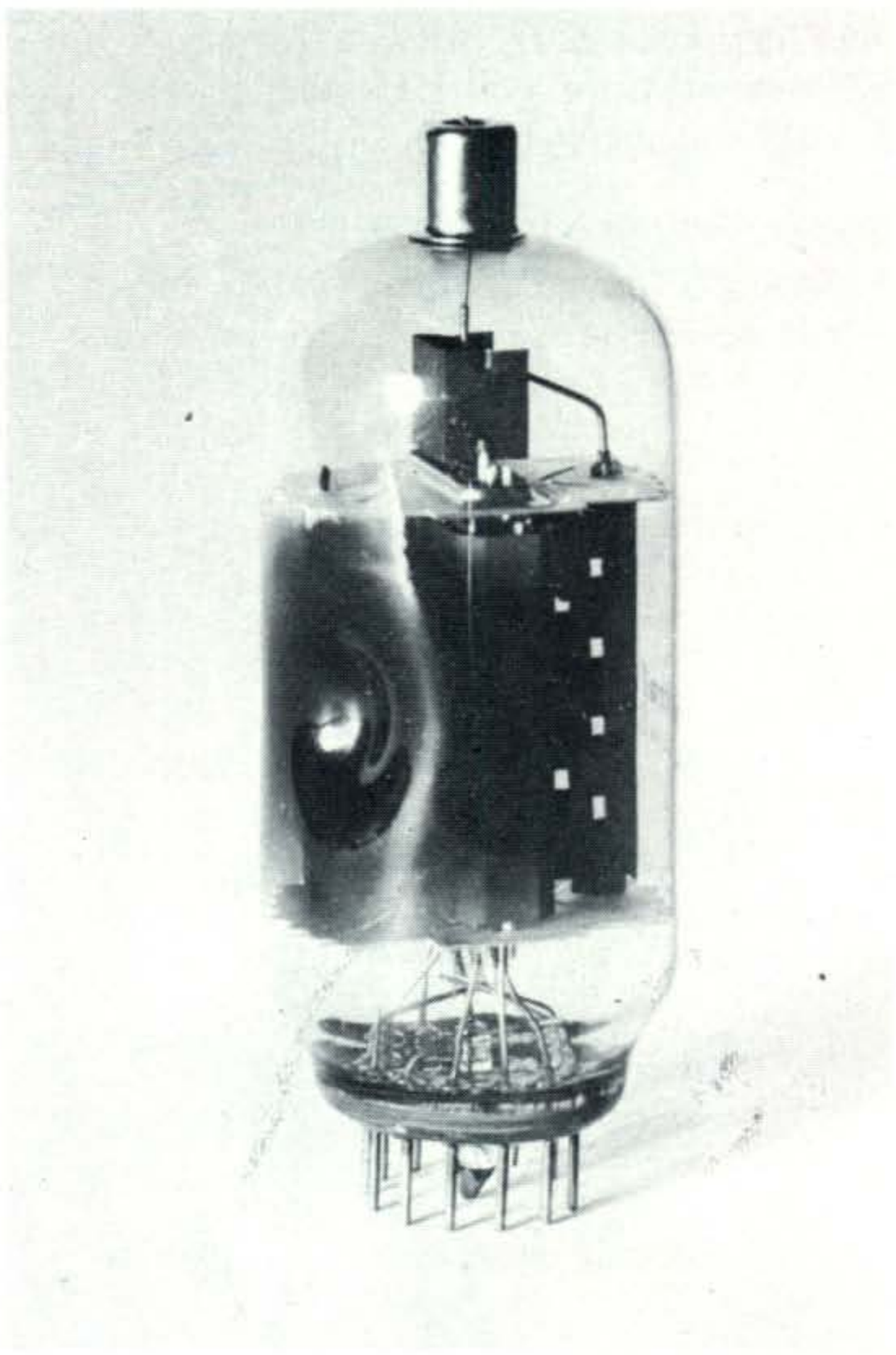

Fig. 1—When r.f. losses in the glass envelope cause excessive heat "suck-in" occurs as shown above.

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Fig. 2—The electrical discharge machining tool and the G_2 and G_1 grid cups are shown before machining.

obvious, the next barrier is a little more subtle. It is encountered when glass envelope tubes are operated (in spite of lower efficiency) at increasingly higher frequencies. R.f. losses in the glass envelope became excessive and heat the envelope beyond the point where it can maintain its internal vacuum. The result is known as "suck-in" because the outside air pressure collapses the envelope. This is illustrated in fig. 1.

Some New Answers

The 4X150 family of power tubes, one of the first generally available to amateurs, solved one of these problems by placing the anode on the outside. The coupling problem was eased, efficiency improved, and new efforts were made to push on to higher frequencies. An increasing number of amateurs (professionals too) then began to encounter the "suck-in" phenonmen. The only answer to this problem was to get rid of the glass envelope.

Fig. 3—Partial cutaway of the grid assembly of a CERMOLOX® tube.

It was recognized that the 4X150 could be improved considerably by the substitution of ceramic material with the required degree of uniformity and tolerances then just becoming available. The result was the 7034/4CX150 family of tubes, which saw, and is continuing to see, wide application in amateur, commercial, and military equipments. In an evolutionary way, this tube family solved the two chief problems which had plagued circuit designers, both amateur and professional.

Search for a Better Grid

It still wasn't time to sit back and contemplate the beauty of all nature. The cause of minor variations between tubes had been under study for many years. (It is called tube-to-tube uniformity or, conversely, the lack of it.) These variations would be obvious to you in your rig, for example, when you plugged in new tubes and found they didn't draw quite the same screen grid or plate currents that previous tubes had. Of greatest concern to you would be the fact that two tubes might draw unequal currents in a push-pull rig so that a greater load would be placed on one tube, and an insufficient load on the other. Extremely small manufacturing tolerances, held to the limit of human skill and dedicated precision, accounted for some of these variations. Many more were perhaps inherent in the design of the control-grid (G_1) and screen-grid (G_2) structures.

In the assembly of these grids into circular cages, wires were welded, one at a time, from a ring at the bottom to a circular plate at the top. Grid G_1 was nested within G_2, and the entire assembly was then examined on an optical comparator which presented a greatly magnified image. Prior to locking each grid cage in position with respect to the other, the skilled worker selected the most favorable position, *i.e.*, the position where the wires of one grid would appear to eclipse the wires of the other. The opportunities for variation were several: accumulated tolerances in the indexing machinery where the grid wires were welded; and the skilled hand and

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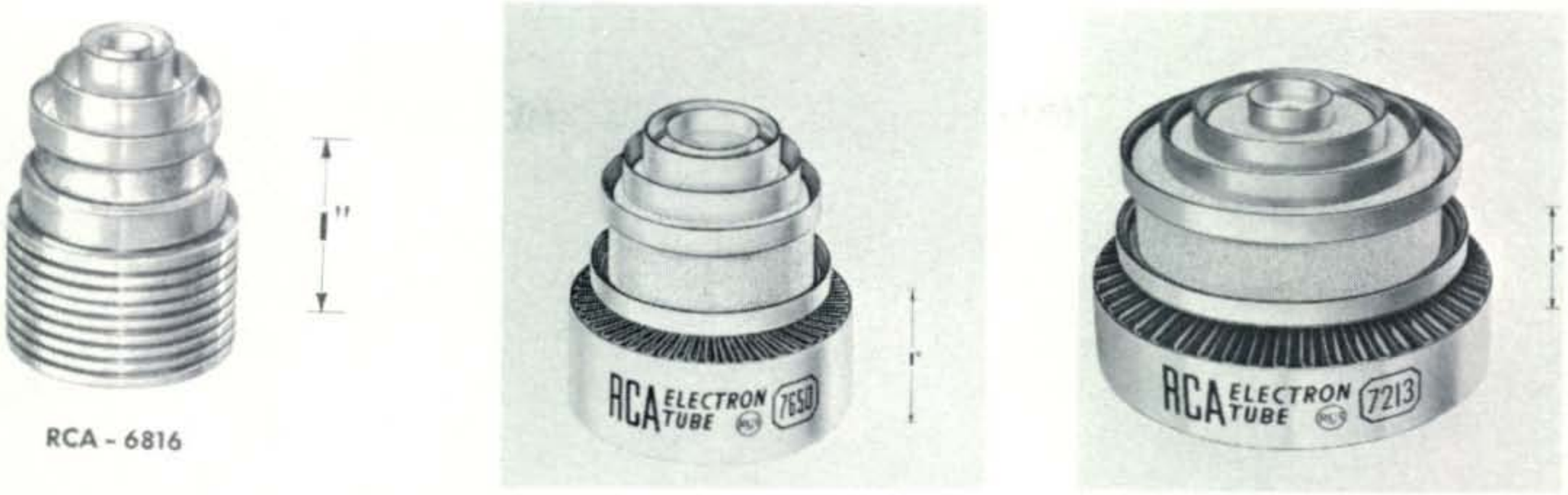

Fig. 4—The 6816 was the first of the tubes with aligned grids and was followed by the 7650 and 7213.

eye of the assembler. Engineering efforts were directed to a solution to these problems, and the answer was found in an entirely new approach.

Precision Grids

Someone reasoned that cutting or machining the grid wires with the same tool would ensure their uniform spacing. It was perhaps even easy to visualize the next step: one grid "cup" inside of the other, and in some way cutting opposing "wires" into each grid simultaneously, and by means of the same tool. The only problem then was how to do the cutting.

History does not record the painful process by which the answer was found, but the solution, fortunately, is now a fact of everyday manufacture. The metalworking industry had for years employed a process known as electrical-discharge machining. This process was developed to permit the machining of intricate parts and shapes that did not lend themselves to the more customary methods of cutting, grinding, and milling. Adapting this process to the machining of grids for tubes provided an elegant solution to a formidable problem.

In the manufacture of the new generation of ceramic-metal tubes, grid "cups", shown in fig. 2, are first locked together in a permanent assembly and immersed in water. A cutting tool, somewhat resembling an internal-tool gear, then descends toward the grid assembly at a precisely controlled rate. As the cutting tool comes within a few thousandths of an inch of the assembly, an electrical arc is struck between them. This electrical arc does the "machining"; the tool never touches the grid assembly. The nonconducting distilled water flushes away metal particles that are not consumed in the arc, and keeps the remainder of the assembly cool.

This technique provides perfectly aligned G_1 and G_2 structures, as shown in fig. 3, and the several advantages found only in this design. For the amateur designer, as well as the professional, one result is greater tube-to-tube uniformity. At replacement time, neutralization and grid-bias adjustments are eliminated; also, if you have more than one tube in the amplifier, you may be assured that each is pulling its share of the load. Of further importance to the s.s.b. operator is a new high in linearity not previously available.

The First of a New Family

The first of these new tubes, the 6816, (fig. 4) found quick application in commercial aviation communications gear and in military designs. A conduction-cooled version was one of the first true power tubes to be used in space, aboard the historic Pioneer V in 1960. Tubes in this family are known as CERMOLOX®.[1]

Since then, the 7650 and 7213, also shown in fig. 4, have been introduced. Slightly better known to amateurs, but even then confined largely to the lonely groups working on EME (moonbounce), these tubes have remained beyond the price which most amateurs can afford. Chiefly, this high price has been caused by a complex coaxial-electrode construction, costly in itself, and even more costly and difficult to socket because you cannot find ready made sockets at your local distributor.

Although CERMOLOX® tubes generally have been priced beyond amateur means, a new family of tubes that possesses many of their electrical advantages but simplifies the socketing is now available at reasonable cost. These tubes may be socketed simply in an eleven-pin Mycalex socket, No. CP464-2, or equivalent.

[1] A registered trade mark of RCA.

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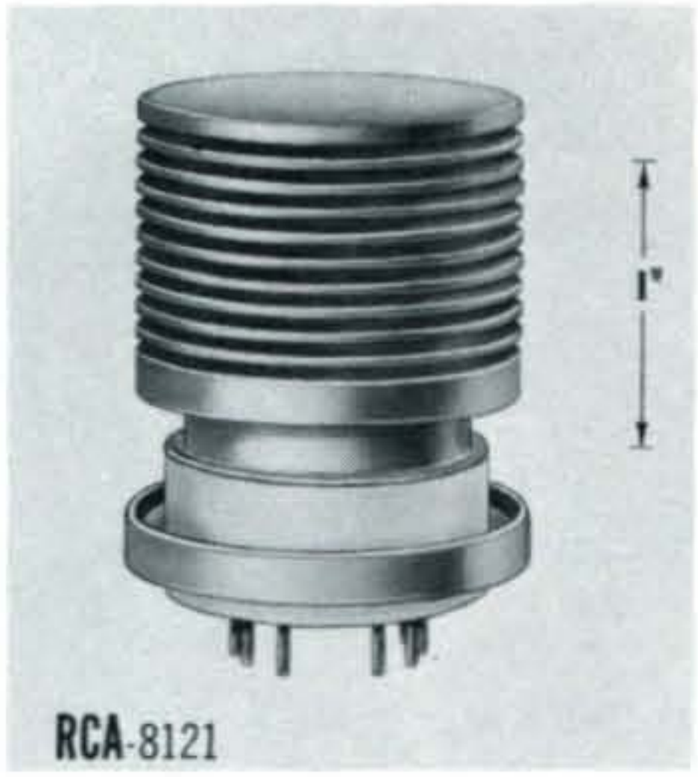

Fig. 5—The 8072 designed for compact equipment has no radiator and requires some form of heat sink. The 8121 and 8122 are electrically identical to the 8072 but have radiators.

Enter the 8072

The 8072, originally designed for compact, medium-power, commercial mobile equipment, at first glance may not appear of interest to amateurs because it has no radiator. In commercial applications, the heat generated in the plate, or anode, is dissipated through a beryllium-oxide block which provides a thermal path to the chassis, or some other heat sink, while providing insulation to d.c. Beryllium is expensive and difficult to work.

V.h.f. and u.h.f. experimenters, however, have employed the large-diameter copper tank circuits used at these frequencies to conduct heat from the plate and dissipate it into the air by natural convection. Rated to full input up to 500 mc and for 85 watts Class C c.w. power output at 470 mc, the 8072 offers the amateur medium-power capability in an amazingly compact package. To facilitate bypassing at the higher frequencies, the eleven-pin base offers three pin connections to the screen grid and three to the cathode. In addition, connection to the screen grid is made even easier by a ring near the base. The control grid has three pin connections.

The 8121 and 8122 are electrically identical to the 8072 and differ from each other only in radiator design and in their heat dissipating capability. Each requires some forced-air cooling.

The 8121 is also rated to full input up to 500 mc, for 275 watts Class C c.w. power output at 50 mc, and for 235 watts Class C c.w. power output at 470 mc. A blower, or fan, mounted within, or near the amplifier compartment and directed at the transverse fins of the radiator adequately cools the tube while it is socketed in the inexpensive eleven pin socket.

The 8122 has the highest heat-dissipatio capability and ratings of this tube family Also rated to full input to 500 mc, the 812 is capable of 375 watts Class C c.w. powe output at 50 mc, and 300 watts Class C c.w power output at 470 mc. Many amateurs hav utilized a compressed air hose to direct coo ing air through the vanes of the radiato Others use a small blower, and a sub-chassi mounted socket and chimney assembly. Th 8122 is currently delivering reliable servic in several commercially designed amateu equipments.

Perhaps the only real note of caution t be sounded in the operation of any of th tubes in this family is that terminal and pla (or radiator) temperature should not be pe mitted to exceed 250°C. Temperature-sens tive paints permit the amateur to check th point easily and economically.

The three tubes in this family offer th amateur a choice of power levels and coolin techniques for operation at all frequenci up to, and through, the 420 to 450 mc ban compactness; high gain; minimum scree grid current; and high-temperature oper tion. In many cases neutralization is n required through the 144 to 148 mc ban and it is easily accomplished at the high frequencies.

Perhaps it is time that amateurs brol with the "glass-bottle" tradition of ham radi and took the step to external-anode, cerami metal tubes. Regardless of the power level mode of operation, there is no more compa reliable, or efficient way to generate comm nications signals on today's crowded freque cies.

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AN ANTENNA TRACKING SYSTEM FOR SATELLITES

BY JOHN B. TUKE, *GM3BST

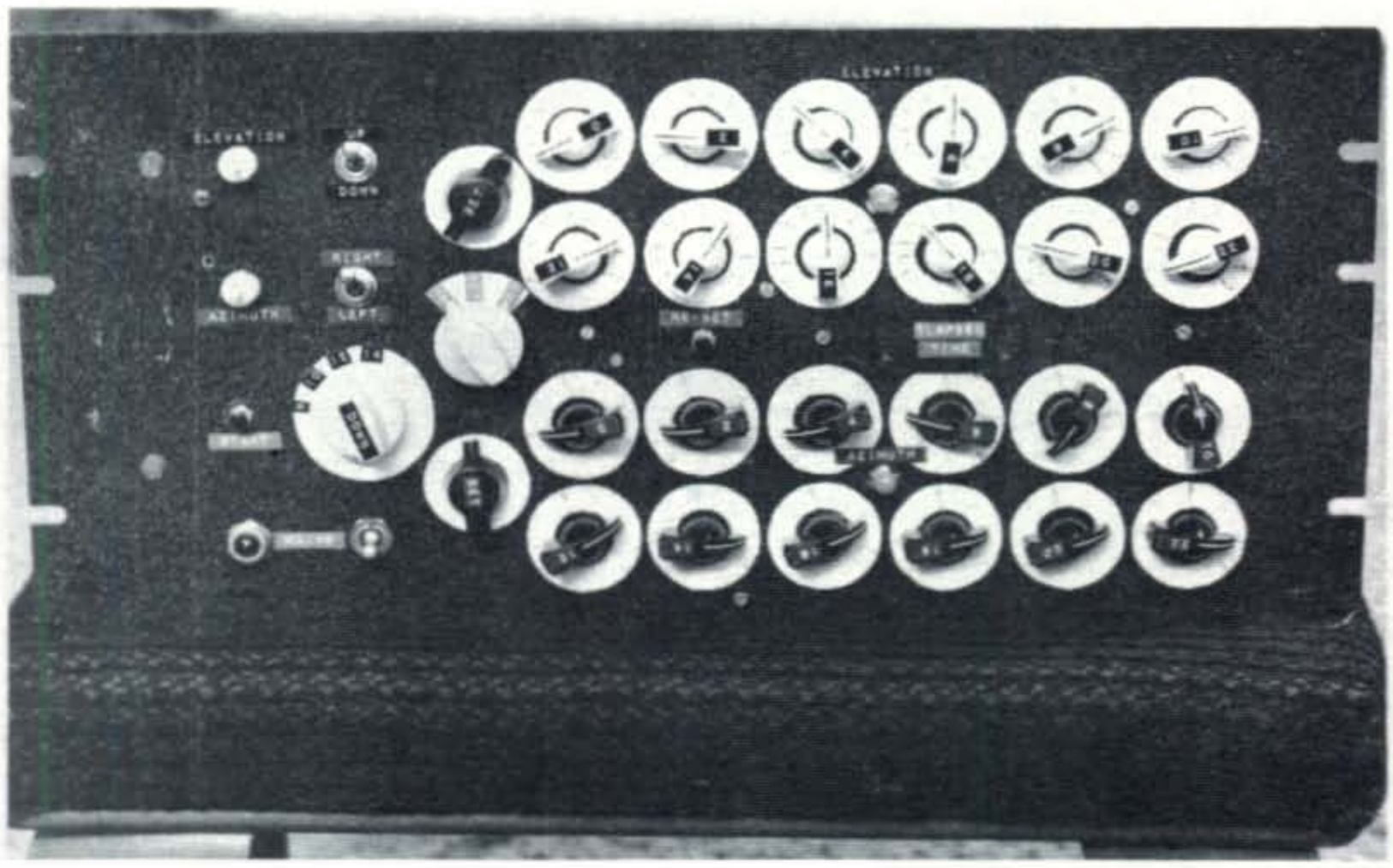
It is now almost two years since GM3BST became interested in copying signals from the American weather satellites, starting with Essa 2. The receiving equipment used was the basic facsimile chart recorder (described in an earlier article)[1] modified to take intermediate shades of grey between the black and white line-drawing type of picture one receives from standard weather chart transmissions. A low noise converter (Nuvistor type) fed into a specially constructed i.f. strip to handle the relatively narrow band f.m. signal from the satellite. The antenna consisted of a simple ground-plane fixed hopefully to the corner of the building.

Since the first pictures were received, a large number of modifications have been carried out to improve the pictures and also the range at which they can be satisfactorily copied. Of all these modifications the most effective has been to use a proper antenna. With the original equipment it was soon found that the ground-plane was pretty hopeless for serious work. There were great "holes" in the pictures where the signal had faded out even though the satellite was well within range. Various experiments with other simple antennas were largely failures and it was finally decided to do the job properly and build a helix. In the interests of simplicity this was first set up on a fixed bearing corresponding to the optimum of Essa 2 on an overhead pass, and the antenna was able to rotate through a full 180 degrees in the vertical plane. This provided correct tracking for the overhead case. The improvement in pictures was so dramatic that a fully steerable system was quickly added so that the antenna could point in any direction both in azimuth and elevation, control at that time being achieved by an ingenious arrangement of ropes and pulleys operated by hand.

After some months of this arrangement (which was highly satisfactory from the technical point of view) it was found that permanent blisters were appearing on the hands, and the arm muscles were becoming more suitable to a wrestler than a radio amateur.

* Torbank, McMasters Road, Stranraer, Scotland.

1 Tuke, J. B., "Copying Weather Pictures Via Amateur Facsimile," *CQ*, August 1966, p. 25.



Front view of the antenna tracking console used to automate the satellite antenna positioning unit.

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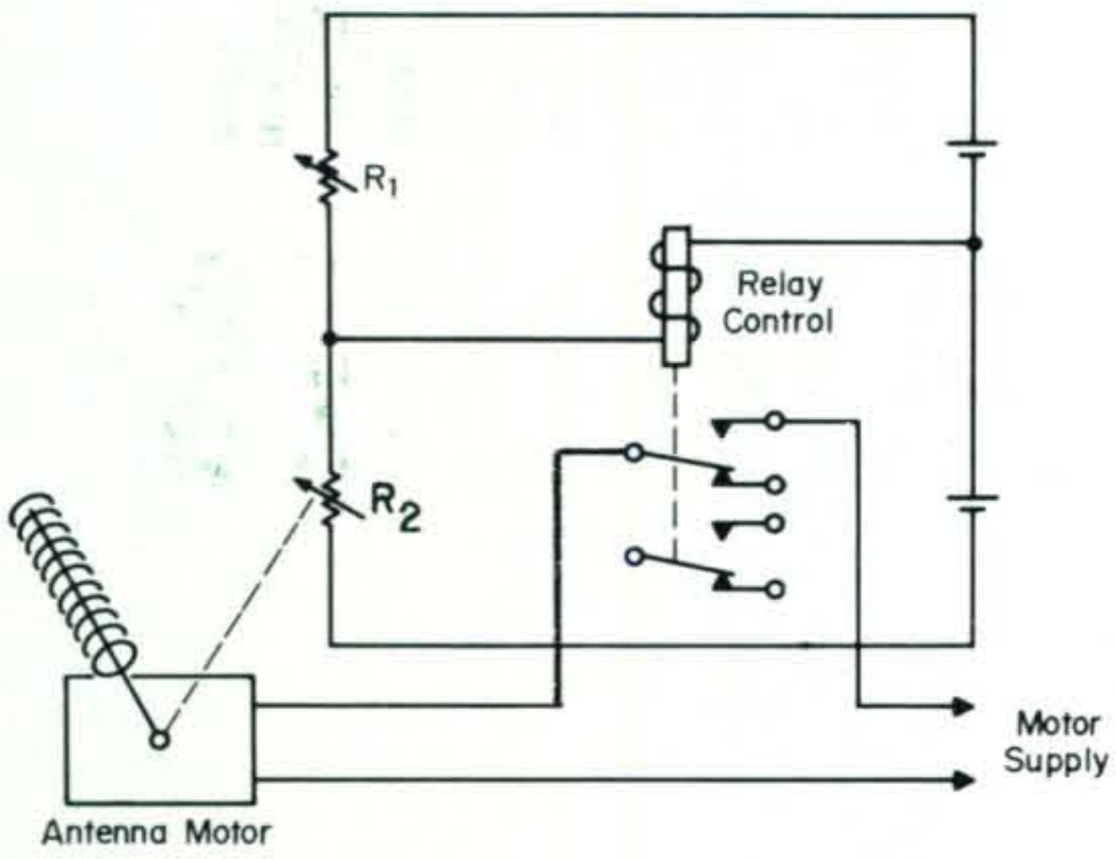

Fig. 1—Basic bridge circuit used to control the antenna position. Control R_1 is located in the shack and R_2 at the antenna.

Visiting amateurs, though impressed with the picture results were reduced to convulsive laughter at the sea-shanty type rope manipulation required to work the aerial, so a couple of motors were obtained to do the hard work. These were of the a.c. type and reversal of direction is arranged by reversing connections to one winding. Control was "manual" with two center zero switches, marked UP-OFF-DOWN and LEFT-OFF-RIGHT for elevation and azimuth respectively. Since the antenna is visible from the operating position, there was no need for repeaters to give direction indication.

Motorizing the antenna, however, brought some problems not encountered when it was operated by ropes. When the ropes were used, the antenna was simply swung around and finally pointed in the direction which gave maximum signal, and as long as it was known in advance whether the satellite was travelling from North to South or vice versa, and whether it was passing to the East or West of the QTH in so doing, that was all the "tracking data" required. But this was not possible once the motors were fitted. The helix is quite large (and the site fairly exposed to the wind) so very low gearing was used between motors and antenna. This gave an elevation speed of about 3°/sec., and an azimuth speed of about 2°/sec. Since the elevation never has to exceed 90°, this is ok, but in azimuth the aerial now required one and a half minutes for a complete half-turn, North to South for example, and though adequate for following a satellite once it had been acquired, it was necessary to have a pretty good idea which way it was going. The days of hopefully waving the antenna about for maximum signal are passed once motors are fitted, and it became necessary to tackle the antenna tracking a bit more scientifically.

Obtaining Tracking Data

With regard to the Essa satellites, it is necessary to copy the data broadcast on RTTY or by other means, or alternatively to "keep an eye on" the satellite for some days and then work it out on your own. With the Nimbus 2 satellite, things are much easier, for if one can copy one picture sufficiently well enough to read the data code down the side, this will give the required information for future use. Even so, no matter how one obtains the necessary data, the satellite's track is plotted on a great-circle map centered on the North Pole, and one ends up with a number of individual satellite "positions" with reference to time. A bit of math or consulting tables will then convert these individual positions into antenna directions in azimuth and elevation.

Asc an example, using the writers QTH as the ground terminal it can be found that if Nimbus 2 were to cross the equator at Longitude 10°E. on a particular day then the following tracking table would apply:

Minutes after crossing equator	*Antenna Azimuth*	*Antenna Elevation*
13	174	31
14	178	38
15	188	49
16	218	68
17	272	71
18	315	52
19	325	45
20	330	32
21	333	24

Similar tables would be made out for different equatorial crossings on different days.

The time at which the satellite crosses the equator (known in this case as the "Ascending Node" since the satellite is North-bound) is always one of the items known from the basic tracking data, and the addition of this stated time to the time in the table given above will convert the antenna positions into real-time positions; that is to say, if we assume that Nimbus 2 crossed the equator at 1030 GMT, then at 1030 + 15, or 1045 the antenna should point 188° from the true North and be elevated 49° above the horizon. Two min-

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utes later, at 1047 these directions should be 272°/71° and so on. Armed with a table such as this, all that is necessary is an accurate watch or clock, and the antenna motors are operated to produce the required results.

After doing this one or twice it was found that instead of trying to move the antenna almost continuously, it was sufficient if it were moved in steps of two minutes. This is because the beam is quite wide (about 30°) and the satellite signal is a good *S*9 most of the time anyway. This reduced the antenna handling to a reasonable arrangement, and the system was pretty good. There remained the fact however, that a good bit of time was spent fiddling with the antenna controls. This time could be better spent on the electronic equipment, if the antenna could be programmed with the information in advance and then left to look after itself. So the drawing board was taken out of the cupboard under the stairs, the pencil sharpened, and a suitable unit designed.

The Tracking Unit Basics

To reduce the problem to its simplest solution, what was required was three separate things. 1. A pair of controls in the shack which could set elevation and azimuth to a given position, knowing that the antenna would then move to this position. 2. A number of such similar pairs of controls to be set to positions in advance, and some sort of step system to connect the controls to the antennas in sequence at two minute intervals. 3. An indicator to show just where one was at any given moment in the progress through the programmed track. Additionally, some simple device to return the antenna to its normal "at rest" position would be useful. If one is going to have automation, one might as well do it thoroughly! There is nothing like laziness as a spur to automated design!

Problem one, the actual controls, has a number of solutions, but the one adopted at '3BST was to use what is really a bridge circuit to control the antenna motor switching, where one arm of the bridge is represented by a variable resistor at the control point, the second arm being a similar resistor mounted on the antenna itself, and controlled by its movement. Figure 1 shows the basic circuit and for simplicity it is assumed that we are thinking of elevation. If R_1 (in the shack) is calibrated in degrees elevation corresponding to the resistance value of R_2 at any particular position of the antenna, then only when the antenna elevation and the

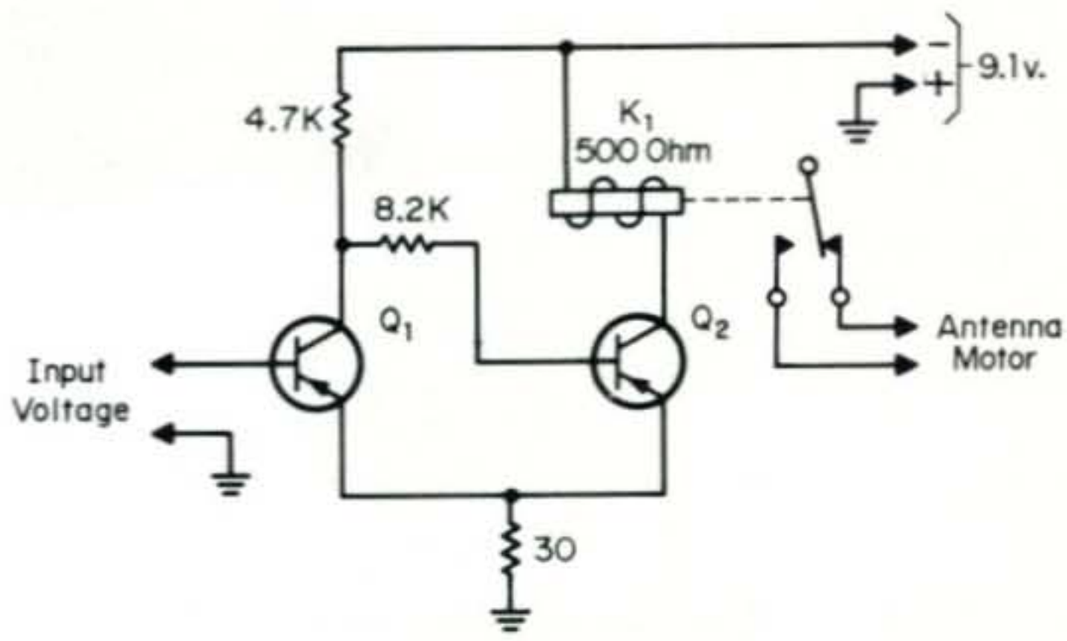

Fig. 2—Schmitt trigger circuit used to provide instant on-off operation for the control relay, K_1.

pointer of R_1 are at the same position will there be no current in the control relay. Shift R_1 to a new setting and a current will flow, and if this is arranged to switch the antenna motor in such a direction as to cause R_2 to "chase" R_1, the antenna will elevate until it has reached a position where R_2 equals R_1. At this point current will cease in the control relay winding and the antenna motor is switched off. This system has the advantages of simplicity, and also that no "indicator" is required in the shack; R_1 already does this.

The control relay must be simple and reliable; it must also have a snap-off snap-on action. The use of a simple relay means that as R_1 and R_2 become equal the relay slowly opens, causing arcing at the motor control contacts. To avoid this, in the practical unit, the bridge operates a transistor Schmitt trigger, which in turn operates the motor relay. This handy little circuit (shown in detail in fig. 2) switches Q_2 from conduction to non-conduction practically instantaneously when the applied voltage to the base of Q_1 moves over a given point. If the trigger is substituted for the control relay winding in fig. 1, then when the ratio of R_1:R_2 is such that the voltage is just over +0.6 v. the relay will be ON, whereas if it is such that the voltage is just over about 0.7 v., the relay will be OFF. The transition from one state to the other will be quite sudden, no matter how slowly the controls are moved. The slight difference between ON and OFF voltages (the differential) means that if R_1 is being increased, and a number of calibration points are obtained, then when it is being decreased, these points will show a slight error in calibration. In practice this differential has been found to be too small to be significant.

Reversing

Many readers will already have seen that in its present form the system will only work

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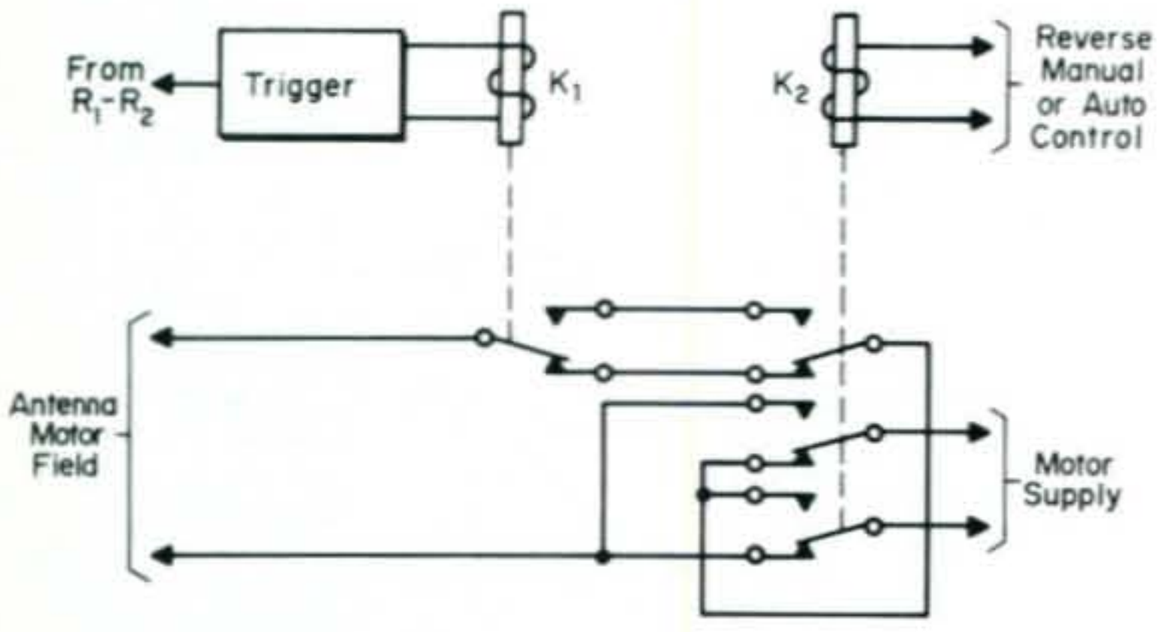

Fig. 3—Reversing circuit makes use of relay K_2 to reverse the motor direction.

in one direction. If R_1 is set to a point where the relay comes ON, the antenna will move until the R_1:R_2 potential shuts the relay off. If R_1 is now turned *back* this will merely increase the potential in the OFF direction, so nothing will happen. Two solutions to this were considered. The elegant one is to use two triggers working on opposite polarities, one of which would also operate the motor reversing relay. This was rejected after some trials due to increased differential (individual trigger differentials add when used in pairs) and unnecessary complication. A much simpler solution was to use a second relay for reversing the motor, and to make the relay in the collector circuit of Q_2 a s.p.d.t. type in place of a simple make/break. Figure 3 shows how this works out. The reversing relay is automatically controlled to operate at a specific time point in the sequence—this being the moment when the satellite reaches maximum elevation.

Azimuth

Azimuth control is similar, with identical resistor and bridge circuits operating a second trigger and changeover relay. In this case it is sufficient if the direction is set manually before the start, since no weather satellite goes first North, then South, then North again. The azimuth control can be considered identical to fig. 3 without the automatic direction change.

Sequencing

The second design problem, sequencing the controls, was relatively simple. We have, at the moment, a system whereby the setting of two resistors controls the position of the antenna. All that is now required is a multiposition switch, with at least two poles, to switch in pairs of resistors in turn. The switch must be electrically operated, and must "step" at two minute intervals. In practice this "switch" became a three pole 25 circuit ex telephone exchange uni-selector, commonly called a stepping relay. One bank switches the azimuth resistors, and the second bank switches the elevation.

The timing sequence has been obtained from an old electric clock, the original movement of 1 rev/second being geared down and fitted with contacts so that a "make" occurs once per minute. This steps the uniselector up one step. Since there are twenty-five circuits on the selector, and it steps every minute, adjacent steps are wired together, giving a change of controls every two minutes.

Indicator

Problem number three, an indicator, was solved by using counter neon tubes. These are multi cathode tubes, where each cathode energizes a separate figure in the sequence 0 to 9. A pair of these was used, to provide a full 25 minutes of tracking, and the appropriate cathodes were energized via the third bank on the stepping relay. Once the sequence has started, the figures visible on the neon tube shows directly how many minutes have elapsed since tracking commenced. This figure of 25 minutes is ample for the weather satellites, but could, if necessary, be extended by using a stepping relay with more circuits. In fact, most weather satellite passes only last 10 to 15 minutes.

The Completed Unit

Having sorted out the basic problems there only remained the task of dovetailing the whole thing together. The unit was built on a 19 inch rack and panel as shown in the photograph.

The point at which the antenna elevation motor would cease to move *up* and move down instead can be preset between 8 and 14 minutes after tracking commences. This is arranged by switching the reversing relay on to the cathode of one of the time indicator lamps. Say it is switched to minute 9; then when the lamp lights on 9, the voltage is also applied to the reversing relay, and after that, the antenna will lower instead of raise. This reversing relay is fitted with latching contacts, so that even when figure 9 becomes de-energized, the relay remains in the down position.

The full circuit diagram is a series of repeats of one particular position, and there would be no point in reproducing it in full. However, fig. 4, which is restricted to three positions only will show how everything is put together.

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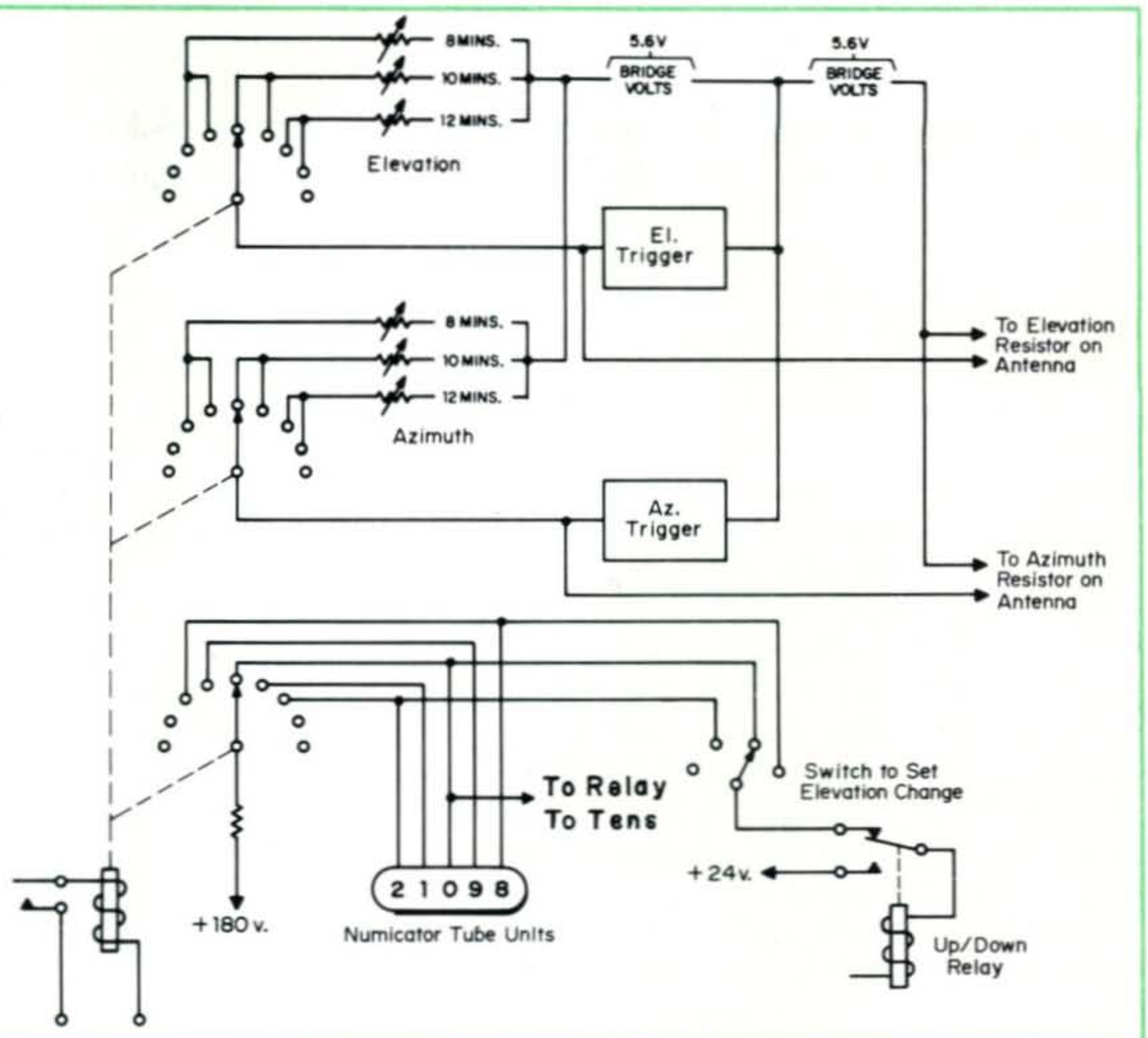

Fig. 4—Overall tie-in of the antenna control unit. The 3 pole stepping relay is energized once a minute by a modified clock.

As a refinement, a FUNCTION switch was added. In the normal position, this connects the triggers to the stepping relay and thus to the pair of controls in sequence at that moment. If placed to SET it connects them to a single pair of controls, not on the sequence; these are preset to the antenna's AT REST position, and return the antenna to this position when not in use. A MANUAL position disconnects the automated system, and reverts to manual switching; this is handy if something goes adrift while tracking or if it is suddenly discovered that yesterday's tracking data has been set up by mistake, just as the satellite is appearing over the horizon.

To assist in future maintenance (by which time even the writer will have forgotten how it works) the wiring was carried out in a prearranged color code. To say there is rather a lot of wiring is to put it mildly. The circuit is simple—but there's a lot of it. A self contained power supply is fitted which provides the necessary 9 volts for the triggers, a stabilized 5.6 volts for the bridges and 200 volts to operate the indicator neons.

Using the Unit

Just how much easier life is since this unit was built can be seen by taking an imaginary satellite pass and considering what now happens.

Referring to Nimbus 2 (summertime) reliable picture reception can be counted on from about 11 minutes after the satellite passes the equator to about 26 minutes after, at the QTH here. A tracking diagram is prepared and the positions set up on the pairs of controls. The time at which the satellite reaches maximum elevation is also set, together with the left/right control for azimuth. Everything is then ready, and exactly 11 minutes after the satellite has crossed the equator, the clock mechanism is started—and that is all there is to it. After that, the antenna looks after itself. A glance at the indicators will show at any moment just where the satellite is in its pass with reference to time, and the antenna steps happily away at two minute intervals until the satellite has gone. The function switch is then put to SET and the antenna returns to its normal homing position, either to await further use, or to be bolted down until the next day. It's all too easy!

Accuracy of Tracking

Sometimes during a transit, it is observed that the signal strength falls, to some extent, below that which would be expected. Since straight forward fading is normally only experienced when the satellite is low down over the horizon, it was considered possible that

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this loss of signal could be due to inaccurate tracking. In fact, on investigation, the errors were found to be due almost certainly to site obstructions which create a condition where, at times, maximum signal does not come truly from the satellite's direction. This is similar to siting a television receiving antenna where best results are often obtained on a trial and error basis, and not by laying a compass bearing from the chimney top to the transmitting station. Although now satisfied that tracking errors are small it is interesting to consider what these are and how they may be kept to a minimum. This could be important if the system were to be used with an antenna having a narrow beam.

Accuracy depends on a number of things. Firstly the differential of the Schmitt triggers. This is not a serious matter, and if the error introduced (about 3°) were important, the controls could be calibrated for each direction, thus removing this particular error entirely. This differential error could be reduced below 3° by increasing the bridge voltages, but it would be necessary to connect pairs of zener diodes across the trigger inputs to prevent large voltage inputs from destroying the transistors. This can occur particularly in the azimuth case, on an overhead pass, where azimuth remains practically constant until the pass is half over, and then a 180° movement is required in a single two minute step. But with precautions, there is no reason why the bridge supply voltages should not be appreciably larger than that used in this unit.

One source of error which looks like a large trigger differential, is mechanical slackness in the system. If the antenna rotates say, a further 5° after the motor has stopped, then this error will always be present. The cure of course is peculiar to that particular mechanical set up, and has nothing to do with the tracking unit.

Another source of error is the variable resistors themselves. Since the resistors fitted to the antenna itself are in use on all positions, it is best to use a good quality job, but as regards the resistors on the console, since there are 26 of them, it would not be far wrong to say that the accuracy and cost are directly proportional. In the '3BST unit, ordinary TV type wirewound pots are used. All these are hopefully stamped "linear", but there is quite an amount of variation between them, and resetting accuracy is not all that could be desired. But before buying very expensive items, it is worth considering what accuracy is required for this particular application. The beam of the helix is about 30° wide for 3 db points, and the unit does not seem to introduce errors exceeding ±8° at the most, so it is well suited to the antenna and that is the important thing.

Conclusion

For use with the weather satellites, the tracking unit does a useful job—and it could obviously be used to track any satellite in a similar orbit—and this will presumably include any future OSCAR spacecraft. To know that the antenna tracking was "spot on" would obviously be a help when using OSCAR. The transit of a fairly low autitude satellite is pretty short anyway, and there is plenty to do without having to attend to antenna tracking.

GM2BST considers that a new system is a success if it makes for easier and more efficient operating of the equipment and the antenna tracker certainly does this. Probably the next step will be to automate the picture equipment! ■

BY THE WAY...

Skywide Amateur Radio Club Display

Here's Stan Pikul, VE3FFA, manning the Skywide Amateur Radio Club booth at the recent Sportsman Show held in Toronto. Thousands of people visited this display and watched the operation of the club station, VE3RSO/3. The club has approximately 50 members including 10 s.w.ls.

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THE FORTY METER ARC PORT MODEL II

BY ED MARRINER, *W6BLZ

VACATIONERS, Ahoy! Here is the ARC PORT Model II[1], for *forty meters*. It is a c.w. transmitter and receiver covering 7.0 mc to 7.3 mc and it only weighs ten pounds. This article was written for those amateurs with lots of time, who like to tinker and have only a minimum of tools and working space. This unit is a classic for a complete station. It has an input of 30 watts and will fit into a zipper bag; nice if you happen to be going on a trip. The unit is different from the original model because it uses the 6 to 9 mc receiver and has been improved mechanically.

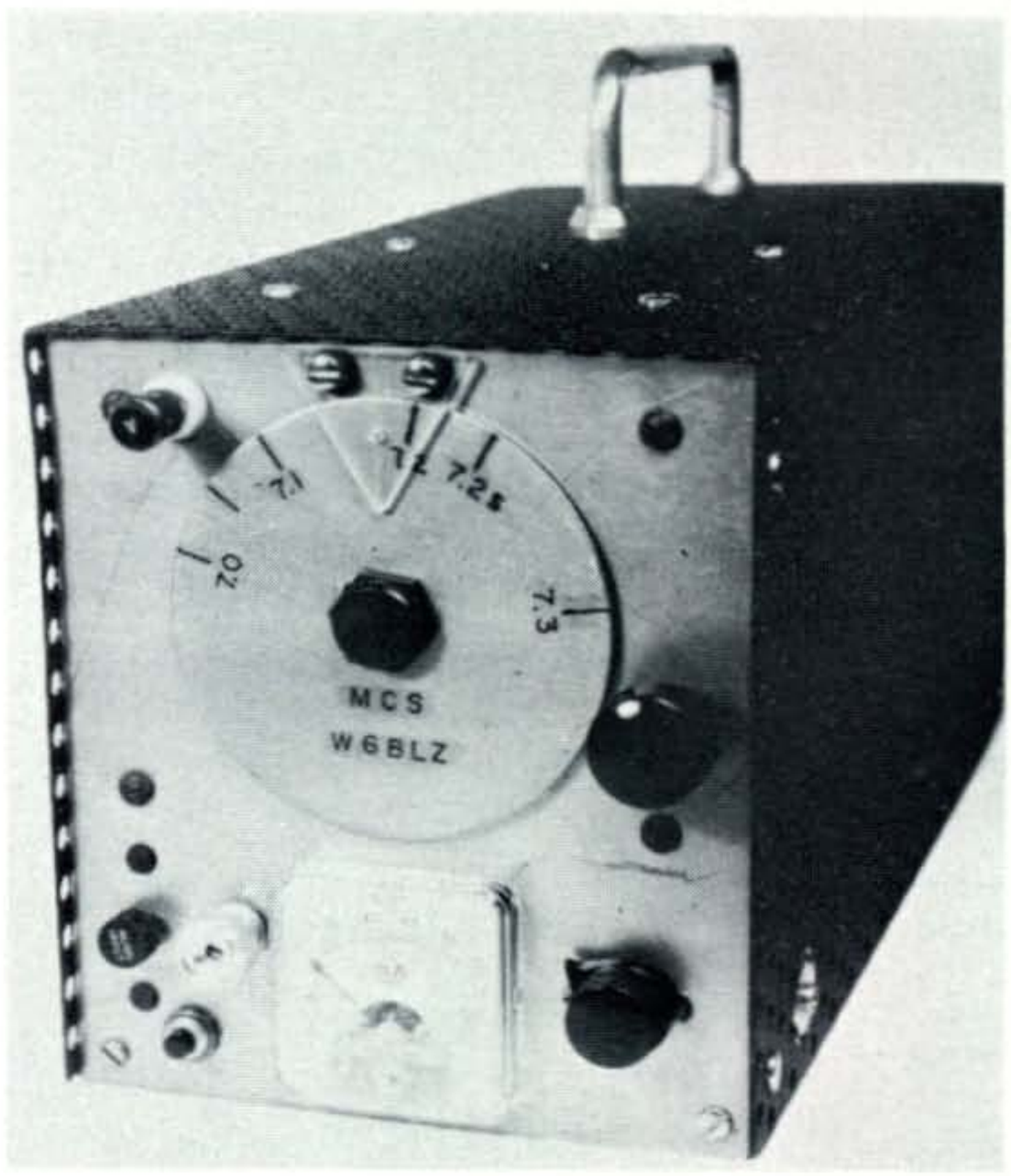
Essentially, the receiver is modernized and improved by replacing parts. The transmitter and power supply are built on the back apron, while the v.f.o. tuning is moved into the front compartment.

How to Start

The receiver should be checked after each part has been changed. In fact, the receiver should first be checked out with the 12 volt tubes in place, after the filaments have been rewired to put them all in parallel. For c.w. operation the b.f.o. line (red wire) has to be grounded, and an i.f. gain control added. (A 5000 ohm potentiometer is connected from the green lead to ground.) After the receiver is working, substitute 6 volt filament type tubes.

Only do one change at a time and check the receiver to see that it still functions. First, the big mica capacitors mounted along the sides of the chassis can be removed and replaced with 0.02 disc types. Next, there are a lot of parts to be removed to make room for the transmitter components and mounting of the new 7500 ohm to voice coil output transformer.

Using nippers cut the rim on J_1, J_2 and J_3 plugs and the motor mount rings, and remove them. Take out the filter chokes, L_{13}, L_{14} and capacitors, C_{16B}, C_{32}, C_{16C}, C_{7C}, C_{15A} and resistor R_8. You should have a yellow wire going to the junction on the top of the two black vertical resistors for screen voltage, a yellow wire (or green, depending on the set) for the filaments, and a red wire for the 12A6 plate supply to connect on for testing. This part takes a little reasoning but should be within the average amateur's ability. Put in the new output transformer and at the same time replace the brown mica capacitors bolted to the chassis with disc type. Is the receiver still working?



Front view of the ARC-Port Forty Model II. The CALIBRATE pushbutton switch is just below the ANTENNA ALIGN knob. The AUDIO GAIN control is just to the left of the plate current meter and the V.F.O. TUNE is just to the right. The case is made from do-it-yourself aluminum stock.

* 528 Colima Street, La Jolla, California 92037.

1 Marrimer, E. H., "The ARC-Port," *CQ*, Dec. 1964, p. 26.

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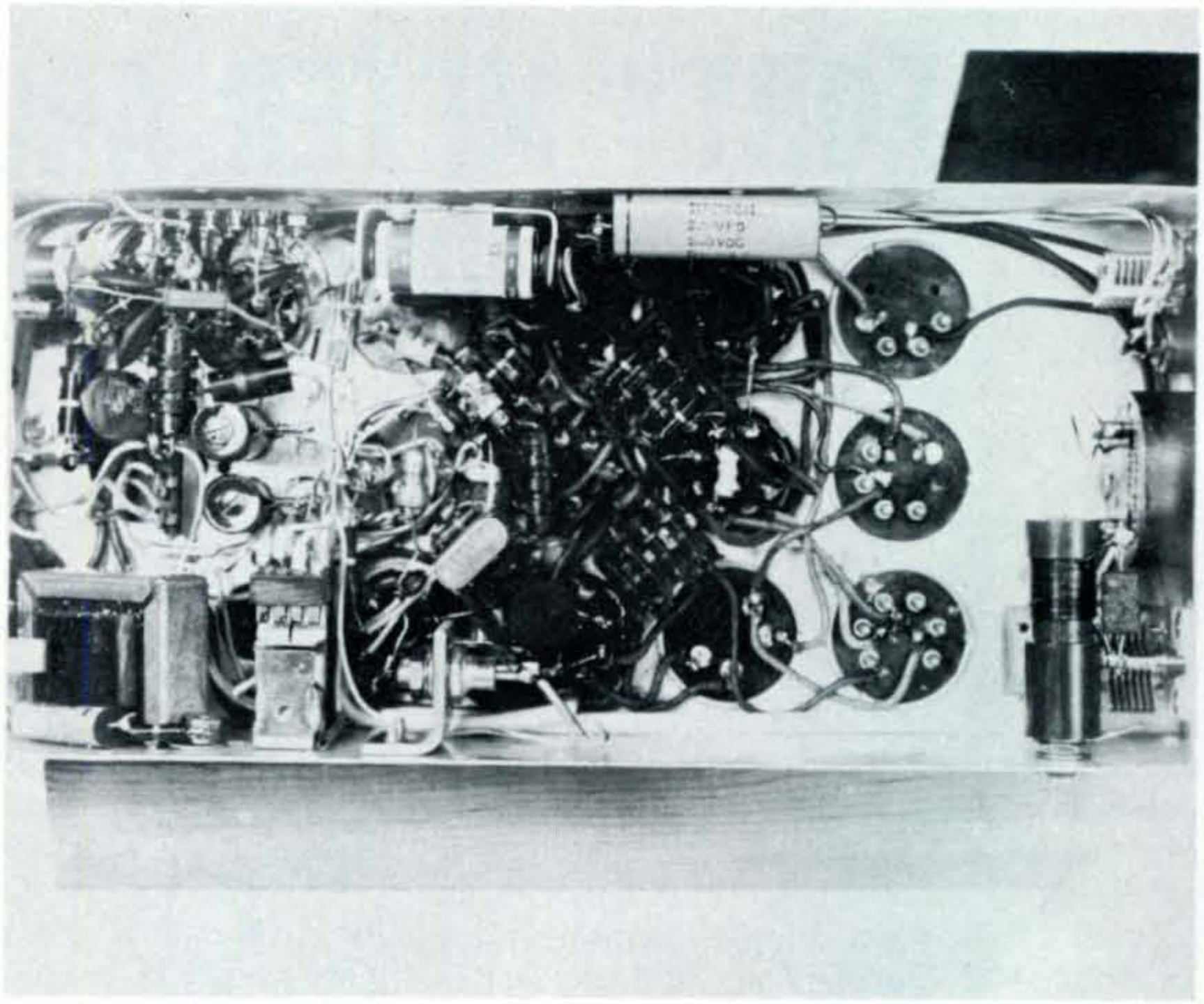

Bottom view of the ARC Port Forty, Model II, shows the component layout. The v.f.o. coil and tuning capacitor is shown bottom right, at the front panel. The antenna trimmer (original component) is in the upper right corner. In the upper left corner of the chassis the doubler plate coil form can just be seen followed to the right by the power supply diodes and shunt components mounted on a terminal board. To the right of the diodes is the keyer battery. On the left side of the bottom flange of the chassis is the audio output transformer, the relay K_1 and the two zener diodes.

The next order of things to do is replacing the detector tube with a diode product detecthe detector tube with a diode product detector so that a 40-40-40 mf at 450 volts capacitor can fit into the old socket hole. The circuit is shown in fig. 1. The 12A6 socket is removed and replaced with an Amphenol 9 pin adapter socket, and is rewired for a 6CX8 audio stage, and crystal oscillator b.f.o. (2831 kcs).

About this time the power transformer can be mounted on the chassis and a back panel made and the parts mounted. Also on the back panel are the two pi-network tuning capacitors and the diode rectifiers. Before putting the panel in place be sure and use long mounting screws to hold the power supply ten watt filter resistors. Placing the resistors above the chassis will reduce the heat level under the chassis. A ¾" hole has to be punched between the motor mount holes for the 6CX8 v.f.o./doubler tube. Both the final and this tube will fit if it is laid out properly.

Bandspreading

Once the receiver is finished it can be band spread by removing all but two of the tuning plates as shown in fig. 4. The coils have to be padded with 100 mmf silver mica capacitors on the oscillator and mixer coil to bring the tuning back into range. The antenna coil only needs 60 mmf to pad it.

During the destruction of the receiver the a.v.c. line parts were removed; this leaves some of the grids open. Ground the 2 megohm resistor on the r.f. tube. It is located topside on the antenna coil. Make sure that the last i.f. tube grid resistor returns to ground. Without writing a step by step book, this information should about clean up the explanation of modernizing the receiver. The photo-

Fig. 1—Circuit of the receiver modifications and two tube transmitter added to an ARC-5, 6-9 mc receiver for a portable 40 meter station.

C_1—47 mmf variable, APC type with ¼" shaft.
C_2, C_3—365 mmf tuning capacitors, J. W. Miller #2111 or equiv.
CR_1, CR_2, CR_3, CR_4—Silicon diodes, 100 ma or greater; 400 to 600 p.i.v.
CR_5, CR_6—100 volt zener diode 10 watts, or two 50 v. 5w units. See text.
CR_7, CR_8—Germanium diodes, 1N38.
CRK_1—7K to 10K relay coil, 4 p.d.t.
L_1—18 t. #20 e., on National XR-50 form without slug.
L_2—18 t. #20 e. on slug tuned XR-50 coil form.
L_3—27 t. #18 e. closewound on a ¾" form.
M_1—O-100 ma miniature panel meter (1½" dia.).
T_1—Output transformer, 7.5K to 3.2 ohms. Stancor A-8114 or equiv.
T_2—Power transformer—260-0-260 v.a.c. at 90 ma, 6.3 v.a.c. at 4 amp. Stancor #8404 or equiv.
Y_1—2381 kc crystal; International Crystal type F-700 with wire leads or equiv.

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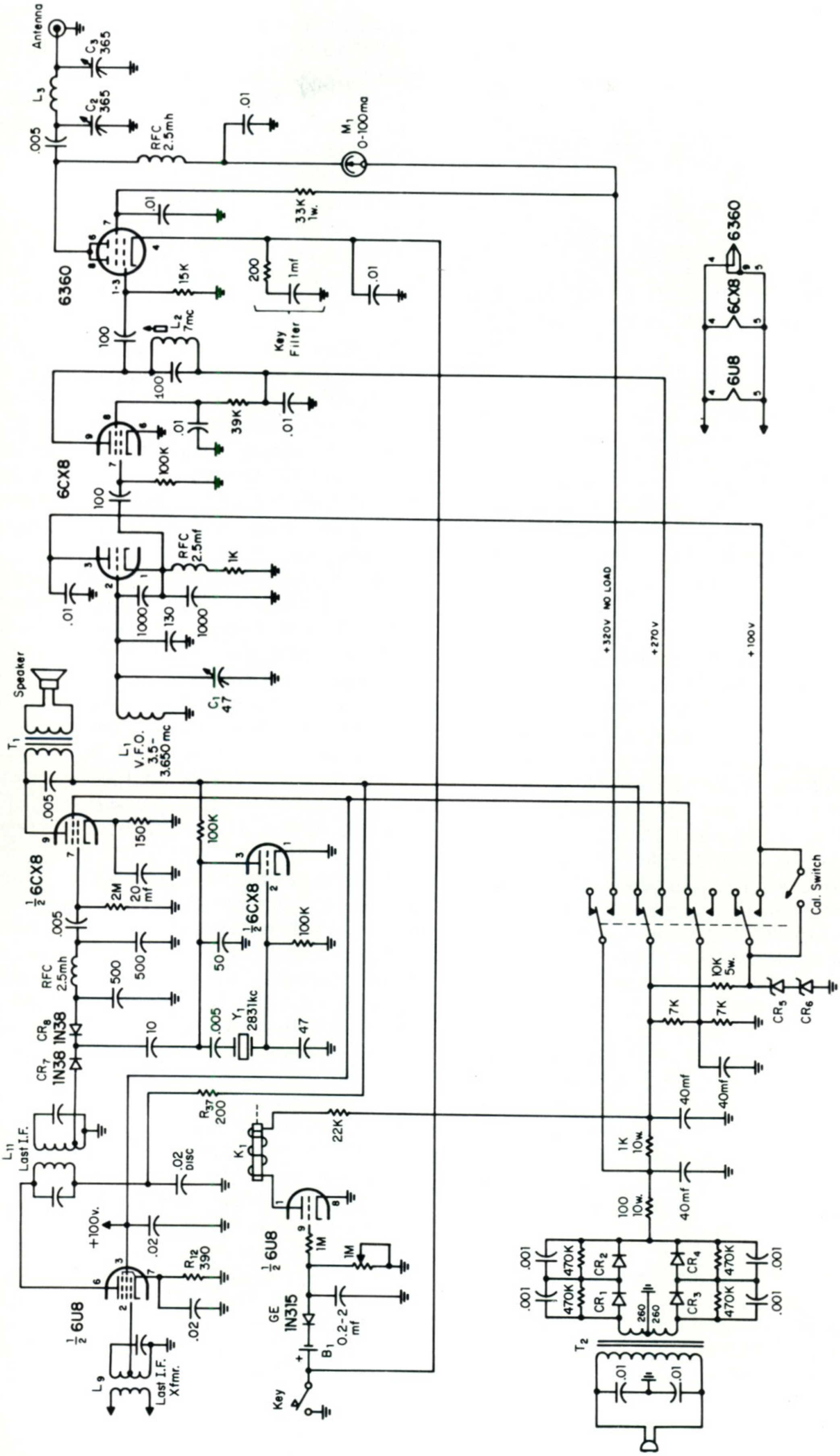

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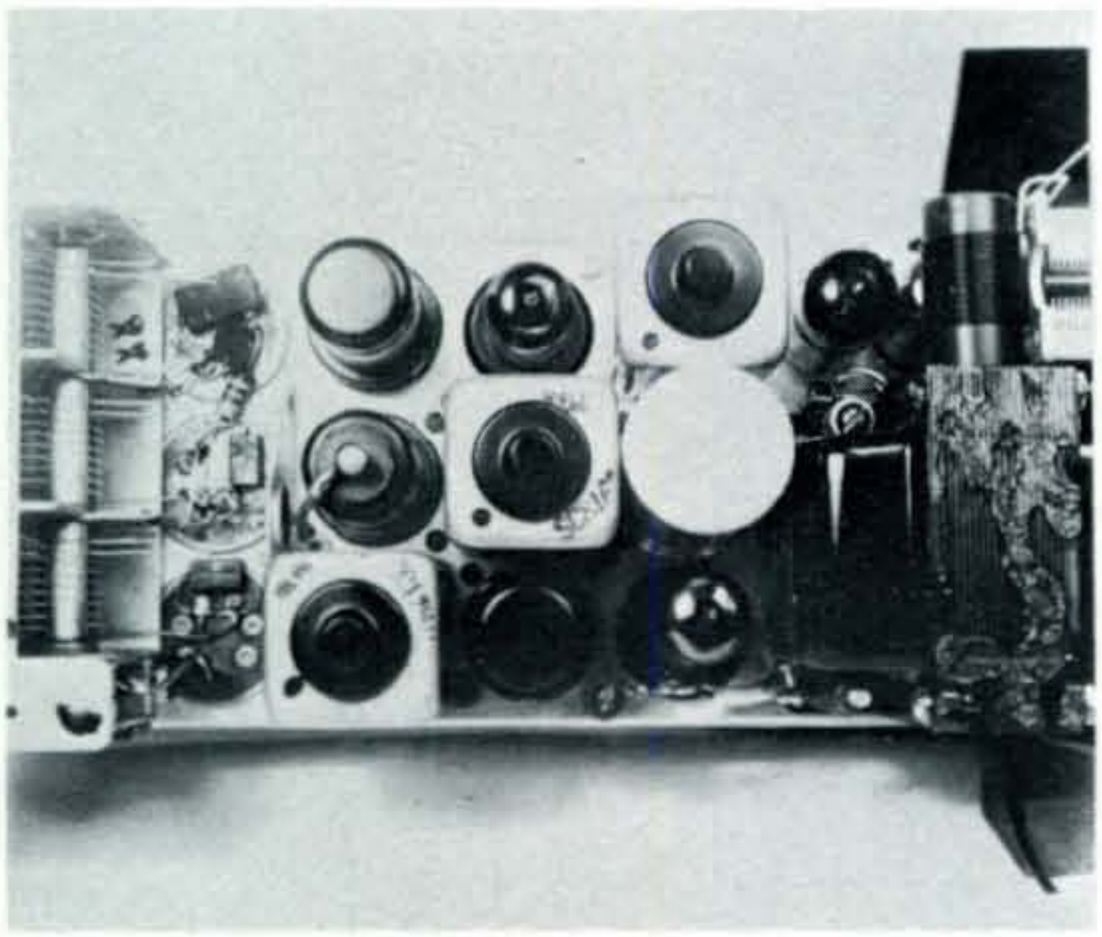

Fig. 2—Top view of the 40 meter station built on an ARC-5 receiver shows the modified tuning capacitor, at the left, with all but two plates removed from each section. The silver mica padder capacitors can be seen soldered directly across the coil terminals. The power transformer and pi-net coil are clearly visible on the other end of the chassis.

graphs should help identify the parts removed.

Transmitter Section

The transmitter section tunes 7.0 to 7.3 mc with the v.f.o. on 80 meters. The pentode half of the 6CX8 doubles to 7 mc and drives the 6360 tube. The v.f.o. is a very stable Colpitts type oscillator with the plate grounded through a 0.01 capacitor. The output is taken from the cathode, and 15 volts r.m.s. is obtained to drive the doubler, the pentode half of the 6CX8. The plate tank of the doubler is on 7 mc, and is a slug tuned coil resonated with 100 mmf fixed capacity. It can be left peaked to the middle of the c.w. band or a knob put on the shaft. The doubler drives the grid of the 6360 until 3.5 ma is flowing through the grid resistor.

The tank circuit of the 6360 loaded into a 60 ft wire, uses about 100 mmf of C_1 and C_2; when coupled into a 50 ohm non-inductive load, it uses about 75 mmf of C_1 and 365 mmf of C_2. The plate current should be 100 ma at 300 volts for maximum loading Do not load the tank beyond a point where C_1 does not show a dip when it is tuned.

Operation

When the key is pressed the relay opens putting voltage on the v.f.o., while the cathode of the 6360 is keyed. The relay holds open during sending, but will close if the hand is taken off the key for a few seconds. This time constant can be changed to suit the operator by replacing the 2.0 mf capacitor with a smaller value, or by varying the 1 megohm resistor. When the relay is energized the receiver is on. This method saves current in transmit position where it is needed the most, reducing the drain on the power supply which might drop the voltage below 300 volts. It is also a simple circuit with better relay action than other types of keying. The drain on the keying battery, (B_1, 15 volts) is so small that it will last the shelf life of the battery.

Power Supply

No filter chokes were used in the power supply in order to save weight and space. The supply to the p.a. is filtered by a 100 ohm resistor to reduce the voltagedrop, and the 1000 ohm resistor makes the voltage drop about right for the receiver. The only hum noticed is when a ten inch speaker is used and the volume turned up full; none is noticed on a 4" speaker.

The elaborate relay circuit was used to put the least drain on the power supply, which is only a 90 ma transformer. A rotary switch could be used in place of it and the keyer tube eliminated if desired.

A 100 volt zener diode is needed for the oscillator line. Two 50 volt units are placed in series because surplus zeners are most common in the lower voltages and no inexpensive 100 volt ratings could be found.

Some surplus 1N1368 Zeners are rejects and may differ from the 50 volt ratings. This will not make any difference on the oscillator just as long as they regulate. If you want a new 100 volt zener diode, the price can be rather stiff and under the circumstances it is almost necessary to use a diode because of space limitations. If two surplus units are placed in series one zener must be insulated with the mica washer that comes with it.

A ten watt zener (or two 5 watt 50 volts units) will handle a maximum of 100 ma. This power transformer is only a 90 ma job, thus conservation is the word, and a very minimum of current through the zener was desirable. The curve for a zener it shows regulation from 10 ma to 100 ma. A series resistor was used to set the current through it at 20 ma when it is across the power supply. When the key is pressed, the oscillator current flows, and the current through the Zener drops to 10 ma, just on the linear portion of the curve. We dared not go any lower than this if the regulation was to hold, and yet we did not want to put excessive drain on the power

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supply. The voltage holds constant at 100 volts during keying.

Audio Section

The product detector was taken directly off from the tap on the last i.f. transformer as shown in fig. 1. The product detector uses two diodes and also works satisfactorily for c.w. reception in this receiver. The type of diodes are critical. They must be germanium and not silicon diodes because there must be a leakage through them to drain off the charge. The oscillator is coupled into the detector through a ten mmf capacitor and the detected audio signal is fed through a filter to eliminate all high frequency output. The r.f. choke could be replaced with a 47K resistor but with a loss of signal. Strange as it may seem, there is plenty of signal strength feeding the product detector and directly into the one audio stage for loud speaker operation. If, however, a filter was used in the i.f. stage it would be necessary to add another audio driver stage. For portable work the selectivity is satisfactory without more filtering.

Be sure and place a .005 mf disc type capacitor across the primary of the audio transformer to prevent any build up of transient oscillations which might puncture the insulation between the windings or arc across the tube socket.

The 6360

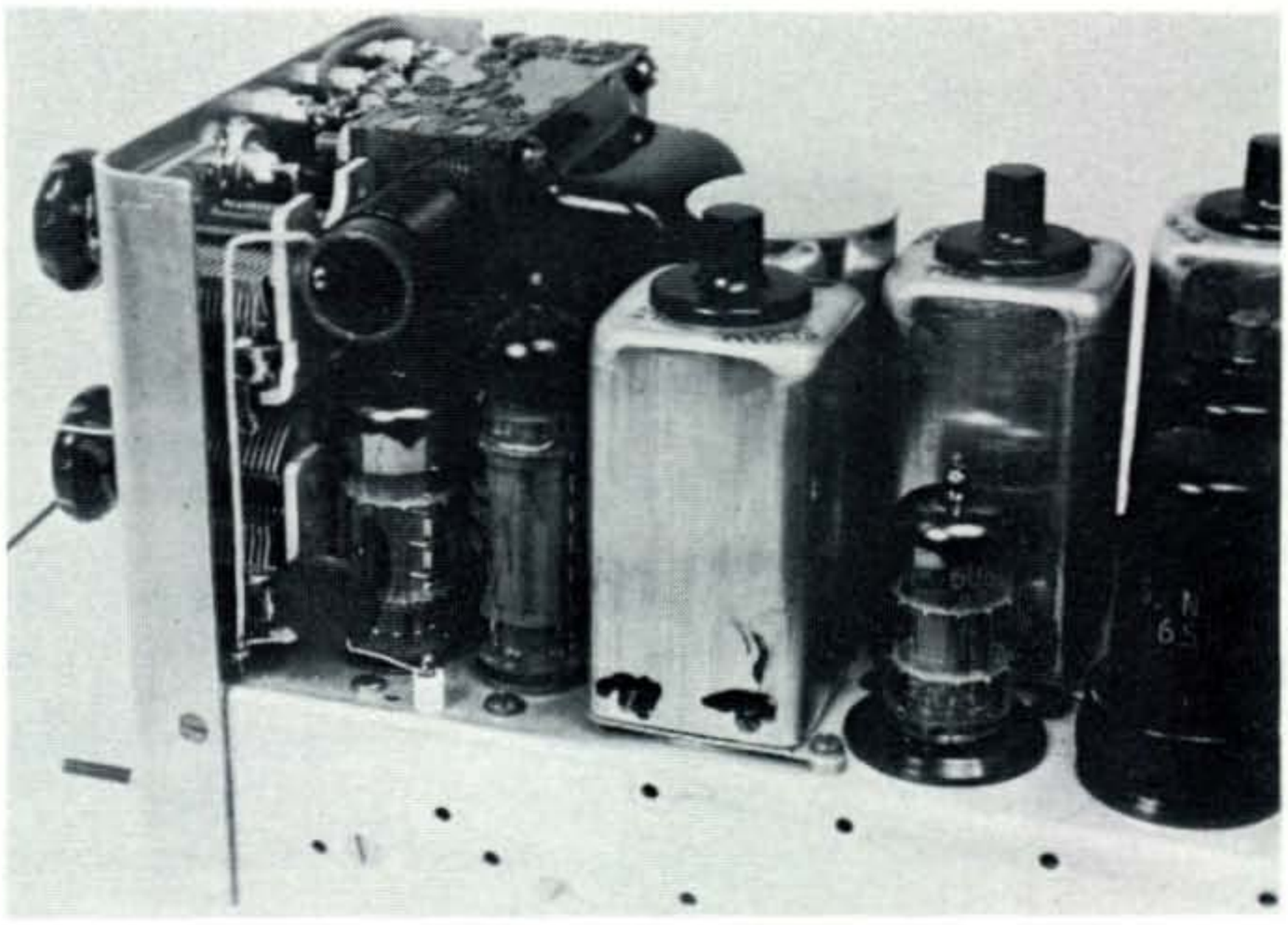
The Amperex 6360 is a twin tetrode and can deliver 16 watts in amateur service with a supply voltage of 300 volts. The filament can be wired for either 6.3 volts or 12 volt operation. Ordinarily the tube is used with a shield between the plates and grid lead, but was not found necessary in this transmitter. It is also recommended by the manufacturer that the cathode be grounded directly to the chassis rather than through a long keying lead. With the cathode bypassed with a 0.01 mf capacitor there was no difficulty when RG-174 (small coax) was used for the key lead, which is about 2 feet long.

Normally the 6360 is biased by the voltage developed across a common grid resistor. If there is a loss of drive the plate current might exceed the maximum rating; make sure you have drive when plate voltage is applied. The screen resistor is high enough in value to prevent the plate current from becoming excessive. The screen does not need to be bypassed, although this circuit uses one. Also, if the values of the tank circuit are not correct, the plate current will not draw its normal amount of current and the screen voltage and current will be excessive. The 6360 is internally neutralized.

Conclusion

At home the transmitter can be used to drive a pair of 6146's or a pair of 811's very nicely. It acts as a good v.f.o. On vacation trips it will load into a dipole or just a 60 foot piece of wire strung out to a tree. Just zero the station you want to contact by pushing the calibrate button, and turning the v.f.o. dial until you hear it in the receiver. Press the key and dip C_1 and decrease C_2 to increase the loading. Keep redipping C_1 and do not load beyond a point where there is no dip in the tuning.

I hope you have as much fun as I did, building this little portable station. Everyone should have one around, if only for emergency use. ■



Side view of the rear section of the ARC-Port Forty, Model II, shows the location of the complete transmitter. The tube on the extreme left is the 6CX8 v.f.o./doubler. It connects to the v.f.o. tank circuit at the front panel through coax leads. The tube just to the right is the 6360 final. The pi-network is just to the left of the v.f.o. The 6U8 to the right of the i.f. can, L_{11}, is the last i.f. amplifier (see fig. 1) and the relay tube. The 6CX8 a.f. output and b.f.o. is located just behind the 40-40-40 filter, behind L_{11}.

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The Hallicrafters SR-400 Cyclone Transceiver with the PS-500A-AC Power Supply/Speaker Console.

CQ Reviews:

The Hallicrafters SR-400 Cyclone Transceiver

BY WILFRED M. SCHERER,* W2AEF

THE latest addition to the Hallicrafters quality-line of amateur equipment is the SR-400 Cyclone Transceiver, a 400-watt input version of the SR-2000 Hurricane 2 kw job[1], but with some additional features not usually found in a transceiver. These include a notch filter and a sharp crystal filter for c.w.

Otherwise the SR-400 is essentially the same as the SR-2000, providing full coverage of the 3.5-28 mc amateur bands on s.s.b. or c.w. with such desirable features as: stable v.f.o. using linear tuning calibrated in 1 kc steps; receiver incremental tuning (RIT) for frequency offset on receive; adjustable noise *blanker;* upper or lower sideband on any range; amplified a.l.c. (a.a.l.c.); four meter functions for receiver S-units, r.f. output, p.a. plate and a.a.l.c. level; p.t.t. or v.o.x. operation (built-in); 100 kc crystal calibrator; front-panel bias adjust; 6-pole crystal-lattice s.s.b. filter; electronic indexing for dial calibration; preselector tuning; keyed sidetone with loudspeaker or headphones for c.w.; v.o.x. type c.w. break-in; adjustable Pi-output for 40-70 ohms; rugged construction; operation from 117/234 v.a.c. or 12 v.d.c. using separate external power supplies; operation with the HA-20 DX Adapter accessory for independent frequency control of receiver and transmitter.

Technical Notes

Except for the p.a., the lineup and many of the features of the SR-400 are the same as those of its big brother. Since most of the details may be found in the earlier review on the SR-2000, further description will be limited

[1] *CQ* Reviews the Hallicrafters SR-2000 Hurricane Transceiver, *CQ* March '67, page 54.

*Technical Director, *CQ*.

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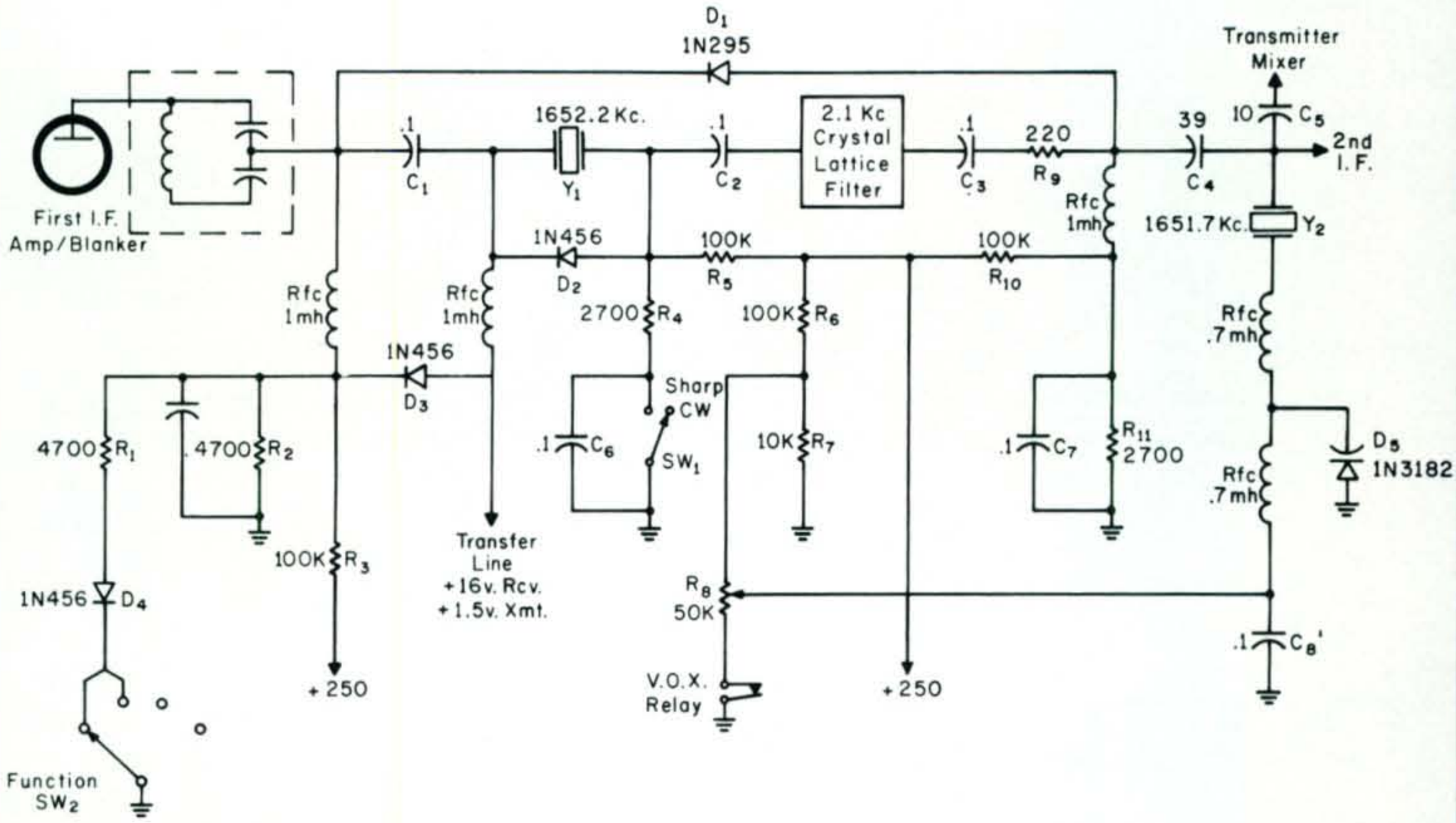

Fig. 1—Circuitry for crystal filters and rejection-notch tuning used in the SR-400. Switching is accomplished with solid-state diodes.

As explained in the text, Y_1 is in series with the 2.1 kc bandpass filter to provide a sharp-selectivity position for c.w.

When only the bandpass filter is to be used, the selectivity switch, S_1, is opened, placing a voltage, obtained from point *B*, on D_2 anode that is more positive than that applied to its cathode from the transfer line. This causes D_2 to conduct, appear as a closed circuit and short out Y_1.

Closing S_1 grounds the bottom of R_4, dropping the voltage at point *B* to a value that is less positive than that applied to the cathode from the transfer line. D_2 then cease to conduct and appears as an open circuit, thus inserting Y_1 into the filter circuit to provide the sharp selectivity for c.w.

In case the selectivity switch is set for the sharp position during s.s.b. transmit, Y_1 is automatically shorted out by D_2 to allow the modulated signal to pass on to the band-pass filter unaffected by Y_1. In this case D_2 is biased to conduction, because on transmit the voltage applied to D_2 cathode, from the transfer line, is changed back to a less-positive one than on the anode.

For tuneup and c.w. transmit, the cathode of D_4 is grounded by the function switch, S_2. D_4 anode is then at a positive potential due to the voltage at point *A*, making D_4 conduct and appear as a closed circuit which shunts R_1 across R_2. This drops the potential at point *A* to a less-positive one than that at point *C*, thus making D_1 conduct and appear as a closed circuit that bypasses the r.f. excitation around the filters.

During receive while the function switch is set for c.w. operation (the positions at S_2 from left to right are: c.w., tune, u.s.b., l.s.b.), the positive voltage from the transfer line causes D_3 to conduct and make the voltage at point A go more positive than that at point C. D_1 then cannot conduct and is thus prevented from bypassing the signals around the filters.

On s.s.b. receive and transmit, D_4 cathode is lifted off ground by S_2 and cannot conduct, thus removing R_1 and allowing the voltage at point *A* to rise to a value more positive than at point C. This biases D_1 into non-conduction and it then appears as an open circuit, allowing the r.f. signal to go through the filter network.

The rejection notch is obtained with Y_2 which is shunted to ground across the output of the filter circuit. Its series resonance, and thus the notch frequency, is varied by Varicap diode D_5 the capacitance of which is controlled by a d.c. voltage from R_8. On transmit, contacts on the transfer relay lift R_8 off ground, placing a higher voltage on R_8 arm which changes the capacitance of D_5 by an amount that tunes the crystal resonance to where the notch falls out of the filter passband.

to the new features and those not taken up previously.

We shall, however, give a brief run-down on the lineup as follows: Dual conversion is used on receive with a 6.0-6.5 mc variable first i.f. and a second fixed i.f. of 1650 kc where selectivity is provided using one or more crystal filters. A crystal-controlled heterodyning oscillator is used at the first mixer. The v.f.o. for the second mixer operates at 4350-4850 kc. A product detector in conjunction with a 1650 kc crystal-controlled b.f.o. is used for deriving the a.f. signal.

On transmit the process goes in reverse

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with the s.s.b. (or c.w.) signal generated at 1650 kc. This is converted to 6.0-6.5 mc by mixing with the v.f.o. These signals are then combined with the crystal-controlled heterodyning oscillator to produce output in the various ham bands.

Crystal Filters

Of special interest is the setup for the crystal filters and the rejection-notch tuning along with the methods for switching them in or out as shown at fig. 1.

The 6-pole 1650 kc crystal-lattice filter has a 2.1 kc bandwidth with a shape factor of 2:1 (@ 50 db) and is used for s.s.b. Sidebands are switched by changing the b.f.o./carrier-generator frequency to either side of the filter, while the v.f.o. is simultaneously shifted 3 kc in the necessary direction to eliminate the need for retuning when sidebands are changed. The process was explained in detail in the SR-2000 review.

For c.w. reception, a single crystal at a frequency near the center of the 2.1 kc bandpass filter is switched in series with the input to the latter and provides a 200 c.p.s. bandwidth (@ 6 db). The switching can be done independently, regardless of whether or not the transceiver is set for the s.s.b. or c.w. mode, thus providing a choice of bandwidths for either case.

On transmit, the single crystal (the sharp-selectivity position) is automatically switched out to allow the signal to go through the 2.1 kc filter only. In addition, on c.w. and tuneup, both filters are shorted out in order that the carrier will not be attenuated due to the fact that its frequency is partly down the filter skirt.

Rejection Notch

The rejection notch is created by a single crystal that is switched in shunt with the output of the 2.1 kc bandpass filter. The notch frequency is shifted to any point in the passband of the filter by varying the series resonance of the notching crystal with a vari-cap diode connected in series with it. This crystal also is automatically tuned out of the passband during transmit. See fig. 1.

Diode Switches

The switching of the filters is accomplished using solid-state diodes as explained at the schematic.

Power Amplifier

The p.a. for the SR-400 has two 6HF5 TV horizontal-sweep type tubes in parallel and incorporates a Pi-network plate circuit with the output adjustable for matching to 40-70 ohm essentially non-reactive loads. Capacitance-bridge neutralization is employed in the conventional manner. Power input on s.s.b. is rated at 400 watts p.e.p., on c.w. it is 360 watts.

Other Details

Sideband generation and the transmitter lineup otherwise are the same as in the Hurricane. Likewise, the a.g.c. system is the same, except for some changes in time constants. Other details as explained in the Hurricane review are: block diagram for basic lineup (except p.a. tubes); the common tuned circuits; mixing frequencies; traps; noise blanker: receiver incremental tuning; amplified a.l.c.; c.w. operation with block-grid keying, v.o.x. type break-in and sidetone monitoring; the handy bias adjust, v.f.o. tuning and dial calibrations; construction and styling. Changes in the metering setup are a provision for reading the p.a. cathode current, instead of screen current, based on the voltage drop across 5 ohms in the cathode circuit.

Crystal Calibrator

The output of the 100 kc crystal calibrator is fed to the receiver input through a diode by which harmonics are generated to produce strong markers at the higher frequencies.

Power Supply

Power is obtained from a separate unit, the Model PS-500A-AC, which is a console type supply with a built-in loudspeaker. It may be operated from a 105-125 or 210-250, 50-60 cycle a.c. source for which a slide switch is provided to accordingly change the necessary connections at the primary of the power transformer. The change can thus be quickly made and no re-wiring is needed.

The output voltages are: 12.6 v.a.c. @ 5 a: 280 v.d.c. @ 100 ma; 750 v.d.c. @ 500 ma and −80 to −135 v.d.c. bias.

The PS-500-DC power supply is available for mobile service. It is a solid-state job which operates from 11.6-16.6 v.d.c., negative-ground systems.

Performance

Once you've experienced the pleasure and convenience of operating gear that is stable and accurately calibrated in 1 kc steps, as is the SR-400, it will be difficult to settle for anything less. The receiver incremental tun-

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ing also is a most desirable feature for keeping slightly-off-frequency stations on the beam without altering your own frequency such as may be necessary in roundtables or where the other fellow tends to tune his transceiver a bit off frequency while listening, in which case both of you may otherwise eventually waltz down the band together while keeping up with each other. Use of the r.i.t. with c.w. also is a must.

If you're operating mobile or in a location subject to man-made-noise interference, such as we are at the *CQ* Lab, you'll really appreciate the noise blanker which digs out the weak signals from under most power-line noises.

The sharp selectivity position will be advantageous not only for the operator who likes to work some c.w. occasionally, but it also is useable for s.s.b. when the going gets real tough. The rejection-notch tuning, while not providing as deep a notch as some other systems, is still quite effective and also acts somewhat like a tone control which is handy under some conditions of QRM.

The electronic indexing for calibration is a neat feature in that calibration can be maintained without changing the hairline fiducial to an off-center or cockeyed position.

Although many operators do not take advantage of a switchable sideband feature when it is available in a rig, it often can be found well worth while for getting out of QRM. We've also found that by operating on the opposite sideband than that normally used on a particular amateur band, you're less likely to be interrupted by other stations (particularly those who cannot switch to that sideband or who do not recognize that you're working that one) when you're enjoying a comfortable private chat on a particular subject.

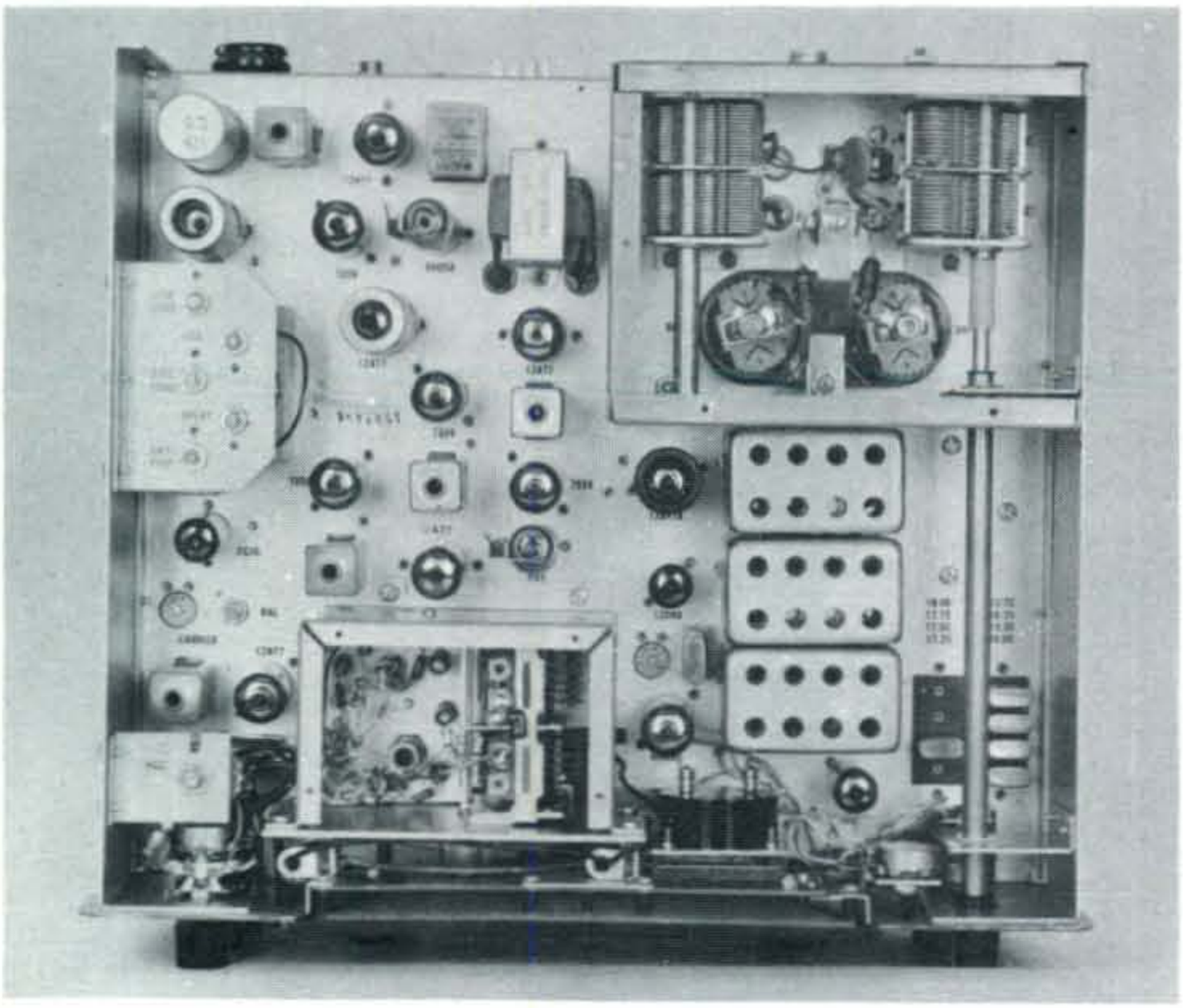
C.w. operation works out nicely and although v.o.x. type of break-in does not provide the so-called instantaneous break-in at high code speeds, for general applications it should be found satisfactory. The sidetone monitor has a pleasant tone around 800 c.p.s. and it is especially desirable where a bug or automatic keyer is used that does not have a built-in monitor.

The tuning handles smoothly and when it is necessary to move quickly from one end of a range to the other, it can be done using a spinner or crank-up type knob provided on the unit.

The transmitter tunes up easily, but care must be taken not to allow the p.a. to remain out of resonance for more than a very short period. We inadvertently let this take place while tuning up with an antenna coupler on a long-wire antenna, with the result that not only did the tubes lose emission, but also the glass envelope sucked in on one tube!

A precaution on receive is that the blanker should not be adjusted too far beyond the threshold, otherwise strong adjacent-channel signals might leak through and cause chatter or interference. Actually, the only case where this was found of concern was during operation within 10 kc of NSS on 4005 kc.

The only criticism we have of the unit is that the parasitic-suppressor resistors in the



Top view of the SR-400. The cover has been removed from the v.f.o. box (near panel left of center) and from the p.a. enclosure (at upper right). The p.a. tank inductor mounts below the chassis. Controls for the v.o.x. system are on panel at the left side bracket.

See page 126 for New Reader Service

p.a. get pretty hot on 15 and 10 meters and emanate that unpleasant burnt-resistor odor[2]. Also, we'd like to see a bit faster a.g.c. attack.

As mentioned in other reviews, the Hallicrafters gear usually is quite conservatively rated. Our lab measurements either bettered or at least equalled the manufacturer's specifications which are as follows:

Receiver: Sensitivity—1 μv for 20 db S/N; Selectivity—2.1 kc bandpass @ 3 db, 4.2 kc @ 50 db or sharp with 200 c.p.s. @ 6 db; Rejection Notch—up to 30 db; First i.f. rejection—56 db or more at all frequencies; Image and Spurious Rejection—better than 50 db; A.G.C. Characteristics—less than 10 db a.f. output change with 60 db r.f. input change; RIT Frequency Range—4 kc min.; A.f. Output—1 watt, @ 10 % distortion.

Transmitter: Power Input—400 watts p.e.p. with 200 watts output on s.s.b., 360 watts input with 200 watts output on c.w. (ratings slightly lower at 21 and 28 mc bands); Distortion Products—30 db signal-to-distortion; Unwanted-Sideband Rejection —50 db below desired output @ 500-2500 c.p.s.; Carrier-Suppression Capability—60 db below p.e.p.; Spurious Emission—50 db below p.e.p.

Frequency Control: Stability—250 c.p.s. drift first hour after 15-minute warmup, 100 c.p.s. or less per hour thereafter; Calibration —1 kc steps, 500 kc tuning range; Calibration Accuracy—less than 2 kc error across dial after indexing at h.f. end of dial, band-to-band error less than $\pm$2 kc.

HA-20 DX Adapter

The HA-20 DX Adapter is designed for use with the SR-400 and SR-2000 Transceivers to provide independent frequency control on transmit and receive. It also has facilities to allow it alone to control both the receiver and transmitter for transceive operation or to permit both it and the transceiver v.f.o. to control the receiver at the same time, thus enabling two signals within any one band-range to be simultaneously monitored. The desired mode of operation may be instantly selected with a panel switch. The unit has its own built-in power supply with voltage regulation and only one cable with an 11-prong keyed connector need be plugged into the transceiver.

Also included in the job is a calibrated s.w.r. meter for use with an external s.w.r. bridge which is the conventional trough-type reflectometer. This coupler is supplied with the HA-20.

The Hallicrafters HA-20 DX Adapter, an accessory v.f.o. for independent frequency control of transmitter when used with the SR-400 or SR-2000 Transceiver.

A Switch on the v.f.o. panel selects either forward or reflected readings and a sensitivity control is provided for an initial reference setting to be made.

The v.f.o. is like that in the transceiver, operating at 4350-4850 kc and it has the same type tuning mechanism, sideband compensation, electronic indexing and calibration. A cathode-follower stage is included which not only provides the proper output impedance for matching to the transceiver mixer, but it also acts as a buffer to eliminate loading effects and thus enhance stability. The v.f.o. may be calibrated against the 100 kc standard in the transceiver.

Operation

The various operating modes are set up as follows:

With the OPERATION switch set at STBY, heater and B-plus power are on, but the v.f.o. is disabled by a cutoff bias. The transceiver v.f.o. then controls the frequency on both transmit and receive.

With the switch set at the *T* position, cutoff bias is removed and the HA-20 v.f.o. controls the transmitter, while the receiver v.f.o. controls the receiver.

At the R & T position, the transceiver v.f.o. is biased to cutoff and the HA-20 v.f.o. controls both the receiver and the transmitter.

At the DUAL R setting, both v.f.o.'s are operating and simultaneously control *only* the receiver.

[*Continued on page 108*]

[2] Late word from the factory is that this is corrected in subsequent units with a re-worked suppressor.

See page 126 for New Reader Service

WANT *MORE* FOR YOUR MONEY?

If you want to get the greatest of operating pleasure, from a most reasonable investment, then you want Drake's new R-4B receiver and their new T-4XB transmitter. Add the new L-4B linear amplifier, and you'll have the BIG sock that brings plenty more satisfying solid QSO's!

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Grumbles

by Sam

AFTER many years of carefully observing the ham radio scene I have come to the conclusion that there are several dominant types of the species *Hammus Operatoris*. It seems that in every area there is at least one representative of these classic types and I thought that perhaps you might like to match up my observations with your own. What do you think, do any of the below operators have a close cousin in your area or club?

Mr. Gung-Ho. Lives, eats, sleeps, ham radio. Regardless of the subject under discussion he can quickly relate it to hamming, much to the nausea of others. Favorite expressions: "What can I tell ya'?" and "How 'bout that?" Last year he won the skip working championship of the 11 meter band with his Viking II—but that was before he got his ham ticket. Sells subscriptions to 73.

Steamboat Annie. Has a laugh which can tear speaker cones as far away as KC4-land. Her OM has a ticket too, but hasn't been able to get within using distance of the rig for the past 3 years. All QSO's are copiously sprinkled with her own brand of homey, country style humor and "down yonder" dialect. Her QSL card shows a cartoon of an 18 year old YL in a Bikini and is captioned by an off-color gag line.

The Expert. Really a fountain of information; he couldn't add up a whole lot of fives but can find fault with any signal heard; what's worse he's ready to treat you to a 30 minute dissertation on how to improve your gear to make it sound as good as his—after all anybody who can still get an Abbott TR-4 tuned up can't be all bad. Brings his bull horn to club meetings to silence whispering during the reading of the minutes.

The Engineer. Comes to every club meeting but nobody has ever heard him actually operating on the air. Somebody who knows him from work once said that he takes home microwave parts and is sometimes mysteriously absent for several days at a time. If you ask him for the time he computes it on his slide rule and then gives it to you both in GMT and also local 24-hour clock. The gang stopped talking to him when they heard that he belonged to the IEEE.

Old "XN," still uses only his telegraphers handle so that anybody working him will know to show suitable respect for his age and experience. Sometimes calls up local operators on the land line to tell them of their operating irregularities which he has monitored. Has been on 3990 kc since the day the 75 meter band was opened and nobody within 100 miles of him would dare to operate within 5 kc of either side of it. Once a year he does a fire and brimstone speech at the club meeting demanding that the members expel what he calls "kids, lids, and space cadets."

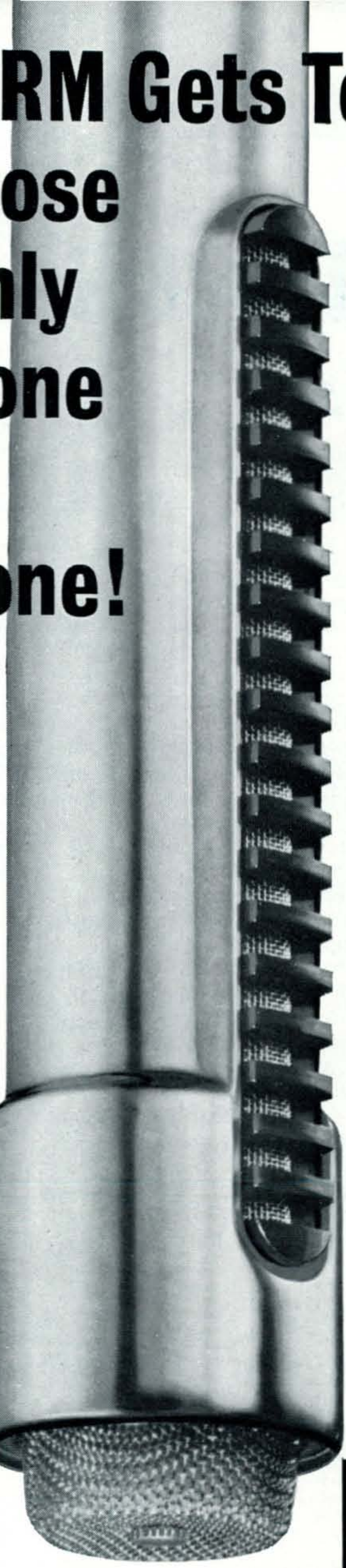
Ed. showed up one day with an out-of-district call and a broken down 1957 green Chevy equipped with a siren and flashing red lights, several rusted whip antennas, scuba gear in the trunk, police and fire monitor converters. Operates 6 meters exclusively, in fact he was the first operator in this country ever to operate above 53 mc. He's chairman of the club's TVI committee—when he calls on a viewer they never seem to complain again.

[*Continued on page 110*]

* c/o *CQ*, 14 Vanderventer Ave., Port Washington, L.I., N.Y., 11050.

See page 126 for New Reader Service

When QRM Gets Tough Choose The Only Microphone With Backbone!



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a microphone so small. Of co
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exclusive bass control switch
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efficiency and lower intelligib
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DX

BY JOHN A. ATTAWAY,* K4IIF

THINGS have moved at a fast pace this month. In a swing out California way your editor had the pleasure of meeting with the Northern California DX Club, the Southern California DX Club, and speaking to a joint session of the Orange County and San Diego DX Clubs. On the way back east there was the North Jersey DX Roundup which presented a rare opportunity to meet many of the legendary DX figures of the New York area. As a consequence it wasn't possible to process all of the award applications received between March 1 and April 1. However, 20 new WPX, 19 new WAZ, and 3 new S.S.B. DX Award certificates were authorized, and the calls of the winners appear below. We promise to catch up on the others next month.

Thanks to Louise, W8HDB, our new S.S.B. DX Awards Manager, we are finally ablet to restore the S.S.B. DX Honor Roll to its proper place. Hopefully it will be a regular monthly feature from now on. Questions regarding your Honor Roll status should be addressed to Louise at 3785 Susanna Drive, Cincinnati, Ohio 45239.

The new certificate winners for June are as follows:

WAZ 2-Way S.S.B.: YV1LA-517, W8BVF-518, JA7MA-519, W3GRS-520, SP8AJK-521, DJ8FC-522, and W8LUZ-523.

WAZ 2-Way Phone: W8GUZ-372, CN8BB-373, EA4DO-373, and W6GPB-375.

WAZ C.W./Phone: F9IK-2401, AP5HQ-2402, WB2UKP-2403, SVØWAA-2404, HB9RX-2405, HB9PV-2406, W1MD-2407, and GM3EOJ-2408.

S.S.B. DX Awards: 100 countries: UA3DA-505, KØYIP-506, and G3SRZ-507.

WPX S.S.B.: WA1IHN-323, DJ3GG-324, W6CHY-325, JA1BN-326, G3SRZ-327, W9BGX-328, K2QOU-329, and WB2OBO-330.

WPX Phone: CT1MW-149.

WPX C.W.: W9UTQ-835, K6TZX-836, SP9DH-837, SP6AKK-838, W8QXQ-839, W9BGX-840, and 9H1AK-841.

WPX Mixed: WB4BMV-161, W9BGX-162, DL6GB-163, and WA6GLD-164.

WPX Endorsement Stickers: *Continent:* Europe: SP6AKK, VE3UR, and W9BGX. Oceania: WA6GLD.
Band: 14 mc: W9BGX and UA3GO. 21 mc: W6CHY. 7 mc: W9BGX. 3.5 mc: G3HDA and W9BGX.
Mode: Mixed: W9BGX-550, SP8AJK-550, WB4BMV-450, and WA6GLD-450. S.S.B.: W6CHY-350. C.W.: SP9DH-450, SP6AKK-400.

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

New Committee Member

We are pleased to announce the appointment of Ben H. Stevenson, W2BXA, as North Jersey DX Association representative on the *CQ* DX Awards Advisory Committee. The committee is presently undergoing some reshuffiing to give a membership based on representatives from each of the major DX Clubs.

160 Meter News

Bouquets to Herb, WØVXO/Ø, now of Durango, Colorado, who has made the first WØ to JA QSOs ever. On Feb. 20 Herb worked KA9AK at 12:15 GMT. Both c.w. signals were 579 with Herb on 1992 kc and KA9AK on 1880 kc. They also worked on 2-way s.s.b. At 1247 GMT on the same date Herb worked JA1RST and again both were 579 on c.w. They then rag-chewed on s.s.b. until 1330 GMT. Herb's new QTH is deep in a canyon surrounded by 14,000 ft. peaks. His antenna is an Inverted Vee only 45 ft. at the apex and with the ends practically on the ground. It was fed with open wire line tied together Marconi style. This was Herb's second WAC on 160. He needs only Africa now for s.s.b. 160 WAC.

KA9AK is continuing his special daily Transpacific tests. Each morning from 11:30-1400 GMT he is on 1880 kc listening on 1992 and 1802.5 kc for W/VEs.

The first 160 meter QSO between the U.S. and Kenya has been chalked up by Stew, W1BB, who worked Roger, 5Z4LE, at 2322 GMT on March 23. Roger's signals peaked all the way to 589. This was W1BB's 99th country on 160 meters. Others who scored included W2KQT, W8ANO, W2RAA, and W3FRA. Sunset W/VE time has proven to be best for 160 QSO's to East Africa.

VK5KO reports that during the *CQ* WW

S.S.B. DX HONOR ROLL

W2TP	305	W2ZX	302	WA2RAU	300	W8PQQ/W8BT	300
K4TJL	305	5Z4ERR	301	W4OPM	300	WA8AJI	300
WØQVZ	305	G6TA	300	W4PAA	300	G8KS	298
TI2HP	305	I1AMU	300	W4SSU	300	W3NKM	296
W2BXA	304	KP4CL	300	W5KUC	300	W2FXN	294
G3AWZ	303	K6ZYG	300	W8EVZ	300	W2VCZ	291

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Louise Rippe, W8HDB, new manager for the CQ S.S.B. DX Awards program. Louise is an honorary member of the Ohio Valley Amateur Radio Association which means she lives in real DXing country. She passed her General exam on her honeymoon and her Advanced test a year later. She started DXing in November, 1963 and has 305 countries worked and is waiting for confirmation #300. She holds 2-way s.s.b. WAZ #372. The rig, which she shares with OM Herb, W8BQH *et al*, is a T-4X and R-4A driving a pair of 4-400Zs in grounded grid on 20 meters. Also a Loudenboomer for c.w. and for 40, 75, and 15 meters. With going-on-5 licensed hams in the family, all DXers, schedules for major contests must be set up a year in advance.

Test he heard KA9MF 579 many times. At one point he walked into the yard and found that he could still copy 100% at a distance of 100 feet from the shack.

W1BB reports that on March 24 he QSOed ZC4RB on Cyprus who was 339 at 0235 GMT. Stew was 569 in ZC4 land.

Club News

The Ontario DX Association has formally changed its name to the Canadian DX Association as of March, 1968. According to *Long Skip*, this move was prompted by statistics showing that almost 50% of the membership resided outside Ontario. The club call, VE3ODX, will remain the same for the time being. Anyone interested in affiliating may contact the club at P.O. Box 717, Station Q, Toronto 7, Ontario.

The VERON club station, PAØAA, was destroyed in a heavy fire on March 11. The antennas were melted down to pieces of copper and the transmitters, receivers, and other gear were flooded with water. A temporary QTH near Leyden has been in use for the regular transmissions, but only on 80 and 2 meters. It is hoped that normal operation will resume soon.

The VR3DY Story de KH6GLU

"The DXpedition was a real experience. Over 4200 QSOs were made including all states, all Canadian provinces, 103 countries, 38 Zones, all JA, VK, and ZL call areas, and many European stations. The equipment included a Heath HW-32A xcvr, Hammarlund HX-500 tx, Hallicrafters SX-101A rx, Astatic D-104 mic, Waters Codax keyer, HyGain 18AVQ vertical, Johnson TR switch, a few dipoles, and a home-made quad for 10, 15, and 20. Each element of the quad was assembled and then nailed to individual palm trees which were conveniently spaced 10 ft. apart and in a NE/SW direction.

"Operation began on Feb. 17 and ended on March 4 at 1800 GMT. The last 2 QSOs were with 9K2BV and VQ8CC. Regards were then paid to Phil Palmer, VR3C, and the gear loaded on the 90 ft. trawler for the return to Honolulu.

"Phil, VR3C, was very grateful to all the DXers of the world when I presented him with the Heath HW-32A, s.w.r. bridge, and antenna. Most of the money for this rig came from DXers who contributed to the DXpedition before I left. The s.w.r. bridge was compliments of KH6GJW (WB6GFJ). Phil has indicated that he will be active again now. I will be keeping regular skeds with him, and will handle all QSLs and correspondence for him. Mail to Fanning is very slow as only 2 Copra-trading ships call there each year."

Here and There

DOTM: The DXpedition of the Month Bulletin #2-68 is now out. For the latest information send an s.a.s.e. to P.O. Box 7388, Newark, N.J. 07107.

EL2, Liberia: Anyone needing a QSL from EL2D or EL2AW should send their card with an s.a.s.e. to K3JXO. The boys are closing their operation after almost 3 years in Liberia. Their activities covered the period Oct. 25, 1965 to March 18, 1968. The calls will be re-issued after Jan. 1, 1969. *(Tnx EL2D).*

FB8, Kergulen: Maurice, FB8XX, is reported on 14027 kc c.w. at 1230 GMT. *(Tnx LIDXA).*

FM7, Martinique: FM7WO is frequently on 14 Mc c.w. near 14010-015. *(Tnx VERON).*

GC8, Guernsey: Dick, GC8HT, has furnished us with an interesting advance schedule of his DXing time during all of 1968. Here are some

See page 126 for New Reader Service

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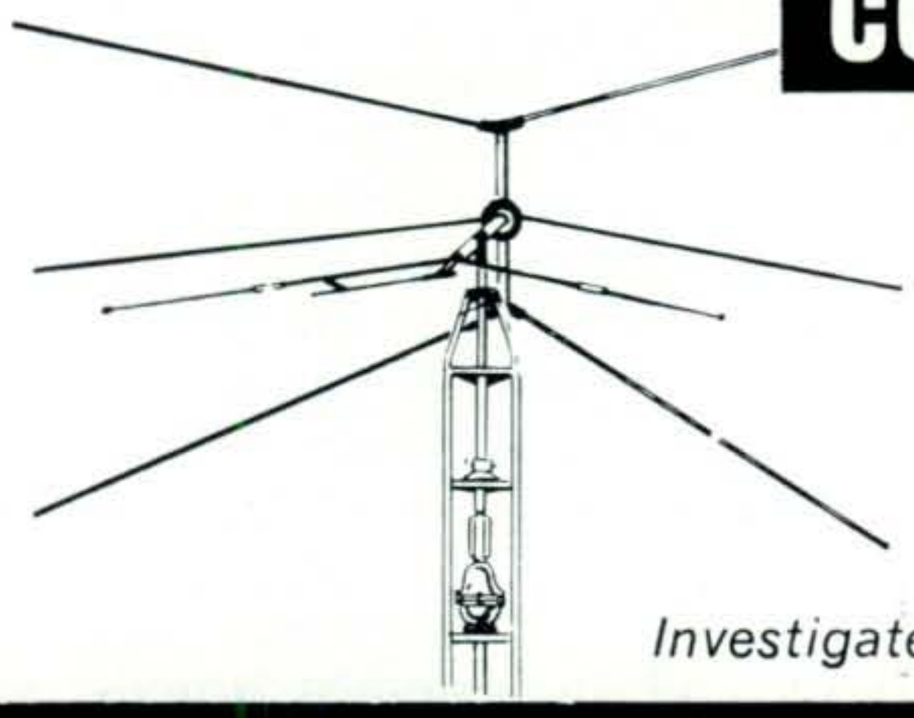

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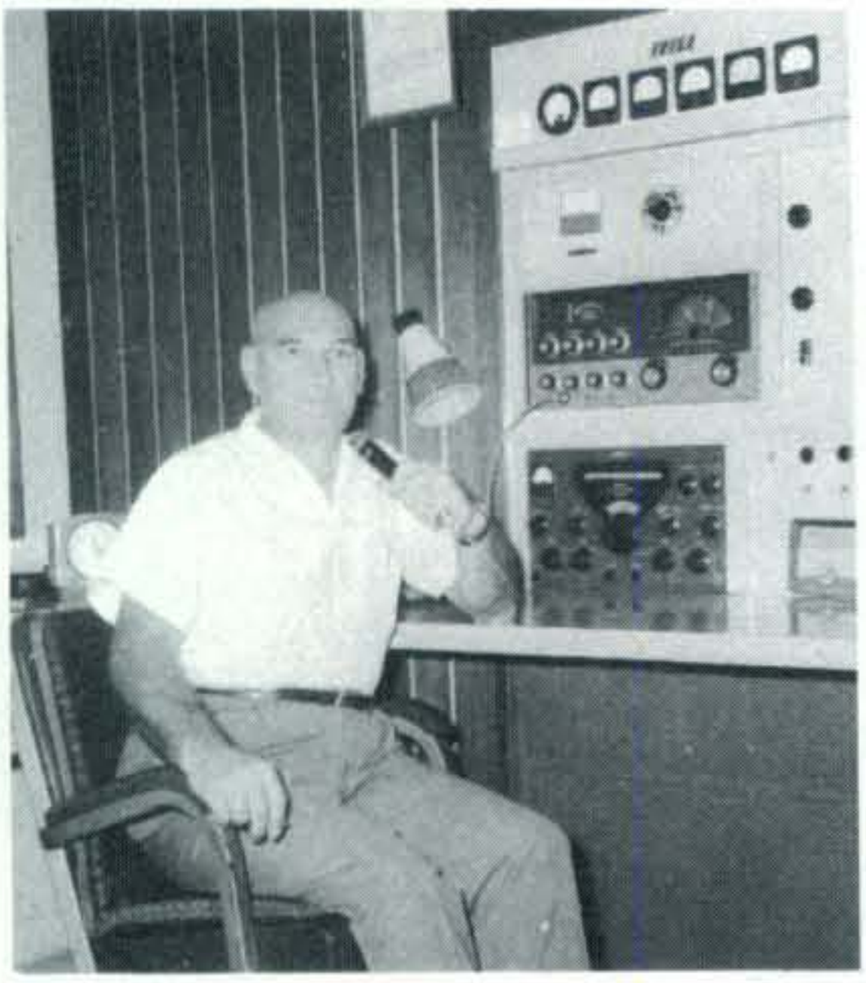
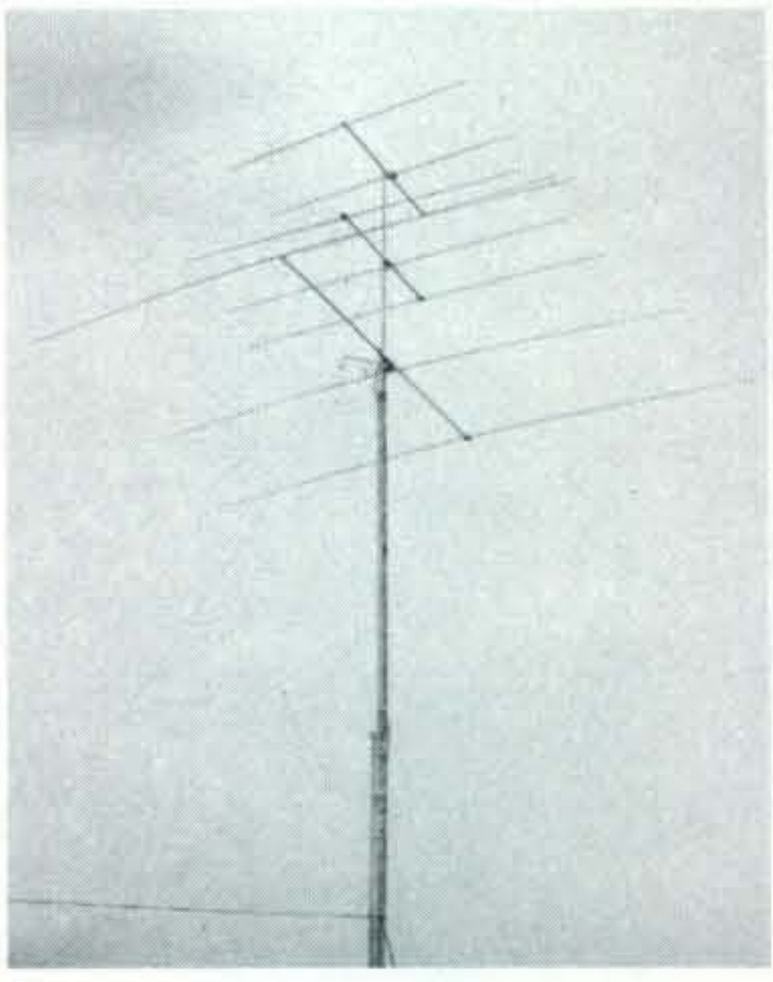


A leading Venezuelan DXer, Janusz Grzesiowski, YV1LA, of Punto Fijo. The Tx and Rx you will recognize. The amplifier is 2 kw PEP of home brew construction. Janusz has now confirmed over 400 prefixes on 2-way s.s.b. The stacked homebrew 20, 15, and 10 meter beams coupled with his inverted vees for 40 and 80, give him one of the top all band signals from S.A.



relevant dates, modes, and times for the next month: June 2, 1400 GMT, 28.643 mc s.s.b.; June 3, 0630 GMT, 7.083 s.s.b.; June 4, 1800 GMT, 7.083 s.s.b.; June 11, 1800 GMT, 28,013 s.s.b.; June 18, 1800 GMT, 28,013 c.w.; June 25, 1800 GMT, 28,643 s.s.b.; and July 1, 0630 GMT, 1.813 c.w. All U.S., Canadian, and other western hemisphere operators should QSL to W6UNP. Europe and other countries send direct to Dick.

JT1, Mongolia: UA1CK/JT1 cards are now beginning to come through with WAZ applications.

KH6, Kure Island: KH6EDY is reported to be on again with 2 new operators. *(Tnx Watts).*

LJ2, Norway: This rare prefix has been activated by LJ2X on 14 mc s.s.b. *(Tnx VERON).*

PK, Indonesia: Amateur radio seems to be in full swing again after a ban of several years. The West Java club has 310 members, but only PK8YAK, PK8YBC, PK8YCK, PK8YEK, PK8YFE, PK8YHR, PK8YJC, and PK8YZZ may use the high frequency bands. Most stations are on a.m. Novices use 80 meter c.w. only. *(Tnx Watts).*

SK, Sweden: SK is the new prefix for Swedish club stations. *(Tnx SM5CBN & SM3CZS).*

ST2, Sudan: ST2SA has been heard on 14012, 14035, and 21035 kc c.w. *(Tnx DX-MB)*

TA, Turkey: TA 1IB, Ismail, and TA2BK/1, Bahri, are now on s.s.b. from the European side of Istanbul. They operate frequently around 14200 and say that 2000 GMT is the best time for working the states. TA1KT is retiring his windom and putting up a 20 meter ground plane to work more W's. The Turkish Radio Amateur Society requests used handbooks, s.s.b. books, callbooks, magazines, and other ham publications to help put more Turkish stations on the air. These may be sent direct to P.O. Box 699, Karakoy, Istanbul, Turkey, or via K4EPI, Box 7542, CMR, Patrick A.F.B., Florida 32925 for reshipment. The special 4th. class rate for books is very cheap. *(Tnx K4EPI).*

TL8, Central African Republic: TL8DL has a daily sked with DL5KJ at 1300 GMT on 21.340 mc. Pse QRX until sked is finished and you will have a good chance of a contact. *(Tnx DXers Magazine).*

UW9, Zone 18: UW9YH is reported on 21050 kc from 1300-1350 GMT with some regularity. He is one of the very few USSR ops having a statewide QSL Manager, namely W1YYM. *(Tnx DXers Magazine).*

VE6, Worldwide DXpedition: It is rumored that the VE6 boys plan a major worldwide DXpedition this fall. Plans are not yet complete. *(Tnx DXers Magazine).*

VK9, Nauru: VK9RJ is scheduled to be active for 3 years. *(Tnx WGDXC).*

VP2, Montserrat: Golden Fuller, W8EWS, was active again this spring as VP2MK. QSLs should be sent to his home QTH. *(Tnx WGDXC).*

VR4, Solomon Islands: With the departure of VR4CR the Solomons may be without amateur operation for a time. *(Tnx VERON).*

VR6, Pitcairn Island: VR6TC is on 21350 kc at 2100 GMT and later on 21065 kc. He has a regular sked with W5OLG who will help with a QSO if requested. *(Tnx LIDXA).*

VS5, Brunei: VS5RCS by 9M2NF and 9M2XX should be on by the time you receive this. Donations may go to WA6VVJ.

VU2, Andaman Islands: VU2DIA left the Andaman Islands at the end of March and is now QRV from India as VU2DI. *(Tnx DX-MB)*

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XF4, Revilla Gigedo Islands: QSLs for the March 16 & 17 operation as XE1PJL/XF4 should go to XE1J.

4A, Mexico: 4A1, 4A2, and 4A3 are prefixes which can be used by XE-land ops until the end of this year. These will be new ones for WPX.

5A, Libya (Zone 34): It is hoped that this rare one will soon be on again. Perhaps operation will have been restarted by the time this arrives. If so it will make WAZ quite a bit easier.

5R8, Malagasy Republic: 5R8AS has been worked on 14211 kc at 1300 GMT. *(Tnx LIDXA).*

5W1, Western Samoa: 5W1AT is quite active on 14 mc s.s.b. *(Tnx LIDXA).*

9G1, Ghana: 9G1GG is none other than Angus, ex-HZ2AMS. *(Tnx VERON).*

9K2, Kuwait: Duane Fuqua, 9K2BV (W5MAE), is on regularly 1400-1600 GMT s.s.b. and c.w., mostly 15 and 20 meters. His rig, an Invader, SB-200, and 3 element beam, accounted for over 100 countries in his first 3 weeks of operation. He will be remembered as SVØWPP, F9DF, and HND9A, the latter in Iraq. HND9A, which many considered to be a bootleg call, was actually arrived at as follows: HN-Iraq commercial, D-Daura refinery, 9- the 9th station, and A-amateur. *(Tnx W5EGR).*

From the Mailbag

de W6RW: "I am quite concerned by the number of intruders in the amateur bands. They are getting worse as each day passes, and amateurs will surely have a tough time retaining the present frequencies at the next international conference unless we start vigorously protesting those present in our bands now.

"A particularly bad example is the station RHU who has been on daily for about 2 months using RTTY on the frequencies 14061-065 kc. He has been positively identified several times on hand key c.w. Frequently he sends only dits continuously and has interfered with many hams including WB6APX, WA8UBJ, VE3DFD, W6WWQ, W6RW, and W6DQH. Occasionally this interference seems deliberate.

"The bearing on this station indicates that he is in Europe, and he contacts station RHF. This intruder is apparently occupying this 4 kc segment of the amateur band to establish a precedent in frequency use. What is the QTH of RHU and RHF? This could become quite serious."

(A check of the Table of Allocation of International Call Sign Series, Radio Regulations, Geneva, 1959, reveals that the letters RAA-RZZ are allocated to the Union of Soviet Socialist Republics. Consequently it appears that Russian stations are at fault in this particular case.

Unfortunately, W6RW has a very legitimate fear. The Radio Regulations also point out that stations may use frequencies outside their normal allocation if they do not cause harmful interference in the normal service operating on those frequencies. Therefore, if no complaints are received from amateurs it is possible that a precedent might be claimed. Consequently, all amateurs, and particularly DXers, should make haste to affiliate with the ARRL Intruder Watch. All that's necessary is a postcard to League headquarters.—*K4IIF, DX Editor*)

de KH6GLU (Ed DeYoung)—"The Fanning Island station was set-up at the QTH of VR3C, Phil Palmer. As Phil needs quite a bit of radio equipment most of the support received by the DXpedition prior to departure will be spent on books, parts, etc. for him. The small remainder, plus a lot of my own money, will be spent on QSLing costs. While there I will obtain a copy of the VR3C log book as far back as possible. When I return to Honolulu I will send cards to all who worked him in past years upon receipt of an s.a.s.e. or s.a.e./IRCs."

de Girard, HB9AW, WA6QAN, 4U1ITU: "Enclosed kindly find just before my departure to Brazil the IARC 4U1ITU application for WAZ S.S.B. We finally received the UA1CK/JT1 QSL card. It was very exciting to operate 4U1ITU for such a long period.

One of the world's top prefix chasers and a member of the CQ WPX Honor Roll, Djura Borosic, YU1AG, of Belgrade, Yugoslavia. This OM recently applied for 600 stickers for both his WPX Mixed Certificate No. 18 and WPX C.W. Certificate No. 283.

See page 126 for New Reader Service

It is quite a new adventure for me to go for the first time to PY-land.

"Too bad I won't see the WPX and WAZ Awards, but I did get to buy the frames. The USA-CA Award is magnificent and everyone likes it. Good DX." (Good luck in PY-land, old friend. Your steady fist will be missed in Geneva—*K4IIF*).

de GM3CDL: "Just a short note to advise that Frank McAinsh, GM8MN, died on Feb. 17, 1968 after a short illness. Would you be so kind as to mention Frank's passing in your column so that his many friends may learn of this great loss to amateur radio."

de 5Z4SS: "Our QSL Bureau is not a large one as there are only about 30 licensed amateurs in Kenya. Quite a lot of cards are sent direct to the station addresses. These cards usually arrive in batches as determined on the arrival of surface mail by sea through the port of Mombasa. On the average it takes 2 months for surface mail to arrive here from the U.S. The mail is kindly held in Robbie, 5Z4ERR's shop in town and sorted by myself every day. We handle about 500 cards a month including a few 5H3 and 5X5 cards which we forward to their respective bureaus."

de 7P8AR: "My old call was ZS8L, but Geneva took care of that after independence of Basutoland which is now named Lesotho. We sure enjoy reading the DX column in *CQ* Magazine."

de AP2AR via KØEZH: "About the QSLs for contacts with AP5CP. Well, the story is a rather disappointing one. The AP5CP station was located about 10 miles from my QTH but I rarely visited the place as it was inside regimental headquarters and difficult for me to gain access. The station is not operational any more. I visited there a short while ago and found the place deserted. The room was locked, and I was told that the station does not even exist any longer. The gear was all junked or else sent away. Three other member stations in other part sof E. Pakistan suffered the same fate. Nobody knows where the logs are or where the cards have gone as the radio men have all been reassigned. Apparently there is no hope of those 'Tiger' stations ever coming on the band again.

"I was again operational in Oct., 1967, but in Feb. of this year I decided to try to get on s.s.b. so I am now trying to convert my DX-100B. Initial results have been disappointing, but I hope that in due course E. Pakistan will be adequately represented on the ham bands with respectable s.s.b. signals."

Ed DeYoung, VR3DY, operating from Fanning Island during his recent DXpedition. See accompanying story.

QSL Information

DL4FS—Bernie Welch, CMR Box 4488, APO, N.Y. 09057.
DL4RM—Gateway to Europe Radio Club Station, CMR Box 2474, APO, N.Y. 09057.
EAØTU—Via HB9AHA.
EL1I—To W2YTO, 42 Dogwood Terrace, Ramsey, N.J. 07446.
EL2AB—c/o W2YTO (see above).
EP2DA—Via W2MXB.
FH8CF—To Box 72, Moroni, Comoro Islands.
GC8HT—Cards from western hemisphere countries go to W6UNP.
GI3AOB—c/o WB6RYN, 15936 Rushford St., Whittier, Calif. 90603.
HC1GC—Via W2CTN.
LX2X—To LA7M.
MP4MBC (Masirah Island)—Via G3HSR.
PJ5MM (April 6-7, 1968)—To Joe Poston, K9GCE, 309 Benton Drive, Indianapolis, Indiana 46227.
SK3AH—Box 83, Harnosand, S-871 01, Sweden.
SK5AJ—P.O. Box 6, Mjolby, Sweden.
TA1IB—c/o K4EPI, Roland L. Guard, P.O. Box 7542, CMR, Patrick Air Force Base, Florida 32925.
VP2AA—Via VE3ACD.
VP2GRN—To W9YSM.
VP2VL—c/o WØNWX.
VK2KW—Via WØIIC.
VK9RJ—To O.T.C., Nauru Island, South Pacific.
VP7DX—c/o W4FRO.
VR3C—Via Ed DeYoung, KH6GLU, 1942-A Iwaho Place, Honolulu, Hawaii 96819.
XE1PJL/XF4—Jose Levy, XE1J, P.O. Box 200, Colima, Col., Mexico.
YS1XEE—Via WB4BOJ.
ZD3F—c/o W2CTN.
3V8BZ—To DL7FT.
5N2ABG—Via W9SCD, 1055 Woodfield Lane, Libertyville, Ill. 60048.
8P6AY—c/o W4OPM.
9K2BV—To W5EGR, 521 Monroe, N.W., Ardmore, Oklahoma 73401.
9Q5EP—Via VE2DLC.
9Q5PT—c/o WB2ZKJ.
9Y4VT—To W3DJZ.

73, John, K4IIF

See page 126 for New Reader Service

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Q AND A

BY WILFRED M. SCHERER,* W2AEF

THE introductory remarks for some of the recent Q & A COLUMNS have dealt with r.f. power. This time we'll take a look at primary-line power which bears a direct relation to r.f. power capabilities.

120 V. Versus 240 V.

When a high-power linear amplifier is used, it generally is better to operate it from a 240-volt a.c. source rather than from a 120-volt one, since only one half as much a.c. line current is then required. This results in a smaller voltage drop when a given size conductor (such as with normal house wiring) is used and better voltage regulation is therefore obtained. This is particularly desirable for good amplifier linearity and full output under dynamic operating conditions (that is, with modulation).

208 or 240 Volts?

When this is done, however, in some cases it may be found that the full power capabilities of the equipment are not realized, because the so-called 240-volt source actually supplies only 208 volts. About a 25% loss of power then is experienced over that otherwise attainable.

Power-plant generators usually provide output in three phases, each displaced by 120°, which is transmitted to the service area at a high voltage rather than a low one, since for a given amount of power the current flow is less. Consequently, smaller diameter conductors may be used with less loss and thus make the setup more economical. At the distribution point for the service area the voltage is dropped to the desired level through transformers the windings of which are connected according to the needs of various type loads in the area.

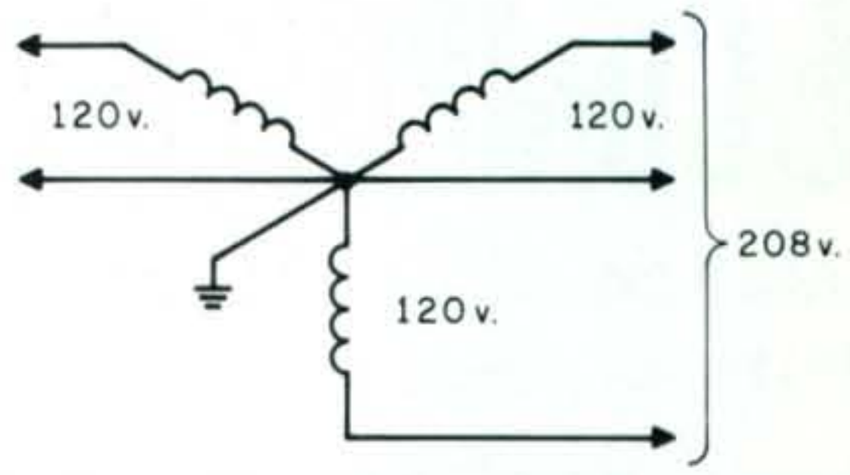

Fig. 1—Distribution-transformer secondary windings "Wye" connected.

Wye Connection

In localities where *lighting* is the predominant load demand, the service is provided with 120 volts from a "Wye" connection at the distribution transformer as shown at fig. 1.

This arrangement is employed, because it is easier to balance such loads and thus reduce the current flow in the neutral (or grounded) leg, allowing a common line for the individual phases to be used without incurring an excessive voltage drop.

Although 120 volts may appear across any one transformer winding, the total voltage across any two windings is 208 volts and not 240 volts. This is so, because there is a 120° phase difference between the voltages on each winding, resulting in a total voltage which is the vector resultant of the two. This amounts to 1.73 times the voltage on one winding.

Delta Connection

In localities where *power* is the predominant load demand, (such as industrial areas), the "Delta" connection often is used at the distribution transformer as shown at fig. 2. The primary-to-secondary ratio of the transformer is set up to provide 240 volts (or 230) on each secondary winding or phase.

Where a 120/240 (or 115/230 volt service is desired, a three-wire single-phase system is set up by a center tap on one of the windings. Since this is done on the one phase, 120 (or 115) volts appears each side of the center tap.

Raising the Voltage on a 208-volt Supply

Where the service provides a maximum of only 208 volts, the potential can be raised by

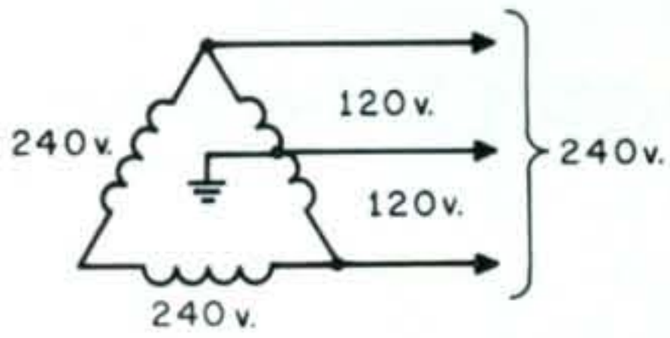

Fig. 2—Distribution-transformer secondary windings "Delta" connected.

* Technical Director, *CQ*.

See page 126 for New Reader Service

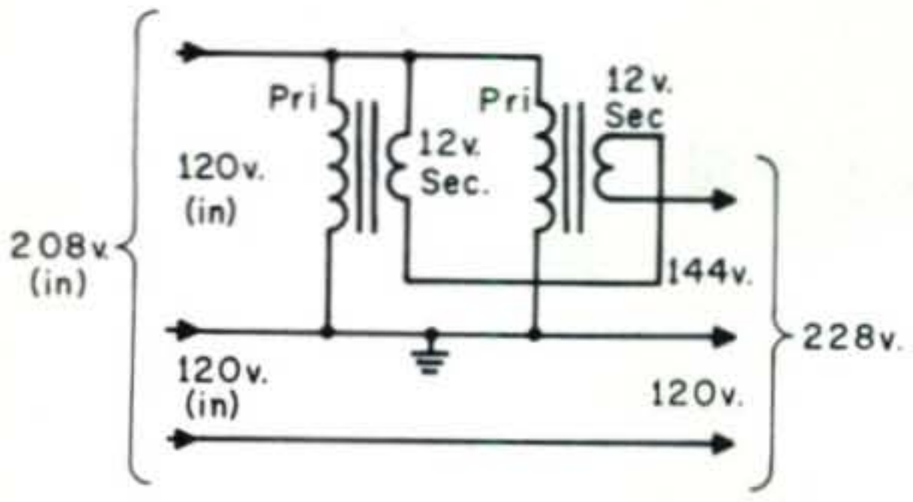

Fig. 3—Circuitry using two 12-volt filament transformers to boost 208-volt service to 228 volts.

the use of a step-up transformer which may be a fixed or variable type.

Fixed types can be found identified as "air-conditioner" autoformers for increasing 208 volts to 230 volts. Two such models are the Chicago/Stancor PSU-2000 for 2300 watts and the PSU-3000 for 3000 watts (available from Allied Radio with respective catalogue numbers and prices of 54-D-3967 at $19.60 and 54-D-3968 at $23.12). These have an attached three-wire line cord which plugs directly into a 208-volt outlet. 230-volts output is obtained from a three-terminal outlet on the transformer.

The third, or center, leg is a common ground for both the input and output. When it is used to provide a three-wire connection to the primary of the equipment power transformer, 120 volts apears between ground and one side, 145 volts between ground and the other side. Therefore, in equipment where one half of its 240 v. a.c. input circuit is used to provide 120 volts for a low-voltage supply or a blower (such as in the Hallicrafters SR-2000, National NCL-2000, Henry 2K, etc.), care must be taken to install the autoformer so that its 120-volt side is connected to the portion of the equipment input designated for 120 volts. This may be checked by first measuring the voltage across each half of the autoformer output.

Also make sure the ground or center pin of the 208-volt-service outlet is connected through to the ground used at the power-service entrance to the premises. This circuit carries a.c. current in the above application, so the connection should be made using a heavy conductor (such as the #12 white lead in a three-wire cable), rather than relying on a connection through the BX-cable shell or through a small size "equipment-ground" wire in the cable sheath; otherwise the setup may be unsafe.

The variable type of autoformer is commonly referred to as a "Variac," but Models designed for 220-volt operation are quite expensive. When a center tap is required, as described above, an external common-ground lead will have to be connected between the equipment and the service outlet, unless the Variac is equipped with three-wire connections.

If you happen to have two 10-12 volt filament transformers on hand (or find them at low cost in surplus) capable of handling the required a.c. current (at least 5 a. for a 1 kw input linear, or 10 a. for a 2 kw job), they may be rigged up as shown at fig. 3 to provide a vector resultant of 225-228 volts.

The connections must be made so that the voltages at the transformer secondaries add to the line voltage instead of subtracting from it. This can be checked experimentally by reversing either their primary or secondary windings.

If it is not necessary to hold the potential on one leg down to 120 volts, one transformer may be connected in each leg as shown at fig. 4. Somewhat better regulation might then be realized.

A single 25-30 volt transformer such as the Triad F79U (Allied #54-E-2025, price $28.19—a 15 a. job) may be connected in one leg, only, to boost this side of the line and provide a vector output of 230-234 volts. The precautions for a common ground connection to the gear should be followed.

The above methods of increasing voltage will result in some loss of regulation; nevertheless, it will not be as severe as experienced with 120-volt operation through normally-used house circuits and full power capabilities will be more easily maintained.

Since a maximum of only 208 volts is available in many areas, we'd like to recommend that for optimum performance of high-power gear, the equipment manufacturers provide transformer-primary taps for 208-volt operation besides the 120/240 volt connections.

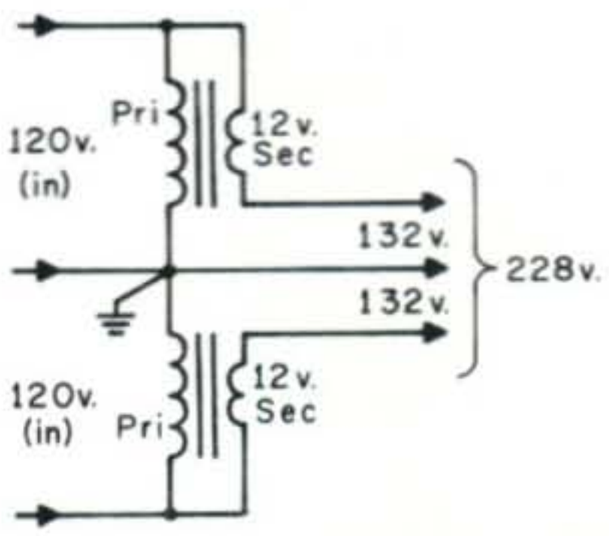

Fig. 4—Alternate method of connecting two booster transformers as explained in text. A single 25-30 volt transformer also may be used installed in one side of the circuit only.

See page 126 for New Reader Service

S.S.B. Interference with Hi-Fi System

QUESTION: My s.s.b. signals are picked up strongly by my neighbor's hi-fi a.m., f.m., tape, phono combination. I bypassed the speaker leads and a.c. input to ground with .01 mf capacitors which killed the interference on a.m. and f.m., but it is still there on tape and phono positions. How can this be cured?

ANSWER: The r.f. signals are probably picked up at the input of and rectified by a low-level a.f. stage in the hi-fi gear. Suggest you connect a 100 mmf (mica or ceramic) bypass directly at the grid terminal at the socket for the preamplifier tube. Keep leads short and make the ground connection at the same point as used for the cathode bypass. If this does not help, *add* a 2.5 mh r.f. choke or a 10K ½-watt resistor is series with the grid lead to this tube. Do this right at the socket. Circuitry is shown at fig. 5. Similar treatment may be required on one or more other stages. In addition, avoid ground loops with the a.f. connecting cables to the gear. A specific one-point ground may be needed as determined by experiment.

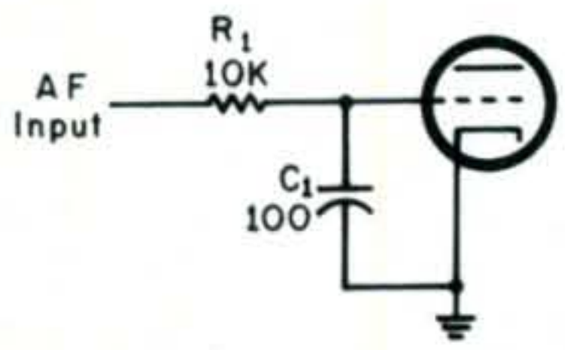

Fig. 5—Filter for eliminating r.f. interference in a.f. equipment. R_1 and C_1 should be connected directly at the socket of pre-amp tube with C_1 ground lead connected at same point as tube cathode.

AC/DC Adapter for Transistor Radio

QUESTION: I need an a.c./d.c. adapter for a GE-P930A portable transistor receiver that has four C-cells and draws 18-27 ma. I don't know what voltage the set requires, because I cannot make out if the C-cells are connected in series or in series-parallel. Can you recommend a store-bought adapter or information on constructing one?

ANSWER: The receiver probably is a 6-volt job. You can check this by removing one of the batteries. If the set goes dead, the batteries normally are connected in series and the potential is 6 volts. If it still plays, the batteries are in series-parallel with 3-volts output.

A 6-volt AC/DC adapter, which also serves as a small-battery charger, may be purchased from Lafayette Radio Electronics, 111 Jericho Turnpike, Syosset, N.Y. 11791 The catalogue number is 33-H-7701, price is $4.95.

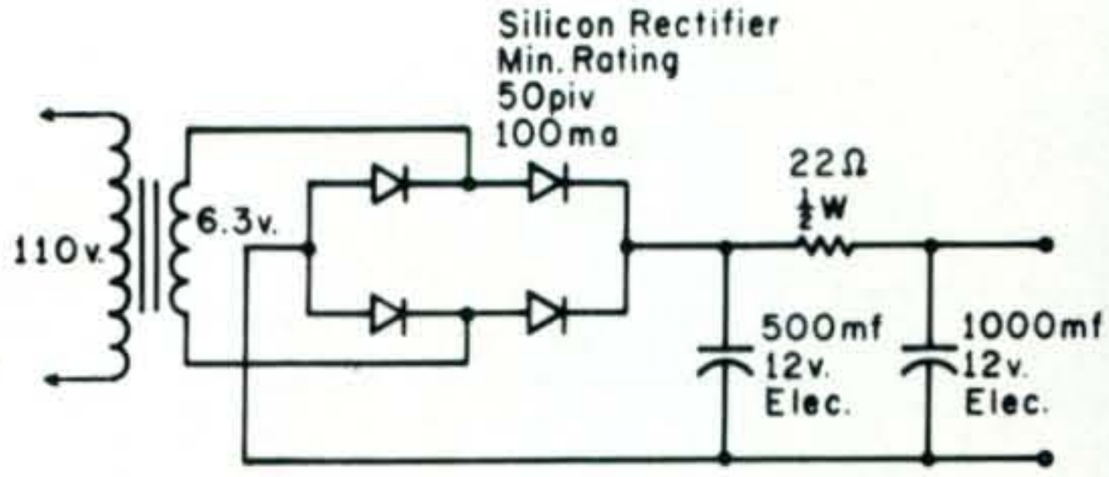

Fig. 6—6-volt a.c./d.c. adapter for transistor radio. T_1 is a small filament transformer. The silicon rectifiers should have a minimum rating of 50 v. p.i.v. and 100 ma.

If you wish to build your own unit, the circuit diagram is shown at fig. 6.

Product Detector Modification for Swan 350 and 400

QUESTION: Have you any suggestions on improving the product detector in the Swan 350 Transceiver?

ANSWER: The circuit shown at fig. 7 is for a modification of the present product-detector setup in the Swan 350 and 400 transceivers that will eliminate the distortion products at full r.f. gain (with a.g.c. on). Thanks to W1PRI.

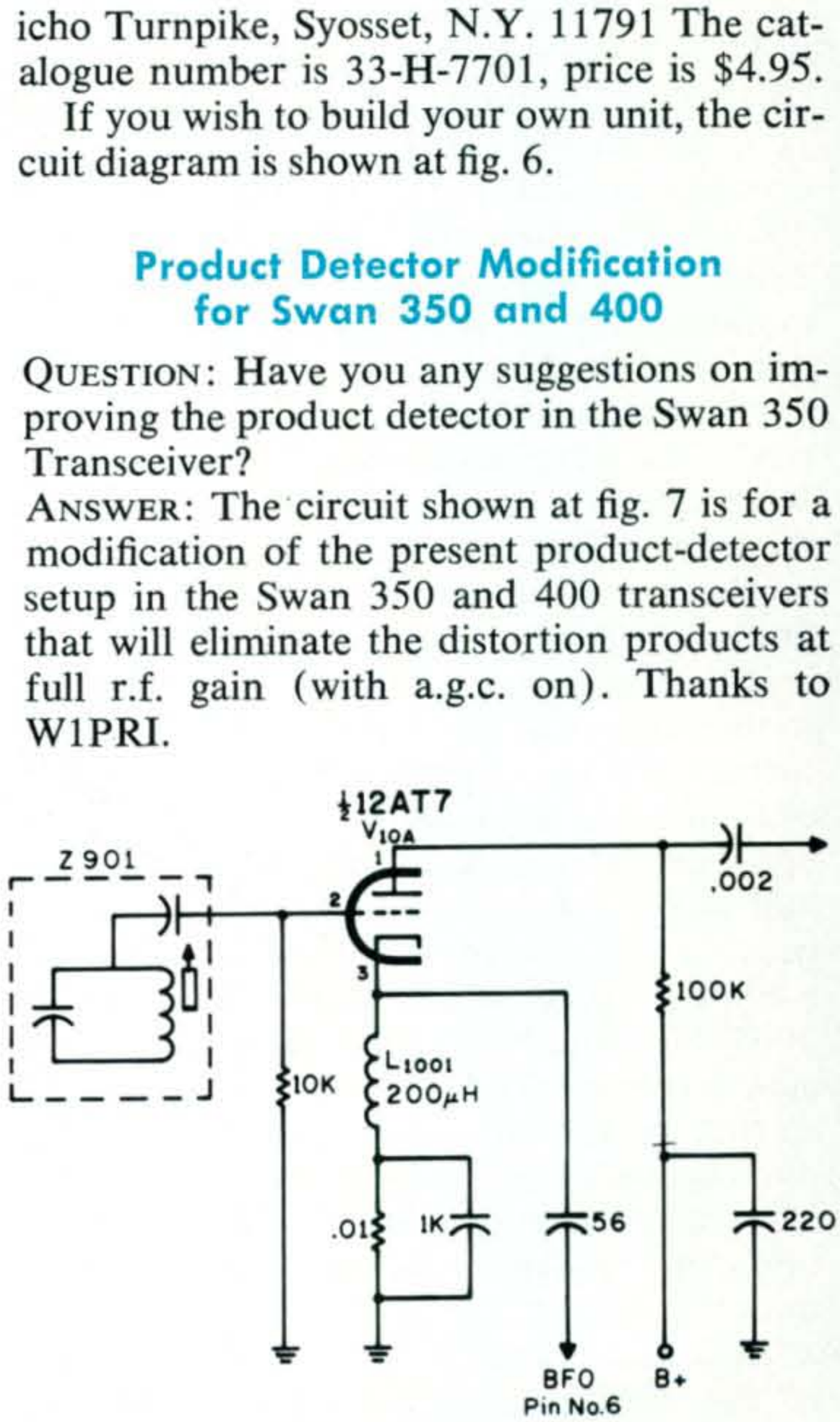

Fig. 7—Product detector modification for the Swan 350 and 400 Transceivers. The b.f.o. in the 350 is V_{14}, in the 400 it is V_{15}.

Back Issues

Back issues of *CQ* are available from our Circulation Department. Issues in the current year sell for face value (.75) and all others in stock are one dollar each, postpaid. If the issue is no longer in stock, photo copies of specific articles are available at one dollar each. Preferably, the entire issue will be sent.

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Propagation

BY GEORGE JACOBS,* W3ASK

THE present sunspot cycle, which began during October, 1964 is slowly nearing its peak level of intensity, with a smoothed sunspot number of 114 predicted for June.

Despite near-peak solar cycle activity, a sharp seasonal decrease is expected in DX propagation conditions on 10 meters during June and the summer months. While fewer openings appear in the Propagation Charts, some fairly good ones still should be possible to southern and tropical areas during the daylight hours.

The relatively high level of sunspot activity is expected to result in excellent world-wide propagation conditions on 15 meters. While the band may open for DX shortly after sunrise on many days during the month, peak conditions are expected during the late afternoon and early evening hours. To some tropical and southern areas of the world, the band may remain open well into the hours of darkness.

Around-the-clock DX propagation conditions are forecast for 20 meters during June and the summer months. While the band is expected to open during the sunrise period, peak conditions will occur during the early evening hours and during most of the darkness period.

A sharp seasonal increase in static levels and fewer hours of darkness are expected to result in noticeably poorer DX propagation conditions during June and the summer months on the 40, 80 and 160 meter bands. While some fairly good openings may still be possible on 40, very few are forecast for 80 meters, and practically none at all for 160. Whatever openings might be possible on these bands, should occur during the hours of darkness and the sunrise period.

In summary, the best bet for DX openings during the daylight hours should be 15 meters; with 20 meters best during the hours of darkness.

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

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for June through July 15, 1968

	Forecast Rating & Quality			
Days	(4)	(3)	(2)	(1)
Above Normal: **2-3, 12, 25, 29-30, 9, 14**	A	A-B	B-C	C
Normal: **1, 4, 6-7, 9, 11, 13-14, 16-19, 21, 23-24, 26, 28, 1, 3-4, 6, 8, 10-11, 13, 15**	A-B	B-C	C-D	D-E
Below Normal: **5, 8, 10, 15, 20, 22, 2, 5, 7, 12**	C	C-D	D	E
Disturbed: **27**	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.

3—With the forecast rating noted above, start with the numbers in parenthese 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 DX Propogation Charts are based upon a transmitter power of 250 watts c.w.; 500 watts s.s.b., or 1000 watts d.s.b., into a dipole antenna a quarter-wave above ground on 160 and 80 meters, a half-wave above ground on 40 and 20 meters, and a wave-length above ground on 15 and 10 meters. For each 10 db gain 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—The Eastern USA chart can be used in the 1, 2, 3, 4, 8, KP4, KG4 and KV4 amateur call areas; The Central USA Chart in the 5, 9, and Ø areas, and the Western USA Chart in the 6 and 7 areas. The Charts are valid from June 15 through July 15, 1968, and are prepared from basic propogation data published monthly by the Institute For Telecommunication Sciences And Aeronomy of the U.S. Dept. of Commerce, Boulder, Colorado.

This month's *CQ* Propagation Charts contain DX predictions for the period *June 15—August 15, 1968*. DX predictions for the early part of June appeared in April's column. Short-skip predictions for June, for distances between 50 and 2300 miles, and from Hawaii and Alaska to the mainland, appeared in last month's column. Instructions for the correct use of this month's DX propagation Charts may be found directly below the "Last Minute

See page 126 for New Reader Service

Forecast" which appears at the beginning of this column.

V.h.f. Ionospheric Openings

Sporadic-E ionization is expected to reach a near-seasonal peak during June, resulting in very frequent short-skip openings on 10 meters, numerous openings on 6 meters, and an occasional opening on 2 meters.

Long periods of 10 meter short-skip openings, between distances of approximately 400 to 1300 miles, are expected to occur almost daily. Six meter openings, between distances of approximately 750 to 1300 miles are likely to occur during most days of the month. During periods of intense and wide-spread sporadic-E ionization, "two-hop" openings up to a distance of about 2400 miles may also be possible on both 10 and 6 meters. An occasional 2 meter short-skip ionospheric opening may also be possible, between distances of approximately 1200 and 1400 miles, during periods of intense sporadic-E ionization.

As its name implies, sporadic-E propagation may be possible at any time, but it is most likely to occur between 9 a.m. and 1 p.m. and between 5 p.m. and 9 p.m., local time. For some useful tips on self-predicting v.h.f. sporadic-E openings, see "Some Notes on Sporadic-E Propagation", which appeared on page 60 of the June, 1962 issue of *CQ*.

No major meteor showers are forecast for June, and very little auroral activity is expected during the month. Check the "Last Minute Forecast" appearing at the beginning of this column, since whatever auroral propagation may be possible is likely to occur on those days forecast to be below normal or disturbed.

Sunspot Cycle

The Swiss Federal Solar Observatory, the official keeper of sunspot records, reported a monthly mean sunspot number of 92.4 for March, 1968. This results in a smoothed sunspot number of 95 centered on September, 1967. A smoothed sunspot number of 114 is forecast for June, 1968, as the present cycle slowly nears a maximum value. ■

JUNE 15 - AUGUST 15, 1968

Time Zone: EST (24-Hour Time)

Eastern USA To:

	10 Meters	*15 Meters*	*20 Meters*	*40/80 Meters*
Western & Central Europe & North Africa	*Nil*	07-08 (1) 08-11 (2) 11-15 (1) 15-18 (2) 18-20 (1)	08-13 (1) 13-14 (2) 14-16 (3) 16-22 (4) 22-00 (3) 00-04 (2) 04-06 (3) 06-08 (2)	19-21 (1) 21-22 (2) 22-00 (3) 00-01 (2) 01-02 (1) 21-23 (1)* 23-00 (2)* 00-01 (1)*
Northern Europe & European USSR	*Nil*	10-14 (1) 14-16 (2) 16-18 (1)	08-14 (1) 14-16 (2) 16-17 (3) 17-20 (4) 20-23 (3) 23-01 (2) 01-06 (1) 06-08 (2)	20-21 (1) 21-23 (2) 23-01 (1) 20-23 (1)*
Eastern Mediterranean & Middle East	*Nil*	10-12 (1) 12-16 (2) 16-18 (3) 18-19 (2) 19-20 (1)	11-13 (1) 13-15 (2) 15-18 (3) 18-22 (4) 22-01 (3) 01-02 (2) 02-05 (1) 05-07 (2) 07-09 (1)	19-21 (1) 21-23 (2) 23-00 (1) 21-23 (1)*
West Africa	10-12 (1) 15-18 (1)	09-11 (1) 11-13 (2) 13-15 (3) 15-17 (4) 17-19 (3) 19-20 (2) 20-21 (1)	13-14 (1) 14-15 (2) 15-17 (3) 17-23 (4) 23-02 (3) 02-03 (2) 03-06 (1)	19-21 (1) 21-23 (2) 23-01 (1)
East & Central Africa	08-10 (1) 16-18 (1)	08-11 (1) 11-13 (2) 13-16 (3) 16-17 (4) 17-19 (3) 19-20 (2) 20-21 (1)	13-15 (1) 15-16 (2) 16-17 (3) 17-21 (4) 21-23 (3) 23-02 (2) 02-05 (1)	19-20 (1) 20-23 (2) 23-00 (1)
South Africa	09-12 (1)	00-02 (1) 07-09 (1) 09-10 (2) 10-12 (3) 12-13 (2) 13-14 (1)	23-00 (1) 00-02 (3) 02-04 (2) 04-07 (1) 13-14 (1) 14-16 (2) 16-18 (1)	19-20 (1) 20-22 (2) 22-01 (1) 22-00 (1)*
Central & South Asia	*Nil*	08-10 (1) 13-18 (1) 18-21 (2) 21-22 (1)	16-19 (1) 19-22 (2) 22-02 (1) 02-05 (2) 05-07 (1)	18-20 (1)
South-east Asia	*Nil*	09-13 (1) 13-15 (2) 15-18 (1) 18-20 (2) 20-21 (1)	05-06 (1) 06-08 (2) 08-10 (1) 15-18 (1) 18-20 (2) 20-23 (1) 23-01 (2) 01-02 (1)	*Nil*
Far East	*Nil*	08-09 (1) 09-11 (2) 11-17 (1) 17-19 (2) 19-21 (1)	05-06 (1) 06-08 (3) 08-09 (2) 09-11 (1) 17-19 (1) 23-01 (1)	*Nil*
Pacific Islands & New Zealand	17-21 (1)	08-10 (1) 13-15 (1) 15-18 (2) 18-22 (3) 22-23 (2) 23-00 (1)	17-20 (1) 20-22 (2) 22-00 (3) 00-03 (4) 03-04 (3) 04-06 (2) 06-08 (3) 08-09 (2) 09-11 (1)	00-02 (1) 02-05 (2) 05-07 (1) 03-05 (1)*
Australia	18-20 (1)	08-10 (1) 16-17 (1) 17-19 (2) 19-21 (3) 21-22 (2) 22-23 (1)	22-00 (1) 00-02 (2) 02-04 (3) 04-07 (2) 07-09 (3) 09-11 (2) 11-13 (1)	02-03 (1) 03-05 (2) 05-06 (1) 03-05 (1)*

* Predicted times of 80 meter openings. Openings on 160 meters are also likely to occur during those times when 80 meter openings are shown with a forecast rating of (2), or higher.

See page 126 for New Reader Service

North-ern & Central South America	10-13 (1) 13-16 (2) 16-18 (3) 18-19 (2) 19-20 (1)	07-08 (1) 08-10 (2) 10-15 (3) 15-19 (4) 19-21 (3) 21-23 (2) 23-00 (1)	05-06 (3) 06-08 (4) 08-10 (3) 10-15 (2) 15-17 (3) 17-00 (4) 00-03 (3) 03-05 (2)	18-19 (1) 19-22 (2) 22-03 (3) 03-04 (2) 04-05 (1) 19-21 (1)* 21-03 (2)* 03-04 (1)*
Brazil, Argen-tina, Chile & Uru-guay	10-13 (1) 13-15 (2) 15-17 (3) 17-18 (2) 18-19 (1)	06-07 (1) 07-10 (2) 10-14 (1) 14-15 (2) 15-17 (3) 17-20 (4) 20-23 (3) 23-01 (2) 01-02 (1)	15-16 (1) 16-18 (2) 18-19 (3) 19-01 (4) 01-03 (3) 03-04 (2) 04-06 (1) 06-08 (2) 08-10 (1)	20-23 (1) 23-04 (2) 04-06 (1) 00-05 (1)*
Mc-Murdo Sound, Antarc-tica	*Nil*	13-15 (1) 15-19 (2) 19-20 (1)	16-17 (1) 17-20 (2) 20-02 (3) 02-06 (2) 06-08 (1)	20-01 (1) 01-03 (2) 03-05 (1)

Time Zone: CST & MST (24-Hour Time)
Central USA To:

	10 Meters	*15 Meters*	*20 Meters*	*40/80 Meters*
Western & Central Europe & North Africa	*Nil*	10-15 (1) 15-18 (2) 18-19 (1) 22-00 (1)	00-04 (1) 04-06 (2) 06-15 (1) 15-16 (2) 16-18 (3) 18-20 (4) 20-22 (3) 22-00 (2)	19-22 (1) 22-00 (2) 00-01 (1) 21-23 (1)*
Northern Europe & European USSR	*Nil*	08-11 (1) 11-15 (2) 15-17 (1)	01-06 (1) 06-08 (2) 08-14 (1) 14-17 (2) 17-22 (3) 22-01 (2)	19-23 (1)
Eastern Mediter-ranean & Middle East	*Nil*	13-17 (1)	12-15 (1) 15-17 (2) 17-20 (3) 20-22 (2) 22-00 (1) 06-08 (1)	20-23 (1)
West Africa	09-11 (1) 15-18 (1)	09-11 (1) 11-14 (2) 14-17 (3) 17-19 (2) 19-20 (1)	13-14 (1) 14-15 (2) 15-17 (3) 17-21 (4) 21-23 (3) 23-02 (2) 02-04 (1)	19-23 (1)
East & Central Africa	15-18 (1)	12-14 (1) 14-15 (2) 15-17 (3) 17-18 (2) 18-19 (1)	14-16 (1) 16-17 (2) 17-19 (3) 19-21 (4) 21-22 (3) 22-00 (2) 00-01 (1)	19-22 (1)
South Africa	08-11 (1)	23-01 (1) 07-09 (1) 09-11 (2) 11-12 (1)	22-23 (1) 23-01 (2) 01-04 (1) 10-12 (1) 12-14 (2) 14-16 (1)	20-22 (1) 22-23 (2) 23-00 (1)
Central & South Asia	*Nil*	14-17 (1) 17-20 (2) 20-22 (1) 08-10 (1)	16-18 (1) 18-21 (2) 21-05 (1) 05-07 (2) 07-09 (1)	*Nil*
South-east Asia	*Nil*	09-10 (1) 10-13 (2) 13-18 (1) 18-21 (2) 21-23 (1)	02-06 (1) 06-09 (2) 09-10 (1) 21-22 (1) 22-00 (2) 00-01 (1)	*Nil*
Far East	*Nil*	08-10 (1) 12-14 (1) 17-19 (1) 19-22 (2) 22-00 (1)	00-03 (1) 03-05 (2) 05-09 (3) 09-10 (2) 10-12 (1)	03-04 (1) 04-05 (2) 06-08 (1)
Pacific Islands & New Zealand	15-21 (1)	12-15 (1) 15-17 (2) 17-19 (3) 19-21 (4) 21-22 (3) 22-23 (2) 23-00 (1)	16-18 (1) 18-22 (2) 22-01 (4) 01-04 (3) 04-06 (2) 06-08 (4) 08-10 (2) 10-12 (1)	22-00 (1) 00-02 (2) 02-04 (3) 04-06 (2) 06-07 (1) 00-06 (1)*
Aus-tralia	16-20 (1)	13-14 (1) 14-16 (2) 16-18 (1) 18-19 (2) 19-21 (3) 21-22 (2) 22-23 (1)	21-23 (1) 23-00 (2) 00-02 (4) 02-04 (3) 04-06 (2) 06-08 (4) 08-10 (2) 10-11 (1)	00-02 (1) 02-06 (2) 06-07 (1) 03-06 (1)*
North-ern & Central South America	10-12 (1) 12-14 (2) 14-16 (3) 16-17 (2) 17-18 (1)	07-08 (1) 08-10 (2) 10-15 (3) 15-18 (4) 18-19 (3) 19-20 (2) 20-22 (1)	02-04 (2) 04-06 (3) 06-08 (4) 08-10 (3) 10-15 (2) 15-17 (3) 17-22 (4) 22-02 (3)	19-20 (1) 20-22 (2) 22-03 (3) 03-04 (2) 04-05 (1) 21-00 (1)* 00-03 (2)* 03-04 (1)*
Brazil, Argen-tina, Chile & Uru-guay	08-12 (1) 12-15 (2) 15-18 (3) 18-19 (2) 19-20 (1)	06-07 (1) 07-09 (2) 09-13 (1) 13-15 (2) 15-16 (3) 16-20 (4) 20-22 (3) 22-00 (2) 00-02 (1)	13-15 (1) 15-17 (2) 17-18 (3) 18-23 (4) 23-01 (3) 01-02 (2) 02-04 (1) 04-06 (2) 06-09 (1)	20-22 (1) 22-01 (2) 01-04 (1) 22-03 (1)*
Mc-Murdo Sound, Antarc-tica	*Nil*	13-15 (1) 15-18 (2) 18-20 (1)	13-16 (1) 16-18 (2) 18-00 (3) 00-03 (2) 03-06 (1)	20-21 (1) 21-23 (2) 23-05 (1)

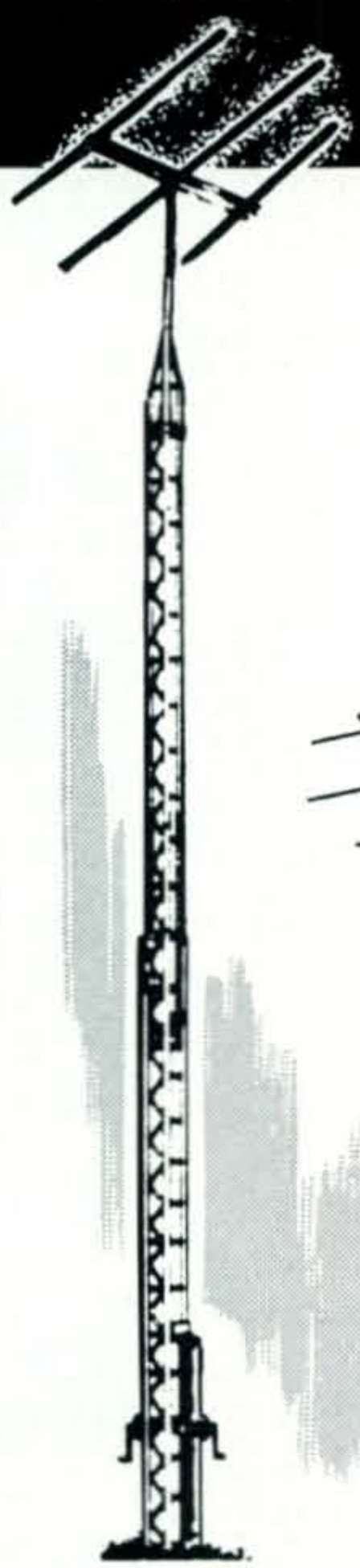
Time Zone: PST (24-Hour Time)
Western USA To:

	10 Meters	*15 Meters*	*20 Meters*	*40/80 Meters*
Western Europe & North Africa	*Nil*	07-08 (1) 08-10 (2) 10-14 (1) 14-16 (2) 16-17 (1) 20-22 (1)	23-05 (1) 05-07 (2) 07-14 (1) 14-16 (2) 16-21 (3) 21-23 (2)	19-22 (1)
Central & North-ern Europe & Euro-pean USSR	*Nil*	06-08 (1) 13-16 (1) 20-22 (1)	13-15 (1) 15-20 (2) 20-23 (3) 23-00 (3) 00-07 (1)	19-21 (1)
Eastern Mediter-ranean & Middle East	*Nil*	06-08 (1) 12-19 (1) 19-21 (2) 21-22 (1)	12-15 (1) 15-19 (2) 19-21 (3) 21-23 (2) 23-00 (1) 05-07 (1)	*Nil*
West & Central Africa	07-10 (1)	06-10 (1) 10-12 (2) 12-16 (1) 16-18 (2) 18-19 (1)	12-14 (1) 14-17 (2) 17-19 (3) 19-21 (4) 21-23 (3) 23-03 (2) 03-07 (1)	20-23 (1)
East Africa	*Nil*	08-12 (1) 12-15 (2) 15-16-(1) 19-21 (1)	14-16 (1) 16-18 (2) 18-21 (3) 21-23 (2) 23-00 (1)	*Nil*
South Africa	*Nil*	07-09 (1) 09-11 (2) 11-12 (1) 22-00 (1)	14-16 (1) 21-22 (1) 22-00 (2) 00-06 (1) 06-08 (2) 08-10 (1)	19-22 (1)

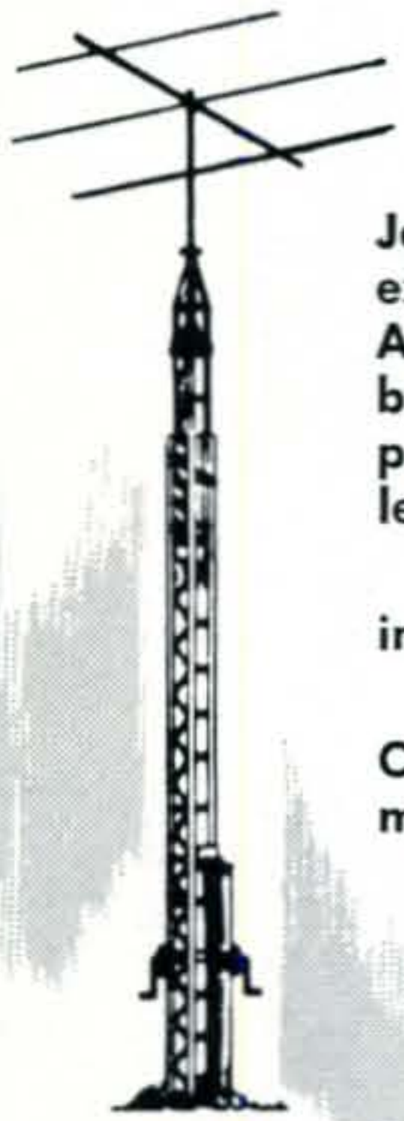
[*continued on page 120*]

See page 126 for New Reader Service

INSTALL A 60 FOOT TOWER YOURSELF WITH NO CONCRETE



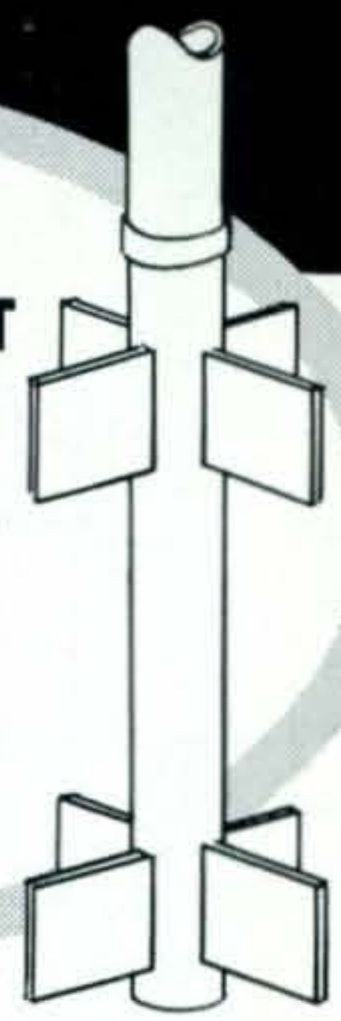
FULL HEIGHT



CRANKED DOWN

E-Z WAY PRODUCTS WONDER GROUND POST

WONDER GROUND POST'S stabilizing fins insure a solid setting under practically all ground conditions **WITHOUT THE USE OF CONCRETE!** Simple installation requiring only a post hole digger. Thousands in use throughout the world for over a decade.



Join the thousands of Hams enjoying E-Z Way Towers' exclusive advantages. The easiest Ham tower to install. Also can be raised and lowered to any desired height by one man and with equal ease tilted to horizontal position permitting access to beam and rotor at ground level.

Standard models from 40 to 150 feet and commercial installations to 1,000 feet.

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- Engineering and Design
- Requirements Analysis
- Site Surveys and Evaluation for AM-FM-TV Broadcast, CATV, Microwave, Meteorology and Telemetry fixed or portable installations.

ONE OF THE WESTERN HEMISPHERE'S QUALITY TOWER SYSTEM SUPPLIERS

CUSTOM COMMUNICATIONS STRUCTURES

THE awards PROGRAM

BY ED HOPPER,* W2GT

AWARDS were issued as follows: A USA-CA-3000 Award endorsed All A3A went to Joe, W2JWK—see story and foto on Joe in *CQ* of November 1967. A USA-CA-2500 Award endorsed All A3A was won by John, W5OYG; while Mixed USA-CA-2500 Awards went to Bob W1BHV/K1CXP; Dave, W5PWG/W4SKI, and "KD", W6DIX/7. Floyd, K7WQJ qualified for Mixed USA-CA-2000, 1500, 1000, and 500 Awards. Phil, WAØEVO received Mixed USA-CA-2000 and 1500 Awards. Ben, K5DRF sure hit the jack-pot with a Mixed USA-CA-1500 Award, an All Phone USA-CA-1000 Award, and an All *6M*, A-3, USA-CA-500 Award. Ken, W9WGQ kept me busy by qualifying for Mixed USA-CA-1500, 1000, and 500 Awards. Al, K5MWV received an All A-3 USA-CA-1500 Award, and a Mixed USA-CA-1500 Award went to Ron, K1VTM. Harold, KL7MF qualified for a Mixed USA-CA-1000 Award, and as of now, he is the only KL7 with a USA-CA Award. Kay, K4TBG won a USA-CA-500 Award endorsed All 50 Mc, All A-3. Mixed USA-CA-500 Awards went to: Ken, WB2EUU; Andrew, WA3DSZ; Carl, W3HCW; Terry, WA4PFD; Ben, WB6SVV; Don, W8IIT, Dr. Martin, KØUHJ; Bert, VE3DUS, and Club Station, KA9MF.

* 103 Whittman St., Rochelle Park, N.J. 07662.

FLASH
VICTOR CLARENCE, WØGYM
HAS QUALIFIED FOR #6
USA-CA-3079
ALL COUNTIES SPECIAL HONORS PLAQUE
SEE HIS FOTOS AND "STORY" *CQ* JAN. '68

Unusual Four County Junction Operation By:

Cliff Davidson, WAØKXJ/Ø and John, WAØNYK/Ø during the 2nd ZERO District QSO Party sponsored by the Roosevelt High School Amateur Radio Club, WAØQJX of Des Moines, Iowa September 9-10-11. Rigs were set-up in an unusual QTH, near the town of Dexter, Iowa, about forty miles west of Des Moines. Taking along a tent, portable generator and their rigs, they set up a station in a cornfield next to the point which marks the spot of a four-county junction. Using dipoles stretched across the dirt roads into Adair, Madison, Dallas and Guthrie counties, they made over 300 QSOs, all on QRP. The farmers of the area were helpful and inquisitive and a few stayed by the shack and watched the operation.

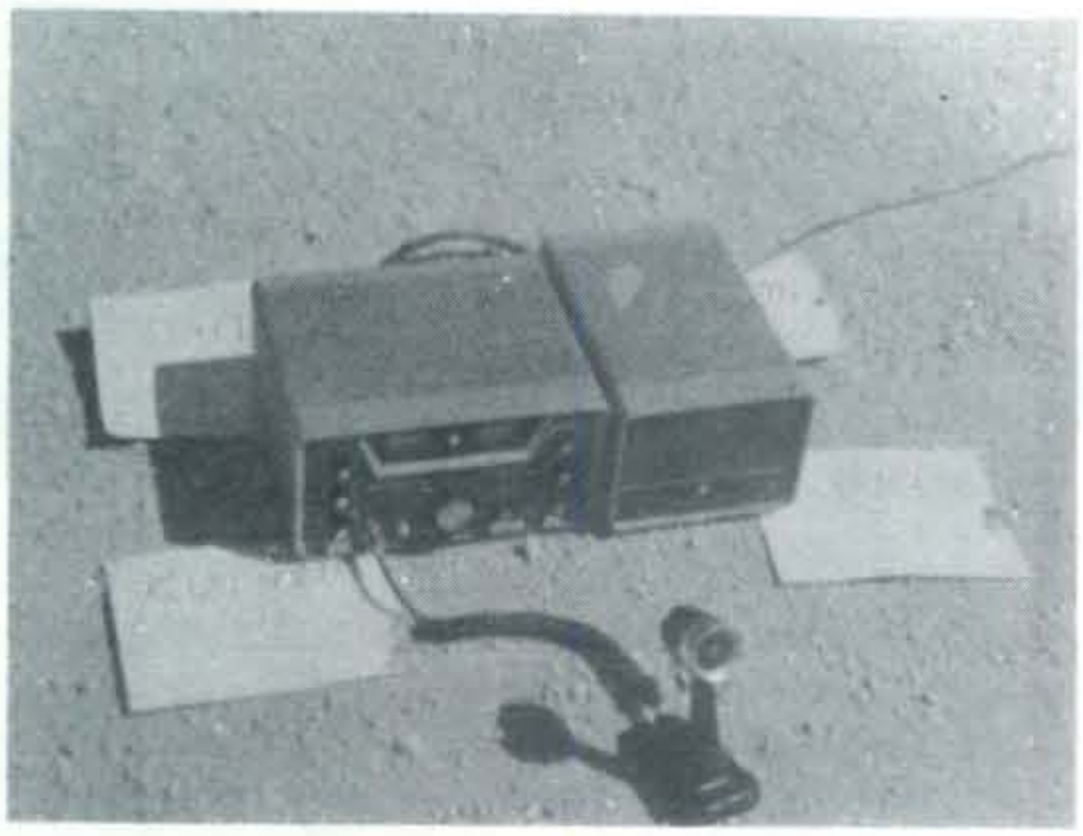
The two fotos were taken through the courtesy of the few motorists who patiently waited while they were snapped. One foto shows the SR-160 resting on the exact spot where the

USA-CA HONOR ROLL

3079		2000		500	
WØGYM	6	K7WQJ	45	WB2EUU	654
3000		WAØEVO	46	K5DRF	655
W2JWK	14	**1500**		W9WGQ	656
2500		K5DRF	69	K4TBG	657
W6DIX/7	24	K1VTM	70	W8IIT	658
W5PWG/W4SKI	25	W9WGQ	71	W3HCW	659
W5OYG	26	K7WQJ	72	VE3DUS	660
W1BHV/K1CXP	27	K5MWV	73	KØUHJ	661
		WAØEVO	74	K7WQJ	662
		1000		WA3DSZ	663
		K5DRF	125	WB6SVV	664
		W9WGQ	126	WA4PFD	665
		KL7MF	127	KA9MF	666
		K7WQJ	128		

FLASH #2
FIRST USA-CA AWARD
TO AN ASIAN STATION
WENT TO CLUB STATION KA9MF

See page 126 for New Reader Service



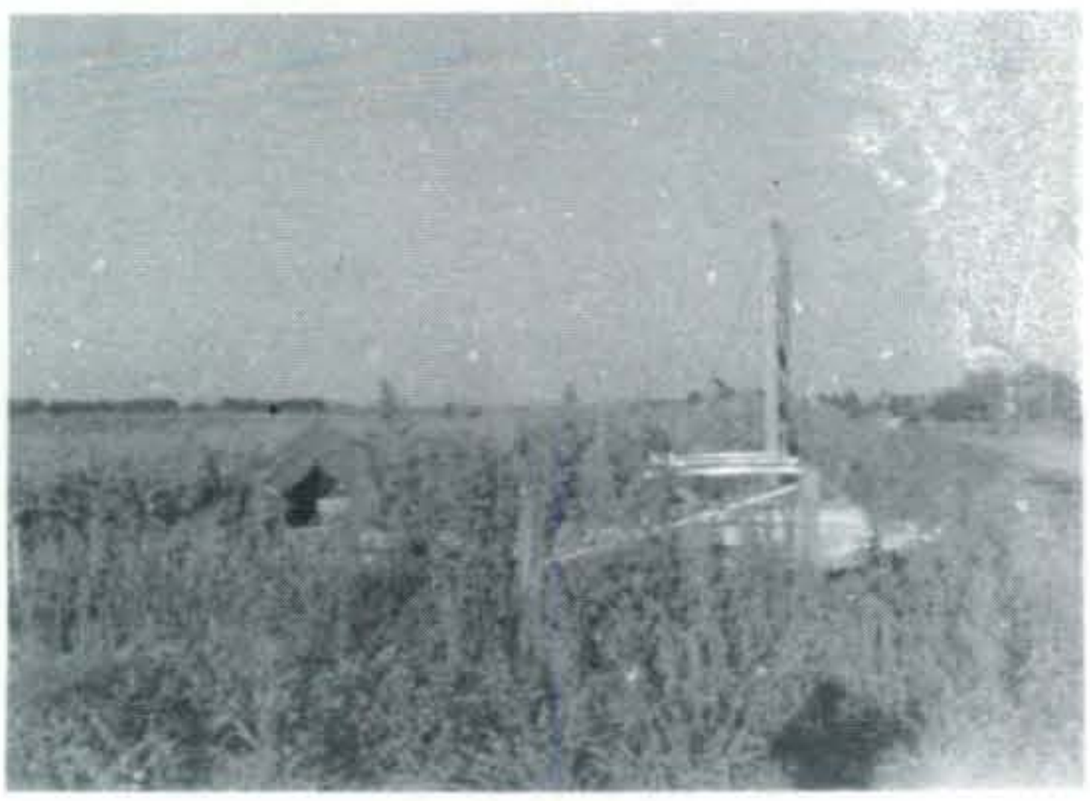
Four County Junction of WAØKXJ and WAØNYK. The rig rests on Adair, Madison, Dallas, and Guthrie Counties.

four counties meet, each county marked repectively on the labels and this could possibly be the #1 operation from 4 counties simultaneously. The other foto is of their tent set up in the cornfield.

WAØNVM, Jeff stopped by their tent and worked a few stations.

Club Station WAØQJX was activated from Dexter, so in all, stations could thus work 4 different calls at the Dexter QTH. More trips are being planned, including some Kansas operation by KØQIX and Missouri operation by the Des Moines gang.

Also during this ZERO QSO Party, Jerry, KØQIX operated portable from 3 rare counties—Lincoln and Perkins counties in Nebraska and Phillips County, Colorado. He managed 348 QSOs from his 3 QTHs using a T4X and R4A. It is suggested that you listen carefully for the QTH of a portable station, as many would probably assume the station stayed in one county during the QSO Party, and thus miss out on one or more rare counties.



What a Ham Shack (tent-shack).

Cliff, WAØKXJ and Jim, WAØHYS took a trip to Owatonna, Minn. in Steele county for the Minnesota QSO Party and had 200 QSOs from that location. Band conditions were good for that trip and their shack was on the second story of a large motel. Unfortunately they were caught off guard by the rail strike and ended up late to work on Monday. QSLs for most of these trips may be obtained by sending an s.a.s.e. to Jim, WAØKXJ, 5200 Shriver, Des Moines, Iowa 50312.

The 4th WAØJKT/WAØDCQ County Expedition

June 7 to June 13, 1968.

Dave, WAØJKT and Dick, WAØDCQ have planned another big one and hope to cover 137 different counties in 11 states, covering 4310 miles in 7 days!

Space does not permit listing the 137 different counties (and few repeats), but it appears that the trip starting June 7, will go through 6 counties in Minnesota, 9 in Iowa, 3 in Missouri by early June 8. Then through 14 more in Missouri and 19 in Kansas by early June 9. Through 10 more in Kansas, 1 in Oklahoma, 15 more in Kansas, and 2 in Nebraska by early June 10. Then 4 more in Nebraska, 1 in Colorado, 6 more in Nebraska and 8 in Wyoming by early June 11. Through 16 in Montant by early June 12. One more in Montana, on through 20 in North Dakota by early June 13. Then on through 3 more in North Dakota, 4 in South Dakota, and 6 in Minnesota—*WOW!* Of course this schedule is tentative and changes might be forced upon them.

They will be using Dick's '65 Chevy Greenbrier truck, in which they will sleep, when possible. With a Swan 240 rig and 2 Hustler Antennas, they plan to operate 20 during the day and 75 at night. They will be able to go to 7225 on request, and will have a pair of walkie-talkies on 3995 a.m. to work each other.

Their basic frequency will be 14336 during the day, starting about 1600 Z, and 14346 will be checked when ever possible. On 75 they will base on 3937 and will try to check 3943.

Although a list would probably be helpful on 75, especially if QRM/QRN is bad, as it probably will be, no list is desired on 20 as they feel they can pick out calls faster without a list.

Calls: WAØDCQ will be used on 20 and WAØJKT on 75.

See page 126 for New Reader Servic

Worked Five KA Stations Award.

Worked 25 KA Stations Award.

Regarding QSLs and expenses: Needless to say, with the large expense of the trip, they will *NOT* pay any postage for stations sending QSLs without s.a.s.e. or s.a.e plus IRC. When sending QSLs and s.a.s.e., if a large business size s.a.s.e. (#10) is sent, they will enclose some comments regarding the trip and County Hunting as a whole. Much mail will be received, so QSLing will take a little time.

The trip is estimated to cost at least $150.00 even though they will sleep in the truck, therefore donations, to help defray expenses, will be accepted *after* the trip is over. Due to their limited funds, future trips will depend on their financial status after all bills are paid, including cost of QSL printing.

It is hoped to have some additional data and fotos on their previous trips, in the near future. Also some fotos and details on this trip, when available.

Letters

Floyd, K7WQJ, writes: "Enclosed is my application for USA-CA-2000, but I would not recommend waiting for this many to send in, it is quite a job.

Just wanted to pass on a little information as to my operations, I am mobile almost every working day. I have given out all counties in Oregon, and most of those in Washington—also many in Idaho, Montana and California.

In 1966 I gave out over 27,000 mobile contacts. In 1967 I gave out over 26,000 and I have kept up the same average so far this year.

I have sure enjoyed the many friends I have made and have enjoyed many otherwise lonely hours of traveling around the northwest."

Jim, W8BZY, writes: "Here is the note I promised some months ago. We have been in Florida over six months and my confirmed total is now 1700 and am awaiting QSLs from 80 more.

Would you kindly print my new address and announce that I will be happy to QSL contacts I made while I was in New Mexico, many did not realize I was in rare Otero county. I recently operated in the Florida QSO Party from here in Brevard county. I am hoping to be able to operate from Charlton county, Georgia in the Georgia QSO Party. I also hope to have time to make some mobile trips here in Florida and give out some of the rarer counties.

I would like to see the Special Honor Roll of the Top 25 County Hunters again in your column. I realize the complications involved, however why not drop a call from the list if no report is received from the station in, say, three months and add the next highest guy to the list. May I suggest that the 3079 guys be kept out of the list (put them in a separate list every few months) so that you can keep twenty-five *active* county hunters in the honor spotlight all the time. New 'QTH—James P. Hamilton, (W8BZY), Capt., USAF, Box 4731, Patrick AFB, Florida 32925.

Ben, WB6SVV, writes: "Well the day has finally arrived. It seems like a long time ago that we embarked on our quest of USA-CA. Sure have had a lot of fun and met lots of great people along the way. The USA-CA

[*Continued on page 110*]

WAGI Certificate

Worked Seven KA Districts Award.

See page 126 for New Reader Service

now... these great combinations from ARROW

SWAN 410C FULL COVERAGE EXTERNAL VFO

The Model 410C Frequency Control Unit, designed for full coverage of 80, 40, 20, 15 and 10 meters, 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.

$115

SWAN MARK II LINEAR AMPLIFIER

Two Eimac 3-400Z Triodes provide the legal power input: 2000 Watts P.E.P. in SSB mode or 1000 Watts AM or CW input. Planetary vernier drives on both plate and loading controls provide precise tuning of the amplifier. Greatly reduced blower noise is provided by a low RPM, high volume fan.

Provides full frequency coverage of the amateur bands from 10 through 80 meters and may be driven by any transceiver or exciter having between 100 and 300 watts output.

$395

SWAN 500 C SSB-AM-CW TRANSCEIVER

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

The new model 500C is the latest development of a basic proven design. It offers greater power and additional features for more operator enjoyment. Using a pair of the new heavy duty RCA 6LQ6 tetrodes, PEP input rating is conservatively 520 watts.

The 500c includes a built-in sidetone monitor. By installing the Swan VOX Accessory (VX-2) you will have break in CW operation.

$520

SWAN 117XC AC POWER SUPPLY

Complete A.C. supply of 117 volts, 50-60 cycles, in a matching cabinet with speaker, phone jack, and indicator light. Includes power cable with plug for transceiver, and A.C. line cord. Ready to plug in and operate.

$105

SWAN 350C SSB-AM-CW TRANSCEIVER

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See page 126 for New Reader Service

Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

June	8-9	National Field Day
June	8-10	New York State Party
June	21-23	ARRL Field Day
July	3-5	KA Field Day
July	6-7	Venezuela Contest
July	20-21	Colombia Contest
August	3-4	Romania Contest
August	10-11	DARC WAE C.W. Contest
August	24-25	QRP QSO Party
August	24-25	All Asian DX Contest
September	7-8	VU/4S7 C.W. Contest
September	14-15	VU/4S7 Phone Contest
September	14-15	DARC WAE Phone Contest
September	21-22	SAC C.W. Contest
September	28-29	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	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**

National Field Day

Starts: 1700 GMT Saturday, June 8
Ends: 1700 GMT Sunday, June 9

This is primarily a European activity but overseas stations are invited to participate.

There is an award to the overseas station that reports the most contacts with these low powered portables.

Send your report no later than June 24th to: RSGB H.F. Contests, 28 Little Russell Street, London WC1, England.

New York State QSO Party

Starts: 1700 GMT Saturday, June 8
Ends: 0100 GMT Monday, June 10

The South Shore Amateur Wireless Association invites all to join in its annual QSO Party.

There are no power restrictions, use both c.w. and phone and the same station may be worked once per band and mode.

Exchange: QSO nr., RS/RST, QTH; county for N.Y. stations, ARRL section or country for all others.

Scoring: One point per QSO. New York uses ARRL sections and countries for their multiplier. Out-of-state stations the number of N.Y. counties worked. (Max. of 62)

Frequencies: 3560, 3900, 7060, 7225, 14060, 14250, 21060, 21300, 28060, 28600.

Awards: Certificates to high scorers in each N.Y. county, ARRL section and country. (Min. of 100 points, 50 for DX)

Logs go to: South Shore AWA, 32 Elmwood St., Valley Stream, N.Y. 11581. Mailing deadline is July 15th. Include s.a.s.e. for results.

ARRL Field Day

Starts: 1900 GMT Saturday, June 22
Ends: 2200 GMT Sunday, June 23

Better check *QST* for the rules and regulations for this annual safari to the hills.

KA Field Day

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

This is an annual affair held over the 4th of July by the Far East Auxiliary Radio Relay League. It's not really a Feld Day or contest but does offer a good opportunity to fatten up your list of KA's and qualify for the many FEARL awards. (See W2GT's COLUMN)

All bands will be activated including 40 and 80 phone. On 40 the KA's will transmit on 7.050 to 7.075 and listen 7.205 to 7.225. And on 80 they will use 3.560 to 3.570 and listen 3.803 to 3.843 mc. Stations KA2PX and KA7AB will also be monitoring 50.115 SSB.

Send your QSLs or list of confirmed QSLs certified by a Radio Club official or two responsible licensed amateurs to: Far East Auxiliary Radio League (M), Att: Awards Manager, Box C-89, APO San Francisco 96525.

* 14 Sherwood Road, Stamford, Conn. 06905.

See page 126 for New Reader Service

1967 All Asian Contest Results

All Band Continental Leaders

JA1AEA	85,285
UP2NK	22,295
5H3KJ	9570
K6DVD	8001
KH6IJ	5894
PY7ACQ	473

U. S. A.
All Band

K6DVD	**8001**
W5WZQ	**7751**
W1EVT	**6524**
W9EWC	**6094**
WA6IVN	5076
WA6OJM	4556
W7EKE	3960
W8GQU	3444
W2HTI	2772
WB6OLR	2520
W4KXV	2512
W2GKZ	2440
W2MEL	1734
K3HTZ	1455
W2LWI	1445
WA7BOA	1190
W9KMN	1080
W4KFC	891
W6RCV	826
W1QV	704
WB6NWK	356
WB2RBT	354
W7GYF	310
K9FHJ	256
W8DWP	162
W4HOS	133
WA8KPO	100
WA6JDT	75
W8KC	60
W6EJA	32
W3QOR	12

21 mc

W6MSM	**1750**
W1BIH	1078
W2BXA	960
WB6KBK	516
WA1BBE/Ø	112
WB6FHH	34
W2FQS	16

14 mc

W3WJD	**4378**
W6AFI	2040
W2JVU	1802
W1YYM	1200
4X4UJ/K5	780
W3ZNB	637
WA5QPA	42
WB6TMC	15
W6EHZ	10

7 mc

WA6HRS	**380**
WB6KVA	52
WB6KIL	6

3.5 mc

WA4PXP	**4**

Alaska
All Band

KL7FRY	**6300**
KL7MF	138

Canada
All Band

VE3NE	**3801**
VE7EH	**2748**
3C7BDJ	**1168**
VO1AW	854
3C6VO	220

14 mc

3C2YU	**1845**
VE3GCO	600
3C2CKW	28

7 mc

VE7APU	**72**

Mexico
All Band

XE2AAG	**236**

Panama
14 mc

HP1BR	**168**

Venezuelan Contest

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

The Radio Club Venezolano invites all amateurs to participate in their annual contest commemorating the anniversary of the independence of Venezuela.

Bands: This is a phone *only* contest, a.m. or s.s.b. all bands 10 thru 80.

Exchange: The RS report plus a 3 figure contact number starting with 001.

Categories: Single operator, single band and all band. Multi-operator, all band only, both single and multitransmitter.

Contacts: *Stations in the Americas:* With YV's, other American countries and the rest of the world. *Stations in other continents:* With YV's and other American countries only.

Scoring: One point per contact, 2 points if its with a YV station.

Multiplier: A multiplier of 1 for each country, YV call area and USA call area.

Final score: For a single band, total QSO points times the total multiplier. All band, total QSO points times the sum of the multiplier from all bands.

Logs: Date/time in GMT, station worked number sent, received, multiplier (only firs time worked) and QSO points. Use separat sheet for each band. Also include a summar sheet with you computed score and name an address in BLOCK LETTERS.

Awards: A certificate to each station wit the following number of contacts. *Americas* With 20 YV's and 10 other countries. *Othe Continents:* With 5 YV's and 5 other Ameri can countries. (s.w.l.'s with 50 different con firmed stations)

There are also 8 Trophies for the To scorers in each category and silver medals fo the continental leaders. You will note tha you do not have to be a winner to qualify fo a certificate. This is probably one of the mos beautiful certificates issued in a contest. It i requested that a remittance of $1.00 or it equivalent in IRC's be included with your lo if you are eligible for an award. Believe me it's well worth the price.

Entries must be postmarked no later tha Sept. 15th and they go to: Radio Club Vene zolano, Independence Contest, P.O. Bo 2285, Caracas, Venezuela.

See page 126 for New Reader Servic

Colombia Contest

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

This is also an annual affair to celebrate the independence of Colombia. The Colombians will contact DX stations, other countries will work HK's as well as other DX.

Use all bands, 10 thru 80 on both c.w. and phone. Cross band or mode contacts not allowed.

Exchange: The conventional RS/RST report plus a progressive 3 figure contact number starting with 001.HK's will also include their district in their number.

Scoring: *Stations in the Americas:* 3 points for each HK contact, 1 point for non-HK. *Stations on other continents:* 5 points for each HK and 1 point for non-HK. The multiplier will consist of the sum of HK districts from all bands plus the number of different countries worked.

Final Score: Sum of QSO points from all bands multiplied by the number of HK districts in different countries from all bands.

Categories: Single operator and multi-operator both single and multi transmitter.

Awards: Certificates to the top scorers in each category in each country. Also for each continent. There is a Silver Cup for the overall non-HK winner. The HK's have many awards for their own contestants.

You are expected to compute your own score and include a summary sheet with all the details.

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

DARC WAE Contest

C.W.—August 10-11 Phone—Sept. 14-15

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

There have been some changes made in the rules and format of this popular European contest. These will be covered in next month's CALENDAR.

It is highly recommended that you use the official DARC log sheets. Include a s.a.e. and sufficient IRC's with your request. (40 QSOs per sheet) Write to: Walter Skudlarek, DJ6QT, An der Klostermauer 3, 6471 Hirenheim, West Germany.

Editor's Notes

Getting the Phone results out in this issue has been quite a chore. Making the C.W.

Top Ten
1968 QCWA Party Results

W4BGO	**10332**
W3IN	7560
W9VZP	7560
W6IL	6342
W5NW	6118
W5BUK	5226
W1DIT	5040
W9CAS	4773
WA1FHU	4752
W3BIP	3774

Contest Chairman Don McClenon, W3IN reported that a total, of 610 members participated and 97 submitted logs. W4BGO is the winner of the QCWA Plaque for this year.

results in the next issue will be a most difficult challenge.

A final reminder, don't forget to send in your log for the WPX SSB Contest which took place in April. Received much too late to give it proper publicity was an announcement from Albert Edwards, KR6TAB who is offering the "Torii" Trophy to the single operator station contacting the most KR6 stations in the contest. Those of you who contacted a number of KR6 stations should send your list to A1, KR6TAB. 498th TMG Dwr 754, APO San Francisco 96239. We will confirm it from your log, therefore it is essential that you send it to us.

And to those of you that will be doing some traveling this summer. Check the list of Trophy winners. Maybe you can be our good will ambassador and personally present the award to one of the luck winners.

We have yet to hear from some of the activities taking place this Fall. Time is running out, so get on the ball some of you secretaries.

Have a good summer.

73 for now, Frank W1WY

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Back issues of *CQ* are available from our Circulation Department. Issues in the current year sell for face value (.75) and all others in stock are one dollar each, postpaid. If the issue is no longer in stock, photo copies of specific articles are available at one dollar each. Preferably, the entire issue will be sent.

See page 126 for New Reader Service

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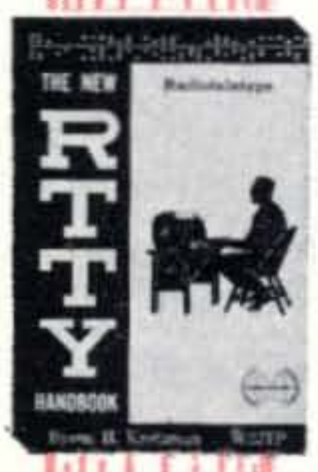

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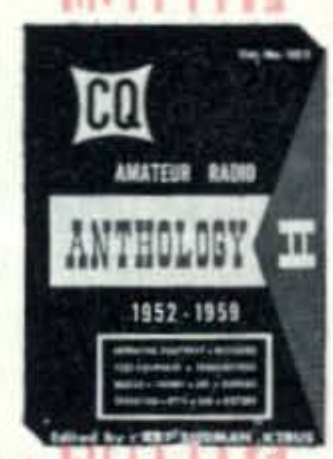

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VHF TODAY

BY ALLEN KATZ,* K2UYH

LAST month we discussed antenna gain and tried to show why the stacked yagi array is a highly favorable antenna on two meters. This month we shall consider the practical construction of this type of antenna. Our construction formula is simple and involves only 3 steps: 1) The use of commercial yagis, 2) The use of open wire phasing lines, and 3) The use of wooden stacking frames.

The use of commercial yagis is certainly not necessary; however, it does make sense. Compare the cost of materials with the cost of a commercial two meter yagi, then add in the time spent running around the state to find the right aluminum stock, making a jig for drilling the element holes straight, and doing all the other tasks. Individual yagis are just not that expensive. As for gain, our experience has shown that on two meters you can do no better in gain by constructing a yagi from hand book dimensions than by going out and buying it. If you spend a couple of weeks playing around with element spacing and length you may be able to achieve an extra ½ db or so. W6HPH had a very enlightening article back in *CQ* of May, 1963 which described how to tune a yagi optimumly. We are convinced (on two meters) that the extra ½ db is not worth the effort, and thus have been using a commercial yagi as the basic building block of our arrays for some years.

When it comes to stacking yagis conditions are not the same—a three db increase in gain does not accompany a two-fold increase in monetary investment. You are better off building your own stacking system than purchasing a commercial stacking kit. One reason the commercial kits are expensive is that they use coaxial cable and an assortment of coaxial adapters and fittings. If you have ever had to buy coaxial adapters at list price, you know how quickly their cost adds up. This fact alone is a good reason to use open wire transmission line for phasing.

Most yagis (commercial ones in particular) have a 200 ohm impedance which is converted down to 50 ohms by a 4:1 balun. When stacked yagis are phased with coaxial line, quarter wave matching sections must be used to bring the 50 ohm coaxial impedance back up to a high impedance level which when parallel with the transformed impedance of the other antennas results in an overall impedance of 50 ohms. This down and up impedance transformation is not really necessary.

Let's consider the case of four stacked yagis. This configuration is nice from both the point of view of symmetry and gain. When four antennas of 200 ohm impedance (disre-

* 48 Cumberland Ave., Verona, New Jersey 07462.

The author and friend prepare to install 8-14' yagis at his QTH. After securing a hoisting line atop the tower, the antenna system is finally seen installed in the last photo.

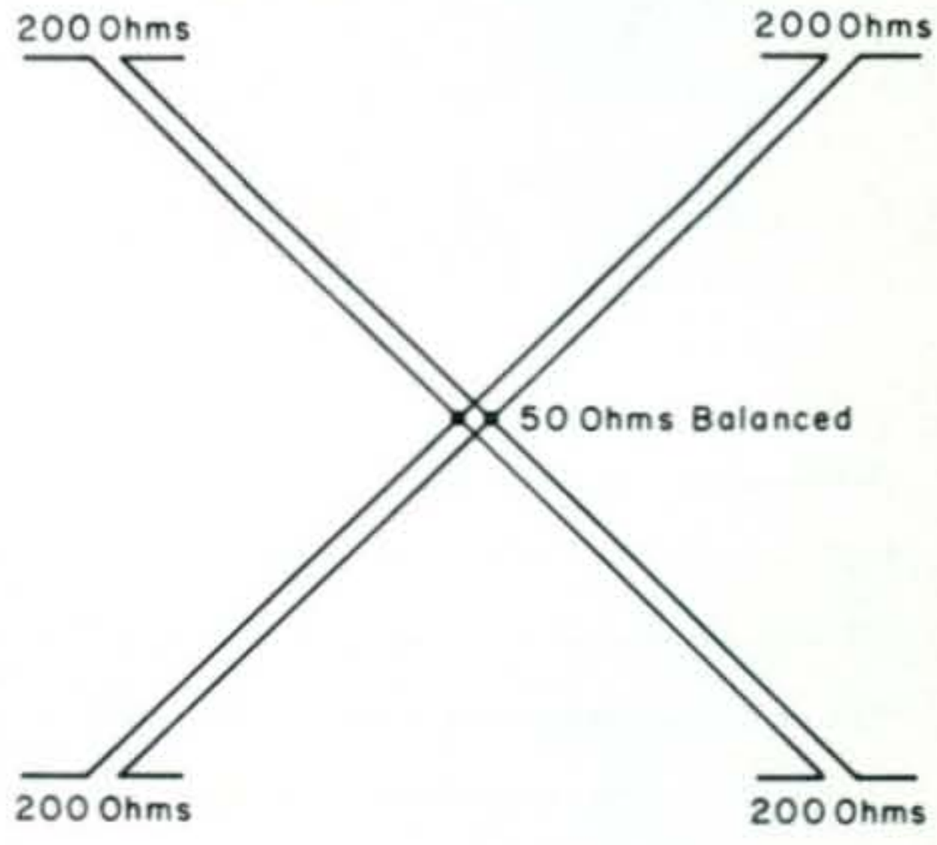


Fig. 1—Phasing arrangement of four yagis using open wire transmission line.

See page 126 for New Reader Service

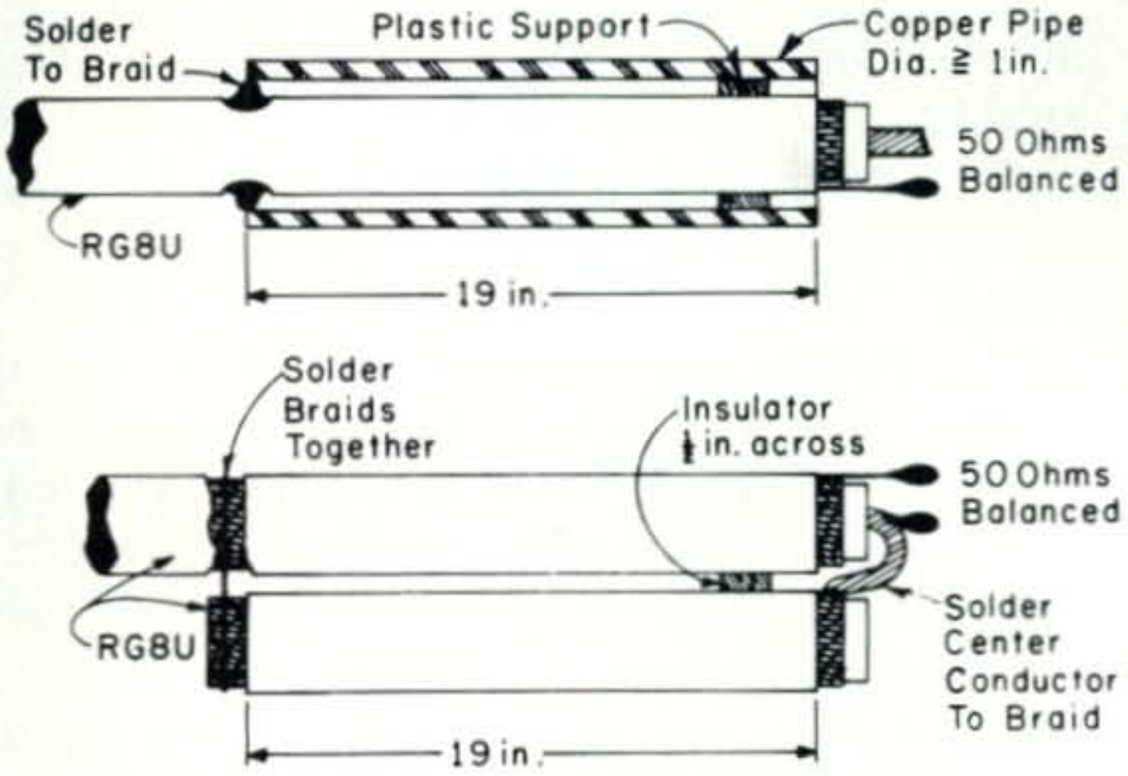
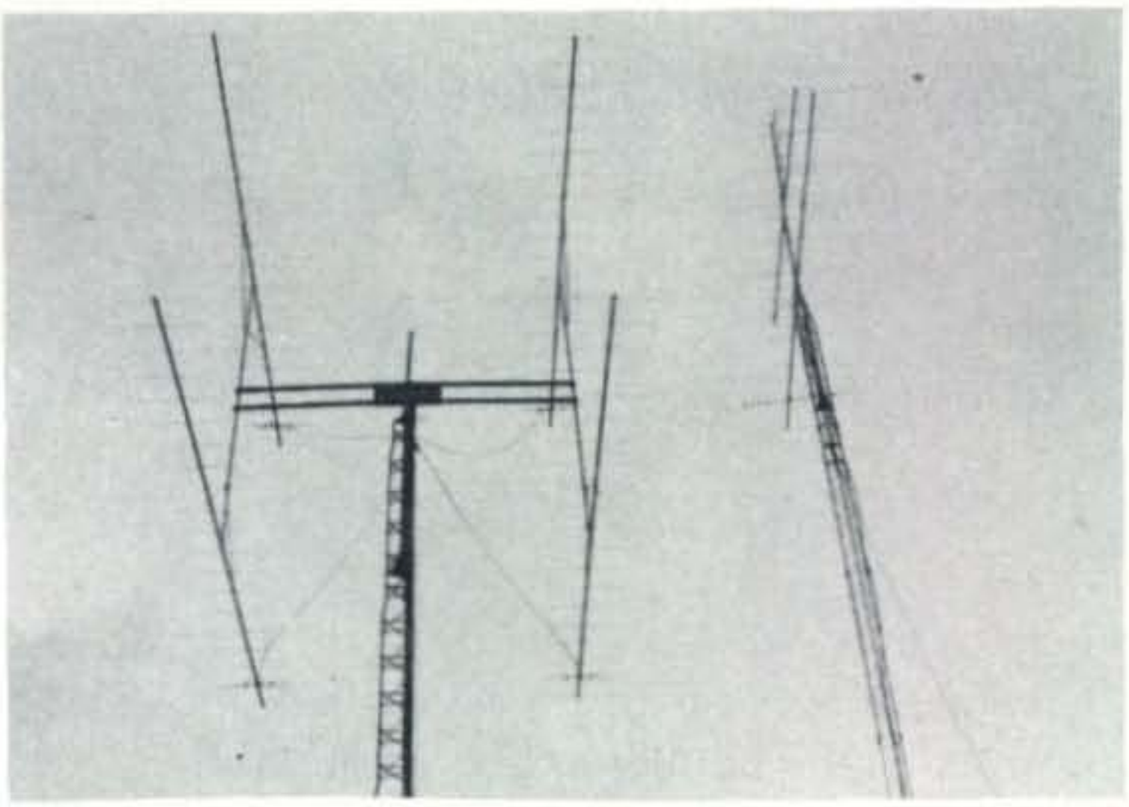


Fig. 2—Two different types of 1:1 baluns.



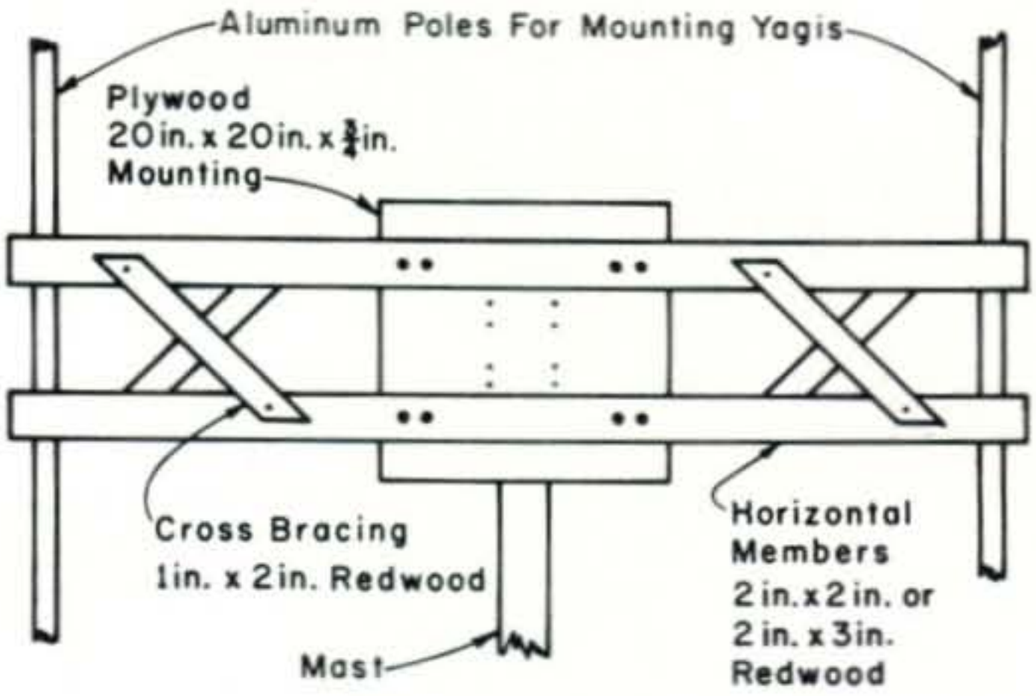
A view of 4-22′ yagis installed and operational.

garding the 4:1 baluns) are connected together, the resulting impedance is 50 ohms—see figure 1. This balanced 50 ohm impedance can easily be connected to 50 ohm coaxial cable by means of a 1:1 balun. Two different types of 1:1 baluns are shown in figure 2. If 200 ohm two wire transmission line is used for phasing, the length of the phasing lines does not matter just as long as they all are the same length. K-200 is an excellent low loss 200 ohm transmission line and ideal for use as phasing line at 2 meters. Unfortunately K-200 or any other 200 ohm transmission line is difficult to obtain. In the event that you can not locate any 200 ohm transmission line, standard 300 ohm transmission line can be used in its place. With 300 ohms, however, the phasing lines must be cut to exact multiples of a half wavelength. An easy way to determine when a transmission line is an integral number of half wavelengths is to short both ends and measure its resonant frequency with a grid-dip meter. When the line resonates on the desired frequency, it is the proper length.

There is a feeling among many hams that antennas must be all metal. Those that adhere rigidly to this principle are missing a lot of advantages which wood has to offer. Wood when properly chosen and treated will last just as long as aluminum and in some cases will carry more load. Besides which is is less expensive, and easier to work. Our stacking frames as shown in figure 3 are actually a compromise between aluminum and wood. The vertical members, where aluminum is definitely superior, are made of aluminum. The horizontal members, though are usually made from 2″ × 2″ or 2″ × 3″ Redwood depending on length and load. The cross bracing is made from 1″ × 2″ stock and should not be neglected.

Using the above approach we have constructed arrays consisting of 4-14 foot yagis and 8-14 foot yagis at my QTH, and 4-22 foot yagis at WA2FGK's QTH. The 4-14′ yagis were pictured in the April column. The 8-14′ yagis are pictured in this column. The 4-14′ yagis is an excellent antenna for 2 meter DX operation. The beam width of the 8-14′ array tends to be a little too sharp for normal operation, but offers interesting possibilities for moon bounce. During 144 mc moon bounce tests with VK3ATN, the moon is always setting here in the East. Under these circumstances the moon is descending very rapidly

[*Continued on page 110*]



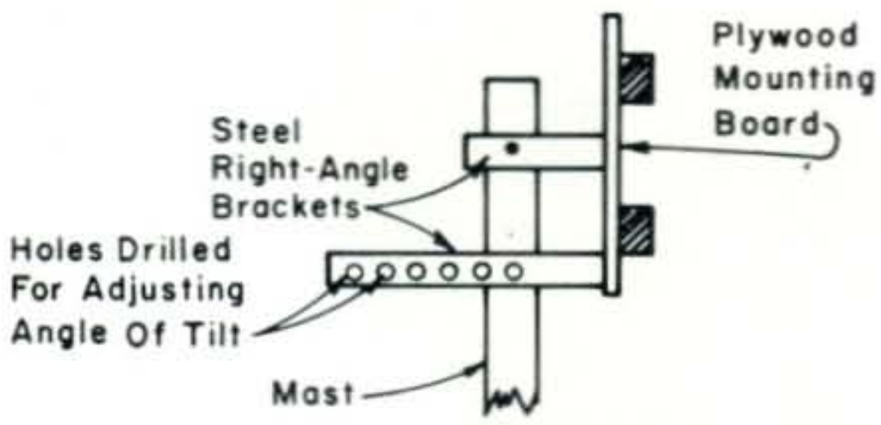


Fig. 3—An open frame stacking system. Also shown is a method of tiltable mounting.

See page 126 for New Reader Service

SURPLUS sidelights

BY GORDON ELIOT WHITE*

BACK in 1942 when the U.S. Eighth Air Force was set up in England, technical level cooperation between the U.S. and British fliers was already well advanced, partly because of the Tizard Mission, a high-level delegation of scientists which secretly began inter-allied discussions as early as 1940, well before Pearl Harbor. There were still problems though, and one was the difference in navigation techniques used by the U.S. Air Corps and the Royal Air Force. Very High Frequency voice communications had been adopted by the Americans, but there were still conflicts over systems to bring aircraft down to safe landings through the prevalent English fogs.

While the U.S. fliers depended largely upon radio compasses to bring them close to the field, the British had advanced to a beam and rudimentary glide slope in the so-called "Lorenz" system. The American system operated in the low frequencies between 190 and 1,500 kc. The Lorenz transmitters used the "VHF" band between 28 and 41 mc.

There were other instrument landing systems—the Navy had its "ZA" and the commerial air lines "ILS" was eventually adapted to military use. The advent of radar led quickly to "ground controlled approach" or GCA, but early in the European air war, the radio compass and the Lorenz systems predominated.

The problem arose of equipping American planes to operate out of Lorenz air fields. The solution adopted, at least temporarily, by Eighth Air Force radio technicians was to convert a Command Receiver (BC-455) from its nominal frequency of 6-9.1 mc to cover the 28-41 mc Lorenz band. This may rank as the first of thousands of Command Set conversions, since the ubiquitous SCR-274-N, ARA, RAV, RAT and AN/ARC-5 units have been made over into almost every sort of electronic unit—signal generators, audio oscillators, s.s.b. transceivers, 10 meter receivers, etc., etc.

For those who may be new to the surplus game, I thought this might be a good month to update the Command Set Story, a tale in which the Lorenz conversion was an early chapter.

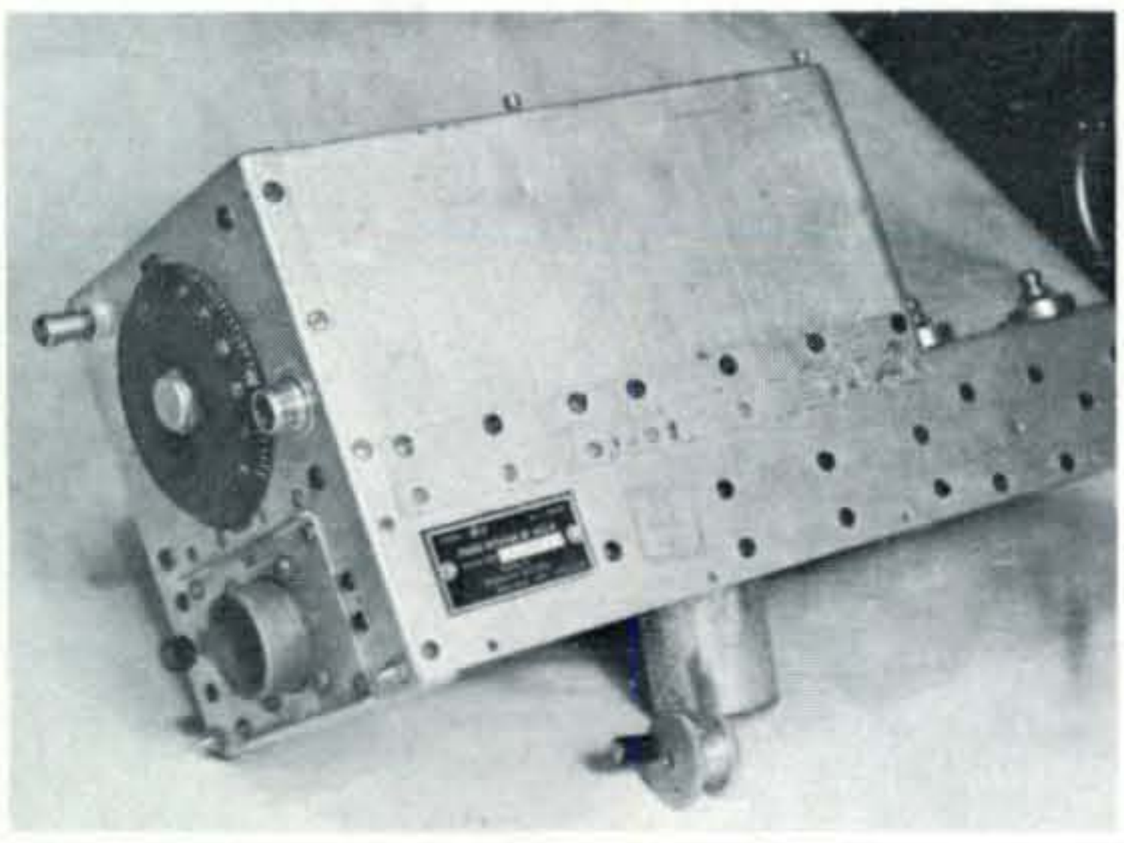
I first ran across mention of the Lorenz Command Set while doing research in some dusty Army Signal Corps files at the National Archives. One of the converted receivers was sent back to Washington with a recommendation that the design be adapted to production-line sets, and a "standard" 28-41 mc receiver be procured. That was never approved, though design engineers at Western Electric Company may have done some work on the idea. As far as I can discover, the plan was never brought to Aircraft Radio Corp., where the Command Sets were originally created.

But as many as several hundred production receiver may have been converted in England. One of these was brought to me this spring by Nick Eaton, VE3CJ who discovered it in a Canadian surplus shop.

The converted Lorenz command receiver is shown in the photo. Outwardly there are few changes. The dial was recalibrated for the 28-41 mc band, and a different plug was installed in the adapter space in the lower front panel. Standard receivers had merely a jumper plug there, but some Navy (and a few Air Corps) receivers had audio output provisions there, used with the ZA and ZB navigation systems. Other receivers, used with "local" rather than the standard remote control, has ON-OFF, B.F.O, R.F. GAIN and other controls mounting in front of the receiver.

The standard antenna mounting post was disconnected and a British type "uhf" con-

* 5716 N. King's Highway, Alexandria, Virginia 22303.



One of the typical Command Sets, the BC-455-B. This unit shown on edge with the crank-handle in the foreground is a converted Lorenz Command receiver.

See page 126 for New Reader Service

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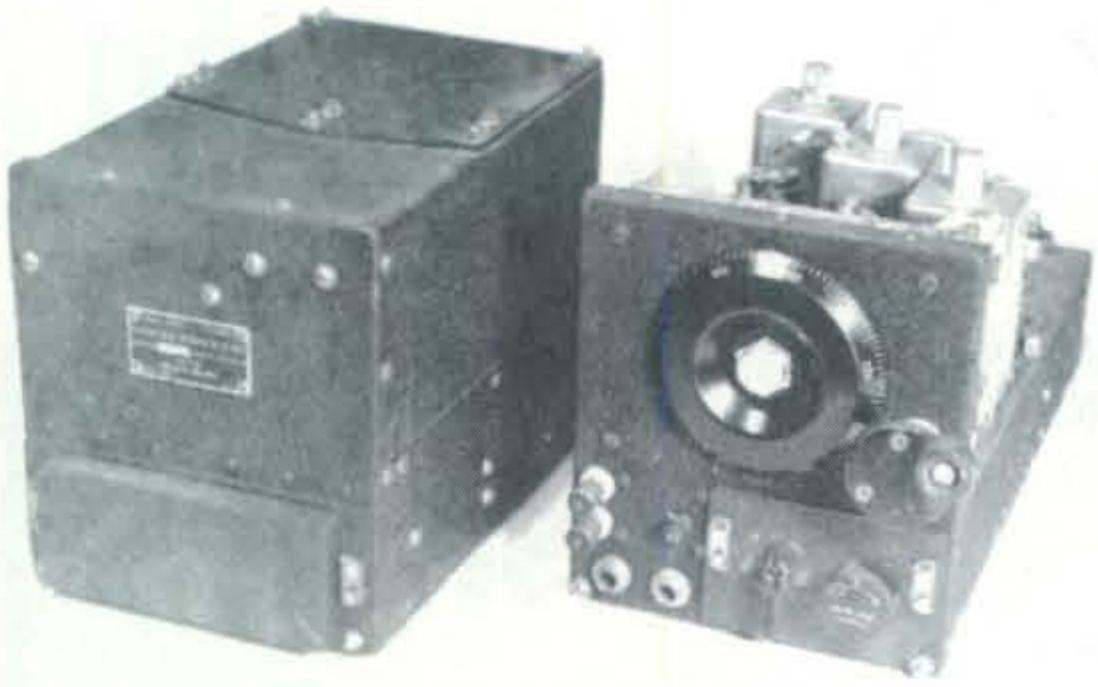
See page 126 for New Reader Service



Another part of the series was the D-150295 voice operated relay unit built by Western Electric, shown on the left. The Type K receiver on the right is Command Set Number 1, Serial Number 1.

nector installed on the left side of the receiver, directly opposite the input to the r.f. amplifier grid.

The set I examined did not have all its tubes, but the ones that were installed were the normal SCR-274-N types, so as far as I can tell, no high-performance tubes were added. I wonder how happy the Eighth Air Force could have been with the performance of the 12SK7 at 41 mc. My tests showed it was not very hot, though CB transmissions boomed in on 11 meters.

The only marking on the converted set is a stamping "MOD CBA" in red ink. This of course is one of the unpainted aluminum sets.

The Command Set line was based on a design, first contemplated in 1934, after the Army Air Mail fiasco showed just how bad military airborne communications were at that time. Aircraft Radio Corporation, a small pioneering company in Boonton, N.J., put the system together starting with the receivers, in 1935-36. Refinements led to the "Type K" receiver which was tested by the Navy in 1939. The Navy liked the design, ordered 13.5-20 and 20-27 mc receivers under RAT nomenclature, and eventually bought receivers covering ten bands from 190 kc to 156 mc.

The Air Corps was in the doldrums in 1939, under General Oscar Westover, who didn't trust electronics in general and the Signal Corps in particular. A Signal Corps design, SCR-240, contracted out to Westinghouse, turned out to be a monster set that simply couldn't be carried in the aircraft of that day. Asked to okay procurement of the Aircraft Radio Corp. Type K, Westover said no. "If the SCR-240 is too heavy," he ruled, "use the SCR-183, which is lighter." All very well, since the SCR-183 was a 1928 design that had been proven inadequate in the Air Mail period.

Meanwhile the Navy ordered the RAV series of eight receivers:

190-550 kc	6-9.1 mc
520-1,500 kc	9-13.5 mc
1,500 kc-3 mc	13.5-20 mc
3-6 mc	20-27 mc

Later types RBD and ATA/ARA were bought by the Navy, by now with companion transmitters covering in all, 500 kc-9 mc.

The advent of the war in Europe led to the declaration of emergency in May, 1940. Westover had been killed, and Hap Arnold

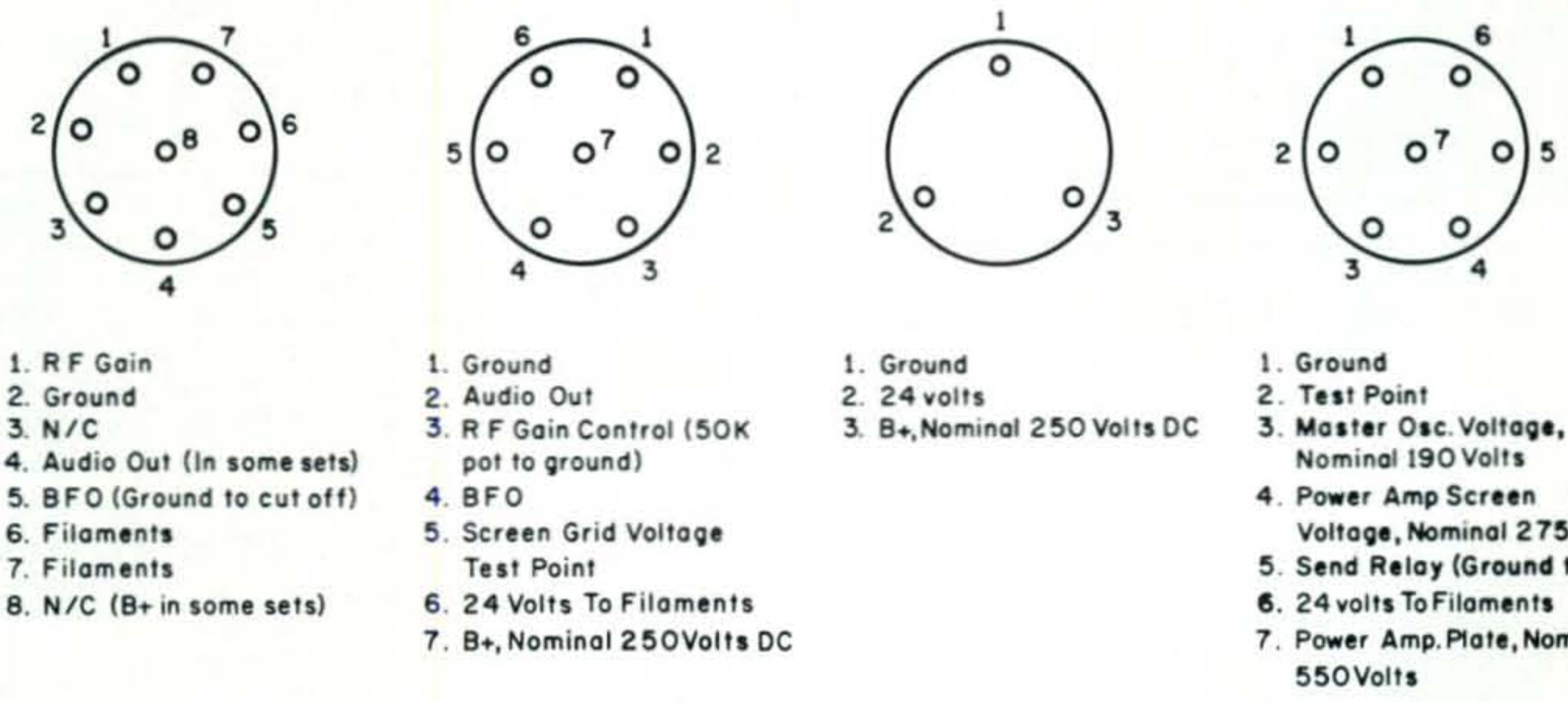


Fig. 1—(A) The Command Set receiver front panel jack with pin connections. (B) The rear panel jack with pin connections. (C) The receiver dynamotor plug connections, rear. (D) The transmitter plug with pin connections.

See page 126 for New Reader Service

was Air Corps Chief of Staff, and a qualified communications man. While the Signal Corps blundered on with an SCR-274-A design, generally a chinese copy of the Type K system, by Bendix Radio, Arnold lost his patience. He ordered the Army to swallow its pride and buy the Aircraft Radio Corp. design as SCR-274-N (N for Navy).

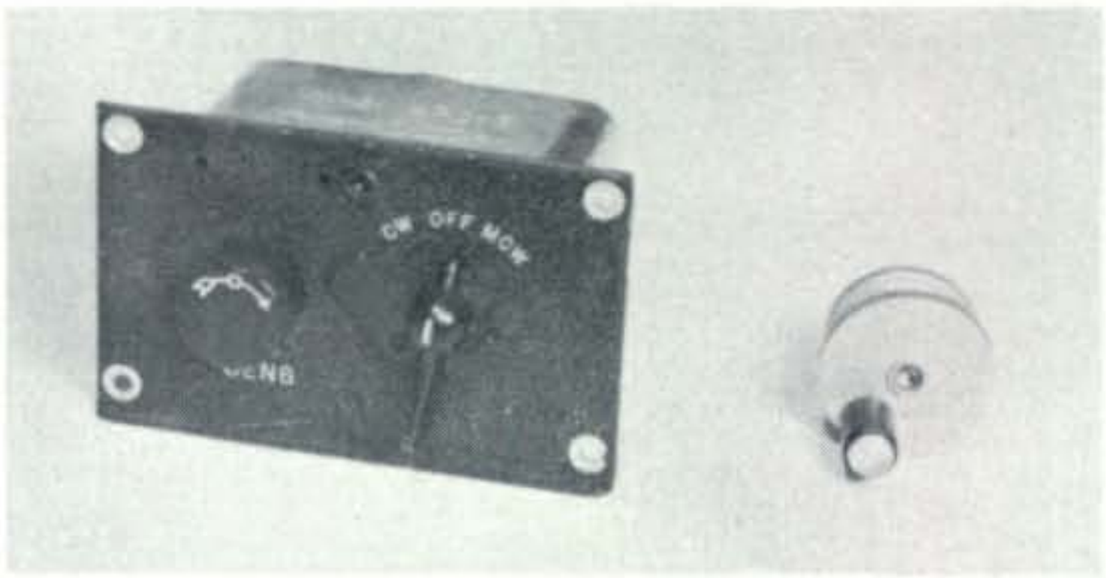
A.R.C. put giant Western Electric and the Stromberg-Carlson company into Command Set production, as war approached.

Between 1940 and 1945, more than a million units were built, by four manufacturers (Colonial Radio joined the operation in 1942). Western Electric engineers designed a v.h.f. receiver and transmitter set as part of the SCR-274-N system, but they bore no relation to the original design beyond a capability to mount in the same racks. These were the BC-942 receiver and BC-950 transmitter, both crystal controlled, with four channels provided in the 100-156 mc band. (There was an earlier prototype non-crystal v.h.f. set which was not produced in quantity.)

A.R.C. engineers designed a tuneable v.h.f. set which was based on the lower-frequency system. Though some were built as part of the AN/ARC-5 equipment of 1944-45, these are known chiefly to amateurs in their commercial, 1947-58, version, R-19, R-15 and R-13, which covered 108-135 mc and 118-148 mc. These were bought during the Korean War under military nomenclature "A.R.C. Type 12".

The last of the line was the TV-10 "transverter," an odd beast which transmitted in the 220 mc band and converted 228 mc incoming signals down to 110 mc to be received on the R-19 (118-148 mc) receiver.

It would seem that the military enjoyed converting command set designs to other



This item is rather scarce in surplus circles and is the local control unit for the Command Sets. The usual conversion of the receiver supplants the need for locating or duplicating the unit. The crank-handle is shown to the right.

uses almost as much as amateurs have since World War II. There may have been as many as 75 different receivers and transmitters, and upwards of 130 different pieces of command set gear given their own military nomenclature.

Amateurs have made Command Sets the most popular item in electronics surplus since the equipment came on the civilian market 21 years ago. Incredibly, these sets still survive, though they have been hacked apart, butchered horribly occasionally, converted skillfully sometimes, and applied to scores of uses in amateur shacks. The most ubiquitous application has been the "Q-Fiver" whereby the 455 kc i.f. output of a rather broad receiver is fed to the low frequency Command Receiver, tuned to 455 kc. (BC-453 or R-23/ARC-5). The superb 85 kc i.f. circuits of the low band Command receiver can narrow down the passband to almost single-signal dimensions, providing excellent c.w. selectivity.

The same selectivity in the 85 kc circuits has been applied profitably to a handful of s.s.b. transceiver conversions.

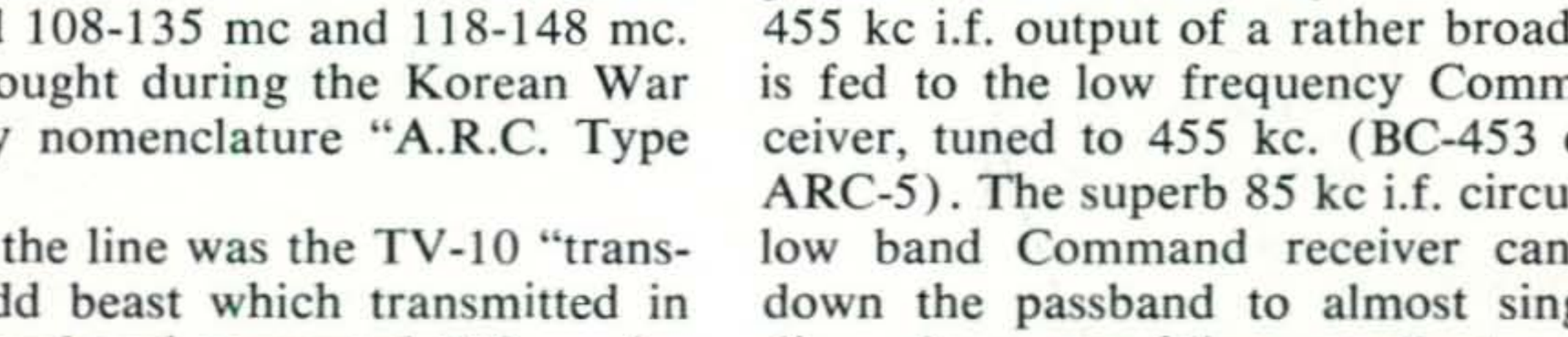


Fig. 2—A typical a.c. power supply which will operate the Command receivers. L_1 can be any small audio choke, possibly #5634 from the receiver itself. T_1 can be any type of power transformer with a 200 volt center-tapped secondary. The filament winding would depend on how you treated the existing filaments (*i.e.* 6, 12, or 24 volts).

See page 126 for New Reader Service

The transmitters have been cut up and down, as veteran *CQ* readers well know, and used for all amateur frequencies through two meters including s.s.b. The League's *Handbook* has long included a straightforward, simple conversion of the Command transmitter as a novice unit, virtually the only mention of surplus in the League's lexicon. The *CQ* Surplus Conversion Handbook contains an exhaustive treatment of Command Set applications.

My own articles in *CQ* over the past four years have detailed both the history and specifications of all the Command Sets, and some of the more interesting military variants. These include November, 1964, October, 1965, March, 1966, January and March, 1967. Virtually hundreds of Command Set articles have been printed in *CQ* since 1947, with *QST* and *73* running behind, but still containing many descriptions of Command Set applications.

Strictly as a receiver, a Command Set unit presents surplus conversion at its easiest. The commonly-available units covering 190 kc-9.1 mc are much alike in all bands, with minor variations such as different i.f. frequencies and the 12SF7 i.f. tube in the AN/ARC-5 units, while the SCR-274-N sets used 12SK7 tubes for r.f. and i.f. positions.

The usual conversion involves removal of the adapter from the front of the receiver and the installation of an audio output jack, r.f. gain pot, b.f.o. on-off switch, and power on-off switch. Since the military local control units are scarce, these are easily built up, using the discarded adapter plate as a base.

Power requirements are not difficult; B+ is nominally 250 volts d.c., but 125 volts will give surprisingly good performance. Standard filament voltage is 24 volts, a.c. or d.c., though a few 12 volt sets were made, in the AN/ARC-5 system. By replacing the 12 volt tubes with their 6 volt counterparts, the sets will run on 12 volts, or the wiring may be overhauled to give 6 or 12 volt operation.

Fig. 1 shows the rear-panel connections. The rear deck of the Command Receiver was designed for a small dynamotor which is almost always discarded. The dynamotor mounting plate will however provide a good oase fbr construction of power supply to be run off 115 volts a.c., when using an appropriate transformer. Fig. 2 shows a typical a.c. supply which will operate the command receiver.

The modular construction of the Command

See page 126 for New Reader Service

RDR RECEIVER & SPARE PARTS WITH 10 CRYSTALS

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Freq. range: 225-390 mMz.
You get two wooden crates which include:
Box #1 RDR RECEIVER with 13 V dynamotor. Output is 385 VDC at 500 ma.
Box #2 1 set of spare parts which include:

- 1 Headset
- 1 Set of operating tubes (spares).
- 1 Headset extension cord
- 10 Sets of fuses
- 2 Pilot lights
- 1 Set of connecting cables, and other parts too numerous to mention.

All this in original military boxes, receiver packed in aluminum waterproof case, manual included. Easily converted to 200 mHz ham band, or use as they are for UHF aircraft band. You get all that is required to operate except the 12 VDC source and the antenna.
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The Stelma Telegraph Distortion Analyzer type TDA-2 is a self contained portable unit designed to measure bias and distortion of telegraph start-stop signals. Distortion is indicated by vertical pips displayed in a rectangular pattern on the face of a cathode ray tube. Measurements can be made while the machine is operating. Measurements can be made on circuits operating at 60, 75 or 100 OPM on 20 or 60 ma neutral circuits or 30 ma polar circuits. Distortion measurements from zero to 50 percent with an accuracy of plus or minus two percent can be made. The set is patched in series with the loop and direct measurements made. No special skills required to make measurements after a few minutes practice. See your distortion, then adjust and watch it disappear.
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Receiver freq. range 1080 mc to 1130 mc variable. Transmitter freq. range 990 mc to 1040 mc variable. 115 Volt 60 c. power supply.

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Surplus [*from page 104*]

Set makes it easy to convert to other frequencies, for example the area above 9 mc. The specifications given in my January, 1967, *CQ* article indicate changes which will allow the receivers to be converted to cover frequencies as high as 54 mc, though tube changes are necessary for best performance above 20 mc. 20 mc.

Despite the lapse of more than 20 years since the low-band Command Sets were last manufactured, "new" ones, still in their original shipping boxes, are still turning up in surplus, along with many depot overhauled sets. The 190-550 kc receiver was mandatory in propeller-driven military planes until recently, and is still found in government service. Sources of Command Sets include almost every surplus dealer in the U.S., and many abroad. One with a good stock is Fair Radio Sales, Box 1105, Lima, Ohio 45802. ■

DX Contest [*from page 40*]

location, but how can you alibi a 7-million-plus score? Since OF2AM (OH2AM) was a winner last year, the Trophy goes to OF5SM. The Tigerstedt family finally made it. A look at the list of operators would indicate that Carola had a few distant cousins visiting over the week-end, or maybe they were on Axel's side of the family.

Over here K2GL again won its annual battle with W3MSK. The Boss Man, Ed Bissell was up in the wilds of Canada operating VE8MB, so the boys had to settle for another call, W3TMZ. Operating without their old familiar call proved a handicap. That plus a few break-downs was more than they could overcome.

On the whole, most of the received logs were in pretty good shape. Even our friends in the USSR are catching on that its Zones + Countries × QSO points for the final score. This improvement was due to the effort of WB2CKS, Andy flooded the UA's with official log forms.

It has always been difficult for me to write about a distasteful topic, and disqualification comes in that category. We have found it necessary to disqualify I9RB's score in the multi-operator, single transmitter division. (Oprs. I1RB & I1RBJ). The rules under section XIII are very specific regarding the accuracy of the contacts and multipliers in a log.

At the rate our Phone Contest is growing it will soon surpass the C.W. section in size. This year's total is 1280 received logs, an increase of almost 20% over last year. This year 390 certificates will be awarded to winners in 108 countries.

Because of the excellent showing made by our friends across the border, we are rewarding the Canadians with certificates by call areas. The entries were more than double those received last year, mostly due to the activity of the clubs in the VE6 area. Keep up the good work fellows, or its back to awards by zones.

We have added another member to our committee, Bob Entwistle, W1MDO. The old standbys are still with us. Andy Bodony, WB2CKS, Fred Capossela, W2IWC, Ben Lazarus, W2JB and Andy Malashuk, W1GYE. I occasionally put in my two cents. We just about made the deadline for this one, meeting the deadline for the C.W. section is another story. But "Simon Legree" Ross says we have got to make it. See you next month.

73 for now, Frank, W1WY

See page 126 for New Reader Service

Using the G.D.O. [*from page 31*]

find the resonant frequency of the combination. The inductance then is $L_X = \frac{1}{4\pi^2 f^2 C}$, where L is the inductance in micro-henries, f is the frequency in megacycles, C is the capacitance in micro-farads; or reference may be made to an L/C resonance chart.

Due to the distributed capacitance of the inductor, a slight error will result, however, if the value of the capacitor is quite high, the error will be negligible. The capacitor itself also should exhibit a low inductance.

Resonant Frequency of Capacitors: Connect capacitor leads together and use g.d.o. coupled to the partial loop formed by the leads.

Finding the resonant frequency of a capacitor often is helpful in determining its effectiveness with bypassing for TVI reduction in equipment.

An interesting experience we ran across with capacitor resonance involved a case where grid drive over a narrow range in the 14 mc band faded away. The culprit, as found with the g.d.o., was a ceramic bypass in a 7 mc doubler stage which heated sufficiently to gradually shift its resonant frequency to smack on the doubler frequency and cause a suckout of the signal.

Circuit Q: Use instrument as a signal generator. Connect v.t.v.m. with r.f. probe across the circuit to be measured. Couple the grid-dip meter to the circuit and tune the instrument for a maximum reading on the v.t.v.m. This is where the circuit is resonant. Note the frequency at which this occurs. Then tune the instrument each side of resonance to the points where the v.t.v.m. reading drops 70.7% of that at resonance. Note the frequency at these two points and calculate the circuit Q from $Q = f_r \div \Delta f$ where f_r is the resonant frequency and Δf is the difference between the two off-resonance frequencies just found.

The coupling of the grid-dip meter should initially be made so that a convenient reading at circuit resonance is obtained on the v.t.v.m. The coupling then should be left fixed for the remainder of the operation. In order to minimize circuit loading, it would be advisable to couple the v.t.v.m. to the circuit with as small size capacitor as possible while still obtaining a reading.

See page 126 for New Reader Service

When the circuit *Q* is quite high, it may be necessary to check the grid-dip meter frequencies with a calibrated receiver, since the off-resonance points will appear too closely together for an accurate reading on the instrument scale.

Relative Circuit Q at a given frequency: Use the g.d.o. and observe whether the dip is sharp or broad (with a given sensitivity adjustment on the g.d.o.). The sharper the dip, the higher the *Q*. The relative *Q* will vary between circuits at different frequencies due to differences in circuit values, as well as due to the changes in the inherent sharpness of the g.d.o. dip, since its *Q* tends to drop at the h.f. end of each range.

The conclusion of this series will be made with Part III which will cover applications relating to transmission lines and antennas. ■

CQ Reviews: SR-400 [*from page 71*]

A red panel lamp goes on whenever the HA-20 v.f.o. is being used.

The HA-20 thus can be a very handy accessory, especially for DX QSO's where the DX station is outside of your own legal band. Also, for operations with contests, traffic networks, etc., the simultaneous monitoring of two different channels can be most helpful.

In respect to dual-frequency reception, the separation between signals is limited to points within each individual range of the transceiver. Where the frequency separation is fairly large, the receiver preselector may have to be retuned according to the related level needed between each signal. With this mode, neither v.f.o. can be used on transmit. This then necessitates turning the operation switch back to one of the transmitter-control positions whenever it is desired to transmit.

There is no specific provision for zero-beating or spotting the HA-20 v.f.o. frequency when independent control of the transmitter is engaged, but by temporarily setting the operation switch to DUAL R and turning the receiver r.f. gain down (to cut out on-the-air background), a beat note from the HA-20 v.f.o. can be obtained on the receiver at the frequency to which it is tuned.

The SR-400 Transceiver is priced at $799.95, less power supply (10-meter crystal furnished is for 28.5-29.0 mc segment). The PS-500A-AC Power Supply/Speaker Console is $119.95. The HA-20 DX Adapter is priced at $199.95. These are products of Hallicrafters, 600 Hick Road, Rolling Meadows, Illinois 60008.—*W2AEF*

See page 126 for New Reader Service

VHF Today

vertically but moving relatively slowly horizontally. Thus for easiest tracking an antenna with a narrow horizontal angle but a wider vertical angle of radiation is desirable. 8-14′ yagis has just this type of pattern. For moon bounce work on the zenith just the reverse pattern is desired. This pattern too can be obtained from 8-14′ yagis.

In the discussion above we have stressed constructional ideas not antenna theory. We strongly suggest that before anyone tries to put constructional ideas into practice that they understand the antenna theory behind them. The best place to learn this theory is in an antenna manual or VHF handbook. Next month we shall consider one of the highlights of the Second International VHF Conference: Vapor Phase Cooled Finals. 73, Allen Katz—K2UYH. ■

Grumbles [*from page 73*]

Doc. Doc finally sold all of his low band gear and moved on to 2 meter FM, just couldn't take the rat race. Used to use vox but couldn't stop kicking on the rig with his incessant "ahhhhh's" and "ummmmm's" At last year's Christmas party the gang put on a really funny skit in which Doc was portrayed as a lecherous old devil trying to pick up all of the XYL's on the air. Doc smiled faintly through it all, and the guys gave him a brass plaque for being "Member of The Year" when the skit was over.

The DX'er. The only guy in town who admits to running 3 gallons, but after all (as he says), "It's da onney way I can get out from my bad locashion." His unique whiskey baritone and laugh is famous the world over. It's easy to hear him, just tune to the foreign portion of the 'phone band. He's got 307 DX awards adorning his walls and is the only known winner of the Worked All Albanian Amateurs Award (WAAAA). Has every issue of *QST* in bound volumes. ■

USA-CA [*from page 91*]

Award is much more fun than DXCC—Rag chews vs a signal report. Another reason we decided to get the "500" off the usual net frequencies.

Well Ed, it was our goal to make the "500" before our General Ticket was a year old, we did it, so now it's on to the "1000" but it will have to wait until the station rebuilding is

See page 126 for New Reader Service

THE *NEW*

MARK 3

5 BAND TRANSCEIVER MOBILE OR FIXED STATION

NOW--even Better than Ever!

GALAXY V MARK III	$420.00
AC-400 SUPPLY	$79.95
SC-35 SPEAKER	$19.95
REMOTE V.F.O.	$69.95
TOTAL LIST	$589.95

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ALL THIS FOR
$500.00

Plus all the great features that put the GALAXY V in a CLASS by ITSELF!

- Smallest of the High-Powered Transceivers. (6"x10¼" x11¼").
- Great for either Mobile or Fixed Station. No compromise in power.
- Hottest Receiver of any Transceiver — Special New Six-Crystal lattice filter.
- Complete 80-10 Meter Coverage. 500 KC on all bands, with 1 Megacycle on 10 Meters.
- Both Upper and Lower Selectible Sideband.
- Highest Stability. Drift less than 100 CY in any 15 minute period after warmup.
- The personal drift chart of every Galaxy that comes off our line goes with the unit to its new owner!

These NEW Features . . .

- New 500 Watt Power
- New Precise Vernier Logging Scale
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- New CW Break-In Option
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See page 126 for New Reader Service

complete—home brew linear and new beam.

Hope to be seeing you soon with a new list for that "1000". In the meantime we'll keep in touch via *CQ* magazine. Thanks for the USA-CA Contest".

Awards

W.A.G.I. Certificate: This certificate is issued by the *Gee Eye* Magazine to promote contacts with Northern Ireland Amateurs. Rules: Stations outside Europe to submit *FIVE* cards in all from these counties—Antrim, Armagh, Derry, Down and *one* from either Tyrone or Fermanagh. European stations to submit *TEN* cards in all: Two from each of the afore mentioned counties. Belfast is divided by the River Lagan into Counties Down and Antrim. Operation may be on any band and/or any mode of transmission. Certificates will be endorsed for one band and/or one mode. Unendorsed certificates will indicate mixed operation. Cards are valid for contacts made on or after 1st January, 1959. The cost, which must be included with each application, is 5/-, one dollar, or 10 IRCs. All applications and enquiries to be addressed to the Certificate Manager, Frank A. Robb, GI6TK, 125 Downshire Road, Holywood, Co. Down, Northern Ireland.

Far East Auxiliary Radio League—Available Awards

The Worked Five KA Station Award: Requirements: Work 5 KA Stations.

The Worked All KA Districts Award: Requirements: Confirmed 3 KA2s and one each from each remaining district, which are KA5, KA7, KA8 and KA9.

The Worked Twenty Five KA Station Award: Requirements: Confirmed 25 KA Stations, endorsements—all on one band; all on phone; all on c.w.; mixed bands and mode.

The Seven KA District Award: This award can no longer be achieved as there are only 5 KA districts in being. However in the event that QSLs were accumulated during the period when there were seven or more KA districts, a certificate is available. Any seven of the following districts will satisfy the requirements: KA2, KA3, KA4, KA5, KA6, KA8, KA9 and KAØ.

To obtain any of these FEARL certificates; forward to the Awards Manager, either the QSL cards or a list of confirmed QSLs certified either by a Notary Public, Radio Club Official or two General or higher class amateurs as witnesses, stating QSLs have been confirmed. Send to: Far East Auxiliary Radio

See page 126 for New Reader Service

League (M), C/O Awards Manager, Box C-89, APO San Francisco 96525 (USA).

Notes

This seemed a most appropriate time to tell about the KA Certificates, as KA9MF qualified for the *FIRST* USA-CA to an Asian station *and* FEARL (M) are having their annual field day 0900Z 3 July to 0900Z 5 July—See CONTEST CALENDAR by Frank, W1WY for details.

I still get much mail asking about the USA-CA Program and *USA-CA Record Books*. Yes, I issue the USA-CA Award and I'll be happy to send you a copy of the USA-CA rules. The *USA-CA Record Book* is available direct from *CQ* for $1.25 and your *first* application for USA-CA *must* be made using one of these Record Books.

Under the new amateur licensing rules, new 2 letter calls are breaking out all over, and although I'd like to list the new calls of some of my close friends, I'm afraid I might offend some by failing to list them, so I will mention the only two dyed-in-the-wool COUNTY HUNTERS who have advised me of their new calls: W3NB, ex-W3AYS and WØBL, ex-WØJWD. So, why don't you take time to write and tell me your latest confirmed score and any other data on calls and also let me know, how was your month?, 73, Ed., W2GT. ■

A 10 Meter Quad [*from page 37*]

tance out should make the Quad 8'7" on each side of the square. As the wire is drawn tight the rods will bow out slightly and keep a strain on the wire to keep it stretched. This bowing effect will change the distance between the reflector and antenna, and the pipe wood and flanges should be adjusted so the distance between the elements is 46" as shown in fig. 2. If you make a trial assembly and measure the distance, the pipe section which is now 24 inches long, can be taken to the hardware store for cutting and rethreading. Since the cumulative errors from thicknesses of the pipe flanges, wood and bowing effect might be different for each constructor no set length can be specified for the pipe. Standard lengths of threaded pipe are 24", and one of them will have to be shortened.

Tuning

It is suggested if possible to use a Johnson Match Box tuner, by connecting the 72 ohm

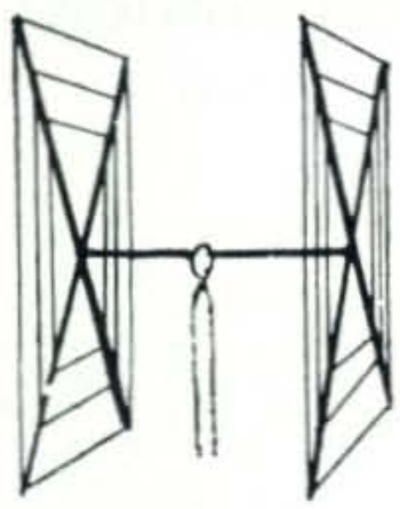
[*Continued on page 118*]

See page 126 for New Reader Service

GOTHAM'S AMAZING ANTENNA BREAKTHRU!!

How did Gotham drastically cut antenna prices? Mass purchases, mass production, product specialization, and 15 years of antenna manufacturing experience. The result: The kind of antennas you want, at the right price!

QUADS Worked 42 countries in two weeks with my Gotham Quad and only 75 watts . . . W3AZR 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!



0/15/20 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 2' sections of 1" OD aluminum 'hi-strength' (Reynolds) tubing, with telescoping ⅞" tubing and short section of dowel. Plated hose clamps tighten down on telescoping sections.
Radiator Terminals: Cinch-Jones two-terminal stings
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 element Gotham beam (20 ft) I worked 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 tubing for *each* 20 meter element, for instance); absolutely complete including a boom and all hardware; uses a single 52 or 72 ohm coaxial feedline; the SWR is 1:1; easily handles 5 KW; ⅞" and 1" alumnium alloy tubing is employed for maximum strength and low wind loading; all beams are adjustable to any frequency in the band.

2 EL 20	$16	4 EL 10	$18
3 EL 20	22*	7 EL 10	32*
4 EL 20	32*	4 EL 6	15
2 EL 15	12	8 EL 6	28*
3 EL 15	16	12 EL 2	25*
4 EL 15	25*	*20' boom	
5 EL 15	28*		

ALL-BAND VERTICALS

"All band vertical!" asked one skeptic. "Twenty meters is murder these days. Let's see you make a contact on twenty meter phone with low power!" So K4KXR switched to twenty, using a V80 antenna and 35 watts AM. Here is a small portion of the stations he worked: VE3FAZ, T12FGS, W5KYJ, W1WOZ, W2-ODH, WA3DJT, WB2FCB, W2YHH, VE3-FOB, WA8CZE, K1SYB, K2RDJ, K1MVV, K8HGY, K3UTL, W8QJC, WA2LVE, YS1-MAM, WA8ATS, K2PGS, W2QJP, W4JWJ, K2PSK, WA8CGA, WB2KWY, W2IWJ, VE3-KT, Moral: It's the antenna that counts!

FLASH! Switched to 15 c.w. and worked KZ5-IKN, KZ5OWN, HC1LC, PY5ASN, FG7XT, XE2I, KP4AQL, SM5BGK, G2AOB, YV5-CLK, OZ4H, and over a thousand other stations!

V40 vertical for 40, 20, 15, 10, 6 meters	$14.95
V80 vertical for 80, 75, 40, 20, 15, 10, 6 meters	$16.95
V160 vertical for 160, 80, 75, 40, 20, 15, 10, 6 meters	$18.95

HOW TO ORDER: SEND CHECK OR MONEY ORDER. WE SHIP IMMEDIATELY UPON RECEIPT OF ORDER BY RAILWAY EXPRESS, SHIPPING CHARGES COLLECT.

GOTHAM, 1805 Purdy, Dept. CQ, Miami Beach, Fla. 33139

THE CQ TECHNICAL LIBRARY SERIES

AUGMENT YOUR COLLECTION OF TECHNICAL BOOKS WITH THESE FINE SELECTIONS FROM HOWARD SAMS

BUILDING YOUR AMATEUR RADIO NOVICE STATION by Howard S. Pyle, W7OE. Many beginners say that existing handbooks and magazine construction articles present equipment that is either too complicated for the novice or does not include sufficient construction details. This book tells how to build an inexpensive transmitter, receiver, and minor accessory items for a novice amateur radio station that will work well. The detailed and full-size templetes given in this book make it simple to build. The equipment has been thoroughly tested for construction ease and for actual on-the-air performance. It will serve well, not only for novice operation, but in the General Class as well. 128 pages, 8½ x 11".
No. 20050 **$3.50**

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 trouble-shooting 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"
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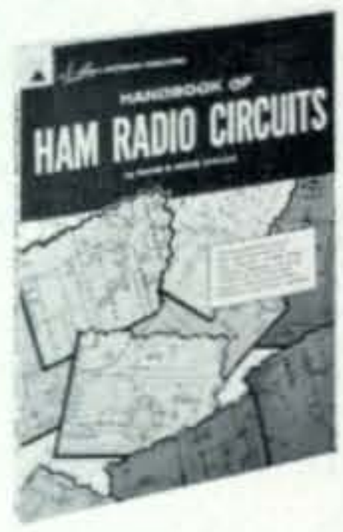

HAM ANTENNA CONSTRUCTION PROJECTS by J.A. Stanley. Shows how to design and construct low-cost antennas which often outperform ready-made units. Step-by-step instructions cover construction methods, installation, transmission-line feeders, antenna tuners, and antenna-tuning techniques. Shows you how to custom-build units to suit your special needs and how to tailor commercial designs to "get out" farther. 160 pages, 5½ x 8½"
No. 20207 **$3.25**

GENERAL-CLASS AMATEUR LICENSE HANDBOOK by Howard S. Pyle, W7OE. A complete guide, including typical questions and answers, to prepare the novice or aspirant for the Technician, Conditional, or General-Class amateur radio exam. Typical questions of the type on the FCC test are included throughout the book. The answers, plus explanations where needed, are also given. 144 pages, 5½ x 8½".
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AMATEUR RADIO MOBILE HANDBOOK by Charles Caringella, Here's complete information for going mobile. Since mobil equipment operates from the auto battery, it requires an entirely different design approach from the "land-based" station. This handbook explains these differences in circuitry and construction of commercially built equipment for amateur bands. Construction data tell you how to build mobile converters, transmitters, transceivers, modulators, and various other accessories. 176 pages, 5½ x8½"
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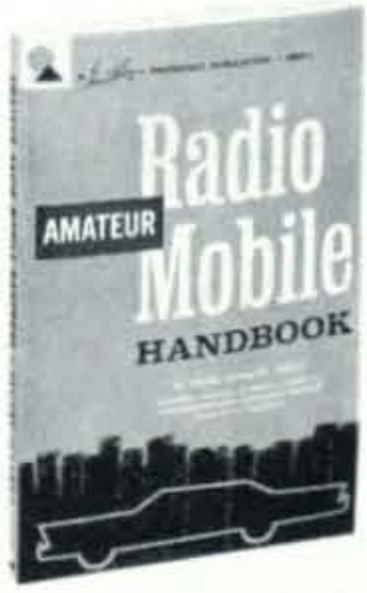

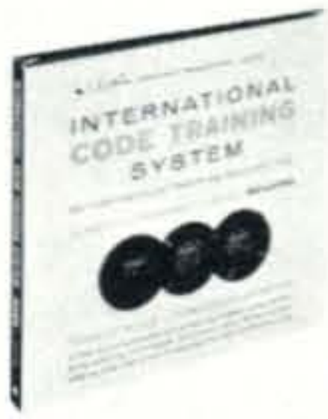

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See page 126 for New Reader Service

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A 10 Meter Quad

[*from page 114*]

twin lead to the two terminals on the back. If a tuner has to be made, two links will have to be used, one from the transmitter and one from the antenna. These need only be two turns of wire.

The stub tuning capacitor on the reflector can be tuned for maximum front to back ratio or maximum forward gain, as you desire. ■

The DXpedition

[*from page 36*]

report that *The Amateur Radio DX Handbook* (Cowan, $5.00) should be released this month.

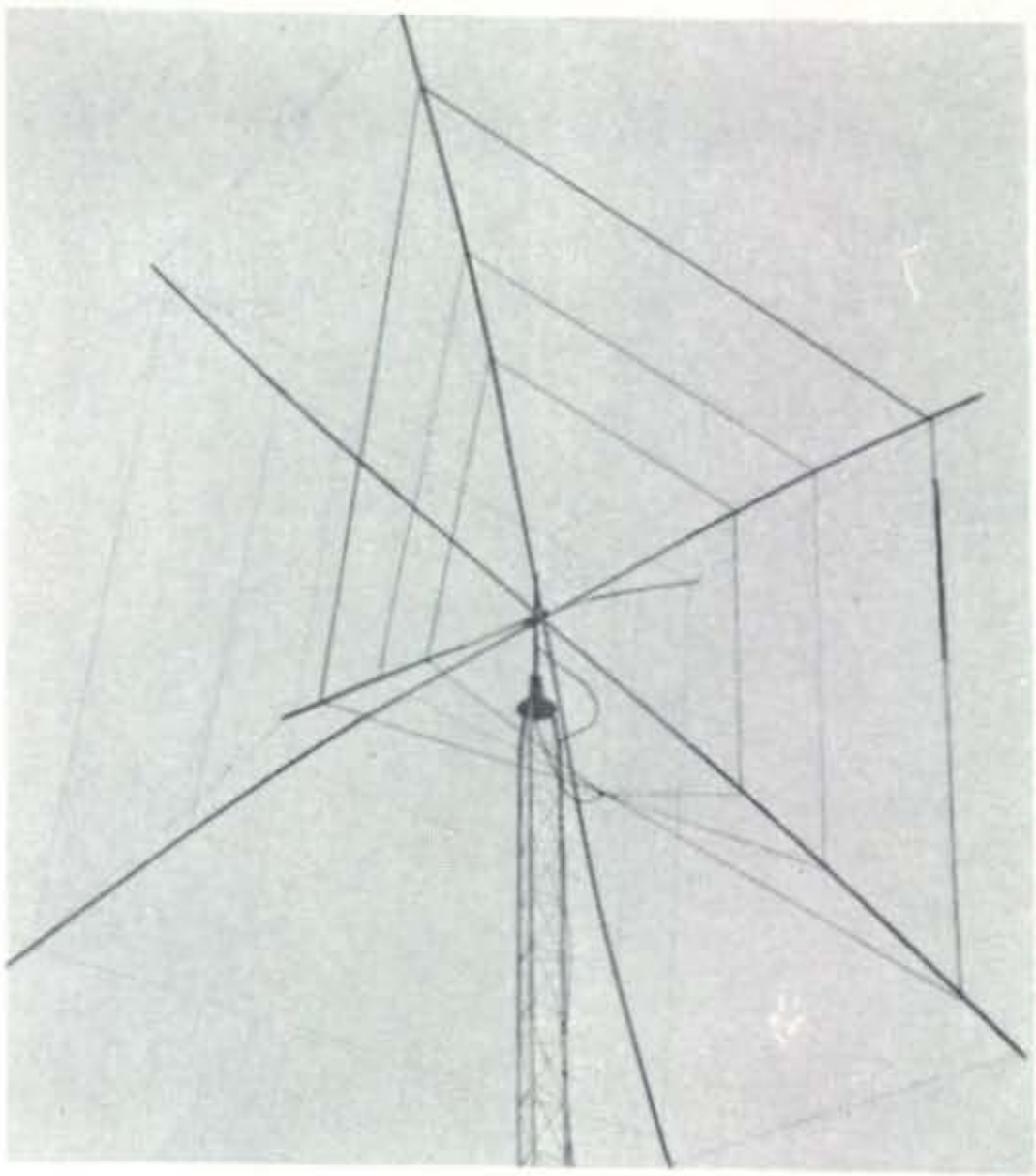
Wednesday dawned as all others. Awake until 4 A.M. with final preparations, we were a little "hung over" at breakfast. Perhaps that was why Jack was so casual when telling me he was unable to move his left hand or wrist since awaking that morning. A brief examination left no doubt—Jack's left hand was completely paralyzed! Although there was no evidence of impaired circulation or trauma, both sensory and motor functions were totally lacking. A careful history and more thorough exam led to the provisional diagnosis of pressure paralysis, a form of neuritis usually occurring during sleep and in individuals who were thin, like Jack. Moreover, he had just slept for the first time on some newly-constructed foam rubber cushions. If the diagnosis were correct, recovery was a matter of weeks or months, the only treatment being preventive physical therapy, immobilization, and regular, cautious exercise. More serious diagnosis could not be ruled out, although they were remote. After some soul-searching we decided to splint Jack's left wrist and depart on schedule. Larry's experience matched that of Jack, so we suggested shorter watches for Jack and slightly longer turns for Larry, Bill, and myself. Jack would have no part of this arrangement, however, insisting on his regular shifts at the helm.

Captain Booker, who had already simplified customs and immigrations formalities, along with Steve, Marjorie, Edmone, and a number of friends and officials, appeared at the dock to wish us *bon voyage*. I could sense Bill's uneasiness as we cast off and slowly drifted into position to hoist sail. Our crew of four included one who really didn't want to go and a one-armed skipper. In five minutes we were clipping along at eight knots toward Rodrigues Island. ■

Next month: Saint Brandon via the long path.

See page 126 for New Reader Service

LOW, LOW VSWR a Reality with the 321



The sole antenna product affording operation on 10, 15, and 20 meters, with one 52 ohm feed line and minimal reflected power is the *Reginair 321-1 Quad*. There are many excellent quads and Yagis on the market. We know, for we sell most of them. But none of them compare, in this respect, with our exclusively distributed Reginair quad. You will note, on the typical competitive product, excellent performance on one band, good performance on the second band, but poor performance on the third. Nor can you slide up or down at will with other manufactured antennas. Most have humped responses as part of their range. Only the *Reginair 321 Quad* guarantees that if all instructions are followed in assemblin the quad will the resulting VSWR be less than 1.5 to 1 over the entire 10, 15, and 20 meter bands.

Why Low VSWR Is Important to You!

Most amateur operations today use transceivers whose designs are marvels of ingenuity and sophistication, whose size and performance belie their modest price. Yet, there has been a compromise built in. That compromise has to do with the rating of the final tubes in the transmitting portion of the transceiver. A typical transceiver has a television horizontal output tube with a dissipation rating of but 30 watts. Usually 2 or more of these tubes are associated in a typical transceiver. Thus, the rating of the most popular transceivers is actually 60 watts of dissipation rating with respect to the tubes themselves. Have you ever wondered why a good commercial linear amplifier, such as the Henry II K or the BTI, uses tubes with a dissipation rating equal to the DX rating of the rig itself? Shouldn't the same situation prevail with modern transceivers? In other words, if we have 60 watts of dissipation in the transceiver, why shouldn't we expect but 60 watts of DC output. But yet, the transceiver manufacturers always rate their transceivers at approximately 4 or 5 times the actual rating of the tubes themselves. This is the incredible compromise which you as a ham operator have to contend with. Your ability to live with this situation depends almost exclusively on your learning to operate your equipment at the frequency on which your antenna is resonant. Failure to do so invariably results in high VSWR, and high VSWR means that 10 or more per cent of the forward power that you are trying to create will come back to haunt your final tubes. You will have very short life indeed. As a matter of fact, we have people buying transceivers from us almost every week who do not seem to understand this situation and within a few days they are back, claiming that the transceiver has gone bad, and that they need new tubes. Little wonder then, the the *Reginair 321 Quad* met with such overwhelming response from people who didn't want to worry any longer concerning this problem of high VSWR.

The *Reginair 321 Quad* is now made so that it can be shipped in a 6 foot long by 6 inches in diameter container, weighing but 37 pounds. Thus, we can effect delivery to our GI's overseas for nominal expense and ship any place in the continental limits of the United States for but $7.90. The price of our quad is but $90.00. Look at the specifications and see for yourself whether this device won't help you in your installation.

BOX SCORE

Forward gain over dipole	5.9 db
Forward gain over isotropic dipole	8.0 db
Front to back ratio	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" radial ice	
Frontal lobe	75°
Standard model price	$89.95

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Woodchuck Hill Road, Harvard, Mass. 01451

"Helping Hams to Help Themselves"

See page 126 for New Reader Service

PLEASE include your ★ ZIP code number on all correspondence ★

[*from page 87*]

Central & South Asia	*Nil*	07-09 (1) 09-11 (2) 11-13 (1) 17-19 (1) 19-21 (2) 21-22 (1)	22-04 (1) 04-08 (2) 08-11 (1)	*Nil*
South-east Asia	*Nil*	07-08 (1) 08-10 (3) 10-12 (2) 12-15 (1) 18-20 (1) 20-22 (2) 22-00 (1)	22-00 (1) 00-02 (2) 02-04 (3) 04-06 (2) 06-08 (3) 08-10 (2) 10-13 (1)	02-06 (1)
Far East	13-15 (1)	08-09 (1) 09-11 (2) 11-13 (1) 13-14 (2) 14-16 (3) 16-18 (2) 18-21 (1)	18-20 (1) 20-22 (2) 22-00 (3) 00-02 (4) 02-04 (3) 04-06 (2) 06-09 (3) 09-11 (2) 11-14 (1)	01-02 (1) 02-05 (2) 05-06 (1) 02-04 (1)*
Pacific Islands & New Zealand	11-13 (1) 13-18 (2) 18-19 (1)	08-10 (1) 10-11 (2) 11-13 (3) 13-15 (2) 15-17 (3) 17-20 (4) 20-21 (3) 21-22 (2) 22-00 (1)	16-18 (1) 18-20 (2) 20-01 (4) 01-05 (2) 05-07 (4) 07-10 (2) 10-12 (1)	21-22 (1) 22-00 (2) 00-05 (3) 05-06 (2) 06-07 (1) 23-01 (1)* 01-04 (2)* 04-06 (1)*
Aus-tralia	13-16 (1) 16-19 (2) 19-20 (1)	06-08 (1) 12-14 (1) 14-17 (2) 17-19 (3) 19-21 (4) 21-22 (3) 22-00 (2) 00-02 (1)	19-21 (1) 21-23 (2) 23-04 (4) 04-06 (3) 06-08 (4) 08-09 (2) 09-12 (1)	23-01 (1) 01-03 (2) 03-05 (3) 05-06 (2) 06-07 (1) 01-06 (1)*
North-ern & Central South America	08-10 (1) 10-12 (2) 12-14 (1) 14-16 (2) 16-17 (1)	07-08 (1) 08-12 (2) 12-14 (3) 14-17 (4) 17-18 (3) 18-20 (2) 20-22 (1)	08-10 (2) 10-13 (1) 13-15 (2) 15-17 (3) 17-23 (4) 23-02 (3) 02-05 (2) 05-08 (3)	19-20 (1) 20-23 (2) 23-02 (3) 02-04 (2) 04-05 (1) 20-00 (1)* 00-02 (2)* 02-03 (1)*
Brazil, Argen-tina, Chile & Uru-guay	08-12 (1) 12-14 (2) 14-16 (3) 16-18 (2) 18-20 (1)	05-06 (1) 06-08 (2) 08-12 (1) 12-14 (2) 14-16 (3) 16-20 (4) 20-22 (3) 22-23 (2) 23-00 (1)	13-15 (1) 15-17 (2) 17-18 (3) 18-23 (4) 23-00 (3) 00-02 (2) 02-04 (1) 04-06 (2) 06-09 (1)	20-22 (1) 22-01 (2) 01-04 (1) 21-02 (1)*
Mc-Murdo Sound, Antarc-tica	16-18 (1)	14-16 (1) 16-20 (2) 20-21 (1)	15-17 (1) 17-18 (2) 18-00 (3) 00-03 (2) 03-06 (1)	20-21 (1) 21-23 (2) 23-03 (1) 03-05 (2) 05-06 (1)

Vertical Antennas [*from page 24*]

ground conductivities in the United States. It is taken directly from the FCC rules. This map is based upon thousands of field intensity measurements made and on file with the FCC. It will be noted that some of the midwest states have ground conductivity as high as 30 mmhos/meter. On the other hand, mountainous areas are quite low in conductivity, around 2 or 4 mmhos/meter.

In the next chapter, the impedance characteristics of vertical antennas of various heights and the circuits used for tuning or matching them to the power source will be discussed.

[*To be continued*]

See page 126 for New Reader Service

Ham Shop

Advertising Rates: Non-commercial ads 10¢ per word including abbrevations and addresses. Commercial and organization ads, 35¢ per word. **Minimum Charge $1.00.** No ad will be printed unless accompanied by full remittance. **Closing Date:** The 10th day in the second month preceding date of publication.

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RTTY gear for sale. List issued monthly, 88 or 44 Mhy toroids, uncased, five for $1.50 postpaid. Elliott Buchanan and Associates, Inc. 1067 Mandana Blvd., Oakland, Calif. 94610.

EARN YOUR DEGREE in electronics engineering. Highly effective home study courses in electronics engineering technology and electronics engineering mathematics. Free Literature. Cook's Institute of Electronics Engineering, P.O. Box 36185, Houston, Texas 77036 (Established 1945).

RUBBER ADDRESS STAMP including call letters. Three or four lines $1.50. Signature stamp $3.50. Free catalog. Jackson's PO. Box 443-F, Franklin Park, Illinois 60131.

QSL's 100, $1.25 and up. Postpaid. Samples, dime. Holland, R3, Box 649, Duluth, Minn. 55803.

PROTECT Radio gear with a warning sticker that reads "WARNING PROTECTED BY LECTRONIC ALARM SYSTEM" Same as supplied to commercial burglar alarm companies. 2" x 3½", yellow/green vinyl applies instantly without water to windows in mobile unit or operating shack. Also ideal for the back door of your house or basement windows. Money back if not satisfied! 3/50¢ or 6/$1.00, prepaid. Order today from: CESR, 4 Parish Court, Stony Brook, N.Y. 11790.

DAH-DITTER Electronic Keyer . . . New Integrated Circuit Electronic Keyer. Fully Self Completing on both dit and dah. Built in AC supply and keying monitor. Isolated reed relay output. Completely assembled and tested, ready for operation. Price only $34.95. Order now direct from M & M Electronics, Dept. K, 6835 Sunnybrook, NE, Atlanta, Georgia 30328.

WANTED—QST's—Last four issues needed to complete private collection 1916—FEB., MAY, JUNE, JULY. Any reasonable price paid. K2EEK, CQ Magazine, 14 Vanderventer Ave., Port Washinton, L.I., New York 11050.

QSL's by RUTGERS VARI-TYPING SERVICE, Thomas St., Milford, N.J. 08848. Free samples.

QSL's — BROWNIE-W3CJI — 3111 Lehigh — Allenton, Pa. 18103, Samples 10¢ with catalog 25¢.

SCOTCH Recording tape, lowest prices, Tape Center, Box 4305, Washington, D.C. 20012.

HAMFESTERS Radio Club, Chicago, Illinois, proudly announces its 34th Annual Midwestern Hamfest, Sunday August 11th at Santa Fe Park, 91st & Wolf Road near Chicago. The Hamfest features manufacturer and distributor exhibits, swappers row, awards and a variety of activities for all. Clowns and games for the children, activities for the XYL while you enjoy amateur radio with friends and acquaintances. The Hamfest climaxes "Illinois Amateur Radio Week August 3 thru 11th" by proclamation of Governor Otto Kerner. For information and tickets write to Charles Borkowski, WA9TWA, 1851 W. 21st Street, Chicago, Illinois 60608.

WRL's used gear has trial-terms-guarantee! SR46—$99.95; Utica 650A & VFO—$99.95; TX-1—$99.95; Valiant—$149.95; HA10—$189.95; SX99—$79.95; HQ100C—$109.95; 75A1—$169.95; SX140—$69.95; HR20—$79.95; NC300—$149.95; RME4300—$79.95. Low prices—Hundreds more. Free "blue-book" list. WRL, Box 919, Council Bluffs, Iowa 51501.

SX-25 W/speaker; Harvey wells Bandmaster TBS 50 D (2 thru 160). Home Brew Power. NCX W/home brew power supply; Apache TX 1 W/SB10; Best offer any or all. WAØLUP Estate Box 241, Kiowa, Kansas 67070.

YOUR CALL engraved white plastic with black letters or reverse—Choice Lapel bar or Tie clasp $1.45. Also 1½" x 6" wall signs $2.95. W2DF, Box 213, Farmingdale, N.Y.

TA33 Triband beam $65.00. No salt air or smog corrosion. Silicone treated traps. Will ship. W6DSX, P.O. Box 201, Paradise, Calif. 95969.

QSL's $6.95 thousand, free samples, C.B. Wholesale Printers, P.O. Box 2311, Anderson, Ind. 64011.

FOR SALE: Heathkit DX60—$50.00; VFO HG-10 $20.00; Monitor HO-10 $50.00; Hammarlund receiver w/clock $95.00; Hallicrafter Xmtr—HT-44 and PS-150-120 best offer. Leaving radio, many accessories, pick up only, for information, Hugh Smith, 4 N. 8th St., Millville, N.J. 08332, 825-3975.

FOR SALE: Heath HR-10 rcvr., $60; QST's, Oct. 1955 thru Dec. 1967, $40; 73's, April 1961 thru Dec. 1967.; Heath Balun coils $5; Heath HD-20 xtal calib., $9; Heath SB-400, $275; mobile mount with heavy duty spring $8. J. Shank, 21 Terrace Lane, Elizabethtown, Pa. 17022.

FOR SALE: Hi-Fi equip. McIntosh MC-60 amp., like new, $115 Bogen R-710 tuner-preamp. $59. Heath HO-10 monitorscope, $54 F. Breidbart, WA2JJJ, 405 Beach 122 St., Rockaway Park, N.Y. 11694.

FOR SALE: BC-459 transmitter, complete, 4 to 9 mc, $10; Thordarson multimatch mod. xfmr, 300 watt, $5. W9TVV, 2028 Oriole Trail, Michigan City, Ind. 46360.

FOR SALE: 80-10m xmtr, 180 watts p.e.p.; Geloso v.f.o. in 8¾" x 19" cabinet w/p.s., and fan, $200; Elect. Prod. D-612T power supplies (2), 0-16 v.d.c. @10 a., $40 ea. W1MRR, 19 Topstone Dr., Danbury, Conn. 06810.

FOR SALE: Heath HW-12, A1 cond., no trades, $75 plus shipping Mike Morrisey, W4LXA, 752 High St., Harrodsburg, Ky. 40330

FOR SALE: Hammarlund HX-50, excellent cond., $225, FOB Las Vegas. Will ship. All inquiries answered. 702-384-3518. Le Turner, W7BKQ, 2213 Sunland Ave., Las Vegas, Nevada 89106

WANTED: Schematic of Mine Detector, AN/PRS-4. W9KPD, 1875 Fairhaven, Santa Ana, Calif. 92705.

FOR SALE: Eico 753 transceiver and matching 751 supply, solid state v.f.o. Perfect cond. $170. L. Colman, WA1CTX, 342 Stillwater Ave., Stamford, Conn. 06902.

"SAROC" the fun convention, Jan. 8-12, 1969, at the Hotel Sahara's new Space Convention center hosted by Southern Nevada ARC. de W7PBV.

FOR SALE: G. E. 30w, f.m., T-powered xcvr on 146.94 mc, $75 Bird #74 6 pos. coax sw. $20; Link T-powered 450 mc xcvr, $40 Want: 3-1000 tube. W. Davis, K6KZT, 4434 Josie Ave., Lakewood Calif. 90713.

FOR SALE: Collins R-388/URR (51J-3) receiver, with product detector, excellent cond., $425. Trade: 1.5 kc mechanical filter (75A-4) for 2.1 kc filter. W6BJI, 1260 West San Ramon, Fresno Calif. 93705.

FOR SALE: Collectors—General Radio type 566-A wave meter, $40 Dumont type 208 scope, $80; RCA type 160-B scope, $80. W1MRR 19 Topstone Drive, Danbury, Conn. 06810.

WANTED: 2 meter converter and power supply, 7-11 mc i.f. David A. Eisenberg, 907 Summit Lane, Oreland, Pa. 19075.

FOR SALE: Eimac SK-640 sockets and SK-060 chimnies for 4X150 4X250 etc. Clean, $3.50 for both, postpaid and insured. Bob Sul WB2ZQI, Box 472, Rifton, N.Y. 12471.

TWO New Swan 500C with 117XC supplies, factory sealed un opened cartons, full factory warranty $488. Don Payne, W4HKG Payne Chevrolet-Oldsmobile, Box 525, Springfield, Tenn. 37172.

FOR SALE: Johnson—Ranger II factory wired. TO Keyer. Autronic Key, like new, $200.00. J. B. Stevenson, 200 W 12th, Flora, Ill. 62839.

FOR SALE: Swan 350 with 117 XC power supply; ten months old $350.00. Box Soares, Rt. 2, Box 420T, Enterprise, Alabama 36330

SELL: Sweep Signal Generator, dual range RF Wattmeter, VOM others. John Perkovich, Cascade, Wisc. 53011.

SACRIFICE must sell all my teletype equip. model 15 $45. Model 19 $75. TD $25. Reperf. $20. Make offer on all. Will trade K60BH, 2253 Kelton, L.A., Calif.

TWENTY-METER Antenna System. Vesto HPX-100 tower, Telrex 20M-546 beam and A2675RIS rotor. $1800 FOB Alamogordo. Write for details, W5OPL, 710 Arnold, Alamogordo, N. Mex. 88310.

SAMCO—"Travel-Pak" QSL kit, $1.00. (Stamp & Call bring sample), Samco, Box 203, Wynantskill, N.Y. 12198.

SALE! HRO50T1, ABCDEF coils, speaker, manual, $165. Will ship prepaid. Cashiers check, Postal Money Order. Clyde Lee, K400W 926 Bluesprings Dr., Pensacola, Fla. 32505.

RUBBER STAMPS. QSL card size. $7.50 and up. Under 2" wide $1.00 first line, 50¢ each additional line. Free style sheet. Fulton Rubber Stamps, Route 216-CQ, Fulton, Maryland 20759.

WANTED for private collection. Grebe and other battery receiver representative 1920's. Advise condition and price. W4JV, Rt. 1 Box 930-B, Pensacola, Fla. 32506.

FOR SALE: 6m Comm. IV w/vfo, Halo, mic, cables, $150, VF 4x150's, 4x250's. 432 & 1296 tubes, parts. Want aircraft radio Lear, Narco, battery sets. S.A.S.E. brings complete list. Dave Raney, 1870 Garden Le., Cincinnati, Ohio 45237.

PYE 450 Mhz WBFM base station, separate Xmtr-Rcvr in attractive cabinet, matching dynamic mike and interconnecting cables, for sale. $159.95. Kevin Boyle, VE2EE, 5360 West Broadway Ave Montreal, Quebec.

HARVEY-WELLS TBS-50C & AC supp. $50, covers 2-80 meter fone/cw. Radio Engineers Handbook, $10. 3E29 RCA (829B) new unused in orig. carton unopened $7.00 each. W6DMP/6, D. Etheredge, 12040 Redband St., Sun Valley, Calif. 91352.

SWAP OR Sell Tubes: 4E27, 4-125, PL-6549, 6252, 833, 4-65A, 832, 826, 3C45. Send SASE for list. Cleaning House. A. J. Savick 105 Nursery Lane, Lancaster, Pa. 17603.

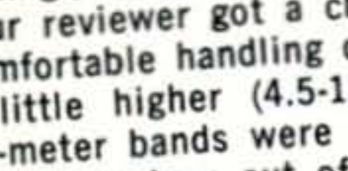
See page 126 for New Reader Servic

No, we're not lazy! It's just that "Popular Electronics" (Dec. 1967) tells the DX-150 story so well.

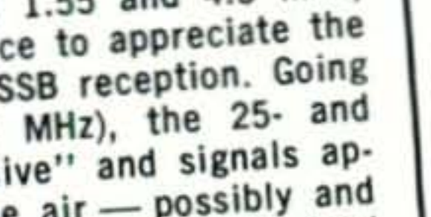
Reprinted Without Editing

"What may be the first really noteworthy advancement in communications receivers is wrapped up in the new Radio Shack imported DX-150. Featuring continuous coverage from the top of the AM broadast band (535 kHz) to the bottom of the 10-meter band (30 MHz), the DX-150 is a single-conversion superhet with a tuned r.f. stage, two i.f. stages, full-wave product detector for SSB/CW reception — and it's 100% solid state. Selling at $119.95, the DX-150 has the flexibility of a communications receiver that a ham or SWL is used to buying for $175-plus. To rattle off a few more "features": there is a front panel antenna trimmer, fast or slow a.v.c. attack, a cleverly concealed built-in monitor speaker, plenty of calibrated bandspread, and noise limiting in both the i.f. and audio stages. Because of the solid state circuitry, the usual warm-up drift expected with a tube-type receiver is virtually absent here. And, although the DX-150 is primarily a base station receiver with a 117-volt a.c. power connection, it can be operated from an outboard d.c. power supply consisting of only 8 D-cells. Radio Shack claims that the receiver will operate for 100 hours — continuously — using only the d.c. supply. Ideal for Field Day and emergency work! The proof of the pudding so far as any communications receiver is concerned is how well it works "on the air". At POPULAR ELECTRONICS, the DX-150 was hooked up to a 125-foot long-wire antenna and tuned across the AM broadcast band. Needless to say, the S-meter was pinned on just about every single channel, and the audio quality with Radio Shack's voice-selective speaker (extra, $7.95) was crystal-clear. Tuning the band between 1.55 and 4.5 MHz, your reviewer got a chance to appreciate the comfortable handling on SSB reception. Going a little higher (4.5-13.0 MHz), the 25- and 31-meter bands were "alive" and signals appeared to leap out of the air — possibly and on the CB frequencies, the DX-150 could hold its own against a usually regarded as a lack of sensitivity, that wasn't the case with the DX-150. On the top band (13-30 MHz), the sensitivity still seemed high; and on the CB frequencies, the DX-150 could hold its own against a dual-conversion receiver built just for CB work. **Summary:** Radio Shack has the Model DX-150 in most of its 190 retail outlets. Take a look at it, and get the "feel" of this unusual receiver."

CUSTOM ACCESSORIES



12 VDC Power Set



Matching Speaker

And only Radio Shack has this 119.95 receiver!

Thousands of hams and swl's have discovered that Radio Shack's Realistic DX-150 is truly the "breakthrough" full coverage receiver of 1968. It's the 100% solid state receiver that *banishes forever* tube failure, tube heat, tube drift, and — thanks to its built-in 117V/12V supply — your dependence upon AC current when power fails or on field day. The brilliant DX-150 is NOW IN STOCK in every one of Radio Shack's over 200 stores.

CAVEAT EMPTOR

Since DX-150 is certain to be the world's most imitated communications product, we advise our readers that "solid state" on a receiver is not necessarily indicative of selectivity, sensitivity and "feel." The DX-150 is built to $200-$300 performance specifications; its modest $119.95 price tag simply designates the extent to which we have sacrificed traditional markup to establish REALISTIC as a quality line! P.S. — DX-150 is a hefty 14 lbs., with a 12¼" dial, extruded 11-control front panel, and 14¼x8¼x6½" in size. It's just the picture that's little! Our no money down policy makes the pain little, too!

ORDER BY MAIL

RADIO SHACK { **EAST**: 730 Commonwealth Ave., Boston, Mass. 02215
WEST: 2615 West 7th St., Fort Worth, Texas 76107

Or Come to One of Our More than 210 Stores Nationwide!

Please rush me the item I've checked below. Dept. XO
I enclose $_____, plus 50¢ for postage and handling:

- ☐ FREE 1968 Catalog
- ☐ Receiver, 20-150, $119.95
- ☐ Matching Speaker, 20-1500, $7.95
- ☐ 12 VDC Power Set, 20-1501, $7.95

Name (print) _____

Street _____

City _____ State _____ Zip _____

FOR SALE: Mint Condx. Eico-720, crystals for Novice 40 & 15, Dow key DK-60, vertical ant. plenty of RG-8U coax 60'. $100. S. Savasky, 910 Jerome St, Midland, Mich. 48640.

FOR SALE: HQ-170 receiver and speaker, new condition, $150. Will deliver 50 mile radius or FOB. R. Scott, 371 Claymore Blvd., Cleveland, Ohio 44143.

WANTED: Schematic and power cable for G-77 Gonset Trans. Pay reasonable price. K. Wolhelmi, Rte. 4 Box 807, Eugene, Ore. 97401.

T-R SWITCH #250-39 $18. Preselector DB-23 $20. A. Emerald, 8956 Swallow Ave., Fountain Valley, Cal. 92708.

WANTED: Novice or Crystals. 40 and 80 mtrs. Ned Sebring, 1083 N. Ball St., Owosso, Mich. 48867.

BERKELEY Eput meter (100KC Counter) Model 7150B. Good cond. C. Thompson, 6250 Thoie Road, Cincinnati, Ohio 45230.

SELL: C. E. 100V, Excellent condx., Instruction book. Original owner, make offer. R. M. Sutton, P.O. Box 45-588, Houston, Texas 77045.

COLLECTORS ATT-Grebe Radio receiver Type MU, Like new. $50. J. Fuller, Rte. 4 Box 613, Chico, Calif. 95926.

MODEL #28 Teletype page printer $99. Other RTTY Goodies. Gordon E. White, 5716 N. King's Hightway, Alexandria, Va. 22303.

FOR SALE: Hallicrafter HT-9-100 Watt AM-CW All band xmitr $50. HT-18 VFO $20. Both $65. You pick up. W. Baby, 233 N. Taylor Ave., Oak Park, Ill. 60302.

FOR SALE: Wheatstone oiled 15/32" perf tape for Boehme keying head, any quantity. P. Lemon, 3154 Stony Point Road, Santa Rosa, Calif. 95501.

FOR SALE: Hallicrafter HT-46, Tran. SX146 Rec. perfect cond. $450. R. Lee, Box 6, Mt. Sterling, Wisc. 54645.

LIKE NEW: Sx-122 $200. I pay shipping. A. Sanderford, 626 AC&W Sq. Box 35, APO Seattle, Wash. 98701.

GIVE-AWAY: QST from 1936 and CQ from 1945. Only cost is transportation. G. Illenberg, 162 North Beacon St, Middleown, N.Y. 10940.

SELL: Zeus $350. Bought reconditioned. Used 40 hrs. No UHF activity in area. R. Ellsworth, Groves Rd, Rt. 16, Keene, N.H. 03431.

WANTED: HRO-50 "AD" (50 MC) Coil. All answers acknowledged. D. Savage, 291 Linebrook Rd., Ipswitch, Mass. 01938.

CQ MAGAZINES '47 to '64 complete, QST magazines '46 to '64 complete, good cond., both for $75. Want propagation/antenna books. D. Etheredge, 12040 Redband St., Sun Valley, Cal. 91352.

FOR SALE: Poly-P.C. 6 Meter Transceiver, now collector's item. New cond., original carton and manual. $195. F.O.B. Original cost $329. H. Mohr, 5670 Taylor Rd., Gahanna, Ohio 43020.

JOYSTICK $30; 6N2, modes pwr supply $100. 20 Aes BC458 VFO, $150 Valiant II, $170. Prices include manuals. F. Huberman, Box 11, Atlantic Beach, New York 11509.

BLANK printed circuit board 029-032 thickness copper both sides, 4 by 8. 5 boards for $1.50 plus postage. B. Hayward, 3408 Monterey, St. Joseph, Mo. 64507.

COLLINS 75A3 or 75A4 wanted in good electrical cond. Also old CQ's and QST's. G. Charlick, 163 Ledgewood Circle, Rochester, N.Y. 14615.

HEATH MARAUDER SSB transmitter. Very good cond. Honest! It works fine. Have bought Heath Transceiver so don't need it. $150 with all manuals. E. Meloan, 1110 Terrace Circle, No. Augusta, So. Carolina 29841.

WANTED: Collins CC-3 Carrying case for 312B-5 Electronic keyer; Coax switches; Antique Kennedy 220 or 110 receiver. Heinlein, 107f Wyoming St., Boulder City, Nev. 89005.

WANTED: 6 or 2 meter FM Base station in good cond., price. J. Coleman, Box 198, Sacramento, Ky. 43272.

SELL: Dx-40 $35; Vfl-vfo, $15; HW-30 two meter, $40; Hw-16, $90; U-ship. K. Rowley, P.O. Box 293, Williston Academy, Easthampton, Mass. 01027.

HAMFEST, 3rd Annual held by the suburban radio club of St. Louis County, Mo. Sunday, June 30th, at Creve Couer Lake Memorial Park, St. Louis County. Main prize HW-32A, many others. Advance registration $1 from K0AHD. J. Owens, 10217 St. Daniel, St, Ann, Missouri 63074.

WANTED: TGIA/AXT2, TV Trans., other equip. for 432 MH TV, Watkins, 2168 Green St., Augusta, Ga. 30904.

TR3 AC3 Ext. VFO Spkr. Extras. FB package, $500. L. Jones, 17173 Lisette, Granada Hills, Cal. 91342.

FOR SALE: DX100 Gud cond. w/manual $65. R 45 all band receiver w/schematic and power supply, $40. 1-177 tube checker w/manual $20. H. Lowry, 915 Madison St., Manchester, Tenn. 37355.

URGENTLY NEED: Service info on HP Audio oscillator CAQ-1-60111-A part of Navy LAJ-1 Audio oscillator equipment. J. Wright, P.O. Box 1316, Rockport, Texas 78382.

I AM still waiting patiently for your offer of CQ April '45. Just this one needed for a complete set. Write: F. Herridge, 96 George St., Basingstoke, Hampshire, England.

SALE: M-15 w/table, complete and perfect $75. R-19 TRC-1 receiver $30. CM-22 $24. Brown, 15 Fisher Dr., Greenville, S.C. 29607.

SBE-33 $189. SB-2DCP $39. Sell or trade: Bolex B8, lens turret, case, $35. Olympus Autoscope projector $90. Astra Cub pistol $20. O. McMahon, Jr., 113 Woodcrest, New Iberia, La.

75A-4 Wideband filter as per Jan. '64 CQ page 50. 6.8 kcs/6 db, 23 kcs/60 db bandpass. Exactly like picture. $12 postpaid. T. Beeler, 260 Oak Hill Rd., Rt. 2, Candler, No. Carolina 28715.

COLLINS KWM-1 with AC and DC Supplies, speaker, phone patch, mobile mount, cables, DX adapter, manuals and xtras xtals. $450. Bill DuHart, 3846 Winona Dr., Pensacola, Fla. 32504.

MUST SELL Eico 753 with 751 p/s, ss vfo ten hours tt $135. SR-160 Mint Condx. NO p/s $165. Heath Mohican rx with ac supply mint $60. Will ship fob. E. Talbot, 131 Pepperidge La., Battle Creek, Mich. 49015.

SALE: Northern VMO; $15 page-prntr; B&W $425 LPF; Mstr-Mobile #900 CL 80/10; Micro-Z-Match; CE QT-1. Smith, 915 Lovera, San Antonio, Texas 78201.

SHACK CLEANUP: Ultimatum by XYL "or else". Sase for list of many years collection of bargain priced goodies as Collins 70-E2 oscil. Megeff, 50-15 Weeks La., Flushing, N.Y. 11365.

HEATH HW-12 VY FB $75, Heath Sixer W/AC-DC PS $30, 4CX250's $5 ea. R. Guard, CMR Box 7542, Patrick AFB, Fla. 32925.

HI FI-McIntosh MC-60, like new, $115. Bogen R-110 Tuner-Pre Amp $59. Heath Monitor Scope Ho-lo $54. F. Breidbart, 405 Beach 122 St., Rockaway Park, N.Y. 12694.

FOR SALE: 1926 Freshman masterpiece 5 tube TRF, Built-in loudspeaker, Manual. Mint Condition. $100 or best offer. F. Shapiro, 834 Hemlock St., Franklin Square, N.Y. 11010.

FOR SALE: Two Surplus 813's, never used, also filament transformer for same $30. F. Kedl, 55 E 8th St., Sheridan, Wyo. 82801.

RTTY INFORMATION for the Amaterur interested in RTTY. F. Demotte, 4008 S. Atlantic Ave., Daytona Beach, Fla. 32019.

RBL-2 NAVY Receiver manual and schematic needed. G. Marts, 4201 Colvin Dr., St. Louis, Mo. 63123.

WØCVU on the air since 1913. Let's meet at the ARRL National Convention in Des Moines, Iowa. June 20-22, 1969. How about it??? C. Boegel, 1500 Center Pt. Road, N.E., Cedar Rapids, Iowa 52402.

MOVING: HQ-180AC Rec. Exc. $250. Johnson SSB Adapter, immaculate. $135. Matching Valiant I cln. $125. All for $75. P. Crum, 751 N. Central Ave., Chicago, Ill. 60644.

HT-37 FOR SALE: Orig. owner, mint cond. Pick up only. $220. L. P. Holmes, 1733 Comanche Ave., Chatsworth, Cal. 91311.

WANTED: Old WWI wireless tubes, Telefunken ER58, EVN 117, EVE193, D21, S14. R. Schnedorf, 610 Monroe Ave., River Forest, Ill. 60305.

WANTED: Two meter CW Skeds in any portion of band. D. Blystone, 812 Niles St., La Porte, Ind. 46350.

DRAKE AC-3, Factory AC Power Supply & MS-4 speaker. Matches TR-3, R-4, T4X, etc. $70. John Bell, 208 Pat Street, Levelland, Texas 79336.

HEATHKIT Service technician will build your Heathkit. J. Isham 286 Western Ave., Benton Harbor, Mich. 49022.

WANTED: Eimac SK711A or SK710 Socket. P. Greenway, 234 Elder Dr., NE, Atlanta, Georgia 30305.

REGENCY: TCR-2B Receiver to be used with ATC-1 80-10 meter converter. Best offer over $15. P. Buyaki, 927 Beryl St., San Diego, Cal. 92109.

PLEASE send old QSL's and correspondence from 1XM, 1MX, and W1MX to us for historical collection. MIT Radio Society, Box 558 3 Ames St., Cambridge, Mass. 02139.

FOR SALE: Model 15 RTTY and table, works good and neat. H. Pederson, Thompson, Iowa 50478.

CLEANING HOUSE: 4-1000A linear, 3kv pwr supply. Many other items, xmtg tubes, etc., sell or trade. R. Senechal, 4028 China Court, Hayward, Cal. 94542.

SELL: New Jennings Var. Vacuum Cap. UCSXF 15-23 Mmfd 10KV $10. Unused 4CX350B's $10. Lafayette Cond. bridge as new $10 Want: Swan 410 VFO and Keyer. Samofsky, 201 Eastern Pkwy. Brooklyn, N.Y. 11238.

GALAXY V: Top condition, AC pwr sup., remote VFO, spkr. console 100 KC cal. $390. J. Leestma, 6 Kensington Terr., Bronxville N.Y. 10708.

TRANSCEIVER, Drake TR3, MS4, AC3, Inquiries welcomed. P. Houston, Old Sickletown Rd., Orangeburg, N.Y. 10962.

WANTED: National NPW-0 Dial & Drive, which is no longer commercially available. A. Zwart, 50 Hillside Rd., Sparta, N.J. 07871

RTTY BACK Issues wanted; all '53 and Mar. '57. Swap for RTTY equip., buy or rent for xeroxing. J. Sheetz, 5 Hansell, Murray Hill, N.J. 07971.

TRADE: RELCO Model 12T metal detector with accessories for CB unit, slixer or twoer. L. Krenek, 211 Hillwood Dr., No. Little Rock, Ark. 72116.

See page 126 for New Reader Service

GENERAL Mc-5 CB Rig, full of crystals, many extras, 6/12/110V, mobile brkt, coupler, $80 or swap for VHF gear. R. Beatie, 1904 E 114 Ave., Tampa, Fla. 33612.

WANTED: Sweep generator, prefer RCA WR-69, also good capacitor checker, TA33JR. Mosley, Vox & Calibrator for 350 Swan. R. Dorough, P.O. Box 61, Terrell, Texas 75160.

WANTED: SB620 receiver, and manual for Heath SG-6, Signal generator. T. Dornback, 19W 167 21st Pl., Lombard, Ill. 60148.

WANTED: McCoy sideband filter. H. Smith, 467 Park Ave., Birmingham, Mich 48009.

FOR SALE: Clegg 66er. Excellent, like new, $180. Swan 175 $100. J. Turkal, 1020 4th St. SW, Massillion, Ohio 44646.

FOR SALE: Heath Apache transmitter with SB10 SSB Adapter, $150. Heath Mohawk receiver, $120. Both in perfect cond. Pick up only. L. Labardi, RR 4, Collinsville Rd., Edwardsville, Ill. 62025.

28 KSR CABINET. Sell or trade on 28 page printer-keyboard assemblies. D. Harrington. 1620 Gardena Ave., Fridley, Minn. 55421.

WANTED: Jan. '61 73; CQ's prior to Sept. '57; QST's prior to '32 and Sept. '52, June-Oct. '46, June-Aug. '47. A. Johnson, 55 Pinnacle Rd., Newport, N.H. 03773.

FOR SALE: Brand new, small motor unit for replacement use with small prop pitch motor assembly. $15 plus shipping. D. Scher, 11 Webster St., Irvington, N.J. 07111.

WANT OLD Battery radios, need not be working condition. State price. Send for list of duplicates for sale. D. McKenzie, 1200 W. Euclid Ave., Indianola, Iowa 50125.

COLLINS 32S-3B ser. 15066. Cert. check $375 plus collect shipment. R. Dutton, 4336 Irvin Simmons Dr., Dallas, Texas 75229.

PROFESSIONAL Oscilloscope, OP1. Excellent cond. Want model 28ASR or 32ASR. R. Mendelson, 27 Somerset Pl., Murray Hill, N.J. 07971.

HW-12 WILL SWAP for you HW-32. R. Guard, CMR Box 7542, Patrick AFB, Fla. 32925.

DO IT Yourself—Build 40 foot crank-up tower under forty dollars. $2 for plans and specs. D and D Towers, 1007 Jan Lee, Burburnett, Texas 76354.

BTI-LK2000—Save money. KWM2 $700. ADcon 500-12 Power $99 new, HW32 $85, HO-13 $49. 32S1 $420, 75S3, $419. SB34 Demo $339. F. Baker, Box 546, McComb, Ohio 45858.

SWAN 420 External VFO $80. Swan model 22 dual VFO Adapter $15. Swan plug in VOX 1 $20. All in new cond. T. Raschick, 123 Park Ave., Grand Forks, N.D. 58201.

WANTED: RTTY equipment in good cond. Give model and other RTTY equipment available with prices. M. Buker, 234 Macready Ave., Monroe, Ohio 45050.

HALLICRAFTERS HA-2, HA-6, and P-26 power supply, added Ameco nuvistor pre-amps in receiver sections, $250. J. Nicholson, 309 Ned Dr., Hampton, Va. 23366.

FOR SALE: Heathkit HW-22 and mobile power supply $110. Bill Brosseau, 1210 So. 93rd East Avenue, Tulsa, Okla. 74112.

SAROC Jan. 8-12, 1969 at Hotel Sahara, Las Vegas, Nevada. Brochure planned for Nov. '68. Are you on mailing list de W7PBV. L. Norman, 652 Utah St., Boulder City, Nev. 89005.

FOR SALE: SB-200 in very good cond. $190 postpaid in continental US. A. Brogdon Rd. 1 Box 390A, State College, Pa. 16801.

HEATH DX-60A Novice Transmitter Mint cond. with 6 novice crystals and home brew antenna-mute switch. $70 fob J. H. Campbell, 204 White Pond Dr., Akron, Ohio 44313.

SELL: QST, 73, CQ, '27 to present. Any amount. Send requirements with SASE. E. Guimares, Jr., 17 West End Ave., Middleborough, Ma. 02346.

SWAN 240 E SW 117 AC Power Supply $200. You pay shipping. Also Elmac AF-67 AC Power. W. Poole, 3441 Cliff Rd., S. Birmingnam, Ala. 35205.

FOR SALE: QST's and CQ's 1954 through 1966, 15¢ each. M. Rosen, 240 First Ave., New York, N.Y. 10000.

MICH HAMS: A-1 Beams 6M 7 E1, $16, 2M 22E1, $16. Bud 19" Cabinet. 22" H New $10. B & W Video Gen. $10, 3 4-400 A $12 ea., 2 813 $4 ea., 2 829B $3 ea., Car Radio Reverb A-1, $15. C. Kidder, 1317 Griggs St., S.E. Grand Rapids, Mich. 49507.

SHURE TUBULAR Mike Stand, New, $3. Burgess spray painter $5. Advance mk2, 5,000 ohm dpdt relays, new, $1. Schultz, 40 Rossie St., Mystic, Conn. 06355.

WANTED: HE 61A VFO for Lafayette HE45B. Please state condition and price in first letter. R. Hathaway, 54 Willow St., Glen Ridge, N.J. 07028.

FOR SALE: Elenco 77 SSB Xmtr; 160 thru 10 meters, 200 watt input. Cost new over $500—make me an offer! R. Kasiigah, 3029 W. Leland Ave., Chicago, Ill. 60625.

WANTED: Tung-Sol 8236 Tubes A pair or a dozen. Also Heath HP-13 A.C. Power supply. Any condition. M. Ludkiewicz, 143 Richmond Rd., Ludlow, Mass. 01056.

WANTED: DK60-G26, 729SR Mike, HT-30, Main Tuning Capacitor from BC-455. D. Halbaaken, P.O. Box 615, Fertile, Minn. 56540.

WANT TO Trade for 4CX1000 have many good items. Write for list if you got tube. J. Amery, 7641 La Avenida Dr., Dallas, Texas 75240.

RCA EMPLOYEES SSB Net meets on 3885 ±2KC Monday nights 0130 GMT; also 21330 ±2KC Saturdays at 1500 GMT and 1800 GMT. All stations welcomed. K. Miller, 309 Cherry Hill Blvd., Cherry Hill, N.J. 08034.

S.B.E. Mobile P.S.—12VDC to 115 VAC—150 watts continuous—and 9 tube rcvr 148 to 175MC. Will trade for Ham Gear. G. Oom, 434 Lansbury Dr., Danville, Va. 24541.

EICO 723 Xmtr. for sale. 60v CW on 80 thru 10. $30. with xtals and manual. R. Gauger, 20 Glen Lane, Glen Head, N.Y. 11545.

IMMACULATE Drake 2-C, 2-CS, $230; Ranger I, Clean, $95; DB-20 Preselector, $20. G. Kaser, 314 Birth Lane, Paw Paw, Mich. 49079

88 MILLIHENRY Toroids for sale, uncased, five for $1.25, pp., L. T. Smith, 6218 East King Pl., Tulsa, Okla. 74115.

FOR SALE: Model 19 Teletype covers $10. Complete. J. Thomsen, 8280 S. Tennessee, Claredon Hills, Ill. 60514.

BEST OFFER: Clean Hallicrafters HT-46 with HA-16 VOX. You pay shipping. Make firm offer on first card. J. Cochran, 204 W. Marshall Dr., Midwest City, Okla. 73110.

FOR SALE: Clegg Zeus Xmtr 6 & 2 meters, 185 watts A-1 ex condx with manual will ship. First $300. M. Harvey, 138 N. Baldwin St., Johnson City, N.Y. 13790.

WANTED: 2.1 Kc mechanical filter for 500 Kc. I-F for Collins 51J2 conversion. M. Hart, 936 Dontaos, St. Louis, Mo. 63131.

WANTED: Commercial crystal sets and one tube broadcast receivers 1920-30. J. Taft, 603 Gailwood Lane, Nashville, 14, Tenn. 37214.

SELL OR Trade: Collins F500 A 14 Mech Filter P/N 522 9029 002, 500KC/21.4KC BW, New $20 or 1.7 to 3.4MC/2.1 to 3.0 KC BW. C. B. Christian, 216 W. Balsam Rd., Sterling, Va. 22170.

WANT MOBILE Mount for TR3. Have mobile mount for Heath (MT-MR1) Cheyenne & Comanche, to trade for above or sell. $15. N. Hipp, 5750 Yukon Dr., Sun Valley, Sparks, Nev. 89431.

FOR SALE: Elmac PMR6A with book, 6 or 12 vdc. Very good cond. Complete for $40. J. Penney, 706 N. Elm St., Three Oaks, Mich. 49128.

FOR SALE: HT 37 $220. SX 101A $175, DX 40 $30., Phasemaster IIA. G. Thiele, R. 3, Vernon, Texas 76384.

HEATH Kit 5B-10 Adaptor $50, DX-100 with three 6146's in final, $100. With manuals. G. Schneider, 30 Hadley Rd., Framingham, Mass. 01701.

6N2 Xmtr/Eico 720/Pwr. Supply; $125. HQ-140X $95. DX100 $69. AMECO CN-144 $29. Want Eico 753, Twoer. R. Johnson, 505 South Elmwood, Waukegan, Ill. 60085.

TO TRADE: A. Rosati 120 Base adult size accordion for equal value transceiver and power supply. Like new with case. Present worth about $250. S. Appleton, P.O. Box 298, Tulia, Texas 79088.

SELL QST '46 to '66 solid. In binders. $8 per year. Local only. Lee Aurick, Mt. Pleasant Rd., Rd. 1, Columbia, Pa. 17512.

"HOSS-TRADER" Ed Moory has a limited supply of new equipment with factory warranty for cash: One to a customer, Please! New Swan 500 in factory sealed carton, regular price $495.00, Cash Price $369.00; SB-34, regular price $449.00, cash price $349.00; New NCX-200 and matching supply, regular price $434.00, cash price $329.00; BTI LK-2000 $659.00; Displayed TR-4, $449.00; T4-XB, $359.00; New Mosley Classic-33 beam and demo Ham-M Rotor, $198.00; Special Rohn 50 ft. Fold-over tower prepaid, $188.00; Drake L-4 Linear, $499.00; New FTdx-400 Transceiver, regular price $599.95, Cash Price $469.00; USED EQUIPMENT: TR-4, $399.00; T4-XB, $329.00: A-2, $129.00: TR-3, $349.00: Swan 250, $209.00: Swan 500-C, $389.00: HT-37, $169.00: Ham-M Rotor, $89.00: ED MOORY WHOLESALE RADIO CO., Box 506, DeWitt, Arkansas 72042. Phone 946-2820.

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To help our readers obtain literature from advertisers, we're instituting a new reader-service facility in this issue. Simply check the box next to the name of each advertiser listed below whose product or service is of interest to you. We'll pass your name on and you'll get literature from the advertiser in short order.

This Form Expires June 30

- ☐ Aerotron Inc.
- ☐ Alltronics Company, The
- ☐ Amateur Electronic Supply
- ☐ Amco Engineering Co.
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- ☐ Automation Technology
- ☐ Barry Electronics
- ☐ Cleveland Institute of Electronics
- ☐ Collins RadioColumbia Electronics
- ☐ Communications Products
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- ☐ Cush-Craft
- ☐ Dow-Key Co.
- ☐ Editors & Engineers Lts.
- ☐ Electro-Voice, Inc.
- ☐ Essco
- ☐ Evans Radio
- ☐ Evansville Amateur Electronic Supply Co.
- ☐ E-Z Way Towers, Inc.
- ☐ Fair Radio Sales
- ☐ Galaxy Electronics
- ☐ Goodheart, R.E. Co., Inc.
- ☐ Gordon, Herbert W. Company
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- ☐ Government Surplus Sales
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- ☐ Hy-Gain Antenna Products Co.
- ☐ Instroctograph Company
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Please send me information on the products and services which I have checked above.
Name ..... Call .....
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Advertiser's Index

See page 126 for New Reader Service

SWAN SWAN

LOOK at your low Monthly Payment
AFTER JUST $5.00 DOWN

SWAN 250 6 Meter Transceiver	(11.55)	$325.00
SWAN 350C 80-10m Transceiver	(14.98)	420.00
SWAN 500C 80-10m (Deluxe model)	(18.59)	520.00
Mark II 80-10m Linear – with tubes	(14.08)	395.00
Power Supply for Mark II Linear	(8.30)	235.00
117XC AC supply w/spkr. in cabinet		95.00
14-117 12v DC supply w/Cable		130.00
405X MARS Oscillator - less crystals		45.00
406B Small Phone Band VFO		75.00
410C Full-Coverage VFO		95.00
210 6 Meter VFO		120.00
VX-11 Plug-in VOX		35.00
22 Dual VFO Adaptor		25.00
100kc Calibrator kit for 350C		19.50
500kc Calibrator kit for 250		19.50
RC-2 Mobile Remote Control kit		25.00
45 Swantenna – manual		65.00
55 Swantenna – Remote control		95.00
Custom Contour Bumper Mount		24.95
Kwik-on Antenna Connector		3.25

NOTE: Above are listed the "Standard - Everyday" Swan Products — Below are listed some special Purpose items.

14X 12v DC Module/cable	$ 65.00
14XP As above, but Positive Ground	70.00
117X Basic 117v AC supply ONLY	65.00
230X Basic 230v AC supply ONLY	75.00
117 or 230vac Line Cord (specify)	5.00
8' Cable w/plug (Supply to Transceiver)	3.00
Cabinet w/Speaker & AC Line Cord	30.00
230XC 230v AC supply, speaker & cabinet	105.00
14-230 12v DC supply w/230v Basic	140.00

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When trading with Amateur Electronic Supply, you may use our STAY-ON-THE-AIR PLAN – which enables you to keep your trade-in until your new equipment arrives. . .Lose no operating time!

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SAVE $50

Purchase any new Swan transceiver or linear at the regular price with no trade-in and you may take a $50.00 Credit toward the purchase of any other merchandise.

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State _____ Zip _____

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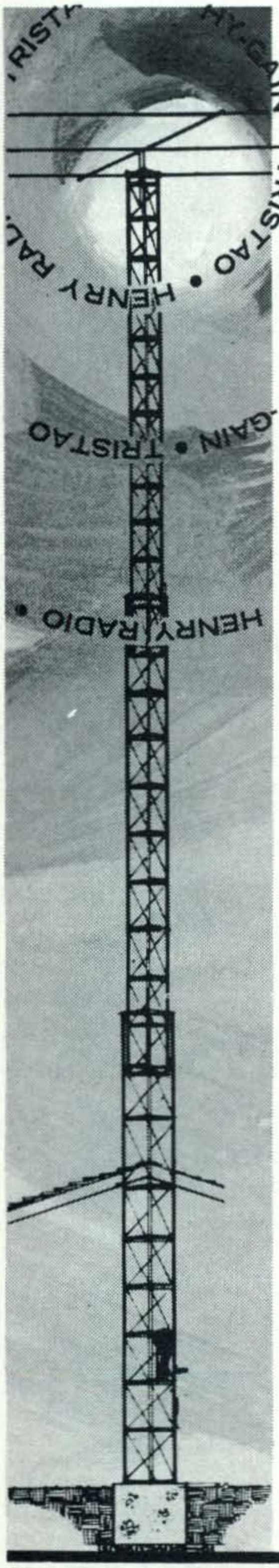

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A NEW CONCEPT IN ITS EXCITING BEAM ANTENNA PROGRAM

Any knowledgeable DX'er will tell you the secret is in the antenna. For over a year Henry Radio has provided an exciting beam antenna package program allowing the average amateur to own an efficient, and unbelievably economical antenna package . . . pre-engineered, prematched and pre-packaged to suit his pocketbook and requirements. NOW! This world famous antenna program moves forward. NOW! You can have the antenna of your choice at the same incredible saving.

Basic package No. HR-1

***Tristao CZ-337 New concept 40 ft. crank-up tower w/mast**
CDR TR-44 rotator
100 ft. RG-58 A/U Coax
100 ft. Control cable

Complete with one of the following:

Hy-Gain TH-3 Jr. antenna	**$325.00**
Hy-Gain TH-2 Mk 3 antenna	**$325.00**
Hy-Gain DB 10-15A antenna	**$325.00**
Hy-Gain 203BA antenna	**$330.00**
Hy-Gain TH-3 Mk 3 antenna	**$375.00**

A savings of approximately $70.00

Basic package No. HR-2

***Tristao CZ-454 New Concept 60 ft. crank-up tower w/mast**
CDR TR-44 rotator
100 ft. RG-58 A/U Coax
100 ft. Control cable

Complete with one of the following:

Hy-Gain TH-3 Jr. antenna	**$480.00**
Hy-Gain TH-2 Mk 3 antenna	**$480.00**
Hy-Gain DB 10-15A antenna	**$480.00**
Hy-Gain 203BA antenna	**$485.00**
Hy-Gain TH-3 Mk 3 antenna	**$520.00**

A savings of approximately $90.00

Basic package No. HR-3

***Tristao CZ-454 New Concept 60 ft. crank-up tower w/mast**
CDR Ham-M rotator
100 ft. RG-8/U Coax
100 ft. Control cable

Complete with one of the following:

Hy-Gain TH-3 Mk 3 antenna	**$560.00**
Hy-Gain 204 BA antenna	**$565.00**
Hy-Gain 402 BA antenna	**$575.00**
Hy-Gain TH-6 DXX antenna	**$590.00**
Hy-Gain DB-24B antenna	**$620.00**

A savings of approximately $120.00

*Free standing tower $10.00 extra

All complete packages are priced freight prepaid to your door in the continental U.S.A. Substitutions may be made . . . write for prices. And remember, you can buy on time. You can trade your used transmitter or receiver. You can rely on Henry Radio to supply the finest equipment and the best value.

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"World's Largest Distributor of Amateur Radio Equipment"

See page 126 for New Reader Service

A NEW Thoroughbred in Solid-State Receivers

NOW—a **Competitively Priced Receiver** for the **most exacting** Professional **Performance!**

Phase-locked Frequency Synthesizer for Maximum Stability!

The superb, new R-530 *by* GALAXY

Designed for the exacting requirements of ***laboratory, broadcast*** and ***HF monitoring*** and ***point-to-point*** complex system ***communications,*** the R-530 is an advanced ***solid-state*** communications ***receiver.*** Its unsurpassed performance is the result of over three years of exhaustive research.

It receives selectible Upper and Lower Sideband, CW AM and RTTY signals...provides ***accuracy of 1 KHz*** tuning throughout the 0.5 to 30 MHz frequency spectrum.

Unique front end design and crystal lattice filters insure ***optimum sensitivity and selectivity.*** An adjustable ***noise blanker*** minimizes interference ...background noise. Frequency stability is amazing...less than 100 Hz drift after turn-on!

Complete transistorization and ***modular construction*** provide ***maximum stability.*** Minimum heat generation and power requirements allow the R-530 to be used in field applications now impractical with vacuum tube equipment. The new Galaxy R-530 is compatible with existing systems. ***Beautifully styled,*** compact, weighing only 25 pounds.

(Priced in the $700 range) Write for free brochure and complete specifications.

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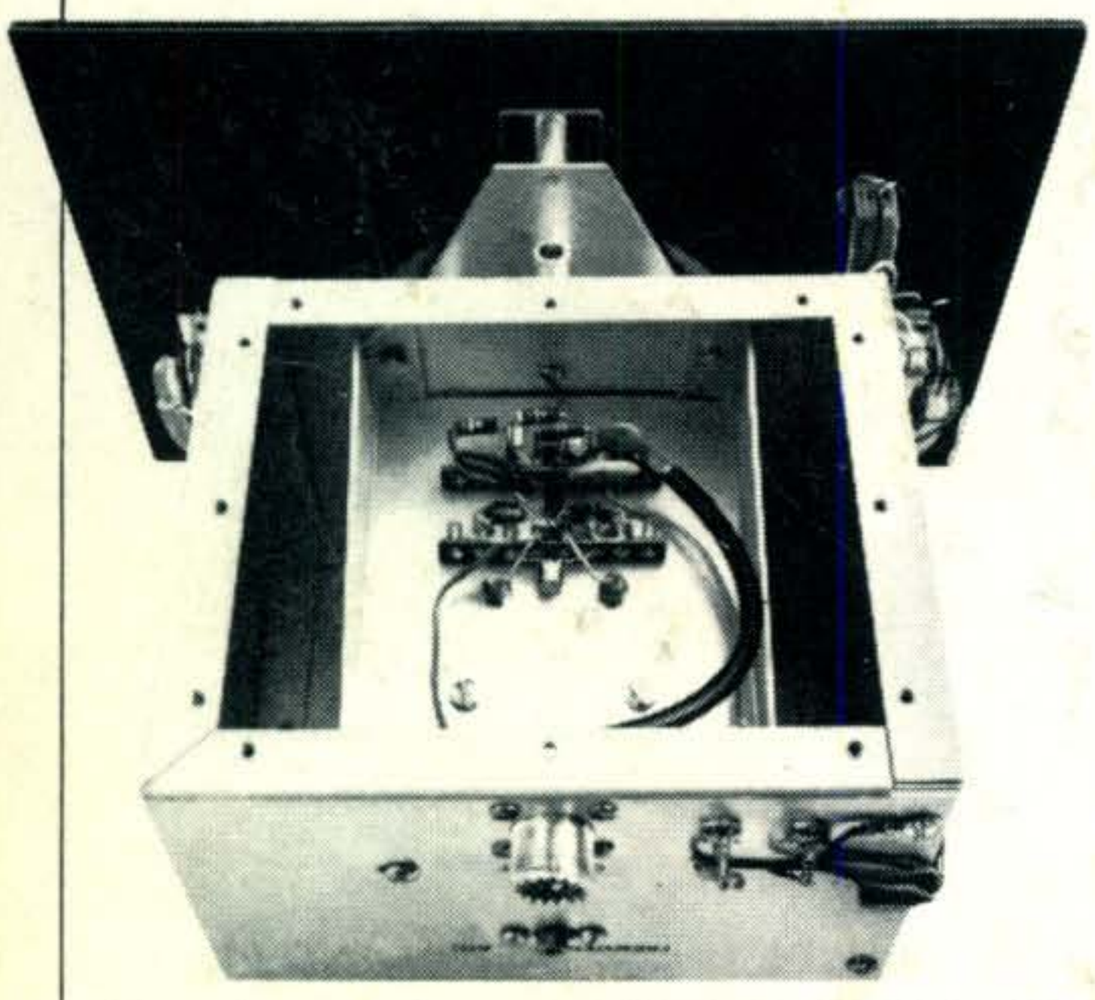
"Pacesetter in Commercial/Amateur Equipment Design"

10 South 34th Street, Dept. CQ-f 30 Council Bluffs, Iowa 51501

Solid-State Projects for the shack

Build this high stability VFO

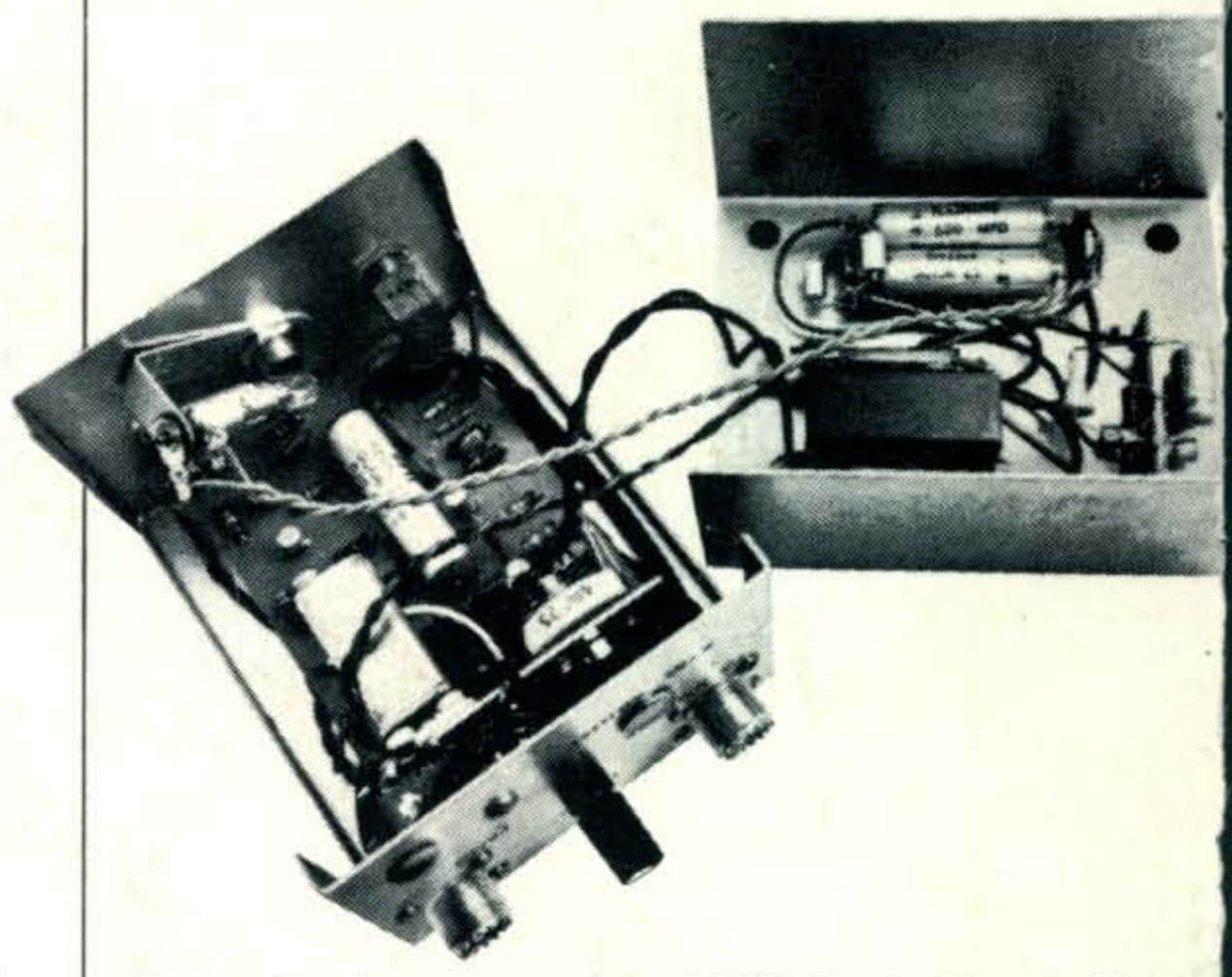


Here's an almost drift-free VFO built around the RCA-3N128 MOS/FET for flexible operation. After just 30 seconds warm-up, it tests out at less than 30 cycles drift in a two hour period.

Look in The Radio Amateur's Handbook, 1968 edition or write to RCA, Commercial Engineering, Section D15-SD, Harrison, N.J. 07029 for full design details, including parts list, schematic, and building tips.

All listed RCA devices are available from your RCA Industrial Semiconductor Distributor

Build this VFO calibrator



If you're interested in MARS and have just a "ham-bands-only" receiver, this may be your answer to VFO calibration outside normal bands. It uses two RCA-1N3193 rectifiers; two 1N34A signal diodes; one RCA-2N2614 and seven RCA-2N3241A transistors—provides calibrating beats at 10 kHz points as well as 50, 33, 25 and 20 kHz. Handy, too, for calibrating test equipment.

Look in August 1967 QST or write RCA, Commercial Engineering, Section F-15-SD Harrison, New Jersey 07029 for August 196 "Ham Tips." RCA Electronic Components, Harrison, New Jersey.

RCA