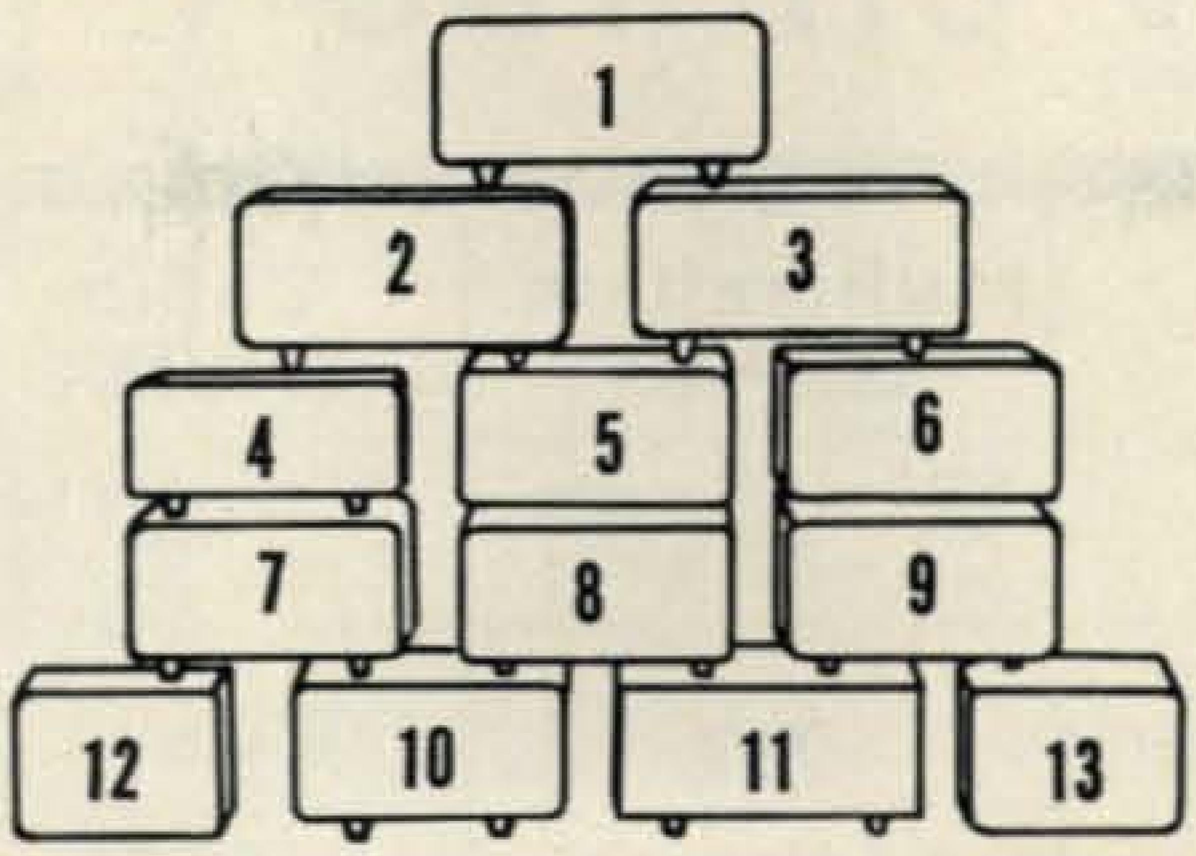

CQ
ICD
September 1968
75¢
CC Rejects
A Proposal
. Page 5
The Radio Amateur's Journal

WHO MAKES MORE TRANSCEIVERS THAN HEATH?

NOBODY

(any way you look at it)

There Are 13 To Choose From



The SB-101 — the transceiver everyone wants and thousands already have. 180 watts input PEP on USB/LSB, 170 watts input on CW. Operates hru 10. PTT or VOX. Linear tuning with 1 kHz dial calibration & virtually no backlash — ideal for crowded nitetime bands. Front panel switch ction of either the standard USB/LSB 2.1 kHz SSB filter (2:1 shape factor) or the optional 400 Hz CW filter. The amazing versatility of the SB-101 be extended even further with the optional SB-640 LMO. Get on the air with the best — get the Heathkit SB-101.
B-101, 23 lbs. **$370.00**

The SB-110A — the "no compromise" 6 meter rig. 180 watts PEP /LSB input, 150 watts CW input. 1 kHz dial calibration. Famous h LMO. PTT or VOX control. Same crystal lattice filter as SB-101. t-in 100 kHz calibrator. Switch select either crystal controlled trans- er or crystal controlled transmit with variable tuning receive-CW or s-mode. Go six meters for less, and still get the best — go Heathkit 110A.
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The HW-100 — Heathkit's newest 5 band transceiver and second to the SB-101 in performance and value. Work 80 thru 10 meters; watts input PEP SSB, 170 watts input CW. High quality crystal lattice r. Built-in 100 kHz calibrator. Patented Harmonic Drive™ dial mech- m. Solid-state (FET) VFO. PTT or VOX. Triple Action Level Control. e friends & influence people — buy the HW-100.
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The HW-17 — the better way to go All Solid-state 2 meter AM for Perfect for local rag chews, nets & DX, as well as CAP, MARS & Auxiliary. 25-30 watts input. Solid-state, dual-conversion receiver. built, pre-aligned FET tuner. Four crystal sockets plus provision external VFO. Battery-saver switch & built-in speaker — well suited rugged mobile work. Overwhelm your friends on 2 with the HW-17.
HW-17, 17 lbs. **$129.00**

The HW-18-1 — the only way to go! This CAP SSB rig is inexpensive effective. Covers 4450 to 4650 kHz and provides 200 watts PEP input USB; 25 watts input with carrier for compatibility with AM stations. stal filter sideband generation. 1 uV sensitivity; 2.7 kHz selectivity. ystal-controlled channels, switch selected. PTT mike and mobile nt included.
HW-18-1, 15 lbs. ... $119.95; **wired HWW-18-1,** 15 lbs. **$179.95**

The HW-18-2 — A 4450 to 4650 kHz MARS transceiver at a fraction e cost you've had to pay before. 200 watts input on either USB or (you specify); 25 watts input with carrier. Fixed tuned for simple operation. Crystal filter IF for high selectivity. Switch select either e two crystal controlled channels. ALC holds output constant under ing voice levels. Complete with PTT & mobile mount. Get fast, cient MARS communication with the HW-18-2.
HW-18-2, 15 lbs. **$109.95**

The HW-18-3 — Good news on 160 M rigs, OM!! 200 watts input LSB; 25 watts input with carrier. Just select either of two crystal rolled channels and push-to-talk — what could be easier! One rovolt sensitivity and 2.1 kHz selectivity. Relayless transmit/receive ching. Automatic Level Control. Easy construction, fast alignment. you on 160 with the HW-18-3.
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8. The HW-22A — the famous Heathkit 40 Meter Single Bander. 200 watts PEP input on either USB or LSB. Choice of power supplies for fixed or mobile operation. Front panel mike input, gain control & bias adjustment for easy change over. Slow AVC action for ideal SSB reception. 1 uV sensitivity, 2.7 kHz selectivity. Temperature compensated VFO. High quality crystal lattice filter.
kit HW-22A, 15 lbs. **$104.95**

9. The HW-32A — the world's best 20 Meter Single Bander. Operates either USB or LSB — 200 watts PEP input. ALC input for use with external linear. Run fixed or mobile, using either of the two accessory power supplies. Change over is easy, thanks to the front panel mounted mike input, bias adjustment & gain control. Built-in S-meter, PTT, VOX and ALC. Your best buy on 20.
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10. The HW-12A — The popular Heathkit 80 Meter Single Bander. The world's best 80 meter value by far. 200 watts input on USB or LSB. Ten-tube superhet receiver with 1 uV sensitivity, 2.7 kHz selectivity and slow AVC action for superior sideband reception. Operates PTT or VOX. Built-in S-meter and ALC. Easy to change from fixed to mobile. Is there a better buy on 80? Not at this price.
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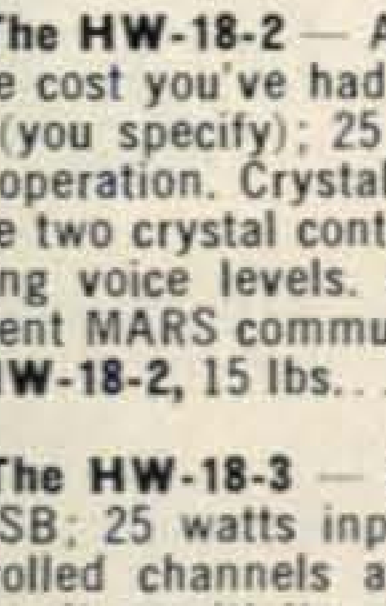
12. The HW-29A — One of the very popular "Benton Harbor Lunch Boxes" — this one for six meters. There's a lot of action in this little package. The crystal controlled AM transmitter has a husky 5 watt input — ideal for local nets, CAP or MARS operations. The tunable super-regenerative receiver with RF stage has 1 uV sensitivity. Get on 6 with the HW-29A.
kit HW-29A, 9 lbs. **$44.95**

13. The HW-30 — The other "Benton Harbor Lunch Box", 2 meter transceiver. Interested in VHF? There's no better way to begin than with this one. Features 5 watt input to the AM transmitter and 1 uV receiver sensitivity. Comes complete with ceramic mike, meter jack and power cables for mobile operation. Can operate on USCG Auxiliary freq. of 143.28 MHz.
kit HW-30, 9 lbs. **$44.95**



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FEATURE	Hallicrafters SR-400	Collins* KWM-2	Drake* TR-4
Power Input	SSB=400 watts CW=360 watts	SSB=175 watts CW=160 watts	SSB=300 watts CW=260 watts
Accessory "dual receive" VFO available	**Yes**	No	No
Noise Blanker	**Yes**	$135.00 Accessory	No
Receiver Incremental Tuning	**Yes**	No	No
Built-in notch Filter	**Yes**	No	No
Sharp CW Filter	**Yes** 200 cycles	No	No
Sensitivity	.3 uv for 10 db S/N	.5 uv for 10 db S/N	.5 uv for 10 db S/N
1 kHz dial readout	**Yes**	Yes	No
Carrier Suppression	60 db	50 db	50 db
Unit Price	**$799.95**	**$1,150.00**	**$599.95**

*Data from published specifications.

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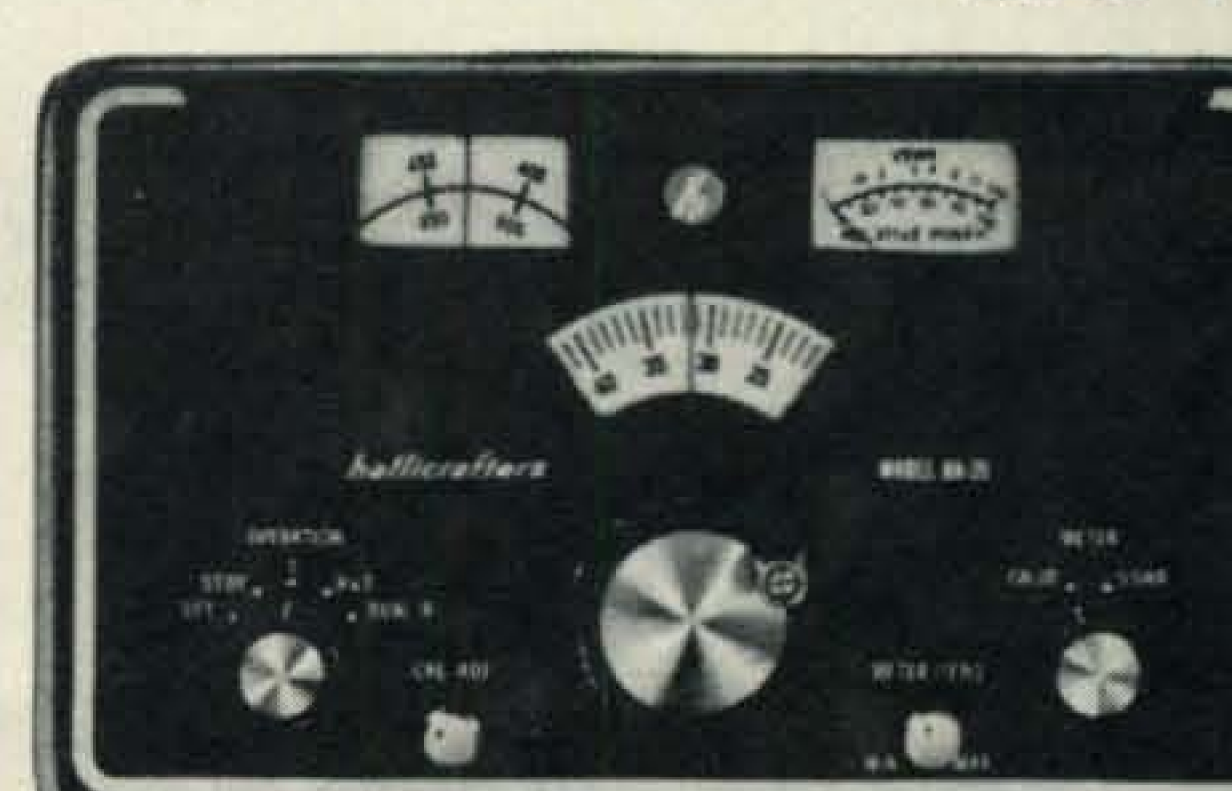

Export: International Dept. *Canada:* Gould Sales Co.

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The Radio Amateur's Journal

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There must be some very good reasons why Swan has become the leading manufacturer of transceivers for the amateur radio service. One of the most important reasons is our dedication to the principles of Value Analysis.

Value Analysis is the process of examining a product to find ways of improving its performance, reducing costs, or whatever can be done to make the product a better value to the buyer. It is surprising how often this leads to greater simplicity, improved reliability, and overall consumer satisfaction.

At Swan our engineering department is constantly applying these principles in an intensive search for improvements in our products. The 500C transceiver is an outstanding example of the results. It combines all the features you require in a complete SSB-AM-CW transceiver with performance, quality, and reliability second to none. Yet the price is substantially less than competitive gear. There's really no secret or mystery about this. We believe that the 500C is the most completely "Value Engineered" transceiver on the market, and this is why we are in the lead. Visit your Swan dealer soon, and see for yourself.

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SWAN SPEAKS YOUR LANGUAGE

ASK THE HAM WHO OWNS ONE

ZERO BIAS

In our May editorial we reported that the mateur Radio Section of the Electronic In-ustries Association (EIA) had petitioned the 'CC for rule changes relaxing the require-ents for obtaining a Novice Class amateur adio license, broadening operating privileges nd making the new Novice license term five ears (renewable). That editorial reflected our hinking on the subject, which, briefly, was ot favorable. We concurred with only one of IA's suggestions; that former holders of mateur licenses be permitted to apply for the Novice ticket.

Apparently, the thinking of the FCC paral-eled ours, for in Docket 18266, released July 6, 1968, the Commission denied all but one f the five EIA proposals. However, the FCC, oo, found merit in the EIA proposal that the Novice be made available to previous license olders, for they have developed a similar roposal which makes a lot of sense. Quoting Docket 18266, "...the Commission proposes o amend its rules to permit any eligible erson to obtain a Novice Class license pro-ided that he has not held a Commission-ssued license within the 12 months prior to is application. The twelve-month gap is ntended to obviate any element of routine enewal. No person would be permitted to old Novice and Technician Class licenses oncurrently."

We wholeheartedly support this proposal.

*　*　*　*　*

The EIA proposals were made in good faith y men of good intentions, interested in the reservation and development of amateur adio in the United States. These men view with alarm the diminishing growth rate of the obby, and being businessmen, the associated decline in the dollar volume of the amateur adio business. Their alarm is neither selfish or unwarranted, but we feel that the direc-ion their possible solutions are taking is wrong. The men of EIA are of the opinion hat the way to expand the amateur service is o reduce its standards to the barest mini-mum. We feel differently.

It is our opinion that the way to greater mateur radio growth is through mass-media ublic relations efforts and through a re-vitalization of the "challenge" of amateur radio. Today's youngsters are not stupid, nor are they lazy. They are instead fact-oriented, science-oriented, and quick to accept a challenge, be it in sports, politics, sociology or academic work. It is an insult to their character to assume that the only thing detering them from engaging in amateur radio is that the requirements are too stiff!

No, don't start there. Start within the hobby to erase some of the antiquity, the traditional stodginess, and inject a modern touch of excitment and challenge. Amateur radio *can* be "where the action is," perhaps not to the surfer or the skier, but certainly to millions of other young people. Once you've created the appeal, sell it, and *not within amateur radio*. Sell it to the public, through the teenage magazines, through radio and TV, and yes, even through *Playboy*.

Amateur radio can flourish with proper nourishment. Let's work to cultivate it, not bury it.

Our Covers

We've been rather negligent these past few months regarding *CQ* cover photo credits. It's been more a matter of finding room here on page 5 than not wanting to give due credit. To catch up a little on recent covers, the July "Sunset" cover photo was taken by W1BIH, part of the PJ3CC DXpedition by six top notch American DXers and contesters: W3GRF, W1TX, W4GF, W1FJJ, W4KFC and W1BIH. The "expedition" to a resort hotel in Curacao for the C.W. portion of the 1967 *CQ* W.W. DX Contest resulted in a 5,000,000 point score, a beautiful cover photo and a soon-to-be-published account of how it was done. Incidentally, the silhouette on that cover belongs to W4KFC.

The August cover turned out to be a conversation piece, not so much because of the pretty girl or the SST Series, but rather because of the green complexion our printer chose to impart on her. Terribly sorry Norma; next time we'll be sure the photo does you justice.

This month's cover depicts a mammoth California-style antenna system: a four-element wide-spaced 40-meter beam on a 140-foot boom, 100 feet in the air, atop a 7,000-foot mountain! Photographer Milton Mann, W9PRH, chooses not to identify the owner or the brave soul clinging for dear life to the tower, but it makes for an eye-catching cover, just the same.

73, Dick K2MGA

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One reason why your amplifier may be unstable...

by Jack Quinn, W6MJG

me hams dropped in the other day and we t to talking about dynatron oscillation and at effect it has when you are trying to bilize an amplifier. We agreed that it is a mmon form of self-oscillation; most of us ve experienced its effect as noise interferce, or distortion on a carrier—even unnted side bands. We agreed that it produces ermal strain on elements. But some hams dn't know that the voltages can get quite gh and can reduce the tube life. In a runay condition, the tube can be destroyed.

We said that dynatron oscillation is caused en any electrode in a vacuum tube has gative resistance. But how this is caused asn't clear to everyone. And perhaps, more portant, what can be done to eliminate it. you were to look inside a tetrode, you uld see some electrons flowing from the thode to the plate hitting the screen grid. is collision would knock loose low energy ectrons which are callėd secondary elecons. Most of them return to the screen grid cause of the relatively low screen-to-plate tential. If they try to get very far from the reen, the plate will attract them. The result an uncontrolled electron flow from the reen to plate. This is secondary emission. nd during part of the operating cycle of the be it is possible that more electrons will leave the screen grid than will arrive. Thus causing dynatron oscillation and possibly a runaway condition.

Now that we had a better understanding of how this oscillation occurs, we began to come up with suggestions of how to eliminate it. One ham suggested that we change the operating line so it doesn't pass through the tube's negative resistance region. In this way, the oscillation would never have a chance to get started. I suggested that we reduce the alternating current impedance in the screen grid circuit so that the voltage could not be developed across it. A very large capacitor across the screen grid power supply (say up to 1000 microfarads) should work well.

Why don't you let me know if you have had this problem—and solved it in another way? I'm always glad to get into discussions like this. I think we all learn a little more.

Jack Quinn
Division Marketing Manager

Eimac

Division of Varian
San Carlos, California 94070

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OUR READERS SAY

What's It All About?

Editor, *CQ*:

I am a fairly new licensed amateur as far as dates go, but both my parents have held tickets for quite a number of years. I will soon be 16 years of age. My General ticket was issued in July, 1967. I have gotten my Advanced now. How often have I wished that I could go to Chicago and take the big step! I cannot. Alas, there is a law stating that a person must have held a General class license or higher for two years before he can apply for the Extra Class license. As the reader may figure out, I've still got a whole year left.

Then it happened. Many rules were changed and some were added. The FCC says, we need to improve our knowledge. Like the good little amateurs which we are, we try. But there is something across the road to improvement. So we run into this silly rule again. Why? Does the FCC actually think this helps?

Let us look at it from a different standpoint. What do the two years do for us? Do they *really* make us better operators? I don't think it is the years which count. It is my opinion that the fact of the matter is that just the knowledge makes us more skilled. But what reason do we have for obtaining this knowledge if it cannot do something for us? The reason is the Amateur Extra Class license. But we must wait two years. I ask everyone. Just what *is* this waiting period for?

Scott Blystone, WA9UNF
La Porte, Indiana

Can You Help?

Editor, *CQ*:

Will you be kind enough to help me locate any amateur who because of cancer has lost his voice box and has become a larynege tomee.

I would like to arrange radio skeds wit him so that we might be able to improve ou esophageal speech and if they cannot talk then we can use c.w.

Thank you for any help you can give me. remain,

Al St.Germain, W6FCE
Sonoma, California

"OUR READERS SAY" welcomes letters about nearly anything of interest to amateurs, whether about *CQ* itself, the state of the hobby, or whatever else you have on your mind. The most interesting letters will be selected for publication each month; just keep them legible, keep them short, and above all, keep them clean! Something bothering you. We're not mind readers, OM, so drop us a line.

Operating in Japan

Dear Dick:

I can give a partial answer to the reques from K9ZXI for information about a licens in Japan (July *CQ*, Letters Column). I jus returned two days ago from extended servic (non-military) in Japan.

First, only Japanese citizens can be li censed. Non-citizens may join Radio Club and may operate club stations (there ar specific rules about the percentage of foreig members, etc.) provided they have passe the standard Amateur Operator's test ad ministered by the government. (To the bes of my knowledge, study material and tes both are available only in Japanese.) No non Japanese can establish an individual station

Second, not all Japanese clubs would welcome outsiders who don't speak Japa nese. Some would. I suggest K9ZXI contact J.A.R.L. Headquarters or some of the Staff of *CQ Ham Radio*, the J.A.R.L. Magazine (on most Japanese magazine stands) for further leads.

Third, the U.S. Embassy in Tokyo told me it is willing to negotiate a reciprocity agreement, but Japan's radio law will have to be amended to permit this. A major revision of the Radio law has been drafted, but more pressing business has kept it from Diet consideration.

In the light of the above, I went QRT. Unless K9ZXI is more successful than I was in contacting a local club, I hope he will make the best of his military club connections.

Hope this will help some.

Don Kirkman, WA6ENG
Berkley, California

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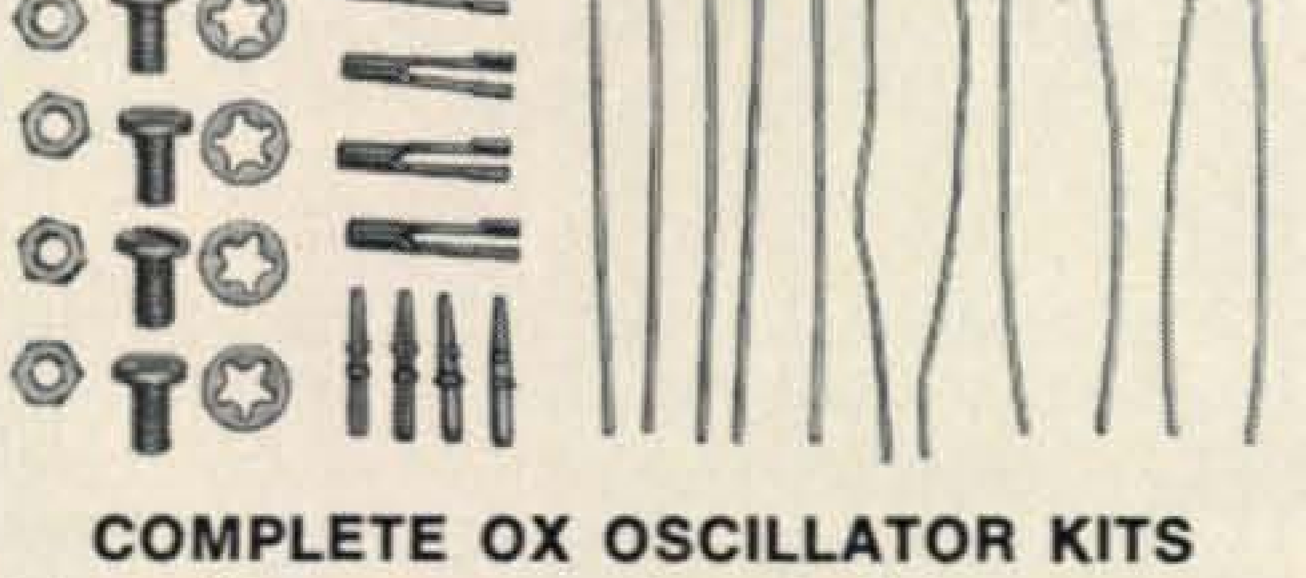

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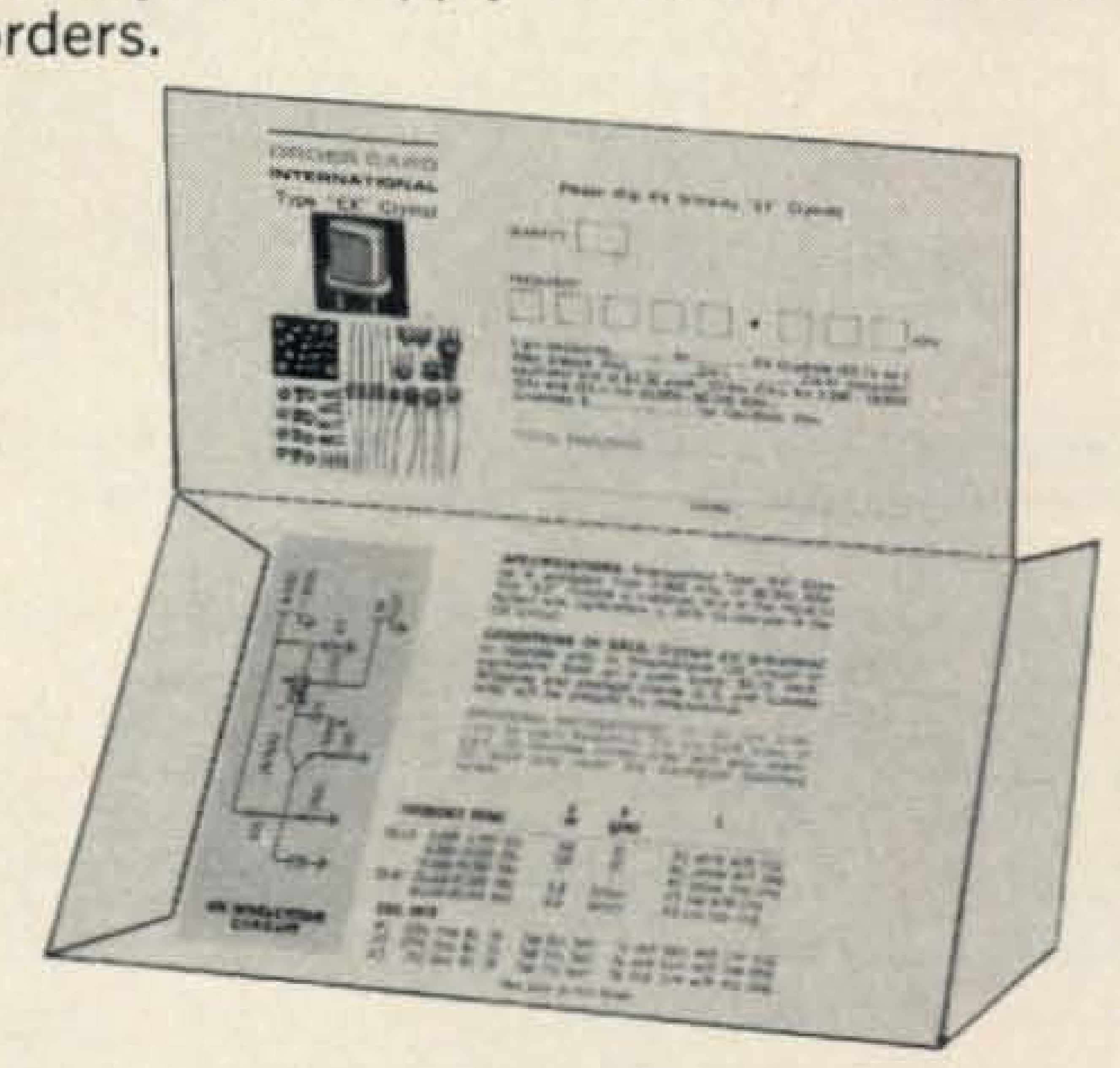

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Announcements

Walla Walla, Washington

The Walla Walla Valley A.R.C will hold its 2 Annual all-family Hamfest on September 22 Jefferson Park in Walla Walla. Registration 9 A.M. on is FREE. For more information contact Stewart, W7GVC, 1404 Ruth Avenue, Walla W Washington 99362.

Schiller Park, Illinois

The 15th Annual W9DXCC program will be h September 14, 1968, at the Ramada Inn-O'H 3939 N. Mannheim, Schiller Park, Ill. Overni rates at the Ramada are $14.00 (single) and $18 (double). The charge for the meeting and banqu $6.00 per person.

Greensboro, North Carolina

The Greensboro Radio Club will host the 1 Roanoke Division ARRL Convention which will held at the Statler Hilton, Greensboro, N.C., September 28th and 29th.

McChord AFB, Washington

The Puget Sound Council of Amateur Radio Cl will issue a Washington State Operating Achie ment Award during 1968 Washington State Amat Radio Week. The certificate will be signed by Gov nor Daniel J. Evans. Out-of-state amateurs m contact 10 Washington State hams, and Washing State amateurs must contact 20 other Washing State hams during the period of September 1st t September 8th. Send list of stations worked, da and QTH's to the Puget Sound Council of Amat Radio Clubs, Drawer A., McChord AFB, Washingt 98438.

Cincinnati, Ohio

The 31st Annual STAG Hamfest sponsored by Greater Cincinnati Amateur Radio Association w be held on Sunday, September 22nd, 1968, at Sti er's Grove on Compton Road, Mt. Healthy, Cinc nati, Ohio.

Farmington, New Mexico

The Totah Amateur Radio Club, Inc., announ their 4-Corners field day held annually at t 4-corners monument. The dates are September and 22. Bands worked will be 15, 20, 40 and 80 s.s.b. and c.w. The club will send out "5 Ø 7" awa for working this point. Club station call is K5W

Peoria, Illinois

The Peoria Area ARC will hold its 11th Ann Hamfest, Sunday, September 15, 1968 at Expo tion Gardens, Peoria, Illinois. Advance registration $1.50; $2.00 at the gate. For further details writ W9DHE, 419 Stonegate Road, Peoria, Illin 61614.

New Kensington, Pennsylvania

The Skyview Radio Society will hold its 6 Annual Swap and Shop on September 15, 1968. T Club grounds are located 6 miles east of New Ke sington, Pennsylvania on Route 366. Time, 12:

[*Continued on page 128*]

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Model MCQ-10 for 10 meters
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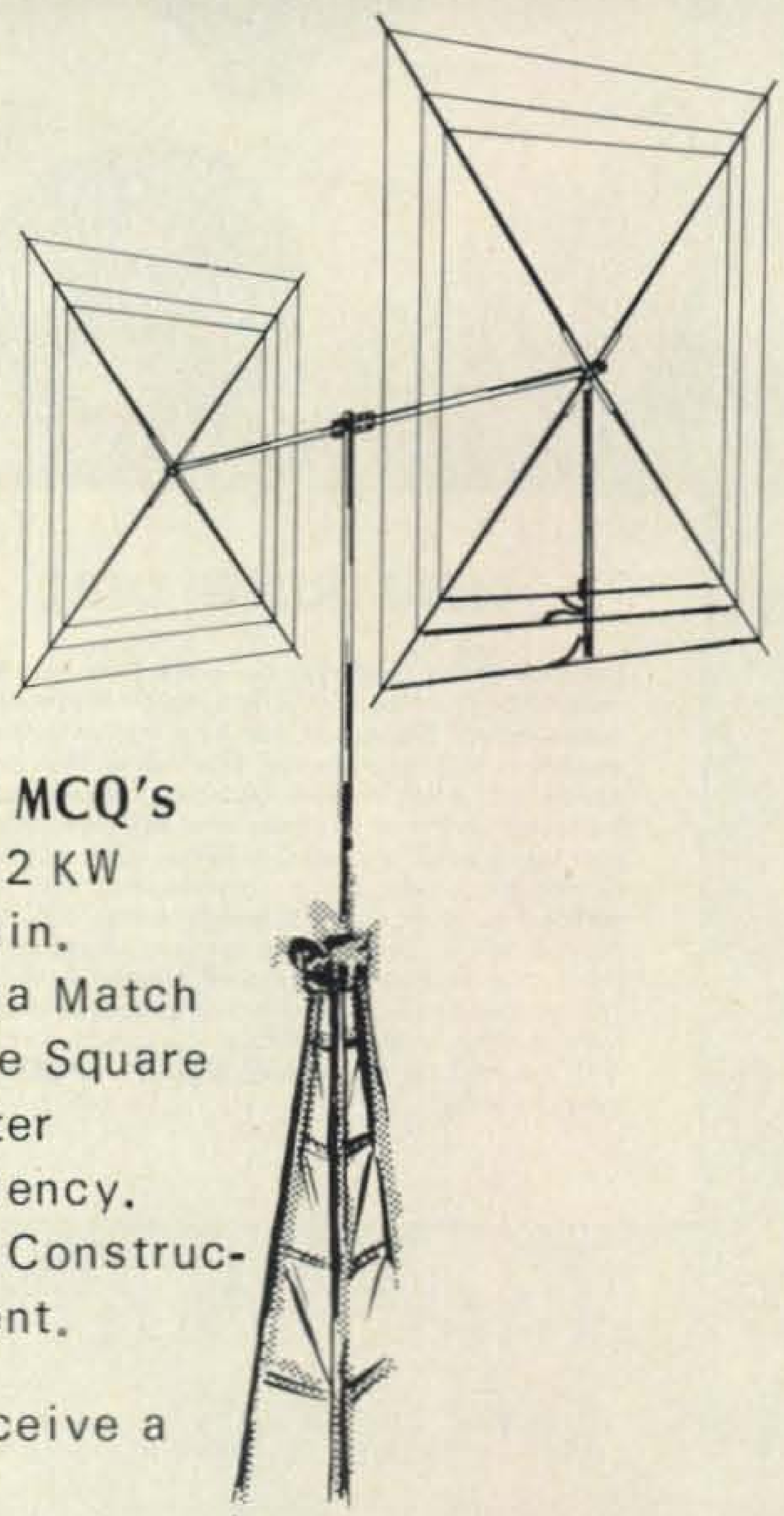

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Nowhere, Ariz.

Deer Hon Ed:

Boy oh boy are Scratchi in deep trubble. Don't try to writing me at above address on acct. I no place any mail can reaching me. Infackly, are in hiding until hole affair blowing over and Hon. FBI losing my trail.

You are not going to buleeving what happening, and, funny thing, I not reely sure how things are happening, although having sneeky idea how. I know you reeding about it in the Hon. Newspapers.

It all very innocent. I reeding in some tecknical journal how single wire in free space acting like peechy xmission line at high freakwencies, so desiding to try out idea, being 1/c tecknical geenyus myself, as you knowing.

Figyouring best way to finding free space is up in air, so desiding to flying kite using wire, with antenna mounted on kite. Having strong winds this time of yeer, so I making kite out of some reel thin aluminum I having. Making also small antenna so it connected to single wire so can using wire both as xmission line and also to flying kite with.

For xmitter I digging in Hon. Junk Box and finding old war surplus high freakwency rig of some sort. Not knowing exact freakwency, but it up high in gigahertz range.

Before running any reel technical tests I figyouring at first I just putting kite up in air and see if I can making antenna take any power from xmitter. So, first day I getting reel peechy wind, I take kite outside, drive along slowly in Hon. Jeep, and managing to getting kite airborn in no times.

Letting out about a mile of wire, and kite almost out of sight. I fastening wire to post outside Hon. Shack, running wire in thru window, connecting it to the xmitter, and firing everything up.

Making few adjustments, and first thing I knowing, are getting good coupling and

See page 134 for New Reader Service

xmission line taking power like blotter taking ink. For next half hour I diddling and tuning, and tuning and diddling, until everything in lash-up are hunky-dunky.

I sitting back, lighting up cigar, and feeling reel pleased with myself, when Hon. Brother Itchi bursting in shack and telling me to come and take a look at what are on tee-v set, as something funny are happening. I running in, and screen are all kinda funny smears, but can heering somebody on audio which sounding like speech from Cuban bigwig Castro.

One broadcaster saying rumors are about that invayshun of west coast are imminent, and military are thinking of having 1/c red alert. Hokendoke Hackensaki but this are exciting!! Lots and lots of people are in high dungeon about it!

On tee-v all you can heering is talk, talk, talk in Spanish. It sounding something like program I listening to in shack when Itchi are bursting in. The more I thinking about it, the more I thinking I better checking, so going into shack and listening. Sure enough, getting same program on short-wave reseever that are heering on tee-v set. I originally turning it on so can practising up on my Spanish while diddling with tuning up surplus xmitter.

Howsumever, nagging thought keep bothering me, and I thinking of saying that my Hon. Ant Fuji always saying, which are . . . if all else fails, try something else. So, just to making sure, I turning off short-wave reseever and rushing into living room. Hockendoke and Double Hokendoke!!—not heering anything on tee-v.

Quicklike rushing to shack, turning on reseever, running back to living room. Hon. Castro on again. Well, not needing two-tons Max truck to running over me, no indeedy. I knowing when I in deep trubble.

So, grabbing side-cutters, running outside, snipping antenna wire, running inside, grabbing some food from Hon. Ice Box, getting outside again, leaping into Jeep, and making like sixty for the foothills.

I've been in cave up here for two days, and are figyouring out, I thinking, how things happening. Evidently kite are accidently getting smack-dab in line of microwave link which Hon. Ma Bell using to send network tee-v programs to Feenix and west coast. Being of metal, kite blocking out regu-

[*Continued on page 117*]

Hy-Gain announces The Quad to make all other Quads obsolete!

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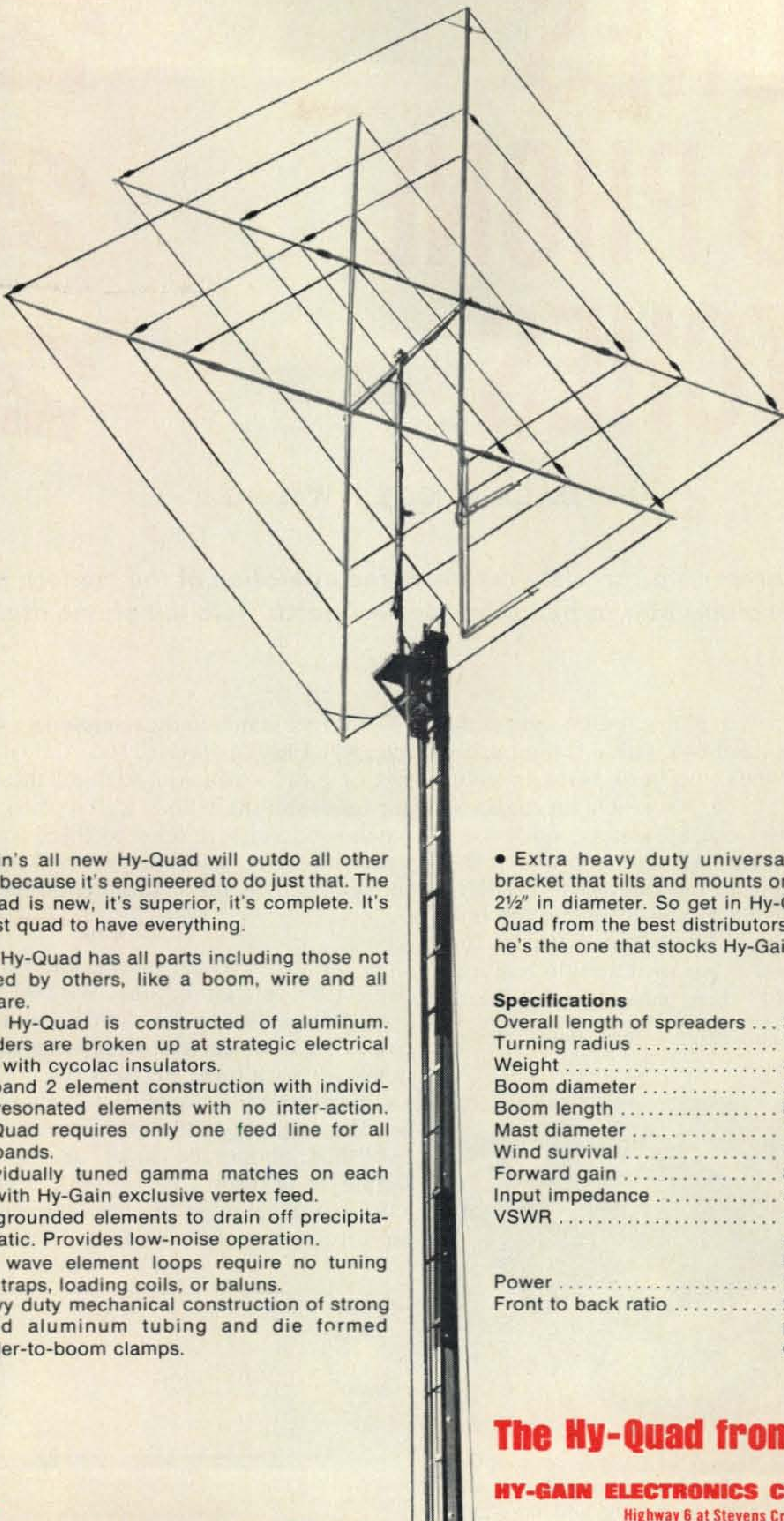

Hy-Gain's all new Hy-Quad will outdo all other quads because it's engineered to do just that. The Hy-Quad is new, it's superior, it's complete. It's the first quad to have everything.

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Overall length of spreaders	305"
Turning radius	13'6"
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Boom diameter	2"
Boom length	8'
Mast diameter	1¼" to 2½"
Wind survival	100 mph
Forward gain	8.5 db
Input impedance	52 ohms
VSWR	1.2:1 or better at resonance on all bands.
Power	Maximum legal
Front to back ratio	25-35 db depending upon electrical height

The Hy-Quad from Hy-Gain

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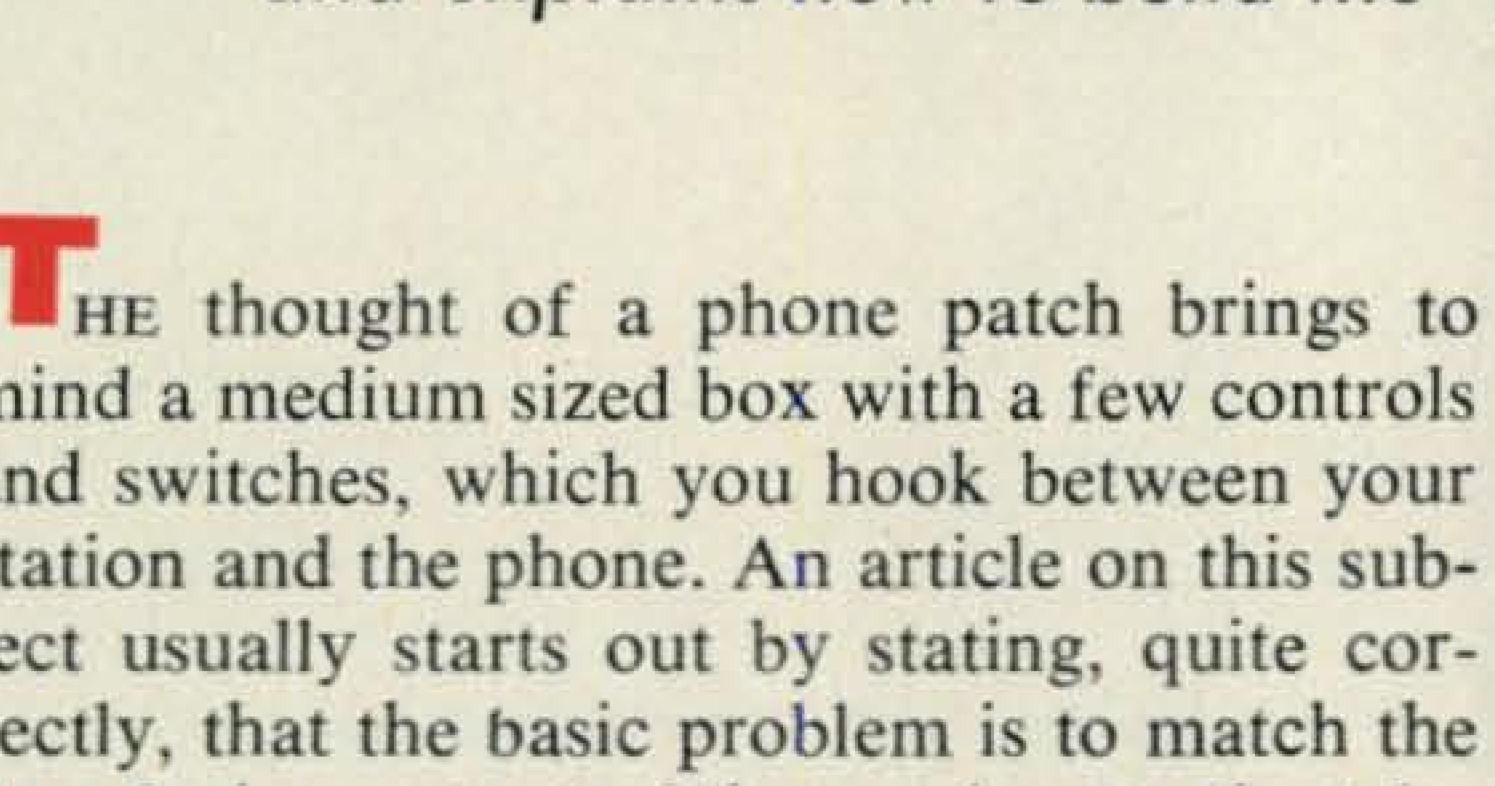
PHONES AND PHONE PATCHES

BY DALE E. COY,* W5LHG

The author presents a complete review of the operation of the modern phone and explains how to build the "perfect patch" into the phone itself.

THE thought of a phone patch brings to mind a medium sized box with a few controls and switches, which you hook between your station and the phone. An article on this subject usually starts out by stating, quite correctly, that the basic problem is to match the 4 or 8 ohm output of the receiver to the telephone line impedance, and to match the line to the much higher input impedance of the transmitter input. A list of desirable features then follows: (1) Low cost, (2) No hum,

* 3322 49th Loop, Sandia Base, New Mexico 87116.



A sampling of the phones which may be modified into Phoney patches. The three larger phones are, from *l* to *r*, W.E.564HL, and 518, and the Automatic Electric 802. In front is the W.E.701 Princess.

(3) Perfect match to the telephone, (4) Smal size, (5) Easy operation, (6) Ability to wor vox or p.t.t.,—*etc.* Although all these point are valid, and the articles well written, and th patches do work, I refer to them as "phon patches." They ignore a piece of equipmen so familiar it is often forgotten—the phone

The Land Line

In our haste to get on the air, we tend t neglect the lowly land line. We feel that an good technician (and certainly any amateur could build a perfect telephone in a fe hours of spare time. Perhaps for this reason and perhaps for reasons best known to Western Electric, very little information has bee published about the inner secrets of thi simple component. Yet countless engineer have spent years in its development. There are lessons here for all of us. In this article,

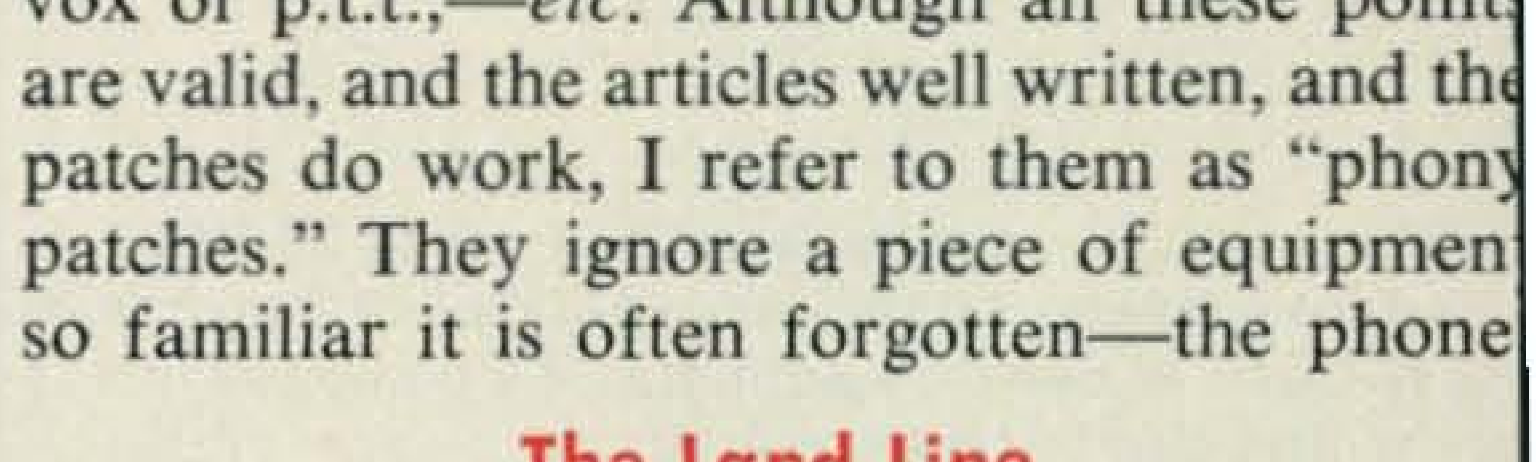


Fig. 1—Basic circuit of an early telephone.

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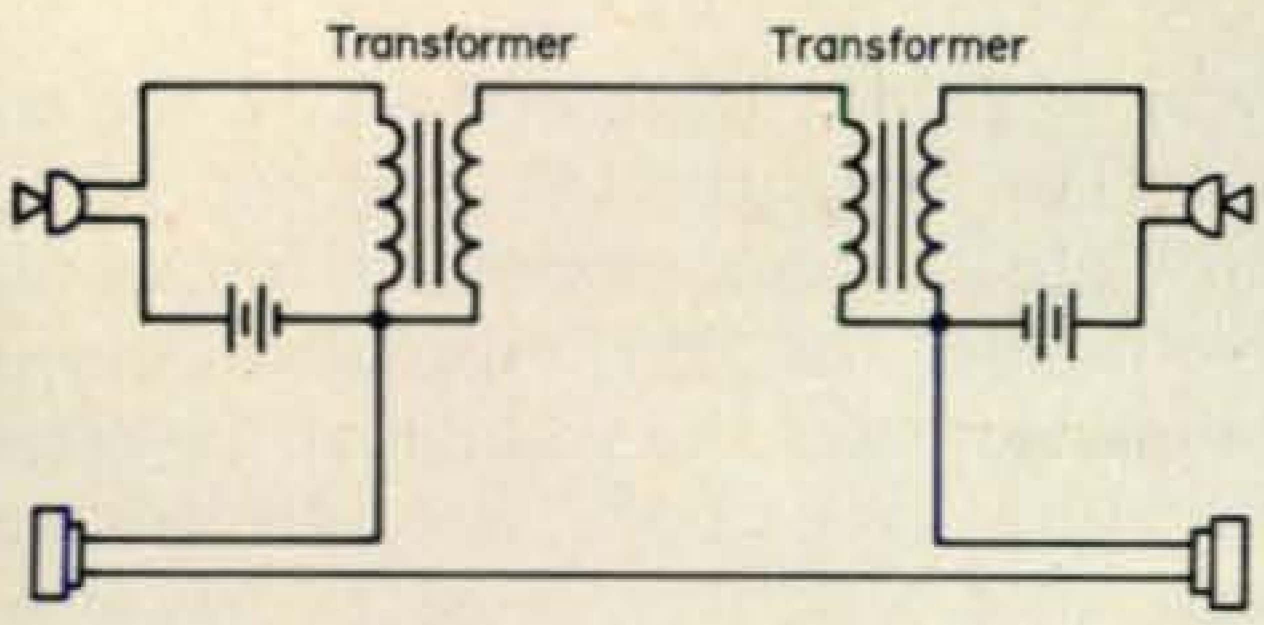

Fig. 2—Addition of transformers to the basic circuit of fig. 1 lowers the resistance in the talking loop.

two subjects will be explored. First, the talents of the telephone; and second (yes, me too, fellows) how to use these talents to make your own "Phoney patch."

A very early telephone circuit might have appeared as shown in fig. 1. The microphones, as in modern telephones, consist of cups of carbon granules which vary in resistance as they are moved about by sound waves. They may be considered as small value variable resistances. The receivers move a diaphragm in response to changing current. Most use the moving-metal-plate method, similar to inexpensive earphones. Although many advances have been made in the details of construction, these components appear in most modern telephones. The circuit, however, has many faults. The most basic of these is the high loop resistance, which results in low voice current because the *percentage* variation in resistance which is contributed by the microphones is so small.

Taking a giant step, we could redesign the circuit as illustrated in fig. 2.

The resistance in the "talking circuit" is thus greatly reduced, and only the signal appears in the receiver. The d.c. present in the receiver caused problems in the preceding circuit. It is possible to reduce the "talking loop" resistance even more by the method

The reactors shown have very low d.c. resistance, and a high impedance to voice frequencies. The d.c. flows *separately* through each phone, allowing large a.c. voice frequency currents which then flow through both phones in the loop, providing signals in both receivers.

Since we have arrived at the method used today for connecting two or more phones, and for supplying battery power, we may eliminate the second phone and discuss only one instrument. Let's take a look at what we have in fig. 4. In this circuit, the transformer has been connected as an auto-transformer. A resistor has been added to control the problem of "sidetone." The voice

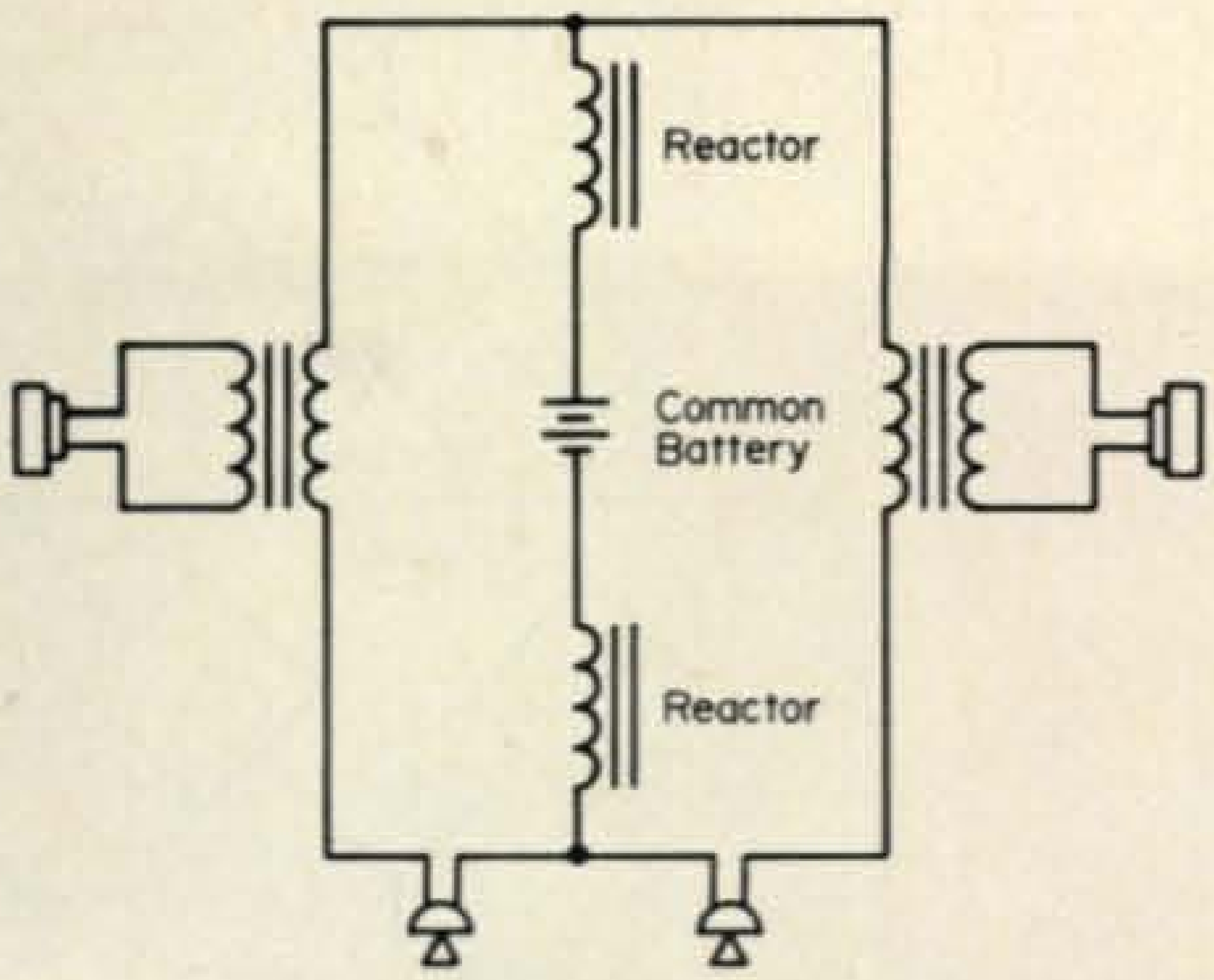

Fig. 3—The addition of two reactances permits the use of a single battery that can be located in a central office.

signal appears in the receiver of each phone. This signal, in the receiver at the phone which is transmitting, is called sidetone. Experiments have shown that the speaker will lower his voice if the sidetone is too high. However, some sidetone is desirable. In this circuit, by controlling the resistance, we can control the amount of sidetone. Unfortunately, high resistance also means less volume when signals are received from another phone. Back to the drawing board for the circuit of fig. 5.

Bridge Circuit

Figure 5 is a basic a.c. Wheatstone bridge. You will recall that when the ratio of impedances Z_1/Z_2 is equal to Z_3/Z_4, the bridge is balanced. The a.c. voltage at points *A* and *B* is always equal, and no signal appears in the receiver. To get back to the subject, we can replace the a.c. generator by a carbon microphone, and Z_4 by a telephone line of equal impedance, for the results shown in fig. 6.

This bridge is balanced if $Z_{(line)}$ is equal to the old Z_4. In practice, this means that the length of the telephone line will affect the balance, as will other factors. It is also true that the bridge will probably be balanced for

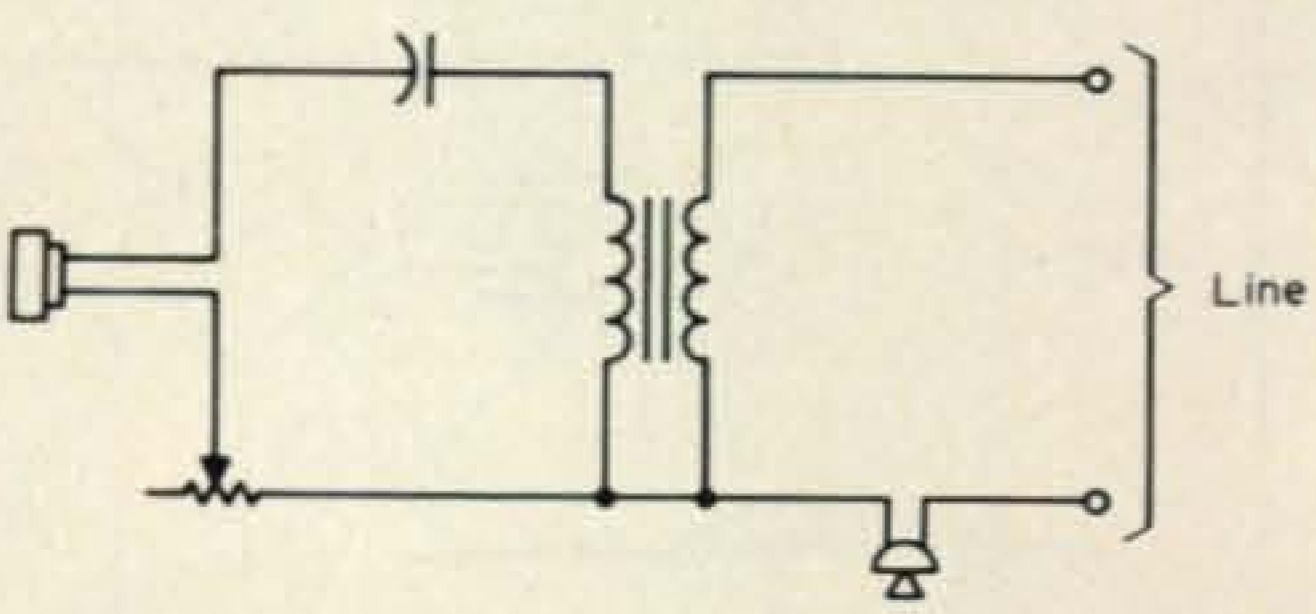

Fig. 4—Circuit of a single telephone. The variable resistance is used to reduce the sidetone.

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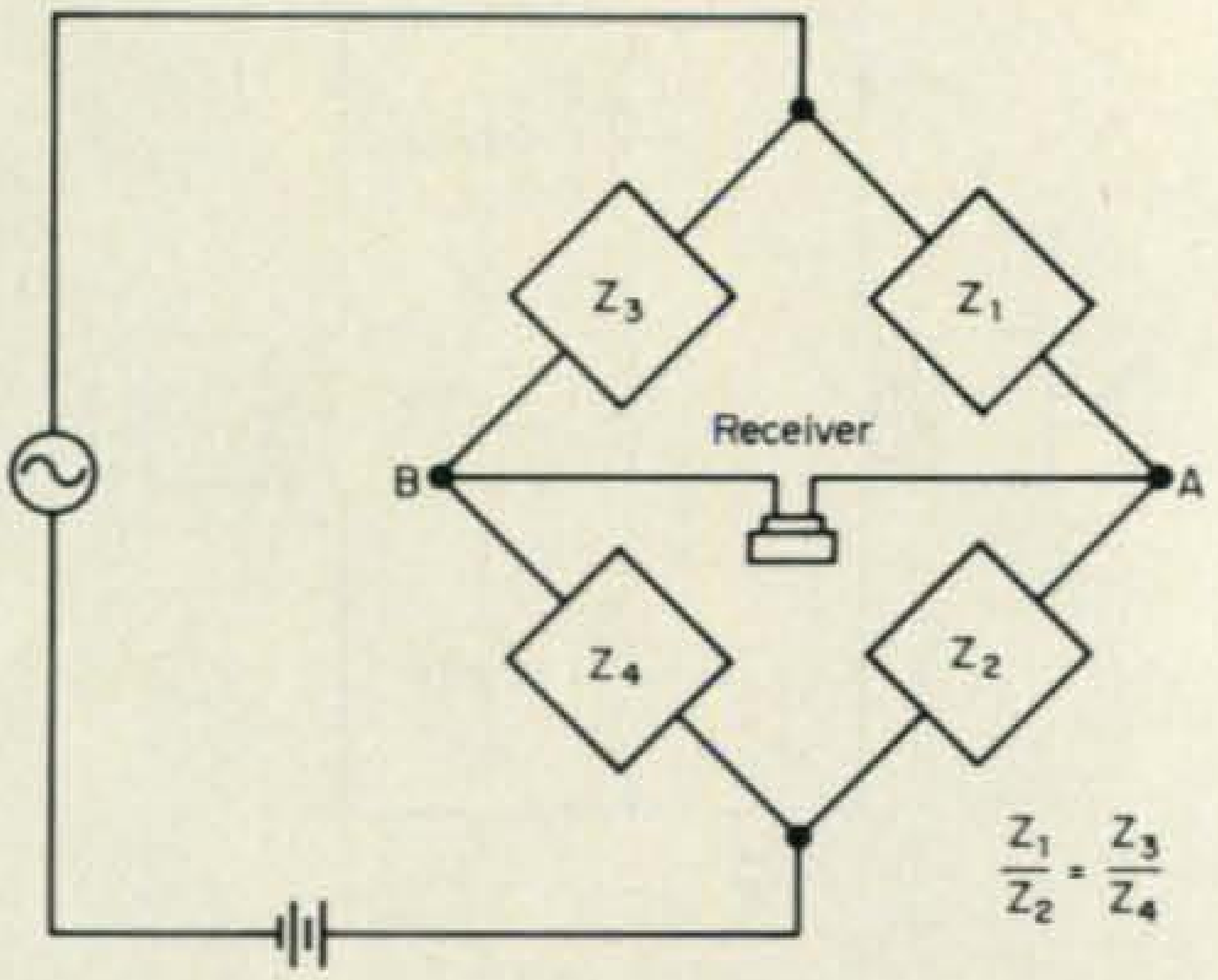

Fig. 5—Basic a.c. Wheatstone bridge circuit. When the bridge is balanced, no signal will be heard in the receiver.

only one frequency. Ignoring these problems, however, you can see that voice frequency (a.c.) produced by the microphone will not produce a signal (sidetone) in the receiver. Voice frequency from the line, however, *will* appear in the receiver since the bridge is not balanced for inputs from this connection at L_1 and L_2. This is a basic sidetone-reduction circuit. It has several disadvantages. Among these is the loss of power in Z_1 and Z_2.

If N_1 and N_2, as shown in fig. 7, are the windings of a perfect transformer, there will be no losses within these components. Here we use a transformer to supply the correct ratio N_1/N_2, and to eliminate losses. What ever happened to the primary use of transformers—to step up voltage levels? This is shown in fig. 8.

A little thought will reveal that this circuit is the same as the previous one. The tapped transformer circuit will have the same characteristics. The voltage induced in the 2-3 winding will be greatly increased across the entire bridge. This has little effect in the receiver, because of sidetone suppression, but increases the voltage at the line impedance terminals and thus increases the voltage at the receiver at the *other end* of the line. Of course, it appears that a battery is necessary at each phone. On the other hand, we have conveniently ignored the d.c. present on the phone line, also. This is compensated for as shown by the changes in fig. 9.

The addition of a third winding on the transformer has little effect on the basic bridge, except to change the values required in the other bridge impedances. By proper selection of values, coupling coefficients, and proper phasing of windings, it is possible to keep the bridge balanced. The capacitor which has been added simply keeps d.c. out of the bridge, and allows a.c. to pass freely. This is the circuit used, with few modifications, in the older Western Electric 302-type telephones. This set has been improved in the newer, but similar, 500-type set which will be discussed later. Let us look first, though, at the circuitry of the Automatic Electric 802-type instrument as seen in fig. 10. The diagram seems to bear little relationship to a bridge. It may be drawn as a horribly unbalanced bridge, as illustrated in fig. 11.

If we remember that the primary purpose of this circuit is to reduce sidetone, we can see that the 4-*A* winding may be connected to make the 4-*A* voltage essentially equal to the 3-*A* voltage, thus making the voltage between 3 and 4 very low. It is also seen that our old friends Z_1 and Z_3 have become *one* resistance. This is possible, since the tap between the impedances was not used.

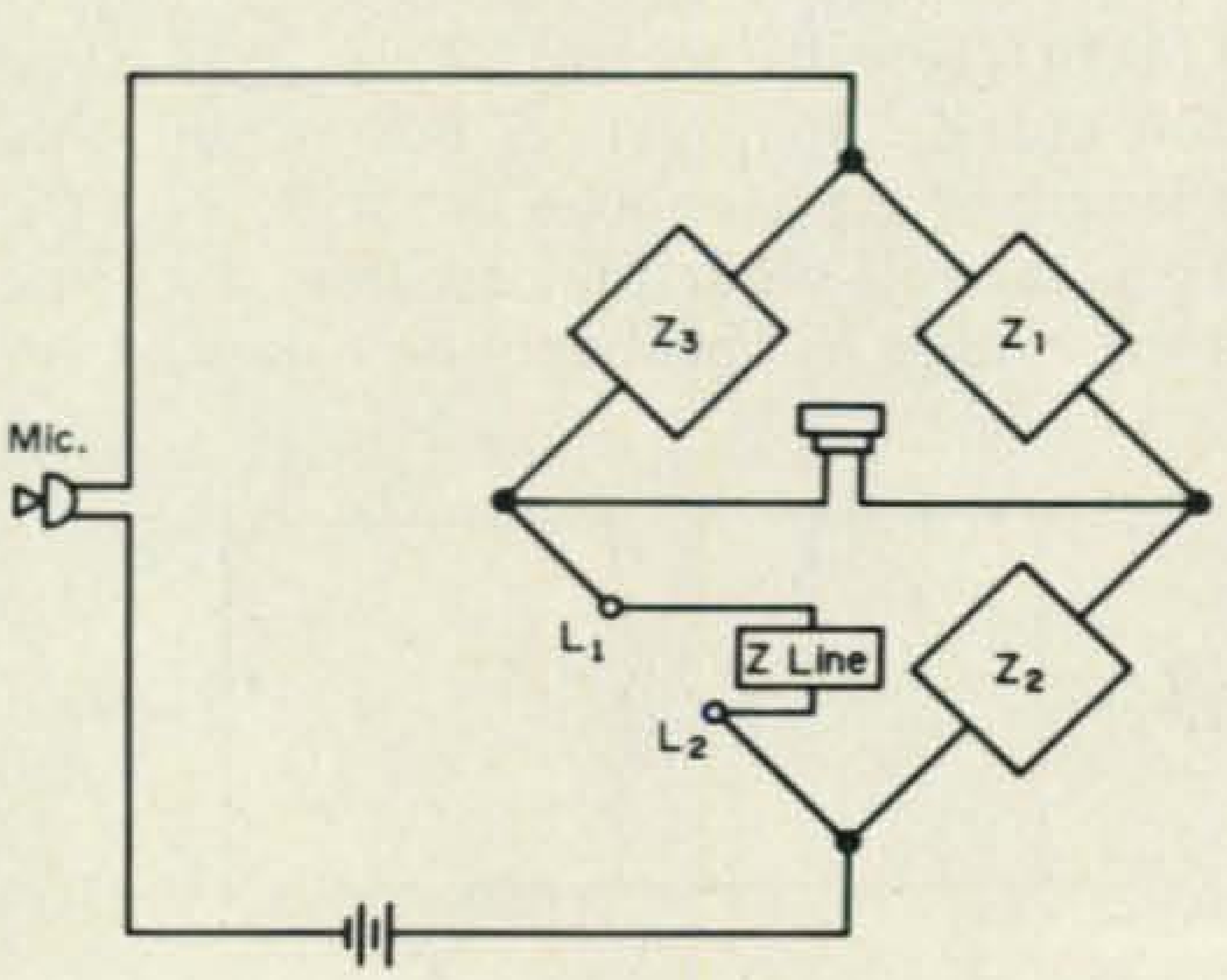

Fig. 6—Circuit of fig. 5 modified for telephone operation.

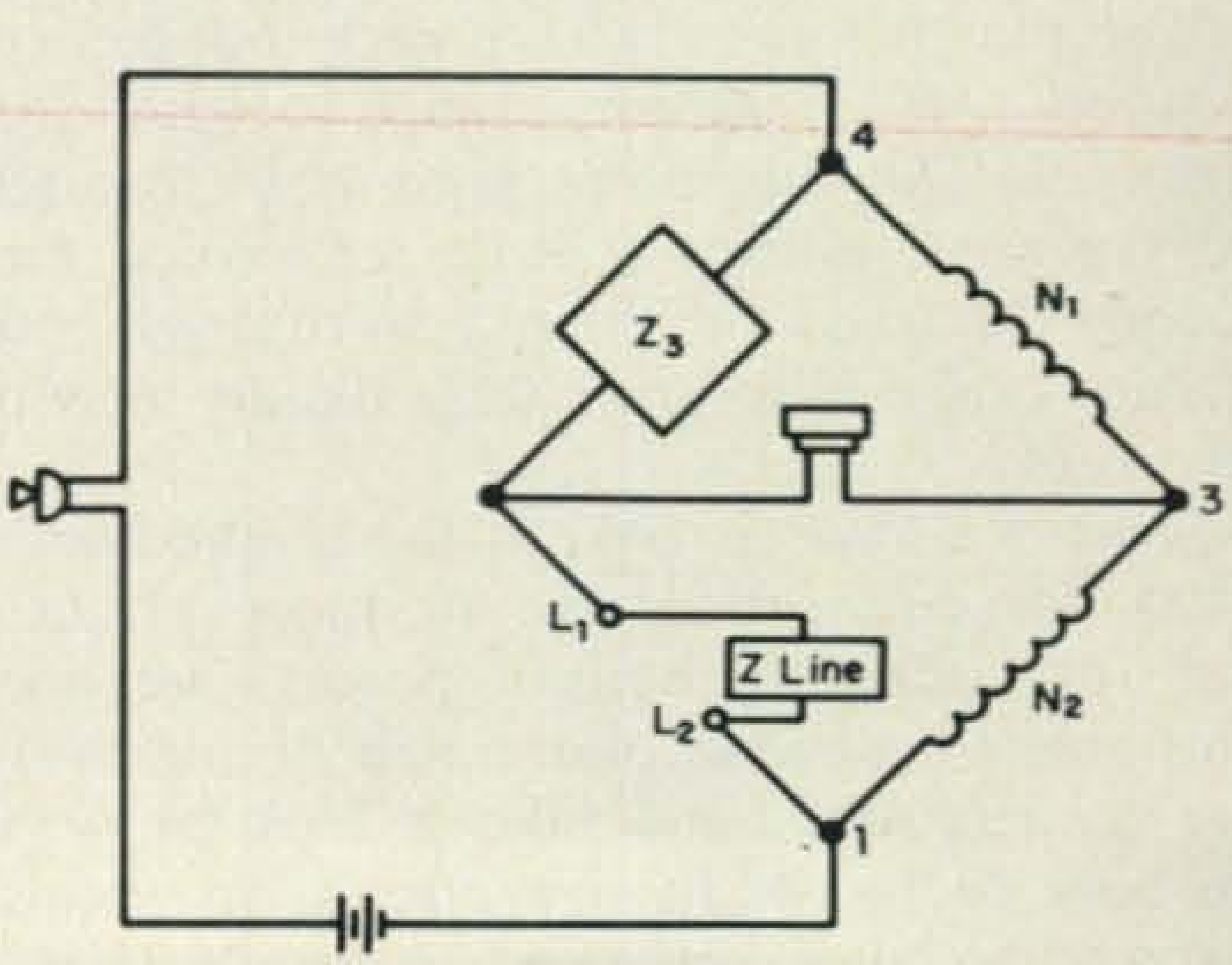

Fig. 7—Bridge circuit using induction coils instead of impedances in order to reduce losses.

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Product improvement is a continuing process. Western Electric has taken the basic circuit of the 302-type telephone and modified it to produce the more modern 500-type sets. These include the 518 basic and 564 pushbutton phones (using the type 425 network), and the 701 "Princess" model with its 495 network. A quick examination of these circuits is in order.

Although the circuit of fig. 12 (425 network for the 500-type sets) does not resemble the previous bridges, it may be easily redrawn in bridge form. If you wish to do so, place both the left-hand windings of the transformer in the same bridge leg as the line and the microphone. This is really a split winding where in previous circuits one winding was used. Several improvements have been added. The 200 ohm resistor and 0.1 mf capacitor form a key click filter to suppress radio interference due to dialing pulses. Varistor V_3 reduces clicks in the receiver. Varistors V_1 and V_2 act to reduce overall sensitivity if line resistance is low (for short distances to the central office), and allow sensitivity to remain high for high line resistance. In addition, V_1 and V_2 compensate for non-standard values of line impedance which would otherwise unbalance the bridge and allow excessive sidetone. As a final bonus, the three varistors help to maintain proper voltage levels within the telephone and eliminate overloads by a type of compressor action.

Designing A Patch

The first lesson we should learn from this discussion is that things are not always as simple as they seem. Perhaps it is not as easy to make a technically good phone patch as it is to make one which works because the phone company's equipment is so good.

Other parts of this discussion have provided information which will help in designing a

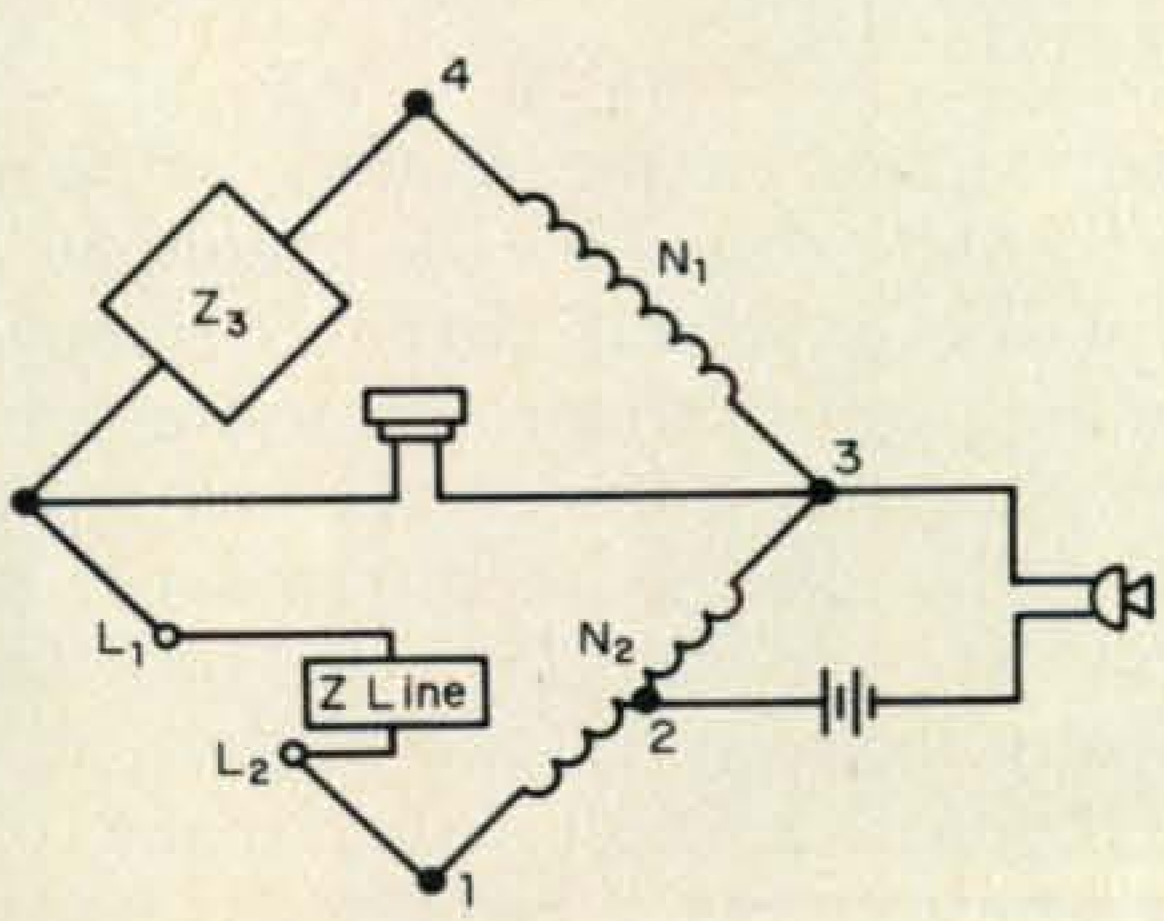

Fig. 8—Tapped coil used to step up the talking voltage.

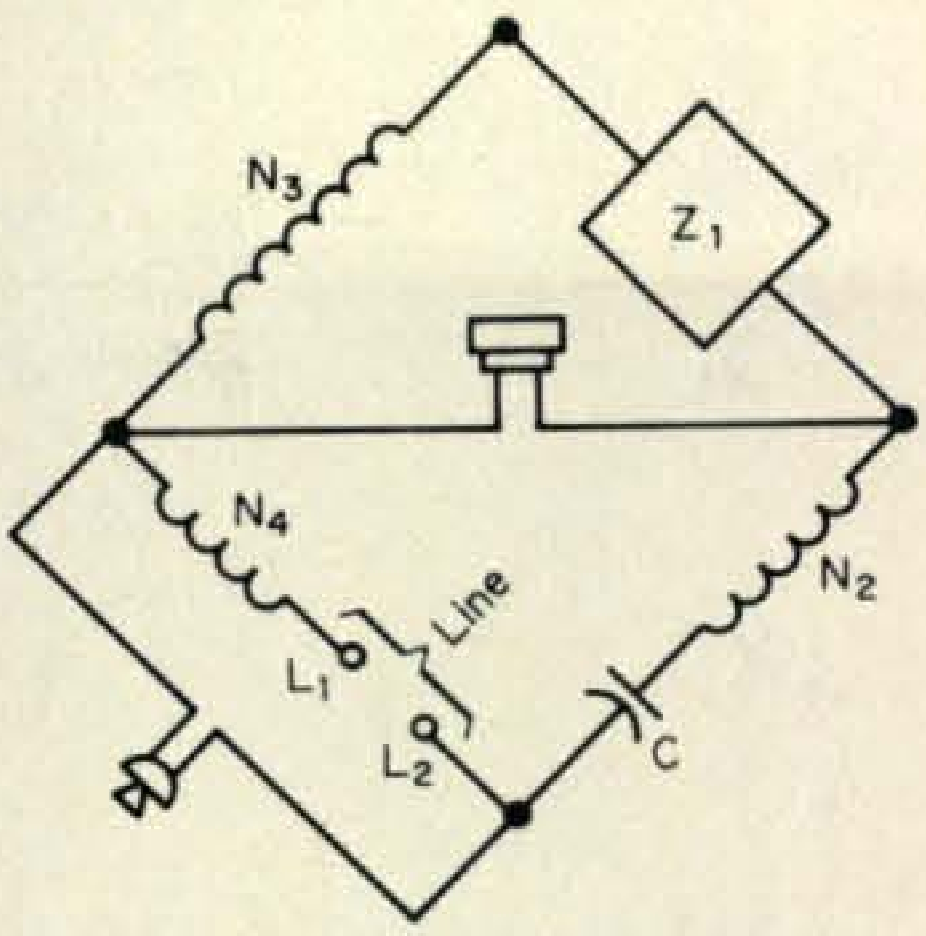

Fig. 9—Use is made of the d.c. present on the line to eliminate the need for separate batteries at each phone.

better phone patch:

1. Line impedance *is* important. The less tampering we do with its value, the better the system (phone *and* patch) will work.

2. Impedance values *within* a telephone are often not 600 ohms.

3. Western Electric compresses a large number of parts into a very small package.

4. The telephone incorporates anti-sidetone features, with the purpose of preventing microphone signals from appearing in the receiver.

To demonstrate the importance of these factors, a phone patch can be constructed which:

1. Has essentially no effect on line impedance, because no part of it is actually connected to the line.

2. Uses a combination of "brute force" methods to connect its elements *within* the telephone. The actual method parallels patch impedances in excess of 1000 ohms across telephone elements with impedances of

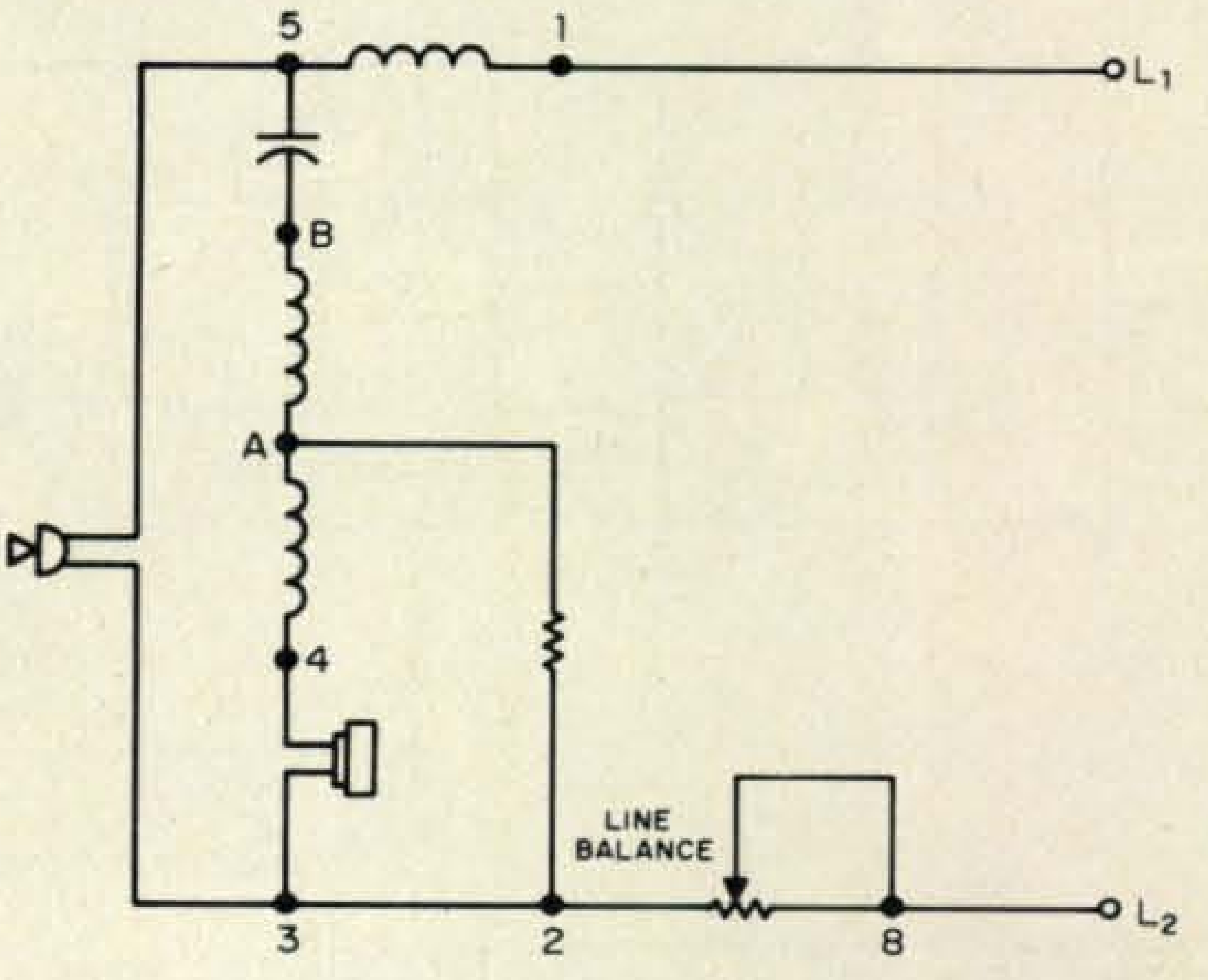

Fig. 10—Network and terminal numbers used in the Automatic Electric 802 telephone.

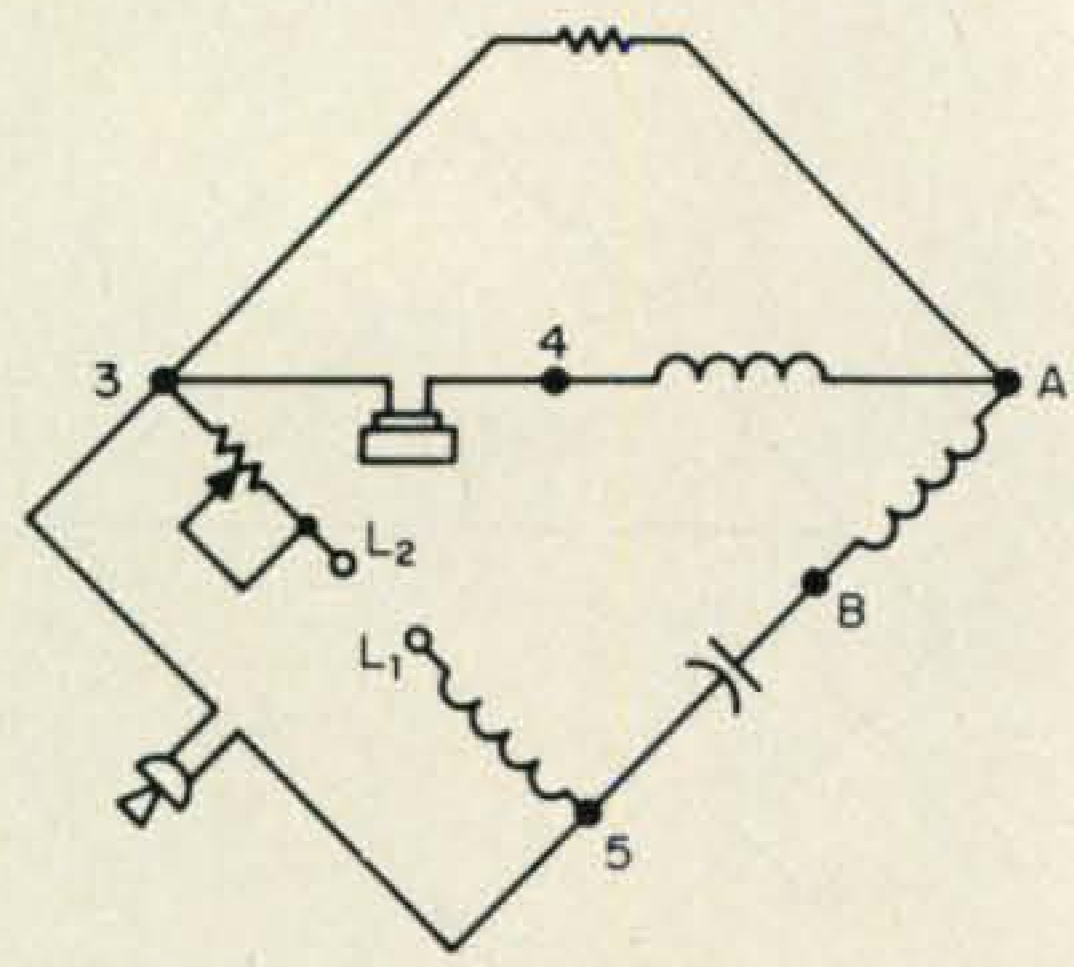

Fig. 11—The Automatic Electric 802 network redrawn as a bridge circuit.

around 100 ohms. The patch elements will thus have very little effect on the balance of the telephone bridge.

3. Is called the "Phoney Patch" because all of its elements (except knobs) are housed *in* a telephone, using space that Western Electric didn't use. See fig. 13.

4. Makes real use of the anti-sidetone features to provide vox capability.

How To Build A Phoney Patch

There are two critical parts in a Phoney Patch. The first is a telephone extension jack, installed by your telephone company at the proper location in your shack. The second is the telephone. You may be fortunate enough to be able to purchase an instrument from your local telephone company. The best selection, if you can obtain one, is the 564HL set. This is a 6 button telephone, and is the one illustrated in this article. A source of older model telephones, which will work very well, is Surplus Center at 900 West "O" Street, Lincoln, Nebraska 68501. Don't scrimp on this phone. Remember, the more built-in

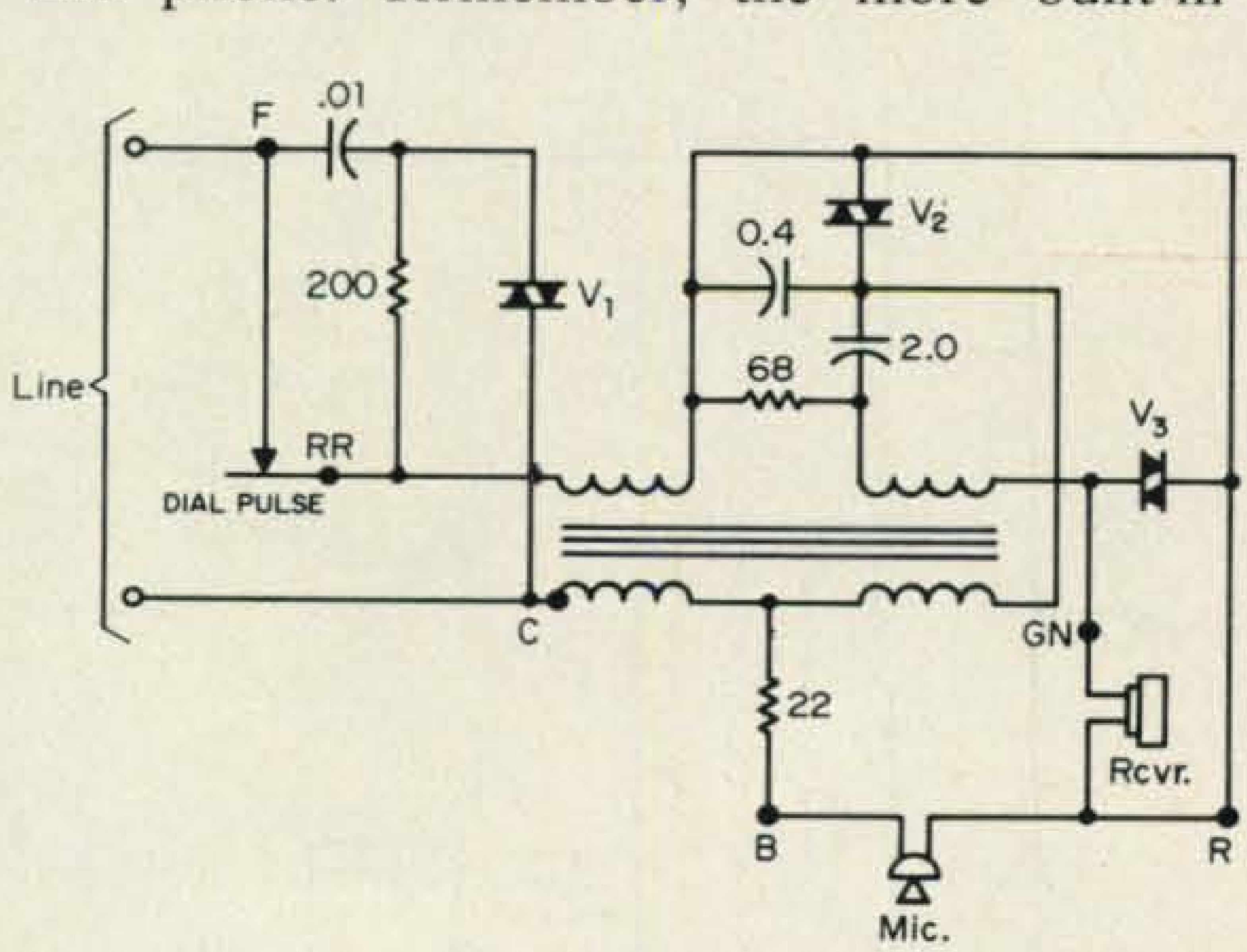

Fig. 12—Circuit of the Western Electric type 425 network is an improved circuit used in the more modern phone.

switches (buttons) you buy, the fewer you' have to add. For this reason, I recommend th first phone on the list below:

Surplus Item	Type	Price
762-XP	6-button commercial	$11.6
749	4-button commercial (W.E.)	9.8
716	Western Electric 302 (no but.)	6.9
716-UF	Used 302	5.7
715	Automatic Electric (no but.)	5.9

As an added note, it turns out that you wi have to save one button to clear (turn off) th other buttons, so a 4 button phone really onl provides 3 switches.

The remainder of the parts can be pu chased for less than $6.00, but the importar factor here is that *none of these parts is criti cal.* All you have to do is to come reasonabl close. However, size is important if you in tend to get them all in. Two transformers ar used. American units will run 3 or 4 dollar each, but any of the outlets dealing in Jap anese parts carry miniature (transistor) trans formers for less than a dollar. I used an "out put" transformer (for input to the patch with 500 ohm and 3.2 ohm windings. I hav also tried a 1000/8 ohm transformer whic worked just as well. The other transforme used (for output) is an input unit, 1K/200K impedance. Again, almost anything with a 1K winding (or more) will work.

The two capacitors used are 5 mf, 25 vol electrolytics designed for printed circuit work These also were Japanese. Substituting 1 mf or 100 mf capacitors makes little difference Anything over 20 volts is sufficient rating Two "junk box" controls were used and any thing will do here if it is *small* enough (les than 1 inch diameter). IRC type Q pots woul do well. The only other components are fou ½ watt resistors, and two knobs. If you phone does not have buttons, you will als need two or three miniature d.p.s.t. switches and a small s.p.s.t. pushbutton switch.

Construction

Construction of the phoney patch shoul begin by finding out how the telephone works The plastic or metal cover is removed b loosening two or three captive screws locate near the outside edge on the bottom of th phone. The dial is then removed, so th "works" are exposed. (See fig. 14.) The dia is usually held on by two screws or sprin clips. If you disconnect wiring, make sure yo know where to put it back.

All phones will contain three basic com ponents: dial, ringer, and network. The dial

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f course, is a pulsing device. The ringer consists of one or more coils, a capacitor usually), and one or two bells. Although it ooks like a doorbell, it is designed to operate roperly with low frequence pulsating d.c. The network contains the components of the bridge," except for the microphone and reeiver, and is located in the right rear corner f the 500-type phones (under the dial in A.E. hones and the W.E. Princess). It also serves s a terminal board for connections between he line, ringer, dial, and the handset.

If you have selected a pushbutton model hone, as illustrated, there will also be a set f switches and a tangle of wires. Almost all f the wires in the photo are associated with his switching. In the 564HL phone, all witches except the leftmost are 3p.s.t., normally open. The left switch is s.p.d.t., and is alled the "hold" switch. It is used in the Phoney patch to cancel the circuit setup at he end of patching by bringing all pushbutons to the up (off) position. Three of the ther switches are used as d.p.s.t. switches to onnect line, receiving, and transmitting porions of the patch. Another is used as a s.p.s.t. ushbutton to key the transmitter in non-vox peration. This leaves one spare switch. Have un thinking of some special function for this witch.

Many variations of this switching assembly xist. You must, of course, thoroughly undertand how *your* switches work before making he necessary changes. The 564HL modificaion begins by removing the pushbutton and witch assembly. Be cautious at this stage that he whole assembly is removed, by taking out ome more screws from the bottom of the hone. The designed purpose of this assembly s to connect *only one* of five lines to the common phone circuits. In the 564HL, the three oles of each switch are called *T*, *H*, and *R*, or Tip, Hold, and Ring. That is, the Line 1 witch (second button) has contacts 1*T*, 1*H*, nd 1*R*. The other side of each set of contacts s connected to one of three common busses. Since we plan to use four *independent* witches, rewiring will be needed. My advice or this is to first understand how the switchng *now* works, and then decide how *you* want t to work. Figure 15 shows the 564 circuitry, and is similar to that for many other phones. Remember that virtually every switch in a hone is normally open.

Button Modification

Since we must have more than one switch closed to operate the patch, and since the pushbutton assembly was designed for only one switch down at a time, mechanical work is also necessary. *Carefully* take the pushbutton assembly apart. Seven springs are involved, so don't let it get away from you. Disassemble slowly, so you know where things go. In fig. 16, the assembly is shown open. Usually, a spring-loaded slider is used to lock and release the buttons. In addition, four A-shaped pieces fit between the bottons so that only one button can be down at a time. Removing at least three of these will allow all buttons to be depressed and locked at the same time. These pieces simply lift out. Getting to them, and then putting the rest of the parts back together, is a little touchy. If you

Fig. 13—The complete Phoney patch. The two knobs are the only obvious modifications to the telephone.

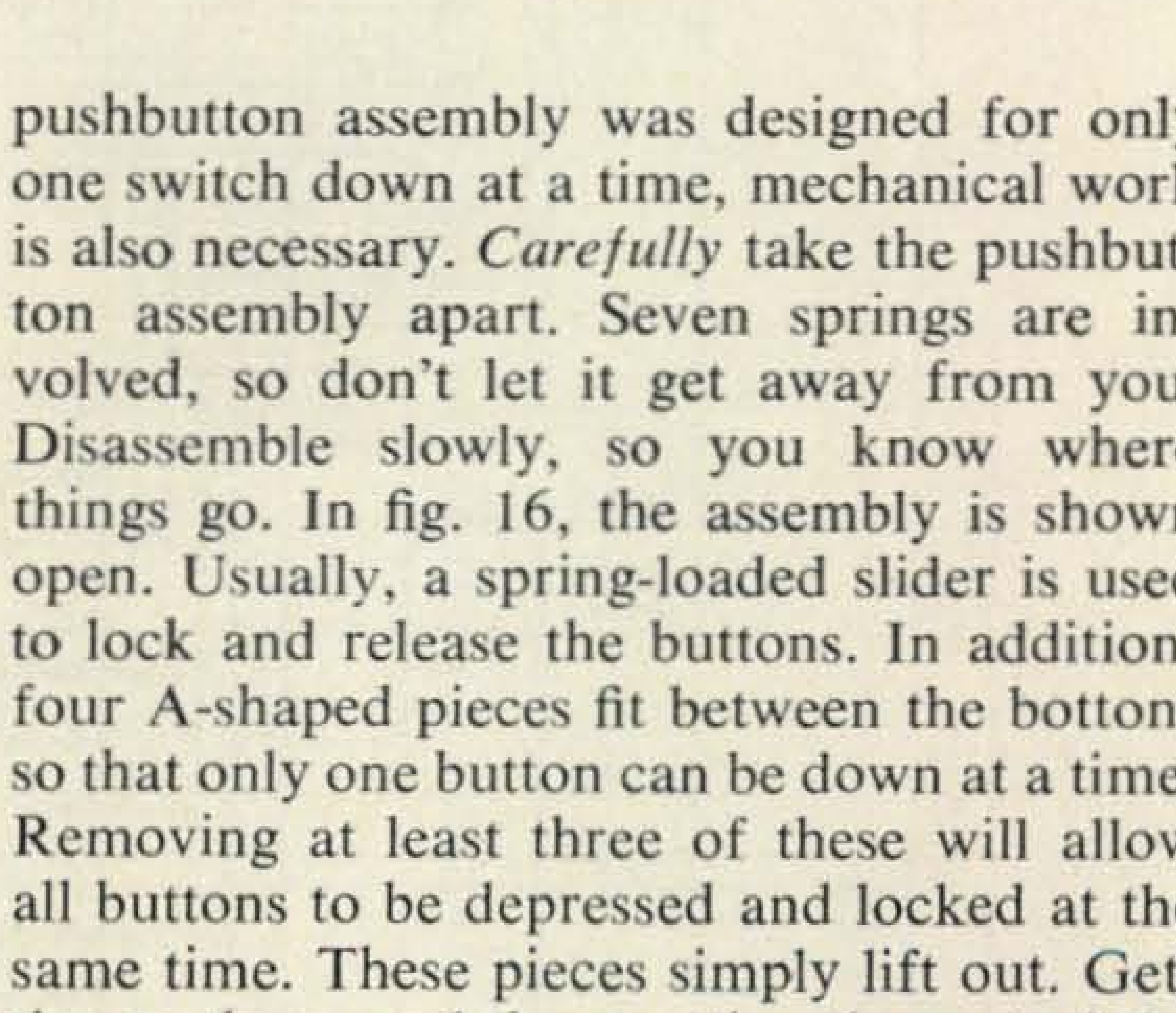

Fig. 14—Shown above is the works of the 564HL telephone. The ringer is at the upper left; the network is at the upper right, and the dial is at the far right. The pushbutton and switch assembly occupies the entire lower half of the phone. The parts used to modify the phone are shown just in front of the pushbuttons and just behind the network.

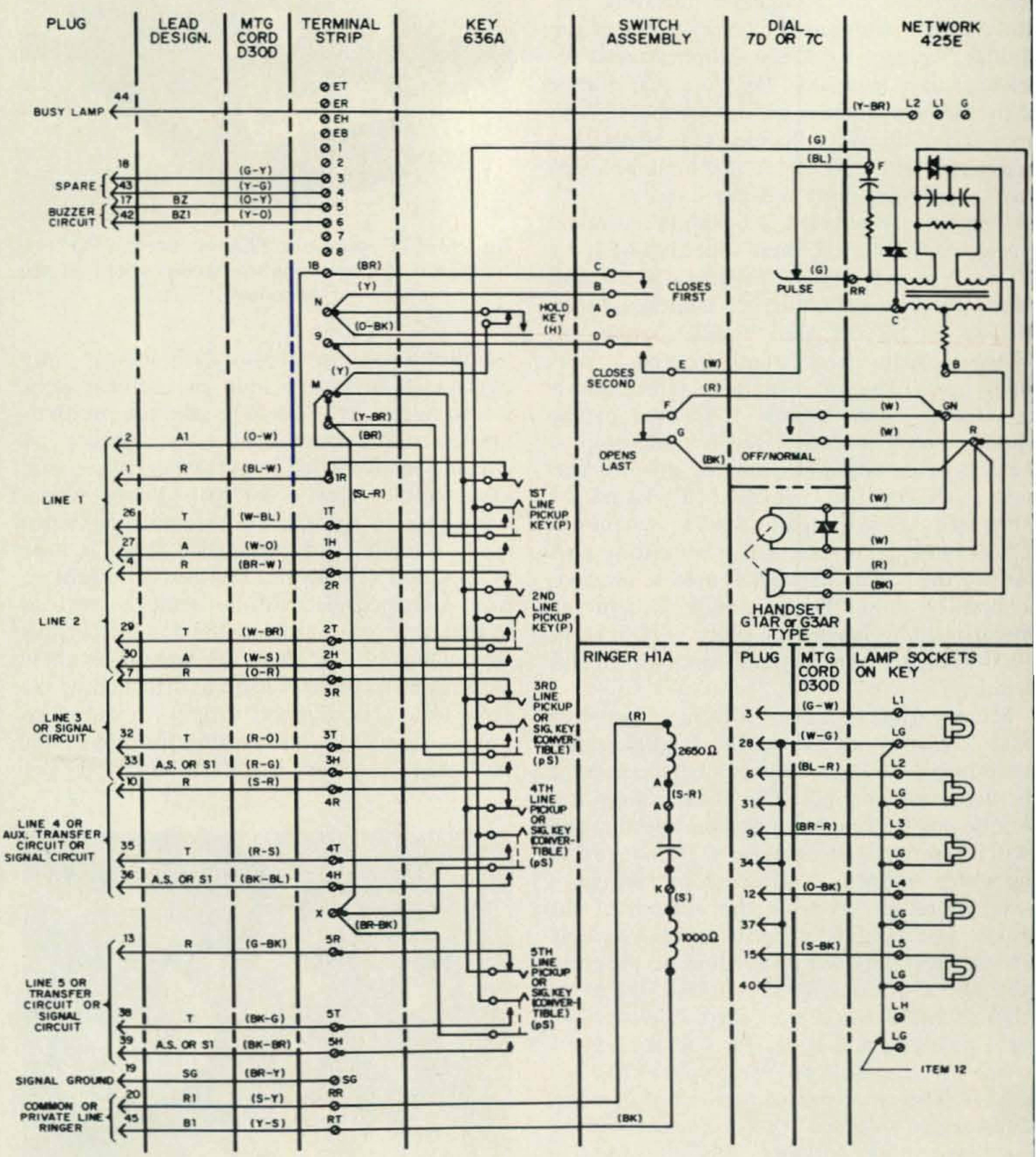

Fig. 15—Circuit of the Western Electric 564HI telephone set. The letters in the parenthesis are wire color codes. The 636A Key is shown with all pushbuttons up. All these switches, except the Hold Key switch, are 3 p.s.t., normally open. The Switch Assembly is shown with the handset in the cradle (hung up). The "dial off normal" switch will close when the dial is rotated clockwise. The dial pulse switch will pulse open as the dial returns to its normal position, with the number of pulses depending on how far the dial was rotated in a clockwise direction. The 425 network is also shown in fig. 12.

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proceed slowly, however, you should have very little trouble.

There will also be some way to make at least one pushbutton non-locking (spring-loaded). This may be simply a slotted pin which is unscrewed. Such a pin is shown in fig. 16, at the left of the pushbutton assembly, in the unscrewed position. Four others are shown in the normal position. The non-locking pushbutton will be used to key the transmitter.

Component Installation

With the modified pushbuttons and rewired switches installed in the proper place, patch construction can begin. Of course, a regular phone and miniature switches may be used instead, with equal results, but the pushbutton model has a little more status value.

Next, select a place for the components. There is really an excess of room. If necessary, on a two-bell phone, one of the bells can be removed. All the components used for the 564HL Phoney patch are shown in fig. 14 (front, and right rear) but are hard to see. The photos show the installation. Figure 17 illustrates the two controls, mounted on aluminum brackets inside the front rim. Miniature switches would also be mounted here, for non-pushbutton phones. The plastic cover is slotted to fit over the bushings on the controls.

Figures 18 and 19 show the transformers and terminal strip. The top of each transformer was cemented to the frame of the phone. The large cable shown carries 24 separate wires from the telephone in its normal use, and may be reconnected to bring out all necessary circuits to station equipment and the phone line with at least 16 spare conductors. As an alternative, it could be replaced with less-bulky wiring.

The Circuit

The Phoney patch schematic is shown in fig. 20. Examination will show that this is indeed a "brute force" approach, and wastes a lot of power. However, this method presents relatively high impedances to the telephone network (to assure that there is little effect on telephone operation), and 470K ohms to the transmitter microphone input. As previously stated, none of the components is really critical.

Signals from the station speaker are connected to the receiver of the telephone. The transmitter mike input receives signals (much attenuated) which appeared across the tele-

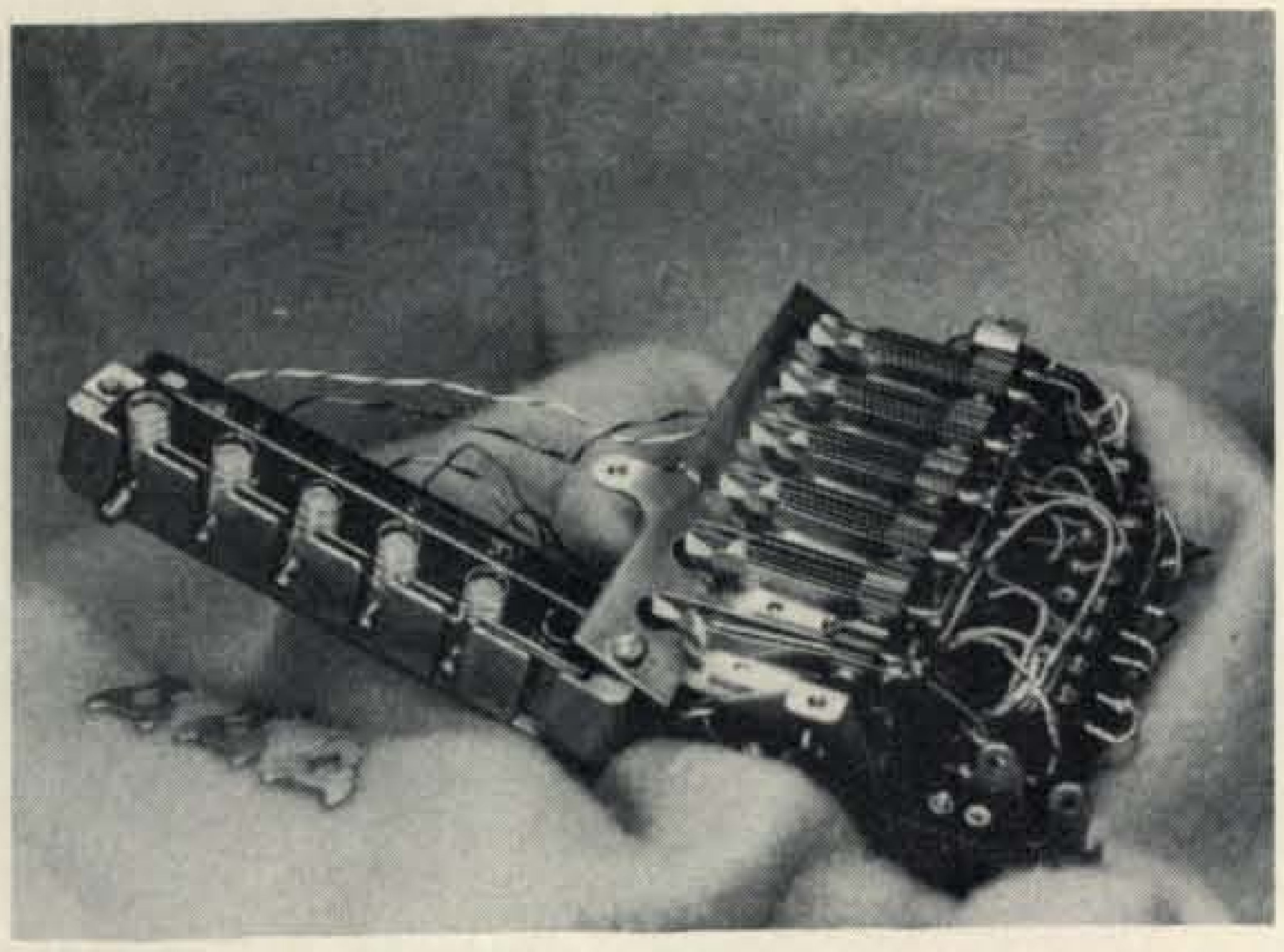

Fig. 16—The pushbutton and switch assembly are shown above with the pushbuttons on the left and the switches on the right. Extending the screw, as illustrated by the leftmost pushbutton, makes the button non-locking. The three A pieces are removed so that more than one button can be depressed at the same time.

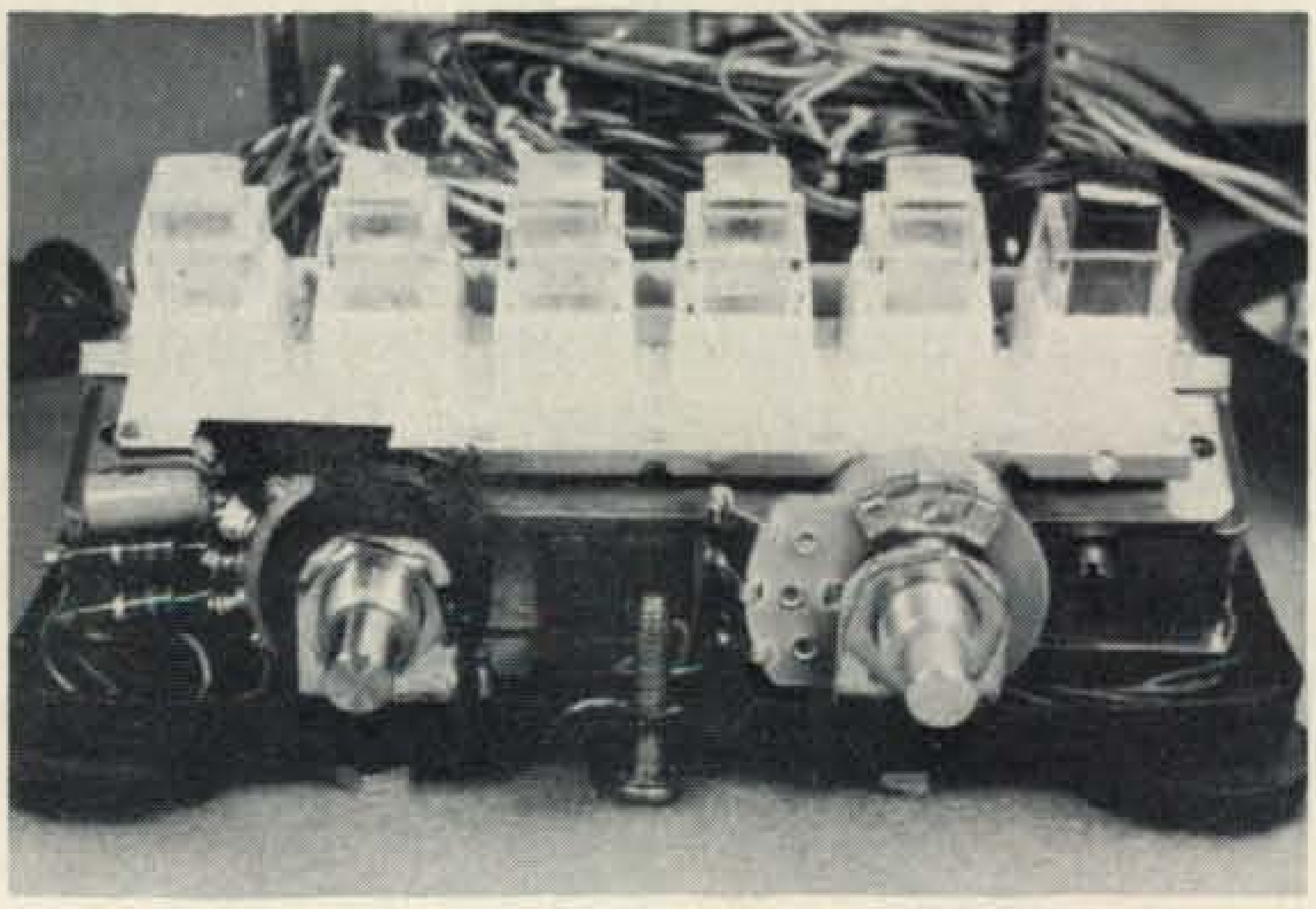

Fig. 17—Front view of the controls shows how they are mounted on brackets. Small size controls must be used as the clearance is limited.

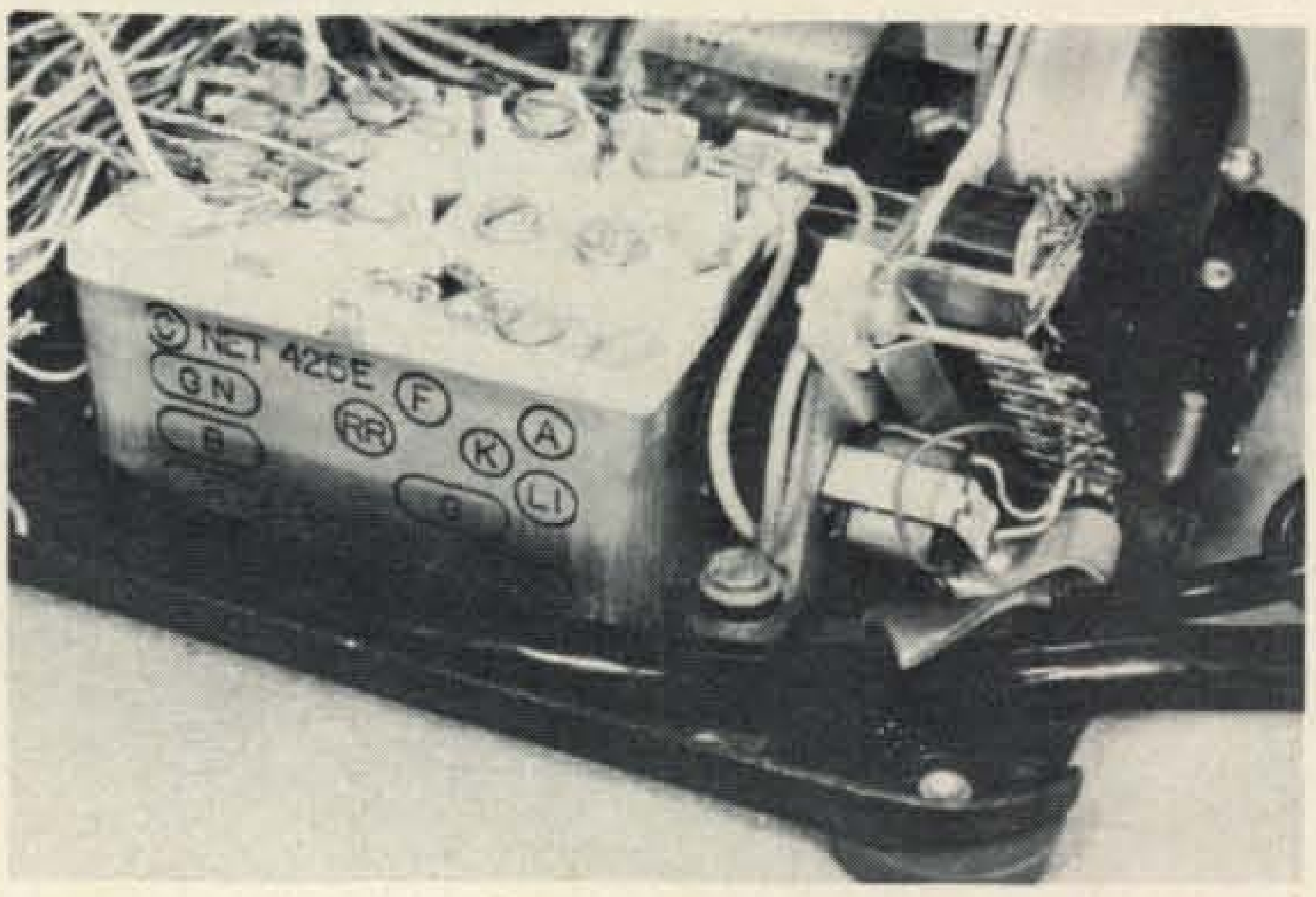

Fig. 18—Components used in the modification are mounted next to the network. Existing screws were used to mount the terminal strips and the miniature transformers were cemented to the frame.

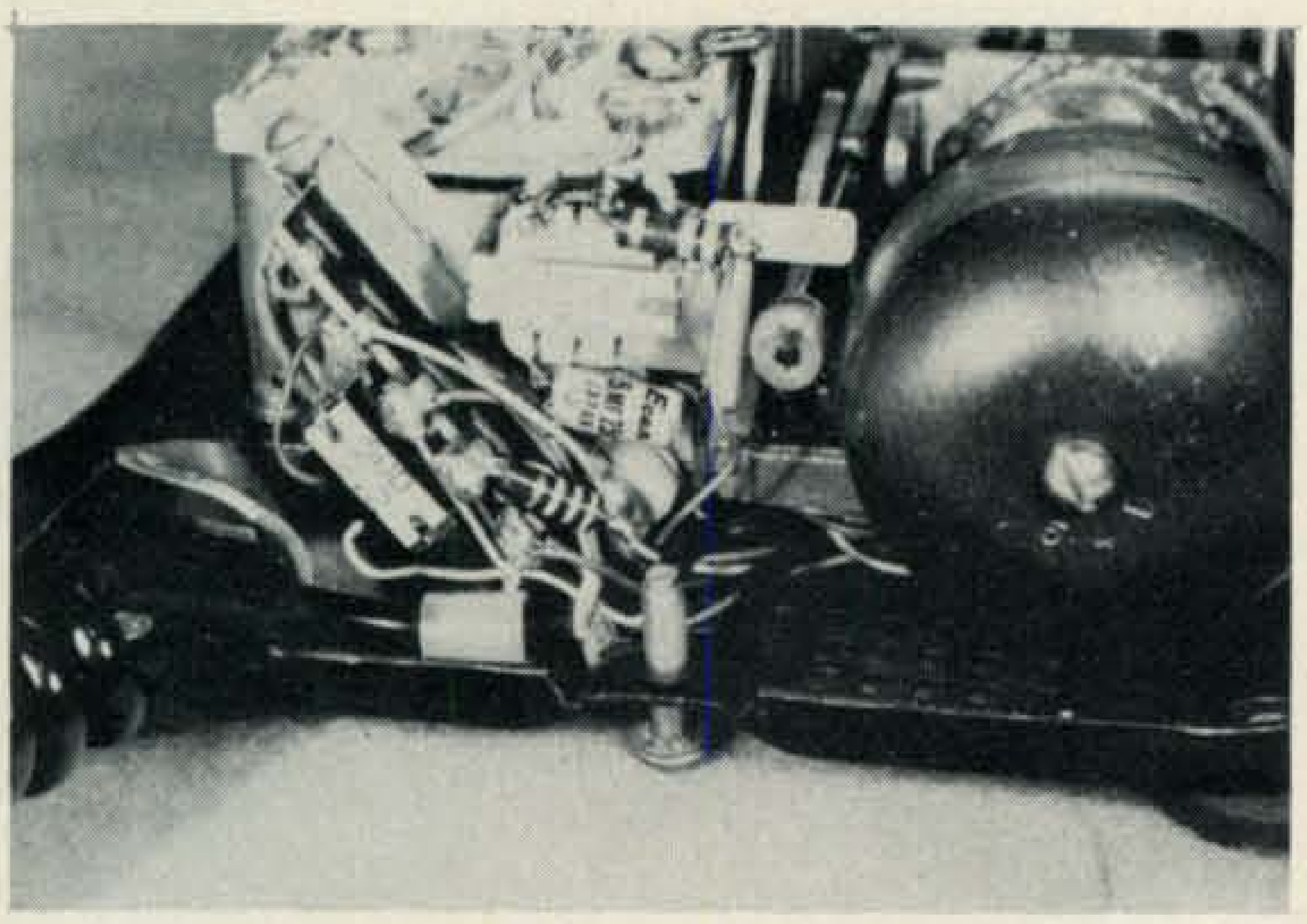

Fig. 19—Close up view of the components shows the cluttered wiring. Short leads make the components self supporting.

phone carbon microphone.

This circuit functions by a type of reciprocity. The telephone mike is connected so that it will place signals on the line; therefore, signals from the line appear across the microphone, where they may be used for input to the transmitter mike input. Signals from the line appear at the telephone receiver; signals injected at the receiver will appear on the line. Anti-sidetone circuits prevent telephone mike signals from appearing in the telephone receiver; the same circuits prevent signals applied to the receiver from appearing across the carbon mike.

A further advantage lies in the fact that the telephone handset (mike and receiver) wil function the same as the phone at the othe end of the line. That is, the audio loudness a the phone to which the call is patched will b the same as that at the Phoney patch, excep for line losses. By adjusting the patch contro to a comfortable hearing level, the outpu level will automatically be correct. Speakin into the telephone mike will provide audio t the transmitter input at about the same leve as that coming from the telephone line. Vo provisions are automatic, although not per fect. There is some coupling between inpu and output, because some sidetone is deliber ately allowed in the telephone network. Thi does not cause a problem, however, if the sig nal is "patch quality". In any case, manua keying is also provided.

Audio quality is equivalent to telephon standards. On-the-air experience indicate that it is really hard to tell the difference be tween patch mike and station mike.

One caution about the hookup. The capaci tors are electrolytic. Measure the polarity o the voltage at the terminals (425 Networ marked *B* and *GN*) to the common termina (*R*). If it is not as shown, reverse the two lin connections. If you telephone operating are rings between one line and ground, chang the ringer wire also so that it is still associate with the same line wire. If hum is a problem interchange the wires at the mike transforme

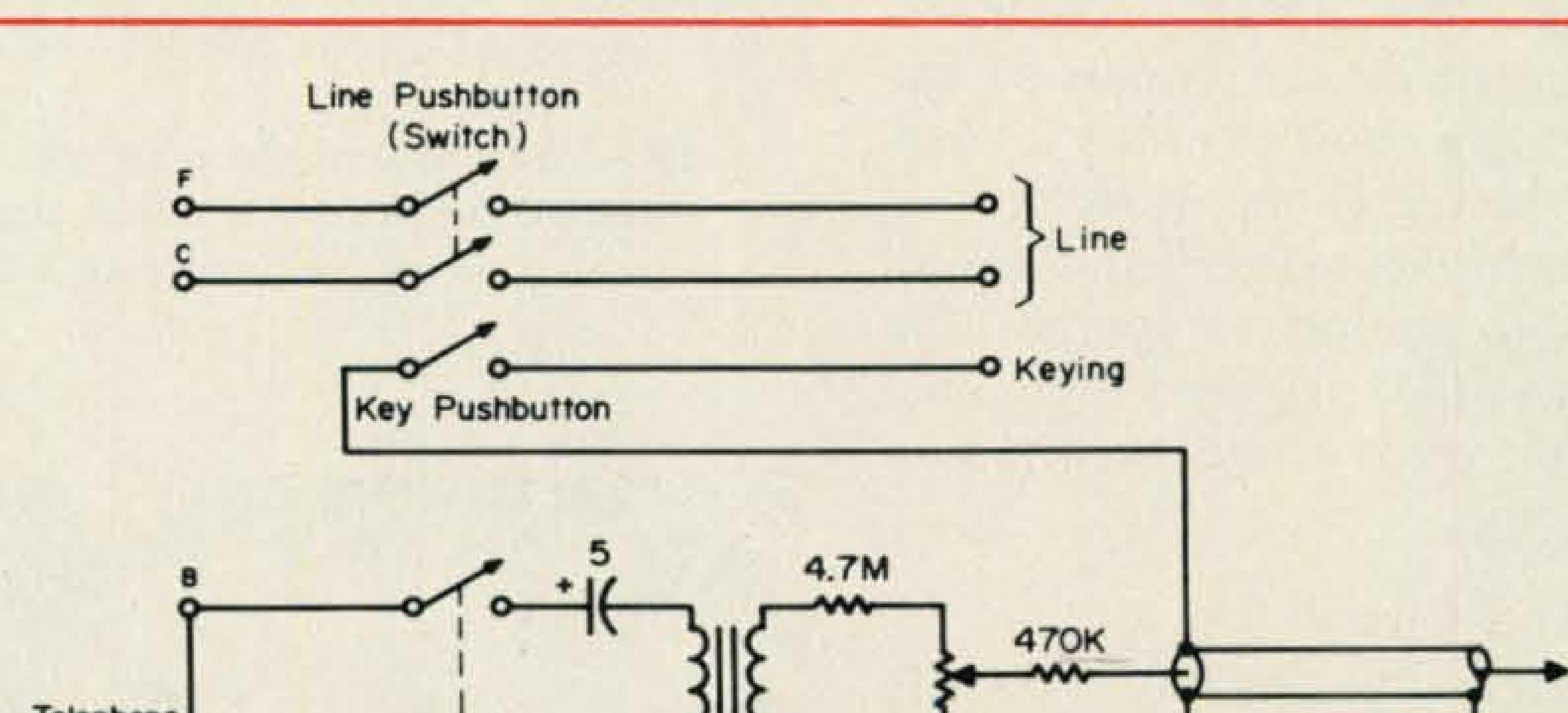

Fig. 20—Circuit diagram of the Phoney patch additions. Component values are not critical. Terminals *B*, *R* and *GN* refer to Western Electric 500-type telephones. On other phones the correct terminals may be located by tracing the wiring from the microphone and receiver.

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econdary. If the vox does not work, inter-
hange the output (speaker) wires.

Operating

Figure 21 shows the operating controls on he 564HL pushbutton phoney patch. As nodified, all pushbuttons which are pressed t the same time will stay down. However, if wo are down and a third is pressed, the other wo will pop up if not held down. You may eed three fingers to operate the patch, but he buttons are grouped together. A couple f minutes practice is needed. After that, the perations listed below can be accomplished uickly, smoothly, and easily:

1. When requested to set up a patch, push he RCVR button. Receiver audio appears in he handset, while you are listening to the ther ham. Adjust the RCVR control for comfortable phone volume.

2. Holding RCVR down, push LINE. Dial the irst digit of the requested number. This aplies line voltage to the telephone mike, and hen removes the dial tone. No dial clicks are ransmitted.

3. Holding RCVR and LINE down, push XMIT. All three buttons will now stay down. Using KEY, or the vox provision, confirm the umber with the other ham. While you are doing this, adjust the XMIT control for proper ransmitter audio. At this time, you are using he telephone mike. By the way, once this XMIT control is set you will probably not need o touch it again. The setting depends on the elephone company equipment, which usually does not change. Small changes will be made f you get an exceptionally bad telephone connection with the called party.

4. Holding down LINE only, push OFF. This disconnects the patch from your station because the RCVR and XMIT buttons pop up, but eaves the phone connected to the line. Now dial the last six digits of the called number. Dial pulses will not be on the air. Your station speaker and mike may be used as they always are. When the call on the phone is answered, explains the situation and procedure (vox or "Over") to the party.

5. Holding LINE down, push RCVR and XMIT and the patch is now operating fully.

6. To break the connection, simply push the OFF button. This disconnects everything, including the line. If you wish to keep the phone connected to the party you called, hold the LINE as you push OFF. The telephone will operate normally, and will break the connection when you hang up.

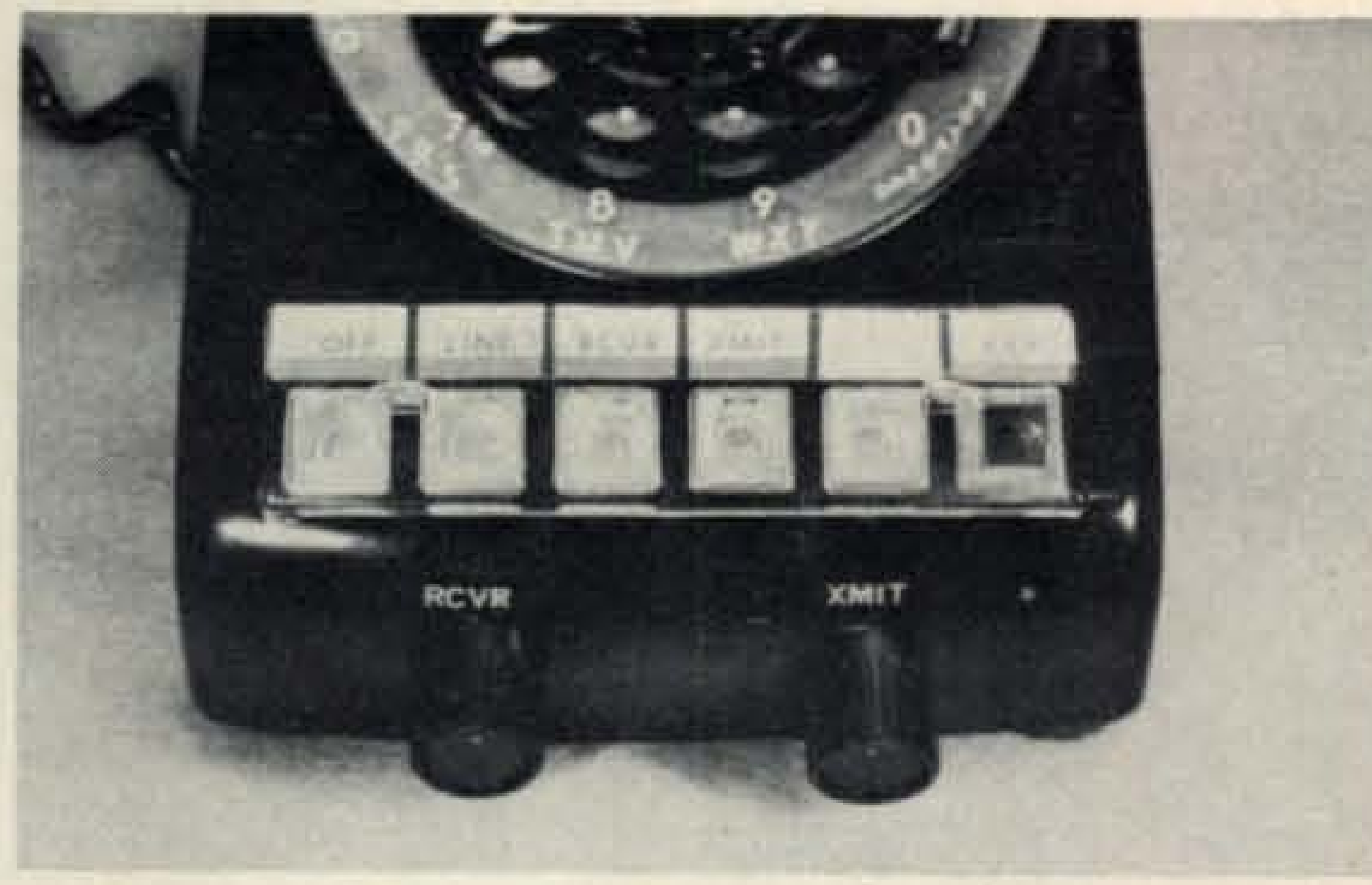


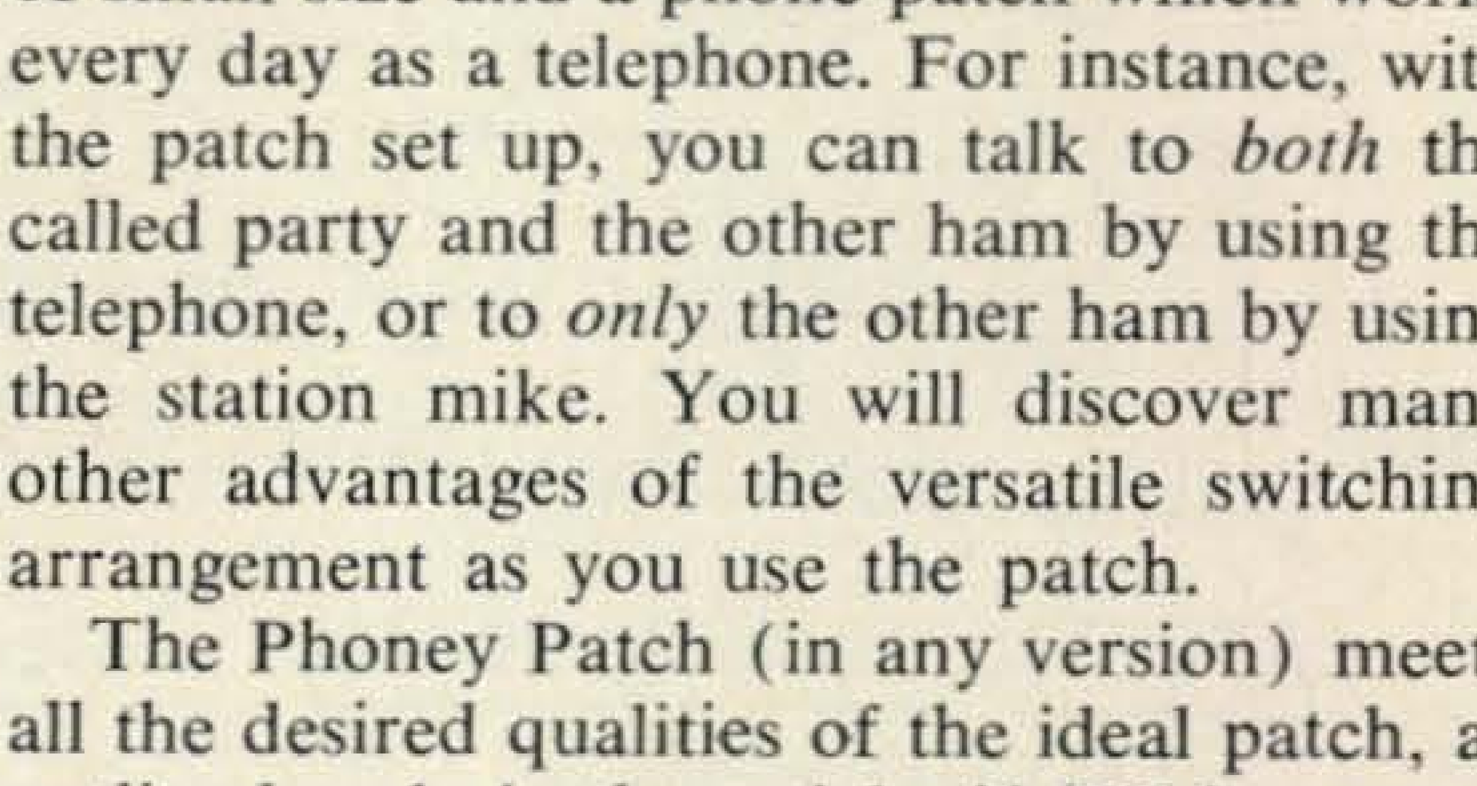
Fig. 21—The pushbutton allows flexible use of the patch. The control operations are described in the text.

Although this may seem rather complicated, it is very simple once you get the hang of it. As you build the patch, you automatically acquire the necessary "hang."

Conclusion

There are many advantages in the operating procedure, in addition to the obvious ones of small size and a phone patch which works every day as a telephone. For instance, with the patch set up, you can talk to *both* the called party and the other ham by using the telephone, or to *only* the other ham by using the station mike. You will discover many other advantages of the versatile switching arrangement as you use the patch.

The Phoney Patch (in any version) meets all the desired qualities of the ideal patch, as outlined early in the article, if $20 is reasonable for your budget. With good construction, there is no hum. Electrically, it will test within telephone company specifications and may be considered as an extension phone. This is a close approximation of "perfect match to the line". If the addition of two knobs to an existing telephone isn't "small size", then somebody will have to write another article. ■



"It's a collapsible yagi I've developed for working portable."

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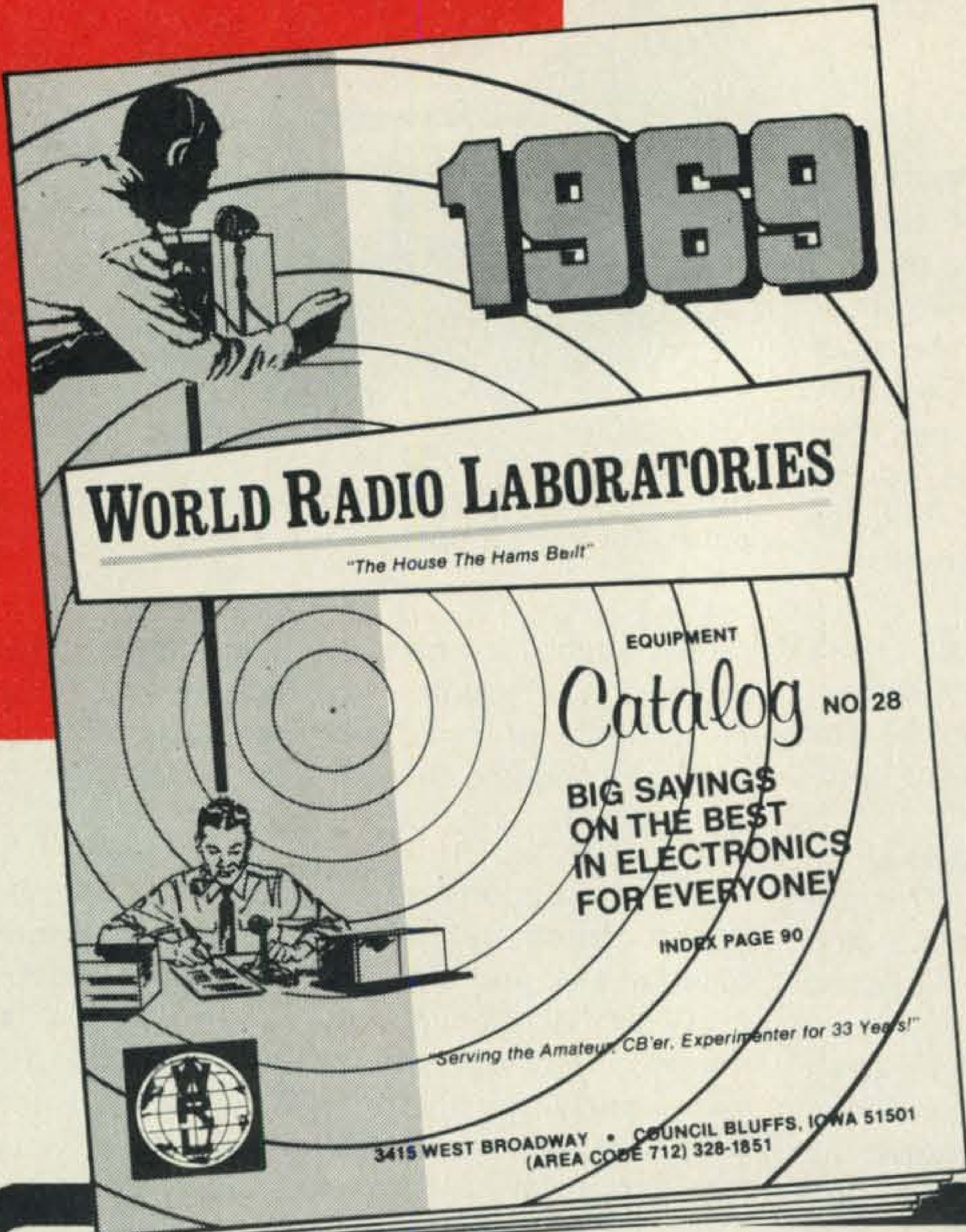

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The Results of the 9th Annual CQ 160 Meter Contest

BY CHARLES M. O'BRIEN,* W2EQS

WHERE were *you* the last week-end of January 1968, during the 9th Annual *CQ* 160-Meter explosion?

The sunspot cycle continued to soar upwards but even with its great adverse effect on Top Band it didn't dampen the spirit of the 1,140 hams from every sector of the world who participated therein. This isn't the usual hit-and-run type of contest but rather an excercise in patience, perseverance and know-how.

Conditions this past season were far from good. There were very few DX openings and, for the most part, the QRN level was above average. Fortunately, though, we struck the very finest conditions of the entire season over this weekend with no static and plenty of DX. Fate was certainly on our side as the QRN had been terrific for the entire week right up to contest time. Then, just as though a fairy waved her magic wand, it ceased completely. The following week-end QRN once again reigned supreme.

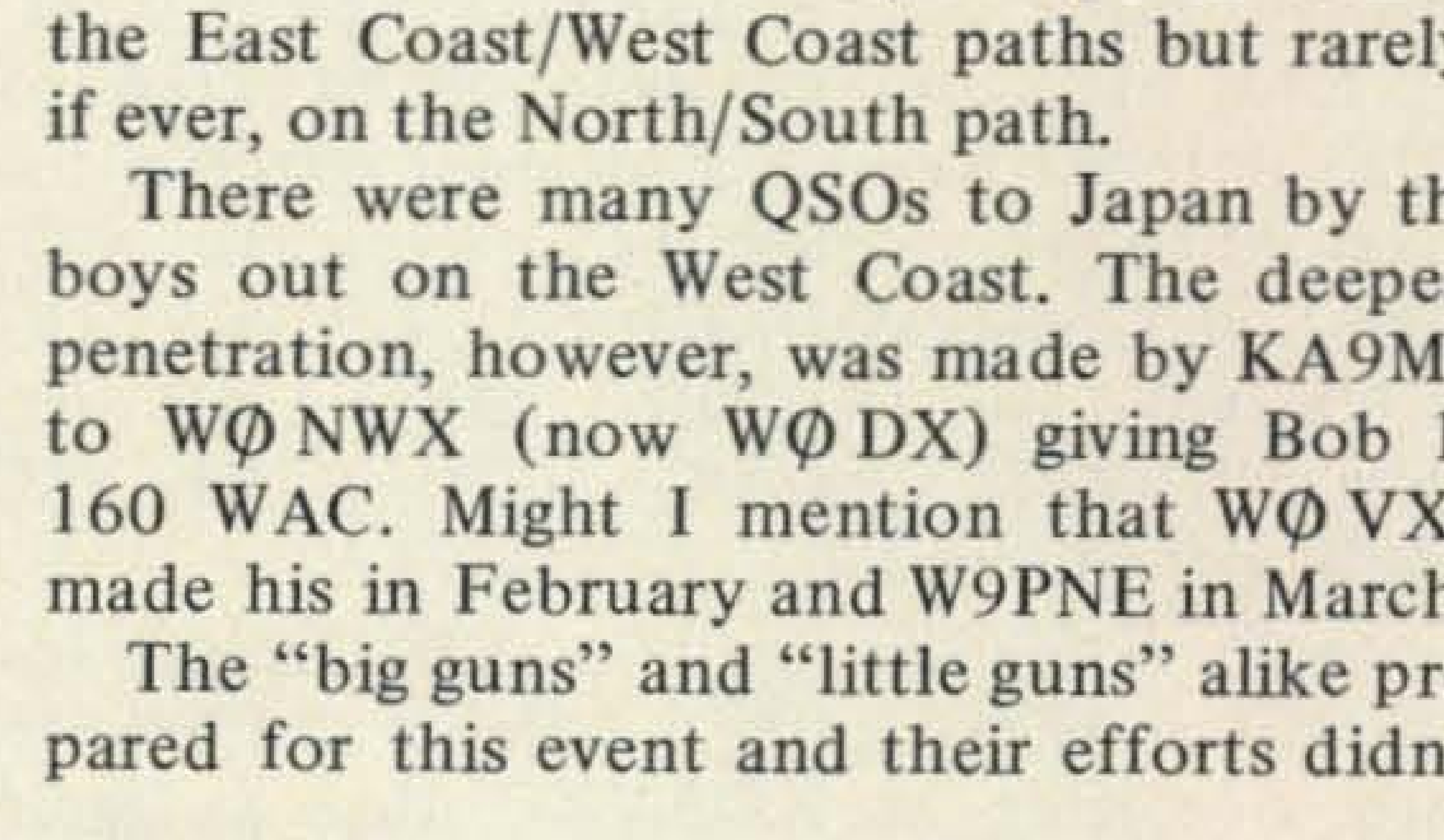
Whereas the opening from the East Coast to Europe was fair the first night, it was fabulous the second with the DX breaking through as early as 2230 GMT and continuing until 0400 GMT. At this hour the goddess of the ionosphere began feeling a little capricious and wane. It was as though she moved her hand around and every so often permitted a few signals to get through but not many. The band finally closed to Europe at 0730 GMT. Strange that signals peaked at the odd hour of 0300 GMT.

Conditions to the West Coast were below those of a year ago. Saturday morning signal strengths were poor and improved to only fair Sunday. However, long skip made its presence known Sunday when KH6IJ boomed through to us easterners at 1215 GMT while, at the same time, practically all W6/W7 signals fade out. During this period peculiar ionospheric conditions occurred with one-way skip taking over. When East Coast signals were being logged and called by KH6IJ we weren't hearing him. Conversely, when his signals burst through here he wasn't copying our frantic calls. Such a shame as so many of the boys need only Hawaii for their 160 WAS.

This one-way skip phenomenon is a most intriguing mystery as it has often been observed on the East Coast/Europe as well as the East Coast/West Coast paths but rarely, if ever, on the North/South path.

There were many QSOs to Japan by the boys out on the West Coast. The deepest penetration, however, was made by KA9MF to WØNWX (now WØDX) giving Bob his 160 WAC. Might I mention that WØVXO made his in February and W9PNE in March?

The "big guns" and "little guns" alike prepared for this event and their efforts didn't



Want to see who it was at the other end of those QSO's so many of you had with PZ1AH last season? Here he is . . . . Andre.

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

"Maybe *next* year I'll work K H 6 I J." WA3BGN at 16 has plenty of "next tears" to go.

go unrewarded. Scores reached heights never before attained. And the greatest number of countries ever to participate were on, with 33 taking part. Of these 33, logs were received from 31. The 256 QSOs of G3KMI weren't far off the record of the 259 made by K8RRH in 1967. K8RRH put in another splendid performance with 250 QSOs. Seven surpassed last year's highest multiplier of 53 and G3SED, with 18 countries worked, topped last year's high of 17. So-o-o-o, regardless of the sunspot cycle the "stuff" was there to be worked.

Again we had activity from 47 States with Nebraska, Utah and Alaska being the only ones to show up amongst the missing. Logs were received from all participating States but Kentucky. To the north we had activity from all Canadian Provinces but New Brunswick, Prince Edward Island and North West Territory.

Most of you aren't aware of the extent of DX activity. Here is a pleasant surprise for you as to what countires were on: CE, CO, DL, EI, G, GC, GD, GI, GM, GW, HB, JA, KH6, KP4, OE, OH, OHØ, OK, PA, PY, PZ, VE, VK, VP7, VP9, VQ8, VQ9, W, XE, YV, ZC4, ZL and 9H1.

Herb, WØVXO, made elaborate plans for this Contest by going south of the border and operating as XEØVXO thus snagging 10-point QSOs with the W/VE gang instead of the usual 2 pointers. He ran up the highest score ever achieved and gave many of the boys their first XE on 160 although ZE1OK and XE2OK are native stalwarts on the band.

An important point for the DX boys to note: a QSO to each separate State and Canadian Province gives you an extra multiplier plus the 10 points for such a contact. But, on top of this you cannot count the United States and Canada/Newfoundland as separate multipliers, too.

For all of you to make note of . . . this is a c.w.-to-c.w. Contest only; c.w.-to-phon QSOs are not permitted nor are any cros band contacts allowed. For the sake o awards, and in lieu of QSL, *CQ* will honor a listings within the logs received as sufficien proof of contact. We believe ARRL will like wise agree on this point for any of the awards.

Often comments make the most interes ing part of the story. What contest would b complete without them? What do the ope ators think of? What thoughts run around i their minds after a weekend such as this Here's what the contestants had t say . . . . .

Comments

1st District—*K1PBW:* It was a great contest. Th uneven condx were amply compensated for by th complete lack of QRN. Used a 135' vertical fo transmitting. When working Eu used a 1,7000' Be erage antenna for receiving as it helped eliminate th heavy stateside QRM. It runs 32 degrees east o magnetic north, 10 to 30 feet high and terminate with a 600 ohm non-inductive load. *W1WY:* Bigge disappointment finding out that KH6IJ called me a 1130 GMT Sunday but I didn't hear him althoug was digging around that portion of the band at th time. *W1BB/1:* Test was a "Jim-Dandy." Cond great the second night. Almost like having a pipe lin to Eu. Most amusing incident was during the wanin hours of the contest, when things were quietin down, the 'shooting' was practically over, everyon on the band had worked everyone else and there ju wasn't any more . . . hardly!! Suddenly Willi W8GDQ, showed up for his KA9AK sked. Wh oping, screaming, hollering, the gang piled up 6 to 1 deep calling him for that "last" contact, that la ounce, those final 2 points. 20 meters had nothin on this.

2nd District—*WA2KHL:* Condx not as good as la year. West coast signals much down in the mu Although we worked Eu before and after the conte we never seem to get over when it counts! *W2HU* Suggest that everyone use the ARRL Operating A no. 6 to avoid duplicate QSOs. *WB2OZW:* It su turned out to be a fine contest. Condx were ju great. *K2GNC:* I thought DX condx were better tha last year but couldn't raise a single Eu or West Coa station. Why? (Move over, Bill, as fate dealt the sam blow to many-*ed). W2FCQ:* Could have run up higher score but flu bug hit hard. Contest su brought the boys out. Wish it could be a month affair.

3rd District—*WA3DDW:* Looks like the 160 C.W Contest has stirred up a lot of interest. Band wa jammed from 1799 to 1826 kc! Noted some opera tions out of the band. Also noted a large number o newcomers. *WA3EPT:* Excellent condx for such high sunspot number. Don't throw away that cryst ball. *W3DPJ:* I got more satisfaction from this con test than anything I've done in ham radio. Bigge thrill was working EI9J for my first trans-Atlanti QSO on 160. Biggest disappointment was hearin KH6IJ but not working him. *W3JXS:* Band cond seemed quite good. Heard quite a few Eu's but non worked. Very enjoyable contest.

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first column indicates the
ber of contacts, second is the
tiplier, third is the number of
erent countries worked and
last column is the final score.

CONNECTICUT
PBW	202	51	11	27,948
VY	162	48	12	23,616
1FDV	98	32	3	6,528
DIT	49	22	3	2,332
MO	2	2	1	8

MAINE
JOT	105	29	2	6,090

MASSACHUSETTS
BB/1	179	55	14	35,530
1FHU	144	34	4	9,724

NEW HAMPSHIRE
NBN	98	24	2	9,408
TW	50	20	2	2,000
SWX	4	4	4	96

RHODE ISLAND
HLY	44	19	2	1,672

VERMONT
TH	67	23	2	3,082

NEW JERSEY
EQS	187	46	6	19,780
U	160	48	9	19,584
2KHL	167	42	6	15,246
ADE	131	40	7	12,080
HUG	139	37	5	11,174
2OZW	113	30	3	7,020
MDE/2	100	31	3	6,448
AQT	86	33	4	6,204
KCB	35	12	2	840
MPP	5	5	1	50

NEW YORK
JWD	184	50	9	21,200
GNC	142	41	5	12,956
FCQ	112	35	5	8,680
VGR	91	30	3	5,700
2KIZ	98	28	2	5,488
ZSD	30	16	2	960
2JZX	35	12	2	840

DELAWARE
3DDW	60	27	4	3,672

MARYLAND
3EPT	227	55	11	30,690
DPJ	234	54	9	28,728
XS	137	39	5	11,622
MSR	122	33	3	8,316

PENNSYLVANIA
EIS	224	52	10	26,624
VGH	202	45	6	19,980
AJS	136	36	2	9,892
3BGN	127	35	3	9,170
RRV	81	32	6	6,208
DO	14	8	1	224

ALABAMA
AI/4	193	51	7	22,542

FLORIDA
4PXP	175	48	8	20,256
3RB	101	37	5	7,622
XG	64	30	4	4,320

GEORGIA
YWX	213	52	8	25,064

NORTH CAROLINA
IHL/4	119	32	2	7,616
PVT	70	25	2	3,500
DMW	63	25	3	3,350

SOUTH CAROLINA
4UPR	120	39	6	10,920
WB	72	31	3	4,712

TENNESSEE
HYY	80	33	3	5,544
DQA	46	25	3	2,500
ZZ	41	20	3	1,960
GS	11	6	1	132

VIRGINIA
SHX	118	39	7	10,744
KXV	46	22	3	2,200
KFC	24	13	1	312

ARKANSAS
WA5KUD	10	7	2	140

LOUISIANA
WA5NLJ	83	30	2	5,220
W5TTB	64	26	3	3,536
WA5EID	12	11	2	352

MISSISSIPPI
K5MZU	114	41	3	10,004

NEW MEXICO
WØVEH/5	83	37	3	6,734
W5SOT	69	33	2	5,016

OKLAHOMA
K5VTA	136	41	3	11,480

TEXAS
K5UWD/5	197	49	6	21,276
W5FIX	117	40	4	10,320

CALIFORNIA
W6GEN	158	49	7	19,012
W6ITY	120	44	6	13,024
W6BHZ	132	42	4	12,096
W6GWQ	78	30	5	5,820
W6AMO	79	27	5	5,562
W6ZDO	40	22	3	1,936
W6YC	29	12	3	792

ARIZONA
WA7BOB	60	26	4	3,744
WA7BOA	55	23	3	2,898
W7BNZ	8	3	1	48
W7GLL	5	3	2	30

IDAHO
K7MKW	69	35	4	5,670
K7YFF	19	10	2	380

MONTANA
W7GBL	58	26	2	3,016

NEVADA
K7ICW	85	33	3	6,138

OREGON
W7AVV	85	29	4	5,626

WASHINGTON
W7DL/7	134	45	5	15,210
W7ZRG/7	99	37	3	7,918
W7DRA	60	24	3	3,264

WYOMING
W7HTL	40	18	2	1,440

MICHIGAN
W8TJQ	230	53	6	28,000
W8DGP	216	43	3	19,264
WA8EMJ	184	43	4	16,512
K8BYI	113	31	3	7,910

OHIO
K8RRH	250	56	10	32,032
K8RYU/8	134	40	3	11,040
W8QWI	130	37	3	9,916
K8EEG	99	34	2	6,732
K8EKG	86	30	3	5,400
W8LOF	75	32	4	5,312
W8TSD	31	23	2	1,610

WEST VIRGINIA
K8UZX	212	43	4	18,920
W8VVE/8	177	42	6	16,212
K8QYG	50	18	2	1,800

ILLINOIS
W9YYG	232	54	8	27,080
W9UCW	228	52	5	25,376
W9PNE	150	47	4	15,228
W9GFF/9	61	29	3	3,770
WA9NSH	58	26	2	3,016
K9DTB	5	5	1	50

INDIANA
K9YWO	240	57	8	30,096
W9YB	231	52	7	27,560
W9DPL	16	12	2	384

WISCONSIN
W9YT	215	51	6	23,970
W9HHX/9	146	43	4	13,588
WA9AIB	40	25	3	2,200
W9BQM	4	4	2	64

COLORADO
WAØCVS	135	43	4	12,642
WØEXS	69	36	3	5,256
WØLRW	51	25	3	2,950

IOWA
WØNFL	184	49	5	19,208
WØRFT	82	34	3	5,748

KANSAS
WAØIYX	151	46	4	14,996
WØPSF	114	40	3	9,520
WAØJVS	113	38	4	9,348

MINNESOTA
WØAIH	200	50	5	21,600
WØRHI	98	37	3	7,548

MISSOURI
KØJPL	158	46	4	15,640
WØAV	94	36	3	7,056
KØYGR	89	37	3	6,882
WØOGC	63	31	3	4,402
WAØKMJ	58	29	2	3,596

NORTH DAKOTA
WØSDN	133	45	3	12,690

SOUTH DAKOTA
WAØMWN	61	32	3	4,160

NEWFOUNDLAND
VO1FB	41	21	10	5,250

NOVA SCOTIA
VE1EK	30	15	2	900

QUEBEC
VE2UQ	173	42	7	15,792

ONTARIO
VE3DU	102	36	4	7,920
VE3ABG	76	27	3	4,320
VE3GAG	41	18	2	1,476
VE3FSQ	1	1	1	2

MANITOBA
VE4JB	61	27	3	3,510

SASKATCHEWAN
VE5JI	38	22	2	1,672

ALBERTA
VE6BA	13	10	2	260

BRITISH COLUMBIA
VE7AKI	67	30	5	4,980
VE7EH	74	26	3	4,264

ALAND ISLANDS
OHØNI	14	6	6	402

AUSTRALIA
VK5KO	2	2	2	14

AUSTRIA
OE1KU	51	10	10	2,520

BAHAMAS
VP7DX	70	31	1	21,700

BERMUDA
VP9BY	40	16	3	6,320

BRAZIL
PY2BJH	9	7	4	504

CHILE
CE3CZ	1	1	1	5

CUBA
CO2QR	1	1	1	5

CYPRUS
ZC4RB	47	9	9	2,115

CZECHOSLOVAKIA
OK2RZ	148	16	16	9,136
OK1ATP	136	16	16	8,000
OK3BU	134	16	16	7,392
OK1IQ	122	17	17	7,140
OL6AIU	121	15	15	6,435
OK1AHZ	82	17	14	5,338
OK1KKS	101	15	15	5,220
OK3CEA/P	108	15	15	5,175
OK1KPR	106	13	13	4,823
OK2HI	103	13	13	4,524
OK1KOK	92	13	13	3,991
OK1AOV	92	13	13	3,835
OK1OO	81	13	13	3,627
OK3BA	82	11	11	3,256
OK2BNY	89	11	11	3,245
OK1KRL	75	12	12	2,904
OK2BOL	80	11	11	2,816
OK2BLC	67	11	11	2,398
OK1BM	66	11	11	2,222
OL1AGS	58	11	11	2,101
OK2BYW	55	11	11	1,969
OK3CDN	61	11	11	1,936
OK1ZW	62	9	9	1,710
OK1AVG	57	9	9	1,431
OK1ACF	41	9	9	1,359
OK2BOB	46	9	9	1,287
OK2KJU	47	8	8	1,184
OK1AKX	46	8	8	1,072
OK1AJY	41	8	8	1,040
OKIXC	33	9	9	918
OL1AHN	51	5	5	690
OKIASE	42	6	6	684
OK1AVY	43	6	6	612
OK2BNZ	26	6	6	438
OK1AIJ	34	5	5	400
OL5AFE	40	3	3	276
OK1AUC	15	5	5	240
OK3BT	16	4	4	224
OL4AJF	23	4	4	220
OK1EP	26	3	3	183
OK1KPX	18	3	3	135
OK1AIA	31	2	2	130
OK1AWR	25	2	2	106
OL8AJJ	23	1	1	46
OL3AHI	9	2	2	42
OK2BJU	7	2	2	34
OK2KNN	13	1	1	26
OK1AEH	11	1	1	22

EIRE
EI9J	105	17	13	9,520

ENGLAND
G3KMI	256	20	15	17,040
G3SED	179	21	18	13,692
G3IGW	146	17	14	9,010
G2DC	81	14	14	4,550
G3SVW/A	130	11	11	4,521
G3VPS	131	10	10	3,790
G3PVA	105	10	10	3,790
G3HZL	91	11	11	3,300
G3SXW	91	10	10	2,930
G3ADH	84	10	10	2,760
G3JVJ	43	11	10	1,881
G3VRY	33	7	7	679

FINLAND
OH2KH	127	14	14	8,736
OH2KK	50	11	11	2,651

GERMANY
DL1VW	53	11	11	2,937

HAWAII
KH6IJ	21	11	3	2,255

ISLE of MAN
GD3TNS	61	11	11	3,322
GD3HQR	54	9	9	2,358

JAPAN
JA2CLI	26	6	3	714
JA3AA	28	5	3	680
JA7CQB	16	2	2	80
JA3JM	13	1	1	26
JA1PIG	12	1	1	12

MALTA
9H1AE	18	7	7	609

MEXICO
XEØVXO	228	50	6	112,850

NETHERLANDS
PAØPN	87	16	11	7,792
PAØGMU	117	13	13	7,527

PUERTO RICO
W1FZJ/KP4	25	19	3	4,560
KP4ES	1	1	1	10
KP4AST	1	1	1	10

SCOTLAND
GM3KMR	151	12	12	8,736
GM3OXX	114	12	12	6,408

NORTH IRELAND
GI3OQR	172	20	16	17,280

SURINAM
PZ1AH	18	12	3	2,100

SWITZERLAND
HB9TT	110	20	16	11,580
HB9QA	26	6	6	780
HBB9UD	23	6	6	672
HB9YL	6	4	4	108

VENEZUELA
YV1OB	18	15	2	2,700

WALES
GW3UCB	75	11	11	4,059

See Page 134 for New Reader Service

John Dormois, WØGDH, one of the old stalwarts and first to achieve a 50-state WAS on 160 meters.

5th District–*WA5KUD:* Sorry I couldn't operate more but I go to college and work 36 hours a week. (Boys, this comment from Steve Norris in the rare State of Arkansas-*ed).* *WA5EID:* Didn't do too well but maybe better luck next year. Antenna was draped across roof and that doesn't speak well for efficiency. Will start plotting against-err-planning for competition with WA5NLJ next year. (Better think of W5TTB, too-*ed).* *WØVEH/5:* Had a lot of fun but not too many contacts. Just arrived in New Mexico. Strung a quarter wave piece of wire only 20 feet high at the highest point and bent at an angle. I'm screened down here from the east by a high ridge of mountains.

6th District–*W6GEN:* The 160-meter contest is probably the only one left which won't be affected by incentive licensing. In general, unlike so many contests, almost everyone operated in a sportsman-like manner. It marked the first time I became involved in this contest. *W6BHZ:* We had fun in this contest. *W6GWQ:* Another FB contest. Cuagn next year. *W6ZDO:* Accidently ran into contest during my usual Saturday 160-meter operation. Started gathering States off and on during evening. Sounded like low end of 40 on a weekend evening.

7th District–(Here is a 160-meter ham family that partook of the contest. W7BNZ is the father and his sons are WA7BOA and WA7BOB-*ed).* Condx were okay but we live in the heart of Phoenix and were plagued with noise. Since W7DOL moved to California I guess we're the sole 160 c.w. representatives in Arizona. (No, Dave, there were several others who were on–*ed).* *W7GLL:* Just got going when my vox-keying tube managed to fail and had no spare. *K7MKW:* Condx to the northeast were rather poor. Very few of the stations had the oomph to get through. The JA's showed up on time during the morning of the 27th but they were very close to the mud level. They weren't heard here the 28th but the 6's were heard calling and working them.

8th District–*W8DGP:* Arrived home from KL7FRY about a month before the contest. All the QRM experienced would have been most welcome last year when I had only 9 QSOs from Alaska. *WA8EMJ:* Enjoyed the contest again. Made more QSO but still not enough. Rain, causing line transformer to discharge, raised noise level to extent I had to QRT. *K8RRH:* Where was Arkansas? *K8RYU/8* Again, I really enjoyed the contest. Good cond observed with all factors such as sunspots taken int consideration.

9th District–*W9UCW:* This was my first contest o any kind. Learned a lot and had a great time. Plan t make a 160 conical monopole for next year's even *W9PNE:* Contests are usually won by young men s this counts me out. Good condx, lots of activity an good operating. *K9DTB:* I called W1BB for an hou and he still wouldn't answer. (Stew?-*ed).* *K9YWO* No special preparation for this contest. Always us 50' vertical with motorized coil at the base an turnable from the operating table. Very high-Q system with antenna structure and grounding. An other very fine 160-meter test.

10th District–*WØLRW:* I didn't have a 160-mete transmitter. So, the night before the contest, wound a couple of coils for my old AT-1. It was so much fun I'm going to plan farther ahead and have better set-up next year. *WØNFL: FB* contest agai this year. Condx fair with no QRN, but signals wer weaker. Had trouble working the W1's through th QRM. KH6IJ had a nice signal. *WØRFT:* Great con test. Band very lively here in the mid-west *WAØIYX:* My biggest thrill was working KH6IJ This is first time in contest. Have been on 160 only month.

Canada-*VO1FV:* Despite my shorter antenna (onl 200' instead of 700') and lack of radials due to m just having moved to a new QTH, I seemed to get ou almost as well as before but maybe condx were jus good. I think the sunspots must have taken a holida on the contest weekend. *VE1UQ:* The east/wes path most definitely has deteriorated here. All I ca say, though, is that if this is 160's low spot at pea sunspot cycle let's look forward to gradual improve ment and, above all, the next contest! *VE3DU:* M biggest drawback is my sister's TV which reall clobbers reception. Think I'll invest in a new set an get away from my ITV problems. That horizonta oscillator!*&$?@%! (Suggest those QRMd by T birdies lay down the law of no TV during contest What to do about the neighbors' sets, though, is th big question-*ed).* *VE3GAG:* We had an ice stor before the contest and it brought my antenna dow with it! *VE3FSQ:* Hope to have a higher score nex time. (The understatement of the century-*ed)*

DX DX DX DX DX

OHØNI: Glad to get two new countries, PAØ an GI. *VK5KO:* Can't figure out how I can hear 'em bu not work 'em. The JA/KA gang rolled in here but no a single QSO. Put KA9MF on speaker, went out i yard, walked around antenna farm and could cop him 100' away from shack at one in the morning Neighbors musta thought me wacky. Biggest traged was hearing VQ8CC calling me on sked on the 2 with signals RST 439 but he would't answer m frantic calls. *VP8DX:* Enjoyed the contest mainl for meeting old friends rather than a big score. M QSL Manager is Tracy Levy, W4FRO, Box 714, Ea Gallie, Florida. *VP9BY:* The contest was the firs that I have entered on this band. Enjoyed it im mensely even though keyer problems and burnt-out transformer in the rig kept me off the ai quite a while. Had lots of fun nevertheless. I'm looking forward to the next one. *PY2BJH:* Band

[*continued on page 116*]

See Page 134 for New Reader Service

ℝules: 1968 *CQ* World-Wide DX Contest

October 26-27 & November 23-24

. CONTEST PERIOD

Phone: Oct. 26–27, **C. W.:** Nov.23–24.

The contest is always held on the last full week-nd of October and November.

I. OBJECTIVE

The object of the contest is for Amateurs around he world to contact as many other Amateurs in as nany different Zones and Countries as they can luring the 48-hour contest period.

II. BANDS

All Amateur bands, 10 thru 160 meters.

V. TYPE OF COMPETITION

1.Single Operator.
   a. Single Band.
   b. All Band.

2.Multi-Operator. (all-band operation only)
   a. Single Transmitter. (Only one signal permitted)
   b. Multi-Transmitter. (Only one signal per band permitted)

. NUMBER EXCHANGE

1. Phone: 4 numbers, RS report plus Zone umber. (i.e.-5805)

2. C.W.: 5 numbers, RST report plus Zone umber. (i.e.-58905)

I. MULTIPLIER

Two types of multipliers will be used:

1. A multiplier of one (1) for each different one contacted on each band.

2. A multiplier of one (1) for each different ountry contacted on each band.

Stations are permitted to contact their own ountry and Zone for multiplier credit.

The *CQ* Zone Map, DXCC country list, WAE ountry list and WAC continental boundries are he standards.

II. POINTS:

1. Contacts between stations on different contients are worth three (3) points.

2. Contacts between stations on the same contient but different countries are worth one (1) oint.

(Exception: Contacts between stations within he North American continental boundries will ount two (2) points. This applies to N.A. *only*)

3. Contacts between stations in the same counry are permitted for Zone or Country multiplier redit but have Zero (0) point value.

Only one contact with the same station on the ame band is permitted.

VIII. SCORING

All stations: The final score is the result of the total QSO points multiplied by the sum of your Zone and Country multipliers.

Example: 1000 QSO points X 100 multiplier (30 Zones + 70 countries) = 100,000 (final score).

IX. AWARDS

First place certificates will be awarded in each category listed under Sec. IV.

1. In every participating country.

2. In each call area of the United States, Canada, Australia and Asiatic USSR.

All scores will be published. To be eligible for an award a Single-operator station must show a minimum of 12 hours of operation. Multi-operator stations must operate a minimum of 24 hours. A single-band log is eligible for a single-band award *only*. If a log contains more than one band it will be judged as an all-band entry, unless specified otherwise.

In countries or sections where the returns justify, 2nd and 3rd place awards will be made.


WORLD-WIDE DX CONTEST

Call W1WY

Band	QSOs	Zone Multiplier		Country Multiplier		Points		Band Score	Band
1.8 Mc	2	2	+	2	×	4	=		1.8 Mc
3.5 Mc	18	9	+	12	×	50	=		3.5 Mc
7 Mc	44	22	+	28	×	121	=		7 Mc
14 Mc	128	26	+	53	×	361	=		14 Mc
21 Mc	61	16	+	33	×	169	=		21 Mc
28 Mc	3	3	+	3	×	9	=		28 Mc
TOTAL	256	78	+	131	×	714	=	149,226	All Bands

Remarks (Suggestions, Criticisms, and Comments) WORKED CH2AM ON 5 BANDS – 3.5 THRU 28 MC!

Club Participation FAIRFIELD COUNTY DX CLUB

This is to certify that in this contest I have operated my transmitter within the limitations of my license and observed fully the rules and regulations of the contest.

Name FRANK ANZALONE (USE BLOCK LETTERS) Call W1WY

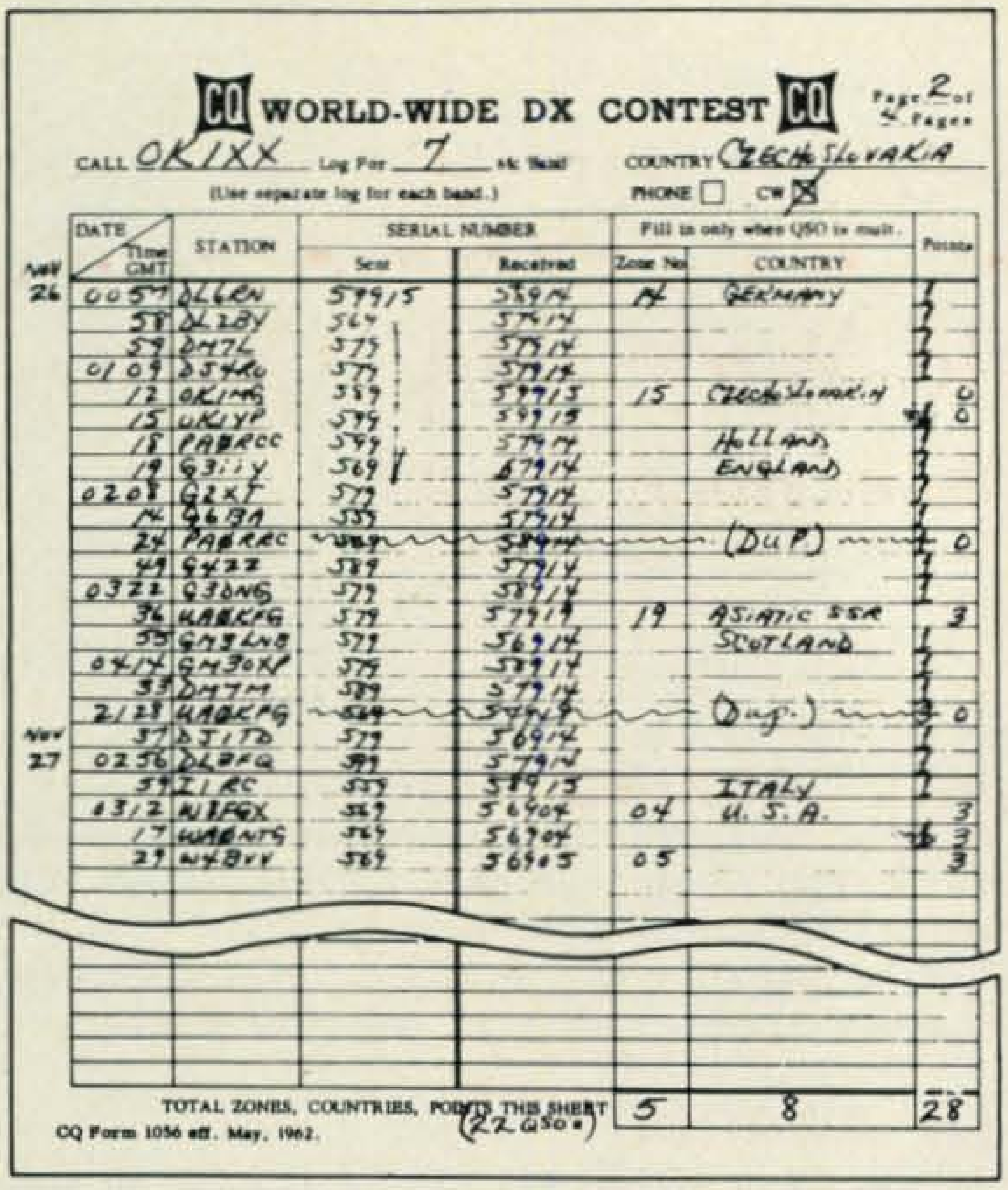
Street and Number 14 SHERWOOD ROAD

City STAMFORD Country CONNECTICUT, U.S.A. 06905

CQ Form 1057 eff. August, 1966

A sample summary sheet. Free summary sheets, log pages and zone maps may be obtained upon receipt of a large s.a.s.e. or, if outside the U.S., sufficient IRC's. When you send in your score . . . include photos.

See Page 134 for New Reader Service



CQ WORLD-WIDE DX CONTEST CQ — Page 2 of 5 Pages

CALL OK1XX — Log For 7 Mc Band — (Use separate log for each band.)

COUNTRY CZECHOSLOVAKIA — PHONE ☐ CW ☒

DATE	Time GMT	STATION	SERIAL NUMBER Sent	Received	Zone No.	COUNTRY (Fill in only when QSO is mult.)	Points
Nov 26	0057	DL6EN	599 15	589 14	14	GERMANY	1
	58	DL2BY	569	579 14			1
	59	DM7L	579	579 14			1
	0109	DJ4KU	579	579 14			1
	12	OK1MG	589	599 15	15	CZECHOSLOVAKIA	0
	15	OK1YP	599	599 15			0
	18	PA0RCC	599	579 14		Holland	1
	19	G3[illegible]Y	569	579 14		England	1
	0208	G2XT	579	579 14			1
	14	G6BA	559	579 14			1
	24	PA0RRC	[illegible]	589 14		(DUP.)	0
	49	G4ZZ	589	579 14			1
	0322	G3DNG	579	589 14			1
	36	UA0KFG	579	579 19	19	ASIATIC SSR	3
	55	GM3LNB	579	569 14		SCOTLAND	1
	0414	GM3OXF	579	589 14			1
	53	DM7M	589	579 14			1
	2128	UA0KFG	[illegible]	[illegible]		(Dup.)	0
Nov	37	DJ1TD	579	569 14			1
27	0256	DL8FQ	599	579 14			1
	59	I1RC	559	589 15		ITALY	1
	0312	W1FGX	569	569 04	04	U.S.A.	3
	17	WA8NTG	569	569 04			3
	29	W4BVV	569	569 05	05		3
		TOTAL ZONES, COUNTRIES, POINTS THIS SHEET (22 QSO's)			5	8	28

CQ Form 1056 eff. May, 1962.

A sample log page—40 QSO's to a page. You may work your own country for multiplier credit, but receive NO QSO points. Logs must be checked for Correct QSO point credit and duplicate QSO's.

X. TROPHIES & PLAQUES

A handsome award will be made to the highest scoring stations in the following categories.

Donors-Single Operators, Single Band.

1. World–Phone. *(Dr. Harold Megibow, K2HLB Memorial–North Jersey DXA)*
2. World–C.W. *(Earl Lucas, W2JT Memorial–NJDXA)*
3. Canada–Phone. *(Gene Krehbiel, VE6TP)*
4. Caribbran/C.A.–Phone. *(Gus Kuether, HR2GK)*

Donors-Single Operator, All Bands

5. World–Phone. *(Bill Leonard, W2SKE)*
6. World–C.W. *(Larry LeKashman, W9IOP)*
7. USA–Phone. *(Potomac Valley Radio Club)*
8. USA–C.W. *(Frankford Radio Club)*
9. Europe–Phone. *(W4BVV Operators)*
10. Europe–C.W. *(W3MSK Operators)*
11. Caribbean/C.A.–Phone. *(Harold Fox, W3AA)*
12. Caribbean/C.A.–C.W. *(Harold Fox, W3AA)*
13. Africa–Phone. *(Gordon Marshall, W6RR)*
14. Africa–C.W. *(Gordon Marshall, W6RR)*
15. Oceania–Phone. *(Jack Chalk, KW6EJ)*

Donors-Multi–Operator, Multi–Transmitter

16. World–Phone. *(John Knight, W6YY)*
17. World–C.W. *(Dr. Anthony Susen, W3AOH)*

Donors-Multi–Operator, Multi–Transmitter

18. World–Phone. *(Radio Club Venezolano)*
19. World–C.W. *(Hazard Reeves, K2GL)*

Donors-Contest Expeditions

20. World–Phone. *(Stuart Meyer, W2GHK)*
21. World–C.W. *(Don Miller, W9WNV)*

The Canadian, Caribbean/Central American and African awards are open to residents *only.*

Trophy winners may win the same trophy only once within a three-year period.

Top scoring stations who are ineligible for a trophy will be awarded championship plaqu (Donated by *CQ*)

There are no "three year" restrictions on t winning of any *CQ* plaque, including Club awar

XI. CLUB COMPETITION

A handsome plaque will be awarded to the Clu submitting the highest aggregate score of the phor and c.w. scores submitted by its member (Donated by *CQ*)

1. The club must be a local group and can no be a national body.
2. Participation is limited to active clu members operating within local geographic ar (except for DX-peditions especially organized fo operation during the contest and manned by clu members).
3. To be eligible for an award a minimum of logs must be received and an officer of the club mus submit a list of participating members and the scores, both phone and c.w.
4. Each participating member must clearly indi cate the name of his club on his Summary sheet.

XII. LOG INSTRUCTIONS

1. All times must be kept in GMT.
2. Use a separate log for each band.
3. Indicate Zone and Country multipliers onl the FIRST TIME they are contacted on each band
4. Logs must be checked for duplicate contact correct QSO points and multipliers, and recopie logs must be in their original form, with correction clearly shown.
5. Each entry must be accompanied by a Sum mary Sheet showing all scoring information, th category of competition, the contestant's name an address in BLOCK LETTERS, and signed declara tion that all contest rules and regulations fo amateur radio in the country have been observed.
6. Official log and summary sheets and Zon maps are available from *CQ*. A large self-addresse envelope with sufficient postage or IRCs must ac company your request.

If official forms are not available you can mak up your own by following the attached sample, wit 40 contacts to the page on 8½ x 11 inch paper.

XIII. DISQUALIFICATION

Violation of amateur radio regulations in th country of the contestant, or the rules of the con test; unsportsmanlike conduct, taking credit fo incorrect QSOs or multipliers, or duplicate contac in excess of 3% of the total made will be deeme sufficient cause for disqualification.

Actions and decisions of the Committee are o ficial and final.

XIV. DEADLINE

All entries must be postmarked NO LATER tha December 1, 1968 for the Phone section and Janu ary 15, 1969 for the C.W. section. In rare isolate areas the deadline will be made more flexible. Log go to:

CQ WW Contest Committee
14 Vanderventer Avenue
Port Washington, L.I. N.Y. USA 11050.
(Indicate phone or c.w. on envelope)

(Please circulate this information to your DX friends and radio clubs.)

See Page 134 for New Reader Service

Signals From Satellites

BY GEORGE JACOBS,* W3ASK

T WICE a year *CQ* publishes an updated sting of satellites that continue to transmit adio signals back to earth. The latest list, ontaining those frequencies on which sigals from U.S. launched satellites could be eard as of June 1, 1968, appears on the ollowing page.

By mid-1968, no fewer than 60 U.S. aunched satellites were in orbit transmitting adio signals of one type or another back to arth on more than 100 frequencies between pproximately 19 and 402 mc. Radio amaeurs and space-listeners report receiving nany of these transmissions, sometimes using nly fairly inexpensive receiving equipment. Vhile signals from many of the satellites now n orbit are very weak and can only be reeived with low noise receivers and high gain racking antennas, signals from some satelites operating in the high frequency bands an often be heard well on shortwave reeivers using relatively simple antennas. Sigals from the higher power satellites in the .h.f. band (136-137 mc) can often be reeived well on relatively inexpensive v.h.f. eceivers, or on shortwave receivers equipped vith a suitable frequency converter. An outide antenna, preferably one with directivity nd gain is generally required for most satelite signals, especially those from low power ransmitters.

The satellites which can usually be heard vith the least difficulty are those which transnit continuous c.w. signals. These signals, vhich are often used as tracking beacons, can sually be identified by their steady tone vhen the receiver's beat frequency oscillator b.f.o.) is in the ON position. Telemetry sigals are often more difficult to receive, since n most cases telemetry data is transmitted for only brief periods upon command from the ground. Telemetry signals usually consist of two or more musical tones transmitted at the same time, or as in the case of many Russian satellites, of a series of dots and dashes of different length. There are so many satellites in orbit at the present time, it is necessary to command-operate more and more transmitters in order to share the use of frequencies and avoid interference between satellites. Note in the listing the number of times three, four and sometimes even five satellite transmitters share the same frequency.

Foreign Satellites

The USSR has launched nearly 225 satellites to date in their COSMOS scientific and space exploratory series, in addition to dozens of other scientific, communication, interplanetary and lunar satellites as well as several manned spacecraft. Since most of the Russian satellites remain in orbit or transmit radio signals for only a few days, their frequencies are not shown in the listing. For the most part, however, signals from Russian satellites can usually be heard on frequencies between 19.990 and 20.010 mc, in the shortwave band. COSMOS satellites operating in this range have recently been launched on inclinations of approximately 51°, 65°, or 73°, and have periods ranging between 88 and 91 minutes.

Signals from Russian satellites in the METEOR weather system (apparently transmitting cloud-cover pictures back to earth), have recently been reported on 461.5, 464 and 466.5 mc. These satellites have a period of approximately 97 minutes, and are inclined about 81° to the equator.

While not shown in the listing, a French geodetic satellite, DIADEME-1, is believed to

* Space Communications Editor, *CQ*.

be transmitting tone modulated signals on command from the ground on 136.980, 149.-70 and 399.920 mc. DIADEME-1 has a period of 104 minutes and an inclination of 40°.

Spaceman Frequencies

The frequencies to be used on the Apollo manned spacecraft had not yet been announced at the time the latest *CQ* listing was compiled. In the past, however, American astronauts aboard Mercury and Gemini spacecraft reported to earth on an h.f. frequency of approximately 15.017 mc and on 296.8 and 243.0 mc in the v.h.f. band. It is likely that the same or similar frequencies will be used with Apollo spacecraft.

Cosmonauts on board Soviet manned spacecraft have used 17.365, 18.035, 19.996 and 143.625 mc for voice and telemetry transmissions.

Identifying Satellites

Orbital inclination and period data are i cluded in the *CQ* listing as an aid in identif ing satellites from which signals can be r ceived. *Inclination* is the angle that tl satellite's orbit makes with the equator. a directional antenna is being used to recei satellite signals, the inclination can be us for determining the direction from which tl satellite's signal should be heard first. Tl satellite's *period* is the time it takes, in mi utes, for the satellite to complete an orb By timing reception on successive orbits, it often possible to identify a satellite by i known period.

The exact time that a satellite passes ove head, or nearest to a listener's location as orbits in space can be determined by notir

[*Continued on page 130*]

Table I—List of Frequencies on which Satellites could be heard as of June 1, 1968

Freq. (mc)	*Satellite Name*	*Purpose*	*Period (Minutes)*	*Inclin-ation (Degrees)*	*Remarks*
20.000	EXPLORER—27	Geodetic studies	108	41.2	Command, tone modulated beacon
20.005	EXPLORER—22	"	105	80	"
40.000	EXPLORER—27	"	108	41.2	"
40.010	EXPLORER—22	"	105	80	"
41.000	EXPLORER—27	"	108	41.2	"
41.010	EXPLORER—22	"	105	80	"
136.020	EXPLORER—33	Scientific	25133	44.6	Command, c.w. beacon & telemetry
136.050	IRIS	European Research	98.8	97.1	"
136.078	ALOUETTE—1	Ionospheric studies	105.5	80.5	"
136.080	ALOUETTE—2	"	121.3	79.8	"
136.141	EXPLORER—34	Interplanetary studies	6228	68.8	"
136.142	RELAY—2	Communications	195	46.3	Command telemetry
136.171	EXPLORER—22	Geodetic studies	105	80	"
136.200	OGO—1	Geophysical studies	3841	53.8	Command, c.w. beacon & telemetry
136.200	OGO—3	"	2913	51.8	"
136.200	OGO—4	"	97.4	86	"
136.200	OGO—5	"	3796	31	"
136.260	ERS—20	Radiation studies	2831	35.1	"
136.290	OSO—3	Solar studies	95.6	32.9	"
136.320	EXPLORER—36	Gravity studies	112.2	106	"
136.350	FR—1	Ionospheric studies	100	75.9	"
136.350	EXPLORER—38	Radio Astronomy	224.4	120.6	Command, c.w. beacon & telemetry
136.380	EXPLORER—31	"	120.4	79.8	"
136.380	ERS—27	Radiation studies	2827	35.2	Continuous, c.w. beacon & telemetry*
136.410	PEGASUS—1	Meteoroid detection	97	31.8	Command telemetry
136.410	PEGASUS—2	"	97	31.8	"
136.410	PEGASUS—3	"	94.1	28.9	"
136.410	EXPLORER—37	Solar studies	98.7	59.4	Command, c.w. beacon & telemetry
136.440	EARLY BIRD	Communications	1437	2.7	"
136.440	INTEL—2—F1	"	718	17.4	"
136.440	INTEL—2—F2	"	1436	1.1	"
136.440	INTEL—2—F3	"	1436	0.5	"
136.440	INTEL—2—F4	"	1436	0.5	"
136.467	SYNCOM—2	"	1436	28.8	"
136.470	SYNCOM—3	"	1436	2.0	"
136.470	ATS—1	Applied technology	1436	0.3	Command telemetry
136.470	ATS—2	"	167	28.4	"
136.470	ATS—3	"	1436	0.1	"

[TABLE I—*continued on page 36*]

See page 134 for New Reader Servic

Looks aren't everything.

This new Ham Cat may be the best looking ham mobile antenna you've ever seen, but that's just the half of it.

After all, beauty is as beauty does, and this one does it better than any other ham antenna you can buy.

First of all, it's got a shake-proof sleeve clutch that folds over when you want to garage it.

Which also means you can change from one band to another in a couple of seconds by simply unscrewing one complete coil and tip rod unit and screwing another onto the foldover mast.

It's also strong enough to take a knock without bending. And the turnover mast is a hefty ⅝" solid rod of highly polished, heat-treated aluminum.

We've also done away with the old-fashioned plastic shrink tubing and sealed the light-weight precision-wound coils in an indestructible epoxy-fiberglass sleeve. (Which is a distinctive white that'll add to the beauty of your car.) And, all fittings are heavy chrome-plated brass.

The new Ham Cat combines higher Q with wider bandwidth performance, without using a lossy-heat generating coil like the others use. So it not only looks beyond your wildest dreams, it works beyond them, too.

It's also designed on a nominal 52 ohm impedance so you don't have to have any special matching. (Any length coax will work.)

The Ham Cat mobile ham antenna is at your Hy-Gain dealer (he's the best one under the sun) right now.

And it's there at a price all the others are charging for half of what you get in this antenna.

And that's the real beauty of it.

ELECTRICAL

- Nominal 52 ohm impedance—no special matching device needed.
- Widest bandwidth, highest power handling —Vs.—heat drift ratio available.
- Lowest VSWR in any mobile available.

MECHANICAL

- Turn-over mast is hefty ⅝" dia. solid rod of highly polished heat-treated aluminum.
- All connections are standard ⅜-24 thread.
- Mast folds over, swivels, and turns over. You can mount it on bumper deck. In addition, this flexibility makes it easy and simple to change coils.
- Coil and tip rods are a one-piece assembly. Coil diameters are constant, only lengths change.
- Shake-proof sleeve clutch facilitates quick band changeover and fold over for garaging.

THE Ham cat MOBILE HAM ANTENNA FROM HY-GAIN

HY-GAIN ELECTRONICS CORPORATION
N.E. Highway 6 at Stevens Creek
Lincoln, Nebraska 68501 **AC-8D**

THE MOST ADVANCED ANTENNAS UNDER THE SUN

Table I—List of Frequencies on which Satellites could be heard as of June 1, 1968

Freq. (mc)	*Satellite Name*	*Purpose*	*Period (Minutes)*	*Inclin-ation (Degrees)*	*Remarks*
136.500	NIMBUS—2	Weather	108.1	100.3	Command, c.w. beacon & telemetry
136.530	EXPLORER—37	Solar studies	98.7	59.4	"
136.530	ERS—18	Radiation studies	2831	35.1	Continuous, c.w. beacon & telemetry*
136.560	ARIEL—3	Scientific	95.2	80.2	Continuous, c.w. beacon & telemetry
136.590	PEGASUS—3	Meteoroid detection	94.1	28.9	Command telemetry
136.590	ALOUETTE—2	Ionospheric studies	121.3	79.8	Command, c.w. beacon & telemetry
136.590	ALOUETTE—1	"	105.5	80.5	"
136.620	RELAY—2	Communication	195	46.3	Command telemetry
136.653	1963—39C	Radiation studies	107.3	90	"
136.709	EXPLORER—24	Air density studies	105.5	81.4	Continuous c.w. beacon
136.710	OSO—4	Solar studies	95.7	33	Command, c.w. beacon & telemetry
136.740	EXPLORER—27	Geodetic studies	108	41.2	"
136.770	ESSA—2	Weather	113.5	101	"
136.770	ESSA—3	"	114.6	101	"
136.770	ESSA—4	"	113.4	102	"
136.770	ESSA—5	"	113.5	102	"
136.770	ESSA—6	"	114.8	102	"
136.800	FR—1	Ionospheric studies	100	75.9	Continuous c.w. beacon
136.800	DODGE	Gravity studies	1316	6.2	Command, c.w. beacon & telemetry
136.840	EGRS—9	Geodetic studies	172.1	89.6	"
136.890	PEGASUS—2	Meteoroid detection	97	31.8	Command telemetry
136.890	PEGASUS—1	"	97	31.8	"
136.890	IRIS	European Research	98.8	97.1	Command, c.w. beacon & telemetry
136.950	NIMBUS—2	Weather	108.1	100.3	Command, telemetry & photos (APT)
136.980	SYNCOM—2	Communications	1436	28.8	Command telemetry
136.980	SYNCOM—3	"	1436	2.0	"
136.980	EARLY BIRD	"	1437	2.7	Command, c.w. beacon & telemetry
136.980	ALOUETTE—2	Ionospheric studies	121.3	79.8	Command telemetry
136.980	ALOUETTE—1	"	105.5	80.5	"
136.980	INTEL—2—F1	Communications	718	17.4	"
136.980	INTEL—2—F2	"	1436	1.1	"
136.980	INTEL—2—F3	"	1436	0.5	"
136.980	INTEL—2—F4	"	1436	0.5	"
137.140	AURORA—1	Auroral studies	172.1	89.9	Continuous, c.w. beacon & telemetry
137.200	NIMBUS—2	Weather	108.1	100.3	Command, telemetry & photos
137.290	EXPLORER—38	Radio Astronomy	224.4	120.6	Command, c.w. beacon & telemetry
137.350	ATS—1	Applied technology	1436	0.3	Command telemetry
137.350	ATS—2	"	167	28.4	"
137.350	ATS—3	"	1436	0.1	"
137.500	ESSA—2	Weather	113.5	101	Command, telemetry & photos (APT)
137.500	ESSA—4	"	113.4	102	"
137.590	EXPLORER—37	Solar radiation	98.7	59.4	Command, c.w. beacon & telemetry
137.740	GRAVGRAD—4	Gravity studies	103.4	70	"
137.980	GRAVGRAD—5	"	103.4	70	"
150	1965—109A	Not specified	105	89	"
150	1966—5A	"	106	89.7	"
150	1966—24A	"	105.3	89.7	"
150	1966—76A	"	106.8	88.9	"
162	EXPLORER—22	Geodetic studies	105	80	Command, tone modulated beacon
162	EXPLORER—27	"	108	41.2	"
324	EXPLORER—22	"	105	80	"
324	EXPLORER—27	"	108	41.2	"
360	EXPLORER—27	"	108	41.2	"
360.090	EXPLORER—22	"	105	80	"
400	1965—109A	Not specified	105	89	"
400	1966—5A	"	106	89.7	"
400	1966—24A	"	105.3	98.7	"
400	1966—76A	"	106.8	88.9	"
400.250	OGO—1	Geophysical studies	3841	53.8	Command telemetry
400.250	OGO—3	"	2913	51.8	"
400.250	OGO—4	"	97.4	86	"
400.250	OGO—5	"	3796	31	"
400.850	OGO—5	"	3796	31	"
401.0125	1967—03—B	Communications	1330	0.6	Command telemetry
401.0125	1967—66—C	"	1312	6.7	"
401.0375	1967—03—C	"	1331	0.5	"
401.0375	1967—66—D	"	1314	6.7	"
401.0625	1967—03—D	"	1332	0.6	"
401.0875	1967—03—E	"	1334	0.6	"
401.1125	1967—03—F	"	1337	0.8	"
401.1375	1967—03—G	"	1340	0.8	"
401.1625	1967—03—H	"	1343	0.7	"
401.1875	1967—03—A	"	1330	0.6	"
401.1875	1967—66—B	"	1310	6.7	"

* Operates only when in sunlight

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VERTICAL ANTENNAS

Part IV

BY CAPTAIN PAUL H. LEE,* W3JM

n this fourth part of a series, the author discusses directional antennas. Basic esign principles are explained, a sample design is worked out, and methods f power division and phasing are shown. Amateur band configurations are covered.

IN past years there have been articles in this nagazine and others on directional arrays sing vertical elements. These have been of oth types, driven arrays and parasitic arrays. 'or the most part these have been fixed rrays, with several elements which could be witched in or out to change the direction of he pattern. It is natural that a horizontal 'agi array, which can be put up in the air n a tower thus requiring practically no real state, and which can be easily rotated to any irection, is in the majority. However, for the , 4 and 7 mc bands, Yagi arrays are some-vhat impractical because of their size. Thus here has been some interest in vertical arrays vhose direction of radiation can be switched. 'here are several rather simple configurations f element spacing and phasing which lend hemselves to this concept. It is the purpose f this part to explain how vertical arrays vork, to show several simple configurations, nd to show how the elements of an array can e fed power of the proper phase and magni-ude to produce the desired pattern.

M.F. Broadcasting Arrays

What is the purpose of a directional array? n the most widely used application, which is n.f. broadcasting, these arrays are usually sed to produce nulls in the horizontal pattern (and sometimes also in the vertical pattern) o protect the service area of a co-channel tation (and often an adjacent channel sta-ion) from interference. Coincidentally, the tation's transmitter site is so located that the nain lobe (or lobes) of the pattern falls over he station's desired service area, insofar as possible. Thus at m.f. the main purpose is protection of other stations from interfer-ence, not production of forward gain. Such an array often has several nulls in its pattern, one for each station to be protected. The patterns are carefully designed, by applica-tion of proper phasing and current ratios to the vertical elements, to produce specific levels of field intensity in the nulls. The FCC always imposes specific levels of field inten-sity, which shall not be exceeded, towards the stations to be protected. Thus, it is the con-sulting engineer's job not only to design the pattern to fit these limits, but to assure him-self that the array will be stable and remain in critical adjustment during changes in weather and ground conditions from season to season. Proper design of the phasing and branching networks enters into this latter consideration.

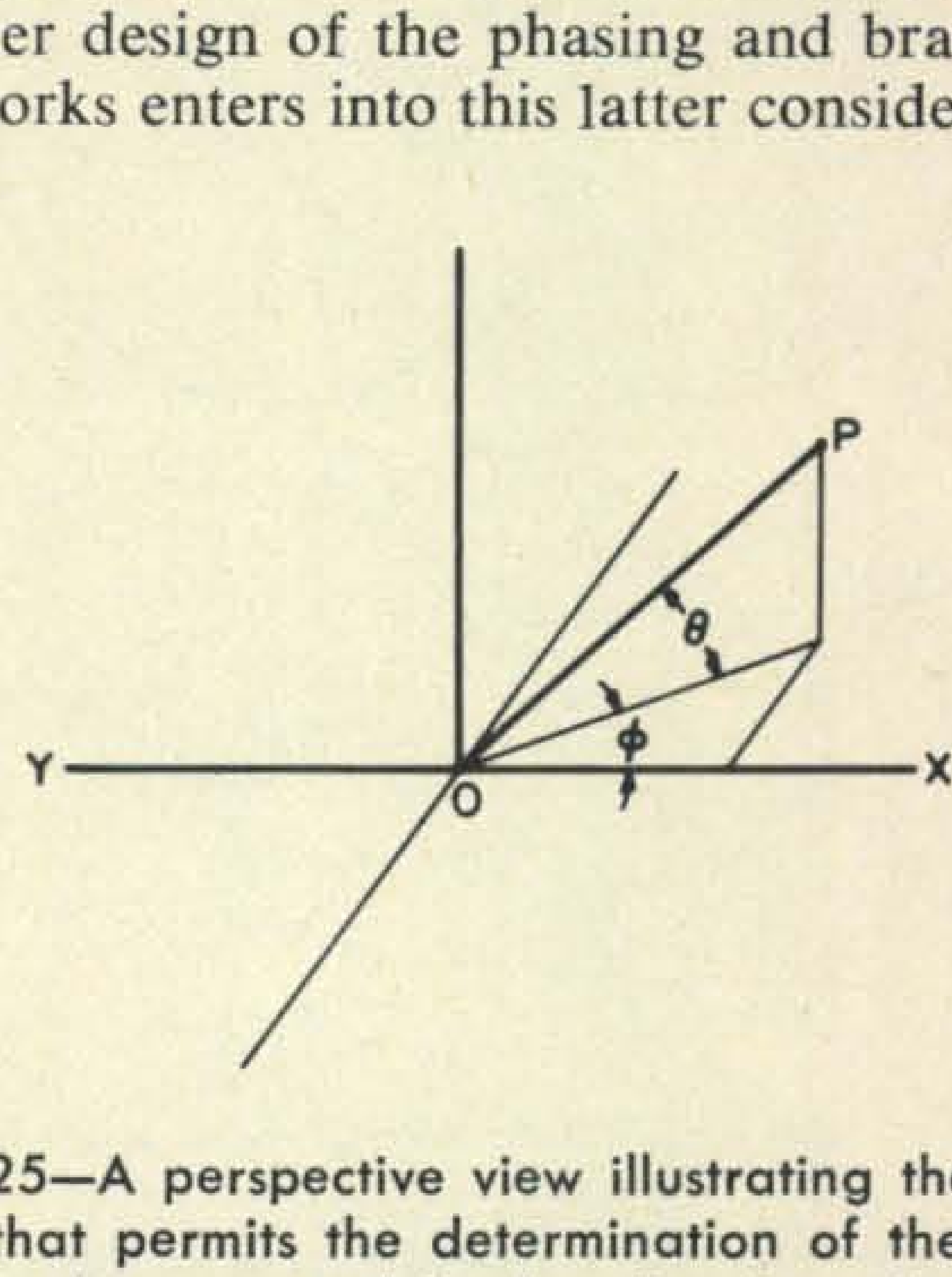

Fig. 25—A perspective view illustrating the equation that permits the determination of the radiation to be expected in the direction of point *P*. In this drawing θ represents the vertical angle of *P*, Φ the azimuth angle of *P*, *XY* is the line of towers and the array is located at O.

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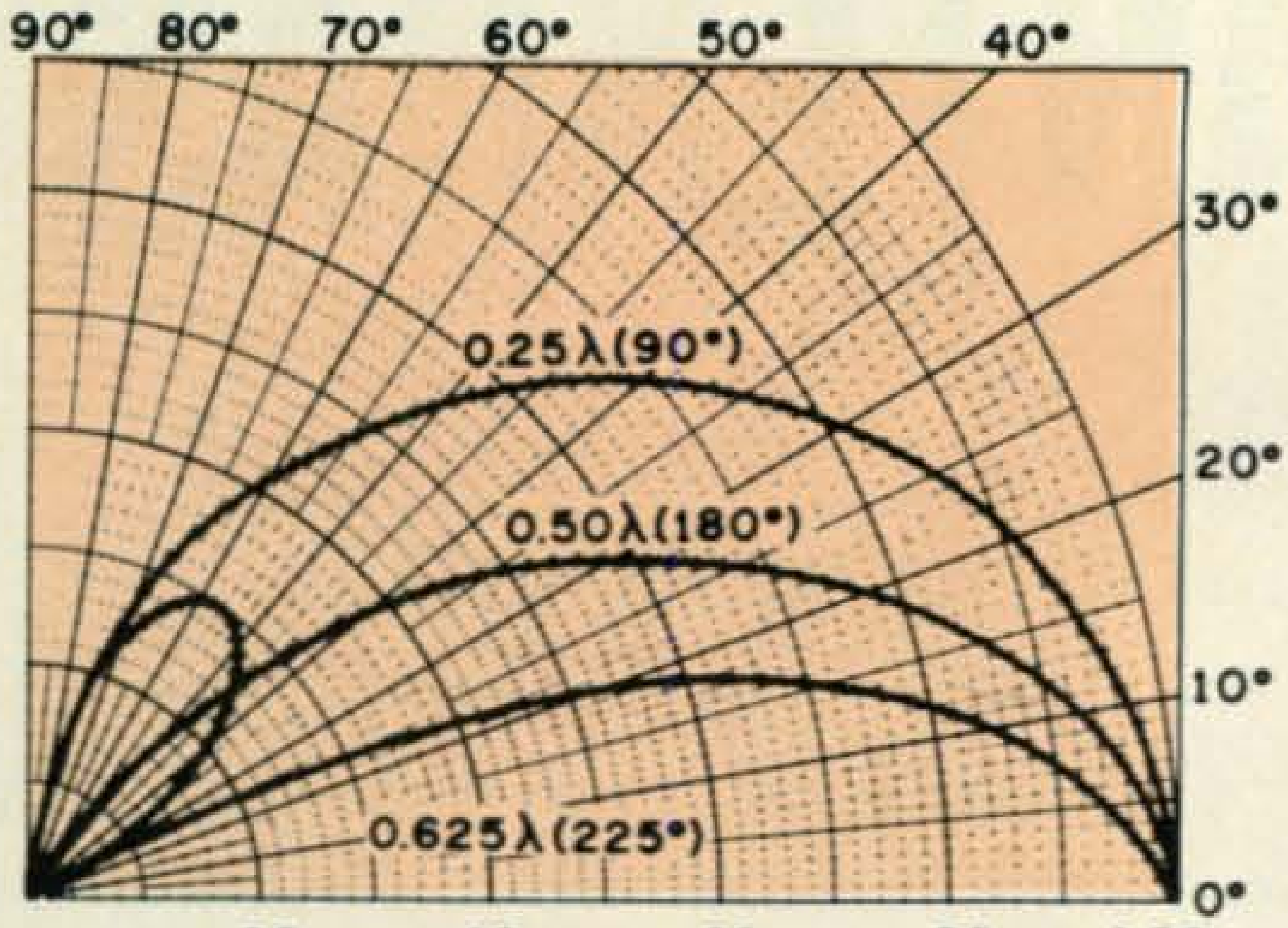

Fig. 26—Plot of the factor f (θ) for towers of ¼, ½ and ⅝ wavelengths height.

Amateur Use

For amateur use, however, we are not concerned with the absolute value of radiation in the nulls. Our main purpose is forward gain, usually in only 6ne direction. Thus we can employ a more simple array of fewer elements, usually in-line, and content ourselves with obtaining forward gain and not worrying about depth of the nulls, nor about absolute pattern stability therein. Patterns can more simple, with one main lobe (or possib two). For reasons of propagation, such arra for amateur use will usually be employed 2, 4 or 7 mc, although they can be used f the higher bands as well, instead of ho zontal Yagis.

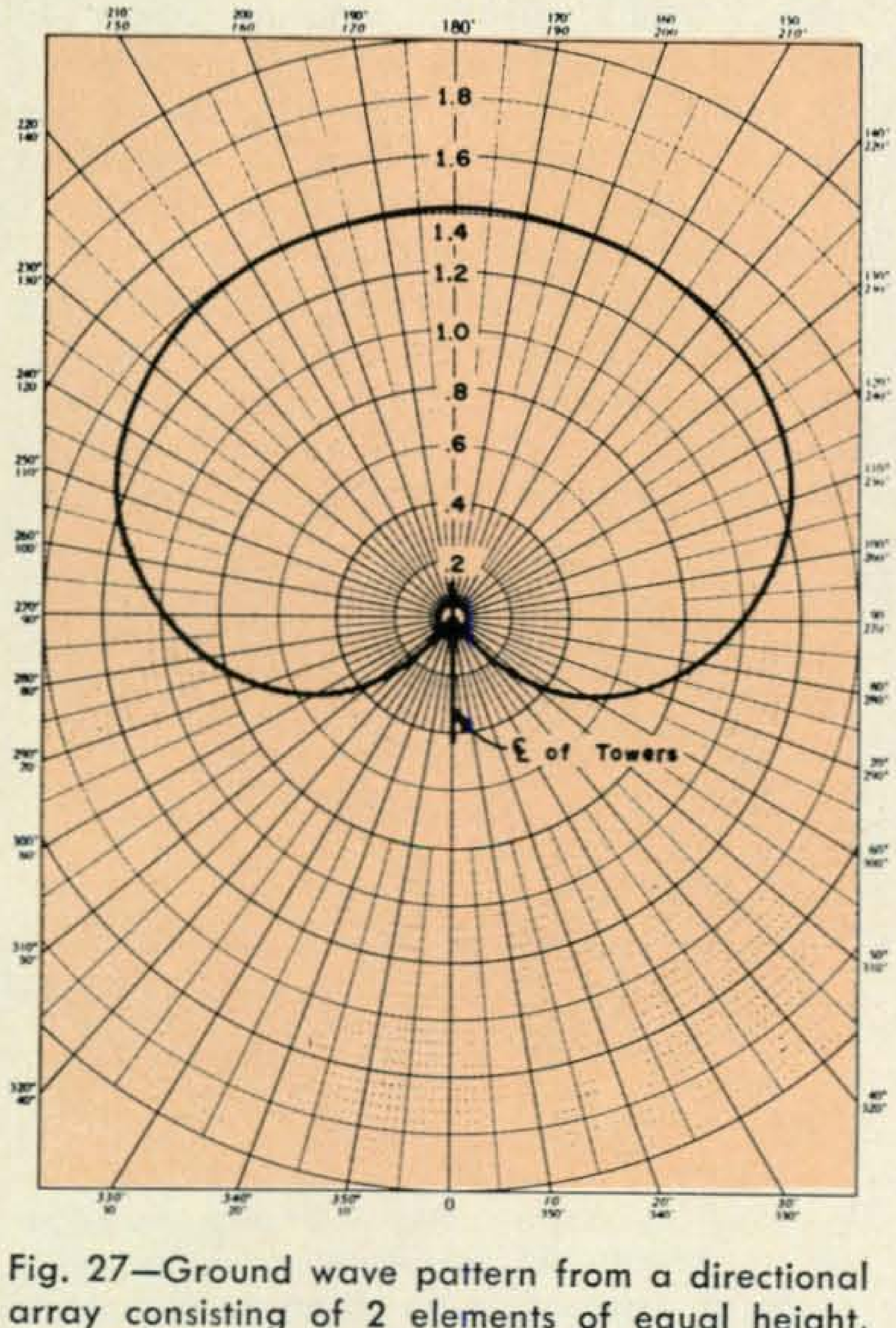

Fig. 27—Ground wave pattern from a directional array consisting of 2 elements of equal height, spaced 90°, equal element currents and a phase angle of 90°. The r.m.s. of the field pattern is normalized to 1.0.

Review

It is well to run through some of the bas mathematics for directional arrays, so that v all know what we are talking about. Figu 25 shows a perspective view which illustrat the following equation, which gives the rad ation to be expected in the direction of ar point *P* in space from a simple two-eleme array. The line of towers is shown as *X* *S* is the spacing between towers. The hor zontal or azimuth angle of point *P* from th line of towers is indicated as ϕ. The vertic angle of point *P* above the ground plane is in dicated as θ. The phasing of the currents the two elements is shown as ψ, and *R* is th current ratio between the two elements. Th field intensity at point *P* is thus equal to:

$$E = Kf(\theta)\sqrt{\left(\frac{1+R^2}{2R}\right)+\cos\,(S\cos\phi\cos\theta+\psi}$$

This can also be written as:

$$E = Kf(\theta)\left(I_1\ \underline{/0^\circ} + \frac{I_2}{I_1}\ \underline{/S\cos\phi\cos\theta+\psi}\right.$$

K is a constant which is used to convert t mv/m, and which depends on the r.m.s. valu of the pattern, the power used, and the heigh of towers to be used. The factor $f(\theta)$ depend on the tower height *G* in degrees, and whic is computed from the following formula:

$$f(\theta) = \frac{\cos G - \cos\,(G\sin\theta)}{\cos G}$$

For example, the $f(\theta)$ for a tower height of ⅝ wavelength (225°) is as follows:

θ°	f(θ)
0	1.000
10	.883
20	.582
30	.219
40	−.119
50	−.260
60	−.292
70	−.250
80	−.138
90	.000

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[T]he minus sign is nothing to worry about. [I]t merely shows that the radiation in the [m]inor lobe is 180 degrees out of phase with [t]hat in the major lobe. Figure 26 shows this [f](θ) plotted, along with similar plots for [t]ower heights of ¼ wavelength (90°), and [½] wavelength (180°). It will be seen that [t]his plot is the same as that of fig. 1 in Part I [o]f this series.[38] This is where the vertical pat[t]erns come from, right from the above equa[t]ion for the value of $f(\theta)$.

Thus, for our two element array, we can [c]ompute the field intensity which will be radi[a]ted towards any point P in space. Now if [p]oint P lies in the horizontal plane, vertical [a]ngle θ is zero, and since cos 0° is unity, it [f]alls out of the equation. Also, $f(\theta)$ is unity, [a]nd it falls out. Thus the horizontal or ground [w]ave pattern equation is:

$$E = K\sqrt{\left(\frac{1+R^2}{2R}\right) + \cos\,(S\cos\phi + \psi)}$$

[T]his can also be written as:

$$E = K\left(I_1\ \underline{/0^\circ} + \frac{I_2}{I_1}\ \underline{/S\cos\phi + \psi}\right)$$

If the currents in the two towers are made [e]qual, the equations simplify to:

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

[w]hich can also be written as:

$$E = K\,(1\ \underline{/0^\circ} + 1\ \underline{/S\cos\phi + \psi})$$

The azimuth angle of the null can be com[p]uted from the following relationship:

$$\cos\,(S\cos\phi_N + \psi) = -1, \text{ or}$$
$$S\cos\phi_N + \psi = \pm 180^\circ, \text{ solving for } \phi_N$$

[T]he pattern is symmetrical about the line of [t]owers, and there will be a pair (or in some [c]ases two pairs) of nulls for a two tower [a]rray.

The pattern for a simple array of two tow[e]rs whose spacing is ¼ wavelength (90°) and whose phasing is 90° is shown in fig. 27. Currents are equal. The figure is normalized to an r.m.s. of 1.0 for the pattern. Maximum radiation is only 1.42, which is a power gain of about 2, or 3 db.

Figure 28 shows a plot of radiation for a pair of towers spaced 90° but phased 135°. It will be noted that a small back lobe has

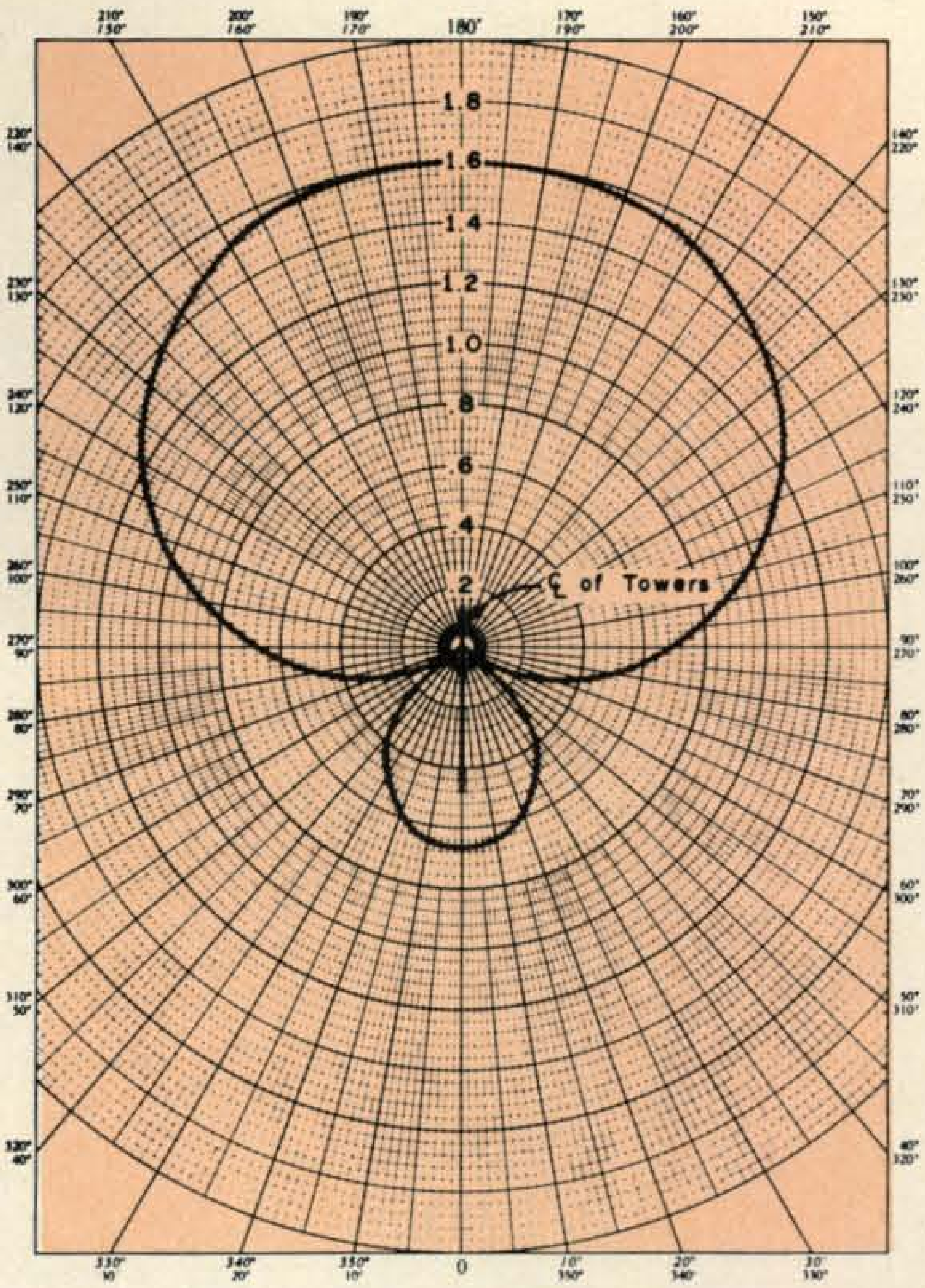

Fig. 28—Ground wave pattern from a directional array consisting of 2 elements of equal height, spaced 90°, equal element currents and a phase angle of 135°. The r.m.s. of the field pattern is normalized to 1.0.

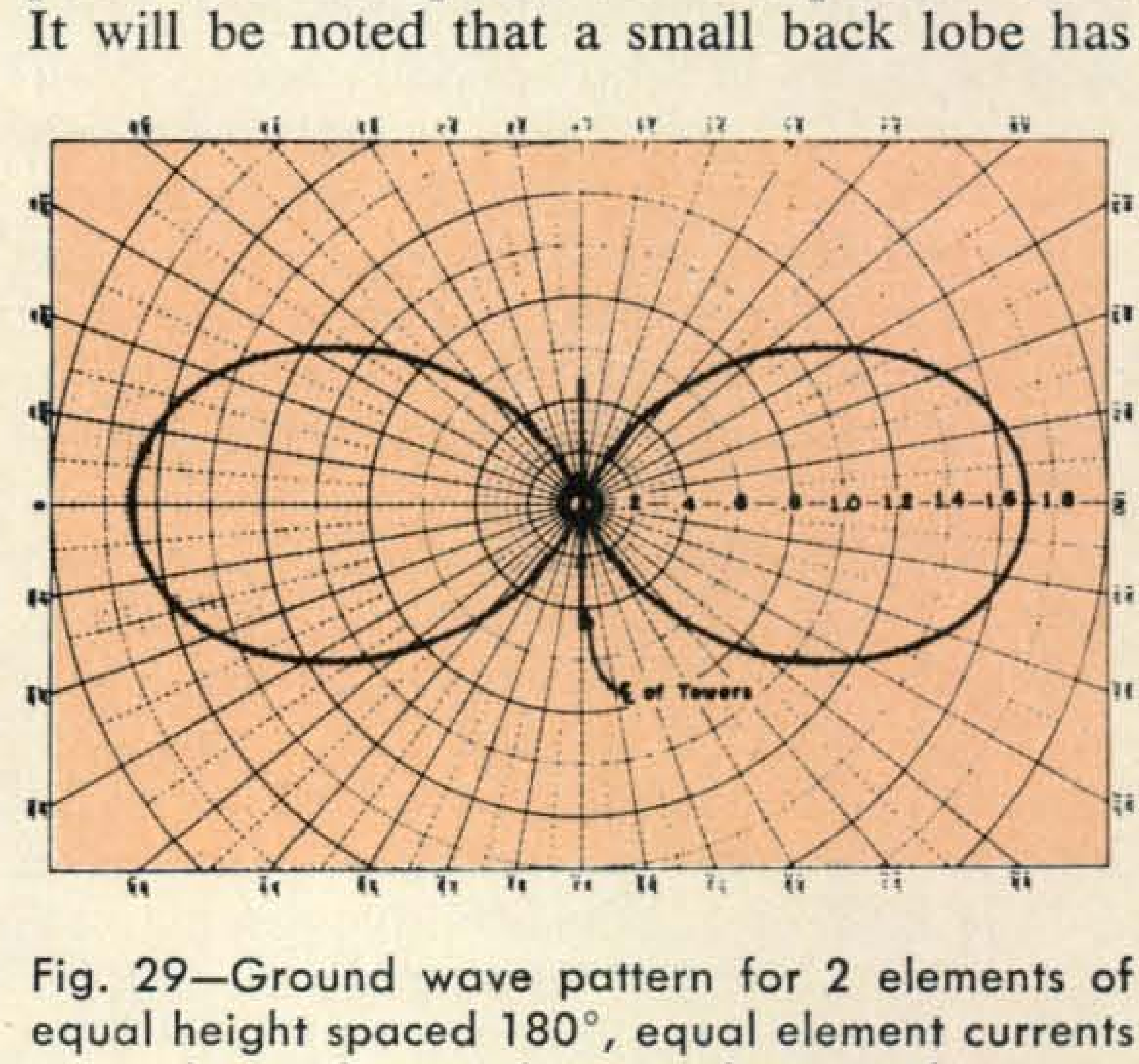

Fig. 29—Ground wave pattern for 2 elements of equal height spaced 180°, equal element currents but with zero degrees phase angle.

[38] Lee, P. H., "Vertical Antennas, Part I," *CQ*, June 1968, page 16.

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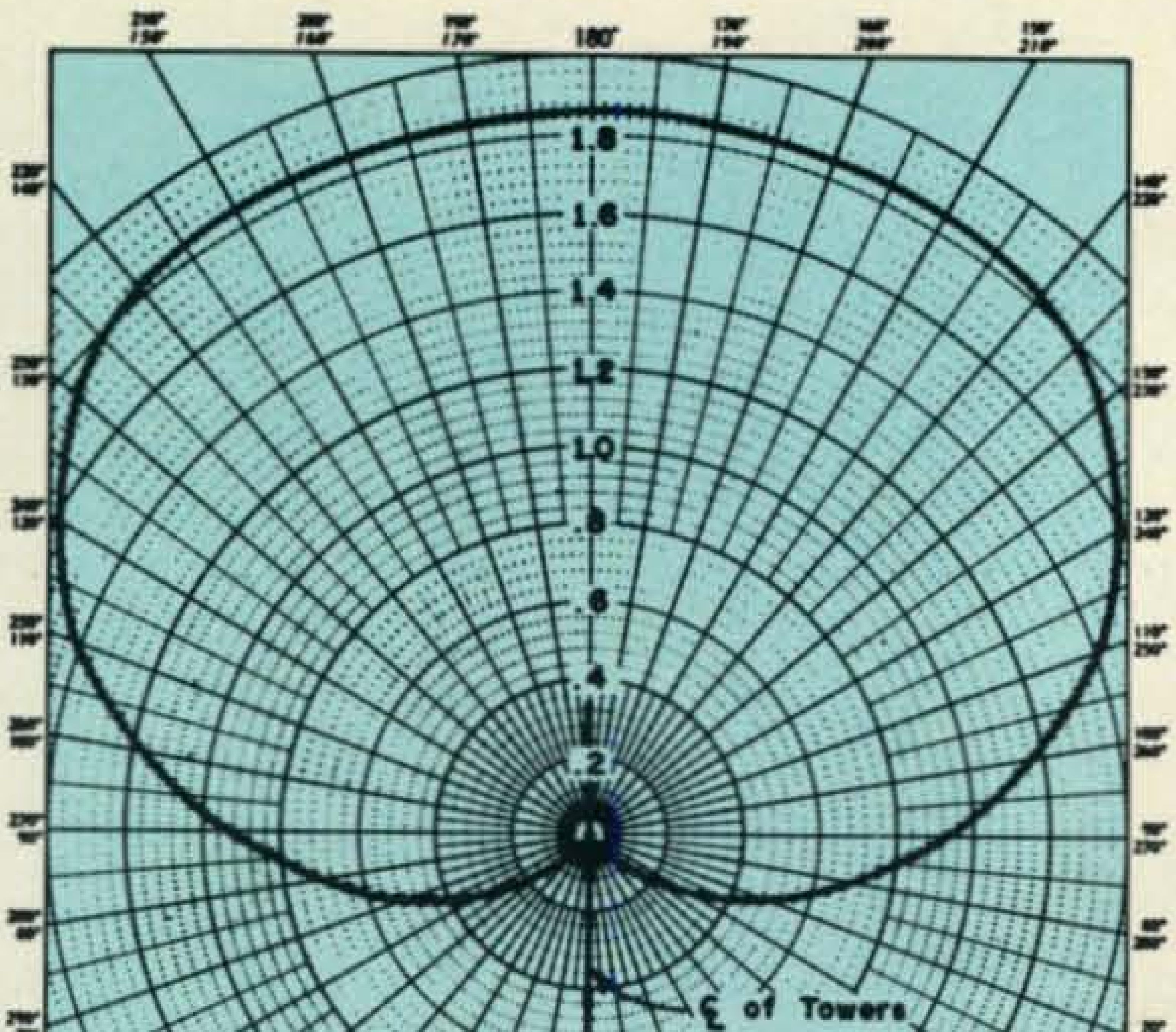

Fig. 30—Ground wave pattern from a directional array comprising three elements of equal height, spaced 90° in line with $I_A=1.0$, $I_B=2.00$, $I_C=1.0$, $\psi_A=0$, $\psi_B=90°$ and $\psi_C=180°$. The r.m.s. of the pattern is normalized to 1.0.

appeared, and there are two nulls, symmetrically placed on either side of the line of towers. The voltage gain of this one is 1.6, and the power gain is 2.56, which is 4.08 db.

Figure 29 shows the pattern from a pair of towers spaced ½ wavelength (180°), and operated in phase. Note that the direction of the main lobes has shifted from that of the line of towers to a broadside direction. Voltage gain is 1.7, power gain is 2.89 or 4.62 db, and we have two nulls in the line of towers. If the spacing is increased beyond 180°, and the phasing maintained at zero, a small lobe will appear in each of the nulls in the line of towers, in this pattern. Thus there will be four nulls instead of two.

The maximum possible gain with two towers for a pattern whose main lobe is in line with the line of towers is a voltage gain of 1.725, or 4.74 db, and this occurs with spacing of 30° and phasing of 165°. For the broadside pattern (two lobes), maximum gain is 1.82, or 5.2 db, and this results from a spacing of 210° and phasing of zero degrees. (With this spacing there will be a very small minor lobe in each null.)

Multiple Towers

So much for two tower configurations. will be seen from the above statements th gain is somewhat limited, and the lobes a quite broad, especially in the in-line case How can we increase gain? The answer is t increase the number of towers to three, o even four. It is not intended that this text g into all the various complicated arrays whic can be formed. We shall simply state that i the case of an in-line array such as that whos pattern is shown in fig. 27, if a third tower i added at a spacing of 90° from one of th others, making it three in line with 90° spac ing, the pattern of fig. 27 can be "squared, or multiplied by itself, to produce the patter shown in fig. 30. The equation for such pattern is:

$$E = \sqrt{[1 + \cos(S_2 \cos\phi_2 + \psi_2)] \times [1 + \cos(S_3 \cos\phi_3 + \psi_3)]}$$

For the in-line case, $\phi_2=\phi_3$. The transitio from the two tower case to the three towe case is shown diagramatically in fig. 31. Cu rent in each tower is assumed to be unity. I will be seen that we start with two pairs o towers, each spaced and phased 90°, but w end up with three in line, whose phasing are entirely different, which produce the pat tern of fig. 30.

Unsymmetrical Patterns

If the three towers are not to be in line making an unsymmetrical pattern, ϕ_2 will dif fer from ϕ_3. Or perhaps the spacing and phas ing of the second pair will not be the same a those of the first pair, making an entirely dif ferent result. It can be seen, therefore, tha there are an almost infinite number of con figurations, which produce all kinds of strang looking patterns. There is a very fine book[39] by Carl E. Smith which shows hundreds o possible configurations. The same author ha written another book[40] which goes into th design of directional antennas in great detail covering not only two and three tower cases but also those with four or more towers. Th mathematical principles for the more compli cated arrays are the same as those for th simple arrays, but the computations are mor laborious and time-consuming, unless one ha a computer available.

[39] Smith, Carl E., "Directional Antennas," *Cleve land Institute of Electronics.*

[40] Smith, Carl E., "Theory and Design of Direc tional Antennas," *Cleveland Institute of Electronics*

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To get back to our three element array of fig. 30, we see that the voltage gain is now 1.86, and the power gain is 3.46 or 5.4 db. By adding the third tower we have gone from a gain of 3 db in fig. 27 to a gain of 5.4 db in fig. 30.

For our maximum possible case previously mentioned, where we had a two-tower gain of 4.74 db (the in-line case) with spacing of 30° and phasing of 165°, we could add a third tower and realize a gain of about 9 db. In this case, and referring to fig. 31 for guidance, I_A would be $1.00\underline{/0°}$, I_B would be $2.00\underline{/165°}$, and I_C would be $1.00\underline{/-30°}$. For the maximum possible gain in the broadside case, adding a third tower would result in about 10 db gain.

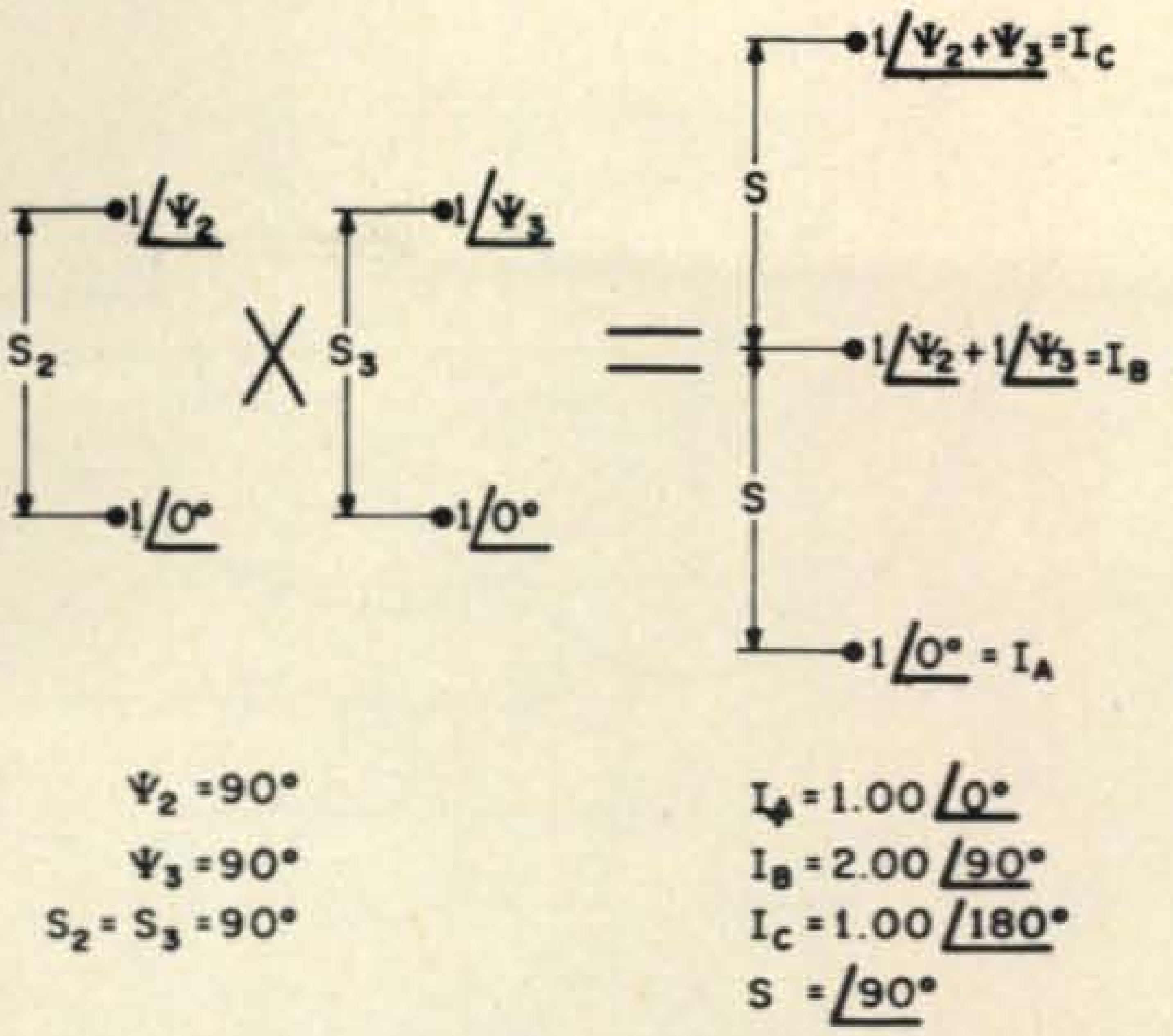

Fig. 31—Multiplication of two equal tower arrays to form a three tower array.

Field Intensities

In our discussion so far, we have normalized everything to 1.0. To obtain actual expected unattenuated field intensity at one mile from fig. 27 through 30, one must multiply by the factor K. For 1 kw into an array of ¼ wave elements, a value for K of 190 mv/m is reasonable. The FCC allows up to 7.5% power loss in the phasing and branching networks for m.f. broadcast directional arrays. When an array is tuned up and in adjustment, the proof of performance consists of making field intensity measurements on at least eight radials, and plotting these measurements on field intensity paper as described in Part I of this series.[38] The unattenuated field at one mile is then obtained from these plots, for each radial. These values are then plotted on polar paper like that in figs. 27 through 30, and if the array is adjusted properly, the polar plot of measured values should conform to the designer's original plot.

Feeding

How are such arrays fed? It is a well known fact that there are mutual interactions between elements. What causes this? What can be done in the design of the phasing and branching networks to take these interactions into account and to compensate for them? First, let us examine the interaction itself. There is a very good explanation in a paper by G. H. Brown[41] whom we have met before in this series of articles. When two vertical (or any other kind) antennas are close together, there exists at antenna number two a voltage which is produced by the current flowing in number one. Thus a current flows in number two due to the current flowing in number one. This curent is over and above the current which flows in number two due to its own connection to the source of power, and it bears a certain phase and magnitude relationship to the current in number one which causes it.

This phase and magnitude relationship is caused by the "mutual impedance" between the two antennas. The mutual impedance depends on the antenna heights and the spacing between them. Figure 32 is a plot of the resistance and reactance parts of the mutual impedance between two ¼ wave vertical radiators (referred to the current loop at the base of the antenna). Note that both resistance and reactance can be either positive or negative in sign. There are similar charts for other tower heights, both for towers of equal height and of unequal height, in Smith[40] and in Brown[41].

The array designer uses these charts in the initial design of the phasing and branching networks. Actually, in the field, the engineer can measure and compute the mutual impedance between two towers by measuring the change in self-impedance of one tower when the other is first open-circuited and then resonated to ground. He can then go to the second tower and repeat the process in reverse, if the towers are equal height, and he should get the same result (within a couple of percent). There is a formula[41] for this computation, but we shall not go into it here. The mutual impedance determined in the field by this method usually is quite close to that which can be read from a chart such as fig. 32.

41 Brown, G. H., "Directional Antennas," *Proceedings of the I.R.E.*, January 1937, pages 78-145.

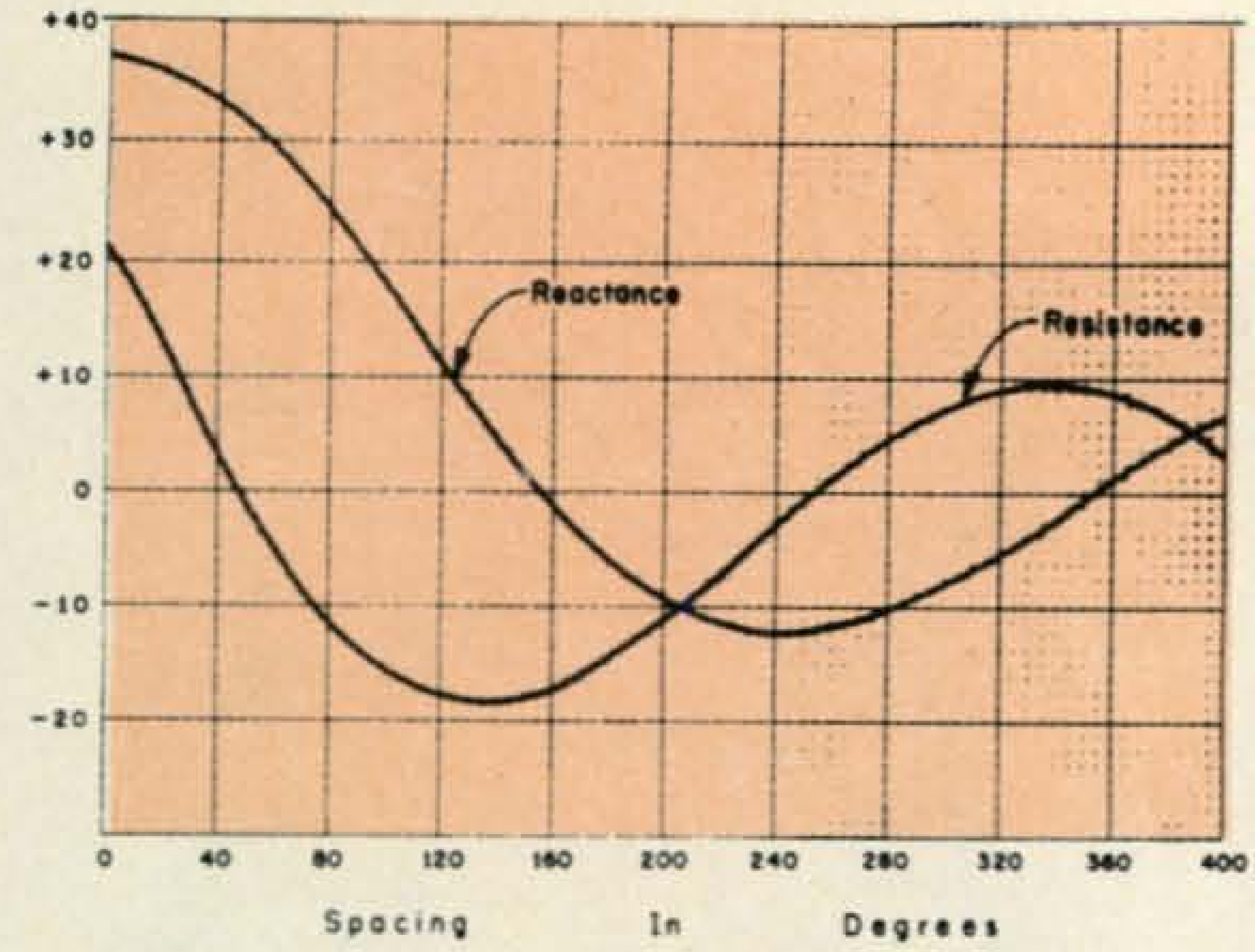

Fig. 32—Plot of mutual impedance between two quarter wave antennas over perfect earth. It is referred to the current loop at the base of the antenna.

Having found the mutual impedance either from the chart or by actual field antenna resistance and reactance measurements, the engineer can then determine the actual operating base impedance of each element of the array, when all the elements are connected to the system and handling power. This is something which cannot be measured by an ordinary radio frequency bridge, because the element or tower cannot be detached from the system for purposes of making impedance measurements. Detaching it destroys the effect of the mutual impedance and gives an entirely erroneous result. The operating impedance of a single element under power can only be determined by use of an s.w.r. bridge which will handle the power involved. One company, Delta Electronics of Alexandria, Va. makes one for m.f. use for powers up to 5 kw. This has become a very handy tool for the consulting engineer to use in the field. The operating impedance can be computed, however, by use of the following formulas:

$$Z_1 = Z_{11} + \left(\frac{I_2}{I_1}\right) Z_{21}$$

$$Z_2 = Z_{22} + \left(\frac{I_1}{I_2}\right) Z_{12}$$

where Z_1 is the operating impedance of tower 1, Z_{11} is the self impedance of tower 1 with tower 2 floating, I_2/I_1 is the ratio of currents, and Z_{21} is the mutual impedance from tower 2 to tower 1. Z_2 is the operating impedance of tower 2, Z_{22} is the self-impedance of tower 2 with tower 1 floating, I_1/I_2 is the inverse of the current ratio, and Z_{12} is the mutual impedance from tower 1 to tower 2. Theoretically, Z_{11} and Z_{22} should be equal, and Z_{21} and Z_{12} should be equal, and in a very carefully designed and constructed array this will be the case, within a couple of percent with equal height towers. However, during actual tuneup and adjustment, the engineer always measures and computes these factors both for a check on his initial design, and to show up any unforeseen defects in the array.

Coupling Networks

It can be seen from the above equations that for most cases the operating base impedances of the towers will be different by an amount dependent on the magnitude and phase angle of the mutual impedance, and on the phase relationship and magnitudes of the tower currents. Thus, the coupling networks must be designed to match those operating base impedances to the transmission lines being used. Designing the coupling networks to match the self-impedance of either tower would result in considerable impedance mismatch as well as an erroneous phase shift.

A typical two-tower phasing and branching network is shown in fig. 33. The two transmission lines are tapped on a low-Q tank circuit, which is in turn tapped to provide a suitable load (usually $50 + j0$ ohms) to the transmitter. This type of circuit is called "the jeep coil type," because of the fine adjustment coils marked "X." It is a very critical circuit to adjust, especially when three or more towers are being fed, because of the extreme interactions betwen individual adjustments.

A much better circuit in this respect is shown in fig. 34. This is called "the Ohm's Law type." It is much easier to adjust when three or more towers are used, because each tower is fed off a separate power divider coil, and the parallel combination of these, in series with L_s, is tuned by capacitor C_A to form a low-Q tank. The tank circuit's input impedance is usually set to be about $150 + j0$ to $250 + j0$ ohms, and this is matched to the transmitter, which usually likes to see $50 + j0$ ohms, by a simple "T" network.

In the circuits shown in fig. 33 and 34, the amount of phasing to be contributed by the phasing networks and the tower coupling units is computed; the required component

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values are then determined by calculation, and the whole thing is then wired up and tested under power (low power at first). The engineer makes the required adjustments to secure the desired phasings and current ratios, and checks the actual field intensity pattern by field measurements. Two-way radio is used, with a field car located in each null, calling in readings as adjustments are made, until the pattern is correct. S.w.r.'s on the lines are checked with the Delta Bridge, required impedance matching adjustments are made (which throws off the array adjustment somewhat), and the process starts all over again. Tuning up a two tower array can usually be accomplished in two or three nights of work (midnight to 6 A.M.), but a multi-element array with critical or deep nulls can take as long as three or four weeks of very tedious adjustments. By keeping a complete and careful log of all adjustments and their resulting field readings, the engineer can soon note trends, and know which way to go with the various adjustments, which always interact somewhat.

Amateur Use

While all of this is not applicable in detail to the amateur case, we have gone through it step by step to show the basic principles involved, so that you will have an understanding of all that goes into the design and operation of these arrays. Perhaps some of you will want to apply these principles to the design of your own arrays for 2, 4 or 7 mc. If so, you will find Smith[39, 40] and Brown[41] invaluable. It might also pay to visit one of your local broadcast stations which has a directional array, and look over the circuitry and discuss its design with the chief engineer. Note particularly the type of power dividing or branching network used ("jeep coil" or "Ohms Law"), how the phasing is accomplished (positive or negative networks), how the tower coupling units are designed, how

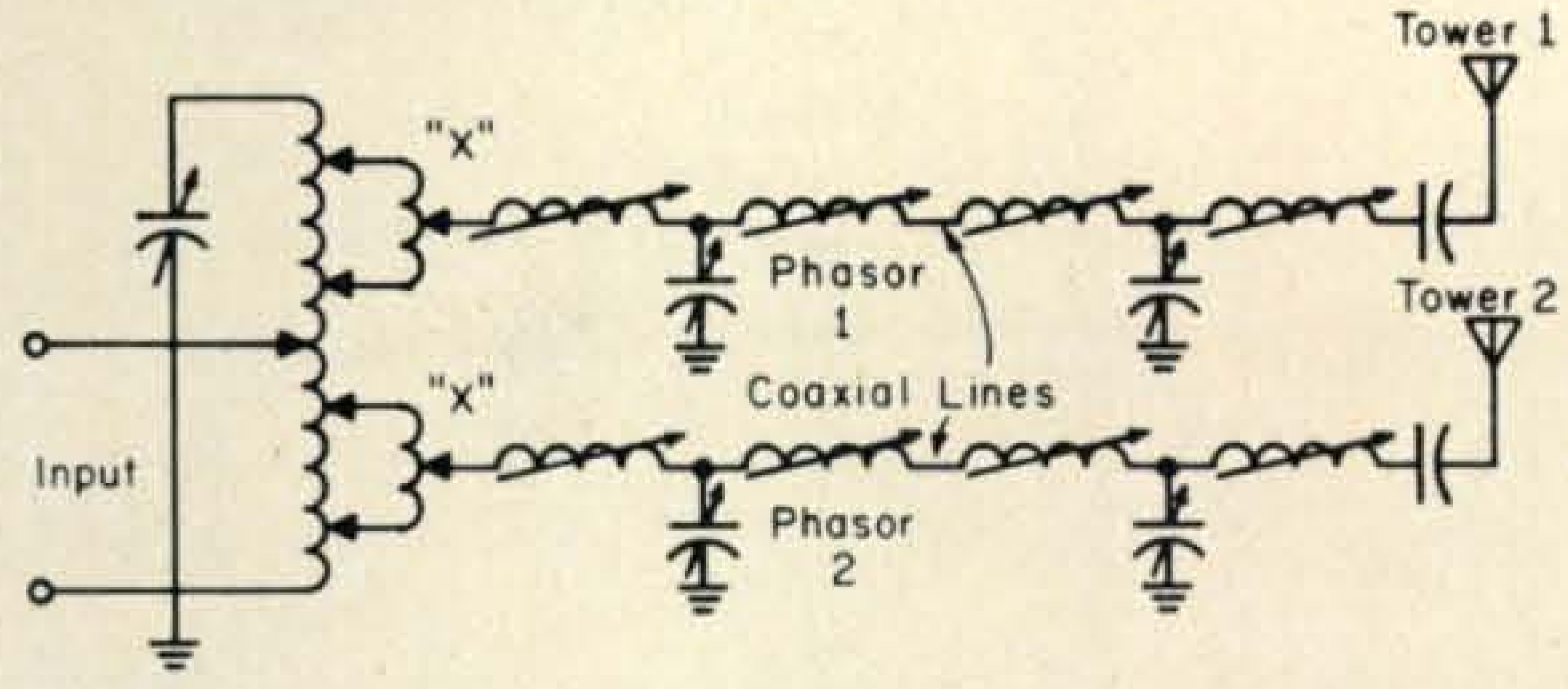

Fig. 33—A typical two tower phasing and branching network called the "jeep coil type."

the tower lighting circuits are brought across the base insulators (choke coils or Austin transformers), how the ground system is designed, and its extent, and, in general, how carefully put together the system is. Most of them are quite well designed and built; they have to be, to pass FCC inspection.

Configurations

Now, for some simple configurations which lend themselves to amateur use, refer to figs. 27 and 29. For the array of fig. 27, the 90° phasing can be accomplished by making the coaxial lines 90° different in length. This is an old trick, often used, for phasing of any amount. A simple matching network is used at each tower, and the Ohms Law power divider is employed. See fig. 35 for a suitable circuit. For the array of fig. 29, if you want a broadside array which will fire in two opposite directions, the phasing is zero degrees. This is very easily accomplished by making the coaxial lines equal in length. In fact, the array is completely symmetrical, and the tower tuning units are alike. Again an Ohms Law network can be used.

For the maximum gain case mentioned previously, locate the towers 30° apart, make the coaxial lines about 135° different in length, and design the tower coupling units for the operating impedances involved. In this case, the effect of mutual impedance will be quite pronounced due to the close spacing,

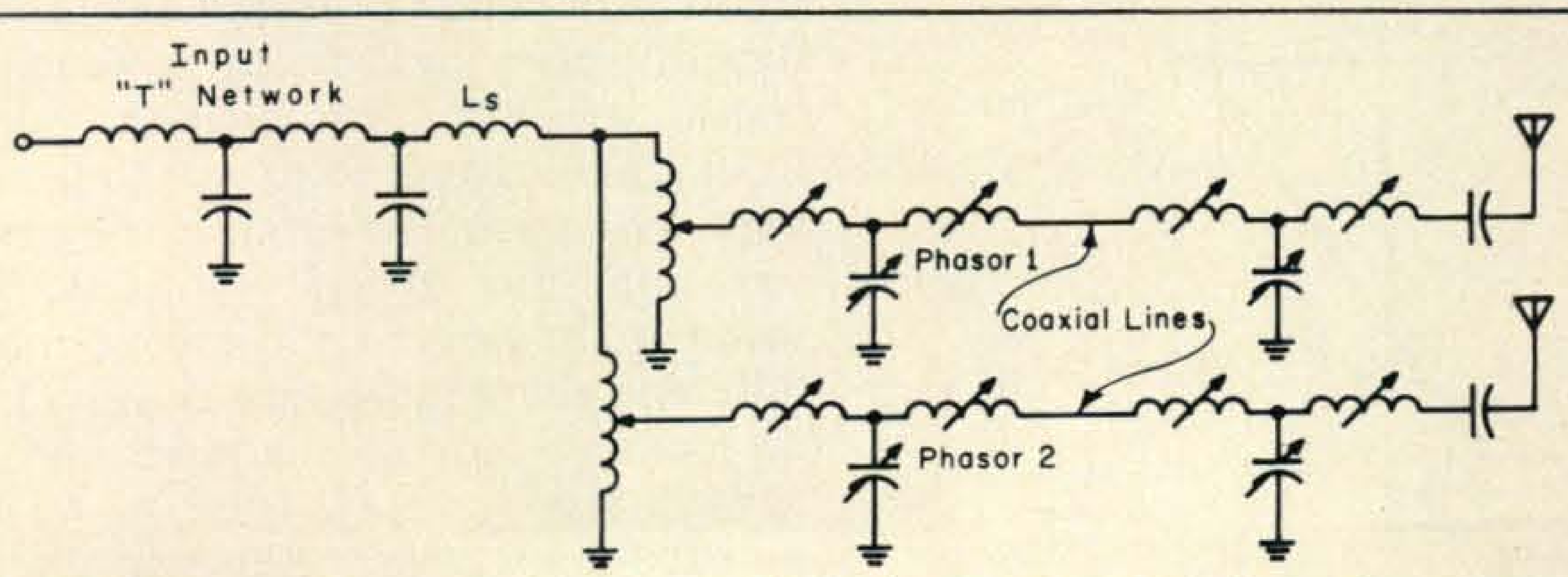

Fig. 34—An improved type of phasing and branching network called "the Ohm's Law type."

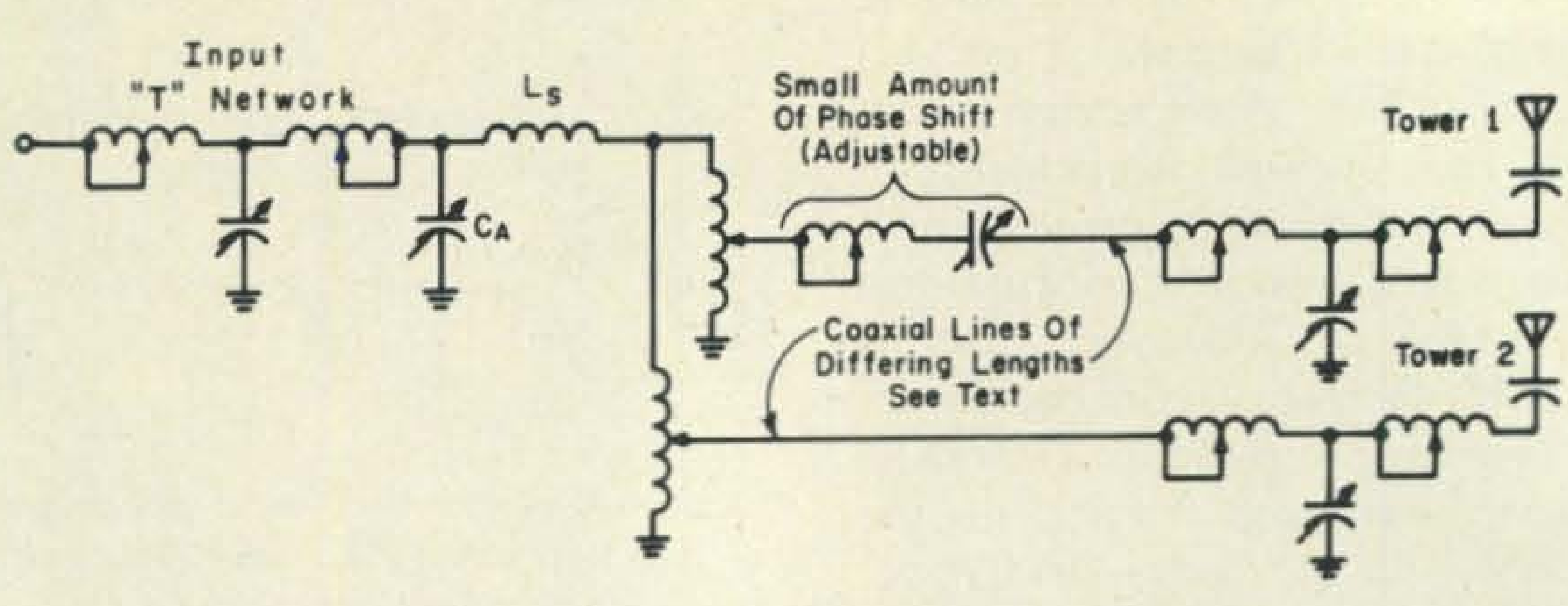

Fig. 35—Circuit of an Ohm's Law power divider suitable for amateur use.

and more attention will have to be paid to s.w.r. on the lines, and to matching. In the two previous cases, perhaps some mismatch and s.w.r. can be tolerated, with only a kilowatt and RG-8/U cable. In the maximum gain case, however, more care should be taken, if the gain is to be realized. For the 210° maximum gain case, we again have a completely symmetrical array, and with the great spacing the effect of mutual impedance is not going to be so apparent. A bit of s.w.r. can be tolerated here.

Radials

Each tower or radiator should have its buried ground system. These should be joined by a copper bus running between tower tuning units. This can be made of copper strap, or three or four ground wires twisted together. Where ground radials ovelap, they should be joined, as in fig. 36. The whole ground system should be one well-bonded unit, with no loose connections or unsoldered crossing wires. Refer to Part I of this series[38] for a discussion of ground system design and

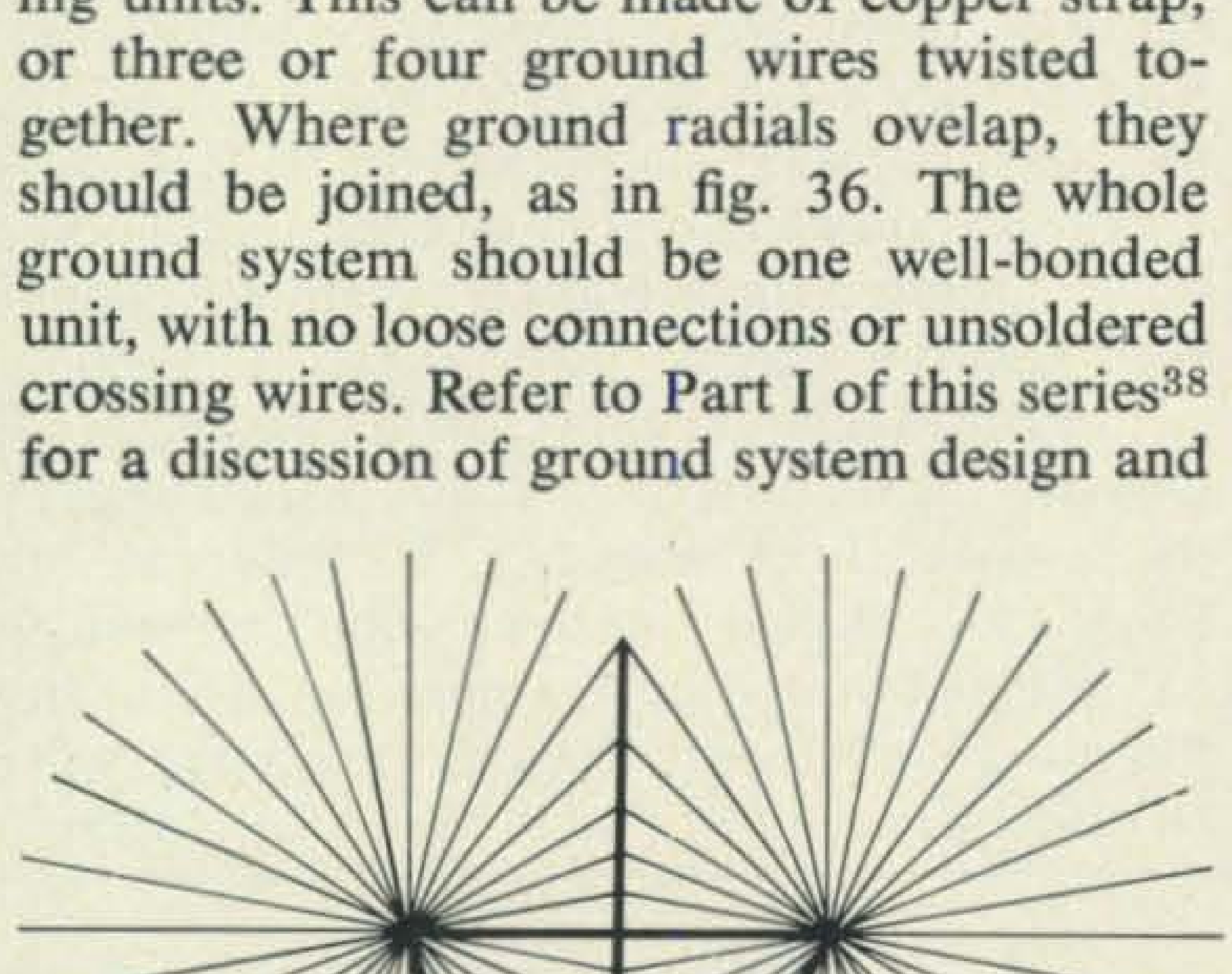

Fig. 36—A 32 radial ground system for a two-tower array.

its effect on radiation efficiency. If I were going to build a directional array for 2, 4 or 7 mc, I would lay down at least 32 radials around each radiator, with the ground bus extending into the building and connecting to the branching unit and the transmitter.

Tower Phasing

One matter I have not touched upon here is the measurement of the tower phasing. For the amateur this will not be too important, inasmuch as the array can be tuned for maximum forward gain (or maximum rear rejection) without much attention being paid to exact direction of the nulls. In the m.f. broadcast case, however, the phasing is required to be logged and maintained within two degrees. There is one common method of measuring it, and that is by means of a current sampling loop located on each tower. Each loop feeds a length of coaxial cable (usually RG-8/U), which is attached in the building to a phase monitor. This is a rather expensive piece of equipment which is designed to read phase difference between two currents. The sampling loop also provides a means of reading tower current remotely, and the remote meter can be calibrated to track fairly closely with the tower base current meter. Most phase monitors have provision for reading up to six towers. There has recently been introduced a simple current transformer which can be inserted in the lead from coupling unit to tower, to provide a remote indication. However, in the case of some self-supporting towers with wide bases, the tower input current will give a considerably different phase indication than will the pickup from the loop on the tower. After all, the actual tower current is what we are after. The pickup loop is usually mounted slightly above

[*Continued on page 130*]

FIFTH INTERNATIONAL YLRL CONVENTION

By LOUISA B. SANDO,* W5RZJ

Setting: Mile-high Denver—cool and green, with backdrop of lofty snow-capped Rocky Mountain peaks.
Dates: June 13-16, 1968.
Cast: 140 YLs, many OMs, jr. ops, and even jr. 's jr. ops.

FROM east, west, north and south they came, the majority flying in via the "proud birds" of jet airliners, and some in their own planes. From Stapleton International Airport we were whisked the few blocks to the Holiday Inn—which suddenly took on a strange appearance from the garden-pool level Coliseum Room, scene of most of the activities, and where a sleek Mustang awaited its claimant, to the eighth floor, home for the duration of KØYL.

No doubt other hotel guests imagined an "invasion"—as room doors sprouted colorful QSL cards, halls streamed with women decorated with gay hats and dangles, all talking in strange jargon, plus non-understandable language or di-ahs echoing from room 814.

*4417-11th St., N.W., Albuquerque, New Mexico 87107.

The Occasion

The occasion was the Fifth International Convention of the Young Ladies Radio League, sponsored by The Colorado YLs. Not the biggest YLRL's 4th, in Columbus, Ohio, drew 165 YLs), but surely it was one of the most delightful. The Colorado YLs had invited us for a fun-filled, casual weekend—and we had such fun meeting, greeting and eyeball QSOing that, believe it or not, some of the planned entertainment was cancelled as we just wouldn't stop yakking long enough!

The majority of the YLs arrived in Denver on Thursday and the registration room buzzed all day as YLs checked in, received name tags and those colorful "tote" bags from among the 200 The Colorado YLs had provided. These were soon festooned and

YLRL Convention registration desk, Holiday Inn-Airport, Denver, from l. to r.: Melanie, WB6VJX/Ø; Marge, WAØECG; Elaine, WØHEM, registration chairman; Kay, KØBTV, co-chairman of the convention. (*W5IWL photo*)

YL-OM banquet, from l. to r.: Elaine, WØHEM, president of The Colorado YLs; Maxine, WA6AOE, president of YLRL, and Marte, KØEPE, chairman for the convention. (Hiding behind the flowers is Bill, K6MQT, OM of Maxine.) (*W5IWL photo*)

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Presidents of YLRL, l. to r.: W3OLY, 1949; W6DXI, 1960; K5BNQ, 1961; W3PVH, 1957; W7NJS, 1958; WA6AOE, 1968; W6CEE, 1954-55 W8TAY, 1942-43; K4LMB (ex-W7FWB), 1940-41; W1ZEN, 1962; W7HHH, 1952-53. (*T. R. Ross photo*)

filled with "goodies", the colorful, cute, often ingenious "swap" items most of the YLs had assembled, some depicting radio call, state or area.

The hospitality room, next to the registration area, filled to overflowing as old friends and new met and greeted each othér. Here on display also were the many lovely prizes that had been donated for the convention, a QSL bulletin board, YLRL and club scrapbooks, and the large blue tablecloth decorated in silver on which WA∅PYZ, Linda, inscribed the name and call of each YL attending. The VE YLs had set up a table to publicize the Midwest YL Convention being sponsored by The Ontario Trilliums and to be held in Toronto May 16-18, 1969. Here, too, The Colorado

YL Editors reporting on the convention, l. to r., W5RZJ, *Peggy*, K1GSF, CQ; *YL HARMONICS*; Louise, W6BBO, QST. (*W5IWL photo*)

YLs kept a pot of coffee ever ready. Thursday evening the room was set up with long tables which were filled with YLs engrossed in bingo.

Tour

Friday we were up early for the Colorado Springs-Air Force Academy tour, and instead of the anticipated one bus load, we had three. First stop was Palmer Lake, QTH of K∅WZN, where with the help of friends Ann served the over 100 travelers with coffee and doughnuts at the Town Hall. A welcome break before we proceeded to the Garden of the Gods and Van Briggles Pottery Works in Colorado Springs. Next stop was the Air Force Academy, with lunch in the cafeteria, a show in the planetarium, and visits to the Chapel (we thought it beautiful) and the ham shack, which was shown off by four fine cadets who are hams.

Back at the Inn for the evening there were many new arrivals to greet or meet and the evening was spent in eyeball QSOing.

All of this time K∅YL was in full swing on the 8th floor of the Inn. Supplied by the Heathkit Electronic Center of Denver, it consisted of SB-101 Transceiver, SB-200 Linear Amplifier, SB-630 Station Control Console, SB-620 Scanalyzer and HD-10 electronic keyer. The antenna was furnished by Electronic Sales Co. Val, K∅ZSQ, was trustee and the station was kept warm till the wee hours of each morning.

On Saturday several of the YL nets met for breakfast, followed at 10 o'clock by the YLRL Forum in the Coliseum Room. YLRL President for 1968, Maxine, WA6AOE MC'd this. We were officially welcomed by convention chairman Marte, K∅EPE, and by Elaine, W∅HEM, president of The Colorado YLs. Maxine introduced the other 1968 YLRL officers who were present, and each gave a short report: Ivy, VE3EZI, secretary; Toni, K8PXX, receiving treasurer; Barbie, K5YIB, disbursing treasurer. Vice President Claire, W4TVT, regretfully could not be there as she was attending a son's granduation from college.

Maxine took roll call by district—and all were well represented. There followed a discussion of YLRL business, including printing of the directory issue of YL Harmonics, ways to attract more members, and the ballot of 1969 officers was announced. Updating of our book *"CQ YL"* was discussed and apparently all were in favor for when a hat was passed it was soon filled with $143 to con-

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tinue this project!

Highlight of the morning meeting was the invitation, issued by W6CEE, Vada, incoming president of the Los Angeles YLRC, for YLRL to hold its 6th International Convention in California in 1972. To be sponsored by the L.A. Club, it will celebrate YLRL's 33rd anniversary—"33" being a most important number in our history!

Luncheon Program

At 1:00 P.M. we again gathered in the Coliseum Room for an excellent luncheon and program. At each place we found more "goodies" for our tote bags—a sack of Idaho beans (K7UBC had sent 200 lbs.); sack of instant Idaho potatoes (courtesy of W7GGV), hand-painted coffee mugs, scarf with crocheted loop holder, flower decorated soap bars and velvet pin cushions.

The tape recorded messages from the founders of YLRL, which brought a standing ovation at the 25th Anniversary Convention in Columbus, was played again and enjoyed by all. Prepared by Lenore, W6NAZ, and her OM, it is a treasure for all YLRL conventions. Founding members of YLRL who were present for this convention included: Ethel, K4LMB (ex-W7FWB, ex-W3MSU); Anita, W8TAY (ex-W4JCR), and Marjorie, W7GXI.

WA6AOE next recognized the past presidents of YLRL who were present, a total of twelve (see photo). She then called for YLs who had been licensed for 5, 10, 15, 20 and 25 years. Five members of QCWA were present, but the prize, five silver dollars, went to Barney, K6GU, who has held her license for 40 years! Also recognized were the approximately 20 YLs present who hold Advanced Class licenses. Various YL clubs and nets also were recognized.

Marte, KØEPE, presented the first place phone award for the 1967 YLRL Anniversary Party, a gold cup, to Ivy Smythe, VE3EZI. Ivy also received the Corcoran award, a copper plaque, for earning the highest combined phone-c.w. score in this A.P.

DX YLs were recognized, including Corinne, CE2SC, who flew from Chile (Corinne was also at the 25th anniv. convention, then as TG9BC), and Helen, W1HOY/KP4, who flew in with OM Sam, W1FZJ/KP4, from Puerto Rico. Also recognized were Betty, KL7FJW, from Alaska, and Beth, W7NJS/KH6GDS, who operates from Hawaii during vacation trips. VE-land was well represented, also, with 8 YLs.

VE YLs at YLRL Convention publicize the Mid-West YL Convention they will sponsor May 16-18 with the slogan "Cross the line in '69." L. to r., Jean, VE3DGG; Chris, VE1AKO; Dorothy, VE3DXZ; Bubbles, VE4ST; Doreen, VE3FUR.

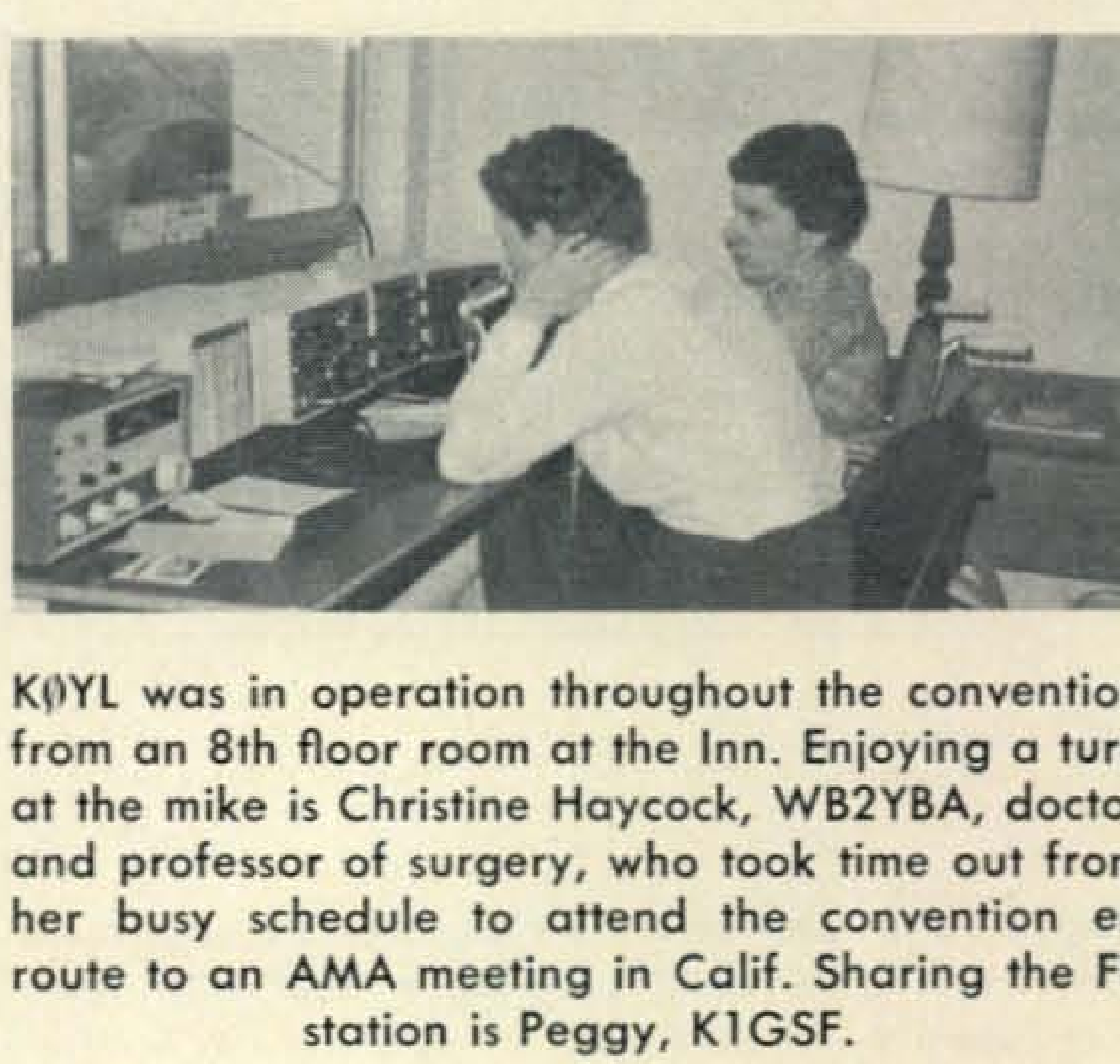
For entertainment we were treated to a short wig show, the models being members of The Colorado YLs. Then it was time for prizes, and Betty, WØEXX, prize chairman, had assembled 150 prizes, 50 of which were drawn for following the luncheon.

While the YLs were at the luncheon, the OMs had their own program, including a tour to Squaw Mountain.

YL-OM Banquet

Saturday evening some 240 YLs, OMs, plus a few jr. ops, gathered in the Coliseum Room for the banquet. Awaiting us here were tile shaped match box covers in blue and silver, coasters for the OMs, silver dollar banks and paper weights cleverly assembled from plastic columbine flowers in baby food jars filled with water and inverted and trimmed

[*Continued on page 119*]



KØYL was in operation throughout the convention from an 8th floor room at the Inn. Enjoying a turn at the mike is Christine Haycock, WB2YBA, doctor and professor of surgery, who took time out from her busy schedule to attend the convention en route to an AMA meeting in Calif. Sharing the FB station is Peggy, K1GSF.

A SIX ELEMENT WIRE YAGI FOR 20

BY KEN STEWART, *W8CLD

To many, there is something very strange and unYagi-like about a wire Yagi. These critics will point out that there aren't many wire Yagis in use or construction articles to be found. This is certainly true. They also argue that wire just won't work for Yagi construction. This argument isn't necessarily valid. To the contrary, it is quite possible to put up a wire beam that will give excellent results, yet cost less than 5% the expense of raising a comparable Yagi made of tubing.

In order to understand why this particular antenna works as it does, it is necessary to comprehend a few basic facts regarding the concepts of radiation resistance and bandwidth. It has been established that the feedpoint impedance (also known as radiation resistance) of an infinitely-thin half-wave dipole located in free space is about 72 ohms. This value becomes lower when the length/diameter ratio of the conductor is made smaller (*i.e.* when the conductor gets thicker

23727 Elm Road, North Olmstead, Ohio 44070.

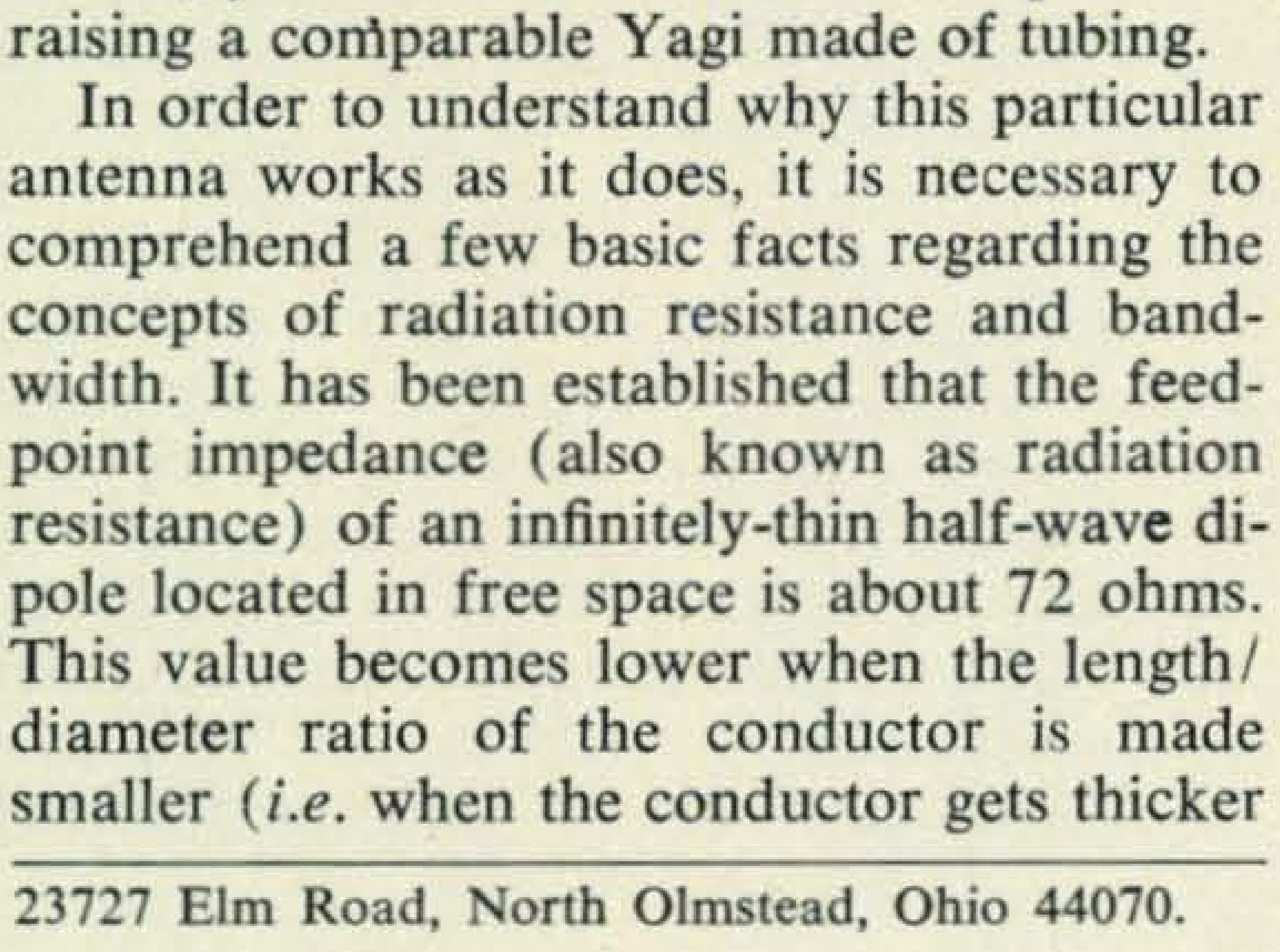


Fig. 1—Top view of a six element wire yagi for 20 meters. The element lengths in feet and inches are listed in Table I and the spacings in Table II.

for a given length) and when one or more antennas are coupled to it, as when parasitic elements are placed parallel to a fed dipole to form a Yagi array.

Antenna Losses

Power lost due to radiation represents a power loss to the antenna just as does the actual I^2R loss due to the real resistance of the conductor. Obviously, energy radiated into space and absorbed by a DX station's receiving antenna is much more useful than energy which is only being used to heat up the transmitting antenna. From this it is possible to conclude that it is desirable to have a relatively high radiation resistance and a relatively low ohmic resistance. But it was just stated that antennas made of tubing have a lower radiation resistance than those made of wire. True, but the value of ohmic resistance is also less. However, wire will work fine as long as it doesn't have a terribly high resistance. Try to use #12 or thicker and steer clear of aluminum or iron wire. My beam was constructed of #10 insulated copper of the type used for house wiring.

Bandwidth

Perhaps the main argument in favor of "Tubing" Yagis is that the low-Q conductor will work over a wider bandwidth than the high-Q conductors inherent in wire beams. In a Yagi made of tubing, a small amount of gain is sacrificed for broadbanding. All this means is that a wire beam cut for the low end of the band will not work as well at the high end as will one constructed of tubing. It will perform satisfactorily at any point in the c.w. portion of twenty if cut for 14.050 mc, however. The same reasoning holds true for the phone part of the band.

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	Center Frequency In Kc.					
	14050	14100	14150	14200	14250	14300
Refl.	34′ 0″	33′ 10″	33′ 9″	33′ 7″	33′ 6″	33′ 4″
Driv. El.	32′ 8″	32′ 6″	32′ 5″	32′ 3″	32′ 2″	32′ 0″
Dir. #1	31′ 4″	31′ 2″	31′ 1″	30′ 11″	30′ 10″	30′ 8″
Dir. #2	30′ 8″	30′ 6″	30′ 5″	30′ 3″	30′ 2″	30′ 0″
Dir. #3	30′ 0″	29′ 10″	29′ 9″	29′ 7″	29′ 6″	29′ 4″
Dir. #4	30′ 0″	29′ 10″	29′ 9″	29′ 7″	29′ 6″	29′ 4″

Table I—Element lengths for the 20 meter six element wire yagi.

Keep in mind what was said about the decrease in radiation resistance of a dipole when elements are paralleled with it. This condition is worsened when closer spacing causes increased inter-element coupling. It is therefore evident that wide spacing is desirable. Wide spacing is employed in the design of the wire beam to be described. All elements are spaced 0.2 wavelengths apart with the exception of the spacing between driven element and the first director, which is 0.15 wavelength. This is depicted in fig. 1. As can be seen the array is over 60′ long. If room is not available for a 6 element array, one or more directors may readily be omitted. Even if all directors were to be left off, the remaining antenna would yield a worthwhile improvement over a dipole alone. It is also possible to add more directors if space is available.

For a 6 element beam, about 200′ of wire and two 100′ lengths of ⅜″ rope is required. Nylon rope is quite expensive, as well as being stretchy, so a cheaper grade of rope is recommended. The anatomy of the wire beam is quite simple. Attach the ends of the elements to two parallel ropes using small pieces of ⅛″ nylon rope as insulators. Don't use big ceramic insulators as they will weigh the antenna down considerably. The only insulator should be at the center of the fed dipole.

Feed Line

The antenna is fed with RG-8/u or RG-58/u. RG-17 or RG-19 is very nice if you have it, but would weigh the antenna down intolerably. There is a method to lick the coax drag problem, though. Install a wooden post beneath the antenna so that the top is a few feet away from the center of the driven element. Attach the coax to this and leave a little slack at the top. This will take most of the strain off the driven element. I found a dead tree in a nearby forest that fit the post requirement nicely.

Construction

The first step in construction is to cut the elements to the proper length. Attach a few feet of thin nylon line to the ends of each

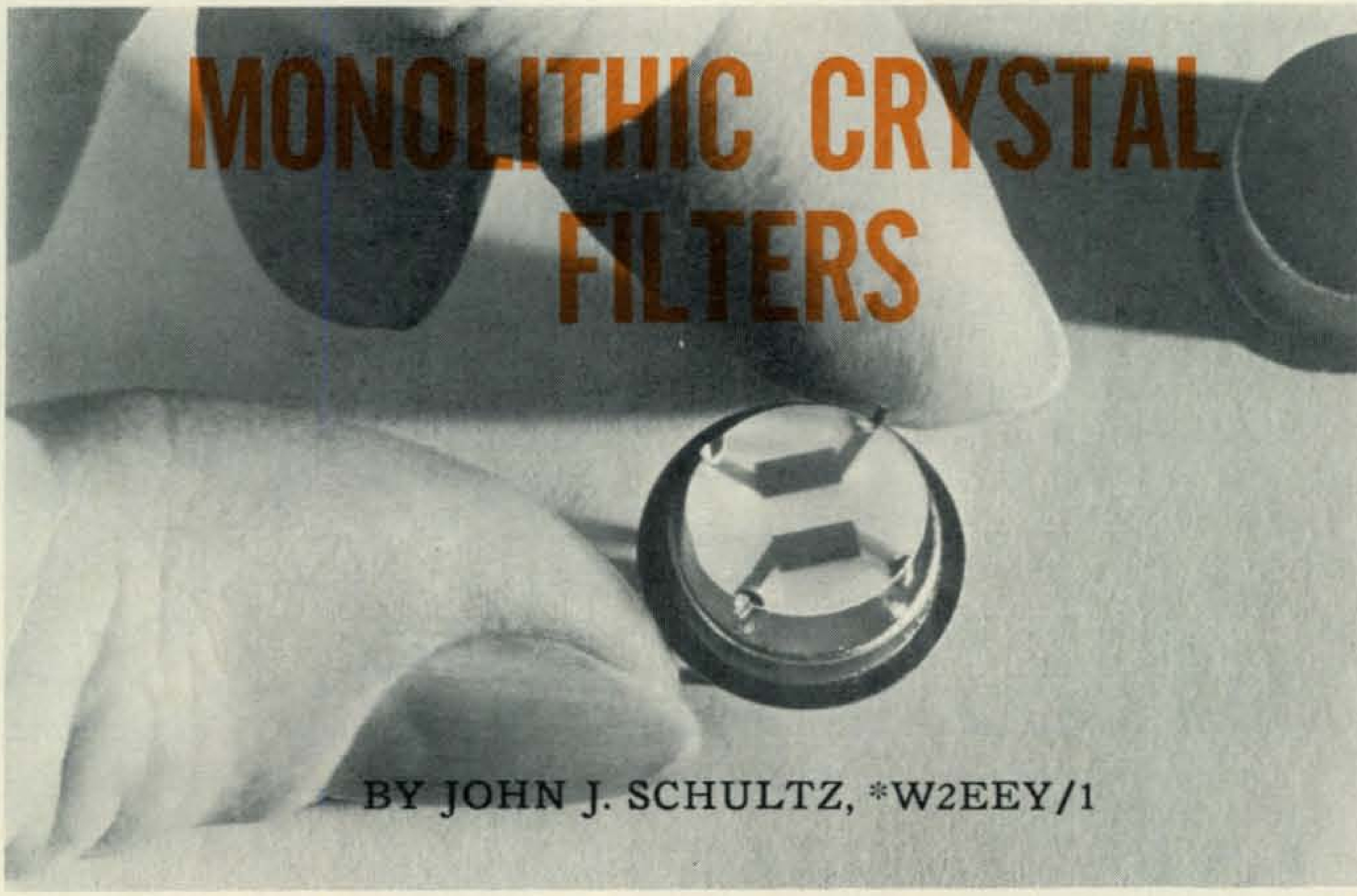
[*continued on page 124*]

Distance in terms of:	Wave-length	Feet
Refl. to Driv. El.	0.20 λ	13′ 4″
Driv. El. to Dir. #1	0.15 λ	10′ 0″
Dir. #1 to Dir. #2	0.20 λ	13′ 4″
Dir. #2 to Dir. #3	0.20 λ	13′ 4″
Dir. #3 to Dir. #4	0.20 λ	13′ 4″

Table II—Element spacing for the 20 meter six element wire yagi.

MONOLITHIC CRYSTAL FILTERS

BY JOHN J. SCHULTZ, *W2EEY/1



The photograph shows a simple two-pair electrode monolithic crystal filter. By itself, it replaces all the components shown in fig. 1(B). Such filters using up to ten electrode pairs, corresponding to a ten crystal discrete form filter, have been constructed. *Photo courtesy of Bell Telephone Laboratories.*

This new development foreshadows an eventual major change in conventional crystal filter circuits. The simple quartz crystal takes on a new dimension as a filter element.

ONE of the latest developments from the Bell Telephone Laboratories may not prove to have such an impact on electronic circuitry as did their crystal triode (transistor) of 1948, but it still should prove important eventually in many amateur equipment circuits. The device is a monolithic crystal filter. Its basic concept is relatively simple, but yet it has taken considerable time to research and develop practical units.

Conventional Discrete Crystal Filters

Conventional crystal filters make use of the same crystals which are used for frequency generation in an oscillator circuit. Such crystals are available in a wide variety of forms and packages and although they have undergone many packaging changes and much research has been done to cut the crystals in various special ways to obtain extended frequency limits, they all remain the basic same element as originally, a sheet of quartz with a metal electrode attached to each side of the sheet (or other similar quartz form).

Various conventional crystal filter circuits are shown in fig. 1 utilizing from one to four crystals. More elaborate circuits are possible and some commercially made filters used in amateur s.s.b. equipment use six or even eight crystals. Although the commercial filters may only have one housing, they all internally contain individual crystals.

The advantage of multiple crystal filters is that they can generally be constructed for any frequency for which individual crystals are manufactured. Their disadvantage is cost, as many individual crystals are required when it is desired to construct a bandpass filter with very steep skirt selectivity.

* 40 Rossie Street, Mystic, Conn., 06355.

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Monolithic Filter Development

The basis for a monolithic crystal filter developed out of the idea of somehow combining all the individual crystals in the circuits shows in fig. 1 into a single crystal structure.

It should be remembered that a simple individual crystal acts as an electro-mechanical filter. Being piezoelectric, it transforms electrical energy into a transverse shear wave in the quartz sheet and then back again to electrical energy. The metal electrodes attached to the quartz lower the resonant frequency of the transverse shear wave in the area in which they contact the quartz. However, the resonance created in the area of contact does not propagate into other areas of the quartz which have no electrodes.

This effect is put to use in the simple monolithic filter shown in fig. 2 which has two pairs of electrodes. The application of a voltage across the input electrodes sets up an electric field through the thickness of the quartz sheet, which in turn produces a mechanical shearing force. When the frequency of the applied voltage coincides with the resonant frequency of the mechanical structure, a strong resonant vibration will be created. If the output pair of electrodes has the same thickness as the input pair, the quartz region between them will have the same resonant frequency. The intervening piece of quartz couples the pair of electrodes at a particular frequency.

The frequency of the filter resonance is determined by the combined thickness of the quartz plate and the metallic electrodes and the spacing of the electrode pairs.

Since the areas of the quartz sheet where electrode pairs are placed form mechanically resonant systems which are coupled through the transmission of energy by the quartz sheet, additional electrode pairs can be added as desired on a single quartz sheet. Figure 3 shows a four pair electrode filter which is essentially the equivalent of a filter using four individual crystals. Figure 3 shows the electrical equivalent of the filter and how the improvement in selectivity takes place as a signal progress through the filter. Filters with up to 10 electrode pairs have been constructed. Figure 4 is the selectivity curve of a filter having eight electrode paids and centered on 8100 kc with a 3.4 kc bandwidth.

Presently, monolithic filters can be constructed with bandwidths of 30 cycles to 3 kc at 3,000 kc and ranging to bandwidths of 300 cycles to 30 kc at 30,000 kc. Continuing refinement of manufacturing techniques will undoubtedly considerably extend this range in the future.

The advantages of this type of filter are multifold. It is considerably smaller than a filter using individual crystals. In addition, no transformers, inductors or other discrete components are necessary as with conven-

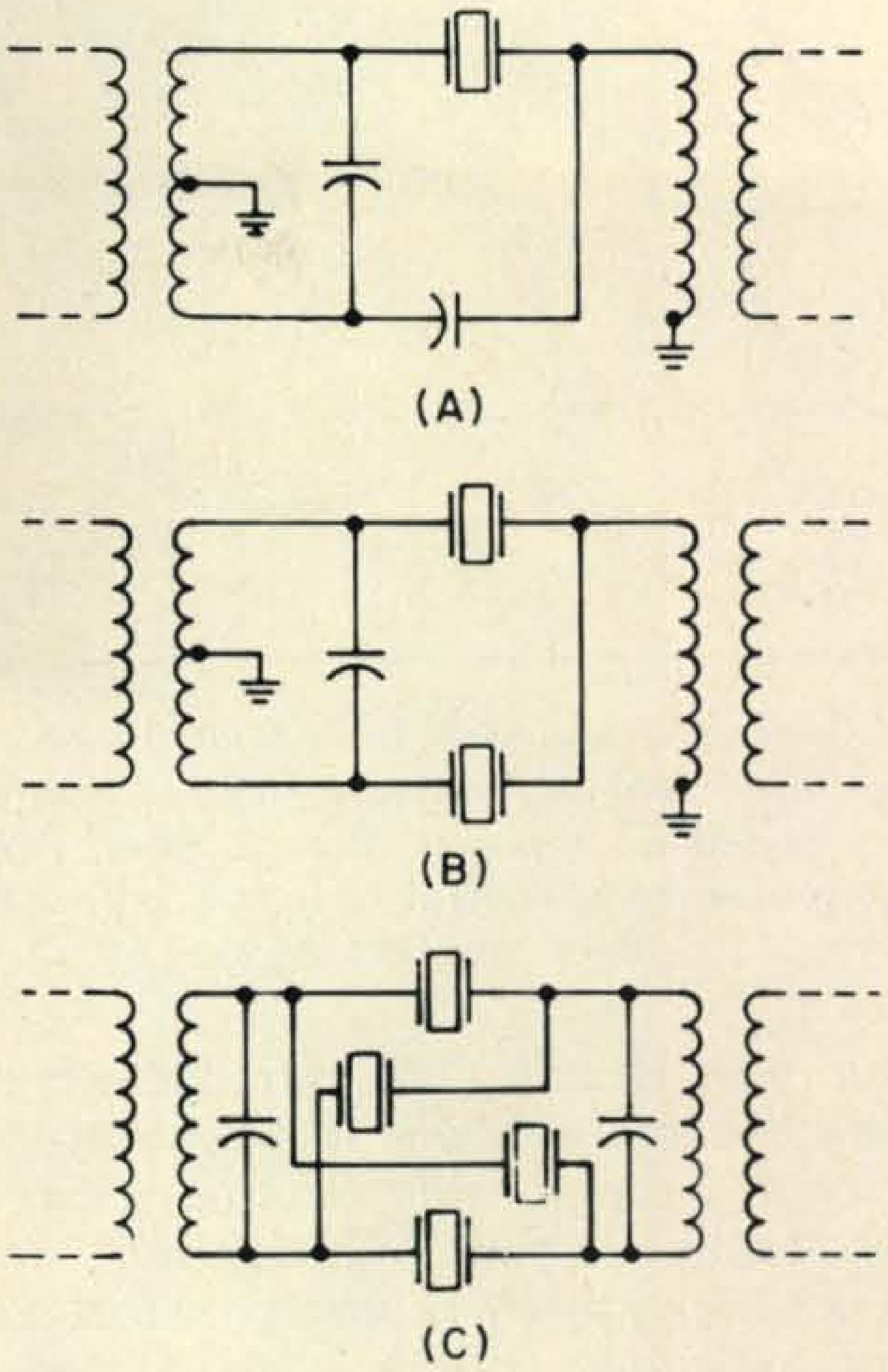

Fig. 1—Various simple, conventional crystal filter circuits.

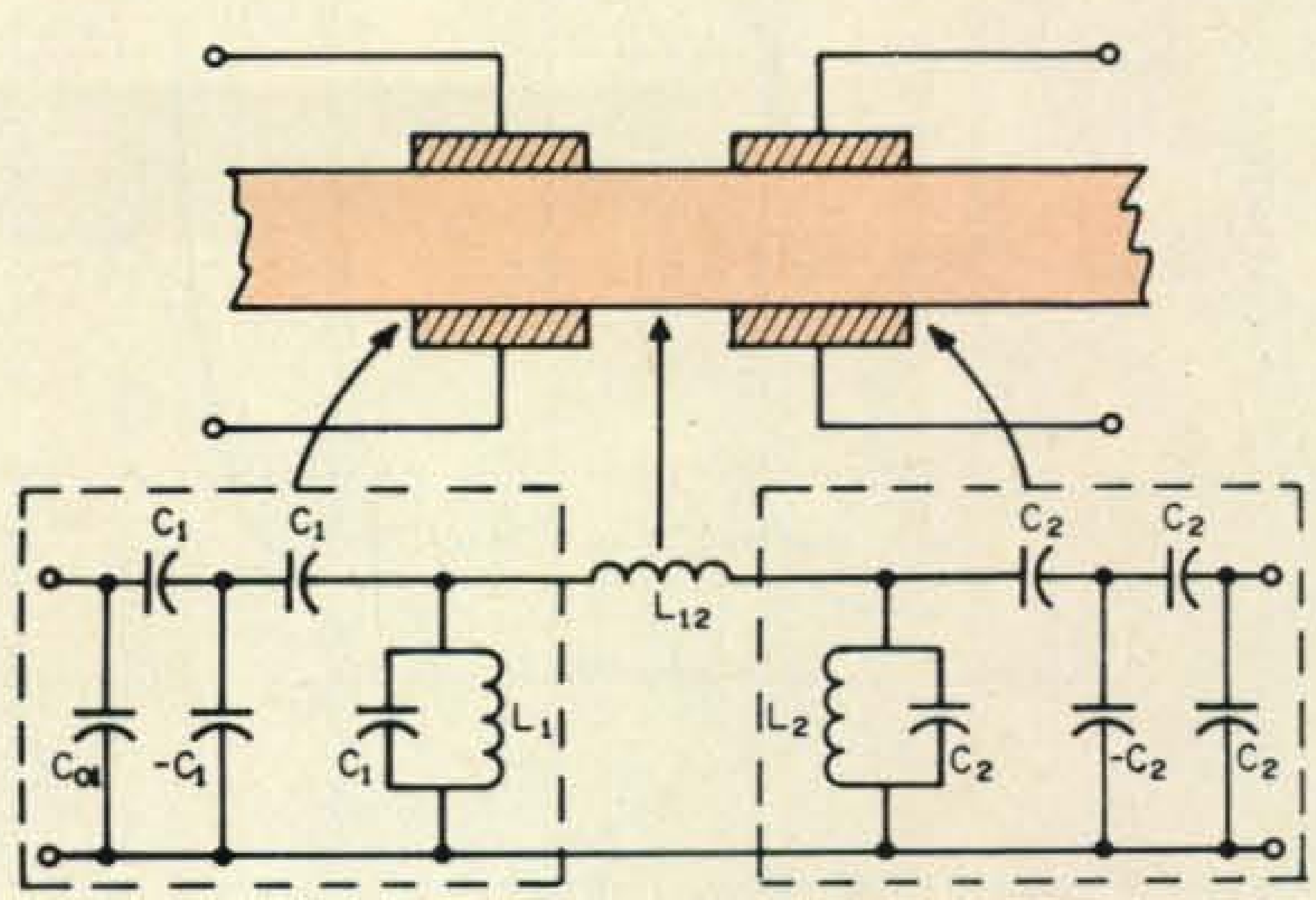

Fig. 2—Basic monolithic crystal filter consists of a pair of input and output electrodes on a quartz sheet. Dimensions and spacing of electrodes determines bandwidth, impedance and other characteristics. Equivalent electrical circuit is shown.

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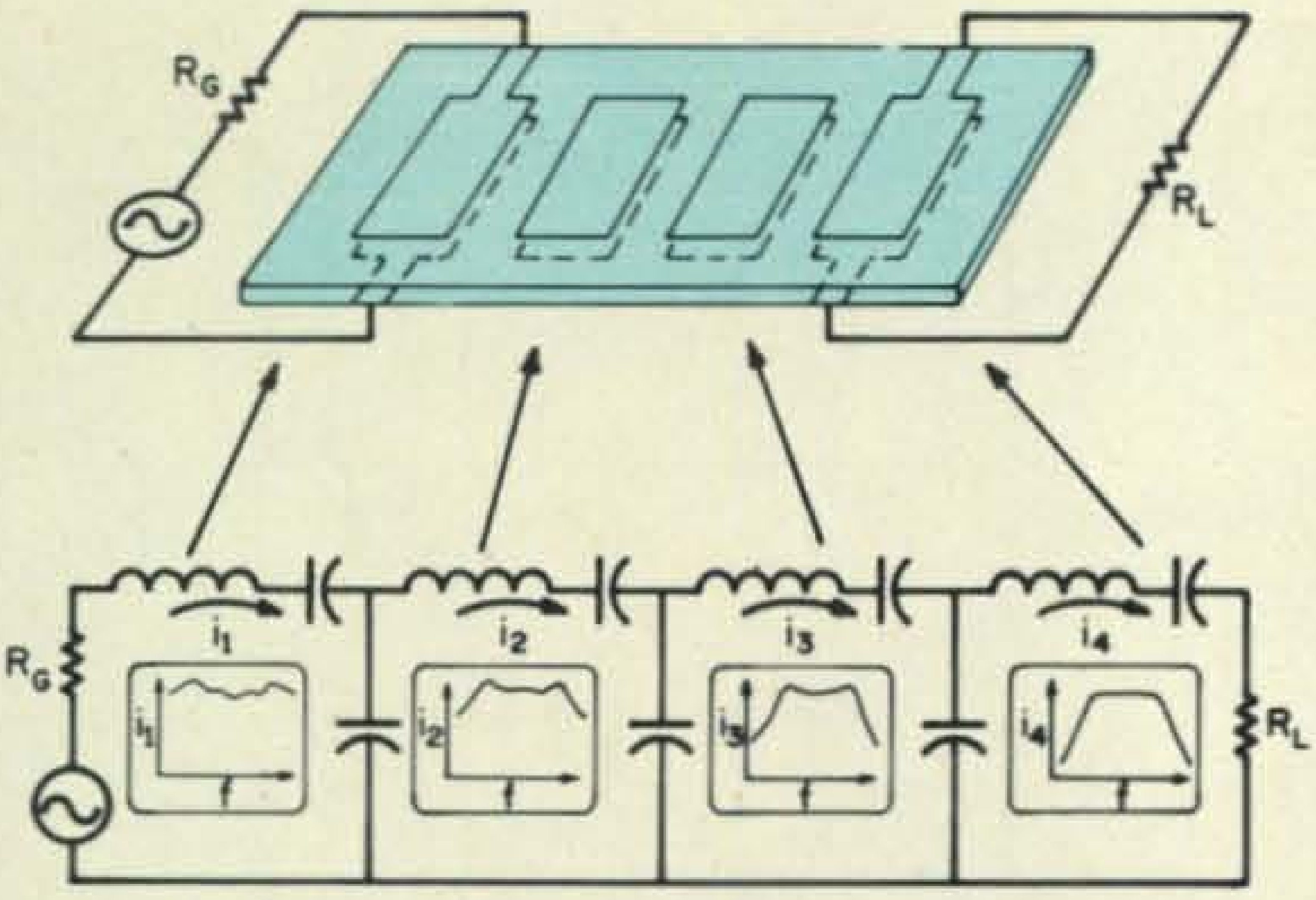

Fig. 3—Multisection monolithic filter showing electrical equivalent circuit and graphs of how signal is processed as it passes through filter. Performance is essentially equivalent to four crystal lattice filter shown in fig. 1.

tional filter circuits. The manufacturing cost is low because only one quartz sheet is necessary and the metallic electrodes can be a deposited metal film. Although no cost data is available, a figure probably half of a filter using individual crystals is anticipated. The ruggedness of the monolithic filter should be the same as a simple crystal.

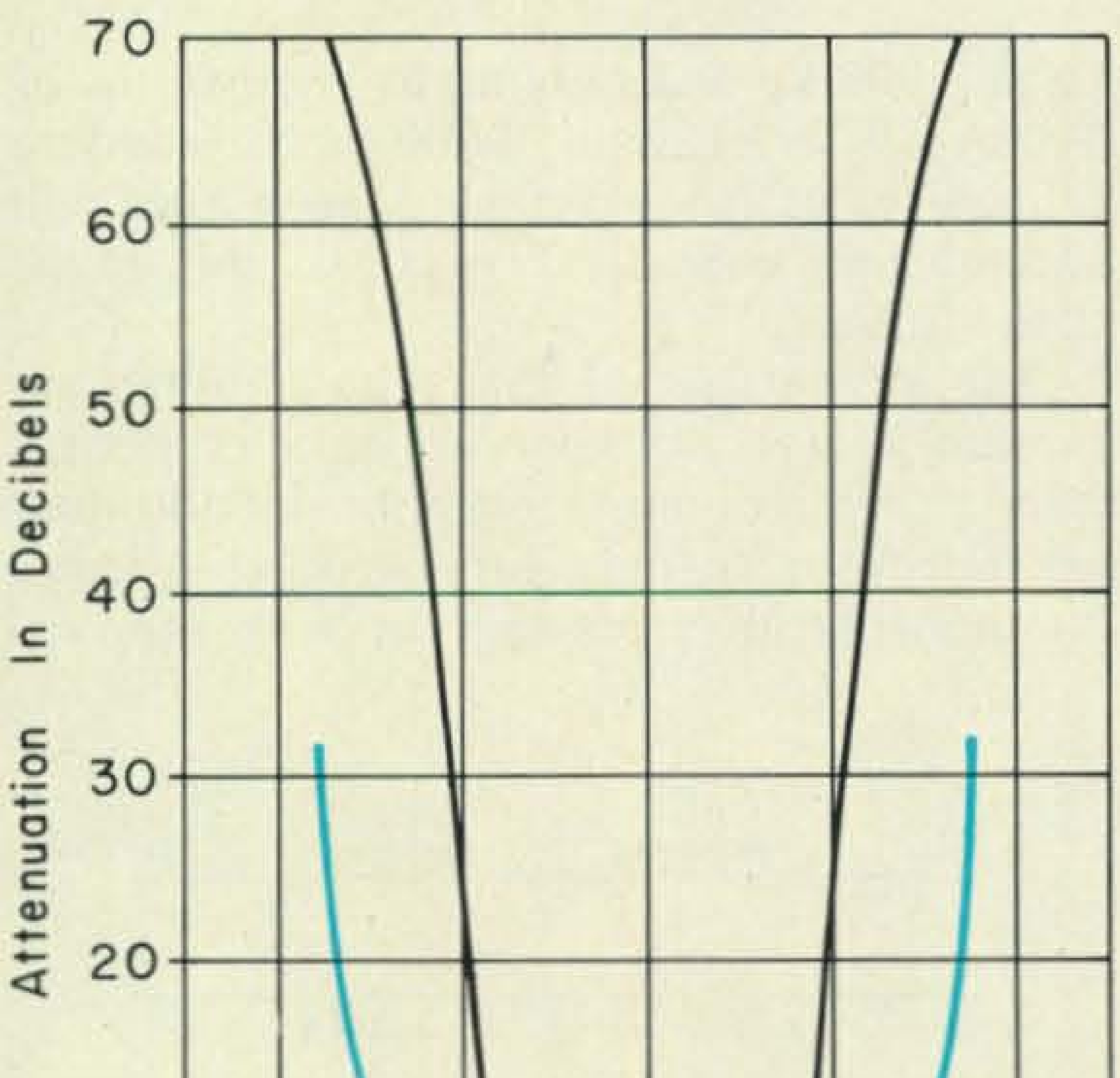

Fig. 4—Selectivity curve of eight section monolithic filter with 3.4 kc bandwidth and 8.1 mc. center frequency. Colored curve shows low in-band ripple.

Comparison to Mechanical Filters

The monolithic crystal filter naturally invites comparison to a mechanical filter since both can be used for the same applications in receiver and transmitter circuits. The frequency range of the monolithic crystal filter (3 to 30 mc) is certainly much greater than that of a mechanical filter which is usually limited to 500 kc. Also, the crystal filters can be constructed with very narrow bandwidths whereas mechanical filters cannot be constructed with bandwidths of less than 500 cycles. The one disadvantage of the crystal filter is that it cannot yet be constructed to operate at i.f. frequencies. As far as external circuit complexity, skirt selectivity (shape factor) and in-band ripple are concerned both filters are fairly comparable. Ruggedness should definitely be in favor of the crystal filter, as anyone who accidentally dropped a mechanical filter once on a floor could attest.[1] Cost should also be in favor of the crystal filter once it is available in production quantities.

Summary

The usual quartz crystal has been around in its present form for many years. Great efforts have been spent to devise circuits to utilize its properties while until now little effort has been expended to change the quartz crystal to suit new functions. Therefore, the development of the monolithic crystal filter is an interesting example of how even components one generally regards as being useful only in their present form can be further developed.

The time period for the common availability of monolithic crystal filters depends upon a multitude of marketing, licensing and development factors. Various forms are presently in use in telephone carrier systems and Collins Radio is expected to shortly announce a commercial series of such filters to complement their mechanical filter line.

When they do become available, however, they should allow the building of various selectivity options of high performance into amateur equipment at a price far below present costs.

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[1] The mechanical filter people will disagree with this view and they are supported by most textbooks. However, the author has seen many crystals survive accidental drops but very few mechanical filters survive similar drops on workshop floors.

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oin "THE TROUBLESHOOTERS"

who get paid top salaries for keeping today's electronic world running

ind today's microwave towers, pushbutton phones, computers, bile radios, television equipment, guided missiles, etc., stand E TROUBLESHOOTERS—the men who inspect, install, and service these dern miracles. Here's how you can join their privileged ranks—without ing to quit your job or go to college to get the necessary training.

r THINK how much in demand u would be if you could prevent / station from going off the air epairing a transmitter...keep a e assembly line moving by fixing nated production controls...pre- a bank, an airline, or your gov- ient from making serious mis- s by servicing a computer.

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THE CARE OF NI-CAD BATTERIES

BY KEN W. SESSIONS, JR., *K6MVH

THERE is a great deal of misunderstanding about the charging requirements of nickel-cadmium (or ni-cad) batteries. Manufacturers of such power packs also supply special chargers that "must" be used "exclusively" to avoid damage to the cell.

Many manufacturers of tiny transceivers and pocket communications receivers supply ni-cad batteries with their equipment that likewise must be used with special chargers if their guarantees are to remain valid.

Ni-cad batteries are supposed to be the toughest and best available; they're by far the most expensive. So what is it about them that requires such delicate attention? Why can't any charger be used for ni-cad power sources? The truth of the matter is that two important rules governing use of a ni-cad battery must be observed at all times: (1) Don't overdischarge and (2) don't overcharge.

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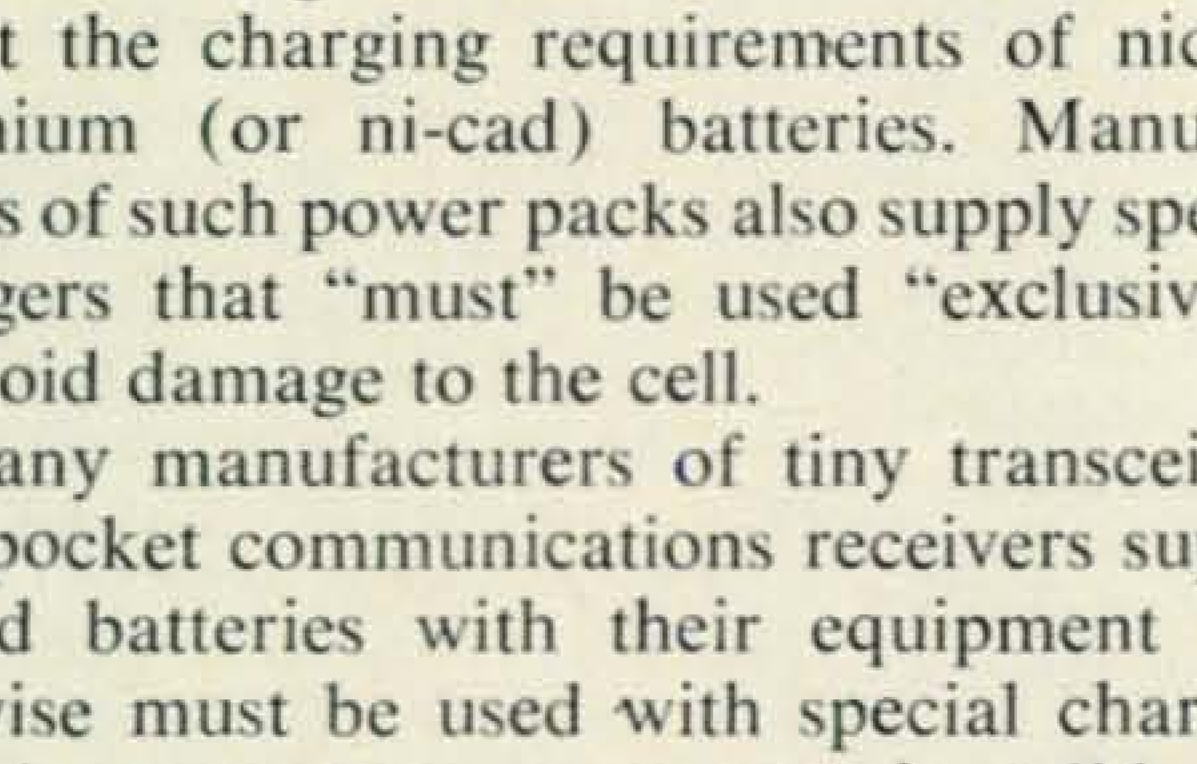

Charge Current	R_1	R_3
2- 15 ma	1K, 10W	50K, 10W
15- 40 ma	1K, 10W	5K, 10W
40-150 ma	250Ω, 10W	1K, 25W
150-250 ma	100Ω, 10W	250Ω, 10W

Fig. 1—Simple charger circuit for nic-cad batteries. The range of M_1 should be greater than the maximum charge current.

Overdischarging

A battery's output capability (or energy storage capability) is called its capacity. Overdischarging can be defined as discharging a cell beyond its rated capacity. It isn't easy to know when a nickel-cadmium battery needs charging, because it should be charged before there is a noticeable drop in output energy. A 100% depth of charge is a term applied to a fully charged, usually new, battery.

Once a battery has been discharged, it will never again regain the 100% depth of charge of its original state, although the level may be imperceptibly below that point. With a nickel-cadmium battery, the further the depth of charge is eaten away during use, the fewer the total number of charged discharge cycles that can be expected. A good rule of thumb is to never allow a nickel-cadmium battery to be used past the 40% depth-of-charge point. An even better rule is to keep the depth of charge above 80% at all times. In terms of voltage, the point at which a ni-cad battery should be charged is the point at which the per-cell voltage drops to 1.1 volts under load. (The fully charged cell will measure 1.25 volts under the load for which it was designed.)

How do you determine the number of cells in a particular battery? Simple. Measure the minimum-load voltage of the battery when it is fully charged, and divide that number by 1.25; the result will equal the number of cells in the battery. For example, a 6 volt ni-cad will measure 6.25V at full charge and will contain five individual cells. To determine the per-cell voltage, just divide the overall battery voltage by the number of cells.

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If the depth of charge is kept above 40%, a ni-cad cell is easily brought back up to the full charge point time after time (although each charge is slightly, almost immeasurably, less than the preceding one). And if the depth is maintained above 80% the charge-discharge cycles can be repeated virtually numberless times while the battery remains in a like-new condition. If the battery can be considered "discharged" at 80%, the fluctuation of potential on the battery is minimized, remaining pretty much the same whether the battery is being charged or discharged.

On the other hand, if the energy from a nickel-cadmium battery is completely expended, it stands a good chance of being permanently damaged. At best, overdischarge can prevent the cells from being recharged fully. The battery's efficiency—even at a 70% depth of charge—could diminish to the point where the charge is lost at an increasingly rapid rate.

There are two common types of ni-cad batteries: vented and nonvented. The nonvented cell is often referred to by the term "dry cell," which is a misnomer because all ni-cads are "wet." The nonvented ni-cad is a hermetically sealed unit which has much the same appearance as a conventional dry-cell battery. The vented cell is similar in appearance to a lead-acid wet cell, and usually has a removable plug which can be used to expose a port for gas relief during charge.

A vented ni-cad battery offers a little better rejuvenation potential at full discharge than a nonvented battery because of the suspension of the electrodes and the inherent capability of the vented battery to eliminate gases and accept new electrolyte. But even the vented battery is heavily penalized by overdischarging. A completely depleted cell may be brought back up to an 80-85% depth of charge again and again after a single overdischarge, but it is possible that the important top 15% may never again be attained.

Overcharging

The most important parameter of a ni-cad battery is its milliampere-hour rating. It is almost impossible to provide a proper charge without having at least a fair idea of what the rating is.

The milliampere-hour rating does not stipulate how many milliamperes of current the battery will provide for one hour. Nor does it tell how many hours the battery will

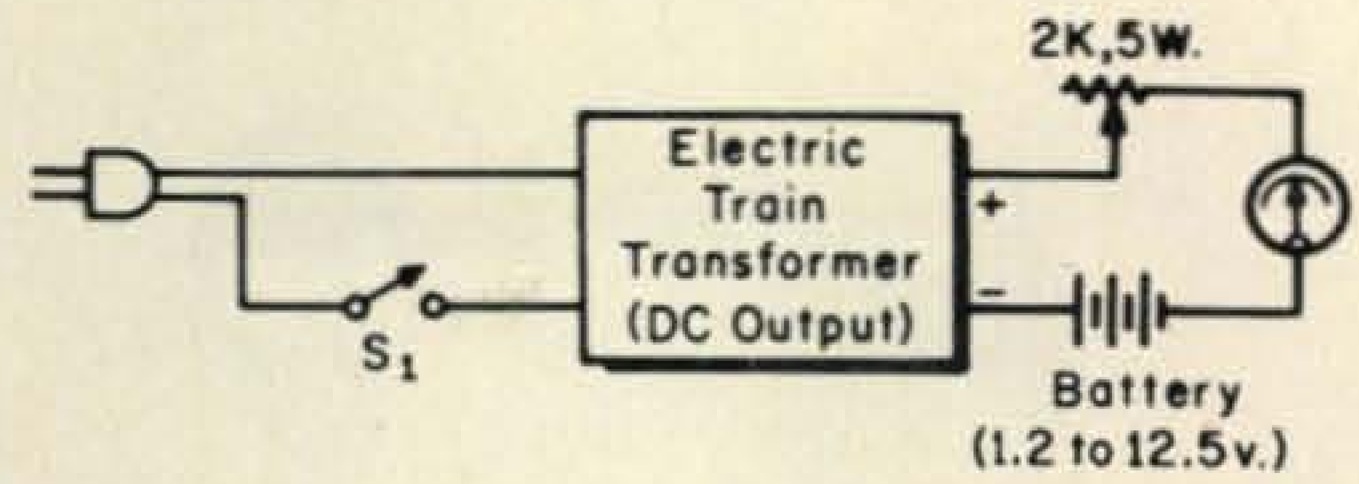

Fig. 2—Ni-cad charger circuit using a d.c. power pack from an electric train or road-race set.

last at a 1 ma drain. The rating is based on this ratio, but the actual figure is calculated to show overall energy output capability to a specified end-point (usually 1.1 volts per cell) over a 10 hour period. The 10-hour figure is used because the battery's capacity depends on rate of discharge. Because of heating and internal losses, a 100 ma-hour battery wouldn't have the capability of producing 100 ma for a full hour. Yet, it might be likely to produce even more than 1 ma for 100 hours. Thus, the 10-hour standard has been accepted by the battery industry as an inflexible value.

Time is also an important factor in determining length of charge to attain proper energy storage. For practical purposes, the longer the charging time (or the lower the charging current), the higher the resultant depth of charge. Of course, this is only true to a point because there is a practical limit on the depth of charge which can be attained in any case. Generally, an ideal charging time will be more than 10 hours and less than 20.

One might logically deduce that a 250 milliampere-hour battery can be charged with a constant current of 25 ma for 10 hours, 2.5 ma for 100 hours, or 250 ma for 1 hour. The high current rate of the one-hour charge would be as bad on the battery as the high-current discharge rate. Such a high charge rate would almost certainly cause gassing that would wipe out the battery. Another rule of thumb can be applied here: Don't allow the charging current to exceed 10% of the battery's milliampere-hour rating, but extend the time period by 50%. Instead of charging a 250-milliampere-hour battery at 25 ma for 10 hours, allow it to charge at the 25 ma rate for 15 hours. This will assure that the expended energy is replaced and will allow for various losses and other anomalies.

The lead-acid battery that starts the car each morning is a tough old brute that can be mistreated and manhandled. But even this

[*Continued on page 120*]

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THE SB-34 TRANSCEIVER Expanded Coverage and Convenience

BY JOHN J. SCHULTZ, *W2EEY/1

Although SBE achieved their design goal with the SB-34 transceivers, many amateurs would have preferred various additional features. This article presents some of the simplest ideas yet developed to provide those additional features with minimum cost and effort. The modifications are basically simple and adaptable to other transceivers as well.

THE SB-34 is literally one of those pieces of equipment which begs for modification. The engineers who designed it created a uniquely compact 4-band transceiver but failed to provide c.w. band coverage and operation, as well as other operating conveniences, although the additional cost to the production line units to provide these conveniences would have been minor.

Various other articles have described modifications to the SB-34. Some articles have described c.w. conversions involving outboard accessories but did not describe

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This photograph shows not only the simple microswitch used as a portable c.w. key, but the use of the microphone jack as a key jack and the replacement of the regular tuning knob with a "spinner" type.

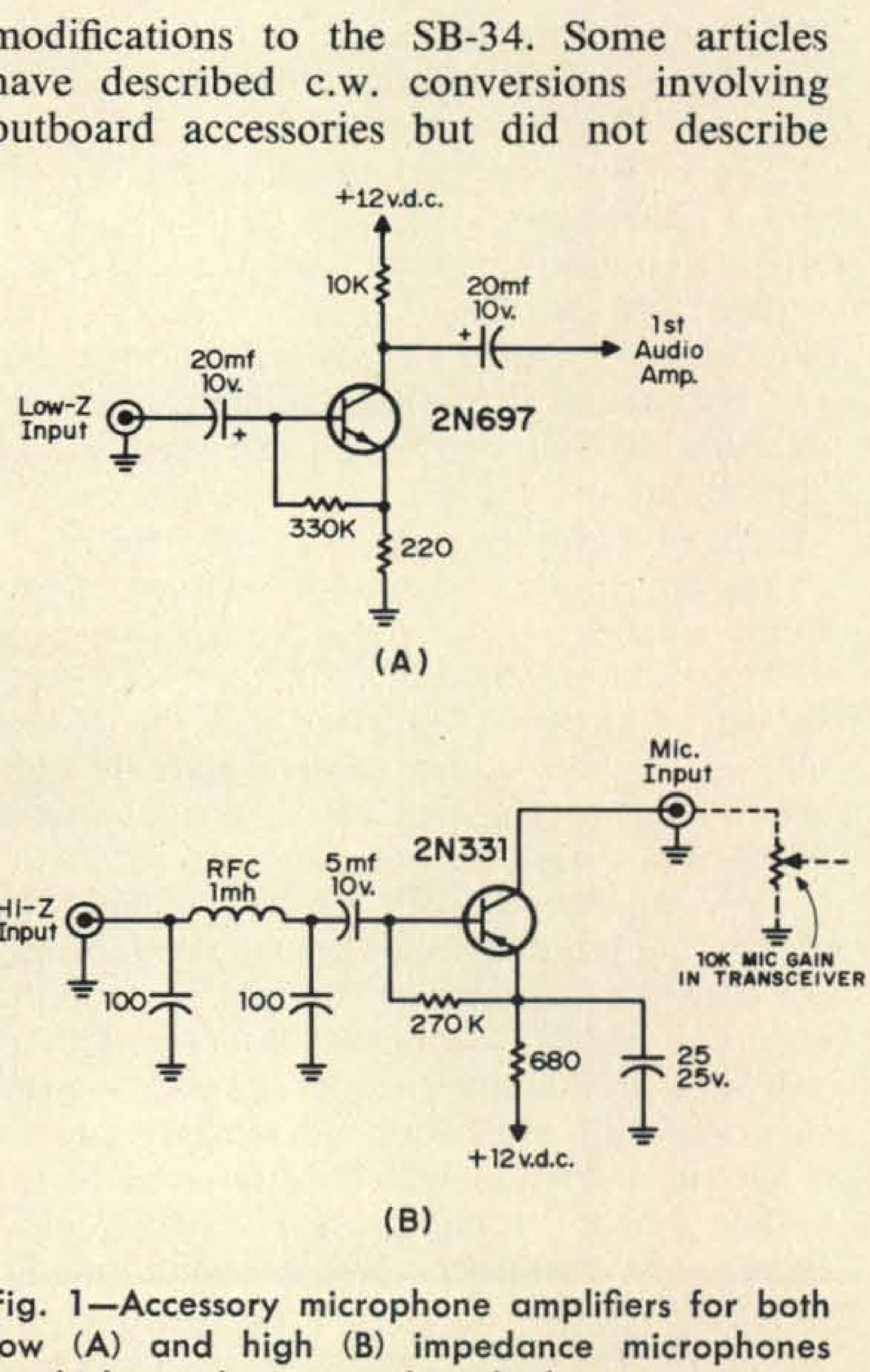

Fig. 1—Accessory microphone amplifiers for both low (A) and high (B) impedance microphones which may be mounted inside the transceiver.

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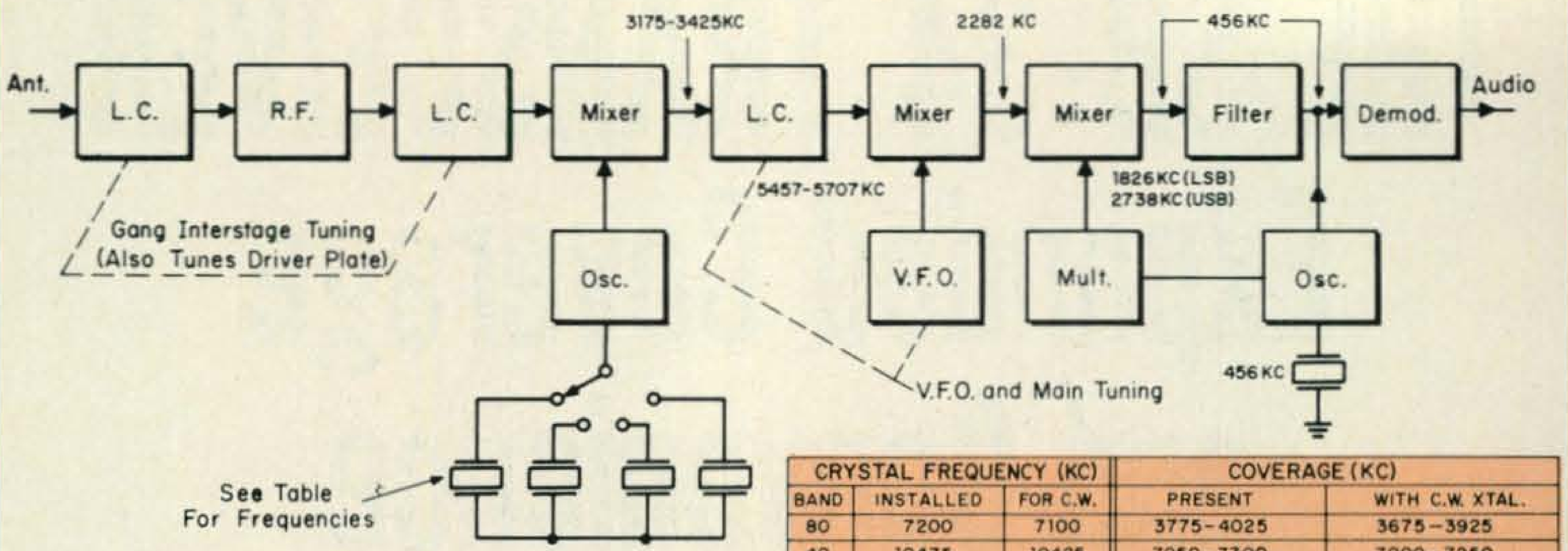

CRYSTAL FREQUENCY (KC)			COVERAGE (KC)	
BAND	INSTALLED	FOR C.W.	PRESENT	WITH C.W. XTAL.
80	7200	7100	3775–4025	3675–3925
40	10475	10425	7050–7300	7000–7250
20	17525	17425	14100–14350	14000–14250
10	24625	24425	21200–21450	21000–21250

Fig. 2—Basic frequency conversion scheme of transceiver (A) and table (B) of used for both regular and expanded coverage.

how to change the frequency coverage to include all of the c.w. portions of each band. SBE themselves produce a keyed audio oscillator to allow c.w. operation by injecting an audio tone into the microphone input. However, they do not provide any information on how to change the frequency coverage of the transceiver, although as it is the unit only covers one really useful portion of a c.w. band (7050 to 7200 kc).

The conversions described in this article retain the prime advantage of the original unit—a station package complete in itself without any need for outboard accessories. The ideas used are all basically simple and can be applied to various other transceivers as well. No hole drilling or extensive wiring is required and present s.s.b. operation is not affected in any manner. The cost for parts compared to the advantages gained is extremely little.

The various modifications are not presented in any special order and the reader may choose to utilize those which he considers most useful. For instance, those amateurs who use the transceiver for fixed station operation with an electronic key containing a built-in monitor might find only the c.w. keying circuit and the c.w. band coverage modifications of interest. Others will want to include the c.w. monitor modification as well. Still others whose only interest is phone operation will be interested in the audio clipper or compressor modifications. Details are, therefore, given on each individual modification so it can be made either alone or in combination with the other changes. The photographs illustrate how each of the modifications were made on the author's transceiver.

It may be found possible to simplify a modification that is suggested by employing a different switching arrangement. However, it must be remembered that all the modifications described in this article are based upon using the present switching circuits that are built into the transceiver. The front panel switches are riveted to the front panel. Their removal would be a tremendously complicated task and, indeed, it is frightening to imagine the work that replacement of a single switch would involve. In fact, the only real criticism that the author can find regarding the mechanical design of the transceiver is the method of fastening various components by riveting techniques to the front panel which precludes simple replacement of a defective component.

As long as one has the transceiver out of its case, it would also be a good idea to inspect all the soldered points carefully, especially those which join wires to a printed circuit board. The author found several cold solder joints. This factor is no singular criticism of the SBE transceiver as the author has found similar defects on manufactured equipment costing many more times the amount of the SB-34 transceiver. Working on the transceiver simply presents an opportunity to give the construction a critical inspection.

Here, then, are the descriptions of the various modifications. Reference to the instruction manual for the SB-34 would be useul to best understand each modification lthough the diagrams presented in this rticle show the essential circuits for each nodification.

Microphone Input Circuit

The SB-34 uses a single stage of audio mplification for the microphone input cir- uit. When their medium impedance dynamic ype microphone is used adequate modula- ion is possible although one must pretty well lways keep his lips very close to the micro- hone. Other microphones, perhaps the one wned before the transceiver was purchased, nay not produce sufficient modulation either ecause the impedance is incorrect or be- ause the output level is too low.

The addition of another stage of audio mplification not only allows a bit of reserve ain but also allows the use of microphone vith various impedances. Figure 1 shows wo possible amplifier circuits, one for low- mpedance microphones (300 to several housand ohms) and one for high-impedance nicrophones of the crystal or ceramic types. The circuits are simple and certainly not the nly type that may be used. The 12 volts perating voltage may be obtained from any oint along the 23 volt transmit bus in the ransceiver. The components can be mounted n a small piece of vectorboard and mounted

Crystals for c.w. coverage of 15 and 20 meters are mounted on a piece of vectorboard directly below the crystal can relay.

directly at the microphone input jack or by the transceiver's audio amplifier on the printed circuit board. If the auxiliary ampli- fier is mounted directly at the microphone jack, the present microphone gain control can be used, without any rewiring, as the col- lector load resistance as is shown in fig. 1(B).

With the extra gain provided by the am- plifier, there may be the possibility that r.f. pickup on the microphone lead will feed into the transceiver and cause instability. To pre- vent this, an r.f. filter is shown in the micro- phone lead of fig. 1(B). The r.f.c. and two

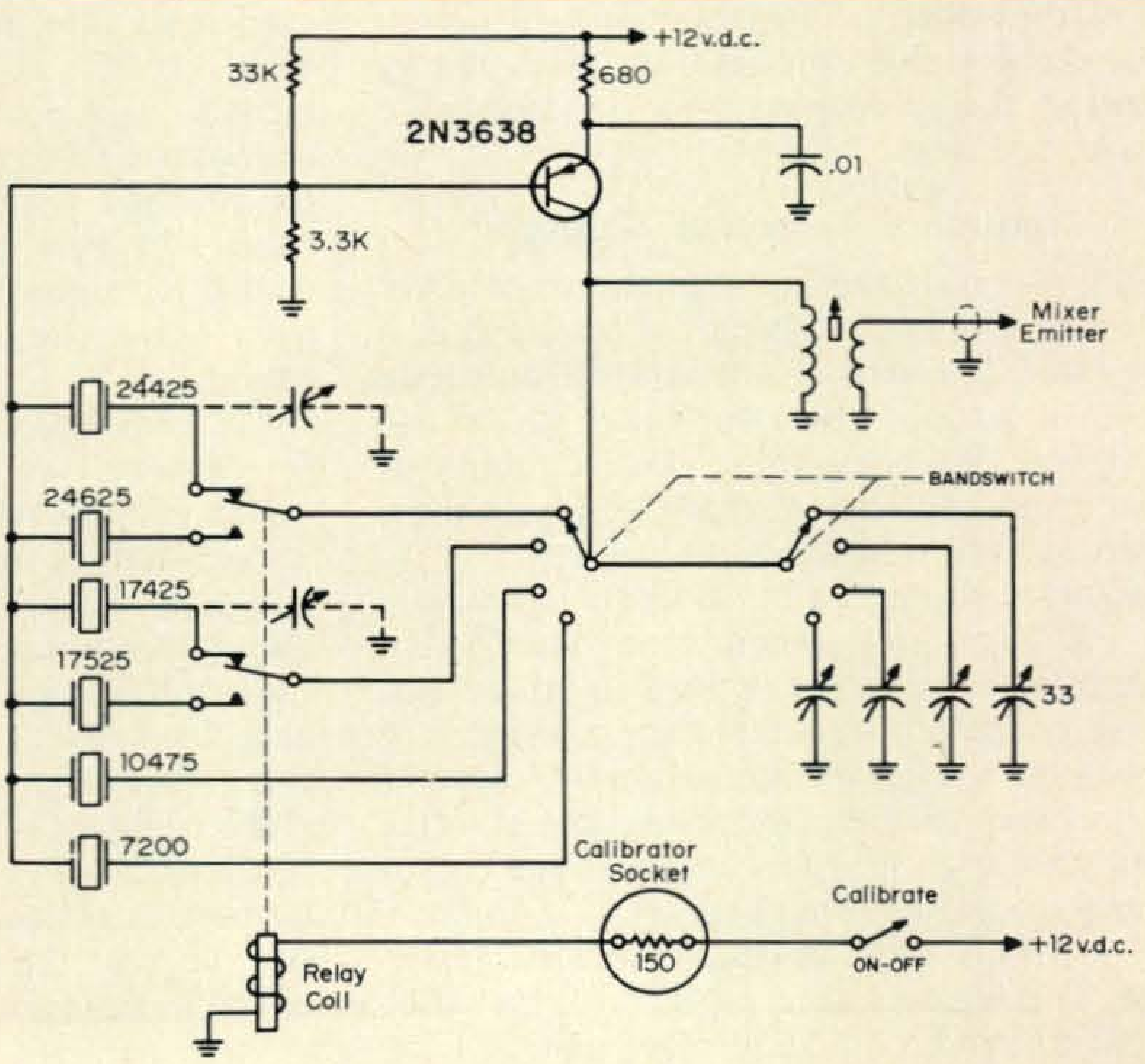

Fig. 3—Modified crystal oscillator circuit to permit c.w. coverage of 15 and 20 meters. The same method can be used to expand the frequency coverage on other bands as well.

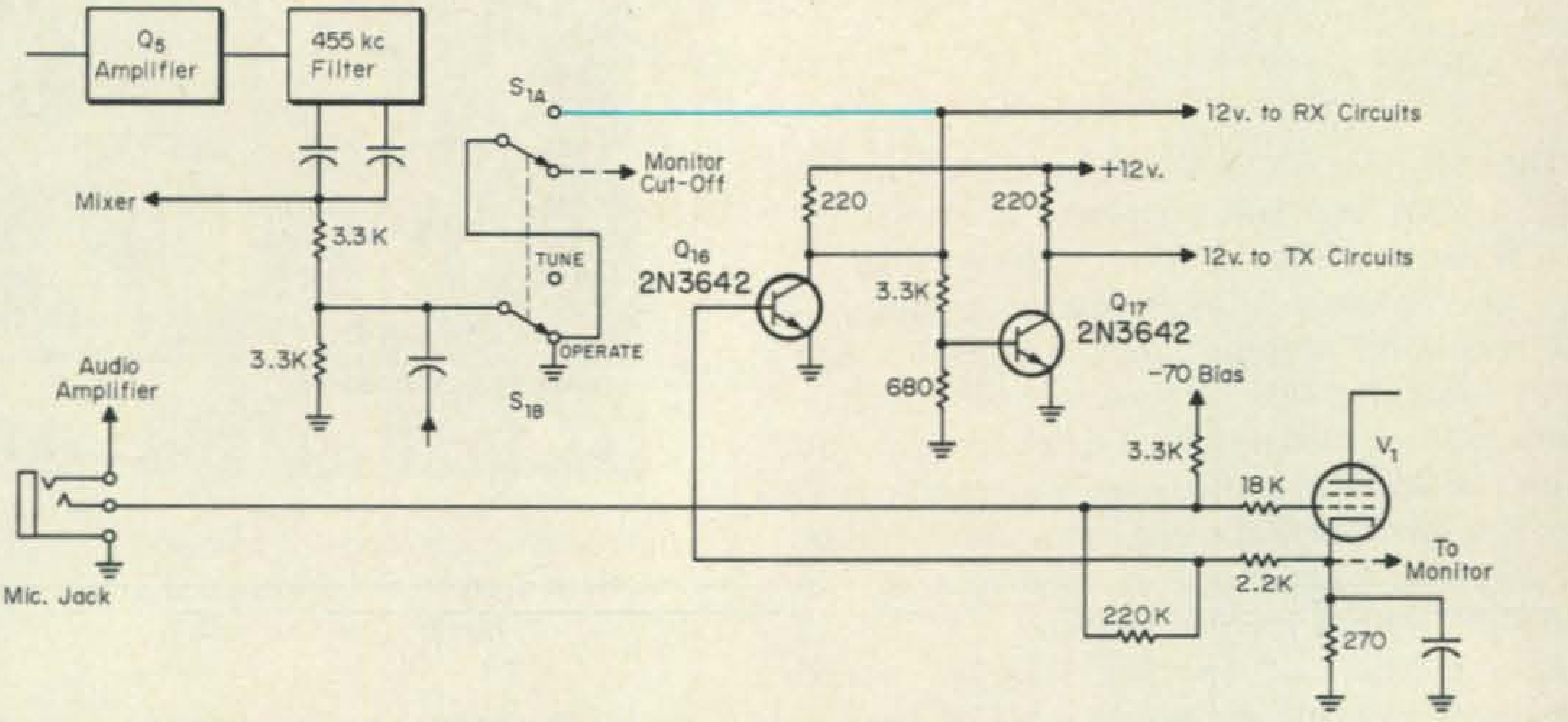

Fig. 4—Modification of the transceiver for c.w. keying requires only the installation of the single lead shown in color.

100 mmf capacitors actually form a low-pass filter which has a cut-off frequency well below 80 meters. The use of all three components to form the filter will show far more effective results than if just a capacitor or r.f.c. is used alone. The value of the components is not critical and an r.f.c. from 1 to 2.5 mh or capacitors from 100 to 200 mmf will suffice.

Even if one has the SBE microphone, the use of the added audio amplifier, will permit more comfortable home station operation by allowing the microphone to be used at a greater distance.

Frequency Coverage Changes

The range of the v.f.o. in the transceiver is 250 kc and thus even partial coverage of a c.w. band segment is possible on only one band, 40 meters, where the range is 7050 to 7300 kc. The basic transceiver circuitry is capable of covering a much greater range, however, than that utilized.

Figure 2 shows the basic frequency coverage and translation system used. The system is demonstrated for the receive mode but would be exactly the same for transmitting because of the bi-directional circuits used in the transceiver. The incoming signal after passing through an r.f. amplifier stage is frequency translated to a range of 3175 to 3425 kc by means of a crystal-controlled mixer stage. This signal is then mixed with the v.f.o. output to produce a single frequency i.f. of 2282 kc which is then translated to 456 kc.

One method of changing the frequency of the transceiver would be to alter the v.f.o. coverage. However, not only would working on the v.f.o. circuit possibly compromise its frequency stability but the v.f.o. variable capacitor also tunes the circuits for the 3175 to 3425 kc variable i.f. and these circuits would have to be modified. Possibly a switching arrangement could be made whereby all the circuits would be capacity loaded so that the total coverage would be extended 250 kc lower on each band. Such a modification would have the advantage of economy and the frequency coverage would be changed by a known amount on each band. The disadvantage is that few amateurs would have the test equipment available to truly check the adequacy of such a modification.

To keep the modification as simple and yet as useful as possible, it was decided to switch crystals in the oscillator stage for the first crystal-controlled mixer. Actually, since the BANDSWITCH/TUNING control on the transceiver tunes, in the RECEIVE mode, the input and output circuits of the r.f. amplifier stage (and the plate circuit of the driver stage in the TRANSMIT mode), the frequency range of the transceiver is limited only by the range of these circuits, providing proper crystals are used in the oscillator for the mixer stage. The range of the pi-network in the transmitter output stage is the most frequency restrictive network in the transceiver but sill has sufficient coverage to include the c.w.

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portions of at least the 40, 20 and 15 meter bands. The table in fig. 2 shows the frequency of the crystals used for both the normal coverage of the transceiver and for coverage of the complete c.w. segments of 40, 20 and 15 meters. On 80 meters extended coverage is only noted down to 3675 kc. Coverage may be possible down lower into the 80 meter c.w. band but no tests were conducted to verify this. The 3675-3925 kc coverage was mainly chosen to correspond to the European 80 meter band allocation for those foreign amateurs who would like to convert the transceiver for such coverage.

On all but 80 meters, where the high capacitance values required in the pi-network restrict the frequency coverage possible, the transceiver is capable of operation both lower and higher in frequency than its normal band coverage. Thus for operation on MARS frequencies or to receive frequency standard transmissions outside the amateur bands, one can calculate from the system diagram of fig. 2(A) the frequency of the crystal necessary to provide the desired coverage.

Figure 3 shows the oscillator circuit for the first mixer in the transceiver and one method which can be used to switch in different crystals to extend the frequency coverage. As shown, extra crystals are switched in by the relay to extend coverage to include the full c.w. segments of both 20 and 15 meters. Crystals could be used to obtain whatever coverage is desired and, if extended coverage of also 40 and 80 meters were desired, another relay could be used to switch the crystals for those bands.

The crystals themselves deserve a special note. The original crystals used on 80, 40 and 20 meters are of the fundamental type; the one used on 15 meters is an overtone type. Although good quality crystals from any manufacturer should prove suitable, one can obtain crystals made to the exact same specifications as the original crystals from either of the vendors who supplied them to SBE: Midland Wright Electronics, 3151 Fiberglass Road, Kansas City, Kansas, or Anderson Electronics, P.O. Box 1589, Hollidaysburg, Pa. 16648. The crystals from Anderson Electronics cost $5.50 each. If crystals of an incorrect cut are used, sufficient oscillator output may not be obtained.

If one has at least a v.o.m. (used with a diode in the probe lead), the relative voltage output of the oscillator can be checked on

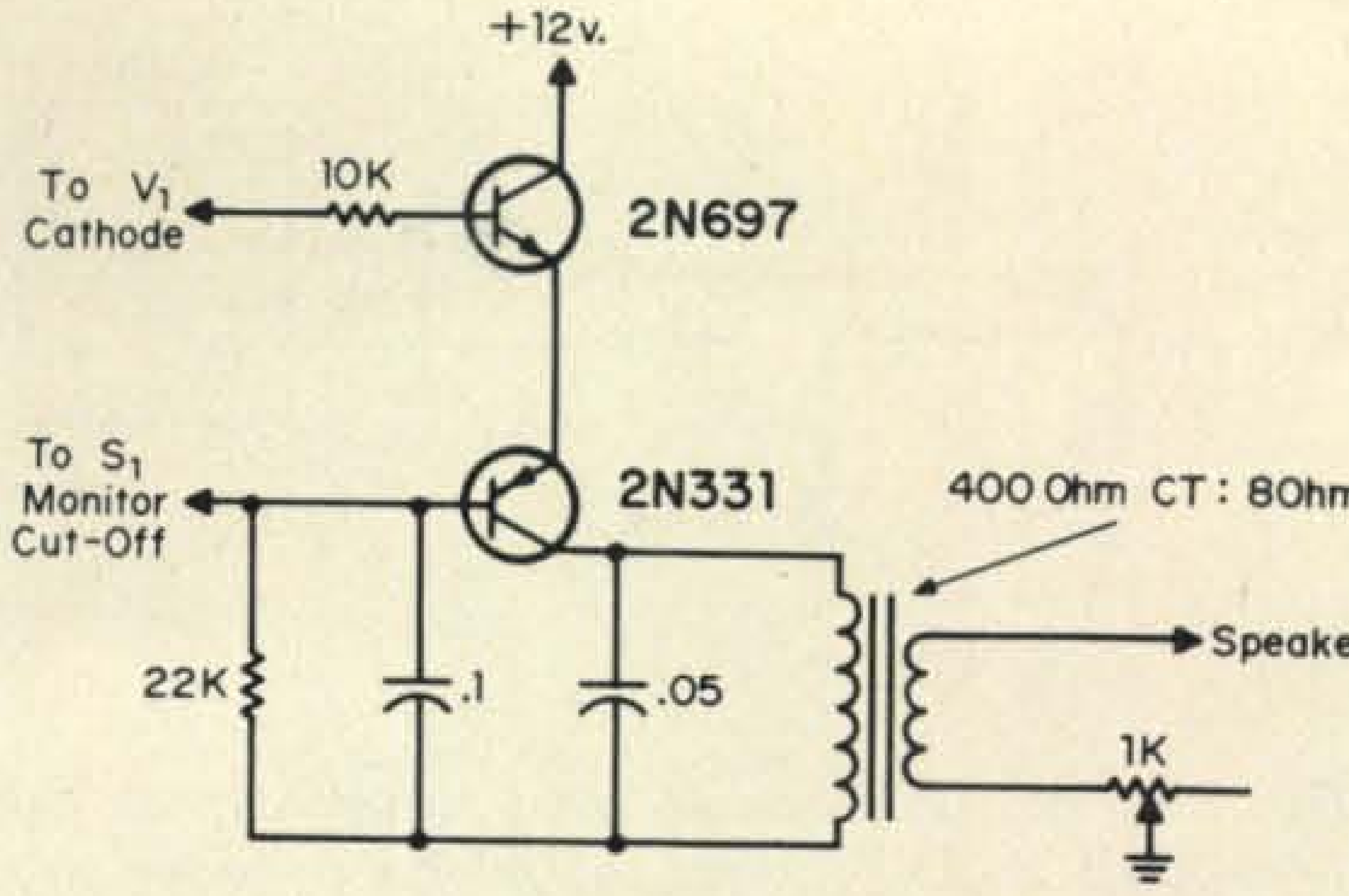

Fig. 5—C.w. monitor circuit which can be constructed simply on vectorboard and mounted on the loudspeaker inside the transceiver as shown in the photograph.

the low-impedance link output circuit side. The relative voltage with one of the c.w. band crystals switched in should read about the same as that obtained with the original crystal for each band. If not, a very small amount of capacitance (up to about 10 mmf) may have to be placed from one side of the c.w. crystal to ground as shown in fig. 3. In effect, this capacitance tunes the primary of the collector output circuit to the lower crystal frequency. The presence of the capacitance will have no effect upon operation on other bands as long as its value is kept low.

The method by which the author mounted the relay and crystals used in the circuit of fig. 3 is shown in the photograph. A 6 volt "crystal can" type of relay was used and the two extra crystals are mounted on a piece of vector board immediately below the relay. The relay is fastened to an existing standoff point. Almost any other type of miniature relay with good r.f. insulation characteristics can be used. The crystal calibrator ON-OFF front panel switch, which was not otherwise being used, is used to control the relay. A 150 ohm resistor is used in series with the 12 volt d.c. bus in the transceiver, and conveniently mounted on spare terminals on the accessory calibrator socket, to supply reduced voltage for the relay. If one had a calibrator installed, the necessary switching action for the relay could be obtained by replacing the present dial calibrator or microphone gain potentiometers with a similar type but with a pull action on-off switch.

Still another approach to providing the correct crystal oscillator frequencies for c.w. band coverage, but avoiding any work on the original crystal oscillator circuit, would be to install a separate transistor crystal oscillator

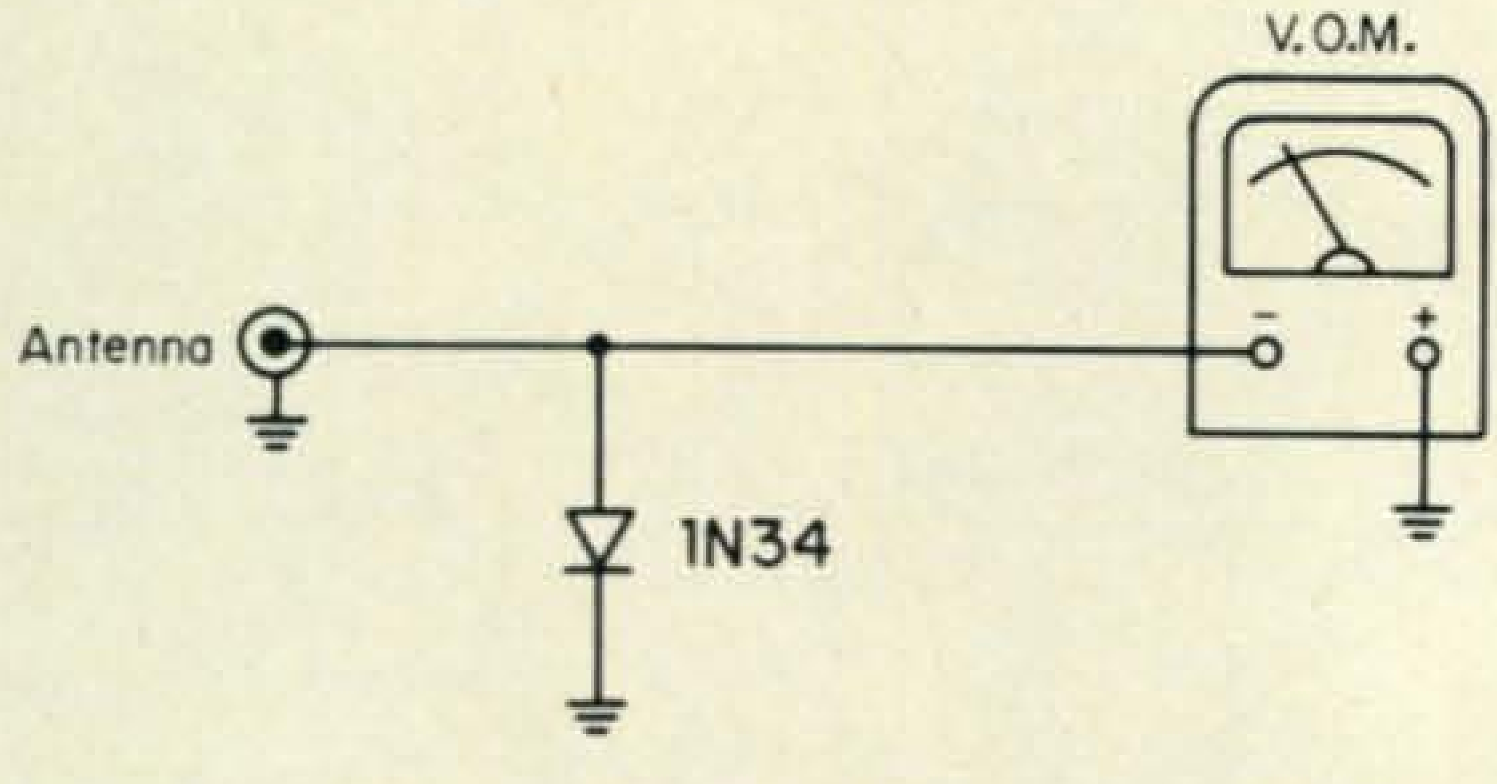

Fig. 6—V.o.m. and diode used to set Carrier Balance control. The v.o.m. should be at least 4000 ohms per volt or more and set on a 5 or 10 volt range.

circuit for the c.w. band crystals, such as the inexpensive International Crystal "OX" oscillator kits, and simply use a relay to switch the coax lead to the mixer stage from either the output of the original oscillator or from the output of the "OX" oscillator. This approach also avoids having to worry about any special crystals since the crystals used only need work in the "OX" oscillator. The output of the oscillator can be varied by tuning its output tank so the output voltage, when working into the mixer circuits, corresponds roughly to the original oscillator output.

C.W. Keying Circuit

Now that the frequency coverage of the transceiver can be extended to the c.w. segments of the bands, a method to key the transceiver is necessary. Actually, the "method" to be described involves only the soldering in of a single 12" piece of hookup wire. It provides highly satisfactory keying characteristics and provides for a simple key jack. However, to understand its usage, the send-receive circuits used in the transceiver must first be reviewed.

Send-receive switching, by depressing the push-to-talk button on the microphone is accomplished first by grounding the junction of the 3.3K and 220K resistors shown in the grid circuit of the driver tube V_1 in fig. 4. This removes the −70 volt bias on its grid, the tube conducts and instead of a very small negative voltage, about +6 volts is developed across the 270 ohm cathode resistor. This positive voltage gates Q_{16} into conduction grounding both its collector circuit and the +12 volt receive bus. When the collector of Q_{16} is thus grounded, Q_{17} is in a non-conducting state, a high effective resistance appears across its collector-emitter path and +12 volts is supplied to the transmit 12 volt bus. Essentially, Q_{16} and Q_{17} simply act as a s.p.d.t. switch t switch either the 12 volt supply to the receiv or transmit circuits. The TUNE-OPERAT switch, S_1, has two functions. The "B" sec tion in the TUNE position couples an outpu of the 456 kc carrier oscillator directly to th output side of the mechanical filter thus rout ing the carrier oscillator signal around th balanced modulator for tune-up purposes. I the OPERATE position, this output of the car rier oscillator is grounded. The "A" sectio of the switch was used simply and only t ground the push-to-talk line in the TUN position.

Essentially, a good grid-block keying sys tem is built into the transceiver. The "A" sec tion of the TUNE-OPERATE switch is rewire so that in the TUNE position, the transceive is locked in the TRANSMIT mode by groundin the collector of Q_{16}. Keying is accomplishe simply by using the push-to-talk line as th keying line. The microphone input jack thu serves also as the key jack. If the collector o Q_{16} is not grounded, considerable key click will result. But, with the modification as de scribed clean, sharp keying of the transceive will result. An example of the microphon jack being used as a key jack is shown in th photograph. The "key" is simply a standar microswitch fitted with a rubber grommet t provide a hand grip. As crude as it looks, i serves as a very usable portable key and ha the advantage that the keying contacts ar completely enclosed and protected from th effects of dust, *etc*. The plug for the key i wired so that the microphone circuit i grounded to protect against the possibility o any hum modulation. Otherwise, the micro phone gain control should be reduced as fa as possible when operating on c.w.

The TUNE-OPERATE switch functions as th SEND-RECEIVE switch when operating on c.w Normal s.s.b. operation is not affected excep that when tuning up on s.s.b. with the TUNE OPERATE switch in TUNE, the push-to-tal switch on the microphone must also be de pressed to have the transmitter circuits op erate.

The TUNE-OPERATE switch is a simple slide type switch. Although it would probabl function for quite some time, the difficulty o replacing a front-panel switch, as mentione previously, would probably make it advisabl to replace the switch function by a relay i really extensive c.w. operation is undertaken One of the spare contacts on the vox or cali brator sockets on the rear of the transceive

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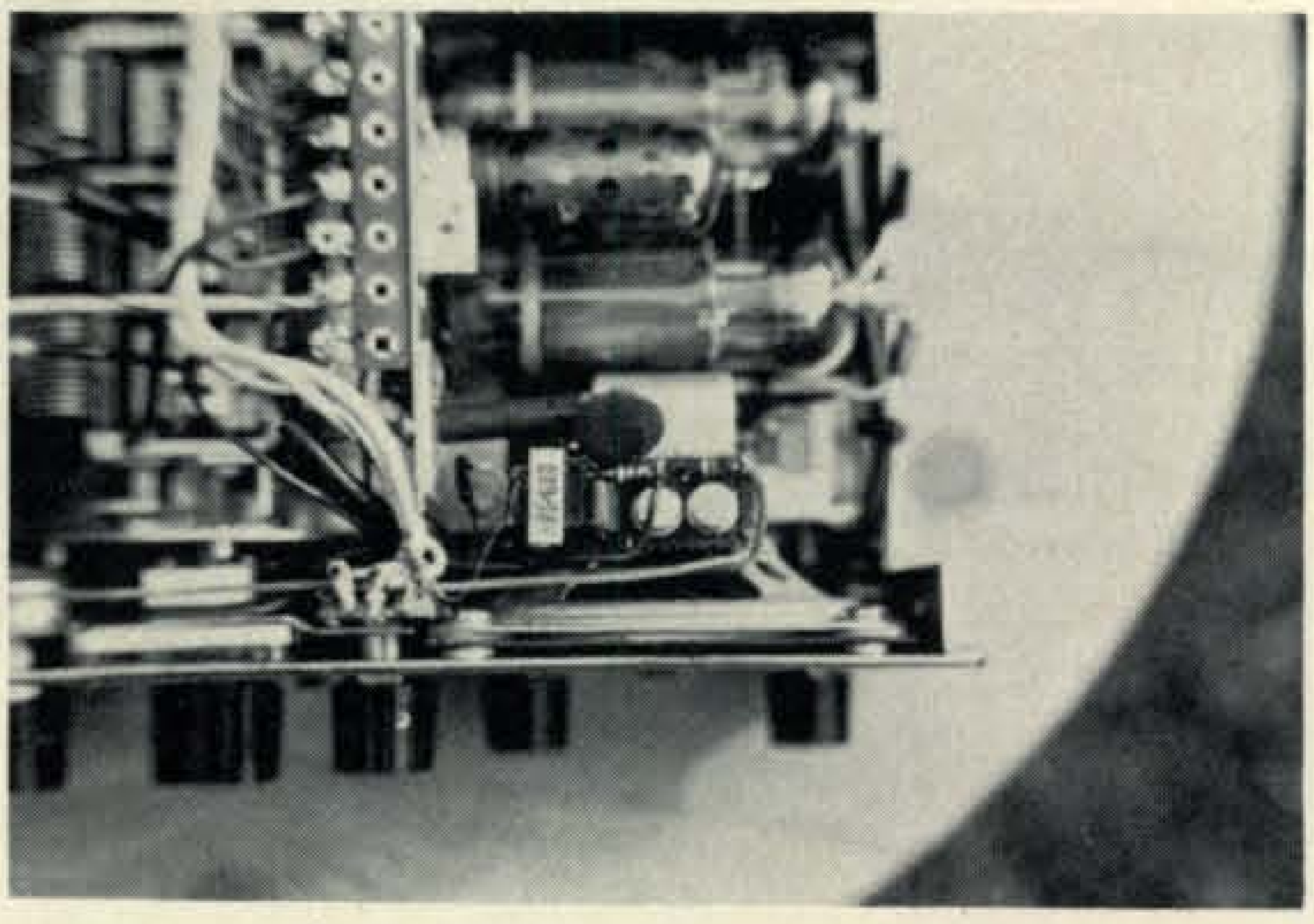
can be used to control the relay.

The input on c.w. will run from about 80 to 90 watts. If still more input is desired the 3.3K ohm fixed resistor connected from the output of the mechanical filter to ground can be replaced by a 20K ohm unit. This will permit a somewhat greater amount of carrier oscillator signal to be injected. The c.w. input will be raised somewhat (20-30 watts) but the amount of drive generated may tend to overload subsequent stages and cause them to increase their harmonic output. Unless TVI is of no concern, the small increase in input power is probably not worth the increase in TVI potential.

C.W. Monitor

Figure 5 shows a simple but very satisfactory c.w. monitor that can be placed inside the transceiver. The voltage across the cathode resistor of the driver tube V_1 which goes from a slightly negative value to about plus 6 volts under key-down conditions provides an ideal keyed voltage source for a monitor. The 2N697 shown in fig. 5 serves as a switch for the c.w. monitor. It is controlled through a 10K isolation resistor that eliminates any loading effects which the transistor switch may have on the cathode circuit. When the cathode is negative, the switch is off and the c.w. monitor (2N331) is inoperative. Whenever the transceiver is keyed so that the driver cathode voltage is positive, the 2N697 switch is turned on and the c.w. monitor is activated.

The switch and monitor are constructed on a piece of vectorboard and mounted on top of the loudspeaker frame as shown in the photograph. The mounting is simply a piece of foam plastic glued to the vectorboard and the loudspeaker frame. This location seems to provide about the shortest leads to all the circuit functions concerned as well as being simple to use. The circuit components, particularly the 22K and 0.1 mf RC feedback network in the base circuit of the monitor, may be changed to provide almost any desired tone. As shown, the tone produced is one very pleasant to hear, about 800 cycles. The monitor is particularly free of annoying key clicks due probably to the switching characteristics of the 2N697. The output of the monitor is connected directly to the ungrounded side of the speaker and the volume is very adequate for operation with normal background noise. If the 1K ohm DIAL CORRECT potentiometer is not being used because a calibrator is not installed, it can serve as a



C.w. monitor is mounted on loudspeaker frame using a piece of glued plastic foam material between board and frame.

combination VOLUME/TONE control for the monitor when wired in one of the c.w. monitor output leads. The leads to the DIAL CORRECT potentiometer are simply connected to a 470 ohm, ½ watt resistor to free the potentiometer for use with the c.w. monitor. As shown in fig. 4, the "A" section of the TUNE-OPERATE switch can be used to provide a grounding lead to the base of the c.w. monitor to disable the monitor when the transceiver is tuned-up for s.s.b. operation; it will be disabled during normal s.s.b. push-to-talk operation.

One interesting feature which was noted after the keying circuit and c.w. monitor modifications were made is that the push-to-talk lever on the microphone can be used very readily to c.w. key the transceiver. Although hardly suggested for normal operation, it does provide an interesting method of c.w. operation, particularly for a mobile installation.

Ease of Tuning

The transceiver has a rather small and awkward to handle tuning knob. The photograph which shows the c.w. microswitch key also demonstrates how a spinner type tuning knob can be installed to improve the tuning action. The knob shown is a Raytheon military type available through most of the large mail-order supply houses. Although about the simplest of modifications possible, it is surprising how the ease of tuning can be enhanced by the installation of a large-size spinner type knob. In effect, an extra vernier action is produced.

Carrier Balance Adjustment

The carrier balance potentiometer on the transceiver is a multi-turn unit and since the

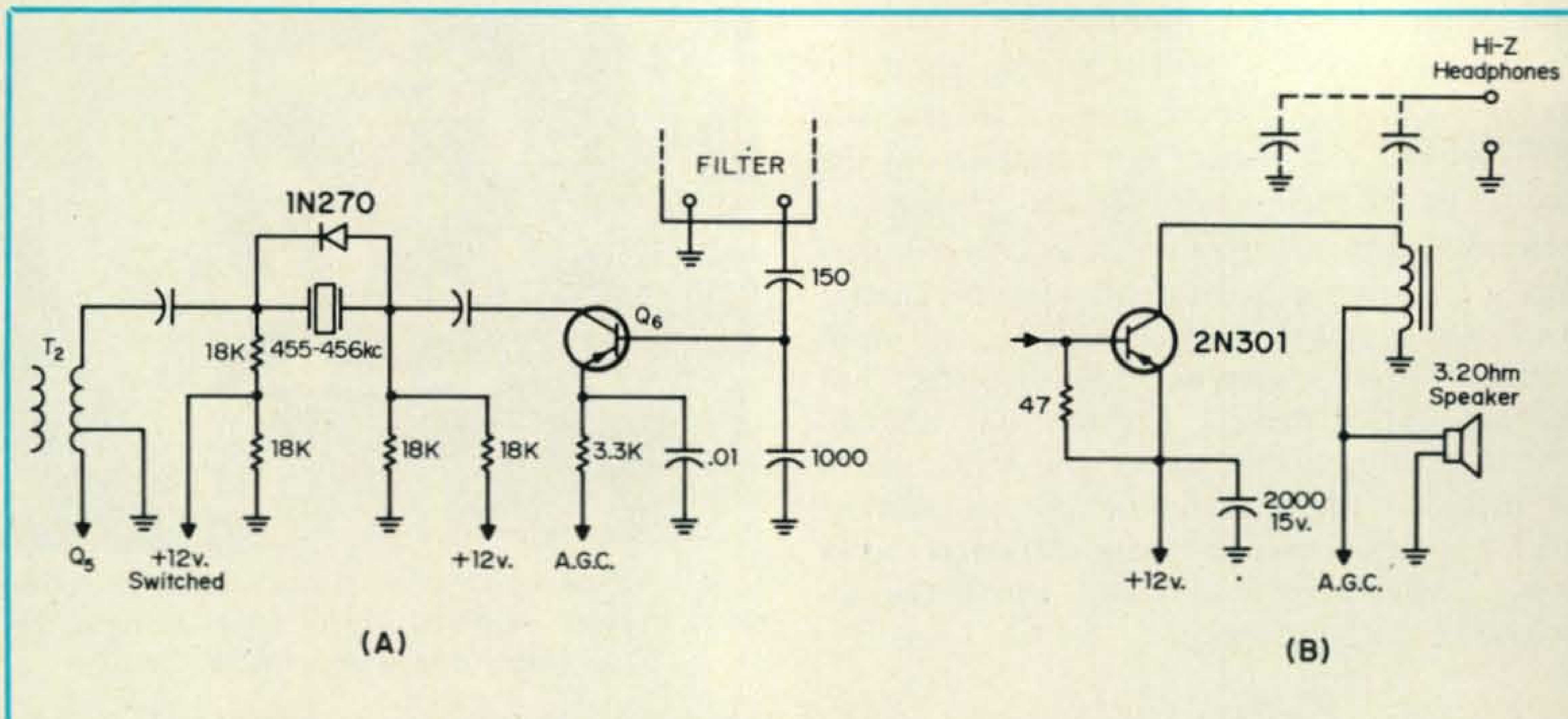


Fig. 7—Methods to enhance the c.w. selectivity; a single crystal filter circuit (A) and "building out" of the audio output circuit, (B).

static plate current of the linear output stage is fairly high (100 ma) it is not possible to notice any decrease in this current when the balance potentiometer is set properly. Also, the r.f. output voltage position of the meter is not sensitive enough to indicate balance conditions. This situation is true with various other transceivers also and usually the instruction manuals call for a sensitive v.t.v.m. with an r.f. probe used across a dummy load to set the balance control. However, with a bit of care, the adjustment can be accurately made with a simple v.o.m. and a diode, as shown in fig. 6.

The transceiver is first loaded normally into a dummy load or antenna. Then it is set up for normal s.s.b. operation and the diode of fig. 6 placed across the output without any other load. The microphone gain is reduced to zero and the push-to-talk switch depressed. The voltage measured across the diode will produce a sensitive indication of the carrier balance and the BALANCE CONTROL can easily be set for a minimum voltage reading. Care must be taken that the transceiver is not modulated during this procedure as even a small amount of power output, as takes place during the slightest modulation, will destroy the diode. The voltage reading obtained is only relative with this method but more than sensitive enough to provide for excellent carrier balance adjustment.

Added C.W. Selectivity

If one uses the transceiver often for c.w. operation the question of additional c.w. selectivity is bound to come up. With its 2.1 k.c. mechanical filter with steep skirts, the selectivity appears to be more than adequate by itself for occasional c.w. operation. For continuous c.w. operation from a home location the addition of an outboard audio filter, such as the FL-5 or FL-8 surplus types, is certainly the easiest and possibly the cheapest way to gain good c.w. selectivity. If an outboard unit is not desired so as to retain the portable features of the transceiver, additional selectivity can be provided at either the single-frequency 2282 kc or 456 kc i.f. points in the transceiver. This would involve a filter in the collector circuit of Q_8 for the first i.f. or in the collector circuit of Q_6 for the 456 kc i.f. A single crystal filter is normally adequate since, although the skirts of such a filter flare out considerably, the mechanical filter will still provide a good overall shape factor.

Figure 7 (A) shows a circuit for installation of a single crystal filter in the 456 kc i.f. circuit. A simple diode switching circuit is used to switch the filter in and out. When 12 volts is applied to the "switched" terminal the diode is back-biased for non-conduction and the crystal is operative. When this voltage is removed, the diode is forward biased to a low resistance and the crystal is inoperative. The 12 volts can be provided from the same switch as energizes a relay to switch in the c.w. band crystals or from a separate pull-switch on one of the front-panel potentiometers, as desired.

The insertion of the crystal will introduce an attenuation that depends upon the char-

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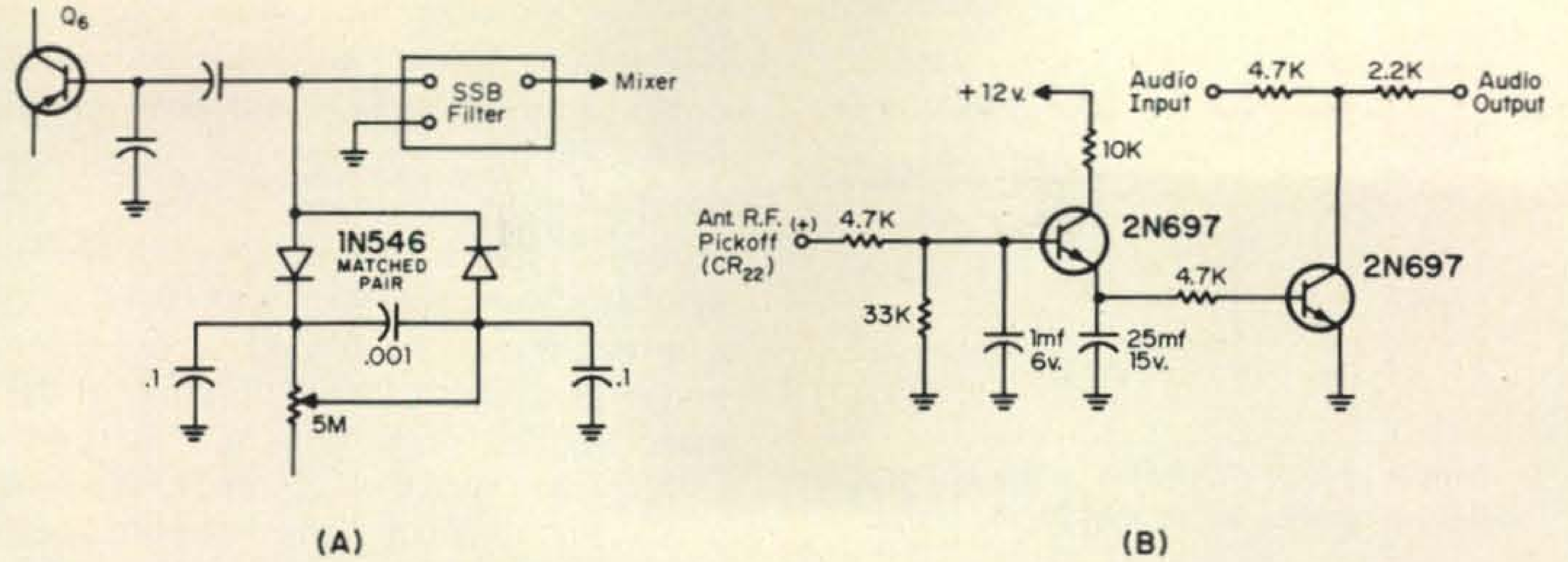

Fig. 8—An experimental r.f. clipper circuit placed between the balanced modulator and s.s.b. filter (A) and a conventional a.l.c. circuit (B) which reduces the audio circuit gain according to the peak r.f. voltage.

acteristics of the crystal used. It may not be severe enough to reduce the i.f. gain to an uncomfortable level and require no change to the i.f. Otherwise, if additional i.f. gain is desired, it can be provided by a simple additional i.f. voltage amplifier stage in series with the crystal or the use of an inexpensive miniaturized i.f. strip such as the Millen 8903-B in series with the crystal and switched in and out of the circuit with the crystal filter. The operating voltage to the i.f. stage is adjusted so that the overall i.f. amplification is about the same with or without the crystal filter in the circuit.

Another method which provides considerably less selectivity but nonetheless is of some usefulness is shown in fig. 7 (B). Using high-impedance headphones connected to the high end of the audio output auto-transformer, the primary of the auto-transformer is "built-out" by either series of parallel paper capacitors of 0.05 to 1 mf, depending upon headphone characteristics, to peak the audio response. The selectivity obtained is not great but still helps and is certainly worth the effort if headphones are going to be used for c.w. operation anyway. The loading provided by low-impedance headphones will normally not allow the scheme to work.

Audio Compression and A.L.C.

The transceiver contains no effective a.l.c. system operative when the transmit mode is used. Perhaps because of the low gain of the microphone amplifier stage, it was not regarded as necessary to prevent overmodulation. But, some form of a.l.c. can definitely be useful to increase the average power output on s.s.b. and, hence, the effectiveness of the transceiver as has been proven on many tests with various transceivers. The simplest way to raise the effective power for fixed-station operation is by the use of an outboard audio compressor, many of which has been described in previous *CQ* articles However, for portable or mobile operation it may be desired to incorporate a compression system within the transceiver itself.

Two methods were tried to provide more effective audio "punch" and both are applicable to a wide variety of s.s.b. transceivers. Figure 8 (A) shows an r.f. clipper that was placed before the mechanical filter and immediately after the balanced mixer. The clipper arrangement is that of the Bishop type i.f. noise limiter standard for many s.s.b. receiver noise limiters. The attempt was made to provide an r.f. clipping scheme without the necessity of having a second sideband filter as conventional systems require. The basis for the system is the fact, which has been experimentally well proven, that a modulated (s.s.b.) waveform can almost be completely peak amplitude limited without affecting seriously the audio quality of the demodulated waveform while a moderate amount of clipping employed directly on the audio waveform itself will soon (15 to 20 db of clipping) produce annoyable distortion. The d.s.b. output of the balanced modulator is peak amplitude limited by the circuit. Since the d.s.b. signal is limited instead of the s.s.b. signal some amplitude variations are again introduced into the s.s.b. signal which occurs after the mechanical s.s.b. filter. Nonetheless, on most contacts, under weak signal conditions, reports have indicated that the clipper is quite effective. Some reports under stronger

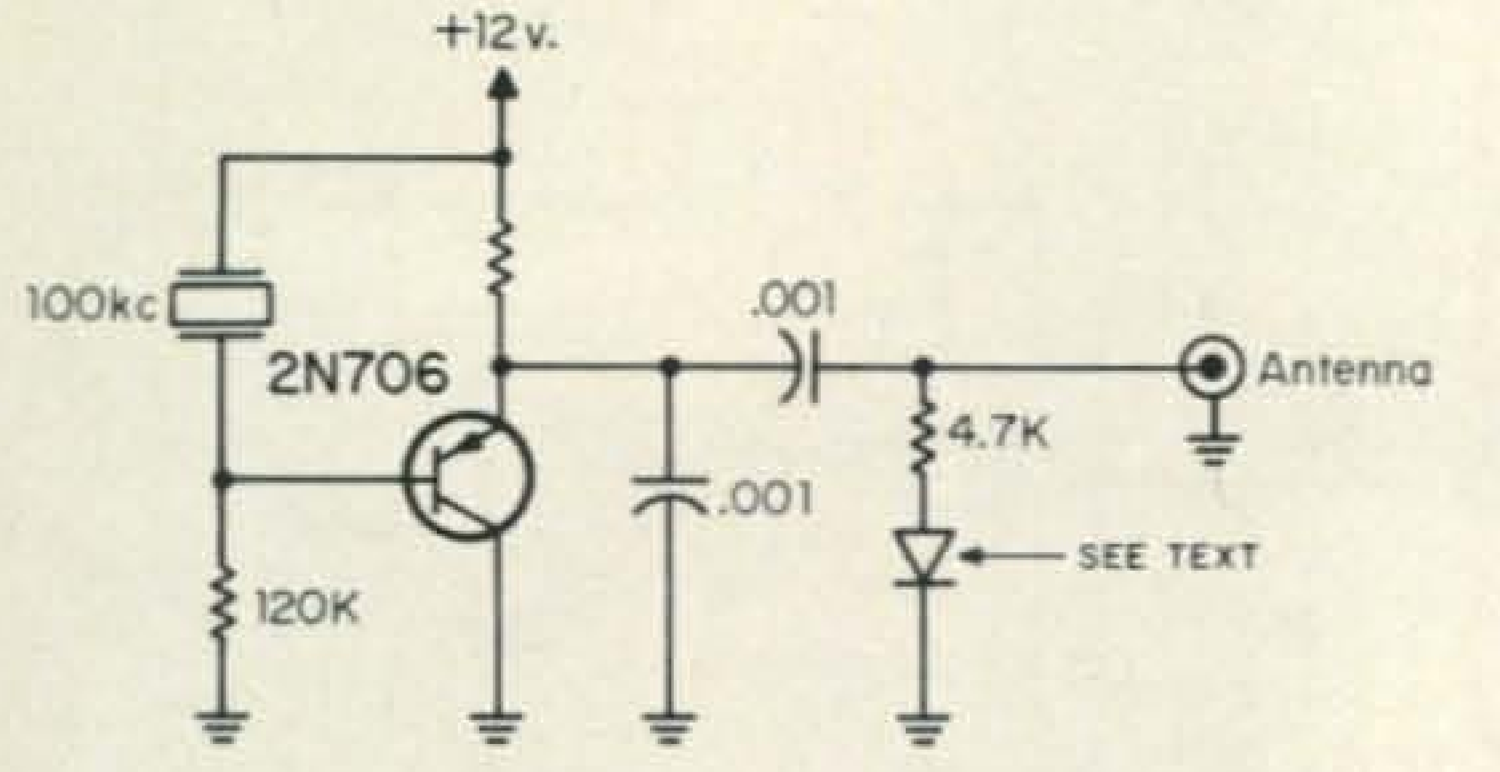

Fig. 9—Simple crystal calibrator which will produce useful harmonics up to the 21 mc band.

signal conditions indicate that some distortion is present when the 5 megohm potentiometer is too far open. The circuit must be presented, therefore, as still a semi-experimental one which the reader may find some interest in to check out for himself. The components used are simple and inexpensive. The two diodes are a matched pair used in f.m. receiver discriminators and chosen so the clipping action would be symmetrical. The rest of the components are standard and should be mounted as close to the mechanical s.s.b. filter as possible.

Figure 8 (B) presents a much more conventional a.l.c. circuit. One position of the meter switch, as on many transceivers, switches the meter to a relative r.f. output position which is driven from a simple diode rectifier circuit connected across the r.f. output. The voltage from this circuit can be used to drive the circuit shown to provide a.l.c. action. The base of the first 2N697 is connected through a 4.7K ohm resistor (to prevent loading of the rectifier circuit) to the RF OUTPUT position of the meter and functions as a d.c. amplifier. The second 2N697 functions as a variable resistor (collector to emitter) in a T resistor attenuator network. The attenuator network can be connected either before or after the microphone amplifier in the transceiver. As the transceiver output increases, the first 2N697 amplifies the d.c. output of the r.f. relative output circuit and drives the second 2N697 into a stronger conductive state thus increasing the attenuation of the T attenuator. The value of the 4.7K ohm resistor and 25 mf capacitor in the base circuit of the second 2N697 determine the time constant of the circuit to amplitude variations and can be varied to produce the best response.

Crystal Calibrator

A multitude of crystal calibrator circuits can be used but that of fig. 9 is one of the simplest possible and quite effective since calibration points must be provided only down to the 15 meter band. It is not suitable for use on the 10 meter band. The circuit will provide quite accurate markers as shown. However, if it is desired to align the marker against a standard, such as WWV, a 32 mmf trimmer should be placed across the crystal and adjusted for exact calibration in the usual manner. The 4.7K ohm resistor and diode (which can be any common type—1N34, 1N67, *etc.*) enhance the harmonic output of the oscillator. The circuit itself can be easily assembled on a piece of vectorboard and mounted inside the transceiver below the calibrator socket.

Miscellaneous Features

There are any number of minor modifications which can be made to the transceiver. The one remaining major modification, operation on 10 meters, was explored but no way could be found to accomplish it without requiring either a change in circuitry which could not be easily returned to its original state or the use of a major amount of alignment/test equipment. An outboard receiver and transmitter converter seems to be the only simple way to accomplish this modification.

Among the minor modifications would be the addition of a noise limiter. Either a Bishop type as shown in fig. 8 (A) could be used in the receive mode only or a low-voltage double anode zener diode could be connected across the primary of the audio auto-transformer in the receiver audio output stage. Another modification would be to provide an "S" meter on receive by having a d.c. amplifier similar to the first stage of the a.l.c. circuit in fig. 8 (B) driven by rectified receiver a.f. and operating a microampere meter. A relay could be used to switch the present meter for use in the RECEIVE mode as an "S" meter.

A low-pass filter can be constructed from about 10 turns of #14 wire with a 190 mmf mica capacitor at each end and connected immediately at the output of the transceiver pi-network inside the p.a. enclosure. The filter will provide about 30 db of additional 2nd harmonic suppression and will be helpful in difficult TVI areas.

Conclusion

This article has explored in depth, various modifications which can relatively easily be

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Antenna Theory In Practice

BY R. H. FRANSEN, *VE6TW

SEEING the variety of amateur equipment on the market nowadays the only thing that seems to be missing is an antenna guaranteed to take power and radiate a pattern as advertised. The truth is, except under ideal test conditions, an antenna very often does not behave like theory and the ads say it should. Because the amateur can seldom duplicate the antenna farm of a manufacturer he often can't repeat the professional results either. Added to this is the difficulty of obtaining accurate measurements because of inferior or lack of test equipment and one has all the ingredients for a frustrating experience.

Listening on the bands, however, can be a real revelation at times. Not satisfied with the manufacturer's specifications, say an s.w.r. of 1.3:1, some of the boys do the antenna makers one better, they juggle feedline and antenna to obtain an indication of 1:1 on their s.w.r. bridge. This is better than the manufacturer can do, or is it? We will look at some of the facts and fantasies of antennas and coaxial transmission lines. By taking certain precautions and using common sense one may obtain useful information instead of some fancy indications meaning exactly nothing. It could prevent the situation of the antenna with the "perfect" transmission line, s.w.r. 1:1, and an S-1 signal. Of necessity certain procedures and statements that follow are simplified and intended to point out possible pitfalls or difficulties in setting up an antenna system. This way an amateur should be able to get better results with his particular installation. We will not pay attention to the brand and type of antenna but only how to adjust the antenna and transmission line as a system so it operates at maximum efficiency.

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Truth and Fiction

For the purpose of this article transmission line, feedline, line or coax means coaxial cable. Furthermore:

1. An s.w.r. indication of 1:1, except under certain conditions, does not prove that the antenna is resonant or operates at maximum efficiency.
2. Anytime the s.w.r. changes when adding to or subtracting from the length of the feedline it is confirmation that the s.w.r. bridge is giving a false indication, not necessarily useless but to be taken with caution. A change in the length of the line does not improve the s.w.r. no matter what the s.w.r. bridge indicates. It may improve the ease of loading, particularly for transmitters with a fixed pi-network output (HT-37 *etc.*), by changing the apparent impedance at the transmitter end of the feedline.
3. When using an unbalanced feedline (coax) on a balanced antenna (any dipole, inverted V, beam, *etc.*) not only will there be radiation from the line but also the possibility of faulty indications on the s.w.r. bridge. The stray effects caused by this arrangement affects almost all inexpensive s.w.r. bridges used by the amateur.
4. By using the proper balun (1:1 impedance ratio) between an unbalanced feedline and a balanced antenna the balun not only prevents r.f. currents on the outside of the feedline but also:

a. Increases the bandwidth of the antenna system because as the frequency changes the susceptances of the antenna and balun change

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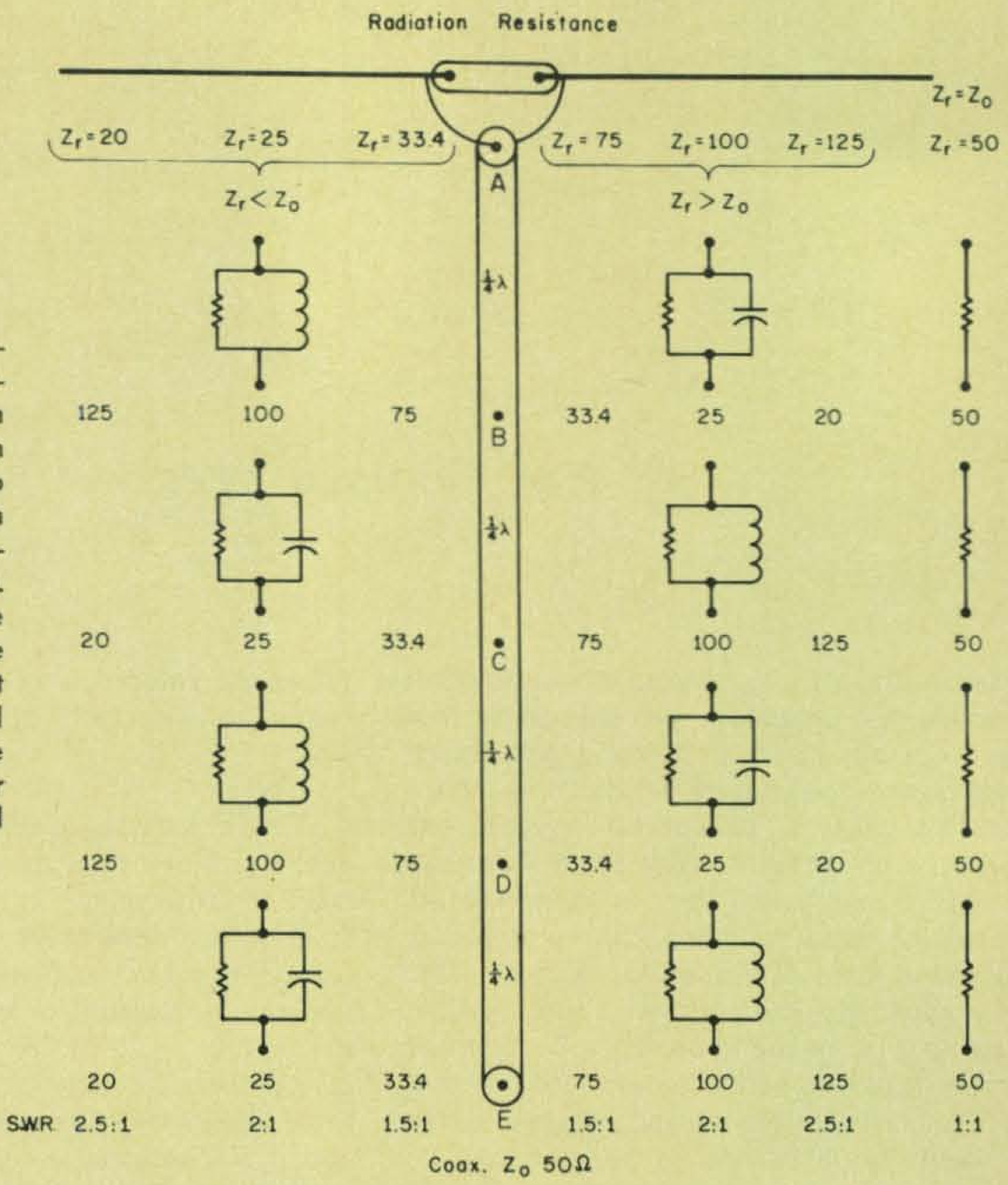

Fig. 1 — Pictorial presentation of the conditions along a 50 ohm coaxial transmission line when connected to a resonant antenna with the various radiation resistances shown (Z_r). Only the quarter wave points along the line are resistive (except when $Z_r = Z_o$) and points between are either inductive or capacitive as described in the text.

in opposite directions (susceptance is reactance divided by the square of the impedance)

b. If mounted on a grounded support (steel tower or mast) it may provide enough reactance in case of a lightning discharge to minimize the effects on feedline and station equipment by resisting the discharge, causing it to drain to ground.

c. If used on a beam antenna a balun will improve the shape of the radiation pattern and prevent skewing. It will increase the directivity of the antenna and decrease the signal pick up on the feedline

d. Under certain conditions will prevent hot microphones, *etc.*, in the station caused by r.f. feedback.

5. An s.w.r. bridge not calibrated for zero reflected power at the surge impedance of the feedline should not be used for tuning an antenna without taking precautions. Exact calibration is very difficult to achieve due to the tolerances in inexpensive s.w.r. bridges and standard coaxial cable.

6. If the radiation impedance of the antenna does not match the surge impedance of the feedline or is unknown a *Coax Phase Detector*[1] (c.p.d.) at the proper point in the line is superior for resonance indication; it takes less experimenting and will indicate resonance more accurately.

From the foregoing it follows that to tune an antenna to resonance and observe the results in the station a c.p.d. is much easier to work with. After the antenna is tuned, an s.w.r. bridge is very useful for observing any changes in the system. Of course, the above remarks presume that an amateur when tuning an antenna does his antenna measuring and testing not at the feedpoint of the antenna but somewhere in the feedline.

1 Geiser, D. T. "Building and Using the Coax Phase Detector," *CQ*, January 1962, p. 24.

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Antenna Theory

Looking at fig. 1 we see a balanced antenna connected to an unbalanced feedline under slightly exaggerated but ideal conditions. Ideal conditions in this case means a feedline exactly 50 ohms, no losses in the line and a non-reactive antenna (antenna always resonant). As can be seen there is a great variation in the radiation resistance at the antenna feedpoint (A), brought about among other things, by the change in height above ground. Further investigation of fig. 1 discloses the fact that anytime the radiation resistance does not match the surge impedance of the feedline only the ¼ wave points B-C-D-E present a resistive impedance; anywhere else on the feedline the impedance presented has also reactance of the type shown in fig. 1. For example, an antenna with a radiation resistance of 33.4 ohms (a typical beam) changes its radiation resistance to 75 ohms after the first ¼ wave section (at B) as presented by the feedline. Anywhere else between A and B the feedline presents a radiation resistance of some value between 33.4 and 75 ohms with added inductive reactance.

As a matter of fact if one would select the 50 ohms resistive point between A and B on the feedline and connect sufficient reactance of the opposite kind (capacitive) at that point the feedline is flat (matched) from there on to the transmitter. This is the stub matching principle. Figure 1 also shows that this same antenna (33.4 ohms) would have an s.w.r. of 1.5:1 and it would make little sense to tune for less by adjusting the length of the antenna. However, an s.w.r. bridge not calibrated to the feedline could indicate 1:1, 2:1 or anything else. This would depend on its location in the feedline. A coax phase detector (c.p.d.) would have no output at any of the ¼ wave points B-C-D-E with a resonant antenna regardless of the radiation resistance.

A balun added at point A in the feedline would not change the s.w.r. or c.p.d. indications much with a minor mismatch but a major mismatch (say above 3:1) affects the transformation ratio of the balun and this in turn affects the s.w.r. and c.p.d. indications. Baluns and coaxial transmission lines should not be used under mismatched conditions.

The impedance transformation from 33.4 ohms to 75 ohms explains also why transmitters having an r.f. voltmeter arrangement as an output indicator (HT-37, *etc.*) show an apparent difference in output. What happens is that by changing the length of the feedline the impedance and the r.f. voltage on the feedline changes. This seems to puzzle many amateurs, especially after they have changed the final tubes expecting a higher output reading.

For example, using the formulas $W = E^2/R$ and $E = \sqrt{WR}$, at a power of 100 watts, the voltage across the various impedances points would be:

33.4 ohms-$\sqrt{33.4 \cdot 100} = 57.8$ volts
50.0 ohms-$\sqrt{50 \cdot 100} = 70.7$ volts
75.0 ohms-$\sqrt{75 \cdot 100} = 86.6$ volts

The meaning of all this is that the absolute value of the s.w.r. as measured with an amateur s.w.r. bridge when tuning an antenna is not reliable because of the tolerances in bridge calibration, surge impedance of the feedline, type of balun, *etc.* Because of these tolerances the position of test equipment in the feedline is important. By doing the measuring and testing at a resistive point in the feedline most of the erroneous indications and stray effects can be minimized, including the reactive component introduced by the mismatched feedline. By using a ½ wave point (C or E) the amateur will get the closest repetition of the antenna impedance possible. To check for faulty indications by the s.w.r. bridge add about 4′-7″ (¼ wave) to the feedline between the s.w.r. bridge and the antenna[2] and look for a change in the s.w.r. at 28 mc. Any difference in the s.w.r. confirms stray effects and poor s.w.r. bridge calibration. An improvement in the antenna system should be possible if this s.w.r. bridge has been used to check antenna performance.

Antenna Practice

When installing an antenna one has two alternatives. One is to install the antenna according to instructions and/or theory, disregarding the s.w.r. indications except for obvious troubles. The other is to tune the antenna for maximum performance after installation. Before inserting the c.p.d. or s.w.r. bridge in the feedline make sure the test equipment is calibrated accurately on a non-reactive dummy load.[3] The recommended ½ wave point for insertion of the c.p.d. and/or s.w.r. bridge (point C or E in fig. 1) is measured starting from the balun or antenna feed

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[2] It is suggested that the addition of an ⅛ wavelength might be more indicative than a ¼ wavelength. *Editor*

[3] Fransen, R. H., "The Perfect Dummy Load," *CQ*, November 1965, p. 50.

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point (A). To calculate one ½ wavelength of feedline proceed as follows:

1. Decide the frequency for antenna resonance (F_{mc}).
2. Check the velocity factor of the feedline. ($V = 0.66$ for RG-8/U.)
3. Use the formula $492V/F_{mc}$.

For example, ½ wavelength (A to C in fig. 1) of RG-8/U at 3800 kc is 492 x 0.66/3.8 = 85.4'. At 7100 kc a ½ wavelength is 492 x 0.66/7.1 = 45.7'.

The ½ wave point(s) on a feedline connected to a 10-15-20 tri-band antenna is a compromise of sorts. Using 45' 6" for phone or 46' 0" for c.w. (or their multiples) works out to 4 half waves on 10, 3 half waves on 15 and 2 half waves on 20.

After installing the antenna and test equipment set the transmitter to the wanted frequency. Adjust the antenna for minimum output on the c.p.d. If zero output cannot be obtained it may be caused by nearby power wiring, one end of the antenna closer to ground than the other end or harmonics in the transmitter output, *etc.* In this case tune for minimum output of the c.d.p. Alternately any calibrated s.w.r. bridge, instead of a c.p.d., can be used if tuning is done for minimum indication on the s.w.r. bridge. It must be understood that if the radiation resistance of the antenna is not the same as the surge impedance of the feedline (it hardly ever is) and the antenna does not have any additional matching device (gamma match, *etc.*) an s.w.r. of 1:1 cannot be obtained. After tuning the antenna the feedline can be rolled up behind the equipment as it will not make any difference in the practical performance of the antenna or the excess feedline may be cut off.

Some Practical Hints

Use a balun, it may solve some of your problems.

Use top quality coaxial cable only. Unbranded cable is usually of poor quality or has aged. Yes, there are coaxial cables that age, and aged cable increases losses and noise.

All beam antennas having the same physical dimensions and elements give the same practical performance, manufacturers claims notwithstanding. The mechanical structure of the antenna is far more important than the often hard to prove claims of performance by the manufacturer.

For a start when installing a beam antenna set the dimensions as recommended. It is very difficult to evaluate any change in performance or tuning due to nearby powerlines, height above ground, location, *etc.*

Use more than one ground rod to ground a tower, possibly 1 or 2 on each leg. Run any feedlines inside the tower for best lightning protection.

Do not bury ground rods under the concrete footing of a tower. Concrete seepage increases ground losses and the resistance of the ground connections.

A good weatherseal can be obtained by taping the connections or cable with plastic tape and covering this with roof shingle cement. This asphalt compound is as good as any and does not seem to affect plastic or coaxial cable.

When installing an antenna use good materials and make sure it is out of reach, especially the ends of an inverted "V". *Caution:* A thin wire dipole has an end voltage of about 1900-2000 volts r.m.s. with 250 watts antenna input if the antenna is a ¼ wave above ground.

Location can make a lot of difference in the performance of two similar antenna systems. This depends on the type of soil, height above surrounding area, *etc.*

An S-point gained by better tuning of the antenna is the same as increasing your power 4 times, but much cheaper.

Once more, tuning for a resonant antenna or an s.w.r. of 1:1 without properly calibrated equipment or understanding the antenna system is senseless. ■

"... and of course, no ignition QRN ..."

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Project MOONRAY

By HARRIS A. STOVER,* WØTKP

ARTICLES in *CQ* magazine have discussed project MOONRAY, a concept conceived and promoted by NASTAR[1] (Nassau College Amateur Satellite Tracking—Headquartered on Campus at Nassau College, Garden City, New York[2].) This is a project whereby a ham repeater or transponder would be carried to the Moon on the third Apollo lunar landing. They hope to provide useful amateur radio relay with a unit weighing only five pounds with three pounds devoted to the power supply, and occupying only 250 cubic inches with 100 cubic inches devoted to power supply. They say they expect to have a thermoelectric isotope power supply capable of supplying five watts of d.c. power for one year which weighs less than three pounds in a 100 cubic inch package. The other two pounds and 150 cubic inches would be available for the electronics. The brief discussion given here will present some of the problems which may be encountered with a project of this type and some of the factors which relate

* 1903 46th St. N.E., Cedar Rapids, Iowa, 52406.

1 "Project: MOONRAY, Ham Radio From The Moon?", *CQ*, July '67, p. 18.

"Project: MOONRAY, Ham Transponder On The Moon Gains Momentum." *CQ*, December '67, p. 44.

2 P.O. Box T, Syosset, L.I., N.Y., 11791.

Frequency (mc)	Space Attenuation (db)
145	187
220	190
430	197
1250	206
2350	212

Table 1 — Space attenuation between isotropic antennas.

Frequency (mc)	Noise Figur
145	2
220	2.
430	3
1250	4
2350	6

Table 2 — Noise figure estimates for u receivers.

to the choice of frequency band and modulation.

It is obvious that any discussion of challenging project as this weighs upon the antenna systems, and that th many possible choices. For this reaso factors will be discussed first to devel requirements for the antenna systems

Consider the free space attenuati tween isotropic antennas located on ea on the moon for five amateur banc might be used for project MOON These are shown in table 1. (An is antenna is a theoretical concept with gain in all directions while a dipole has 2 db gain in its maximum direction compared with an isotropic antenna change in tabulated space attenuatio frequency is due to changes in receivi tropic antenna aperture size rather th sipation of the signal in space.) Fro table, it is obvious that if space atten between isotropic antennas were th consideration, 145 mc would be the b pick. Unfortunately antennas of equ gain get larger at lower frequencies a a most important consideration. (Ac with an isotropic antenna at one end link and an antenna of constant aper the other, the space attenuation do change with frequency.) It should a noted that cosmic noise is greater at th frequencies and that ionospheric scint fading will influence operation below 500 mc.

Another important factor is the r

Frequency (mc)	Power (watts)	Powe
145	2.8 watts	
220	2.6 watts	
430	2.4 watts	
1250	1.5 watts	
2350	0.4 watts	—

Table 3 — Power output estimates for fiv input.

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	145 mc	220 mc	430 mc	1250 mc	2350 mc
Noise power density (a)	−204 dbw	−204 dbw	−204 dbw	−204 dbw	−204 dbw
Noise figure (b)	2 db	2.5 db	3 db	4 db	6 db
Bandwith (c)	37 db	37 db	37 db	37 db	37 db
Desired S/N (c)	4 db	4 db	4 db	4 db	4 db
Miscellaneous Losses (d)	3 db	3 db	3 db	3 db	3 db
Desired Received Signal Power	−158 dbw	−157.5 dbw	−157 dbw	−156 dbw	−154 dbw

(a) KT = Boltzman's constant times 290° Kelvin.

(b) From table 2, no allowance is made for Galactic noise or propagation degradation.

(c) A bandwidth of 5 kc corresponds to 37 db compared with 1 cycle used for Noise power density. Experiments at Collins Radio Company have shown that for low threshold frequency modulation voice communications, it is desirable to use an audio bandwidth of 300 cycles to 2500 cycles with 6 db octave pre-emphasis above 800 cycles. A volume compressor with a fast attack time should also be used together with a peak clipper providing 17 db of peak clipping which will result in a peak-to-average ratio of 7 db. The peak f.m. deviation should be 2.5 kc or the peak-to-peak deviation should be 5 kc. The receiver should use a 5 kc bandwidth although some of the voice sidebands will fall outside the receiver bandwidth. Under these conditions a signal-to-noise ratio of 3.6 db in the 5 kc bandwidth using a standard frequency discriminator will result in about a 75% phonetically balanced word intelligibility, which may be chosen as a threshold condition. The 3.6 db S/N in the 5 kc i.f. bandwidth corresponds to about 1.6 db S/N in the audio bandwidth. If single sideband is used, the audio bandwidth should be 300 cycles to 4000 cycles and assuming hard-limiting in the transponder transmitter on the moon about 6 db better performance should be obtained than with the f.m. system as described above. Of course, hard-limiting will produce some distortion of the voice signal and therefore the hard-limited s.s.b. should not be directly compared with the above f.m. system. For a more direct comparison, if hard-limiting was used in the f.m. system prior to modulation, the difference between f.m. and s.s.b. would only be about 4 db. Conceivably the use of other demodulators than the standard frequency discriminator could produce a lower f.m. threshold. Hard-limiting in the MOONRAY transponder is being assumed for all applications.

(d) 3 db of miscellaneous losses includes losses in diplexers which permit use of the same antennas for both transmitter and receiver on earth and on the moon.

Table 4—Desired received signal power for voice.

noise figure available to the amateur making use of project MOONRAY. It is rather difficult to predict what an individual amateur might achieve in his station. Table 2 provides some estimates of what could be achieved by good engineering design with uncooled receiving systems.

Assume that 5 watts of power at the correct voltages is available from the isotopic power supply and that only 100 milliwatts is required from the receiver, then virtually the entire 5 watts would be available for the transmitter. Table 3 provides estimates of the power outputs that could be provided with solid-state units on each band with a frequency modulation transmitter.

Table 4 shows the desired received signal level for f.m. voice communications in the five bands and table 5 shows the desired received signal level for ten words per minute cw communications in the five bands.

Combining the results of tables 4 and 5 with the information in tables 1 and 3 yields table 6 for the total required antenna gain, *i.e.*, the sum of the gains in db of both the lunar antenna and the earth antenna.

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	145 mc	220 mc	430 mc	1250 mc	2350 mc
Noise power density (a)	−204 dbw	−204 dbw	−204 db	−204 dbw	−204 db\
Noise figure (b)	2 db	2.5 db	3 db	4 db	6 db
Bandwith (c)	30 db	30 db	30 db	30 db	30 db
Desired S/N (c)	−3 db	−3 db	−3 db	−3 db	−3 db
Miscellaneous Losses (d)	3 db	3 db	3 db	3 db	3 db
Desired Received Signal Power	−172 dbw	−171.5 dbw	−171 db	−170 dbw	−168 db\

(a) KT = Boltzman's constant times 290° Kelvin.

(b) From table 2, no allowance is made for Galactic noise or propagation degradation.

(c) A bandwidth of 1 kc corresponds to 30 db compared with 1 cycle used for Noise power density. Experiments at Collins Radio Company have shown that Morse Code with a signal-to-noise ratio of −3 db in a 1.35 kc bandwidth at 10 w.p.m. can provide nearly 100% copy. For individual operators using a 20 cycle filter following the 1.35 kc bandwidt 90% copy could be obtained at −10. db in a 1.35 kc bandwidth at 10 w.p.m and at 5 w.p.m. this dropped to −12. db. However, for our purposes we wi define −3 db at 1.00 kc bandwidth a the threshold for c.w. communication although we know that some individua operators can do much better than thi under certain conditions.

(d) 3 db of miscellaneous losses include losses in diplexers which permit use o the same antennas for both transmitte and receiver on earth and on the moon

Table 5—Desired received signal power for Morse code.

Remember that the information contained in table 6 is based upon some assumptions and appropriate allowance must be made if these assumptions are not met. It has been assumed that appropriate voltages are available from the power supply and no voltage conversion losses have been included. No allowance has been made for the increase in Galatic noise and the effects of propagation through the ionosphere at the lower frequencies. The miscellaneous losses shown in the tables assume that the r.f. preamplifier at the earth station is mounted directly on the antenna and no excessive cable losses are included. Similarly no excessive cable losses were allowed between the transmitter and the antenna on the moon. Perhaps the most important assumption of all is related to the definition of threshold, *i.e.* 75 percent phonetically balanced word intelligibility which corresponds to over 90 percent sentence intelligibility. This is surely satisfactory for amateur use but might not be satisfactory for some military or commercial applications. With all of these things in mind a closer look at table 6 shows that the system capability is certainly on the threshold of providing an amateur radio voice link via the moon. The antennas become a very important consideration.

The Lunar module will be carrying a erectable ten foot diameter paraboloidal re flector for use in transmitting television pic tures to earth on 2282.5 mc. This antenn with 34 db of gain will be left behind whe the astronauts return to earth and could b used with an amateur radio transponder i the 2300 mc band. Table 6 indicates tha using this antenna and another of equal siz on the earth correctly pointed at one anothe could provide a useful voice communica tions link for amateur radio with the trans ponder power levels assumed here. For c.w communications the antenna on earth coul be less than two feet in diameter when use with the 10 foot antenna on the moon. *How ever, there is a hitch!* The moon's longitudi nal libration (libration is an apparent oscil latory motion as viewed from the earth) i between six degrees and seven degrees eac side of the mean position and the latitudina libration is about six degrees and forty-fou minutes each side of the mean position. Th ten foot dish on the moon will have a 3 d beamwidth of around three degrees in th 2300 mc band. The earth would be withi this antenna's beamwidth only during tha portion of the monthly cycle when th moon's position points the antenna almos directly at the earth. It might be possible t

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degrade the LM antenna to provide wider beamwidth and less gain but this would require a greater antenna gain at the earth station. Alternatively, if this same ten foot reflector is fitted with another feed for 430 mc after it has completed its function at 2282.5 mc, it could provide 20 db of gain with a 3 db beamwidth of 15 or 16 degrees to allow for the moon's libration plus the approximate two degrees subtended by the earth at lunar distances. Checking table 6, if this approach is used only 16 db of antenna gain would be needed on earth to provide voice communications in the center of the beam from the moon or a 20 db antenna on earth would permit use of the moon's antenna throughout its 3 db beamwidth. The strong emphasis here on the use of the 10 foot paraboloidal reflector normally carried to the moon is in the interest of conserving weight and space. There is a strong desire on the part of NASTAR to keep the size and weight of the entire package to five pounds and 250 cubic inches. Obviously when considering the size and weight that the spacecraft must carry, the antenna becomes of equal importance with the electronics package. Perhaps if weight and size can be conserved in the antenna system, more weight and size could be made available for the electronics package. However, it appears that 2.4 watts power output at 430 mc using a three pound power source and a two pound transponder is feasible with current technology, and could provide a voice channel as discussed above.

Nearly all discussion to this point has been devoted to the transmission link from moon to earth. This is because the low power available on the moon makes this the limiting link. High power transmitters on the earth should provide an excellent signal-to-noise ratio at the moon if the same antenna gains are used both directions. Except for note (c) of table 4 only FM voice and cw modes of operation have been considered. This is because high efficiency is easier to obtain with a saturating or limiting amplifier. However, if a frequency translation type of saturating transponder is used, the same transponder may be used for nearly any of the modes of operation other than amplitude modulation. Frequency translation type of saturating transponder means the received signal is heterodyned to a new frequency, amplified and used as the drive signal for the saturating transmitter. Frequency modulation is normally used with this type of saturating

Frequency (mc)	Total Required Antenna Gain for f.m. Voice (db)	Total Required Antenna Gain for c.w. (db)
145	25	11
220	28	14
430	36	22
1250	48	34
2350	62	48

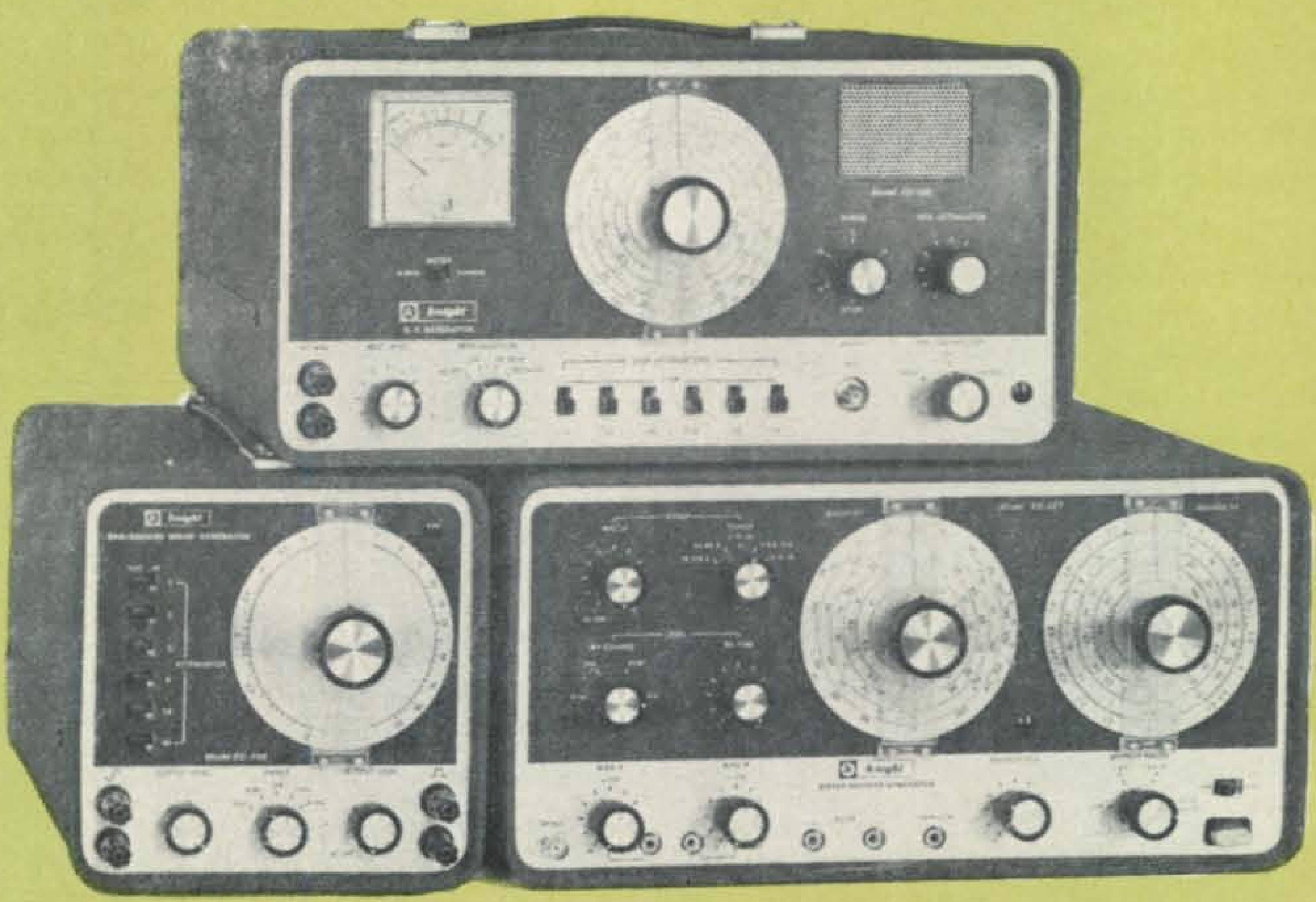
Table 6—Total required antenna gain.

transponder. Morse Code may also be used since the keyed signal effectively changes the drive to the transmitter in the transponder from receiver noise to the received sine wave whenever the sine wave is present. Frequency shift keying or phase shift keying are both naturals for this type of system and would be effective for teletype use. Since hard-limiting doesn't seriously harm the intelligibility of an s.s.b. signal, s.s.b. may also be used with this type of system. Hence, it is noted, this type of transponder provides both high efficiency and versatility.

One of the questions related to system design is, "What type of modulation should be used?" A good answer to this question is that the system should be flexible so that there could be experimentation with a large number of different modulation techniques. The system design should aim at providing a single narrow band f.m. voice channel, and as discussed above the same transponder could then be used for s.s.b. voice, frequency shift teletype, c.w., etc.

Another question related to system design is, "What frequency band should be used?" All of the preceding discussion has been based upon supplying a single communications channel which must be time shared by all individuals wishing to use the channel. If more than one station attempts to use the channel at one time the available power in the lunar transponder may be so divided among them that none of them would have adequate power for useful voice communications. However, if the power balance among c.w. signals received at the transponder were correct, it might be possible for several c.w. stations to use the transponder at a time. It would seem desirable to provide for full duplex operation such as we enjoy in telephone communications, but

[*Continued on page 118*]



Knight Generators: Top—KG686 R.F. Signal Generator; Left—KG688 Sine/Square Wave Generator; Right—KG687 Sweep/Marker Generator.

CQ Reviews:
The Knight-Kit Solid-State Signal Generators

BY WILFRED M. SCHERER,* W2AEF

SEVERAL new Knight-Kit signal generators are available which provide facilities for conducting a wide variety of functions as may be needed for alignment, measurement, test, design and developmental work in the shack, shop or lab.

The Knight-Kit instruments are: the KG-688 Sine/Square-Wave Generator with a sine-wave frequency coverage of 20 c.p.s. to 2 mc and a square-wave output from 20 c.p.s. to 200 kc; the KG-686 Standard R.F. Signal Generator covering 100 kc to 54 mc; and the KG-687 Sweep/Marker Generator covering the range of 3-220 mc.

A special feature of these units is that they are solid-state affairs offering accurate, dependable, cool, stable and instantaneous operation with low power consumption. Although designed to meet the exacting requirements for high-quality service, they are relatively low cost jobs available either in kit form or as factory-wired units.

Other common general features are: professional styling in matching units with retractable carrying handle to allow easy stacking of units; rugged steel case with baked scuff-resistant wrinkle finish; four-inch diameter polished-aluminum dials with clean-cut calibrations; fine-hairline cursor; 6:1 ratio planetary ball-drives; full-view panel meter with D'Arsonval movement; accurate step attenuators; separate ground post; BNC-type r.f. connectors, 5-way binding posts

* Technical Director, *CQ*.

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(accepting GR dual plug) for other connections; 115 v.a.c. 50/60 c.p.s. operated power supply with Zener-diode voltage regulators on critical circuits; detachable line cord for convenient transportation or storage of equipment.

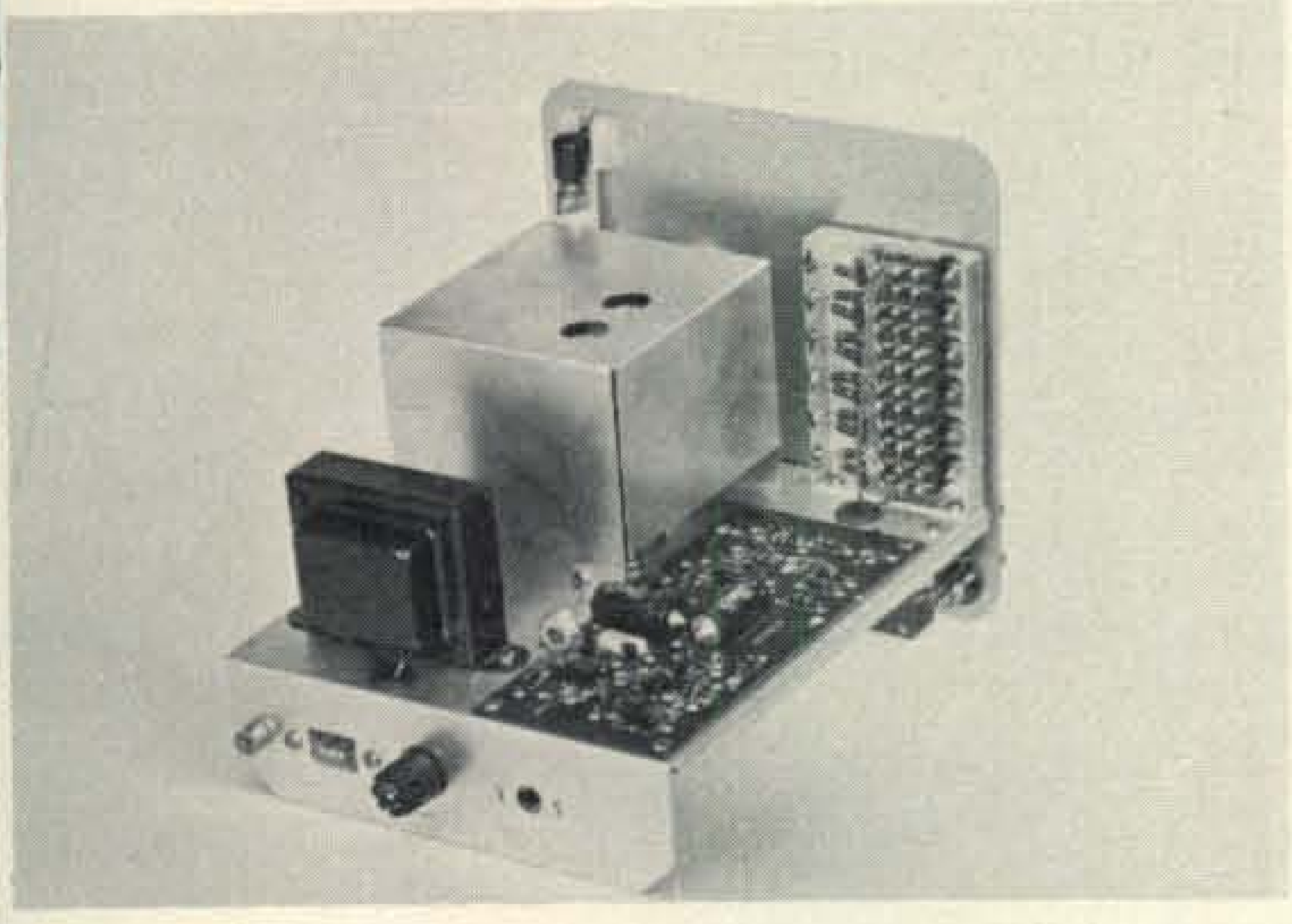
KG-688 Sine/Square-Wave Generator

The 20 c.p.s. to 2 mc sine-wave coverage of the KG-688 is provided in 5 decade ranges with a frequency accuracy of ±3%, except ±5% below 100 c.p.s. and above 1 mc. 0-7.5v. r.m.s. is obtained into loads of at least 10,000 ohms, 0-6.5v. r.m.s. with 600 ohms at an output level constant to ±1 db to 1 mc, ±2 db to 2 mc. A six-step attenuator permits adjustment of the output voltage in discrete 1 db steps up to a total of 41 db with 5% accuracy into a 600-ohm load. A fine-tuning control provides continuous output adjustment down to 0.5 mv. The distortion is rated at 0.25% over the a.f. range (up to 20 kc).

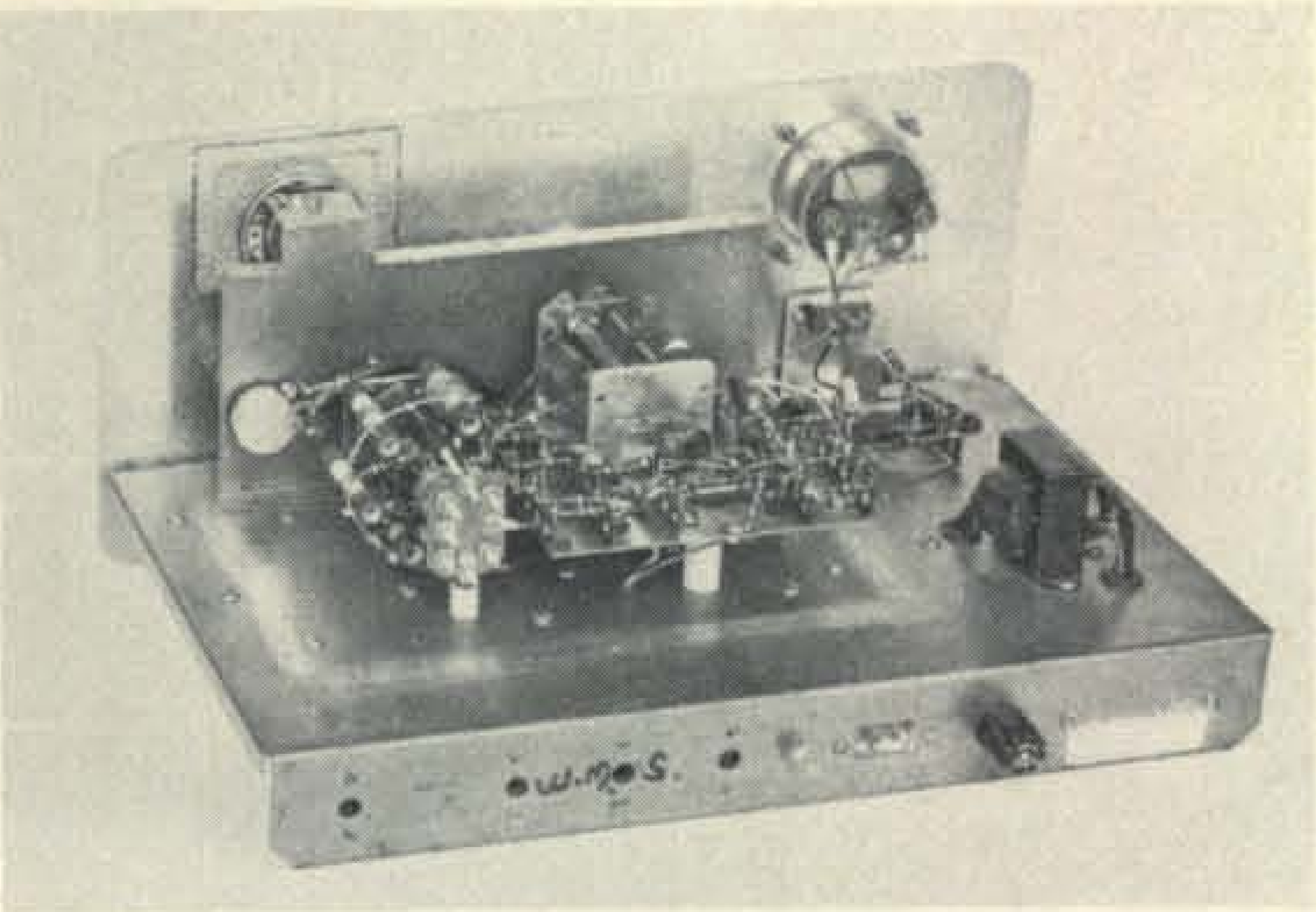
The 20 c.p.s. to 200 kc square-wave coverage is in 4 decade ranges with 0-10 v. peak-to-peak output with loads of at least 10,000 ohms. The square-wave signal is positive-going with a clamped reference to ground. The rise time is rated at 0.1 micro-seconds at 20 kc. The symmetry may be internally adjusted to 50% (±10%). The a.c. power consumption is 15 watts. Size of the unit is 7¾" × 7⅜" × 10¼" (H.W.D.) and it weighs 9¼ lbs.

KG-688 Circuitry

A brief run-down of the circuitry is as follows: 7 silicon transistors, 1 field-effect transistor and 11 diodes, including 4 zener types, are employed. The sine-wave oscillator is a Sulzer type using 4 amplifier stages with positive and negative feedback loops. A barreter in the positive loop maintains constant amplitude; while the frequency is controlled by a tunable *R/C* bridged-T network in the negative loop. The f.e.t. is used at the input to provide a very high-impedance termination for the network. The output is obtained from a push-pull type of emitter follower with complimentary PNP and NPN transistor circuitry.



Top view of the KG-688 Sine/Square Wave Generator. The tuning capacitor is in the metal enclosure at top left, the attenuator switches are on the panel at the right. Other components are on the printed-circuit board in the foreground.



Rear view of the KG-686 R.F. Signal Generator. A copper enclosure fits over the r.f. oscillator assembly (at center) which is mounted on standoff insulators and is grounded to the chassis at one point.

The output attenuators are constant-impedance Pi-section types designed for use with a 600-ohm load, and are operated by slide switches. There are six steps: 1, 2, 3, 5, 10 and 20 db each. A vernier level-adjust control also is provided.

Square-waves are obtained by applying the sine-waves to a Schmidt squarer that uses two transistors in a level-sensitive bistable-oscillator circuit with an emitter-follower output stage. A positive-going wave clamped to ground reference is obtained with a diode shunted at the input of the output stage. The signal level is continuously adjustable with a potentiometer. There are separate posts for either sine- or square-wave output.

KG-686 Standard R.F. Signal Generator

The 100 kc to 54 mc coverage of the KG-686 is provided in 5 bands (all operating on the fundamental) with a frequency-calibration accuracy of ±1.5% of the h.f. end of each band; however, a crystal calibrator in the unit provides either 1 mc or 100 kc accurate references (to 0.1%) that produce an audible beat on a built-in loudspeaker when the signal generator is tuned to one of the related points.

Up to 120,000 microvolts may be obtained into a 50-ohm load with a six-step attenuator

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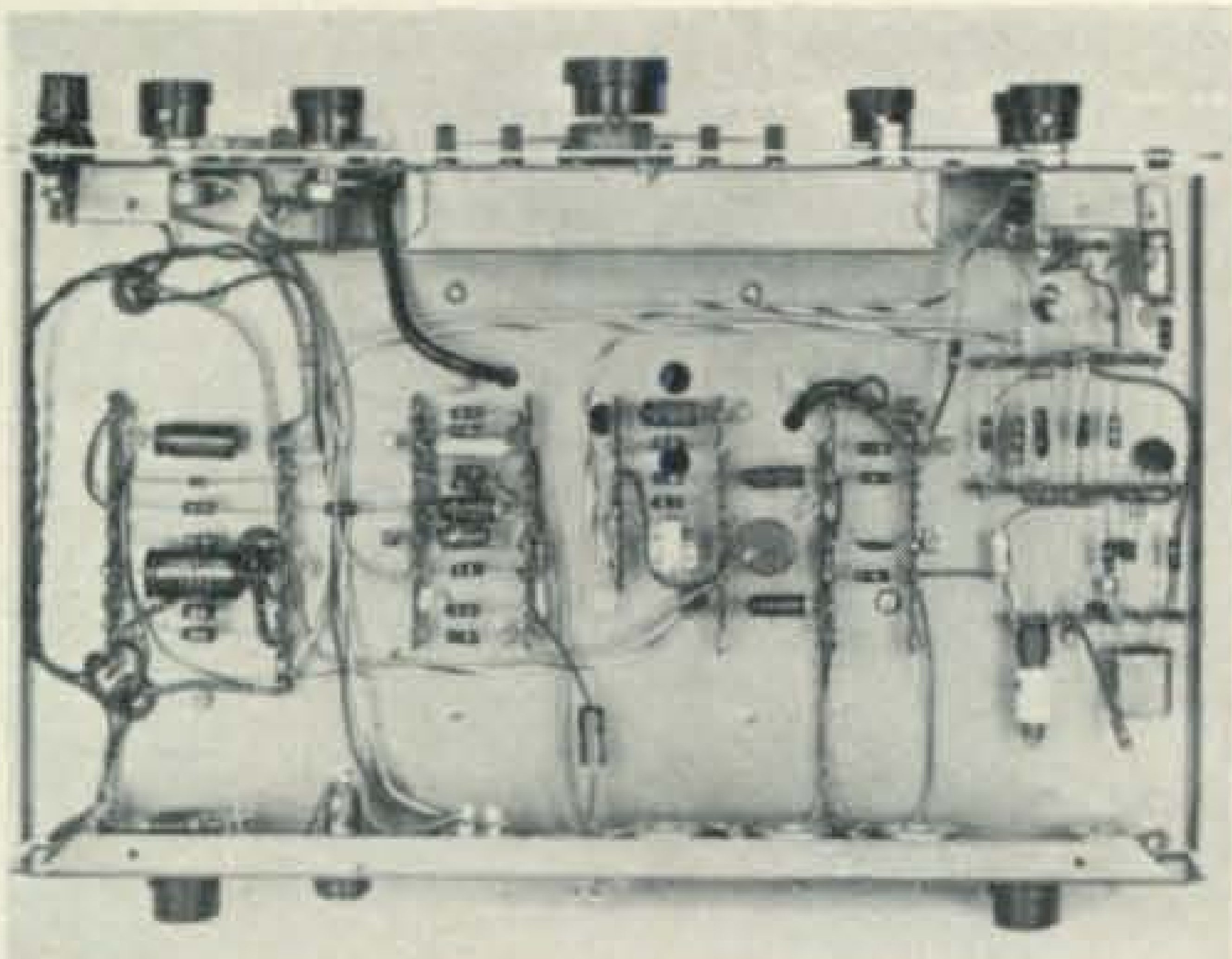

Under-chassis view of the KG-686 showing type of wiring with components installed between well-separated terminal strips for easy access. The step attenuator with the output connector is shielded in a copper box at top center.

provided to obtain known r.f. voltages down to 0.5 μv with an accuracy of ± 2 db ($\pm 20\%$) of nominal to 30 mc. A panel meter provides a 100,000 μv reference and it also is calibrated in db which, along with a fine-attenuator control prior to the step attenuator, provides continuous adjustment to other references. The open-circuited output voltage is uncalibrated and varies from 3v. r.m.s. on the lowest band to 0.3v. on the highest one.

Modulation may be applied from an internal 400 c.p.s. oscillator or from an external source and may be varied and metered up to a depth of 50% ($\pm 5\%$ to 30 mc). One-volt r.m.s. is needed for 50% modulation from an external source (at 400 c.p.s.).

The a.c. power consumption is 6 watts. The size of the unit is 7¾" × 14¾" × 10¼" (H.W.D.) and it weighs 14¾ lbs.

KG-686 Technical Details

The KG-686 utilizes 10 silicon transistors and 6 diodes, including 1 zener. The r.f. oscillator is a Hartley type operating at a very low level to minimize r.f. leakage and distortion or harmonics. An emitter-follower then precedes an output amplifier which is a Vander Bjil type modulator the operating principle of which is that of an amplifier whose gain varies at the modulating rate. Internal modulation is provided by a 400 c.p.s. oscillator using two transistors in a bridged-T feedback setup. A c.w. carrier is obtained simply by removing the a.f. oscillator output.

A potentiometer is used for a fine-attenuator control ahead of the modulator. R.f. output is sampled, rectified and amplified to activate a meter with a db scale. The meter setup also may be switched to show th modulating level in percent, from either th internal or external a.f. oscillator.

Output from the signal generator is ob tained through a constant-impedance step at tenuator each section of which is a Pi-typ designed for a 50-ohm load. There are fou 20 db steps, a 10 db one and a 6 db one activated by slide switches. The r.f. outpu voltage is determined according to the d attenuation in use and the number of db b which the meter reading differs from th 100,000 micro-volt reference at zero db o the meter scale. A table is furnished in th manual for quickly converting the relative d level to r.f. volts.

Attenuator accuracy is maintained usin 5% resistors and individual shielding of eac section. Radiation leakage from the signa generator is held to a minimum through th use of a power-line filter and extensiv copper shielding with sub-assemblies floate above chassis with one-point grounding.

Frequency calibration is obtained by mix ing the output from a 1 mc crystal-controlle oscillator, or that from a 100 kc L/C oscil lator synchronized by the 1 mc signal, wit the r.f. signal to produce an audible beat o a built-in loudspeaker.

KG-687 Sweep/Marker Generator

The 3-220 mc frequency coverage (cente frequencies) of the KG-687 is in 5 bands all operating on the fundamental. The swee frequency is 60 c.p.s. with r.f. retrace blank ing and a sweep width variable 0-18 mc o the 28-220 mc band and 0-8 mc at the lowe frequency i.f.'s. The output voltage is 0. v. r.m.s. minimum up to 50 mc, 0.1 v. up t 120 mc and 50 mv up to 220 mc. The out put level is controlled by an attenuator usin a 4-position switch and a continuously variable-adjust control. Output impedance i 75 ohms.

A marker oscillator is included for 2-7 mc on 3 fundamental bands, with harmonic identified on an additional dial-scale up t 225 mc. A 4.5 mc crystal-controlled marke oscillator also is supplied along with a socke on the panel for using 500 kc-20 mc marke crystals mounted in HC/6U type holders.

The horizontal output (sweep frequency is 6 v. r.m.s. minimum with a screw-driver adjust phasing control provided. There als are two isolated 0 to −20 v.d.c. supplie with individual calibrated controls. Thes voltages are for a.g.c. bias needed durin certain alignment procedures.

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A.c. power consumption is 11 watts. Size of the unit is 7¾" × 14¾" × 10¼" (H.W.D.) and it weighs 14½ lbs.

KG-687 Technical Setup

Employed in the KG-687 are 9 silicon transistors and 7 diodes including 2 zener diodes. The r.f. sweep oscillator is a Colpitts type with its frequency swept by varying inductance in the frequency-determining circuit. The inductor is a saturable reactor like the "increductor"[1] The center frequency is controlled by a variable capacitor.

The sweep voltage for controlling the inductance is obtained from the 60 c.p.s. power-line source and is continuously variable for adjustment to the desired sweep width. This voltage, for which there is a phasing control, also goes to an output jack for connection to the horizontal-sweep input on an oscilloscope.

Automatic level control of the oscillator output is obtained by rectified r.f. from the output fed back to a transistor that controls the operating voltage for the oscillator, thus correcting amplitude changes that may tend to occur. Retrace blanking is obtained by disabling the voltage-control transistor with alternate half-cycles of the sweep voltage. This cuts off the oscillator supply voltage during these periods.

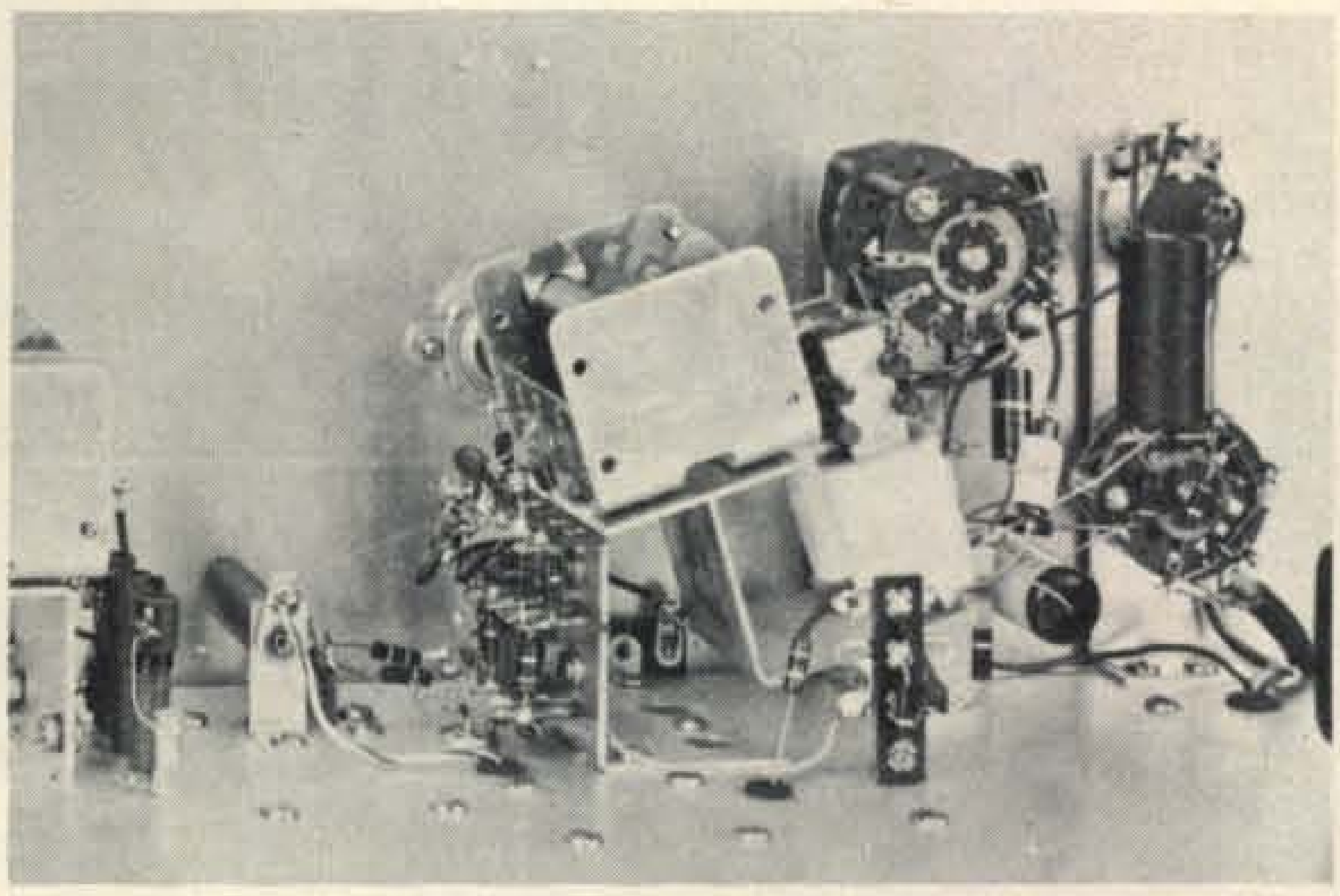
After the oscillator there are two cascaded emitter-followers with a vernier level-adjust control and a rotary-switch type attenuator with four decade-voltage steps designed for operation into a 75-ohm load.

The r.f. output also is mixed with signals from a Colpitts type v.f.o. or a crystal-controlled oscillator to produce "birdie" markers that are superimposed upon the demodulated-output response from the equipment under test that is fed to the vertical input of the scope. This is the post-injection marker system that prevents markers from being lost or from distorting the response display.

Except for the BNC type r.f. output connector, phono jacks are provided for connections to the gear under test and to an oscilloscope which must be used in conjunctio with the sweep generator. The two a.g.c. bias voltages are adjustable from the panel, as is the marker size.

Assembly

Assembly of the kits for these Knight-Kit units is easily made with the usual type of



The sweep-oscillator section in the KG-687. The saturable reactor is between the bandswitch and the tuning capacitor.

step-by-step procedures set forth in the manual along with the parts identification method. 7 hours were required for doing the work on the KG-688, 14 hours for the KG-686 and 11 hours for the KG 687.

Much of the KG-688 is built on a printed circuit board mounted on the chassis. In the other two units, point-to-point wiring is used with the components, including transistors and diodes, soldered to terminal strips which are spread out quite a bit, allowing plenty of room for easy access. A number of subassemblies are used above the chassis for various oscillator sections. Any screw-driver-adjust controls are conveniently located on the rear of the units.

Applications

Some of the most useful applications for these instruments, particularly related to amateur radio needs, are as follows:

SINE/SQUARE-WAVE GENERATOR—determining response, bandwidth or gain of a.f. amplifiers, receivers, transmitters, a.f. filters; adjusting phasing networks or phasing-type s.s.b. exciters; checking unwanted-sideband suppression; finding resonant frequency of L/C combinations; determining value of capacitors or inductors; checking distortion in gear; use as an interpolation oscillator with frequency measurements; square-wave tests for determining equipment characteristics such as response, ringing, oscillation, instability, etc.

STANDARD R. F. SIGNAL GENERATOR—Measurement of receiver sensitivity, signal-to-noise ratio, image rejection, unwanted or i.f. signal rejection, i.f. bandwidth, unwanted-sideband suppression, notch rejection, a.g.c. characteristics, S-meter calibrations; tests for over-

[*Continued on page 128*]

1 "The Incredible Increductor", HAM CLINIC, *CQ* '60, page 66.

CQ World-Wide DX Contest
ALL-TIME C.W. RECORDS

In the records listed below, boldface listings denote world records. Nu
ber groups after calls are: year of operation, total score, contac

Single Operator/Single Band

WORLD RECORD HOLDERS

1.8	**ZC4RB ('67)**	**4,335**	**86**	**3**	**14**
3.5	**UC2AA ('66)**	**83,496**	**714**	**20**	**64**
7.0	**5A1TW ('64)**	**227,814**	**918**	**22**	**64**
14	**1G5A ('66)**	**792,370**	**1594**	**37**	**133**
21	**ZS6IW ('65)**	**440,213**	**1081**	**36**	**103**
28	**PY2SO ('67)**	**532,956**	**1319**	**37**	**101**

AFRICA

1.8	No Entrant				
3.5	No Entrant				
7.0	**5A1TW ('64)**	**227,814**	**918**	**22**	**64**
14	**1G5A ('66)**	**792,370**	**1594**	**37**	**133**
21	**ZS6IW ('65)**	**440,213**	**1081**	**36**	**103**
28	9J2WR ('67)	260,190	877	32	73

ASIA

1.8	**ZC4RB ('67)**	**4,335**	**86**	**3**	**14**
3.5	4X4DH ('64)	55,440	301	14	49
7.0	4X4FA ('64)	174,505	781	25	60
14	HL9KH ('63)	339,920	910	37	103
21	4X4TP ('66)	162,104	640	25	67
28	4X4VE ('67)	94,340	384	29	60

EUROPE

1.8	OK1ZC ('64)	3,060	167	5	15
3.5	**UC2AA ('66)**	**83,496**	**714**	**20**	**64**
7.0	OK1ZQ ('66)	125,130	783	28	69
14	G2LB ('57)	213,112	701	36	100
21	G3HCT ('67)	235,209	886	30	81
28	DL4AAP ('57)	253,680	728	36	84

NORTH AMERICA

1.8	VO1FB ('66)	4,165	92	4	13
3.5	W8NDK ('65)	20,800	126	20	45
7.0	W6AM ('64)	161,991	468	37	86
14	KZ5TW ('67)	343,850	1177	36	94
21	W4KFC ('66)	211,106	609	32	87
28	K8AEK ('58)	166,270	520	37	93

OCEANIA

1.8	VK5KO ('64)	6	1	1	1
3.5	KH6EPW ('66)	7,068	132	9	10
7.0	VK3ADB ('66)	84,456	435	22	46
14	VK3APJ ('67)	422,240	1150	35	95
21	KH6DLF ('59)	156,658	720	31	43
28	VK8UG ('67)	320,008	1048	32	72

SOUTH AMERICA

1.8	No Entrant				
3.5	PY7VNY ('66)	105	5	4	3
7.0	PY4AP ('64)	81,673	421	22	45
14	PY2BGL ('67)	642,400	1490	36	110
21	CX1AAC ('66)	438,616	1353	31	78
28	**PY2SO ('67)**	**532,956**	**1319**	**37**	**101**

Single Operator/All Band

AF	ZD8J ('67)	1,616,673	1586	107	24
AS	HL9KH ('62)	1,142,748	1554	103	22
EU	UB5WF ('67)	999,700	1349	93	25
NA	KZ5TW ('66)	1,105,190	1738	96	19
O	**VR2EW ('65)**	**2,499,536**	**2215**	**126**	**26**
SA	PY2SO ('66)	1,499,020	1642	102	20

WORLD RECORD

Station	Band	Contacts	Zones	Countries
VR2EW (1965) 2,499,536	1.8	—	—	—
	3.5	101	19	36
	7.0	514	27	54
	14.0	834	37	93
	21.0	737	37	73
	28.0	29	12	12
	Total	2215	126	268

Multi-Operator/Single Trans.

AF	ZS5QU ('67)	1,615,350	2005	94	181
AS	**4L3A ('67)**	**3,084,536**	**2376**	**116**	**330**
EU	OF2TI ('67)	1,076,160	1296	110	270
NA	TGØAA ('67)	1,948,360	2615	116	219
O	VK5NO ('63)	945,248	1199	86	185
SA	CX2CO ('66)	2,199,694	2278	104	225

WORLD RECORD

Station	Band	Contacts	Zones	Countries
4L3A (1967) 3,084,536	1.8	—	—	—
	3.5	306	13	49
	7.0	472	23	64
	14.0	604	31	88
	21.0	425	26	63
	28.0	569	23	66
	Total	2376	116	330

Multi-Operator/Multi-Trans.

AF	ET3FMA ('67)	1,387,680	1476	105	231
AS	4X9HQ ('62)	1,681,988	1975	84	224
EU	OF2AM ('67)	3,829,375	3317	142	415
NA	W3MSK ('67)	4,063,920	2452	158	416
O	KG6FAE ('57)	691,601	1321	76	105
SA	**PJ3CC ('67)**	**5,527,788**	**5194**	**110**	**247**

WORLD RECORD

Station	Band	Contacts	Zones	Countries
PJ3CC (1967) 5,527,788	1.8	—	—	—
	3.5	191	7	8
	7.0	898	20	46
	14.0	1590	29	68
	21.0	1553	26	64
	28.0	962	28	61
	Total	5194	110	247

CQ World-Wide DX Contest

ALL-TIME PHONE RECORDS

zones, and countries. All-band and Multi-Operator records include a band-by-band breakdown of the world leader in each category.

Single Operator/Single Band

WORLD RECORD HOLDERS

1.8	**DL9KRA ('67) 486**	**57**	**2**	**7**
3.5	**YV5BTS ('66) 69,471**	**296**	**21**	**62**
7.0	**K2GXI ('67) 60,204**	**254**	**27**	**60**
14	**YV5BIG ('66) ...840,252**	**1929**	**36**	**111**
21	**DL6EN ('67) 503,034**	**1462**	**38**	**82**
28	**LU1DAB ('67) ...501,828**	**1375**	**34**	**90**

AFRICA

1.8	No Entrant			
3.5	No Entrant			
7.0	No Entrant			
14	CR6BX ('67) 698,640	1450	39	125
21	ZD8WZ ('66) 378,200	1076	31	91
28	CR6DX ('67) 190,872	659	29	70

ASIA

1.8	No Entrant			
3.5	4X4AS ('64) 29,392	227	11	33
7.0	JA2BTV ('67) 46,620	196	29	55
14	HL9KH ('63) 318,960	826	37	107
21	4X4TP ('67) 375,354	1019	33	93
28	JA3EGE ('67) ...190,008	745	32	55

EUROPE

1.8	**DL9KRA ('67) 486**	**57**	**2**	**7**
3.5	ON4UN ('66) 61,523	616	19	58
7.0	G3NLY ('67) 58,982	410	19	58
14	G5AAM ('67) 824,344	1634	39	144
21	**DL6EN ('67) 503,034**	**1462**	**38**	**82**
28	G2BOZ ('67) 280,675	960	32	77

NORTH AMERICA

1.8	VE3BS ('67) 400	51	2	2
3.5	W1FZJ/KP4 ('66) ..26,270	152	18	53
7.0	**K2GXI ('67) 60,204**	**254**	**27**	**60**
14	KP4AST ('67) ...400,928	1288	31	105
21	W1HQV ('67) 216,543	572	33	98
28	W2BXA ('67) 309,844	751	35	107

OCEANIA

1.8	No Entrant			
3.5	KH6EPW ('66) 5,040	82	10	11
7.0	ZL4BO ('65) 11,232	106	17	22
14	KX6BQ ('65) 449,306	1125	38	107
21	KØILI/KG6 ('67) .188,324	733	30	59
28	VK9GN ('67) 291,194	1035	34	63

SOUTH AMERICA

1.8	No Entrant			
3.5	**YV5BTS ('66) 69,471**	**296**	**21**	**62**
7.0	PY7LAK ('67) 15,228	114	16	31
14	**YV5BIG ('66) ...840,252**	**1929**	**36**	**111**
21	CX8CZ ('66) 231,462	847	30	69
28	**LU1DAB ('67) ...501,828**	**1375**	**34**	**90**

Single Operator/All Band

AF	VQ9AA/D ('66) .3,624,942	2518	133	369
AS	ZC4RB ('67) 967,483	1175	80	201
EU	DJ6QT ('67) 2,270,224	1966	119	315
NA	W4AXE ('67) ...1,301,776	1094	127	286
O	**VK2ADY/9 ('67) 5,045,115**	**3310**	**153**	**384**
SA	CX2CO ('65) ...1,815,288	1849	106	238

WORLD RECORD

Station	Band	Contacts	Zones	Countries
VK2ADY/9 (1967) 5,045,115	1.8	—	—	—
	3.5	29	15	20
	7.0	118	25	37
	14.0	949	38	110
	21.0	1084	38	104
	28.0	1130	37	113
	Total	3310	153	384

Multi-Operator/Single Trans.

AF	ET3WH ('66) ...2,139,696	2306	98	226
AS	KA9MF ('67) ...1,244,910	1680	86	169
EU	**I4GAD ('67) ...2,764,820**	**2572**	**114**	**276**
NA	WA6ZQU ('67) ..1,451,219	1264	126	275
O	KG6AAY ('67) ..1,525,396	1813	106	181
SA	CX2CO ('66) ..2,600,923	2413	114	263

WORLD RECORD

Station	Band	Contacts	Zones	Countries
I4GAD (1967) 2,764,820	1.8	—	—	—
	3.5	67	6	26
	7.0	80	10	35
	14.0	616	31	80
	21.0	716	33	65
	28.0	1093	34	70
	Total	2572	114	276

Multi-Operator/Multi-Trans.

AF	ZD8AR ('65) ...2,839,005	2873	103	242
AS	KA2MA ('57) 359,040	711	66	104
EU	**OF2AM ('67) ...9,259,941**	**6048**	**151**	**448**
NA	K2GL ('67) 5,414,252	3045	154	460
O	KX6AF ('58) 306,642	711	59	88
SA	4M5A ('67) 7,468,117	5033	134	393

WORLD RECORD

Station	Band	Contacts	Zones	Countries
OF2AM (1967) 9,259,941	1.8	3	2	3
	3.5	330	10	43
	7.0	467	28	68
	14.0	2256	39	141
	21.0	1850	36	104
	28.0	1142	36	89
	Total	6048	151	448

 See Page 134 for New Reader Service

DX

BY JOHN A. ATTAWAY,* K4IIF

You know gang, back when I took this job they told me that there would be a summer slump. Everyone is supposed to go in for outdoor sports, vacations, and the like so that the harried DX Editor can take it a little easier for about 3 months. Well, I got news for you. That's a great big MYTH. During the month of June I processed 33 new WPX applications, 31 WPX endorsement applications, and 27 more new WAZ applications. In addition, there are 15 sets of WAZ cards up on the shelf that I haven't had time to check yet.

What this all means is that with a rising sunspot number we have a rising interest in DX, and as a consequence the *CQ* DX Department can no longer function as a one man show. During the sunspot minimum of just a very few years ago one man could do it, maybe, but not now. We aren't a one mule farm anymore, we've got to buy a tractor.

Our first step in modernizing was to bring in Louise Rippe, W8HDB, to look after the S.S.B. DX Award program. Her first move was to restore the S.S.B. DX Honor Roll. To say that this has been popular would be the understatement of the year. Louise has been so busy checking cards for the Honor Roll boys this month that she hasn't had time to process any new certificate applications.

The second step in modernization, just taken this month, was to hire us a WPX Award Manager. All the new applications, plus the WPX Honor Roll we are working up, has made WPX a real major operation. Consequently, we are lucky to have secured the services of Howard Kelley, K4DSN, and his gracious XYL, Ann, to look after this phase of the program. Howard and Ann always handle my QSLs when I operate as DX during the contests, and they do a thorough, conscientious job. I'm sure they will do the same for WPX. Their address is 6563 Sapphire Drive, Jacksonville, Florida 32208.

As most of you know we have a second prefix award which is for Novices only. It is called the WPNX Award and is awarded to Novices who have confirmed 100 prefixes. Now that the term for the Novice license has been increased to 2 years we expect this award to move along more rapidly. Giving it an extra nudge is Bob Norman, K4GRD, who is now managing WPNX. Bob is both an avid DXer and a county hunter as well. For you Novices who would like to have the complete rules and an application blank for WPNX, Bob's address is P.O. Box 524, Lakeland, Florida 33802.

The WPX Program

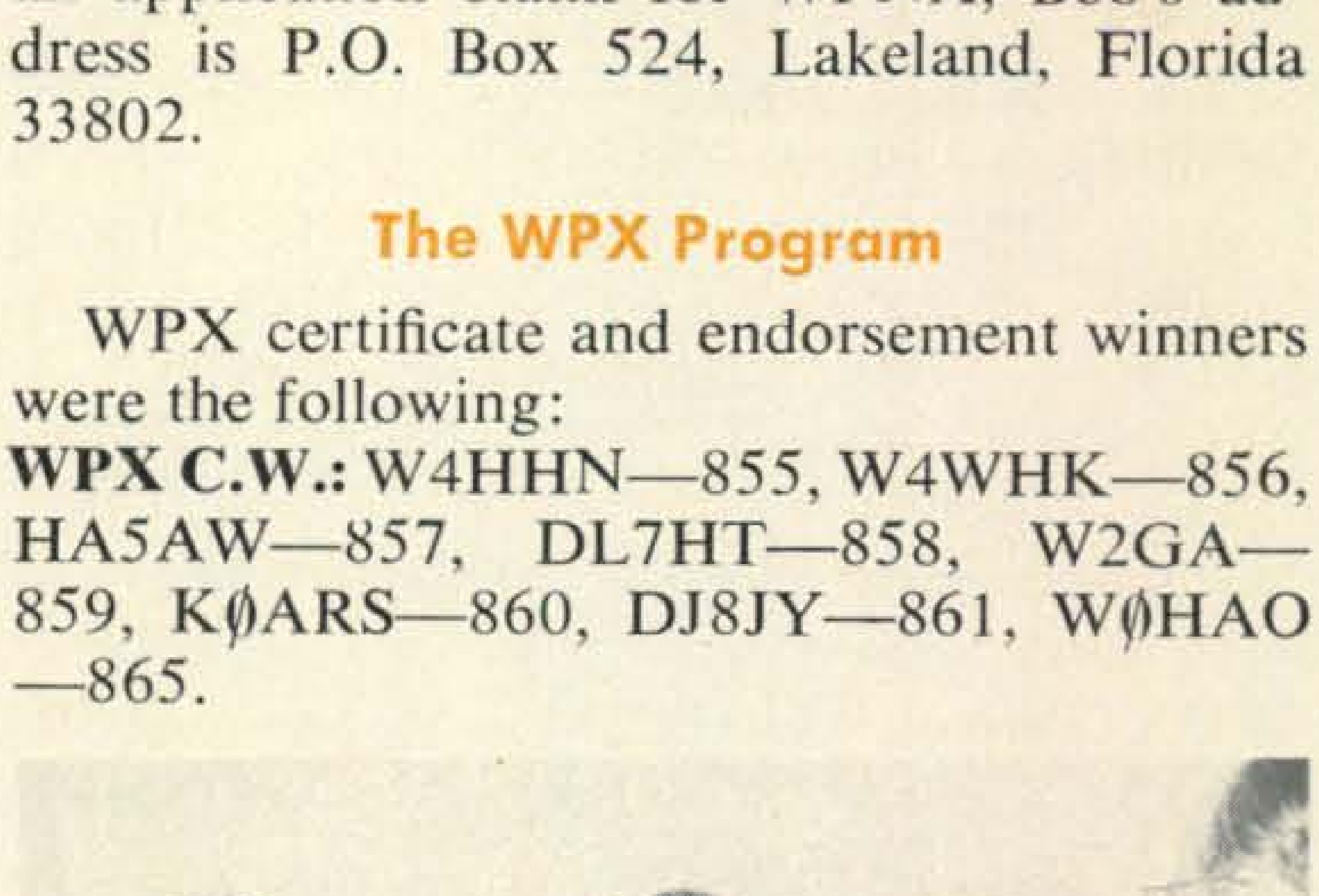
WPX certificate and endorsement winners were the following:

WPX C.W.: W4HHN—855, W4WHK—856, HA5AW—857, DL7HT—858, W2GA—859, KØARS—860, DJ8JY—861, WØHAO—865.

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

S.S.B. DX HONOR ROLL

VK3AHO	318	G3AWZ	303	W9EXY	286	MP4BBW	270
K9ILW	318	G6TA	303	W1LLF	282	W2MJ	267
W2TP	313	W3DJZ	302	W6UOU	282	G2PL	266
G3FKM	313	W4PAA	301	W3KT	282	W6YMV	265
W3NKM	313	5Z4ERR	301	I1AMU	282	G2BVN	264
WA8AJI	312	KP4CL	301	K4OEI	280	G3DO	261
DL9OH	310	W4QCW	300	K4HYL	277	DL3RK	261
G8KS	310	W8EVZ	300	W7DLR	277	W4LRS	260
WA2IZS	309	W8PQQ/		DL1IN	276	W6WNE	260
W2RGV	309	W8BT	299	W4HUE/		WA2EOQ	259
W4OPM	309	W4SSU	299	W4IC	276	PZ2AA	258
W5KUC	308	K2MGE/		PZ1AX	275	K1SHN	257
K6CYG	308	W4MYE	297	W6RKP	274	W6BAF	254
W2ZX	307	W2VCZ	296	K9EAB	274	K6CAZ	254
T12HP	306	W2FXN	294	W2LV	271	PAØSNG	252
K4TJL	305	W3MAC	294	K8ONV	270	K6LGF	251
WØQVZ	305	K1IXG	289	G3NUG	270	W1AOL	250
W2BXA	304	K8RTW	288				



A quartet of Brazil's foremost DX operators. From left to right: PY7AKW, PY2PE, PY2DYI, and PY2PA. (*Photo courtesy WB2EPG, President LIDXA*)

See page 134 for New Reader Service

This shot includes 2 of the only 3 licensed hams now in San Marino, and the only 2 who are active. From left to right: M1B, Gordon (WB6JKQ), and M1H. The only other licensed amateur is M1D who is not on the air. Gordon advises that there is no chance for outsiders to operate again from M1/9A1 land until after April 1, 1969. M1B operates 10, 15, & 20 meter phone only, and is active about 10 days per month using an SX-146, 350 watt xmtr, and a triband beam. M1H operates only c.w. and is not active on a regular basis. (*Photo courtesy WB6JKQ*)

WPX S.S.B.: DJ9ZB—337, DL5NI—338, W2BHK—339, WA3APO/4—340, K5HYB—862, SP9AI—863, DJ4UF—864, DL6ZB—341, YV7AV—342, YV4IQ—343, KH6FJL—344, CR6IK—345, W5TXN—346, G3RWQ—347, VK3AMK—348, IS1EP—349.

WPX Mixed: WA1ERM—169, WB6ADY—170, W9VNE—171.

WPX Phone: G3BID/mobile — 152, VK2AAK—153, YV4IQ—154, W8PQD—155, VK3XO—156.

WPX S.S.B. Contest: SK6AB—10.

Endorsements: *Continent*—Europe: W2GA, DJ4UF, W3DJZ. Africa: W3DJZ. Asia: W3DJZ. S. America: W3DJZ.

Band—14 mc: DL9OH, VK3XO.

Mode—Mixed: W9IRH—600, W4IC—600.

S.S.B.: DL9OH—600, G3DO—600, W3DJZ—550, G3WW—500, DJ9ZB—300, YV4IQ—300, G3RWQ—300, KH6FJL—250, VK3AMK—250, CR6IK—250.

C.W.: W4OPM—850, SM7TV—550, W9IRH—550, VE2IJ—450, K1QZV—450, KØARS—400, W2GA—350.

Phone: W3DJZ—600, VK3XO—450, YV4QG—400, VK2AAK—350.

The WAZ Program

The new WAZ certificate winners this month are as follows:

WAZ S.S.B.: W6DZZ—560, W2BMK—561, K3MVP—562, WA4WIP—563, WA6AUD—564, DJ7QI—565, DL1MM—566, W9JT—567, W5CCP—568, DJ6FN—569.

WAZ C.W.–Phone: K8EHD—2452, W8CH—2453, W7DH—2454, W3DKT—2455, K6OBA—2456, W4GRG—2457, W4HKJ—2458, K3MVP—2459, K2ZCD—2459A, WA3HUP—2460, W4UHC—2461, K6YUI—2462, WB6ADY—2463, W7SFA—2464, W3BT—2465.

WAZ Phone: W4EEU—381, W7VSM—382, XE1YG—383.

CQ SSB 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 will be issued for each additional 25 countries confirmed up to 300, there after 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 envelope 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 inchecking 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.
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.

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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.

Bob Norman, K4GRD, with his neat set-up for the 1968 Georgia QSO Party. Bob operated from a farm in a rare South Georgia county. He is the new manager for WPNX, CQ's prefix award for novice only. Contact him at P.O. Box 524, Lakeland, Fla. 33802.

De Extra

De Extra this month is by Einar Palsson, TF3EA, and is based on an article which he wrote for the 1965 ITU Centenary Edition of *4U1ITU Calling*. The subject is the establishment of an International QSL Service.

"One of the obligations of a radio amateur is to QSL all QSO's. I have no time for amateurs who do not complete and send cards to the stations they work. Therefore, I direct my remarks to the distribution of QSL's.

"Radio amateurs located in well developed countries of the world do not usually give much attention to the fact that there are fellow-amateurs in many places throughout the world who are having difficulties in forwarding their QSL-cards in an efficient speedy way. Radio amateurs are always waiting impatiently for QSL's, especially those needed for certificates, awards, etc.

"We must exclude the 'mailing direct' method of circulating cards from consideration, as many radio amateurs must save for the equipment always needed for the station, and therefore cannot afford the great expense to mail their cards direct. This situation is relieved by QSL-bureaus which are to be found in some form in almost every country where the Radio Amateur Art is practiced. However, where there are only one or a few active amateur stations in a country, the amateurs are on their own to send QSL-cards.

"We have an international organization—the I.A.R.U.—and an international amateur radio club—the I.A.R.C. Would it not be worthwhile for these organizations to organize an International QSL-service? Such a service, operated in an efficient and speedy manner, would eliminate QSL worries for most of the hams throughout the world.

"According to I.A.R.U. News in *QST* for December, 1964, there were 148 official QSL-bureaus. Under an international system these would remain active, and in fact some more would eventually be added to the list. The principal change would be that these bureaus would be organized by REGIONS. The number of local or domestic QSL-bureaus would not matter from the point of view of the individual amateur as he would do business only with his own bureau, which in most cases would be operated by his country's amateur club. Where local bureaus do not exist, the amateur could send and receive cards directly from his Regional bureau. The local bureaus would not exchange cards directly, as is the present practice, but would send the cards to the Regional bureaus for forwarding to the local bureaus within the region. The Regional bureaus could be established on a continental or semi-continental basis. Suggested Regions might include North America, South America, Africa, Asia, Europe, Oceania, and the U.S.S.R.

"The 'in' and 'out' QSL-cards, to and from the Regional bureau could be on a predetermined schedule once each month, or more frequently if that were found to be more practical. Radio amateurs would quickly learn to use and rely on such a service. The present laborious method of sending self-addressed envelopes, International Reply Coupons, and sometimes an item to hasten the request for the QSL, is not what we are expecting in amateur radio. We are entitled to something better. Why not have an effective, international QSL-service, one we are all proud of. Then let us use it in a way that the QSL-card will be a welcome confirmation of an enjoyable QSO, not, as it is now in many instances, an unpleasant drag on the QSO and the ever-needed friendship in this world."

(*I'm sure that Einar would welcome comments, and certainly suggestions or offers of direct action. These may be addressed to him as follows: Einar Palsson, TF3EA, Lynghaga 15, Reykjavik, Iceland.—K4IIF*)

WAZ In Record Time???

Mary Ann Crider, WA3HUP, qualified for WAZ C.W.-Phone certificate #2460 on July 3, 1968. You will remember her as WPNX Winner No. 1, (WN3HUP) see January, 1968 issue of *CQ*. Her WAZ was won after only 13 months in amateur radio including several months as a Novice. Can anyone top this?

DX Bulletins

In the August, 1967 column we gave a complete description of the various DX bulletins we were receiving. In response to popular demand here is a list of those we are now receiving with the addresses of the editors. As you can see the *West Gulf DX Club Bulletin* and the *Puerto Rican Dxer* have fallen by the wayside while the *West Coast DX Bulletin* and the *Utah DX Association Bulletin* are new additions. The Northern California DX Club's *'DXer'* is restricted to only club members.

Canadian DX Association *Long Skip*, Editor-VE3DLC, 30 Zenith Drive, Scarboro, Ontario

North Eastern DX Association Bulletin, Editor-K1IMP, 51 Gulliver St., Milton, MA 02186

Long Island DX Association Bulletin, Editor-W2GKZ, PO Box 74, Massapequa Park, NY 11762

The DXers Magazine, Editor-W4BPD, Route 1, Box 161-A, Cordova, SC 29039

Florida DX Club DX Report, Editor-W4BRB, 6510 Carambola Cr., West Palm Beach, FL 33406

Utah DX Association Bulletin, Editor-K7ZIA, 630 E. 1700 S, Orem, UT 84057

West Coast DX Bulletin, Editor-WA6AUD, 77 Coleman Drive, San Rafael, CA 94901

So. Calif. DX Club Bulletin, Editor-WA6GLD, 5031 Arroway Ave., Covina, CA 91723

DX News-Sheet, Editor-Geoff Watts, 62 Belmore Rd., Norwich, Nor., England

DX-Press, Editor-PAØFX, V.E.R.O.N., Postbus 9, Amsterdam, Netherlands

DX-MB, Editor-DL3RK, Box 262, *895 Kaufbeuren*, Germany

From the Mailbag

de G3UML: "I was amused by your 'De Extra' in the May *CQ*. I must confess that for a while I thought you were being funny, but now I'm not too sure. Firstly, I really don't think that the A.R.R.L. is in a position, either financially or morally, to sponsor its own personal expeditions. They would have to find operators with time to kill, and visit just about everywhere to really satisfy everyone. The whole thing would be on a shaky foundation before it left Newington. (*There's truth here of course, but with W4BPD on the road and W4ECI looking after things at home it could be started off in good shape.—DX Ed.*)

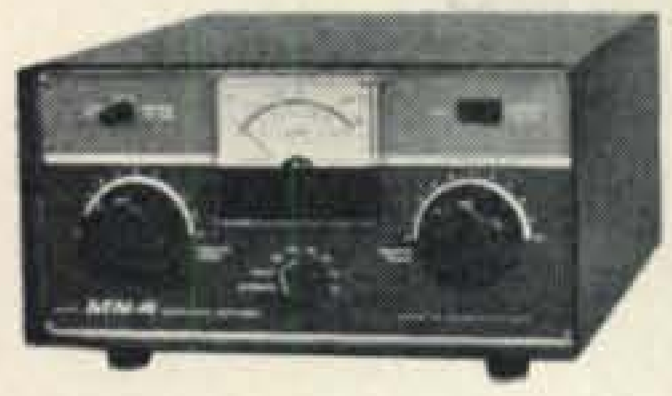
"The A.R.R.L.'s present documentation requirements are understandable, but the whole thing should be handled in a civilized and polite manner. Their present attitude is like that of a teacher to a group of truant schoolboys. Their letter setting out their conditions is not rude, but it has an unpleasant impact on men of integrity. A long established amateur is right in objecting to having to verify his movements. The League is displaying mistrust in its fellow amateurs. This is not nice to see, and it must raise many doubts in the minds of those non-amateurs who are viewing our hobby.

"It seems to me that the league should require documentation only when the location of a station is in doubt. Let's face it, this arises only rarely.

"It has been suggested that DX-peditions as they stand today should not be allowed for country credit. This strikes me as ludicrous. There is unlimited fun, excitement, and satisfaction in preparing and completing a successful expedition. In today's mechanized world, every encouragement should be given to those who are prepared to set themselvs a difficult task and then go on to achieve their aims. Perhaps it is more acceptable if a native of a rare country is worked, rather than a W6 portable. However, this sort of thinking is for the purists, to me the fact that someone is on a rock is sufficient."

See page 134 for New Reader Service

NOW. . . YOUR BEST SOURCE FOR DRAKE



DRAKE MN-4
Matching Network
$90.00

DRAKE MN-2000
Matching Network
$160.00

A Drake MN-4 or MN-2000 matching network is a worthwhile addition to any amateur station where peak performance is desired. Basically identical, except for power handling capabilities, the MN-4 and MN-2000 enables feedline S.W.R.'s of 5:1 to be matched to the transmitter. If input impedance is purely resistive, even higher S.W.R.'s can be handled.

DRAKE R-4B
Receiver
$430.00

The R-4B Receiver is a top quality all-band s.s.b. receiver providing the ultimate in versatility. With accessory crystals, the R-4B covers 160 m., MARS frequencies, CB, WWV, etc., or up to 5 mc continuous coverage for use with VHF converters. Features passband tuning, noise blanker that works on a.m., c.w., and s.s.b., notch filter, crystal lattice 1st i.f. filter for low cross-modulation. Gear driven dial on solid state p.t.o.

DRAKE T-4XB
Transmitter
$430.00

The T-4XB is an all-band, all mode transmitter providing 200 watts p.e.p. input on s.s.b. or a.m. and a conservative 200 watts on c.w. Transceive capability is provided for, when used in conjunction with the Drake R-4 series receivers. Solid state linear permeability tuned v.f.o. produces better than 100 cycle stability, and 1 kc calibration. 160 meter operation with accessory crystal. VOX or PTT. Sideband suppression better than 60 db.

DRAKE W-4
Directional
RF Wattmeter
$49.50

The new Drake W-4 directional, through line, RF wattmeter represents a significant advance in wattmeter design. Through the use of printed circuits, toroids and other techniques, performance is attained which up to now was available only in units selling for more than twice the price. The W-4's accuracy meets or exceeds that of these units.

ARROW proudly announces that BERNIE SHAPIRO, K2IMD has joined our staff. He's looking forward to greeting old friends in our New York store.

ARROW ELECTRONICS, INC.

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- 225 Rte. 46, Totowa, N.J. 201—256-8555
- 97 Chambers St., N.Y., N.Y. 212—DIgby 9-4411
- 525 Jericho Tpke., Mineola, N.Y. 516—PIoneer 2-2290
- 18 Isaac St., Norwalk, Conn. 203—838-4877

See Page 134 for New Reader Service

Gene, K9KDI, et al, sustained by Swiss chocolate alone, operating 40 meter c.w. from 4U1ITU.

de VE6AJT: "Another VE6 and myself leave on Sept. 8 for a DXpedition to the South Pacific. Places such as VR1, ZM7, ZK2, and others will be covered. After that we plan to go to Indonesia, Sikkim, Nepal, etc., then up the west coast of Africa to EAØ-land. In all, we hope to operate from 60 rare or semi-rare countries. This will be a non rent-a-boat, non-luxury hotel type of expedition. QSLs will be handled by VE6AO."

de WA5MYR: "Getting a reciprocal license in Trinidad is not difficult, and if you can find the right parties you could have your license the same day you visit the Government Wireless Station. You are allowed to choose your own call if it isn't already given out."

de W6IL: "Tom, VR6TC, has a 14 mc sked on Tuesday nights, 0500 GMT on Wednesdays, with W6HS. The frequency used is 14220 kc. Tom is handling his own QSLs now and finds that s.a.e. and 2 IRCs are a must."

de W4ORT: "Bob, VR1L, says to advise the gang that he doesn't operate on c.w. Someone has been bootlegging his call on c.w. & he sends apologies to all who have been disappointed."

de 9M2DQ: "Have really missed amateur radio, & sure am glad to be back on the air. My new QTH is quite good, and in a low swampy area so I may try 80 to 160 meters. My Chinese XYL, Kim See (that means Golden Thread), still does the QSLs, keeps up the proper log, and polishes the rig every day.

"I knew personally poor Chuck. I have often spoken to Don Miller and have always appreciated the way he looks for low power fellows, and I admire the way that you are standing up for him."

de WA4WTG: "I use only commemorativ stamps to all DX stations. It would be nic if they would do likewise as many of us ar stamp collectors."

de W4HKJ: "I am no longer QSL Manage for ZD8WZ and 6O6BW. In fact, I would lik to have their addresses."

de W6BCT: "Just a quickie to let you know that I am no longer QSL Manager fo VU2LE, VU2KV, VK7SM, and 4X4MZ a I am leaving for 3 years in 4X4-land. Now in stead of being a QSL Manager I will need on myself." (*see below—DX Ed.*)

de WA2BPL: "I would like to offer my serv ices as QSL Manager for any needful DX station." (Elliot Levin, 415 Sheffield Road Cherry Hill, N.J. 47714)

de WA9VYR: "I would like to be a QSL Man ager." (Mike, 11195 Englewood, Evansville IN)

de 9Q5GE: "The QSL Bureaus in Kinshash and Lubumbashi have been defunct for abou a year now. If I can help out in the Cong let me know. We can forward cards cheapl in the local mail." (Dr. Glen J. R. Eschruth Piper Memorial Hospital, Kapanga, via Lu bumbashi, Rep. Dem. du Congo)

de KZ5FX: "The callsign KZ5BBN o KZ5BB is being used by a station in the mari time mobile service. Canal Zone licenses ar valid for use only *within* the Panama Cana Zone, and this call has been invalid sinc April, 1967."

de K1DRN: "Here is a strange coincidence During the recent FG7TI/FS7—PJ5MM operation I received *identical* reports of 5/8 665 from each station. Both QSOs were wit the same operator, namely Joe, K9GCE. Thi is remarkable as over 1400 contacts wer made from FS7 and 3800 from PJ5 by 5 different operators. Yet out of this total o about 5200 QSOs I was #665 from each sta tion." (*The odds against this must be ver high, anybody care to figure them for us.— DX Ed.*)

de TU2BA: "From Nov. 18-24, 1968 we wil have an 'American Week' at the Hotel Ivoir in Abidjan. Displays of American foods and products will be featured. The Ivorian Radi Club will have an exhibit in the hotel lobby."

Comments on the PJ5MM—FG7TI/FS7 Operation
de Joe Poston, K9GCE

"First of all we would like to thank every one for the really tremendous cooperation in the pile-ups. During QSOs everyone stood by until we could exchange reports and contact

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he first photographs for publication in the U.S. from the PYØSP, PYØDX operation from St. Peter nd Paul Rocks. Left, PY7ACR and PY7AKW after installation of the DXpedition's commemorative laque. Center, PY7ACQ and PYØAOA, *et al* setting up the PYØDX operating position. Right, PY7ACQ kes a break during the operation. PY7ACQ advises that he is QSL Manager for PYØDX, and has nly received QSLs from 35% of the stations worked. *(What's with you rag chewers??? If you don't want a card from this one what are you waiting for?—DX Editor)*

mbers. The band was completely quiet ile each fellow gave his report, then when said 'QRZ Stateside', the S-meter flew to over 9.

'We also want to express our appreciation the large % of DXers who sent self-ad-ssed, stamped envelopes (s.a.s.e.) with ir QSLs. Only about 12-15 cards out of r 2000 were sent without s.a.s.e. All over-s cards were accompanied by I.R.C.'s, fre-ntly more than were necessary. Most Ls showed both report and contact num- which made it a breeze to find the con-t in the many pages of log.

'We had the times of our lives on Sint arten both before, during, and after the ntest. José, PJ2MI, and his friends ren-ed every measure of courteous assistance setting up and taking down the equipment l antennas. We used 3 transceivers, 2 ms, a vertical, and 2 dipoles in covering bands. The operators at PJ5MM were GCE, W9ZRX, W9AQW, and W9RHN. FG7TI/FS7 were PJ2MI and K9GCE.

'Jose, PJ2MI, made most all of the con-ts from the French side of the island, St. rtin. With his great ability as a contest erator plus speaking 5 different languages, made more DX contacts than everyone e combined. I assisted him for a short time d was able to work W's at a rate of 8/hour. You get writers cramp in a hurry ging them at that rate as there is no let-up.

'Dave, W9ZRX, plans to operate again m PJ5M during the *CQ* WW Contest in tober. He will be trying for a new world ord high score. I will return to FS7 at that e to try to work the many W's who were unable to contact us before.

"Anyone still needing a QSL send s.a.s.e. to Joe Poston, K9GCE, 309 Benton Drive, Indianapolis, Ind. 46227."

Contests in September

Some of the most important DX contests take place in September and offer a wonderful opportunity to work some unusual prefixes. The Phone weekend of the DARC Worked All Europe contest is the weekend of Sept. 14-15. Complete rules are in Frank's Contest Calender for July. The SAC c.w. contest is that same weekend while the SAC phone weekend is Sept. 21-22. The VU/4S7 contest weekends are Sept. 7-8 for c.w. and Sept. 14-15 for phone. There are a lot of conflicts the weekend of Sept. 14-15 which is unfortunate. Perhaps the schedule can be improved before next year.

QSL Information

AP5HQ—Fida, Radio Amateur Club, Signal Training Center, Kohat, West Pakistan.
CEØAJ—Via DL9KRA
CR3KD—To W2CTN
CR9AK—c/o CT1BH
CT2AA—Via WØOMN (NOT W2CTN)
EA8FE—P.O. Box 860, Las Palmas, Canary Islands, Spain
EIØRF—To EI2AW
EL2AG—c/o W4NJF
F2UT/FK8—Via R.E.F.
FK8AU—To VE3ACD
FO8BQ—c/o WA6MWG
FO8BY—Box 545, Papeete, Tahiti
FR7ZS—Box 130, St. Peter, Reunion Island
HA5KBP—Via DM5YHL

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HA5KBX–To DM5YHL
HS3TM–c/o K3LTV
KX6EN–Via W1MV
KZ5JO–To K1IYA
LH2A–c/o LA1HL
LJ2X–Via W4NJF
MP4BGU–To G3CAE
ON8VO–c/o W8BT (ex-W8PQQ)
OX3DX–Via OZ3FD
PYØDX–To PY7ACQ
PYØSP–c/o PY7AOA
SKØAL–Via SM5BGK
TG9RN–P.O. Box 892, Guatemala City
TI2CAP–To YV4QG
TT8AN–c/o W5LEF
TU2AZ–Box 8377, Abidjan, Ivory Coast
UA3KBO–Via DM5YHL, Reinhard G. Geissler, DDR-8239 SCHMIEDEBERG, Box 15, E. Germany
VK4EV–To VK3 Bureau
VK4ZK/VK9–c/o VK4ZK
VK9RJ–Via W6UJW
VP1LL–To VE3DLC
VP5AA–c/o W1WQC
VP5CB–Via K3NAU
VP5RS–R.C. Strong, c/o RCA/MTP, Ascension, Patrick AFB, Fla. 32925
VP7CC–see VP5RS
VP8JX–To GD3HQR
VQ8CC–c/o VQ8AZ
VR1LL–Via K6UJW
VR2DI–To VE6KT
VR2FF—c/o WA6NFI, 2437 Irma Way, Castro Valley, CA 94546
VR6TC–Tom Christan, P.O. Box 1, Pitcairn Island, South Pacific Ocean
VS5MH–Via VK6EZ
VS5RCS–c/o 9M2NF
WA4DOU/MM—Roy D. Lincoln, STG USS Charles P. Ware, FPO, New Yor N.Y. 09501
XW8BQ–To WA4ZTW
XW8CAL–Via VE6AO
YA2HWI–c/o W9FLJ
YS1XEE–To WB4BOJ
ZD8CC–see VP5RS
ZD8Z–c/o W6CUF
ZD9BE–Via W2GHK
ZL1TU–c/o WA6NFI
ZL5AA–To ZL2GX
ZS3XQ–Box 1100, Windhoek, Southwe Africa
ZS9Q–Box 45, Francistown, Botswana
4W1ADO–Via HB9ADO
5R8AF–To K7HCD
5U7AN–c/o W4WHF
7XØAH–Via VE3DLC
7Z3AB–To Paul Nance, W4YDD, PO Box Windy Hill Beach, S.C. 29597
8P6AH–c/o VE3DLC
8P6AY–Via W4OPM
9F3FMA–To W7WLL
9J2LK–P.O. Box 1928, Kitwe, Zambia
9K2BG–Box 5979, Kuwait
9K2BV–c/o W5EGR
9M2DQ—James C. Pershouse, Selana Esta Group, Serdang, Kedah, MALAYSIA
9M2US–Via W3GRS
9Q5EP–To VE3DLC
9Y4AT–c/o KV4AM
9Y4JR—Jack, P.O. Box 862, Port of Spai Trinidad
9Y4ZZ–Via WA5MYR, 1704 Glenn Driv Fort Worth, Texas 76131

73, John, K4I

"Can't stand large nets myself . . ."

". . . and I would appreciate it if you would not send me a QSL . . ."

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Propagation

BY GEORGE JACOBS,* W3ASK

UNDER the new, and improved computer-
l program used in preparing the *CQ* pagation forecasts, September is the one nth of the year in which both short-skip DX charts appear at the same time. The d for both sets of charts results from the rked seasonal change in propagation con- ons which generally takes place on the h frequency bands during September. The rt-skip charts appearing in this month's umn are valid through November 15, le the DX charts will be valid through ober 15, 1968.

During September a greater number of DX nings are expected during the daylight urs on 10, 15 and 20 meters, although these ds will close somewhat earlier than dur- the summer months. Improved nighttime propagation conditions are forecast for 80 and 160 meters, with considerably er static levels and with the bands remain- open somewhat longer than during the t few months.

V.H.F. Ionospheric Openings

With the present sunspot cycle at or near peak, there is a possibility that some ayer 6 meter openings between the USA l South America, South Africa and Aus- asia may take place during September. t time for these openings should be to- rds the end of the month, between the urs of noon and sundown, local time. There also a fair possibility that 6 meter trans- uatorial scatter openings may take place long north-south paths during the early ning hours.

Although the summertime Sporadic-E pagation season usually comes to an end ing September, some 6 meter short-skip enings are still likely to occur over dis- ces ranging between approximately 1000 l 1300 miles. Some v.h.f. ionospheric openings may also result from an increased level of auroral activity expected during September. Check the "Last Minute Forecast" appearing at the beginning of this column for periods that are forecast to be "disturbed" or "below normal" during the month, as these are the days on which auroral type openings are most likely to occur.

Meteor activity is generally at a very low level during September. No major showers

11307 Clara Street, Silver Spring, Md. 20902.

LAST MINUTE FORECAST

Day-to-Day Conditions and Quality for Sept. 1 through Oct. 15, 1968

Days	*Forecast Rating & Quality* (4)	(3)	(2)	(1)
Above Normal: **8, 11, 14, 19, 26,** 8, 10	A	A-B	B	B-C
Normal: **5, 7, 9-10, 12-13, 15, 18, 20, 22-25, 27-28,** 2, 5-7, 9, 11, 15	A-B	B	C	D
Below Normal: **1, 4, 6, 16-17, 21, 29,** 1, 3-4, 12-14	B-C	C-D	D	E
Disturbed: **2-3, 30**	C-D	D-E	E	E

HOW TO USE THESE CHARTS

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

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

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

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

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

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

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

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

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are expected and few meteor-scatter openings are likely to occur.

Sunspot Cycle

The Swiss Solar Observatory reports a mean sunspot number of 115 for June, 1967. This results in a smoothed sunspot number of 100, centered on December, 1967. According to *CQ's* method of predicting solar activity, the present cycle is very close to its maximum value and a smoothed sunspot number of 115 is predicted for September. Other sources estimate that maximum solar intensity has already occurred, and that the present cycle is now on the decline, wit smoothed sunspot number of between and 110 predicted for September.

CQ DX Contest Special

This year's *CQ* Worldwide DX Con will be held on the following dates:

October 26-27 Phone Section
November 23-24 C.w. Section

As has been the practice for the past years, next month's Propagation column be devoted to a special, comprehensive fo cast for the Contest periods.

Time Zone: EST (24-Hour Time)
Eastern USA To:

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

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

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

	10 Meters	15 Meters	20 Meters	40/80 Meters
stern entral rope & rth ica	08-10 (1) 10-12 (2) 12-13 (1)	07-09 (1) 09-11 (2) 11-13 (3) 13-15 (2) 15-16 (1)	05-06 (1) 06-08 (2) 08-12 (1) 12-15 (2) 15-18 (3) 18-22 (2) 22-02 (1)	17-19 (1) 19-22 (2) 22-00 (3) 00-01 (2) 01-02 (1) 20-22 (1)* 22-00 (2)* 00-01 (1)*
rthern rope & ropean SR	09-12 (1)	07-08 (1) 08-12 (2) 12-14 (1)	05-06 (1) 06-08 (2) 08-11 (1) 11-14 (2) 14-16 (3) 16-18 (2) 18-20 (1) 00-03 (1)	19-22 (1) 22-00 (2) 00-01 (1) 21-00 (1)*
stern diter- ean & ddle st	09-12 (1)	07-08 (1) 08-10 (2) 10-12 (3) 12-13 (2) 13-15 (1)	05-06 (1) 06-08 (2) 08-13 (1) 13-15 (2) 15-19 (3) 19-21 (2) 21-23 (3) 23-00 (2) 00-01 (1)	19-22 (1) 20-22 (1)*
st & ntral ica	09-11 (1) 11-13 (2) 13-15 (3) 15-16 (2) 16-17 (1)	06-09 (1) 09-12 (2) 12-14 (3) 14-16 (4) 16-17 (3) 17-19 (2) 19-20 (1)	04-07 (2) 07-14 (1) 14-16 (2) 16-18 (3) 18-20 (4) 20-22 (3) 22-01 (2) 01-04 (1)	19-22 (1) 22-00 (2) 00-01 (1) 22-00 (1)*
th ica	08-10 (1) 10-12 (2) 12-13 (1)	06-08 (1) 08-11 (2) 11-12 (3) 12-14 (4) 14-15 (3) 15-16 (2) 16-17 (1)	05-07 (2) 07-13 (1) 13-15 (2) 15-18 (3) 18-21 (2) 21-23 (3) 23-00 (2) 00-05 (1)	19-20 (1) 20-22 (2) 22-00 (1) 20-22 (1)*
t ica	10-12 (1) 12-15 (2) 15-16 (1)	08-09 (1) 09-12 (2) 12-16 (3) 16-17 (2) 17-18 (1)	12-14 (1) 14-16 (2) 16-19 (3) 19-22 (2) 22-00 (1)	20-23 (1)
ntral & th Asia	07-09 (1) 18-20 (2)	08-10 (1) 17-18 (1) 18-20 (2) 20-21 (1)	06-07 (1) 07-09 (2) 09-11 (1) 16-18 (1) 18-21 (2) 21-00 (1)	05-07 (1) 18-20 (1)
theast a	10-11 (1) 11-12 (2) 12-14 (1) 16-17 (1) 17-18 (2) 18-19 (1)	08-10 (1) 10-12 (2) 12-14 (1) 17-18 (1) 18-19 (2) 19-21 (1)	06-07 (1) 07-08 (2) 08-10 (3) 10-12 (2) 12-18 (1) 18-21 (2) 21-23 (1)	04-07 (1)
East	15-17 (1) 17-18 (2) 18-19 (1)	09-11 (1) 13-15 (1) 15-17 (2) 17-20 (3) 20-21 (2) 21-22 (1)	06-07 (1) 07-08 (2) 08-10 (3) 10-12 (2) 12-16 (1) 16-20 (2) 20-22 (1) 22-00 (2) 00-02 (1)	02-04 (1) 04-06 (2) 06-08 (1) 05-07 (1)*
th cific New land	10-14 (1) 14-16 (2) 16-18 (3) 18-19 (2) 19-21 (1)	08-12 (1) 12-16 (2) 16-18 (4) 18-20 (3) 20-22 (2) 22-00 (1)	03-07 (2) 07-10 (3) 10-12 (2) 12-17 (1) 17-19 (2) 19-21 (3) 21-23 (4) 23-03 (3)	23-00 (1) 00-06 (3) 06-07 (2) 07-08 (1) 01-03 (1)* 03-06 (2)* 06-07 (1)*
stralia	09-11 (1) 13-15 (1) 15-16 (2) 16-18 (3) 18-19 (2) 19-21 (1)	07-08 (1) 08-10 (2) 10-14 (1) 14-16 (3) 16-18 (2) 18-20 (3) 20-21 (2) 21-22 (1)	03-05 (2) 05-07 (1) 07-08 (2) 08-10 (3) 10-12 (2) 12-19 (1) 19-00 (2) 00-03 (3)	01-03 (1) 03-07 (2) 07-08 (1) 04-07 (1)*

Northern & Central South America	07-08 (1) 08-09 (2) 09-12 (3) 12-15 (4) 15-17 (2) 17-18 (1)	06-07 (1) 07-08 (2) 08-10 (4) 10-13 (3) 13-16 (4) 16-18 (3) 18-19 (2) 19-20 (1)	06-09 (4) 09-11 (3) 11-15 (2) 15-17 (3) 17-21 (4) 21-00 (3) 00-02 (2) 02-04 (1) 04-06 (2)	18-19 (1) 19-20 (2) 20-00 (3) 00-04 (4) 04-05 (3) 05-06 (2) 06-07 (1) 19-22 (1)* 22-04 (2)* 04-05 (1)*
Brazil, Argentina, Chile & Uruguay	07-08 (1) 08-12 (2) 12-14 (3) 14-16 (4) 16-17 (3) 17-18 (2) 18-19 (1)	05-06 (1) 06-07 (2) 07-10 (3) 10-14 (2) 14-15 (3) 15-18 (4) 18-19 (3) 19-21 (2) 21-23 (1)	08-15 (1) 15-17 (2) 17-19 (3) 19-23 (4) 23-02 (3) 02-05 (2) 05-07 (3) 07-08 (2)	20-23 (1) 23-03 (2) 03-05 (1) 00-04 (1)*
McMurdo Sound, Antarctica	16-19 (1)	10-15 (1) 15-18 (2) 18-19 (3) 19-21 (2) 21-22 (1)	16-18 (1) 18-20 (2) 20-02 (3) 02-04 (2) 04-06 (1) 06-08 (2) 08-09 (1)	23-06 (1)

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

	10 Meters	15 Meters	20 Meters	40/80 Meters
Western Europe & North Africa	08-11 (1)	07-08 (1) 08-12 (2) 12-14 (1) 21-23 (1)	05-06 (1) 06-09 (2) 09-11 (1) 11-13 (2) 13-16 (3) 16-18 (2) 18-20 (1) 22-00 (1)	19-20 (1) 20-22 (2) 22-23 (1) 20-22 (1)*
Central & Northern Europe & European USSR	*Nil*	07-08 (1) 08-10 (2) 10-12 (1) 21-23 (1)	05-06 (1) 06-08 (2) 08-11 (1) 11-16 (2) 16-18 (1) 20-22 (1)	19-23 (1)
Eastern Mediter- ranean & Middle East	08-10 (1)	07-08 (1) 08-10 (2) 10-11 (1) 19-21 (1)	04-06 (1) 06-09 (2) 09-13 (1) 13-15 (2) 15-18 (1) 18-21 (2) 21-22 (1)	19-22 (1)
West & Central Africa	09-11 (1) 11-14 (2) 14-16 (1)	07-10 (1) 10-12 (2) 12-14 (3) 14-16 (4) 16-17 (3) 17-18 (2) 18-19 (1)	00-06 (1) 06-08 (2) 08-13 (1) 13-15 (2) 15-17 (3) 17-19 (4) 19-22 (3) 22-00 (2)	20-23 (1)
East Africa	10-12 (1) 12-14 (2) 14-15 (1)	08-13 (1) 13-16 (2) 16-18 (1)	06-08 (1) 12-14 (1) 14-16 (2) 16-18 (3) 18-20 (2) 20-22 (1)	20-22 (1)
South Africa	08-09 (1) 09-11 (2) 11-13 (1)	06-08 (1) 08-11 (2) 11-13 (3) 13-15 (2) 15-16 (1)	00-06 (1) 06-08 (2) 08-12 (1) 12-15 (2) 15-19 (3) 19-00 (2)	18-21 (1)
Central & South Asia	08-10 (1) 16-18 (1)	07-10 (1) 15-16 (1) 16-18 (2) 18-20 (1)	06-07 (1) 07-10 (2) 10-12 (1) 16-18 (1) 18-21 (2) 21-00 (1)	05-07 (1) 18-20 (1)
Southeast Asia	08-09 (1) 09-10 (2) 10-11 (1) 15-16 (1) 16-17 (2) 17-18 (1)	08-09 (1) 09-11 (3) 11-15 (1) 15-17 (2) 17-20 (1)	02-06 (2) 06-08 (3) 08-11 (2) 11-13 (1) 20-21 (1) 21-23 (2) 23-02 (1)	02-05 (2) 02-05 (2) 05-07 (1)

e page 134 for New Reader Service

Far East	14 15 (1) 15-17 (2) 17-19 (1)	08-10 (1) 13-14 (1) 14-16 (2) 16-18 (3) 18-20 (2) 20-22 (1)	06-07 (2) 07-09 (4) 09-12 (3) 12-14 (2) 14-19 (1) 19-21 (2) 21-23 (3) 23-01 (2) 01-06 (1)	00-02 (1) 02-07 (2) 07-08 (1) 02-06 (1)*
South Pacific & New Zealand	10-12 (1) 12-14 (2) 14-17 (3) 17-19 (2) 19-21 (1)	06-08 (1) 08-10 (2) 10-12 (3) 12-16 (2) 16-18 (3) 18-20 (4) 20-22 (3) 22-00 (2) 00-01 (1)	05-06 (2) 06-08 (4) 08-10 (3) 10-12 (2) 12-16 (1) 16-18 (2) 18-20 (3) 20-00 (4) 00-02 (3) 02-04 (2) 04-05 (1)	21-22 (1) 22-05 (3) 05-07 (2) 22-01 (1)* 01-04 (2)* 04-06 (1)*
Australia	10-13 (1) 13-15 (2) 15-17 (3) 17-18 (2) 18-20 (1)	06-07 (1) 07-09 (3) 09-12 (2) 12-16 (1) 16-18 (2) 18-20 (3) 20-21 (2) 21-22 (1)	18-20 (1) 20-22 (2) 22-06 (3) 06-09 (4) 09-11 (3) 11-12 (2) 12-14 (1)	00-01 (1) 01-02 (2) 02-05 (3) 05-07 (2) 07-09 (1) 01-03 (1)* 03-05 (2)* 05-06 (1)*
Northern & Central South America	07-09 (1) 09-11 (3) 11-13 (4) 13-15 (3) 15-16 (2) 16-17 (1)	06-07 (1) 07-09 (3) 09-11 (2) 11-14 (3) 14-16 (4) 16-18 (3) 18-19 (2) 19-20 (1)	05-07 (4) 07-09 (3) 09-14 (2) 14-16 (3) 16-22 (4) 22-00 (3) 00-05 (2)	18-20 (1) 20-01 (3) 01-03 (2) 03-06 (1) 19-21 (1)* 21-02 (2)* 02-04 (1)*
Brazil, Argentina, Chile & Uruguay	06-08 (1) 08-11 (2) 11-13 (3) 13-15 (4) 15-16 (3) 16-17 (2) 17-18 (1)	05-06 (1) 06-08 (2) 08-12 (1) 12-14 (2) 14-15 (3) 15-18 (4) 18-19 (3) 19-20 (2) 20-22 (1)	05-14 (1) 14-16 (2) 16-18 (3) 18-22 (4) 22-02 (3) 02-05 (2)	20-23 (1) 23-01 (2) 01-03 (1) 23-02 (1)*
McMurdo Sound, Antarctica	16-18 (1)	10-14 (1) 14-17 (2) 17-19 (3) 19-20 (2) 20-21 (1)	07-09 (1) 16-18 (1) 18-19 (2) 19-21 (3) 21-23 (4) 23-03 (3) 03-07 (2)	00-05 (1)

CQ Short-Skip Propagation Chart

SEPTEMBER 15 - NOVEMBER 15, 1968

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

Distance From Transmitter (Miles)

Band (Meters)	50-250	250-750	750-1300	1300-2300
10	*Nil*	09-15 (0-1)	07-09 (1) 09-11 (1-2) 11-13 (1-3) 13-15 (1-4) 15-17 (0-3) 17-18 (0-2) 18-21 (0-1)	07-08 (1-2) 08-09 (1-3) 09-13 (3-4) 13-15 (4) 15-17 (3) 17-18 (2) 18-21 (1)
15	*Nil*	07-09 (0-1) 09-12 (0-2) 12-14 (0-3) 14-16 (0-2) 16-21 (0-1)	07-09 (1-2) 09-12 (2-4) 12-14 (3-4) 14-16 (2-4) 16-19 (1-3) 19-21 (1-2) 21-07 (0-1)	09-16 (4) 16-19 (3-4) 19-21 (2-3) 21-00 (1) 00-07 (1-0)
20	11-13 (0-1) 13-16 (0-2) 16-21 (0-1)	07-09 (0-3) 09-11 (0-4) 11-16 (2-4) 16-21 (1-3) 21-02 (0-2) 02-07 (0-1)	07-09 (3-4) 09-16 (4) 16-21 (3-4) 21-00 (2-3) 00-02 (2) 02-07 (1)	07-09 (4) 09-15 (4-3) 15-21 (4) 21-23 (3-4) 23-00 (3) 00-02 (2) 02-07 (1-2)
40	07-09 (2-3) 09-18 (4) 18-20 (3-4) 20-22 (2) 22-05 (1) 05-07 (1-2)	07-09 (3-4) 09-11 (4-3) 11-15 (4-2) 15-17 (4-3) 17-20 (4) 20-22 (2-4) 22-00 (1-4) 00-05 (1-3) 05-07 (2-3)	07-09 (4-2) 09-11 (3-1) 11-15 (2-1) 15-17 (3-2) 17-20 (4-3) 20-00 (4) 00-06 (3-4) 06-07 (3)	07-09 (09-15 (15-17 (17-19 (19-20 (20-06 (06-07 (
80	06-11 (4) 11-18 (4-3) 18-23 (4) 23-06 (3-4)	06-08 (4-2) 08-11 (4-1) 11-16 (3-1) 16-18 (3-2) 18-06 (4)	06-08 (2-1) 08-16 (1-0) 16-18 (2-1) 18-21 (4-2) 21-03 (4) 03-05 (4-3) 05-06 (4-2)	06-08 (08-16 (16-18 (18-21 (21-03 (03-05 (05-06 (
160	16-18 (1-0) 18-20 (2-1) 20-05 (4) 05-07 (3-2) 07-09 (2-1) 09-11 (1-0)	17-19 (1-0) 19-20 (1) 20-02 (4-3) 02-05 (3-2) 05-07 (2-1) 07-09 (1-0)	19-20 (1-0) 20-22 (3-1) 22-02 (3) 02-05 (2-1) 05-07 (1)	20-22 (22-02 (02-05 (05-07 (

OPENINGS GIVEN IN HAWAIIAN STANDARD TI

To:	*10 Meters*	*15 Meters*	*20 Meters*	*40/8 Mete*
Eastern USA	06-08 (1) 08-12 (2) 12-14 (3) 14-16 (2) 16-17 (1)	05-06 (1) 06-08 (2) 08-12 (1) 12-16 (2) 16-18 (3) 18-20 (2) 20-22 (1)	11-14 (1) 14-16 (2) 16-18 (3) 18-21 (4) 21-00 (3) 00-04 (2) 04-06 (3) 06-07 (2) 07-08 (1)	18-20 20-23 23-00 00-01 01-02 20-22 22-00 00-01
Central USA	06-08 (1) 08-11 (2) 11-14 (4) 14-16 (2) 16-17 (1)	05-06 (1) 06-08 (2) 08-10 (1) 10-12 (2) 12-14 (3) 14-16 (4) 16-18 (3) 18-20 (2) 20-22 (1)	09-14 (1) 14-16 (2) 16-18 (3) 18-22 (4) 22-00 (3) 00-04 (2) 04-06 (3) 06-09 (2)	18-20 20-22 22-01 01-03 03-04 21-22 22-00 00-02
Western USA	07-09 (1) 09-11 (2) 11-14 (4) 14-16 (3) 16-18 (2) 18-19 (1)	06-07 (1) 07-09 (2) 09-14 (3) 14-17 (4) 17-19 (3) 19-22 (2) 22-00 (1)	10-15 (2) 15-17 (3) 17-19 (4) 19-00 (3) 00-02 (2) 02-04 (1) 04-06 (2) 06-08 (4) 08-10 (3)	18-19 19-20 20-02 02-04 04-05 05-06 21-22 22-23 23-02 02-03 03-04

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

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

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

[*Continued on page 117*]

See page 134 for New Reader Se

VHF TODAY

BY ALLEN KATZ,* K2UYH

THE v.h.f. transistor revolution has been
th us for more than 5 years now, yet some us still think about getting 417A's on 2 eters. As was shown last month, you do not ally lose that much using a tube like the re- und 417A on 144 mc, but this is the space e[1]! Why fly prop when you can take a jet so sily. On the higher bands this kind of think- g can hurt.

The state of the art is transistor today as ure 1 clearly shows. This graph plots noise ure (NF) of various preamplifing devices vailable to amateurs) versus frequency. In s respect the data is conservative. For in- nce on 1296 mc, there are transistors with easured NF's better then 3 db. But just try d get your hands on them. Likewise there e parametric amplifiers which get down be- v 1 db NF; but without liguide nitrogen oling a noise figure this low is quite un- ely.

From this data and the discussion in last onth's column we can make some conclu- ns as to what type of preamplifier to use on iven v.h.f. band. On 50 mc it does not mat- NF wise which type of amplifier you use. oss-modulation (over load) and reliability oblems will not be considered this month, ffice to say that field effect transistors look od in this department.

On 144 and 220 mc the story is pretty uch the same. Here on a quiet night a choice nsistor can pay off, with largest dividends 220 mc.

By 432 mc, the sky noise has dropped to a v enough level that the two conditions of restrial and moonbounce—satellite com- unications should be considered separately. r both types of operation there is little contest between the vacuum tube and the transistor, the transistor is significantly superior, and as good a transistor as you can get your hands on will be worthwhile. For space communications the question arises of the advantage of paramp over a transistor. On 432 mc (in our opinion) there is little if any advantage in using a paramp rather then a transamp. The construction of a paramp, however, can be quite interesting from an experimental point of view.

On 1296 mc the transistor has only recently come into its own[2]. The transistor is definitely superior to the diode mixer. Though the recently developed hot carrier diode mixers supposedly will develop a NF of better than 5 db, we have yet to see an amateur built mixer (balanced or otherwise) with a NF better then 7 db. In most cases they run 10 db or worse. To overcome typical mixer noise two stages of transistor amplification are needed. For terrestrial paths there is still a noticeable difference in going to a paramp on 1296 mc, however the difference is small and the transamp NF's obtained are better than many amateurs have using tubes on lower v.h.f. bands. For space communication because of the low sky temperature the parametric amplifiers advantage becomes even greater. But even under these circumstances, we would not recommend the construction of a paramp unless you're prepared to do the job right with a crystal controlled pump. Incidentally there is a definite advantage to running a paramp into a transistor amplifier—

[2] Katz, A., "A 1296-Mc. Preamplifier – That works!" *QST* Nov. 1967, p. 32.

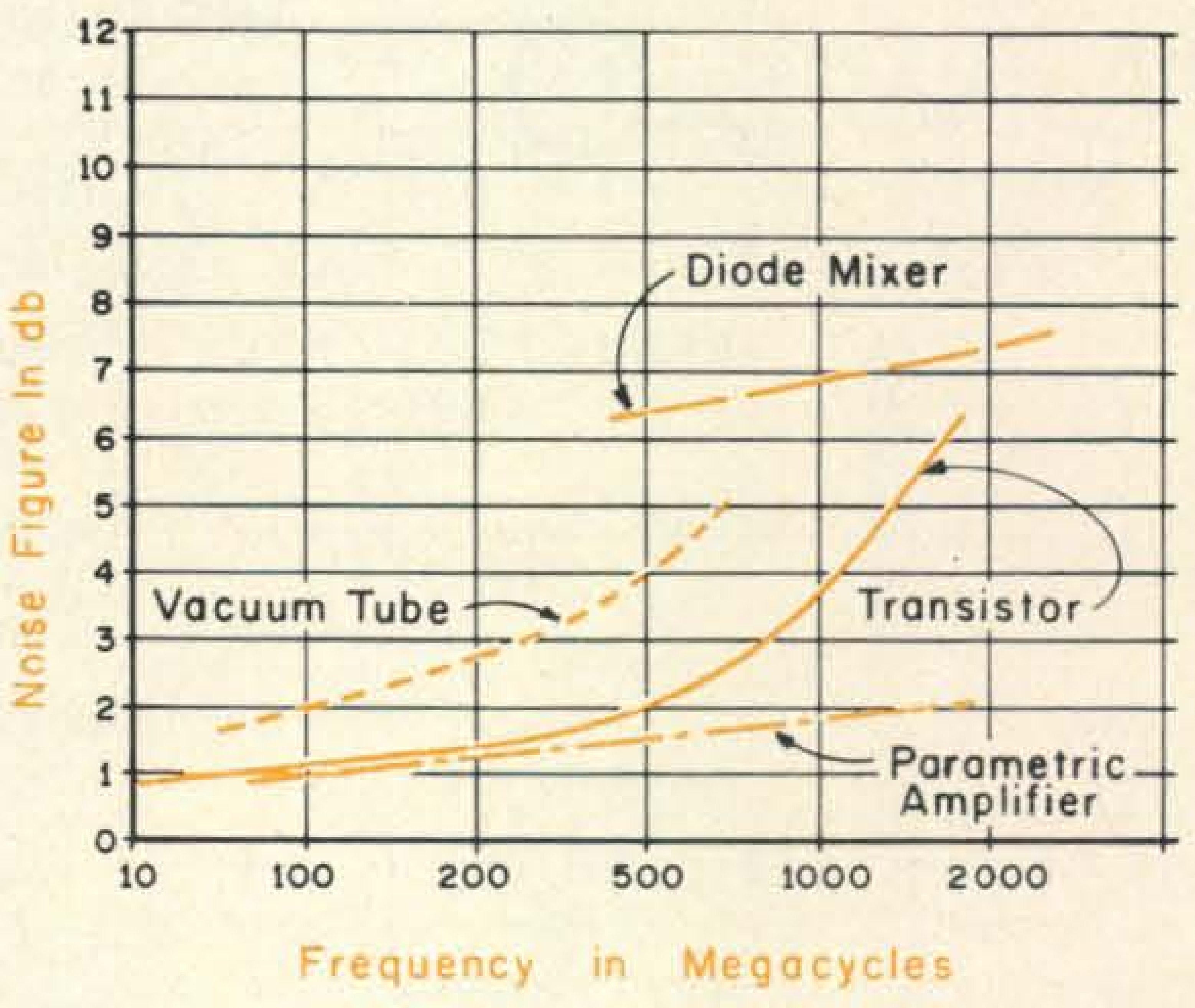

Fig. 1—The noise figure of various amplifiers available to amateurs.

*48 Cumberland Ave., Verona, New Jersey 07462.
[1] Katz, A., "VHF Today" *CQ* Aug. 1968.

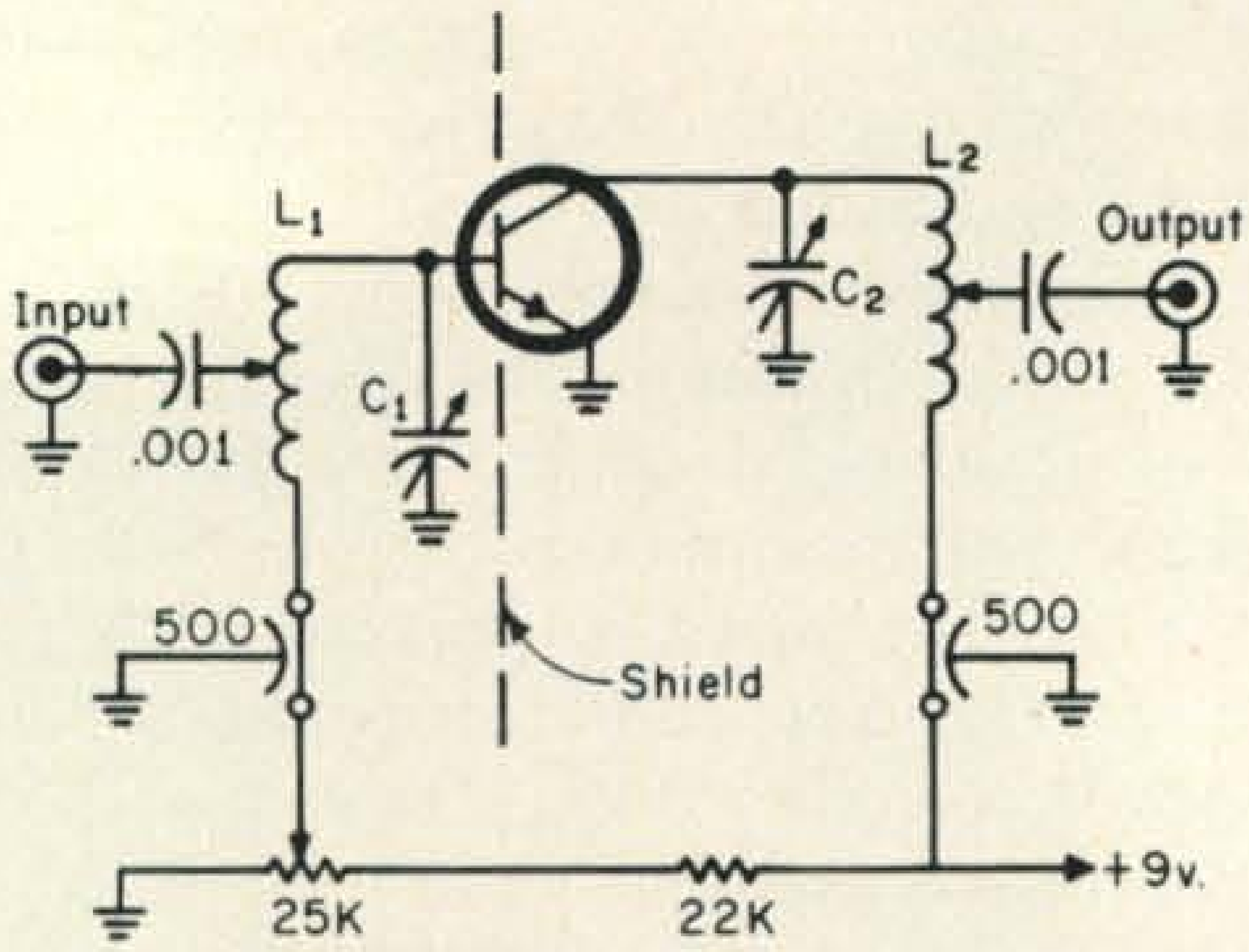

Fig. 2—A low noise 432 mc transistor amplifier using a K5000.

L_1—1½" hair pin coil of # 16 tinned copper wire tapped ¾ of the way up from cold end.
L_2—Same as L_1 except tapped ¼ of the way up.
$C_{1\cdot 2}$—1-15 mmf tubular plastic trimmer.

this allowing you to run the paramp at a lower gain level.

We have said a lot about transistor amplifier, but not much about the transistors themselves. On two and six meters there is a wide choice of low price, low noise transistors. On 220 you have to be a little more selective, but there are still plenty of good low priced transistors which will work on this band. On 432 mc where low NF really pays off transistor acquisition becomes a little sticky. The TIXMO5 (50¢) which was a happy accident

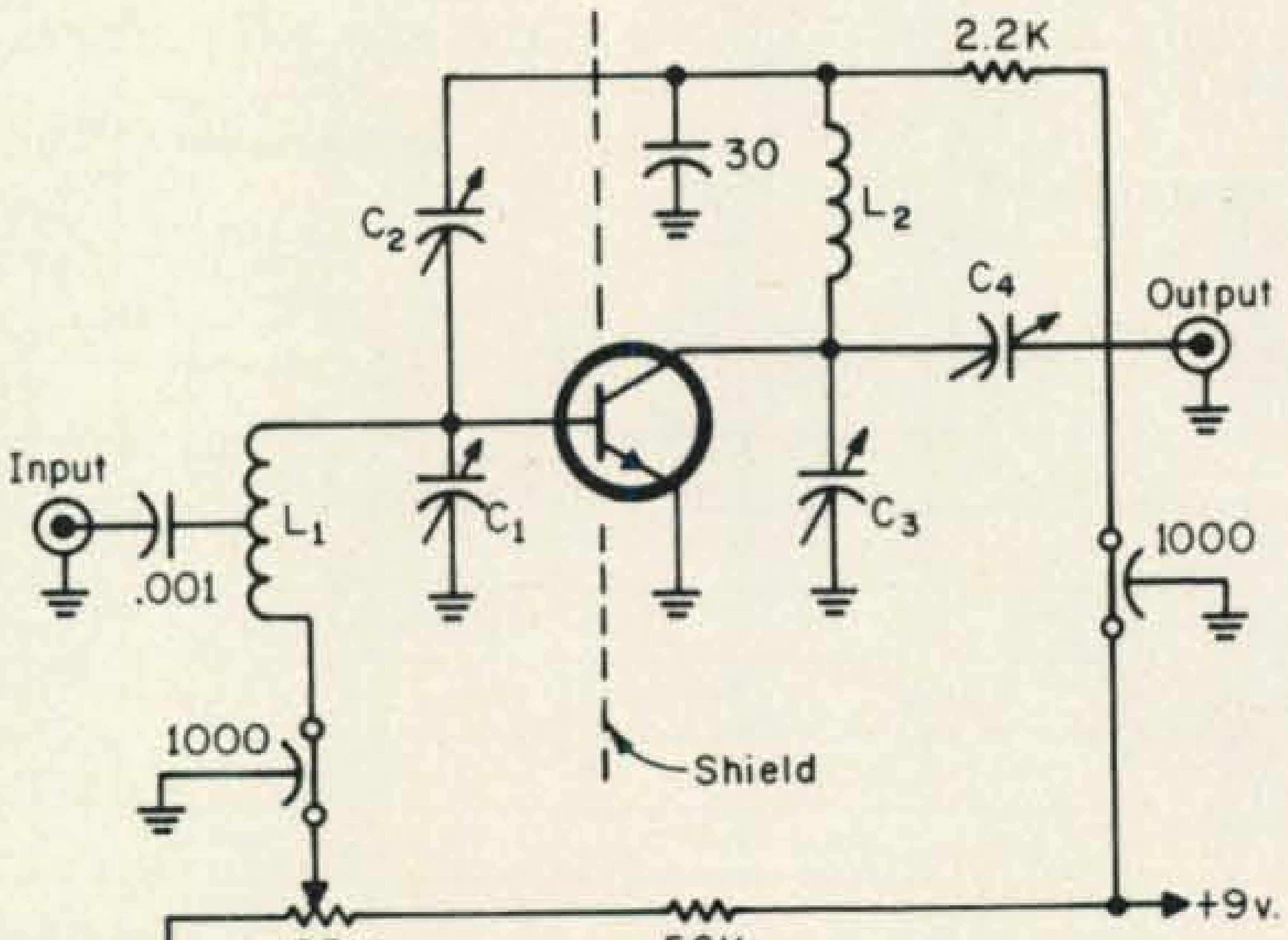

Fig. 3—A low noise 144 mc transistor amplifier using a K5000.

L_1—5 turns #16 tinned copper wire, ⅜" dia., tapped 3½ turns up from cold end.
L_2—4 turns #16 tinned copper wire, ⅜" dia.
$C_{1,3}$—15 mf tubular plastic trimmer.
C_2—8 mf mica trimmer.
C_4—15 mf pica trimmer.

as far as amateurs are concerned (2.8db N
is no longer available. On 1296 mc there
only two companies with usable transist
in general production; these are Texas Inst
ments and KMC semiconductors. The pr
of these transistors are above what most of
could afford to pay. Fortunately a group
amateurs at KMC have gotten together
make available to amateurs out of spec
low noise transistors. This group is sell
K5000 transistors which will produce a
around 3 db at 432 mc for 5 dollars
K5200 transitors which will produce a 5
NF or better and 12 db of gain on 1296
for 10 dollars[3].

There have been numerous circuits pu
lished of v.h.f. transistorized amplifiers,
these we add the following two circuits. F
ure 3 shows a 144 mc amplifier and figur
shows a 432 mc amplifier. The circuits are
good NF wise as any and are designed for
above mentioned K5000's. The comm
emitter configuration is used in both circu
which because of its degenerative feedba
produces lower gain then the common b
configuration, but also lower noise figure.
cause of this feedback no neutralization
required of the 432 mc amplifier. Both am
fiers can be built in standard mini boxes w
a small piece of copper flashing used to shi
the base from the collector section. Tun
and taps of the base and collector circ
should be adjusted for maximum gain and
bias set for a collector current of about
ma—this level produces minimum NF w
K5000's. The maximum gain coil tap
sitions are very close to those for minim
noise figure. Slightly better NF can be
tained by readjusting the base coil tap
minimum detectable signal.

That's the column for this month.

73, Allen Katz—K2U

[3] For Information write: Samuel G. Nel
W2MHK, Reaville Associates, RFD 1, Box
Flemington, N.J. 08822.

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Q AND A

BY WILFRED M. SCHERER,* W2AEF

Voltage-Variable Diode Capacitors

In a recent article describing the use of a voltage-variable diode capacitor for shifting the frequency of a v.f.o., it was stated that the reverse bias should be held low to maximize the capacitance change, but no mention was made of the limitations imposed by the presence of an r.f. signal. Several readers noted this point, or lack of it, and were somewhat concerned as to the possibility of the r.f. signal causing rectification in the diode and forward biasing it into conduction, thus rendering it useless as a capacitor.

For those who may have wondered about such a situation or who may contemplate the use of one of these devices, we'll discuss some of the operating requirements related to variable-voltage diode capacitors.

A detailed description of how the voltage-variable diode capacitors function will not be given at this time, except to mention that solid-state diodes will function as a capacitor when they are reverse-biased into non-conduction. (Special silicon types are specifically designed for this application.) The capacitance depends on the magnitude of the reverse bias, so the diode can be made to perform as a *variable* capacitor controlled by a variable voltage. Typical circuitry is shown in fig. 1.

The degree or range of capacitance change with these diodes is by a greater percentage-per-volt of bias at potentials below about 5 volts than it is at higher values. Also, the capacitance increases as the bias voltage is lowered. Thus, the use of low bias voltages cause the maximum capacitance variation and provide the widest tuning range of the circuit involved.

When these values are chosen for a particular application, another factor must be taken into consideration. This is that the bias voltage must not be low enough to allow the signal voltage to drive the capacitor diode into conduction (at least not by more than a few tenths of a volt in the forward-bias direction), as this will result in clipping of the signal and creating a self-bias that may alter the capacitance or cause non-linear effects.

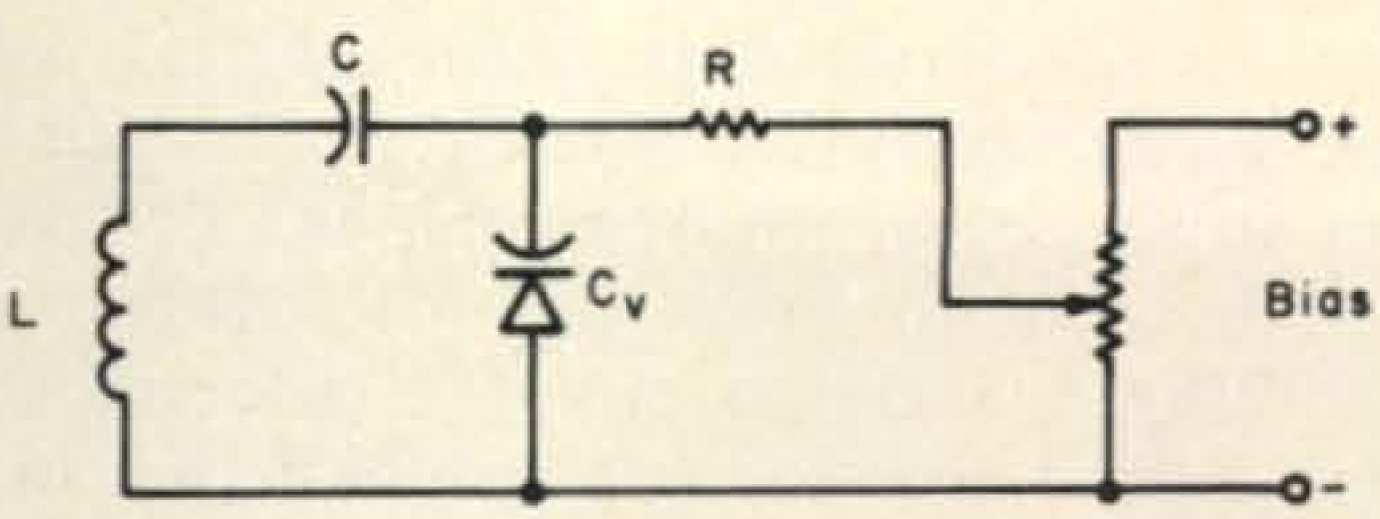

Fig. 1—Basic setup for tuning a circuit with a voltage-variable capacitor diode. *C* is a d.c. blocking capacitor, *R* isolates the signal energy from the bias source. *R* may have a value as high as several megohms.

Therefore, in order to avoid these possiblities, the peak-to-peak signal voltage must not be allowed to exceed the bias voltage. In addition, the sum of the bias voltage and that of the peak signal should not exceed the maximum voltage rating for the diode.

The effect that the capacitance variation has on changing the resonant frequency of the circuit depends on the ratio of the variable-capacitance diode to the d.c. blocking capacitor and the ratio of this combination to any other circuit capacitances. Where a suitable capacitance variation or relationship cannot be obtained with the diode capacitor because of bias limitations imposed by the signal level, these ratios must therefore be altered accordingly.

On the other hand, difficulties due to high signal voltages may be avoided by using the scheme shown in fig. 2. Here, two diode

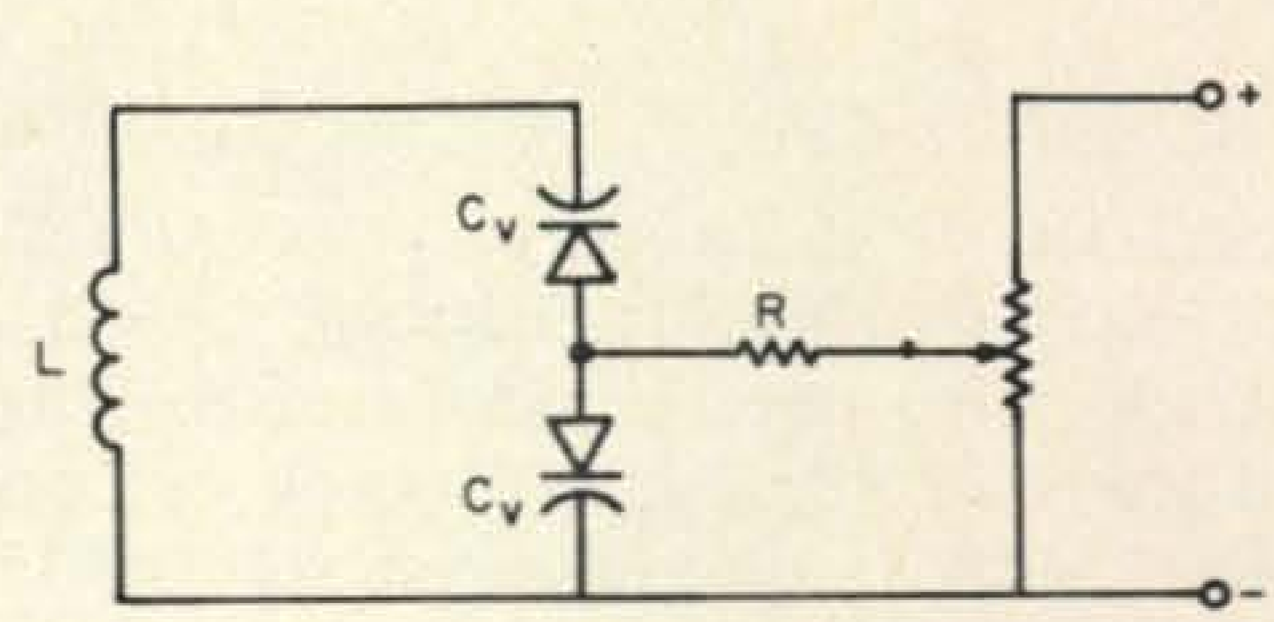

Fig. 2—Two capacitor diodes used in this back-to-back configuration avoid diode conduction or self-bias by signal levels higher than the control bias. A d.c. blocking capacitor is not needed.

* Technical Director, *CQ*.

capacitors are connected back-to-back, so they are in series opposition and no self-biasing can take place. Even zero bias can be used in the presence of signal, as can a forward bias up to about 0.3 volts. However, this setup incurs the price of reducing the total capacitance to only one-half that of a single diode.

In cases where the capacitor diodes are used in critical circuits, as in a v.f.o., the temperature effects on the diode capacitance also must be taken into account. While with some type units these effects might be negligible, with others the response to temperature may become significant, particularly with low bias voltages. This may be ascertained by reference to the specifications for the particular unit. It also should be noted that the Q of these devices increases as the bias is raised.

Use of the voltage-variable capacitor diodes in amateur gear has been mostly limited to shifting v.f.o. frequencies, although we have run across a situation where they were used for tuning r.f. circuits in a receiver. Another application is that for a sweep oscillator such as may be used in a sweep generator or a pandapter.[1]

For such use, additional concern is that of sweep linearity which is dependent on the ratio of capacitance change to the total circuit capacitance over the desired sweep-frequency range. This in turn is related to the change in the diode capacitance *v.s.* the bias voltage. The curve for this characteristic is non-linear with respect to the percentage of bias voltage, but it does not necessarily have to be linear to produce a linear sweep frequency.

The proper operating point for the capacitor diode for obtaining the required ratios therefore must be calculated with reference to the published response curve or by experimentation.

Identifying PNP and NPN Type Transistors

QUESTION: Is there any easy way of telling which are PNP or NPN transistors?

ANSWER: The determination of whether a transistor is a PNP or an NPN type may easily be made with an ohmmeter as follows (also refer to fig. 3):

[1] *A general discussion on applications*, including use as Varactor multipliers for v.h.f., may be found under the title of "Practical Uses of Voltage Variable Capacitors," by J.J. Schultz, *CQ* '67, page 81.

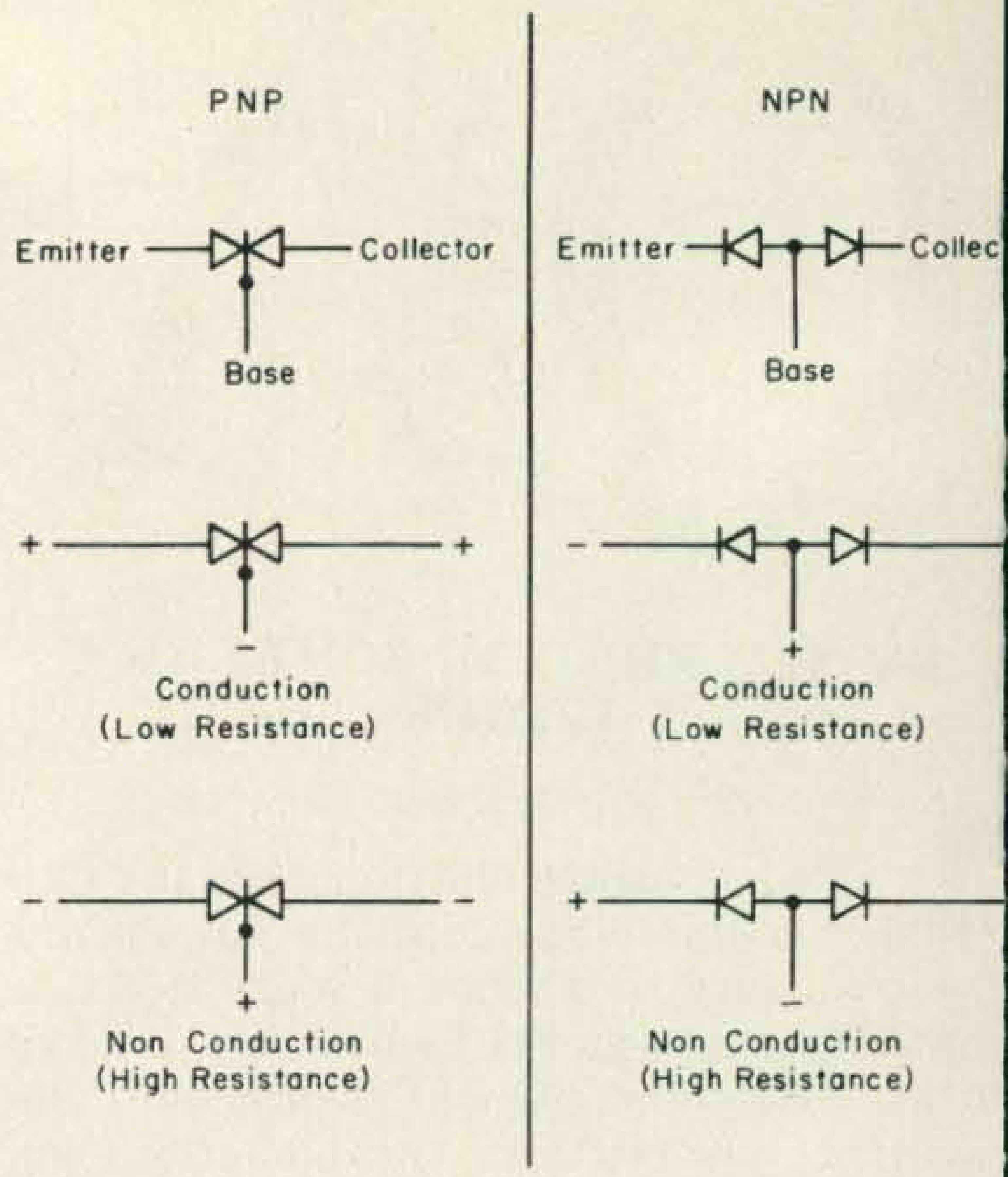

Fig. 3—Ohmmeter readings and polarity for determining PNP or NPN-type transistors. The makeup of a transistor is like back-to-back diodes as indicated at the top row.

If conduction (low resistance) is indicated when the *negative* side of the ohmmeter is connected to the *base* and the positive to either the emitter or collector, the transistor is a PNP type.

Conversely, if conduction (low resistance) is indicated when the *positive* side of the ohmmeter is connected to the base and the negative to either the emitter or collector, the transistor is an NPN type.

Reversing the polarity in either of the above cases should show non-conduction (very high resistance). A high resistance also should be indicated between the emitter and collector, regardless of the meter polarity. If any of the "high"-resistance readings fall between a high and low value or tend to drift, there is excessive leakage.

If no reading or a short is indicated between the base and other elements regardless of meter polarity, the transistor is either open or short-circuited as the case may be.

In making the tests, be sure the polarity of the ohmmeter is correct. On some v.o.m.'s the ohmmeter polarity is opposite that of the voltmeter section. Therefore, check the ohmmeter polarity with another voltmeter.

Before using either a v.o.m. or v.t.v.m. for these measurements, check the current

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through the ohmmeter probes when shorted together, using another meter. Some ohmmeter circuits (particularly on low ranges) have a short-circuit current of a few hundred milliamperes more than enough to destroy most receiving-type transistors. Should your ohmmeter prove to be this type, check the higher ranges for their operating current (usually much less). In this application, the higher resistance ranges are quite suitable for polarity checks.

R.F. Connections for Heath IO-12 Oscilloscope

QUESTION: I should like to convert my Heathkit IO-12 scope for use as a modulation monitor. In order to insert the signal directly to the vertical plates, would anything other than a patching arrangement or switch to break the leads from V_3 and insert the r.f. signal be needed?

ANSWER: The r.f. signal should be fed directly to the vertical-deflection plates through d.c. blocking capacitors. The vertical amplifier should be left connected to these plates in order to properly center the spot; however, the r.f. must be isolated from the amplifier, using either 100K to 1 meg resistors or 2.5 mh r.f. choke inserted in series with the amplifier leads. This should be done right at the c.r.t. socket terminals. R.f.-carrying leads inside the scope should be shielded. This will alter the normal 5 mc vertical response, but it may be restored by shorting out the resistors or chokes. Circuitry with the necessary switching is shown at fig. 4.

If the display is distorted or fuzzy, similarly install isolation resistors or chokes at the horizontal-deflection plate socket terminals to prevent stray r.f. leakage into the horizontal circuits.

73, Bill, W2AEF

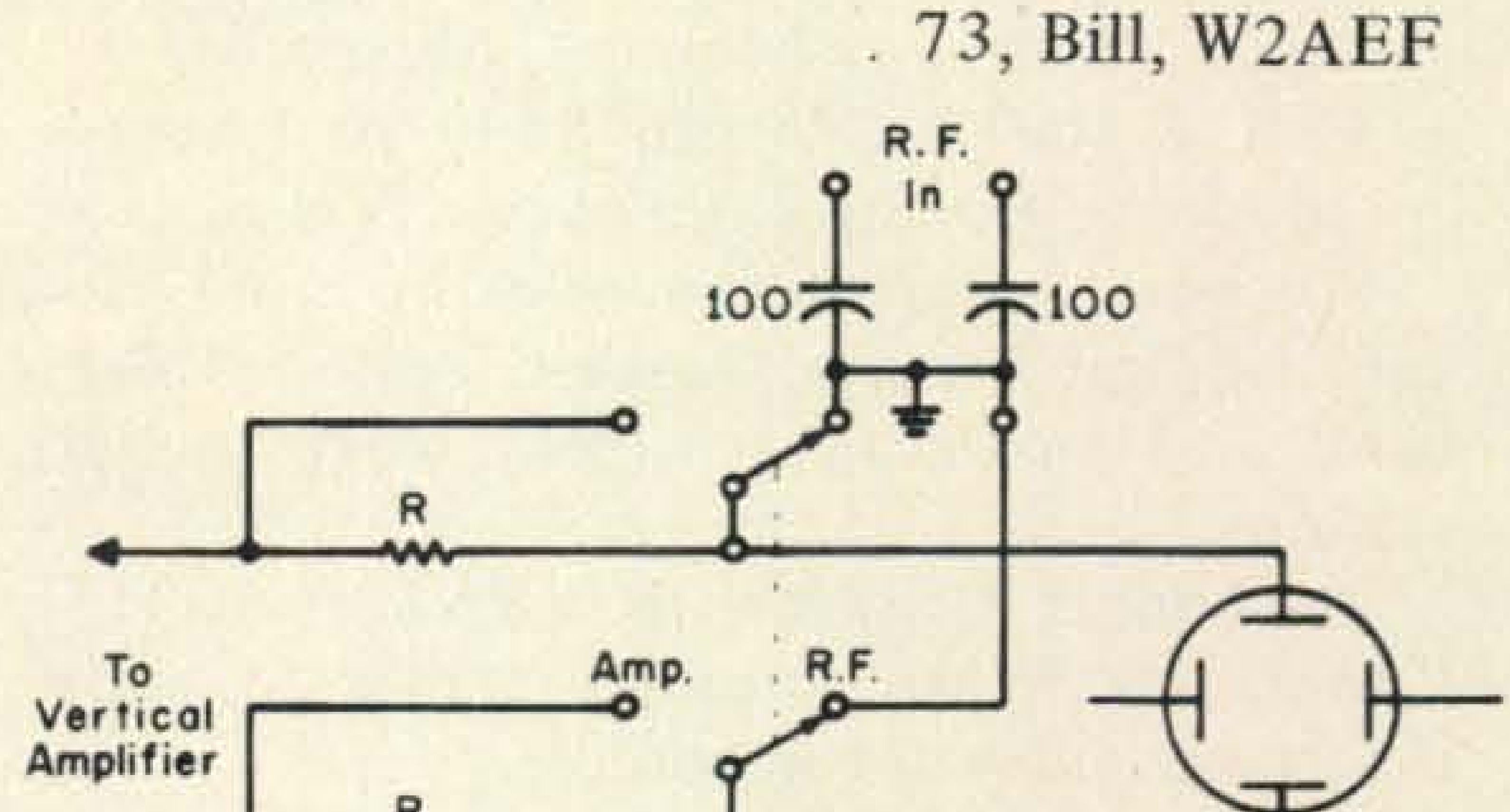

Fig. 4—Oscilloscope modification for application of r.f. directly to vertical-deflection plates. *R* is inserted in series with existing leads from vertical amplifier and may be 100 K to 1 Meg or 2.5 mh r.f.c. See text for other details.

Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

September	7-9	Wash. State QSO Party
September	7-8	VU2/4S7 C.W. Contest
September	14-15	VU2/4S7 Phone Contest
September	14-15	DARC WAE Phone Contest
September	14-15	ZERO District QSO Party
September	14-15	SAC C.W. Contest
September	21-22	SAC Phone Contest
September	21-23	Pennsylvania QSO Party
September	26-28	YLRL Howdy Days
October	1-31	Floridora Contest
October	5-7	California QSO Party
October	5-6	Massachusetts QSO Party
October	5-6	C.A.R.T.G. (RTTY) Contest
October	5-6	VK/ZL/Oceania Phone
October	12-13	VK/ZL/Oceania C.W.
October	12-13	RSGB 28 mc Phone Contest
October	16-17	YLRL Anniv. C.W. Party
October	19-20	Boy Scout Jamboree
October	19-20	WADM C.W. Contest
October	**26-27**	**CQ WW DX Phone Contest**
October	26-27	RSGB 7 mc C.W. Contest
November	2-3	Okinawa (KR6) Contest
November	6-7	YLRL Anniv. Phone Party
November	9-10	OK C.W. DX Contest
November	9-10	RSGB 7 mc Phone Contest
November	9-11	ARRL SS Phone Contest
November	16-18	ARRL SS C.W. Contest
November	**23-24**	**CQ WW DX C.W. Contest**
December	7-8	CHC International C.W.
December	14-15	CHC International S.S.B.

Wash. State QSO Party

Starts: 2300 GMT Saturday, September 7
Ends: 0500 GMT Monday, September 9

This is the 3rd Wash. State party sponsored by the Boeing Employees' A.R.S.

All bands and modes may be used, and each station may be worked once on each band and mode. (Wash. may work in state stations.)

Exchange: QSO nr., RS/RST and QTH. County for Wash. stations, and state, province or country for all others.

Scoring: Wash. stations score 1 point per QSO, multiply by total of states, VE provinces and countries worked. Others score 2 points per QSO and multiply total by number of Wash. countries worked. (Max. of 39.)

Frequencies: CW–3560, 7060, 14060, 21060, 28100. AM—3990, 7260, 14230, 21310, 28600. SSB—3960, 7220, 14290, 21290, 28700. Novices—3735, 7175, 21110.

Awards: Certificates to the top scorers in each state, province, country and Wash. county.

The "Five Bears" certificate is also available to those working five club members before, during or after the contest. A gold seal endorsement goes on your certificate if you work club station K7NWS.

Logs must show date/time in GMT, station worked, exchange sent/received, band and mode, and claimed score.

Mailing deadline is October 5th and logs go to: Boeing Employees' A.R.S., Att: Contest Chairman K7RSB, 18415 38th Avenue South, Seattle, Washington 98188.

VU2/4S7 DX Contest

C.W.–Sept. 7-8 **Phone**–Sept. 14-15
Starts: 0600 GMT Saturday,
Ends: 0600 GMT Sunday
in each instance.

Rules for this one were covered in last month's CALENDAR. Mailing deadline is October 15th and logs go to: ARSI Contest Committee, Post Box 534, New Delhi 1 India.

DARC WAE Phone Contest

Starts: 0000 GMT Saturday, September 14
Ends: 2400 GMT Sunday, September 15

The c.w. section of this contest was run off last month. Rules were published in the July issue. Mailing deadline for c.w. logs is Sept. 15th and Oct. 15th for the phone. Logs go to: Walter Skudlarek, DJ6QT, An der Klostermauer 3, D-6471 Hirzenhain, West Germany.

SAC DX Contest

C.W.–Sept. 14-15 **Phone**–Sept. 21-22
Starts: 1500 GMT Saturday,
Ends: 1800 GMT Sunday
in each instance.

* 14 Sherwood Road, Stamford, Conn. 06905.

See page 134 for New Reader Service

Rules for this interesting European contest appeared in last month's CALENDAR. Mailing deadline October 15th, logs go to: SSA Contest Manager, Karl O. Friden, SM7ID, Valhall 26200, Angelholm, Sweden

ZERO District QSO Party

Two Periods (GMT)
0100-0500 Saturday, September 14
2300 Saturday, September 14 to
0300 Monday, September 16

This 3rd annual party is sponsored by the Theodore Roosevelt High School ARC. All bands and modes may be used and the same station worked once per band and mode.

Exchange: QSO nr., RS/RST and QTH. County and state for ZERO stations, state, province or country for all others.

Scoring: Each contact is worth 1 point. ZERO stations use states, provinces and countries for their multiplier. (Including ∅ districts states) All others, ZERO district states (max. of 8) plus ZERO district counties. (max of 682)

Frequencies: 1815, 3575, 3950, 7075, 7230, 14075, 14300, 21075, 21290, 28600 and v.h.f./u.h.f. bands. Novices—3720, 7165, 21110.

Awards: 1st and 2nd place certificates in each state, province and country. And to the top scorer in each ZERO district county.

Mailing deadline is October 14th. Logs go to: Roosevelt H.S., ARC, c/o Jeff Schwartz, 648—56th Street, Des Moines, Iowa 50312. Include s.a.s.e. for results.

Pennsylvania QSO Party

Starts: 2300 GMT Saturday, September 21
Ends: 0300 GMT Monday, September 23

This is the 11th annual party sponsored by the Nittany ARC. Each station may be worked once per band and mode.

Exchange: QSO nr., RS/RST and QTH. County for Penn. stations ARRL section or country for others.

Scoring: Penn. stations, 3 points per out of state QSO 1 point for Penn. contacts. Out of state 1 point for each Penn. QSO. Penn. stations use ARRL sections and countries for their multiplier. Others will use Penn. counties. (Max of 67

Frequencies: 3575, 3880, 7075, 7280, 14075, 14280, 21075, 21325. Check phone bands on even GMT hours. Look for portables from rare spots.

Log data: Date/time in GMT, QSO nr., station, report sent/received, QTH, band and mode.

Awards: Certificates to stop station in each ARRL section and country, 2nd and 3rd place where justified. The latest U.S. call book to the highest scoring Penn. and out of state stations. Multi-operator stations are a separate category and NARC members not eligible for any awards.

Mailing deadline is Oct. 21st and logs go to: Nittany ARC, P.O. Box 60, State College, Penna. 16801.

YLRL "Howdy Days"

Starts: 1800 GMT Thursday, September 26
Ends: 1800 GMT Saturday, September 28

Scores will be based on contacts with licensed women operators only. All bands and modes may be used, but only one contact with each station is permitted. Cross-band and net contacts do not count.

Scoring: Score 2 points for each YLRL member worked, 1 point for each non-member. There is no multiplier.

Awards: Top scoring YLRL member will receive her choice of a YLRL Pin, Charm or Stationery. Non-member receives a year's membership YLRL.

Logs go to: Claire E. Bardon, W4TVT, 2238 Morgan Lane, Dunn Landing, Virginia 22027.

Floridora Contest

This is another YL activity that runs for the entire month of October. Contacts may be made on all hands and modes, YL to YL, who need not be Floridora members as long as both stations are in the state. (Open to Florida only) There are prizes for the highest scores.

Logs must be mailed before Nov. 15th and go to: Bertha Farr Eggert, WA4BMC, 1510 17th Ave. North, Lake Worth, Florida 33460.

California QSO Party

Starts: 2000 GMT Saturday, October 5
Ends: 0200 GMT Monday, October 7

This 3rd annual party is sponsored by the North Hills Radio Club this year. Use all bands and each station may be worked on each band and mode.

Exchange: QSO nr., RS/RST and QTH. County for Calif., ARRL section or country for others.

Scoring: All QSOs count one point. Calif. use ARRL sections and countries for their multiplier, all other use Calif. counties. (Max. of 58) Calif. stations may also work in state stations for QSO points only.

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Frequencies: 1910, 3550, 3725, 3900, 7075, 7175, 7220, 14075, 14270, 21075, 21125, 21370, 28075, 28700.

Awards: Certificates to the top station in each ARRL section and DX country. The three top Calif. stations will receive awards. Additional awards may be made by the committee.

Mailing deadline Nov. 8th and this year logs go to: John F. Minke, WA6JDT, 6230 Rio Bonite Drive, Carmichael, Calif. 95608. Include a s.a.s.e. if results desired.

Massachusetts QSO Party

Starts: 2300 GMT Saturday, October 5
Ends: 0500 GMT Monday, October 7

This is the 4th annual party sponsored by the MIT Radio Society, W1MX. The same station may be worked on each band and mode.

Exchange: QSO nr., RS/RST and QTH. County for Mass. stations, state or VE province for others.

Scoring: Each completed QSO counts 2 points. Mass. will use states and provinces for their multiplier, others Mass. counties. (max. of 14) DX stations may work Mass. stations but only count for QSO points.

Frequencies: CW—3560, 7060, 14060, 21060, 28060. Phone—3960, 7220, 14290, 21410. Novices—3735, 7175, 21110.

Awards: Certificates will be awarded to state, province and county winners.

Mailing deadline is Nov. 4th and logs go to: MIT Radio Society, W1MX, Box 558, 3 Ames Street, Cambridge, Mass. 02139.

RTTY Sweepstakes

Starts: 0200 GMT Saturday, October 5
Ends: 0200 GMT Monday, October 7

The 8th world wide RTTY contest is again sponsored by the Canadian Amateur Radio Teletype Group.

This year a rest period has been introduced. Operation is limited to 36 hours out of the 48 contest period. The 12 hour non-operating time may be taken at any time but in periods of not less than 2 hours.

Use all bands 3.5 thru 28 mc, and the same Zone map used in previous contests. Not same as the *CQ* map. (See CPR Map, Mar. '65 *CQ*)

Exchange: Message nr., signal report, time GMT, zone, and country or state.

Points: a. Two points for contacts with stations in one's own zone. b. Contacts with stations in other zones, score points as listed in the exchange table. (See Nov. '67 *CQ*) c. The same station may be worked once on each band for QSO and multiplier points.

Multiplier: Each country worked on each band, including one's own, counts as a multiplier of one. (ARRL list plus KL7, KH6, VO)

Scoring: Total QSO points, multiplied by sum of countries from each band, and again by the continents worked. (Max. of 6)

Awards: A total of 16 Trophies and Plaques, for the top ten scores, most VE contacts, most states and VE provinces, high scores on 40/80, 10 meters, s.w.l. and NFSK.

Logs must be received no later than Nov. 30th and go to: C.A.R.T.G., 85 Fifeshire Road, Willowdale, Ont., Canada.

VK/ZL/Oceania DX Contest

Phone—Oct. 5-6 **C.W.**—Oct. 12-13
Starts: 1000 GMT Saturday,
Ends: 1000 GMT Sunday
in each instance.

Rules apply to stations other than VK/ZL.

Exchange: Usual 5 and 6 figures, RS/RST plus a progressive 3 digit contact number starting with 001.

Scoring: Oceania stations: 2 points for VK/ZL contacts, 1 point for rest of world. Stations outside Oceania: 2 points for VK/ZL contacts, 1 point for Oceania. Final score: Total points multiplied by sum total of VK/ZL call areas worked on all bands.

Logs: Must show in this order: Date/time in GMT, station worked, number sent/received, and QSO points. *Underline* each new VK/ZL call area worked on each band, and use a separate log sheet on each band.

A summary sheet showing the scoring and other information pertinent to the contest is also requested. Your name and address in BLOCK LETTERS, and include a signed declaration that all rules and regulations have been observed.

Awards: Attractive coloured pictorial certificate in each country and call areas for W/K, JA and UA, to the top scorer on all bands and each individual band. Additional awards may be made depending on the activity and logs submitted.

There is also a s.w.l. section, but only VK/ZL stations are to be listed. Include call of station being worked and serial number sent. Log procedure same as above.

Logs go to: NZART Contest Manager, Box 489, Wellington, New Zealand, and must be received before January 20th, 1969.

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RSGB 28 mc Phone Contest

Starts: 0700 GMT Saturday, October 12
Ends: 1900 GMT Sunday, October 13

It's the world working the British Isles on 28 mc phone *only* this year. Contacts may be made on a.m. or s.s.b. and only single operator entries are acceptable.

Following rules are for overseas stations.

Exchange: Five figures, RS report followed by a progressive 3 figure contact number starting with 001.

Scoring: Each complete QSO with a G, GC, GD, GI, GM, GW counts 5 points. In addition a bonus of 150 points may be claimed for the first contact with each B.I. country/numeral prefix. i.e. G2, GC3, GD4 and etc. (max. of 36) Contacts with GB stations score 5 points only. There is no multiplier.

Awards: 1st, 2nd and 3rd place certificates to the leading overseas stations.

There is also a s.w.l. section. Only British Isles stations are to be listed and scoring is same as above. Logs must show time in GMT, call heard, number sent, station being worked and points. Awards same as above.

A summary sheet with the scoring, a signed declaration and your name and address in BLOCK LETTERS is requested for both categories.

Mailing deadline is October 28th and logs go to: R.S.G.B., H.F. Contests Committee, 35 Doughty Street, London WC1, England.

WADM C.W. Contest

Starts: 1500 GMT Saturday, October 19
Ends: 1500 GMT Sunday, October 20

This is a c.w. contest only and all bands 3.5 thru 28 mc may be used. The same station may be worked once per band.

Classifications: Single Operator, multi-operator and s.w.l.

Exchange: The usual six figure number, RST plus a QSO number starting with 001.

Scoring: Three points for each DM contact, multiplied by the number of DM districts worked on each band. (A district is identified *not* by the number in the call but by the last letter in the call. (A thru O)

Awards: First place, a WADM contest flag (or plaquette) to the top scorer in each country, 2nd and 3rd place awards will be made in countries with large entries.

Applications for the WADM or RADM awards may be made from contacts in your contest logs. (Plus QSL cards if they accompany your log.) (Check W2GT's column for details.)

Mailing deadline is November 15th and logs go to: Radio Club of DDR, P.O. Box 30, 1055 Berlin, German Democratic Republic.

CQ WW DX Contest

Complete rules including a list of Special Awards will be found on page 31 of this issue. A brief run-down was given in last month's CALENDAR. Rules same as last year but have been streamlined.

Attention is again called to Sect. XIII, Disqualification. Duplication of QSOs and multipliers must especially be closely checked. We also expect you to indicate the number of QSOs you made. Although not used in the scoring, these are listed in the final results. Recopied logs must remain in their original form, with duplicate contacts crossed out and no credit taken.

A summary sheet is a *must*. Official log sheets are not essential, but follow the sample shown with 40 contacts to the page.

There is still time to get official forms from *CQ*, a large s.a.s.e. will do the trick. International log sheets are available from Daystrom Limited, 1480 Dundas Highway East, Cooksville, Ont., Canada.

Windblowers "Big Blow"

The Windblowers will hold their annual "Big Blow" on Saturday, Sept. 28th from 2 to 10 P.M. EDT. Four stations will be manned on 2 meters A.M. in four states. Conn. K2GOS/1, Penn. W2ERZ/3, N.J. W2ZDR/2 and N.Y. W2RRP/2. A certificate will be awarded to all who contact all four stations. Send your QSLs to: Harold B. Fuller, WA2ZAU, 11 Hemlock Drive, North Caldwell, N.J.

Editor's Notes

If you were looking for PYs in the LABRE contest on the week-end of Aug. 10/11 as announced last month, you probably didn't find any. Long after we had gone to press we received another announcement that the c.w. date had been changed to Aug. 3/4. Much too late to make the change in *CQ*.

Also no word from the MARC regarding their VE/W contest usually held the last week-end in September. Maybe they are not going to have one this year. Or maybe they do not want us to know about it. Have received no answer to my letters of inquiry. Makes you wonder, doesn't it?

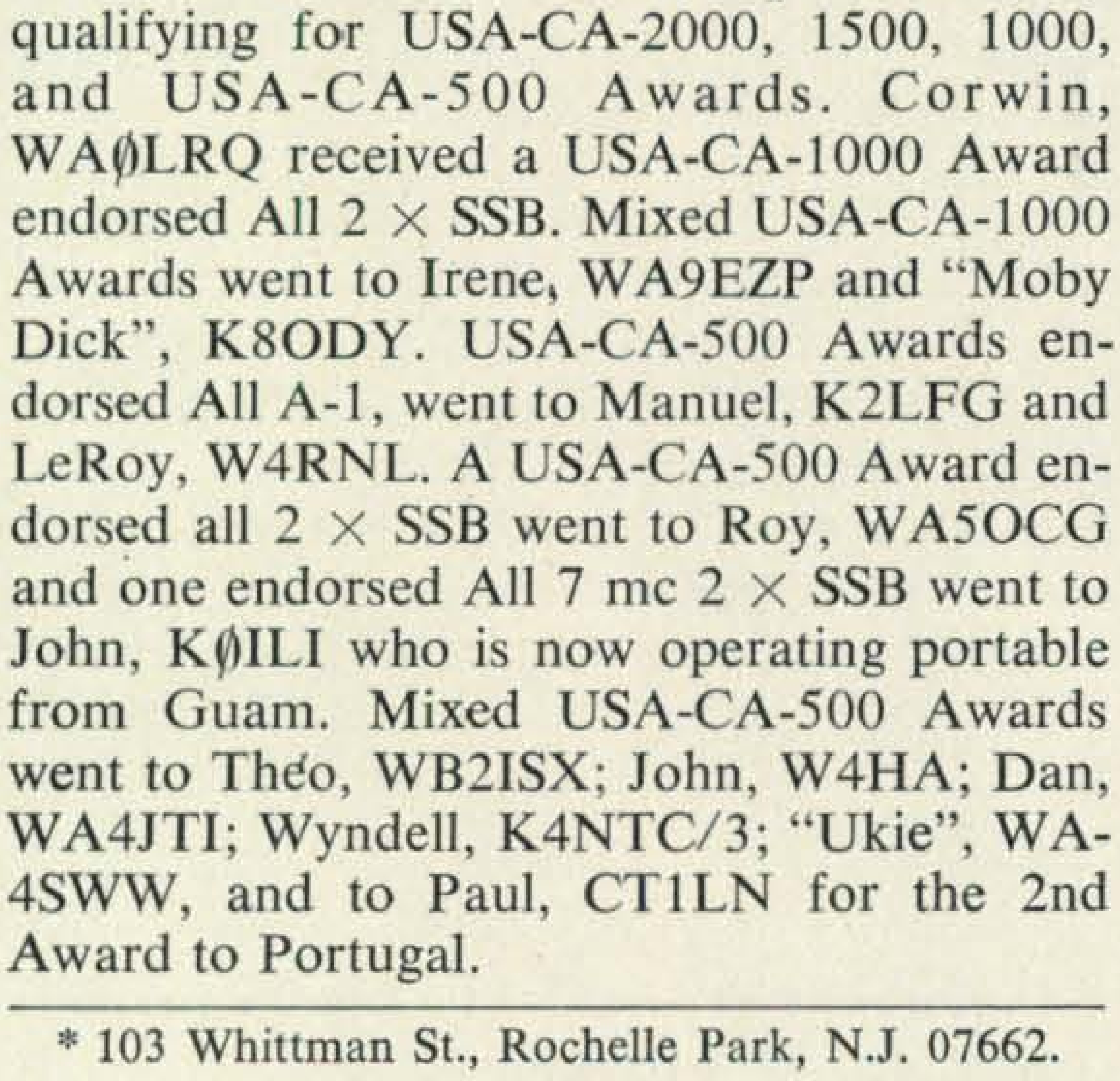
73 for now, Frank W1WY

THE awards PROGRAM

BY ED HOPPER,* W2GT

THE September, "Story of The Month", about Jim, K1QZV after this data on awards issued. A USA-CA-3000 Award was sent to Jim, K1QZV. Mixed USA-CA-2500 Awards went to Steve, K3LXN; Bill, K41SE; Dave, WAØJKT/WAØRJH, and to John, W8UMR who also received USA-CA-2000 and USA-CA-1500 Awards endorsed All 14 mc 2 × SSB. Marvin, WB2SJQ kept me busy by qualifying for USA-CA-2000, 1500, 1000, and USA-CA-500 Awards. Corwin, WAØLRQ received a USA-CA-1000 Award endorsed All 2 × SSB. Mixed USA-CA-1000 Awards went to Irene, WA9EZP and "Moby Dick", K8ODY. USA-CA-500 Awards endorsed All A-1, went to Manuel, K2LFG and LeRoy, W4RNL. A USA-CA-500 Award endorsed all 2 × SSB went to Roy, WA5OCG and one endorsed All 7 mc 2 × SSB went to John, KØILI who is now operating portable from Guam. Mixed USA-CA-500 Awards went to Theo, WB2ISX; John, W4HA; Dan, WA4JTI; Wyndell, K4NTC/3; "Ukie", WA-4SWW, and to Paul, CT1LN for the 2nd Award to Portugal.

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



The beautiful set-up at K1QZV.

James L. Harrington, K1QZV

Jim was born in Fall River, Massachusetts where he was raised and schooled. During high school days, he worked for the local newspaper and considered a career in either newspaper work or electronics. He took all available courses in electricity-electronics but upon graduation still unsure of his plans he tried trade school. A change was soon made when he enrolled at Fitchburg State where he graduated with a B.S. While at Fitchburg his Fraternity was Phi Delta Pi.

Like K8VSL Jim got married before he had a job and he and "Bev" now have two daughters, Lynne and Barbara, both in Grammar School. "Bev" has no interest in ham radio, but deserves a lot of credit for her understanding and patience for the long hours of watching TV alone while Jim chases rare counties and DX and for the number of people who have tramped through her house for whom she has made snacks and drinks and then rapidly retreated so the unknown could be discussed.

While in College Jim had majored in Graphic Arts and was always interested in electronics and tinkering so it was natural when he came to Cranston, Rhode Island and

USA-CA HONOR ROLL

3000		**2000**		**500**	
K1QZV	15	WB2SJQ	47	K2LFG	667
2500		W8UMR	48	WA4JTI	668
K4ISE	28	**1500**		WB2ISX	669
WAØJKT/ WAØRJH	29	WB2SJQ	75	W4SWW	670
W8UMR	30	W8UMR	76	WB2SJQ	671
K3LXN	31	**1000**		WA5OCG	672
		WAØLRQ	129	W4RNL	673
		WA9EZP	130	W4HA	674
		WB2SJQ	131	K4NTC/3	675
		K8ODY	132	CT1LN	676
				KØILI	677

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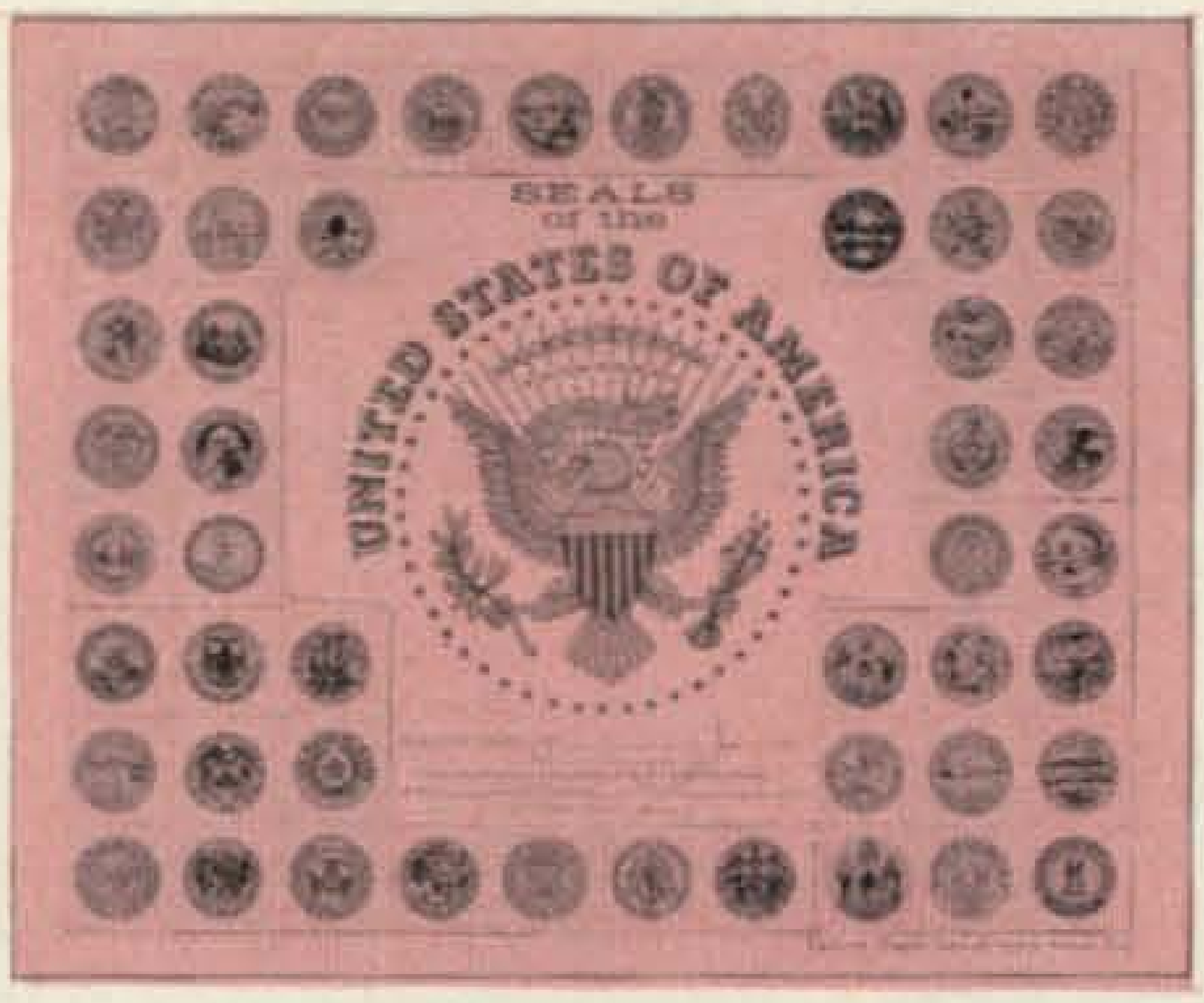
"There is hardly anything in the world that some man cannot make a little worse and sell a little cheaper, and the people who consider price only are this man's lawful prey."

JOHN RUSKIN

CQ's advertising rates are three times greater than those of one competitor and one and a half times greater than those of a second. At the same time, CQ's readership is approximately ten times that of the first competitor and four times larger than the second.

Advertising in CQ is still the best buy in the Ham Radio Market!



Seals of the U.S.A.

spotted one of his neighbors with a tower and beam, to introduce himself and become involved (the neighbor was K1ABR of v.h.f. fame). Jim came up through the Novice ranks to General and last year when they announced the new Incentive Licensing plan, he took and passed the Advanced Class examination and probably by the time this story is in print, he will have passed the Extra examination.

Jim has taught Graphic Arts in Cranston for ten years and during the summer months directs a day camp for handicapped youngsters (crippled with polio and birth defects), is an Assistant Director of a YMCA Day Camp and in charge of Counselor in Training at Camp Massasoit—so you can see he is as busy during the summer months as the calm winter period!

He is President of the Cranston Radio Association and has been involved with Rhode Island Amateur Week since its inception three years ago and being a Certificate Hunter, Jim donates the QSLs and Certificates for this event. Being also a part-time printer, he prints them as well and has donated QSLs for other worthy causes and persons. He acts as an advisor and general resource person to the

Armino, I1BOI; Gene, W2GOO; Enzo, I1SCA.

A.C.I. (Adult Correctional Institution) the State Prison for their newspaper, *The Challenge* (a fabulous publication, of which the inmates can be justly proud).

Although collecting counties did not start until 1962, Jim has been collecting certificates for many years and can not remember when it started. Although he received his basic USA-CA-500 Award #163 in January 1963, he held off many years for additional endorsements because of the time involved with the paper work. He hit upon the idea of splitting the Record Book apart and running the pages through his copying machine and then he went at it hot and heavy, sending for QSLs from previous contacts that had not QSL'ed and going through his QSL file for cards never cataloged and trying different bands to find people not normally on any of the nets. He found ten meters to be a place many county hunters have skirted due to limited activity, but 90% of the people on this band come on only during the peak sunspot period and are mostly old timers and live in some pretty rare counties.

In his collection of certificates, Jim has WAC, WAZ, WPX, WAS, A-1 Op, CP 35 and 150 different other Amateur Awards. In March 1967 USA-CA-1000 Award #111 was received; USA-CA-1500 Award #62 in September 1967; USA-CA-2000 Award #39 in October 1967; USA-CA-2500 #21 in December 1967 and USA-CA-3000 #15 was received in April 1968, this is #1 3000 Award to the 1st call area. To complete USA-CA, 10 additional counties are needed in Kentucky and 9 in Texas. Jim expects to get the needed ones in Texas, but finds little or no activity in Eastern Kentucky.

His service career was spent in the Army basically in Ordnance and later in basic combat training.

Jim has been licensed for ten years with the same call in the same location. The present gear is the Collins "S" Line 32S-3, 75S-3B and console to a Hy-Gain TH6-DX beam on a 50 foot Spaulding tower. A trapped 40-80 meter Vee is used for the low bands, and for mobile operation an HW 32 to a Hustler single band antenna is used. "Bev" and Jim love to relax by riding through the N.E. countryside while Jim gives out some of the more rare N.E. counties.

Other hobbies have been raising and racing pigeons (a big hobby in Fall River, Mass.) to being a pistol shooter in the three main calibers, both doing his own reloading and

See page 134 for New Reader Service

processing of ammunition, to collecting coins and stamps. But finding he could only do justice to one hobby, all others were sold and ham radio is *THE* hobby—but with all his other activities, it would seem that a 40 hour day was needed.

As an interesting sidelight, Jim includes with all his QSLs, an unusual Award, WATVAR, which signifies that the recipient has succeeded in causing undue interference to all televisions and radios in his area. Needless to say, this helps with his QSL return percentage as well as bringing many letters of appreciation. To quote from just one letter—"I want to tell you how much I enjoyed receiving your WATVAR Certificate! I came home from work that day feeling a bit like a "Blue Monday". Well, when I opened your letter and saw the WATVAR Certificate, the sun came throught the clouds and I *laughed!* So you see, your certificate was very effective!" (Signed, Tom, W2RUK). Jim has sent these certificates to all 50 states and about 150 different countries. He also includes a brochure on Cranston and when he has them, a color brochure of Rhode Island is also included. This seems like a great idea and it would be nice if more of us could do this, so we could know more about each others QTH.

This story could not be concluded without giving credit for the K1QZV photograph to Alec, K1UXS who owns his own studio and does all the official photographs for the Governor and is very active in all Rhode Island ham activities.

Awards

New Custodian: Massachusetts Chapter National Award Hunters Club is George J. Hayes, W1DOM, 29 Belmont Street, North Quincy, Mass. 02171 (previous custodian was Steve Rich, WA1DFL).

New Custodian: The Auto State YL Club (TASYLS) has a new custodian, Betty House, K8VCB, 1276 Webster, Birmingham, Michigan 48008 *AND* a slight change in requirements—Continental U.S. and VEs need 15 points (was 20). Certificate described in March '67 *CQ*.

Washington State Operating Achievement Award: This Award sponsored by the Puget Sound Council of Amateur Radio Clubs will be issued for QSOs made during the 1968 Washington State Amateur Radio Week, September 1st through September 8th. The certificate will be signed by Governor Daniel J. Evans. Out-of State amateurs must contact

Ogdensburg Centennial Certificate.

10 Washington State hams, and Washington State Amateurs must contact 20 other Washington State hams. Send list of stations worked, dates, and QTHs to The Puget Sound Council of Amateur Radio Clubs, Drawer A, McChord AFB, Washington 98438. Be sure to include your own name, call and mailing address.

Ogdensburg (N.Y.) Centennial Certificate: The Ogdensburg Amateur Radio Club is helping to celebrate Ogdensburg's Centennial year by offering this certificate for QSOs with their members during 1968. Rules: An applicant in St. Lawrence County, N.Y. must contact 3 members; all others contact 2 members. OARC members may be claimed wherever they are located. Contacts may be made on any authorized band and using any mode of transmission. Contacts may be retroactive to include any made during 1968. Endorsements will be given for additional contacts, *i.e.* for a total of 5, 10, 15 or more. Please include your name, call, full QTH with zip code and list the OARC stations you worked with date, time, mode and frequency for each. Submit applications to Ogdensburg Amateur Radio Club, Lois Ierlan, 725 Proctor Ave., Ogdensburg, N.Y. 13669. Active stations are: WB2ASK, WA2BFY, W2BZY, WA2DRA, WA2ENR, WA2FDJ, WA2-FKK, WA2FUE, W2IDM, K2IK, WB2JYO, WA2KFT, WA2KTM, WA2MWF, WB2-QNV, K2RUK, WA2SPM, K2UAN, WB2-VAS, WA2YWW, WA2YWX and WB2ZIY. *Congratulations* to Ogdensburg on her birthday! As a community Ogdensburg is well over 200 years old. First there was a Mission Post and Fort when the French occupied the

Extra Class Award.

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entire St. Lawrence Valley. Later there was a trading post and village at the confluence of the Oswegatchie and St. Lawrence rivers, now Ogdensburg has reached 100 years as a City.

Grand Prix Award: On the occasion of the "Grand Prix" of formula 1 racing cars, and other auto and motorcycle races, which are held at the Monza (Italy) Motodrome during every September, the Amateur Radio Club of Monza issues an award to every licensed amateur who makes 40 points working any station in the city of Monza under the following rules: Contacts must be made between 0001 GMT September 1st and 2359 GMT September 30th of the same year on any band from 3.5 mc to 144 ms, excluding the 50 mc band. All phone contacts are allowed but crossband and mixed contacts (PH/CW) are not valid. Credit for a contact may be claimed only once on each band, but contacts on different bands will be credited. As shown in the table, each QSO with a station in Monza has a different value of points, depending on your Zone. Applications, postmarked not later than Nov. 1st of the year in which contacts were made, and consisting of log data showing call, day, time, frequency, mode, reports of each QSO must be sent to: SEZIONE A.R.I. DI MONZA—DIPLOMA GRAN PREMIO, P. O. Box 1—20052 MONZA, ITALY. Please be sure to include 8 IRCs for handling fees.

ZONE	POINTS
14-15-16-20-33	2
3-4-5-9-11-13-17-34-35-36-37-38	4
2-7-8-10-12-21-25-30-32	6
1-6-18-22-29-39-4O	8
19-23-24-26-27-28-31 and	
Antarctica	10

Most active stations are: I1AT, AMC, AME, BFO, BGB, BOI, CAS, CNC, CRE, EB, EGR, FJ, KB, LG, MOX, TIG, TMZ, VGO, XN, ZSI, ZTI, BOO, CF, JPL, SAW. Because of skip condition difficulties, contacts of Italian Station outside Lombardia, will be given double score.

Extra Class Award: This award will be issued by the St. Louis Amateur Radio Club to all amateurs for confirmed contacts with an Extra Class licensee from each of the 24 FCC licensing districts of the USA. Log data application must include the FCC district and license number of the operator contacted. No time limit no endorsements. Send GCR list with 50¢ or 5 IRCs to W. J. Bergmann, WAØAUB, 842 Tuxedo Blvd., St. Louis, Missouri 63119. Rules and application blank may be had by sending an S.A.S.E. to WAØAUB.

Seals of the U.S.A.: A new certificate issued by the California Chapter of the National Award Hunters Club. This is an attractive 11" x 14" certificate which when completed will display all of the United States Seals. The cost of the award is $2.00 and a GCR list is required, QSL cards should not be sent with the application but must be in your possession for spot checking. The basic award and seal is for one State, seals are issued for each State thereafter with a GCR list and a s.a.s.e. required. No charge for the seals. Certificates issued for mixed band operation count 1 point and if endorsed for band and mode they count 2 points. All future seals requested at a later date for a certificate that has been endorsed band and mode will have to be for the same band and mode or will not be issued. Point system for this award is: Mixed band and mode—1 point. Endorsed for band and mode—2 points. Each five seals—1 point. Maximum of 12 points when completed. For additional information; and for award—write Awards Chairman, Mildred Fox, WB6FND, 5610 Gifford Ave., Maywood, California 90270.

Notes

As this is being written, I am sure most of you are enjoying your vacations (as I am) and I hope you find time to do the many things you planned (I didn't).

A note from Don, W2GA to advise that his call has been changed from WA2WEE and that it is the fifth call since his original "8DKQ" in 1923.

An official notice received about YU Awards—beginning 1968 radio amateurs who apply for the YU certificates WAYUR, W-YU-R-VHF and H-YU-R-VHF do not have to send QSL cards to confirm their achievements, instead they may send a list with all data on their QSOs and this list can be certified by a radio club or two operators of the radio club. Awards Manager, YU1AG, P. O. Box 324 Belgrade, Yugoslavia.

Hope you find time to write and tell me—How was your month? 73, Ed., W2GT.

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BE CAREFUL, IT'S LOADED

New 500-Watt 5-Bander from NRCI only $399.95

For $399.95, you can't buy a more potent package than the new NRCI NCX-500 transceiver. This versatile 5-bander is packed with the performance extras that give you the sharpest signal on the band, plus an enviable collection of QSL's. Check it out!

- 500-Watt PEP input on SSB, grid-block keying on CW and compatible AM operation.
- Receive vernier, with tuning range greater than ± 3kHz.
- Separate product and AM detection.
- Sidetone monitor, plus built-in code practice oscillator.
- Generous overlap for adjacent-channel MARS coverage.
- Fast-attack slow-release AGC in all modes.
- Rugged heavy-duty 6LQ6's.
- Crystal-controlled pre-mixing with single VFO for effective frequency stability, plus identical calibration rate on all bands.
- Crystal lattice filter for high sideband suppression on transmit, and rejection of adjacent-channel QRM on receive . . . plus solid-state balanced modulator for "set-and-forget" carrier suppression.
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AC-500 Power Supply— $95 **Great things are happening at NRCI**

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NRCI 37 Washington St., Melrose, Mass. 02176
617-662-7700 TWX: 617-665-5032

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SURPLUS sidelights

BY GORDON ELIOT WHITE*

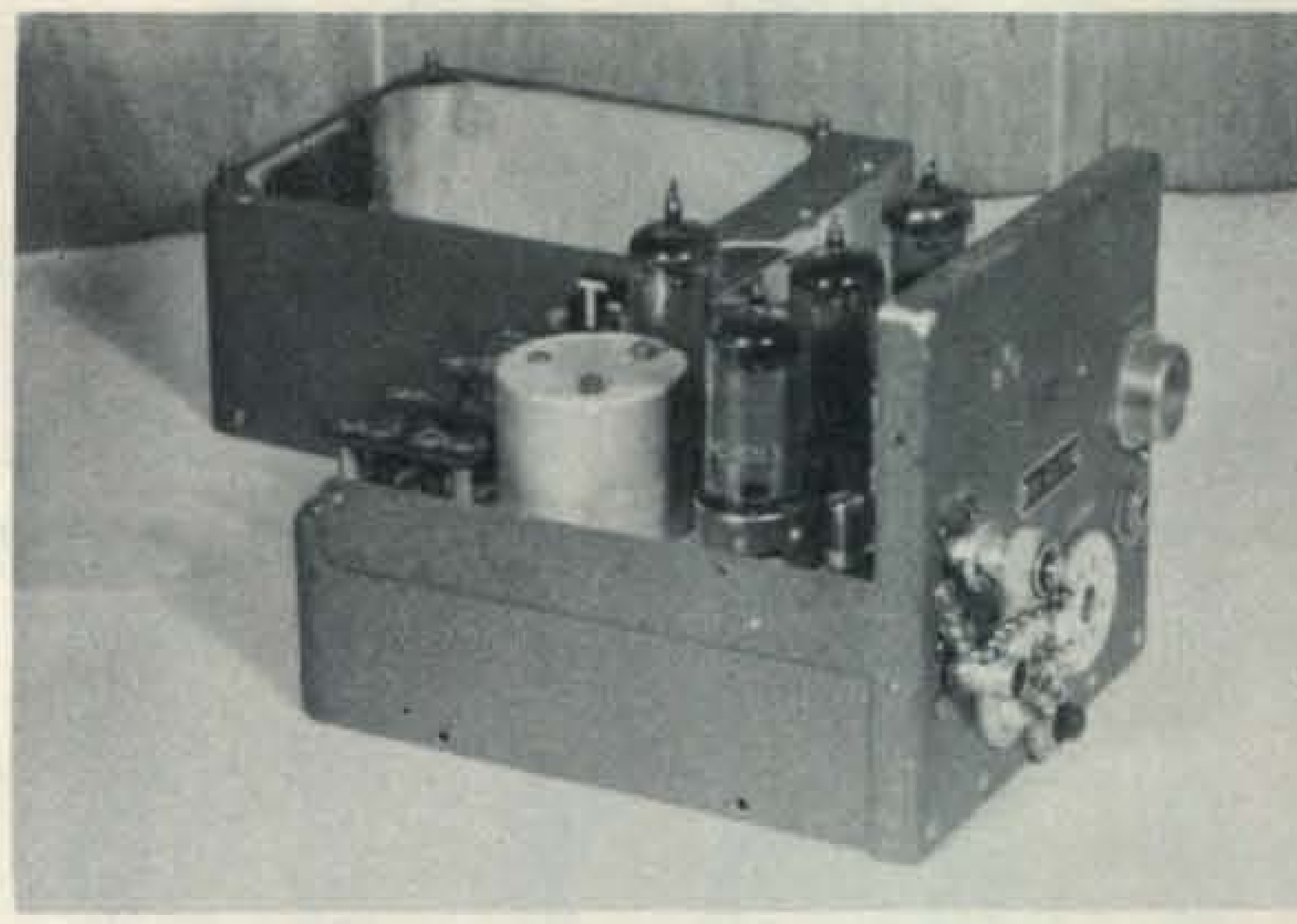

Fig. 1—V.h.f. command transmitter type T-11-B; the T-13 is physically identical. Together the two may be used to cover frequencies from 116 to 148 mc.

THE T-11 and T-13 transmitters designed by Aircraft Radio Corporation in 1947, were the v.h.f. companions to the postwar Command Receivers, R-13, R-15 and R-19, which covered the 108-135 and 118-148 mc bands. These little gems have been covered only briefly before, but we will try to correct that oversight this month, for these are about the simplest transmitters to convert for 2 meter operation we know. They can even be adapted to six meters with about an hour's work.

Built as part of a commercial set for civilian use, the T-11 and T-13 transmitters did not need to meet mil specs, though they were well-built, and were adopted for service use during the Korean unpleasantness as A.R.C. type 12, and as AN/ARC-60 components. (The A.R.C. nomenclature in the Type 12 stood for Aircraft Radio Corp. In the AN/ARC-60 the same letters were part of the JAN nomenclature standing for Airborne Radio Equipment.)

The T-11 covered 116-132 mc, the T-13 132-148 mc, and the latter, with a modification to increase plate capacity, would tune as low as 25 mc. Of course both were crystal controlled, with five channels available in a 2 mc band, in any one transmitter. The tuned circuits were broad-band enough to handle up to a 2 mc spread without serious problems, but of course it was pretty bulky business where many channels were needed. They are definitely out of the picture now, when even most light aircraft use 1,200 channels for common cross-country flying.

This is of course not a problem at 2 meters. For work in the 148 mc area, using the T-13, tuneup simply involves insertion of the correct crystal, operating on *either* 1/12th or 1/18th the desired v.h.f. frequency, and alignment of the oscillator, multiplier and doubler stages. With the output stage doubling to 2 meters, there is a chance of TVI, and for fixed amateur use, normal suppression techniques are needed to keep the neighbors off one's neck. The Amateur's Handbook will tell you how; see the *CQ Antenna Handbook* for that item if necessary.

These latter Command Transmitters of course lend themselves readily to mobile work, indeed are almost ideal for a cheap, light, mobile rig. They may be wired for 12 volt operation (see fig. 2) and require little power. Output is rated at two watts—no rockcrusher, but still useful.

These are four-tube sets, designed for carbon mike input, via a front panel jack conveniently labeled "MIC". They also incorporate an antenna changeover relay, with the antenna connected in the unenergized position to a receiver. The antenna and receiver jacks are also clearly labeled. Control is via

* 5716 N. King's Highway, Alexandria, Virginia, 22303.

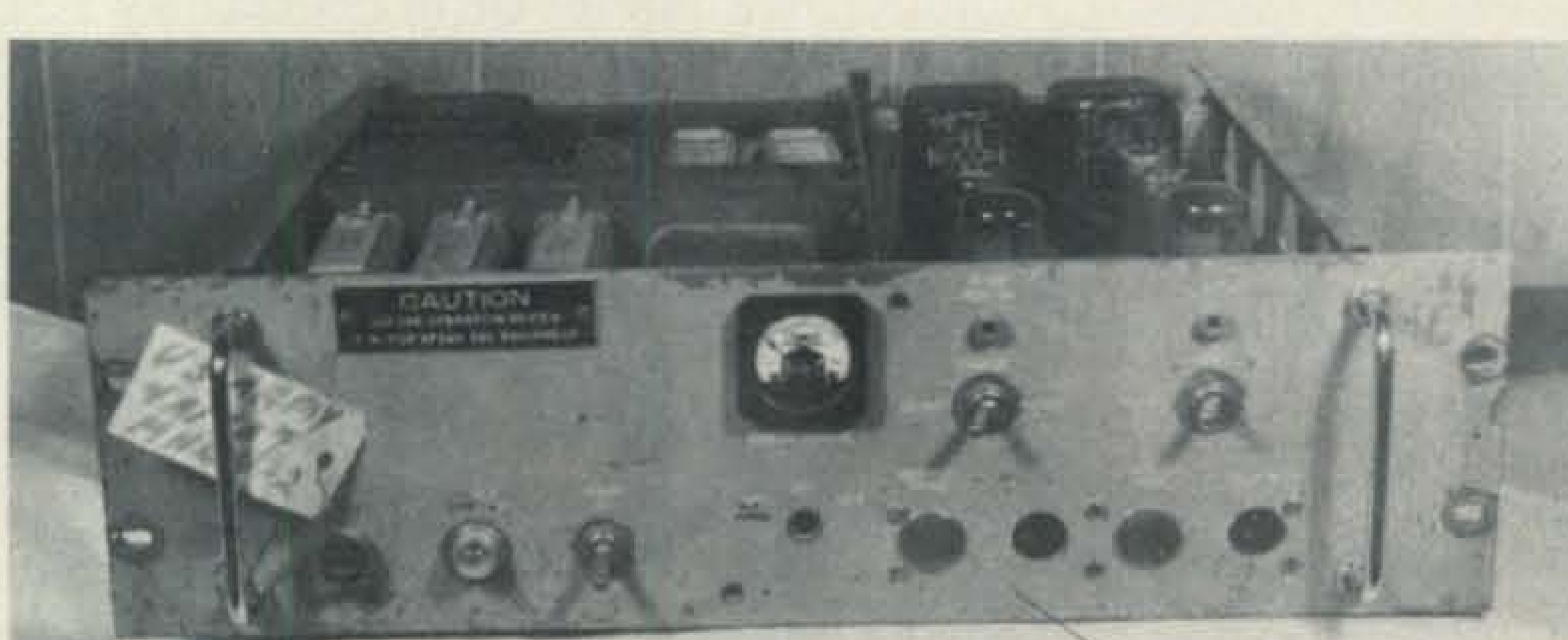

Fig. 3—AFSAV-39-C demodulator. This well-worn unit was used with the DEN-35 and other secret monitoring gear for copying teleprinter signals of interest to U.S. intelligence agencies.

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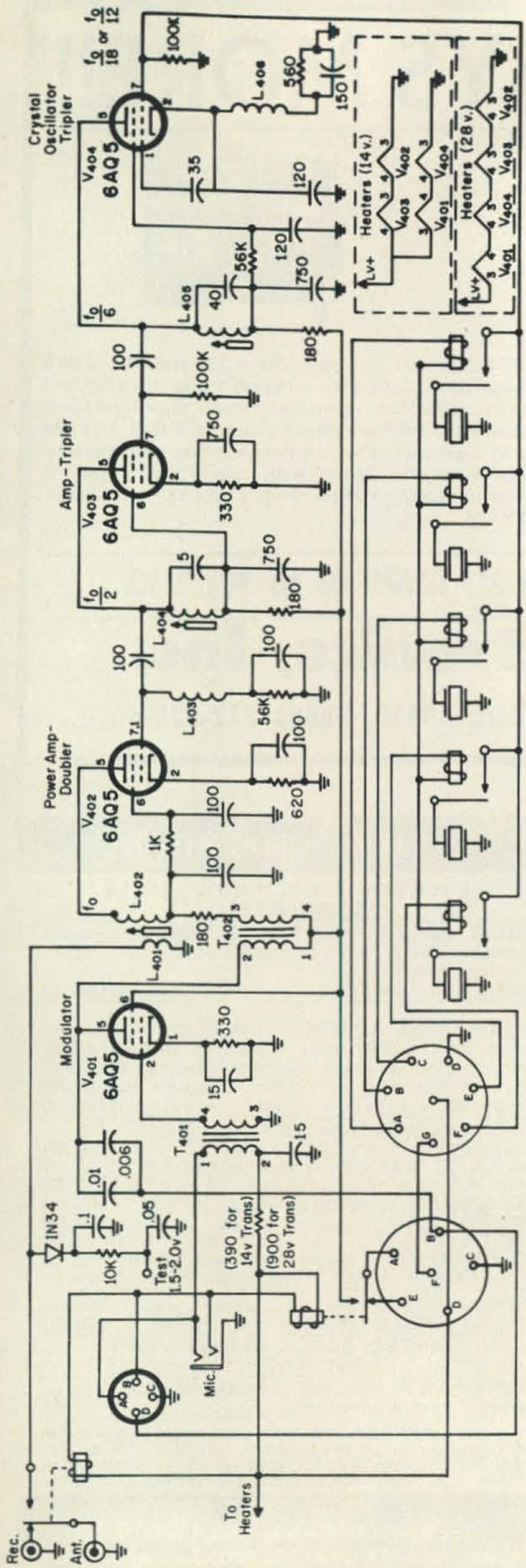

Fig. 2—Schematic and actual wiring diagram of the T-13 transmitter.

the mike push-to-talk button; commonly the military T-17 was used in the original application.

The A.R.C. A-12 whip antenna was broadbanded to cover 116-148 mc, being a 21⅞ inch stub ¼ inch in diameter coupled to 52 ohm coax (RG-58/U). For amateur work, the literature mentioned above will provide better performing skyhooks.

The transmitters took B+ voltage from their companion receivers, via a second transmit/receive relay. The receiver B+ was thus routed through the transmitter. A similar system could be used by mobiling amateurs one supposes. All this ought to be clearly seen on the schematic of fig. 2.

B+ voltages, under load condition, should be in the vicinity of 240 volts, but a leeetle boosting is o.k. for fanatics among us. The test point inside the transmitter (red button with probe point at top gives a d.c. reading which is useful in alignment: just tune for maximum. Output with no crystal in the transmitter will show that the mike and modulation circuits are perking.

For the two-meter area, the coils in the T-13 should be set as follows:

slug # 1-13½ turns up from bottom
slug # 2-9 turns up from bottom
slug # 3-5 turns up from bottom

The T-13A set requires a little *less* tuning from the bottom position to reach two meters. The T-11 equipment (less frequently seen) can be readjusted to reach 144-148 mc, but it probably won't go that far by tuning the slugs alone. Try chopping (neatly now, neatly) a turn off each coil.

I am indebted to the local Bolling Air Force Base MARS group here for a step-by-step conversion, simple though it be, of the T-11-B to cover six meters.

First, decide what crystals you will need. These units operate on harmonics of course, and not going to 2 meters you can multiply 8 or 12 times from the crystal fundamental. Strip out all unneeded crystal sockets and relays, running the hot side of the crystal to the grid of the oscillator tube. In sets with a 6AQ5 this will be pin 7, for the 5763's use in the −B models it is pin 8. (There are several numbering systems used, but in a 4-tube set they ought not be too confusing.)

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B+ should be applied to pin 6 of the power amplifier for either 5763 or 6AQ5. The set is rated at 262 volts, but more, probably up to 300, would be safe.

Wire the filaments for 14 or 28 volts as indicated in fig. 2. Note that the modulator series resistor, R_{01} or R_{16}, depending upon model, must be 390 ohms in a 14 volt set, 900 in a 28 volt unit.

Remove one turn from the oscillator output coil, L_{02}; add a 10 mmf silver mica capacitor across the doubler plate coil L_{03}, and a 68 mmf mica across the output plate coil L_{05}.

Now tune up on six meters; that's all there is to it.

Incidentally, the patent notice in the T-13's says "not licensed . . . for amateur purposes . . ." etc. This arises from the sale, by Aircraft Radio Corp., in 1929, to R.C.A. of the non-aircraft rights for its patents. Little old Aircraft Radio was teaching the giants, even then, and A.R.C. engineers were responsible for the first automatic volume control circuit, now a commonplace. You can ignore the label. No one will prosecute you for the violation.

On two units I mentioned in the August column, I can now report more information. The "mystery" RTTY terminal unit is, actually, the DEN-35, a super-secret (?) beast, known familiarly as the "fusebox" because of its resemblance to a Navy circuit-breaker cabinet. The thing was used to demodulate "twinplex" signals transmitted by another country which used 33 word per minute speeds and printed in the cyrillic alphabet, but which I will not otherwise identify. Other devices were used with the DEN-35, but it may be operated with the AFSAV-39C, a loop keyer vaguely similar to the AN/FCC-3 which I described last spring. The DEN-35 put out an on-off tone, which the AFSAV-39C converted to a 60 mil loop signal. The AFSAV-39C (fig. 3) is a 5¼ inch high, rack-mount unit, containing two channels of demodulation circuitry and a power supply. My unit has been through the wars, as the photo shows, but it still works, putting out the squarest keying I have yet seen from a tube unit.

Actually, the DEN-35 will deliver the goods on either regular simplex FSK or on twinplex. A switch inside the unit labeled "FSK" and "DFS" makes the changeover. Tune for a 45 degree line when the mode switch on the front panel is set to "dots." ■

Back Issues

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

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THE CQ TECHNICAL LIBRARY SERIE

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AMATEUR RADIO ANTENNAS (2ND Edition) by Harry D. Hooton, W6TYH. Explains the theory and design of radio antennas, including the propagation of radio waves, practical design applications, impedance matching, transmission lines, and antenna coupling. The book also gives practical information about the design and construction of directional antenna arrays and quad antennas. A number of commercial antenna systems are included to illustrate good mechanical and electrical practices. 176 pages, 5½ x 8½".
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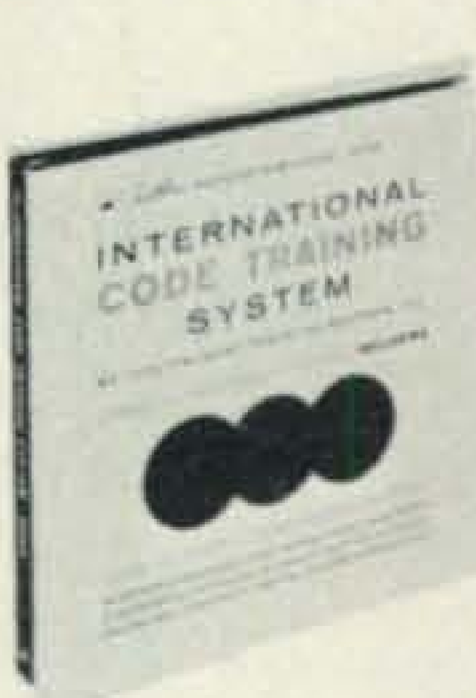

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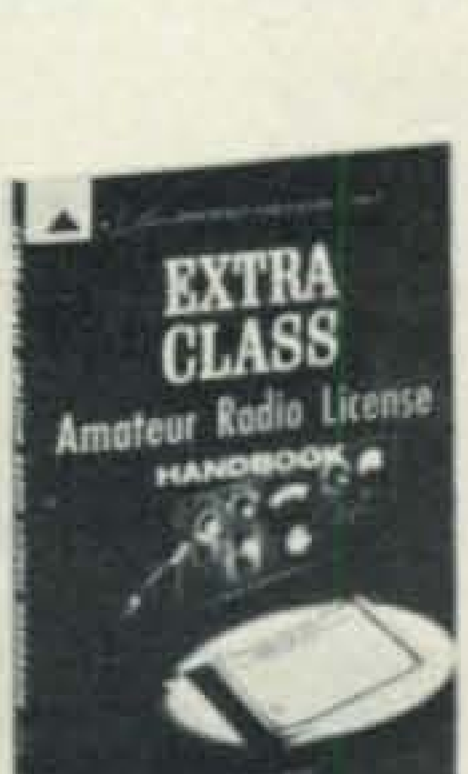

EXTRA-CLASS AMATEUR RADIO LICENSE HANDBOOK by Howard S. Pyle, W7OE. Contains the information you need to obtain your Extra-class license. Makes preparation for the "top" amateur license far easier for present holders of General-, Conditional-, or Advanced-class licenses. Covers: Requirements for the Extra-class license, building up code speed, all the advanced data you'll need to know for passing the license exam—including information on power supplies, r-f oscillators, frequency multiplication and r-f amplification, the radiating system, modulation, and advanced principles of electricity, r-f, and a-f. 160 pages, 5½ x 8½".
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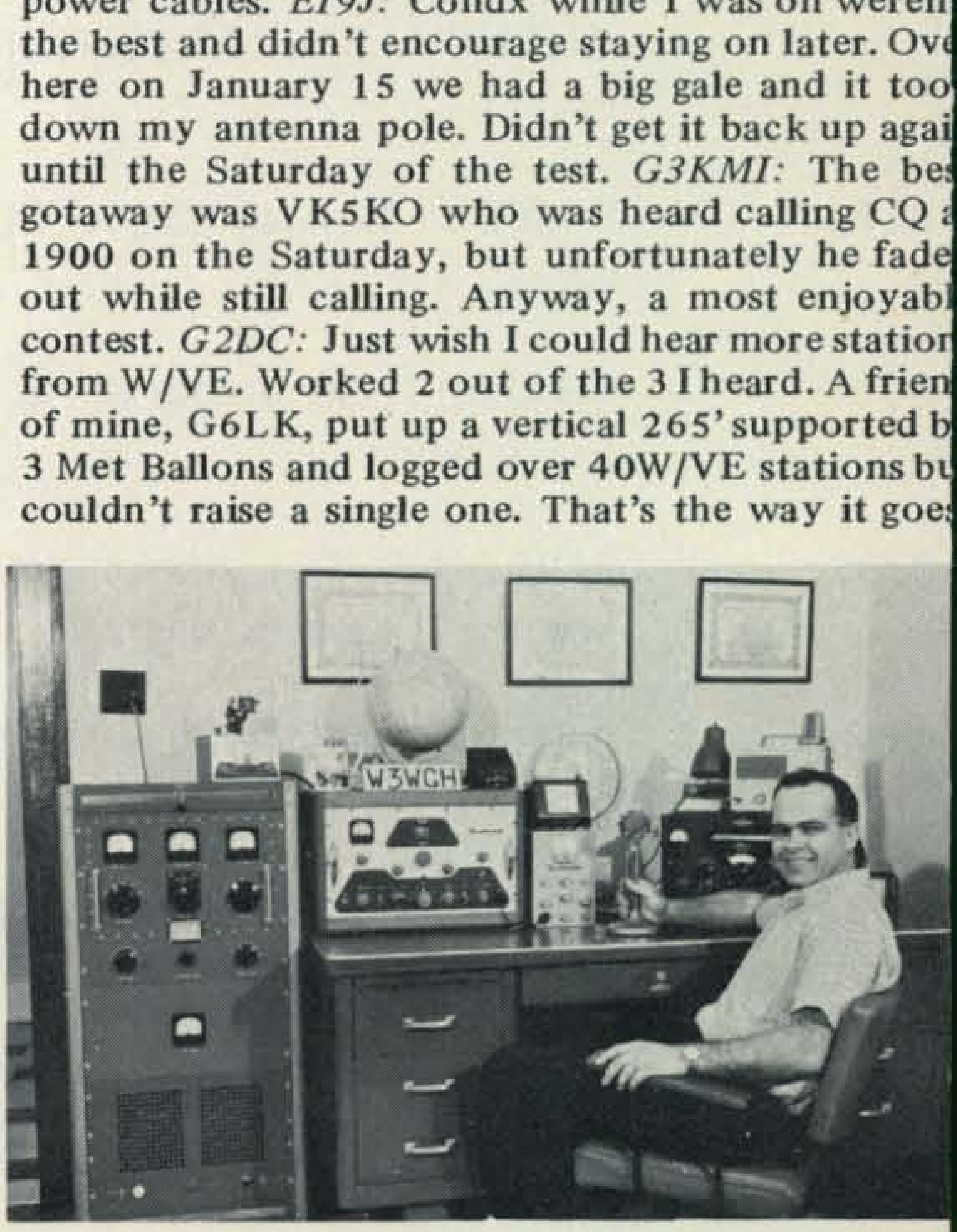
160 m. Contest [*continued from page 30*]

condx in South America very poor; extreme loc summer QRN. G3RXH was the only Eu statio heard. Made first ever 160 m Chile/Brazil QS *CE3CZ:* As compared to the excellent 160 cond tions during my Easter Is. trip (CEØPC) everythi was against us this time in Chile. QRN bad an couldn't hear anything through it. (This is Ja better known as DL9KRA, 6W8CW, CEØP FP8BV-*ed). ZC4RB:* After the last *CQ*WW 160 Co test I thought I was going to do real well, but a ver bad storm came up and put me out of the affair. T top it off, we had an S9 plus noise level from loc power cables. *EI9J:* Condx while I was on weren the best and didn't encourage staying on later. Ov here on January 15 we had a big gale and it too down my antenna pole. Didn't get it back up agai until the Saturday of the test. *G3KMI:* The be gotaway was VK5KO who was heard calling CQ 1900 on the Saturday, but unfortunately he fade out while still calling. Anyway, a most enjoyab contest. *G2DC:* Just wish I could hear more statio from W/VE. Worked 2 out of the 3 I heard. A frien of mine, G6LK, put up a vertical 265' supported b 3 Met Ballons and logged over 40W/VE stations b couldn't raise a single one. That's the way it goe



W3WGH does his 160-meter contesting from th neat installation at Appolo, Pa.

G3HZL: I still can't raise the Stateside stations. Ca you send over a typical American backyard? Sa 300' long or so? *KH6IJ:* (As for us easterners, th least said about Nose, the better, hi!-*ed).* Fir Hawaii/Japan contacts. Antenna nothing other tha guy wire of 20-meter beam tower 37' high. *9H1A* During the nignt of 27/27 Jan. a gale blew up wit gusts up to 60 m.p.h. which snapped the 300 oh ribbon feeding my antenna. I did, in fact, operate th contest with only 65' of 75 ohm co-ax into 28½' 300 ohm ribbon which, by mere luck, was shorted the end. *VQ8CC:* Only signal heard was VK5KO, b didn't raise him. Was still broad daylight here 1454 so was quite surprised to hear him. The ban sounded good so I kept monitoring it at interva Then a storm brewed and by 2200 the band w wiped out by QRN. Before the contest I spoke wi VQ9JW and AC4RB on 160 and they were all set f the big push. *XEØVXO:* Northern Mexico is perfe Top Band location. Was able to hear all continen but Africa and I don't believe they were o *PAØGMU:* Heard many Ws but the antenna is m downfall. It is only a ¼ wave-end fed about 20' hig in the center of a large town.

See Page 134 for New Reader Servic

Scratchi [*from page 13*]

lar program, so screen just getting smeary nothings.

Then, my war-surplus xmitter are somehow being modulated by Castro's speech from short-wave reseever, and sending signal into microwave antenna. The rest you can figyouring out.

I still confused as to how modulation getting from speaker into surplus xmitter, but if you think I experimenting some more when I getting back home, you Hon. Crazyman.

No indeedy, when going home in cupple days, I burying xmitter in desert under six feets of cacktus.

In case anybuddy asking for me, I don't know you, and you don't know me.

Respectively yours,
Hashafisti Scratchi

Propagation [*from page 94*]

ALASKA

OPENINGS GIVEN IN GMT ‡

To:	*10 Meters*	*15 Meters*	*20 Meters*	*40/80 Meters*
Eastern USA	18-20 (1) 20-23 (2) 23-00 (1)	16-18 (1) 18-22 (2) 22-01 (3) 01-02 (2) 02-03 (1)	14-16 (1) 21-23 (1) 23-00 (2) 00-02 (3) 02-03 (2) 03-04 (1)	08-12 (1)
Central USA	19-21 (1) 21-00 (2) 00-02 (1)	17-19 (1) 19-22 (2) 22-00 (3) 00-02 (4) 02-03 (2) 03-04 (1)	15-17 (1) 21-23 (1) 23-00 (2) 00-04 (3) 04-05 (2) 05-07 (1)	08-14 (1)
Western USA	20-22 (1) 22-00 (2) 00-02 (3) 02-03 (2) 03-04 (1)	18-21 (1) 21-23 (2) 23-02 (4) 02-03 (3) 03-05 (2) 05-06 (1)	16-18 (1) 18-20 (3) 20-00 (2) 00-02 (3) 02-04 (4) 04-05 (3) 05-06 (2) 06-10 (1)	08-11 (1) 11-14 (2) 14-16 (1) 11-14 (1)*

SB-34 [*from page 66*]

made to the SB-34 transceiver to increase its versatility. Just because a transceiver does not have all the features desired is no reason why an amateur should wait to purchase a unit until a later model is developed. With a bit of care, almost every wanted feature can be added without affecting original operation and with a minimum of expense. Utilizing Vectorboard type construction, fabrication of accessories is simplified and their size is kept to a minimum so they can be mounted within the transceiver enclosure thus avoiding long external leads and the provision of an external enclosure. ■

See page 134 for New Reader Service

Project Moonray [*from page 75*]

in current amateur practice on the lowe frequency bands, all participants in a conversation time share a single frequency wit only one of the stations transmitting at time. The desirability of maintaining thi same form of operation is very evident whe it is considered that at least twice the bandwidth and therefore twice the transponde power would be required for full duple operation and an added degree of complexit would be required to properly maintain th balance of power between the two channels The one channel aspect of this discussion i pertinent to the question of how much consideration should be given to amateur activity and band occupancy. Only one statio may transmit voice through the transponde at one time unless greater capability (mor power) is provided over the system discusse here. Even in the case of c.w. signals it i entirely possible that a single station coul capture virtually all of the transponder' power. Therefore it would be best to avoi user congestion. In order to use the system for voice communication some special construction of the ground stations would b desirable and every existing facility in th band couldn't be used effectively. Since project MOONRAY will primarily service limited number of special purpose groun stations (at least for voice communications) the question becomes "What band would be desirable to build the transponder, and t build the ground stations?" The 430 MH band is certainly a satisfactory answer bu not necessarily the only one. One end of the band could be used for transmission from the ground station and the other end of the band for reception at the ground station.

A very challenging thermal design problem will exist with project MOONRAY. Unlike project OSCAR where the small satellite was in orbit around the earth at nearly constant temperature, a long life transponder on the surface of the moon will be subjected to temperatures from —250°F during darkness to +150°F or 300°F in the sunlight depending on whether it is on a plane surface or in a crater or next to a rock, etc. It is assumed that the power supply would be designed to maintain the transponder electronics package temperature during darkness and that the temperature during periods of sunlight could be controlled by proper use of heat emitting and reflecting coatings.

[*Continued on page 120*]

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YLRL Convention [*from page 47*]
with blue net ruffles—how ingenious these YLs!

WA6AOE announced that the lovely arrangement of flowers at the head table was a gift from the executive director of the Eyebank in Denver, in recognition of the amateurs' contribution to the Eyebank Net.

Following the excellent dinner we were entertained by a Variety Show put on by some of our own talented YLs and MC'd by WØITB. The MINOW Net members put on a hilarious style show and members of BAYLARC, led by effervesent W6BDE, gave us a "Salute."

Again it was time for prizes, and thanks to the generosity of many people, and hard work of the Colorado YLs, there were 100 more to be drawn for at the banquet, including many lovely ones such as silver bowls, handmade sweaters, paintings, arts and crafts from many DX countries. When all had been drawn for the stubs were returned to the box for the special YL prizes. These included a bronze plaque from Chile, courtesy CE2SC, which was won by Ivy, VE3EZI; a gaily decorated Christmas tablecloth made by K8RAI and won by Clarice, W6AXX; an HW-100 from The Colorado YLs which was won by Beth, W7NJS. The autographed tablecloth was won by Jean, VE3DGG. The handsome coffee table, made by WØESC, OM of Estelle, WØESD, and incorporating inlays created in the design of the various YL club emblems, was won by an absentee ticket held by Louise, K4COB/VE6. The lovely afghan made by Hazel, K9QGR, also was won by an absentee ticket held by Catherine, W2RZQ, of the New York YLRL.

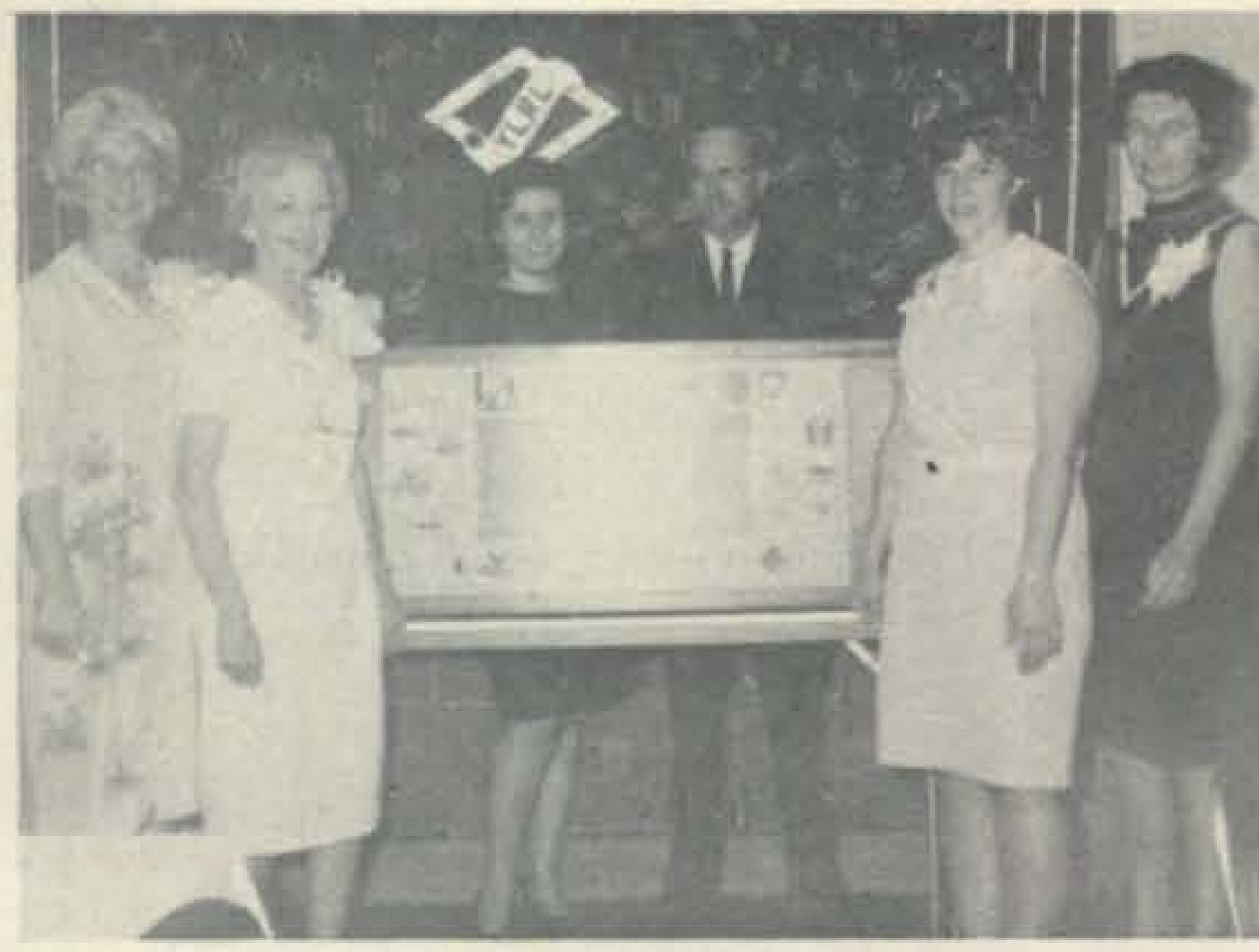
Finally the long-awaited moment had arrived—the drawing for the main donation prize—a Mustang complete with mobile rig (or Mustang and $200). The lucky winner was Dale Rogers, WA8PKQ, of Toledo, Ohio!

On Sunday The Colorado YLS maintained open house in the hospitality room with coffee and rolls for all.

Our Thanks

In their Souvenir Program the Colorado YLs wrote: "To the YLs and OMs, YL Clubs, DX YLs, and to all our friends, we wish to convey our heartfelt thanks and deepest appreciation for your many efforts in helping toward this convention."

All of us who so greatly enjoyed the convention in turn express our appreciation to



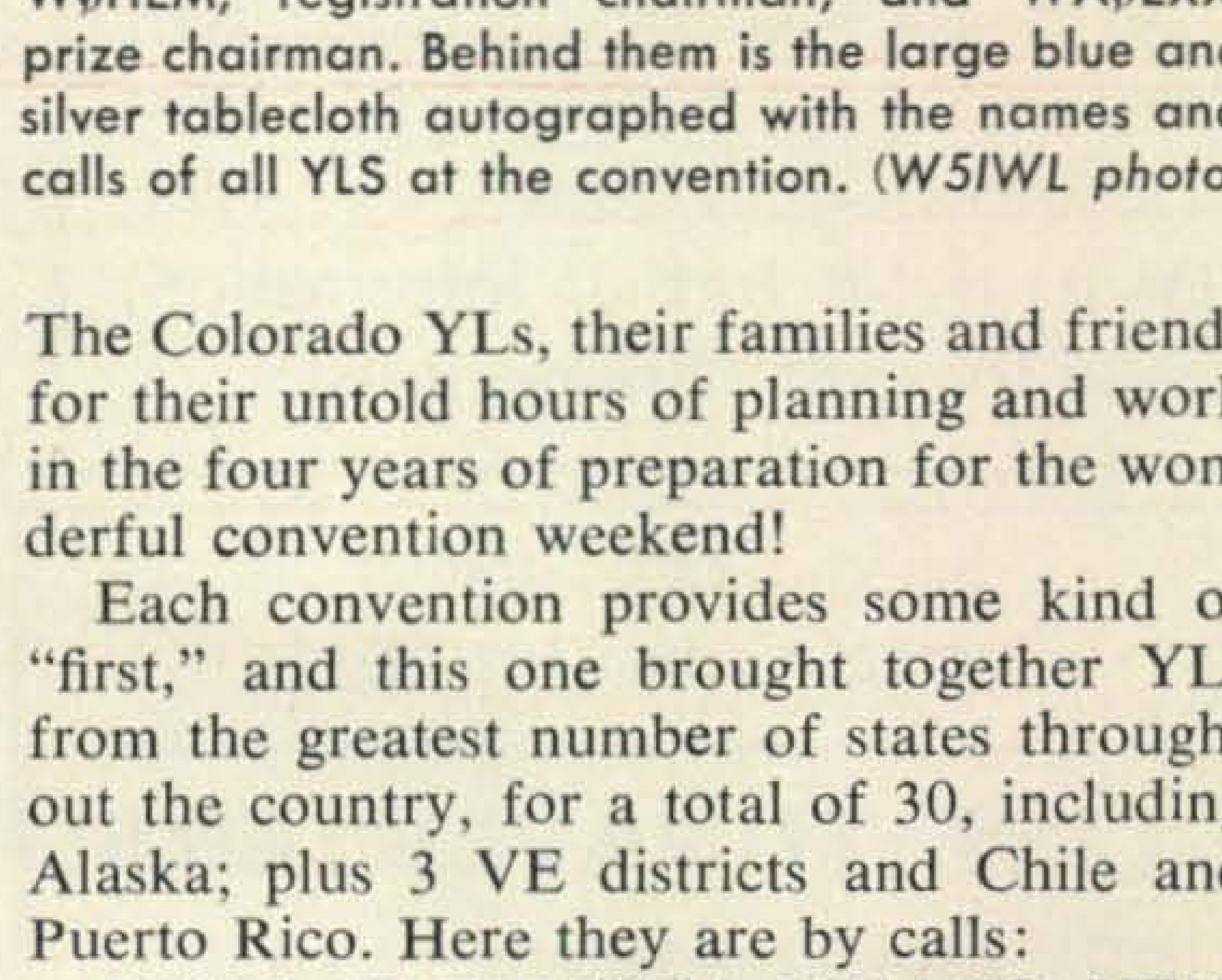
Prize time, l. to r.: KØEPE, chairman; KØBTV, co-chairman; WØESD and WØESC, her OM, who made the inlaid coffee table as a special YL prize; WØHEM, registration chairman, and WAØEXX, prize chairman. Behind them is the large blue and silver tablecloth autographed with the names and calls of all YLS at the convention. (*W5IWL photo*)

The Colorado YLs, their families and friends for their untold hours of planning and work in the four years of preparation for the wonderful convention weekend!

Each convention provides some kind of "first," and this one brought together YLs from the greatest number of states throughout the country, for a total of 30, including Alaska; plus 3 VE districts and Chile and Puerto Rico. Here they are by calls:

OE2SC; W1HOY/KP4; VE1AKO; VE3's BBO, CLT, DGG, DXZ, EZI, FUR; VE4ST; K1's GSF, IIF, IZT; W1's VOS, ZEN, YWT;

[*Continued on page 130*]



Marte KØEPE (left), convention chairman and vice president of YLRL in 1967, presented the first place phone award (gold cup) and the Corcoran award (plaque) for highest combined phone-c.w. score to Ivy, VE3EZI, which she earned in the '67 YLRL Anniversary Party. (*WB6BBO photo*)

Moonray [*from page 118*]

In conclusion, a single amateur radio voic communication link via a moon relay utiliz ing a five pound 250 cubic inch transponde is on the threshold of practicability if watts of power can be obtained from a thre pound isotopic power supply and antenna are provided which are equivalent to the te foot dish used for television from the luna module. Conversion of the lunar module disl antenna for use at 430 mc following com pletion of its mission at 2282.5 mc woul satisfy the requirement. ■

Ni-Cad Batteries [*from page 55*]

old workhorse is cheated of longevity whe it is given a one-hour charge at its full am pere-hour rating. The ni-cad suffers a grea deal more from abuse by overcharging tha the lead-acid type. Two or three severe over charges will destroy a battery or cell tha might otherwise have lasted for thousands o charge-discharge cycles.

One other thing to remember: A batter is only as capable as its weakest cell. You ma be able to get by with damaging only one cel of a 12.5 volt battery during a heavy charge But the battery is just as useless as if they' all been destroyed.

Gassing

Nickel-cadmium batteries generate gase during the last few hours of charging an during most of the cycle during an over charge. Hydrogen forms at the cadmiun electrode and oxygen forms at the nicke electrode. The vented cells, of course, hav ports to allow these gases to be freed alon with the electrolyte fumes during the charg cycle. But in the sealed ni-cad, the type use in most miniature electronic applications, th gases must be accommodated or used in som way to avoid destruction by overpressure.

Burgess ni-cad batteries are designed s the cadmium electrode has an excess ampere hour capacity. This feature causes the posi tive nickel electrode to become fully charge first so it will begin to generate oxygen. Th oxygen travels to the surface of the negativ cadmium electrode where it reacts to form cadmium oxide. The overall effect is to kee the cadmium electrode oxidized at a rate jus sufficient to offset the input energy, and th cell is maintained at a reasonably stable equi librium at full charge.

But even with this precautionary measure overcharging can damage the cell. High-rat charging can cause oxygen to be produce

See page 134 for New Reader Servic

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at a faster rate than it can be used at the cadmium electrode. This can cause pressure buildup to the point where the seal is ruptured.

Charging

Knowing the milliampere-hour rating of a ni-cad battery is extremely important if its life is to be protected. If there are no clues provided on the battery case, the rating can usually be determined within a fair margin of error by estimating. A standard D-size 6 volt cell (the size of a conventional flashlight battery) will have a milliampere-hour rating of approximately 250. Using the 10% rule, it can be seen that the basic charge rate is 25 ma, and by application of the "plus 50%" time rule, the proper charge period is 15 hours.

Trickle-charging may be employed if the battery is used at low drain rates. A general rule for trickle-charging is to maintain the charge level at 10% of the standard charge rate, and keep the battery under this charge during all periods of nonuse. The trickle-charge current for the D-size battery is 2.5 ma.

A very simple battery charger can be built up readily with run-of-the-junkbox parts. If the battery is not to be in use during a charge, a half-wave rectifier will be adequate. The diagram in fig. 1 shows a simple rectifier circuit and lists the component values for various charging currents.

With the lower voltage ni-cads, a very simple and satisfactory charger can be made with an electric-train or road-race transformer, a potentiometer, and an inexpensive meter. The electric-toy transformer offers the advantage of a pre-rectified low voltage output. The hookup is shown in fig. 2. ■

Six Element Yagi [*from page 49*]

element and trim so that all elements plus nylon line add to the same length. Element lengths are given in Table I; spacings in Table 2.

The next step is to take the two lengths of ⅜" rope and measure off the points where the elements are to be attached. This is easily done by taking both lengths of rope laid side by side and tying one end of the pair to a tree. Measure off about 20′ and spot with a marker pen. This is where the reflector is attached. Measure off another 13′ 4″ and mark for the driven element, making sure that both ropes are marked in the same place. Measure off another 10′ 0″ and spot

See page 134 for New Reader Service

See Page 134 for New Reader Service

for the first director. All remaining spacing are 13′ 4″ so continue accordingly. Whe this has been done, attach the elements to th rope. Be sure to use good knots with the thi nylon line, as the wrong ones will just com apart.

Cut the center of the driven element an install the insulator and feedline. All tha remains is to raise the antenna, using the end of the side support ropes to tie onto nearb trees. If not enough trees are available, coun on using more wooden posts. Get the antenn as high as possible and watch for kinks in th elements. If necessary, use thin line (nc wire) to pull the side ropes out a bit to lesse element sag.

Results

Although my beam is only 25′ high, found that I could work stations never pos sible with the 3 element Yagi I had on a 50 tower. Obviously, since the antenna can't b rotated, (but then again, neither can a rhom bic) it is best to align the antenna in the mos interesting direction. Since I wanted an an tenna that could be used to provide reliabl communications to the Far East, I aligne my beam accordingly. The results surpasse my expectations. The first morning that th band was open to the Far East, I worked different JAs in one hour, all of which gav me 579 or better reports. That morning I als worked a KR8, a VK8, and a whole flock o UA∅s, receiving good reports from one an all. I was running 350 watts at the time. Th next morning was even better. Besides whole log page of JAs and UA∅-UA9s, worked a KX6, a UI8, and three UL7s. found that I could work stations slightly of the main lobe but had trouble working then off the sides and back of the beam. I even tually put up a ground plane to use when th band wasn't open to Asia.

In order to arrive at an approximate valu of forward gain, I installed a reference dipol aligned in the same direction as the beam and at the same height. The same feedlin length was also employed. Upon tuning in a strong JA using the dipole, the signal in creased 2 S-units when the beam wa switched in. This would seem to indicate a 12 db gain over the dipole. Solid copy of certair stations was possible with the beam when th station could hardly be heard when either th dipole or the ground plane was switched in This to me is good performance from some thing so cheap and dirty. ■

See page 134 for New Reader Servic

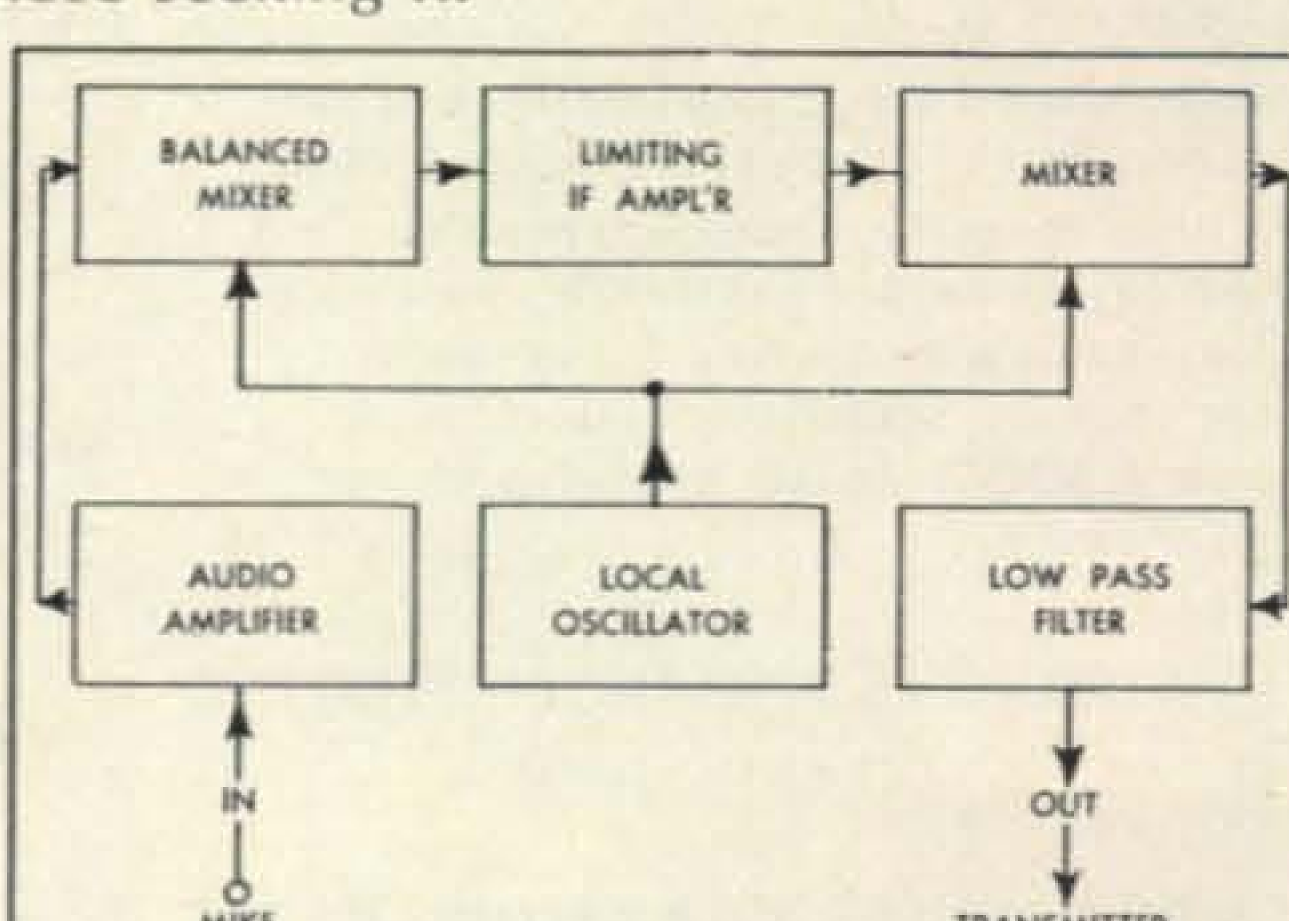
For Sale—More Usable Sideband Talk Power

- Instantaneous limiting action
- No appreciable distortion
- Talk power gain greater than 10db
- Completely compatible with SSB
- Optimum frequency response for voice
- Installs in microphone lead
- All solid state circuitry

A new design of distortion free audio clipper called the Comdel CSP 11 has been made available to the trade. Frankly, we are enthused about its performance from actual on-the-air tests. Two NCX-5's were hooked up to a SPDT coax antenna switch. One was barefoot with the processor in series with its mike. The other was using a BTI loaded to one kilowatt input and the same mike without processer. **Reports indicate almost comparable results.** I am not saying that the Comdel replaces the linear, but I do say that the greatly increased talk power is most obvious and therefore advantageous in pile ups or when the going gets rough.

The Comdel speech processer is in itself a complete miniature sideband transmitter and receiver with a common oscillator. Its circuitry includes filters and limiters designed so as to keep out the "crud" and at the same time, raise the average level of the spoken voice by a factor of 10 db. Each human voice is different. Various qualities of inflection, euphonics, and amplitude are characteristic of each of us individually. Our human voice has a notoriously low mean-to-peak signal ratio. Hence, the average signal, which determines the loudness at the receiving end, is only a small fraction of the total available peak power output. Conventionally, clippers are effective for increasing the mean-to-peak power ratio at the expense of severe and often objectionable harmonic distortion. Normally this distortion limits the usefulness of these clipping devices. In the Comdel speech processor, the objectionable harmonic distortion is absent and the intelligibility is enhanced by the unique circuit shown in the block diagram.

Conventional sideband transceivers or transmitters have power supplies which are designed for a duty cycle of about 15 to 25%. Application of the Comdel speech processor will make it necessary for the power supply to bear a substantially greater burden, since the average power is now approximately 60%. Thus the average transceiver of and by itself cannot be utilized advantageously by the Comdel. But if you have a transceiver which drives a linear with lots of room to spare, or if the linear that you have has a real bruiser of a power supply, such as may be found with the Henry II K or the BTI, or some Collins linears, or most home-brew linears, then the Comdel will positively amaze you with its effectiveness. The unit is completely transistorized and requires but 9 volts of DC at 18 miliamperes, with the negative side grounded. This power may be supplied by dry cells or by means of a dropping resistor from a higher voltage supply. The front panel provides an in and out switch which connects the microphone straight through the equipment, or shunts the microphone around the equipment, depending upon your own wish. The volume control provides a means for setting the peak level when the device is turned on. The Comdel is priced at $120.00, postage paid, in the continental limits of the United States. We have this very advantageous tool in stock, for immediate shipment, and we are heartily endorsing this product for use by radio amateurs or even commercial sideband stations. Literature is available for those seeking it.



BLOCK DIAGRAM CSP 11

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Swantenna – remote control		95.00
ustom Contour Bumper Mount.............		24.95
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CQ Reviews: Knight-Kits [*from page 79*]

load or cross modulation; receiver alignment and trouble shooting; trap adjustments, r.f. filter response.

SWEEP/MARKER GENERATOR—Visual indication of the entire response or bandpass characteristics of v.h.f. converters, other broadband circuits or amplifiers, r.f. filters[2], traps, s.w.r. bandpass, loss *vs.* frequency in attenuators, plus the commonly associated applications for alignment of TV and f.m. gear.

Unfortunately, space limitations do not allow a detailed description on pursuing these applications with this or similar test gear; but if sufficient reader interest is indicated in this area, we'll prepare such material for a future issue.

Performance

The performance of these instruments measured up to the specifications given earlier. Of special interest in this respect is the KG-686 R.F. Signal Generator, since a job like this for professional-type measurements on receivers using accurately known r.f. voltages[3] has heretofore been unavailable to the radio amateur at its low price.

Excellent performance in this regard is enhanced by low r.f. radiation leakage from the instrument. Such radiation, as *was* found did not introduce difficulties, even with measurements in the vicinity of 1 μv.

As for the Sine/Square-Wave Generator a handy feature is the step attenuator which is most convenient for use in conjunction with a reference output voltage for ascertaining the response, directly in db, of a.f. gear and filters.

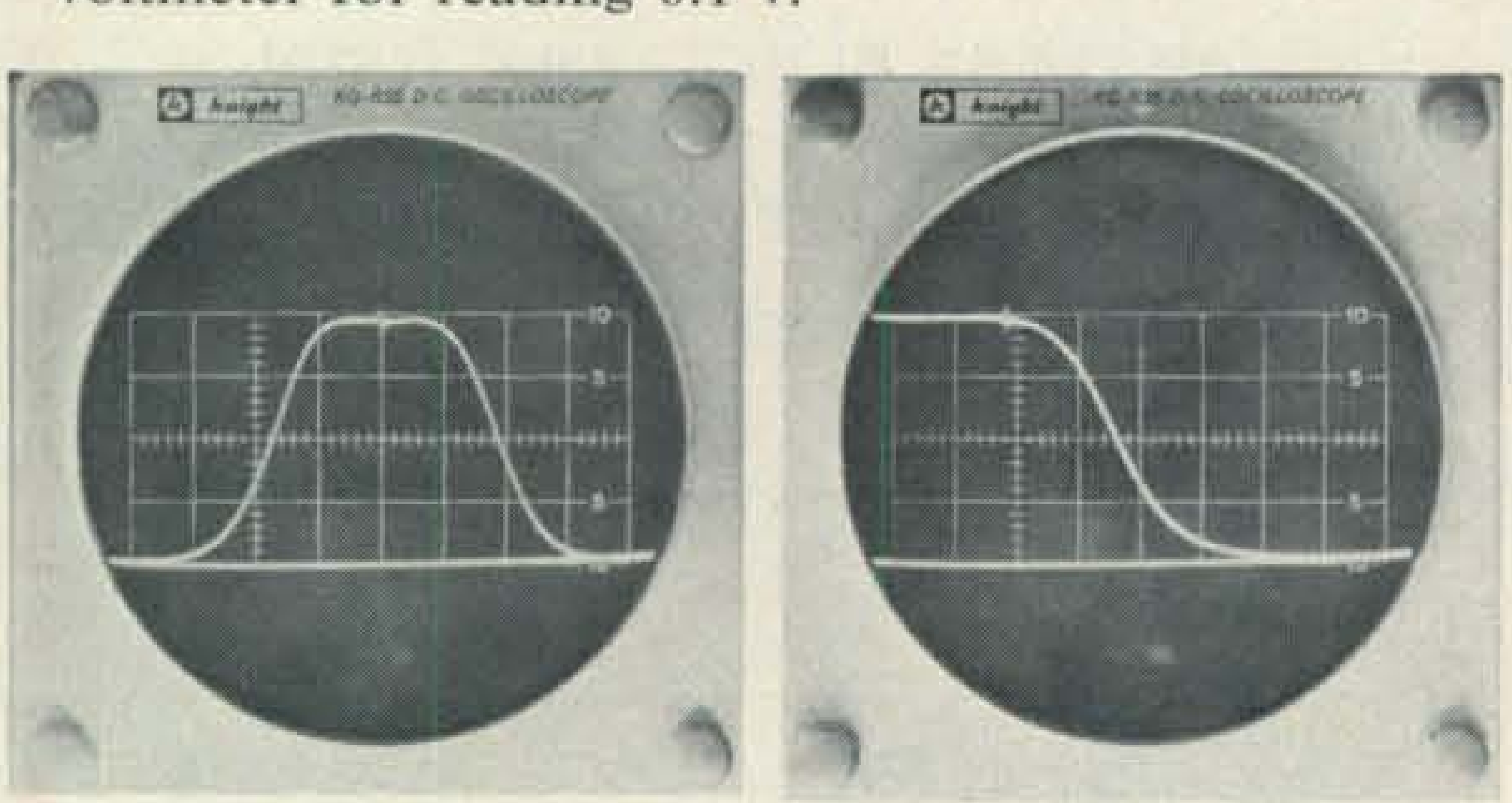
At fig. 1 are shown typical visual displays for the response of converters or the characteristics of filters, as obtained with the Sweep/Marker Generator and an oscilloscope. Where a bandpass response is involved the symmetry at the skirts, as seen on the scope, is dependent on the linearity of the sweep generator. This was found to be good in the 6-meter region, but some non-linearity around the 2-meter band caused skirt unbalance on the display; however, except for the lack of a nice-looking trace, this may not be of a serious nature, inasmuch as the marker birdies pin-point the actual relative points. Best overall accuracy also was experienced by using as narrow a sweep as possible consistent with obtaining the necessary information.

All told, these instruments will do a fine job and should be a worthwhile investment for those interested in the type of work associated therewith or for purchase by radio clubs for use by their membership.

The Knight-Kit KG-686 R.F. Signal Generator is priced at $95 (kit), $129.9 (factory-assembled); the KG-687 Sweep/Marker Generator is $120 (kit), $169.9 (factory-assembled); the KG-688 Sine/Square-Wave Generator is $75 (kit), assembled model is not available. These products are sold by Allied Radio Corp., 100 N Western Ave., Chicago, Illinois 6068(—W2AEF

[2] Except sharp crystal or s.s.b. filters for which a very slow sweep rate is required.

[3] Accuracy is largely dependent on that of reference instrument used during initial calibration which may be a d.c. voltmeter for reading 0.74 v. or an r.f. voltmeter for reading 0.1 v.



(A) (B)

Fig. 1—Sweep displays obtained with the KG-687. The sweep width has been set for 2 mc between the major horizontal-scale divisions. The vertical response is linear with respect to voltage. A—Bandpass response of 50 mc converter. The marker birdie is at 52 mc at the center of the curve. The response at 2 mc either side is about 0.5 db down. B—Cut-off characteristic of a transmission-line TVI filter. The marker birdie is slightly to the left of cutoff at 36 mc. Attenuation at 46 mc is at least 40 db at the calibration line to the left of the numerals.

Announcements [*from page 10*]

noon to 6:00 P.M. For further information writ K3ZCA, 239 Michigan Ave., Lowever Durrell, Pa 15068.

Des Moines, Iowa

The Jester Park Hamfest will be held Septembe 15, 1968, at Jester Park. Registration $1.00 per ham XYL's and harmonics no charge. For informatio write DMRAA, Box 88, Des Moines, Iowa 50301.

Knokke, Belgium

The "4th International Ham Convention" wi take place in the Casino at Knokke on the 13th, 14t and 15th of September, 1968. For further informa tion and a detailed program contact ON4LV, Lip penslaan 284, Knokke 1, Belgium.

See page 134 for New Reader Servic

YLRL Convention [*from page 119*]
W2's EEO, OWL; WA2FGS; WB2YBA; W3's OLY, PVH; WA3ATQ; K4LMB; W4's BIL, HRC, ZDK; W5's UXW, RZJ, ZPD; K5's BNQ, JKV, YIB, JFJ, ECP, OPT; WA5MPM.

W6's MWU, BIS, YKU, QGX, VDP, DXI, ALL, BDE, AXX, CEE, PJU, LBO: K6's GU, JCL, BUS, HHD, KCI, ELO, DLL, RLR; WA6's AOE, PKP, WFZ, UBU, LWE, OGK, BNS; WB6BBO.

W7's HPT, NJS, LXQ, GXI, ULK, GGV, HHH, QYA; K7's BED, UBC, UJV, YFD, CHA, WVT, YDO, BII, KSF; KL7FJW.

W8's, RZN, UAP, TAY, LGY, WRJ; K8's ZNC, RZI, MZT, BDC, PXX, LHF, UXM, CEN, ITF; WA8's HWL, EBS, ZMU, ARJ, UYJ, FSX, CJP, GPO; W9's RTH, QGR, LYU; K9's ILK, HGY; WA9HLW.

WØ's WZN, HEM, RAW, EVT, ZWL; KØ's EPE, KHR, WZS, SPW, LCZ, EVG, WGL, JFO, BTV; WAØ's FSK, KRB, KER, SSS, OIG, CSF, ECG, NNC, EXX, PPV; WNØUMB; WB6VJX/Ø.

Now we can enjoy many pleasant memories of "Our Big Date in '68"—and also look forward to 1972! ■

Vertical Antennas [*from page 44*]
the base in a ¼ wave tower, or at the voltage node (current loop) in the case of a tower taller than ¼ wave. The sampling loop is insulated from the tower, and its angular position is adjustable to vary the amount of pickup. The sampling line is brought down the tower on insulators, because it is usually buried from the base of the tower into the building. For the sake of easy reading of the phase monitor, it is customary to make all sampling lines of equal length, coiling up any excess in some out of the way place. This makes the monitor read correctly, without any "fudge factors." Perhaps some enterprising reader will build a phase monitor. It is not too difficult. Again, a visit to your local station may enable you to find a copy of a circuit diagram.

2 mc Vertical Arrays

With the increases of power recently granted in some areas of the country on 2 mc, and with crowded conditions on 4 mc, use of vertical directional arrays might pay off. This leads me to think about possible use of such an array here on the east coast to protect the Loran coverage areas, while still delivering a strong signal to the interior of the country. This might be an interesting point to explor with the FCC—whether the FCC would per mit one using an array to protect Loran area to run increased power input over and abov that normally permitted in his area. Such a array could be easily designed and tuned up and with proper monitoring equipment i could be every bit as effective as one for th m.f. broadcast band. If any of you have an thoughts on this subject, I would be happy t hear of them.

If you have enough land available, you ca put up a switchable directional array. Fo example, the array of fig. 29 can be used t provide coverage in six directions, by use o three elements spaced 180° on the corner of an equilateral triangle, and switched in o out by use of relays. The element would b used a pair at a time. Other interesting con figurations can be arranged, depending o the individual amateur's desired directions c communications.

(To be continued)

The readers attention is called to footno 10 in Part I. It should read "Proceedings c I.R.E., June 1937, page 753. Also, in fig. 1 of Part II, the designation of (A) and (B) reversed.

Signals From Satellites [*from page 34*]
the Doppler shift on the satellite's signal. Th relative velocity of the satellite with referenc to a listener on earth causes the satellite signal to change pitch in much the same mar ner that a train's whistle changes pitch as th train approaches and then moves away fror an observer at relatively high speeds. Th frequency on which the satellite is transmi ting will appear to increase as the satellit approaches, and decrease as it moves awa from the listener on the ground. The satellit is nearest to being overhead at the instant th pitch of its signal begins to decrease. At 2 mc the Doppler shift will be approximatel one kilocycle each side of the center fr quency, while at 136 mc the shift can be a much as six kilocycles, for satellites in orbi below a thousand miles.

With a suitable receiver and antenna, an the information contained in the followin list of trasmitting satellites, it should be po sible to tune into the wide, wide regions c space, and listen to the exciting sounds c the satellites as they flash signals back t earth.

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cause the advertisers and equipment contained in Ham have not been investigated, the publishers of CQ cannot ı for the merchandise listed therein.

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ERSEY QSO Party—Aug 17-18. See CQ Contest calendar onth for complete rules. D. Popkin, 303 Tenafly Rd, ood, N.J. 07631

LIKE to correspond with Hams living in the northern part mont and New York. ReJean Matthieu, VE-2-AEW. 12080 Boul, Montreal 9, Quebec, Canada.

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uly 1938 thru May 1950 $4.00 per year. Apex Model 36 odyne" All electric antique receiver, make offer. Starbuck, lian St., Denver, Colo. 80221.

perfect condition $175.00, D.C. mobile supply $25.00, p! Durwood Farmer, P.O. Box 1101, Goldsboro, N.C. 27530.

): Mechanical filter plug-in adapter 353E-1 for Collins lso Hammarlund converters SPC-10 and HC-10. Excellent n only. P. Dziulak, Box 386, Pell Lake, Wisconsin 53157.

RLUND HQ-110 in excellent condition, $175. WA2TLK, 15 ane, Roslyn Heights, N.Y. 11577, 516-621-6666.

egrated circuit keyer. Fully self completing. Built in AC and keying monitor. Relay output. Ready for operation. 200 cycle plug in CW audio filter. 6DB gain, $24.95. st Camera Repair, 3119 Arcade Bldg., Seattle, Wn. 98101.

ar new, Parks 144-1 $45.00, Parks 432-3 $40.00, Both 10 F. Johnson 6N2 and VFO $70.00. WØEUQ, 1822 S. 17th St., orks, N. Dak. 58201.

RBOLT. Complete with spare tubes. Will ship. $225. 511 Oak St., Roseville, California 95678.

E or Trade: HW-12 with spare final tubes and manual less upplies. Condition excellent—$85.00. Heath Sixer HW-29A. er transceiver. Brand new with all cables and manual. Want SB-200 linear. W5PKM, 321 Burgess Pl., Baton La. 70815.

: Non working or damaged HW22 or HW32. Must be rea- for ham class. Curt Foltz, 234 So. Richmond, Carson City, 80901.

Fourth Annual fun convention scheduled January 8-12, Hotel Sahara's new space convention center, Las Vegas, Advanced registration closes January 1, 1969. Ladies pro- Don the Beachcomber. Technical seminars, FM, MARS, CWA, WCARS-7255. Registration $12.00 per person en- SAROC" participant to special room rate $10.00 plus room night single or double occupancy, admittance to cocktail technical seminars, exhibit area, Hotel Sahara's late unday breakfast equal to any banquet dinner, ask any " veteran. Brochure planned November mailing for details L card with ZIP Southern Nevada ARC, Box 73, Boulder vada 89005.

sed gear has trial-terms-guarantee! SR46-$94.50; SR500- ; HW12-$89.95; HW22-$89.95; Galaxy V-$289.95; Galaxy 9.95; TX62-$99.95; 75A3-$229.00; 51J3-$395.00; NC300- ; RME6900-$149.95. Hundreds more low prices. Free Blue- t. Write WRL, Box 919, Council Bluffs, Iowa 51501.

UCTIONS can be taken for full value of old parts, rcvrs, tubes, magazines, tech books, etc., donated by you to ams, a non-profit organization of physically-handicapped s and those studying for licenses, who are financially to purchase gear to get on the air. Send donations of nt, etc. which will be acknowledged to Handi-Hams, c/o man, WØZSW, Route 4, Rochester, Minn.

TWO METER Station: Clegg 22'er with original box, instructions, one halo never used. All $175. Gerry Skloot, WB2FJX, 158-14 85th St., Howard Beach, L. I., N.Y. 11414. Phone 212-MI 1-4573.

FOR SALE: Add 12 v. to 6 v. VW for ham gear. Complete mint Motorola Alternator, regulator, pulley and mount from 62 VW. $60. V. R. White, W4BPQ, 1414 Ft. Bragg Rd., Fayetteville, N. C. 28305.

F.M. 60/W 2 meter base station $50, Bird #74 Coax switch $20, Want 450 M. C. F. M. Transceiver, W. Davis, 4434 Josie Ave., Lakewood, Calif. 90713.

SELL or trade-Eico 753 transceiver, ss vfo, d.c. supply, Hustler: mount, 75 and 20 M resonators. Want telescope or offer. WA8CKT, J. Wagner, 662 W. Lincoln, Caro, Mi. 48723.

WANTED: R-100 or R-100A RCVR. Must have S-meter. Will pay $45. Sell Eico 753 and 752 DC P. S. $175 for both or sell separately. Make offer. R. L. Guard, K4EPI, Box 7542, Patrick AFB, Fla. 32925.

CQ's and QST's, 1947 through 1966 one or dozen 25¢ each plus postage. Erv Rasmussen, 164 Lowell, Redwood City, Calif. 94062.

MASTER MOBILE antenna, bumper mount, coils 80-20-15 new $30 postpaid. KW ATU for longwire antenna $15 postpaid. A. Rugel, Rt. 2, Box 1941, Escondido, Calif. 92025.

BOOKS on Antenna/Propagation Theory, Microwave Theory wanted. Info on amateur microwave antenna experiments desired. "Reference data for radio engineers" By itt book wanted, state edition, price desired. D. R. Etheredge, 12040 Redbank St., Sun Valley, Cal. 91352.

FOR SALE or trade: 180 new, pre 1947 receiving tubes. About 150 separate numbers. All to go. All but 6 in original cartons. Write for listing. Donald R. Knott, WAQNQH, Raymond, Minn. 56282.

GALAXY: V MK II, like new, $325. Galaxy Deluxe Accessory Console, $60. New-Tronics Cliff Dweller Rotatable Dipole 80/40/10 meters, never used, $85. All items postpaid. W6UFJ, John Schroeder, 5625 Quinn St., Apt. 0, Bell Gardens, Calif. Tele. No. 213-927-5478.

WANTED: Carrying case for SBE-33 transceiver. Collins carrying Case CC-3 for 312B-5. Heinlein, 107 Wyoming St., Boulder City, Nevada 89005.

HEATH ELECTRA Keyer $40—Waters Compreamp $20—Vanguard 6M. Conv. BCBIF $10 Mif. $15. Joe Heffler, WB2QFR, 2200 Morris, Bronx 10453, 212-295-1694.

WANTED: SX117, MAIO, SX100, 75A Series, 355 Series. Even Faulty Units OK. Details to Rodukoff, 21 Derby St., Hawthorne 4171, Brisbane, Australia.

WANT: 32-5-1, 516F-2 312B-4, Mech. Filter F455Q5, Coax Ant. Switch, Manual CV-57. K2HWP, Tom Conley, 28 Bayberry Circle W, Liverpool, N.Y. 13088. (315-452-9011).

SALE: Heath 10-21 Scope, demod. probe, Lafayette audio generator. $50. Wm. Karl, 24 Mill St., Cooperstown, N.Y. 13326.

3B28 TUBES: New, pair for $5.00 plus $1.00 parcel post and insurance. E. A. Hubbell, W7DI, 6633 E. Palo Verde Lane, Scottsdale, Arizona 85251.

2-WAY RADIO Business and Property for sale 100' Tower. Ideal Qth. Write, Jack Mayr, Radui Doctor, 818 Salem St., Chico, Calif. 95926.

FOR SALE. Ameco CN-144-W factory-wired 2m converter. Output 28-32mc; easily changed. Almost new. Instructions. $30 ppd, K9YRA, 1017 Pfingsten, Glenview, Ill. 60025.

"SAROC" Jan. 8-12, 1969 in Hotel Sahara's new Space Convention Center, Las Vegas, Nev. QSP QSL ZIP Box 73, Boulder City, Nev. 89005.

G3IDG would appreciate old ham call license plates, for decorating his shack, from KH6, KL7, KP4, KZ5, and VO. F. Herridge, 96 George St., Basingstoke, Hants., England.

FOR SALE: RG-8/U, Co-Ax Cable, new-70 feet for $3.00. 300 feet for $12.00. Dale R. Lee, W3JRM, 1228 Shelbourne Dr., Bethlehem, Pa. 18018.

DX100 modified for SSB $50; Johnson Valiant $95; Monitoradio DR200 $100; Measurements 78B, 25-50 and 120-240 Mc. Sig. Gen. $80. J. Wasiewicz, 4230 N.W. 10 St., Pompano Beach, Fla. 33063.

WANTED: 5 band SSB transceiver in excellent condition. $300 cash maximum. A. G. Barry, 135 N.W. Drive, Patrick AFB, Fla. 32925.

TWOER with mike and stand, 145.170 XTAL, 2 extra new 6BA8A's, manual. $45 plus postage. D. Hershberger, WA9QCH, 1033 DeKalb Ave., Sycamore, Ill. 60178.

RTTY INFORMATION for the Amateur interested in RTTY. F. DeMotte, P.O. Box 6047, Daytona Beach, Florida 32022.

ANTIQUES—Desire purchase old shipboard receivers such as Navy SE 1420 or IP-500, IP501, Etc. K4GT, Frank J. Shannon, Sr., 140 Bosphorus Ave., Tampa, Fla. 33606.

FOR SALE: CQ and QSTs 1950 thru 1960 inclusive. Best offer. E. G. Taylor, 4100 Worthington Dr., North Highlands, Ca. 95660.

COLLEGE STUDENT in financial trouble, must sell as is: SB610-$70; SB630-$75, Warrior Linear-$180 Gonset GSB-100, Needs plate Xformer and rectifiers, for only $110. WB4BGU, Scott Galbraith, P.O. Box 862, Cookeville, Tenn. 38501.

age 134 for New Reader Service

FOR SALE: SX101-$100.00, Knight R100A-$70.00, BC1032 Panadapter-$35.00, Ranger II-$150.00, DX60-$40.00, HW32-$75.00. Don Ahonen, Rt. 1, Box 291A, Lisle Road, Owego, N.Y. 13827.

FOR SALE: Heath SB-200 w/xtra pwr trans. $200. Swan 350 w/117XC and Ameco pt preamp $330. Drake W-4 wattmeter new $35.00, Heath HO-15 phone patch new $15.00. K2RUD Dave Shineman, 502 Thurber St., Syracuse, N.Y. 13210.

SELL: Jennings vacuum variable capacitor. UCS-500. Brand New. $56.00. Charles Kaptain, 2225 Albion, Denver, Colorado 80207.

Q.S.L. Cards $6.95 per (1,000). C. B. Wholesale Printers, P.O. Box 994, Anderson, Ind. 64015.

HALLICRAFTERS HT32 like new, $250. Globe-King 500A 160-10 CW. AM. with your exciter will run 700 watts. SSB. ALC extra final vfo $195. Like new, 3-5 KVA generator $200. Ship. John Smith, 1924 Dolphin Blvd., St. Petersburg, Fla. 33707.

WANTED to buy Heathkit Model QM-1 "Q" meter in any condition. James Fred, RR1, Cutler, Ind. 46920.

MORE DX with a new QSO phrase book. Spanish, German, French, Russian. $3.00. M. Holubov, VE2BAG, 22 Vaudreuil Baie Comeau, P.Q. Canada.

HEATH SB-400, factory inspected, used only 10 hours, $275. Hammarlund HQ-180, exc. cond., $225. Deliver 50 miles or FOB. Hoshal, Box 191, Aberdeen, Md. 21001.

WANTED: Clean, converted ARC-5 for 80 mtrs. with 115 v.a.c. P.S. Prefer AM and CW rig. CW only considered. Describe and price. Bill Lindblom, 512 Grandview Ave., Chillicothe, Mo. 64601.

MAGAZINES wanted: CQ, 1945, Jan. Feb. Mar. June. Buy or other issues to trade. Also RTTY magazine. Fred Schmidt, W4NYF, Box 8873, Ft. Lauderdale, Fla. 33310.

FOR SALE: Hy Gain 14 AVQ and 14 RMQ. 3 months old and in excel. cond. Best offer. E. Levin WA2BPL, 415 Sheffield Rd., Cherry Hill, N.J. 08034.

NOVICE XMTR 50 watt 2-stage w/6146A amp. Hi-eff. home brew compact commercial construction, w/dual P. S. keying and antenna relays $40. Megeff, W2DXK 5015 Weeks La., Flushing, NYC 11365.

HEATH IM-30 transistor tester and IP-20 regulated power supply (up to 50 volts at 15 amps, metered), both like new, $49 each or $89 for both. C. F. Enix, W8EN, Box 474, White Pigeon, Mich. 49099.

WANTED: Schematics or Manual for Bendix Communicator Unit. Type M. M. T.-3B. Western Electric VHF receiver. Type B.C. 406. R. Walker, VE2APW, 78 Marois Blvd., Laval Des Rapides, Montreal 40 Que. Can.

SELL: Excellent CE100V $495. Kent Merkel, Box 144A rr 1, Lexington Park, Maryland 20653, 301-863-5967.

EXPERIENCED KIT Builder in Benton Harbor Area will build your heathkit. W8TXX, 712 Marvin Ave., St. Joseph, Mich. 49085.

SELL: Hammurland HQ110C Rcvr $125.00. Globe Hi Bander VHF 6&2 Xmitter $65.00 National V.F.O. Model 62. $35.00 Astatic D104 Mike with stand $15.00. All units mint condition. John E. Spiegel, W4MEL, 1586 Moravia Ave., Holly Hill, Fla. 32017.

WANT Complete Tuning Condenser for SP-600 State Price, Be Reasonable. Merlin C. McCoombs, W4GZL, 505 Cedar Rock Road, Easley, S.C. 29640.

SELL Central Electronics 100-V. Excellent Condition $35.00 FOB. Also sell cv-89 teletype converter. $175.00 W4AIS, 7 Artillery Road, Taylors, South Carolina 29687.

M.I.T. Radio Society desires to recover old QS's, correspondence, etc. from stations 1XM, 1MX, W1MX, for historical file. Box 558, 3 Ames St., Cambridge, Mass. 02139.

TRADE: Homebrew 6 meter 15 watt transmitter, see CQ '62 page 50. NEED: BC-221 or I-177-B tube tester. Stan., 2748 Meade, Detroit, Mich. 48212.

SELL 10 Panel Meters, Assorted Ranges, Mostly 0-1 Ma. DC Basic Movements. Only $19.00 for all. Samkofsky, 201 Eastern Parkway, Brooklyn, N.Y. 11238.

FOR SALE: Northern Radio Company, demodulator type 104. $30.00. P. L. Lemon, W6DOU, 3154 Stony Point Rd., Santa Rosa, Ca. 95401.

COLLINS 75A3, Serial 505 with F455B-31 Filter, Manual IMMA culate. Will ship, $225.00. John Gardella, WNIJFG, 120 Oaktree Dr., North Kingstown, R. I. 02852.

FOR SALE: Johnson Ranger I in Perfect condition (New Tubes and Recently Aligned) $85 or Best Offer. Will also trade toward XCVR. Tom Ginkel, WA0AHV, 820 Center St., New Ulm, MN. 56073.

WANTED: Remote Control Console similar to Motorola T-1200. Have cash or will trade RTTY Equip. All letters answered, J. Thomsen, W9YVP, 8280 S. Tennessee, Claredon Hills, Illinois 60514.

HEATH HO-13 Ham-scan (IF set for SB series), $64; Heath HX-11 50 watt cw transmitter, $34; Heath Twoer 2-meter transceiver, $29. C. F. Enix, W8EN, Box 474, White Pigeon, Mich. 49099.

TRADE—Freq Meter TS 174-U 20 to 280 Megs with power. Want filters for 75A-4, or what have you. Lee Roy Scott, W5DL, 335 Burwood Lane, San Antonio, Texas 78213.

WANTED: Collins DL-1, and SM-2 Mike. Will sell or trade, Pr
612 tube tester, E-200C Sig. Gen. Collins 35C-2 Low Pass
All like new. H. L. Green, W9ARM, 1 Fleetwood Dr., Munc
47302.

FOR SALE: All in excellent condx, will ship. Apache TX-1,
SX-43, $40.00, HQ129X, $45.00. Coan, W3CPU, 1513 Farlo
Crofton, Md. 21113.

PROFESSIONAL OSCILLOSCOPE—5MHZ, triggered sweep—E
Condx Good price. R. M. Mendelson, W2OKO, 27 Somer
Murray Hill, N. J. 07971.

WANTED: 30 S-1 Amplifier. T. G. Soukup, WA1AWX, RFD
Hill Rd., Ridgefield, Conn. 06877.

SWAP or SELL: Bolex B8 movie camera and case, $35.00.
Autoscope projector, $90.00. I177 Tube Tester, $20.0
Curta Computer, CIE slide rule, Gonset Super 12, K5M
Woodcrest, New Iberia, La. 70560.

TOROIDS, 44 and 88 mhy. center-tapped, unused, 5/$1.5
PAID. 11/16" paper tape $3/box. Tecraft two meter tra
with P.S. $30. Globe chief 90A $25. D104 with "G" sta
HQ100AC $90. WANTED: Rotator, matchbox, RTTY gear
gear. Van, W2DLT, 302X Passaic Ave., Stirling, N.J. 07980.

VHF/UHF Group Desperately Needs any of the Following P
lications—VHF Horizons; 6 up; VHF Amateur; '61 and '62
Radio Engineers Handbook. Please can you help us? W
some issues of Qst, CQ, or buy. All offers answered. D. R
edge, K6UMV, 12040 Redbank St., Sun Valley, Cal. 91352.

WANTED: Heath HP-23 AC power supply. Any condition
Ludkiewicz, 143 Richmond Road, Ludlow, Mass. 01056.

BACKBONE cardioid mike. EV-674. Brand new, $40. fob J
guson, 336 Brookside Blvd., Pittsburgh, Pa. 15241.

STOP & LOOK! C.E.-20A $100, Hallicrafters SX-100, Tw
Ameco CN-50 (7-llmc.out) $35, and more!! Peter Gould, 4
bardy Rd., Drexel Hill, Pa. 19026.

WANTED: Swan 402 Oscillator (Tunable) Trade BC221 T
or what do you want. Les Basham, 735 Caves Hwy., Cave
Oreg. 97523.

WANTED: Professional 'Scope Cart. Will Trade Heath 1
pedance Bridge or Cash. Bill Blake, W5SCM, Star Ro
135D, Columbus, Miss. 39701.

CAPACITORS for Sale. Sprague 22,000 MFD 50 Volt C
Grade $3.00. R. C. Vail, 2514 Birch Dr., Richmond, Ind. 4

FOR SALE: Astatic D-104-C $12.00. Transmitter for 2 Me
T-14 TRC1 10 watts low power, 50 watts High power, Pow
is enclosed in unit, Manual included $60 F.O.B. H. S
K4VFA, 915 Madison St., Manchester, Tenn. 37355.

WANTED: Power transistors-2N1100, 2N174, 2N1412, 2N1
K2CBO, 1268 E. 12 St., Brooklyn, N.Y. 11230.

RELINQUISH—High quality. Hammarland HQ170C nearly n
ual and TLC included write Al, K7JYR, 5012 11th NE,
Wash. 98105. Split shipping costs.

WANTED: CB. old model Brownings, General MC-6. Bob
Box 565, Grove Hill, Ala. 36451.

SALE: HT-40; L/N $60, 180 W. SSB xmitter; $180, 2 KW
$300, Photo on Request R.C.A. Scope 160B; $50, Dumo
208; $50. L. Kulhay, 19 Topstone Dr., Danbury, Conn. 068

FOR SALE: Handsome green buckram bound volumes of
1967; blue bound volumes of QST 1963-1967. Also unb
1947-1962. Best offer. Frank Zerilli, RD #1, Box 620, P
N. J. 08540.

WANTED: BC-348 Receiver, also Grid-DIP Meter. Richar
K5YBB, 3409 Sevier Dr., No. Little Rock, Ark. 72116.

FOR SALE or trade: 60' crank up tower-triasto THD 354,
204BA 20 MTR Beam, AR-22 Rotator, Home Brew 4-1
Linear. Wanted—Swan 350. Please make an offer. All
answered. Tom Frenaye, WB6KIL, 617 Purdue, Clarem
91711. Phone 714-624-8138.

SALE: B&W Low-pass Filter #425 52 ohm 1 KW rating
Smith, 915 Lovera, San Antonio, Texas 78201.

VHFers, for sale, Tubes, 2C39, 2C40, 2C42, 2C46, 3CX100
5675; Gear APX-6, R-77/ARC-3, R-574/ARR-39A, etc. S.
brings list. W8GNS, 1185 Mosswood Ct., Cincinnati, Ohio

JOHNSON K W & desk: Last one factory made. SSB-AM-CW
2-4-400A. Ranger 1, HRO-60 with—A-B-C-D—AC coils C.
audio compression amplifier Mod. AFC2. One owner all
dition. Package deal $1200. Jack King, K9CET, 4849 N. G
Ave., Milwaukee, Wisc. 53209.

WANTED for ham shop: Have 100 channel 44 and 45 su
Frequency Crystals For sale or trade. W5BSU, W. D.
1210 So. 93, East Tulsa, Okla.

FOR SALE: AF-68 Transmitter. PMR-8 Receiver. Model 10
Supply. Turner Mobile Mike. Cables and 3 Manuals in
dition. $110. E. W. Edwards, WA9CZC, 9609 W. 57t
Grange, Ill. 60525.

CANADIANS: Wanted SB 10, SSB Adapted with Manual. St
and Price. D. G. Miller, Chester, N. S., Can.

See page 134 for New Reader

LE: 800 watt 14 mc final and pwr sup described in Mar. 64/ Q. Price $80 will not ship. W6BLZ, 528 Colima St., La Jolla, 92037.

ONLY: Plate xformer 2440-1340-0-1340-2440 vac, 203 vac l primary. 4t kilowatts, CCS. Need high mfd 4kv oil cap, or have you? R. Nelson, 110 Morning Valley, San Antonio, 78227.

N VHF Transmitter $50; LYSCO 160-10 VFO/AM/CW $35; 52A $20; Cleanup List Stamp. Spitz, 1420 S. Randolph, ton, Va. 22204.

r TRADE: Heath SB-400-$260.00. HRO-60 with speaker, Cali- and all coils for 80 through 6 meters—Excellent condition .00. Want Ncx-5 or SB-34. J. Shank, 21 Terrace Lane, Eliza-wn, Pa. 17022.

75A3 Prod. Det. Audio AVC3-1-12KC Filters SPO SPKR $200. B Slicer QMULT. $25. Knight P2 SWR Meter $12. M. Segal, itani Place, Teaneck, N. J. 07666.

ED: Skeds with YL's in Ark., Del., Hawaii, Mo., Nev., Okla., Tenn., Utah, W. Va., and Wyo. to Complete WAS/YL. A. La K2DDK, 28 The Beach Way, Manhasset, N.Y. 11030.,

ALE: AMECO CN-144-W factory wired Zm converter. Output nc; easily changed. Almost new. Instructions. $30 ppd. ro, 1017P Fingsten Road, Glenview, Ill. 60025.

z markers from your 100KHz calibrator. Ready to install nstructions. $6 postpaid. J. Green, Box 1038, Boulder, Colo.

ALE: Johnson Ranger I, $75. Knight VTVM, New meter $20. vertical w/o loading coil, $10. Wanted—Joystick, reason-. Kaser, 314 Birch Lane, Paw Paw, Mich. 49079.

TION ALL Novices! I have new extrals I want to sell: 3.724, 3.740, 7.192, 7.196. Cheaper then wholesale. Want for $1.25/1, or will swap your 15m. xtals. L. Sweet, P.O. , Hobbs, N.M. 88240.

D: Old battery operated radios of the early '20's. Also early wireless equipment. State price, model, and make t letter. These need not be in working condition. D. Mc-, 1200 W. Euclid Ave., Indianola, Iowa 50125.

T IV very good cond. National 200-AC200-AC supply-DC supply. All like new. $400 or best offer. W. Shapiro. iffside Ave., N. Woodmere, New York 11581.

Pair RCA 2043 one inch scope tubes $6; 12VDC PE-98 sup-r SCR 522 $5; TS-382-F $145. Brown, 15 Fisher Dr., ille, SC 29607.

ALE: Henry 2K2 linear. Final tubes not guaranteed. Looks new. $450. Will ship. W. Nicol, M.D. 3678 Bechelli Lane, g, Cal. 96001.

D: KWM2 or S line or SB101-100 Good cond. reasonable. le, 251 Collier Ave., Nashville, Tenn. 37211.

D: Old tube type CB sets in as-in but working condition. ption, accessories and price 1st let. B McGwier, P. O. 65, Grove Hill, Ala. 36451.

JAMES Knight Co., secondary frequency standard. 100-KC. L. Stapp, 2903 ASH., Hays, Kans. 67601.

LE: Seneca 6NZ transmitter & Plate modulator. J. Wantz, 2, W. Liberty, Ohio 43357.

Bendix 150 MC Transceiver, two channel, 12/110V use i Base or Mobile, like new $40. W. J. Davis, 4434 Josie , Lakewood, Cal. 90713.

ADIOS, tubes, parts-circa 1925 AK's Amrad, RCA, Lemco-full, $150. West coast only. J. Mayr, 818 Salem St., Calif. 95926.

WE 219 VLF filters, contain 8 cupcore Ind. and 23 mica BT 45 KC-$10 each. R. H. Sanborn, 5665 N. 38th St., kee, Wisc. 53209.

Globe tell direction of your beam. FOR sale: 10 pr. 110 V. chronous Units type XV. Unused surplus in original metal den containers. $20 pr. V. White, 1414 Ft. Bragg Road, ville, N.C. 28305.

To Fish noises; Navy JR-1 sound receiving equipment—w $60 FOB. Send for details. Vincent Barker, West Dr., ven, Sag Harbor, N.Y.

LE: DX-100B Transmitter, HQ-170C Receiver Swan 350 with C & DC power supplies, all in good condx. R. Dorough, Box 61, Terrell, Tx. 75160.

OLD RADIO Equipment, receivers, parts, transmitters, magazines and books wanted for amateur museum, E. Rasmussen, 164 Lowell St., Redwood City, Calif.

40 METER CW Transceiver: 40 watts input; conv. command receiver and power supply in one cabinet; Knight span master. Sell or trade for Antenna, Tower, or PS-2V. C. Coggins, 7235 Hunters Brance Dr., NE, Atlanta, Ga. 30329.

SET TO GO on 1750 meters. Want local skeds. R. Cobaugh, W2NX, 29-29 213 St., Bayside, N.Y. 11360.

JOIN THE OOTC. IF you have been licensed 40 years you are eligible. Send a QSL card to C. Boegel, Jr. 1500 Center Pt. Road, NE. Cedar Rapids, Iowa.

WANTED: Any novice or general interested in starting a weekly net to serve the states of Ohio. Mich., and W. Va. T. Sommers, RFD 1 Box 137, Bridgeport, Ohio 43912.

FOR SALE: Hallicrafters HT 37 and HT 41 both $400. M. Rexsen, 493 Oxford Road, Cedarhurst, N.Y. 11516.

FOR SALE: Like new heath 5 band HW-100 used very little perfect $259. A. Geheard, 326 W. 3rd St., Berwick, Pa. 18603.

FOR SALE: Galaxy 300 transceiver with pwr supply $185. Bandit 2000B zKw linear $225. D. Goover, 1021 W. 14th, Hastings, Nebr. 68901. Box 684.

WANTED TO BUY: Power transistors 2N1100. 2N1412. 2N174, 2N1358, 2N278, DT-100 or similar types. K2CBO, 1268 E. 12th Street, Brooklyn, New York.

SWAP: HW-32 with crystal calib. & Mic. for HW-12A K2QMM, 79-35 209th St., Bayside, N.Y. 212-776-8069.

"HOSS-TRADER," Ed say's if you don't buy your HAM Gear from him you might pay too much. Write us or Telephone for best trades anywhere in U.S.A. Used Equipment: HT-37, $179.00; Galaxy 5 transceiver, $249.00; SR-150 & AC supply, $339.00; HA-350 receivers, $59.00; Drake 2-A, $139.00; HRO-500 receiver mint: $1,095.00; SB-34 $269.00; Swan 500, $319.00; L-4 Drake linear, $419.00; 20-A, $75.00; Viking 500, $249.00; HQ-170-C, $159.00; 75S-1, $289.00; 32S-1, $389.00; 75A-4, $395.00. Discontinued new gear; Swan 500. $379.00; NCL-2000, $489.00; National VX-501 VFO, $129.00; NC-200, $279.00; New Rohn 50 ft. foldover tower prepaid $195.00; New Classic 33 Beam and Demo-Ham M Rotator, $189.50; Display BTI LK-2000, $639.00; Ed Moory Wholesale Radio Co., Box 506, DeWitt, Arkansas 72042. Phone Code (501) 946-2820.

TELETYPE 28KSR console and 28 unchecked tape equipment. Sell or trade for 28 page printer may be incomplete or not working. D. C. Harrington, 1620 Gardena Ave., Fridley, Minn. 55421.

AUTOMATIC CQ sender for sale. Works well with inexpensive imported recorders; Battery or A.C. C. C. Coggins, WN4JFV, 7235 Hunters Branch Dr., Atlanta, Ga. 30328.

KW PARTS: B&W 852 Tank Coil; also Jennings Model UCS-300 Vacuum Variables—Send offer: M. I. T. Radio Society, W1MX; Box 558. 3 Ames St., Cambridge, Mass. 02139.

FOR SALE: Wheatstone oiled 15/32" perf. tape for Boehme keying head. any quantity. P. Lemon, 3154 Stony Point Road, Santa Rosa, Calif. 95501.

WANTED: 1Z2 Electron Tubes. State price and quantity. J. T. Smith, W8ESH, P.O. Box 1034, Huntington, W. Va. 25713.

SHACK Cleanup. Send two, loose, 6¢ stamps for big list of clean items. R. A. Leskovec, 25884 Highland Rd., Cleveland, Ohio 44143.

SHACK junk box cleanout. $$$worth useable goodies for projects you intend building some day. No trash. money back guarantee. Ppd pkg $3.50. Irv Megeff, W2DXK, 5015 Weeks La., Flushing, N.Y. 11365.

FOR SALE: Gonset G-50 8 mo. old mint. $250. Gonset II-B 12/117v, mint $125. Want G-76 AC & DC power supplies. will swap gear. Have 6 meter SSB. J. Gysan, 53 Lothrop St., Beverly, Mass. 01915.

MEMBERS wanted for the worked all states Net. Increase your WAS. Forms and info. R. Hajdak WA3JDT, 4 Homer St., Greenville, Pa. 16125.

TRADE: R4A for SB-101, SB-100 or other Xcvr. Trade or sell CN50, Navigator & Vanguard 300Q (2 mtr) Jon P. Zaimes WA3BGN, 6117 Smithfield St., Harrisburg, Pa. 17112.

SELL: Mint SBE-34, SB2-LA, Mike, Mobile Mount, Hustler Deck Mast, Resonators for 75-40-20 meters, new unused Mini-Products 2 element 6 thru 20 meter beam. First Certified check for $550. or best offer take it. WA9PTJ, S/Sgt. Laurence E. Rasmussen, Co C, Box 82, DLIWC, Monterey, Calif. 93940.

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Advertiser's Index

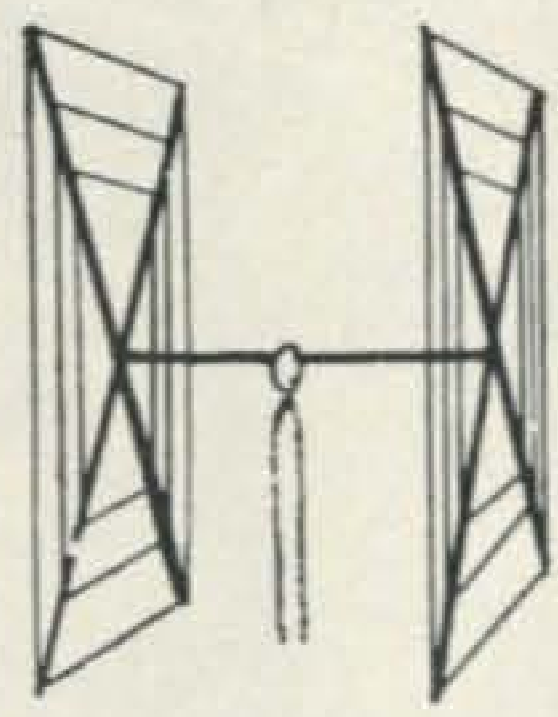
See Page 134 for New Reader Serv

GOTHAM ANTENNAS ARE MUCH BETTER OF COURSE, YOU PAY MUCH LESS

How did Gotham drastically cut antenna prices? Mass purchases, mas production, product specialization, and 15 years of antenna manufacturin 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

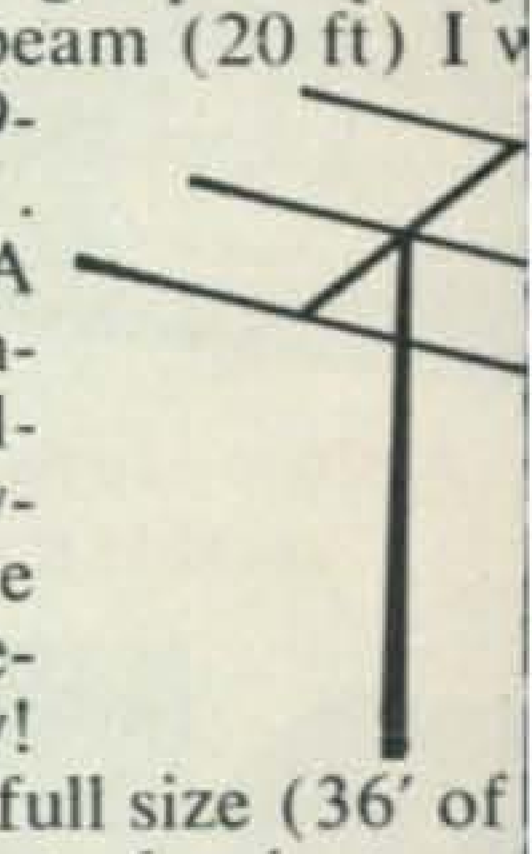
Now check these startling prices—note that they are *much lower* than even the bamboo-type:

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 ment Gotham beam (20 ft) I w



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 for *each* 20 meter element, for instance solutely complete including a boom and al ware; uses a single 52 or 72 ohm coaxia line; the SWR is 1:1; easily handles 5 K and 1″ alumnium alloy tubing is employ maximum strength and low wind loadi beams are adjustable to any frequency band.

2 EL 20	$16	4 EL 10	
3 EL 20	22*	7 EL 10	
4 EL 20	32*	4 EL 6	
2 EL 15	12	8 EL 6	
3 EL 15	16	12 EL 2	
4 EL 15	25*		*20′ boon
5 EL 15	28*		

ALL-BAND VERTICALS

"All band vertical!" asked one s "Twenty meters is murder these days. L you make a contact on twenty meter pho low power!" So K4KXR switched to t using a V80 antenna and 35 watts AM. a small portion of the stations he w VE3FAZ, T12FGS, W5KYJ, W1WOZ ODH, WA3DJT, WB2FCB, W2YHH, FOB, WA8CZE, K1SYB, K2RDJ, K K8HGY, K3UTL, W8QJC, WA2LVE MAM, WA8ATS, K2PGS, W2QJP, W K2PSK, WA8CGA, WB2KWY, W2IWJ KT, Moral: It's the antenna that counts

FLASH! Switched to 15 c.w. and worke IKN, KZ5OWN, HC1LC, PY5ASN, F XE2I, KP4AQL, SM5BGK, G2AOB, CLK, OZ4H, and over a thousand other st

V40 vertical for 40, 20, 15, 10, 6 meters ....

V80 vertical for 80, 75, 40, 20, 15, 10, 6 meters ....

V160 vertical for 160, 80, 75, 40, 20, 15, 10, 6 meters ....

HOW TO ORDER: SEND CHECK OR MONEY ORDER. WE SHIP IMMEDIATELY UPON RECEIPT OF ORDER BY RAILWAY EXPRESS, SHIPPING CHARGES COLLECT.

GOTHAM, 1805 Purdy, Dept. CQ, Miami Beach, Fla. 33

A NEW Thoroughbred in Solid-State Receivers

NOW—a **Competitively Priced Receiver** for the **most exacting** Professional **Performance!**

Phase-locked Frequency Synthesizer for Maximum Stability!

The superb, new R-530 by GALAXY

Designed for the exacting requirements of ***laboratory, broadcast*** and ***HF monitoring*** and ***point-to-point*** complex system ***communications,*** the R-530 is an advanced ***solid-state*** communications ***receiver.*** Its unsurpassed performance is the result of over three years of exhaustive research.

It receives selectible Upper and Lower Sideband, CW AM and RTTY signals...provides ***accuracy of 1 KHz*** tuning throughout the 0.5 to 30 MHz frequency spectrum.

Unique front end design and crystal lattice filters insure ***optimum sensitivity and selectivity.*** An adjustable ***noise blanker*** minimizes interference ...background noise. Frequency stability is amazing...less than 100 Hz drift after turn-on!

Complete transistorization and ***modular construction*** provide ***maximum stability.*** Minimum heat generation and power requirements allow the R-530 to be used in field applications now impractical with vacuum tube equipment. The new Galaxy R-530 is compatible with existing systems. ***Beautifully styled,*** compact, weighing only 25 pounds.

(Priced in the $700 range) Write for free brochure and complete specifications.

GALAXY ELECTRONICS

"Pacesetter in Commercial/Amateur Equipment Design"

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