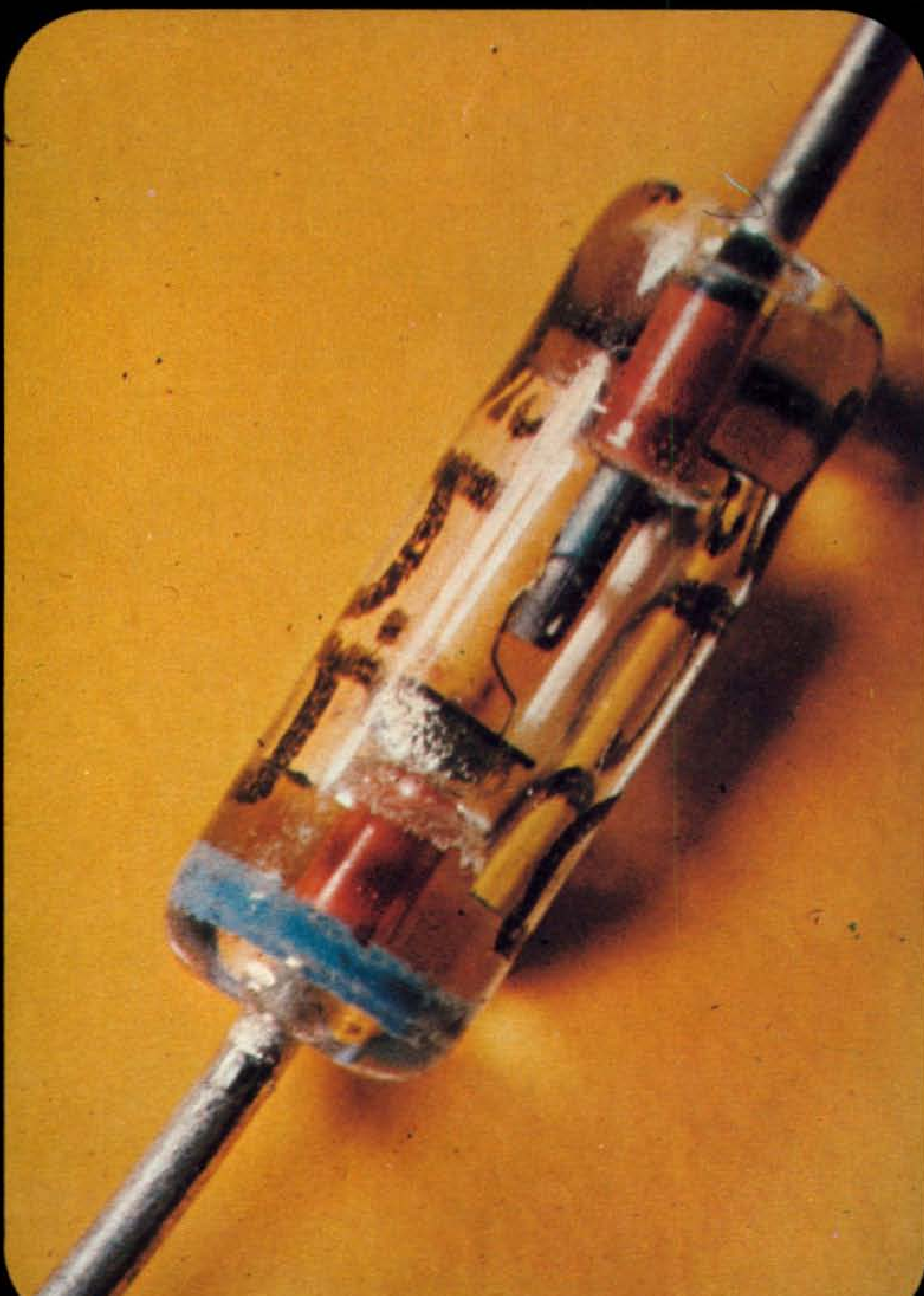
1968 SSB/WPX CONTEST RESULTS Pg. 52

CQ

January 1969
75¢



eaturing:

A Primer On Diode Amplifiers Pg. 29

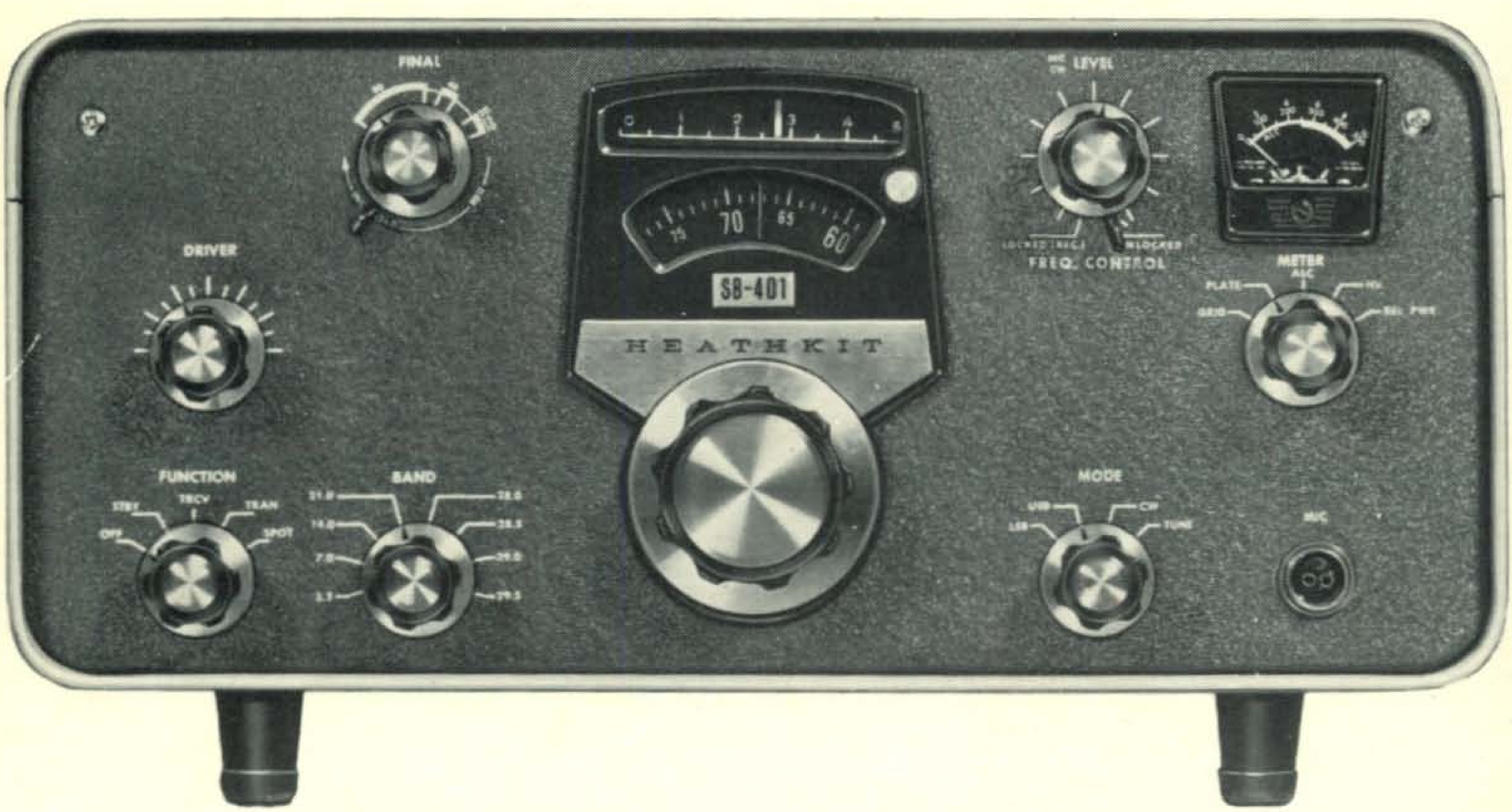
A Visible Light Frequency Tuner- Pg. 16

Build A Simple Impedance Bridge- Pg. 34

The Radio Amateur's Journal

Some Hams Still Prefer A Separate Receiver

And Transmitter...



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Look over the specs and find out why thousands of hams have chosen the SB-301 for their shack!

SB-301 PARTIAL SPECIFICATIONS — Frequency range (megahertz): 3.5 to 4.0, 7.0 to 7.5, 14.0 to 14.5, 15.0 to 15.3, 21.0 to 21.5, 28.0 to 28.5, 28.5 to 29.0, 29.0 to 29.5, 29.5 to 30. **Intermediate frequency:** 3.395 megahertz. **Frequency stability:** Less than 100 Hz per hour after 20 min. warmup under normal ambient conditions. Less than 100 Hz for ±10% line voltage variation. **Visual dial accuracy:** Within 200 Hz on all bands. **Electric dial accuracy:** Within 400 Hz on all bands after calibration at nearest 100 kHz point. **Backlash:** No more than 50 Hz. **Sensitivity:** Less than 0.3 microvolt for 10 db signal-plus-noise to noise ratio for SSB operation. **Modes of operation:** Switch selected; LSB, USB, CW, AM, RTTY. **Selectivity:** RTTY; 2.1 kHz at 6 db down, 5.0 kHz at 60 db down (crystal filter supplied). SSB; 2.1 kHz at 6 db down, 5.0 kHz at 60 db down (crystal filter supplied). AM; 3.75 kHz at 6 db down, 10 kHz at 60 db down (crystal filter available as accessory). CW; 400 Hz at 6 db down, 2.0 kHz at 60 db down (crystal filter available as accessory). **Spurious response:** Image and IF rejection better than 50 db. Internal spurious signals below equivalent antenna input of 1 microvolt. **Audio response:** SSB; 350 to 2450 Hz nominal at 6 db. AM; 200 to 3500 Hz nominal at 6 db. CW; 800 to 1200 Hz nominal at 6 db. **Audio output impedance:** Unbalanced nominal 8 ohm speaker and high impedance headphone. **Audio output power:** ½ watt with less than 8% distortion. **Antenna input impedance:** 50 ohms nominal. **Muting:** Open external ground at Mute socket. **Crystal calibrator:** 100 kHz crystal. **Power supply:** Transformer operated with silicon diode rectifiers. **Power requirements:** 120/240 V AC, 50/60 Hz, 50 watts. **Dimensions:** 14⅞" W x 6⅝" H x 13⅜" D.

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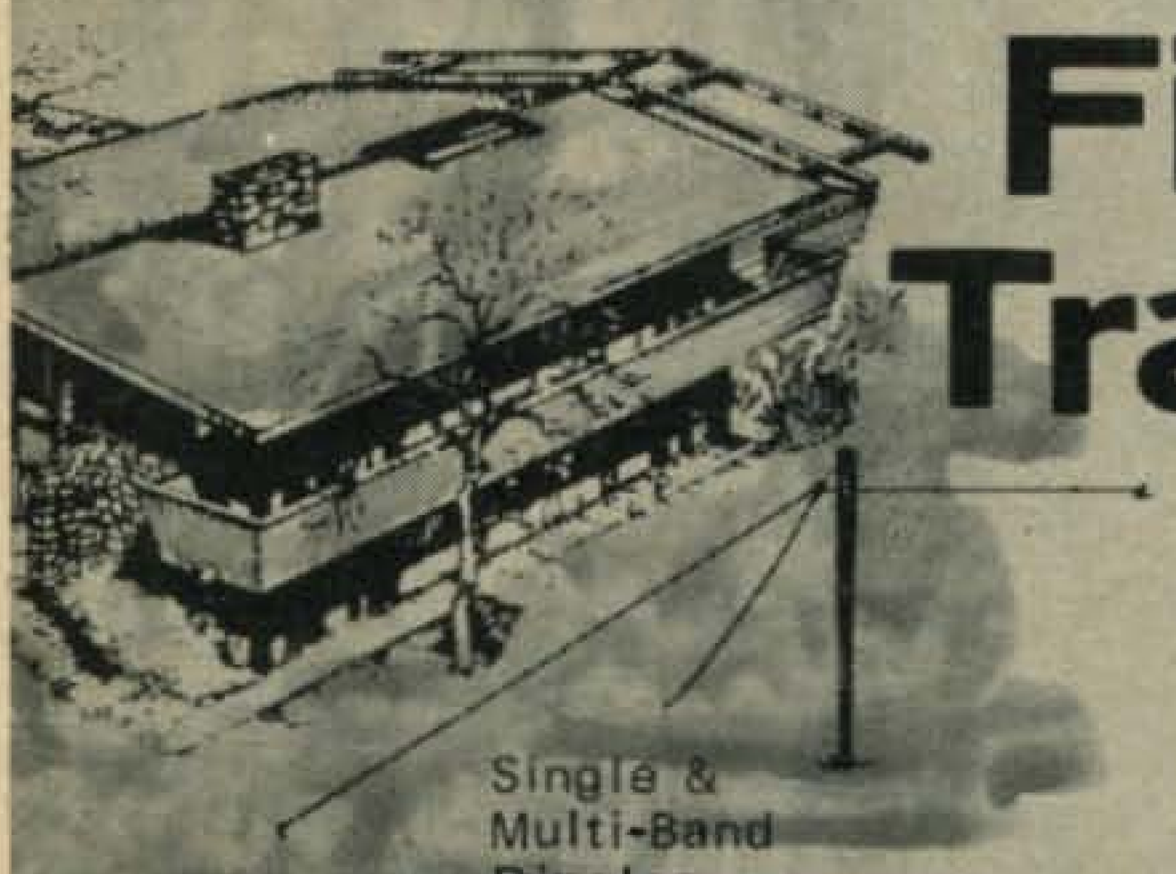

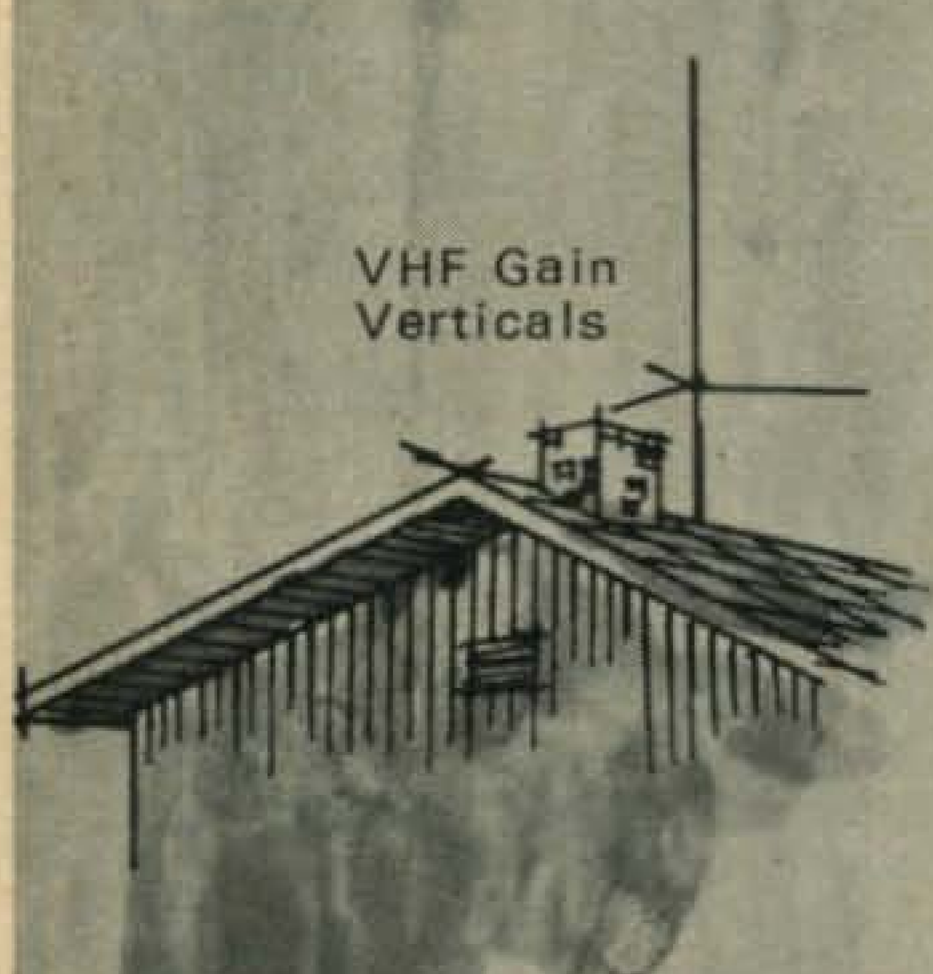

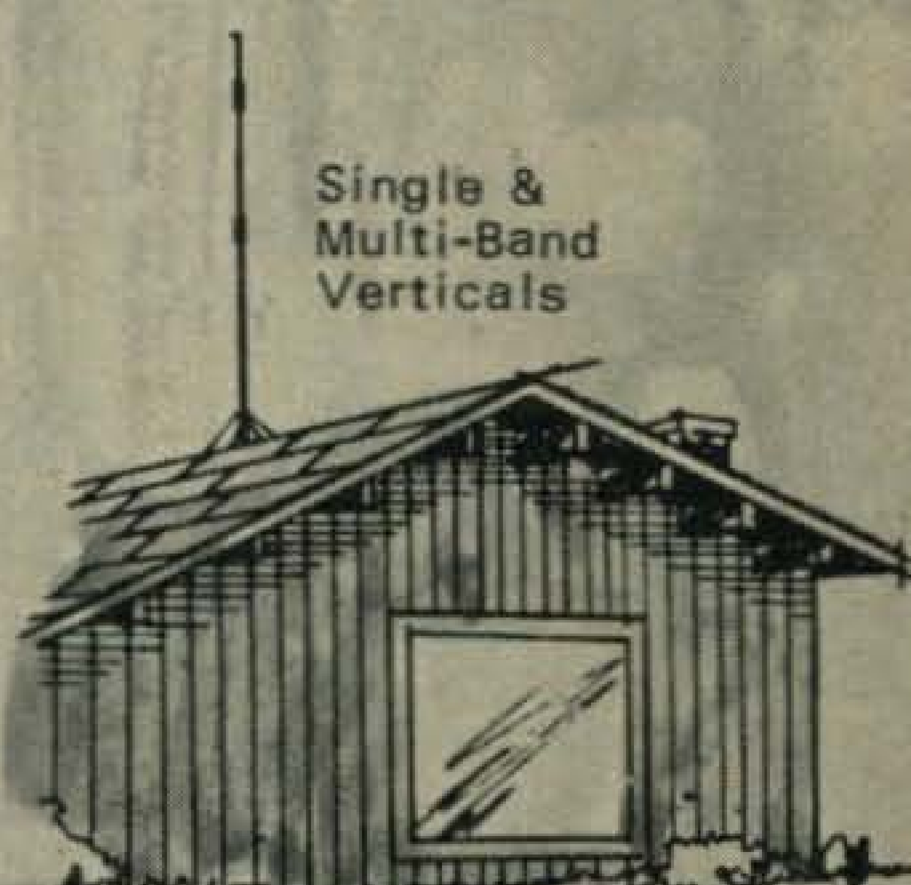

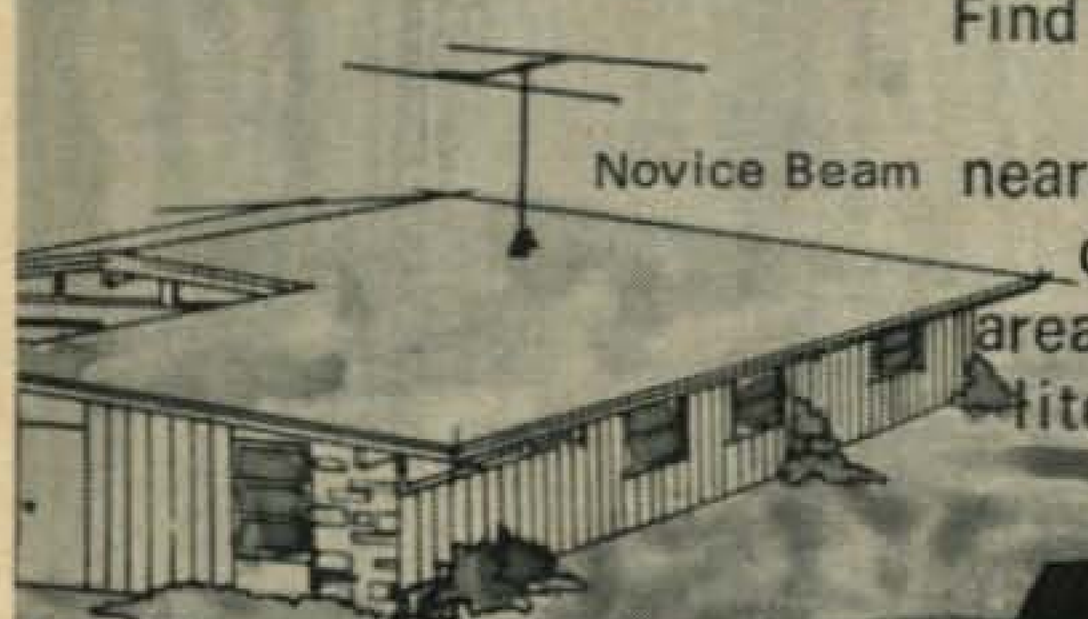

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CQ
The Radio Amateur's Journal

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DEPARTMENTS

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ZERO BIAS

A FAIRLY recent outgrowth of the ARRL's problems with DXCC, spurred by Don Miller's DXpedition and subsequent legal action has been a bad case of over-reaction by the League, a typical big-business response. One of ARRL's major points of contention with Don was verification of having actually been where he claimed to have been. In the case of some of his expedition stops he was unable to convince the DXCC Committee of the veracity of his claimed operating locations, and for a while, things were touch and go as to whether or not the contacts would be accepted by ARRL for DXCC credit. As matters developed, most of these trouble spots were ironed out and with the exception of a mere handful of rare and not-too-rare DXpedition spots Don's operations have been sanctioned for DXCC credit.

The "over-reacting" by the DXCC committee began even before the Miller case had come to a head. In a probably well-meaning effort to insure the integrity of DXCC, the committee decided that *all* DXpeditions must henceforth deliver to ARRL proof that the foreign operations did in fact take place from the claimed location. It is unfortunate that the committee did not invest more time in discussion of the possible repercussions of such a simple rule, for had they done so, they might have avoided a new breed of problem—grown out of this "proof required" ruling.

Apparently, no time limitation was decided upon beyond which proof would not be demanded from DXpeditioners, nor was a realistic determination made of what actually constitutes a DXpedition. The absence of these two limits, coupled with an indiscriminate and heavy-handed application of the rule have once more sown the seeds of discontent in the DX world.

Elsewhere in this issue John Attaway's DX Column briefly describes a series of events John personally encountered with regard to a vacation trip to the U.S.-owned Virgin Islands to operate the *CQ* World Wide DX Contest in 1967. Aside from describing a feeble attempt at a slur of *CQ*, K4IIF and W9WNV (which are obviously unique to this one situation), the item entitled "Comment on the ARRL Rejection of K4IIF/KV4 QSL Cards" describes the over-reaction which alarms us.

It is insulting enough to be called a possible fraud by ARRL if you're an American amateur thoroughly familiar with the background of the situation, but for a moment, put yourself in the place of a foreign operator returning from a hamming vacation at a not-very-rare location and suddenly being dunned by ARRL—the national amateur organization of the U.S. and Canada, mind you—for written evidence that you went where you claim to have gone! And being intimidated by reminders that unless you cooperated, your QSL's would not be counted for an award issued by ARRL—the sacred DXCC award—and therefore you'd be hurting all the ham friends you'd just worked. How would you react? Would you eagerly rummage through cartons of DXpedition trivia to locate the demanded evidence or would you do a not-too-slow burn that some nearly anonymous individual in Newington had the sheer gall to question your integrity?

We feel that the DXCC committee has an obligation to the world's DX fraternity to view each and every DXpedition-type operation as an individual case with attention to the people involved, the DX location, and the possible ill-will towards ARRL and American amateurs in general which might be engendered by rude and heavy-handed treatment of a request for verification.

IEEE Fellowship to W3ASK

It is with considerable pride that we report that the Board of Directors of the Institute of Electrical and Electronics Engineers has conferred the grade of Fellow upon George Jacobs, with the following citation.

"For outstanding engineering contributions in the development of international broadcasting and telecommunications."

George is now beginning his 27th year as a professional in the field of telecommunications. But radio is both his livelihood and his private passion. While he is known throughout the world for his many contributions to international telecommunications, he is known to the radio amateur fraternity as W3ASK, and to readers of *CQ* as the Editor of a radio propagation column which has not missed a single issue since it first appeared, almost 18 years ago.

On behalf of the Editors and readers of *CQ*, we extend our heartiest congratulations to you, George, on receiving the IEEE Fellowship.

73, Dick, K2MGA

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VALUE ANALYSIS

From 80 meters . . .

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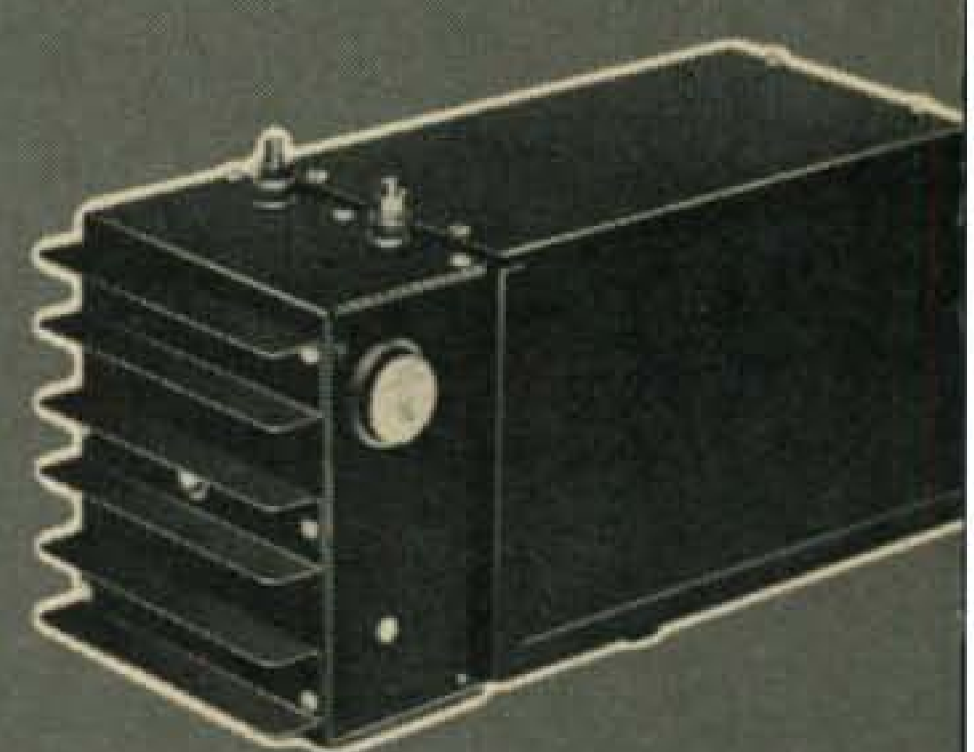

SWAN 14-117 12 VOLT DC SUPPLY

Complete D.C. supply for 12 vol mobile or portable operation. In cludes cables, plugs, and fuses. Wil also operate from 117 volt A.C. b detaching the D.C. module & pluggin in 117 volt line cord. Negativ ground standard. Positive groun available on special order.

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PHONE PATCH, Model FP-1 . . . . **$48**

ASK THE HAM . . . WHO OWNS ONE

OUR READERS SAY

Ultra Modulation

Editor, *CQ:*

So, what's all the hassle over "Ultra" or "Super" modulation?

It looks to me like W3PHL simply did a little digging in past history. His system is nothing more than a rehash of the old Super Modulation system developed about 1946 by Mr. Taylor (can't remember his first name) of the old Taylor Tube Co.—Remember the T-20's and TZed 40's—

He incorporated this system into an amateur/commerical transmitter called the Taylor-Western. He used 4-250's in it—the tube had just come out, and Taylor Tube Co. had just, I believe, been sold to EIMAC. The rig was legal then if properly adjusted, and is still so. If properly set up and used, it sounded absolutely beautiful and put out the best a.m. signal on the band, many db above the rest of the crowd. If improperly adjusted, it was a real dog.

If memory serves me correctly, the first of these rigs was sold to W7LVR of Tucson, Arizona. Al's signal was the envy of everyone who heard him. The second unit was demonstrated at Elliott Electronics in Tucson, and was eventually sold for commercial use in Mexico. Not too many of these were made, and Mr. Taylor would personally supervise the set-up of a new installation. They were touchy to set up, and you didn't shift frequency easily because of the critical tuning.

Although effective, the impracticality of the system caused it to be soon passed by. This is, however, about the third time in 20 years that someone has revived it. W3PHL references Villard's 1947 article, but neglects the fact that many others have successfully used the system, and that the original work was actually Taylor's.

Willliam J. English, WA4RME
Miami, Florida

Back Ordered

Editor, *CQ:*

The November SCRATCHI is so true-to-life! After several such experiences with "Mail Order Houses," I now write this in red letters on each order: "No Back Orders Accepted. If an item is not in stock, please make a refund." I then order such items from a different company. Apparently many other people also do this, because my order always comes back neatly *stamped* "DO NOT B.O." Lets let the companies know that it will cost them not to stock what they advertise.

John J. Herro, K9YRA
Glenview, Ill.

Philippine Operating

Dear Dick,

I just thought I would write and give anyone who is planning to come to the Philippines the situation on the amateur radio. (Or rather, the lack of it.) I have been stationed here with the U.S. Navy for several months now, and have been trying to get permission to operate or to obtain a Philippine call. So far, all of my efforts, and those of several other hams, have been in vain. The number of hams stationed here with the armed forces is in the hundreds, but of all those, I have only heard of one (a Filipino by birth, now a U.S. Citizen) who has managed to get permission to operate. It took almost two months of letter writing and inquiries just to find out who was in charge (if anybody) of the amateur radio in this country. I have even written to President Marcos trying to get permission. I received a letter signed by him stating, "that no provisions have been made for reciprocal licensing." How I could obtain a Philippine call was not mentioned. Apparently, all these difficulties have a fairly recent origin, since it used to be possible to get permission in about six weeks to two months.

I am not exactly a stranger to operating in foreign countries, having operated KA2USA, XW6USN, VK2NS, KA2KS, KM6BI, HL9KS, HL9KR, XW8AW, VK2EVW, KG6NA, etc., but I have never run into a situation like we have here. When I was on board ship, I traveled all over the Western Pacific, and although I would sometimes have to wait a few days to get permission to operate or would have to use a station of someone who lived there, I have never been told that I could not operate.

I am a RTTY fanatic, so I can still get some satisfaction from copying DX. Oh well, in 8 months I will be operating from KA2 land, but it still hurts to see this S-line gather dust.

W. F. Lauzon, K7MZC
Philippines

For The Record

Editor, *CQ:*

Ever since the first "Radical Proposal" article (February 1967 *CQ*, p. 19) I have been hearing from confused readers who claim that international treaties prevent the United States from granting amateur licenses for 144 mc and above without code test. For the record, let me quote from Article 41 of the 1959 Geneva radio regulations, which also appears as Appendix 2 Part 97 of the F.C.C. Rules (Vol. VI, p. 55):

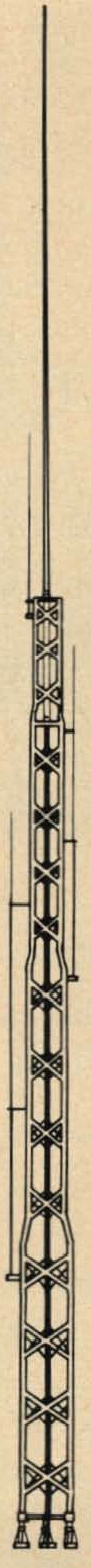
> Article 41, Section 3. (1) Any person operating the apparatus of an amateur station shall have proved that he is able to send correctly by hand and to receive correctly by ear, texts in Morse code signals. *Administrations concerned may, however, waive this requirement in the case of stations making use exclusively of frequencies above 144 Mc/s.* (2) Administrations shall take such measures as they judge necessary to verify the technical qualifications of an amateur station.

I have underlined the pertinent sentence.

Raphael Soifer, K2QBW
Hartsdale, New York

[*Continued on page 12*]

If you want more out of a vertical, then what you need is not an ordinary vertical!



By any standard of measurement, the Hy-Tower is unquestionably the finest multi-band vertical antenna system on the market today. Virtually indestructible, the Model 18HT features automatic band selection on 80 thru 10 meters through the use of a unique stub decoupling system which effectively isolates various sections of the antenna so that an electrical 1/4 wavelength (or odd multiple of a 1/4 wavelength) exists on all bands. Fed with 52 ohm coax, it takes maximum legal power. . . delivers outstanding performance on all bands. With the addition of a base loading coil, it also delivers outstanding performance on 160 meters. Structurally, the Model 18HT is built to last a lifetime. Rugged hot-dipped galvanized 24 ft. tower requires no guyed supports. And, a special hinged base assembly permits complete assembly of antenna at ground level. . . easy raising and lowering. Top mast, which extends to a height of 50 ft., is 6061ST6 tapered aluminum. All hardware is iridite treated to MIL specs. And, for directional control, many amateurs have bought two Hy-Towers and "phased" them. So, if you want the best vertical. . . bar none. . . get down to the best distributor under the sun (he's the one that stocks the Hy-Tower).

The Hy-Tower from Hy-Gain

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THE STRONGEST SIGNAL UNDER THE SUN

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SCRATCHI

Feenix, Ariz.

Deer Hon. Ed:

Merry Xmas!! Diddley bump de bump. If I never heering those words again for cupple months it being plenty soon.

Now don't misunderstanding me, Hon. Ed. I'm no Hon. Scrooge, but after six weeks of heering Silent Nite and other assorted carols; after hectic last-minute Xmas shopping in heavy QRM buying things I can't afford for peeple who won't need 'em; after paying fifteen bux for scrawny Xmas tree barely five feets tall before squaring up base; and, replacing burned out Xmas lites on average of one per hour, I not needing Xmas until next yeer rolling around again.

Not to menshunning next job I having which is getting Hon. Pine Needle and Hon. Tinsel out of the house. Howcums, Hon. Ed. when having Xmas tree in living room, you can finding needles and tinsel from tree everywhere in house? I even finding pine needles in logbook. It'll be August before getting rid of last of the needles and tinsel.

And, also got problum of what to do with cupple dozen neckties and half a gross of white and colored hankercheeves. You thinking maybe you can running contest in your Hon. Rag and giving prize of one yeers free subscripshun to reeder what having best idea on this?

Only idea I getting right now is making signal flags with them. This would take lotsa sewing howsumever, and Scratchi can't even thread a needle. My XYL-to-be Lil are just giving me big horseylaff when I suggesting she make some signal flags, or even a bedspread with them.

Don't telling me to keep ties and hankercheeves to giving away *for Xmas presents* next yeer. I tried that a yeer ago, and this yeer getting most of them back again.

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So, nothing left to do now but to wiping slate cleen on good old 1968, and looking forward to 1969. It look promising, on acct. Scratchi can't making half as many mistakes in 1969 as he making in 1968.

Are even planning to making some Hon. New Years Resolooshuns. In fackly, Hon. Brother Itchi telling me it time to turning over new leef. He handing me list of resolooshuns he thinking it being good idea for me to keeping. Reddy, Hon. Ed? Here's what square old Itchi suggesting:

1. Resolving not to mess up yard by building any more oddball antennas.

2. Resolving not to messing up Hon. Ranch by holding any more Hamfests on ranch.

3. Resolving not to trubble neighbors with any more TVI.

4. Resolving not to getting any pink tickets from Hon. FCC. Hah!! Big deel. What kinda resolooshuns are those. But not worrying, I not taking this lying down. No indeedy.

I getting out old trusty tipewriter and making list for Itchi that Scratchi are willing to keep. Likesame these:

1. Resolving not to work any more than 200 countries.

2. Resolving to not working any more than 50 states.

3. Resolving to not using more than 2 kilowhats to final.

How you like them apples, Hon. Ed? Any red-blooded amchoor would be happy to adopting this list, are you not thinking?

You know, as I re-reeding list of resolooshuns, they may be pretty tough to keep at that. I might get in reel red-hots dee-x contest and blow resolooshun number 1.

And with my luck, Puerto Rico will becoming 51st state, which would knock the heck out of resolooshun number 2.

Also, Hon. Brother Itchi's ranch are neer end of power line, and if Hon. Electric Lite and Power Co. ever come across with new pole-pot for us, and we get a power surge—whammo!! my input to final will be well over 2 kilowhats, and that'd be the end of resolooshun number 3.

Well, we finding out. It won't be long now, as monkey saying when he putting tail in power saw. Gotta be running, as I heering KP4 calling seek-you. Happy New Yeer.

Respectively yours,
Hashafisti Scratchi

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Mission Accomplished

Editor, *CQ:*

Thank you for printing my letter requesting contacts with fellow amateurs who have lost their voice box because of cancer.

You will be interested in knowing that many contacts were made and we are well on the way to having a net for not only laryngectomees but other hams who have speech problems. The net will be used to exchange ideas on rehabilitation.

As lifetime amateurs who love their hobby, nothing hurts quite as bad as being deprived of voice communication.

Alfred St. Germain, W6FCE
Sonoma, Calif

Pen Pal Wanted

Dear Friend:

I hope you will forgive me for writing to you. I'm a Japanese ham of sixteen years of age. I've been looking for a ham in a foreign country, with whom I may correspond, and you can't imagine how happy I should be if you would enable me to realize my cherished dream.

Well, I am going to tell you a little about myself.

My name is Noboru Subuki. Age: 16.

I attend a senior high school and am in the 11th grade. My hobbies are ham radio, playing judo, cycling, and so on. My call sign is "JH1PLL".

I want to correspond with a boy about the same age. I'll be happy if you will be kind enough to find some boy fit for me. I want somebody who has the same hobbies as me. It doesn't matter whether it is from California or everywhere.

I'm afraid you can't read my English easily because I'm not good at it. But I hope you can understand it anyway.

Noboru Suzuki, JH1PLL
Saitama, Japan

Amateurs wishing to write to Noboru can reach him at 4839 Uchimaki, Kasukabe, Saitama, Japan.—*Ed.*

The Generation Gap

Editor, *CQ:*

After reading your October editorial, I am inclined to disagree with the idea of an amateur radio generation gap which is alienating newcomers. New-comers are new-comers and they will remain that for many years until experience classifies them differently.

I imagine there is certain glory in being an old time and, as you say, that glory attracts new-comers. But for myself and a lot of my amateur friends, the basic attraction for the hobby was and still is a desire to experiment with useful radio gear—a desire to build something better and enjoy using it on the air. Amateur radio has so much opportunity in this respect. I think for many people like myself, contests and awards are not such a big deal. The attraction comes from a real desire to work with and use electronics. Of course I look up to the old timer and recognize his prestige but cannot hope of becoming one overnight.

John Richardson, K8SOM
Berea, Ohio

Announcements

YL-OM CONTEST 1969

TIME: Phone—Sat., February 22, 1969, 1300 EST (1800 GMT); Sun., February 23, 1969, 1300 EST (1800 GMT).

CW—Sat., March 8, 1969, 1300 EST (1800 GMT); Sun., March 9, 1969, 1300 EST (1800 GMT).

Eligibility: All licensed OM, YL, and XYL operators throughout the world are invited to participate.

Operation: All bands may be used. Cross-band operation is not permitted. Net contacts do not count.

Procedure: OMs call "CQ YL" YLs call "CQ OM".

Exchange: QSO number, RS, or RST report, ARRL section or country. Entries in log must show band worked at time of contact, time, date, transmitter and power. (ARRL section list available for S.A.S.E. to YLRL Vice President.)

Scoring: (a) Phone and CW contacts will be scored as separate contests. Submit separate logs.

(b) One point is earned for each station worked YL to OM, or OM to YL. A station may be contacted no more than once in each contest for credit.

(c) Multiply the number of QSOs by the number of different ARRL sections and/or countries worked.

(d) Contestants running 150 watts input or less at all times may multiply the results of (c) by 1.25 (low power multiplier).

Logs: Copies of all phone and CW logs showing claimed scores, and signed by the operator must be postmarked no later than March 24, 1969 and received no later than April 12, 1969 or they will be disqualified. Please file separate logs for each section of the contest. Send copies of logs to:
Ebba Kristjansson, VE5DZ, Box 71, Colonsay, Saskatchewan, Canada

Awards: 1st Place Phone: YL—Cup OM—Cup
1st Place CW: YL—Cup OM—Cup
The winner of the Phone Cup is also eligible for the CW Cup. Certificates will be awarded to high place phone and CW winners in each ARRL district and country. No logs will be returned. Be sure the copy of your log is legible. Be sure it is signed. PLEASE note POSTMARK DEADLINE date: March 24, 1969.

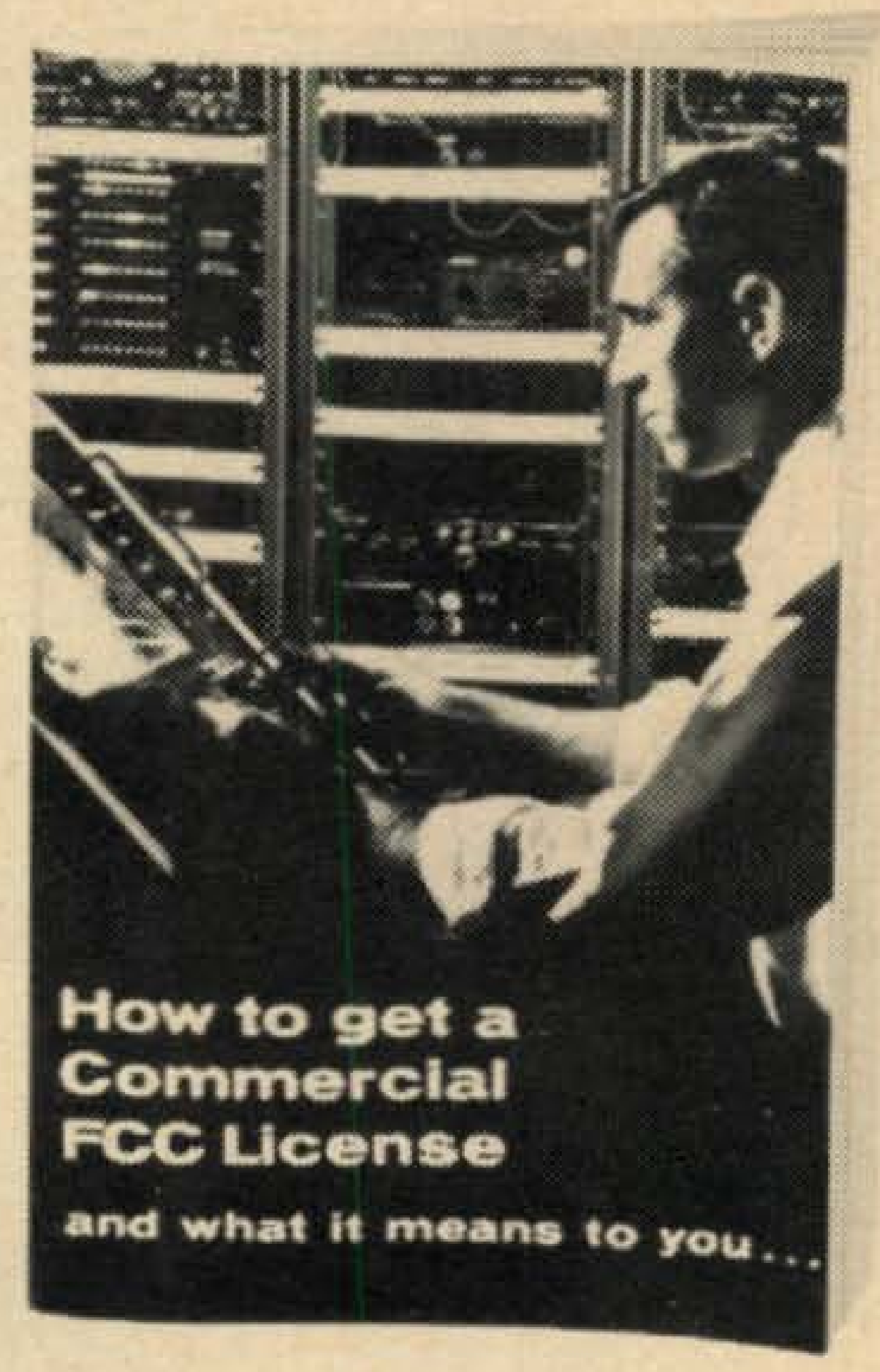
Back Issues

Back issues of *CQ* are available from our Circulation Department. Issues in the current year sell for face value (.75) and all other 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 110 for New Reader Service

Want a high-pay career in Electronics?

This free book may change your life



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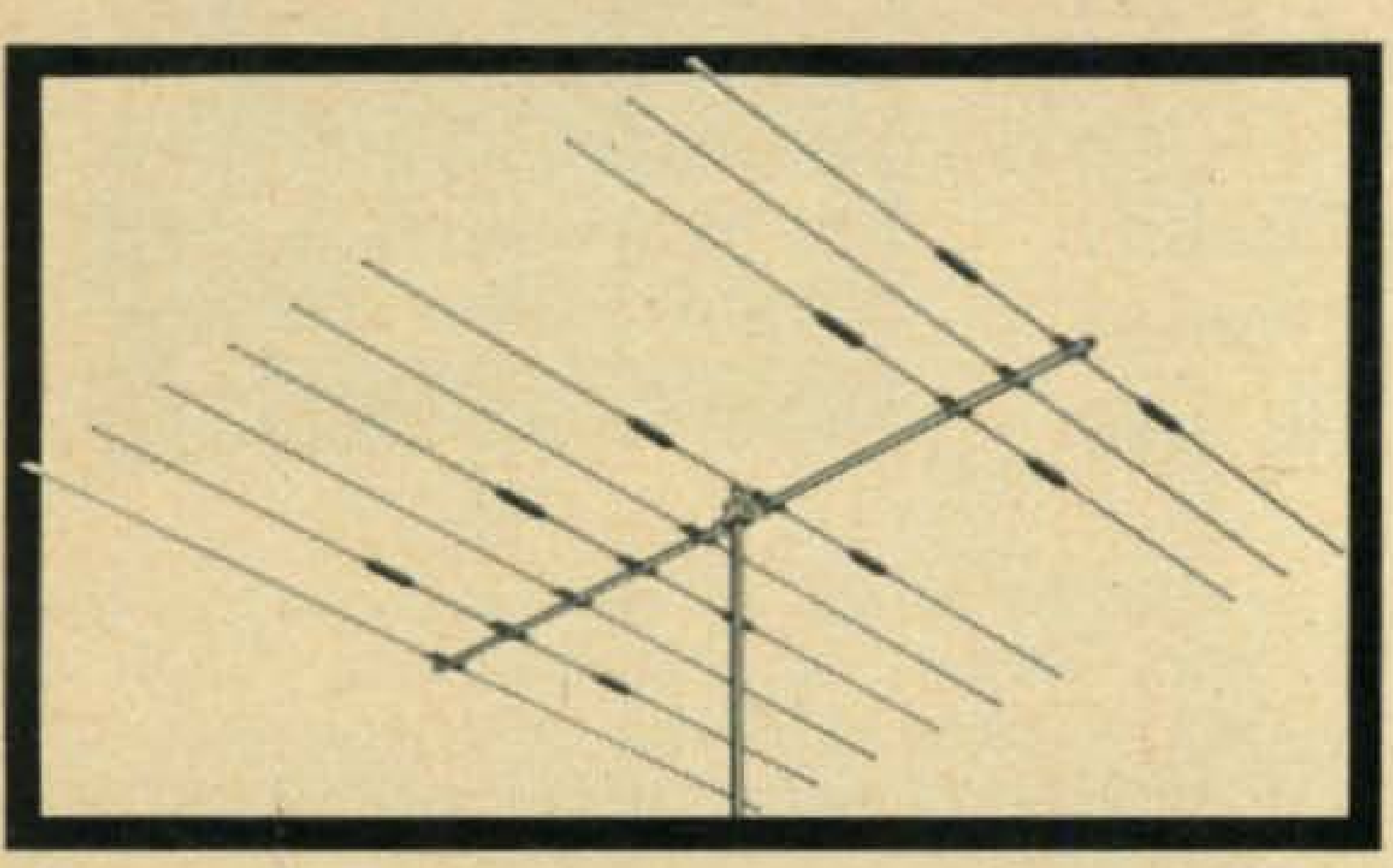

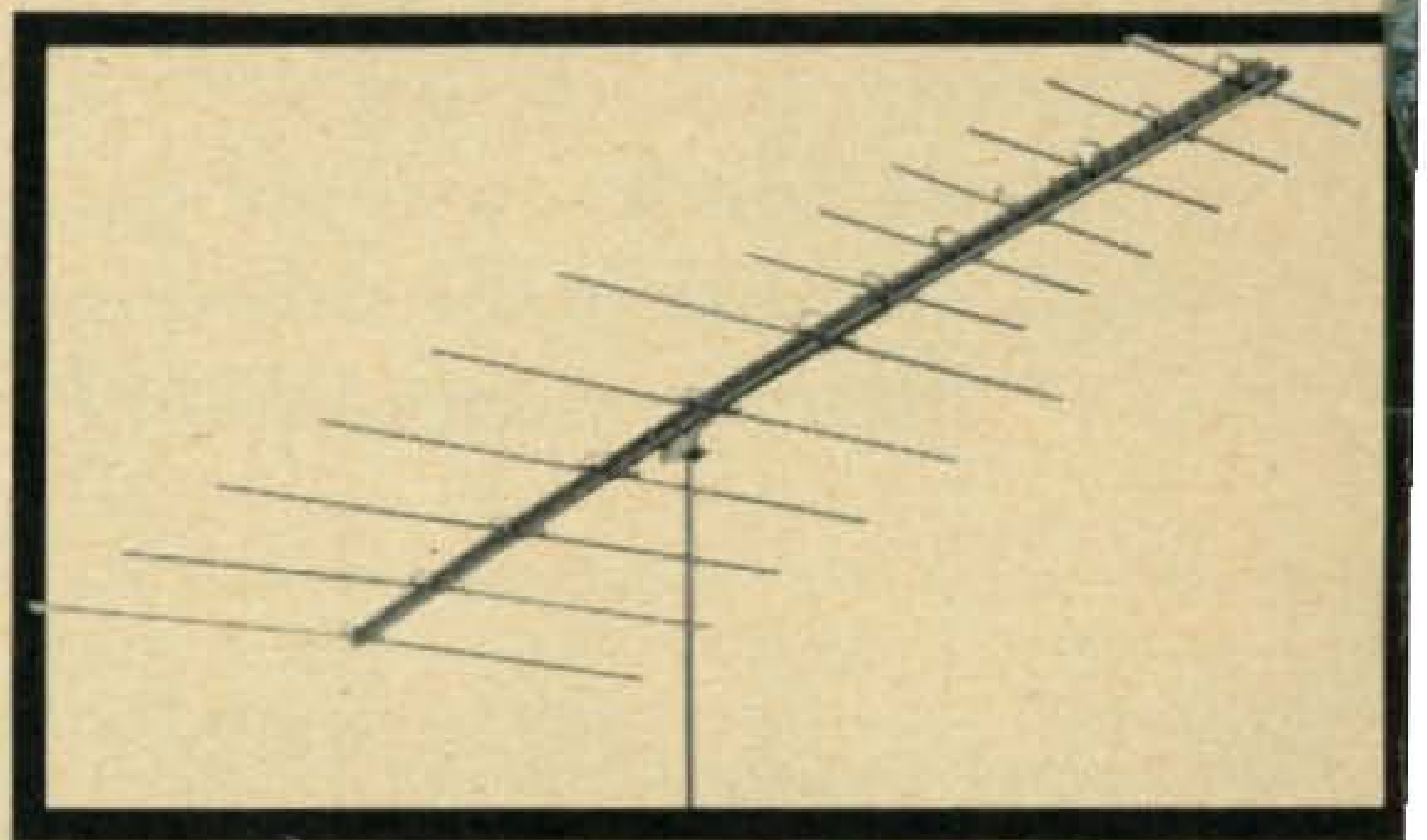

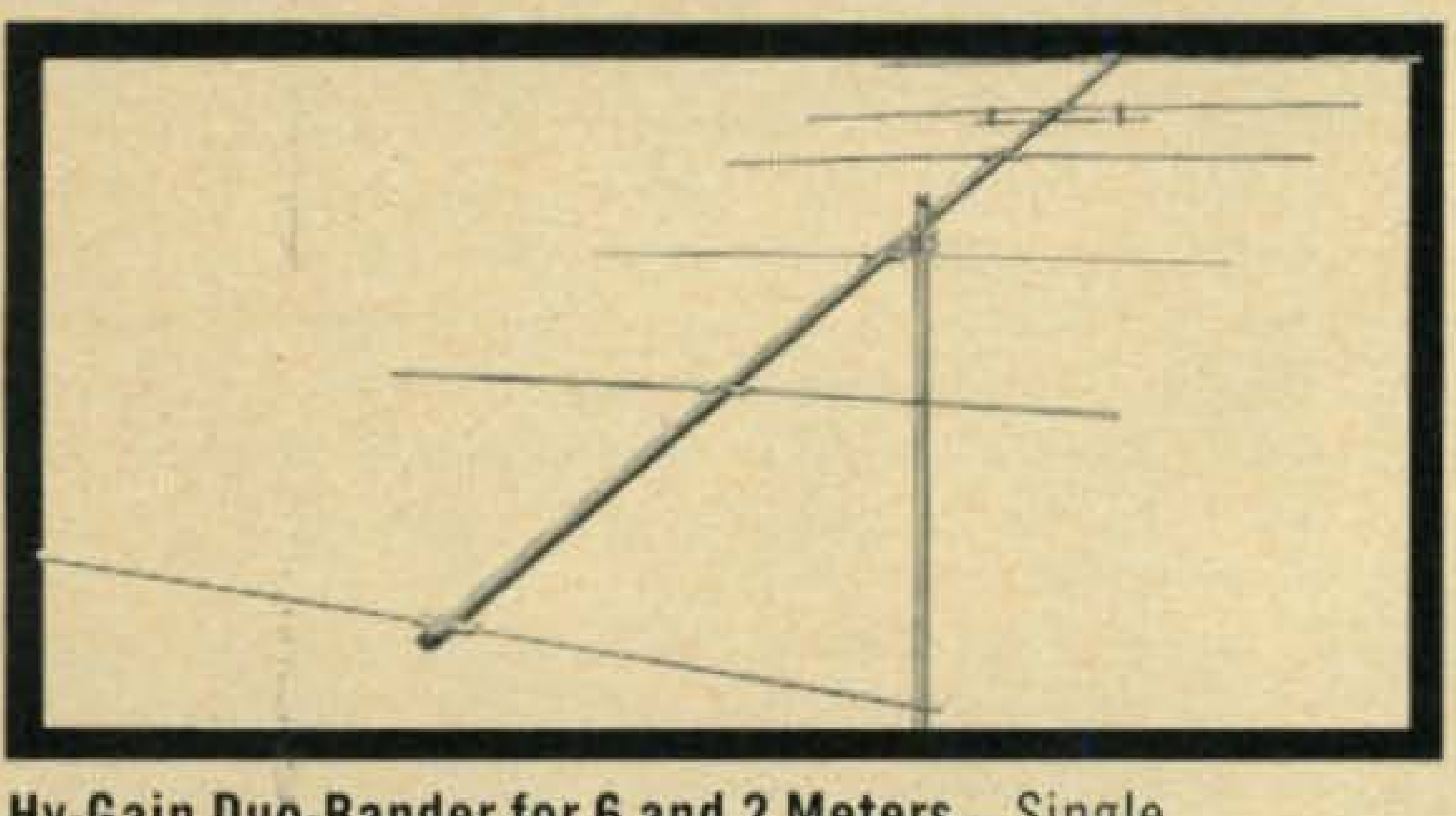

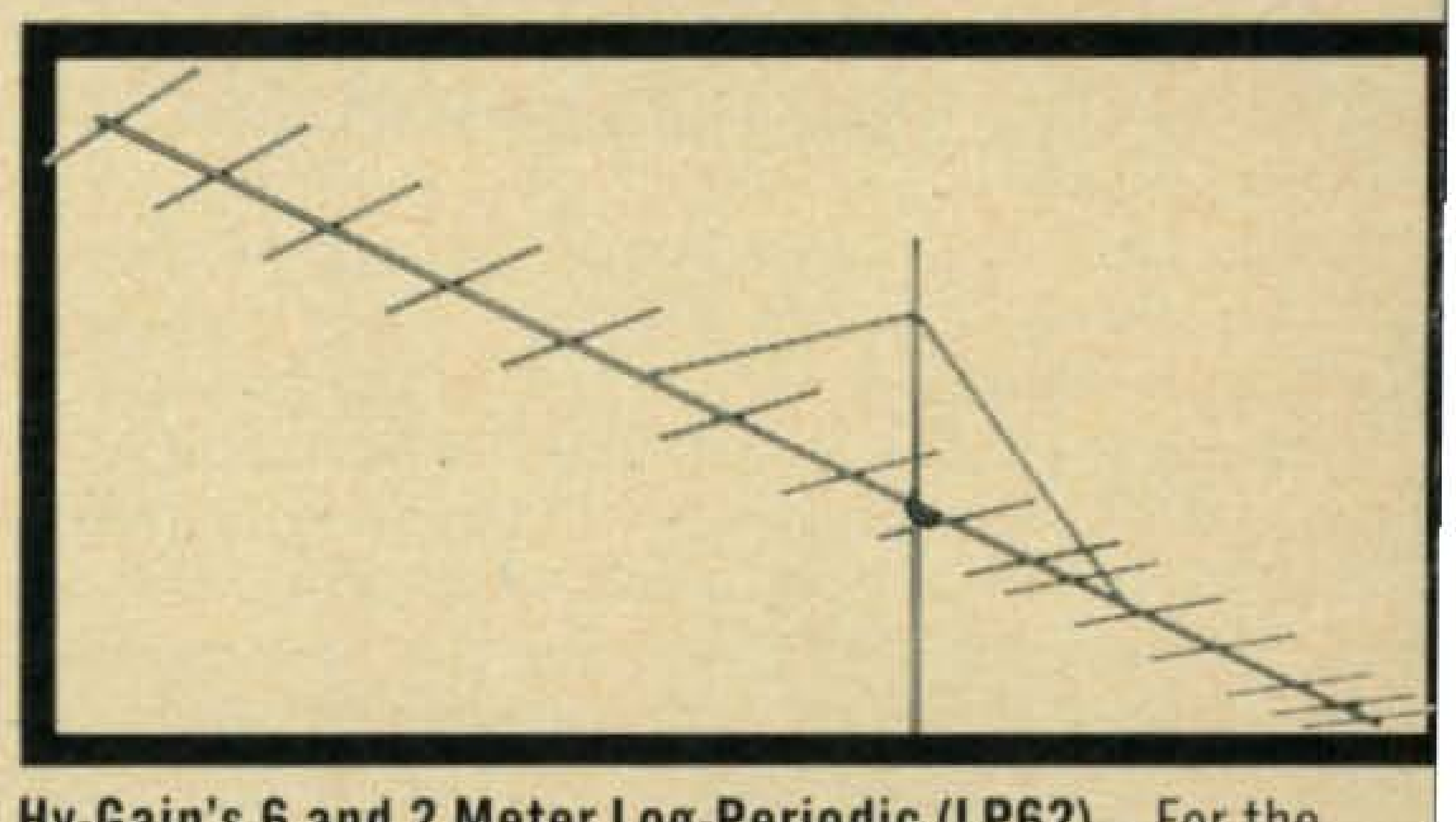

Hy-Gain Duo-Bander for 6 and 2 Meters—Single transmission line Duo-Beam for 6 and 2 meters...4 elements on 6 meters...18 elements on 2 meters. 8db forward gain on 6 meters and 15db gain on 2 meters. Outstanding 6 and 2 meter performance.

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

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

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

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

FOR THE MOST ADVANCED ANTENNAS UNDER THE SUN

See page 110 for New Reader Service

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

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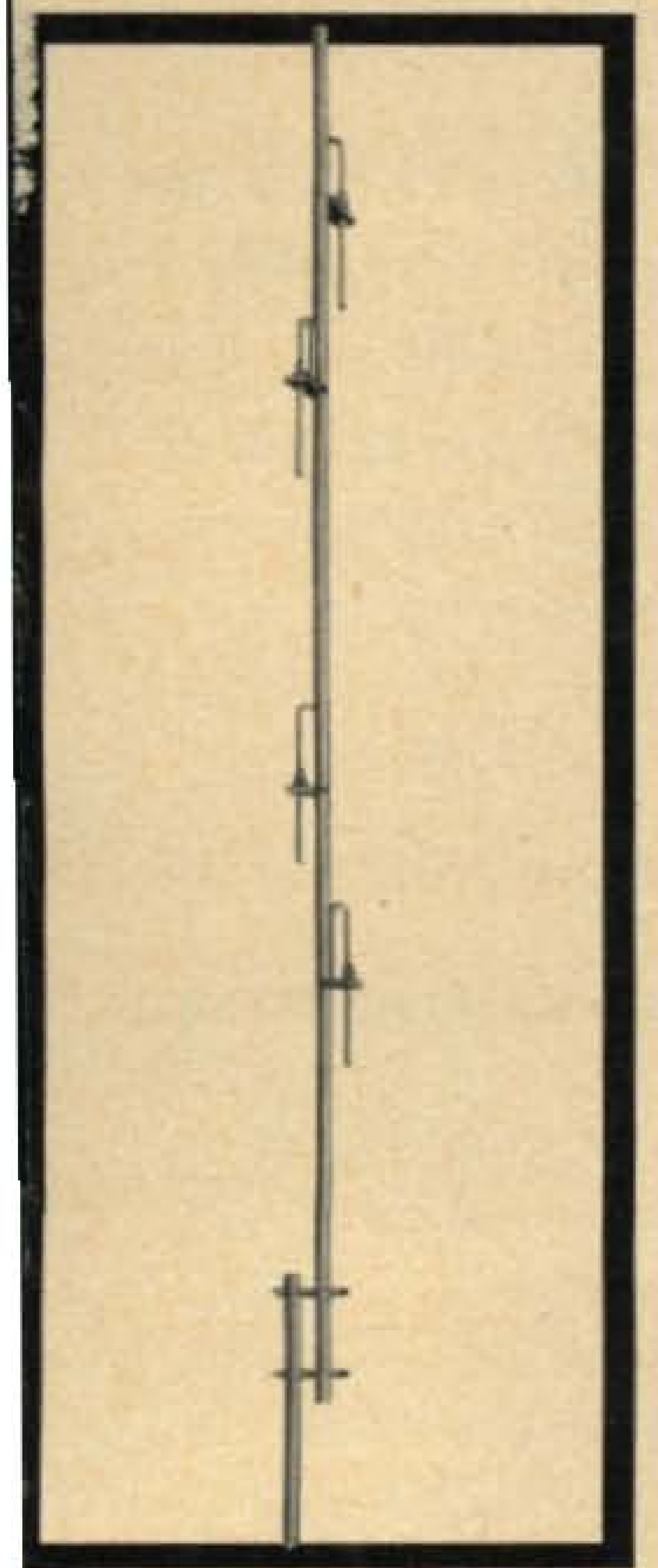
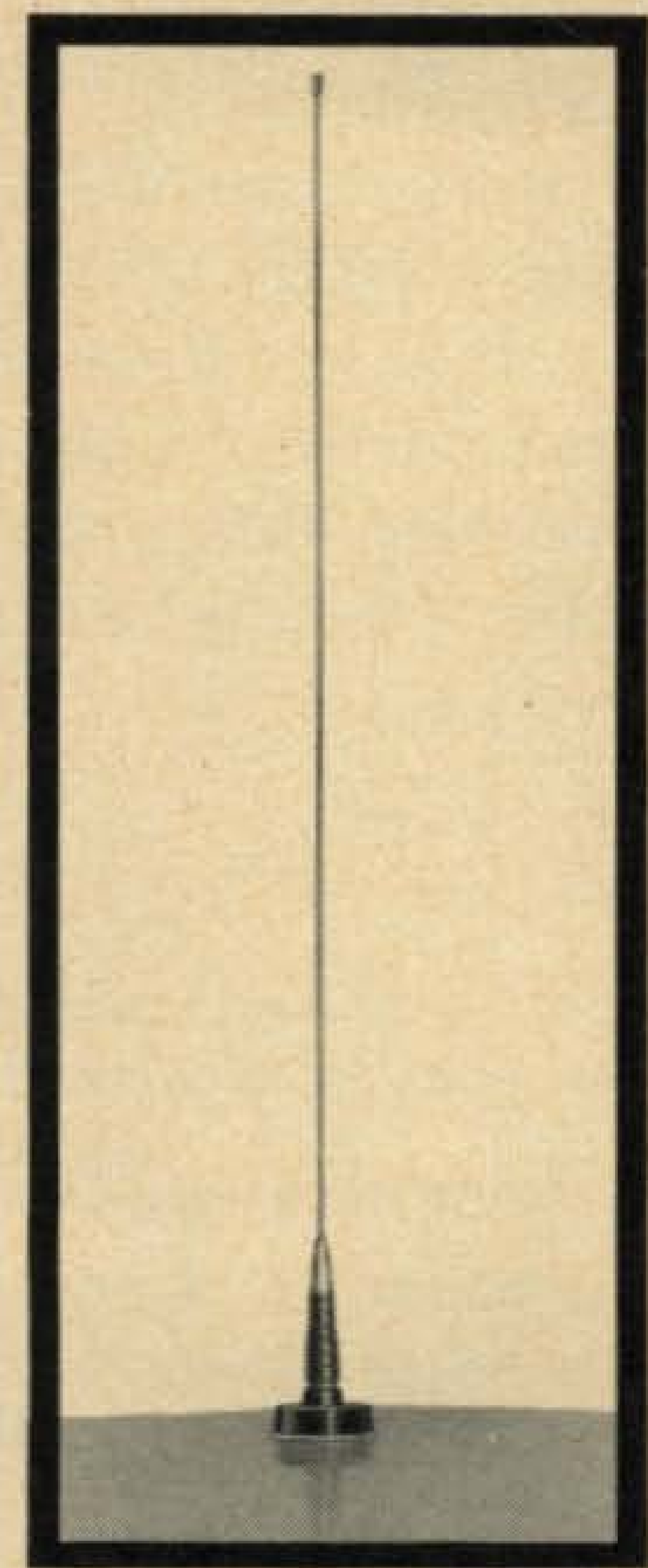
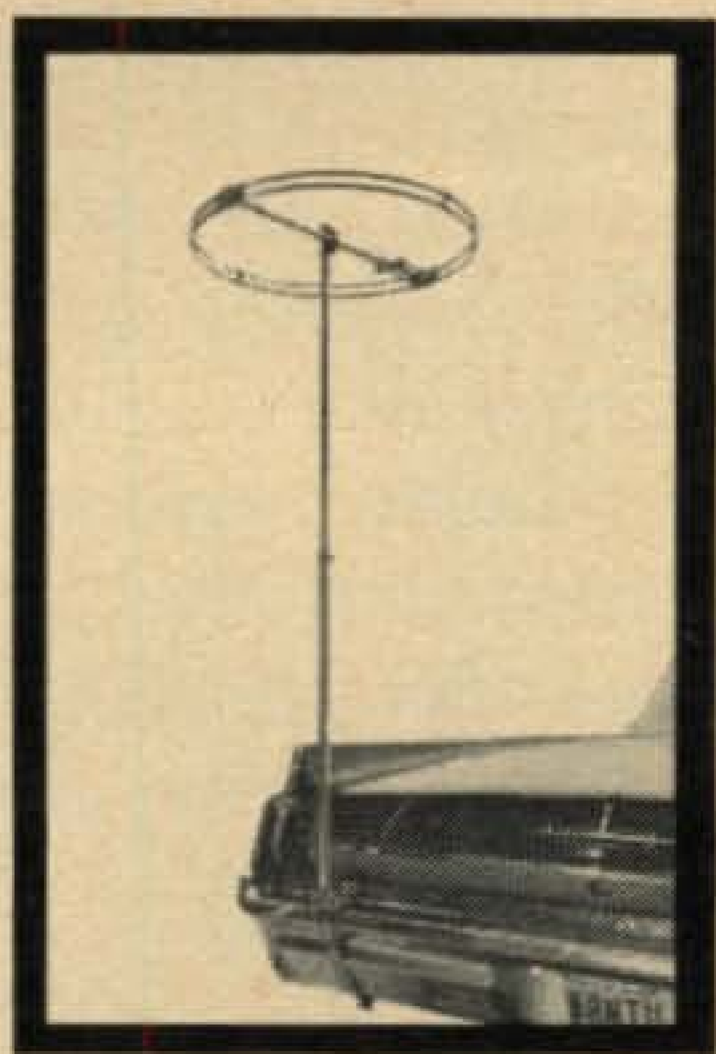
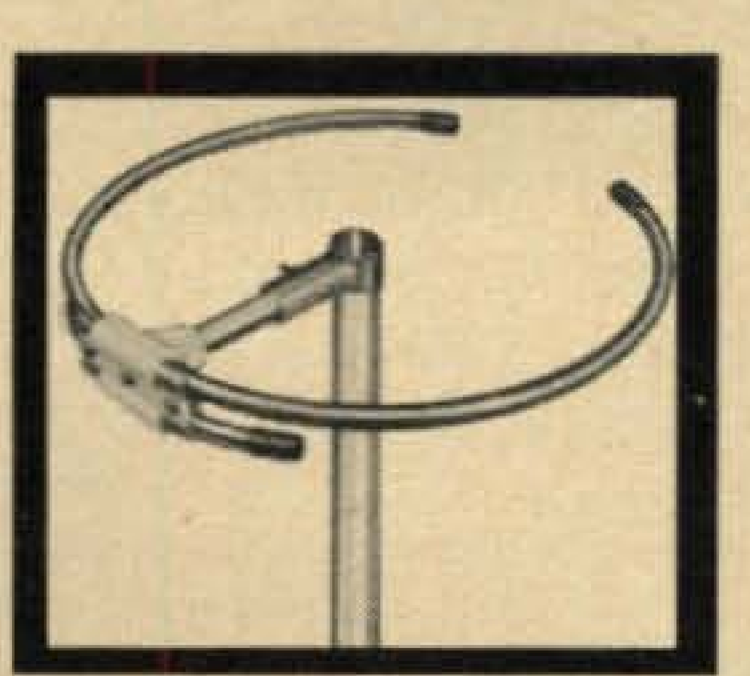
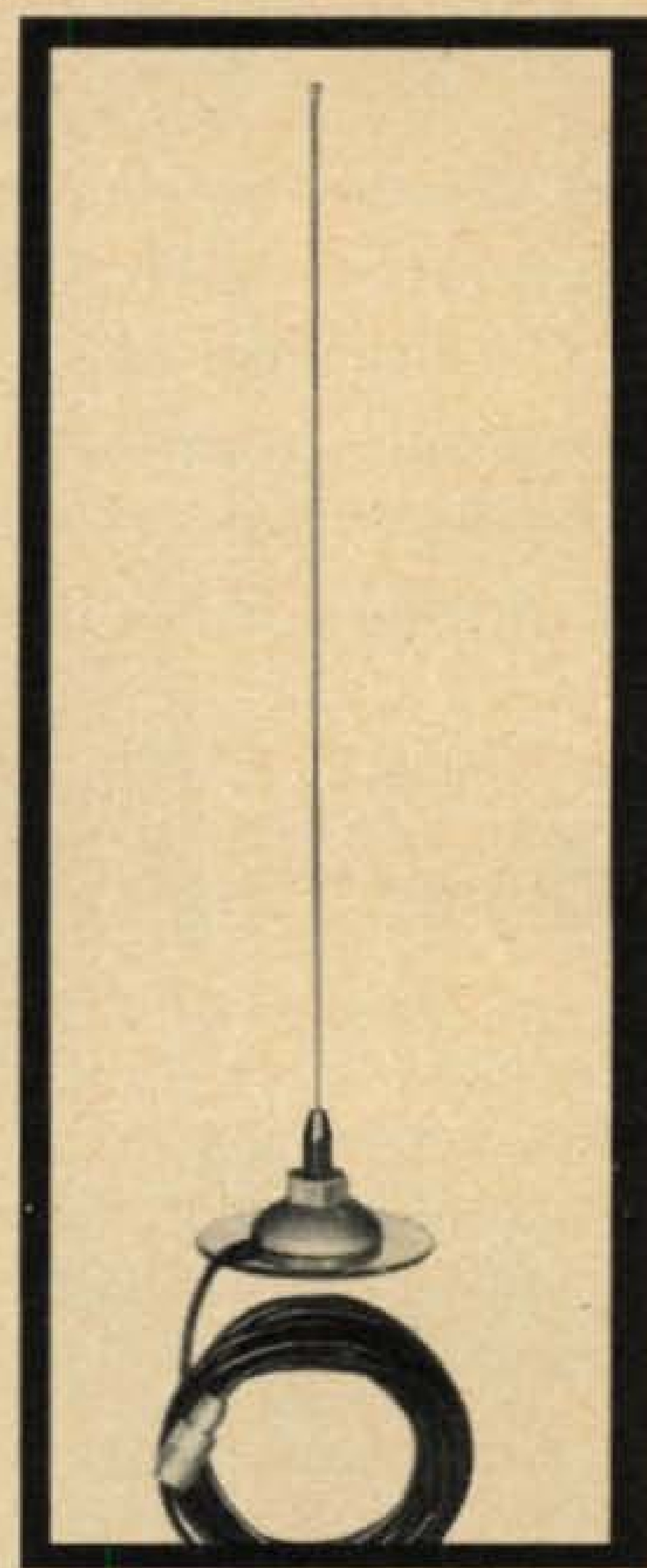
Mechanical Reliability—The rugged, long life construction is available only in Hy-Gain antennas which feature heavy walled, seamless aluminum tubing. All element-to-boom clamps are machine formed of heavy gauge aluminum. All steel hardware is iridite treated to Mil-Specs for the kind of long life reliability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











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

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

CRG150—Vertically polarized omni-directional 55" whip with photographically etched copper base matching coil. Exclusive "Claw" mounting device easily installs in any hole ⅜" to ¾".

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

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

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

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VARIABLE FREQUENCY TUNER FOR THE VISIBLE LIGHT BAND

BY JAMES A. GUPTON, JR., *W4AML

Part I

In an earlier issue of CQ[1] a semi fictional story discussed communication in space via light. The article aroused so much interest that the author proceeded to homebrew a monochrometer and detector that could be duplicated by the average amateur. Part I below reviews the principles of light, the operation of the light detector and describes the construction of both photo-cell and photo-multiplier tube detectors. Part II will describe the construction of the actual monochrometer.

THE December 1967 issue of *CQ* magazine carried a story titled, "DX-ing the Galaxy on 633×10^{-10} by yours truly.[1] Immediately a flood of letters came pouring in. As a matter of fact, the first letter arrived before *CQ* appeared on the local newsstands.

* 4120 Camelot Drive, Raleigh, North Carolina 27609.

[1] Gupton, James A., "DXing the Galaxy on 633X 10^{-10}," *CQ*, Dec. 1967, p. 56.

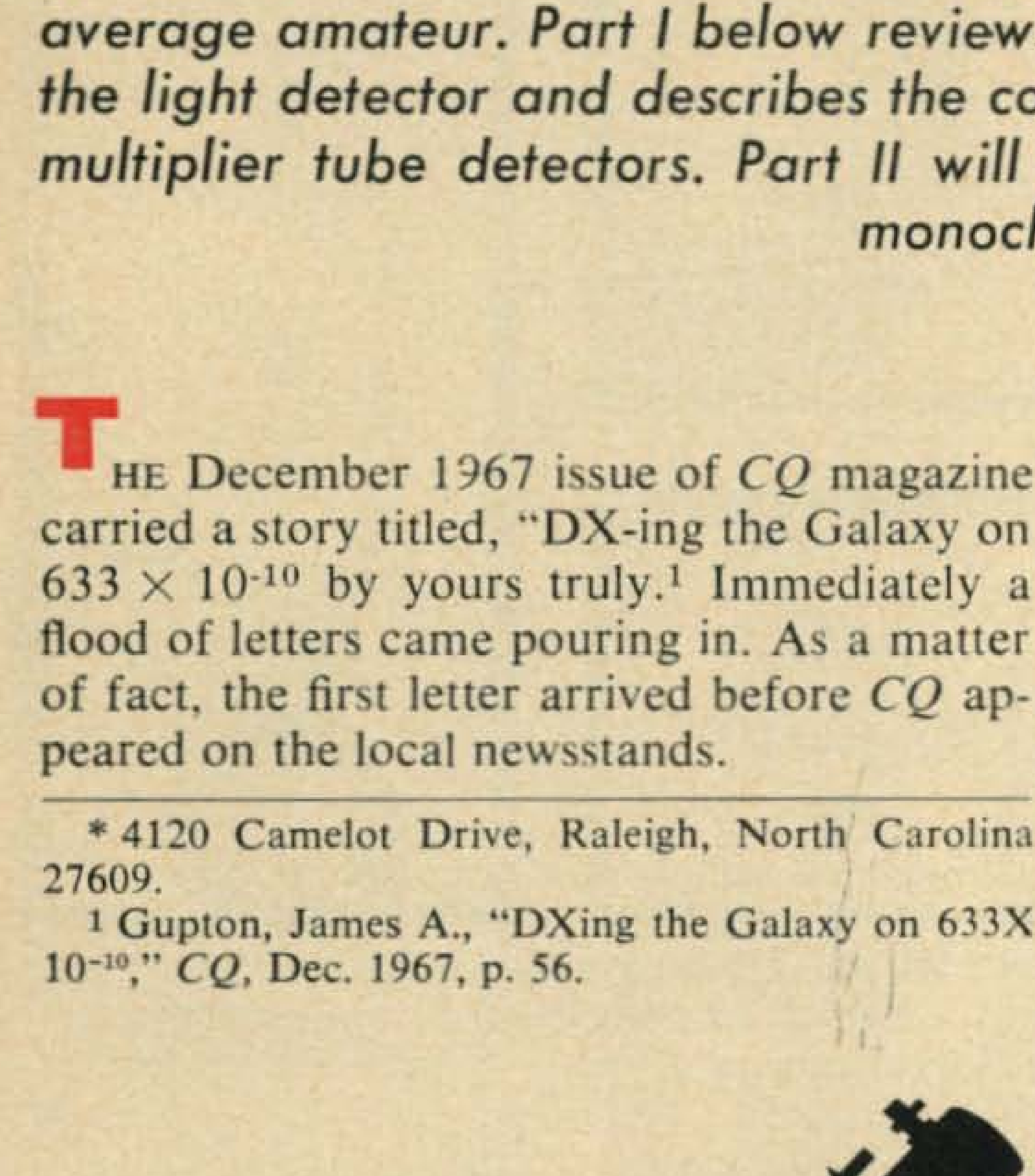

Fig. 1—Block diagram of the basic approach to the detection and measurement of various light frequencies.

The story was headed as semi-fictional yet some readers sent congratulatory letters on the achievement. Many letters agreed with my feelings of boredom and were delighted with the prospects of something new to "tinker" with. Others asked dozens of questions but the one single question that was outstanding was, "Can I homebrew a monochrometer?"

Naturally, I wrote to Dick Ross, K2MGA, the editor of *CQ*, and told him of the interest the readers of *CQ* had expressed in a construction project on building a monochrometer. Dick agreed that this area of interest could fit very well into *CQ*.

The basic approach is that shown in fig. 1. A monochrometer is connected to the output of a reflecting type telescope. The monochrometer separates the light output into individual frequencies. The output of levels of the individual frequencies are measured by the photo cell detector whose output is amplified to increase sensitivity.

A monochrometer is a very precise optical measuring instrument which sells commercially in the neighborhood of five thousand dollars. Still, it is possible for one to construct a practical monochrometer with a very little outlay for optical components. How great an expense will be determined by the degree of accuracy and sensitivity you wish to obtain. A workable monochrometer using a cad-

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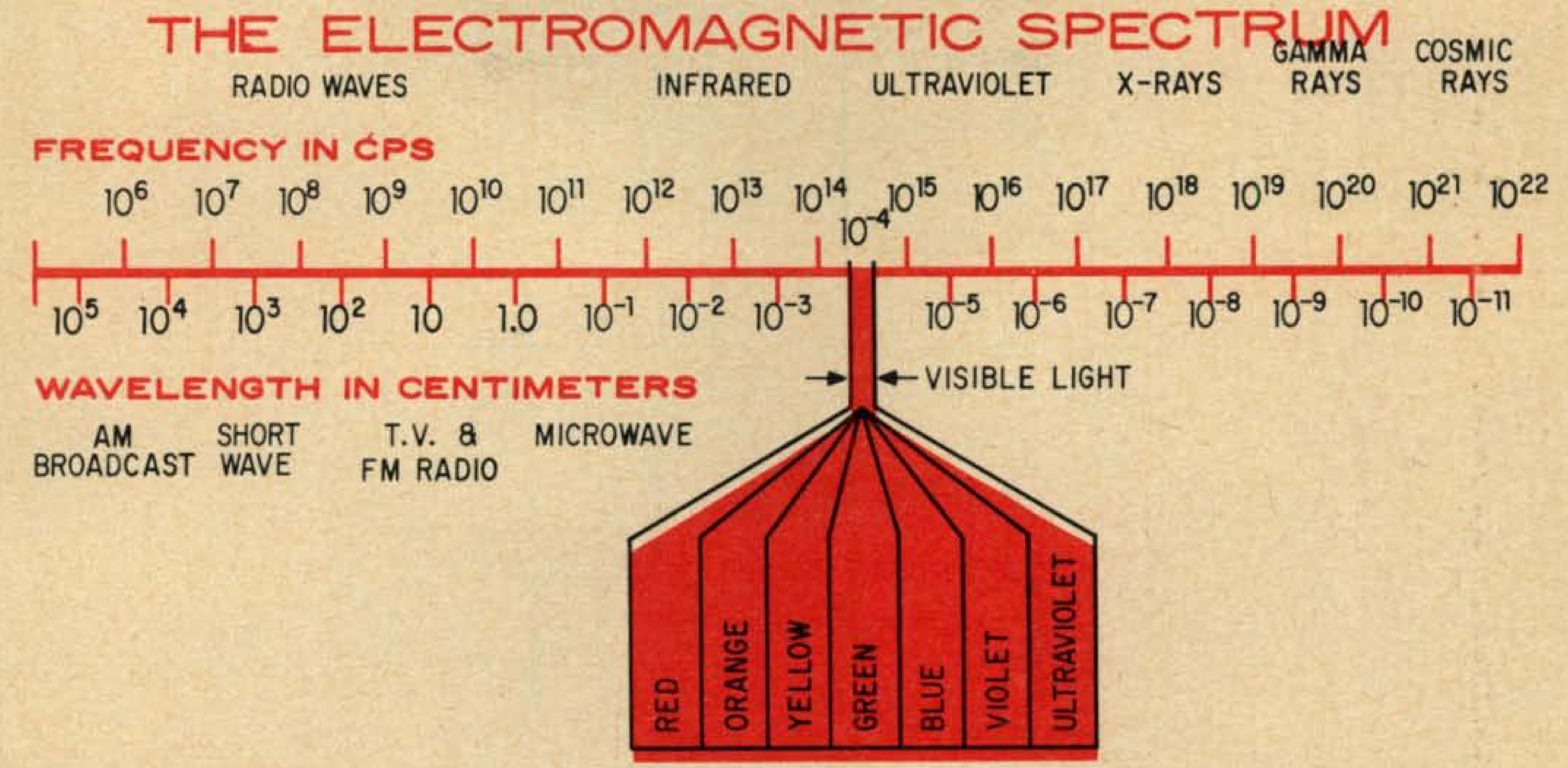

Fig. 2—Chart of the electromagnetic spectrum. Frequency is in c.p.s. and wavelength is in centimeters. Visible light covers a portion only 380 millimicrons wide.

mium-sulfide photocell detector can be made for as little as $10.00 plus a few odds and ends from the "junk" box.

Before getting into the construction project, it may be to your advantage to "bone-up" a little on the nature of light. You will be surprised to learn that there is more to light than meets the eye.

Nature of Light

Take a look at the Electromagnetic Spectrum Chart in fig. 2. It is designed to show the entire spectrum and indicating frequencies in c.p.s. or wavelengths in centimeters.

Sandwiched between the monstrous 3100 mile wavelength of power frequency and the infinitesimally short cosmic rays lie all the frequencies of radio, television, heat, light, and X and Gamma Rays. The spectrum of light extends from 100,000 millimicrons to 10 millimicrons, yet the visible portion is only 380 millimicrons wide. Two terms are employed to denote the wavelength of light. The Angstrom defined as a wavelength of 10^{-10} meters and the Millimicron which is 10^{-9} meters. For those who still think in terms of inches and feet, the millimicron is equal to 0.00000003937 inch. Now try this on your yardstick, the Cosmic Ray wavelength is 0.0000000000003937 of an inch long.

There are several classifications of light. Incandescent light is termed incoherent and chromatic. This refers to the way light is radiated in all directions from the source and contains many frequencies of light. Coherent monochromatic light is radiated in a single direction with all random radiation eliminated. The term monochromatic indicated there is but one frequency of light being radiated. The Laser is a form of collimated

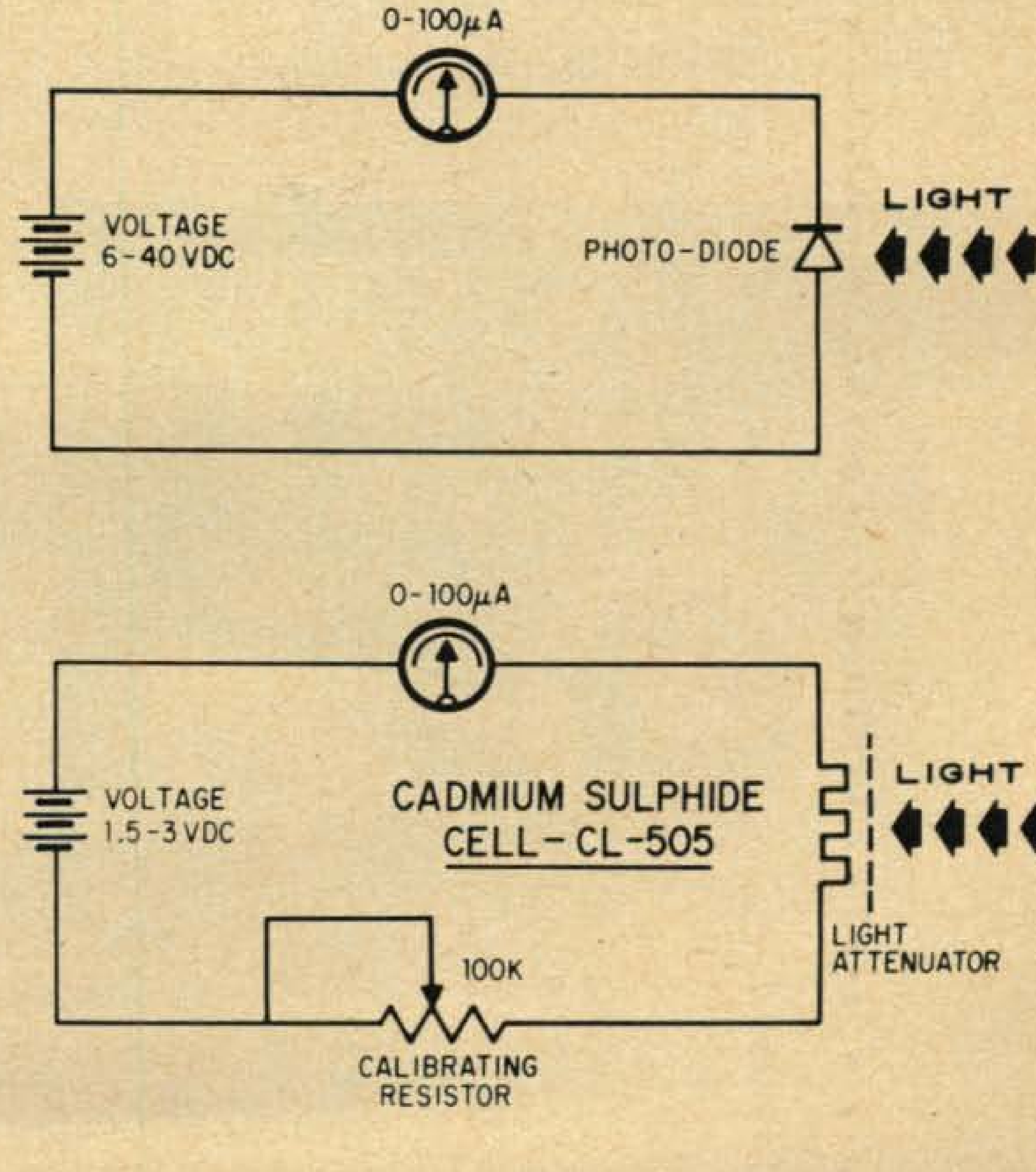

Fig. 3—Typical circuit diagrams for photo cell devices.

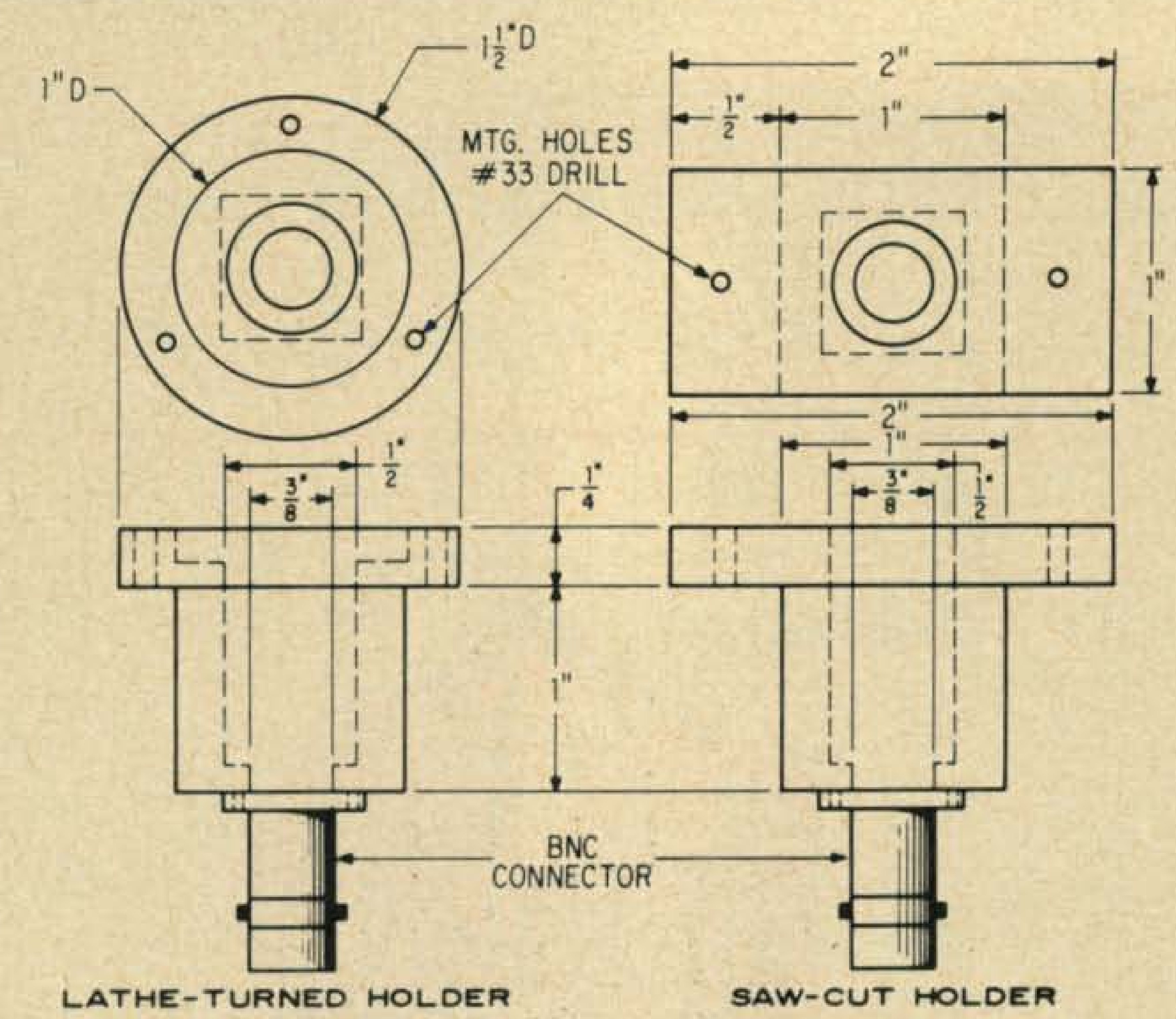

Fig. 4—Two types of photo-cell holders with BNC connectors.

monochromatic light. Collimated light may originate as incoherent and chromatic form of light but by means of lenses or traveling vast distances it becomes collimated. Light from the sun, planets or stars is said to be collimated since only the narrow angle parallel rays ever reach earth while the random incoherent rays are lost.

The Monochrometer

The purpose of the monochrometer is to separate chromatic light into the individual frequencies contained therein. This will include all the vsible frequencies as well as the invisible frequencies of infrared and ultraviolet.

You will note that the entire visible portion of the light spectrum is but a small fraction of the total energy of light therefore a very sensitive detector is essential if significant measurements are to be obtained. The charts supplied for calibration (to be shown later) exemplify the need for sensitivity in the detector. The total visible energy in the light from a standard 100 watt/120 volt lamp measures 28 milliwatts. The remaining 99.720 watts are distributed in the invisible frequencies of infrared and ultraviolet.

To compound the need for sensitivity, the monochrometer itself contributes considerable loss to the power of light. Each optical element offers loss through diffraction, reflection or diffusion which, collectively, could produce losses up to 90% of the available light energy.

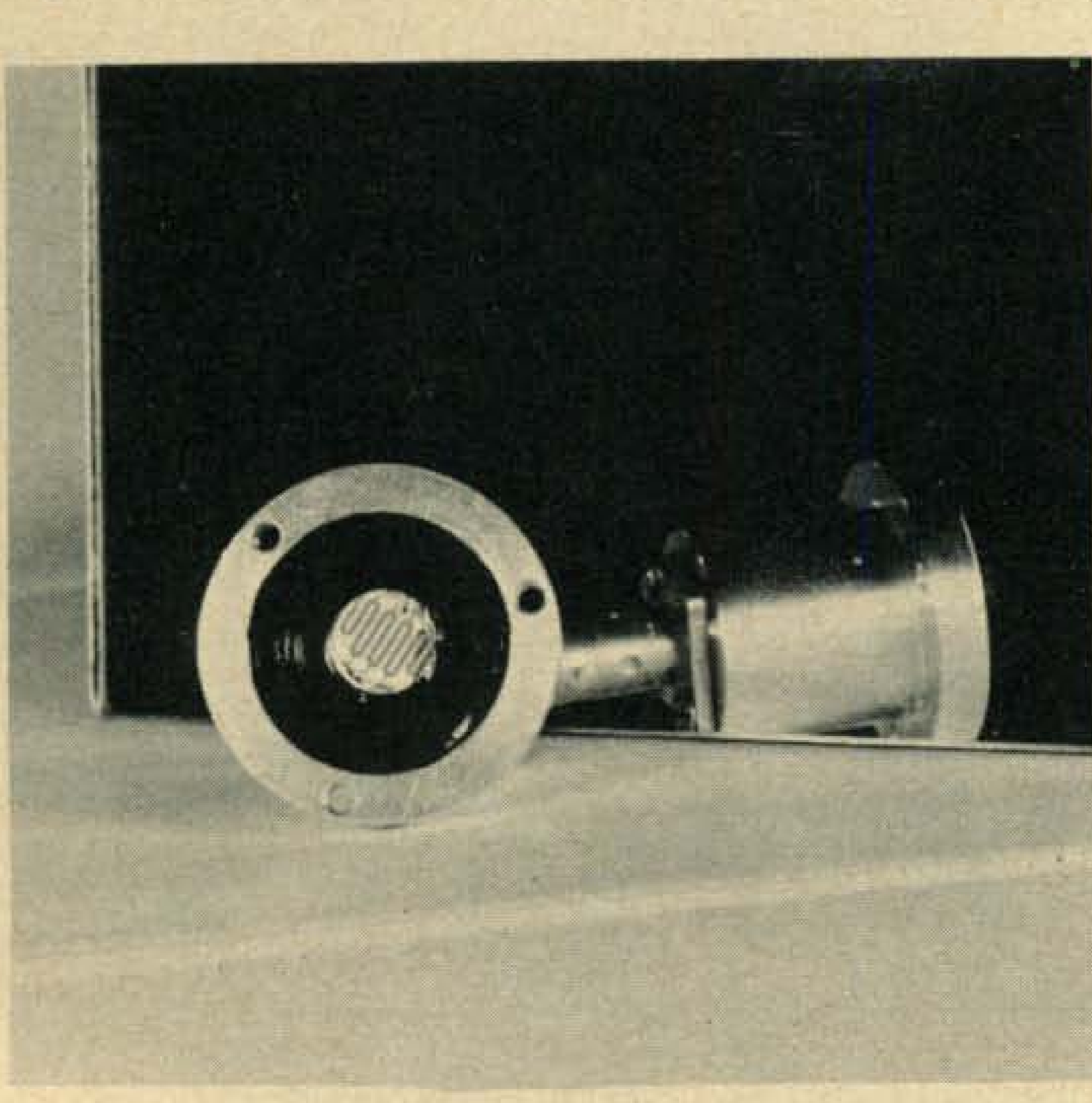

Fig. 5—A cadmium sulfide photo-cell in the lathe turned housing of fig. 4.

The Detector

The sensitivity of the detector will depend on the type most suited to your experimental budget. A low sensitivity (1×10^{-3} watt) photo diode can be homebrewed by removing the metal top of most any p.n.p. or n.p.n. transistor case, then using the base and collector leads to form the diode. The best photodiode action is obtained by using audio power output transistors such as the 2N250, 2N1183

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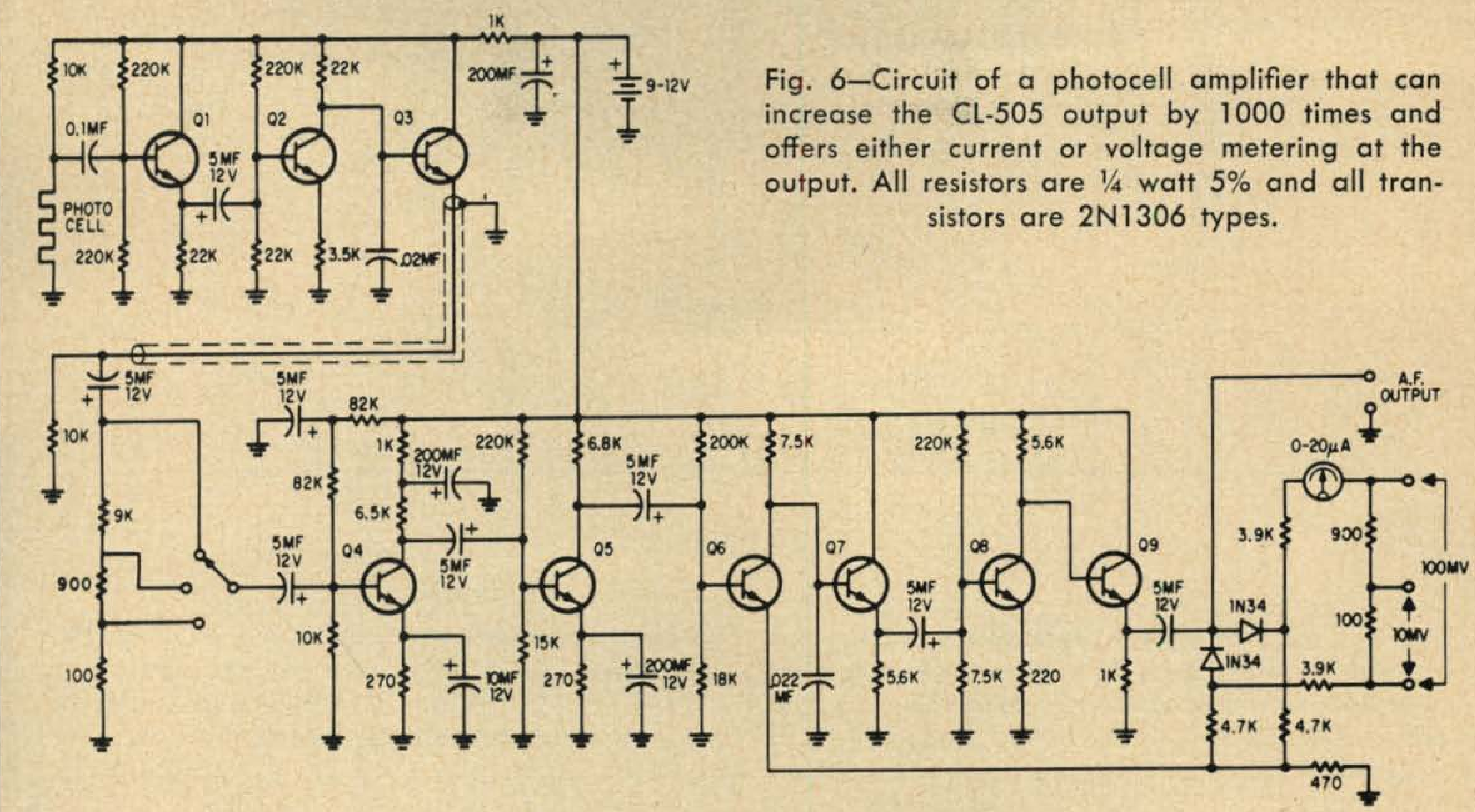

Fig. 6—Circuit of a photocell amplifier that can increase the CL-505 output by 1000 times and offers either current or voltage metering at the output. All resistors are ¼ watt 5% and all transistors are 2N1306 types.

or 2N455. One disadvantage of the home-brewed photodiode is that you have no spectral response data available to aid you in photometric measurements.

There are a number of commercial photodiodes available that have a sensitivity of 5×10^{-7} watts or better. Calibration and spectral response curves are supplied with the commercial photodiodes as well as circuit diagrams for construction of measuring devices using the photodiode.

The Clairex CL505, Cadmium-Sulfide

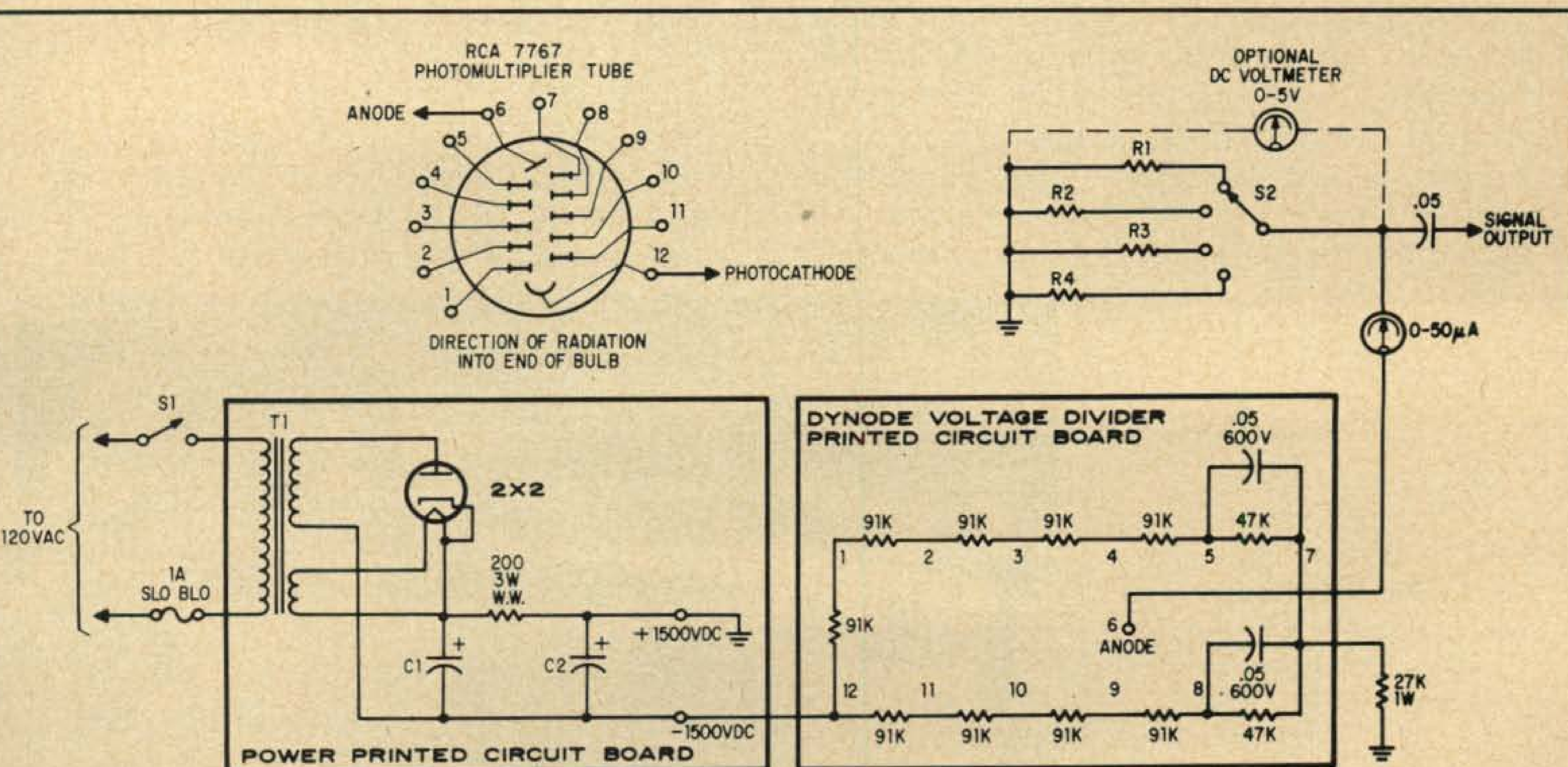

Fig. 7—Power supply and voltage divider network for the RCA 7767 photo-multiplier tube. The circled numbers on the divider board to the tube lead numbers shown in the inset. All resistors are 1 watt 5% unless otherwise noted. The values of R_1 to R_4 are determined as explained in the text.

C_1, C_2-1000 mmf, 5 kv. Centralab 850 series.
T_1—Scope type power transformer, 1,550 v @ 1.5 ma, 2.5v @ 1.75 a. Allied #54E3533, 1968 Industrial Catalog #680, p. 349.

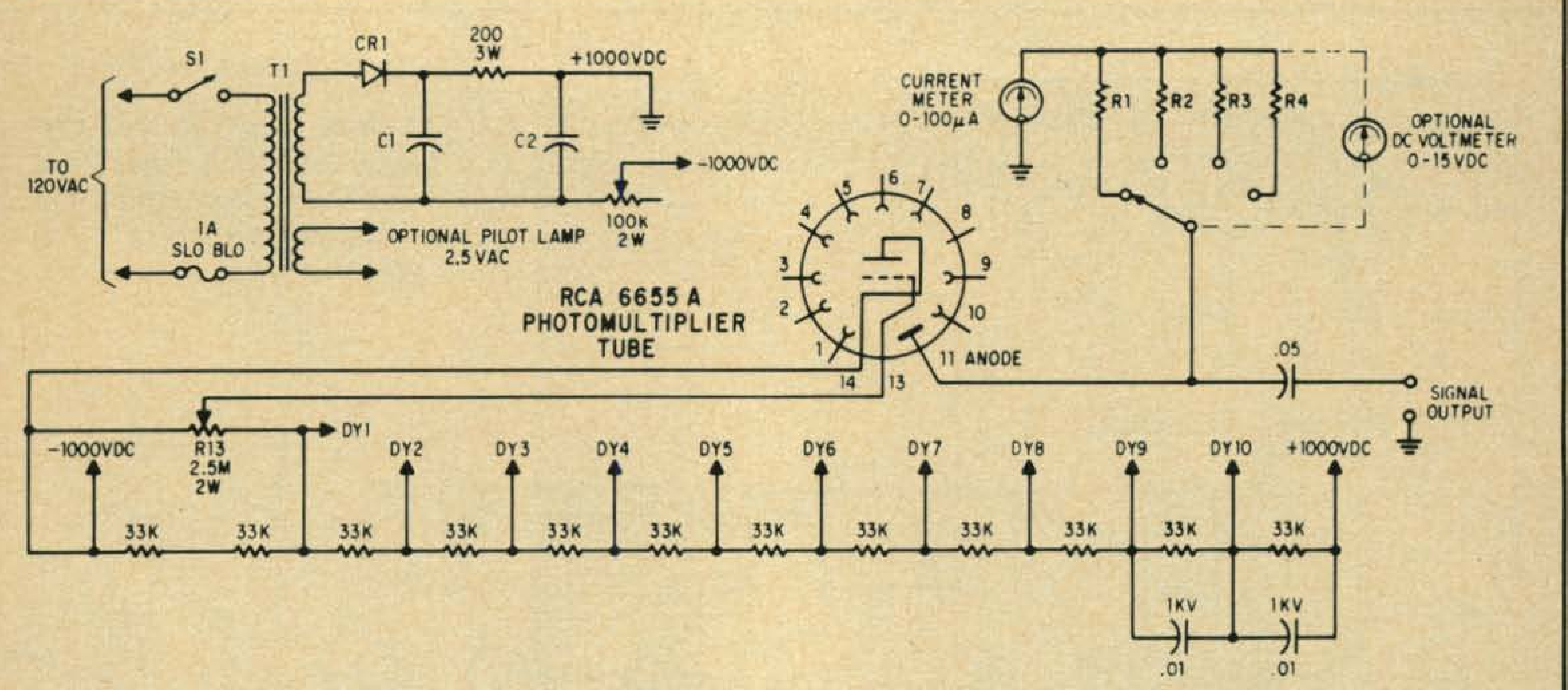

Fig. 8—Circuit of a solid state power supply and voltage divider for an RCA photo-multiplier tube type 6655A. The power supply components are the same as those used in fig. 7. The diode, CR_1, is a Sarkes Tarzian type HVC-240, 2.4 kv p.i.v., at 250 ma. (Allied #49E31HVC240). All resistors are 1 watt 5% unless otherwise noted. The values of R_1 to R_4 are determined as described in the text.

photocell is perhaps the lowest priced, sensitive, photocell suitable for a detector in conjunction with a monochrometer. Only $1.50, it has a sensitivity of 2.5×10^{-9} or better. The CdS photocell has a response curve that peaks at 550 millimicrons which matches the response of the human eye.

Photocell Detector Construction

I would suggest that the first step be to construct the detector circuit. This can be done while awaiting receipt of catalogs or material ordered for the monochrometer.

Fig. 3 illustrates several photodiode and photocell basic circuits. You only have to choose the type of photo device and form of metering to get started.

The calibrating resistor for the CL-505 circuit is adjusted under daylight (bright sunlight) conditions with a suitable light attenuator cover (to be discussed shortly). The 100k pot is adjusted for full scale deflection on the 0-100 microampere meter. Without a light attenuator subdued light conditions are necessary for the calibration and this will result in lower sensitivity.

Detector Housing

The photodiode or photocell must be shielded from ambient light and have a means of attachment to the monochrometer. The diagrams in fig. 4 offer a choice of two forms

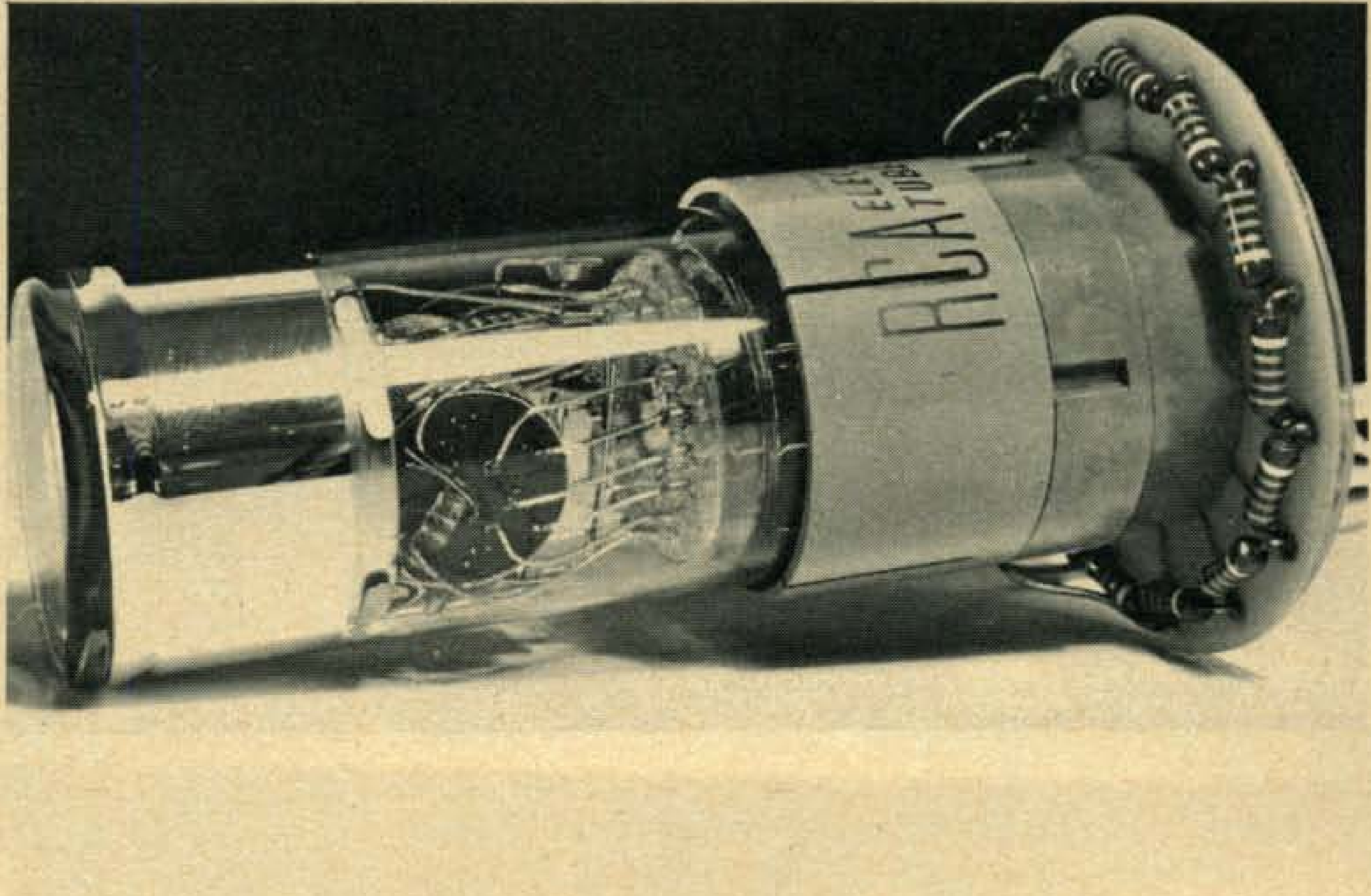

Fig. 9—The RCA 6655A p.m. tube and the voltage divider built on the socket base.

 See page 110 for New Reader Service

of housing for the photocell. For those with access to a wood or metal working lathe, it is a simple matter to turn an attractive and effective light-tight holder from wood, plastic, or metal as shown in fig. 5. An equally effective holder is readily constructed from wood by sawing to shape and drilling a ½ inch hole to receive the photocell. It is essential that the interior of the holder be painted with flat black paint to absorb random light.

In connecting the photocell to the power and metering circuits, direct solder connections may be employed or detachable connections by means of BNC connectors can be used. The use of detachable coaxial cables will eliminate awkwardness of handling when assembling the equipment.

Amplifier

To permit the use of low sensitivity photodiodes and still obtain meaningful measurements, fig. 6 illustrates the circuit of a suitable amplifier providing and amplification of approximately 1000. If you desire the added gain, the circuit will be worthwhile assembling. The 2N1306 is an inexpensive transistor and the circuit is easy to breadboard. One advantage of this circuit is the provision for metering either current or voltage.

Photo Multiplier Tube Detectors

For those who desire maximum sensitivity and have a fat experimental budget, the photomultiplier tube offers an input sensitivity of 1×10^{-12} watts or better. The chief disadvantage is the higher cost of the p.m. tube and the necessity for a high voltage power supply.

To offer a choice in circuits, figs. 7 and 8 illustrate two popular RCA photomultiplier tubes with the accompanying power supply and voltage divider networks.

A printed circuit can be made to receive the resistors in each type of voltage divider network. The RCA 7767 photo-tube does not have base pins therefore a 0.750" dia. hole is cut in the center of the printboard to receive the tube base and make direct connection of the leads to the printboard. Figure 9 illustrates the RCA 6655A tube and socket mounted on the voltage divider printboard along with the resistor network.

Like the photo-diodes or photo-cells, the p.n. tube must be shielded from ambient light. Figure 10 illustrates the coffee-can housing which not only provides the necessary shielding from ambient light but is both cheap and

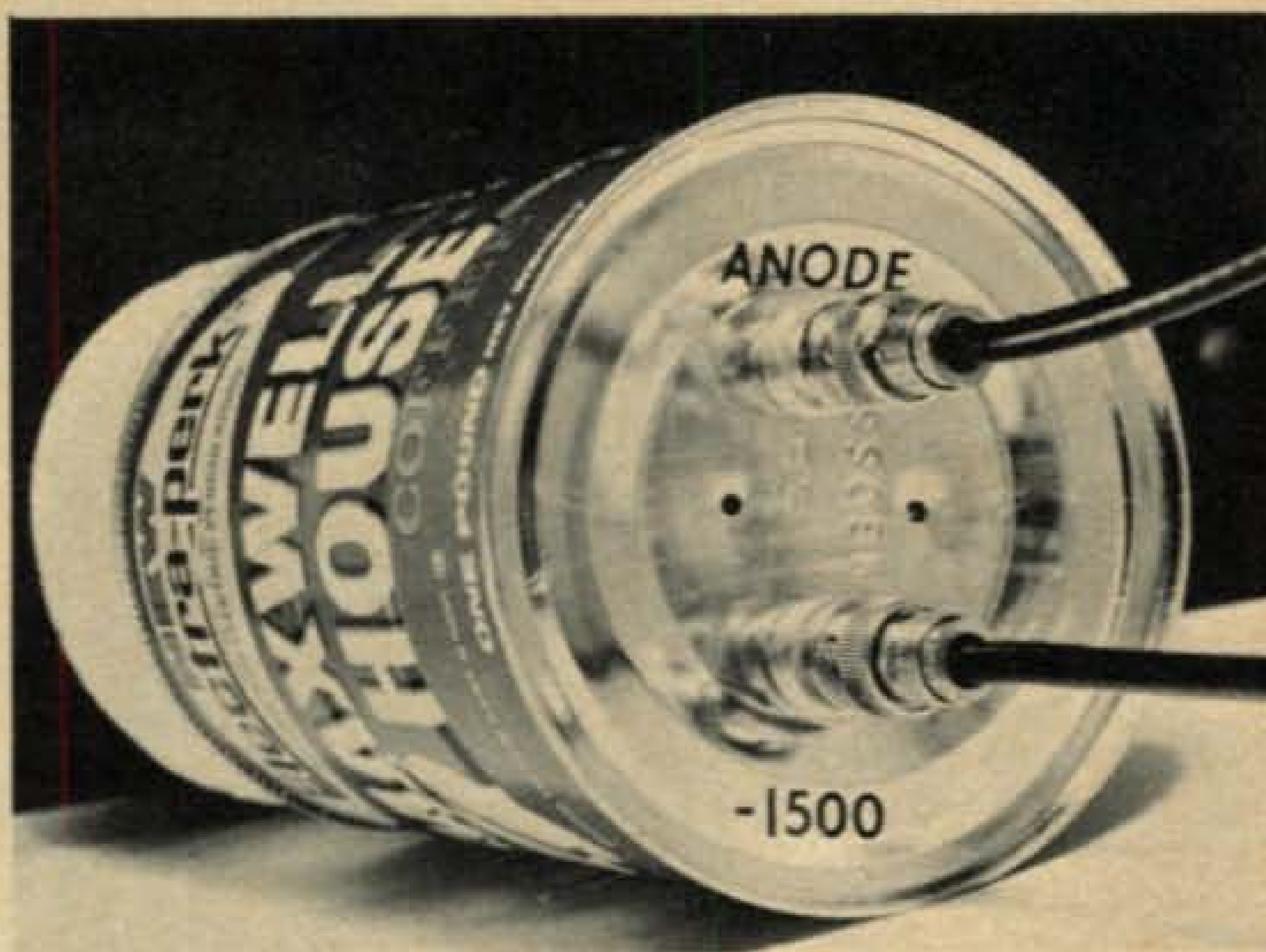

Fig. 10—A coffee can p.m. tube housing.

readily available. Again, paint the interior with flat black paint.

P.M. Power Supplies

Both p.m. tubes employ the same basic power supply to furnish the high voltage. The power transformer is a standard oscilloscope type using a 2X2 rectifier tube. If desired, you may use one high voltage diode or several series diodes to eliminate the tube. Figures 11 and 12 show the completed power supply for visual details.

Multiplier Resistors

The manner in which you intend to meter your photo-detector will govern how you select the multiplier resistors for the range selector switch. You may elect to measure a

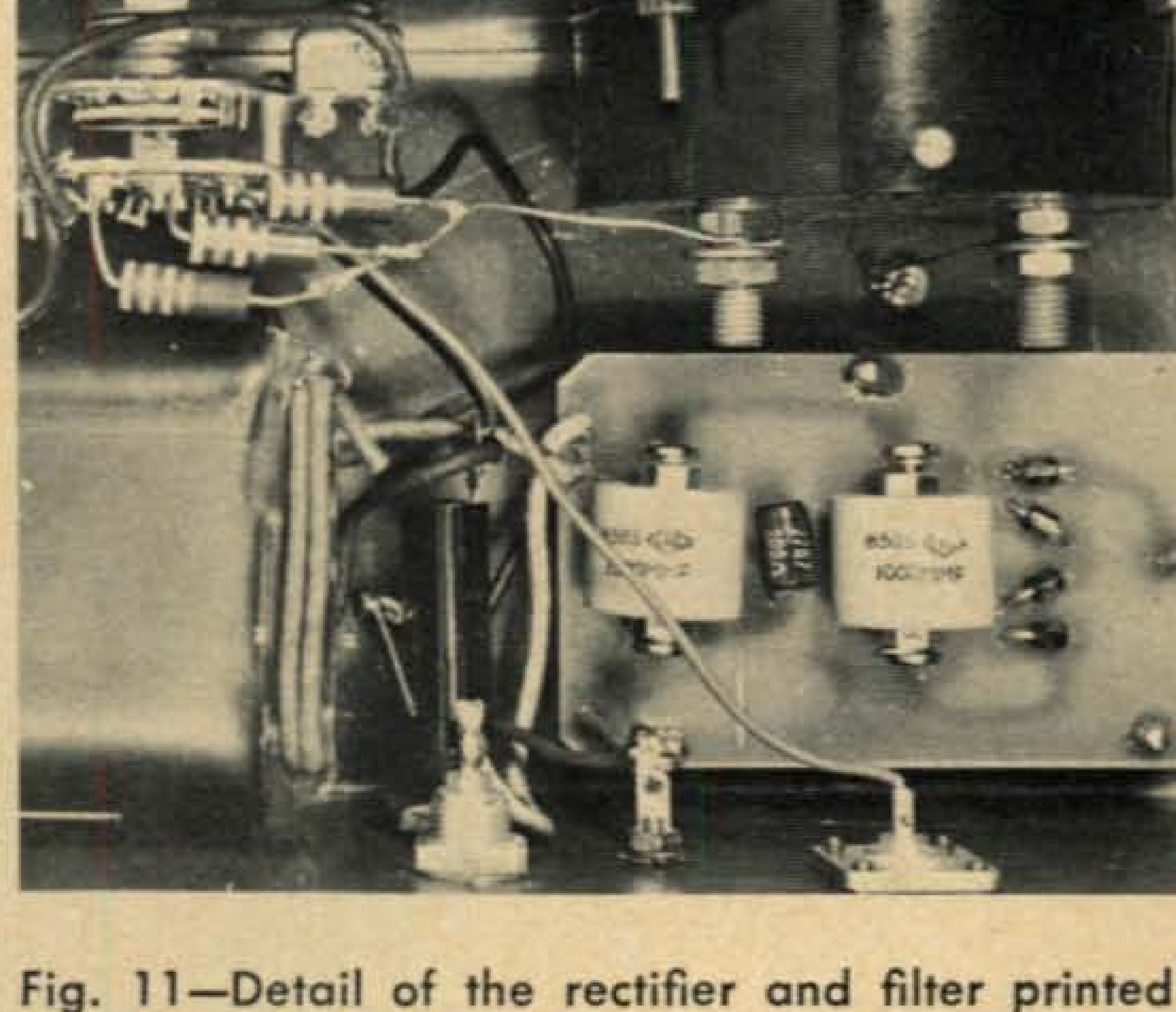

Fig. 11—Detail of the rectifier and filter printed board located behind the meter. The multiplier switch can be seen in the upper left corner. The copper clad printboard measures 3" × 6" × 1/16".

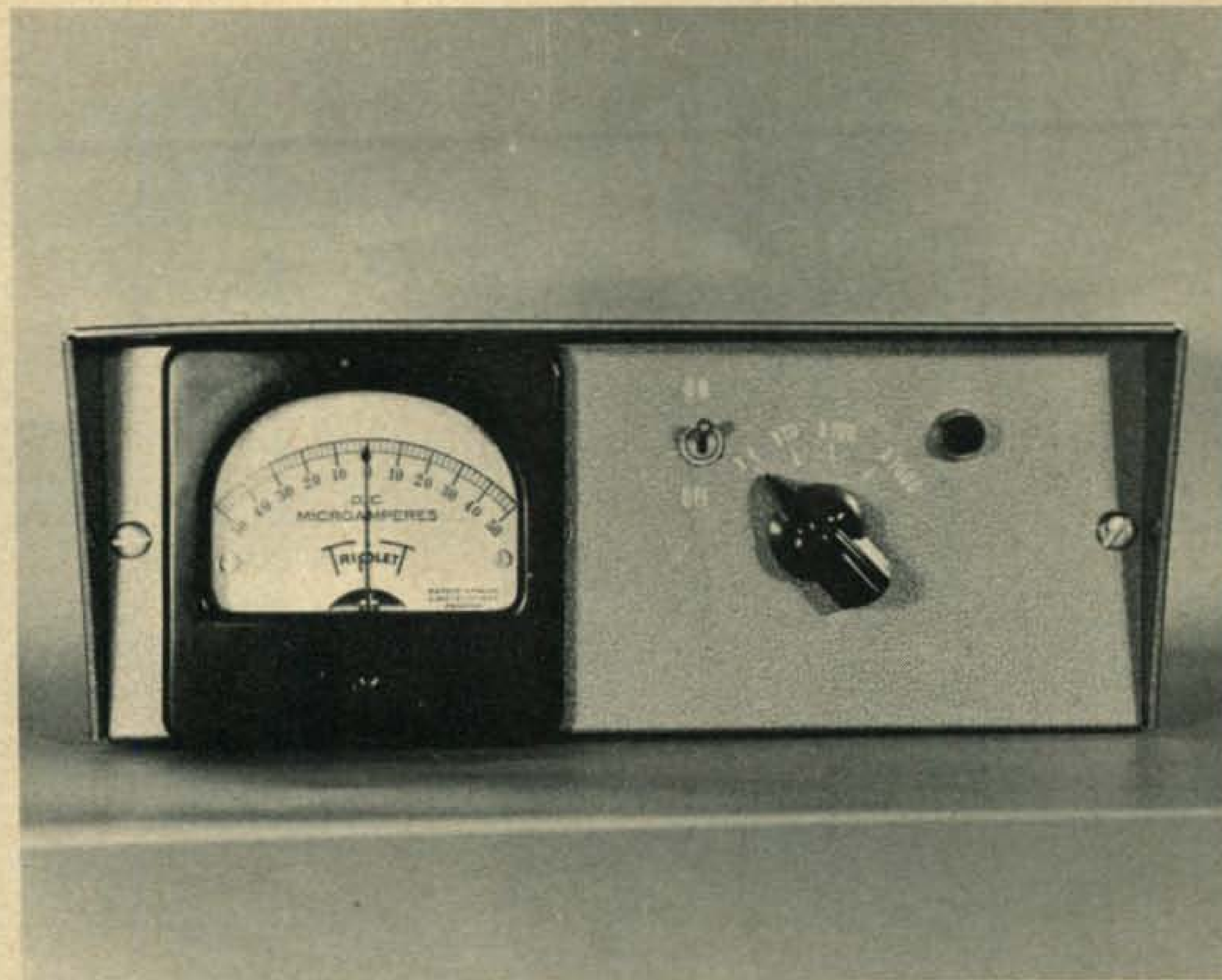

Fig. 12—Front view of the housing containing the power supply, meter and multiplier switch for the photo multiplier tube. The cowl type minibox measures 7" × 12" × 8".

voltage developed across the photo-devices load resistance or measure the current drawn or produced by the photo sensitive device and limit the flow of current by resistance. Either method will work satisfactorily providing you keep in mind the low currents involved.

One method of calculating the proper multiplier resistor values is to install a 2 megohm potentiometer wired as a variable resistor Adjust your meter to full scale deflection with the photo-sensitive device in daylight. Measure the resistance of the potentiometer and divide by 10, 100, and 1000 to arrive at the appropriate multiplier resistance values. In case of the photomultiplier tube, its sensitivity is too great for daylight. Use a 100 watt lamp at a distance of 10 feet for your light source and measure the voltage across the load resistance of 10K ohms to start. By varying the load resistance or current limiting resistance you can arrive at suitable multiplier values.

Aperture Size and Filters

Another method for limiting photo-sensitive devices is to restrict either the aperture of the photo-sensitive area or restrict the amount of light arriving at the photo-sensitive area. In aperture restriction, pinholes of various sizes, are drilled into metal covers and placed over the photo-sensitive area. These holes should vary from 0.010" to 0.500" governed by the sensitivity of the device.

Light restriction is accomplished by means of neutal density filters. These filters reduce the available light without affecting the color frequencies. The amount of attenuation is labeled in decibels, which is identical to power formulas where ratios of input power to output power are described in decibels. Optical density decibel formula is stated as:

$$\textit{Density in db} = 10 \log_{10} \frac{1}{\textit{Transmission }\%}$$

$$\textit{Actual response} = \frac{\textit{Meter reading per millimicron}}{\textit{Det. response in }\%\textit{ per millimicron}} \times 100$$

To give an example, if a filter offered a reduction of 50% in transmission, what would its attenuation be in decibels? From the formula we find $\textit{Density in db} = 10 \; \textit{log} \; 1/50 = 10 \; \textit{log} \; 0.02 = 10 \times 0.300 = 3$ db. Suitable neutral density filters should offer reductions from 10 to 1000 × or 10 to 30 db.

Having selected a suitable photo-detector for your project, it would be wise to complete the detector circuit before beginning the construction of the monochrometer as it will prove useful in alignment of the optical components.

(To be continued)

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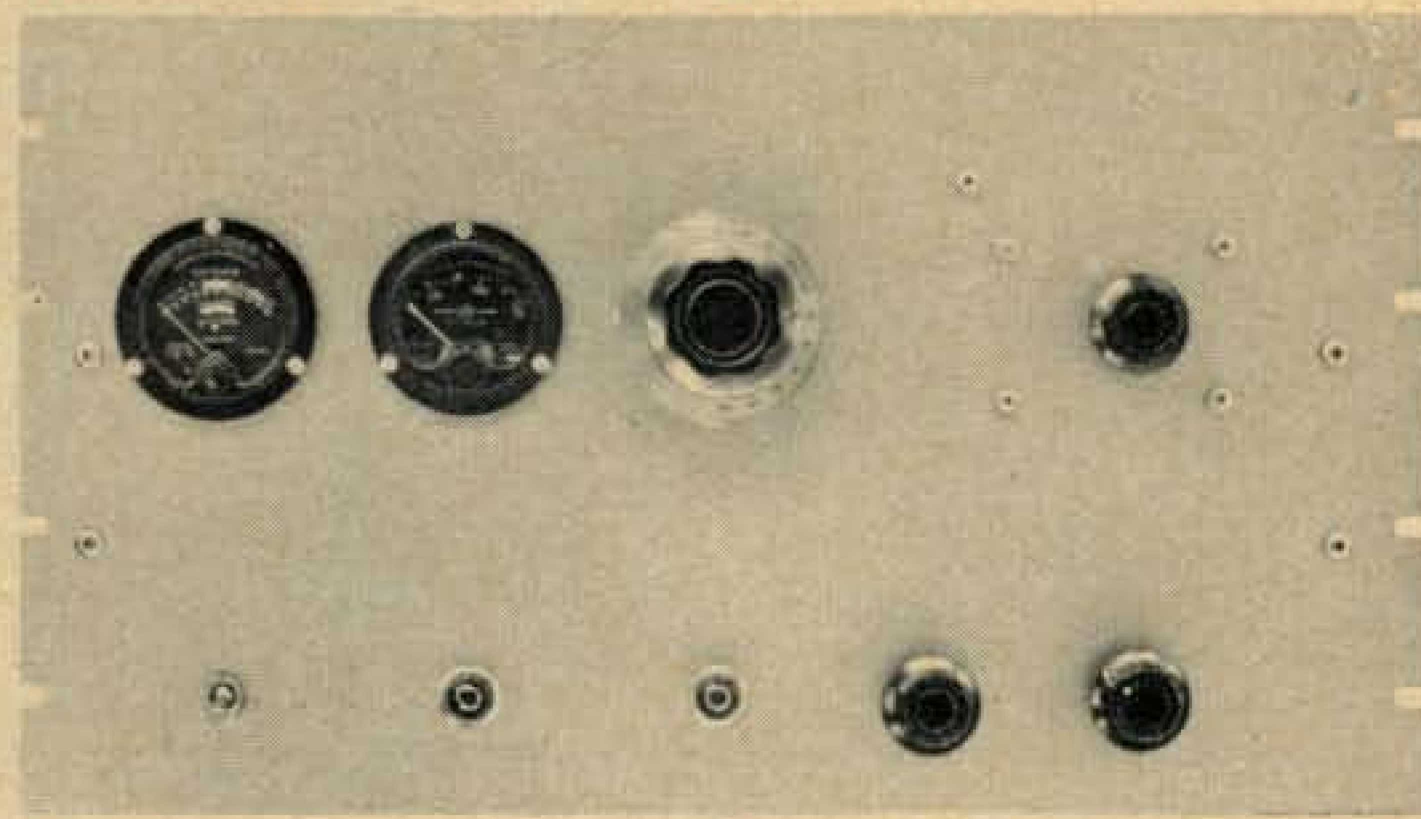
Front view of the 160 meter linear. The left hand is the relative r.f. output indicator and the right hand meter the plate current indicator. To the right of the meters are the Plate Tuning and Loading controls. The bottom row from left to right are: On-Off, pilot light indicator, Relative Output Meter Sensitivity, Loading Switch.



A 160 Meter Linear

BY LOUIS B. BURKE JR.,* W8QJH/7

After having an article published some time ago on a top-loaded vertical antenna for 160 meters, I was overwhelmed by the surprising amount of correspondence concerning the article. I did not realize that 160 meters was still as popular throughout the country as it appears to be. And now, with some of the commercial built equipment putting 160 back on the bandswitch, activity seems to be increasing even more. All of these factors inspired me to try to improve my operation capability on 160. My Ranger II, along with the top-loaded vertical has done a tremendous job, but I felt that an increase in power would give me a great advantage over my present system.

After kicking around several different ideas of a cheap and easy way to increase power, I finally decided to try a linear. For the amount of dollars spent, this seemed to be the most effective way to increase power. After seeing so many articles on various kinds of linears, I thought that grounded grid would be the answer. All I need is some filament voltage and B-plus and I could be on the air with an appreciable increase in output power.

Of course, at this frequency, tube types are not of any special concern as is the case at higher frequencies. The ideal tube, therefor, will be one that can handle a reasonable amount of power and can be bought at a reasonable price. After considering quite a few different types of tubes, I chose the 6LQ6/6JE6C because of the many TV horizontal tubes now being used in linears. These tubes offer a greater plate dissipation for the same amount of money as would be spent on other tubes in the same category. The total price of four 6LQ6's was $13.50 from a local distributor.

About The Circuit

I built the linear on a 17″ x 12″ x 3″ aluminum chassis with front panel dimensions of 19″ x 10½″, but this size could be greatly reduced if desired. In my case, the power supply is incorporated on the same chassis, so the linear is completely self-contained.

The power supply is a standard bridge rectifier type, and I used a surplus power transformer capable of delivering 800 v.r.m.s. total secondary voltage. I have no way of knowing the current capability, but judging from the physical size, I would guess at least 0.5 amps. The transformer also supplies filament voltage of 6.3 volts at several amps. The power supply will deliver a no-load voltage of around 1200 v.d.c., which falls down to about 1 kv under a load of 300 ma. Any transformer capable of 800 v.r.m.s., rated at 200 ma will do the job quite well.

---

*3301 W. Turney, Phoenix, Arizona 85017.

[1] Burke, L. B., "Top Loaded 160 M Vertical," *CQ*, Jan. 1968, p. 74.

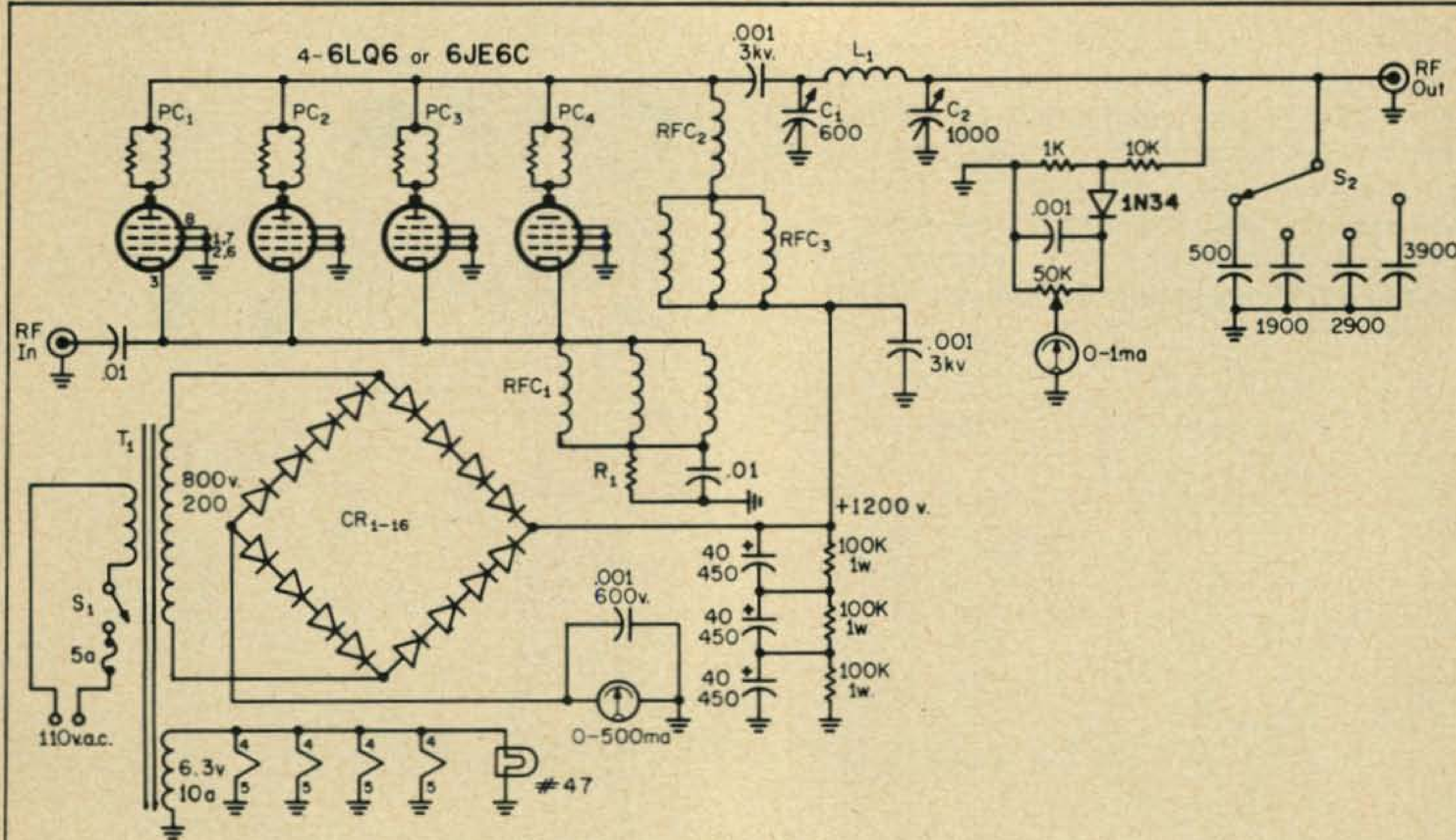


Fig. 1—Circuit of a 300 watt d.c. input linear for operation on the 160 meter band. All resistors are 1/2 watt except where otherwise noted. Capacitor values greater than one are in mmf except for electrolytics (marked by polarities) which are in mf. Capacitor values less than one are also in mf.

C_1—600 mmf, two gang broadcast variable, 360 mmf per section, paralleled.

C_2—1000 mmf, three gang broadcast variable, 360 mmf per section, paralleled.

CR_1 to CR_{16}—1N 4005 diodes, 600 p.i.v., 1 ampere.

L_1—27 t. #14 e., 2" dia. 4½" long, or 4½" length of Air-Dux 1606T.

PC_1 to PC_4—6 t. #16 e. wound on a 47 ohm 2 watt carbon resistor.

R_1—Fifteen 1K 2 watt carbon resistors paralleled for 50-60 ohms, 30 w.

RFC_1, RFC_3—10 mh, 125 ma, Cambion Lab 6-RFC or equiv.

RFC_2—B&W 800 (optional—see text).

T_1 — 800 v.r.m.s. at 200 ma, 6.3 v. at 10 amperes.

The input to the linear offers a reasonably good match to the Ranger II, so no difficulty was encountered in driving the linear. As a matter of fact, it was found necessary to decrease the coupling on the Ranger in order to keep from over driving the linear.

Of Particular Interest

No matter what you may have read about TV horizontal tubes being zero-bias tubes when operated in a grounded grid amplifier, forget it. These tubes, like all other *non*-zero bias tubes, require bias. It really does not make much difference how they are biased, as long as they do have the proper amount of bias required for linear operation. I experimented with various types of bias, and finally ended up with cathode bias.

The chokes RFC_1 and RFC_2 are Cambion-Lab 6 RFC. They are 10 mh each, and rated at 125 ma each. This provides a current capability of 375 ma and offers an inductance of a little over 3 mh at 1.9 mc. The dc resistance of these chokes (three in parallel) is around 35-40 ohms. The dc resistance is not high enough to develop the proper amount of cathode bias, so some resistance must be put in series with the choke to ground. But do not forget that this resistor must be able to handle the total current fo- the tubes. The value was found, experimentally, to be about 50-60 ohms. A resistor bank was made up consisting of 15 resistors each having a resistance of 1000 ohms and a 2 watt rating. With 15 resistors in parallel, the total resistance is around 60 ohms and is capable of 30 watts dissipation. With this resistor in series with the cathode chokes I was able to develop the proper bias for AB^1 operation. Also, with this value of resistance.

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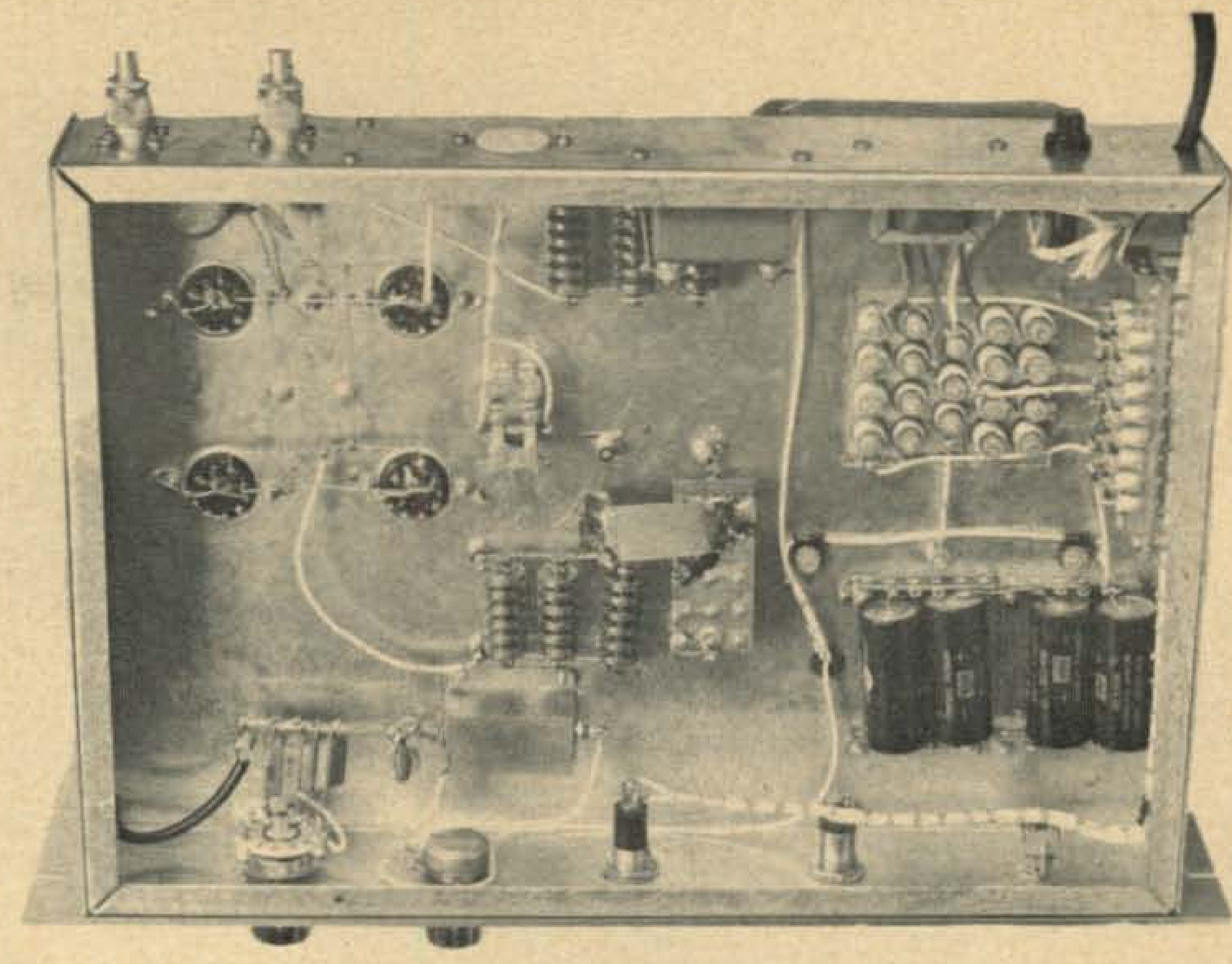


Bottom view of the 160 meter linear shows the power supply wiring on the left. The input biasing resistor R_1 is made up from fifteen 2 watt carbon resistors mounted between two sheets of copper and connected to the r.f. chokes with a copper tab. The plate r.f. chokes can be seen along the rear chassis flange. Fuse and input and on the rear flange. The relay and one pilot light seen in this view are part of an earlier version and no longer used.

the static plate current or idling plate current (no signal input) is 80 ma which is well within the plate dissipation capabilities of the tubes.

The control grid, screen grid, and suppressor grid are all tied to chassis ground with the shortest leads possible.

The parasitic plate chokes are made up of 6 turns of #16 wire, wound over a 47 ohm, 2 watt carbon resistor.

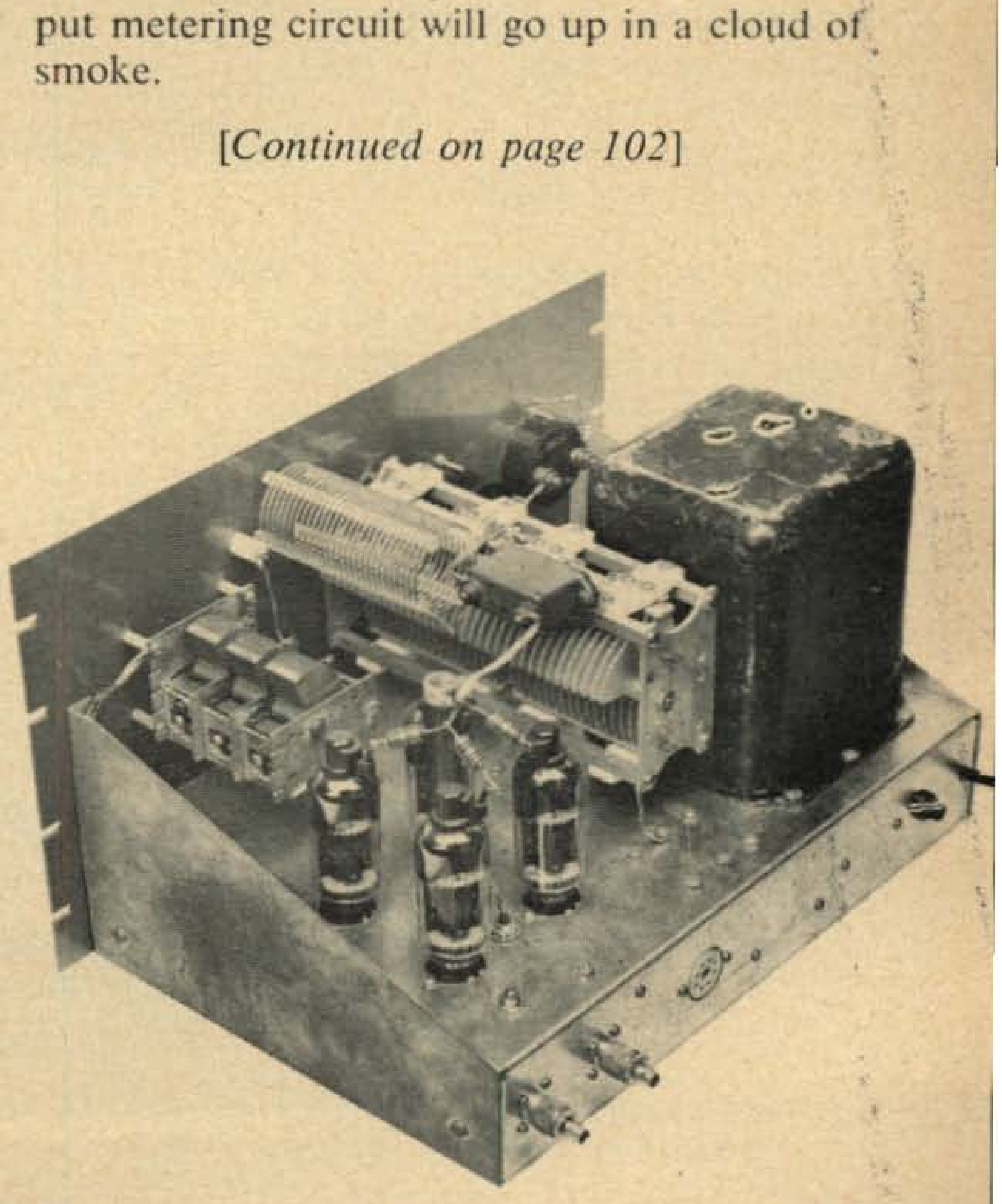
The B&W 800 plate choke is really not necessary, but it provides a convenient method of supporting the parasitic plate chokes. The plate choke RFC_2 provides enough inductance for good choke action to the r.f., so the B&W 800 could be eliminated if desired and a good heavy piece of buss wire run in its place to support the parasitic chokes.

Output Tank Circuit

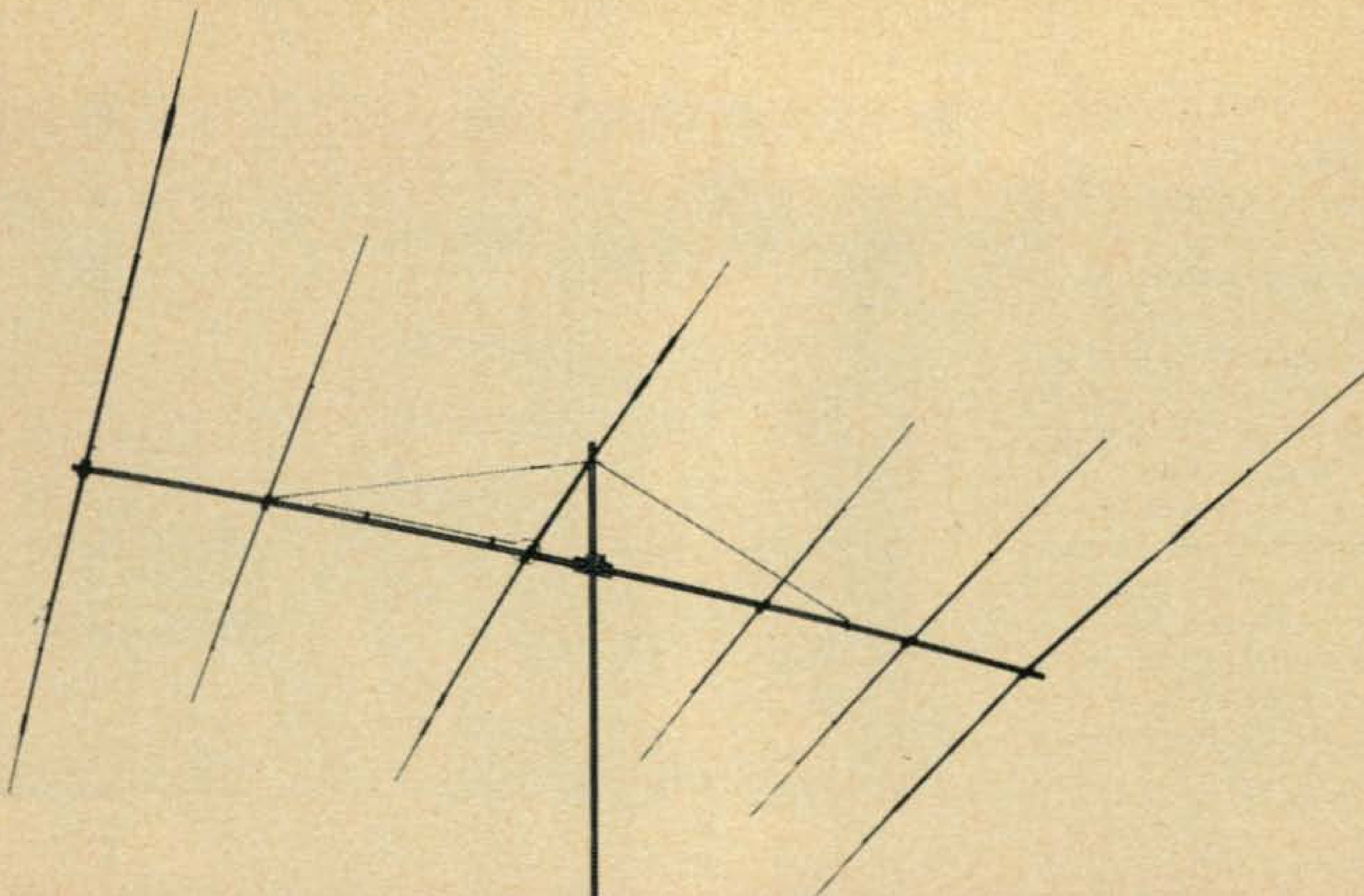
The pi-net tank circuit was designed from formulas furnished with coil specs from Air-Dux. With 1000 volts d.c. on the plates, and a plate current of 300 ma, the Rp seen by the tank circuit is 1666 ohms. To transform the plate impedance of 1666 ohms to 50 ohms, with a Q of 15, the values must be, C_1 755 mmf, L_1 9.8 μh and C_2 about 4000 mmf. I had a two gang variable with 300 mmf per section in the junk box, so I used it and changed the coil to an inductance of 13 μh. On the output side, I used fixed mica capacitors and switch in capacity as it is needed, along with having 1000 mmf variable available at all times. The tank circuit works very well and I am able to load the antenna with no problems at all.

I incorporated the output meter as a means of tuning for maximum power output. The plate current meter is a means of monitoring plate current, rather than being used for tuning. One word of warning, do not apply power to the linear without a load such as an antenna or dummy load because the output metering circuit will go up in a cloud of smoke.

[*Continued on page 102*]



Top rear view of the 160 meter linear shows the layout of the tank circuit and the position of the four 6LQ6's. Note the parasitic suppressors for the final tubes.



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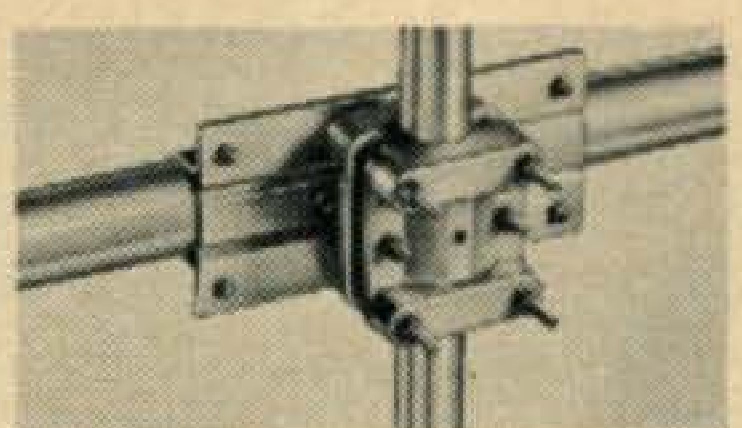

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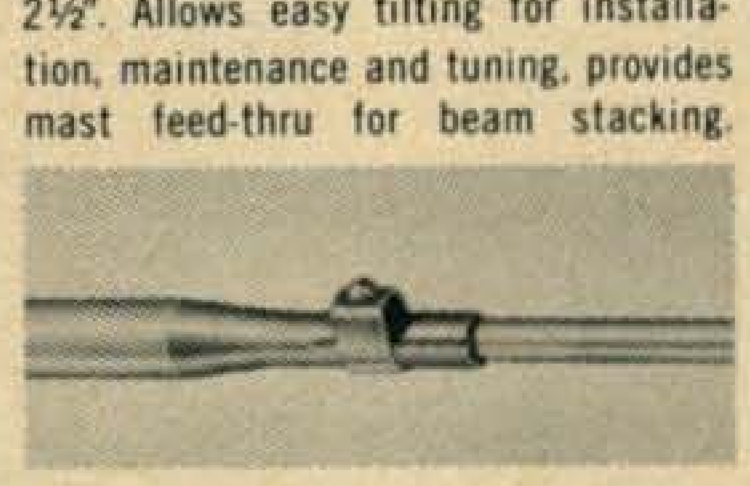

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A Primer on Diode Amplifiers

BY JOHN J. SCHULTZ,* W2EEY/1

Diodes up until recent years have been regarded primarily as devices for rectification and signal mixing. Besides their use as switching devices they are also now used extensively for signal amplification and possess some unique advantages over conventional vacuum tube or transistor circuits used for the same purpose.

MANY of us have been brought up on the idea that amplification is the process involved when the control grid in a vacuum tube or the relative current flow in one junction of a transistor controls another larger current flow. With this viewpoint too solidly fixed in mind it becomes almost impossible to visualize how a device such as a diode with only two leads or terminals can possibly provide amplification.

With such a viewpoint one tends to make the situation fit the concepts we have learned rather than relearning and realizing more fundamental ideas. The situation is similar to the amateur who, once he has obtained his license, throws away all ideas of technically progressing and then later on wonders why anyone should possibly have the idea of taking away amateur frequencies. Such amateurs must "unlearn" their concept of amateur radio if the hobby is to grow and mature, and so, one must do a bit of "unlearning" if diode amplification is to be understood.

* 40 Rossie Street, Mystic, Conn. 06355.

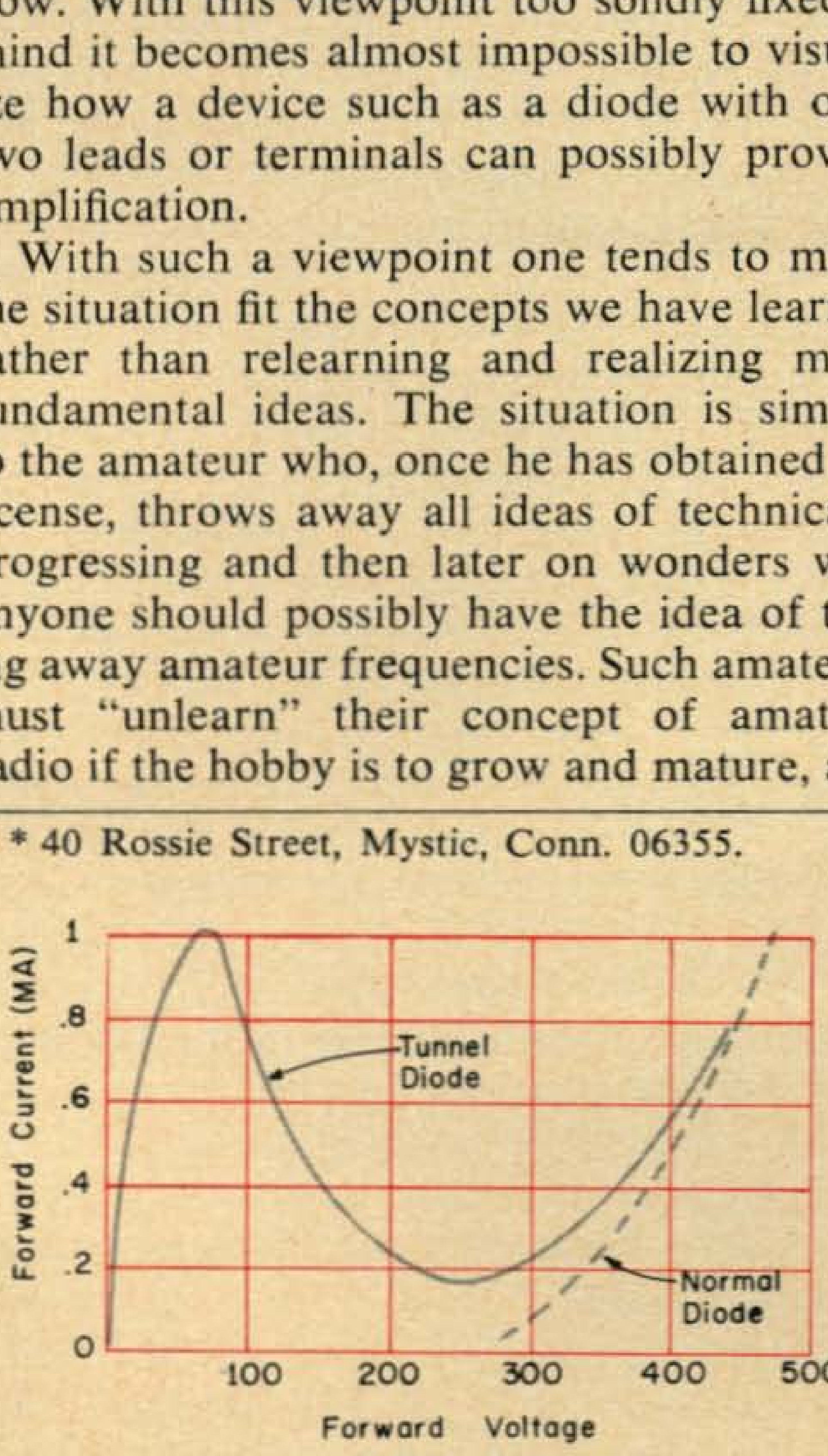

Fig. 1—Comparison of conduction characteristics of a normal junction diode and a tunnel diode.

The "unlearning" is really not difficult at all in respect to amplifiers. Instead of thinking of amplification in terms of tubes or transistors, it should be visualized as a process whereby the input signal is increased in amplitude by taking some power source and using the energy available in such a manner that amplification takes place. Usually this power source is a d.c. supply but it need not be, as will be seen later in the case of the parametric amplifier. Many factors enter into the making of a "good" amplifier, low noise, efficiency, the quality of the amplified waveform as compared to the shape of the input waveform, *etc*. But if the concept of an amplifier as a form of power conversion device is retained, diode amplifier operation can be easily understood.

The purpose of this article is not to delve into great technical detail concerning the most common types of diode amplifiers — tunnel and parametric amplifiers — but rather to present clearly their basic operational concepts. Such amplifiers are certainly not new to u.h.f. experimenters, but they are generally unknown to most amateurs who operate mostly on the high frequency bands. Why

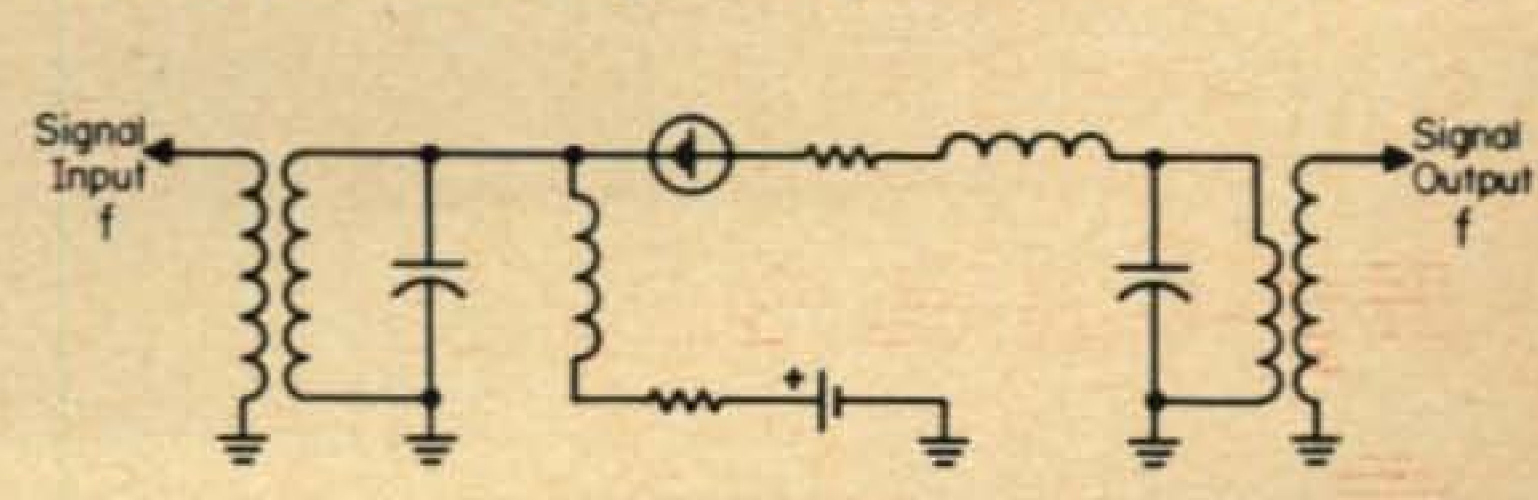

Fig. 2—Tunnel diode series type amplifier.

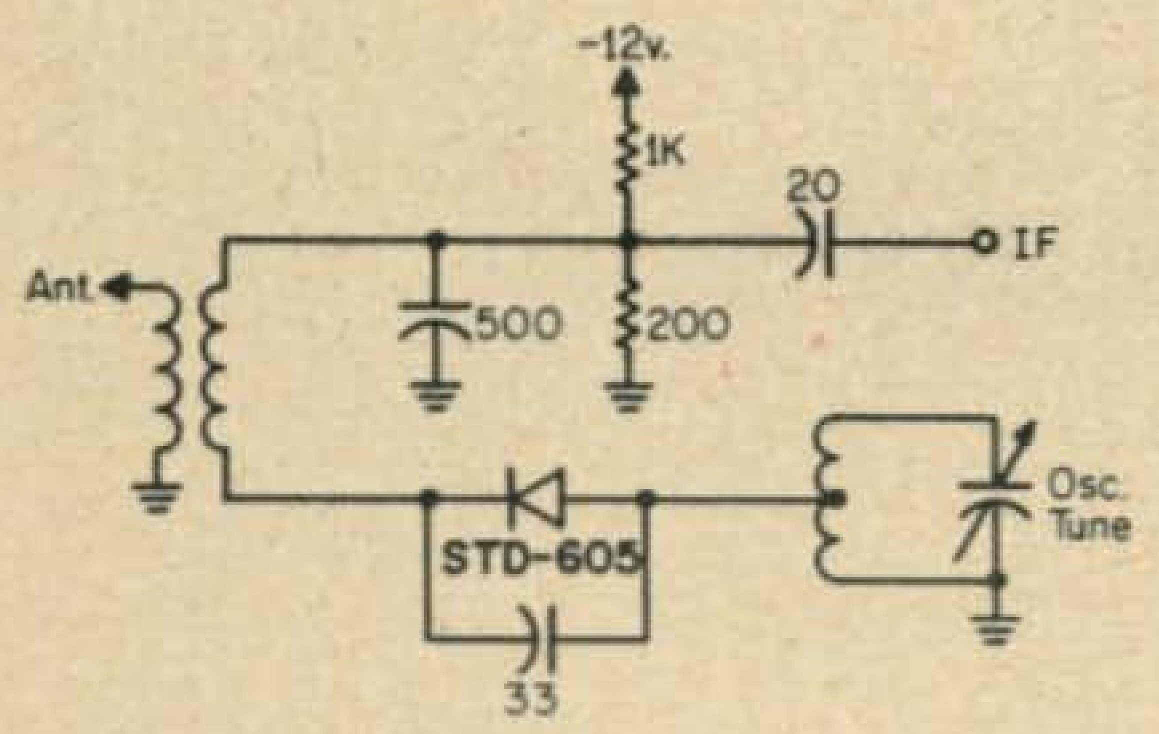

Fig. 3—Tunnel diode oscillator-mixer for use in the 100-150 mc range.

should one be concerned about them? Mainly because they or very similar devices will most likely constitute the next generation of front end r.f. amplifiers in high-frequency receivers. Many of the larger receiver manufacturers have been working towards this goal for several years now (Collins, National, *etc.*).

Tunnel Diode Applications

To understand a tunnel diode amplifier, it is first necessary to have clearly in mind the basic principle of tunnel diode operation. A tunnel diode is very much like a normal p.n. junction diode except that both the p and n semiconductor materials have been much more heavily "doped" with impurities than would be the case of a small signal diode. The heavy "doping" allows current to flow fairly easily in either direction through the diode and it becomes useless as a rectifier or switching diode for most applications. As current flows through the diode in what would be normally considered its forward or normal conductive path, however, a peculiar voltage/current relationship exists over a narrow range at very low voltage levels.

The dashed line in fig. 1 shows the forward

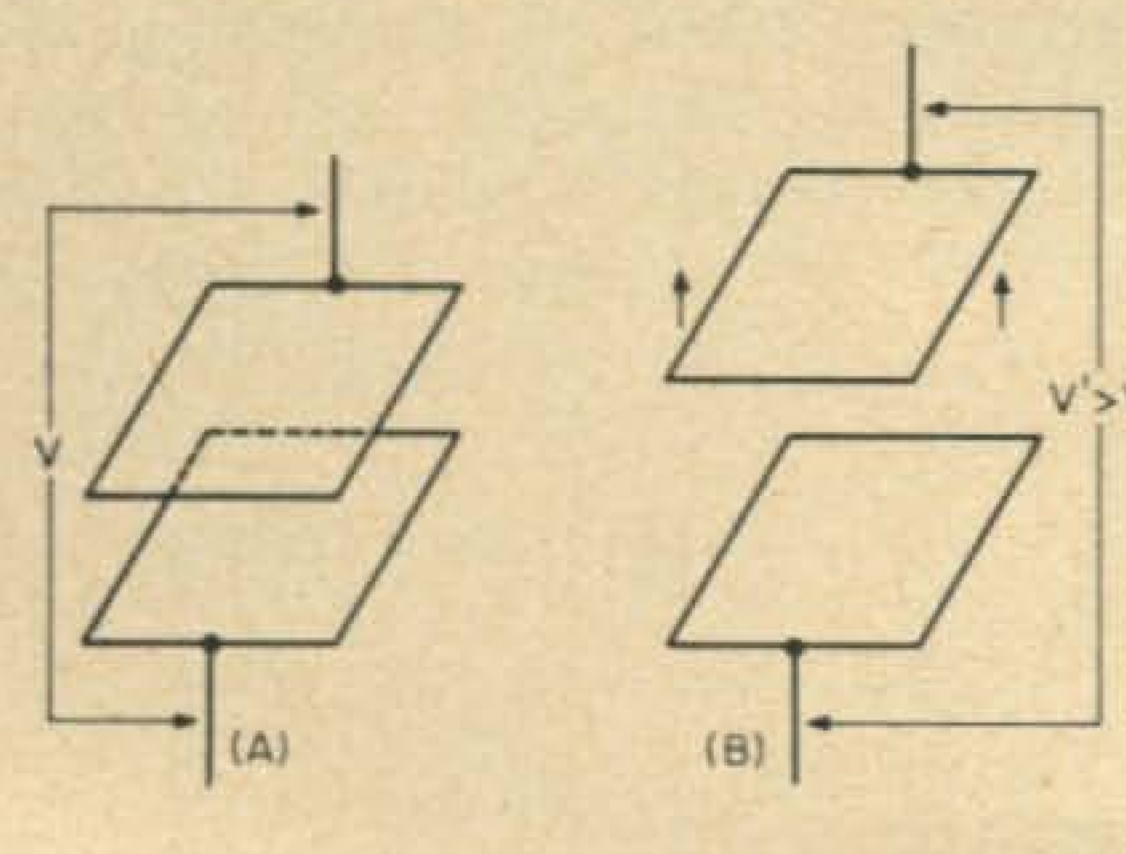

Fig. 4—If the plates of a charged capacitor (A) are suddenly separated by an external force (B), the external energy is translated into an increased voltage level across the capacitor.

characteristic of a normal diode. After a certain initial "inertia" is overcome at a few hundred millivolts impressed across the diode, the current conducted through the diode rises as the voltage impressed across it rises.

The solid line shows the tunnel diode characteristic. At extremely low voltages (50 millivolts), the current through the diode increases rapidly. It almost seems that the current carriers within the diode semiconductor materials are so anxious to get moving that they "tunnel" their way through the material. As the forward voltage increases from about 50 millivolts to 300 millivolts, there is a lack of current carriers and the current *decreases*. Above 300 millivolts, approximately, the carriers settle down again and the diode characteristic is essentially the same as a normal signal diode.

Since there is a region where the current *decreases* as the voltage *increases*, the diode in this region acts as a negative resistance. It is only because the negative region exists that the tunnel diode can be made to act as an amplifier or oscillator while a normal diode cannot perform these functions. The tunnel diode has another unique feature in that the tunneling effect takes place at the speed of light. There is no transit time effect such as in vacuum tubes or other semiconductor devices and so the theoretical limit of the tunnel diode is many millions of megacycles.

Figure 2 shows the diagram of a simple series type tunnel diode amplifier. Amplification occurs when the real resistance in the circuit is slightly less than the negative resistance of the diode. Also, the diode can only amplify signals that are in the small voltage range where a negative resistance effect takes place. Within this range, however, signal gains of 60 db can be achieved with very low noise figures (to 3 db) from relatively simple circuits. The power source for the amplified signal is the d.c. supply.

The major disadvantage of the tunnel diode amplifier is the fact that it must operate over a rather restricted voltage input range. It can be easily overloaded and precautions are required to achieve even poor dynamic ranges of about 40 db.

Various circuits have been devised to improve the dynamic range of tunnel diode amplifiers but few are practical below u.h.f. frequencies as yet, although the diode itself is usable to amplify frequencies from d.c. on up. So, to date, the tunnel diode remains practically and essentially a u.h.f. amplifying

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device. Its r.f. uses at lower frequencies have mainly been as a combination mixer-oscillator as shown in fig. 3. Used in this manner, the negative resistance feature sustains the local oscillator action while the mixing function is performed in a manner comparable to a normal diode mixer.

Parametric Amplifiers

Amplifiers which are built on the basis of parameter variation in order to achieve amplification are classed as parametric amplifiers. The only practical amplifier of this class so far developed has been one using varactors or voltage variable capacitance diodes.

The varactor diode is much more similar to the normal signal diode than the tunnel diode. In any diode (or transistor for that matter) there exists a so-called depletion region at the interface of any n.p. or p.n. semiconductor materials. This depletion region acts as sort of an insulator between the materials and that is why the normal diode characteristics shown in fig. 1 requires some definite voltage before conduction through the diode actually starts. If reverse instead of forward voltage is applied to the diode, the "insulation" region actually increases in width. This effect is not great in normal diodes but the materials of varactor diodes are chosen to emphasize this effect. The "insulation" region acts as the dielectric of a capacitor and the rest of the n and p materials act as the plates of the capacitor. Thus, by varying the reverse voltage applied to the diode, the capacitance is made variable both noiselessly and changeable instantaneously with variations in the applied voltage.

How can a variable capacitor actually amplify a signal? Figure 4(A) shows the two plates of a capacitor where the lower plate is fixed and the upper plate can be moved. Assume that the capacitor has some charge.

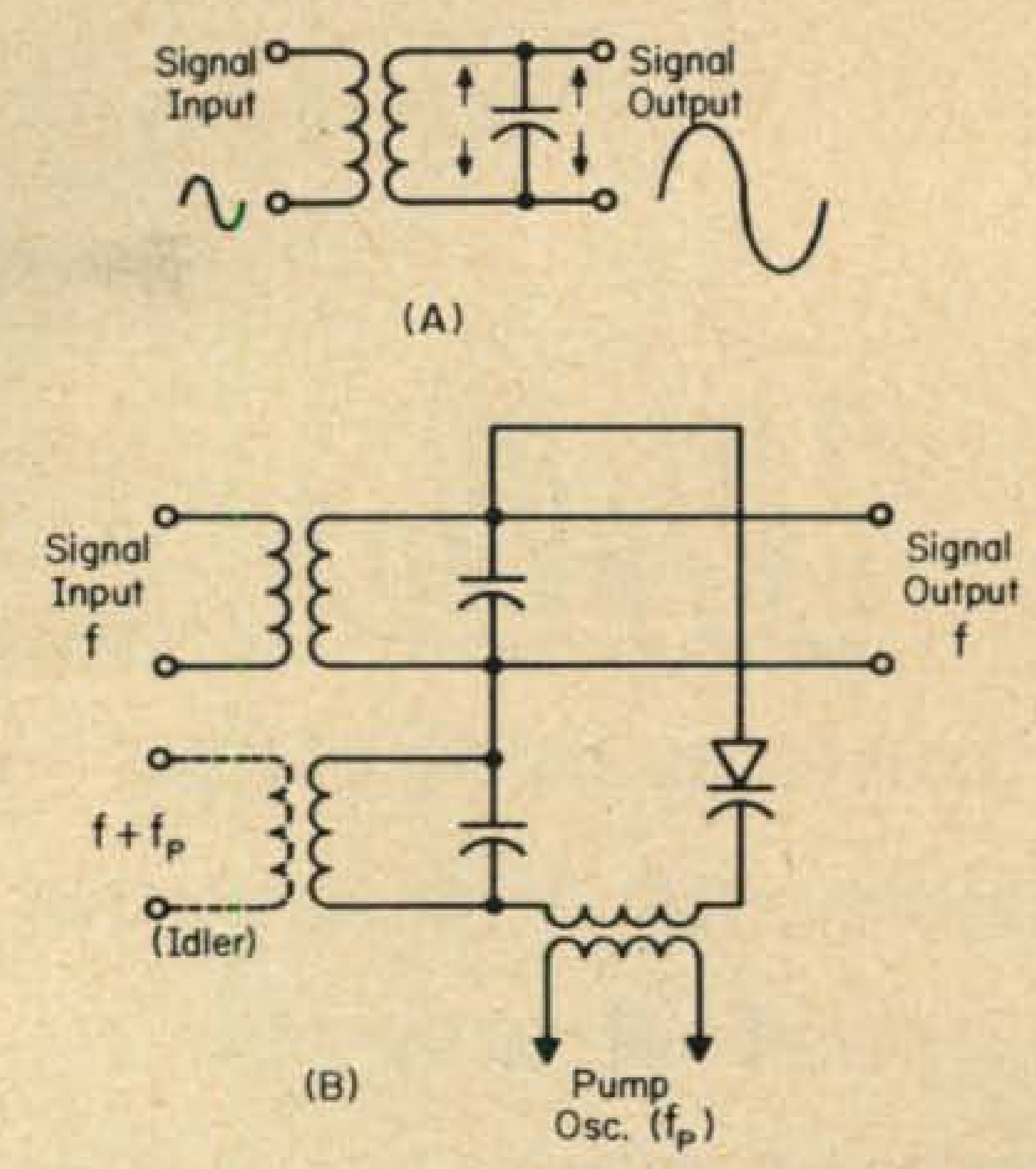

Fig. 5—Basic parametric amplifier principle (A) is reflected in practical basic circuit (B). The practical circuit requires the presence of either an $f + f_p$ or $f - f_p$ tank circuit. The output can be taken from this tank circuit and is said to be either up-converted or down-converted. Up converters generally perform much better. If the output is taken at the input signal frequency, the $f + f_p$ tank remains in the circuit as an "idler."

If the upper plate were then suddenly pulled away (fig. 4(B)) some energy would be necessary for this action. From the fundamental capacitance equation that the voltage across the capacitor is equal to its charge divided by its capacitance, it will be seen that the voltage across the capacitance must *increase* since its capacitance was reduced by pulling the upper plate away but the charge was not changed.

Figure 5(A) shows a variable capacitor as part of a tuned circuit. If the tuned circuit were tuned to the frequency of the input signal and if the capacitor were given an extra "pull" at just the right time when the input signal had charged the capacitor, the voltage amplitude of the input signal would be in-

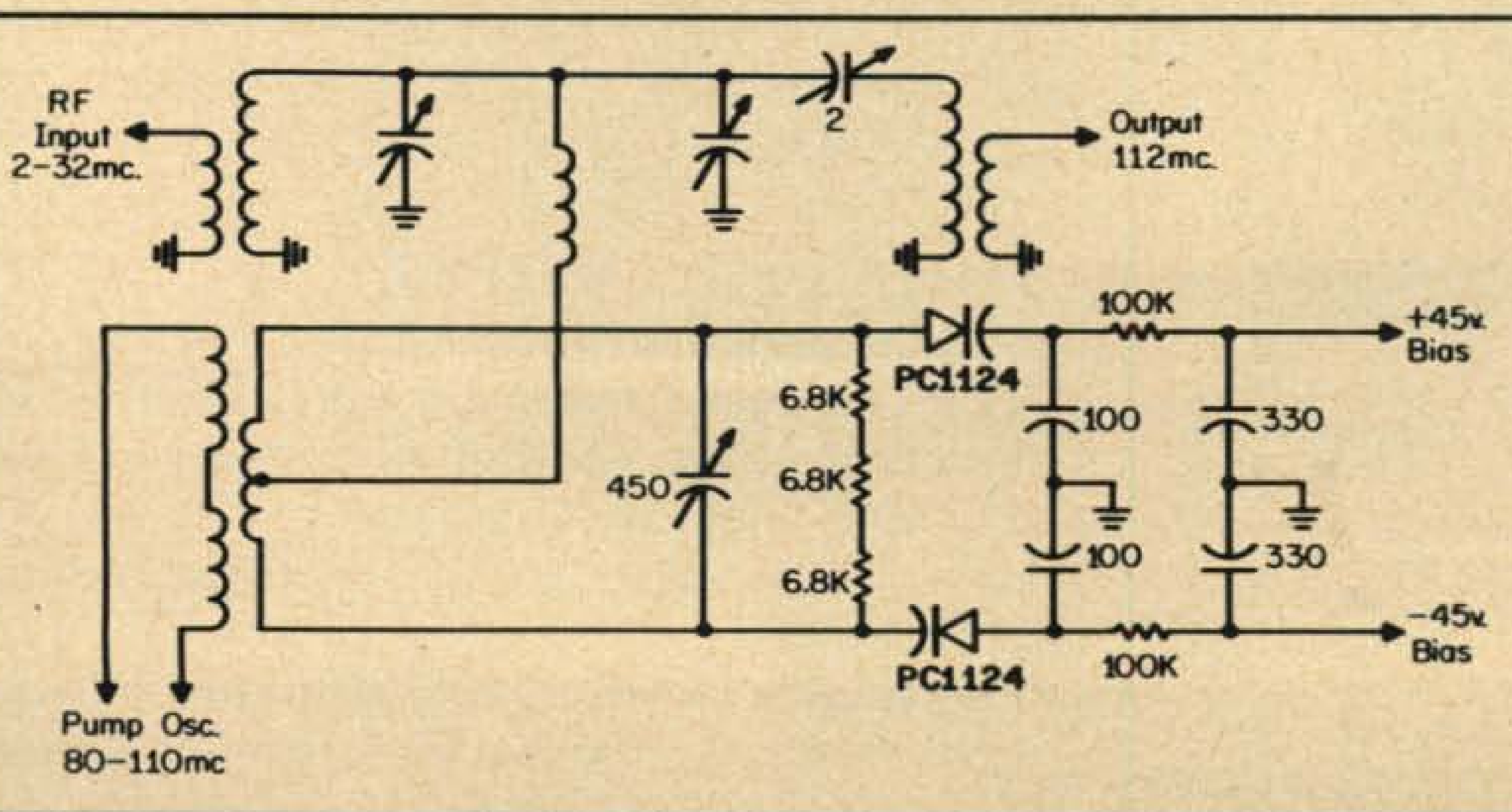

Fig. 6—Experimental high frequency parametric amplifier. Signal output is taken from equivalent of the "idler" tank shown in fig. 5 (B). Schematic courtesy USAEL, Ft. Monmouth, N.J.

creased. The extra "pull" at the right time is supplied by a pump oscillator (it "pumps" the varactor diode) in an actual parametric amplifier. Figure 5(B) shows the basic circuit arrangement of an amplifier. The power to amplify the input signal comes from the pump oscillator, not from any d.c. supply. The latter may be seen in an actual amplifier circuit but they are only for establishing the operating point on the varactor diode. The noise figure of a parametric amplifier can be very low since very low level current flow is involved in the various components. Cooled parametric amplifiers have achieved 1 db noise figures while even uncooled types can achieve very respectable 5-6 db noise figures. The noise figure is dependent upon the frequency of the pump oscillator and generally decreases as the pump frequency is made higher (up to 10 times the input signal frequency). On the other hand, the dynamic range of the amplifier is dependent upon the power level of the pump oscillator but, with sufficient power, can be in excess of 140 db. Such a figure exceeds that possible with almost all vacuum tube or transistor circuits.

More than any other diode amplifier, the parametric amplifier offers the possibility of achieving almost all of the desired properties for an ideal r.f. stage, low noise figure, extreme dynamic range, reasonable gain and circuit simplicity.

Figure 6 shows the circuit of an experimental 2-32 mc parametric amplifier. In this case, the signal output is taken from the "idler" circuit shown in fig. 5(B) and is upconverted. Another following mixer stage converted the signal down gain to the 2-32 mc range so the entire unit could be used ahead of a normal high frequency receiver. The unit provided a sensitivity of 1-2 microvolts at a 10 db s+n/n ratio into a 20 kc bandwidth. The dynamic range was 140 db with 2 watts of power from the pump oscillator and dropped to only 130 db when the pump oscillator level was reduced to 2/10 watt.

Summary

Diode amplifiers are still in a development stage for high frequency use, although the parametric type particularly is the backbone of many high performance u.h.f.-s.h.f. receiving systems. It is probably only a question of time before they burst into popularity for high frequency usage as other semiconductor developments provide the necessary complimentary circuit functions. ■

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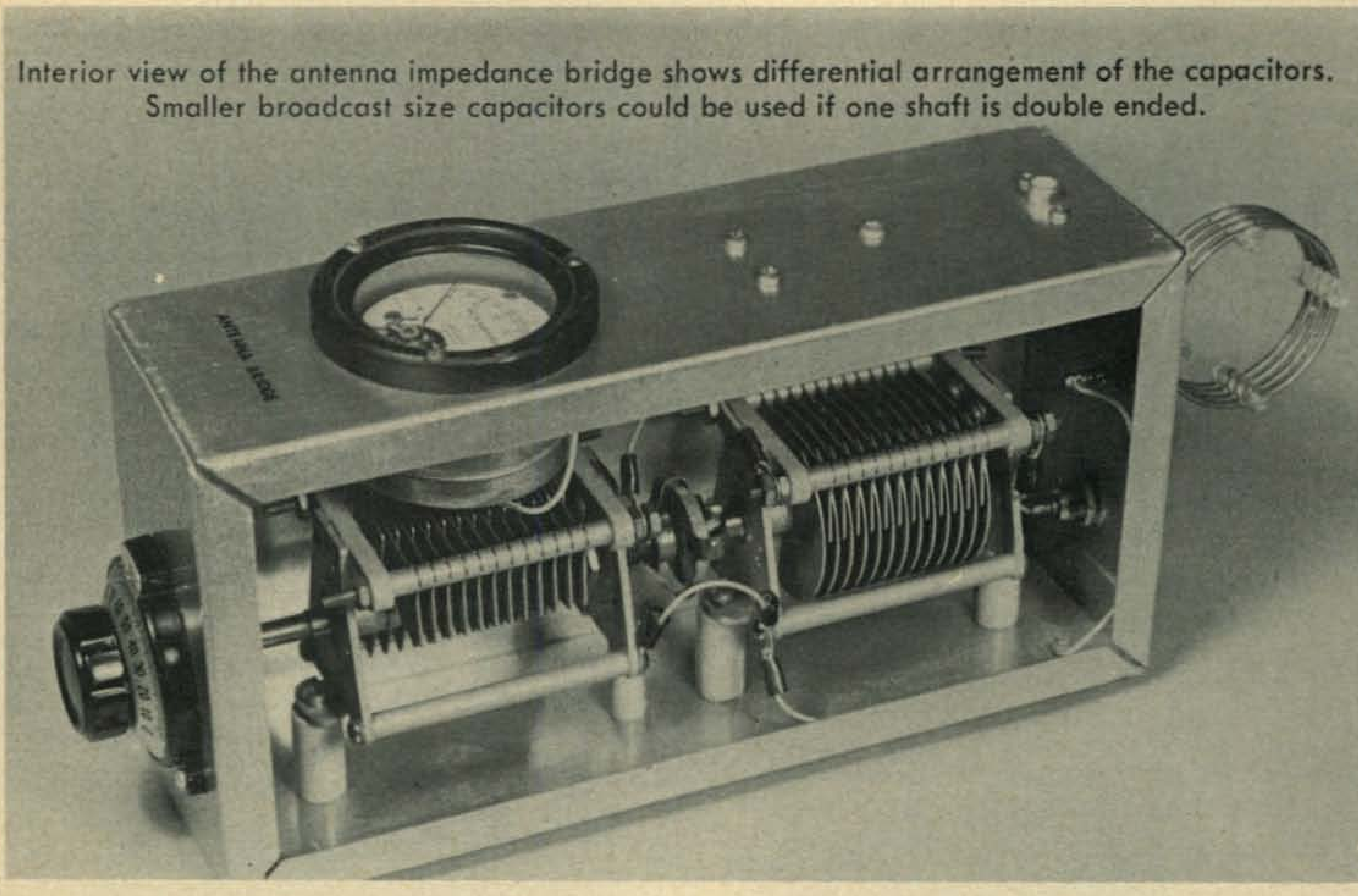

Interior view of the antenna impedance bridge shows differential arrangement of the capacitors. Smaller broadcast size capacitors could be used if one shaft is double ended.

Build A Simple Z-Bridge

Take The Guesswork Out Of Tuning A Sky-Hook.

BY WILLIAM S. GARDNER,* W4UOY

THIS simple impedance bridge, built in one afternoon using mostly junk-box parts, has proven to be a valuable addition to my station equipment. Used in conjunction with a grid-dip meter, it may be used to resonate an antenna, cut a length of transmission line to any multiple of a quarterwavelength, set the slope on a ground-plane for proper feed-point impedance or tune a beam. I have also used it to set the taps on an antenna tuner and to match the front end of a receiver to a 50 ohm transmission line.

Construction

Any identical variable air capacitors from 100 to 200 mmf may be used provided they have the type of shafts which may be ganged together. It is the ratio which is important, not their specific value. They should be ganged as a differential, that is, so the capacitance of one will decrease as the other increases. The mid-range null point is determined by the value of R_1 in fig. 1, which should be chosen to be the approximate value of the transmission line at your QTH.

The value of the coupling coil is not critical. I used a ten turn section of 12 gauge B&W stock because it gives a snug fit and is self-supporting in two standard tip-jack plugs.

I had a pair of E. F. Johnson 150 mmf capacitors in my junk-box and a 5″ × 6″ × 9″ chassis to house them. Admittedly they are a little large, and two capacitors with broadcast spacing would have fit into a much smaller box. They are tuned with an inexpensive 3 to 1 Japanese made vernier dial. Using the vernier made it necessary to make up a small calibration graph rather than have the read-out directly on the dial; however, the added accuracy afforded by the slower tuning rate seemed worth the extra effort.

If you do not happen to have a low range meter movement and do not feel like buying

*106 Castle Road, Mary Ester, Florida 32569

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one, tip jacks could be mounted instead and a VOM used in its place. Most VOMs have a microamp range which places the input directly across the meter movement (usually 100 microamps).

Tuning And Operation

The bridge is calibrated using a decade resistor box or a handful of 1% resistors. With the values shown, mid-range of the differential capacitors falls around 50 ohms. Bridge resistor R_1 should be the approximate value of the surge impedance of the transmission line, since the most complete null obtainable falls at this point.

To use the bridge to cut a length of transmission line to an exact quarter-wave. First cut the line to the approximate length, having it about 5% longer than the formula $L_{(feet)} = 246/f \times$ *velocity factor*. Connect the line to J_1, leaving it open at the far end. Position the grid-dip meter close enough to L_1 to give full-scale deflection of the meter. Vary the frequency of the GDO until a null shows on the meter. This is the frequency at which the length of line is an exact quarter-wave. If you have done your initial trimming correctly, this will be a lower frequency than the one of interest. Next, start trimming the line a little at a time, re-tuning the grid-dip meter for a null after each cut. When the null falls at the point where the grid-dip oscillator is heard on your station receiver, you are ready to put your connector on the other end and install it.

To cut a length of line to a half-wave, the procedure is repeated with the far end of the line shorted, using the formula $L = 492/f \times$ *velocity factor*. For odd multiples of a quarter-wave leave the line open. For even multiples, short the ends together.

To use the bridge to cut an antenna to resonance, care must be taken to insure that no reactive component remains. This is easy enough if the coupling between the grid-dip meter and the bridge is correct. First, connect a composition type resistor of the value of the characteristic impedance of the line to be matched, across J_1. Tune the bridge for a null and vary the distance between the g.d.o. and L_1 until this null falls at zero. Using the procedure already outlined, cut a length of transmission line to an exact quarter-wave length and connect it between the antenna terminals and J_1. (This line length is unimportant if you happen to have a balun of the correct value.)

Next, tune the g.d.o. until the signal is heard on your station receiver. Tune the bridge for a null and note the value on the meter. If this null does not fall at zero the antenna is not resonant at this frequency. In this case, vary the frequency of the GDO until a complete null shows on the meter. Then tune the bridge for a zero reading and you have the resonant frequency and input impedance of your antenna. If this frequency is lower than the desired frequency, the antenna is too long and must be shortened. If the frequency is higher than the frequency of interest, the antenna is too short and must be lengthened.

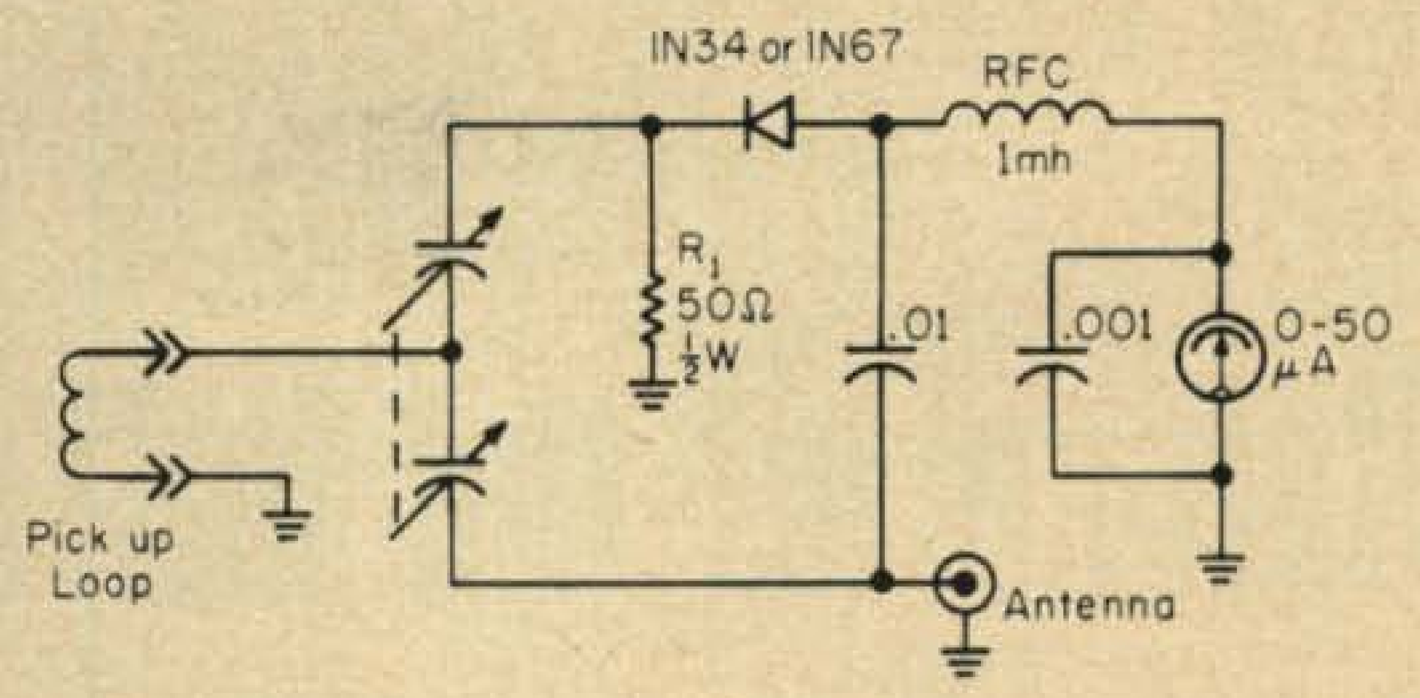

Fig. 1—Circuit of the antenna impedance bridge. Both stator and rotor of the differential capacitor must be insulated from ground.

Parasitic beams are usually mounted quite a bit higher than a half-wavelength above ground. Unless you have a tilt-over tower or happen to own a helicopter, tuning a homebrew beam can become quite a chore indeed. Perhaps this difficulty explains why so many commercial arrays are sold. With a prefabricated array you simply follow the manufacturer's instructions, hang the beam, and your only problem is replacing the hundred-

[*Continued on page 100*]

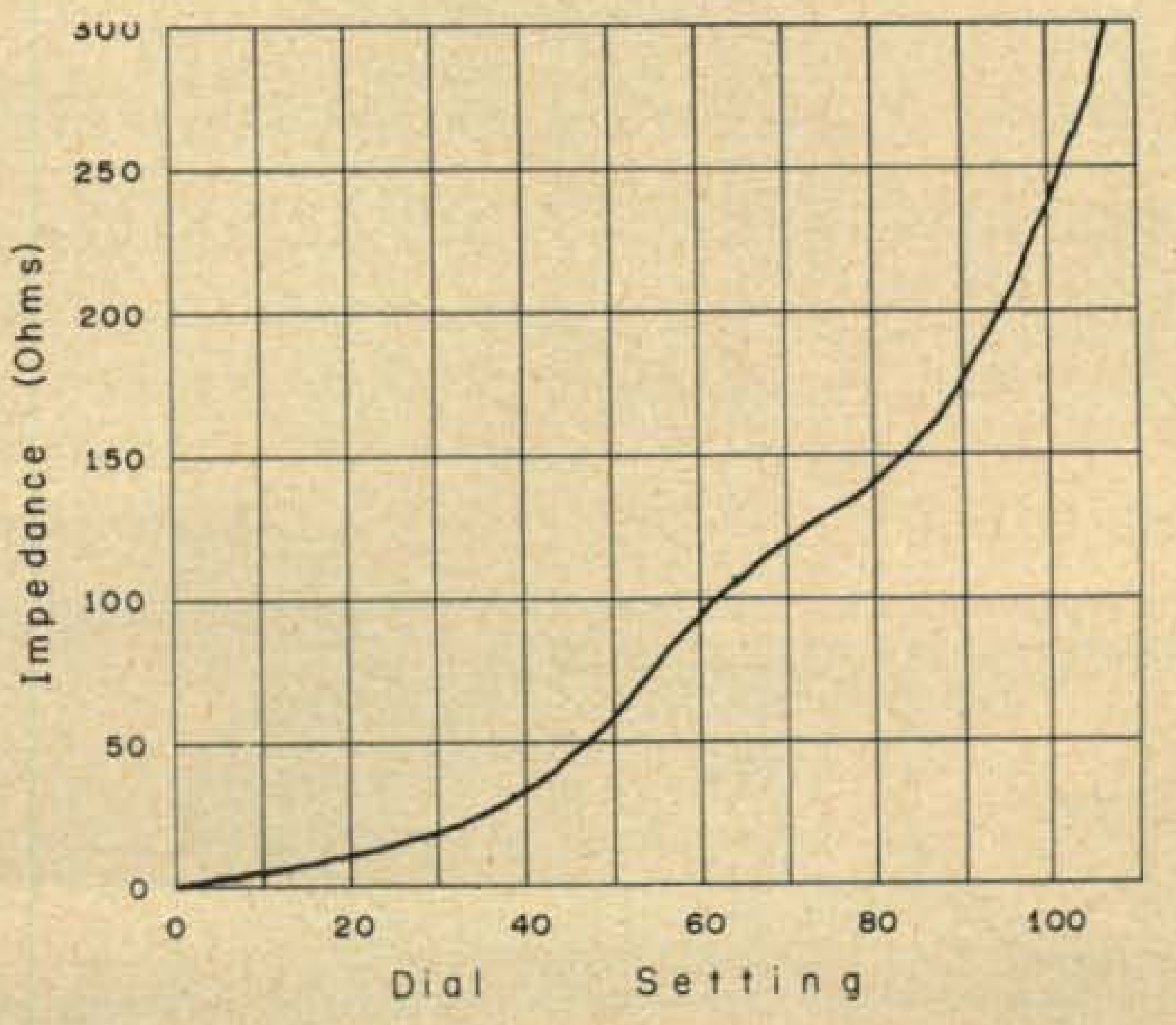

Fig. 2—Typical plot of dial calibration versus impedance.

 See page 110 for New Reader Service

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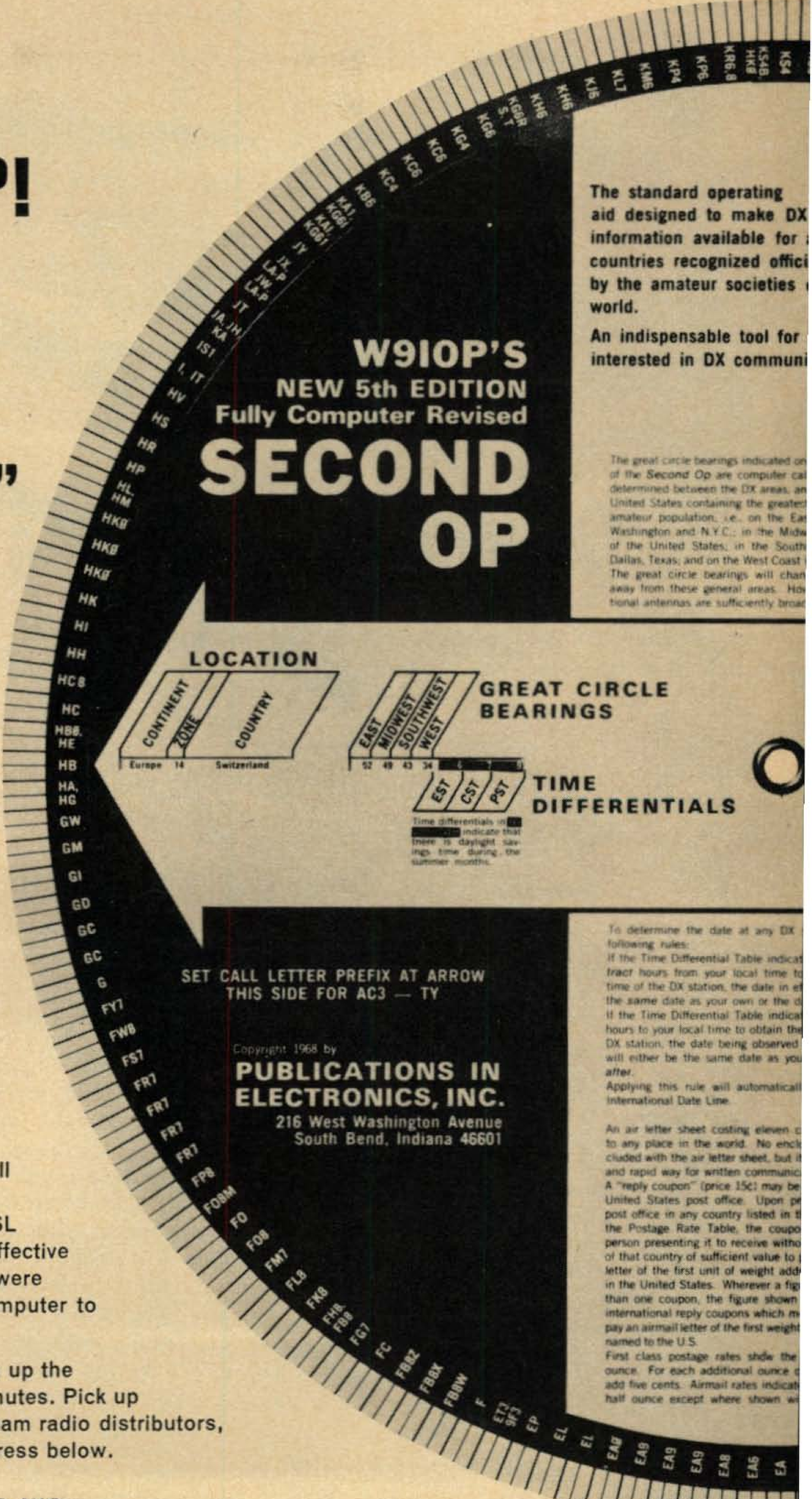

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View of a finished trap for the all band dipole antenna. Two are needed with the dimensions described in fig. 1.

Antenna Traps Using Linear Capacitors

BY W. J. PACE,* W1ILV

THE acquisition of a new all-band transceiver, with all its flexibility and ease of operating, made the need for an equally convenient antenna almost mandatory.

Under such easy band-change conditions, the old 75 meter dipole and its choice "air-space" could not bear up, and a search was made to find one that would truly permit the maximum switchability.

We rediscovered the all-band trap dipole described by Bucchanan in QST March, 1955. [1] This antenna had years ago proven its versatility in those features for which we were now looking.

It was recalled that no compromise in performance on both lower bands had to be made, and, on the higher bands, the slight gain achieved by the use of multiple half-waves in phase certainly did not hinder the DX ability of the antenna. It was decided! The 75 meter-dipole would give way to the shortened all-band trap dipole.

Trap Description

No originality is claimed for the antenna design here described, as it is patterned after several others covered in previous issues of various radio periodicals. The novel feature here is the use of "linear" capacitors in the design of the traps. This was enforced primarily because of the inability to acquire any of the capacitors described by other authors.

These traps are built utilizing a length of co-axial cable as a capacitor. As is common knowledge, most small coax, such as RG-11/U or RG-59/U, develops approximately a 25 mmf capacity between the inner and outer shield for every foot of length. It was reasoned this type of high voltage, high efficiency capacity would be most suitable in the design of this type of trap. Disposition of the length of cable required for 75 mmf gave some pause to the idea until a means of storing the extra length of cable could be

---

*Upland Road, Middlebury, Connecticut.

[1] Buchanan, C. L., "Multimatch Antenna System," *QST*, March 1955, p. 22.

See page 110 for New Reader Service

devised. Dangling 3½ feet of cable in mid-air would be most impractical from a design point of view.

The final result as shown in fig. 1 and photo has produced traps with an extremely high *Q* based on our rudimentary measurements, which can handle the full legal limit of power without problem.

As can be seen in the photo, the trap-support and insulator consists of a piece of heavy wall 1¼" diameter, fiber or plastic tubing about 5" long. These are the dimensions we used, but, of course, are most arbitrary and can be almost any practical size consistent with the tuned circuit required. It must be remembered, however, that the trap must have the strength necessary to support the weight of the structure under all weather conditions.

Coax Dress

As shown, the holes drilled in each end of the tube are used to mount screws which support one end of the coax as well as provide a means of fastening the antenna wire to the trap. The coax used in these designs was 30" long, and the ends were prepared as follows:

One end was clipped square and the balance dressed to clear any short to the inner conductor, covered with tape, and given a coat of Krylon plastic spray or coil dope. On the other end, the insulation was peeled off and the braid separated from the center conduit for approximately 2" and a solder lug affixed to each end. This prepared end is pushed inside the tubing and a solder lug is fastened under each screw at either end of the tube. The coil is then wound. It consists of 14 turns of #14 enamelled copper wire, close wound, and the ends terminated under the nut at each end of the tube.

Trap Frequency

At this point, the resonance frequency of the trap can be determined using a grid-dip meter. Fine adjustment to frequency can be made by spacing of the turns on the form. In our antenna, the center-frequency chosen on 40 meters was 7150 kc. This, of course, is dependent upon the mode used, whether phone or c.w., and must be decided by the user.

After the trap is tuned, it should be given several coats of Krylon spray lacquer to both affix the turns and weatherproof the whole assembly. Finally, the free end of the cable is threaded through the open end of the tube and pulled through three times. If the lengths are correct, the loose end should finally end up in the center of the coil form, making a small tight package. The whole trap is then given several more coats of spray to insure weatherproofing.

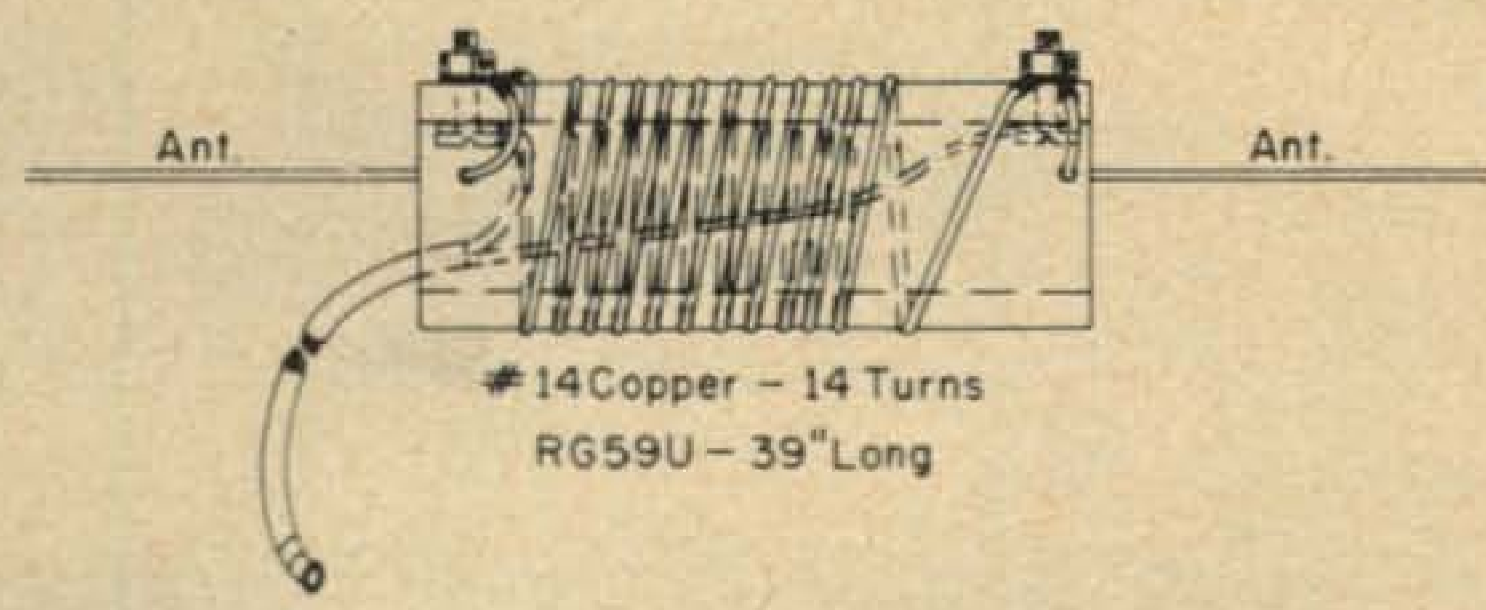
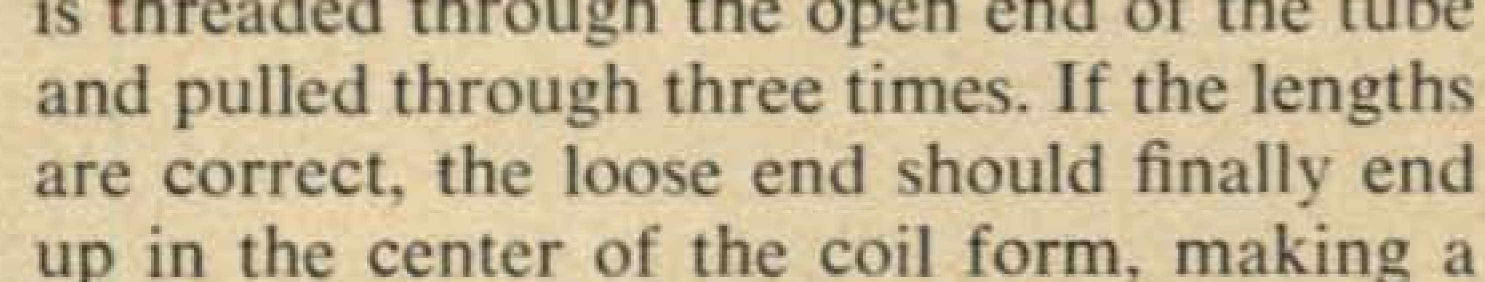


Fig. 1—Trap construction details for the all band trap dipole antenna. The winding is 14 turns of #14 enamelled wire on a 1¼" diameter form, 5" long. The RG-59/U forming the capacitor is 39" long.

S.W.R.

Standing wave ratio measurements have been made covering all bands and, depending on the choice of lengths, center frequencies can be determined at reasonably low standing wave ratios. All bands will *not* give 1 to 1 ratios. This is impossible in this type of design. All, however, will be acceptable.

[*Continued on page 102*]



Band	L¹	L²	f reson.	S.W.R.
80	34′	21′	3.75 mc	1:1.7
	32′	21′	3.90 mc	1:1.7
40	34′	21′	7.00 mc	1:1.9
	32′	21′	7.10 mc	1:1.4
	34′	21′	14.00 mc	1:1.8
20	32′	21′	14.10 mc	1:1.6
	32′	20′	14.20 mc	1:1.6
	34′	21′	21.00 mc	1:1.9
15	32′	21′	21.20 mc	1:2
	32′	20′	21.35 mc	1:2
	34′	21′	28.30 mc	1:1.5
10	32′	21′	28.50 mc	1:1.8
	32′	20′	28.65 mc	1:1.8

Fig. 2—Dimensions for the lengths of L_1 and L_2 for various portions of the 80, 40, 20, 15 and 10 meter bands.

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View of the loop antenna mounted on a wooden pole driven by a TV type rotator. The two fittings on the sides of the loop were used for vertical rotation experiments and are not needed for the application described in the text.

A Top Band Loop Antenna

BY RICHARD A. GENAILLE,* W4UW

THE recent revision of amateur frequency assignments and power maximum in the 1.8 to 2.0 mc band, the availability of the new Heathkit HW-18 series s.s.b. transceiver, and the approach of winter with improved band conditions is certain to rekindle the interest of many hams and produce an increase in the amount of activity on the 160 meter band. It suffices to say that increased activity also means increased QRM.

The author regained interest in the top band several years ago by designing and constructing a transmitter described in *CQ*.[1] Operation of this transmitter on the 160 meter band during the past few years has convinced the author that a need exists for a simple, rotatable, receiving type directional antenna to help lick the intereference problem. There isn't too much one can do about constructing a full size, rotatable antenna for transmitting and receiving on the 160 meter band. The mechanical problems would be tremendous, to say the least.

Since, generally speaking, most stations use omnidirectional antennas for receiving and transmitting on the top band the most reasonable approach is to attempt to provide some means of directional discrimination for receiving. The purpose of this article is to describe a simple approach to the construction of a directional loop antenna for receiving on the top band.

Loop Theory

The usefulness of loop antennas in rejecting unwanted signals is well known and accounts for the wide use of loops, for direction finding, aboard aircraft and vessels. Amateurs have used loops on all bands although loops of small physical size in comparison to the wave length at which they are being operated are primarily used on frequencies below 4 mc for direction finding in transmitter hunts. The physical arrangement of a loop antenna need not be restricted to a circle and shapes such as squares, triangles, octagons, and diamonds are often used. The mechanical simplicity of the circle makes this shape most desirable, however. Whatever physical arrangement the loop assumes, maximum directivity will be along the plane of the loop with a pronounced null at right angles to the plane. This null or minimum can be extremely sharp in a well designed loop providing accuracy of one degree or better in low frequency direction finding application. The antenna pattern is

*719 Quarterstaff Road, Winston-Salem, North Carolina 27104.

[1] Genaille, R. A., "A Top Band SSB Transmitter," *CQ*, September 1967, p. 33.

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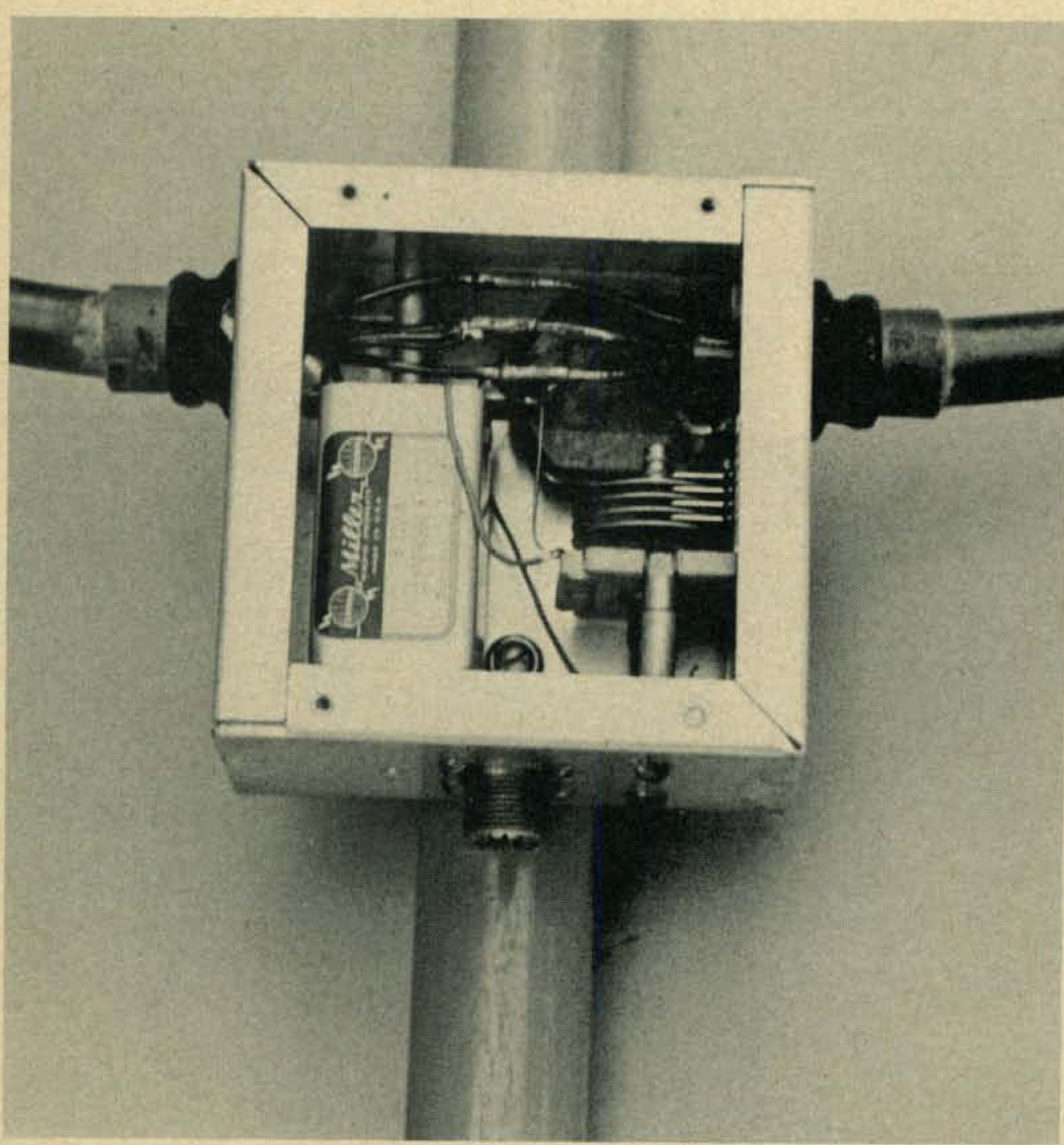

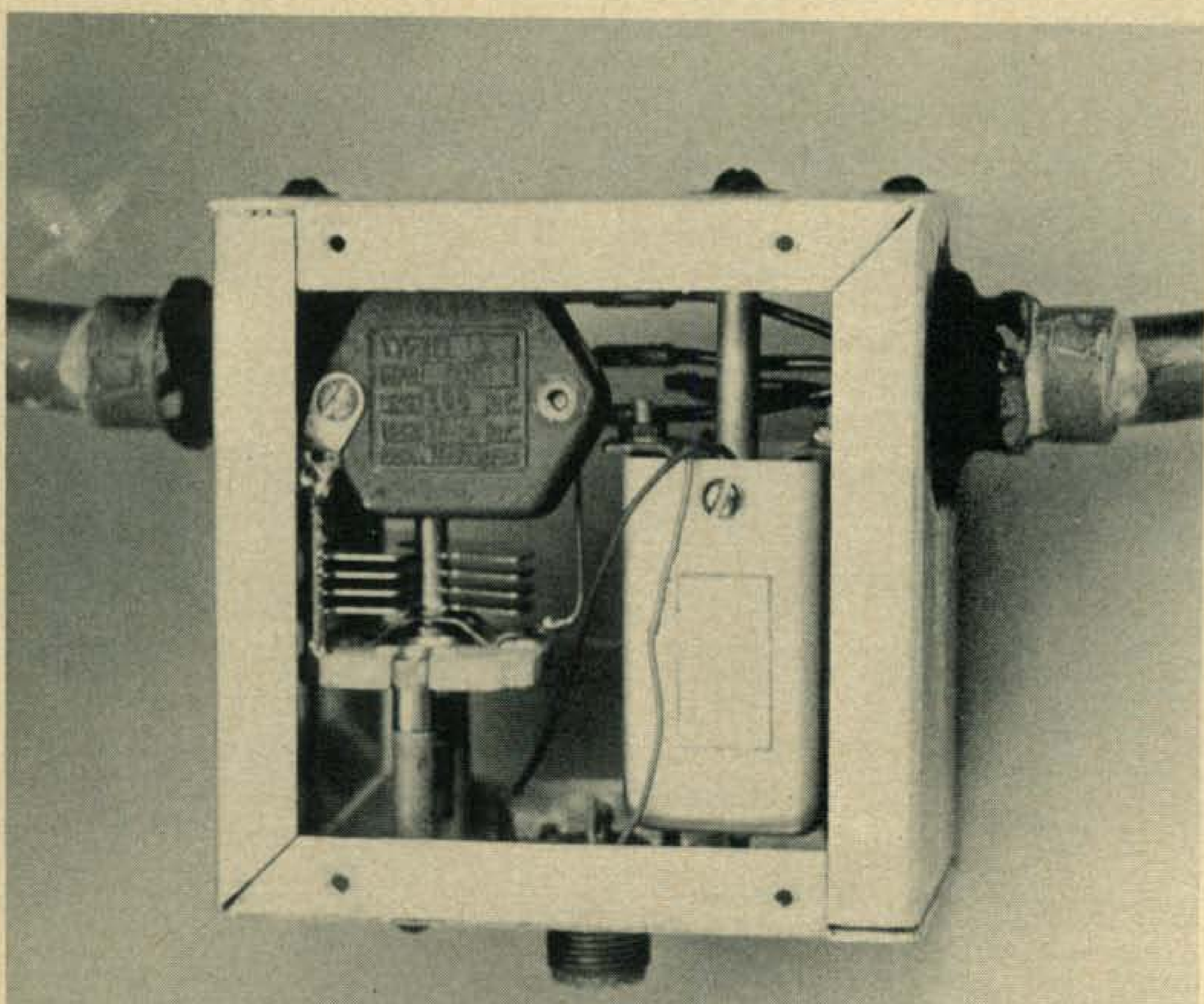

Front and rear views of the aluminum housing that contains the impedance matching network.

very much like the familiar figure 8 field pattern of a doublet antenna.

Electrically, the loop senses the direction of signal sources by virtue of the voltages induced in the loop wire by electromagnetic waves generated at the source. The induced voltages in turn produce a current flow depending upon the positioning of the loop with respect to the electromagnetic wavefront. When the loop is exactly broadside to the incoming wavefront a current cancellation is effected which results in little or no signal voltage appearing at the loop feedpoint. Repositioning the loop with respect to the incoming wavefront causes an unbalance with incomplete cancellation of current and consequently a signal voltage at the feedpoint.

The null property of the loop antenna, which makes this type of antenna so useful for direction finding by nulling out signals, can also be used for discriminating against interfering signals providing that these signals are not coming in from the direction in which we wish to receive. It can easily be understood from previous discussion, that a loop will have two nulls one at zero and one at 180 degrees. This presents certain complications when using the loop for direction finding but not when discriminating against interfering signals such as we wish to do. Good loop electrical balance is required for accuracy in direction finding work and, although the loop circuit design shown is not perfectly symmetrical, excellent results may still be obtained even though the bearing accuracy may be impaired. Since signal discrimination is the prime function of the subject loop, and not direction finding, bearing accuracy is not of major importance.

See page 110 for New Reader Service

Static electricity in the air is a source of much noise in 160 meter band reception, in fact, static noise level is what accounts for the rather limited activity on this band during the summer months. Static noise pickup is greatly reduced by enclosing the loop wires in a non-magnetic shield. To enhance the over-all receiving signal-to-noise ratio the loop wires are completely enclosed by a copper tubing shield except for a narrow transverse gap or break at the apex of the electrostatic shield. The noise reduction capability of the shielded loop should increase operational activity during those periods when the static noise level is high or when high levels of man-made noise are encountered.

Circuit Arrangement

The loop antenna shown in the photograph can be tuned over the major portion of the 160 meter band with the components specified in the schematic diagram. The feedpoint impedance will be very close to 52 ohms. The construction of the loop is quite simple and straightforward and the cost of the materials used represents a very small investment for the results obtained. All of the components of the loop antenna circuit are readily available.

The schematic of the loop is shown in fig. 1. Winding L_1 is a continuous loop made of 4 turns of #12 enameled or formvar insulated wire. Transformer T_1 is a matching transformer with slug tuning which, with capacitor C_1, tunes the loop to the desired frequency. The capacitors and transformer are housed in an aluminum box with suitable dimensions to permit freedom in making the necessary internal connections.

The electostatic shield for the loop wires is made from a length of soft drawn copper tubing with a 1/2 inch inside diameter. This tubing is available from Sears Roebuck or any plumbing supply house. A length of inexpensive plastic hose with a 3/8 inch outside diameter is used inside the copper tubing to protect the loop wires when pulling them into the tubing loop. The hose is not absolutely necessary but it may help prevent abrasion of the wire insulation and subsequent operational troubles. The plastic hose also provides additional loop rigidity lost by the necessity for a gap in the copper tubing at the apex of the loop.

Construction Details

The first step in the construction of the loop proper is to stretch out about 6½ feet of copper tubing on a level floor and straighten the tubing so as to remove all bends. After the tubing has been straightened, solder a 1/2 inch copper tubing-to-outside thread adapter to each end of the copper tubing. Next, measure to the exact center of the length of tubing and make a suitable reference mark for future cutting. A piece of masking tape will do quite well. The loop can now be formed into a 2 ft diameter circle by using a suitable form. The author used a hot water tank having a diameter of 2 feet as a form. Using a tubing cutter or hacksaw cut the tubing at the center of the loop. A 2 inch long piece of plastic pipe having an inside diameter of 5/8 inch can be slipped over the center cut to hold the apex of the loop together during the plastic hose and wire threading operations that are to follow. The plastic pipe is of the variety used for cold water lines in many areas. If the plastic pipe is used care must be taken to insure that the copper tubing ends at the apex do not make contact. A small air gap must be maintained between the two

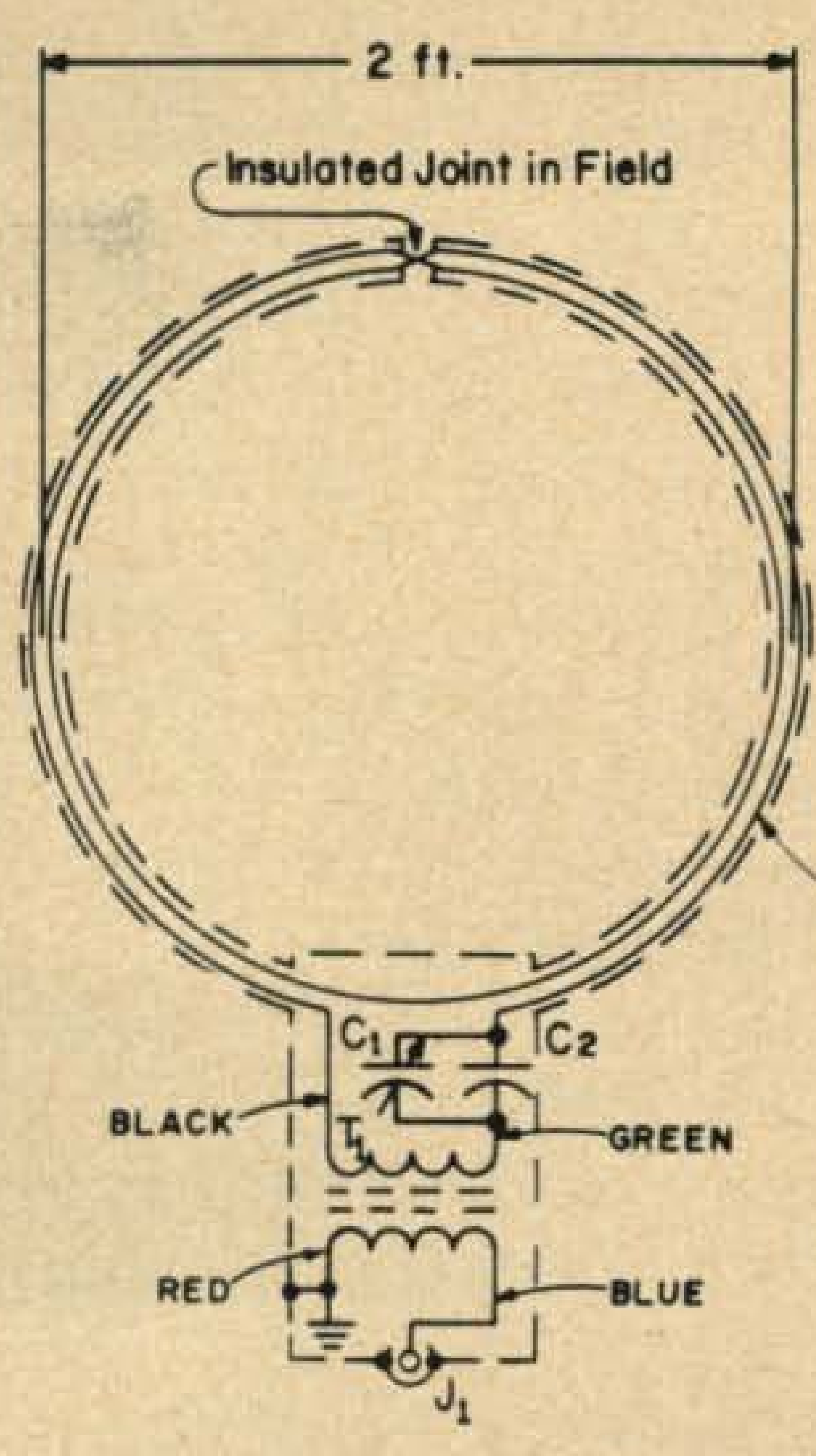

Fig. 1—Schematic of a 160 meter loop antenna and impedance matching network. The network is contained in a 4" × 4" × 2" aluminum box and is fed to a 52 ohm line. The loop is formed from a 6½' length of 1/2" i.d. soft drawn copper tubing.

C_1—4.6—51 mmf variable capacitor. E. F. Johnson 167-3 or equiv.
C_2—100 mmf mica capacitor.
J_1—U.H.F. type coax connector, SO-239.
L_1—4 t. #12 e. wire wound as directed in text.
T_1—Antenna coil, J. W. Miller #B-320-A or equiv.

sections of copper tubing in order for the antenna to function properly.

Insert a 7 foot length of plastic hose into one end of the copper tubing loop and, by working it slowly, pass the hose through the tubing so that equal lengths of hose remain outside at each end of the tubing. At this point, four 7½ foot lengths of #12 insulated wire should be pulled through the hose and tubing with equal lengths of wire remaining outside at each end of the tubing.

Before fitting the loop to the aluminum box cut back the excess plastic hose. The wire insulation should be removed by scraping or by using paint and varnish remover, making sure that the insulation is not removed where the wires begin to "bundle" upon entering the tubing, and the wire ends tinned. The tinned wire ends should not be permitted to short together.

Assuming that suitable size holes have been cut in the aluminum box at the appropriate locations, screw a conduit nut up on each tubing adapter as far as possible. Fit the adapters into the aluminum box and secure the adapters with conduit nuts inside of the box.

The wire ends should be soldered so that one continuous loop is made. Identifying the individual wire ends may be accomplished by using an ohmmeter or a dry cell and buzzer or pilot light combination. After the loop wires are all connected the remaining components may be mounted approximately as shown in the photographs and the wiring inside of the aluminum box completed.

The loop proper is now electrically complete and should be mounted in a manner convenient to the builder. The author mounted the loop and associated box on a 5′ length of 2¼ inch o.d. wooden closet pole. Don't use a metallic support for the loop proper otherwise the electrical operation of the loop may be impaired. As shown in the photograph, a simple TV antenna-type rotator was used for antenna rotation. The fitting on the sides of the loop, that show up in the photograph, are not necessary. These were originally installed by the author to permit rotation in a vertical plane; however, the improvement in electrical results did not justify the additional mechanical complications of being able to rotate the loop in two planes. To help keep water out of the tuning box the author "gunked" around the tubing adapters, on the outside of the box, with plastic rubber cement.

Tuning and Impedance Matching

Tuning the loop to resonate in the 160 meter band is not much of a problem. It is accomplished in the same manner as tuning and impedance matching of other types of antennas for this band or other bands. A standing wave ratio bridge or reflected power meter can be used. Connect the bridge or reflected power meter to the loop antenna coax connector through a short length of 52 ohm coax cable, feed the bridge or reflected power meter with signal of the appropriate frequency and adjust capacitor C_1 and the slug in transformer T_1 for minimum reflected power. A standing wave ratio very close to 1:1 should be obtained at the adjustment frequency.

While the design of the top band loop is not perfectly symmetrical excellent nulls may still be obtained provided that the loop is not installed in close proximity to power lines, other antennas, gutters, downspouts, or other large metallic objects. Reradiation from nearby metallic objects acting as antennas may be as strong or stronger than the direct signal received by the loop resulting in poor null response and, consequently, unsatisfactory loop operation.

Operation of the loop needs little comment. After connecting the loop antenna feedline to the receiver and listening for signals one will find that the signal levels are lower than those obtained on the regular station antenna but that the signal-to-noise ratio will be somewhat improved over the conventional station antenna. Rotation of the loop, when listening to a signal, should produce two very sharp nulls broadside to the plane of the antenna loop where the signal is completely eliminated or considerably attenuated. You will also notice that once the null position has been passed the received signal will stay almost at the same level while the loop is being rotated through 180 degrees to the opposite side null. Weaker signals which previously were drowned out by QRM and QRN can now be copied by nulling out the QRM providing the QRM is not arriving from the same direction as the desired signal.

The 160 meter band promises to become more active than ever. Constructing the top band loop antenna described in this article will give you a distinct advantage over interference and static noise conditions and will increase your operating pleasure considerably. ■

See page 110 for New Reader Service

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VERTICAL ANTENNAS

Part VIII

BY CAPTAIN PAUL H. LEE,* W3JM

Part IV, dealing with directional arrays, aroused considerable interest. In this part the author discusses the design of a specific array and its feed system. This array is easily adaptable to multi-element switchable configurations for changing direction of transmission.

SINCE the publication of Part IV[66], there has been considerable reader correspondence concerning the detailed design of directional arrays and their feed systems. Most of the inquiries have concerned the two-element array with 90° spacing and 90° phasing, and ways of switching three or four elements in pairs in order to use this two-element array for transmission in several selectable directions. Examples of this are three elements in an equilateral triangle, or four elements in a square, with 90° sides, with means of switching to any pair of them at one time.

Outlined below are the complete details of the design of a two-element array with 90° spacing and 90° phasing, and the design of its feed system and antenna matching units. This configuration will give only 3 db gain over the radiation from a single element, in spite of some claims of 6 db made by others.

*5209 Bangor Drive, Kensington, Md. 20795

[66]Lee, P. H., "Vertical Antennas—Part IV", *CQ*, Sept. 1968, p. 37.

A	B	C	D	E	F	G	H
ϕ	Cos A	S x B	C + ψ	Cos D	1+E	$\sqrt{F}$	KxG
0°	1.000	90.0	180.0	-1.00	0	0	0
10°	.985	88.7	178.7	- .99	.01	.1	13.8
20°	.940	84.6	174.6	- .99	.01	.1	13.8
30°	.866	77.9	167.9	- .98	.02	.14	19.3
40°	.766	68.9	158.9	- .93	.07	.26	35.9
50°	.643	57.9	147.9	- .85	.15	.39	53.8
60°	.500	45.0	135.0	- .71	.29	.54	74.5
70°	.342	30.8	120.8	- .51	.49	.70	96.5
80°	.174	15.7	105.7	- .27	.73	.85	117.3
90°	0	0	90.0	0	1.00	1.00	138.0
100°	- .174	-15.7	74.3	.27	1.27	1.12	154.6
110°	- .342	-30.8	59.2	.51	1.51	1.23	169.7
120°	- .500	-45.0	45.0	.71	1.71	1.31	180.7
130°	- .643	-57.9	32.1	.85	1.85	1.36	187.7
140°	- .766	-68.9	21.1	.93	1.93	1.39	191.8
150°	- .866	-77.9	12.1	.98	1.98	1.40	194.6
160°	- .940	-84.6	5.6	.99	1.99	1.41	195.6
170°	- .985	-88.7	1.3	.99	1.99	1.41	195.6
180°	-1.000	-90.0	0	1.00	2.00	1.41	195.6

T:ble I—Data for the computation of antenna radiation pattern.

It is impossible to obtain 6 db gain from two elements in any configuration. Three elements are required. Maximum in-line gain from two elements is 4.74 db, and this is with 30° spacing and 165° phasing. Readers are refered to references 39, 40 and 41 of Part IV for complete details of directional designs and patterns, and gains obtainable.

Pattern Computation

The first step in the design of any array is the pattern computation. This is a rather laborious process if one does not have a digital computer handy. It requires use of a slide rule and trigonometric tables, and a quick ability to visualize angles of more than 90° and their sines and consines. For pattern computation for ground wave only, and where the two tower currents are equal, the equation; $E = K\sqrt{1 + \cos\,(S \cos \phi + \psi)}$ is an easy one to use, where S is the spacing in degrees, ϕ is the azimuth angle, ψ is the phase angle, and K is a constant which depends on the r.m.s. of the mathematical plot.

For the array in question, S is 90°, ψ is 90°, ϕ is taken every 10° from 0° through 180°, and the computations are tabulated as shown here. For simplicity in labelling the columns, each is given a capital letter designation in Table I.

Columns A through G can be computed directly from the equation and the given values of S, ϕ and ψ. The next step is the determination of K, in order to produce column H which is a tabulation of unattenuated field intensity at one mile in millivolts per meter, for 500 watts radiated power using

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two quarter wave elements. The first thing to be done is to find the r.m.s. of the pattern. This is done by adding up Column *F*, multiplying it by 2 (to get the whole pattern from 0° through 350°), then subtracting one set of values for 0° and 180° (so that they are not added in twice), dividing by 36, then taking the square root of what remains, thus:

$$\begin{array}{rr} \text{Sum of column } F = & 19.00 \\ & \times 2 \\ \hline & 38.00 \\ & -0.00 \\ \hline & 38.00 \\ & -2.00 \\ \hline & 36.00 \end{array}$$

$$\frac{36.00}{36} = 1.00$$

$$\sqrt{1.00} = 1.00 \text{ r.m.s. of pattern.}$$

$$1.00 = 138 \text{ mv/m for } \lambda/4 \text{ elements.}$$

$$K = 138$$

The pattern can be plotted in mv/m, in which case Column *H* is plotted, or it can be plotted normalized to its r.m.s. When one is discussing array theory and design, the plot is usually normalized to an r.m.s. of 1.00 so that the plot shows the gain or loss at any particular azimuth angle ϕ. The plot of the above computations is shown on this basis in fig. 76, which is the same as fig. 27 in Part IV. It will be seen that the voltage (field intensity) gain at 180° is 1.41. The power gain is therefore 2, and this equals 3 db.

In the event that you are a bit confused by the mathematics above, let's say that in the case of an in-line array the pattern will be the same on both sides of the line of towers. Hence the tabulation stopped at 180°. There is no need to carry it on to 360°, for the values will be identical to those already tabulated. However, in computing the r.m.s., one must include 36 items, and only 36. Hence the doubling of the sum of Column *F*, and the subtraction of one set of 0° and 180° items which would otherwise appear twice in the summation. It is purely happenstance that the sum of Column *F* comes out as it does, and that the r.m.s. of the pattern is 1.00, in the above case. It does so because of the 90°

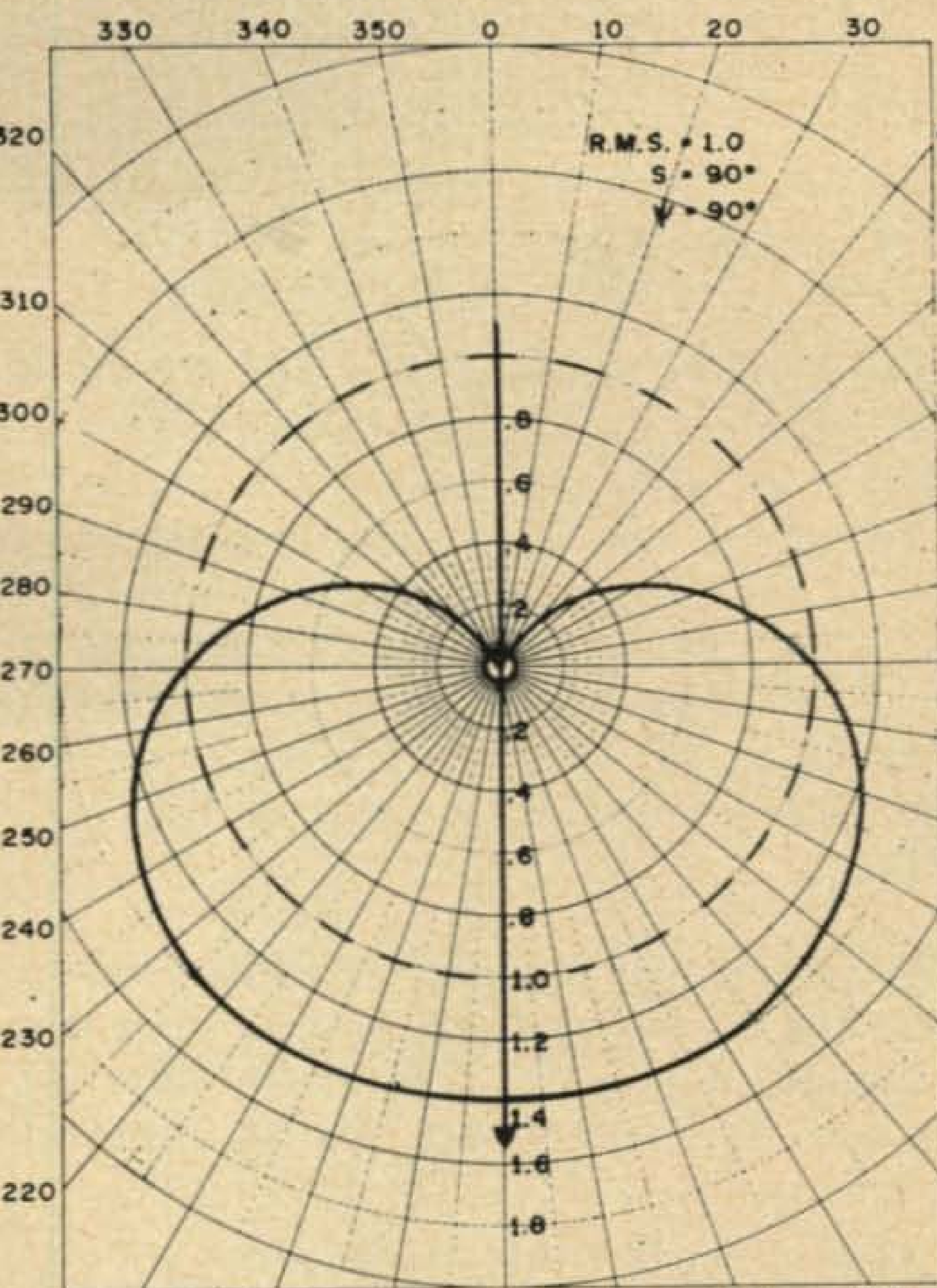

Fig. 76—Polar pattern for the design problem illustrated in the text.

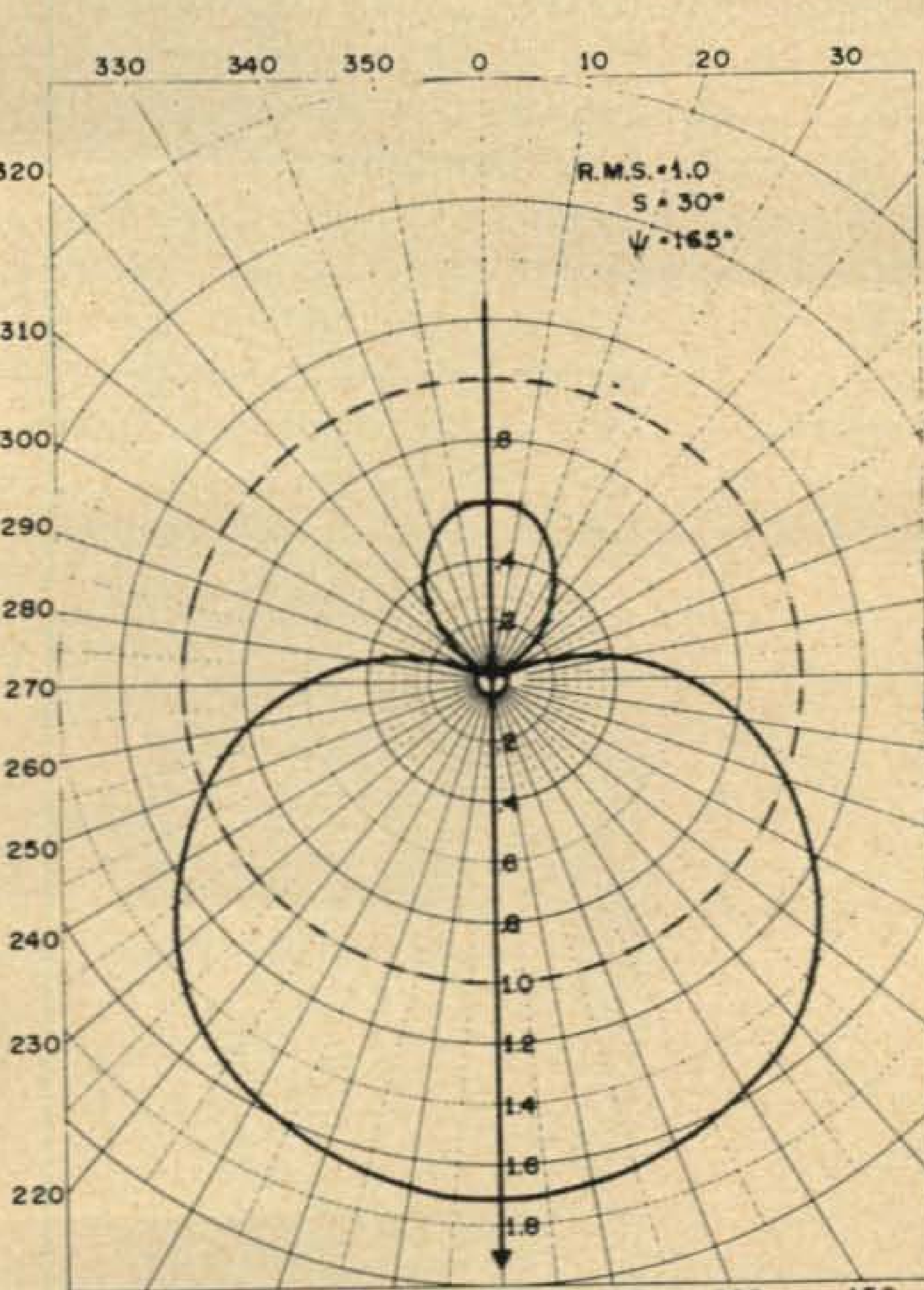

Fig. 77—Polar pattern for a vertical array with a spacing of 30° and a phasing of 135°.

A	B	C	D	E	F	G	H	I	J
ϕ	CosA	.985B	S×C	D+ψ	CosE	1+F	$\sqrt{G}$	965H	K×I

Table II—Headings needed for tabulation of data for vertical pattern computation.

phasing and 90° spacing. It would not do so with other values. For example, if I were to tabulate the computations for the case of S = 30° and ψ = 165° (maximum in-line gain of 4.74 db), the sum of Column *F* would be 1.871, and when the r.m.s. is computed it would be 0.308. For an r.m.s. of 138 mv/m, *K* would be 448. Figure 77 is a plot of this pattern, normalized to an r.m.s. of 1.00.

Vertical Pattern

In commercial practice we often need to know the vertical pattern as well. This can be computed in a like manner, by inserting the vertical angle θ into the formula, as shown here:

$$E = K\, f(\theta)\sqrt{1 + \cos\,(S \cos\phi \cos\theta + \psi)}$$

The vertical shape factor $f(\theta)$ was discussed in Part IV, and it depends on the tower height *G* in degrees. For the case of quarter wave towers used here, $f(\theta)$ is 0.965 when θ is 10°. Cos θ is 0.985 when θ is 10°. The table of computations would thus look like Table II as a start. There is no point in finishing it as it would not accomplish very much except to use up space. A similar table would be required for each value of θ, every 10 degrees. In broadcast consulting work, this is required by the FCC for directional arrays. Let me summarize by saying that for in-line arrays, the vertical pattern of the main lobe in the line of towers is generally a bit more flat than that from one tower alone, the vertical pattern broadside to the line of towers is the shape of that of one tower alone, and the vertical pattern at other angles has to be computed to be known accurately. But in our case, let's not worry about the exact vertical pattern of this array, and get on with the design of the system.

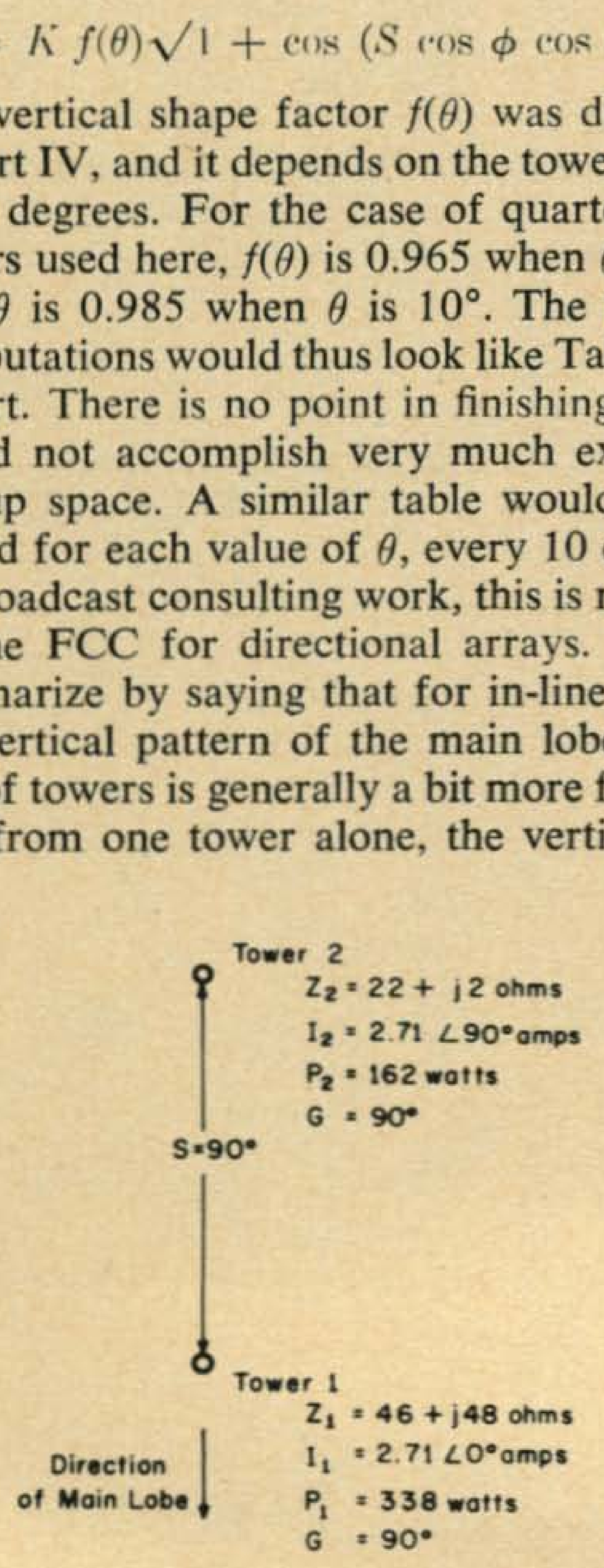

Fig. 78 — Array configuration of the design example discussed in the text.

Element Self-Impedance

Now that we have the array parameters, how do we feed it? The first step is a determination of the self-impedance of the elements (which are called towers). The array designer has to start somewhere, and that place is with published plots of *R* and *jX* versus tower height in wavelengths. Let's assume that this array is to be designed for 3.9 mc. A tower height of 60 feet would be about right for a quarter wavelength. An effective diameter of 7 inches would be reasonable. L/D would therefore be about 100. Referring back to Part II[67] it will be found that K_a for this value of *L/D* is 599. Or K_a can be computed from the equation:

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

Again referring to Part II, figure 13, for a tower height of a quarter wave and K_a of 600, R = 34 ohms and $X = +j25$. The next step is the computation of the effect of the mutual impedance between the towers, and the actual operating impedances of each tower. Again refering to Part IV, fig. 32, we find that the mutual impedance between towers 1 and 2 equals 23−*j*12 ohms, for the 90° spacing of two quarter wave elements.

The equations for the operating impedances of the two towers when connected in the array are:

$$Z_1 = Z_{11} + \frac{I_2}{I_1} Z_{21} \text{ and}$$

$$Z_2 = Z_{22} + \frac{I_1}{I_2} Z_{12}$$

where Z_{11} is the self-impedance of tower 1 by itself,

Z_{22} is the self-impedance of tower 2 by itself,

I_1 is the base current (loop current) of tower 1,

I_2 is the base current (loop current) of tower 2,

Z_1 is the actual operating impedance of tower 1 in the array, and

[67] Lee, P. H., "Vertical Antennas–Part II", *CQ*, July 1968, p. 25.

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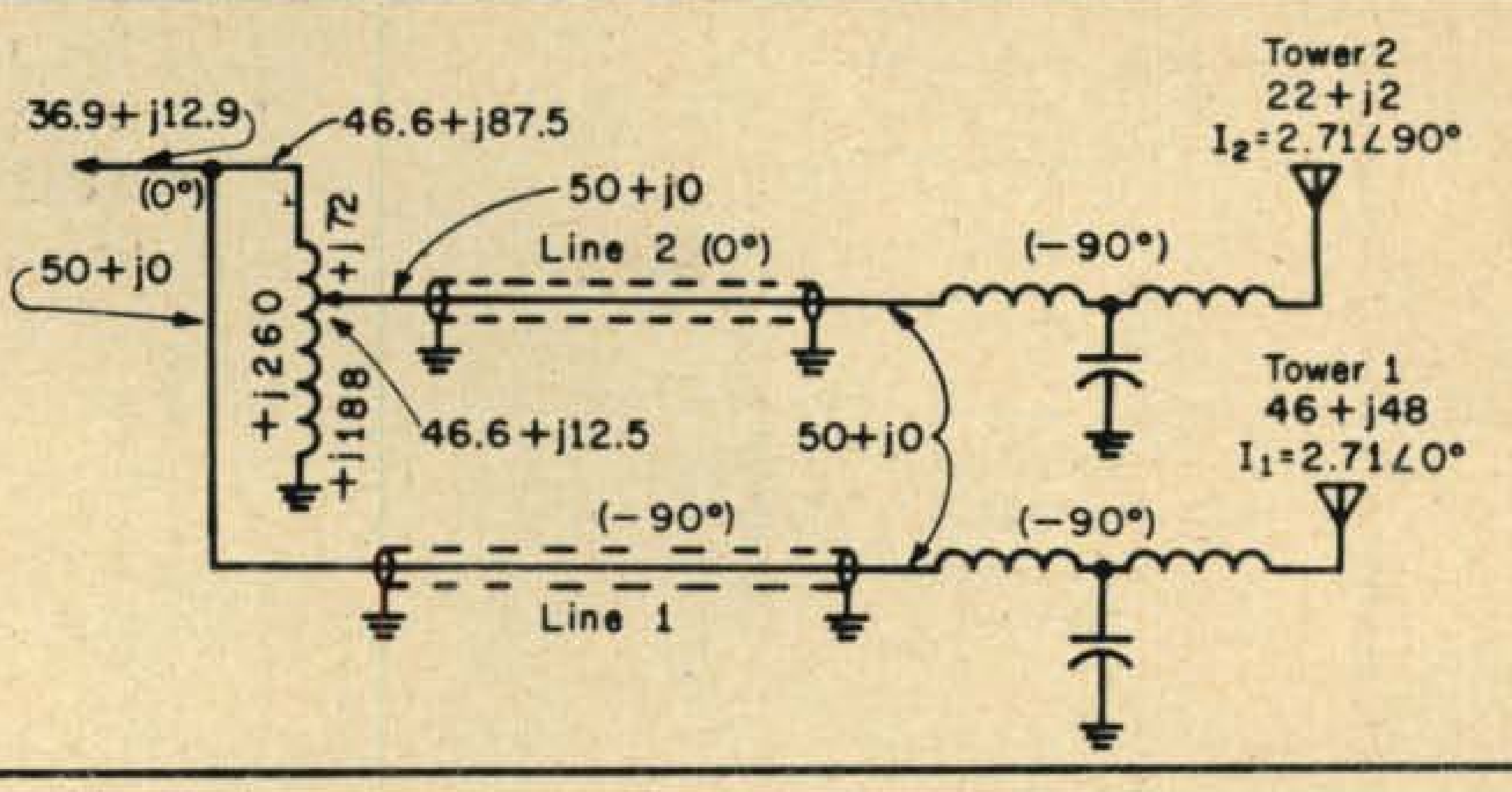

Fig. 79—Power dividing circuit for the array design of fig. 78. Phase shifts and impedances at various points are noted. Line 1 is 90° longer than line 2 and the relative phase shifts are 90° and 0°.

Z_2 is the actual operating impedance of tower 2 in the array.

We just found Z_{11} and Z_{22} from fig. 13 of Part II, and they are $34 + j25$. Since we don't know the currents yet, and we are only interested in their ratio and phase angle at this time, let $I_1 = 1.0\underline{/0^\circ}$ and $I_2 = 1.0\underline{/90^\circ}$. Mutual impedance $Z_{21} = Z_{12} = 23 - j12$.

Solving for Z_1:

$$Z_1 = (34 + j25) + \left(\frac{1.0\,\underline{/90^\circ}}{1.0\,\underline{/0^\circ}}\right)(23 \times j12)$$
$$= (34 + j25) + (1.0\,\underline{/90^\circ})\,(26\,\overline{\diagdown 27.5^\circ})$$
$$= (34 + j25) + (26\,\underline{/62.5^\circ})$$
$$= (34 + j25) + (12 + j23)$$
$$= 46 + j48 \text{ ohms}$$

Solving for Z_2:

$$Z_2 = (34 + j25) + \left(\frac{1.0\,\underline{/0^\circ}}{1.0\,\underline{/90^\circ}}\right)(23 - j12)$$
$$= (34 + j25) + (1.0\,\overline{\diagdown 90^\circ})\,(26\,\overline{\diagdown 27.50})$$
$$= (34 + j25) + (26\,\overline{\diagdown 117.5^\circ})$$
$$= (34 + j25) + (-12 - j23)$$
$$= 22 + j2 \text{ ohms}$$

Note the difference between these values and the self-impedance of the towers! The mutual impedance and the currents flowing cause quite an effect!

Now that we have the actual operating impedances of the two towers, we can find the currents.

$$P_1 = I_1^2 R_1$$
$$P_2 = I_2^2 R_2$$
$$P_1 + P_2 = 500 \text{ watts}$$
$$I_1 = I_2$$
$$I_1^2 R_1 + I_1^2 R_2 = 500$$
$$I_1^2 (R_1 + R_2) = 500$$
$$I_1^2 (46 + 22) = 500$$
$$I_1 = 2.71 \text{ amps.}$$

As a check:

$$P_1 = (2.71)^2\,46 = 338$$
$$P_2 = (2.71)^2\,22 = 162$$
$$P_{\text{Total}} = 162 + 338$$
$$= 500 \text{ watts}$$

The array configuration is shown in fig. 78. This brings up one point to be remembered, which is that in the case of an in-line array, the main lobe is always in the direction of the tower with the lagging phase (in this case I_1 legs I_2 by 90°).

Power Divider

Now that we have the tower operating impedances, it is possible to design the power dividing circuit and the antenna tuning units. Again referring to Part IV, we shall use the Ohms Law network. Since we have only two towers, and one of them is taking 2.1 times the power taken by the other, it is quite simple. We can feed tower 1 directly from the branching point, and tap down on a power divider coil for the feed to tower 2. See fig. 79 for the complete network.

How do we arrive at the various values of reactance shown? First, since the array is to work on 3.9 mc, we assume a 10 micro henry power divider coil will be used. This is a reasonable value. Since the power ratio between the towers is 2.1, tower 2 feed is tapped down on the coil at a 72.5% point. The total coil reactance at 3.9 mc is $+j260$ ohms. The tap is at $+j188$ ohms, leaving $+j72$ ohms above the tap. Considering the feedline to be a pure 50 ohms resistive load, the parallel combination of 50 and $+j188$ is computed:

$$\frac{(50\,\underline{/0^\circ})\,(188\,\underline{/90^\circ})}{50 + j188} =$$

$$\frac{9400\,\underline{/90^\circ}}{195\,\underline{/75^\circ}} =$$

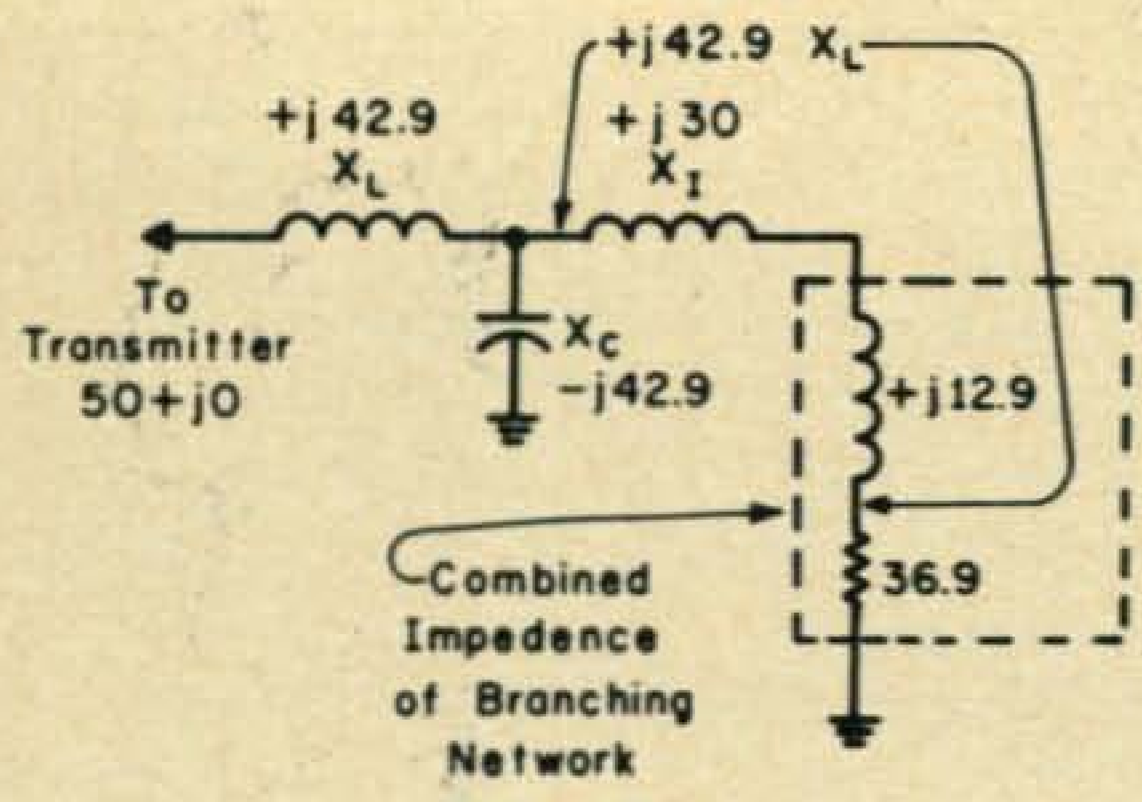

Fig. 80—Input T network.

$$48.2\angle 15^\circ = 46.6 + j12.5$$

Add the upper portion of the coil to this, to find the total impedance of the tower 2 feed which is presented to the branching point:

$$46.6 + j12.5 + j72 = 46.6 + j87.5 \text{ ohms}$$

Next, add in parallel the 50 ohm pure resistance of tower 1 line and the above combined value for tower 2 feed:

$$\frac{(46.6 + j87.5)(50\angle 0^\circ)}{50 + 46.6 + j87.5} =$$

$$\frac{(99.1\angle 67^\circ)(50\angle 0^\circ)}{96.6 + j87.5} =$$

$$\frac{4960\angle 62^\circ}{130\angle 42.2^\circ} =$$

$$38.1\angle 19.8^\circ = 36.9 + j12.9 \text{ ohms}$$

This is the parallel combination of the tower 1 and tower 2 feeds at the common point. As may be seen, it is quite a long way from being a pure $50+j0$ ohms which a transmitter would like to see. Since we have only two towers, and this impedance value is so close to 50 ohms, we can dispense with the tuned tank arrangement shown in fig. 35 of Part IV and transform this $36.9 + j12.9$ ohms to $50 + j0$ with a simple T network. (Another reason for the tuned tank in broadcast applications is that it enables the operator to maintain the common input impedance to licensed value quite easily. In this application we are not concerned with this.)

Another very helpful trick which one soon learns in this business is the usefulness of a 90° network. It is so easy to compute and to use, where the 90° phase shift is of no consequence! In a 90° network, where R_1 and R_2 are the input and output terminating resistances, the values of X_C and X_L in the network are determined very easily from the formula:

$$X = \sqrt{R_1 R_2}$$

The T network for the input of this branching system is shown in fig. 80. In this case:

$$X = \sqrt{36.9 \times 50}$$
$$= 42.9.$$

$X_C = -j42.9$ or 950 mmf at 3.9 mc.
$X_L = +j42.9$ or 01.85 mh at 3.9 mc.
$X_1 = +j42.9 - j12.9 = +j30$ or 0.14 mh at 3.9 mc.

Tuning Units

Now we must turn our attention to the antenna tuning units. Working our way outward from the branching circuit, tower line 1 must have 90° more electrical length in it than tower line 2. If it does not, a T phase shift network would be necessary. A 90° T for 50 ohms would consist of series $X_L = +j50$ elements, and shunt $X_C = -j^{50}$ elements, which would have to be variable to take care of strays. It is much easier to make the lines 90° different in length, and take care of any strays by slight adjustment of the antenna tuning units (ATUs).

As in the case of the input T, we again make use of the easy design of the 90° T in the ATUs. For tower 1, the ATU is shown in fig. 81.

$$X = \sqrt{46 \times 50}$$
$$X = 47.9$$

$X_C = -j47.9$ or 850 mmf at 3.9 mc.
$X_L = +j47.9$ or 1.85 mh at 3.9 mc.
$X_1 = +j47.9 - j48 = -j0.1$

In this case it would be necessary to put a series capacitor in, because X_1 is so close to zero, it could go a bit either way in actual adjustment. Series 50 ohms is 800 mmf at 3.9 mc. X_1 should then be made about $+j75$, adjustable.

ATU number 2 is done in the same way. It is shown in fig. 82.

$$X = \sqrt{22 \times 50} = 33.2$$

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$X_C = -j33.2$ or 1230 mmf at 3.9 mc.
$X_L = +j33.2$ or 1.35 mh at 3.9 mc.
$X_1 = +j33.2 - j2 = +j31.2$ or 1.27 mh at 3.9 mc.

This, then, is how we design a directional antenna system with its phasing and branching networks and antenna tuning units. In actual practice the values of reactance required are given about a 50% increase in tolerance to take care of differences between measured and computed antenna impedances and mutual impedances. The first step is the design shown here. The next step is construction of the array and its ground system, and actual r.f. bridge measurement of tower and mutual impedances. These should be fairly close to the predicted values. Using the *measured* values, the professional engineer then runs through the phasing and branching network calculations *again*, to determine as closely as possible the values to which all reactances should be set. Coils are variable, either with movable taps or of the rotary variety. Fixed capacitors are used, in series with adjustable coils, to obtain the $-jX_C$ values required. (Capacitive reactance is made too large, and a portion is cancelled out by a variable coil.) The engineer then uses the r.f. bridge to set all components to their final *computed* values. Power is then applied (low power at first), and tower currents and phases are read. Field intensity readings are taken in the nulls in the pattern. Final adjustments are made, sometimes over a period of many night (midnight to 6 A.M.), to bring the array in to its design values and the nulls down to FCC required values of field intensity.

For the amateur, the proof of successful operation would be the reading of tower currents, and a check of the forward gain, or the depth and azimuth of the designed nulls. This can be done more easily and with less hard work than in the broadcast case where tolerances must be very close. If a good check on the operation of the above array is desired, it can be obtained by first operating one tower alone, with the other one floating or detuned, and measuring field intensity around it at various azimuths. If it is in the clear, with no other objects to absorb or distort the field, a fairly circular pattern should be obtained. With a known power input, the radiation efficiency can be obtained by plotting field intensity versus distance as described in Part I.[68] The array an then be connected, and with the same input power, its field intensity should be measured *at the same points* as with the single tower. This pattern can then be plotted. The ratio of the directional to non-directional field intensity at a particular point or along a particular radial is the gain (or loss) of the array at that azimuth. Unless there are unpredictable things such as houses, power line, other antennas, *etc.*, distorting the field, the plot should be close to the original design plot. In no case will the two-element array shown, with 90° spacing and 90° phasing, produce more than approximately 3 db in the main lobe.

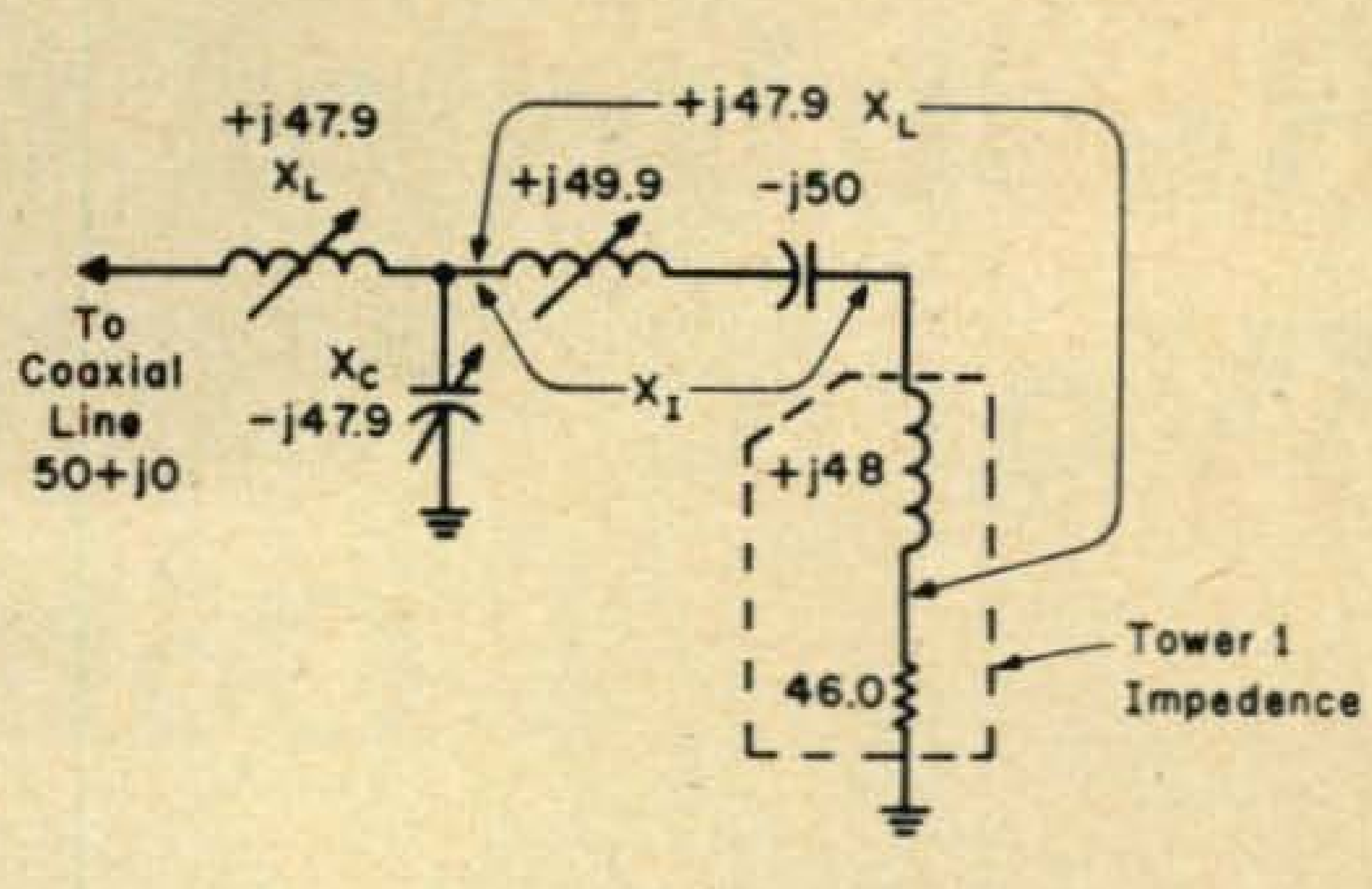

Fig. 81—Antenna tuning unit (ATU) for tower 1.

One additional check which is useful is that the r.m.s. value of the directional pattern should approach very closely the value of the field of the circular non-directional pattern, with the same input power. It may be slightly lower due to added losses in the second tower and coupling systems.

Arrays of this configuration have been built without ATUs or branching circuits, feeding power to the towers by merely connecting coaxial lines to them and paralleling them, with one 90° longer than the other. These do

[68]Lee, P. H., "Vertical Antennas—Part I", *CQ*, June 1968. p.

[*Continued on page 100*]

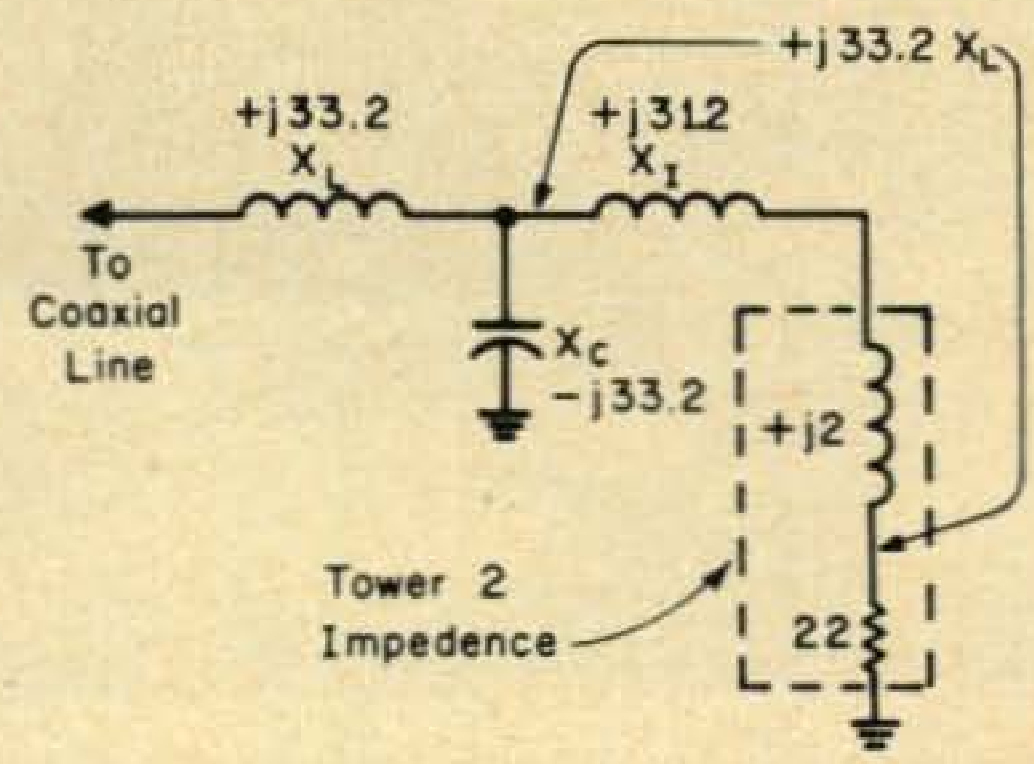

Fig. 82—Antenna tuning unit for tower 2.

Results of the 1968 CQ World Wide WPX SSB Contest

BY FRANK ANZALONE,* W1WY

We were a bit disappointed in the returns for the 1968 WPX SSB Contest. We would like to blame it on the poor conditions of last April, but then how do you account for some of the record breaking scores. We received only 532 logs for this one, which is quite a drop from the 628 received last year.

The listing of the top scores require no explanation but attention is called to the very close scores of ET3FMA and VK9GN on all bands. Don and Gene had a dilly of a battle going for top honors.

This was Don's swan song from Ethopia, and he went out in a blaze of glory and the Paul Bavassano, I1RB Trophy to prove that he was the "Top Banana" back in 1968.

Gene says he could have done much better but for Murphy's Law. A jammed rotor made it necessary to rotate the Quad manually, 27 trips up the tower! A burned out gamma on 10 had to be repaired, two power failures, so he had to switch to emergency generator, and finally he short changed himself on the rest period and quit almost 2 hours early. The Jack Chalk, KW6EJ Trophy should sooth his frustration.

*Contest Committee Chairman, *CQ*.

Don Murray, ET3FMA, the all band champ in the 1968 WPX Contest. A rather modest layout but a TH-3 90 foot up helped a bit.

Last year's high man on all bands, ZL1KG had to be satisfied with the 3rd place spot, even though he also broke a million. Better luck in the next one Roy.

The 14 mc domination for top honors on a single band has finally been broken, and by none other than our friend Jaycee, the perennial 10 meter DXer. So LU1DAB is finally rewarded for his many years of spirited competition. Nice going Jaycee. Now KW6EJ will have to figure how he is going to get his Single Band Trophy all the way from Wake Isand to Argentina.

Incidently, all the trophies except the two Don Miller awards, are being handled directly by the donors, so any inquires regarding them should be addressed to the respective donors. We of course will notify them of the results of the contest, but it will be the donor's responsibility to get the award to the winner. The two W9WNV multi-operator awards will be handled by us.

It seems quite fitting that KW6EJ should also be the receipient of an award after donating two himself, so we are happy that we will be sending him the Ted Thorpe, ZL2AWJ Memorial Award for the Multi-Operator, Single Transmitter division.

This is the first year for the Multi Transmitter category, and as yet not lured the "big guns" into the contest. Only 5 entries were received, but the PJ5MM operation by Joe Poston, K9GCE and a group of W9's did a credible job to win the Chuck Swain, K7LMU Memorial Award. Joe also managed to shuttle over to the French side of the Island and give Jose, FG7TI/FS7 a hand with the operation over there.

The Canadian award goes to VE3FHO, operated by VE3GCO, and Gene Krehbiel, VE6TP will take care of that one.

The rest of the single band high scores speak for themselves. JA1AEA again was high man on 14 mc, and W4BVV, usually a "big gun" in the multi division, went as a solo on 21 mc and topped that division.

Operation on the two l.f. bands was limited. "There is no percentage in using 40 and 80," we have been told by more than one operator. And as I have said before, there is a lot of merit in what they say. However the astronomical scores that would result if the multiplier was figured on prefixes from each band, makes it very impractical to use that method of scoring. The Committee will have to give this problem a lot of thought and consideration.

Although the operation on 40 was not limited to Europe, most of the activity did come from that area. On 80 it was definitely a European affair, but it was YV5BTS again at the top of the list. Nice going Bill.

At least there was one thing that everybody favored, the compulsary rest period. That is, almost everyone. GM3SSB wants to abolish the rest period. I can imagine the chorsu of boos when this is read. No Ken, the rest period is here to stay.

Many contestants requested WPX credit for contacts made in the contest. Credit will be given if the necessary contacts are made, *but* application for WPX awards must be made via the usual channels by submitting a list of the claimed prefixes. We in turn will confirm your claim at the request of our DX department.

Among the single operators at least 50 stations had a multiplier of 200 prefixes or more, 20 of them on a single band, so it can be done over a week-end.

Bill Mitchell, XW8AX expects to be back in Laos for the '69 contest, and with the experience he gains each time, should make quite a splash in the next one. He has been in the States the past few months.

WA8LYF found conditions so poor on Saturday that he gave up and went out to play baseball. When he got back things had improved considerably so he stuck out the rest of the contest. I'm afraid you struck out Steve, K8DOC stayed home and picks up all the marbles.

And the operation at 5W1AR was none other than our old friend Trev Fergusen, ex-ZK1AR.

Just in case there might be some question regarding the operation of HS3DR, we have been assured by Don Riebhoff, K7CBZ that it was a legal operation within the framework of the Post and Telegraph laws of Thailand.

TROPHY WINNERS

World Single Operator, Single Band (28 mc). The Jack Chalk, KW6EJ Trophy Won by Juan Carlos Naon, LU1DAB.

World Single Operator, All Band. The Paul Bavassano, I1RB Trophy Won by Donald Murray, ET3FMA.

World Multi-Operator, Single Transmitter. The Don Miller, W9WNV Award: The Ted Thorpe, ZL2AWJ Memorial Trophy Won by Station KW6EJ. (Oprs: KW6EJ and KW6GH).

World Multi-Operator, Multi Transmitter. The Don Miller, W9WNV Award: The Chuck Swain, K7LMU Memorial Trophy Won by Station PJ5MM. (Oprs: K9GCE, K9RHN, W9AQW, W9ZRX).

Canada Single Operator, Single Band (14 mc). The Gene Krehbiel, VE6TP Trophy Won by Station VE3FHO, (Operated by G. V. Hammond VE3GCO).

Oceania Single Operator, All Band. The Jack Chalk, KW6EJ Trophy Won by Gene A. Nurkka, VK3GN.

One of the more exotic calls in the contest, HM1AJ, and his XYL HM1AM. A 2 EL Quad on 14 mc gives his low power a boost. (W2CTN QSL mgr.)

Top Ten

ALL BAND—SINGLE OPERATOR

ET3FMA ..1,291,680	CX3BH 808,128
VK9GN 1,285,842	KP4AST 807,680
ZL1KG 1,103,760	G3NMH 807,275
XW8AX 934,724	KH6IJ 790,992
DJ6QT 892,422	OA4OS 656.424

Top Scores

28 mc	KØILI/KG6 ..445,986
LU1DAB 737,856	YV1SA 363,792
UF6CR 244,496	OH2BCZ 363,384
WA3IJS 148,824	K8DOC 328,256
WA6ZQU 117,376	WB6CWD 316,692
WB4DJQ 98,933	14 mc
21 mc	JA1AEA 678,240
W4BVV 483,446	DJ2YA 615,065
PY3BXW 570,451	YV1B1 16,254
VK2APK 567,418	SM5CAK 15,300
4Z4HF 520,030	3.8 mc
OH2BC 459,296	YV5BTS 36,120
7 mc	G3SZG 28,090
DJ4AX 43,215	PAØMCF/P .. 20,790
PY7APS 36,080	GM3VTB 14,784
UA9BE 35,752	OK2RO 11,850
I1BER 22,454	OE1WO 11,264

Top Six

MULTI-OPERATOR—SINGLE TRANSMITTER

KW6EJ 1,496,840	UA3KBO 938,605
PA9FE 1,076,652	DU1FH 924,615
KG6AAY .. 959,040	LZ2KKZ 844,426

Not so however, the operation of the Bavassano father and son duo, under the call I9RB/4U. We have been officially notified by the Chief Field Service Officer of the United Nations, that no permission was given for the operation of an amateur radio station under the 4U suffix in Torino. Therefore since this was not a legal call we cannot accept the I9RB/4U entry, nor give credit for the 4U suffix.

These results were compiled by a limited portion of the Contest Committee, by Bob Entwistle, W1MDO and yours truly. Freddie, W2IWC, was galavanting around Europe with his bride. Andy, W1GYE was busy putting up a 70 foot tower. Andy, WB2CKS had his nose to the grindstone with company business all summer, and Ben, W2JB wants no part of this s.s.b. business, he's a c.w. man.

If you fellow have any suggestions for any rules modifications, especially the multiplier per band problem, get them to me soon as possible. The next one comes up April 12th and 13th.

That's it for this one,

73 for now, Frank, W1WY

Number groups after call letter denote: Band, Score, QSO's and prefixes. Bold listings are certificate winners.

SINGLE OPERATOR
North America

United States

W1OKG	A	230,078	432	202
W1ORV	"	125,771	287	173
W1PCD	"	52,400	166	120
W1FZ	"	18,360	92	68
WA1ANR	"	13,320	74	60
K1ZYM	"	9,366	75	42
W1IXL	"	6,076	68	48
K1AJQ	28	31,872	153	96
K1HVV	21	192,950	425	185
W1PLJ	"	4,884	48	37
K1IIK	14	58,000	202	125
WA2SFP	A	527,592	755	267
K2DJD	"	122,120	299	172
W2LEJ	"	52,281	186	111
W2QKJ	"	49,407	148	129
W2DKM	28	16,905	91	69
WB2YRU	21	117,245	308	155
K2RUD	"	28,208	174	82
W2MT	"	12,768	83	56
WA2YCA	"	11,918	85	59
WB2YJS	"	4,719	59	33
F3VN/W2	"	243	9	9
W2IUV	14	26,125	118	95
WA2BZV	"	8,415	71	55
K2GXI	7	1,794	32	23
W3JNN	A	617,048	813	274
W3GN	"	42,488	150	94
WA3DWD	"	28,810	163	86
WA3HRV	"	11,682	90	59
W3CBF	"	4,788	45	36
WA3IJS	28	148,824	402	159
W3TLN	21	272,126	488	206
W3YUW	"	66,420	202	135
W3QZH	"	15,990	93	65
WA3JSA	14	4,539	63	51
K4YFQ	A	327,672	574	222
W4YWV	"	126,650	321	170
W4ZNI	"	98,092	270	137
W4HOS	"	68,531	234	129
WB4AMT	"	48,312	173	122
W4TKN	"	4,921	51	37
WB4HNV	"	4,025	43	35
WB4DJQ	28	98,933	305	127
W4TXE	"	47,840	187	104
WA4ZDR	"	18,469	113	73
W4DS	"	13,608	87	63
WB4FLA/4	"	90	6	6
W4BVV	21	483,446	737	241
K4YMQ	"	86,523	254	151
WB4DJT	"	70,226	238	146
W4AZK	14	132,610	303	178
W4SPX	"	31,863	121	94
W4BYB	7	3,479	74	49
W5BUK	A	25,819	128	87
W5AJY	"	20,703	117	67
K5MDX	28	72,419	182	139
WA5MYR	"	4,270	44	35
W5QNQ	"	3,286	39	31
W5JAW	21	109,701	293	153
W5NOP	14	104,004	262	162
W5OBS	"	78,234	253	157
WA5RQA	"	75,920	235	146
W5ODJ	7	5,936	190	53
WA5ALB	3.8	165	15	15
WB6UDC	A	184,464	498	144
K6KA	"	176,260	494	140
W0DAD/6	"	35,244	156	89
WA6ZQU	28	117,376	351	128
W6ISQ	"	13,440	98	60
WB6CWD	21	316,692	698	171
W6UED	"	309,258	707	162
K0GJD/6	"	168,554	445	142
K6SVL	"	143,400	474	120
W6GBI	"	83,012	314	99
WB6YKA	"	20,603	181	67
K6YRA	14	34,314	301	172
WA6JDT	"	855	19	15
W7AYY	A	123,216	361	136
W7MSI	"	60,229	267	113
W7YEX	28	2,970	38	30
K7RLS	21	60,028	282	86
W7BJ	"	37,920	166	96
W7YBX	"	26,080	156	80
W7AAI	"	9,945	108	45
WA7JCB	"	3,565	70	31
K8HZU	A	206,336	383	208
WA8PSD	"	154,275	335	175
W3TBF/8	"	89,487	212	163
W8FRJ	"	29,274	137	82
WA8GGN	"	4,796	66	44
W8WEJ	28	26,511	125	89
K8DOC	21	328,256	615	223
WA8LYF	"	252,356	488	211
WA8TKM	"	10,614	80	58
K8QYG	"	5,895	51	45
K8YBU	14	336,168	554	232
W8HDB	"	109,480	253	170
W8BVF	"	34,917	136	103
WA8PRR	"	600	15	15
W8IHD	7	544	60	32
W9EWC	A	210,672	440	198
K9ZJV	"	52,670	193	115
K9IDQ	"	26,488	118	86
W9JJV	"	23,838	119	87
W9ZTD	28	60,388	219	124
W9LKI	"	47,736	194	117
WA9IBT	"	17,017	111	77
W9VNE	21	110,979	262	171
WA9LMY	"	58,624	189	128
W9CTY	14	62,865	225	12
K9YHB	7	448	34	2
WA0KDI	A	86,400	245	14
W0GNX	"	62,478	235	11
W0ACT	"	25,506	147	7
WA0MOJ	28	7,905	72	5
W0PAN	"	5,371	57	4
W0OTE	14	59,318	200	13

Canada

VO1HI	14	135,240	345	16
VO2AC	28	12,306	114	4
VO2AB	14	28,380	243	6
VE1AJJ	14	36,045	187	8
VE2YU	14	201,996	457	18
VE3BS	A	118,320	262	17
VE3HJ	"	51,000	236	12
VE3ES	"	43,964	152	11
VE3EFX	"	630	20	1
VE3BMB	21	86,583	255	13
VE3FHO	14	369,494	605	23
VE4SD	14	138,281	450	14
VE4RP	"	23,571	123	8
VE5US	14	342,592	689	21
VE6TP	A	158,436	416	16
VE6MC	"	23,392	112	8
VE6GN	14	129,272	396	14
VE6IN	"	630	17	1
VE7IQ	21	10,160	120	4
VE8BB	A	160,035	518	14

Dominican Republic

HI8LC	14	4,674	46	3

Mexico

XE1DP	A	43,428	306	6
XE0WPG	28	3,082	72	2
XE2RE	14	34,204	239	6

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Montserrat				
VP2MK	A	24,276	229	51
Panama				
HP1JC	A	219,170	478	155
Puerto Rico				
KP4AST	A	807,680	1319	256
KP4DBU	14	152,490	530	130
KP4CPB	"	68,888	270	109
Salvador				
YS2CEN	14	149,000	513	166

Africa

Angola				
CR6GG	A	46,046	172	91
Ascension				
ZD8CC	A	76,400	265	100
Ethiopia				
ET3FMA	A	1,291,680	1870	240
ET3REL	"	745,721	1002	251
Malawi				
7Q7AM	14	48,321	203	91
Morocco				
CN8AW	14	149,628	340	148
Tanzania				
5H3KJ	A	38,430	138	105

Asia

Afghanistan				
YA5RG	A	144,620	455	140
India				
VU2DKZ	A	655,608	1085	236
Israel				
4Z4HF	14	520,030	768	238
Japan				
JA7JM	A	269,330	427	230
JA1NDO	"	225,939	550	147
JA1XIQ	"	15,592	104	57
JA2DCI	"	3,350	48	25
JA9CHH	28	7,696	83	37
JA7ERJ	"	4,712	57	31
JA7CAB	"	2,813	39	29
JA3LVA	21	249,280	588	164
JA1IZZ	"	11,616	90	48
JH1GNL	"	1,722	32	21
JH1COI	"	1,610	58	10
JA1SKE	"	1,083	24	19
JA0ANO	"	72	6	6
JA1AEA	14	678,240	988	240
JA6AD	"	186,973	382	181
JA1ALX	"	68,520	155	120
JA3GNQ	"	28,512	130	81
JA1RJU	"	10,317	80	57
JA4FM	"	7,452	68	46
JA2JAA	"	4,800	44	40
JA1BNW	"	2,460	40	30
JA4AQR/5	"	1,820	37	26
JA2HFB	"	171	9	9
JA3BCT	"	152	9	8
JA3ADW	"	1	1	1
JA2BAY	7	7,260	77	44
JA2EKX	"	2,449	45	31
JA4EMC	3.8	12	33	12
KA2HC	A	98,857	332	121
KA5MC	21	158,360	388	148
Korea				
HM1AJ	14	106,001	350	133
Laos				
XW8AX	A	934,724	1255	266
Lebanon				
OD5BA	A	385,320	1047	169
Malaysia				
9M2PO	A	562,128	1036	239
Okinawa				
KR6TAB	28	25,382	167	74
KR6KN	14	343,508	647	211
Thailand				
HS3DR	A	251,715	615	173

U.S.S.R.

Asiatic				
UA9MR	A	164,980	488	146
UA9FU	"	136,188	311	156
UA0UA	"	1,617	86	21
UV9PP	28	35,640	222	81
UW9DZ	21	16,929	133	57
UW9KDL	14	24,563	136	77
UA9MT	"	6,794	60	43
UA9BE	7	35,752	148	82
Georgia				
UF6CW	A	134,064	347	144
UF6CR	28	244,496	631	148
Kazakhstan				
UL7IE	28	2,664	37	24
UL7YD	14	71,232	274	112
UL7LA	"	61,425	208	117
Turkoman				
UH8BO	14	72,590	241	122

Europe

Austria				
OE1WO	3.8	11,264	123	88
Belgium				
ON4XG	21	81,196	277	106
Czechoslovakia				
OK1ADM	A	178,287	367	201
OK1AHZ	"	74,095	310	145
OK1AGQ	"	13,590	150	90
OK1WGW	21	28,980	151	70
OK1AKL	"	3,201	42	33
OK2BEN	"	244	11	8
OK3BU	14	312,423	772	223
OK1ADP	"	69,069	263	143
OK1KUH	"	9,394	110	61
OK1NH	"	6,160	102	55
OK2VP	"	476	24	17
OK2RO	3.8	11,850	174	75
OK1APB	"	2,691	70	39
OK1ALE	"	2,668	63	46
Denmark				
OZ3SK	A	372,800	659	233
OZ1LO	"	274,658	580	191
OZ5DX	"	15,480	102	60
OZ7DX	"	5,871	66	57
OZ2NK	"	1,920	38	32
OZ5OF	"	700	18	14
OZ2TE	14	1,200	38	30
England				
G3NMH	A	807,275	1227	245
G3UML	"	205,119	443	213
G3IAR	"	79,288	548	212
G2AJB	"	14,288	130	76
G3KMA	28	40,120	176	85
G3SME	21	153,408	635	94
G5AGA	"	3,456	51	32
G4JZ	14	250,074	585	198
G3MWZ	"	12,859	113	77
G3PQF	"	8,905	97	65
G3SZG	3.8	28,090	251	106
Faroes Island				
OY1F	A	9,636	115	66
OY4OV	"	2,881	54	33
Finland				
OH7PI	A	198,440	902	220
OH5UQ	"	33,774	166	78
OH8OW	"	14,652	106	66
OH2XK	"	4,551	57	41
OH3QA	28	12,572	103	54
OH2XA	"	656	16	16
OH2BCZ	21	363,384	810	168
OH2BC	14	459,296	840	248
OH2HC	"	210,375	635	187
OH5VT	"	25,365	187	87
OH3XZ	"	23,970	187	75
France				
F9MS	A	126,048	302	202
F8RU	"	64,655	238	139
F2JE	"	27,832	183	98
F3IJ	"	663	19	17
F9OE	14	3,185	40	35
Germany				
DJ6QT	A	892,422	1283	258
DJ0RM	"	192,710	457	178
DL8PC	"	142,506	338	189

Our own Louise Rippe, W8HDM custodian of the SSB awards, is also a contestant of a small note, Louise was the runner-up on 14 mc in the 8th district.

DL8TG	"	129,350	397	158
DJ7IK	"	110,200	333	190
DL7EN	"	107,672	308	172
DL6WE	"	81,015	291	165
DL1MD	"	79,734	273	137
DL6QH	"	58,102	258	139
DJ3EJ	"	51,569	228	139
DK1SN	"	32,334	172	102
DK1YK	"	22,599	153	93
DL7IG	"	20,022	100	71
DL7AA	28	67,872	219	112
DL7DI	"	16,256	90	64
DJ8IF	"	3,584	41	32
DJ9ZB	21	6,435	65	45
DJ2YA	14	615,065	911	265
DJ1WT	"	13,360	103	80
DJ5WM	"	11,502	110	71
DJ4AX	7	43,215	269	129
DJ6TK	"	30,371	215	121
DJ5ID	3.8	7,154	125	73
DM2ATD	A	502,576	1010	202
DM2BTO	"	19,068	134	84
DM2BUL	"	17,933	111	79
DM2CDL	"	10,452	136	78
DM4JM	"	2,870	70	41
DL4GW	A	41,019	193	121
DL4FS	28	47,216	175	104
DL5LR	21	165,501	530	111
DL4RO	7	12,201	157	83
Hungary				
HA5BY	A	858	30	26
HA8CF	14	61,176	400	134
HA5BI	"	2,294	59	37
Italy				
I1AUM	21	27,720	189	63
I4LCK	14	392,476	758	262
I1KBT	"	111,708	330	174
I8CLC	"	43,524	254	124
I1SGZ	"	14,946	96	94
I1BER	7	22,454	179	103
I1ZSQ	"	15,570	160	90
I1ASH	"	6,480	100	60
Netherlands				
PA0LV	A	5,632	52	44
PA0VB	"	2,349	41	35
PA0EYM/P	21	81,168	377	78
PA0UC	14	10,080	81	72
PA0MCF/P	3.8	20,790	233	90
Norway				
LA0AD	A	516,200	878	232
LA7JH	"	57,132	303	138
LA8WI	"	29,610	231	105
LA1QK	"	11,620	118	83
LA6U	"	6,901	65	67
LA8QI	"	207	9	7
LA3QG	7	5,712	88	56
LA8RI	"	1,734	41	34

Poland				
SP8AJK	A	321,620	640	260
SP5CJT	14	31,710	232	105
SP5CLK	"	28,710	211	110
SP2BSX	"	13,455	145	69
Portugal				
CT1BH	A	383,424	786	192
CT1MW	"	17,613	115	57
CT1GD	14	41,912	277	124
Romania				
YO3JU	14	1,008	32	28
Sicily				
IT1EZ	14	127,224	550	228
Scotland				
GM5AHS	A	104,496	422	168
GM3RFR	"	36,024	237	114
GM3JDR	21	24,153	160	83
GM3SSB	14	27,664	202	104
GM3VTB	3.8	14,784	183	84
Sweden				
SM5CEU	A	256,742	599	202
SM7ID	"	39,688	205	121
SM5BPJ	"	33,852	154	93
SM7BKH	28	30,616	132	89
SM7CCU	"	20,550	105	75
SM6CQV	"	10,516	94	44
SM5BUT	21	304,425	694	165
SM0MC	"	68,377	254	101
SM7DMN	"	38,614	176	86
SM4DPB	"	2,378	42	29
SM6CKU	"	1,190	26	17
SM7CSN	14	199,728	547	219
SM0CER	"	103,827	477	159
SK6AW	"	97,626	321	159
SM5API	"	81,624	354	152
SM5GA	"	43,815	221	115
SM3DKO	"	37,400	266	110
SM2ME	"	32,865	250	105
SM0ATN	"	20,604	119	102
SM3UL	"	4,080	84	48
SM5CAK	7	15,300	173	90
SM5ARR	"	6,696	98	62
SM5BNX	"	322	15	14
SM6DOK	"	42	7	6
SM4MI	3.8	8,712	136	72
Switzerland				
HB9UD	A	68,510	234	130
HB9AKJ	"	66,500	293	140
Yugoslavia				
YU1YG	14	147,445	473	185

U.S.S.R.

Estonia				
UR2OP	28	3,978	43	34

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UR2IV	"	2,016	31	24
UR2EK	"	918	20	17
UR2DL	14	2,176	42	34
UR2AO	7	7,410	110	65

European

UV3TP	A	247,025	596	205
UA3HO	"	231,870	562	177
UA4KUB	"	120,213	420	171
UA6NF	"	74,802	254	137
UV3MM	"	9,114	77	49
UA3DR	"	5,200	46	40
UW3IN	"	1,220	24	20
UA3TD	28	15,360	118	48
UA3AYN	"	13,846	105	43
UW1BM	21	23,904	152	83
UA4CZ	14	153,984	450	192
UW3EH	"	95,518	445	163
UA3BK	"	26,643	200	107
UV3TQ	"	21,408	165	107
UA3KOB	"	8,883	117	63
UA3WZ	"	1,953	43	31
UA1D1	"	165	11	11

Lithuania

UP2NV	A	653,975	1078	259
UP2OV	28	676	18	13
UP2CV	14	76,738	445	143

Moldavia

UO5BZ	A	2,700	41	36

Ukraine

UB5DW	A	65,762	303	131
UB5WF	14	256,230	602	234
UB5SJ	"	73,720	277	152
UT5GM	"	20,056	189	92
UB5ZJ	"	2,673	65	27

Oceania

Australia

VK2AND	A	119,973	472	87
VK2APK	14	567,418	961	202
VK2FU	7	15,066	99	54
VK3QV	28	41,454	226	63
VK3SM	21	30,195	181	61
VK4FH	A	122,820	453	92
VK4PJ	"	8,200	60	50
VK5LC	14	23,200	128	90
VK6RU	A	317,920	682	160

Guam

K0ILI/KG6	21	445,986	982	162
KG6AQG	14	329,804	688	164
WA0KKR/KG6	"	15,236	100	52

Hawaii

KH6IJ	A	790,992	1831	144
KH6GNE	"	85,988	413	74
K2KZI/KH6	21	40,005	232	63
KH6FQB	"	18,135	201	39
KH6GJW	14	14,084	101	48

New Guinea

VK9GN	A	1,285,842	1787	246
VK9KS	"	133,665	366	133

New Zealand

ZL1KG	A	1,103,760	1545	252
ZL1AAS	14	288,616	584	172
ZL1AGO	"	216,153	535	141

Western Samoa

5W1AR	A	380,844	912	149

South America

Antarctica

VP8JT	A	177,480	497	120

Argentina

LU2FAO	A	43,995	164	105
LU1DAB	28	737,856	1337	192
LU8FAO	14	27,798	128	82

Brazil

PY2GE	A	224,895	502	165
PY3APH	"	139,200	411	120
PY1BAR	"	76,800	374	80
PY7VNY	28	29,260	153	72
PY2DBN	"	27,945	138	70
PY1ATG	21	284,425	672	155
PY3BXW	14	570,451	851	227
PY1NBF	"	518,468	820	227
PY4KB	"	11,300	82	50
PY7APS	7	36,080	147	88

Chile

CE6EF	14	445,776	820	178

Colombia

HK3ACN	A	6,000	50	40
HK4DF	21	182,269	667	113
HK6BMF	"	24,790	226	37

Ecuador

HC4TB	A	93,366	360	91

Guyana

8R1G	A	610,839	1027	201

Peru

OA4OS	A	656,424	1053	216
OA4JR	14	305,324	532	201
OA4BS	"	181,920	408	160
OA8V	3.5	9,614	72	46

Suriname

PZ1BI	14	59,599	195	107

Venezuela

YV7AV	A	230,298	612	131
YV1IV	"	9,288	76	43
YV1SA	21	363,792	1007	132
YV1QN	14	164,640	369	160
YV4UA	"	6,600	51	44
YV1BI	7	16,254	103	63
YV5BTS	3.5	36,120	154	84

Uruguay

CX3BH	A	808,128	1164	244

Another exotic one, HS3DR. Don says the license and operation was all legal, so its OK if you worked him.

MULTI-OPERATOR SINGLE TRANSMITTER

North America

W1EZM	47,000	186	100	(W1EZM & K9CVO/1)
WB2ZKJ	235,330	447	202	(WB2:ZKJ, SQN, WOW)
K4WUY	260,391	500	219	(K4WUY & K4CFB)
WB6HGU	277,083	665	153	(WB6HGU & WB6VXJ)
WB6UHJ	242,580	547	156	(WB6:UHJ, NWK, WGP)
WB6OLR	214,676	524	154	(WB6OLR & WB6LFR)
WB6QIT	127,950	341	150	(WB6:QIT, KBK, SJS, THT)
W7SFA	387,606	815	182	(W7:SFA, NLB, LAV)
K7NWS	4141	60	41	(W7:RJW, EVT & K7:TPN, KYG & WA7: GYD, HKD, ACQ, BSQ, FHG, GHC)
K8UDJ	186,732	398	189	(K8UDJ & K1ZND)
WA0PUJ	99,820	284	155	(WA0PUJ & WA0PIU)
WA0KXD	37,515	184	123	(WA0KXD & WA0NBZ)
VE6ADX	344,416	808	188	(VE6:ADX, XJ, NW, BX, SB, AEY)
VE7LB	157,470	531	145	(VE7:LB, IG, SV, BDJ)
XE2ITM	89,934	530	78	(XE2ITM & 4 OPERATORS)
FG7TI/FS7	502,400	1411	160	(K9GCE & PJ2MI)

Asia

4X4HM	26,810	144	70	(2 OPERATORS)
JA1YFL	148,213	339	169	(JA6CZF, JA0CAG, JH1CRF)
JA8CDE	17,650	128	50	(JA8CDE & JH1:BYP, CMW, JRI, KKK, LPL)

Europe

LZ2KKZ	844,426	1584	293	(3 OPERATORS)
GC3VZT/A	650,000	1300	200	(G3VZT & G5:AFS, AKD)
OZ1RH	235,846	520	193	(2 OPERATORS)
OZ4EDR	202,692	460	266	(CLUB)
OZ1RV	72,414	248	162	(OZ1RV & OZ6TL)
G3WYX	717,604	1158	244	(G3: HTA, RUV, RUX, TJW)
G3SSO	338,100	827	147	(G2HDU, G8KG & G3:CNW, PEU)
G3SKY	116,616	462	172	(G3:SDD, UCW, WIT, NTM, AFK)
G3EBH	60,915	282	131	(G3EBH & G3TGK)
OH6AA	61,570	380	131	(OH6:QP, WG, YA)
DL8RL	473,421	897	199	(DL8:RL, RM, RK & DL3LU & DJ:5FT, 9YG)
I1AT	405,015	816	201	(I1:AT, BOI, TIG, LG, JPL)
4U1ITU	363,735	791	179	(HB9OP & DJ2SL)
PA9FE	1,076,652	1374	324	(PA0SNG, PA0HBO, PA1555)
PE2EVO	147,752	423	184	(PA0:BE, FW, IB, MS, PAZ, PFW, PMJ, PWA, RE, WJG)
PA0CYM	31,351	226	107	(MULTI-OP)
LA3T	80,355	307	165	(MULTI-OP)
IT7GAI	645,048	1275	279	(IT1:GAI, FTT & I1:AA, JT)
SK5AJ	556,904	848	268	(SM5AD & SM5EAC)
SK5AA	369,783	885	227	(SM5:TU, ZZ, ACQ, CVH)
SM3CNN	241,248	590	224	(SM3CNN & OLLE)
SK0AL	58,519	317	139	(SM5BGK & SM5DKH)
SK1AQ	53,013	259	123	(SM1CXE & SM1CJV)

Oceania

KG6AAY	959,040	1440	222	(CLUB MEMBERS)
DU1FH	924,615	1325	243	(DU1FH, WA6OBM, EARL)
KW6EJ	1,496,840	2235	230	(KW6EJ & KW6GH)

U.S.S.R. Club Stations

UR2KAC	66,304	301	148
UR2KBG	63,155	326	135
UA3KBO	938,605	1477	295
UA6KOE	337,120	1004	224
UA3KND	267,520	684	209
UA3KAG	17,255	145	85
UA2KBD	296,730	670	210
UP2KPI	238,370	626	197
4K2A	36,966	268	101
UB5KSP	222,888	679	222
UB5KBV	77,592	377	159
UA9KDL	388,614	582	271

MULTI-OPERATOR MULTI TRANSMITTER

PJ5MM	1,873,120	3822	230	(K9GCE, K9RHN/5, W9AQW, W9ZRX)
SK6AB	1,485,900	2027	325	(SM: 2BJI, 5AOE, 6BJJ, 6BSK, 6CAS, 6CKU, 6CKV, 6DSK)
OH1VR	399,487	905	253	(OH:1VR, 1UR, 3LC, 6VR)
KH6GLU	394,869	973	129	(KH:6GLU, 6GJW, 6FRF)
OH2NM	128,960	484	130	(OH:2BBR, 2BHN, 2DG, 2HR, 2VB)

CHECK LOGS: DM2AYK, DM-2CGL, HA5FA, LA4DJ, LU4-DMG, OE1PKA, OD5BZ, OH2-BAC, OH3NY, OZ4HAM, OZ4-LX, OZ6FR, PY9AI, SM2COR, SM5BHW, SM5BNX, SM7-ANB, SM0CWC, VK3HE, W2-EGI, WA7HOX, K9LET, WPE9-HBT, UA9YHH, UB5-07325.

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The Sunspot Story-1969

BY GEORGE JACOBS,* W3ASK

ALTHOUGH not yet established for certain, it now appears very likely that the present sunspot cycle reached its maximum intensity during 1968, and is now on the decline. In this special article, *CQ's* Propagation Editor takes a close look at the course of the present cycle, and makes his annual predictions for the new year.

Although the basic physics of sunspots, what they are and what causes them, is little understood, it is known from observations dating back hundreds of years that the number of spots on the sun's surface varies cyclically—from a minimum to a maximum and back to a minimum again, over an average period of just under eleven years. Nineteen complete sunspot cycles have been recorded since comprehensive daily observations of the sun's surface were begun in 1749 at the Swiss Federal Solar Observatory, and the 20th cycle is now in progress.

Since the number of spots appearing on the sun is subject to erratic day-to-day variations, scientists use monthly figures averaged over a 12-month period to describe the resulting smooth curve of the sunspot cycle. These figures are called the *12-month running smoothed sunspot numbers*. Further reference in this article to sunspot numbers will be to the smoothed numbers.

*Radio Propagation Editor, *CQ*, 11307 Clara Street, Silver Spring, Md. 20902

Table I—Smoothed Sunspot Numbers Cycle 20

Month	1964	1965	1966	1967	1968	1969
Jan.		12	28	75	102	111†
Feb.		12	31	79	103	110†
March		13	35	82	105	108†
April		14	37	85	107	107†
May		15	41	87	109*	105†
June		15	45	91	110*	104†
July		16	50	94	111*	103†
Aug.		16	57	95	112*	101†
Sept.		17	63	94	113*	100†
Oct.	9.6	20	68	94	115*	98†
Nov.	10	22	70	96	114*	97†
Dec.	11	25	73	100	113*	95†

*Estimated values. †Predicted values.

The Average Cycle

While each of the 19 cycles recorded to date have differed from each other, statistically they provide the following picture of an average sunspot cycle.

1. The cycle begins with a sunspot number between 0 and 11, with 5 as an average value.
2. The ascending period to a maximum value varies between 2.6 and 6.9 years, with 4.1 as an average.
3. The maximum values recorded range between 49 and 201, with 109 as an average
4. The descending period from maximum to minimum varies between 4 and 10.2 years, with 6.7 as the average.
5 From minimum to maximum takes an average of 10.8 years, with the ascent somewhat faster than the descent
6. The interval between the maxima of two adjacent cycles varies between 7.3 and 17.1 years, with an average of 10.9 years.

Figure 1 shows the average sunspot cycle described by the characteristics summarized above. It must be emphasized, however, that there have been some rather large deviations from these average values in the characteristics of many individual cycles.

Cycle 20—Past & Future

Cycle 20, the present sunspot cycle, began during October, 1964 with a smoothed sunspot number of 9.6. Figure 1 shows that Cycle 20 began at a slightly higher than average level of solar intensity, but since then has followed the average cycle almost exactly. In fact, the course of the present cycle parallels that of the average cycle more closely than any previous cycle.

If the present cycle continued to parallel the average cycle during the latter half of last year, its maximum should have occurred during November, 1968 with a smoothed sunspot number close to 110. Based on a more detailed examination of cyclic behavior,

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indications are that the present cycle probably reached its peak intensity during October, 1968 with a smoothed sunspot number of 115. It will require, however, several more months of data before this can be confirmed.

The peak of the present cycle is considerably lower than the peak values of the previous two cycles. Cycle 19 soared to a record breaking maximum of 201 during March, 1958, and cycle 18 peaked during June 1947 with a smoothed sunspot number of 152.

Values of smoothed sunspot numbers observed during the present cycle are recorded in Table I. During 1968, solar activity began with a level of 102, rose to an estimated peak of 115 during October, and by the end of the year had declined to an estimated level of 113.

The present sunspot cycle is now believed to be declining, but at a very slow rate. As shown in the above Table, the new year is expected to begin with a solar level of 111, and decline to a level of 95 by the end of the year. This will be a moderately high level of solar activitiy, not very much different from last year, and about the same level that was last observed during 1960.

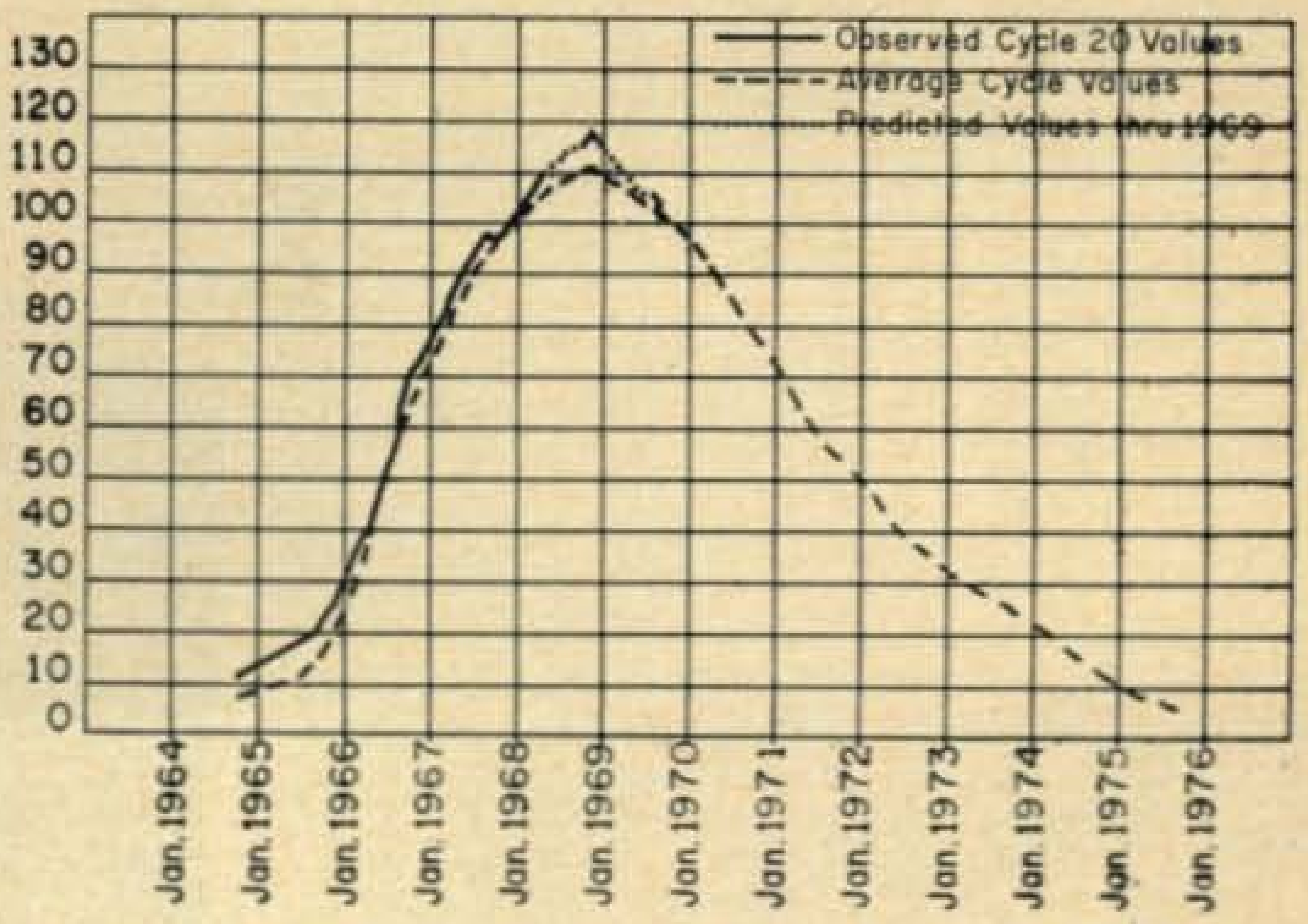


Fig. 1—Progress of the present sunspot cycle 20 from 1964 to 1968 and predictions for 1969 to 1970, compared to the mathematical average curve.

H.f. Propagation

There is a direct relationship between the sunspot count and high frequency or shortwave radio propagation. During the years when the sun's surface is covered with a great number of spots, the degree of ionization of the earth's atmosphere is very strong, and long-distance radio propagation on the h.f. bands is at its best. When the number of spots are fewer, the ionosphere becomes weaker, and h.f. communications become generally poorer.

From the standpoint of radio propagation, 1968 will go down as a very good year. Solar activity was high enough to permit worldwide openings on 10 meters during the daytime hours of the spring, fall and winter months, and occasionally during the summer months as well. Excellent worldwide openings were possible on 15 meters throughout the year during the daylight hours and into the early evening.

During the past year, the 20 meter band was excellent for round-the-clock DX propagation, with openings possible to one area of the world or another at almost any time. During the hours of darkness good DX conditions existed on 40 and 80 meters throughout most of the year, but peaking during the fall, winter and spring months. Some fairly good 160 meter openings also took place during the hours of darkness of these same seasons.

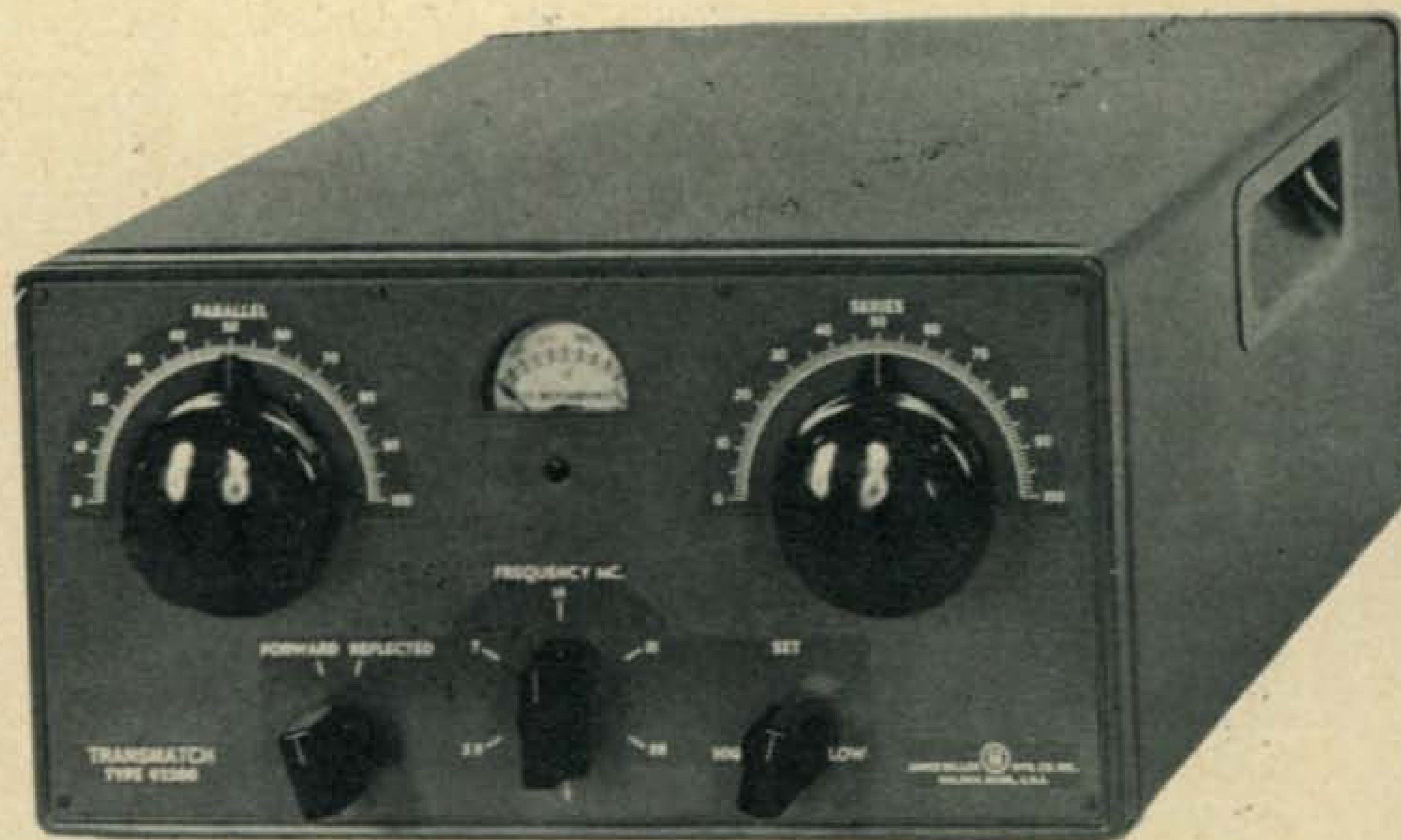
Solar activity during 1968 was not high enough to permit the worldwide 6 meter DX openings that took place during the peak periods of cycles 18 and 19. Some transcontinental 6 meter openings were reported, however, as well as a few openings between the USA and Central and South America, primarily during the late fall, winter and early spring months.

Without a doubt, 1968 will go down as a very good year for h.f. propagation conditions; the best since 1960.

With only a slight decline expected in sunspot activity during 1969, h.f. propagation conditions should be much the same during the new year as they were last year. Ten meters should continue to open to all areas of the world during the daylight hours of the spring, fall and winter months, with some openings also possible during the summer months as well. Excellent conditions are forecast for 15 meters for all seasons of the year during the daylight and early evening hours. Twenty meters will continue to be an around-the-clock band, with conditions peaking during the late afternoon, evening and early morning hours of the spring, summer and early fall months, and during the daylight and early evening hours of the winter months. Good DX propagation conditions are expected on 40 and 80 meters during the hours of darkness, and some 160 meter openings

[*Continued on page 98*]

CQ Reviews: The Millen 92200 2 KW Transmatch



BY WILFRED M. SCHERER,* W2AEF

MUCH of the present-day transmitting gear is designed with a fixed output impedance for matching to loads of 50 ohms or so. Others may have an adjustable output for matching over only a limited range such as for essentially non-reactive loads of 25-100 ohms. As a consequence, in such cases, maximum output from the transmitter or sufficient loading for proper operation of a linear amplifier may not be possible where the load impedance falls outside the matching range or where such loads are reactive and the s.w.r. seen by the transmitter is greater than 1.5 or 2 to 1. These situations may exist where large frequency excursions are made over a band, a multi-band antenna is in use or other cases where the transmission line cannot be properly matched or be thus maintained for presenting a low s.w.r. to the transmitter.

Under these conditions, it would therefore be desirable to employ some external means of providing the proper load for best transmitter performance. An expedient for accomplishing this is an impedance-matching antenna coupler. A number of such affairs have been described in amateur literature and have become to be known as a "Transmatch." This is a title suggested in an article on a matching device described some time ago by Lewis McCoy, W1ICP[1].

Commercial versions of W1ICP's Transmatch are produced by the James Millen Manufacturing Co., Inc. There are two models, the No. 92201 for handling up to 300 watts peak r.f. power and the No. 92200 for 2 kw peak. Both models are designed to allow a 50 ohm transmitter output on the 3.5-28 mc amateur bands to be matched to impedances ranging from 10 ohms up to 300-1300 ohms, depending on the frequency of operation.

Athough they have been available for some time and are widely used, we shall take a look at the Millen units at this time for the benefit of those who may have missed other published data on them or to whom they may not otherwise be familiar.

Circuitry

The basic circuit is shown at fig. 1. It consists of an LC network made op of an inductor (L_1) in parallel with which is a split-stator variable capacitor (C_1). A single-section variable capacitor (C_2) is in series with the output

*Technical Director, *CQ*.

[1]McCoy, L. G., "The 50-Ohmer Transmatch," *QST*, July 1961, p. 30.

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line. The inductor is tapped to provide bandswitching. Examination of the circuit will reveal that it is similar to a Pi-network, except for the reversal of the ground and the hot r.f.-input connections and the addition of the series output capacitor. C_1 provides the resistive tuning or impedance conversion, while C_2 tunes out the load reactance.

The input to the network is fed through a reflectometer that provides relative forward-and reflected power readings. Its primary purpose is to show when the Transmatch is properly tuned to provide a non-reactive low-impedance input as will be indicated by a minimum or zero reflected-power reading. Forward power readings are subsequently useful for adjusting the transmitter for maximum output.

An additional feature is a small loop that allows an oscilloscope to be coupled to the network for monitoring or measurement purposes.

Construction

The Transmatch made available to us for evaluation was the No. 92200, designed for 2 kw peak power. It embodies the high-quality construction which typifies Millen gear. Except for some comments on special details, the type of components and the method of construction are best visualized from the photograph of the interior view.

Rugged variable capacitors with wide-spaced polished-aluminum plates are provided to withstand breakdown at the high voltages with the high impedances that might be encountered in the particular portion of the circuit under the various conditions within the design limitations. In the case of the parallel capacitor, the breakdown rating is 6000 volts, while that of the series capacitor is 9000 volts. The capacitors are mounted on 1″ high ceramic insulators and the capacitor control shafts are insulated from the panel and the operating knob by high-voltage type ceramic couplings.

The inductor is made up of two sections, both of which are used for 3.5 and 7 mc operation. Only the smaller inductor is used for 14, 21 and 28 mc. They are space-wound with #10 wire held by grooved glasskyd supports. The oscilloscope-coupling loop mounts alongside the smaller inductor section.

The bandswitch is one of the Millen 51000 series, designed especially to handle high r.f. currents and voltages.[2] It has large size

[2] "New Components by Millen Mfg.," *CQ*, June 1965, p. 55.

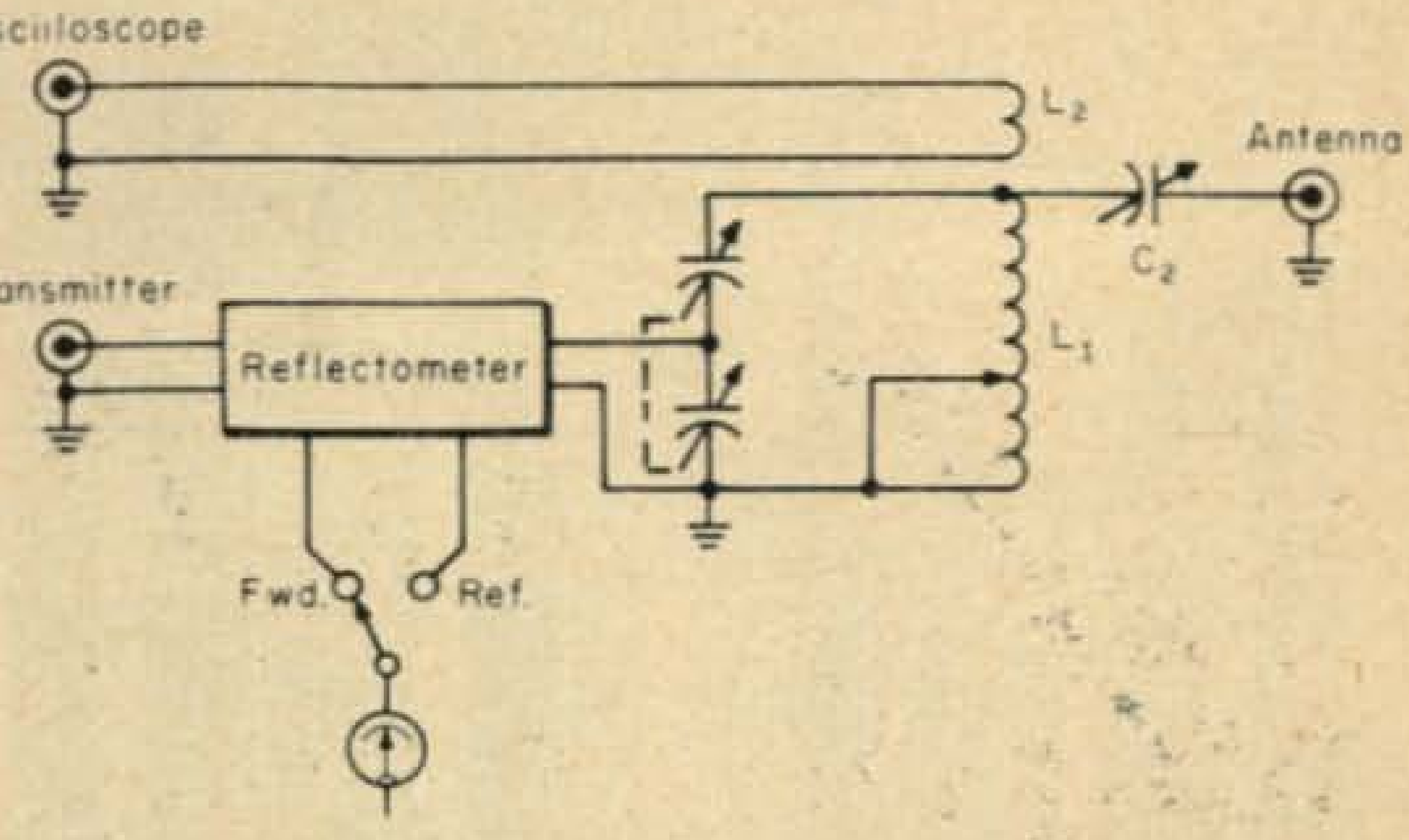


Fig. 1—Setup as used in the Millen Transmatch. Details are given in the text.

heavy-duty solid-silver contacts and silver-plated conducting elements. A very heavy spring pressure is used to further ensure a low resistance r.f. contact and reduce heating, while a positive snap-in detent maintains correct alignment.

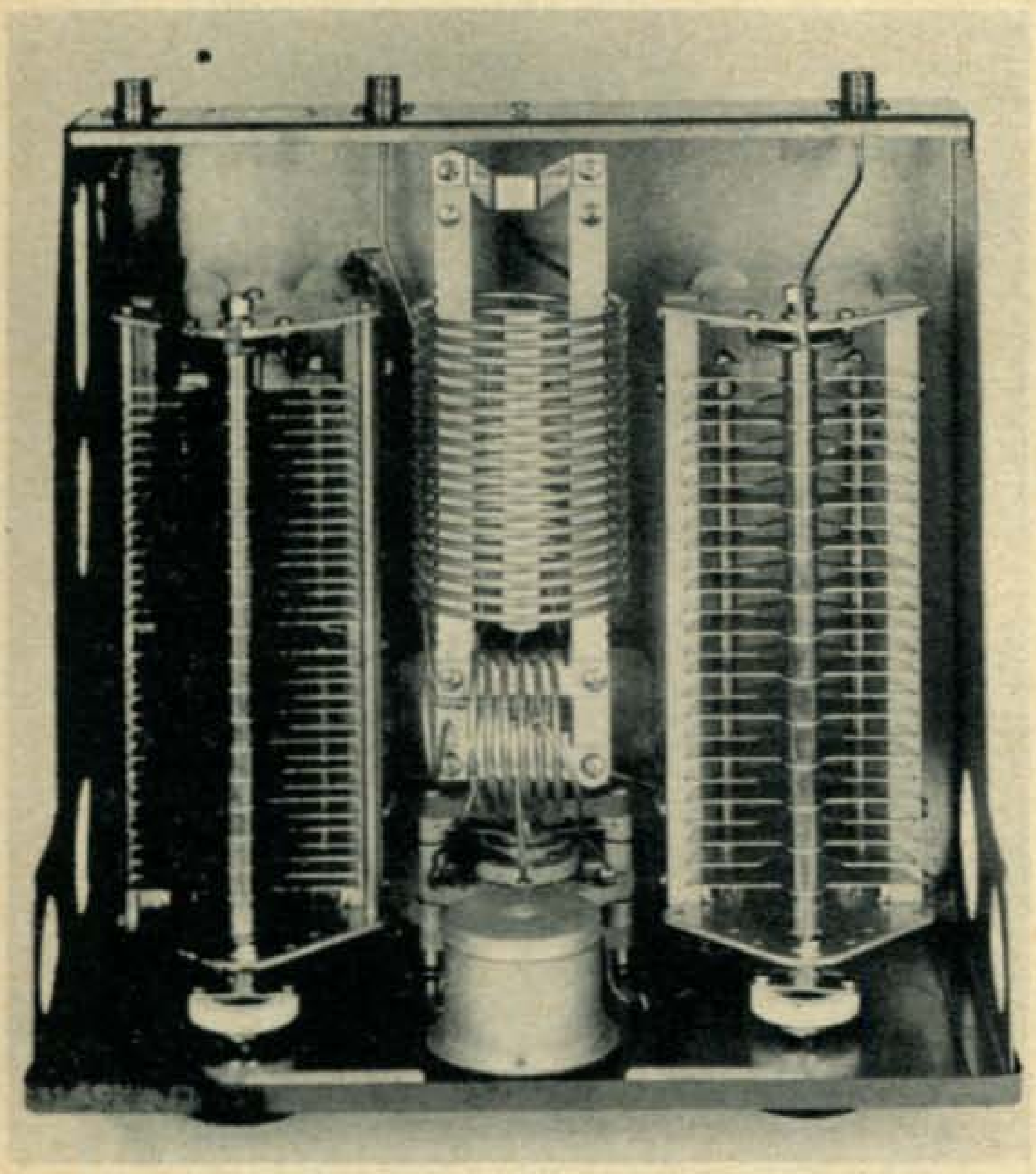
When the switch is operated, both the switch contacts and the common connection to the switch arm are opened at the same time. This provides a dual break to minimize arcing should a "hot switch" be inadvertently attempted. The insulated frame is made of glass-reinforced alkyd that has a very high voltage-breakdown characteristic and which is most resistant to arcing and arc-tracking.

Since the 3.5 mc band covers a large percentage of the basic frequency, two bandswitch positions are provided for this range to optimize operation toward both the low and high ends of the band.

The reflectometer is the trough-line type. Its associated meter is a 0-500 microamp job and it is completely shielded at the rear. Forward- or reflected-power readings are selected by a panel switch, while another control adjusts the meter sensitivity.

Dial scales, calibrated 0-100 in unit steps, are provided for both the parallel- and series-tuning capacitors. They are useful for logging the settings for operation on various bands or under different conditions. Reference to these settings thus avoids the need for any extensive retuning, or determination thereof, when changes in operation are made.

The Millen transmatch is built on a heavy-gauge chassis formed in one piece along with sturdy side brackets to which the panel is fastened. The cabinet slides into lips that are bent around the edges of the panel. This produces a very tight fit which, together with spot welding along the joints of the cabinet, results in a virtually water-proof enclosure that provides the maximum effectiveness of



Interior view of the Millen 92200 Transmatch. The series-tuning capacitor is at the left. The parallel-tuning one is at the right. The h.f. inductor is the small one near the center. The larger inductor, toward the bottom of the photo, is added to the h.f. inductor for the lower frequency bands. The bandswitch is underneath the round meter shield on the panel at the top.

the shielding for the minimization of stray r.f. radiation or harmonics that might otherwise cause t.v.i. or other difficulties. This is further enhanced by the shielding at the rear of the meter. In addition, all the metal work in respect to the above is copper-plated. Type SO-239 u.h.f. coax receptacles are furnished for the input, output and oscilloscope connections.

The size of the No. 92200 2 kw Transmatch is 7″ × 14″ × 13⅝″ (h.w.d.) and it weighs 17 pounds. The No. 92201 300 watt model is 4¾″ × 7″ × 9″ with a weight of 6 pounds. Its small size makes this unit suitable for mobile applications. Both models are finished in medium gray and have black knobs.

Operation

The No. 92200 Transmatch is designed to work into a wide range of impedances (unbalanced loads) while providing a 50 ohm impedance at the input or transmitter end. These ranges are as follows:

3.5-4.0 mc	10-1300 ohms
7.0-7.3 mc	10-1300 ohms
14.0-14.35 mc	10-600 ohms
21.0-21.45 mc	10-500 ohms
28.0-29 mc	10-300 ohms
29.0-29.7 mc	10-700 ohms

Presumably these specifications are for resistive loads. The maximum values for reactive impedances may differ somewhat.

Operation on MARS frequencies in the 3.0-5.2 mc range also will provide matching ranging from up to 8000 ohms at 4.6 mc to 90 ohms at 3.0 and 5.2 mc.

Adjustment

Detailed information for adjusting the Transmatch is given in the instructions supplied with the unit. Basically it simply involves initially tuning up the transmitter in the normal manner, setting the Transmatch meter-sensitivity control for a convenient forward reading near full scale and then, with the meter switched to read reflected power, alternately adjusting the two Transmatch capacitors until a zero reflected-power reading is obtained.

The instruction sheet also includes charts with calibration curves indicating the capacitor settings over the operating-impedance range for the frequencies at the end of each amateur band. These are helpful as a guide for providing approximate dial settings for a starting point *before* tuneup or for estimating the actual load impedance *after* tuneup.

It should be noted that the Transmatch is designed for operation with unbalanced or coaxial line loads. Where the load is a balanced affair, a suitable balun should be used between the transmitter and the load.

Performance

The Model 92200 Transmatch was tested using a 2 kw p.e.p. input amplifier with 1300 watts output. No problems were encountered with voltage breakdown or overheating and in easily obtaining a 50 ohm match to the transmitter with a number of different type loads, including a random length end-fed antenna working against ground. One important consideration found in most cases, especially in relation to operation with an end-fed antenna, was that the Transmatch should be grounded directly rather than relying on a ground patch through the shield of the cable to the transmitter. There is no ground post on the unit, but the connection may be made to a screw at the rear.

No built-in provisions are included to bypass the network for direct feed to the

[*Continued on page 98*]

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DX

BY JOHN A. ATTAWAY*, K4IIF

It has been a long time since the rules for all the *CQ* DX awards were printed between the same set of covers. Therefore, we're full-filling a New Year's resolution by putting everything together in this, the *CQ* DX Award Rule's Issue. In the future we will print the rules every 2 years, and will continue to keep a supply of reprints available in the interim.

Complete WAZ Rules

The WAZ Award will be issued to any licensed amateur station presenting proof of contact with the forty zones of the world. This proof shall consist of proper QSL cards to be checked by the DX Editor or verified at one of the authorized checkpoints for *CQ* DX Awards. Most of the major DX clubs of the USA and national amateur radio societies abroad can be authorized checkpoints if they clear in advance with K4IIF. If in doubt consult the DX Editor. Any legal type of emission may be used providing communication was established after Nov. 15, 1945.

1. The official *CQ* WAZ Zone Map will be used in determining zone boundaries.

2. Confirmations must be accompanied by a list of claimed zones showing the call letters of the station QSOed and the mode. The list should also show the applicant's name, call letters, and complete mailing address clearly.

3. All contacts must be made with licensed, *land based*, amateur stations working in authorized amateur bands.

4. All contacts submitted by the applicant must be made within a 250 mile radius of the original location.

5. Any altered or forged confirmations will result in permanent disqualification of the applicant.

6. Continued use of poor operating ethics will result in disqualification of the applicant.

7. In addition to the conventional certificate for which any and all bands and modes may be used, specially endorsed and numbered certificates are available for phone and single sideband operation. The phone certificate requires that all contacts be two-way phone and the s.s.b. certificate requires that all contacts be two-way s.s.b.

8. If, at the time of the *original* application, a note is made pertaining to the possibility of a subsequent application for an endorsement or special certificate, only the missing confirmations required for that endorsement need be submitted with the later application.

9. Include with the application $1.00 or 8 International Reply Coupons to defray the cost of the certificate.

10. Decisions of the *CQ* DX Awards Advisory Committee on any matter pertaining to the administration of this award shall be final.

11. All applications should be sent to the DX Editor, P.O. Box 205, Winter Haven, Florida 33880.

12. Zone Maps and/or WAZ applications are available from the DX Editor or from *CQ* for a self-addressed stamped envelope or self-addressed envelope and 1 IRC.

The following list of zones is presented as a guide. Any questions will be decided by the zone map.

Zone 1. Northwestern Zone of North America: KL7, VE8-Yukon, the VE8-Northwest Territories Districts of Mackensie and, Franklin, and the islands west of 102° including Victoria, Banks, Melville, and Prince Patrick.

Zone 2. Northeastern Zone of North America: VO2-Labrador, that portion of VE2-Quebec north of the 50th parallel, and a portion of the Northwest Territories-VE8 east of longitude 102°. The latter includes part of the District of Franklin and the islands of King William, Prince of Wales, Somerset, Gathurst, Devon, Ellesmere, Baffin, and the Melville and Boohtia Peninsulas.

Zone 3. Western Zone of North America: VE7, W6 and the W7 states of Arizona, Idaho, Nevada, Oregon, Utah, and Washington.

Zone 4. Central Zone of North America: VE3, VE4, VE5, VE6, the W7 states of Montana and Wyoming, WØ, W9, W8 (except W. Va), W5, and the W4 states of Alabama, Tennessee, and Kentucky.

Zone 5. Eastern Zone of North America: FP8, VE1, VO1, that portion of VE2-Quebec south of the 50th parallel, VP9, W1, W2, W3, the W4 states of Florida, Georgia, South Carolina, North Carolina, and Virginia, and the W8 state of West Virginia.

Zone 6. Southern Zone of North America: XE and XF.

Zone 7. Central American Zone: FO8-Clipperton, HP, HR, KS4, KZ5, TI, TI9, VP1, TG, YN, and YS.

Zone 8. West Indies Zone: CM/CO, FG7, FM7, HH, HI, KG4, VP2, VP5, VP7, KC4-Navassa,

S.S.B. DX Honor Roll

W2TP	317	WA8AJI	304	W2FXN	292	MP4BBW	267
VK3AHO	315	W6YMV	303	W2LV	286	G2PL	265
WA2RAU	315	WØQVZ	303	W6EUF	286	G2BVN	264
W9ILW	315	W2BXA	302	K8RTW	286	W2MJ	261
T12HP	313	G3AWZ	301	W1LLF	280	DL3RK	259
W3NKM	313	G6TA	301	W6UOU	280	G3DO	259
WA2IZS	311	W3DJZ	301	W4RLS	279	W6WNE	259
KP4CL	310	W5KUC	299	K4OEI	279	PJ2AA	258
G3FKM	310	XE1AE	298	DL1IN	276	K1SHN	257
W2RGV	309	5Z4ERR	298	K4HYL	276	WA2EOQ	256
W4OPM	309	K2DX	297	W6RKP	276	W6BAF	254
DL9OH	309	W4QCW	297	PZ1AX	274	K6CAZ	254
G8KS	307	W4SSU	297	K9EAB	273	PAØSNG	252
I1AMU	305	W8BT	297	K9KUI	273	W1AOL	250
W2ZX	305	W4UF	295	G3NUG	270	K6LGF	250
K6CYG	305	W4PAA	294	G3WW	269		
W8DE	304	W8EVZ	293	K8ONV	269		

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

PJ2M/FS7, PJ2E, PJ2S, and YV∅-Aves.

Zone 9. Northern Zone of South America: FY7, HK, PJ2 PZ, VP3/8R, VP4/9Y4, and YV.

Zone 10. Western Zone of South America: CP, HC, HC8, and OA.

Zone 11. Central Zone of South America: PY and ZP.

Zone 12. Southwest Zone of South America: CE.

Zone 13. Southeast Zone of South America: CX, LU, VP8, and all Antarctic prefixes.

Zone 14. Western Zone of Europe: CT1, CT2, DJ/DL/DM, EA, EA6, EI, F, G/GB, GD, GI, GM, GW, HB, HL, LA, LX, ON, OY, OZ, PA/PI, PX, SM/SL, ZB2, and 3A2.

Zone 15. Central European Zone: FC, HA, HV, I, IT, IS, OE, OH, OK, SP, UA2, UP, UQ, UR, YU, ZA, ZB1/9H1, 9A1.

Zone 16. Eastern Zone of Europe: UA1, UA3, UA4, UA6, UA9-Bashkir & Chkalov, UB5, UC2, UN1, and UO5.

Zone 17. Western Zone of Siberia: UA9-Sverdlovsk, Chelyabinsk, Komi, Jurgan, Molotov, Omsk, Tyumen, plus UH8, UI8, UL7, and UM8.

Zone 18. Central Siberian Zone: UA9-Novosibirsk, Tonsk, Kamerovo, and Altai; UA∅-Keasnoyarsk, Irkutsk, Chita, Bruyate Mongolia, and Dickson Island.

Zone 19. Eastern Siberian Zone: UA∅-Khabarovsk, Amur, Yakutsk, Primorsky, Sakhalin Island, Wrangel Island, and the Soviet Kuriles.

Zone 20. Balkan Zone: JY, LZ, OD5, SV, TA, YK, YO, ZC4/5B4, and 4X4.

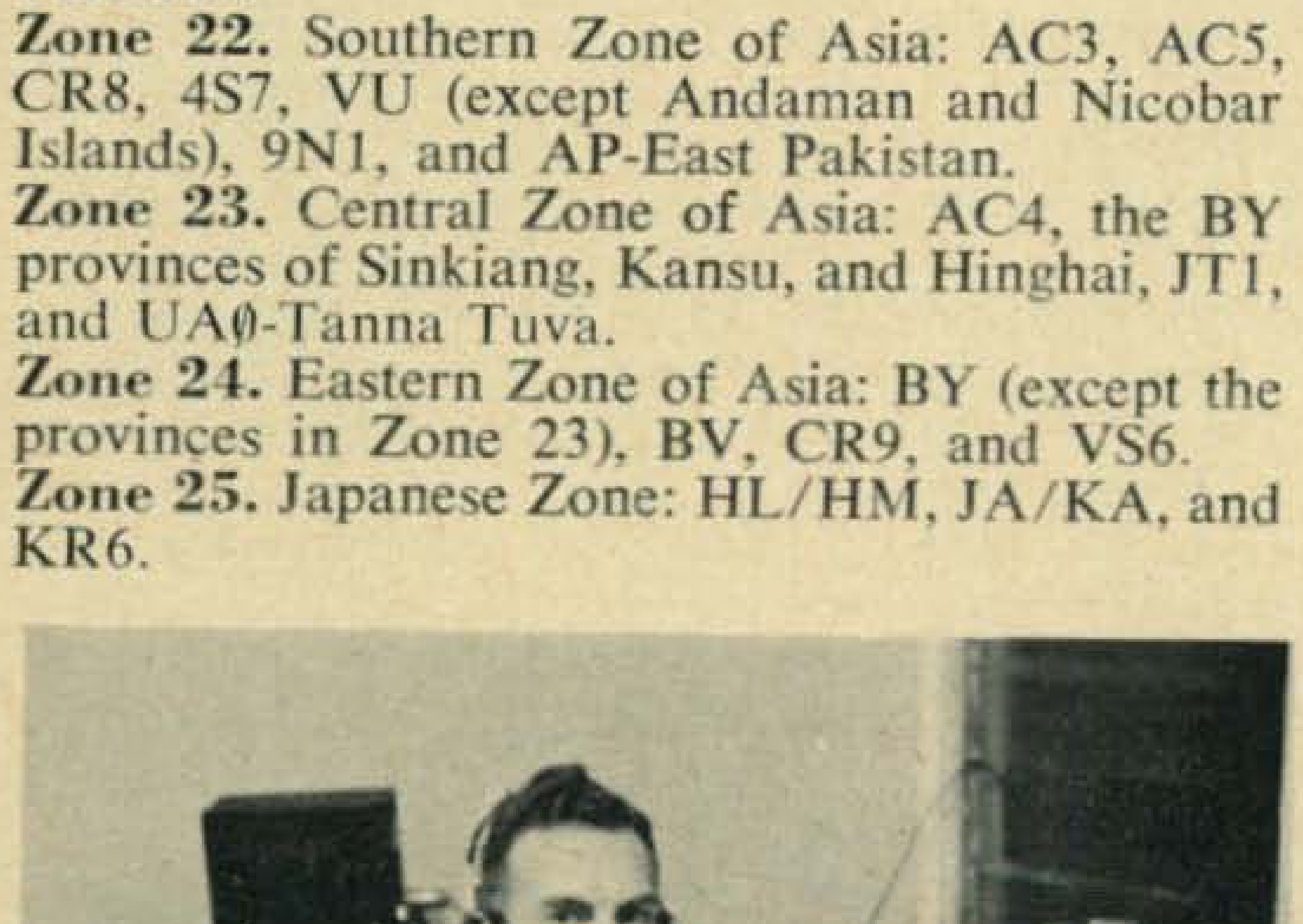
Zone 21. Southwestern Zone of Asia; EP, HZ, MP4, 9K, VS9 (except Maldives and Socotra), YA, YI, 4W1, UD6, UF6, UG6, and AP-West Pakistan.

Zone 22. Southern Zone of Asia: AC3, AC5, CR8, 4S7, VU (except Andaman and Nicobar Islands), 9N1, and AP-East Pakistan.

Zone 23. Central Zone of Asia: AC4, the BY provinces of Sinkiang, Kansu, and Hinghai, JT1, and UA∅-Tanna Tuva.

Zone 24. Eastern Zone of Asia: BY (except the provinces in Zone 23), BV, CR9, and VS6.

Zone 25. Japanese Zone: HL/HM, JA/KA, and KR6.



VR4CR—Arthur, who has just completed a tour of duty in the weather office of Honiara, Guadalcanal. He dispersed thousands of QSO's from the Solomons and regularly kept the low end of 20 meter c.w. warm. *(Photo via K4DSN)*

Zone 26. Southeastern Zone of Asia: HS, XV, XW, XZ, 3W8, and VU2-Andaman and Nicobar Islands.

Zone 27. Philippine Zone: DU, KC6, and KG6.

Zone 28. Indonesian Zone: CR∅, VR4, VK9 (except Nauru, Norfolk Is., and Christmas Is), VS1, VS4, VS5, ZC5, 8F, and 9M.

Zone 29. Western Zone of Australia: VK6, VK8, and VK9-Christmas Is.).

Zone 30. Eastern Zone of Australia: VK1, VK2, V3, VK4, VK5, VK7, and VK∅-Macquarrie Is.

Zone 31. Central Pacific Zone: KB6, KH6, KJ6, KM6, KP6, KW6, KX6, VK-Nauru, VR1, VR3, and ZM7.

Zone 32. New Zealand Zone: FK8, FO8, (except Clipperton), FU8/YJ, KS6, VK9-Norfolk Is., VR2, VR5, VR6, ZK1, ZK2, ZL, and 5W1.

Zone 33. Northwestern Zone of Africa: CN2, CN8, CT3, EA8, EA9, 3V8, and 7X.

Zone 34. Northeastern Zone of Afrcia: ST, SU, and 5A.

Zone 35. Central Zone of Africa: CR4, CR5-Guinea, EL, TU, TY, TZ, XT, ZD3, 5N2, 5U, 5V, 6W8, 9G1, and 9L1.

Zone 36. Equatorial Zone of Africa: CR5-Sao Thome, CR6, EA∅, TJ, TL, TT, TN, TR, 9Q5, 9U5, 9J, ZD7, and ZD8.

Zone 37. Eastern Zone of Africa: CR7, ET2, ET3, FL8, 6O1, 6O2, 5H3, 5X5, 5Z4, and 7Q7.

Zone 38. South African Zone: ZD9, ZE, and ZS.

Zone 39. Madagascar Zone: FB8, 5R8, FR7, VQ8, VQ9, and VK∅-Heard Is.

Zone 40. North Atlantic Zone: LA-Jan Mayen, LA-Svalbard, OX, TF, and UA1-Franz Joseph Land.

The UA9 and UA∅ Zones are sometimes rather hard to determine. However, the DX column in the June, 1967, issue has a handy table to use in locating stations in these zones.

Complete WPX Rules

The general rules 3-11 of the WAZ Award also apply to WPX where appropriate. In addition, the following other rules specific to WPX must be followed:

1. All applications for WPX certificates and endorsements must be submitted on the official application form CQ 1051. This form can be obtained free by sending a self-addressed stamped envelope to the DX Editor. It is highly desirable to use business size envelopes, 8½ x 11 inches, for this purpose.
2. All call letters *must* be in strict alphabetical order.
3. All entries *must* be clearly legible.
4. Use separate application for each endorsement, and be sure to specify whether your certificate is mixed, c.w., phone, or s.s.b.
5. For additional WPX credit list only additional calls.
6. Include with application $1.00 or 8 International Reply Coupons (IRCs) for certificate. A self-addressed stamped envelope or self-addressed envelope with 1 IRC should be sent for endorsement stickers.

Certificates are issued for the following categories and numbers of prefixes: MIXED–400; C.W.–300; PHONE–300; S.S.B.–200.

Contacts between a s.s.b. station and an a.m. phone station will be accepted for the phone

See page 110 for New Reader Service

certificate. Cross-mode contacts between CW and SSB/Phone will not be valid for WPX.

Endorsements are issued for each 50 additional prefixes submitted. Band endorsements are available for working the following numbers of prefixes on the various bands: 1.8 mc–35; 3.5 mc–150; 7 mc–250; 14 mc–300; 21 mc–300; 28 mc–250.

Continental endorsements are given for working the following numbers of prefixes in the respective continents: North America – 126; South America–88; Europe–146; Africa–80; Asia–68; Oceania–51.

Cards need *not* be sent but *must* be in the possession of the applicant. Any and all cards may be requested by the DX Editor or the Committee.

The definition of prefixes will be as follows:

Prefixes

1. The 2 or 3 letter/numeral combinations which forms the first part of any amateur call will be considered the prefix.

2. Any difference in the numbering, lettering or order of same shall constitute a separate prefix. The following would be considered different: W2, WA2, WB2, WN2, WV2, K2 and KN2.

3. Any prefix will be considered legitimate if its use was licensed or permitted by the governing authority in that country.

4. A suffix would designate portable operation in another country or call area and would count only if it is the *normal* prefix used in that area. For example, K4IIF/KP4 would count only as KP4. However, KP4XX/7 would NOT count as KP7 since this is not a normal prefix. Suffixes such as /M, /MM, /AM, /A and /P are not counted as prefixes. (See also rule #5).

5. All calls without numbers will be assigned ar arbitrary Ø plus the first two letters to constitute a prefix. For example, RAEM counts as RAØ, AIR is AIØ, UPOL is UPØ. All portable suffixes that contain no numerals will be assigned an arbitrary Ø. For example, W4BPD/LX counts as LXØ and HB9XYZ/PX counts as PXØ.

6. WPX is intended to be a pleasant past-time and not a contest for "blood". All legitimate prefixes will be counted. For example, if you have both a VP4 card and a PY4 from Trinidad, both will be counted.

In addition to the 4 categories of WPX certifiactes, a WPX Honor Roll is maintained with a separate listing for c.w., s.s.b., mixed, and phone. Applications may be obtained by sending a self-addressed stamped envelope to WPX Manager, Howard Kelley, K4DSN. The rules governing admission to the Honor Roll are as follows:

WPX Honor Roll

The WPX HONOR ROLL recognizes those operators and stations that maintain a high standing in confirmed, current prefixes. The rules, therefore, reflect the belief that Honor Roll membership should be accessible to all active radio amateurs and not to be unduly advantageous to the "old-timers." With the exceptions listed below, all general rules for WPX apply toward Honor Roll credit.

Karl Eskel, DL1PC, one of the real old-timers of German amateur radio.
(Photo via WB6OLR of the San Diego DX Club)

1. Only current prefixes may be counted toward WPX HR standings; those prefixes to be listed and updated annually in *CQ* or available from the DX Editor or WPX Manager.

2. Special Issue prefixes, *i.e.*, 3C, 4A, OF, etc. will be considered current during their existence and for five years after the date of last issuance after which time they will be deducted as credit for Honor Roll standings.

3. Honor Roll applicants must submit their list of current prefixes separate of their WPX applications. Forms are available for this purpose and there use is highly recommended. WPX HR applications may be gotten free by sending a self-addressed stamped envelope (or 1 IRC) to the DX Editor or WPX Manager. A separate application must be made for each mode.

4. A filing charge of $1.00 is required for each original WPX application.

In addition to the regular WPX Awards, *CQ* has 2 specialized prefix awards which follow the same general rules as WPX. These are the WPNX Award for Novices only, and the VPX Award for Short-Wave Listener's only.

WPNX: The WPNX Award can be earned by Novices who work 100 different prefixes prior to receiving a higher class license. The application may be submitted after receiving the higher license providing the actual contacts were made as a Novice. Prefixes worked for the WPNX Award may be later used for credit toward the WPX Award.

The rules for the WPNX Award are the same as for WPX except that only 100 prefixes must be confirmed, and applications are sent to WPNX Manager, Bob Norman, K4GRD, instead of to WPX Manager, Howard Kelley, K4DSN.

VPX: The VPX or Verified Prefixes Award can be earned by s.w.l.'s who possess QSL cards showing that they have verified the correct numbers of prefixes as specified in the WPX rules. Applications are handled by WPX Manager, Howard Kelley, K4DSN.

Complete S.S.B. DX Award Rules

The 2 × SSB Certificate will be issued to any licensed amateur station presenting proof of contact with 100, 200 and 300 countries. Stickers

The neat set-up, down-under way, of Allen, VK3SM. On the top row is an antenna switching device, a low pass filter and an Australian Air Force AR-7 receiver. On the bottom row is a homebrew power supply, K. W. Viceroy transmiter, and Drake 2B receiver.

will be issued for each additional 25 countries confirmed up to 300, thereafter they will be issued in increments of ten. This proof shall consist of a proper QSL card to be checked by the 2 × SSB Award Mgr. or by one of the authorized checkpoints for *CQ* DX Awards.

1. All applications should be submitted on official application form *CQ* 1067. This form can be obtained free by sending a self-addressed stamped enelope to the 2 × SSB Award Mgr.

2. All QSL cards must be clearly marked 2 × SSB, and be in alphabetical order.

3. Claims for 100 countries must be included in the first application.

4. Confirmations must be accompanied by a list of claimed countries and stations to aid in checking and for future reference.

5. Include with the application $1.00 or 8 IRC's to defray cost of the certificate. Sufficient postage for the return of confirmations must be included with a self addressed stamped envelope with each application. When sending for endorsements 2 International Reply Coupons or a self addressed stamped envelope should accompany each application.

Vic Dubois, K4SHB, (left) and Harold North, VP7NA (right) outside the shack of VP7NA during the 1968 CQ Worldwide Phone Contest operation by K4IIF and K4SHB.

6. All contacts must be with licensed land based amateur stations working in authorized amateur bands.

7. All contacts submitted by applicant must be within a 250 mile radius of the original location.

8. Any altered or forged confirmations will result in permanent disqualification of the applicant.

9. Fair play and good sportsmanship in operating are required of all amateurs working toward 2 × SSB Award. Continued use of poor ethics will result in disqualification.

10. Once a country has lost its status as such it will automatically be deleted from our records. There will only be a current country count.

11. Decisions of the *CQ* DX Awards Advisory Committee on any matter pertaining to the administration of this award shall be final.

12. All applications should be sent to: Louise Rippe W8HDB, 2 × SSB Award Mgr., 3785 Susanna Dr., Cincinnati, Ohio 45239.

Comment on the ARRL Rejection of K4IIF/KV4 QSL Cards

Please permit me a short personal note.

In October, 1967, David Field, WA4RFB, and I operated from St. Thomas during the *CQ* World Wide Phone Contest. At that time ARRL had not passed its rule requesting certification of DXpeditions. Actually Dave and I did not consider that a weekend of portable operation from this delightful place, which is afterall U.S. territory, really qualified as a DXpedition.

In October, 1968, a full year later, we received a letter from a Mr. C. White at League headquarters notifying us of the new rule, and that we would have to send him our airline and hotel receipts before the League would accept our cards for DXCC credit. I informed him that we did not save our old airline receipts, and that we had stayed in the home of a friend, not a hotel. I sent him the names and addresses of three friends in St. Thomas, two of them amateurs, *and gave him my permission to contact any or all of them* if he seriously doubted that I had operated from St. Thomas. Mr. White rejected this offer, apparently feeling that the burden of proof was on me. After thinking it over for a few days I declined to do anything further. I admonished him that when there isn't the slightest doubt of a man's innocence he should be presumed innocent.

A month later I received another letter over the signature of a Mr. Richard L. Baldwin, W1IKE, Assistant General Manager. The highlights of Mr. Baldwin's letter are as follows:

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"*CQ* continues to support Dr. Miller editorially as evidenced by the misinformation printed in the November issue. Whether the average reader believes that with your magazine association you, too, support Dr. Miller will have to be left up to the individual judgement.

"In any event, we shall not press you further for certification of your DXpedition to the Virgin Islands. Any of your cards received for DXCC credit are simply being returned with a statement that you have declined to provide the requested certification. The individual who worked you is the loser —not you, not the League, not Dr. Miller."

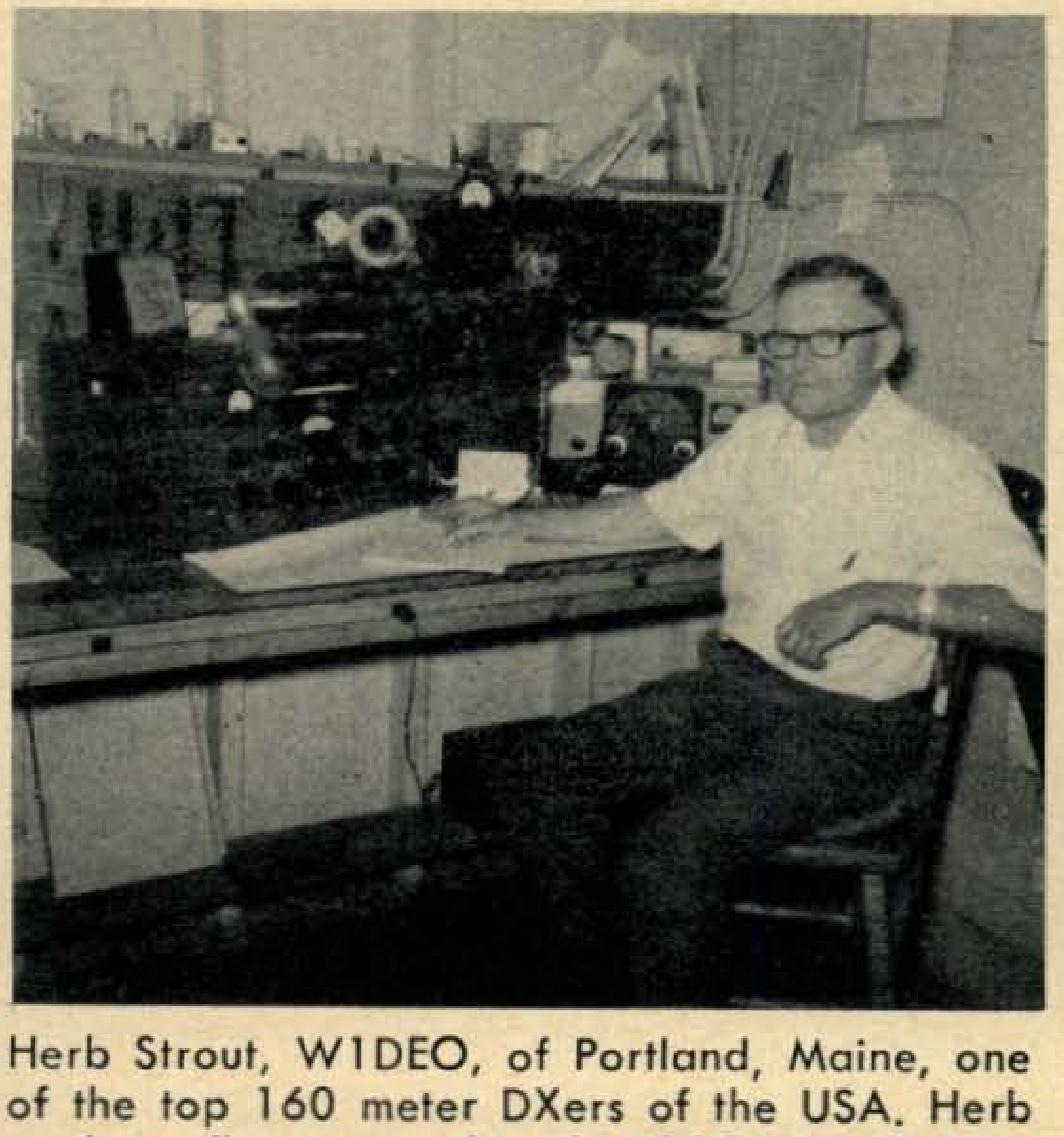
For the record, Dave Field and I paid every penny of our expenses on this trip from our own pockets. *CQ* Magazine did nothing but print the QSL cards for us. Don Miller had nothing to do with our operation. He was clear around the world operating from Cocos-Keeling at the time. Don's name was not mentioned in any of the correspondence until Mr. Baldwin raised it in his letter. My column was *scrupulously neutral* in the Miller-Award's Committee fiasco. We printed the facts as we received them and refused to take sides. Mr. Baldwin is well aware of this. Why he should make Don Miller an issue in rejecting my QSL cards is beyond my comprehension. The only thing I agree with is his statement that the poor individual DXer is the loser, in this case because someone resents the editorial policy of a magazine for which I happen to write.

De Extra

The Committee Speaks: We feel a great deal of pride in our *CQ* DX Award's Advisory Committee. It has been a big success, and as a consequence other organizations have followed our lead and established advisory committees to deal with various aspects of the hobby. However, our's is still the only DX Advisory Committee, and when it spontaneously renders an almost unanimous judgement on a question which we haven't even asked it, we certainly have to sit up and take notice.

The magic question deals again with the matter of 'country lists.' In the November, 1968 issue, page 105, we published the latest *CQ* DX Advisory ballot which evaluated various criteria which could be used to determine what is or isn't a country. The Committee exhibited a wide range of opinions on the various criteria, and made many spirited comments. They were far from unanimous on most of the points. However, almost every committee member did venture a definite opinion that there should be only ONE country list, universally accepted by all amateur organizations throughout the world. They felt strongly that the many lists in use today were needlessly confusing. Since this point hadn't even been presented for discussion, but rather was raised simultaneously by DX Committee members in every section of the USA, it merits some thought.

As the Committeemen pointed out, the present situation is far from ideal. Not only



Herb Strout, W1DEO, of Portland, Maine, one of the top 160 meter DXers of the USA. Herb made a first ever when he QSO'd 5H3KK in Tanzania using his Ranger II and 75A4.

The 160 meter antenna support at W1DEO. The 325 ft. tower on a hilltop supports Herb's 265 ft. semi-vertictal antenna.

(Photo via W1BB)

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Here is a rare quartet from FP-land. From left to right are FP8CY, FP8AP, FP8CS and FP0EB, who is also Alex, VE2AFC. Alex was only the 2nd to have the rare new FP0 prefix for foreigners visiting St. Pierre. QSL all FP0EB QSO's to P.O. Box 382, Quebec City 4, Canada. Incidentally, Alex hopes to be on from FO0, Clipperton next summer. *(Photo courtesy FP0EB/VE2AFC)*

is there a lot of argument about some of the things we call countries, there are simply too many different lists as well. The ARRL has its list which *CQ* recognizes as a courtesy to that organization although it frequently disagrees with some of the places the League considers to be countries. WTW and Gus Brownings DX Marathon have other lists. DARC (German Amateur Radio Club) has a slightly different version for its WAE and Eu-DX-D awards, as does NZART for its WAP award, just to name a few. This causes a lot of confusion because what is a country on one list sometimes isn't on another. This is unnecessary confusion.

So what do we do about it? There is probably more than one way this could be handled, but for a starter we suggest that all national amateur radio societies who now issue awards based on country lists designate a representative to a Country Congress which would convene by mail and adopt a worldwide list. A prerequisite to participation would be agreement to abide by the opinion of the majority. A list of everything now designated as a country could be compiled, and each country voted on individually. A majority vote would be required to enter the country on the accepted worldwide country list. This is a truly democratic solution. Comment anyone?

The WAZ Program

Ole Man WAZ, the grand-daddy of the DX Awards, he just keeps rolling along. With 46 successful new applicants this is the second biggest month in the award's history, topped only by the 50 reported in the August, 1967 issue. The new winners of the world's most difficult and most coveted DX award were the following:

WAZ S.S.B.: W8ILC–606, W4AQW–607, JA1BWT–608, KR6AB–609, YV4IQ–610, EA4JL–611, 3C5FO–612, K6YUI–613, OA4JR–614, W9DWQ–615, HB9ADE–616, HB9ADD–617, K4HJE–618, and ZL1LD–619.

WAZ Phone: CE6EZ–393, W5NMA–394, VK2AIA–395, W9ARV–396, K3RPY–397, and YA5RG–398.

WAZ C.W. – Phone: W8IHN – 2512, VE3GCO–2513, WA8GPX–2514, K4DRO–2515, K4DV–2516, K6SDR–2517, W2ASF–2518, W3ZNH–2519, W5ZVU–2520, W9ELQ–2521, W9PWM–2522, K9VLE–2523, W9BZW–2524, SP9QS–2525, G2DF–2526, WA1DJG–2527, K7AGJ–2528, WØOAQ–2529, HB9ADD–2530, KA9MF–2531, HA1SB–2532, GM3CFS–2533, UB5DW–2534, HA5AW–2535, UA6KAE–2536, and F2IU–2537.

The WPX Program

It was another great month under the extra-capable direction of WPX Manager Howard Kelley, K4DSN. Howard has processed every application within 7 days of receiving it, and the ham fraternity has again shown its approval with 25 new applications this month. The winners were:

WPX S.S.B.: SM6CKU–361, TF2WKP–362, DL2CG–363, KØYIP–364, W5NQR–365, K7RLS – 366, YS2CEN – 367, WB2RBG–368, and I1LCK–369.

WPX C.W.: HA8CF–882, HAØHC–883, HA7PG–884, UT5KDP–885, UA1ZL–886, UB5FL–887, UB5JR–888, CR6EI–889, SM6CKU–890, VO1AW–891, DJ1IW–892, and DJ9ON–893.

WPX Phone: YS2CEN–160.

WPX Mixed: VE3GCO – 180, W4DRK – 181, and DJ2EL–182.

Endorsements: *SSB:* I1LCK – 400, 350, 300, 250, 20-meters, Europe; K6SDR–400, 350; SM6CKU–300, 250; WAØOTE–250; W8FPM–20 meters.

C.W.: W9UZS–700, Asia; UT5CC–500, 450: W2GA–400; UB5FL–350; OK2BLG–80-meters; UA1ZL – 20 meters, Europe; UB5FL–Europe; WTGA–North America.

Mixed: K4ZCP–550, 500, 450, 20-meters; VE3GCO – 500, 450; WB2CDZ – 500,

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SM6CKU–450; W4DRK–450, VE3AAZ–Oceania.

The S.S.B. DX Award Program

There were only 3 S.S.B. DX Awards authorized this month. The new winners were: **100 Countries:** TF2WKP–530, K7RLS–531, and VE4BJ–532.

The WPNX Program

WPNX Manager, K4GRD, reports two more winers for *CQ*'s DX Award exclusively for novices. These hard-working, freshmen DXers and their certificate numbers are as follows:

William C. "Bill" Clark, WN6GRQ–7
George J. Agememnon, WN4GXW–8

160 Meter News

The latest 160 Meter DX Bulletin from W1BB is brimming with optimism about prospects for the coming year, as there is new interest in 160 Meter DXing all over the world. Plenty of operating activities are planned including the "First-Timer's" tests, the Transatlantic and Transpacific tests, and the *CQ* Worldwide 160 C.W. test. Anyone desiring further information should send W1BB a self-addressed envelope with 12¢ postage for a copy of the Bulletin.

New Oversea's Checkpoints for CQ DX Awards

BAHAMAS: Harold K. North, President, Bahamas Amateur Radio Society, P.O. Box 5321, M.S., Nassau, N.P., Bahamas.

CEYLON: Denver, A.C.E. Wijesuriya, 4S7DA, AMQ 346a, Royal Ceylon Air Force, Katunayake, Ceylon (Member Awards Committee, Radio Society of Ceylon).

RHODESIA: Molly E. Henderson, ZE1JE, Secretary of the Council, Radio Society of Rhodesia, P.O. Box 2377, Salisbury, Rhodesia.

Bahamas Reciprocal Licensing

Effective Nov. 7, 1968 DX Editor K4IIF was licensed to operate from the Bahamas using the callsign K4IIF/VP7. This is an official license issued by the Bahamas Telecommunications Corporation, the licensing authority in VP7-land. To our knowledge this is the first reciprocal license issued by the Bahamian government, and all future licenses will be for /VP7 calls rather than regular VP7 callsigns.

One of the top DXers of YV-land, Pedro Mena, YV4IQ. This OM has qualified for WPX Phone and SSB and confirmed over 270 countries using a TR-3 barefoot to a TA-33 at 30 feet.

Barbados Reciprocal Licensing

Everett C. Bollin, WA3DVO, reports that U.S. citizens may now apply for Barbadian licenses. Everett is now licensed as 8P6CV.

QSL Information

AP2MR–Via VE3ACD.
BV2A–Western hemisphere amateurs QSL to B2UKP.
FG7TI/FS7–c/o VE3EUU.
FR7ZG–Guy Langlois, 44 Rue Sainte-Marie, B.P. 592, Saint-Denis, Reunion Island.
GC5AET–Via DJ1QP.
HC4TB–Tom Brigham, 460 Westminster Ave., Haddonfield, N.J. 08033.
I1AV/M1–c/o I1LCK.
OA2BH–To WA5BNG.
OE1ZNC–Via WB2GQK.
OE1ZRC–c/o WB2GQK.
PJ0MM–D.O.T.M., P.O. Box 7388, Newark, N.J. 07107.
PJ0MN–To W9ZRX
PY0DX–Via PY7ACQ.
PY0SP–c/o PY7AOA.
SV0WM–To K9CSM, 9238 So. Kingston Ave., Chicago, Ill. 60617.
TA1KT–Via K4IEX.
TA1AM–c/o K4EPI.
TA1IB–To K4EPI.
TA1RT–Via K4EPI.
TA2SC–c/o K4EPI.
TA3AR–To WA7GQA.
TG9RN–North and South American stations to P.O. Box 892, Guatemala City, Guatemala; Europe, Africa, Asia, and Oceania stations to DL3RK.
VP7NA–c/o K9GZK.
VP8KF–To G3TWV.
VQ9DH–To WA6AHF.
XW8CS–c/o VE6AO.
4S7DA–W6FJ, 12622 So. 8th St., Garden Grove, Cal. 92640.
4S7PE–Via WA4GQM.
5W1AE–c/o VE6AO.
8P6CV–To WA3DVO.
9JZXZ–Don McCarthy, 5 Pennypacker Drive, Willingboro, New Jersey 08046.
9K2CB–Via K9CSM.
9K2CC–c/o K9CSM.
9Q5EB–*not* via WA8PWZ after Nov. 1, 1968.
9U5HI–To WA2CRD.

73, John, K4IIF

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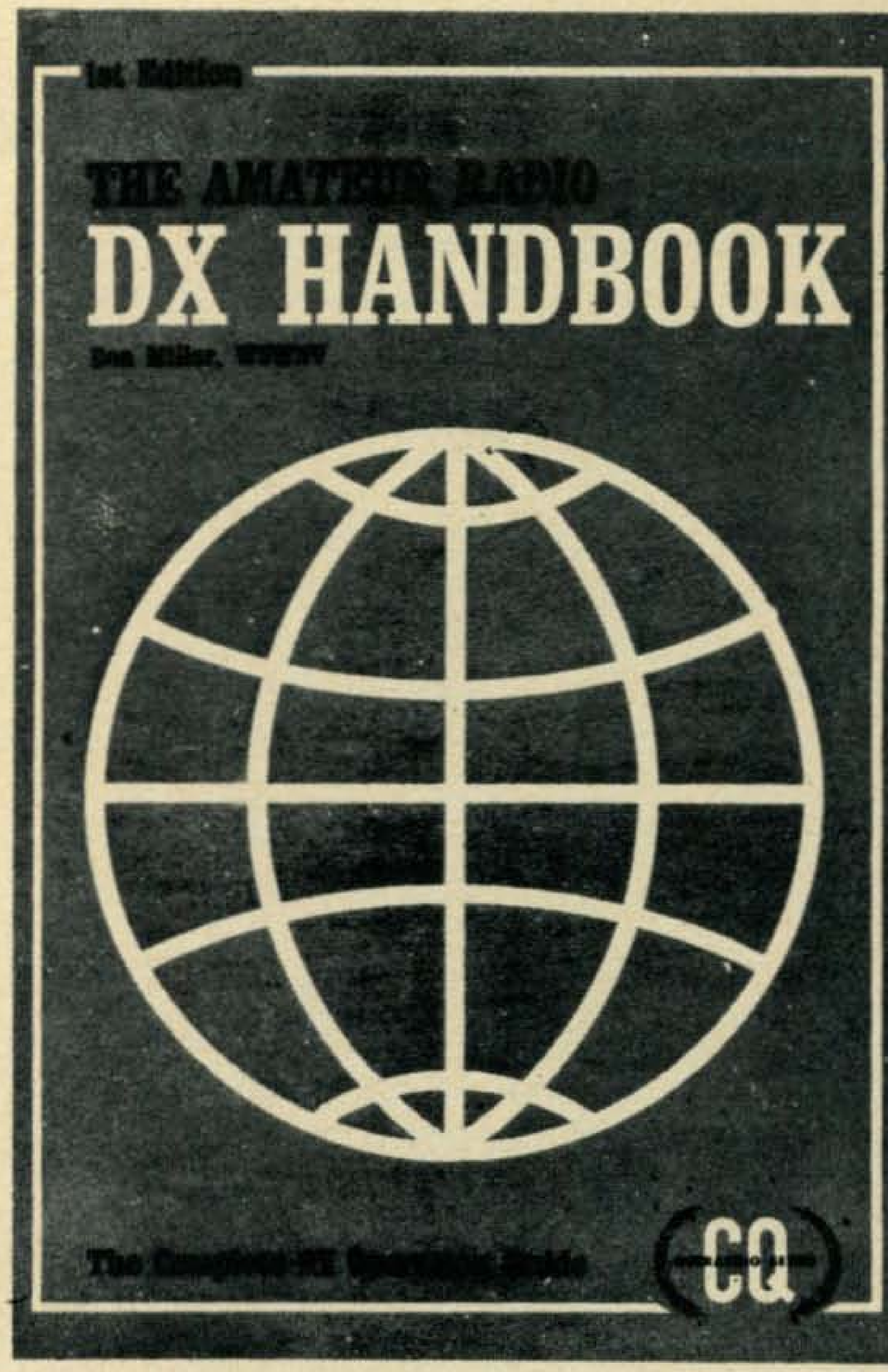
SPECIAL NOTICE

The Amateur Radio DX Handbook is off the presses and in the mail. CQ readers who ordered their copies direct from the publisher will have their copies as this issue of CQ is being prepared. Hundreds of local distributors and book stores will also have copies in stock.

This book is the absolute, most comprehensive sourcebook available on DX to the Radio Amateur. It contains every conceivable piece of information he'll need toward working better DX.

The chapter headings are listed below, although they don't come close to doing this fantastic volume the justice it deserves. You have to see a copy to appreciate just how valuable it is.

We anticipate that our first print run will be exhausted within the next month. To make sure you get your copy while they're still available, check your local distributor or order direct from the publisher. The price is $5.00 for 200 pages of priceless reading.



Introduction
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Amateur Frequencies and the DXer
The DXer: International Factors and Local Regulations
The DX Station
Working DX From the Home Station
Mobile DXing

DXing From the Rare Location
QSLing
The SWL DXer
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Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

January	11-13	Arkansas QSO Party
January	18-19	Louisiana QSO Party
January	18-19	Connecticut QSO Party
January	18-19	Golden Bear Party
January	18-26	Quelimane Contest
January	**25-26**	***CQ* WW 160 CW Contest**
January	25-26	French CW Contest
January	24-26	Old Old Timers Party
Jan. 26–Feb. 2		Kansas Week Award
February	1-2	ARRL DX Phone Contest
February	7-9	QCWA QSO Party
February	8-10	Vermont QSO Party
February	8-10	Arizona QSO Party
February	15-16	ARRL DX CW Contest
February	22-23	YL/OM Phone Contest
February	22-23	French Phone Contest
February	22-23	Operation's Day
March	1-2	ARRL DX Phone Contest
March	8-9	YL/OM CW Contest
March	8-9	RSGB BERU Contest
March	15-16	ARRL DX CW Contest
April	**12-13**	***CQ* WW WPX SSB Contest**
April	19-20	Helvetia 22 Contest
April	26-27	PACC CW/Phone Contest
April	26-27	One Land QSO Party
May	24-25	YL International SSB

Arkansas QSO Party

Starts: 2200 GMT Saturday, January 11
Ends: 0400 GMT Monday, January 13

Rules for this one were covered in last month's CALENDAR. However a note of caution, some of the suggested frequencies are on the band edge of the new operating restrictions for non-extra class stations. So be careful to note on which side of the line you operate.

Mailing deadline for logs is January 30th, and they go to; North Arkansas ARS, Att: Robt. E. Townsend, W5HYZ, P.O. Box 333, Harrison, Ark. 72601

Louisiana QSO Party

Starts: 1800 GMT Saturday, January 18
Ends: 2200 GMT Sunday, January 19

This one was also covered last month. Mail in your log before February 28th to: Lafayette ARC, 123 Normandy Road, Lafayette, La. 70501

*14 Sherwood Road, Stamford, Conn. 06905.

Old Old Timers QSO Party

Starts: 2220 GMT Friday, January 24
Ends: 2200 GMT Sunday, January 26

This party is for OOTC members only and has been fully covered in last month's CALENDAR as well as the club magazine Spark-Gap Times.

Mailing deadline is March 15th to: Bob Robertson, W5BUK, 2609 Halsey Avenue, New Orleans, Louisiana 70114

This one is sponsored by the Candlewood A.R.A., and its the 6th annual party.

Connecticut QSO Party

Starts: 2000 GMT Saturday, January 18
Ends: 0400 GMT Monday, January 20

This one is sponsored by the Candlewood A.R.A., and its the 6th annual party.

Exchange: QSO no., RS/RST and QTH; county for Conn. stations, ARRL section or country for others.

Scoring: 1 point per QSO. Conn. stations multiply total contact points by number of ARRL sections and countries worked. All others use Conn. countries for their multiplier. (max. of 8) Each station may be worked once on each band and mode. (With only 8 counties available, a multiplier of counties per band would seem more realistic.)

Awards: Certificates to the high scorer in each ARRL section and each country. (min. of 5 contacts) The two highest scorers in each Conn. county will also get a certificate, as well as leading Novices.

Frequencies: 3540, 3900, 7040, 7250, 14040, 14250, 21050, 21300, 28040, 28880. Novices, 3740, 7175, 21125.

Indicate the date/time, (GMT) band, mode, QSO no. RS/RST and QTH on your log. And now they are also requesting that you not the class of your license.

Mailing deadline is Feb. 20th to: Connecticut QSO Party, Att: Tom O'Hara, W1D-DJ, 7 West Wooster St., Danbury, Conn. 06810. A s.a.s.e. will get you the results.

YL-OM Contest Rules, Page 12

Claimed Scores
1968 CQ WW DX Phone Contest

Single Operator All Band	
W0VXO/KV4	3,135,475
VU2DKZ	1,372,781
W2CP/2	1,082,496
WA8LYF	791,046
CR7DS	723,294
W3JNN	677,352
K8HZU	655,600
ZE1CU	620,540
KH6GPM	611,100
W9EXE	609,249
K2DJD	595,455
W9ARV	579,480
W4SYL	541,650
W4ZCY	500,889
HP1JC	401,098
VE3YU	331,470
WA9BFE	306,908
DL1MD	235,616
28 mc	
DL4PM	623,145
SM7CCU	413,792
G2BOZ	241,998
G3VZJ	234,255
W1GL	181,168
K4II	165,564
KR7TAB	144,760
VE3BS	123,172
K1KNQ	108,777
WA1HFN	105,905
21 mc	
SM3CNN	525,150
KH6BZF	290,628
W6GHM/5	275,762
W1MDO	206,554
W2AH	205,608
K7RLS	124,722
14 mc	
YV5ANF	754,075
VE1TG	372,155
K4THY/YV5	348,836
OM3BU	281,550
VE3DLC	242,005
YS2CEN	208,465
VO1HH	151,575
WA1IHN	170,200
W7HEU	106,560
7 mc	
JA2BTV	61,910
K8HYC	27,761
3.8 mc	
W1FZJ/KP4	50,410
Multi-Single	
UA9AN	2,714,600
VP7NA	1,374,756
W9LKJ	963,549
KA9MF	881,925
W6NJU	824,895
K8UDJ	672,237
K1DWQ/LX	636,104
Multi-Multi	
OH5SM	9,510,588
W7SFA	1,460,256
K3HTZ	711,205
W8NGO	605,220
WB6GFT	535,788

CQ WW 160 CW Contest

Starts: 0000 GMT Saturday, January 25
7 P.M. EST Friday, January 24
Ends: 1500 GMT Sunday, January 26
10 A.M. EST Sunday, January 26

Rules same as last year and completely covered in last month's CALENDAR. If the conditions are also the same as last we will be sitting pretty.

We are all aware of the increased frequency and power allocations. (If you do not have them the new list is available from *CQ*)

With "DX Alley" the 5 kc between 1825 and 1830 now open to US hams, it is difficult to recommend a spot for the DX stations. However it is recommended that the DX stay in that spot and work the W/K and VE stations at the low end, 1800 to 1805, same as in previous years. We implore the W/Ks and VEs to stay out of "DX Alley" and not to try and work the DX on frequency. It just does not work out on 160.

The DX stations can more or less control the situation if they in turn do not work station on their own frequency.

We also implore the phone boys to please keep this spot clear for the contest weekend. Also keeping in mind that a phone carrier is a bit broader than a c.w. signal.

A s.a.s.e. will get you a supply of log sheets and new frequency list from *CQ*.

Mailing deadline is February 28th to: *CQ* 160 Contest, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.

French Contest

C.W.: Jan 25-26 **PHONE:** Feb. 22-23
Starts: 1400 GMT Saturday
Ends: 2200 GMT Sunday

Rules for this contest remain the same as in previous years.

Exchange: The usual five and six figure serial number, signal report plus a progressive 3 digit QSO number starting with 001.

Points: Each contact counts 3 points.

Multiplier: A multiplier of 1 per band for each French Department and DUF country worked. French stations will indicate their Dept. in their call. (ie: F8TM/78) DUF stations will be identified by their prefix.

Scoring: Total QSO points multiplied by sum of multiplier from each band.

Awards: Certificates to top scorers in each country and W/K and VE call areas.

Contest contacts may be also applied for the several French Awards, DUF, DDFM, DPF, DTA. (or contest QSOs plus QSL cards)

During the above contest period activity is also expected from HB, LX and ON. (and 9Q, 9U, 9X) Contacts with these stations can also be counted for QSO and multiplier credit in the French Contest.

Logs go to the REF Contest Committee, B.P. 42-01, Paris R.P.. France.

QCWA QSO Party

Starts: 2200 GMT Friday, February 7
5 P.M. EST Friday, Feb. 7
Ends: 2200 GMT Sunday, February 9
5 P.M. EST Sunday, Feb. 9

This year's party is being sponsored by the Joliet Chapter of QCWA. Only members are eligible for the QCWA Certificate and Plaque donated by National Hdqts., and only contacts with other members will count toward the awards.

This is primarily a party to renew old acquaintances and see how many members can be contacted over a week-end, including overseas members, Like last year, a simple scoring system has been added to make it more interesting.

Exchange: QSO nr., RS/RST, QTH, name and QCWA membership number.

Scoring: One point for each member worked, multiply total by sum of states,

See page 110 for New Reader Service

Canadian provinces and foreign countries worked. (A member may be worked only once for QSO credit and non-member contacts have no value.)

Frequencies: c.w.–3530, 7030, 14030, 21030, 28030. phone – 3855, 7230, 14240, 21340, 28530. RTTY–7105, 21140.

Awards: The QCWA Certificate to the leading stations and the QCWA Traveling Plaque to the overall winner. (To be held for one year)

Mailing deadline is March 8th, this year logs go to: R. H. Woolsey, W9AQP, 1511 Burry Street, Joliet, Ill. 60435.

Vermont QSO Party

Starts: 2300 GMT Saturday, February 8
Ends: 0300 GMT Monday, February 10

The Central Vermont ARC again offers the opportunity to work the comparatively rare state of Vermont in its annual QSO party. The same station may be worked on each band and mode for QSO and multiplier credit.

Exchange: QSO nr., RS/RST and QTH; county for Vt., ARRL section for others.

Scoring: Vermont stations, 1 point per QSO, total multiplied by ARRL sections and foreign countries worked. Others, 3 points per QSO, total multiplied by number of Vt. counties worked on *each* band (max. of 14 per band).

Frequencies: 3685, 3855, 3909, 7030, 7240, 7290, 14040, 14290, 14325, 21050, 21375, 28100, 28600, 50.250, 50.360, 144-144.5, 145.8 and Novice frequencies.

Awards: Certificates to the top scorers in each ARRL section, plus 1st-4th place in Vermont and a special award for multi-operator stations. There are also two Trophies, one for Vermont stations and one for the out of state station with the highest score.

The "Worked Vermont" certificate will be awarded to stations working 13 out of the 14 Vermont counties. (If not previously issued.)

Mailing deadline March 31 to: CVARC c/o E. Reg. Murray, K1MPN, 3 Hillcrest Drive, Montpelier, Vermont 05602.

Arizona QSO Party

Starts: 1400 GMT Saturday, February 8
Ends: 0200 GMT Monday, February 10

This is the 3rd party sponsored by the Saguaro High School ARS.

The same station may be worked on each band and mode for QSO credit.

Exchange: QSO nr., RS/RST and QTH; county for Ariz., ARRL section or country for others.

Scoring: Arizona stations, 2 points per QSO, multiplied by ARRL sections worked. Others, 5 points per QSO, multiplied by Arizona counties worked (max. of 14).

Frequencies: 3575, 3850, 7025, 7275, 14075, 14275, 21075, 21325, 28075, 28600. Novices; 3735, 7175, 21110.

Awards: Certificates to top scorers in each ARRL section, 2nd place awards in sections where more than four logs are received.

Logs go to Brian Wood, WA7FIK, 6707 N. 60th Street, Scottsdale, Ariz. 85251. Include a s.a.s.e. if copy of results are desired. Mailing deadline is March 15th.

Golden Bear QSL Party

From 0500 GMT Jan. 18 to 0200 Jan. 19

Check in the net control on 3975 kc and give your name and mailing QTH for the Golden Bear QSL. Your card can be sent to: Dave Browers, WB6RVM, 9902 Chanticleer Rd., Anaheim, Calif. 92804.

Quelimane Contest

From 1200 GMT Jan. 18 to 1700 Jan. 26

This is not really a contest but an activity to commemorate the landing of the Portuguese Navigator Vasco da Gama in the city of Quelimane.

A minimum of 5 QSOs with CR7 stations are required for an award. (A s.a.s.e to me will get you a detailed explanation.)

Send a QSL card for each contact to: The Radio League of Mozambique, P.O. Box 265, Quelimane, Mozambique.

Kansas Week Award

From 0001 GMT Jan. 26 to 0600 Feb. 2

Kansas stations are required to contact at least 25 out of state stations. Rest of USA must work 10 or more Kansas stations. DX stations only 3 Kansas stations.

Send your log information to: Jayhawk ARS, P.O. Box 1144, Kansas City, Kansas 66117.

Operation's Day

From 1300 GMT Feb. 22 to 0100 Feb. 23

Station WA2DNR will be active on 3725 and 7175, also the 10 and 15 meter bands when conditions permit, and possibly the 15

[*Continued on page 98*]

Propagation

BY GEORGE JACOBS,* W3ASK

DX propagation conditions during January are expected to be much the same as they were during December. From shortly after sunrise through the late afternoon hours it should be a toss-up between 10 and 15 meters for DX progagation honors. Excellent openings to almost every area of the world should be possible on both bands during this period, with some 15 meter openings extending into the early evening hours as well.

Good-to-excellent DX progagation is expected on 20 meters from sunrise, through the daylight hours and into the early evening hours. To some areas of the world, 20 meters may remain open during the hours of darkness as well. Optimum DX condtions are forecast for this band during the sunrise period and against during the later afternoon and early evening hours.

Seasonally low static levels are expected to continue during January, and good DX propagation conditions are forecast for 40 meters from the late afternoon hours, through the hours of darkness and until shortly after sunrise. Fair-to-good conditions are forecast for 80 meters during the hours of darkness and the sunrise period, with some 160 meter DX openings also likely to take place during this same time period.

Short-Skip Propagation

This month's column contains a Short-Skip Propagation Chart for use in the continental United States for distances between approximately 50 and 2300 miles. (2300 miles is the maximum distance possible under normal propagation conditions, for a one-hop, short-skip opening). Special progagation charts are also included for readers in Hawaii and Alaska. The charts appearing this month are valid through March 15, 1969. See last month's column for detailed DX Propagation Charts for use during January.

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

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for Jan. 15, through Mar. 15, 1969 (color)

	Forecast Rating & Quality			
Days	(4)	(3)	(2)	(1)
Above Normal: 6, 10, 17, 23, 28, 7-8, 14	A	A-B	B	B-C
Normal: 2, 4, 5, 7, 8-9, 11, 13, 15-16, 18, 22, 24-27, 1-3, 5-6, 9-10, 12-13, 15	A-B	B	C	D
Below Normal: 1, 3, 12, 14, 19, 21, 29, 31, 4, 11	B-C	C-D	D	E
Disturbed: 20, 30, none	C-D	D-E	E	E

HOW TO USE THESE CHARTS

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

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

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

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

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

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

6—These Propagation Charts are valid through Mar. 15, 1969. These Charts are prepared from basic propagation, data published monthly by the Institute For Telecommunication Sciences And Aeronomy of the U.S. Dept. of Commerce, Boulder, Colorado.

Until late March, excellent short-skip openings are expected on 10 meters during the daylight hours, between path lengths of 1200 and 2300 miles. Excellent conditions are also forecast for 15 meters from shortly after sunrise through the early evening hours, for openings ranging between 900 and 2300 miles.

From mid-morning and continuing through the early afternoon hours excellent short-skip openings are expected on 20 meters

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over distances between approximately 300 and 1000 miles. During the later afternoon and early evening hours conditions should peak for somewhat longer openings, between approximately 1000 and 2300 miles.

Excellent short-skip openings are forecast for 40 meters during the daylight hours over distances between 100 and 500 miles. The skip should begin to lengthen during the late afternoon, and by nightfall conditions are expected to peak for short-skip openings between 750 and 2300 miles in length.

Optimum conditions are forecast for 80 meter short-skip openings during the daylight hours, for distances up to approximately 250 miles from the transmitter. During the late afternoon and early evening hours, conditions should peak for openings between approximately 250 and 1500 miles, and by nightfall excellent openings beyond 1500 miles should be possible.

Intense solar absorption generally limits 160 meter propagation to groundwave distances of no more than several dozen miles during the daylight hours. During the hours of darkness and the sunrise period, however, fairly good short-skip openings should be possible up to approximately 1000 miles from the transmitting location, with occasional openings considerably beyond this range.

V.H.F. Ionospheric Openings

The *Quadrantids* meteor shower should take place on January 3. This is expected to be one of the most intense showers of the new year, and could result in a number of meteor-scatter openings on the v.h.f. bands. The shower is expected to peak during the late afternoon and early evening hours, with an average of 30 to 40 meteors entering the earth's atmosphere each hour.

An occasional trans-continental F2- layer opening should be possible on 6 meters during January, as well as occasional openings between the mainland and Hawaii, and between the USA and Central and South America. The most likely time for F2-layer 6 meter openings is from an hour or so before noon, through the early afternoon hours.

There should be a noticeable seasonal decrease in the number of trans-equatorial type 6 meter openings during January, but some may occur between 8 and 11 P.M., local time.

Relatively little sporadic-E or auroral activity is forecast for January. Some v.h.f. openings due to these phenomena are likely to occur, however, when h.f. propagation conditions are below normal or disturbed. Check the "Last Minute Forecast" appearing at the beginning of this column for those days that are expected to be disturbed or below normal during the month.

Sunspot Cycle

The Swiss Federal Solar Observatory at Zurich reports a monthly mean sunspot number of 109 for October, 1968. This results in a smoothed sunspot number of 107 centered on April, 1968. This month's *CQ* propagation forecasts are based upon a predicted smoothed sunspot number of 111. See the feature article entitled *The Sunspot Cycle—1969*, which appears elsewhere in this issue of *CQ*, for more details concerning the progress of the present cycle, and the trend predicted for the new year.

CQ Short-Skip Propagation Chart

JANUARY 15-MARCH 15, 1969

LOCAL STANDARD TIME AT PATH MID-POINT

(24-HOUR TIME SYSTEM)

Distance From Transmitter (Miles)

Band (Meters)	5-250	250-750	750-1300	1300-2300
10	*Nil*	*Nil*	07-08 (0-1) 08-09 (0-2) 09-10 (0-3) 10-12 (0-4) 12-15 (0-3) 15-17 (0-2) 17-18 (0-1)	07-08 (1) 08-09 (2-3) 09-10 (3-4) 10-12 (4) 12-15 (3-4) 15-16 (2-4) 16-17 (2-3) 17-18 (1-2) 18-19 (0-2) 19-20 (0-1)
15	*Nil*	07-08 (0-1) 08-10 (0-2) 10-12 (0-3) 12-15 (0-2) 15-17 (0-1)	06-07 (0-1) 07-08 (1-3) 08-10 (2-4) 10-12 (3-4) 12-15 (2-4) 15-16 (1-4) 16-17 (1-3) 17-18 (0-3) 18-19 (0-2) 19-21 (0-1)	06-07 (1) 07-08 (3-2) 08-16 (4) 16-18 (3-4) 18-19 (2-3) 19-20 (1-2) 20-21 (1) 21-22 (0-1)
20	09-11 (1-2) 11-14 (1-3) 14-15 (1-2) 15-17 (0-1)	06-07 (0-2) 07-09 (0-3) 09-11 (2-4) 11-14 (3-4) 14-15 (2-4) 15-17 (1-4) 17-19 (0-3) 19-20 (0-2) 20-06 (0-1)	06-07 (2-3) 07-08 (3) 08-09 (3-4) 09-17 (4) 17-19 (3-4) 19-20 (2-3) 20-22 (1-3) 22-00 (1-2) 00-06 (1)	06-07 (3-2) 07-08 (3) 08-10 (4) 10-14 (4-3) 14-19 (4) 19-21 (3-4) 21-22 (3) 22-00 (2) 00-03 (1-2) 03-06 (1)
40	07-08 (0-2) 08-09 (1-3) 09-10 (2-4) 10-17 (4) 17-18 (3-4) 18-20 (2-3) 20-22 (1-2) 22-07 (0-1)	07-08 (2) 08-09 (3) 09-11 (4-3) 11-15 (4-2) 15-18 (4) 18-20 (3-4) 20-22 (2-4) 22-02 (1-3) 02-07 (1-2)	07-08 (2) 08-11 (3-1) 11-15 (2-1) 15-17 (4-2) 17-18 (4-3) 18-22 (4) 22-02 (3-4) 02-05 (2-4) 05-07 (2-3)	07-08 (2-1) 08-15 (1-0) 15-17 (2-1) 17-18 (3) 18-04 (4) 04-05 (4-3) 05-07 (3-2)

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80	07-08 (2-3) 08-10 (3-4) 10-15 (4-3) 15-21 (4) 21-00 (3-4) 00-04 (2-3) 04-07 (1-2)	07-08 (3) 08-09 (4-2) 09-10 (4-1) 10-15 (3-1) 15-16 (4-1) 16-18 (4-2) 18-00 (4) 00-04 (3-4) 04-07 (2-3)	07-08 (3-1) 08-09 (2-0) 09-16 (1-0) 16-18 (2-1) 18-20 (4-3) 20-04 (4) 04-06 (3) 06-07 (3-2) -(3-2)	07-08 (1-0) 08-16 (0) 16-18 (1-0) 18-20 (3-2) 20-03 (4) 03-04 (4-3) 04-05 (3) 05-06 (3-2) 06-07 (2-1)
160	09-17 (1-0) 17-19 (3-2) 19-05 (4) 05-07 (3) 07-09 (2-1)	17-18 (2-1) 18-19 (2) 19-21 (4-3) 21-05 (4) 05-06 (3) 06-07 (3-1) 07-09 (1-0)	17-18 (1-0) 18-19 (2-1) 19-21 (3-1) 21-03 (4-3) 03-05 (4) 05-06 (3-2) 06-07 (1)	18-19 (1-0) 19-21 (2-1) 21-03 (3) 03-05 (4-2) 05-06 (2-1) 06-07 (1-0)

ALASKA

OPENINGS GIVEN IN GMT‡

To:	*20 Meters*	*15 Meters*	*20 Meters*	*40/80 Meters*
Eastern USA	18-20 (1) 20-21 (2) 21-23 (3) 23-00 (1) 23-00 (1)	16-17 (1) 17-20 (2) 20-23 (3) 23-01 (2) 23-01 (2) 01-02 (1)	11-15 (1) 15-17 (2) 17-22 (1) 22-23 (2) 22-23 (2) 23-03 (3) 03-04 (2) 04-05 (1)	04-13 (1) 07-12 (1)*
Central USA	18-20 (1) 20-21 (2) 21-00 (3) 00-01 (1)	16-18 (1) 18-20 (2) 20-23 (3) 23-01 (4) 01-02 (2) 02-04 (1)	11-16 (1) 16-18 (2) 18-23 (1) 23-01 (2) 01-04 (3) 04-05 (2) 05-06 (1)	05-14 (1) 08-13 (1)*
Western USA	18-19 (1) 19-21 (2) 21-23 (3) 23-01 (4) 01-02 (3) 02-03 (2) 03-04 (1)	16-17 (1) 17-19 (2) 19-23 (3) 23-02 (4) 02-03 (3) 03-04 (2) 04-05 (1)	11-17 (1) 17-18 (2) 18-20 (4) 20-01 (3) 01-04 (4) 04-05 (3) 05-06 (2) 06-07 (1)	04-05 (1) 05-12 (2) 12-15 (1) 15-16 (2) 16-17 (1) 05-12 (1)* 12-15 (2)* 15-17 (1)*

HAWAII

OPENINGS GIVEN IN HAWAIIAN STANDARD TIME†

To:	*20 Meters*	*15 Meters*	*20 Meters*	*40/80 Meters*
Eastern USA	07-08 (1) 08-12 (2) 12-14 (3) 14-15 (2) 15-16 (1)	06-07 (1) 07-12 (2) 12-14 (3) 14-16 (4) 16-18 (2) 18-19 (1)	12-15 (2) 15-17 (3) 17-19 (4) 19-22 (3) 22-01 (2) 01-06 (1) 06-08 (2) 08-12 (1)	18-19 (1) 19-21 (2) 21-01 (3) 01-03 (2) 03-04 (1) 19-21 (1)* 21-01 (2)* 01-03 (1)*
Central USA	07-08 (1) 08-10 (2) 10-13 (3) 13-15 (4) 15-16 (2) 16-17 (1)	06-07 (1) 07-08 (2) 08-14 (3) 14-16 (4) 16-17 (3) 17-18 (2) 18-20 (1)	13-14 (3) 14-19 (4) 19-21 (3) 21-23 (2) 23-04 (1) 04-06 (2) 06-08 (3) 08-13 (2)	18-19 (1) 19-20 (2) 20-03 (3) 03-04 (2) 04-06 (1) 19-21 (1)* 21-03 (2)* 03-05 (1)*
Western USA	06-08 (1) 08-09 (2) 09-11 (3) 11-13 (4) 13-15 (3) 15-17 (2) 17-18 (1)	06-07 (1) 07-08 (2) 08-09 (3) 09-16 (4) 16-18 (3) 18-20 (2) 20-22 (1)	06-07 (2) 07-10 (4) 10-14 (3) 14-18 (4) 18-20 (3) 20-22 (2) 22-06 (1)	17-18 (1) 18-19 (2) 19-02 (4) 02-04 (3) 04-06 (2) 06-07 (1) 19-20 (1)* 20-22 (2)* 22-04 (3)* 04-05 (2)* 05-07 (1)*

†Hawaiian Standard Time is 5 hours *behind* EST; 4 hours *behind* CST; 3 hours *behind* MST; 2 hours *behind* PST and 10 hours *behind* GMT or Z time. For example, when it is Noon in Honolulu, it is 17 or 5 P.M. EST, in NYC, and 14 or 2 P.M. in Los Angeles.

*Indicates predicted 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.

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

BY THE WAY...
INTERNATIONAL BOY SCOUT RADIO JAMBOREE

ONE of the few Radio Amateur Licensees in West Africa's The Gambia is Cecil Wiltshire, Zd3D, who set up his Drake TR-3 transceiver in a typical African grass-roofed hut on the occasion of the 1968 International Boy Scout Radio Jamboree. In addition to talking to several U.S. East Coast Jamboree Stations, the Scouts of Africa's smallest country (4,000 square miles) made contacts with Regional Boy Scout Headquarters all over the world. Scoutmaster Paul Gomez is seated to the right and Scouts from Gambia's Troop 4 look on at left. ■

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THE awards PROGRAM

BY ED HOPPER,* W2GT

THE January, "Story of The Month", about Arne, W8DCD, after this award information. A USA-CA-2500 award, endorsed ALL FONE went to Leo, W4KA. Merle, W6HVU earned USA-CA-2500, 2000 and 1500 awards. Al, K1WQU was issued USA-CA-2500 and USA-CA-2000 awards. Marv, WB2SJQ, also received a USA-CA-2500 award. USA-CA-1500 and 1000 awards went to Roy, WA5OCG. Lou, WB2AHB received USA-CA-1000 and USA-CA-500 awards endorsed ALL 14 MC SSB. A USA-CA-1000 award went to Jerry, K5IKL. USA-CA-500 awards endorsed ALL A-1 were issued to: Jeff, KØWNV; Armando, I1IZ (#4 to Italy); Joe, K8NQP and Ed, WB4GGE. USA-CA-500 awards, endorsed Mixed, went to Cliff, WAØKXJ (that traveling man), and to Rick, WA2IRN.

FLASH
JIM HARRINGTON, K1QVZ
HAS QUALIFIED FOR #7
USA-CA-3079
ALL COUNTIES SPECIAL HONORS PLAQUE
SEE HIS FOTO AND "STORY" *CQ* SEPT. '68.
Previous winners are K9EAB; WØWCX; K8CIR; W2QHH; WØJWD (now WØBL); and WØGYM.

Arne E. Kangas, W8DCD

Arne was born in the little mining community of Baltic, Michigan in Michigan's upper peninsula on June 1st, 1909. In 1918 a move was made to a farm in Trout Creek, Michigan where he attended Public schools and has lived most of his life.

A big event in Arne's life came in 1934 when he married Miss Helen Maki. They have two children, a son John now living in Milwaukee and a daughter Mary Ann, living in Maywood, Illinois. They also have nine grandchildren.

For a number of years, Arne worked in a local sawmill and during the war years he worked at the Packard Motor Company, building Packard Marine Engines for PT

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

Arne, W8DCD, circa 1949.

Arne, W8DCD, 1968. (New equip., op. a shade older.)

See page 110 for New Reader Service

USA-CA HONOR ROLL

2500		1500		500	
W4KA	33	W6HVU	80	WA0KXJ	684
W6HVU	34	WA5OCG	81	K0WNV	685
K1WQU	35	1000		I1IZ	686
WB2SJQ	36	WB2AHB	137	K8NQP	687
2000		WA5OCG	138	WB2AHB	688
W6HVU	51	K5IKL	139	WA2IRN	689
K1WQU	52			WB4GGE	690

Boats (the type of boat the late President Kennedy commanded). The last fifteen years have been spent in maintenance work for the White Pine Copper Company.

An interest in amateur radio was kindled in the 1930s and he spent a lot of time just listening. But it was not until 1948 that a Class C license was obtained and then in 1950 a Class A license was acquired.

The first rig used a pair of 6L6Gs' running about 65 watts and operated on six bands and was built as described in a Jones Handbook. Several other homebrew rigs were made and used before going to commercially built equipment.

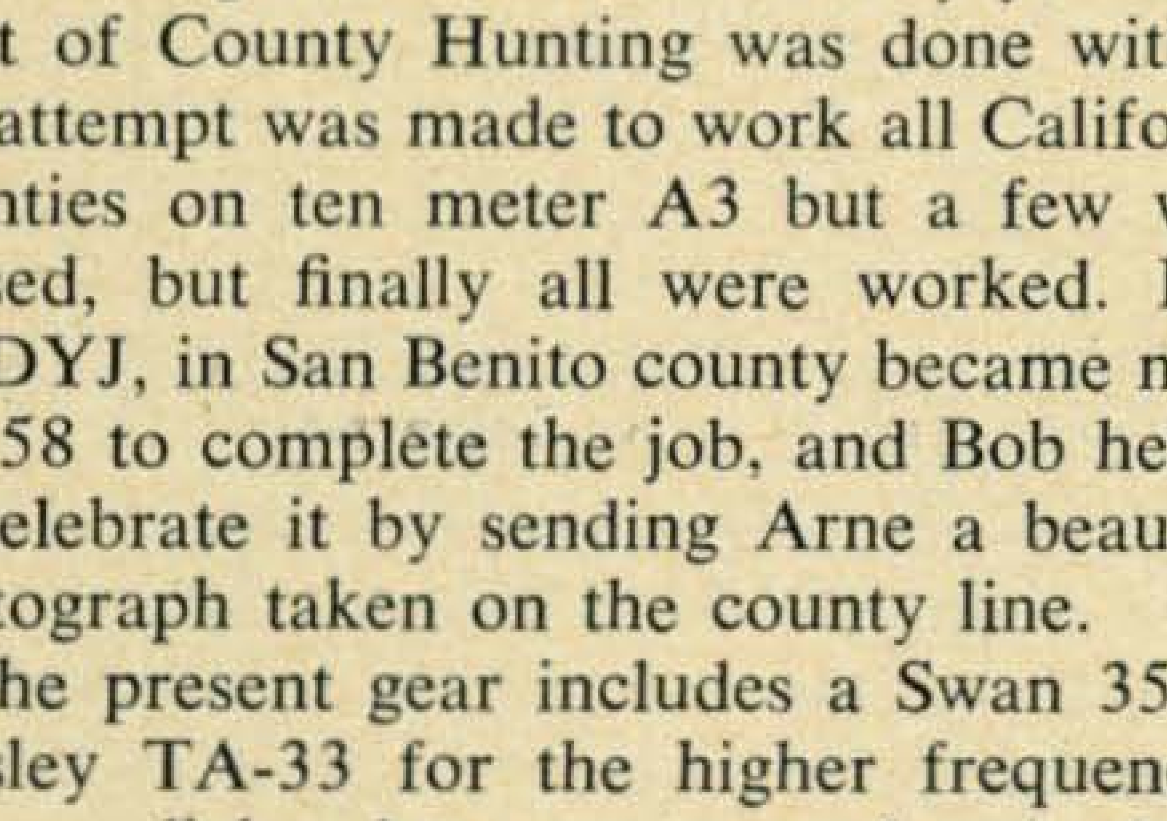
A Viking II was used for many years and a lot of County Hunting was done with it. An attempt was made to work all California counties on ten meter A3 but a few were missed, but finally all were worked. Bob, W6DYJ, in San Benito county became number 58 to complete the job, and Bob helped to celebrate it by sending Arne a beautiful photograph taken on the county line.

The present gear includes a Swan 350, a Mosley TA-33 for the higher frequencies, and an all band trap antenna for the lower frequencies.

Last fall and winter, during the strike at the White Pine Copper Company, much time was available and was spent chasing counties and the present confirmed score is 2850 with 23 states completed.

The USA-CA records show that Arne received USA-CA-500 Award #477 and USA-CA-1000 Award #76 in April 1965. In January 1968, USA-CA-1500 Award #67; USA-CA-2000 Award #43 and USA-CA-2500 Award #23 went to Arne.

Although it is nice for Arne to find much extra time for County Hunting, I hope it will not again be due to a strike. Good Hunting.



New Orleans 250th Year Award

Letters

Wilberta (Willie), WN7IRD, writes: "Wanted to let you know I received my USA-CA-500 Award in good shape. Have it proudly framed and on the wall of the ham shack—we call our ham shack the "Longwell Mole Hole" as the OM around here is always making something and the clutter reminds me of a mole hole—Hi!

My county hunting is now going to drop off sharply for a little while as I must spend the hours I used to be on the rig studying for my General. Theory is coming hard for this gal, so must really study to get it.

Once again Ed., thanks for your prompt sending of the award and also for your letter. Have also received notice that my WPNX was accepted but was told it would be sometime before the award would come through. Patience is not one of my virtues, but I guess I will live—Hi!"

Larry, WN4HLX, writes: "I live in Webster County, Georgia and am the only resident amateur, few mobiles have operated from here, so it is rare. I started back to college in September and live at the dormitory but will be home near the rig on weekends and will be happy to make schedules with those who need Webster County. I can sked on 80, 40 or 15 and by the time this letter appears in print, I hope to have my General." (For schedule, write Larry W. Irwin, P.O. Box 55, Weston, Georgia 31832).

Rod, W9CMC, writes: "The counties are coming mighty slowly now, but I'm still plugging away, 2891 confirmed to date. Always enjoy your section in *CQ*."

Jerry, K5IKL, writes: "I finally got all of my information together and here is my application for USA-CA-1000. I have been idle on county hunting for the past six years, so it has been fun getting back into it and gathering up six years of QSOs for county hunting. Hope to stay a little closer to it from here on in.

I am the only real active ham in Luna county, New Mexico, so to help those who

See page 110 for New Reader Service

might like this county, I operate mostly on 10 and 15. On 15 s.s.b. around 21.4, on 10 s.s.b. around 28.65 and on 10 a.m. around 26.8. I sometimes check into the county hunters net on 20."

Rick, WA2IRN, writes: "Well I finally got my 500 counties for USA-CA. I've been trying on and off since 1963 and probably would still be far short of the goal if it hadn't been for the Independent County Hunter's Net on 14336. Also picked up some needed counties on 6 and 2 meters.

I would like to thank you and Frank Anzalone (CONTEST CALENDAR) for your two columns, both of which are extremely useful. One thing though–is it possible to get *CQ* out on time?".

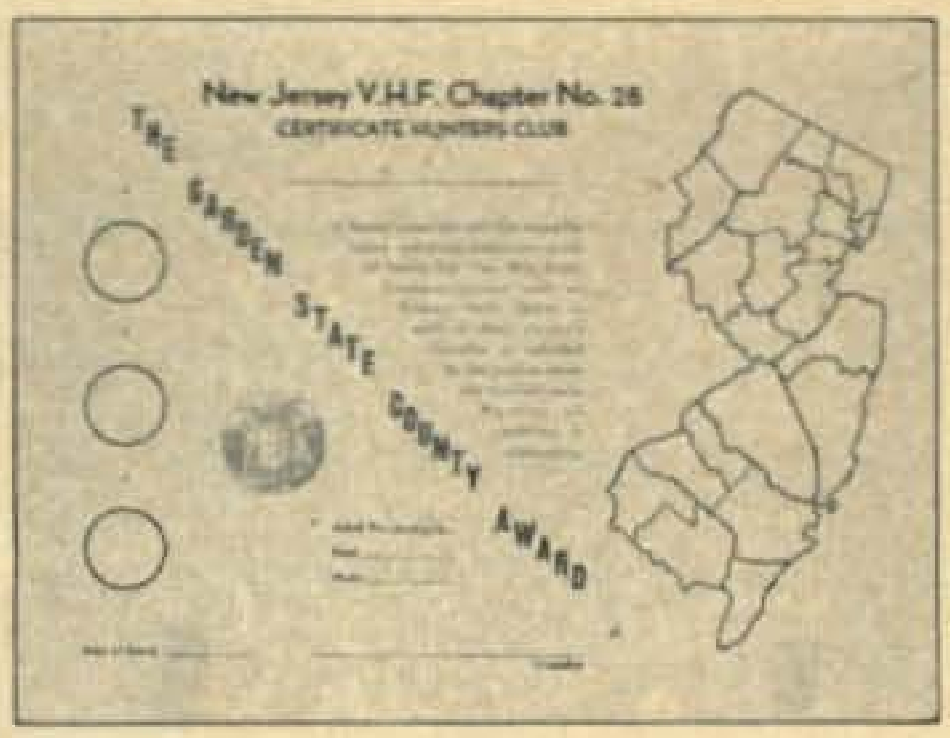
Jerry, WA∅LYO, writes: "Just thought I'd write and let you know how things are going for a new county hunter. At this writing, I have 539 counties worked but only 356 confirmed. Still have a pile of cards to go out, but that will have to wait until I get a few more pennies in my pocket for postage. Am going to school majoring in instrumental music, and money is very scarce.

I suppose I could sell the rigs, but then how could I work counties? I use an HW-32A and 14AVQ vertical and hunt with the 20 meter gang. Have only been working on the award seriously for a short time but have picked up nearly 300 new counties (in between school and girls-Hi.).

Would like to thank the guys on the 20 meter net for their help in getting the new counties and if I can get enough of those pennies saved, I'll get the d.c. supply and give out some of the South Dakota, Wyoming, and possibly North Dakota counties."

Tom, W∅IUB, writes: "Never miss your column, although I am kept very busy issuing my own awards, HI! Have IRCs for sale to the county hunters for 10 per dollar." (Tom Harmon, W∅IUB, 1629 Pleasantview, Wichita, Kansas 67203. Tom is the custodian for the *United Nations Amateur Radio Award* as described in *CQ* March '66; *The 5-9/5-9-9 Awards* as described in *CQ* April '66; and the 6 *Kansas Radio Club Awards* described in *CQ* May '66).

Ken, W6CIS, writes: "Just a quickie note. Am doing fine again after the 2nd heart attack on June 5th, and the Doc says the XYL and I can start our "roaming" again December 1st. I have written to Dick, K2UFT (Yes, I also subscribe to their monthly Bulletin) about my trip to some fairly rare counties in the Southwest this winter.



Garden State County Award

In the spring we will head north again probably through Utah, Colorado, Wyoming and Montana.

Would like to see a net on 14 mc (c.w.) as well as the one on 7055."

Jack, WA5OFN, writes: "Have just finished plans to operate mobile from just about all the counties in South Texas, that is, those South of San Antonio.

In February, plan a trip from Texas up to Pennsylvania and then down to Florida.

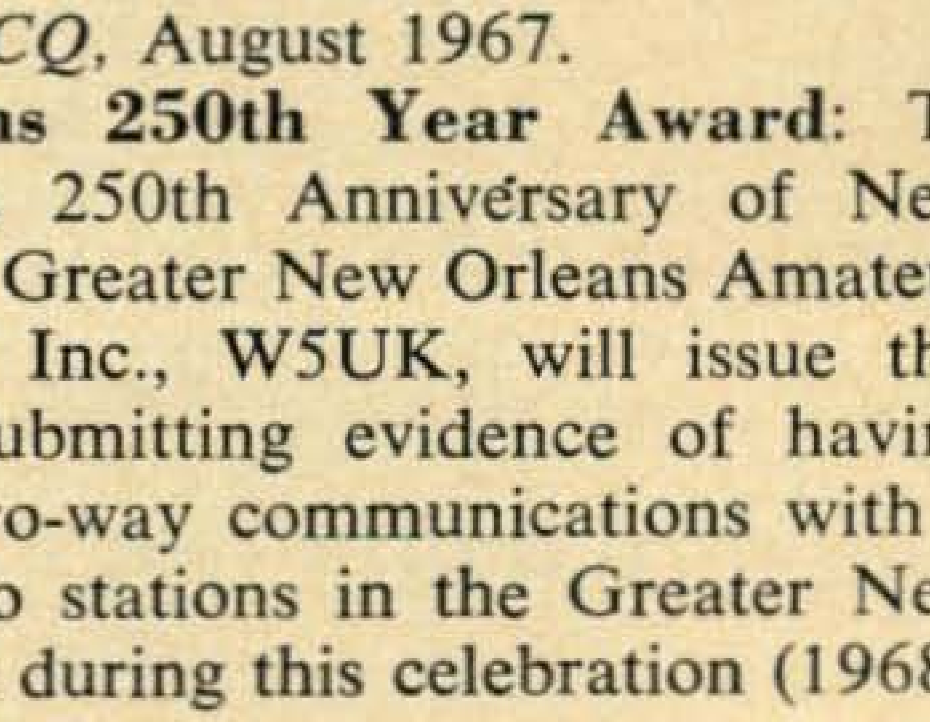
Please tell the gang that as of 27 January, '69, my address will be, Jack C. Shaffer, WA5OFN, 831 Hoffman St., Kingsville, Texas 78363."

Awards

Oregon Counties Award: Note, this award will cease to be available as of January 1, 1969. Any club or such organization within the state boundries of Oregon, who would be interested in sponsoring this fine award–please write (at once) to Robert A. Peschka, K7QXG, 2580 SW 195, Aloha, Oregon 97005. This nice award was fotoed and described in *CQ*, August 1967.

New Orleans 250th Year Award: To celebrate the 250th Anniversary of New Orleans, The Greater New Orleans Amateur Radio Club, Inc., W5UK, will issue this award for submitting evidence of having conducted two-way communications with 3 amateur radio stations in the Greater New Orleans Area during this celebration (1968).

[*Continued on page 82*]



Trieste Award

You say your taxes were raised?

You missed three payments on your Jaguar XK-E?

You had to turn in your Playboy Club Key?

Your salary was cut?

You say the F.C.C. has expressed interest in your four different calls?

You say food is so expensive it's cheaper to eat money?

You say you invited your boss to dinner and during the soup course the finance company repossessed your furniture?

You say your XYL backed the family car out of the garage after you backed it in the night before, and now you can't get to the Newsstand to get your monthly copy of CQ?

HOLD IT!!

While we are in no position to alter the tax structure, give you a raise, or sway the F.C.C., We can save you a pile of cash on CQ! So drop that anchor, pick up a pen and dash off a CQ subscription right away!

1 yr.	I PAY ONLY $ 6.00	a savings of $ 3.00
2 yrs........	I PAY ONLY $11.00	a savings of $ 7.00
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And now with all this newfound money at your disposal, you can begin to really live again!

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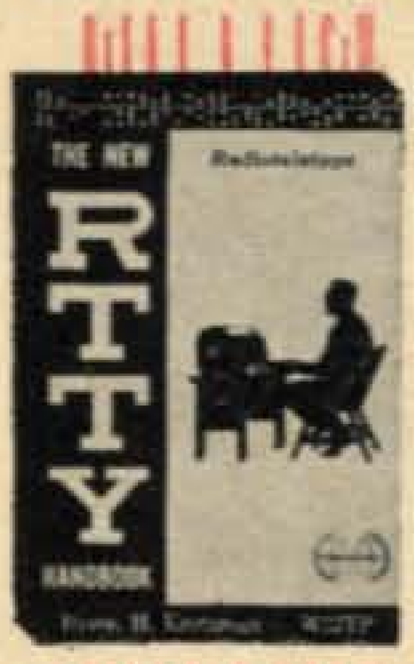

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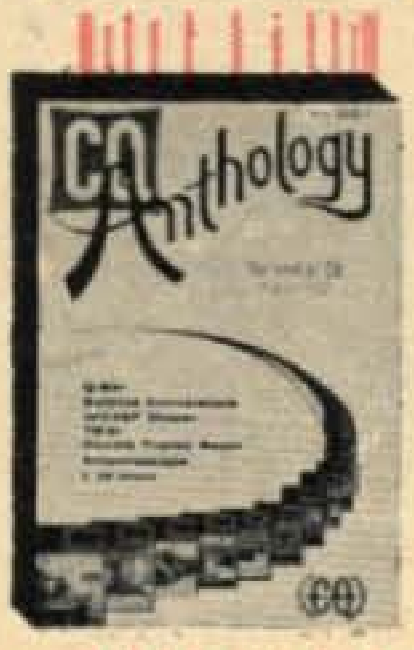

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Cat. #102-1. We've looked back through the years 1945-1952 and assembled all in one place the articles that have made a lasting stir. The issues containing most of these articles have long ago been sold out and are unavailable.

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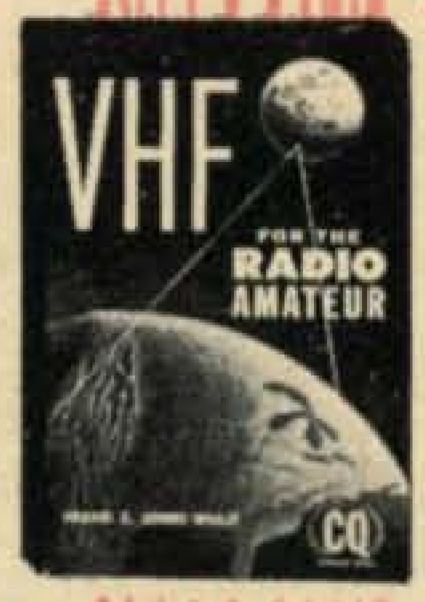

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Cat. #115. If you are, or are planning to be a VHF operator you can't afford to be without this dynamic new handbook written especially for you. Filled from cover to cover with all new and original construction material presented so you can understand it.

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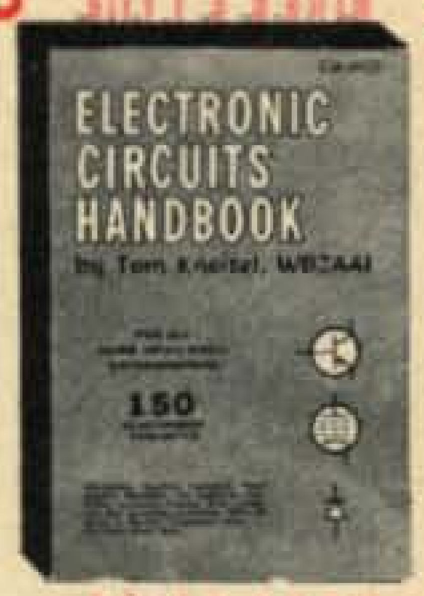

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Cat. #121. Describes and discusses in detail 150 of the most often needed circuits around the shack. Novices and old-timers alike will find many valuable circuits here ideal for construction projects. Eleven great chapters cover a multitude of circuits for all.

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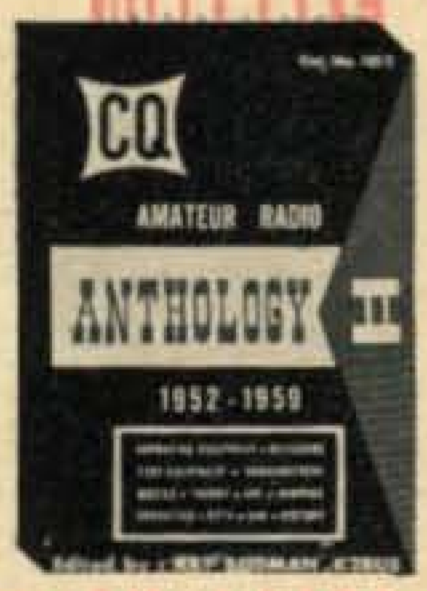

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109	Ham's Interpreter	1.50		120	Shop & Shack Shortcuts	3.95	
112-A	Reg. Ham Log Sheets, per C	1.00		121-1	Electronic Circuits Handbook vol. 1	3.00	
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USA-CA *[From page 79]*

Write, Fred Korson, W5HUT, President, Greater New Orleans ARC, 2935 I. T. M. Building, New Orleans, Louisiana 70130.

The Garden State County Award: This New Jersey County Award is presented in three stages for proper completion. The basic award is issued for contacts with ten N.J. Counties, next endorsement for 7 additional counties and then for the final four counties. For stations more than 50 miles from Morristown, N.J., basic award is issued for working 5 counties, but an additional 5 must be worked before going for the other 7 and 4 endorsements. This Award is sponsored by the New Jersey State CHC Chapter 28 and send GCR list and $1.00 to the custodian—please note new custodian—Joe Stauhs, 105 Carpenter Terr., Belleville, N.J. 07109.

Trieste Award: This Award is sponsored by the Trieste DX Club in memory of VR4CU, Captain Giorgio Vianello. All amateurs are eligible to participate for this award by working the required number of Trieste stations after April 1, 1957. There are no band or mode. restrictions.

PLAN A

Basic Award

1. Italian stations	—7 QSOs with Trieste
2. European stations	—5 QSOs with Trieste
3. DX stations	—2 QSOs with Trieste

PLAN B

Special Trieste Seal added to Award

1. Italian stations	—10 Trieste QSOs.
2. European stations	— 8 Trieste QSOs.
3. DX stations	— 4 Trieste QSOs.

For basic award send application (GCR or LOG) certified by Radio Club or 2 other amateurs with 10 IRCs or U.S. $1.00 to the Award Manager: Luciano Hinze, I1HL, P.O. Box 1342, 34100 Trieste, Italy. Special Trieste Seal for s.a.s.e.

Maryland Two Meter Termites Award: This certificate sponsored by the Maryland Two Meter Termite Net and is issued for working six (6) Termites on Two Meters. There are 116 scattered through a nine state area. Cost is 25¢ to cover postage and handling. Send list of stations worked, 25¢, your name and call and QTH, to the Awards Chairman, Nelson Miles, K3PVW, P.O. Box 153, Maryland Two Meter Termites, Linthicum Heights, Maryland 21090.

Maryland Two Meter Termites Award.

Notes

To Amateur Radio Clubs and such organizations in OREGON, I wish to again call your attention to the NOTE regarding the OREGON COUNTIES AWARD which will not be available after January 1, 1969.

Although I receive many letters requesting the resumption of the Special Honor Roll listing the Top 25 County Hunters. this I would be happy to do, but I receive about one new score every few months—so flood me with your confirmed scores and I'll be forced to resume the list.

Letters are starting to arrive complaining that apparently, *at times,* on the 14 MC SSB NET, NCS has been over zealous and relaying calls/reports *both* ways when the Mobiles and Fixed stations are obviously *not* reading each other. There is no intention to chastise chaps acting as NCS (Heavens knows they are hard to find, and it is a thankless job) but to *ALL,* may I request we keep things above board and be sure they are genuine contacts!

Another sad item to report, the loss of another old friend, Chas. Brown, W2ER. He was Chief Engineer of Radio Station WMSG atop the old Madison Square Garden back in the late 1920's, and later Chief Engineer of Radio Station WEVD.

Just received a copy of the new DX AWARDS LOG for *Amateurs* and *SWLs.* I would like to recommend this LOG, it lists 113 awards from all continents and 47 different countries. It also has space to list the QSOs you have toward these awards and thus keep track of your progress. It has a fine opening index to easily check these awards. In the back it has an up-to-date ARRL Country List, plus a prefix and zone list. The cost—$3.95, send to Robert J. McMahon, The McMahon Company, 1055 South Oak Knoll, Pasadena, California 91106.

I would also like to recommend the *Amateur Radio Achievement Awards Directory* which lists as well as has photographs

[Continued on page 98]

See page 110 for New Reader Service

Q AND A

BY WILFRED M. SCHERER,* W2AEF

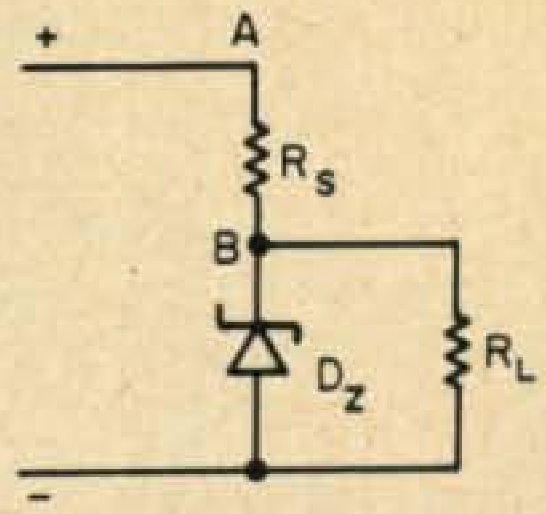


Fig. 1—Circuit for zener-diode voltage regulator (shunt type).

Zener-Diode A.C. Voltage Regulation

In the article "Simple Heater-Voltage Regulation", presented recently in *CQ*[1], it was mentioned that the 2% or better regulation, provided by the regulated - transformer scheme described therein, surpasses that obtainable with zener diodes. As a result, there was a bit of "eyebrow-lifting" in respect to the veracity of this statement, so we'll set about to clear up the matter at this time.

First of all, it should be noted that the original statement was qualified by "employed for this particular application." If we had been dealing with d.c. voltages, doubts would be justified, since in such cases zener regulation can be held to a small fraction of a percent; however, when it comes to a.c. voltages, the situation is somewhat different in regard to the required regulation for tube heaters.

Zener-Diode Operation

Without going into a detailed explanation on the theory and operation of a zener diode, it can otherwise be simply stated that at the zener-voltage point the voltage drop across the zener diode remains constant, regardless of the voltage applied at *A* in fig. 1 or the current drawn by the load R_L (up to the limitations imposed by the characteristics of the particular zener diode and the value of R_S). Since the diode and R_L are connected in parallel, the voltage at the load also is held constant.

When an a.c. voltage is applied to the zener diode through R_S, the voltage at *B* during any portion of the a.c. cycle, that is greater than the zener-voltage point, will be held to the zener level. The result is that such portions of the a.c. waveform will be clipped as shown at fig. 2. From this it may be seen that it is the *peak* output value (at *B*) that is regulated to the zener voltage.

In the case of vacuum-tube heaters, it is the root-mean-square (r.m.s.) value that must be regulated, as this is what determines the heating effect. The r.m.s. value thus is also known as the effective value. It is determined by the *square root* of the *average* of all the *squares* of the *instantaneous* values. Fig. 3 shows how this works out for a sine wave for which those familiar with a.c. voltages know beforehand that the r.m.s. voltage is .707 times the peak voltage.

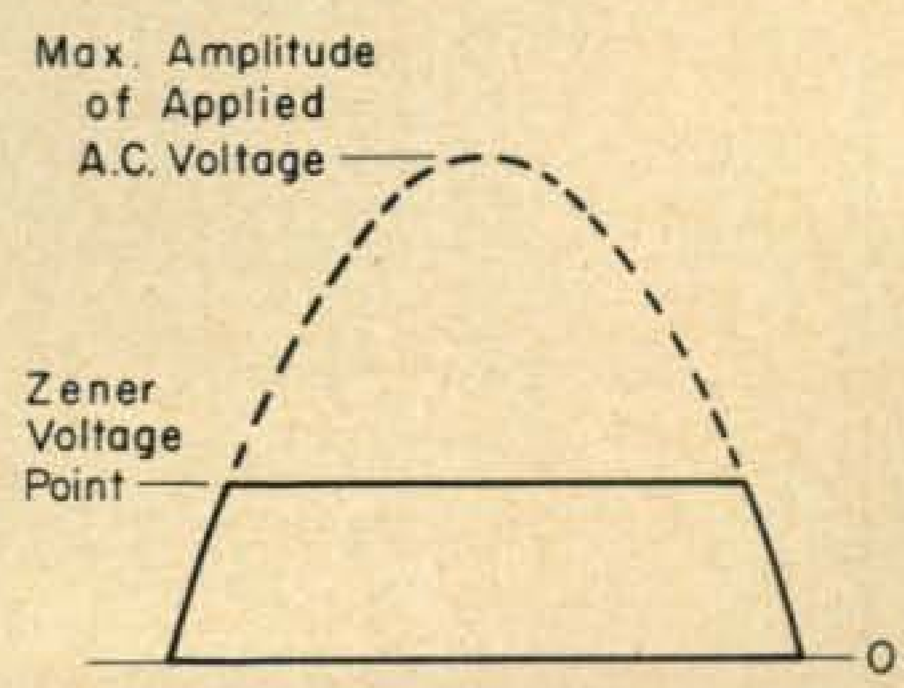
When a sinewave is clipped, the r.m.s. value is dependent on the voltage point at which the wave is clipped in relation to the peak amplitude of the *applied* sine wave. Thus, for a *given* clipping level, the r.m.s. value varies by an amount depending on the peak amplitude of the applied voltage.

This is demonstrated at fig. 4 where the approximate relative-r.m.s. values can be determined for two a.c. voltages of different peak amplitudes that are clipped at the same voltage point.

Consequently, the r.m.s. output from a zener-diode a.c. regulator is not held to the same degree of regulation as is the peak output under variations of the applied voltage. Also, the r.m.s. value will be somewhat lower that the zener-voltage point.

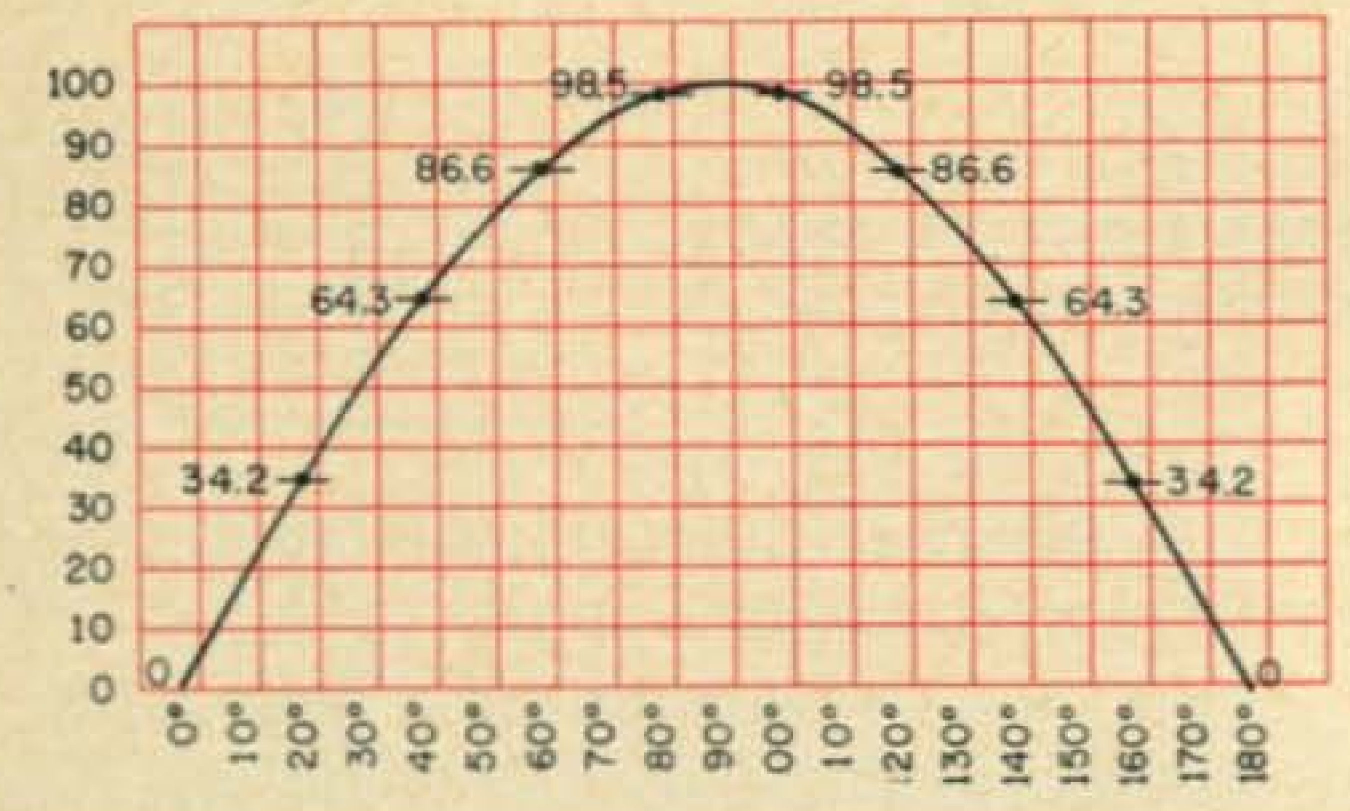
In practical applications the r.m.s.-voltage regulation with the zener diodes usually amounts to 3-4% with 10% input-voltage changes; unless very high voltages are applied, in which case the r.m.s.-voltage regulation will more closely approach the regu-

Fig. 2—Sine wave clipped to the zener-voltage point. For a. c.-voltage regulation, two zener diodes are connected back-to-back to regulate both halves of the a.c. cycle, but only one-half cycle is shown here.



*Technical Director, *CQ*

[1]Scherer, W. M., "Simple Heater-Voltage Regulation," *CQ*, Nov. 68, p. 75.



Degrees	E	E²
20	34.2	1169.64
40	64.3	4134.49
60	86.6	7499.56
80	98.5	9702.25
100	98.5	9702.25
120	86.6	7499.56
140	64.3	4134.49
160	34.2	1169.64
180	0	0

9 | 45011.88

5001.32 = Mean Square

$\sqrt{5001.32} = 70.72$ RMS

Fig. 3—One-half cycle of a sine wave showing how the r.m.s. value is determined by the square-root of the averages of all the squares of the instantaneous values which are determined according to the sine of the number of degrees within the start of the cycle. Since only a limited number of points are used, the calculated result is a trifle higher than the actual value of 70-71.

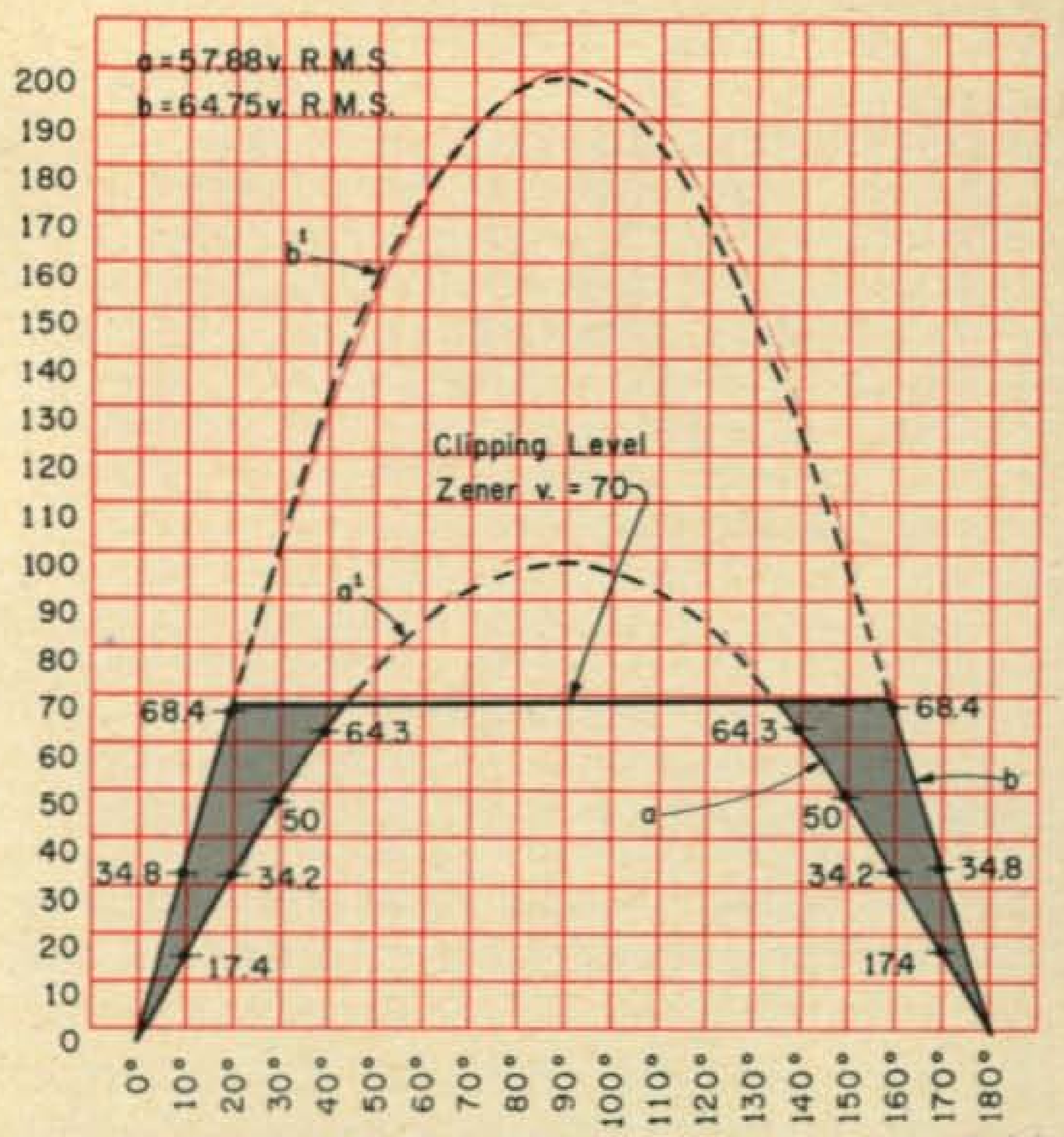


Fig. 4—One-half cycle of two sine waves (a & b) of different amplitudes clipped at the same level of 70 volts. The r.m.s. value of the remaining portion of a is less than that of b, where a greater portion of the signal appears below the clipping level. Hence b's higher r.m.s. value. The approximate r.m.s. voltages may be calculated as shown at fig. 3 by using the voltages indicated at the eighteen 10° points (10°-180°) along each clipped wave. The r.m.s. for a is 57.88 v., for b it is 64.75 v.

lated peak value obtained at the zener-voltage point. Under these conditions, however, the zener diode will have to handle a very large current and thus must have a much higher power rating (if not an impractical one) than otherwise, as will *R*s.

Blocking On SX-117 Receiver

QUESTION: I have an early model Hallicrafters SX-117 receiver which tends to block for 10-30 kc around an especially strong signa. Only the strongest signals then come

Table I—Frequency-Coverage Limits

Band (mc)	*Preselector Incremental Range* (mc)	*Range Per Manual* (mc)	*Maximum Frequency Coverage* (mc)
SB-300 & SB-301			
3.5	700	3.4 - 4.1	3.4 - 4.6
7.0	500	7.0 - 7.5	6.9 - 8.0
14.0	800	14.0 - 14.8	13.5 - 17.0
21.0	1300	20.3 - 21.6	16.5 - 23.5
28-29.5	2000	28.0 - 30.0	27.8 - 33.0
SB-400 & SB-401			
3.5	600	3.5 - 4.1	3.5 - 4.3
7.0	500	7.0 - 7.5	6.3 - 7.5
14.0	800	13.8 - 14.6	13.5 - 15.5
21.0	1500	20.5 - 22.0	18.0 - 24.5
28-29.5	2000	28.0 - 30.0	26.0 - 32.0

See page 110 for New Reader Service

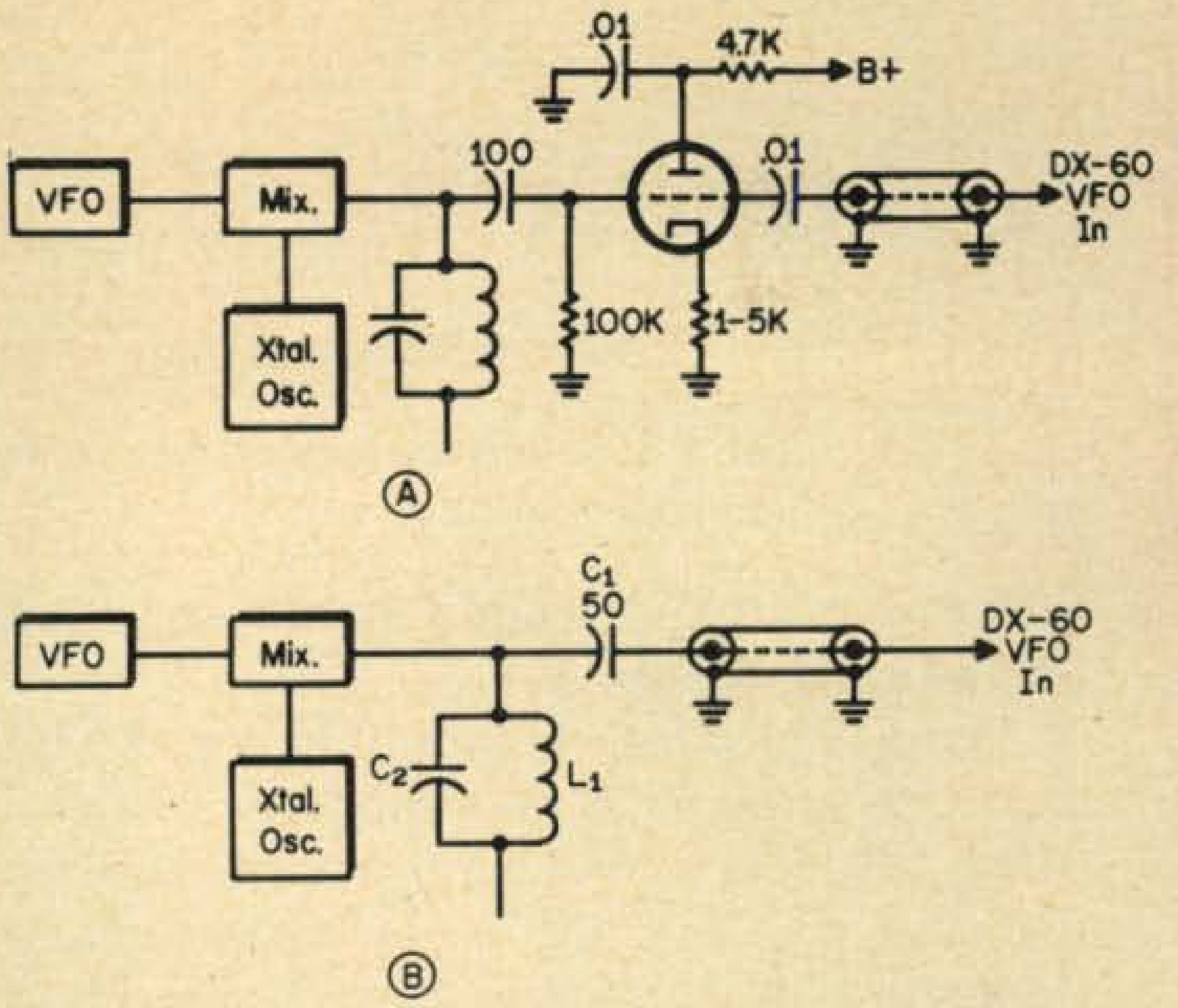


Fig. 5—(A) Setup for employing cathode follower between output of mixer-type v.f.o. and v.f.o. input of DX-60 transmitter. (B) Setup for feeding DX-60 v.f.o. input directly from mixer output of the v.f.o. affair. The capacitance of the coax cable (approx. 24 mmf per ft.) in series with C_1 will be in shunt with L_1-C_2 and thus must be taken into consideration when resonating this circuit.

through and they are distorted. Is there some alteration I can make to the set (other than detuning the preselector which does not help) to reduce the blocking?

ANSWER: We have run into such a situation with the SX-117 on 3.5 mc. Although we have not tried it ourselves, a solution known to have cured the problem is to reduce the number of turns for the antenna-input winding (on L_5). This will reduce the coupling and minimize the loading on the tuned secondary winding, thus improving the front-end selectivity. About one-third of the turns should be removed from the end next to the secondary winding.

Also, make sure that the crystal-controlled oscillator for the first mixer is properly adjusted as explained in paragraph 6-5 in the manual.

An additional point is that the screen of the 1st mixer in your unit should be found wired as shown in fig. 6. A change in the cathode-resistor return also is shown here for better muting on transmit.

Other causes of your trouble may be due to an open grid or lack of sufficient bias on a tube, particularly in an r.f., mixer or i.f. stage. Improper a.g.c. on one or more stages also may be involved. Suggest you check the a.g.c. voltage at the grids of V_1 and V_7, as well as checking for proper operating voltage and resistance readings as specified in the manual. Improper bias voltages may be due to a defective cathode resistor in a stage, shorted cathode-bypass capacitor or open a.g.c. line.

Table II—SB-300/301 & SB-400/401 Transceive Operation

Band (mc)	*Maximum Limits* (mc)
3.5	3.5 - 4.3
7.0	6.9 - 7.5
14.0	13.5 - 15.5
21.0	18.0 - 23.5
28-29.5	27.8 - 32.0

Straight-Through V.F.O. Operation With DX-60

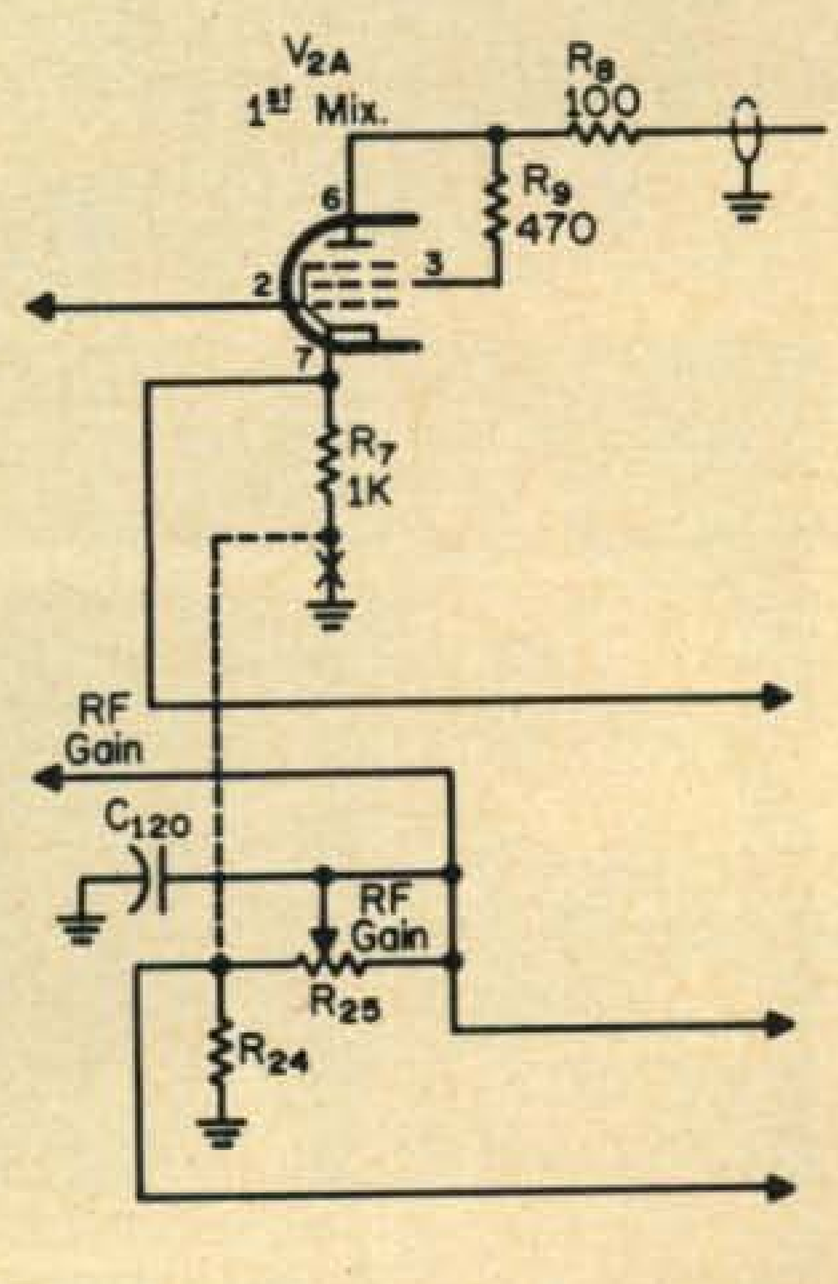
QUESTION: I'd like to use a mixer-type v.f.o. with a DX-60 transmitter in order to obtain better stability. Can the DX-60 be operated straight-through on all bands and thereby obviate the need for frequency multiplication? How about the efficiency and stability of the DX-60 oscillator stage which would operate as an untuned amplifier, except on 7 mc. Also will the 6CL6 stage (formerly used as a multiplier) be stable as an amplifier, especially on 21 & 28 mc? Will neutralization be required?

ANSWER: At the output of the external "mixer-type" v.f.o., use a cathode follower as shown at fig. 5A. Connect it with a short piece of coax to the v.f.o. input of the DX-60.

In the DX-60 change L_1 to a 1 mh r.f. choke. The former oscillator stage, V_1, will be operating as an untuned amplifier. The

[*Continued on page 96*]

Fig. 6—A portion of the circuitry for the 1st mixer in the SX-117 shown with proper screen-grid connections. The tube essentially functions as a triode, instead of as a pentode. Improved muting performance may be obtained by lifting R_7 off ground, as indicated by ×, and connecting this end of R_7 to R_{24}-R_{25} junction as shown by dashed lines.



VHF TODAY

BY ALLEN KATZ,* K2UYH

THIS being the January issue and the start of a new year, we have decided to try and clean up some of the material left over from last year.

Back in November, we ran a column in which we discussed antenna measurement contests. At the end of that column, we indicated that we had more to say but that space had run out on us. What we had in mind was another method of antenna gain measurement suggested to us by Dick W2IMU. If you remember the big bugaboo in antenna gain measurement is ground reflections, and the problems they create in trying to get

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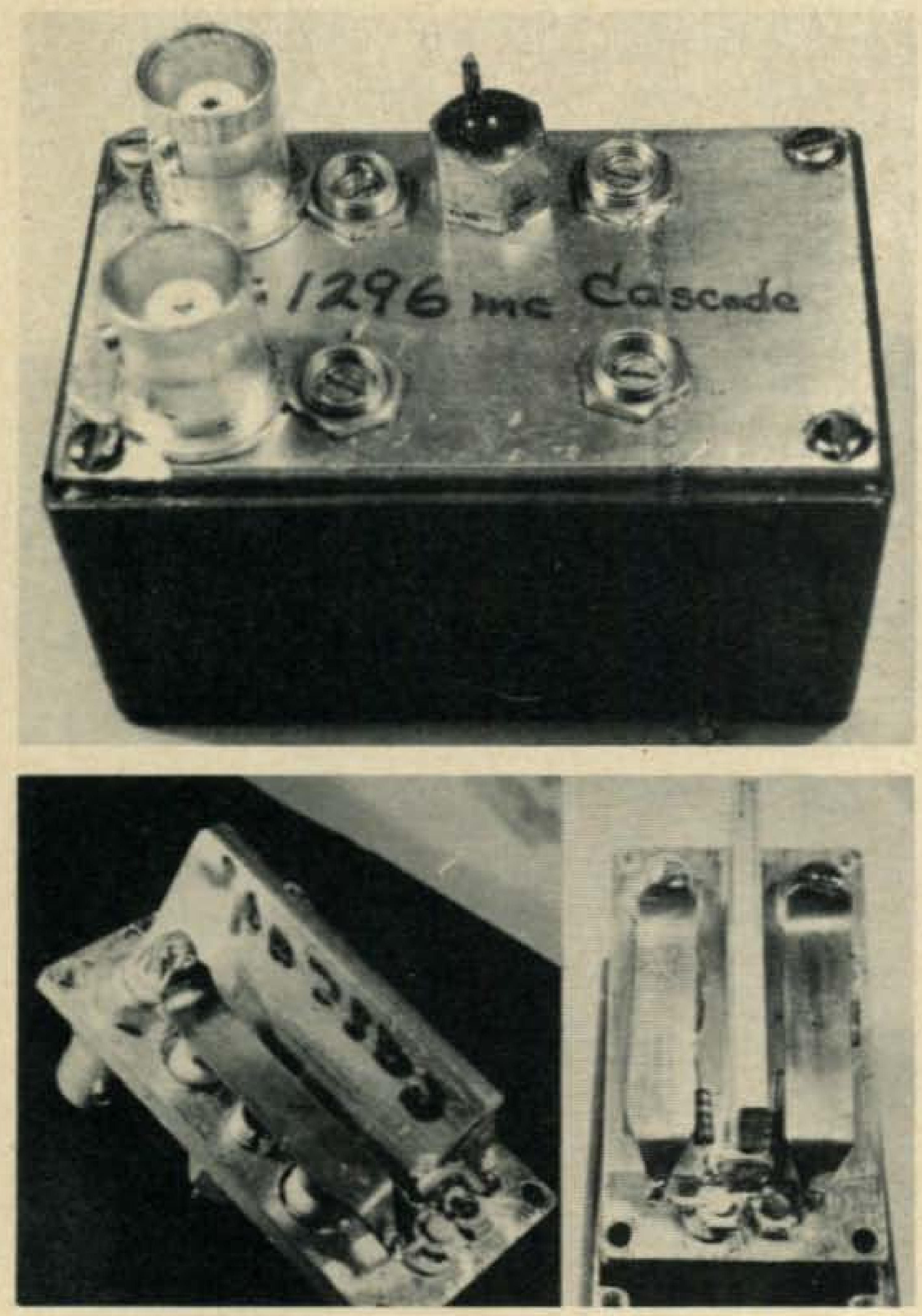

K2TKN's 1296 mc preamp. Photos show the basic component locations and the "symetrical" design.

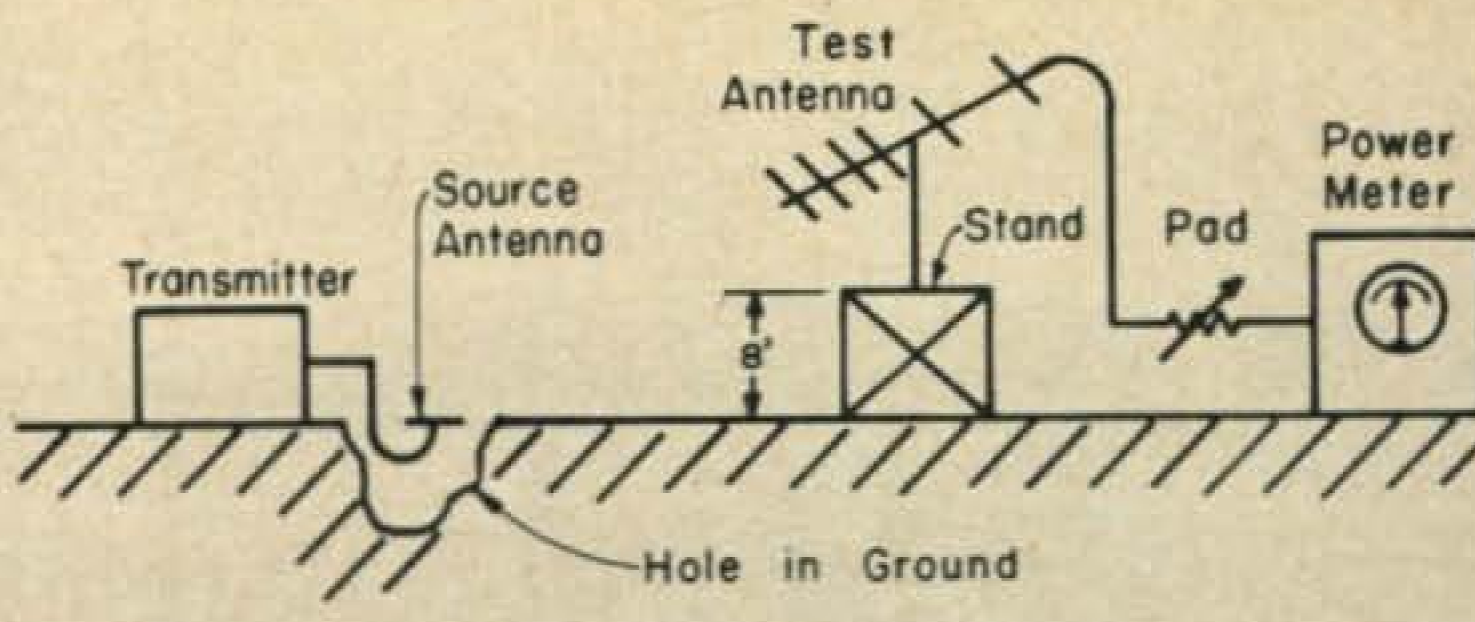

Fig. 1—Proposed antenna measurement contest test range.

uniform energy distribution across a large aperature antenna.

Normally, when conducting an A.M.C., a source antenna is mounted up in the air 30 or 40 feet above the ground and at a distance of at least $2D^2/\lambda$ from the antenna under test. D is the largest radiating dimension of the test antenna and λ is the wavelength of the frequency on which the antenna is being measured. This arrangement usually works well for comparisons between large antennas with large front to back gain ratios, as pointed out in November. However, for comparisons between large antennas and small antennas or large antennas with weird side and back lobe patterns, this method can yield misleading results.

The method Dick suggests has the source antenna mounted in the ground, rather than up in the air, and the test antenna elevated. Figure 1 depicts this scheme. The source antenna is placed in a shallow hole, while the test antennas are held by the contestants on an elevated platform or ladder. The distance between the source and test antennas should (as before) be at least $2D^2/\lambda$.

This arrangement virtually eliminates ground reflections, although there is still a taper in the energy distribution at the test antenna, due to the pattern of the source antenna. Dick feels that for antenna sizes, which are practical to bring to an antenna measurement contest, an elevation of 6 to 8 feet should yield satisfactory results. To our knowledge this arrangement has never been used at an amateur antenna measuring contest, but might be very interesting to experiment with.

Video Modulator

The most popular construction article presented in this column appears to be the transistorized video modulator of October. Unfortunately, the schematic diagram appearing along with the write-up on the modulator had numerous errors in it. Most of these errors were rather obvious, but because of the popularity of this unit, we felt it would be worth while to run the whole schematic

See page 110 for New Reader Service

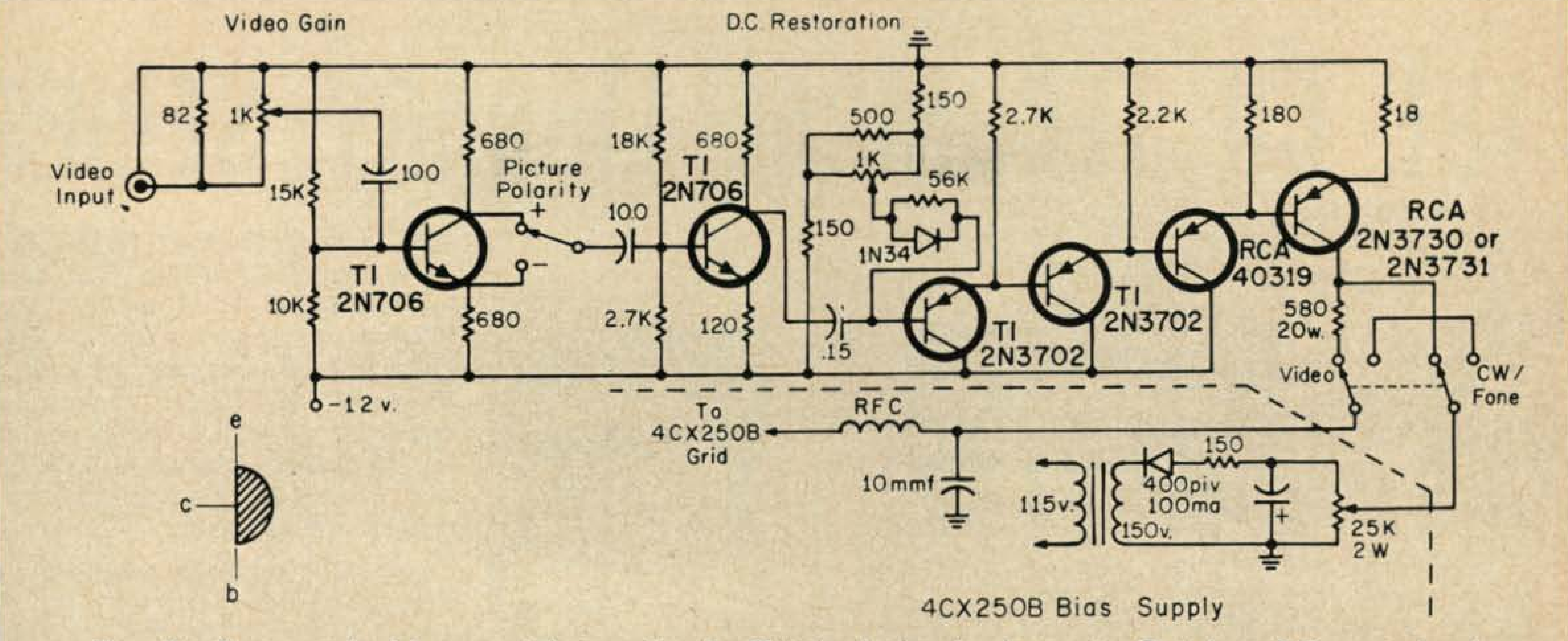

Fig. 2—Corrected video modulator circuit. Original circuit shown in October CQ contained several drawing errors. All resistors are 1/2 watt; capacitors in mf unless noted otherwise.

diagram again. The correct schematic (we hope) is shown in fig. 2. We have also made up some photographs which should be helpful in laying out the modulator. The original video modulator is still functioning well at our place. The only change we have initiated since its construction is the lowering of the 100 mmf 4CX250 grid by-pass capacitor to 10 mmf. This change gives slightly better high-frequency response; and the smaller capacitor RFC combination appear to be adequate to keep r.f. out of the modulator.

1296 Cascode Preamplifier

Last month we ran a discussion of 1296 mc transistorized preamplifiers. Among the designs mentioned was one by Bill, K2TKN, which offered high gain (20db) and low noise figure (4-5db) with fewer components and fewer adjustments than other designs. Since the writing of that column, we have been able to obtain the construction details for Bill's preamplifier.

The amplifier is constructed on a piece of aluminum "T" bar, which is a stock hardware item and mounted in a #2417 Pomona Electronics Box. The dimensions of the "T" bar along with layout of one of the amplifier's tuned lines is shown in fig. 3. Both input and output lines are identical. Electrical connection of components to the aluminum bar is made by means of a conductive epoxy cement. We suspect the amplifier could be built on copper stock and solder used in place of the epoxy cement. Bill notes that RFC's shown in the schematic are made different sizes to eliminate oscillation on a lower frequency and should be made with care. The amplifier is properly biased, when the 12 volts supplied divides equally across the two

[*Continued on page 96*]

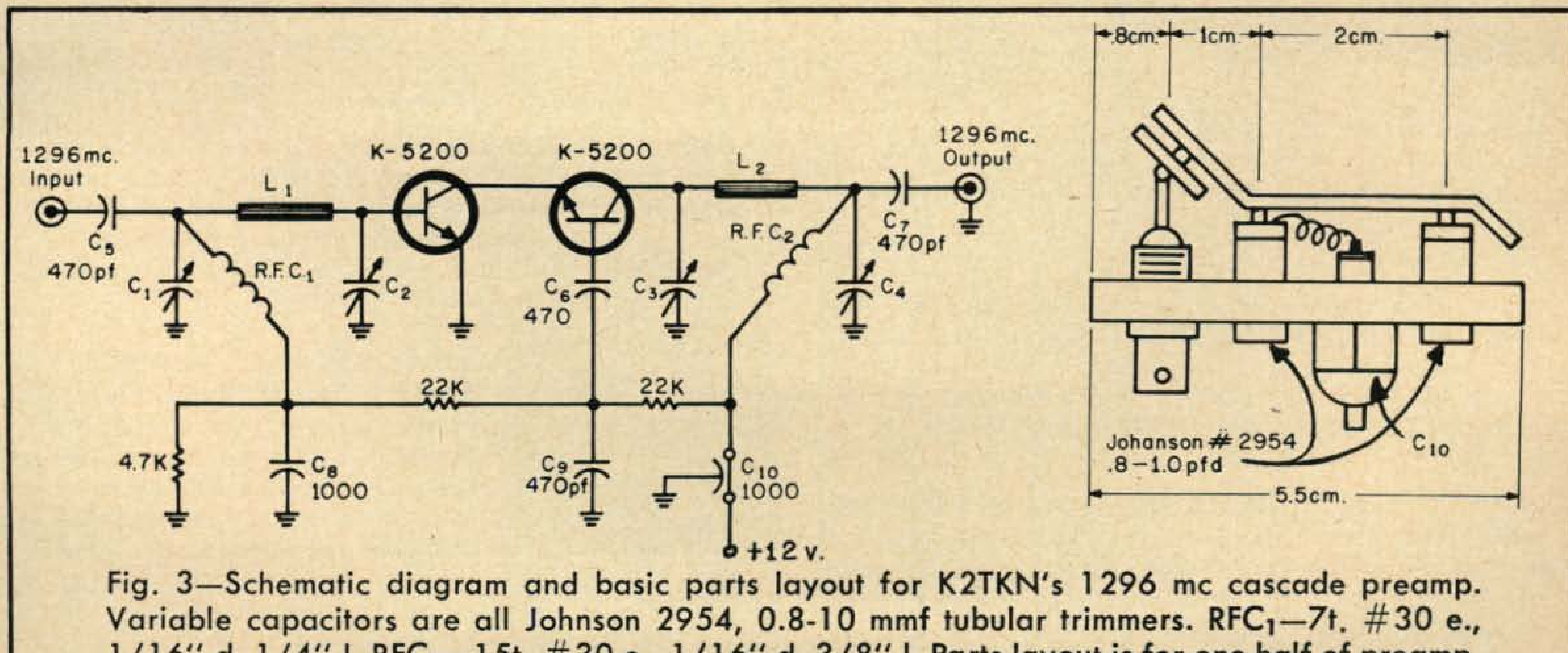

Fig. 3—Schematic diagram and basic parts layout for K2TKN's 1296 mc cascade preamp. Variable capacitors are all Johnson 2954, 0.8-10 mmf tubular trimmers. RFC$_1$—7t. #30 e., 1/16" d. 1/4" l. RFC$_2$—15t. #30 e., 1/16" d. 3/8" l. Parts layout is for one half of preamp, both halves being "symetrical" as shown in the photo.

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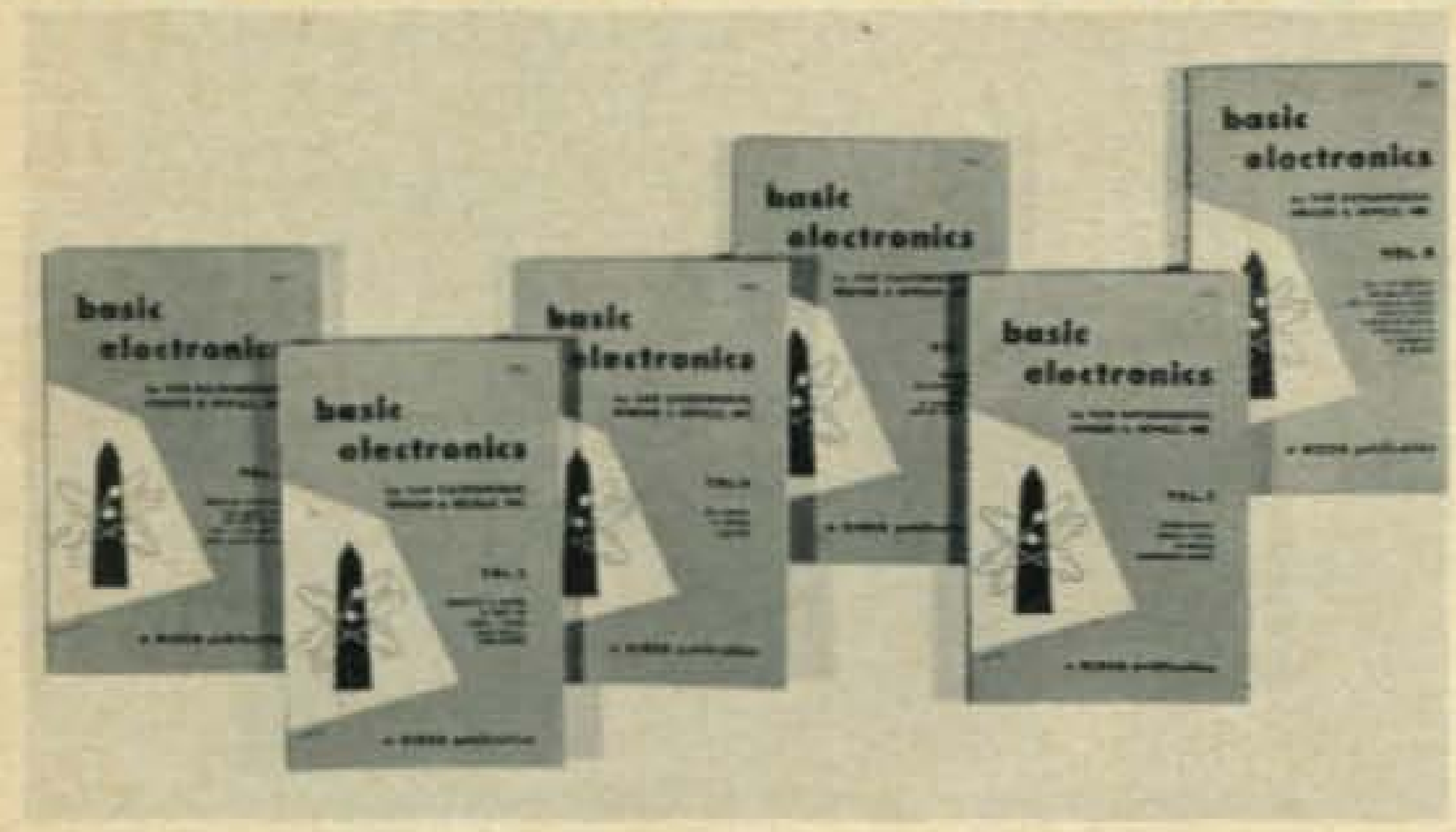

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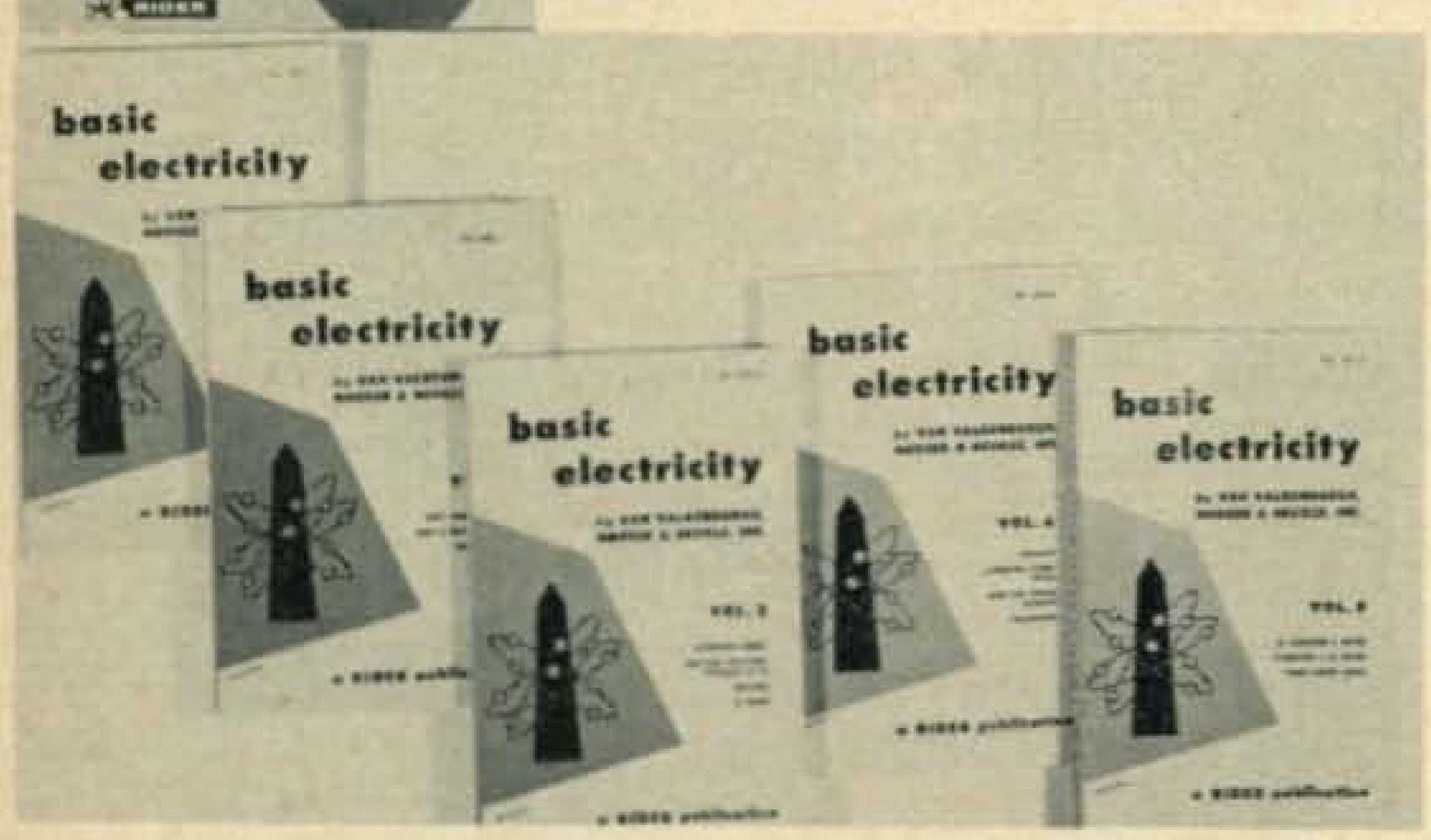

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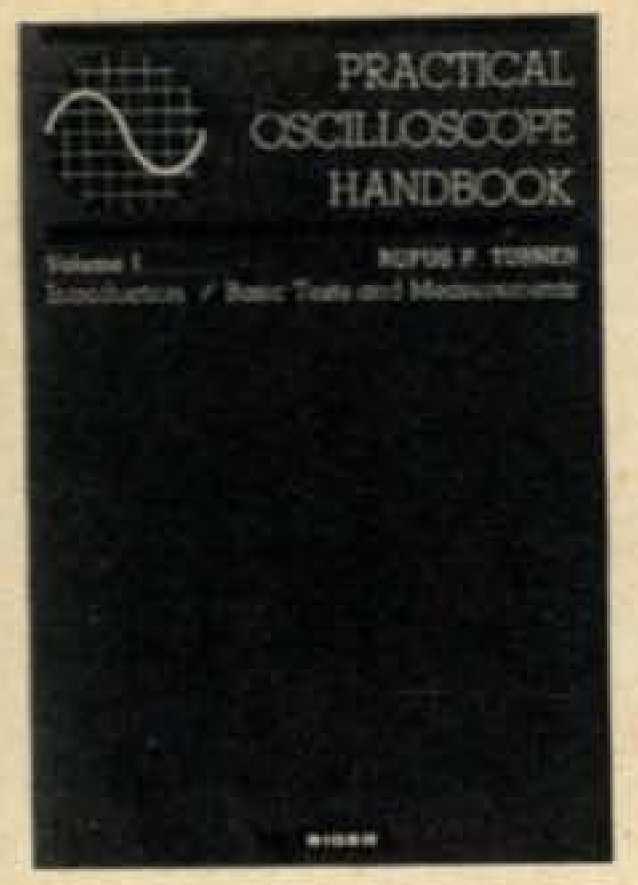

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SURPLUS sidelights

THE current Teletype Machine now in commercial service is the Model No. 35, a modernized, repackaged version of the familiar No. 28 which has been standard since 1951. As I noted in this column last year, the No. 35 equipment is beginning to appear in salvage and surplus. For the amateur RTTY gang, this provides a chance to update the appearance of the shack, and this column will detail the conversion of No. 28 equipment to the latest in Teletype styling.

The No. 35 equipment differs from the No. 28 in two chief respects: it is 8-level where No. 28 units are operated on 5-level codes, and the No. 35 is designed to harmonize with computers and other 1969-style office equipment. Eight-level codes are of little use at present on the amateur bands, since current Federal Communications Commission RTTY authorization is for 5-level, 60 word per minute operation, but the No. 35 styling has considerable attraction for the RTTYer who "has everything."

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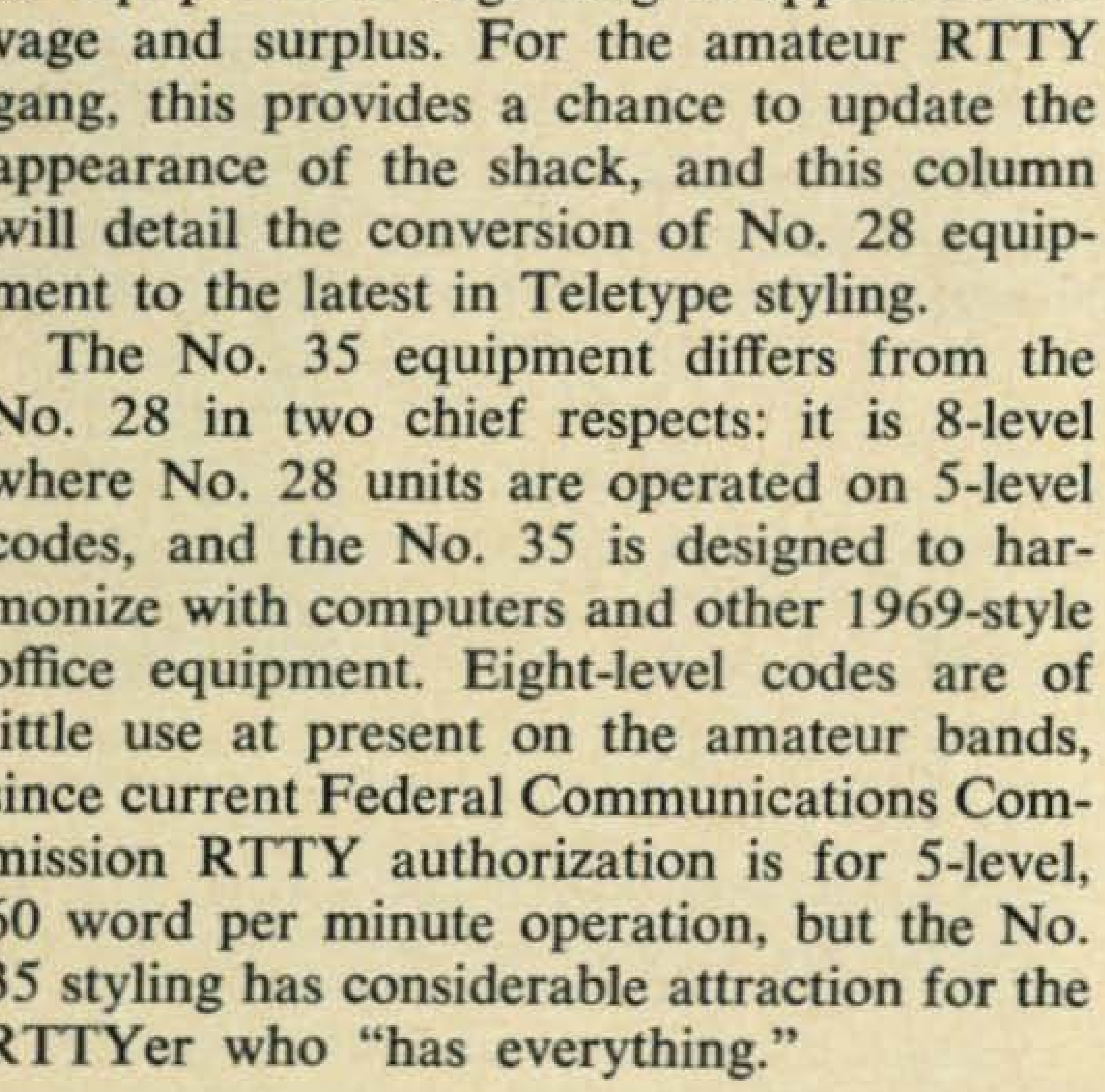

fig. 1—Model 35 Automatic Send-Receive console cabinet. This unit may be easily adapted to amateur use as the Model 34, 5-level set using Model 28 components.

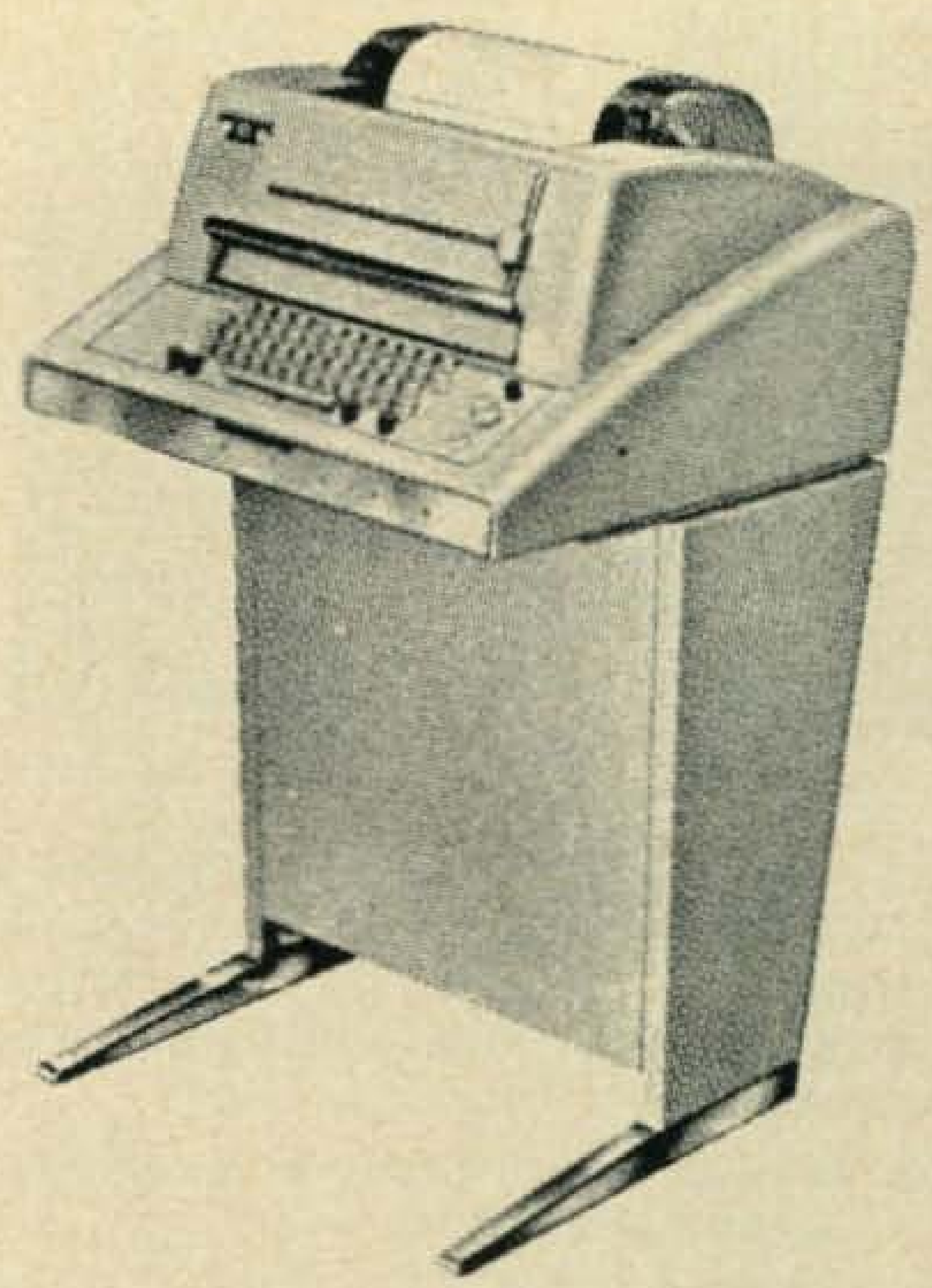

fig. 2—Model 35 KSR cabinet. Like the larger ASR, this may be converted to house model 28 Teletype units.

Now it is with care that I describe a purely cosmetic "conversion," offering no electronic advantages, but to judge from my mail since I mentioned the No. 35 sets almost a year ago, the modern look has a great deal of appeal in the amateur ranks. I do know of those who swear by the looks of the No. 28 machines, but many RTTY men consider the No. 28 appearance rather unattractive; with neither the solid functionalism of the No. 15, nor the modern appeal of the No. 35. If you are one of those who hankers after a little style, read on!

Figure 1 shows the No. 35 automatic send-receive console. The No. 35 KSR set is seen in fig. 2. Fortunately 95% of the "guts" of the No. 35 are much the same as No. 28, and the conversion of your No. 28 to the No. 35 configuration is a relatively straightforward switch of cabinets.

The No. 28 KSR will go into the No. 35 cabinet with only a change of the keyboard frame. The ASR set is a little more complex, but for someone who wants to go from a KSR to ASR at a lower cost than the usual price in surplus of the complete automatic send-receive set, the converted 35 cabinet arrangement offers some advantages.

Of course the first step in the process is to obtain an operating model 28 set. M.A.R.S., the numerous surplus dealers, the amateurs around the country who salvage Teletype, or, for the affluent, the Teletype Corporation itself, can supply the keyboard,

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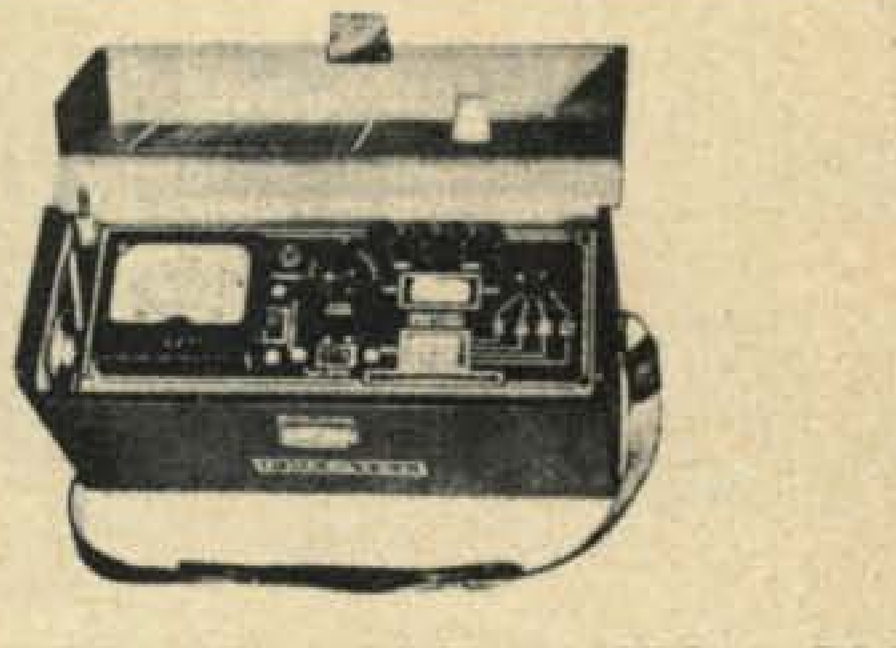

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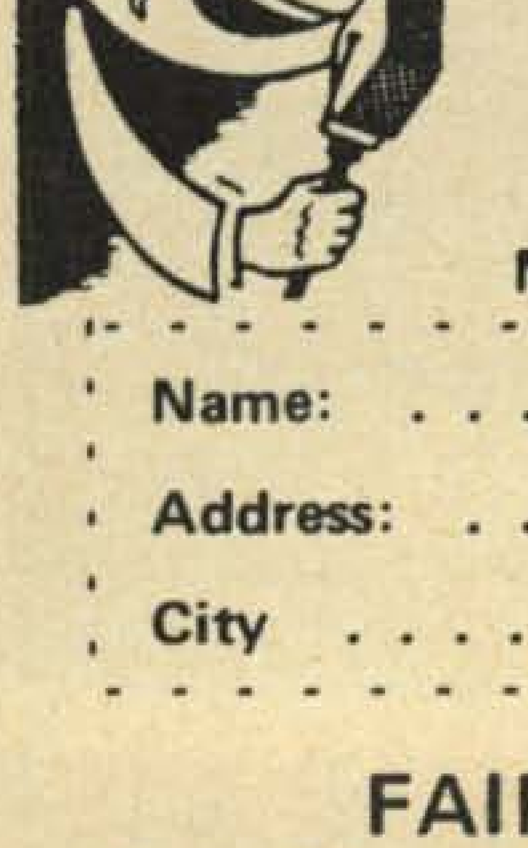

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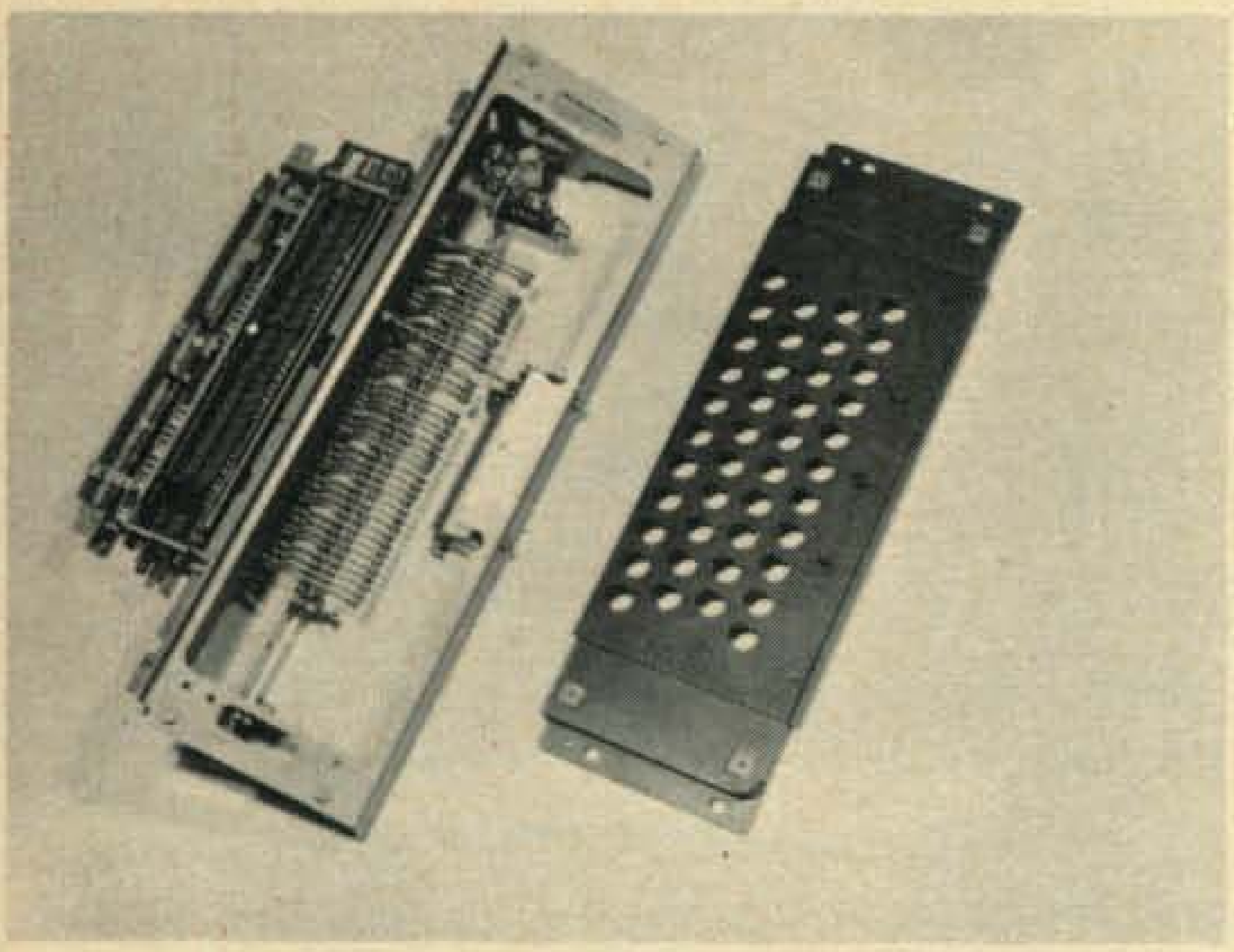

fig. 3—Model 28 keyboard parts which must be replaced to mount #28 units in #35 cabinets.

printer, motor, perforator and transmitter-distributor.

The No. 35 cabinets may be bought new, or found in Western Union, I.T.T., R.C.A., or Western Electric salvage. For radio clubs with donation agreements with the Bell companies it may be possible to obtain used No. 35 cabinets destined for the scrap yard. Cabinets generally are not sent all the way to the AT&T metals refinery on Staten Island, and may possibly be wangled from the telephone companies.

If you can afford it, the No. 35 KSR cabinet, LAC-300, may be ordered from Teletype Corporation, Skokie, Illinois, at a list price of $227. The LAAC-300, ASR cabinet costs $275. These usually are furnished in a light olive vinyl finish, code "HF." Amateurs would presumably be interested in the "private line" cabinet, without provisions for the call control electronics. A table top KSR cabinet, LAC-302, costs $154.

To put any Model 28 keyboard send-receive (KSR) unit into the No. 35 cabinet, the keyboard frame parts (fig. 3) must be removed and the corresponding No. 35 parts (fig. 4) installed. The green No. 28 keys may be used, or harmonizing grey keytops from the model 32 keyboard may be purchased at 15¢ each to replace No. 28 keys. I will send along a list of the catalog numbers of the grey keytops to any interested reader who sends me a self-addressed stamped envelope, since it is too long to reproduce here.

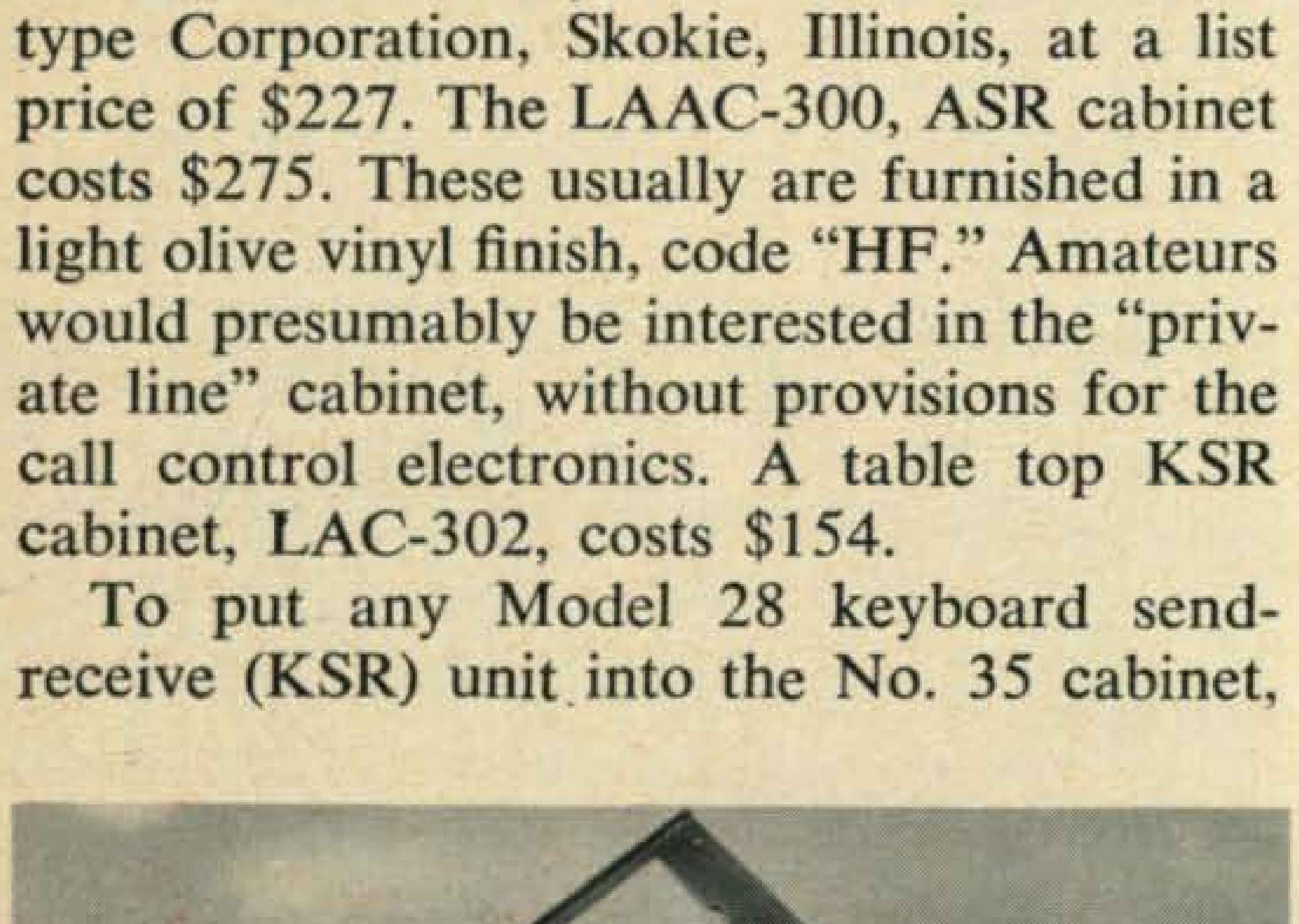

fig. 4—Model 35 parts which may be obtained to convert #28 units to the newer cabinets.

The necessary parts to make the conversion of the frame area of the keyboard are:

Part No.	Description	Qty.
117608	speed nut	17 ea.
192538	button	17 ea.
192553	bracket	1 ea.
192554	bracket	1 ea.
192555	frame	1 ea.
192556	frame	1 ea.
192552	channel	1 ea.
170379	bar	1 ea.
170380	bar	1 ea.

Total cost of these parts from the Teletype Corporation would be $13.37 plus postage. If you are willing to cut down the No. 28 lock bar assembly yourself, to the 11¾ inch width necessary to make it fit in the No. 35 frame (fig. 5), you can save $8.00 of the figure above, eliminating the last three items.

The modification requires hacksawing down the No. 28 bar (part number 163647 or 151841) by 11/16 on each end and drilling new mounting holes. The holes should be tapped, but may be drilled through and nuts used to secure the bar in place.

When converting the older MK I and MK II keyboards which have a short keylever in the center for "space", It may be necessary to use shims (washers) under the screws which attach the No. 192553 and 192554 brackets to the base to give proper clearance on the lockbar channel. The late MK III No. 28 keyboard ought to fit without shims.

The big No. 35 ASR console will accept a No. 28 ASR keyboard, perforator and transmitter-distributor easily, with the same switch of keyboard frame parts as on the KSR, plus a new tape bin for the perforator and a new base for the TD. If you are building up an ASR from scratch you can save on the TD base and the perforator linkages over standard No. 28.

The Teletype Corporation itself made a five-level machine in the No. 35 cabinet,

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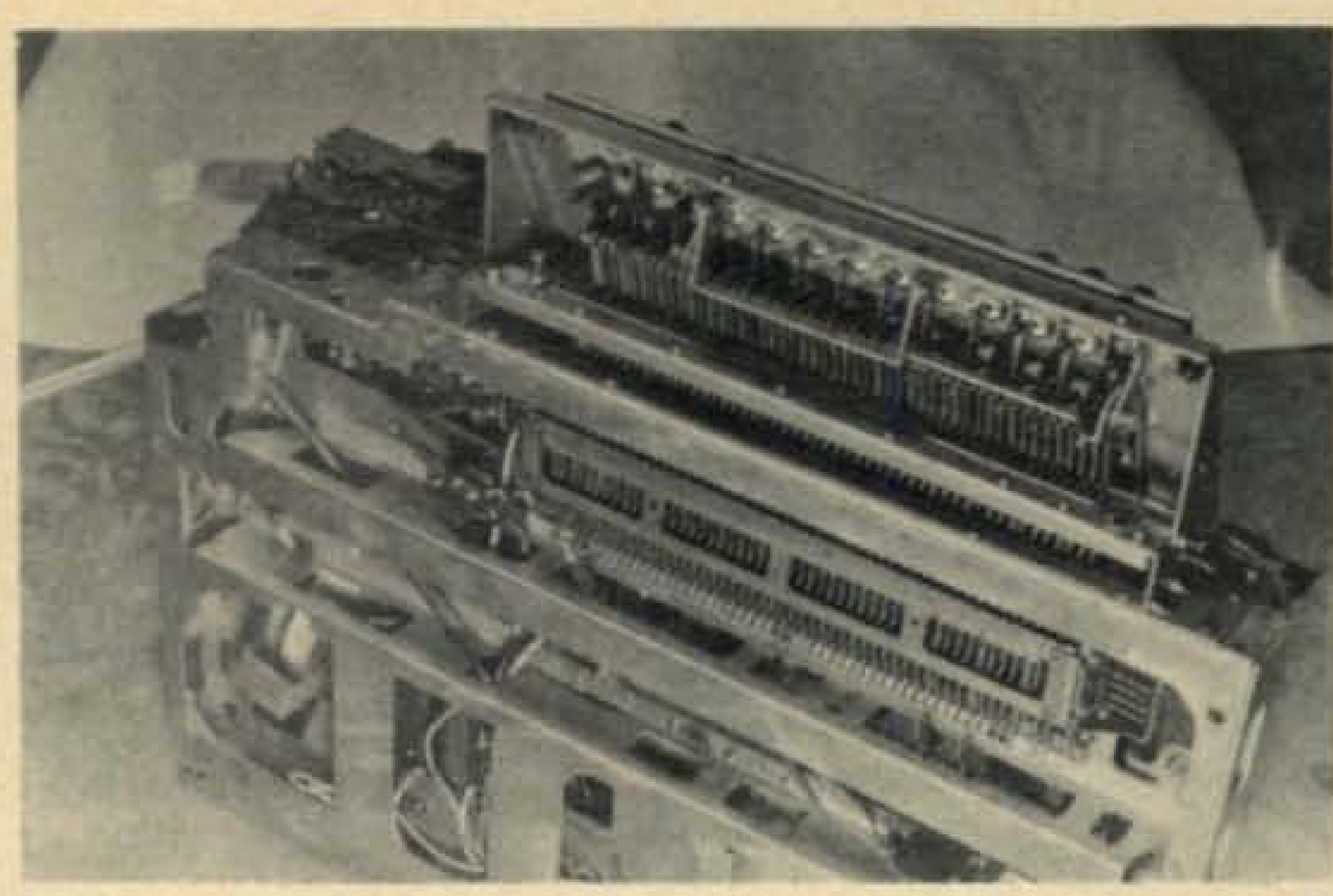


fig. 5—Bottom view of #34 ASR keyboard, showing lockbar which must be changed or converted in order to use 5-level units in the #35 cabinets.

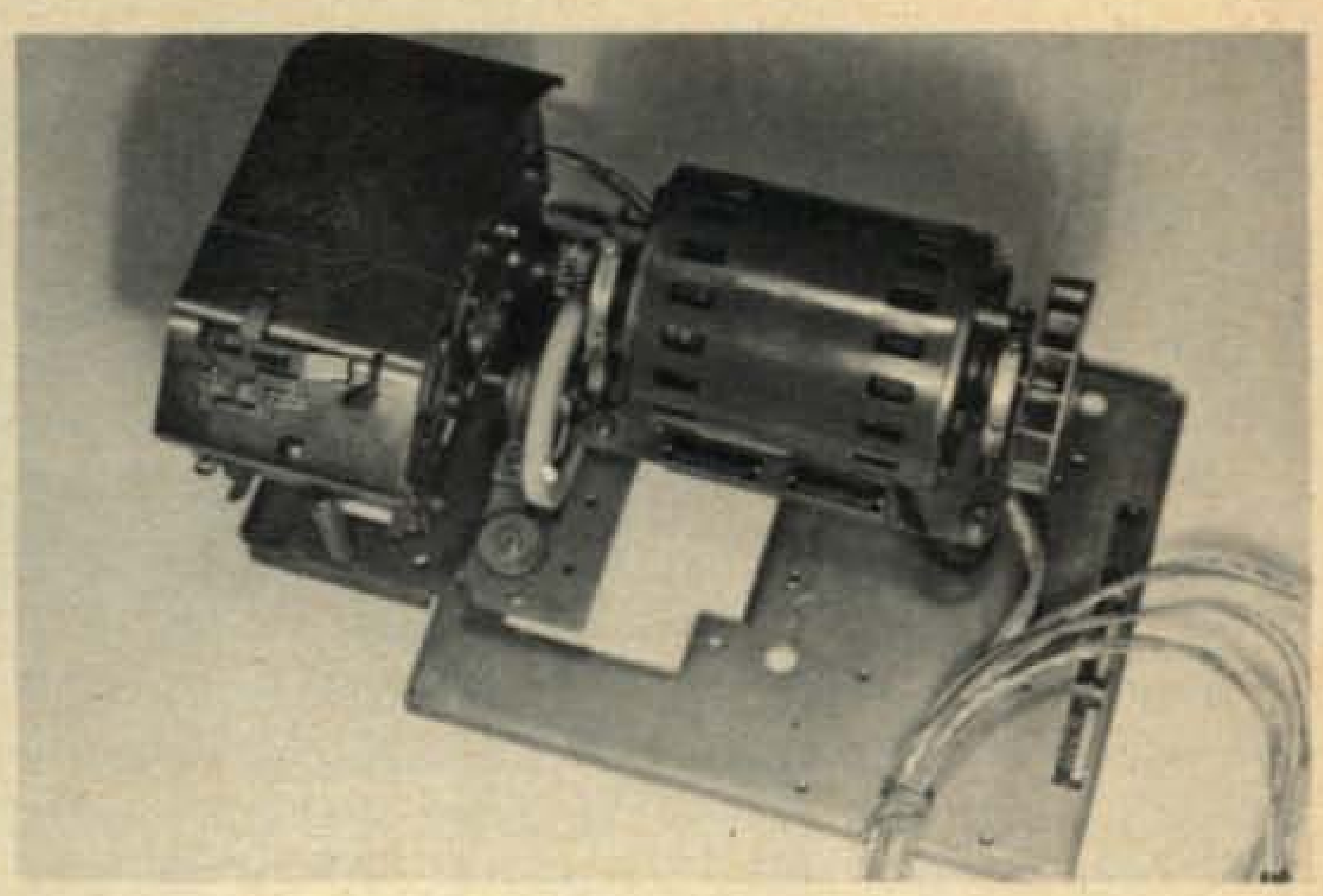


fig. 6—Model 34 ASR transmitter-distributor and base assembly, showing 3600 r.p.m. synchronous motor mounted so as to drive a 5-level TD on the #35 base insert.

calling it the Model 34. Few were made, mostly for a military application involving the secret LXCC five-to-eight-level code converter.

To put the ASR in a No. 35 cabinet you will need the following parts, in addition to the KSR conversion:

Part No.	Description	Qty.
142623	disc	1 ea.
192224	tape bin	1 ea.
192237	TD top plate	1 ea.
192243	TD base	1 ea.
192240	studs	3 ea.

Total cost of these parts from Teletype Corporation is $11.53, plus postage.

Now to use the No. 35 ASR cabinet, a *separate motor* must be provided for the TD, unlike the setup in the No. 28 cabinet, which drives the TD from a set of shafts and couplings to the main printer motor. You must mount a 3600 r.p.m. motor on the No. 192243 base to drive the LXD TD. An ordinary No. 28 LMU-3 motor will do very well, (fig. 6) driving through a set of intermediate gears. The parts which I used here were:

156821 bracket	158788 retainer
161246 gear	156819 shaft
155551 retainer	156658 gear set

These parts cost a total of $18.98 in the current Teletype price list. In addition, the motor must be mounted to meet the intermediate gears, which will require some screws and shims, plus wiring to an a.c. power switch.

If any readers need assistance with this conversion, I will be glad to offer pointers by mail.

The single-contact 28H or LXD transmitter-distributor fits the No. 35 cabinet best, but the LBXD TD can be used, or the dual-headed LXD. The LAXD and LCXD climbing head TDs will not fit the No. 35 cabinets without major metal surgery. I don't recommend using them.

The No. 35 cabinets will accept the standard No. 28 electrical service unit (LESU) but clearance must be maintained between the "ears" of the LESU and the cabinet top hinges. It may be convenient to cut off the "ears" although they can be made to clear the top by correctly positioning the LESU in the cabinet.

There are no terminal strips in the No. 35 cabinet, but the No. 28 strips may be attached to the No. 35 with screws and nuts. I recommend removing the terminal strips entirely and using simplified wiring in the LESU, since most amateurs will not want

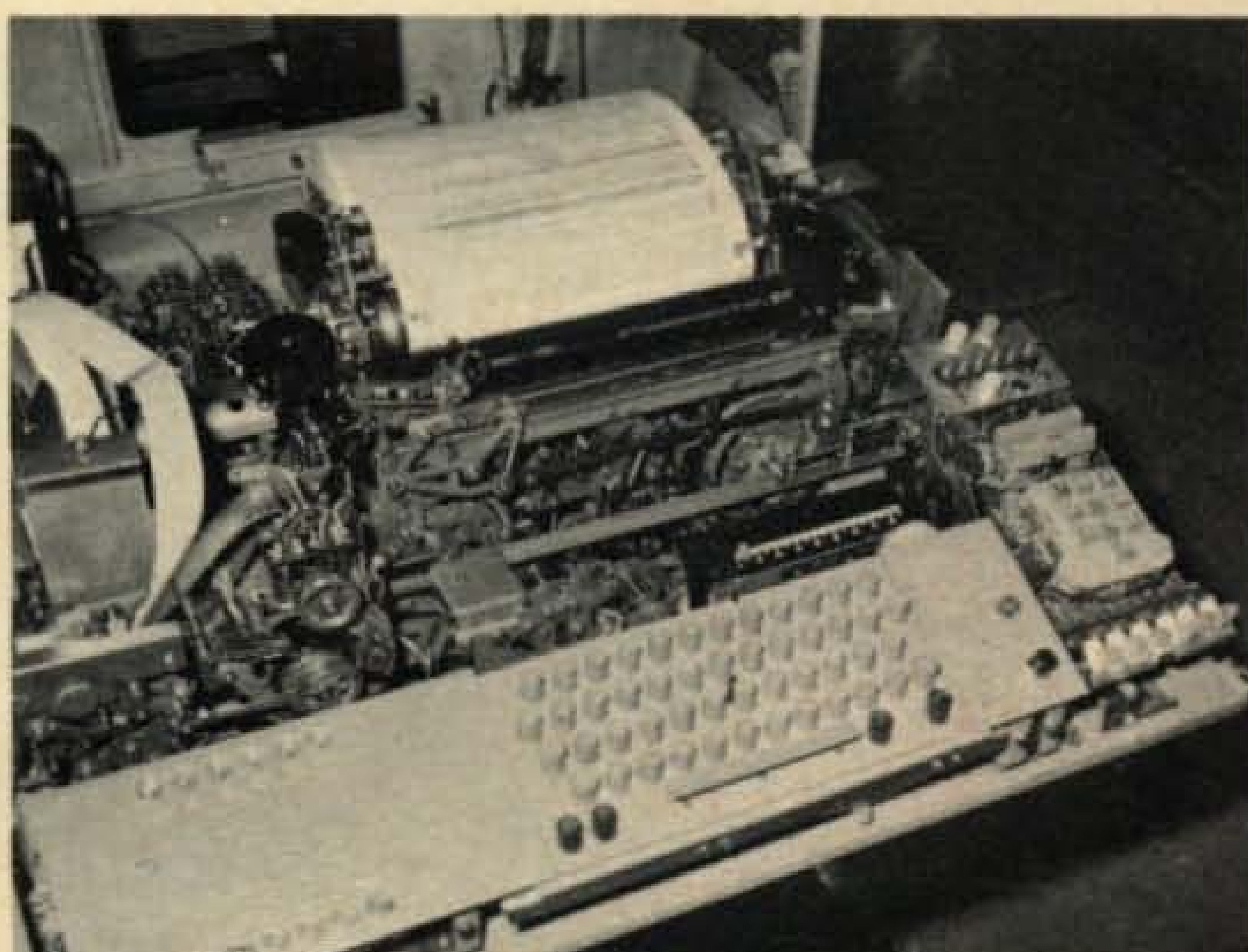
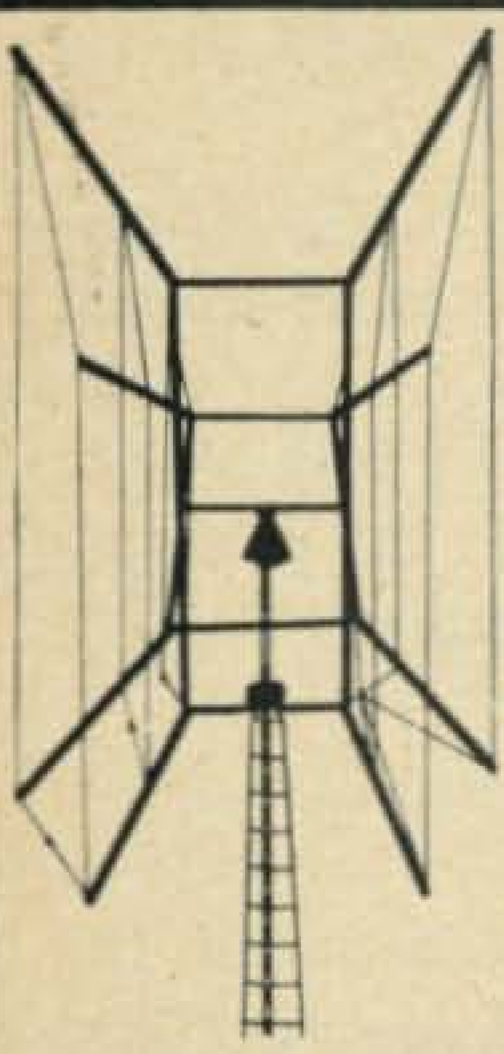


fig. 7 — Standard #35 ASR set with cover removed.

See page 110 for New Reader Service



all the hookup options normally in the No. 28 system.

In the No. 28 ASR, the perforator is driven in the "T" position by "fingers" extended from the keyboard. In the No. 35 set the perforator is equipped with selector magnets and driven electrically, with switching done electrically. In converting a standard No. 28 ASR, a hole will have to be drilled in the front of the cabinet for an extended "K-KT-T" switch shaft. A U-shaped slot may be made in the lip of the cover so that it may be closed over the extension.

If you are putting together an ASR set, the No. 28 "fingers" and their associated cams and levers may be left out and a reperforator mounted on the base to punch tape. Now many No. 28 reperforators are single-shaft types, from receive-only sets. These are not normally used on the ASR, which requires a two-shaft perforator. But Teletype Corporation made a special multi-magnet punch several years ago, with a single shaft, and designed a special way to drive it. By using the No. 144750 bearing bracket and the No. 144768 shaft, you can adapt a single-shaft perf to the ASR keyboard. The cost of these two parts is $17.30.

Of course when using a reperf, marking current has to be applied to the reperf magnets when it is desired to keep it in idle condition.

Some of the conversion steps may appear complex, but they are really fairly straightforward. To make the job easier, you should have the pertinent No. 28 manuals, plus the No. 35 parts bulletin No. 1187B and the No. 35 description and adjustment books.

Sources of No. 28 and No. 35 parts are:

Fred G. Schmidt, 405 NW 30th Terrace, Ft. Lauderdale, Florida.

Philip Rickson, Box 96, Morrisonville, N.Y.

Martin Geisler, 8926 Kester Ave., Van Nuys, California.

Jim Cooper, 837 Palmer Ave., Maywood, N.J.

New parts may be ordered, as I have indicated, from the Teletype Corporation, 5555 Tuohy Avenue, Skokie, Illinois, attention R.C. Simon. The parts numbers I have listed are for guidance only, and should be checked, as there are many steps between my typewriter and the column where errors could creep in, and mistakes could be expensive! Teletype charges for return of incorrect orders. ■

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VHF [*from page 87*]

22K bias resistors. Tuning-wise this amplifier acts much like the other 1296 amplifiers described in December; when properly adjusted the outside piston trimmers of both tuned lines should tune "in" while the inside trimmers should be "out".

Best Wishes for the New Year.

73, Al, K2UYH

Q & A [*from page 85*]

grid of the 6CL6, V^2, also will be untuned. These stages should therefore be stable and not require neutralization.

There should be enough gain through V_1, but if not, feed the DX-60 v.f.o. input directly from the mixer-output tuned circuit as shown at fig. 5B.

Heathkit SB-300/301 and SB-400/401 Operation Outside the Amateur Bands

In the July '68 Q & A Column data was given as to the selection of heterodyning crystals for operating the Heathkit SB-300 receiver on certain MARS frequencies. We have since received additional information from the Heath Company which gives the required ordering specifications for the crystals for both the SB-300/301 and SB-400/401. The crystals must be obtained directly from a crystal manufacturer, the names and addresses of which may be found by reference to the *CQ* advertiser's index.

The Heath data also indicates the frequency limits to which the preselector or driver-p.a. may be tuned. The "Range Per Manual" is that with the normal r.f. alignment, requiring only the crystal change and retuning of the crystal-oscillator coil. The "Maximum Frequency Coverage" range requires the additional procedure of readjusting the cores of the preselector or driver coils.

CRYSTAL FREQUENCY: Lowest desired fre-

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quency *plus* 8.895 mc.

OPERATION MODE: Fundamental, except 3rd overtone above 16 mc.

TOLERANCE: .01%.

HOLDER: HC-6/U.

PIN DIAMETER: .050".

PIN SPACING: .486".

LOAD CAPACITANCE (*C*L): 32 mmf.

INTERNAL CAPACITANCE (*C*o): 7 mmf max.

SERIES RESISTANCE (*R*s): 25 ohms max.

DRIVE LEVEL: 10 milliwatts. ■

USA-CA [*From page 82*]

of some 340 U.S. and Canadian Awards and rules. Also explaining AWARD Abbreviations such as GCR, AOM, AOMB, AOMB/M as well as latest phonetics, etc. The cost–$4.00, send to Amateur Radio Achievement Club, Box 7326 Euclid Stations, St. Petersburg, Florida 33734.

Some of you will be reading this around Christmas Time (1968) and other in January (1969), so in view of the fact that in writing the column 2 months prior to publication–I showed I was human (?) and failed to wish you–A WONDERFUL CHRISTMAS –last month. May I now say, I hope "Santa" brought you a new upgraded license, many needed QSLs and some new equipment (and good health). May I also wish you ALL THE BEST IN THE NEW YEAR (1969). Among your new resolutions I hope you included one to be sure to write me and tell me–How was your month? 73, Ed., W2GT. ■

Sunspot Story [*From page 59*]

should also be possible at the same time during all but the summer months.

During 1969, an occasional F-2 layer 6 meter opening should be possible during the fall, winter and spring months across the continent, between the mainland and Hawaii, and between the USA and Central and South America, and perhaps other areas as well. These openings should occur around noontime and during the early afternoon hours. Trans-equatorial scatter openings generally peak during the evening hours.

In summary, 1969 is also expected to go down as a very good year for h.f. propagation conditions. ■

CQ Reviews: Millen [*From page 62*]

antenna, but although such a setup might furnish convenience in some cases, chances are that such switching would not be required, even with a multi-band antenna system using a common feedline, inasmuch as the Transmatch can be used for proper matching on the available bands.

Where bypassing *is* required or other antenna feedlines need be connected, from our experiences with other antenna-matching devices equipped with internal switching, it can be done with lower loss and less impedance discontinuity by use of a good external coax switch.

Another feature of the Transmatch is that it will attenuate harmonics. The second-harmonic attenuation measured on the Millen unit averaged 16 db, depending on the fundamental frequency and the matching-impedance settings used at the time. The average loss of power through the network measured 0.5 db.

Although the bandswitch is designed for high-power applications, operating it with power applied is not recommended, especially since switching transients or momentary loss of load caused thereby may result in arc-overs or other serious damage in the transmitter amplifier. The heavy spring pressure and solid detent of the switch require quite a bit of twisting energy before the switch turns. This can serve as a good reminder to cut off the transmitter power, before the switch is actually rotated.

As a final comment, it should be noted that the Transmatch does not alter the s.w.r. on the transmission line to the antenna, but it simply allows the transmitter to look into a non-reactive 50 ohm load or the equivalent of a 1:1 s.w.r. on a 50 ohm line.

The Millen No. 92200 Transmatch (2 kw peak) is priced at $147. The No. 92201 (300 watts peak) is $77. These are products of James Millen Mfg., Co., Inc., 150 Exchange Street, Malden, Mass. 02148. ■

Contest Calendar [*From page 73*]

meter Novice band. Operation is also planned on 2 and 6 meters.

A special QSL card has been printed for the occasion. Send yours to: Colonie Central High School Radio Club, 100 Hackett Ave., Albany, New York 12205.

Editor'd Notes

Conditions for the Phone Contest were again excellent, especially on the higher frequency bands. Looks like George Jacobs has scored another hit, and Freddie Caposella will have to rewrite the record book.

The list of claimed scores is only a cross-

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STATEMENT OF OWNERSHIP MANAGEMENT AND CIRCULATION (act of October 23, 1962; Section 4369, title 39, United States Code) (1) Date of Filing—September 29, 1968; (2) Title of Publication—CQ THE RADIO AMATEUR'S JOURNAL: (3) Frequency of Issue—Monthly; (4) Location of Known Office of Publication—14 Vanderventer Avenue, Port Washington, County of Nassau, New York 11050; (5) Location of the Headquarters or General Business Offices of the Publishers—14 Vanderventer Avenue, Port Washington, County of Nassau, New York 11050; (6) Names and Addresses of Publisher, Editor and Managing Editor: Publisher: Richard A. Cowan, 32 Burham Street, Smithtown, New York; Editor—Richard A. Ross, 90C McLaughlin Street, Glen Cove, New York; Managing Editor—Alan M. Dorhoffer, 75-15 177th Street, Flushing, New York; (7) Owner—(If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.)—Sanford R. Cowan, 6 Embassy Court, Great Neck, L.I., New York; (8) Known Bondholders, Mortgagees, and other Security Holders Owning or Holding 1 percent or More of Total Amount of Bonds, Mortgages or other Securities (if there are none, so state)—NONE; (9) Paragraphs 7 and 8 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than of a bona fide owner. Names and addresses of individuals who are stockholders of a corporation which itself is a stockholder or holder of bonds, mortgages or other securities of the publishing corporation have been included in paragraphs 7 and 8 when the interests of such individuals are equivalent to 1 percent or more of the total amount of the stock or securities of the publishing corporation. (10) Extent and Nature of Circulation—Average No. Copies Each Issue During Preceding 12 months, Single Issue Nearest to Filing Date: (A) Average No. Copies Each Issue During Preceding 12 Months—Total No. Copies Printed (Net Press Run)—64,027; (B) Paid Circulation 1. Sales Through Dealers and Carriers, Street Vendors and Counter Sales—30,014. 2. Mail Subscriptions—32,388; (C) Total Paid Circulation—62,402; (D) Free Distribution (including samples) By Mail, Carrier or Other Means—1,504; (E) Total Distribution (Sum of C and D)—63,906; (F) Office Use, Left-over, Unaccounted, Spoiled After Printing—121; (G) Total (Sum of E and F—should equal net press run shown in A)—64,027. Single Issue Nearest to Filing Date: (A) Total No. Copies Printed (Net Press Run)—64,108; (B) Paid Circulation 1. Sales Through Dealers and Carriers, Street Vendors and Counter Sales—30,097. 2. Mail Subscriptions—32,471; (C) Total Paid Circulation—62,568; (D) Free Distribution (including samples) By Mail, Carrier or Other Means—1,487; (E) Total Distribution (Sum of C and D)—64,055; (F) Office Use, Left-over, Unaccounted, Spoiled After Printed—53; (G) Total (Sum of E and F—should equal net press run shown in A)—64,108. I certify that the statements made by me above are correct and complete. (Signed) Richard A. Cowan, Publisher.

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section of the higher and most interesting early scores, so don't panic if you don't see yours listed.

All certificates for the 1967 contest have been mailed. Some have already been returned marked "unknown" or "insufficient" address. So if you have not received yours you might forward us your correct mailing address.

A report on the c.w. weekend next month.

73 for now, Frank, W1WY

Vertical Antennas [*from page 57*]

work after a fashion, but the adjustment can hardly be optimum without some means of assuring proper power division and equal tower currents.

There have been inquiries about the broadside case, where $S=210°$ and $\psi=0°$. This one produces a figure eight pattern with a gain of 5.2 db in each lobe. This one should be very popular, for the fact that all ATUs are the same (with 0° phasing) makes it very easy to erect three towers in an equilateral triangle and switch pairs of towers, thus covering six directions. I plan to discuss this one in the next installment.

Erratum

It is regretted that figs. 42 and 43 were inadvertently reversed in Part V.[69]

For those who write, please enclose a self-addressed stamped envelope if you wish a reply. The mail from this series is quite heavy.

[To be continued]

[69]Lee, P. H., "Vertical Antennas—Part V", *CQ*, Oct. 1968, p. 43.

Z-Bridge [*from page 35*]

odd dollars the apparatus cost. Aluminum tubing and U-bolts are much cheaper than pre-built arrays, and the home-brew jobs work just as well as their commercial counterparts provided they are tuned and matched correctly.

To tune a parasitic array whose front-to-back ratio is 18 db or more, actual height operating conditions may be closely simulated by pointing the beam straight up in the air, provided the back reflector is about nine feet off the ground. Using the bridge to adjust feed-point impedance and a field strength meter to adjust back cut-off, one man may tune a beam very close to optimum in a very short time. ■

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160 Meter Linear *[from page 27]*

After the wiring has been completed and checked, we are ready to put the linear into operation. Turn on the power supply and check to make sure that the filaments are lit up. Next, check to see that the high voltage is around 1200 volts d.c.

Next, check to see that the plate current meter reads about 80 ma with no input signal applied.

Now apply an input signal and note that the plate current value rises to between 200 and 400 ma. Proceed to tune the pi-net tank circuit in the normal manner, while watching the output meter. Tune both C_1 and C_2 for a maximum deflection on the output meter. For linear operation of the amplifier, the final value of plate current should be 300 ma. Increase or decrease the drive until the plate current is 300 ma, at the time the output meter is peaked. This will require a driving power of about 10-15 watts, and will provide a power gain of 10-12 db. The amplifier plate efficiency is about 62% under these conditions. The plate input power is 300 watts d.c. or 600 watts p.e.p.

The increase in power has made the difference of being heard at times that I could not have been heard with low power. I have talked to several California stations, Utah, Washington, and Nevada and all stations reported very good audio and modulation quality, plus very good signal strength reports.

I believe that the increase in power was a worthwhile project and has improved my operating capabilities on 160. ■

Antenna Traps *[from page 39]*

The chart in figure 2 shows antenna lengths which might be used for center frequencies on each band as indicated.

The antenna performs well on low frequencies. No compromise need be made in the expectations of performance as measured against dipoles.

On the higher bands, although they will assuredly not operate as efficiently as high gain antennas, they will nevertheless perform most satisfactorily in long range communication. The directionality of the antenna at high frequencies tends to run along the length of the antenna.

In conclusion, I would be most happy to hear from anyone attempting the use of the antenna for comparisons of design, data and performance. ■

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Ham Shop

Advertising Rates: Non-commercial ads 10¢ per word including abbreviations and addresses. Commercial and organization ads, 35¢ per word. **Minimum Charge $2.00.** 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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Direct All Correspondence & Copy to: **CQ Ham Shop, 14 Vanderventer Ave., Port Washington, L.I., N.Y. 11050.**

A GUIDE TO OVER 700 electronics construction projects. 4 years in the making. Over 160 test equipment projects, 70 ham projects, and hundreds more! $3.95. Bel Enterprises, P.O. Box 381, CQ, Bellflower, Calif. 90706.

FOR SALE: VFO—Heath HG-10 kit, in original packing —$30. E. Flutot, 14922 Janine, Whittier, Calif. 90605.

FREE SAMPLE copy of equipment for sale—trade—wanted. Write: Readout, Box 34658, Los Angeles, Calif. 90034.

FOR SALE: Heathkit QM-1, Q multiplier $10. plus postage, includes users manual. James Fred, RR 1, Box 28, Cutler, Ind. 46920.

WANTED: your S.A.S.E. for my list of units, components, radio engineering books and odd-ball scientific items. Cleaning out-going appliance operation after 40 years of hamming! Vincent Barker, Box 725, Sag Harbor, N.Y. 11963.

FOR SALE: Swan xcvr with homebrew power supply $115. Viking Ranger with ptt $75. Both excellent condx. Larry Hammel, R.F.D. 2, Sparta, Ill. 62286.

CANADIANS—National NCX-5 MK2 with NCX-A p.s./spkr. Like new, in original cartons, $750. R.C.A. AR88/LF Revr. in cabinet, good cond. $100. Ameco converters CN50W and CN144W, 30.5-34.5 IF brand new and unused $50 each. Will ship F.O.B. VE6KD, 5303-114 St., Edmonton 70, Alberta, Canada.

COLLINS 32S-3 transmitter and 516F-2 power supply. Like new, $600. FOB G. L. Grothren, 90 Florissant Park Drive, Florissant, Missouri 63031.

FOR SALE: Like new Collins equipment-Receiver 75S-3B, transmitter 32S-3, power supply 516F-2 and microphone SM-1 all for $1,050 plus freight. L. Ahlstrom, 209 New Mexico Drive, Portales, New Mexico 88130.

NCX-3 and Heath A.C. power supply $180. Rev. D. L. Roberts, P.O. Box 12, Steinhatchee, Fla. 32359.

BEST OFFER: NCX-5 Mk II, NCX-1 AC power supply, remote console, all xtal's (10 mtr) and xtal cal. Less than year old. Superb condition. Original cartons. Going abroad. Will consider all offers. Act Now! Harold E. Fox, 20 Citrus Drive, Rochester, New York 14606.

500 GREAT CIRCLE bearings, return bearings, distances, time differences, computerized to your QTH. $3.00. Samples 25¢. Bearings, 122 Lockhart Hall, Princeton University, Princeton, New Jersey 08540.

LONG RANGE TV reception easy! Booklet outlines methods to receive distant TV stations using inexpensive materials. $1.50 postpaid. Practical Plans, Box 56-F, Killeen, Texas 76541.

NORTHERN CALIFORNIA HAMS: Best deals — new and reconditioned equipment. Write, or stop for free estimate. The Wireless Shop, 1305 Tennessee, Vallejo, Calif. 94590.

QSL's: 100—$1.25 and up, postpaid. Sample — 10¢. Holland, R 3, Box 649, Duluth, Minn. 55803.

AMATEUR RADIO CERTIFICATE: Display impressive 8½" x 11" personally endorsed certificate in your shack. Send $1.00 to Amateur Certificate, P.O. Box 244, Miami, (Kendall Br.) Fla. 33156.

T4 RECEIVER—new $190., or swap for Thunderbolt; National 6m conv.—$20. Art Ford, 6 Stoothoff Rd., E. Northport, L.I., N.Y. 11731.

WANTED: One Swan 250 used very little, including factory installed calibrator and under warranty. H. L. Snyder, 2185 Sampson St., Pittsburgh, Pa. 15235.

FOR SALE: HW-16 — $100. 300 watt xcvr; Johnson VFO and TR switch, $100; BC-342-J rcvr.—$50. Gud order. S. Rowley, Athol, Mass. 01331.

COLIN KENNEDY regenerative receivers Models 281 & 2-Step, Model XV, Atwater Kent regenerative receiver. Will swap for Grebe or Federal receivers. T. Turner, 301 Sabin St., Kalamazoo, Mich.

LOOK FOR W0CVU at ARRL National Convention 1969, June 20-22 at Des Moines, Iowa. Make plans to attend.

FOR SALE: Complete desk top kw ssb and cw transmitter—$350. Eldico SSB 100A and SSB 1000 matched exciter and linear. Excellent, manuals included. Sell: CE200V mint cond., late serial E-1307, manual —$350. N. Grieveson, 89 Van Horn, Demarest, N.J. 07627.

ESTATE SALE: Drake TR-3—$360; MS-4—$70; Johnson Thunderbolt linear—$215; Gonset GPP-1 phone patch—$25; Instructograph and tapes—$25. All mint condition, shipped collect. Mrs. Lloyd Shelton, 2523 Woodfin Ave., Chattanooga, Tenn. 37415.

FOR SALE: Mobile TX86 w/VFO, Gonset Super 6 w/rcvr, noise limiter and squelch, console w/Topaz pwr supply—$140. Telrex 2 mtr Spiralray—$20. Hy-Gain 14AVQ—$15. J. E. Horner, W1AIP, P.O. Box 533, Groton, Conn. 06340.

FOR SALE: Antennas—Telrex TC99 tribander—$75. Telrex 503—3 element optimum spaced 20 meters—$60. Hy-Gain 153—3 element full size 15 meters—$20. Telrex 2M5C-5 element 2 meters —$5. Sorry, no shipping, pick-up only. W. Heckman, 92 Lagoon Blvd., Massapequa, L.I., N.Y. 11758.

WRL's USED GEAR has trial-terms-guarantee! Galaxy 300—$139.95; Galaxy V—$249.95; Galaxy V mk2—$299.95; Swan 350—$299.95; SR-150—$299.95; HW-22—$89.95; HT-40—$49.95; VHF62—$89.95; HX-500—$269.95; Galaxy 2000 & PS — $329.95; SB-300 — $249.95; hundreds more. Free blue-book list. WRL, Box 919, Council Bluffs, Iowa 51501.

FOR SALE: 75A-4 Serial 212, 3.1, 8 KC filters and Lafayette 2 kc. Superb calibration. Dual 1:1 and 6:1 tuning. Clean. $300. HT-32. One owner. Factory carton. $175. W. F. Mathemeier, W0AW, 935 E. Military, Fremont, Nebr. 68025.

FOR SALE: Tectronix 310A scope — $500. New this year, perfect condition in factory carton with probe and instruction books. Cash. Frank A. Hayes, Red Hill Rd., Middletown, N.J. 07748.

SOLID STATE POWER supplies, 115 v., 60 hz input RTTY loop 115 v. dc output,5 a. at $8.00 or 1 a. at $9.50; Transistor regulated —12V. 500 ma., 12 v. 500 ma., & —25V. 1.5a. outputs; FOB Dale R. Lee, W3JRM 1228 Shelbourne Drive, Bethlehem, Pa. 18018.

DRAKE—R-4A, T4-X, AC-4, power supply, matching speaker. Used only 25 hours, mint condition. First $700 plus freight takes them. Reason, going mobile. R. T. Tatarons, 4½ Hawthorne Ave., Melhuen, Mass.

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DAYTON Hamvention, April 26, 1969: Sponsored by Dayton Amateur Radio Association for the 18th year. Technical sessions, exhibits and hidden transmitter hunt. An interesting ladies program for XYL. For information watch ads or write Dayton Hamvention; Dept. C, Box 44, Dayton Ohio 45401.

SELLING my old radio books, magazines, catalogs and parts. Send stamped envelope for price list. W6CXD, Elmer A. Piere, Box 666, Victorville, Calif. 92392.

UFO's sell 50 paper back books, plus 4 hard cover, plus 2" pile clippings, plus NICAP and other information. Very fine collection made over past years. Make offer. Wells Chapin, W8GI, 2775 Seminole Road, Ann Arbor, Michigan 48104.

SWAN 500C xcvr, 117XC pwr supply, Turner 454C mic. $530. 3 months old. Original factory cartons, mobile mount, and warranty. Hy-Gain TH-3JR Beam, BN186 Balun, rotor control and cable and bearing (Channel Master) 3 months old. $105. Must sell for school expenses. All new equipment. D. Parker, 651 Probart St., Brevard, North Carolina 28712.

WANTED: Lampkin type 205-A FM modulation meter. S. Copenhauer. 1617 Daisy St., Clearfield, Pa. 16830.

TRADE: LAB METERS for ssb transceiver, Drake 2B, etc. Send for list. Samkofsky, 201 Eastern Parkway, Brooklyn, New York 11238.

FOR SALE: Gonset G-76, ac supply, manual. Fine condx. $135 and shipping or best offer. K. Johnson, RR2, Ames, Iowa 50010.

INFINITY/SCRAMBLER telephone transmitter, color TV plans—$4.20 12 vdc/117 vac 120 w. inverter $14. G. Denman, Rt. 3, Box 164, Grapeland, Texas 75844.

TRADE: RTTY, AT&T surplus telegraph station test set 161A1 with booklet. Trade for anything of equal value. Want Millen or other grid dipper. L. Biese, 70 Court, Plymouth, Mass. 02360.

RTTY gear for sale. List issued monthly, 88 or 44 mhy toroids, uncased, five for $2.00 postpaid. Elliott Buchanan and Associates, Inc. 1067 Mandana Blvd., Oakland, Calif. 94610.

FOR SALE: HW-16. Excellent condition. $100. A. L. Small, 116 Faye St., Red Bluff, Calif. 96080.

FOR SALE: SBE-33 Transceiver. Good condition. Priced to move $150. Contact Al Martinson, Box 455, Dunkirk, New York 14084.

FOR SALE: WRL Duo-Bander 84. $95. Realistic DX-150 general coverage $85. plus postage. Want R4 or Drake SW4A. James R. Belt, 1006 N. 76th St., Omaha, Nebr. 68114.

TEST EQUIPMENT WANTED: Any equipment made by Hewlett-Packard, Tektronix, General Radio, Stoddart, Measurements, Boonton. Also military types with URM-(), TS-(), SG-() and similar nomenclatures. Waveguide and coaxial components also needed. Please send accurate description of what you have to sell and its condition to Tucker Electronics Company, Box 1050, Garland, Texas 75040.

Q.S.L. CARDS $6.95 (1000) F.O.B., C.B. Wholesale Printers, P.O. Box 994, Anderson, Ind. 64015.

TOROIDS: 44 and 88 mhy center-tapped, unused, 5/$1.50 postpaid. 11/16" paper tape $3/box. Motorola P33 5-watt FM transceiver with Ni-cad supply—$85. H-23 1-watt version—$75. Eico 720—$40. Model 28 and 32 page printers — write if interested, and make offer. Wanted: tower, rotator, matchbox, RTTY gear and FM gear. Van, W2DLT, 302X Passaic Ave., Stirling, New Jersey 07980.

FOR SALE: 3 plastic holders will frame and protect 60 cards—$1.00. 10 holders—$3.00. Prepaid and guaranteed. Patent 3309805. Tepabco, Box 198Q, Gallatin, Tennessee 37066.

RTTY INFORMATION for the amateur interested in RTTY. F. DeMotte, P.O. Box 6047, Daytona Beach, Florida 32022.

FOR SALE: DX-60A, HR-10B, automatic relay, spkr., key, reference library, VOM, cables, key. 24-hour clock, monitor. Fine condition. $170 plus shipping. WN2FSB, 799 Wenwood Dr., East Meadow, N.Y. 11554.

FOR SALE or trade — TDQ two-meter transmitter, modified for 150 watts output. $65 freight collect. W6NUI, T. L. Rutherford, 28810 Covecrest Dr., Palos Verdes Peninsula, Calif. 90274.

FOR SALE: Classic TA-33 beam, like new—$90. 52 ft. Tri-Ex c/u tower, 10 ft. sections, like new—$200. W6TCQ, 5014 Mindora, Torrance, Calif. 90505.

IMMACULATE HENRY 2K linear, used very little $425. Prepare pick-up, Collins station control 312B4 immaculate $125. Write Mel Marsley, Stevens Ave., Kalamazoo, Michigan 49001.

BOSTON VHF RTTY activity—51.192 mhz.—AFSK/AM-horiz. polar. 30 Active Stations—Join the fun every nite—more info s.a.s.e.—Contact WA1DPX—Ray Dick, 6 Herbert Rd., Arlington, Mass. 02174.

HAVE $35. Want CB rig. Hart Smith, Box 452, Birmingham, Mich. 48012.

FOR SALE: 8 over 8 two meter J-Slot antenna by Antenna Specialists, 50 ohm, $20. You pay the freight. WA0CPX Ed Gray, Rt. 1, Burke, S.D. 57523.

VHF/UHF amateurs, need following: VHFer Magazine, Jul, Oct, Dec '64 and all 1961-1963; VHF Horizons after July '63 6 UP after Mar '65; VHF Amateur Dec '60, Dec '61, Feb & Mar '62; 73 Oct '60 & Jan '61. Parks 432 & 220 converters. Book "Scatter Propagation Theory & Practice". D. Etheredge, 12040 Redbank, Sun Valley, Cal. 91352.

WANTED: Jan, Mar, May, Jun, July, Aug, Dec 1961 CQ. Have 1954, '55, '57, '59 issues to trade. Want TMC FFRD tuning unit 4-8 mcs. H. Brown, 110 Adams Dr., Greatview, Florida 32536.

DRAKE T-4X, mint; R-4A, mint, factory overhaul 1968; AC-3 Power Supply; MS4 speaker and cabinet light scratches on top; 160 meter crystal; $599. Dr. J. Robinson, FOB Creston, Iowa 50801.

WANTED: 2 to 4 kva 220 volt Variac. Sell: 75A-2A in good condition $220. Paul Bittner, 814 4th St., South, Virginia, Minn. 55792.

WANTED: 20 Meter 3 Element Beam. Also manual for Heath Mk-1 SSB conversion to DX-100. Mike Ludkiewucz, 143 Richmond Dr., Ludlow, Mass. 01056.

FOR SALE: Decade Scaler plug in's good to 100 kc. Beckman, $8.00 unused Mod. 15 page printer in crate. $75. Complete station, SB-34, Alum. inst. case, ants, etc. $275. R. M. Ellis, 1356 Elizabeth St., Las Vegas, Nevada 89109.

SALE OR TRADE: Channel Master and Craig portable tape recorders, with ac converters. Need good c.w. rig with stable v.f.o. W3BQS, 709 Main, Edwardsville, Pa. 18704.

WANTED: Capacitor decade box, 500 cycle filter for 75A-4. Robert Rossi, 55 St. N.W. Rochester, Minn. 55901.

FOR SALE: DX-110B in excellent condition. $75. plus shipping or will trade for 2kw linear pwr. supply. A. C. Barry, 135 N.W. Drive, Patrick AFB, Fla. 32925.

FOR SALE: Heathkit HR-10 in excellent condition with its crystal calibrator. Please offer. Jim Morgensen, 5 Corte Holganza, Orinda, Calif. 94563.

WANTED: SB-610 or SB-620. Tom Dornback, 19 W. 167 21st Pl., Lombard, Ill. 60148.

WANTED: C.R.T. Bezel for ID-60/APA-10 state price wanted—first letter. E. A. Sjolander, 119 7th St. W., Ashland, Wisc. 54806.

FOR TRADE: Like new RME DB-23 pre-selector for tuneable model. DB-20 in good condition with manual. E. A. Sjolander, 119 7th St. W., Ashland, Wisc. 54806.

FOR SALE: SX-101A mint cond. $190. 2kw final with sup. parts and pr. 4-400A $195. Pick-up only. R. Formica, 1300 Greenbriar Lane, N. Bellmore, L.I., N.Y. 11710.

FOR SALE: Wheatstone 15/32" oiled perforator tape. P. L. Lemon, W6DOU, 3154 Stony Point Rd., Santa Rosa, Calif. 95401.

FOR SALE: Swan 350 with homebrew AC supply $300. Clegg 99er $65. Knight V107 $20. Heath HA-14 and HP-24, $130. D. J. Reese, 747 Madison Ave., Charlottesville, Va. 22903.

FOR SALE OR TRADE: Heath CD-1, color bar/pot generator; GR-64 rcvr, want tower. Don Dahlin, WB6WGR, Box 174, Sousbyville, Calif. 95372.

FOR SALE: HW-12, $55. FOB, or swap 2m. f.m., W5SPY, McCaul, 9714 Titan Drive, San Antonio, Texas 78217.

WANTED: Loudenboomer rotator and control box in good condition. W2GQN, 114 Phylis Court, Elmont, N.Y. 11003.

FOR SALE: Drake 2B receiver with loudspeaker in excellent condition—$165. Hammarlund xmtr HX-500, all modes, SSB, AM, CW, FM, in excellent condition —$95. K4GT, Col. Frank J. Shannon, Sr., 140 Bosphorus Ave., Tampa, Florida 33606.

WANTED: SB-101 or equal transceiver. Must be in good condition and reasonable. Don Bryant, W4PZQ, Box 1063, Merritt Island, Fla.

FOR SALE: Antique, com'l breadboard style loose coupler xtal wireless receiver, about 1912 vintage, converted to audiotron vacuum det. about 1915, converted for radio with home wound coils in 1922. Tube lit in recent test. Make offer. Frank M. Miller, W5OYT, 315 S.E. Wilshire Ave., Bartlesville, Okla. 74003.

WANTED: SB-110 or HX-30, working or not. WA4OSR, Mitch, P.O. Box 756, Mobile, Ala. 36601.

WANTED: New or good used Spaulding TB series Strato Tower sections ST-1 thru ST-5. W0BNA, 1011 N. Lincoln, Hastings, Nebr. 68901.

TRADE: GE-4ES12C1 FM single unit transceivers with control head and crystals. 146.34 transmit, 146.94 receive. Trade for SSB transceiver fro A.F. Mars HF nets 5.3 or 7 mc. F. R. Harmon, P.O. Box 203, Owasso, Okla. 74055.

MUST SELL: Complete station for school expenses. HT-37, 4-1000 linear, relays, coax. Everything must be sold. L. Kirschemann, P.O. Box 633, Regent, N.K. 58650.

WANTED: To borrow, schematic and/or manual for Johnson Adventurer. Will Xerox and return immediately. A.M. Fox, Box 895, Greeley, Colo. 80631.

FOR SALE: Globe HG-303 75 watts, Lafayette HA-225, Eico 722 VFO, relay, xtals, all great shape & manuals —$145. D. Gross, 31 Eaton Rd., Syosset, L.I., N.Y. 11791.

WANTED: 220 mc and 432 mc gear, both converters and transmitters. A. J. Savicky, 105 Nursery Lane, Lancaster, Pa. 17603.

FOR SALE: Exciter 20A, Cent. Elec. — $75. Globe Champion xmtr, Model 350 w/new AX9909's in final —$150. W3ZYU/4, 432B Sheridan Ave., Fort Myer, Va. 22211.

FOR SALE: 100 kc xtal — $2.50 — $1.60. WE416B — $3.50;$3.50; NC-33, 0.5-30 mc rx-$18. Eico-710 dipper —$19. List—s.a.s.e. J. K. Green, Box 1038, Boulder, Colo. 80302.

WANTED: Good linear amplifier. Have mint oscilloscope, Heath Seneca 6 & 2 also 730 Eico modulator. To trade or sell. J. P. Fuqua, Rte. 1, Box 118, Anderson, Tex. 77830.

WANTED: Early Atwater Kent and RCA radios and parts, by former employee—now collector. (Crystal & battery sets only.) F. Atlee, 92-31st Ave., St. Petersburg Beach, Fla. 33706.

WANTED: SP-44 Skyrider panoramic adaptor, state price and condition—first letter. Condition unimportant. E. A. Sjolander, Jr. 119 7th St., W. Ashland, Wisc. 54806.

WANTED—QST's—Last four issue needed to complete 19616JFEB., MAY, JUNE, JULY. Any reasonable price paid. K2EEK, CQ Magazine, 14 Vanderventer Ave., Port Washington, L.I., New York 11050.

WANTED: Socket & chimney for 4-1000A; a HB, GG linear using one or two 803's; KW matchbox & bridge. Bill Lindblom, 512 Grandview, Chillicothe, Mo. 64601.

FOR SALE: Drake R-4, $275. Unimat $85, Mite teleprinter $525. Monitoradio M-160 $75. Bdex P4, $95. All perfect. T. Perera, 410 Riverside Dr., New York, New York 10025.

INFORMATION wanted on ideas and experiences in converting BC-1000 (SCR-300) to ham bands. T. Field 1002 Prospect Ave., Melrose Park, Pa. 19126.

FOR SALE: Drake 2B, $150; Invader 200, $200. All items in perfect condition. You pay shipping. Garland Jet, 12913 Laurel-Bowie Rd., Laurel, Md. 20810.

WANTED: Novice Xmtr like DX-60 or T60. Send price in letter. D. Eisenberg, 907 Summit Ln., Oreland, Pa. 19075.

FOR SALE: SB-400 $260.00; Ranger-$70. Old HRO with 9 coils—$75. Much more—send stamp for list. J. Shank, 21 Terrace Lane, Elizabethtown, Pa. 17022.

JOIN THE OLD TIMERS CLUB. Eligibility—forty years on the air. Send your QSL card to: Chas. W. Beogel, Jr., W0CVU, 1500 Center Point Road, Cedar Rapids, Iowa 52402.

FOR SALE: Capitol Radio engineering home study course. $50 plus shipping. N. Gruenfelder, 126 Parkway Dr., Westbury, N.Y. 11590.

MANUAL for Hughes Memo Scope type 104. Jerry K0RHK, 13312 Inverness Rd., Hopkins, Minn. 55343.

SCHEMATICS for T-61 AXT-2 transmitter CRV-59AAE ATK/ATJ camera. Jerry, K0RHK, 13312 Inverness Rd., Hopkins, Minn. 55343.

COLLECTORS—trade for old radio gear or sell, excess supply of General Radio 247E cased variable capacitors and General Radio 274 wave meters which includes a 247E cased variable capacitor all in very good condition. Make an offer. Want for private collection—DeFaust panel units, loose couplers, slide tuners, crystal detectors, cased variable capacitors, spark gear, early radio catalogues and magazines. Describe and state price in letter. Glen Angle, K0TAM, Clear Lake, S. Dak. 57226.

FOR SALE: Ameco CN 6 meter converter, 4 new 6HF5's, PTO units from R-390. Best offer. D. Meeves, 7209 Old Branch Ave., Camp Springs, Md. 20031.

TRADE: Complete collection of 349 issues "Radio News", Vol. 1, No. 1 July 1919 thru July 1948. Want: Transceiver setup as TR-4. Farmer, 3009 N. Columbia, Plainview, Texas 79072.

WANTED: Mech. filters for 75A-4. SASE for list of junque. Jack C. Short, W4UHA, Oxford, Ala. 36201.

WANTED: Antique radio tubes made prior to 1920. W2EZM, 431 Oakland Maple, Shade, N.J. 08052.

FOR SALE: Drake 2B and 2BQ. Used very little. $170 or best offer. Also have xtals for 40 and 80 meter novice bands at 50¢ each. Write WB2GZL, 191 West St., Closter, N.J. 07624.

FOR SALE: Bird #43 less case $60; two meters U/W #43—$15 ea; Mil Model 611 wattmeter—$75; misc. v.h.f. list, stamp. Spitz, 1420 S. Randolph, Arlington, Va. 22204.

FOR SALE: CE-100V excellent—$295. Deluxe version TT/L-2, perfect—$175. R-388/51J3 excellent—$300. G. Tate, W4AIS, 7 *Artillery, Taylors, S.C. 29687.*

FOR SALE: Plans & specs 40 ft. crank up tower for under $40. Send $2. P. Schelter, 1007 Janlee Dr., Burkburnett, Tx. 76354.

See page 110 for New Reader Service

SALE OR TRADE: RBV-1 Panadptor, H/W TBS-50D, 6 M & 1¼ M Ameco converters; Apache; square wave generator and other goodies also tubes. Send stamp for list. A. J. Savirky, W3JYL, 105 Nursery Lane, Lancaster, Pa. 17603

FOR SALE/TRADE: Raytheon model 1030 marine xceiver, $75. Lafayette HA-230 receiver $35. Both in excl. working cond. Want SX-117, SX-146, 2C receiver. Glenn Anderson, 1100 New Jersey Ave., Pine Beach, N.J. 08741

FOR SALE: Collins 70-H FO's, $20. 100kc xtal SSB filters carrier down 50db, $12, New Steward OD 7-13, OD 10-15 BWO's. Art Klinger, 6287 Elm Valley, San Antonio, Texas 78242

COLLECTOR of antique radios wants National SW3, 4, 5, FB7, HRO, AGS 1-10. Give description and price. Erv Rasmussen, 164 Lowell, Redwood City, Ca. 94062

WANTED: Elmac M-1070 power supply. Have Elmac PSR-6 to trade and cash if necessary. Need PMR-8 Rcvr Manual also. Erv Grossman, 8031 Cedar Lake Rd., Minneapolis, Minn. 55426

FOR SALE: Collins S-Line station. 755-3B, 325-3, 312B-4, 516F-2, SM-2, DL-1 and 399-B-4. Four years old. You pick up. $1200 cash. W. F. Nicol, M.D., 3678 Bechelli Lane, Redding, Ca. 96001

FOR SALE: 30L 1 #17106 with an extra set of tubes. Exc. condition. C. Kaufman, 231 S. Jasmine St., Denver, Colo. 80222

WANTED: Mobile supply 14-117 for SW350 also 6 meter mobile rig. G. Charlick, 163 Ledgewood Circle, Rochester, N.Y. 14615

AMPLIDYNE 6 N2 Transmitter, also 220 and 432 Adaptors; RBY-1 Panoramic receiver, VHF/UHF Gear; Bird equip. List sase. C. Spitz, 1420 S. Randolph St., Arlington, Va. 22204

WANTED: Battery charger (NLN6259A) single unit AS as used with Motorola H23 Den handy talky. Cash or will swap ritty equipment. J. Thomsen, 8280 Tennessee Ave., Clarendon Hills, Ill. 60514

FOR SALE: Johnson Viling KW with desk and Ranger driver. 2 KW Pep. Excellent condition. $895. Glen Richie, W4JGO, Box 26, Salem, Virginia 24153

KITS BUILT: Experienced Amateurs in North Springs Amateur Radio Club will build your kit. All profits go to finance new station equipment. Write for quote. North Springs Amateur Radio Club, c/o Carey C. Coggins, 7125 Hunters Branch Drive, Atlanta, Ga. 31328

JOIN NOW: The old old timers club. Qualifications 40 years on the air. Send QSL card to: C. W.Boegel, 1500 Center Point Road, N.E., Cedar Rapids, Iowa 52402

WANTED: For USCA-QSLs from stations worked by me as 3C6UP in 1967, and as VE6UP in 1967 or any other year. C. Kropinak, 513-19th North, Lethbridge, Alta., Canada

FOR SALE: Yaesu Musen FL-2000DX Linear amplifier used 20 hours spare finals original carton $200 WB6RQK Bruch Wachtell, Box 433, Sausalito, Calif.

SELL: T-150A smtr, Lafayette HE30 rcvr, speaker, Good condition $105. EICO 566 VOM excellent $23. Lafayette HB115A CB transceiver w/mic, 12v p/s, CH. 11 crystal works good $32. QST's 1956-65 except 6, $16. Wanted: Heath HP13 DC p/s Jerry Van Vactor, 811 10th St., Spearfish, So. Dak. 57783

75A4: Modified in 1967, 3 filters, speaker. A real nice one. $425. W. Reynolds, 40 Fern Ave., Wareham, Mass.

FOR SALE: LM 13 Freq. Meter, 100 VAC P/S, Self $35. Want Rx preamp and Q/Mult WB2RNL, 36 Gerhard Rd., Plainview, L.I., N.Y.

GE MESSAFE MATE: On 52.980 Mc. Excellent condx. Nicad batt, tone decoders, desk charger, manual, case. $100 offer. J. F. Clifton, 1000 W. Carson St., Torrance, Ca. 90509

FOR SALE: 100 Watt Am XMTR $50. Vfo $15. Gonset Phone patch $25. Complete SSB station SX117 RCVR HT325 XMTR HT41 1000 watt Amp. only $650. W. J. Rade, 233 North Taylor, Oak Park, Ill. 60302

WANTED: Instructograph complete with tapes. Give lowest price and condition. Heinlein, 107 Wyoming St., Boulder City, Nev. 89005

FOR SALE: DX-60A, 3 novice crystals, HR-10B, crystal calibrator, Dow-Key, monitor, cables, 10 volume technical library, VOM. $170 plus shipping. WN2FSB, 799 Wenwood Drive, East Meadow, N.Y. 11554

FOR SALE: Southern Alberta Area Hams: DX-100 XMTR. $125. C. Kropinak, S 13-19th North, Lethbridge, Alta. Can.

WANTED: 160M broadband coil for CE 200 V. Bill Payette, 25 Elliott St. Morristown, N.J. 07960 8 a.m.-5 p.m.

FOR SALE: 2 KW on all band SSB xmitter. Extras. $375. Stamps for photos. Want NC-80X or NC-81X state price. Condition. L. G. Kulhay, 19 Topstone Dr. Shelter Knolls, Danbury, Conn. 06810

DONATIONS wanted for North Springs Amateur Radio Club. Need old parts, reverse, xmtrs, tubes, magazines, tech books, etc. Will you help these interested high school students get on the air. All donations will be acknowledged for tax deduction. Send these donations to North Springs Amateur Radio Club, c/o Carey Coggins, 7235 Hunters Branch Drive N.E., Atlanta, Georgia 30328

COLLECTORS: Rare German rec & tsmt. circa 1938. Tmt acts as amplifier since no tuned circuits. Frequency from rec. tuning low band marine and 550 kc to 1650 kc. Full engineers report to serious parties willing to offer multi-band transceiver even trade. I doubt there is another wet like this, this side of Germany. Bob McGwier, Box 565, Grove Hill, Ala. 36451

FOR SALE: BC-342, $75; BC312, $50. Globe chief XMTR $25. S. N. Silbert, 20066 Creston Ave., Bronx, N.Y. 10453

FOR SALE: TX-62. Mint cond. $90. Will ship. D. R. Brown, Box 361, Beulaville, N.C. 28518

SWAP OR SELL: Eico 720, Eico 730 modulator, Hallicrafters SX-99, Heath Twoer, 2 meter Vangueard Convertor, extras to complete station. Want 2 meter transceiver or 6 meter SSB xcur. Station price $250. R. Hajdak, 4 Homert Street, Greenville, Pa. 16125

FOR SALE: Collins 75A-2. $185. Johnson Viling II with VFO $95. Units in perfect condition. H. Bertan, 41 Moss La., Jericho, N.Y. 11753

FOR SALE: NCX-3 with AC supply, manuals and extra finals. HA-10 kw linear with manual and extra 866's. Local sale only $330. J. Moyer, 11 Durham Road, Ellicott City, Md. 21043

SCIENCE FICTION. Large collection for sale or trade for ham gear. Send your offer and s.a.s.e. for list to G. Lucas, 414 Durango St., El Paso, Texas 79901

RTTY BACK ISSUES wanted: all 1953 and Mar 57. Also all Florida RTTY bulletins prior to Mar. 68. J. Sheetz, 5 Hansell, Murray Hill, N.J. 07974

FOR SALE: Apache zmtr $89. Lafayette 80-6mtr rcvr and speaker, mint cond. $95 or both for $180. You pay shipping. Eugene Gascho, 1064 So. Brown Rd., Pigeon, Mich. 48755

FOR SALE: Heath tw'er mint cond. $35. with xal 145.2 Will ship or trade what have you? J. Fuqua, Rte 1, Box 11B, Anderson, Texas 77830

THE BRIGHTLEAF AMATEUR RADIO CLUB of Eastern North Carolina will appreciate any help or information in obtaining some used or surplus two-meter gear. E. Meier, Rt. 2, Box 89 A, Washington, N.C. 27889

See page 110 for New Reader Service

RECONDITIONED EQUIPMENT

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- BC-458 VFO 24
- 100V Transmitter 349
- 200V Transmitter 449
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- 22'er 2m Xcvr $169
- 66'er 6m Xcvr 169
- 99'er 6m Xcvr 69
- 418 DC sup./mod. 75
- Zeus VHF Xmtr 325
- Interceptor Rec. 325
- Interceptor B Rec. 349
- Allbander tuner 69
- 416 AC supply 75

COLLINS
- 75A-3 Receiver $269
- 75A-4 (ser. #601) 349
- 30S-1 Linear 995
- 312B-4 Sta. Cont. 149
- KWM-2 Xcvr 750
- 351D-2 Mount 75
- PM-2 AC supply 125

COMDEL
- CPS-11 75

DRAKE
- 2A Receiver $159
- 2AQ Spkr/Q-mult. 25
- 2AC Calibrator 9
- 2B Receiver 189
- 2BQ Spkr/Q-mult. 29
- 2BS Speaker 9
- 2C Receiver 175
- 2CQ Spkr/Q-mult. 34
- 2NT Transmitter 99
- TR-3 Transceiver 375
- RV-3 Remote VFO 59

EICO
- 711 Receiver $ 49
- 720 Transmitter 49
- 730 Modulator 34
- 753 SSB Xcvr 139
- 751 AC supply 49
- 221 VTVM 15

ELECTROPHYSICS
- Autronic Keyer $ 49

GLOBE/GALAXY/WRL
- SB-175 SSB Xmtr $ 59
- V-10 VFO 34
- Galaxy V Xcvr 249
- AC-35 AC supply 65
- AC-400 AC supply 75
- G-35 DC supply 75
- DAC-35 Console 75
- F-3 300 cy. filter 24
- VOX-10 9

GONSET
- Comm I 6m $ 79
- Comm III 6m 109
- Comm IV 2m 199
- GC-105 2m Xcvr 169
- 2m Linear II 89
- 6m Linear II 75
- 6m Linear III 89
- G-50 Xcvr 175
- Thin Pak 19
- G-77 Transmitter 45
- G-77A Transmitter 59
- 6m 12v converter 19
- VHF conv. (6-10-15m) 29

HALLICRAFTERS
- S-38E Receiver $ 39
- SX-71 Receiver 99
- SX-96 Receiver 119
- SX-101 Mk III Rec 149
- SX-101 Mk IIIA Rec 159
- SX-101A Receiver 199
- S-107 Receiver 59
- SX-111 Receiver 139
- SX-122 Receiver 225
- SX-140 Receiver 69
- SX-146 Receiver 199
- HT-33A Linear 275
- HT-44 Transmitter 225
- SR-150 Xcvr 299
- PS-150-120 AC sup. 75
- PS-150-12 DC sup. 39
- P-500AC supply 75
- P-500DC supply 69
- HA-6 Transverter 89
- P-26 AC supply 49
- SR-46 6m Xcvr 89

HAMMARLUND
- HQ-110 Receiver $119
- HQ-140X Receiver 99
- HQ-140XA Rec 109
- HQ-160 Receiver 189
- HQ-170C Receiver 179
- HQ-170AC (rack mt) 225
- HQ-170AC/VHF 325
- HQ-180 Receiver 239
- S-200 Speaker 15

HEATHKIT
- GC-1A Receiver $ 59
- MR-1 Receiver 49
- HR-10 Receiver 49
- SB-300 Receiver 225
- SB-301 Receiver 249
- SBA-300-3 6m conv. 19
- HS-24 Speaker 6
- QF-1 Q-multiplier 4
- MT-1 Transmitter 39
- DX-40 Transmitter 39
- DX-60 Transmitter 59
- DX-100 Transmitter 89
- TX-1 Transmitter 115
- HX-10 Transmitter 225
- HA-10 Linear 175
- HX-20 Transmitter 149
- HX-30 6m Xmtr 175
- HA-20 6m Linear 95
- HW-12 75m Xcvr 89
- HW-12A 75m Xcvr 99
- HW-32 20m Xcvr 89
- SBA-100-1 Mob. Mt. 9
- HP-14 DC supply 75
- VF-1 VFO 19
- HW-10 6m Xcvr 149
- HP-20 AC supply 29
- MP-1 DC supply 29
- UT-1 AC supply 25
- HRA-10-1 Calibrator 9
- HO-13 Hamscan 59
- T-4 Signal tracer 15

HUNTER
- 1000A Linear/sup. $175

JOHNSON
- Challenger $ 54
- 122 VFO 19
- Ranger II 139
- Valiant I 139
- SSB adaptor 175
- KW Amplifier Desk 595 (store pick-up only)
- Audio Amplifier 49
- Pacemaker 139
- Invader 200 275
- Invader 2000 549
- Thunderbolt Linear 275
- 6N2 VHF Xmtr 89
- 6N2 VFO 34
- Mob. Xmtr (AS-15) 25
- Signal Sentry 9

KNIGHT
- T-150A Xmtr $ 69
- V-44 VFO 19
- TR-108 2m Xcvr 109

LAFAYETTE
- HE-35 Transceiver $ 39

LAKESHORE
- Phasemaster II $ 89
- P-400GG Linear 99

LINEAR SYSTEMS
- LSA-3 Linear $ 75
- 500-12 DC supply 100
- 250 AC supply 49
- 350-12 DC supply 75
- 400 Century DC sup. 75

MOSLEY
- CM-1 Receiver $ 99

NATIONAL
- NC-183 Receiver $ 99
- NC-183D Receiver 139
- NC-300 Receiver 149
- XCU-50 Calibrator 9
- XCU-300 Calibrator 9
- NCX-5 Mk II Xcvr 395
- NCXA AC supply 75
- 200 Transceiver 259
- AC-200 AC supply 59
- NCL-2000 Linear 375

P & H
- LA-400C Linear $ 89

POLYTRONICS
- PC-2 2m Xcvr $199
- PC-6 6m Xcvr 149

RME
- 6900 Receiver $175

SBE
- SB1-LA Linear $159

SWAN
- SW-140 Xcvr $ 99
- 117AC AC supply 59
- 410C VFO 95
- 350 Xcvr (early) 269
- 350 Xcvr (late) 299
- SW-117C AC supply 75
- 512 DC supply 69
- 500 Transceiver 369
- 117XC AC supply 80
- 405X MARS osc. 35
- 22 VFO Adaptor 22
- 250 6m Xcvr 249
- TV-2 Transverter 249

TMC
- GPR-90 Receiver $249

TAPETONE
- XC-50N (30.5-34.5) $ 29

TEKTRONIX
- 512 Oscilloscope $275

UTICA
- 650 6m Xcvr/VFO $ 99
- 650A 6m Xcvr/VFO 109

WATERS
- 331 Dipper $ 79

WHIPPANY LABS
- "Lil Lulu" Xmtr $ 75

NEW CLOSEOUTS

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- LK-2000 (Demo) $675

DRAKE
- T-4 Reciter $225
- SC-6 Conv. (Demo) 54

EICO
- 753 Xcvr Kit $139
- 753 Xcvr Wired 189
- 751 AC Sup. Kit 54
- 752 DC Sup. Kit 54
- 752 DC Sup. Wired 89
- 720 Xmtr Kit 59
- 722 VFO Kit 34
- 730 Mod Kit 39
- 730 Mod. Wired 59
- HF-90 Tuner Kit 39
- ST-97 Tuner Kit 59
- 1050 Bat. Elim. Kit 33
- 255 AC VTVM Kit 44

HALLICRAFTERS
- SR-46 6m Xcvr $119
- HA-26 6 & 2m VFO 39
- HT-46 Xmtr 250
- HA-20 VFO SR-400 149

MOSLEY
- V-5 80-10M Vert. $ 98
- RV-4 40-10M Vert. 26
- RV-4K Roof Kit 12

NATIONAL
- 200 Xcvr $299
- AC-200 AC Sup. 65
- NCXA AC Sup. 95
- HRO-500 (Demo) 1428
- NCL-2000 (Demo) 580

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SACRIFICE: Raytheon model 1030 marine ciever $75. Lafayette HA-230. $35. Both in excl. working cond. Want SB-300, SX-117 or HQ-170C. Glenn Anderson, 1100 New Jersey Ave., Pine Beach, N.J. 08741

FOR SALE: 65 Watt novice rig. $25. H. B. Smith, 467 Park Ave., Birmingham, Mich. 48009

NOVICE STATION: Knight T-150A. 150 watt AM CW transmitter, R-100A receiver, antenna relay, many extras. Allen Reuben, 5919 Elderwood, Dallas, Texas 75230

WANT TO BUY: Amateur Radio Eqpt or Test equipment needing repairs. R. Dean Sever, P.O. Box 120 Div. 23, US Navcommsta Guam, FPO, San Fran, Cal. 96630

BTI: New factory to you. Save. Need 51S1-KWM-2A. Sell. 75S1 $300. 32S3 $400. F. L. Bsker, Box 546, McComp, Ohio 45858

WANTED: AN/ARC-58, (618-T or AN/TRC-75). compl. with R-761, R-1149, T-605, pwr supply, ant tuner, blower and C-1939. Transport can be arranged. L. Stromberg, Box 12, Bromma 1, Sweden.

WANTED: Heathkit DX-100B operating instructions and schematic. Will copy and return. A. G. Barry, 135 NW Dr., Patrick, AFB, Fla. 32975

VHF & TV-DX: 7 year old club with new format. Pictures, international column, DX reports every month. Dues $3.50. Samples 30¢ Worldwide TV-FM DX Assn. F. S. Dombrowski, P.O. Box 5001-Q, Milwaukee, Wisc. 53204

WANT: Receivers as S20R's, RME84, S40, etc. Quote lowest cash price. G. Samkofsky, 201 Eastern Parkway, Brooklyn, New York 11238

WANTED: Ham radio counselor for Berkshire coed camp. Contact: Stissing Lake Camps, 70 Straton Rd., Sir-Norm. wbedlp

WANTED: 1 K.W. R.F. Amplifier and/or P.S. 4Mcs. $100. Allen Porterfield, P.E. 41 Winnebago Rd., Yonkers, New York 10710

FOR SALE: Johnson Ranger I, perfect condition. $90. F.O.B. Bertha Swenson, Alamo, No. Dak. 58830

COLOR TV: Sub-Carrier Osc. Xtals (3569.545 KC) New, american made. 10 for $5. Money order PP G. Haymans, P.O. Box 468, Gainsville, Ga. 30501

ANY STATION who has worked OX5AP since June '66 and has no QSL and desires one, send your card with SASE or SAE and 2 IRC to IX5AP, Box 12 RCA, APO New York, 09023 for a QSL by return air mail.

FOR SALE: Clean Colin Kennedy 110 Rec., 525 Amp. with manual—$135. E. Diggins, 55 Brantwood Rd., Arlington, Mass. $2174.

WANTED: Short, long, B.C. receivers before 1930 old radio and other catalogs, books, courses. M. Hoshiko, W9CJW, 707 S. James, Carbondale, Ill. 62901.

TRADE: Heath SB 620 Scanalyzer or Heath Apache transmitter for Heath SB 630 station monitor. Louis L. Litwin, WA6ZFF, 9033 Wilshire Blvd., Beverly Hills, Calif. 90211

FOR SALE: Heathkit Seneca 2 and 6 meters. AW/CW 100 watts. Excellent condition. $120. Bob Massey, 305 Water St., Hancock, Michigan 49930

FOR SALE: Heathkit Novice transceiver 80-40-15 meter bands. 50-90 watts input. Perfect working order—$100. S. Rowler, Box 293, Williston Academy, Easthampton, Mass. 01027

WANTED: Diagram and/or manual for Johnson Adventurer transmitter. A. M. Fox, Box 895, Greeley, Colo. 80631.

FOR SALE: Eldico TR-1 300 watt transmitter with power supply. Dowkey Relay. Johnson vicing UFO Model 122. All five bands perfect $65. pick-up. S. D. Rowley, Williston Academy, Easthampton, Mass. 01027

See page 110 for New Reader Service

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- **Top Notch Service Department**

LOOK at your low Monthly Payment AFTER JUST 5^{00} DOWN

SWAN 350C 80-10m Transceiver	(14.98)	$420.00
SWAN 500C 80-10m – Deluxe	(18.59)	520.00
SWAN 250C 6m Transceiver	(14.98)	420.00
Mark II 80-10m Linear – w/tubes	(14.08)	395.00
Mark 6B 6m Linear – w/tubes	(14.08)	395.00
Power Supply for Mark II & 6B	(9.38)	265.00
TV-2 2m Transverter – specify IF	(10.47)	295.00
117XC AC Supply w/spkr. in cabinet	(3.61)	105.00
14-117 12v DC Supply w/cable	(4.51)	130.00
405X MARS Oscillator - less crystals		45.00
410C Full-Coverage VFO		115.00
210 6 Meter VFO		120.00
VX-II Plug-in VOX		35.00
22B Dual VFO Adaptor		32.00
100kc Calibrator kit for 350C		19.50
500kc Calibrator kit for 250		19.50
RC-2 Mobile Remote Control kit		40.00
45 Swantenna – manual		65.00
55 Swantenna – remote control		95.00
Custom Contour Bumper Mount		24.95
Kwik-on Antenna Connector		3.25
14C 12v DC Module/cable		65.00
14CP As above, but Positive Ground		75.00
117X Basic 117v AC supply ONLY		65.00
230X Basic 230v AC supply ONLY		75.00
117 or 230vac Line Cord (specify)		8.00
8' Cable w/plug (Supply to Transceiver)		6.00
230XC 230v AC Supply, speaker & cabinet		115.00
14-230 12v DC supply w/230v Basic		140.00
Swan Phone Patch		48.00

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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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I am interested in the following new equipment: ______

I have the following to trade: (what's your deal?) ______

Ship me the following New Equipment. ______

I enclose $______; I will pay balance (if any)

☐ COD ☐ 1 year ☐ 2 years ☐ 3 years

Name ______

Address ______

City ______

State ______ Zip ______

☐ **SEND 1968 AMATEUR CATALOG**

READER SERVICE

This Form Expires January 31st

- ☐ Aerotron
- ☐ Amateur Electronic Supply
- ☐ Arnold's Engraving
- ☐ Arrow Electronics
- ☐ Barry Electronics
- ☐ Cleveland Institute of Electronics
- ☐ Columbia Electronics
- ☐ Eimac, Division Varian Associates
- ☐ Fair Radio Sales
- ☐ Galaxy Electronics
- ☐ Goodheart, R. E. Co., Inc.
- ☐ Gordon, Herbert W. Co.
- ☐ Hafstrom Technical Products
- ☐ Heath Company
- ☐ Henry Radio Stores
- ☐ Howard Sams Co., Inc.
- ☐ Hunter Sales, Inc.
- ☐ Hy-Gain Antenna Products Co.
- ☐ Instructograph Company
- ☐ International Communications & Electronics
- ☐ International Crystal
- ☐ Joga Products
- ☐ Lampkin Laboratories
- ☐ Liberty Electronics
- ☐ Military Electronics, Space Electronic Div.
- ☐ Millen Electronics
- ☐ Mosley Electronics
- ☐ Quement Electronics
- ☐ RCA Electronics Components & Devices
- ☐ Radio Officers' Union
- ☐ Signal One
- ☐ Swan Electronics
- ☐ Telrex Communications Engineering Labs
- ☐ Texas Crystal
- ☐ Weller Electric Corp.
- ☐ WRL World Radio Laboratories

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Sirs:

Please send me information on the products and services which I have checked above.

Name .... Call ....

Street Address ....

City .... State .... Zip ....

Advertiser's Index

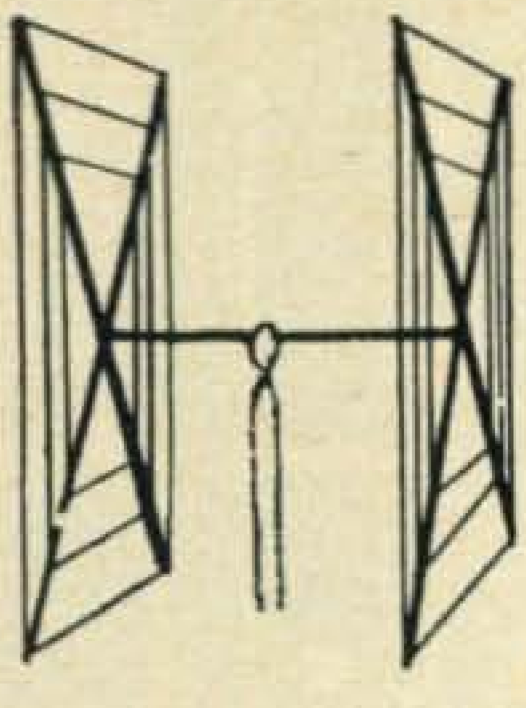
See page 110 for New Reader Service

GOTHAM ANTENNAS ARE MUCH BETTER OF COURSE, YOU PAY MUCH LESS

How did Gotham drastically cut antenna prices? Mass purchases, mass production, product specialization, and 16 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... W3



CUBICAL QUAD ANTENNAS — these two element beams have a full wavelength driven element and a reflector; the gain is equal to that of a three element beam and the directivity appears to us to be exceptional! ALL METAL (except the insulators) — absolutely no bamboo. Complete with boom, aluminum alloy spreaders; sturdy, universal-type beam mount; uses single 52 ohm coaxial feed; no stubs or matching devices needed; full instruction for the simple one-man assembly and installation are included; this is a fool-proof beam that always works with exceptional results. The cubical quad is the antenna used by the DX champs, and it will do a wonderful job for you!

10/15/20 CUBICAL QUAD SPECIFICATIONS

Antenna Designation: 10/15/20 Quad
Number of Elements: Two. A full wavelength driven element and reflector for each band.
Freq. Covered: 14-14.4 Mc. 21-21.45 Mc. 28-29.7 Mc.
Shipping Weight: 28 lbs. Net Weight: 25 lbs.
Dimensions: About 16′ square.
Power Rating: 5 KW.
Operation Mode: All
SWR: 1.05:1 at resonance
Gain: 8.1 db. over isotropic
F/B Ratio: A minimum of 17 db. F/B
Boom: 10′ long x 1¼″ O.D.; 18 gauge steel; double plated; gold color
Beam Mount: Square aluminum alloy plate incorporating four steel U-bolt assemblies. Will easily support 100 lbs. Universal polarization.

Radiating Elements: Steel wire, tempered and plated, .064″ diameter.

X Frameworks: Each framework consists of two 12′ sections of 1″ OD aluminum 'hi-strength' (Revere) tubing, with telescoping ⅞″ tubing and short section of dowel. Plated hose clamps tighten down on telescoping sections.

Radiator Terminals: Cinch-Jones two-terminal fittings

Feedline (not furnished); 52 ohm coaxial cable

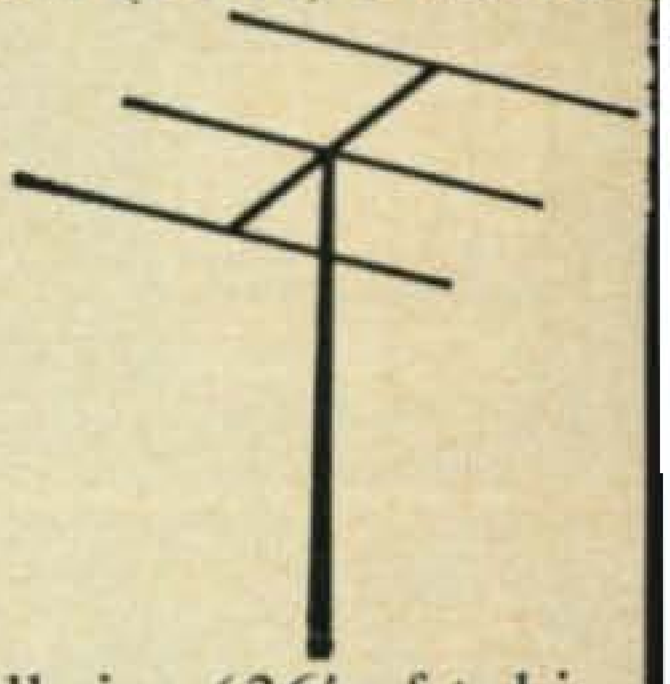
Now check these startling prices—note that they are *much lower* than even the bamboo-type:

10-15-20 CUBICAL QUAD	$35.00
10-15 CUBICAL QUAD	30.00
15-20 CUBICAL QUAD	32.00
TWENTY METER CUBICAL QUAD	25.00
FIFTEEN METER CUBICAL QUAD	24.00
TEN METER CUBICAL QUAD	23.00

(all use single coax feedline)

BEAMS

The first morning I put up my 3 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	**$19**	**4 EL 10**	**$18**
3 EL 20	**25**	**7 EL 10**	**32***
4 EL 20	**32***	**4 EL 6**	**18**
2 EL 15	**15**	**8 EL 6**	**28***
3 EL 15	**19**	**12 EL 2**	**25***
4 EL 15	**25***		
5 EL 15	**28***		

***20′ boom**

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

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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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