CQ

March 1974
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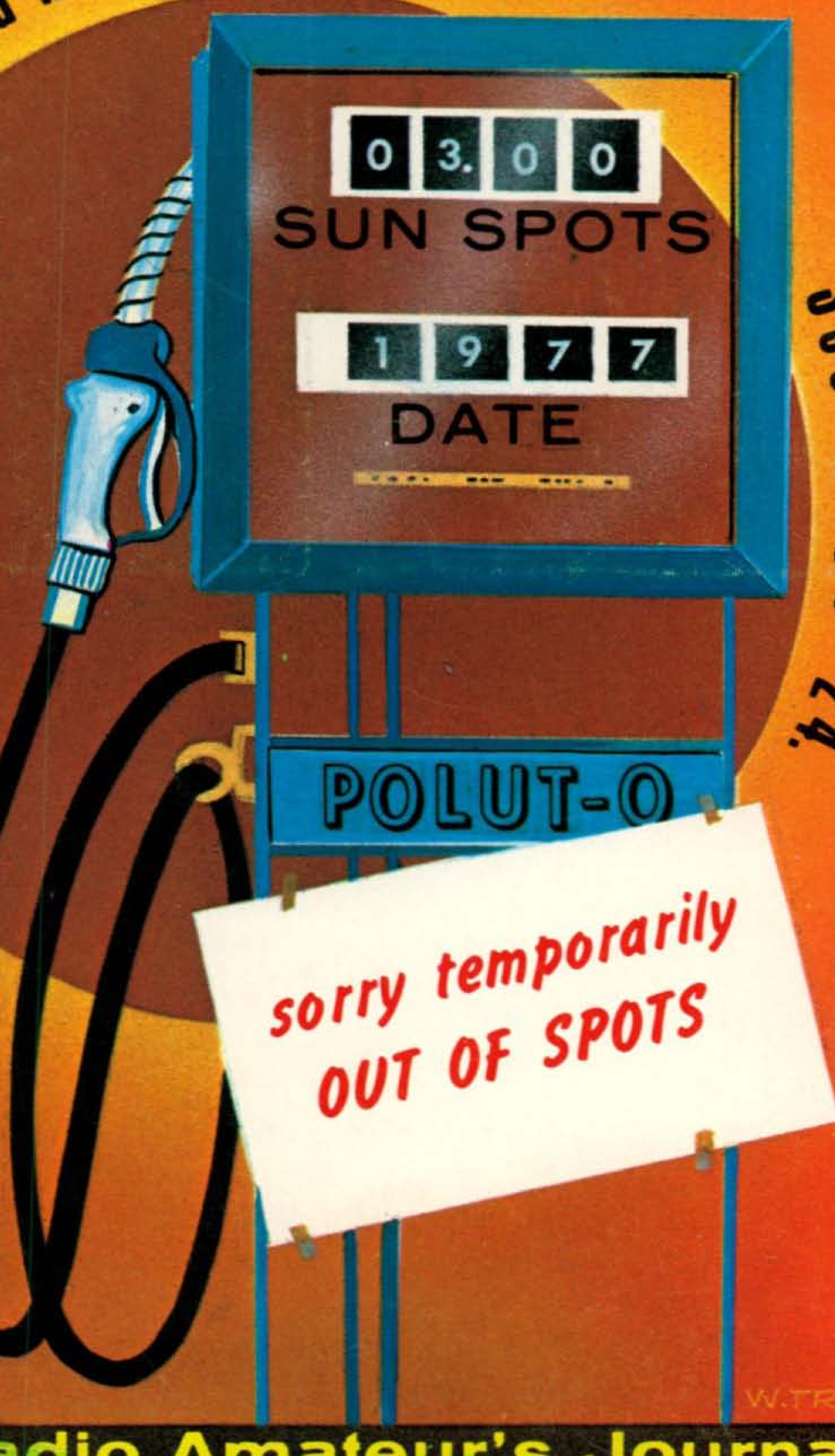
LET YOUR FINGERS DO THE TALKING p. 35

A grim outlook for the Sunspot Cycle See page 24.



The Radio Amateur's Journal
08240

Our two hot runners when you put on

Build the Heathkit SB-102 and SB-220 and set new DX track records!

Here's exceptional stability and dial linearity — made possible by an all solid-state linear master oscillator with 1 kHz calibration. The SB-102 stabilizes itself in a fast 10-minutes, drifts less than 100 Hz per hour after initial warm-up. The receiver section delivers an S+N/N ratio of less than 0.35 uV for 10 dB — with front-panel selection of built-in 2.1 kHz SSB crystal filter or optional 400 Hz crystal filter. And there's a dial resettable to 200 Hz; 180 W PEP SSB input, 170 W CW input; switch selection of upper or lower sideband and CW: built-in sidetone for monitoring; built-in 100 kHz crystal calibrator; triple action level control to reduce clipping and distortion; built-in VOX, and complete metering.

The SB-102 is the value leader because you build it yourself to save on initial investment and service. Simple circuit board/wiring harness construction gets it all together. Order your hot runner now — the famous Heathkit SB-102 SSB/CW Transceiver. Combine it with the SB-220 Linear for the ultimate long-distance runner.

Kit SB-102, 24 lbs. **385.00***

Kit SB-600, 8 ohm matching speaker with mounting space for AC supply, 7 lbs. . **19.95***

SBA-301-2, 400 Hz CW crystal filter, 1 lb. **22.95***

Kit HP-23B, AC supply, 19 lbs. **51.95***

Kit HP-13B, DC supply, 8 lbs. **69.95***

SBA-100-1, mobile mount, 6 lbs. **15.95***

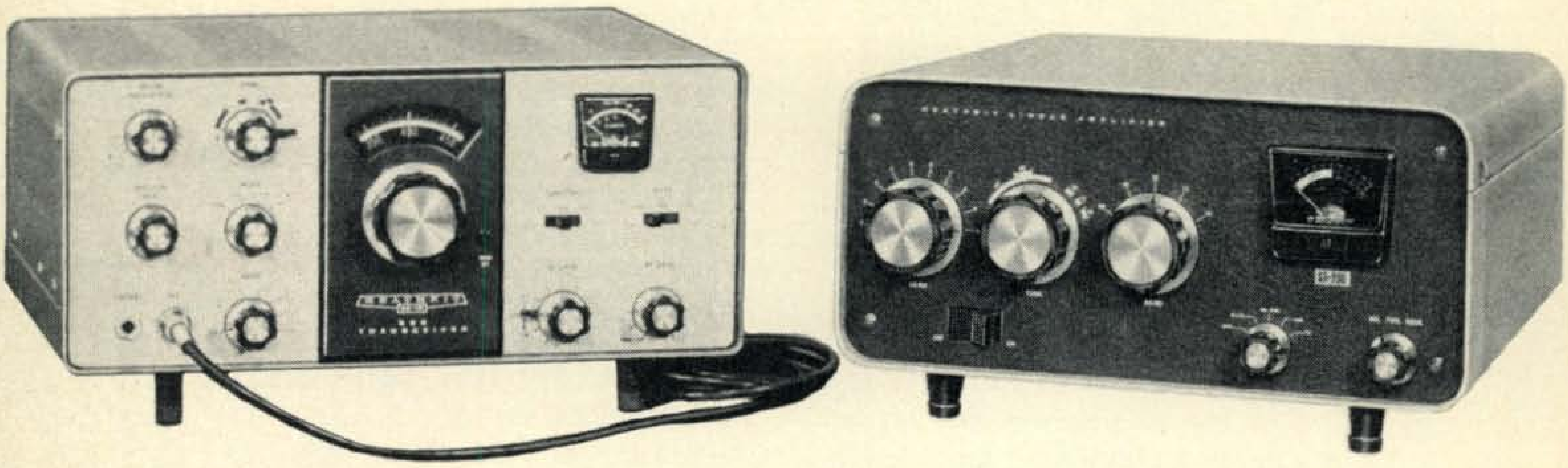
The Heathkit SB-220 is the linear amplifier that the competition tries to measure up to. Two conservatively rated Eimac 3-500Z's in a grounded grid circuit offer up to 2000 W PEP SSB input, or a full 1 kW on both CW and RTTY. The broad-band pretuned pi-input delivers maximum efficiency with low distortion over 80-10 meters. Only 100 watts of driving power is needed to produce full-rated input.

SB-220 features include a built-in solid-state 120/240 V power supply; circuit breaker protection; zener diode regulating operating bias to reduce idling current for cooler running and extended tube life; a large quiet fan; ALC to the driving unit to prevent overdriving; front panel switch selected monitoring of grid current; relative power and high voltage. The SB-220 offers a clean, compact design with the liberal use of internal shielding for extra strength and component isolation. Its green table-top cabinet complements all your SB-series gear.

To tune-up, you simply set the band switch, push the CW-Tune/SSB rocker switch to the CW-Tune position and adjust the Load & Tune controls for maximum relative power. Push the rocker switch to the SSB position and you are ready to set a new DX track record — with 2kw PEP input, or a full gallon on CW and RTTY.

Kit SB-220, 70 lbs **369.95***

get stronger yet, the long-distance shoes



Build the Heathkit HW-101 and SB-200 and run with a 1kw kick!

The HW-101 has improved receiver circuitry and dial drive and added front-panel SSB/CW filter selection. Sensitivity better than 0.35 uV for 10 dB S + N/N. Image and IF rejection better than 50 dB. 36-1 knob to dial ratio in a ball bearing drive mechanism. Thermal stabilized FET VFO with 5 kHz readout. Built-in 100 kHz crystal calibrated and zero reset button. Front panel crystal filter selection. Optional SBA-301-2 crystal fiter installs in minutes. CW filter offers razor sharp 400 Hz selectivity. Built-in SSB crystal filter delivers 2.1 kHz selectivity at 6 dB down.

Kit HW-101, 23 lbs. **259.95***

Kit HP-23A, AC power supply, 19 lbs. **51.95***

Kit HP-13A, DC power supply, 7 lbs. . . **69.95***

SBA-301-2, 400 Hz crystal filter, 1 lb. . . **22.95***

Brawny partner in the Economy Kilowatt pair, the SB-200 is a completely self-contained, compact desktop rig with built-in solid-state power supply that sets you up with 1200 watts SSB, 1 kW CW with 80 through 10 meter hand coverage. And since it requires only 100 watts PEP drive, it's the ideal mate for the Heathkit HW-101 and almost all other popular transmitters and transceivers. A pair of 572B/T-160-L are used for amplification, fan cooled and shielded for maximum TVI protection. Other noteworthy features include a pre-tuned cathode input circuit for efficiency, low distortion; ALC output for automatic exciter control; circuit breaker protection; built-in SWR meter and antenna relay that automatically switches to the exciter when the linear is off; 120/240 VAC operation.

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Proven design in the tradition of the HT-37 and solid-state dependability are combined in this compact transceiver featuring state-of-the-art FET's, hot carrier diodes and bi-polar transistors for peak, reliable performance for only $625.

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- Built-in speaker
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- Type of service: continuous operation with 2-tone S SB-CW-RTTY (50% duty cycle)
- Power Output: 125 Watts P.E.P. (Nominal) into 50 ohms
- Receiver Sensitivity: Less than 1 uV for 15 db SN Ratio
- Selectivity: 2.0 kHz
- Receiver IM: 60 db below 2 equal 10MV signals
- Receiver Image and IF Rejection: Greater than 60 db.
- Internal Receiver Spurious: Less than equivalent 1 Microvolt Signal
- Transmitter IM: 30 db below P.E.P. (26db below one of two equal tones)
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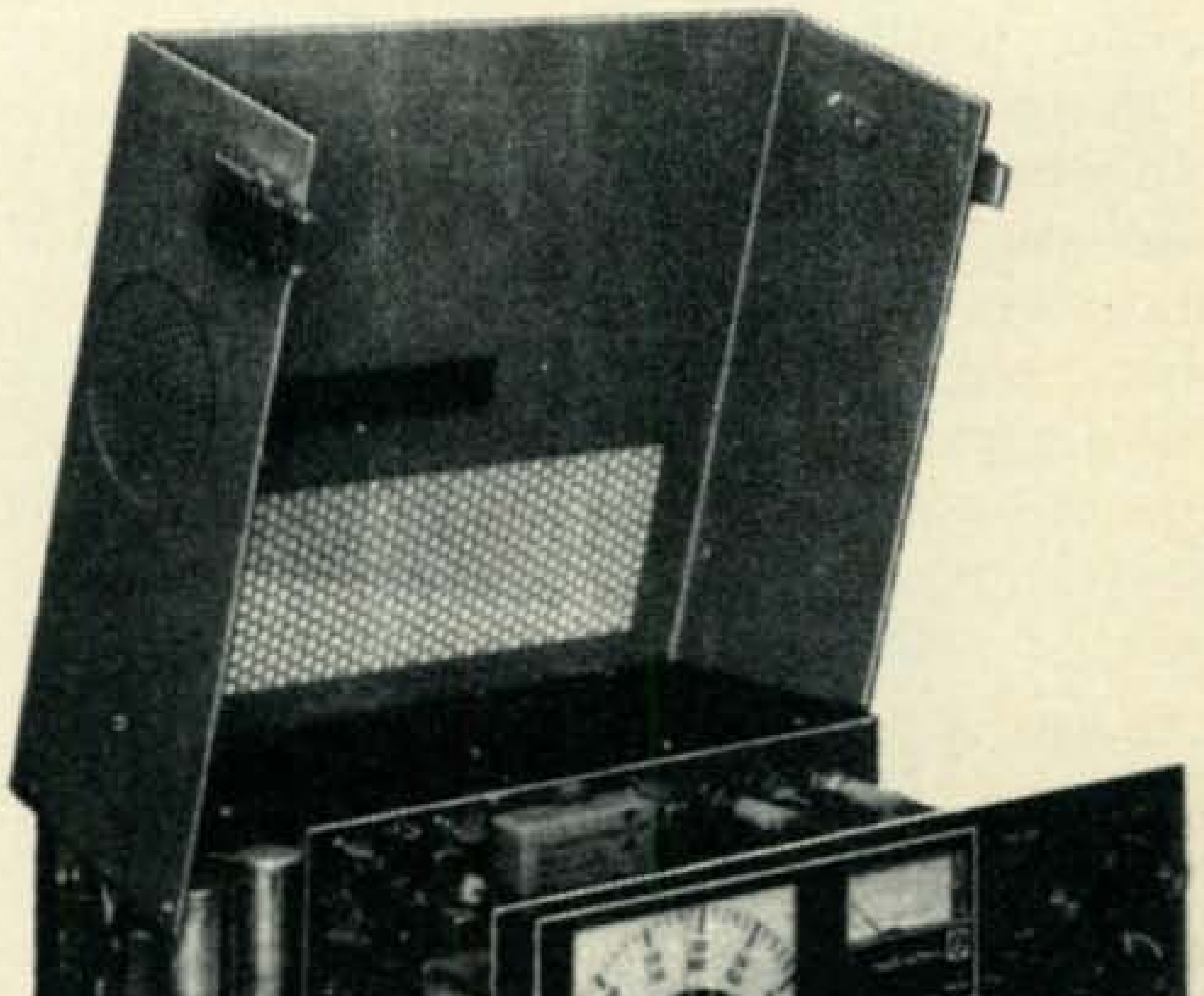
- AF Power Output: 2 watts
- Stability: 100 Hz after warmup. Max. 100 with 10% line voltage change
- Frequency Readout: Within 1 kHz ± 100 kHz of Cal. Point not more than 3 kHz across entire 500 KC Band
- Break-In CW: Semi-Automatic
- CW Sidetone
- Audio Frequency Response: 500-2500 Hz Nominal
- AALC: 12 db Compression
- AGC Figure of Merit: 60 db minimum
- Crystal Calibrator: Provides 25 kHz Calibration Signals
- Optional Accessories: MR-300 Mobile Installation Kit; HA-60 Blower Fan Kit, works on AC or 12VDC



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MARCH, 1974 VOL. 30, NO. 3

CQ

The Radio Amateur's Journal

FEATURES

DEPARTMENTS

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RTTY FROM AtoZ

DURWARD J. TUCKER, W5VU

Drawn partly from the pages of **CQ**, and partly from previously unpublished material, this new RTTY classic has been produced to fill the void in RTTY knowledge among amateurs and professionals alike.

Written to round out the amateurs' RTTY bookshelf which up to now has relied solely on another **CQ** classic: "The New RTTY Handbook," the combination of the two is unbeatable. To properly describe the scope of this volume would demand a volume in itself, but the chapter headings below tell the story:

Chapter 1—**RTTY Basics.** Chapter 2—**The Teletypewriter.** Chapter 3—**Teletype and Radio Reception.** Chapter 4—**Converter (Terminal Unit) Basics.** Chapter 5—**Polar Relays and Distortion.** Chapter 6—**Special RTTY Circuits.** Chapter 7—**Test Sets.** Chapter 8—**Machine Adjustments.** Chapter 9—**Tape Printers.** Chapter 10—**Kleinschmidt Machines, Tape Readers, Teletype Models 28 and 32.** Chapter 11—**Codes, Data Processing & Advanced Machines.** Chapter 12—**Distortion Producing Test Sets.** Chapter 13—**Regenerative Repeaters and Frequency Shift Monitors.** Chapter 14—**Terminal Units.** Chapter 15—**The RTTY Station.** Chapter 16—**FCC Rules, Operating Procedures.**

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OUR READERS SAY

Means Vs. Ends

Editor, *CQ*:

VK7RG's article on "Means vs. Ends in Amateur Radio" (Dec '73 *CQ*) unquestionably gets my vote for best article of the year! Now if we can only be as *painstakingly* realistic in devising some answers to the problems he raises...

Though I agree with VK7RG that contests are meaningless from a communications standpoint, I do feel they have potential as tests of *operating skill*. Current contest format and practice places primary emphasis on station capabilities—of 2kw (or more) linears, super beams on multiple super towers, programmable keyers, computer check-logging, etc. Since a contest which attempts to equalize station capabilities (see my 1972 suggestion of an "A-1 operator's contest with limits of 200 watts to ordinary dipoles and verticals no more than 20' up) seems to be impractical; why not at least a coding system which distinguishes, say, 5-10 levels of station sophistication. Let the class 1 stations such as W7RM, W3UA, W6AM, etc., compare with each other as usual, but also let the class 7 guys running 100 watts to simple dipoles or a multiband ground plane and using a simple keyer compare among themselves as well.

William B. Bachary, WB6CEP
Berkeley, California

Editor, *CQ*:

I wish to commend *CQ* for publishing the excellent and timely article by VK7RG, entitled "Means vs. Ends in Amateur Radio" in the December *CQ*. This is a well presented THINK piece and should be a MUST for all amateurs. It is remarkable how well he has hit the situation in this country, far away in VK7! I am writing him directly to thank him for the piece and wish you to know that I, a thinking amateur, realize the truth in what he says and I, for one, and many others like me are trying to do something about this situation. Before it is too late!

Furthermore, I wish to thank you and commend you at *CQ* for installing the QRPp column (by K8EEG) in *CQ*. QRPp has become a vital part of ham radio today and is widening its influence all the time. I run from 0.5w. to 1 kw myself, so I am in both worlds as well as a contributor to *The Milliwatt*.

Also, it was great to see The Novice Shack by Herb Brier back in *CQ*. The Novice is an important part of ham radio and Herb has done an excellent job of promoting the Novice's knowledge and operation.

A. David Middelton, W7ZC
Springdale, Utah

More Customer Service

Editor, *CQ*:

I was not surprised to see William A. Pearson's letter "Good Customer Service" in December *CQ*, because I myself had similar outstanding service from Mr. Ted Henry of Henry Radio in Los Angeles.

I recently was looking in vain for a Swan TV2B so that I could operate through Oscar 6. The only dealer that I called that had one was Henry Radio. Henry sent the unit to Swan in Oceanside Calif. and Swan changed the i.f. to 50mhz, replaced a final, changed a crystal and gave it a complete factory check. I received the unit within 3 weeks at absolutely no extra charge for all that work.

I was quite thrilled with this customer orientated effort. Business people must realize that word gets around quickly when they provide good service. Good customer service can be more effective than thousands of dollars of advertisements. Hams talk frequently about equipment dealers. Good service reports can be propagated quickly on the amateur bands.

I will never settle for less than top service again. I would not hesitate in buying equipment from Henry in Ios Angeles even if I live in New York.

Howard Bernstein, WA2ZWS
Albany, N.Y.

Whither DX?

Editor, *CQ*:

KH6IJ's article, "Whither DX?" in the December issue is exactly the kind of article that I find most interesting—written by an acknowledged expert, filled with historical lore, and raising a number of most pertinent questions as to this rather large segment of ham activity. I also graduated to high power (ten watts) in 1932 with a pair of '45 tubes in TNT and vividly recall working every station heard on 20 meters one evening, namely, two of them, VK5HG and J2CL. It took nearly half an hour with each of these 1X1 whispers in the static to verify call letters and signal reports. 8,100 miles was superb DX then—it's still pretty good—and the thrill of it is still well remembered. But is this sort of thing "communication?" And were the 1930's really the "Golden Age of DX," as Katashi calls them? What are the fundamental differences between then and now?

In ball park numbers, modern beams are better by a factor of 5—both ways—and powers are up by a factor of 100, which gives the modern DXer a factor of 2,500 over the Golden Days. Compounding this gigantic factor are the inestimable advantages of operating tranceive, and by voice with the efficient single sideband. The number of hams have gone up by a factor of ten, and therefore, it is easy to see that it's an entirely new ball game and to my mind a far better one, even though the "shoe pinches" in entirely new ways. Katashi questions—and a good question it is—as to whether DX has lost its spirit of competition and sportsmanship; he writes of "disorganized bedlam and turmoil" and of "the pettiness and snarling, characteristic of the phone bands of today." He refers to the manufactured contact and questions whether a DX operator is competant who takes calls by district or call areas in sequence.

Speaking to this last point first, I recently operated from French Saint Martin for six days and worked by call areas just as soon as the pileup began to overwhelm. I worked each call area right down to the weakest signal in the "grass" and maintain that this is the way to do it; further, all DX operators should operate in this fashion. This forces the big boys to wait a few minutes for their turn but gives the QRPer, the youngster with minimal home brew equipment who doesn't have either a linear or a beam and who perhaps has never worked rare DX before, a tremendous sense of accomplishment and exhilaration in making a contact that would be absolutely impossible if the DX operator simply skims the cream off the top of the pile. It's tough to do it this way, digging them up out of the static, but I think it is far better sport at both ends. Further, the cooperation and courtesy shown by the Stateside hams in staying off the air and awaiting their turn was almost unbelievable, even under conditions of high pressure and desire.

I have heard DXing and especially DX Contests spoken of disparagingly as a Numbers Game, or worse. This is like referring to football as "agitating an inflated pigskin around the lawn." If one goes through one or two DX Contests without beam and/or a linear amplifier, the frustration is so tremendous that there is every incentive to dig in and build up one's station to the point that it is at least reasonably competitive. The challenge of DXing has surely brought about much more and far better communication equipment, along with a host of new and better operators. For example, in the 1930's, Grote Reber, having worked more than 50 countries, looked around for new worlds to conquer and for nearly a decade was the only radio astronomer in the world, mapping for the first time the Milky Way, with his homebrew 31-foot dish. In the process he went for a year and a half without getting a signal(!); in recent years he has received the very highest honors for his

[*continued on page 73*]

Announcements

Lancaster, Pennsylvania

The second annual SERCOM Hamfest and Flea Market will be held Sunday, March 3rd, from 9 a.m. to 4 p.m. at the U.S. Naval Reserve Center, Orange Street and Parkside Ave., Lancaster, PA. Talk-in on .52 and .94 Simplex; .01-.61 repeat. Hams and adults, $1.50; wives and children free.

Canton, Ohio

The Canton Amateur Radio Club will hold its annual Auction & Flea Market Friday March 8, at the Imperial House Motel in Canton, Ohio, beginning at 7:30 p.m. Doors will open for set-up at 5:00 p.m. with Mobile Check-ins on 147.06

[*continued on page 81*]

Q AND A

BY CHARLES J. SCHAUERS,* W6QLV

Tracking down power line interference is a difficult task. Even if a trained crew from the electric utility company has the proper instruments the job of locating an offending transformer, insulator leaks, poor ground etc., requires time.

One of the things *most* amateurs plagued by power line noise forget to remember is that *all* the noise they hear may not be coming from one trouble-spot. For example, one amateur who had "power line" noise problems found out (with the help of an interference location crew) that not only were two electrical circuits in his own home causing noise but a neighbor a block away had a defective electric stove that really caused QRN when turned on. The power company found no problems with its own lines or transformers!

Dirty high voltage insulators are a prime cause of noise. So are leaky pole pigs—transformers which feed a given section of housing. Then you have poor grounds—these can be a problem especially during dry weather. On the higher voltage lines corona is a problem when there is high humidity—the hash generated by corona (arcing) is terrible! This is a power company responsibility.

Various noise sources can be probed with an ordinary hand-held transistorized BC receiver.

Do not blame the power line feeder system until you have checked all possible noise sources in the home first. Check all switches (especially dimmer and mercury types), motors, transformers etc.

Dummy Loads

"I just got my General license and have been having a ball! However, although my tune-up time is very short I have been bawled out for 'messing' up a frequency when I thought no one was on. I have been told a number of times, 'hey lid, use

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

a dummy load to tune up and then listen for awhile.' I know what a dummy load is but do I really need one?"

All *concerned* hams have a dummy load that can be switched in. This antenna "load" does not "guarantee" that your set is perfectly tuned to your antenna (fine adjustments may be necessary to compensate for the s.w.r. your antenna feedline exhibits).

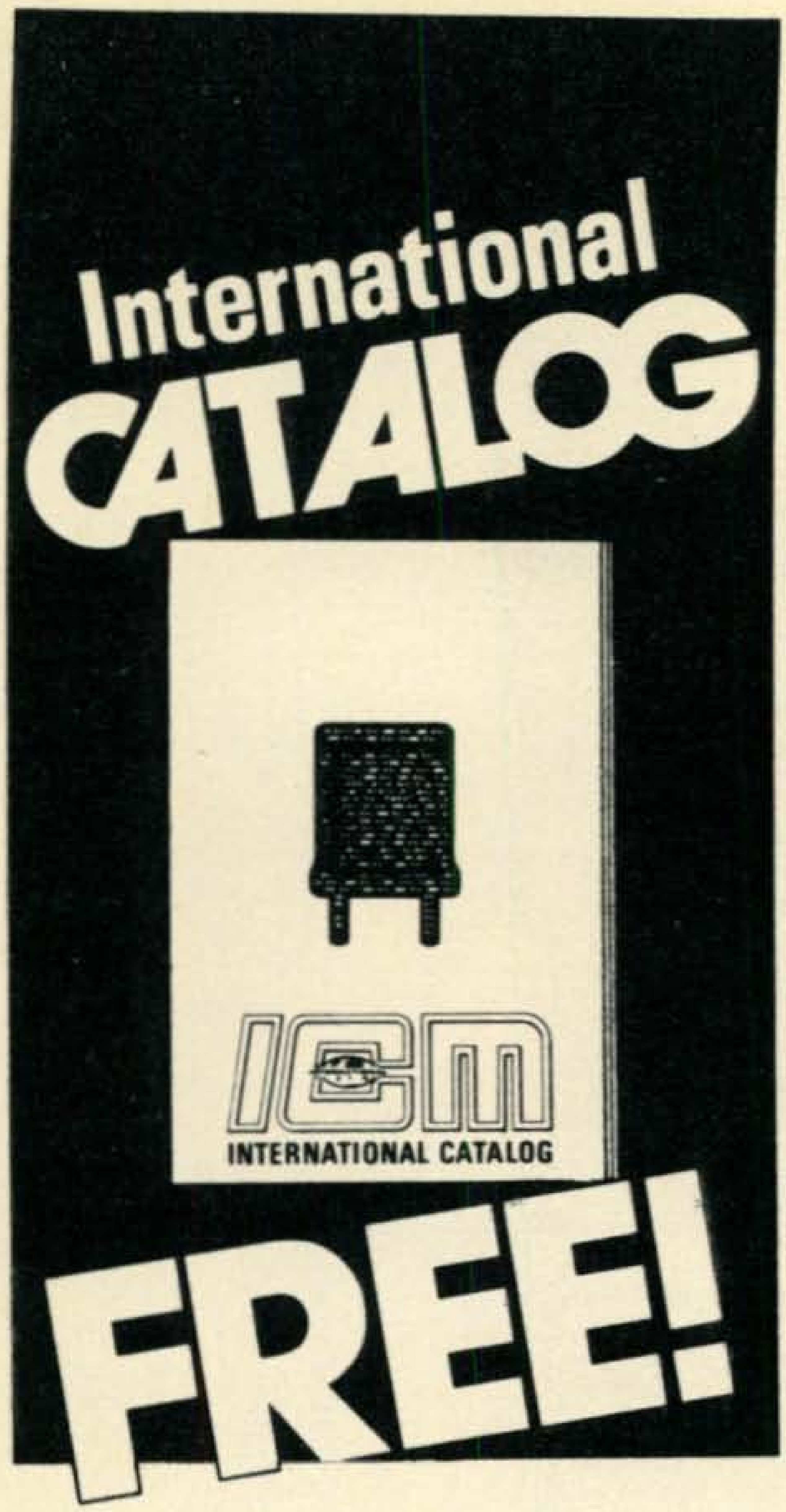
Swan 350 BC Overload

"I have a problem with my Swan 350 (bought in 1966) which I hope you can help me with. On 75 meters I get a local 50 kw BC station. This station operates on 1260 kHz and comes in with a bang on 3780 kHz (third harmonic). Then recently I have been getting other local BC stations in the middle of the band. What may be the answer?"

I'm glad you say "may be" for there are a number of things that could be happening and I do not like to guess if I can come up with a solid answer. However, I had a 350 for awhile and my problem, believe it or not was ground rectification! I just had a poor ground. A real good one stopped the whole problem even after I replaced Q_2 (2N706) transistor in the v.f.o. which is used as a buffer for isolation and Z matching. I did suspect trimmer capacitors but this turned out to be a false lead. I checked the crystal lattice filter and it was okay. I did cure the trouble with a filter tuned to the BC station's frequency, but then I ran into other problems. Try this: borrow a signal generator. Set it up for 1260 kHz and connect it to the antenna through a .001 mf capacitor. Use low input. Connect an a.f. output meter to the set and note the reading. Without changing the generator output, disconnect the generator from the antenna and probe various points in the rig until you once again detect a reading on the meter. Stop there and check all components in the section. A defective antenna coil in most receivers can raise havoc with reception . . . however, strong stray r.f. entering mixer sections can do likewise.

Yeasu FT-101 A.L.C.

"I am unable to receive an indication on the meter of my FT-101 when in the A.L.C. position by varying the mike gain when on 80 meters. What could be a cause for this?"



First check the a.l.c. level adjustment as given on page 23 of your manual. If this does not work, then check pot VR_2 on pcb-1184. Suspect capacitors C_8 and C_9 in this circuit. Also check switch connections. Check both r.f. and a.f. drive.

Voltage Regulator

I have been reminded by a friend who has had voltage problems in his shack, that he has been using a General Electric voltage stabilizer rated at 30 volt-amps, #9T91Y4090 since 1968. It provides a very stabilized voltage of 115 volts when the input ranges from 95 to 130 volts. It cost him less than $20 in 1968. So those of you having line voltage regulation problems should consider the GE stabilizer.

Burglar Alarm Tripping

My rig is a Tempo I transceiver which I have been using for just under a year. Recently I installed an MP 33/40 antenna on the roof. Since then, when I work on 15 meters it sets off my Honeywell "Concept 70's" series alarm. Honeywell who had not encountered r.f. interference in the alarm before could not suggest an answer. I have tried to bypass the long power leads with .01 mf capacitors with no effect. Since 15 meters is my favorite band, this really bugs me. Do you have any ideas for clearing up this problem?"

I am not familiar with the burglar alarm you mention, but I can say this: anytime you experience r.f. interference, the device must be frequency sensitive. Your new antenna in the position it is must certainly be putting out a good signal and your alarm is picking this up, rectification is taking place and tripping relays. A brute force filter may work (see the *Radio Handbook*) . . . this would be installed in the a.c. line of the rig. On the other hand, the wires going to the various switches may be picking up the r.f. and feeding it back to the main control unit. In this case, if you install an r.f. choke, say 2.5 mh in series with each lead to each entry point this may help. You may have to resort to a rejection trap tuned for 15 meters, this would be installed in series with the *master* control line. If your alarm contains diodes, install .01 mf ceramic capacitors across each. Let me know how you make out so that I can tell others.

73, Chuck, W6QLV

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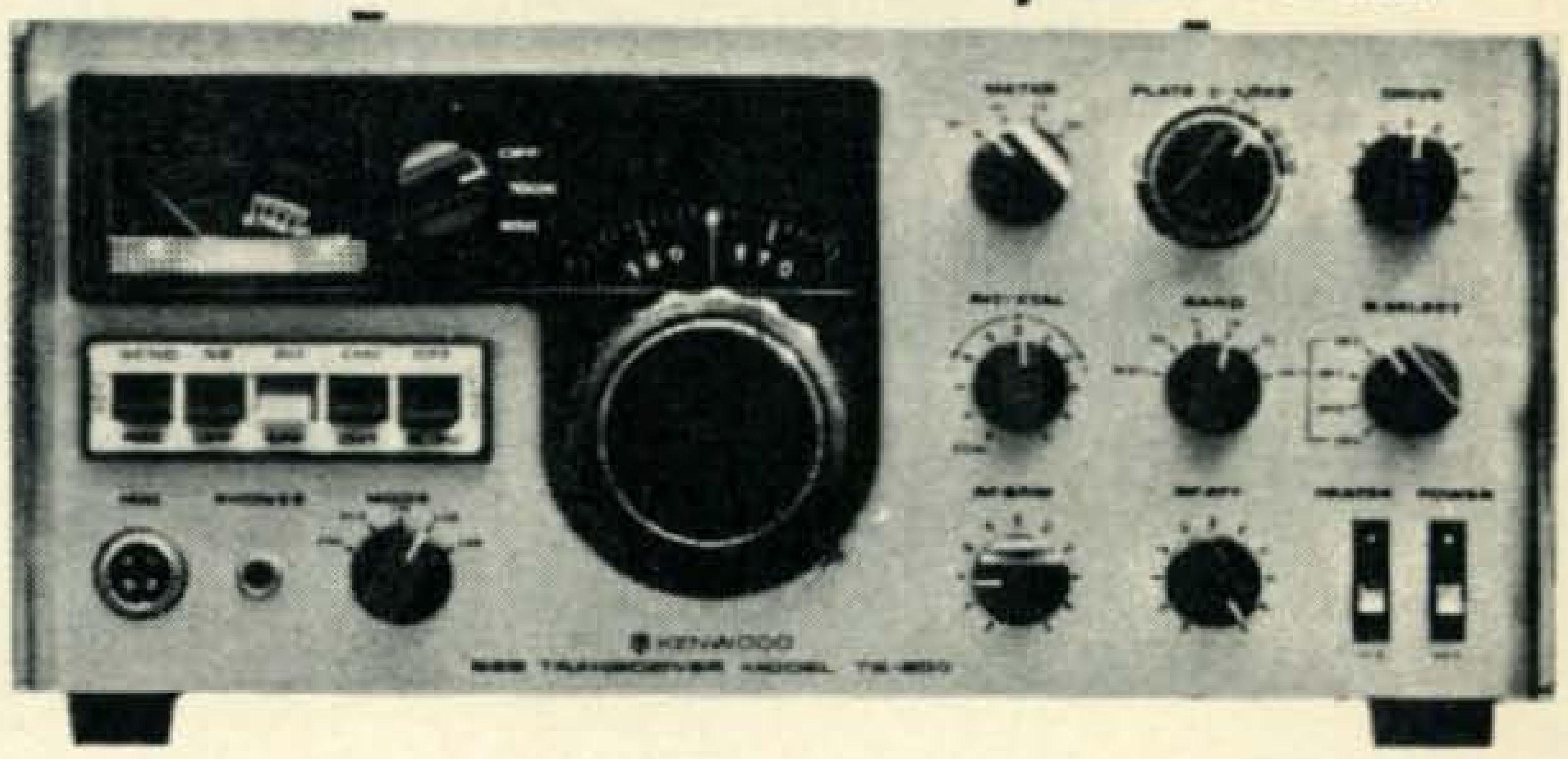
TS-900



. . . the ultimate transceiver. The promise of the transistor has been fulfilled. Here is the transceiver you will want to own . . . whatever you have now, get ready to trade up. Its important features are far too numerous to list. Its specifications are superb. The TS-900 is unquestionably the best transceiver of its kind ever offered. The price $795.00

PS-900 (AC Supply) $120,00. the DS-900 $140.00

TS-520 Kenwood's go every place . . . do everything transceiver

The new TS-520 is the transceiver you have wanted, but could not buy until now. It is a non-compromise, do everything, go everywhere 5 band transceiver for SSB or CW that performs equally well at home, in an automobile, airplane, boat or trailer. The TS-520 features built-in AC power supply, built-in 12 volt DC power supply, built-in VOX with adjustable gain delay and anti-VOX.

The price $599.00

Kenwood's winning pair

The R-599A is the most complete receiver ever offered. It is solid state, superbly reliable, small and lightweight, covers the full amateur band . . . 10 thru 160 meters, CW, LSB, USB, AM, AM.N and FM.

The price $439.00

The T-599A is mostly solid state . . . only 3 tubes, has built-in power supply, full metering (ALC, Ip, RF output and high voltage), CW-LSB-USB-AM operation.

The price $459.00

See the Kenwood line at the following dealers: CALIFORNIA Communications Headquarters, San Diego • Gary Radio, Inc., San Diego • Ham Radio Outlet, Burlingame • Henry Radio, Anaheim • Henry Radio, Los Angeles • Sequoia Stereo, Arcata • Webster Radio, Fresno • FLORIDA Amateur Electronic Supply, Orlando • Amateur-Wholesale Electronics, Miami • IDAHO United Electronics Wholesale, Twin Falls ILLINOIS Erickson Communications, Chicago • Klaus Radio, Inc., Peoria • INDIANA Graham Electronics, Indianapolis • Hoosier Electronics, Terre Haute • Radio Distributing Company, South Bend • IOWA Hobby Industry, Council Bluffs • KANSAS Associated Radio Communications, Overland Park • LOUISIANA Trionics, Inc., New Orleans • MARYLAND Electronic International Service Corp., Wheaton • Professional Electronics, Baltimore • MICHIGAN Electronic Distributors, Muskegon • Radio Supply & Engineering Company, Detroit • MINNESOTA Electronic Center, Minneapolis • MISSOURI Ham Radio Center, St. Louis • Henry Radio, Butler • MONTANA Conley Radio Supply, Billings • NEW JERSEY Simon Side Band Company, Oak Ridge • NEW YORK Adirondack Radio Supply, Inc., Amsterdam • Harrison Radio Corp., Farmingdale NORTH CAROLINA Vickers Electronics, Durham • OHIO Amateur Electronic Supply, Cleveland • Communications World, Cleveland • Queen City Electronics, Cincinnati • Srepco Electronics, Dayton • OKLAHOMA Derrick Electronics, Broken Arrow • Radio, Inc., Tulsa • OREGON Portland Radio Supply, Portland PENNSYLVANIA JRS Distributors, York • Kass Electronics, Drexel Hill • SOUTH CAROLINA Accutek, Inc., Greenville • SOUTH DAKOTA Burghardt Amateur Center, Watertown • TEXAS Douglas Electronics, Corpus Christi • Electronics Center, Inc., Dallas • Industrial Distributors, Dallas • Ed Juge Electronics, Inc., Fort Worth • Madison Electronics, Houston • UTAH Manwill Supply Company, Salt Lake City • WASHINGTON Amateur Radio Supply Company, Seattle • WISCONSIN Amateur Electronic Supply, Milwaukee

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One, you can change bands instantly. Just turn the band switch—and go!
Two, there is less internal heat to prematurely age components and no high voltage to break down insulation or cause accidental shock.
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Four, it is light and compact with a detachable AC power supply to work directly from 12 VDC—For mobile operation without tedious installation.
Five, the TRITON is a delight to operate. SSB is clean, crisp and articulate. Amplified ALC puts all available speech power into the antenna without splatter. CW is wave-shaped to cut through QRM and pile-ups. Instant break-in (not "semi" which really isn't break-in) lets you monitor the frequency while transmitting.
And six, a lot more goodies such as excellent dial illumination, plug-in circuit boards, offset tuning, built-in SWR bridge, speaker, crystal calibrator, snap-up anti-parallelax front feet, light indicators for offset and ALC, direct frequency readout, WWV, entire 10 meter band coverage—and a lot more.
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The Sunspot Cycle

Analysis and Prediction

BY THEODORE J. COHEN, W4UMF AND PAUL R. LINTZ*

The present sunspot cycle, the 20th since telescopic observations of the sun began on a regular basis in 1750, is slowly approaching its end. Methods for predicting long-range solar activity have met with very limited success in the past. In this article, the authors discuss a new prediction method which they have developed, and upon which they forecast the length of the present cycle as 13 years, with its minimum coming as late as the summer of 1977. They also predict a period of relatively low solar activity for the next 40 years! While probably no less speculative than other attempts to chart the course of nature, the authors have taken a new and interesting approach in their attempt to predict long-range solar activity. —W3ASK

THE sunspot cycle, classically associated with an eleven-year undulation in sunspot activity, has for centuries mystified scientists and laymen alike. Speculations abound, not only on the probable cause(s) of the cycle, but on its possible effects on life, weather and other terrestrial activities. As users of the high-frequency spectrum, however, amateur radio operators are acutely aware of a very real phenomenon associated with the sunspot cycle . . . the cycle's effect on ionospheric propagation. Many remember the exceptional propagation conditions of the late 1950's when sunspot activity reached levels never before observed (fig. 1). Today, sunspot activity is on the decline, with a low expected within the next few years.

*8603 Conover Place, Alexandria, VA 22308

What will be the nature of this low? And what level of sunspot activity can be expected during the next cycle, Cycle 21? Answers to these and other questions related to the sunspot cycle are the subject of this paper. Implicit in all of the analyses presented is the assumption that the driving mechanisms for the sunspot cycle, whatever they may be, exhibit periodic behavior.

Conventional Sunspot Analyses

Solar scientists and those involved in ionospheric propagation are aware of an approximate eleven-year periodicity in sunspot activity. In fact, with this information alone, one can *roughly* describe the major variation in the sunspot cycle.

Figure 1 shows the cyclic characteristics of the 19 complete solar cycles recorded at the Swiss Solar Observatory since telescopic observations began in 1750. The progress to date of the present cycle, cycle 20, is also shown. Most scientists use only the date recorded after about 1850 for statistical studies, since they are of much higher quality.

Figure 2 is a *periodogram* we calculated for the 12-month running smoothed sunspot numbers from 1844 to 1971, a period of 128 years. A periodogram is probably the simplest method that can be used for determin-

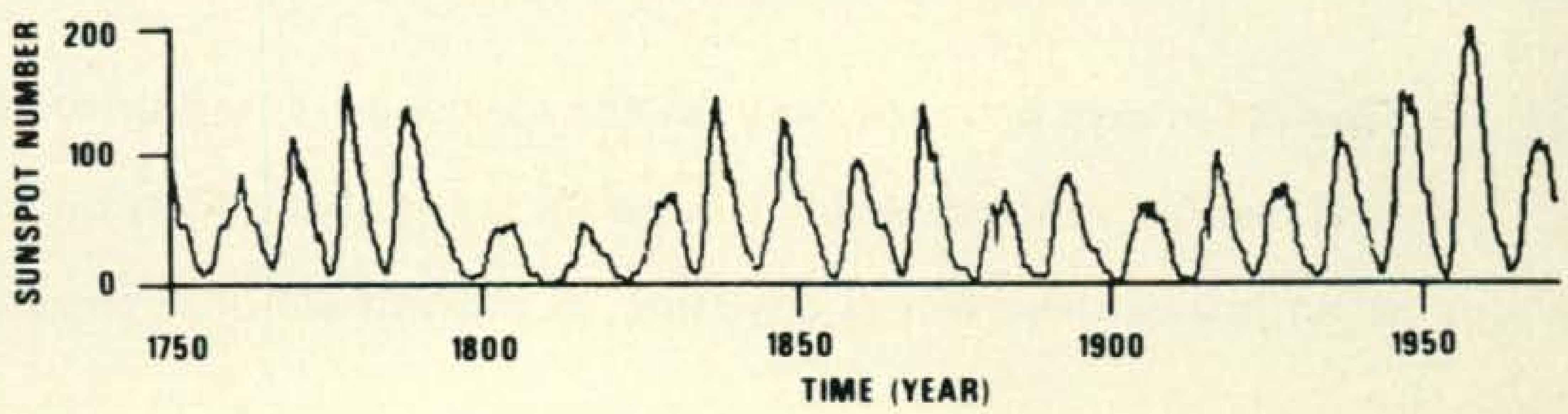


Fig. 1—12-month running smoothed sunspot numbers (1750-1971).

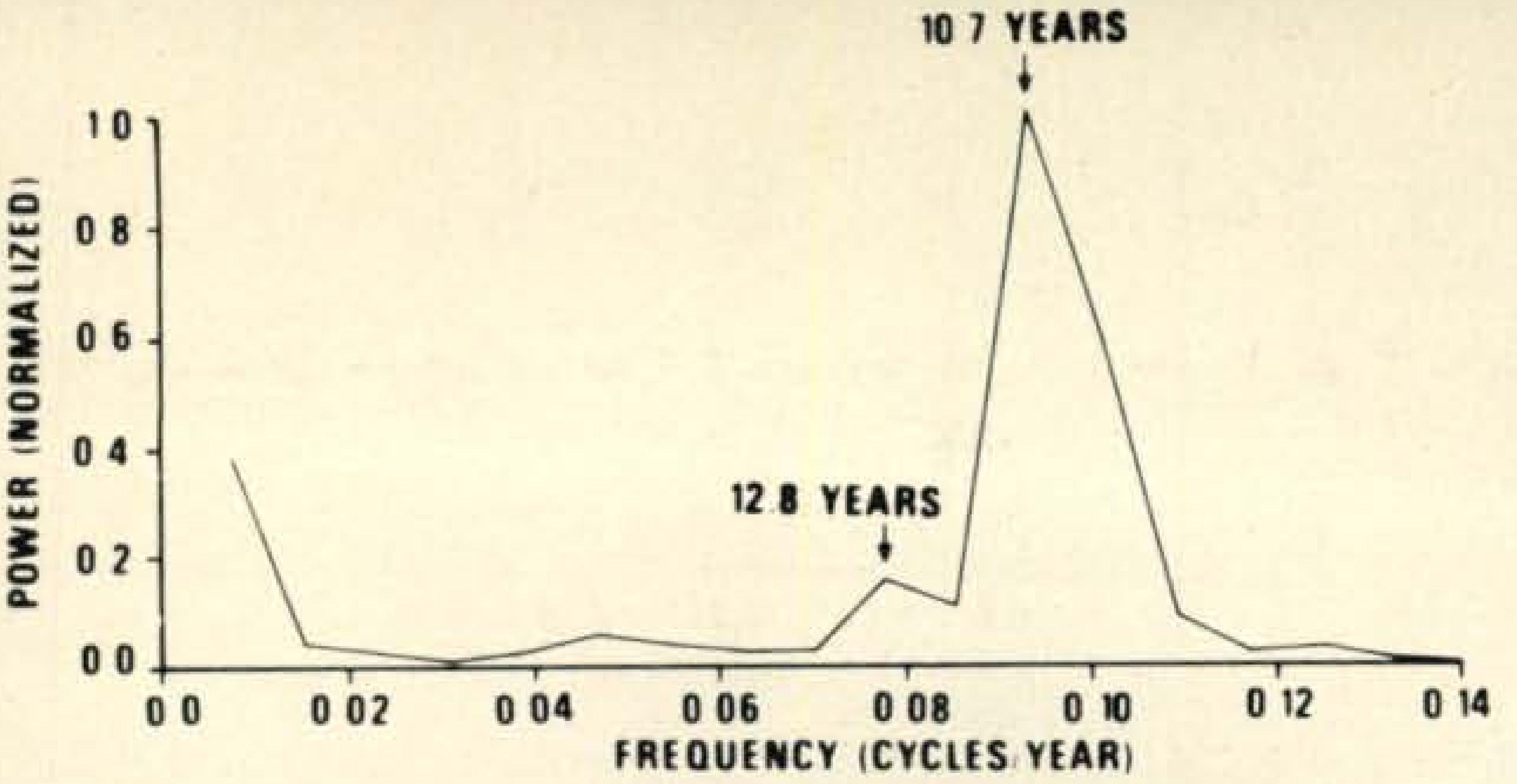


Fig. 2—Periodogram for the data interval 1844-1971.

ing the cyclic behavior of solar activity. This and similar type of analyses have been used in the past in an attempt to develop trends and data upon which to base forecasts of future sunspot activity.

The spectrum shown in fig. 2 is dominated by a relatively broad peak with a period of 10.7 years. Based on this result, one might expect the present cycle, which began during October, 1964, to end 10.7 years later, or by July, 1975. We question this result.

While the predominant period shown in our periodogram is 10.7 years, in actual fact some cycles have been as short as 7.3 and as long as 17.1 years. Clearly, there must be other cyclic characteristics in solar activity which account for these variations, and which do not show up in the periodogram. What is needed is a more accurate analysis of solar activity. One, which while using the same 128 years of data, will better define the cyclic characteristics of solar activity. The method we turned to is called *Maximum Entropy Spectral Analysis*, or MESA.

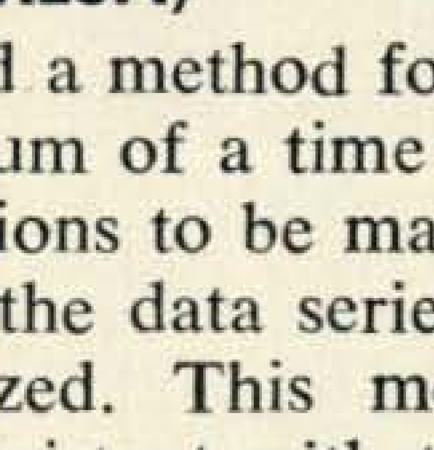
Maximum Entropy Spectral Analysis (MESA)

Burg (1967) suggested a method for estimating the power spectrum of a time series that requires no assumptions to be made regarding the behavior of the data series outside the interval analyzed. This method, which yields a result consistent with the information of the data and nothing more, is called Maximum Entropy Spectral Analysis.

MESA is of considerable value where short time series are encountered. To see this, consider the 0.57-second waveform produced using a 1 Hz sinusoid and 10% additive noise (fig. 3). For data lengths less than 0.58 times the period of the sinusoid, conventional methods for estimating the power spectrum yield a spectrum with maximum power shifted toward zero frequency. This is demonstrated by the spectrum for the waveform of fig. 3 shown in fig. 4(a). However, as seen in fig. 4(b), application of MESA yields the correct result. In addition, the resolution of MESA is striking. In using the maximum entropy technique to analyze the smoothed sunspot observations, then, we expect to resolve spectral components with periods on the order of 200 years, and possibly longer, if such components are present.

Application of MESA to the previously analyzed data (1844-1971) yields the results shown in fig. 5. The MESA spectrum suggests that no significant power is present at periods greater than about 110 years. Further, the spectrum is dominated by three peaks having periods of about 110, 10.9, and 9.7 years. Though the peaks in the maximum entropy spectra may be shifted slightly in frequency, we note that the spectral components with periods 10.9 and 9.7 years are separated in frequency by about 0.012 cycles/year. This frequency separation is an order of magnitude smaller than the frequency of either component ($\sim$0.1 cycles/year), and so, these two sinusoids interfere with one another in such a manner as to produce beats with a period of roughly 167 years. Thus, the sunspot cycle should exhibit a long-term periodicity; however, this periodicity arises not from a primary long-term excitation function, but rather from interference between two excitation functions having approximately the same frequency.

Fig. 3—A 1 Hz sinusoid with 10% white noise truncated with a 0.57-sec. window (after Ulrych, 1972).



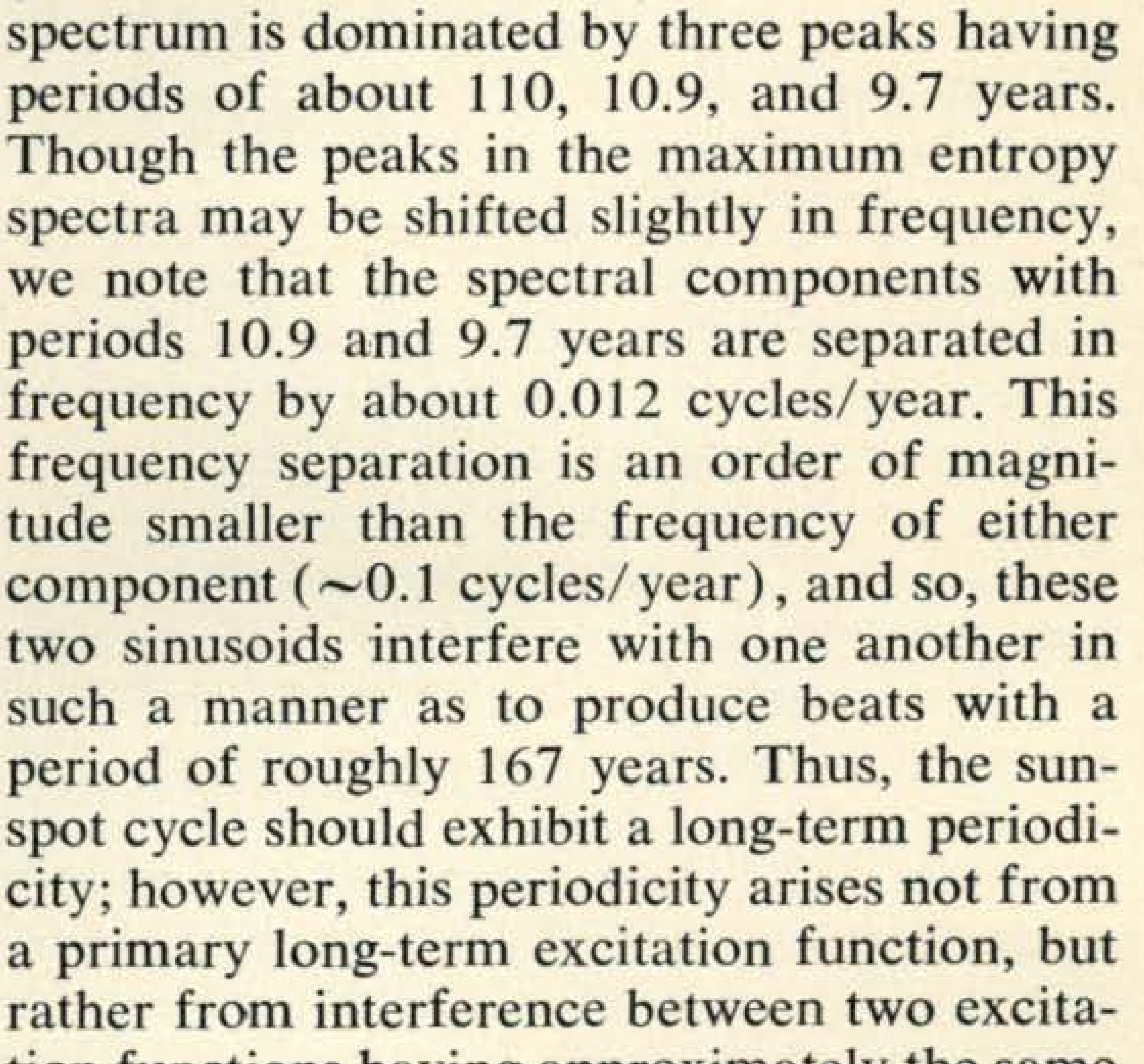


Fig. 4—(A) The conventional power spectrum for the signal in fig. 3 (B) the maximum entropy power spectrum of the signal in fig. 3 (after Ulrych, 1972).

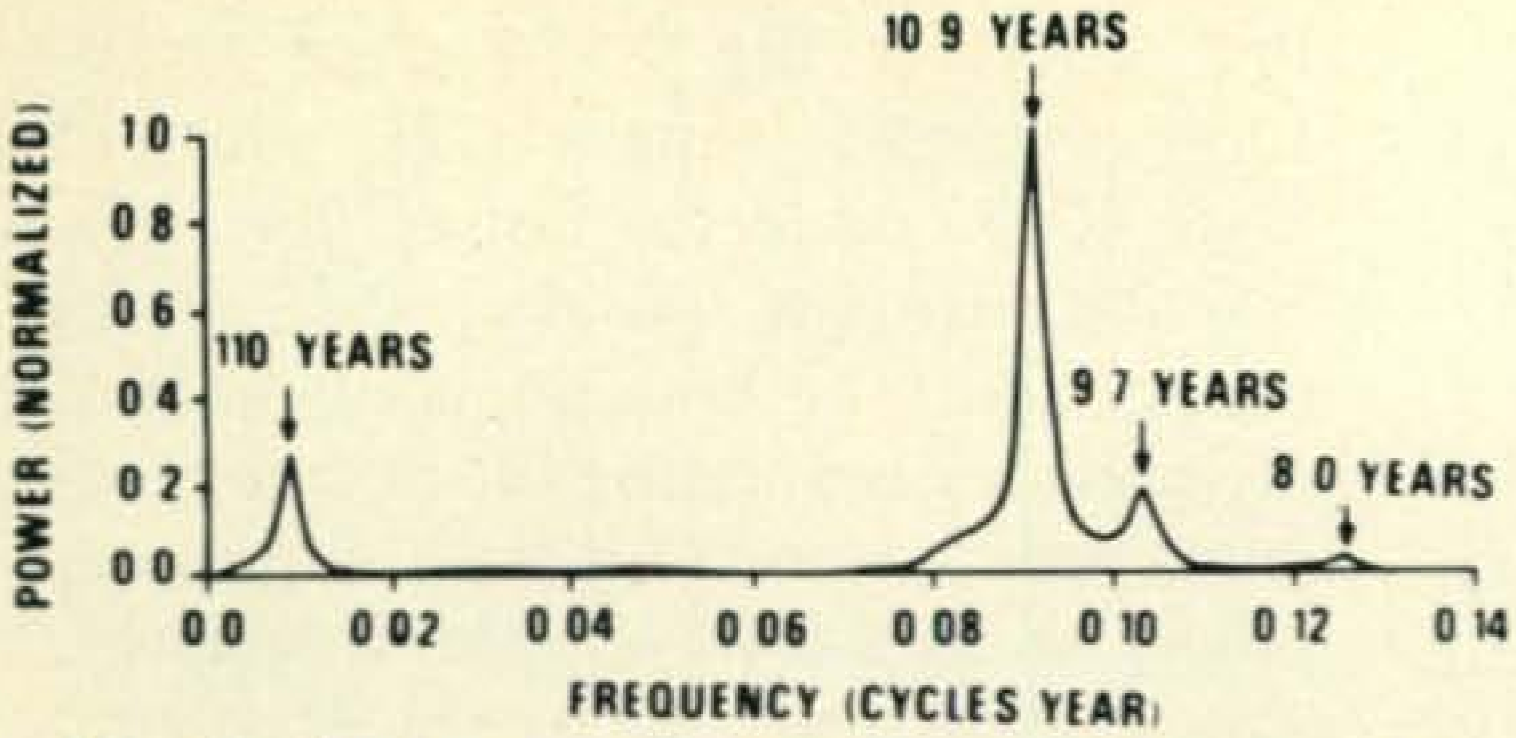


Fig. 5—Maximum entropy spectrum for the data interval 1844-1971.

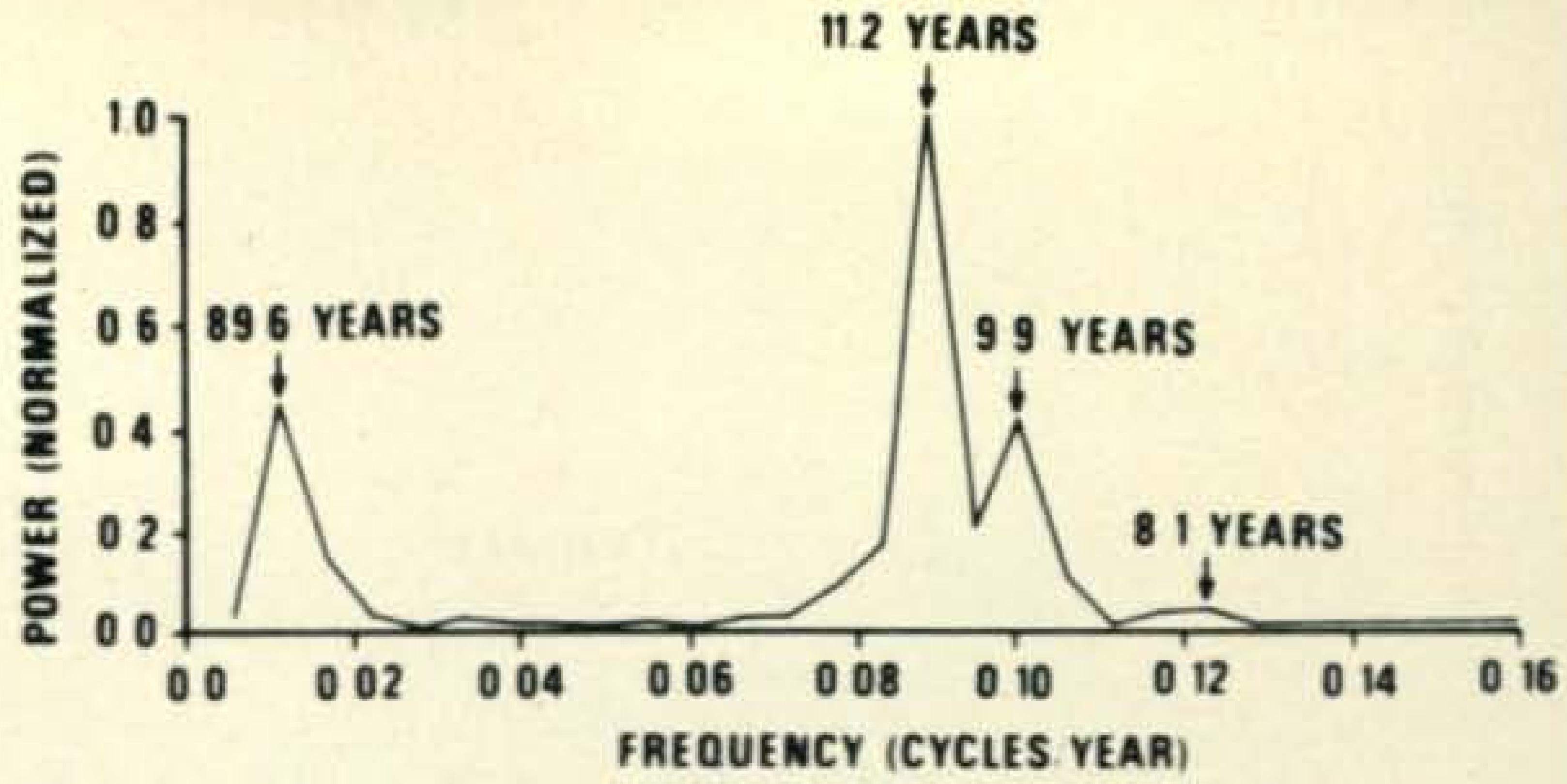


Fig. 6—Periodogram for the data interval 1793-1971.

The existance of a long-term periodicity in the sunspot cycle was postulated by Carruthers (1973), among others, who observed a similarity in the behavior of Cycles 1, 2 and 3, and of Cycles 17, 18, 19 (fig. 1). On the basis of this similarity, Carruthers postulated a repetition in the sunspot cycle every 178 years. That a long-term periodicity can be observed in the data lends credence to our results as well as to the sunspot observations in the interval 1750-1850. To better estimate the true frequencies for the spectral components in fig. 5, therefore, we used all of the sunspot observations in fig. 1, and correlated these data with a suite of sinusoids finely spaced in frequency about the peak frequencies in the maximum entropy spectrum. In performing this operation for the three dominant peaks in fig. 5, we found the best correlations to occur at frequencies which correspond to periods of 90.6, 11.2 and 9.9 years. The latter two periods are separated by 0.01116 cycles/year, and as such, our best estimate for the period of the long-term undulation in the sunspot cycle is 179 years.

If the major characteristics of the sunspot cycle repeat every 179 years, then by definition, the data are periodic outside an interval of this length. As such, we should be able to compute a periodagram using 179 years of data which is very similar to the maximum entropy spectrum of fig. 5. For example, the periodogram for the interval 1793-1971 is shown in fig. 6. As seen, this spectrum exhibits the same spectral characteristics found in the maximum entropy spectrum. To predict future sunspot observations, therefore, we can simply shift the sunspot data 179 years forward into time so that the predictions for 1972 are given by the data for 1793, the predictions for 1973 are given by the data for 1794, and so forth.

An equivalent prediction method, similar to the above, would be to use the spectral components corresponding to the data for any given 179-year interval to reconstruct the smoothed sunspot numbers in this interval. Then, by repeating the waveform outside the interval, smoothed sunspot numbers could be predicted forward or backward in time. Applying this method to the spectral components corresponding to the periodogram of fig. 6 (components at periods of less than 4.5 years are eliminated) yields the results shown in fig. 7. The actual sunspot observations from 1793 through 1971 are shown in fig. 7(a), while the predicted sunspot numbers are given in fig. 7(b) and Table I. An error trace (predicted minus observed) is shown in fig. 7(c); in the interval 1793-

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
65.0	70.0	74.9	79.9	84.9	89.9	94.9	99.7	104.5	109.2	113.7	118.0	
122.1	126.1	129.8	133.2	136.4	139.3	141.9	144.2	146.3	148.0	149.3	150.4	
151.2	151.6	151.8	151.6	151.2	150.5	149.5	148.3	146.8	145.1	143.3	141.2	
139.0	136.6	134.1	131.5	128.8	126.0	123.2	120.3	117.4	114.5	111.6	108.7	
105.9	103.0	100.3	97.5	94.8	92.2	89.7	87.2	84.7	82.3	80.0	77.7	1950
75.4	73.2	71.0	68.8	66.7	64.5	62.4	60.2	58.1	55.9	53.7	51.4	
49.2	46.8	44.5	42.1	39.7	37.3	34.8	32.3	29.9	27.4	24.9	22.5	
20.1	17.8	15.5	13.3	11.3	9.4	7.6	6.0	4.6	3.4	2.4	1.7	
1.3	1.1	1.3	1.8	2.6	3.7	5.2	7.0	9.3	11.9	14.9	18.1	
21.8	25.8	30.2	34.9	39.9	45.2	50.8	56.6	62.7	69.0	75.4	82.0	
88.7	95.5	102.3	109.2	116.0	122.8	129.5	136.0	142.4	148.6	154.6	160.4	
165.8	171.0	175.8	180.3	184.4	188.1	191.4	194.3	196.7	198.8	200.3	201.5	
202.2	202.4	202.2	201.6	200.6	199.2	197.4	195.3	192.8	190.0	186.9	183.5	
179.8	176.0	171.9	167.6	163.3	158.7	154.1	149.5	144.7	140.0	135.2	130.5	
125.8	121.2	116.7	112.2	107.9	103.6	99.5	95.5	91.7	88.0	84.5	81.1	1960
77.9	74.8	71.8	69.0	66.4	63.8	61.4	59.1	56.9	54.8	52.8	50.9	
49.0	47.2	45.5	43.8	42.1	40.5	38.9	37.4	35.9	34.3	32.8	31.3	
29.9	28.4	27.0	25.5	24.1	22.8	21.4	20.1	18.9	17.7	16.6	15.6	
14.6	13.7	13.0	12.3	11.8	11.3	11.1	10.9	10.9	11.1	11.4	11.9	
12.5	13.4	14.4	15.5	16.9	18.4	20.0	21.9	23.8	26.0	28.3	30.7	
33.2	35.9	38.7	41.6	44.5	47.6	50.6	53.8	56.9	60.1	63.3	66.5	
69.7	72.8	75.9	78.9	81.9	84.8	87.6	90.2	92.8	95.2	97.5	99.7	
101.7	103.6	105.3	106.8	108.2	109.5	110.5	111.4	112.1	112.7	113.1	113.3	
113.3	113.3	113.0	112.6	112.1	111.4	110.6	109.7	108.6	107.5	106.2	104.9	
103.4	101.9	100.3	98.6	96.9	95.1	93.3	91.4	89.5	87.6	85.6	83.7	1970
81.7	79.7	77.8	75.8	73.8	71.9	70.0	68.1	66.2	64.4	62.6	60.8	
59.1	57.4	55.7	54.1	52.6	51.0	49.5	48.1	46.7	45.4	44.1	42.8	
41.6	40.4	39.2	38.1	37.0	36.0	35.0	34.0	33.1	32.1	31.2	30.4	
29.5	28.6	27.8	27.0	26.2	25.4	24.6	23.8	23.0	22.2	21.5	20.7	
19.9	19.1	18.3	17.6	16.8	16.0	15.2	14.5	13.7	12.9	12.2	11.5	
10.7	10.0	9.3	8.6	8.0	7.3	6.7	6.1	5.6	5.1	4.6	4.2	
3.8	3.5	3.2	3.0	2.8	2.7	2.7	2.7	2.7	2.9	3.1	3.3	
3.7	4.0	4.5	5.0	5.6	6.2	6.9	7.6	8.4	9.2	10.1	11.0	
12.0	13.0	14.0	15.1	16.2	17.3	18.4	19.6	20.7	21.9	23.0	24.2	
25.4	26.5	27.6	28.8	29.9	31.0	32.0	33.1	34.1	35.1	36.0	36.9	1980
37.8	38.7	39.5	40.3	41.0	41.7	42.4	43.0	43.6	44.2	44.7	45.2	
45.6	46.0	46.4	46.7	47.0	47.2	47.4	47.6	47.7	47.8	47.8	47.8	
47.8	47.7	47.5	47.4	47.2	46.9	46.6	46.3	45.9	45.5	45.0	44.5	
43.9	43.3	42.6	42.0	41.2	40.4	39.6	38.8	37.9	37.0	36.0	35.0	
34.0	32.9	31.9	30.8	29.6	28.5	27.4	26.2	25.1	23.9	22.8	21.6	
20.5	19.3	18.2	17.1	16.0	15.0	14.0	13.0	12.0	11.1	10.2	9.4	
8.6	7.8	7.1	6.4	5.8	5.2	4.7	4.2	3.8	3.4	3.0	2.7	
2.4	2.2	2.0	1.9	1.7	1.6	1.6	1.5	1.5	1.5	1.5	1.5	
1.6	1.6	1.7	1.8	1.8	1.9	2.0	2.0	2.1	2.1	2.2	2.2	
2.3	2.3	2.4	2.4	2.4	2.5	2.5	2.5	2.6	2.6	2.6	2.7	1990
2.8	2.9	3.0	3.1	3.2	3.4	3.6	3.9	4.1	4.4	4.8	5.2	
5.6	6.1	6.6	7.1	7.7	8.4	9.1	9.9	10.7	11.5	12.4	13.3	
14.3	15.3	16.4	17.4	18.6	19.7	20.9	22.0	23.2	24.4	25.7	26.9	
28.1	29.3	30.5	31.6	32.8	33.9	35.0	36.0	37.0	37.9	38.8	39.7	
40.4	41.1	41.8	42.3	42.8	43.3	43.6	43.9	44.1	44.2	44.2	44.2	
44.0	43.8	43.6	43.2	42.8	42.3	41.8	41.2	40.5	39.8	39.0	38.2	
37.4	36.5	35.6	34.7	33.7	32.7	31.8	30.8	29.8	28.9	27.9	26.9	
26.0	25.1	24.2	23.3	22.5	21.7	20.9	20.1	19.4	18.7	18.0	17.4	
16.8	16.3	15.7	15.2	14.7	14.3	13.8	13.4	13.0	12.6	12.2	11.9	
11.5	11.1	10.8	10.4	10.1	9.7	9.3	9.0	8.6	8.2	7.8	7.4	2000
7.0	6.6	6.2	5.8	5.3	4.9	4.5	4.1	3.7	3.4	3.0	2.7	
2.4	2.1	1.9	1.7	1.5	1.4	1.4	1.4	1.4	1.6	1.8	2.0	
2.3	2.7	3.2	3.7	4.4	5.1	5.8	6.7	7.6	8.5	9.6	10.7	
11.8	13.0	14.3	15.6	16.9	18.3	19.7	21.2	22.7	24.1	25.6	27.1	
28.6	30.1	31.6	33.0	34.5	35.9	37.3	38.7	40.0	41.3	42.6	43.8	
45.0	46.1	47.2	48.3	49.4	50.4	51.3	52.3	53.2	54.0	54.9	55.7	
56.5	57.3	58.1	58.8	59.5	60.3	61.0	61.6	62.3	63.0	63.6	64.3	
64.9	65.5	66.1	66.6	67.1	67.6	68.1	68.5	68.8	69.1	69.3	69.5	
69.6	69.6	69.5	69.3	69.0	68.7	68.2	67.5	66.8	65.9	64.9	63.9	

Table I—Predicted 12-month running smoothed sunspot numbers.

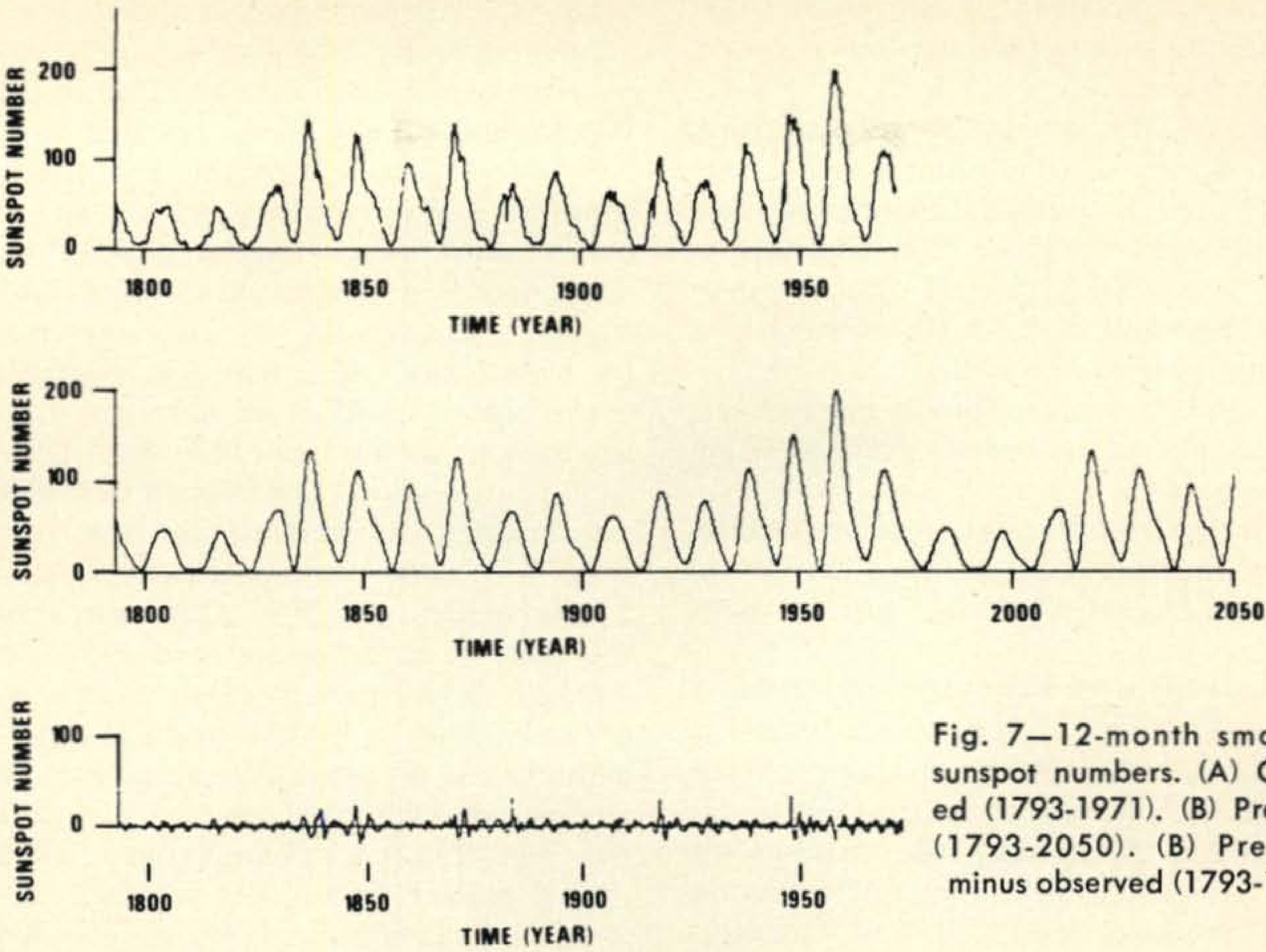


Fig. 7—12-month smoothed sunspot numbers. (A) Observed (1793-1971). (B) Predicted (1793-2050). (B) Predicted minus observed (1793-1971).

1971, the reconstructed waveform has an r.m.s. error of 5 sunspots.

Because our predictions can be projected backward as well as forward in time, it follows that the predictions for the interval 1750-1792 correspond to the estimated sunspot numbers in the interval 1929-1971. As a measure of our prediction capability, therefore, let us compare our predicted smoothed sunspot numbers for major features of the sunspot cycle from 1750 through 1792 with the corresponding observed values (Table II). The data suggest that our predictions for the smoothed numbers at sunspot maxima may be in error by up to ±25%, while our time estimates for the occurrence of the sunspot minima and maxima may differ from the true times by up to ± 2 years. Further, our predictions may tend to underestimate the smoothed sunspot numbers at sunspot minima.

Predictions

Based on the data shown in fig. 7(b) and listed in Table I, the following predictions can be made:

I. The current cycle, Number 20, will exhibit a prolonged decay in sunspot activity, with a null-to-null period of nearly 13 years. The activity of Cycle 20 has already exhibited unusual decay behavior by rising briefly, instead of falling continuously, in 1972. It seems possible, therefore, that the forthcoming sunspot low will not be reached until after 1975, and possibly as late as the summer of 1977. This is somewhat later than the August 1975 date for the time of the minimum predicted by Jacobs (in 1969) and

Sunspot Maxima

Predicted Date	Observed Date	Difference Predicted-Observed (Months)	Predicted Number	Observed Number	Difference Predicted-Observed
Oct., 1748	Apr., 1750	—18	78.3	92.6	—14.3
May, 1759	June, 1761	—25	112.5	86.5	26.0
Mar., 1769	Sept., 1769	— 6	151.8	115.8	36.0
Feb., 1779	May, 1778	9	202.4	158.6	43.8
Jan., 1790	Feb., 1788	23	113.3	141.2	—27.9

Sunspot Minima

Predicted Date	Observed Date	Difference Predicted-Observed (Months)	Predicted Number	Observed Number	Difference Predicted-Observed
Sept., 1754	May, 1755	— 8	2.2	8.5	— 6.3
Mar., 1765	June, 1766	—15	6.7	11.2	— 4.5
Feb., 1775	June, 1775	— 4	1.1	7.2	— 6.1
Aug., 1785	Apr., 1784	16	10.9	9.7	1.2

Table II—Comparison of predicted and observed sunspot numbers (1750-1792).

by Wood (in 1972), whose data indicates that the low will occur in the Spring of 1976. At the minimum, smoothed sunspot numbers could be as low as 3.

II. Cycle 21 will have a rather broad peak, possibly reaching its maximum value in late 1982. However, smoothed sunspot numbers for this peak may not exceed 50. The sunspot minimum following Cycle 21 should occur around 1988, and could exhibit smoothed sunspot numbers as low as 2.

III. Smoothed sunspot numbers in excess of 100 will not be observed again until approximately 2015.

In sum, the next 40 years may be characterized by relatively low sunspot activity as compared to the activity of the last 40 years.

Conclusions and Recommendations

The implications of low sunspot activity with respect to ionospheric propagation are, unfortunately, all too obvious. During the coming sunspot minimum, few openings will occur on 10 meters, with a significant reduction in 15 meter openings, as well. Openings on 20 meters will be more infrequent, and will be characterized by reduced signal levels and generally unstable conditions. Openings on 40 and 80 meters, however, should improve. Even during the next peak (Cycle 21), however, band conditions may, at best, be no better than those experienced in early 1973. For a more comprehensive discussion see "Seven Year Propagation Forecast," by Jacobs and Leinwoll in the Nov. 1969 issue of *CQ*, p. 52.

If our predictions are correct, high-frequency propagation during the next six to eight years will be marginal. While weeks of solar quiesance will be punctuated by bursts of activity, only those lucky enough to be on the bands at the right times may reap the rewards. There is a way, however, to remove some of the chance in knowing when conditions are favorable for long-distance communications. By establishing immediately a network of world-wide beacon stations in the 10, 15 and 20 meter bands, operators can have continuous indications of propagation conditions over various paths. In the 20 meter band, for example, beacon stations could operate in the range 14120-14130 kHz, transmit ten seconds of continuous carrier for signal-level measurements (perhaps the first ten seconds of every minute), and identify in c.w. at the beginning and the end of each transmission. The beacon stations could also be used by amateurs and s.w.l.'s worldwide to conduct comprehensive studies on ionospheric propagation. Questions related to the time a path opens and closes, signal strength as a function of time, fading, type of path (long or short) and apparent beam azimuth can all be studied. As a result of such studies, we will, perhaps, learn how to use the high-frequency bands more effectively during periods of sunspot minima.

In sum, communications using ionospheric propagation in the high frequency bands will be a challenge in the years to come. But amateur ingenuity and perserverence can overcome the obstacles we face. ■

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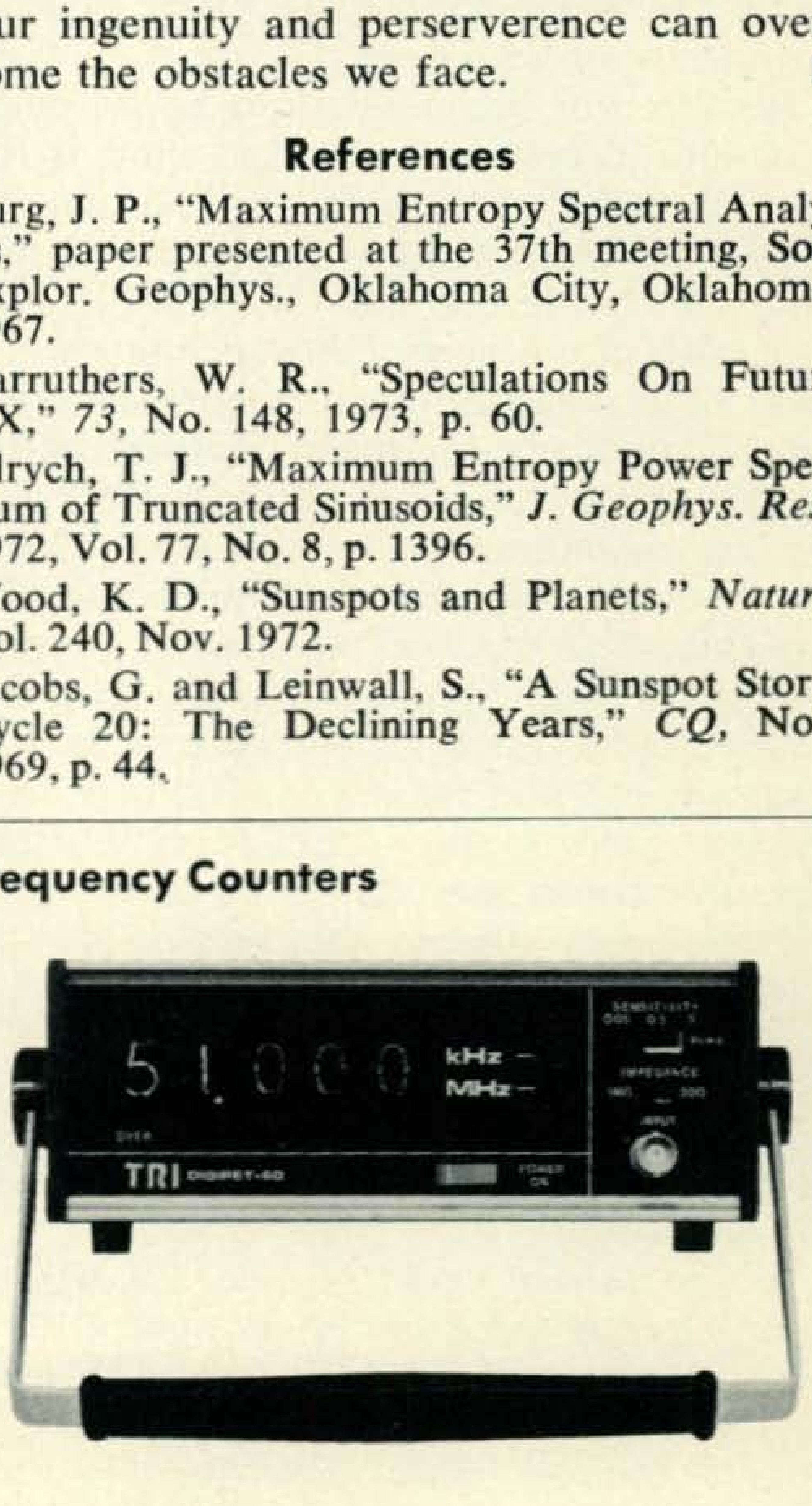
TRI to Market Digipet Frequency Counters

TRI Corporation of Sunnyvale, CA, has taken over US marketing for the Digipet 60 Frequency Counter and model 160 Converter, effective immediately. The Digipet 60 gives 1 Hz resolution from 1 kHz to 60 mHz with a stability of 1 p.p.m./week. Maximum sensitivity is 50 mv, with attenuators for 0.5 v. and 5 v. Price is $299. The Digipet 160 Frequency Converter extends coverage to the 130-160 mHz range, and sells for $50. For detailed information, circle A on page 94.



Worst-Case-Analysis
or
"It Doesn't Work!"

BY JOE KASSER,* G3ZCZ/W3

THE Super Dooper Exciter didn't work. It had been taking up most of Fred's time for the last two months. He had seen it described in his favorite ham magazine. In fact, it had leapt out at him when he had first glanced through the magazine. It was just what he needed for his station. The article had been written with care; construction would not be too difficult and, most important of all, most of the parts were already in his junkbox.

Over and over again Fred read the magazine until he knew the article by heart. He was sure that he understood the reason for every component drawn on the schematic. As for the operation of the unit, he could recite that backwards, upside down or sideways as required.

As the days passed he frantically dismantled his junkbox in a search for the required parts, carefully sorting and testing them. The few parts that he did not have he scrounged from his friends or purchased.

It was early on a Saturady morning when Fred began to build the Super Dooper Exciter by drilling the first hole in a brand new chassis. His work was only interrupted by short breaks to replenish the inner Fred. His understanding XYL aided and assisted him, basking in his happy and contented mood. By late Saturday night the heavy work had been finished. Further work on Sunday was interrupted by his taking the dog for a walk, visiting his in-laws, taking the children to a ball game and some maintenance work on the local two-meter repeater.

After spending most of his free time during the next week on the project, he finished it. The Super Dooper Exciter was ready. Fred cleaned his desktop, all the bits of wire, blobs of solder and spare resistors were reconsigned to the junkbox. Fred plugged the line cord into a handy wall outlet and reached over to flip the power switch.

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As he touched the switch he remembered what had happened to his friend Mike a few months before. He withdrew his hand as if the switch had been red hot and yanked out the line cord. He had been visiting Mike's shack just as Mike had completed work on a linear amplifier designed to cut through pile-ups. Mike had soldered the last connection, plugged in the line cord and switched on the power all in one smooth movement. It had taken five minutes for the black specs of carbon floating in the air to settle down, covering all exposed surfaces with a black layer one eighth of an inch thick. Mike still had a nervous twitch in his right arm and a strange fixation about line cords. He now went around making strange unintelligible noises, and pulling line cords out of wall sockets.

"Not me," thought Fred and settled down to check his work. It took him all day but was worth it, for he did find and correct one small wiring error.

Only then did Fred apply power to his handiwork. The pilot light came on and glared at him. After a few moments it was apparent that the smoke test was proceeding in a satisfactory manner, so while he waited for the rig to warm up, he went to the kitchen for a drink, spoke to the XYL to show that he was still living, settled an argument between his youngest harmonic and the TV set and finally just as he got back to the shack, tripped over the dog. Having got back into the shack he found that the Super Dooper Exciter had completely passed the smoke test.

As Fred examined his handiwork he found that not only could he not tune it up on any band, but the transmit relay persisted in remaining in the transmit position no matter what he did. As he checked and rechecked his work against the schematic without finding any errors his frustration increased. After about two hours, Fred was thoroughly fed up and almost reduced to tears.

"It doesn't work!" he announced as he kissed his XYL and went to sleep. "It doesn't work!"

The following evening Fred went along to his local radio club. There he met his friend Dave who was an electronic engineer. Over a cup of coffee Fred explained his problem to Dave.

"I can't understand it Dave," he said. "I mean, I checked my wiring against the schematic. I checked the parts against the component list and I can't find any mistakes, yet that relay is switched on."

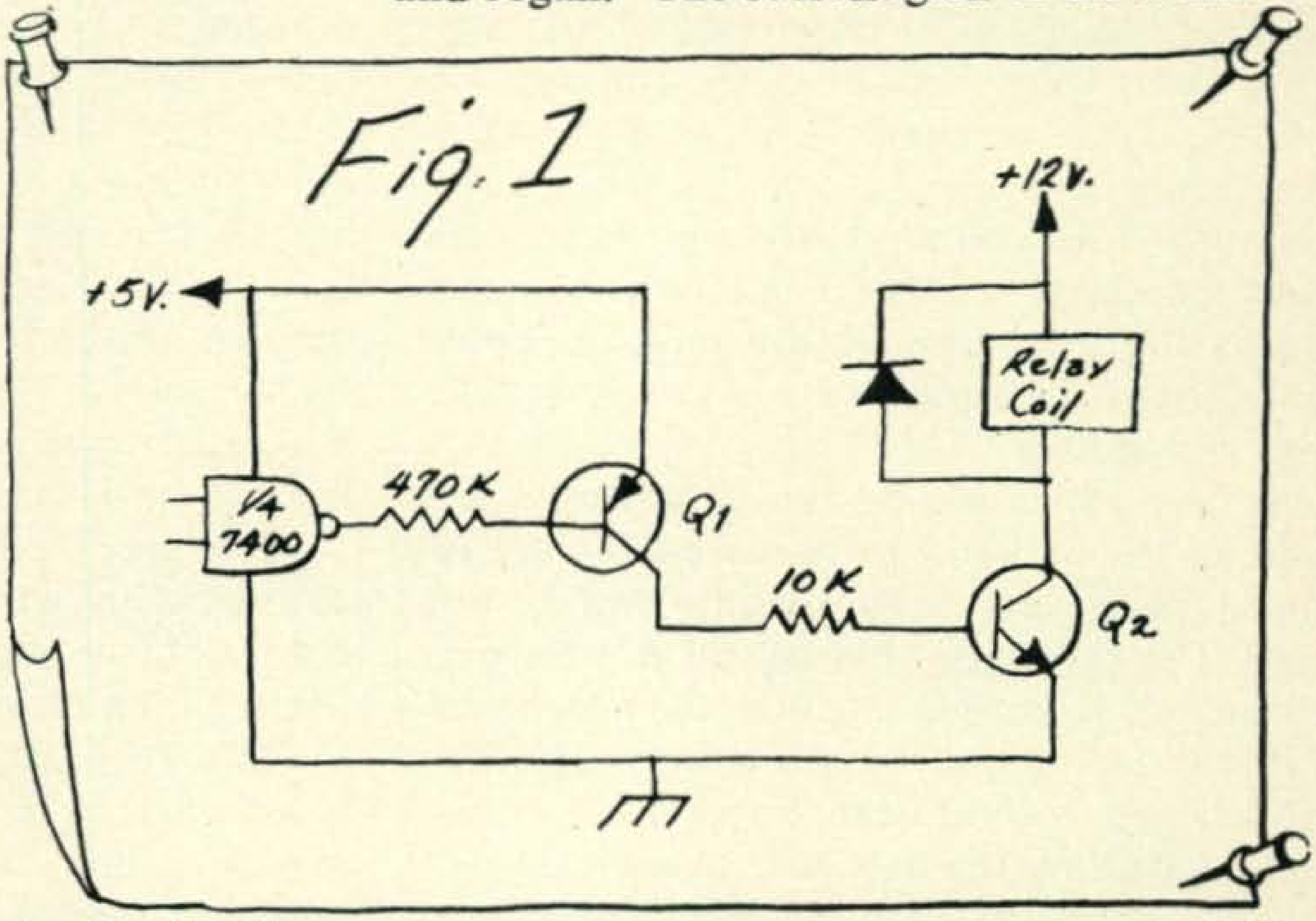
"What parts did you use?" asked Dave "New or used?"

"A mixture, but mostly used," answered Fred, then adding, "I even checked the resistance values on a VOM, so I know that the parts are as marked. I don't understand it."

"Sketch the relay driver circuit on this napkin," suggested Dave "and let's see if there's a circuit error."

Fred sketched the schematic on the napkin (see fig. 1), and they both looked at it. Dave studied it with interest and then asked "What transistors did you use, Fred?"

"Oh, some I picked up last year," was the reply. "The article said that the actual type wasn't critical as long as they were PNP or NPN as required."



"Do you know what kind of gain they have?" queried Dave.

"At least a hundred," said Fred. "I chose the best ones I had."

"That might be your problem!"

"What! How?"

"Well, Fred, most people when they build a rig do not perform any analyses to determine how much of an operating margin they have. They don't check to see the effects of using transistors with lower or higher gains. They usually build it, troubleshoot and debug it. They then operate it for a while and write it up and get it published in a magazine."

"It works, so what?" asked Fred.

"Well, take your circuit for example," said Dave "Do you understand how it works?"

"Sure," said Fred, "listen: the output of the 7400 gate is normally high. Transistor Q_1 is a PNP type and is thus biassed off. When it is off, then the base of Q_2 does not have any current flowing into it. Q_2 is thus switched off and the relay coil is de-energized. When the output of the gate goes low, Q_1 conducts so that Q_2 also conducts and the relay coil is energized."

"Right," said Dave, "But what about the input current to Q_1?"

"What about it?" asked Fred. "I mean the voltage at the output of the gate is either high or low, Q_1 conducts or is switched off. This circuit is independent of the current flowing through the input of Q_1."

"Not quite. Let me show you."

Dave sketched some numbers on the schematic and passed it to Fred (fig. 2).

"Now let's just analyze the circuit," he said and began. "The current gain of the transistor is roughly equal to the output current divided by the input current."

"Of course," interupted Fred. "Even a Novice knows that!"

"OK. Thus, the input current of Q_2 is equal to the relay current divided by the current gain (B_2) of the transistor, and, similarly the input current to Q_1 is equal to its collector current divided by its current gain (B_1)."

"Yes, and the input current of Q_2 is the same as the output current of Q_1," added Fred.

"Exactly, so writing it down we get

$$I_{B2} = \frac{I_R}{B_2} \text{ and } I_{B1} = \frac{I_{B2}}{B_1} = \frac{I_R}{B_2} \times \frac{1}{B_1}$$

$$\text{that is } I_{B1} = \frac{I_R}{B_1 \times B_2}$$

"What current does the relay need to operate?" asked Dave.

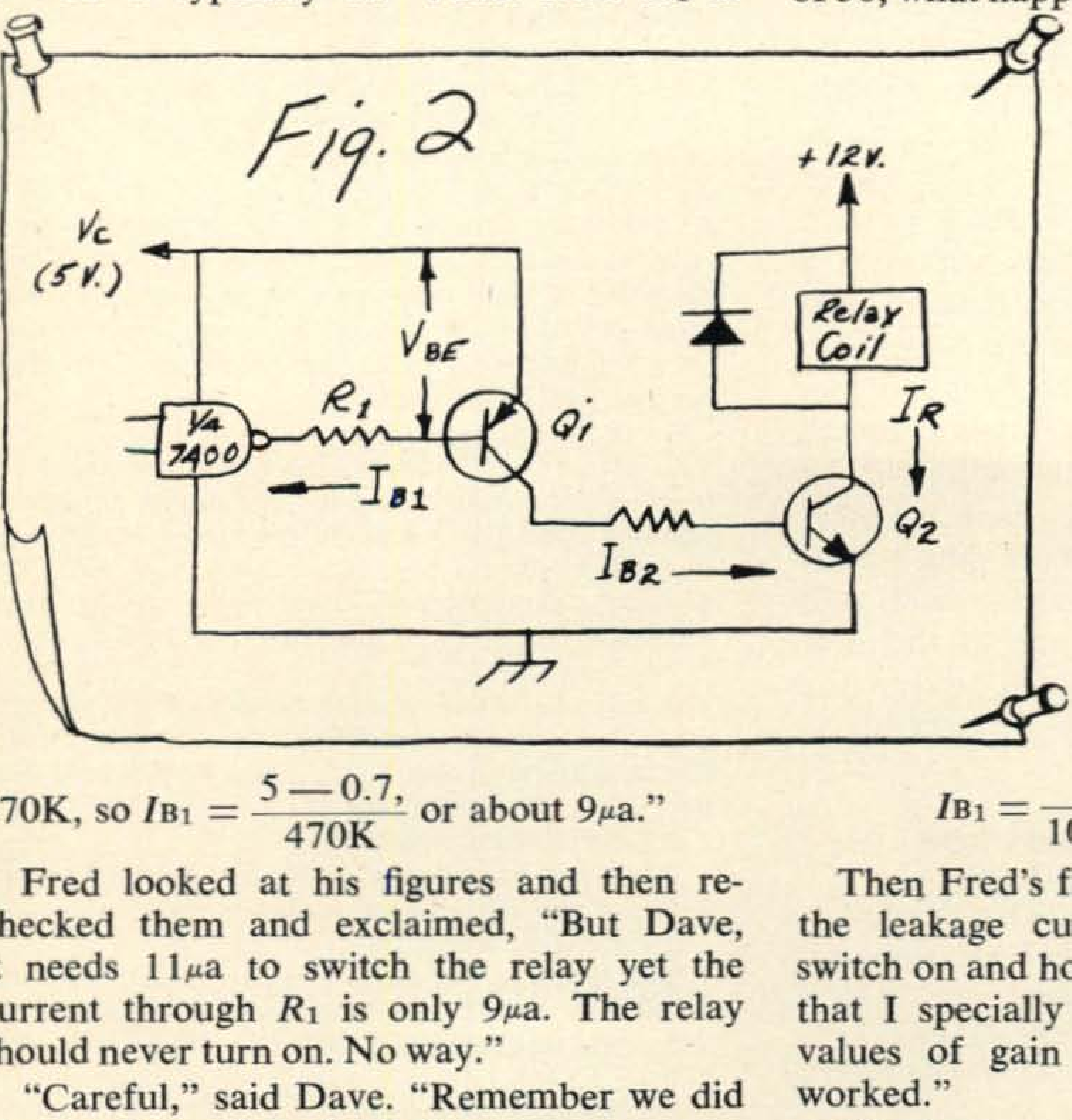
"Oh, about 10ma," replied Fred.

"Suppose," postulated Dave, "that the author had used transistors with gains of 30, what value of input current would be required?"

"That's simple," said Fred, "substituting into the equation, it's

"So when the output of the gate goes low, $11\mu a$ of current must flow through R_1 to switch the relay," said Dave. "Does it?"

"I suppose so," answered Fred, "let's check. In the circuit formed by R_1 and the base-emitter of Q_1, the current flowing is equal to the voltage divided by the resistance, that is $I_{B1} = \frac{V_C - V_{BE},}{R}$ ignoring any voltage drop inside the gate. Its a silicon transistor so V_{BE} is typically 0.7 Volts. Now R_1 is



470K, so $I_{B1} = \frac{5 - 0.7,}{470K}$ or about $9\mu a$."

Fred looked at his figures and then rechecked them and exclaimed, "But Dave, it needs $11\mu a$ to switch the relay yet the current through R_1 is only $9\mu a$. The relay should never turn on. No way."

"Careful," said Dave. "Remember we did choose a low value of gain."

"That's right!" said Fred "I suppose that the actual transistors that the author used in his circuit must have had higher values of gain than 30."

"Good," said Dave, "now we're getting somewhere."

"But that doesn't solve my problem," said Fred "I can't get that relay to switch off!"

"We're coming to that," continued Dave. "Let's assume that the gate is not a perfect switch and has some leakage."

"But silicon transistors have negligible leakage currents," returned Fred.

"Not necessarily," answered Dave. "A 7400 is a logic device. The manufacturer only specifies a high as being a voltage of between +2.4v. and +5.5v. and a low as being a voltage between 0v. and +0.3v."

"What has that got to do with current?" asked Fred.

"The manufacturer again says that the output transistor of the gate must be able to sink 16ma in the low state, and supply about 10ma in the high state. They don't say anything about leakage currents."

Fred was not yet convinced. "Well, let's allow a slight amount, say $1\mu a$."

"OK. If the transistors have current gains of 30, what happens in our circuit?"

"Well," said Fred, "the leakage current must flow in R_1."

"Right."

"Since the input current of Q_1 must be about $11\mu a$ to switch the relay, a leakage current of $1\mu a$ has no effect."

"Good," said Dave, "but if those same transistors had current gains of about 100, what value of input current would Q_1 require to switch the relay on?"

"Well" said Fred taking pencil to paper,

$$I_{B1} = \frac{10}{100 \times 100} \text{ ma or } 1\mu a."$$

Then Fred's face lit up. "Why, that means the leakage current will make the relay switch on and hold it on all the time. To think that I specially chose transistors with high values of gain to ensure that the circuit worked."

"It does work," said Dave, "exactly as you designed it. You only considered the conditions under which you wanted the relay to operate, you did not check for 'not' operating conditions. Think it over, and redesign the circuit so that the relay is not held in by leakage currents yet pulls in when the output of the gate goes low."

"Yes, that's simple enough," said Fred.

[*Continued on page 73*]

EIA Sets Standards For Amateur Antennas

IN early January, the Engineering Department of the Electronic Industries Association released a set of standards for commercially manufactured amateur radio antennas. The published report, entitled, "Minimum Standards for Amateur Radio Antenna—Part I—Base or Fixed Station Antenna," is available from the EIA Engineering Department—Standards Orders, 2001 Eye Street, N.W., Washington, D.C. at $2.00 per copy. If you are not too concerned about struggling with mice type, the entire text of the new standards is reprinted below. Presumably, Part II, when available, will cover mobile antennas and perhaps other ancillary equipment.

The purpose of these standards is to give both the manufacturer and the consumer a basis by which to measure the relative performance and value of an amateur antenna, something which has been clearly lacking in the amateur antenna field until now. Not all antennas manufactured in the US will be built and rated to these standards, but at this writing, at least two large ham antenna manufacturers hold EIA membership and will probably make their adherence to the new standards widely known through advertising in the amateur publications. It should be interesting.

MINIMUM STANDARDS FOR AMATEUR RADIO ANTENNA PART I — BASE OR FIXED STATION HF ANTENNA

(From Standards Proposal No. 1100, formulated under the cognizance of EIA Committee TR-33 on Amateur Radio Equipment)

FOREWORD

The widespread use of commercially constructed antennas in the Amateur Radio Service has resulted in a proliferation of statements of antenna gain and/or directivity based upon various reference antennas.

It is the purpose of this standard to establish a reference antenna to which all antenna gain and/or directivity specifications can be related and to define parameters of measurement and establish standard methods of measurement of such antennas. This standard will assist both the manufacturer and the user in specifying antenna performance.

1. SCOPE

1.1 This standard applies only to base or fixed station antennas as defined herein.

1.2 Base or fixed station antennas are antennas used in the Amateur Radio Service at the base (home) station or other fixed station location.

2. ELECTRICAL STANDARDS

2.1 STANDARD REFERENCES AND TEST CONDITIONS

Standard references and test conditions are those which shall apply to an antenna while it is being tested for minimum performance requirements. These conditions apply unless otherwise specified.

2.1.1 *Standard Impedance*

The characteristic impedance of the transmission line connection test equipment to the antenna under test shall be 50 ohms $\pm 5\%$.

2.1.2 *Half-Wave Dipole*

A half-wave dipole is an antenna formed by a straight radiator, one-half wavelength long, whose diameter is small compared to its length, so energized that the current has two nodes, one on each end, producing a maximum radiation in a plane normal to its axis (IEEE).

2.1.3 *Standard Gain Unit*

The gain of a lossless half-wave dipole shall be used as a standard gain unit. The power gain of an antenna (see 2.8) shall be expressed in dB over that of a lossless half-wave dipole, or dBd. The gain of a lossless half-wave dipole in the plane perpendicular to its axis is therefore 0 dBd.

2.1.4 *Test Site*

The test site is the general vicinity of the antenna under test. Specific conditions for the test site are stated in detail in Section 2.2 for VSWR and Section 2.3 for radiation pattern.

2.1.4.1 Source Antenna

The source antenna that illuminates the antenna under test for gain or radiation pattern.

2.1.4.2 Test Range

The test range is the space enclosing the source antenna and the antenna under test. Conditions for the test range are stated in detail in Section 2.3.3.1.

2.1.5 *Ambient Conditions*

Measurements of VSWR radiation patterns and antenna power gain may be made at outdoor test sites under prevailing weather conditions.

2.1.6 *Polarization*

The polarization of an antenna is the orientation of the electric vector of the wave radiated by the antenna.

2.2 VOLTAGE STANDING WAVE RATIO (VSWR)

2.2.1 *Definition*

Voltage standing wave ratio (VSWR) of the antenna is the ratio of the maximum to the minimum values of voltage in the standing wave pattern that appears along a lossless 50-ohm line with the antenna as a load.

2.2.2 *Minimum Standards*

The VSWR shall not exceed 2.0 at the specified frequency or over the band of specified frequencies.

2.2.3 *Method of Measurements*

The VSWR will be tested on full scale model antennas only.

2.2.3.1 Test Procedure

The antenna shall be connected to an RF signal source through a VSWR measuring device such as an RF Impedance Bridge or other device that has a nominal impedance of 50 ohms and a residual VSWR of not more than 1.05. The VSWR, as read on the measuring device, will be the VSWR of the antenna at the selected frequency. If the RF loss in the line connecting the antenna to the VSWR measuring device exceeds ½ dB, the measured VSWR values shall be corrected to eliminate the effect of the line loss. The readings from this bridge will then be recorded on a Smith Chart, properly corected to eliminate the effects of line loss.

2.2.3.2 Test Site

The antenna under test shall be located in a space relatively free from reflections and sufficiently far from test equipment and personnel. The test site is considered to be satisfactory if the change in VSWR reading is less than 0.1 when the antenna is moved around and up-and-down by plus or minus one quarter of a wavelength. The HF antenna will be tested at a minimum height of one-half wavelength at the operating frequency.

2.2.3.3 Effect of Supporting Structures

For certain applications, such as side-mounted vertical radiators, the supporting structure is in the RF field of the antenna. In this case the antenna supporting structure shall be included in the mounting of the antenna under the VSWR test.

2.3 RADIATION PATTERN

2.3.1 *Definition*

The radiation pattern is a graphical representation of the magnitude of the relative electric field strength radiated from an antenna in a given plane, plotted against direction from a given reference.

2.3.2 *Standard*

The radiation pattern shall be for the horizontal plane. The polarization shall be specified.

2.3.3 *Method of Measurement*

Owing to the principle of reciprocity, test results obtained with the source antenna transmitting and the antenna under test receiving, are the same as those obtained with the source antenna receiving and the antenna under test transmitting. For brevity, the following sections assume that the source antenna is a transmitting antenna.

2.3.3.1 Test Range

A typical test set up for radiation pattern measurements is shown in Figure 1.

2.3.3.2 Test Procedure

A signal source tuned to the test frequency is connected to a source antenna. The radiated signal is received on the antenna under test. The latter is so mounted that it is similarly polarized to the source antenna. The antenna under test is connected to a radio receiver, calibrated to measure the signal level at its input. The antenna under test is rotated around in an axis perpendicular to the line between its center and the center of the source antenna as shown in Figure 1, and the received signal is recorded continuously through 360° of rotation.

1. Horizontal Pattern—For horizontal pattern test, the vertical direction of the antenna in its normal operating position shall be the axis of rotation in the test.
2. Vertical Pattern—For vertical pattern test, the vertical direction of the antenna in its normal operating position shall be perpendicular to the axis of rotation in the test.

2.3.3.3 Test Conditions

1. The separation between the source antenna and the antenna under test shall be at least 10 wavelengths.
2. The radio receiver used as a signal detector shall present an impedance of 50 ohms resistive to the antenna under test of all frequencies used for the measurements. This condition is to be assured by the use of a fixed resistive attenuator pad at the antenna input of the receiver as in 2.8.3.2.2.
3. Both the signal output of the signal source and the sensitivity of the receiving equipment shall be monitored so as to insure that they are maintained constant during the test.
4. Each horizontal pattern shall be calibrated with attenuator pads to show a 3 dB, 10 dB, and 20 dB attenuation from maximum radiation.

2.4 OMNIDIRECTIONAL ANTENNA

2.4.1 *Definition*

An omnidirectional antenna is an antenna having an essentially non-directional pattern in azimuth and a directive pattern in elevation (American National Standard).

2.4.2 *Minimum Standard*

The relative gain of an omnidirectional antenna in any azimuth direction shall not vary from the mean value by more than ± ½ dB through 360° of rotation.

2.4.2 *Method of Measurement*

Same as that for Radiation Pattern Test (2.4).

2.5 PATTERN CIRCULARITY

2.5.1 *Definition*

The pattern circularity of an omnidirectional antenna is the deviation of its horizontal radiation pattern from a true circle.

2.5.2 *Standard*

The departure from circuitry measured from a mean value shall be stated in ± dB by the manufacturer.

2.5.3 *Method of Measurement*

Same as for Radiation Pattern Test (2.4).

2.6 DIRECTIONAL ANTENNA

2.6.1 *Definition*

The directional antenna is an antenna which radiates or receives waves more effectively in some azimuthal directions than in others.

2.6.1.1. Radiation Lobe

Radiation lobe is a portion of a radiation pattern bounded by one or two angular regions of minimum radiation in either the electric field or magnetic field.

2.6.1.2 Major Lobe

The radiation lobe containing the direction of maximum radiation.

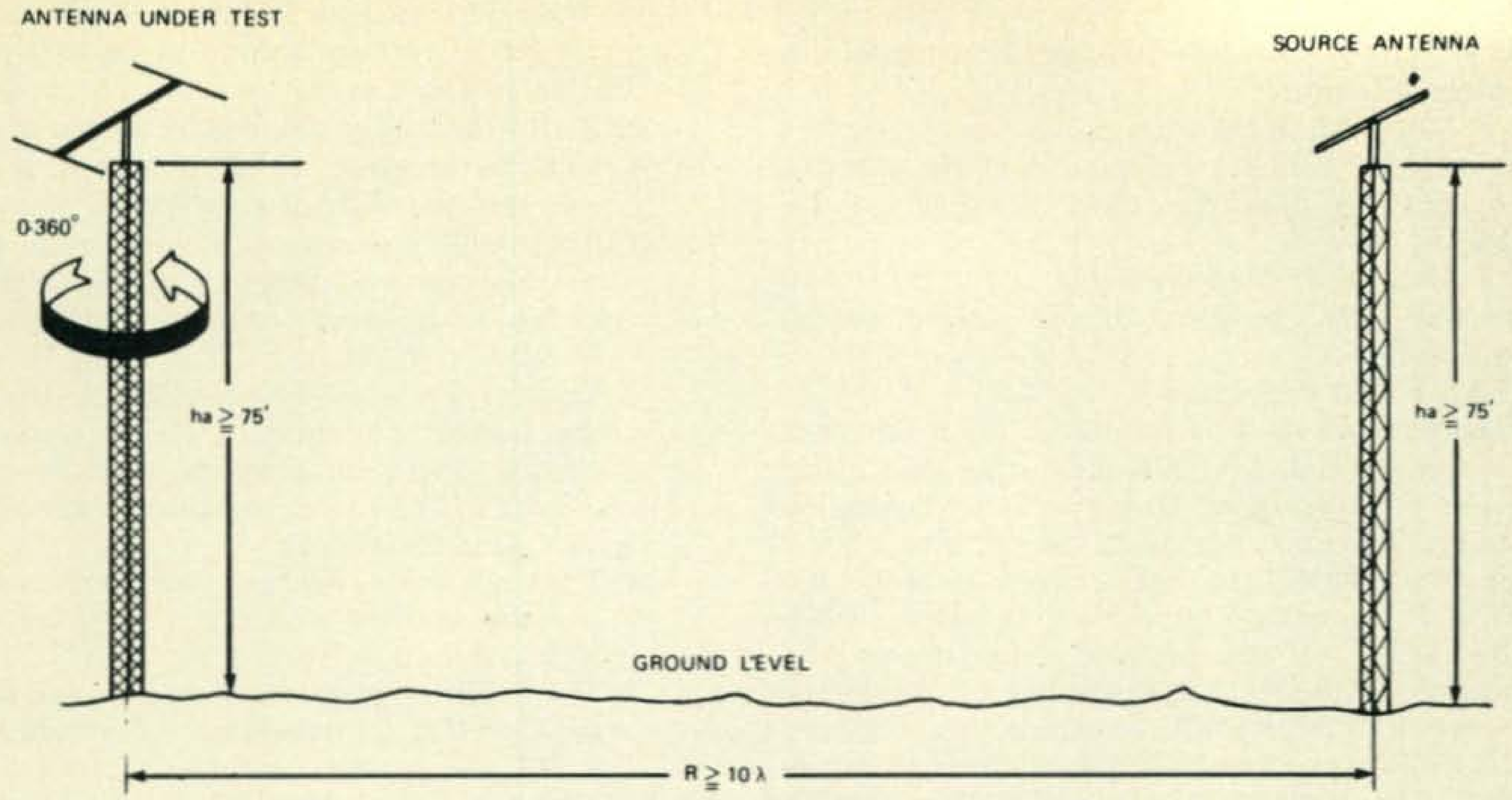


Fig. 1—Test set up for radition pattern measurements.

2.6.1.3 Minor Lobe
Any radiation lobe except the major lobe.

2.6.2 *Standard*
A directional antenna shall have one or more major lobes in a horizontal pattern whose maximum relative gain shall exceed the minimum relative gain by more than 3 dB. The manufacturer shall show all lobes down to 20 dB below the major lobe on the radiation pattern.

2.6.3 *Method of Measurement*
Same as for Radiation Test Pattern (2.4).

2.7 HORIZONTAL BEAM WIDTH

2.7.1 *Definition*
Horizontal beam width of an antenna is the angular width including maximum radiation measured between the two points on the major lobe on the horizontal pattern 3 dB below the maximum.

2.7.2 *Standard*
The horizontal beam width shall be stated by the manufacturer.

2.7.3 *Method of Measurement*
Same as for Radiation Test Pattern (2.4).

2.8 ANTENNA POWER GAIN

2.8.1 *Definition*
The power gain of an antenna is the ratio of the radiated intensity of the antenna in a given direction, usually on the horizon, to the maximum radiation intensity of a lossless reference antenna, usually a half-wave dipole with same input power.

2.8.2 *Standard*
The power gain of the antenna shall be expressed in dB over the gain of a lossless half-wave dipole, manufacturer. The measured power gain shall not be less than that stated by the manufacturer at any stated frequency or band of frequencies.

2.8.3 *Method of Measurement*

2.8.3.1 Test Range
Same as that for pattern test (Section 2.3.3.1), as shown in Figure 1.

2.8.3.2 Test Procedure
Substitution methods shall be used for measuring the antenna power gain.

A signal source tuned to the test frequency is connected to a source antenna. The radiated signal is received on an antenna under test. The latter is so mounted that it is similarly polarized to the source antenna. Two methods of determining the gain may be used.

2.8.3.2.1 The antenna under test is connected to a radio receiver calibrated to measure the signal level at its input. The antenna under test is rotated and adjusted until the receiver signal power level reaches the maximum. This level is designated as P_a.

The antenna under test is removed and a standard ½ wave dipole with gain of 0 dBd as listed in Section 2.1.3 is substituted in its place. The standard antenna is then rotated and adjusted until the receiver signal power level reaches the maximum. This level is designated as P_s.

The measured power gain of the antenna in the direction of the maximum radiation is:

$$G_a = 10 \times \log \text{ of } (P_a/P_s) \text{ or}$$

$$G_a = 20 \times \log (E_a/E_s)$$

2.8.3.2.2 The antenna under test may be connected to a variable coaxial attenuator with characteristic impedance equal to the transmission line. The input of the receiver is isolated from the variable attenuator by a fixed attenuation pad with a value of at least 10 dB. The half-wave dipole, as described in 2.1.3 is connected to the variable attenuator and reference field strength reading is taken with all attenuators set at 0 dB except the isolation pad.

Remove the half-wave dipole and connect the antenna under test. Adjust the variable attenuators to obtain the same reference reading.

Power gain now is the amount of attenuation required to obtain a field strength reading equal to the reference reading.

NOTE: The meter movement in the receiver should have a deflection which is linear with respect to the voltage input to the antenna input terminals of the receiver. The readings used are relative field strength readings, not absolute field strength readings in μV per meter.

2.9 ANTENNA POWER RATING

2.9.1 *Definition*
Antenna power rating is the maximum CW or SSB

[*Continued on page 81*]

"LET YOUR FINGERS DO THE TALKING"

BY FREDERICK M. KRUGER*, PH. D., K2LDC

CLOSE your eyes and try to read this page. Obviously you can't do it. But there is an alternative, you say: Someone could read it to you. True enough. Now try to imagine that you can't hear either! What would you do to find out what was happening? If you can't see or hear, how can you communicate with others?

With the loss of the senses of vision and hearing—so crucial to normal communications—you would find serious problems in doing what was previously simple. No longer could you use your amateur radio equipment as you had. The telephone would no longer be an immediate link with friends, business associates, or emergency services. Of what use is a television set or a radio if you can't even tell whether it is on or off, let alone use it for entertainment or for obtaining information? These are fearful thoughts, and maybe you would feel more comfortable reading other material; but first consider this:

Deaf-blindness is a fact of life for 10-15 thousand people in the United States. With no means of distinguishing between day and night, no radio or T.V., and minimal access to magazines or newspapers, most of these people live a very lonely, isolated life. Because of the relatively small number of such persons, and the circumstances surrounding their lives, deaf-blind individuals belong to an all but invisible minority. Even though some of these people have some sight or hearing, their use of it is, at best, quite limited. To the extent that most people are aware of the deaf-blind at all, it is with feelings of pity, discomfort, and detachment. An automatic assumption is made that society has no place for people who are unable to make use of the major avenues of human experience and interaction.

In reality, deaf-blind people are like everyone else in most respects. Intellect is not a function

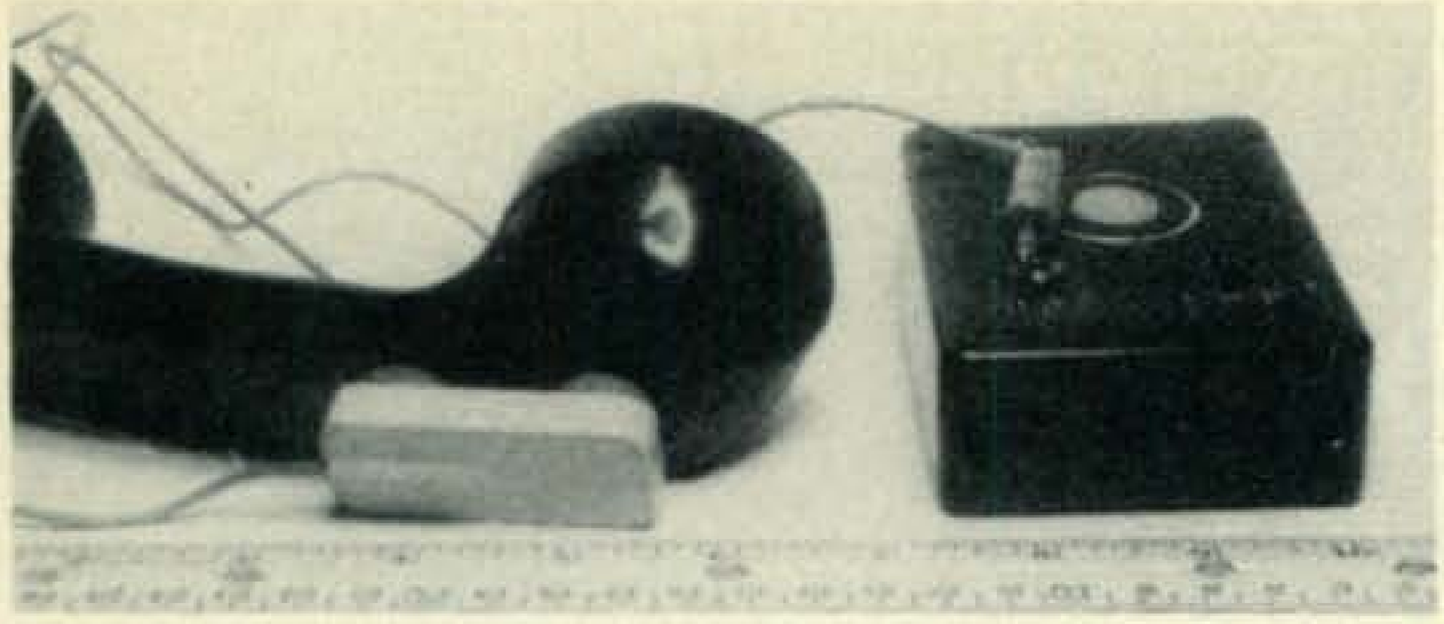
*Director of Research, National Center for Deaf-Blind Youths and Adults, 105 Fifth Ave., New Hyde Park, N.Y. 11040.

Methods of Tactile Communications

Send	Receive
1. Gestures and modified American Sign Language	1. Gestures and modified American Sign Language (uses own hands to follow sender's movements plus residual vision if available)
2. Block print alphabet in palm of hand	2. Block print alphabet in palm of hand
3. Braille	3. Braille
4. One hand manual alphabet (finger spelling)	4. One hand manual alphabet (finger spelling)
5. Speech (some deaf-blind people can speak intelligibly)	5. Morse code (finger tips on speaker cone or other tactile transducer)
6. Written messages (large script or print)	6. Written messages if there is some residual vision (large script, print, or type)
7. Typewriting	7. Tadoma (tactile lip reading used by some deaf-blind persons)
	8. Tellatouch

Table I—Methods of Tactile Communications.

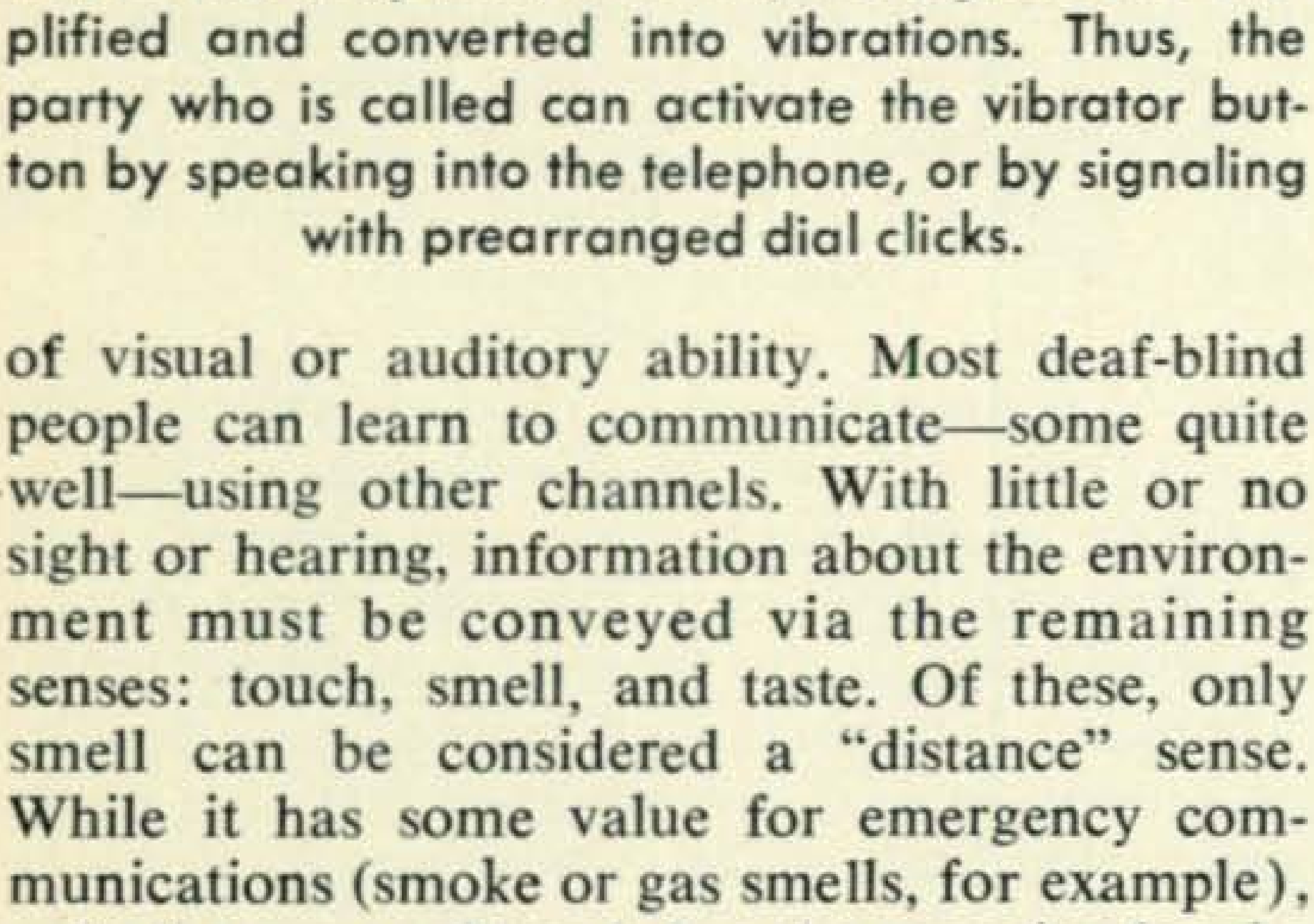
Dr Frederick M. Kruger, Director of Research (at the National Center for Deaf-Blind Youths and Adults), is using the one hand manual alphabet to teach the use of the *Telebraille* to Dr. Robert J. Smithdas, Director of Community Education (also at the National Center), who is himself deaf-blind. The *Telebraille* is a newy-designed device which will enable deaf-blind people to use the telephone independently and to communicate by Braille.



The Tactile Speech Indicator enables a deaf-blind person to conduct rudimentary communication over the telephone. It consists of an induction coil and an amplifier box with a vibratory output transducer. When the user couples the induction coil to the telephone handset, the signals are amplified and converted into vibrations. Thus, the party who is called can activate the vibrator button by speaking into the telephone, or by signaling with prearranged dial clicks.

of visual or auditory ability. Most deaf-blind people can learn to communicate—some quite well—using other channels. With little or no sight or hearing, information about the environment must be conveyed via the remaining senses: touch, smell, and taste. Of these, only smell can be considered a "distance" sense. While it has some value for emergency communications (smoke or gas smells, for example), only the sense of touch has the capacity for the fine resolution so necessary for communications.

There are several ways for a deaf-blind person to communicate through touch. Table I lists some of the possibilities.



A prototype of the Telebraille device. On the left is the accoustical coupler which cradles the telephone handset for transmission of Braille information. The six white buttons in the center are switches, each corresponding to a dot position in the Braille cell. The small object in the lower center of the photo is an electro-mechanical Braille cell read-out whereby any combination of six pins are raised to form Braille characters. Two operators therefore can "key" each other's read-out and hold a running conversation via the telephone. Not shown in the photo are: send/receive switch, power switch and display duration control.

Definitions

1. **Braille** is a system of writing for the blind in which various combinations of six raised dots (2 columns of 3 dots each) are used to represent letters and numbers. These dots are read by using the fingertips. The basic six dot configuration is called a Braille cell.
2. **One Hand Manual Alphabet** is a system of finger positions where each position represents a letter or number. It is used by the deaf and deaf-blind and can be read visually or tactually—by forming the letters into the individual's cupped hand.
3. **American Sign Language** is used by the deaf and deaf-blind. It is a system wherein a standardized hand movement represents an entire word. It is a language in that it has its own grammatical rules.
4. **Tellatouch** is a device whereby the sender uses a typewriter-like keyboard to send messages. When a key is pressed, the corresponding braille letter is mechanically raised on a braille cell on the back of the Tellatouch. The receiving person reads the braille with one fingertip.

As you can see, communication is possible for the deaf-blind person, but almost all of it is on a one-to-one basis. Until quite recently, only morse code and "click codes" provided a means of communication at a distance, and not many deaf-blind individuals know or will learn morse code. (*Remember the trouble you had learning it?!*) The click codes provide the deaf-blind person who can speak with a means of using the telephone. The called party is instructed to respond to the deaf-blind person's question in a specific manner, such as dialing a 1 for "yes," and a 4 for "no." The caller places his fingers on the earpiece (or on the output transducer of a device designed to amplify these clicks) and feels the coded replies to his questions. Thus, through a series of questions, similar to the game of Twenty Questions, the deaf-blind person can converse. Morse code can be transmitted by dialing a 1 for a dot and a 4 for a dash, or the speaking individual can say "dit" for a dot and "da-a" for a dash. The vibrations can be felt on the output transducer. All other communication must be through *direct physical contact.*

Electronic Aids in Communications

The following devices are a partial listing of what is currently being used and planned for use by deaf-blind people.

The **Tactile Speech Indicator** consists of an induction coil and an amplifier box with a vibratory output transducer. Questions are asked so as to require a yes or no answer. "Yes-yes" signifies an affirmative response, "no" a negative one; or, dialing a "1" is used for yes, and a "4" for no. The voiced and/or click responses are felt on the output transducer.

The **Sensicall** is directly connected to the telephone. The deaf-blind person with speech talks directly into the phone. If he has no speech, he uses a transmitting key to send morse code. The other person can use the key or his voice to respond in morse code or in a manner similar to that used with the Tactile Speech Indicator. The output device is either a flashing light or a vibrating tactile pad (depending on whether the deaf-blind person has any residual vision). The **Code-Com** combines these two output devices into one package and will eventually replace the Sensicall.

The **Telebraille** is in the field-test stage. Braille is transmitted over the telephone with this device. Keys are pressed corresponding to a braille letter, and the braille letter is converted into corresponding audio frequency - shifted binary strings which are acoustically coupled to a telephone handset. On the receiving end, the handset is acoustically coupled to an identical unit which converts the binary strings to signals that drive pins in the braille cell.

The **Wrist-Com** is still in the design stage. It is a pager that will be small enough to be worn on the wrist. Different vibratory signals will be receivable to warn of emergencies, the ringing of a doorbell, and the ringing of the telephone. It will be waterproof and very shock resistant.

What You Can Do

Many deaf-blind people could function much more independently if they had more and better ways to communicate at a distance. Some basic devices described above already are manufactured and exist for this purpose, and others have been designed and simply require construction. Very significant, however, is the requirement that the acquisition cost of each device be quite low. Remember that a device which costs you a week's salary could cost a deaf-blind person a month's or several month's income. The purchase of any communications aid should not cause financial hardship. Remember, too, that the cost can increase significantly if family members or friends want to purchase compatible devices so that they can communicate with the deaf-blind individual

In this period of rapid technological advancement and engineering sophistication, there is no reason why deaf-blind persons should be deprived of the everyday conveniences we most take for granted: 1) a signal which tells when the doorbell has rung, 2) a telephone ring indicator, and 3) a reliable means of communicating over the phone in an emergency. (The Telebraille and Wrist-Com, to be described in detail in a subsequent article, could provide answers to these needs). Yet most deaf-blind people are without these things that we rely on without thinking.

The simple reality is that it is not profitable for a manufacturer to make devices for so small a group of *potential* users. Even with some government support for the development of these devices, the cost of parts *and labor* puts the price beyond the reach of most deaf-blind people.

This is where radio amateurs can help. You can supply the labor to assemble the various devices. As noted earlier, circuit descriptions and construction details will be published in future articles. You don't have to know a deaf-blind person to help. By providing the necessary labor, you will help to keep down the cost of getting a device into the user's hands.

The construction of special morse code output units would enable some deaf-blind individuals to listen to telegraphed news and weather broadcasts or even "listen in" on amateur conversations. Some might even become amateurs and add to the already existing—though small—ranks of deaf-blind radio amateurs. (c.w. is received by placing finger tips on a loudspeaker cone or on a special output transducer). Morse code transmission techniques are among the communications methods already used by some deaf-blind persons and could literally put the world of communications at their finger tips.

If you have had reasonable experience building from scratch or kits, and are willing to help assemble communication aids for deaf-blind people, or if you are in a position to offer other engineering or manufacturing assistance, *please* contact the author. ■

Triumph

Because God chose for me this somber fate
of darkness centered in a world of light
and silence where the earth's rich songs pulsate,
I felt that I must turn away in flight,
fly from the shadows, brooding day and night
and the strange stillness, deep and desolate
where only scattered memories were bright
and only broken songs could penetrate.
I do not know exactly how it happened,
but suddenly, as if a door had opened,
I felt a warm glow in my heart, and heard
a trumpet voice cry: "Courage!" Then I stirred
the silver embers of my dreams to fire,
and played a song of triumph on life's lyre.

Robert J. Smithdas
Director of Community Education
National Center for Deaf-Blind Youths and Adults

Slow Scan TV

BY COPTHORNE MACDONALD,* WØORX

How does one go about creating an electronic "something" when nothing just like it ever existed before? There are as many different design "styles" as there are designers. In the "ivory tower" approach everything is done on paper, with calculations carried out to three significant figures. In the extreme "cut and try" approach, nothing is calculated. Parts arrangements and values are shuffled around until the circuit works. The first approach often results in making a mountain-sized pile of paperwork out of a molehill-sized design task. The second often leads to unreliable designs, burned up parts, and unnecessary discouragement. In my view, there is an optimum mix of "paper design" and "bench design," and part of the designer's task is choosing the most appropriate approach in any situation.

Let's say you need a parallel resonant trap using a 30 pf capacitor, and resonant at 50 mHz. You could spend two hours or more designing and building a "precision designed" inductor, with compensation calculated for the stray C of the inductor, etc. A 100% equivalent in performance could be worked out in ten minutes on the bench using a grid dipper. The bench approach, or possibly an approximate calculation followed by "grid dipping" and "turn squeezing" is obviously the best answer here. On the other hand, "try it and see if it works" can cause lots of problems in designing with semiconductors. It works now, but will it for the next 6 months? Will it work if I replace the transistor? Will it work on a hot summer day? In a simpler era, with simpler circuitry, it was possible to look at the vacuum tube in a "cut and try" circuit and have a reasonable assurance that it would continue to work for awhile if the plate wasn't glowing red. Today's semiconductors don't give advance warnings of abuse; they just abruptly fail when they've taken all they can take. Paper design, therefore, makes a lot of sense here. The kind of paper design I'm talking about doesn't have to be a big precision deal. It happens, when you get into it, that changing lines on schematics and numbers on paper is about as fast as changing parts on a breadboard; it's less costly, and gives you confidence that the device ratings are not being exceeded. The numbers don't always work out the way you'd like them to, but will usually indicate what to try next. My point is that running off a few calculations on paper can save time, energy, and money. It can also yield reproduceable solutions that might be useful to others. Failure to do so can lead to unreliable solutions. (Incidentally, if you have access to a calculator, the drudgery part of the math disappears).

*P.O. Box 483, Rochester, Minn. 55901.

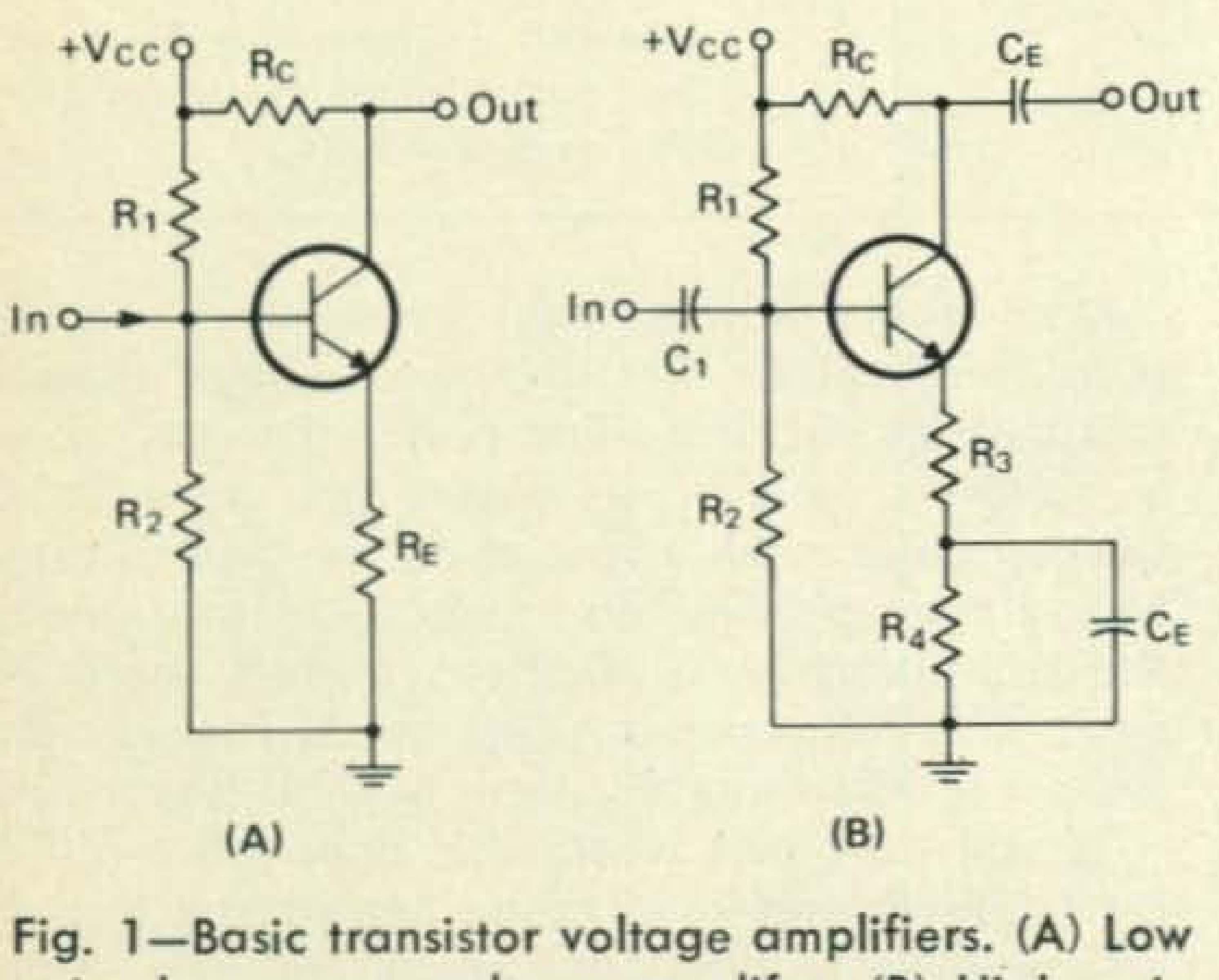


Fig. 1—Basic transistor voltage amplifiers. (A) Low gain d.c. or a.c. voltage amplifer. (B) High gain a.c. voltage amplifier

Paper design is a "cut and try" process too, much of the time. There are lots of devices and simple building-block circuits that can be put together in all sorts of ways; but rarely can you lift an entire circuit, with parts values and all, from a handbook or magazine and have it fit your situation exactly. It is very important to get the *feel* of what individual devices do under various circumstances. Learn to think like a transistor. Think like an op amp. Think like a transformer. Think what might work, and try it out on paper to see if it will. I've thought about the steps I usually go through, and the routine goes something like this:

1. Define the problem in its most fundamental terms. Think about the final result you're after, and forget for a moment the possible ways of making it happen.

2. Think of approaches that might work. Don't settle for the first one you think of; try to conjure up 2 or 3. Don't worry about details at this point. Let inspiration hit. If you draw a blank, dig into back issues of magazines and other reference material to find out how related things have been done in the past. Sleep on it.

3. When inspiration does hit, put it on paper in the form of a schematic with as much known info as possible. Your eraser comes into play here, as you have a dialogue with the paper. You put it down, see it doesn't work, change it, etc. When you're all through does it still look promising?

4. Next, calculate the unknown component, voltage, and current values and any critical performance data.

5. Does it all work out on paper, at least as far as you're able to calculate? If it does, build it and check the performance. If performance doesn't match up with the calculations, try to figure out why. (You'll learn a lot from this.) If it doesn't work out on paper, don't be too discouraged. Do the numbers give you any clues to an "add on," or a related approach that might work? Usually the numbers will.

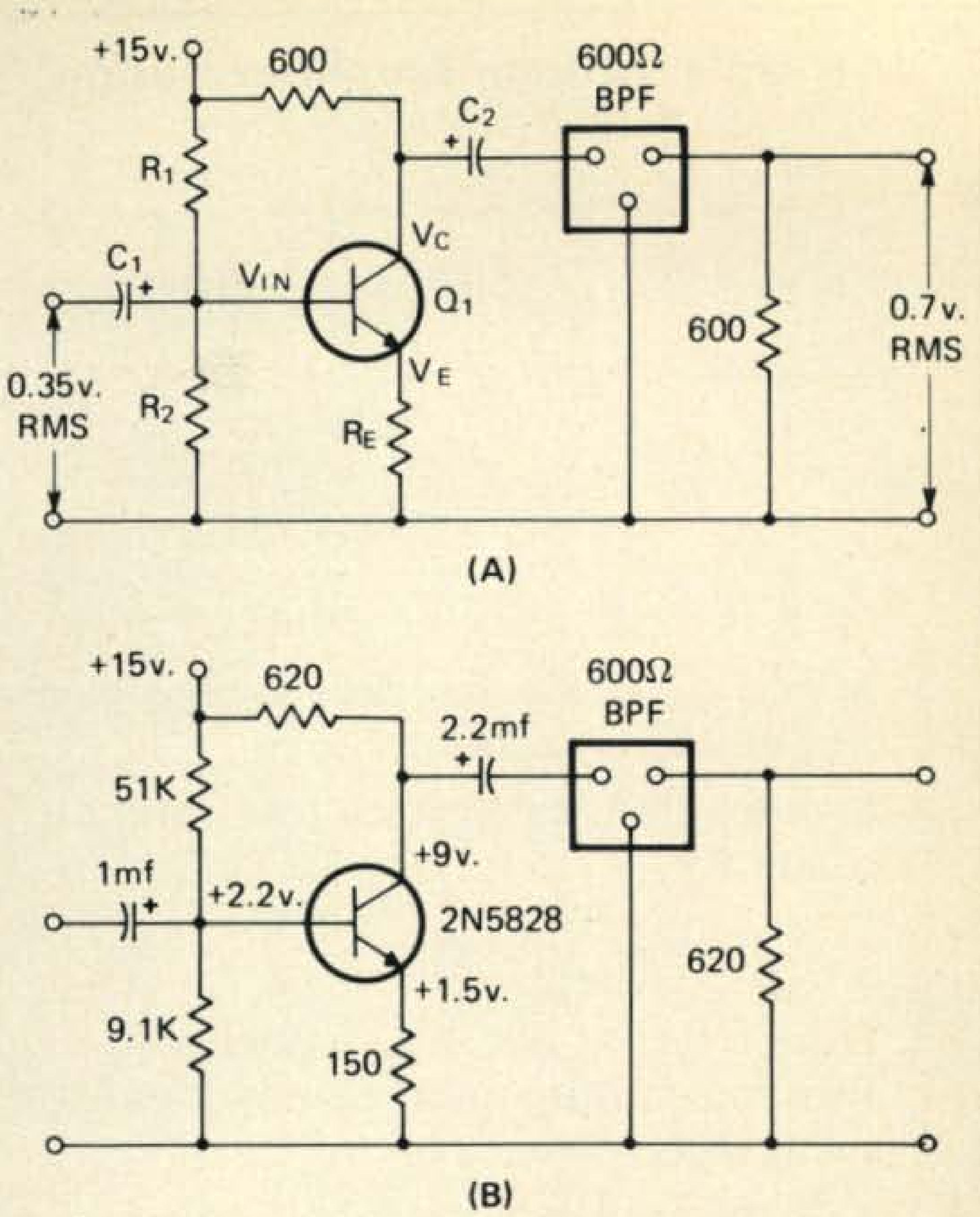


Fig. 2—The design examples worked out in the text. (A) Schematic of tentative design showing what is known and what must be found. (B) Completed design with parts values.

Low Gain Amplifier Design

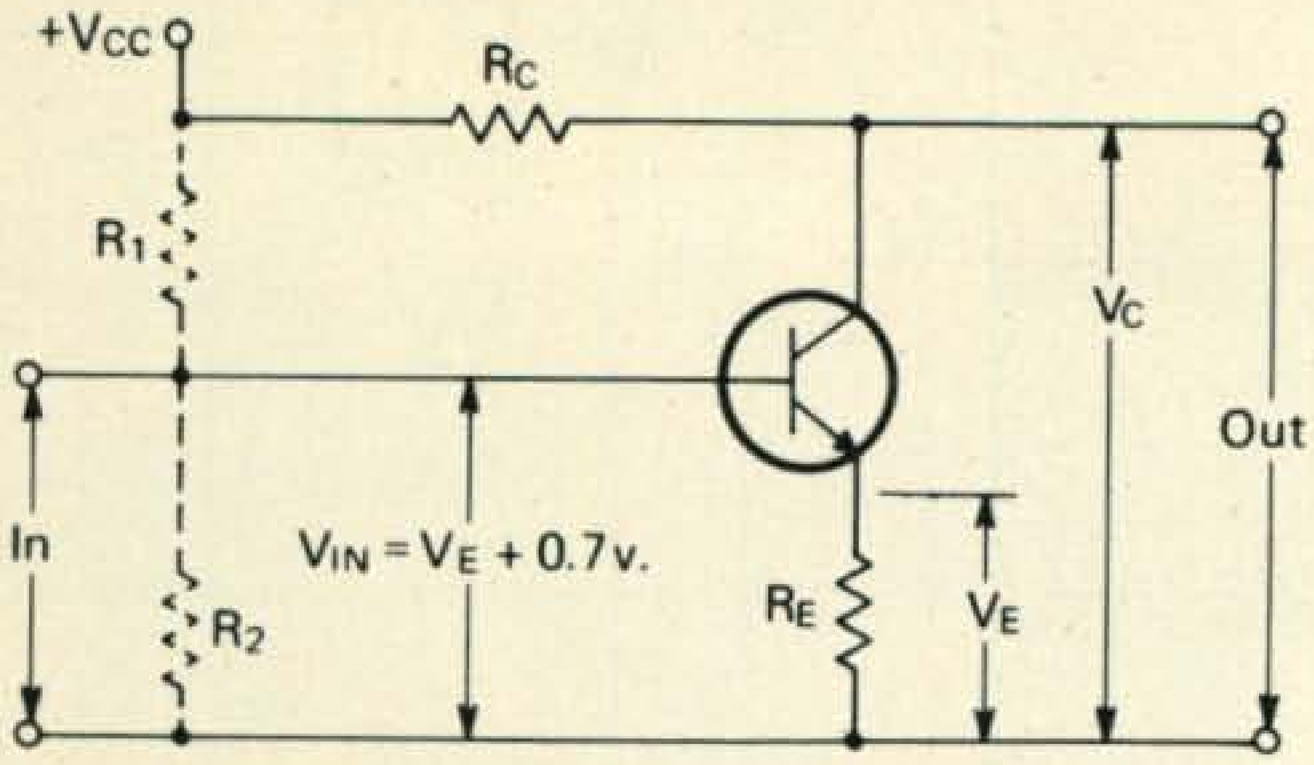
Last month we looked at the basic procedures for designing emitter followers: stages that have a gain of one, and the capability of transforming a high input impedance to a low output impedance. In this issue we'll look at a procedure for designing d.c. and audio frequency amplifiers having a voltage gain greater than one.

Transistors themselves are basically current amplifiers having low input impedance and high output impedance. Fortunately, these current amplifier *devices* can be used to make beautiful voltage amplifier *stages* by using negative feedback in the form of an unbypassed emitter resistor. This simple technique raises the input impedance, allows one to design an amplifier having a known voltage gain, stabilizes the d.c. collector current, and improves the linearity.

Figure 1 illuustrates two versions of the basic voltage amplifier. The one on the left maintains constant voltage gain at all frequencies, from audio and above, way down to d.c., and may be used to provide voltage gains up to about 5. (As the gain goes up, the collector current becomes increasingly susceptible to variations caused by shifts in ambient temperature and transistor Beta—so there are limits.) In the right hand circuit a portion of the emitter resistance is bypassed for a.c. In this way it is possible to select a high a.c. gain and still have low gain at d.c., with the bias current stability that goes along with it. (We'll get into this right hand circuit next month.)

Let's consider the circuit of Figure 1(a) which is also shown in the box entitled "Low Gain Voltage Amplifier Design." It's a very useful circuit. The input impedance is high if a high gain transistor is used. The output impedance is a known fixed value (*R*C) which makes it useful for driving filters that must be driven by a specific source impedance. It inverts the input signal; *i.e.*, if the base goes negative, the collector goes positive, and vice versa. (This can be important in d.c. coupled video amps when you want to invert the polarity of the video signal.) Finally, since

Low Gain Voltage Amplifier Design



1. Select a specific no-load voltage gain, A_V, in the range from 0 to 5.
2. Pick a value for R_C (see text) and calculate R_E.

$$R_E = \frac{R_C}{A_V}$$

3. Decide on V_C and V_E. (see text) For maximum peak-to-peak output swing select:

$$V_E = \frac{V_{CC}}{2(1 + A_V)}$$

In all cases: $V_C = V_{CC} - A_V V_E$

and,

$$V_E = \frac{V_{CC} - V_C}{A_V}$$

4. Calculate I_C:

$$I_C = \frac{V_{CC} - V_C}{R_C}$$

5. Select a Transistor:
   a) V_{CEO} rating should be appreciably greater than V_{CC}.
   b) Rated power dissipation at 25° G should be well above the calculated power dissipation, P_D:
   $$P_D = I_C(V_C - V_E)$$
   c) If a high input impedance is desired, use a high beta transistor. The input Z of the transistor itself (not including R_1 and R_2 in parallel with it) is:
   $$Z_{IN} = H_{FE} R_E$$
6. Calculate the maximum possible base current:

$$I_{B\,MAX} = \frac{I_C}{H_{FE\,MIN}}$$

7. a) If V_{IN} is supplied by a previous stage or other voltage source, is that source capable of supplying I_B max?
   b) If the input is to be biassed by an $R_1 - R_2$ type of network, proceed as follows:
      1) The total resistance of $R_1 + R_2$ should be such that the current through the resistors is about ten times the expected I_B max:
      $$R_T = R_1 + R_2$$
      $$R_T = \frac{V_{CC}}{10\,I_{B\,MAX}}$$
      2) Once R_T has been decided upon, R_2 can be calculated
      $$R_2 = \frac{V_{IN}}{V_{CC}} \times R_T$$
      3) Calculate R_1:
      $$R_1 = R_T - R_2$$

R_E is not by-passed, the stage is not prone to v.h.f. parasitics.

As with the emitter follower design, sometimes you will want to take the given design steps in a different order. When designing a d.c. amplifier, for example, in the V_{IN} and V_C requirements may be fixed by the adjacent circuitry. In this case you would start with step 3.

How does one pick a value for R_C? Occasionally, the value of R_C will be dictated by an outside requirement. Using an amplifier stage such as this to drive an *L-C* filter is an example. Since the collector impedance is high, R_C can simply be a resistor that equals the proper source impedance for the filter. If the stage is unloaded, or loaded only by a high impedance, selecting a value of R_C as high as 10K or even higher will keep the stage's power consumption down, and input impedance high. (For a given gain, a high value of R_C calls for a high value of R_E, and consequently a high input impedance.) If the stage must drive a low impedance load, R_C can be dropped to as low as a couple of hundred ohms or so, if the power dissipation is not excessive. (See step 5(b).) Another possibility is using a fairly high value of R_C and an emitter follower output stage, direct coupled to the collector of the gain stage. (See fig. 3 of last month's column.)

If the stage is capacitively coupled at the input and output, you are free to choose any reasonable values of V_C and V_E. The value for V_E found by using the equation in Step 3 is the value that will allow maximum peak-to-peak output voltage without clipping. Keep in mind that whenever the instantaneous transistor base voltage drops below +0.7 volts, the transistor is cut off, and the positive peaks of the output waveform are clipped. Likewise, if the positive-going peaks of the

[*Continued on page 74*]

ANTENNAS

BY WILLIAM I. ORR, W6SAI

"No more about Ye DX Bands
Do Wild Men Push and Pull,
Or brag about 3A's, TJ's
Or toss about Ye Bull.
Ye sunspotte count Hath Gummed
Ye Game,
Ye bands are Dry as Snuffe,
And many a Hardy Soul, no doubt,
Doth find it hard to do Without,
Except Thee and Me, Olde Scout,
Who Never worked Ye Stuff."

*48 Campbell Lane, Menlo Park, CA 94025.

"Where in Heaven's name did you get that bad poetry?", I asked Pendergast as he breezed in the door and slid gracefully into my favorite armchair.

"Written about 1938 by that great minstrel of 20 meters, W1DX", replied Pendergast. "I will copy it into your logbook so you will always have it at your fingertips."

"Forget it," I said. "I can't understand why you are quoting poetry instead of working DX. Have you given up the chase?"

Pendergast settled more comfortably into the chair and looked me squarely in the eye. "Ten-four, old buddy," he said. "I've left the merrie 20 meter band and am now a big-time operator on 2 meter f.m. with a rice-box and a brick. Behold!" He thrust a 10 watt, 12 channel f.m. transceiver and an amplifier under my nose, cables dangling from the units like a dead octopus.

I recoiled slightly, as one would from a dead octopus, and asked my erstwhile DX-companion why he had made such a startling change in his life-style and operating habits.

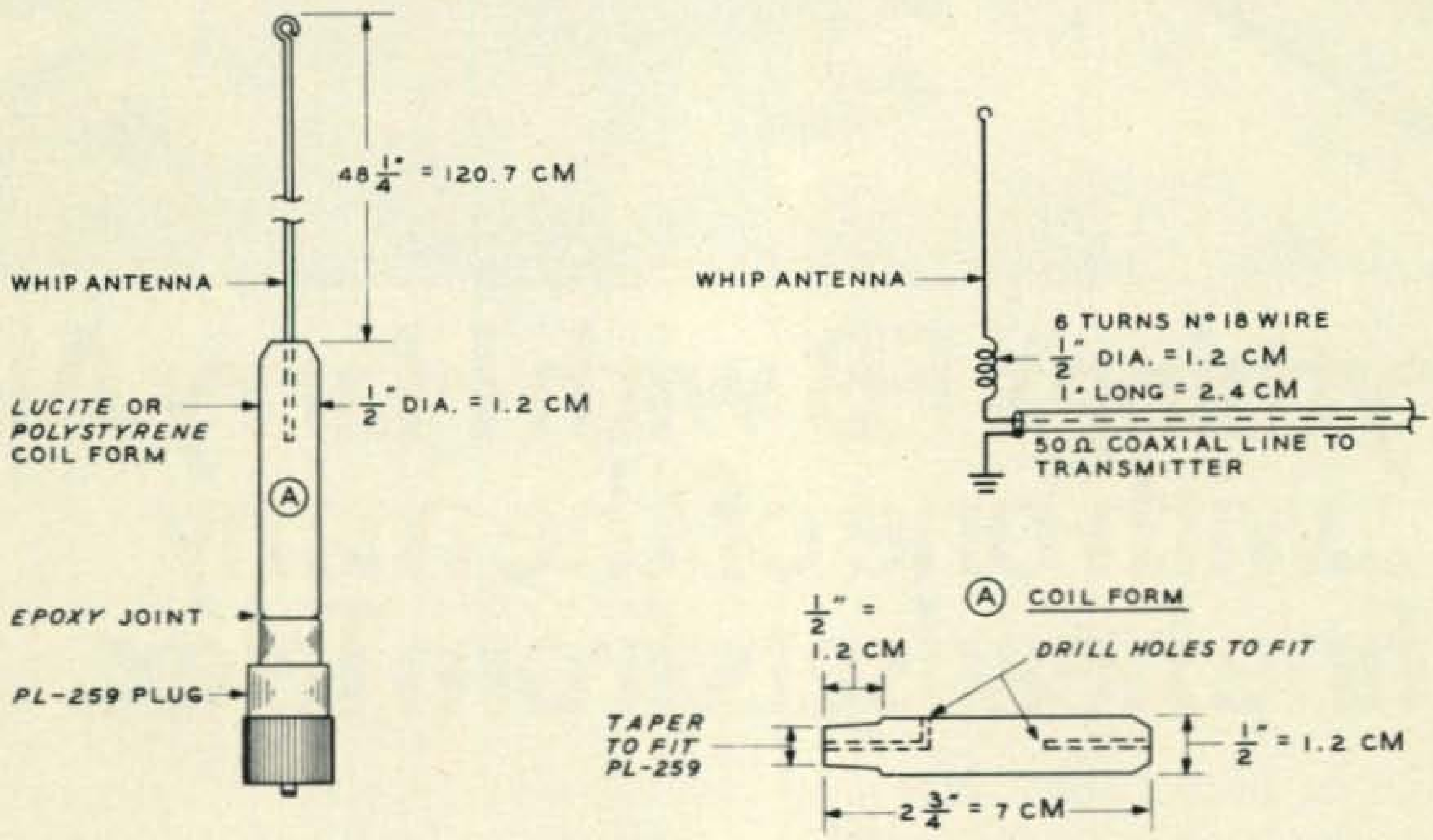


Fig. 1—A simple gain antenna for 2 meter mobile f.m. The ⅝ wavelength whip is assembled from a PL-259 coaxial plug, a plastic coil form and a modified CB whip antenna. The whip is cut to length and fitted into the end of the coil form which is mounted in the open end of the plug. The small matching coil is wound on the form. Whip, coil form and plug are firmly joined with epoxy cement.

The coil form is drilled at one end to accept the whip and the other end is drilled to pass the wire connection from the plug to the coil. The wire is "fished" through the side hole and wound into a small six turn loading coil.

The coil form may be turned out of lucite, polystyrene or other plastic. One end makes a force-fit into the coaxial plug. Before the coil is pressed into the plug, a short length of wire is soldered to the center pin of the plug to make the connection to the coil.

The antenna may be adjusted for lowest s.w.r. by either changing the length of the whip or adjusting the spacing of the turns on the coil. When completed, the coil should be given several thin coats of acrylic lacquer (Krylon) to waterproof it.

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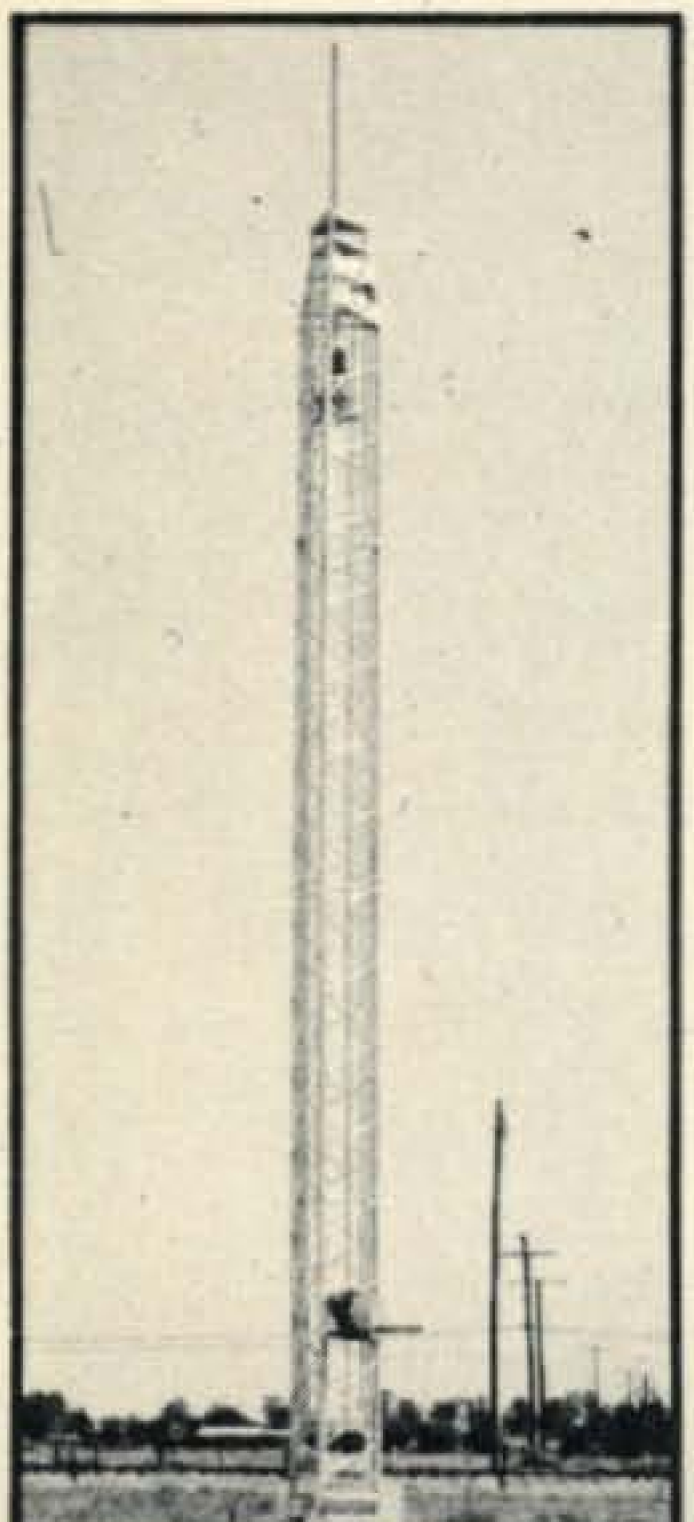
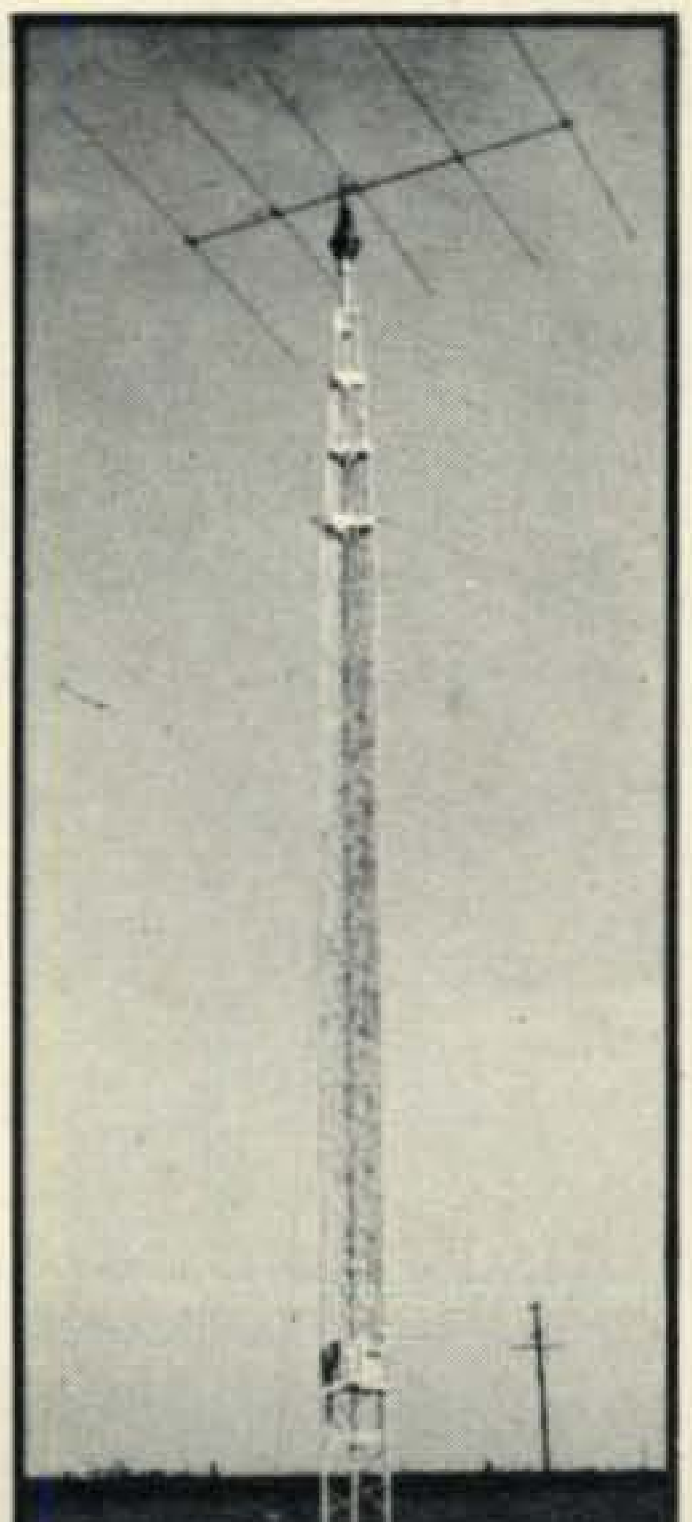
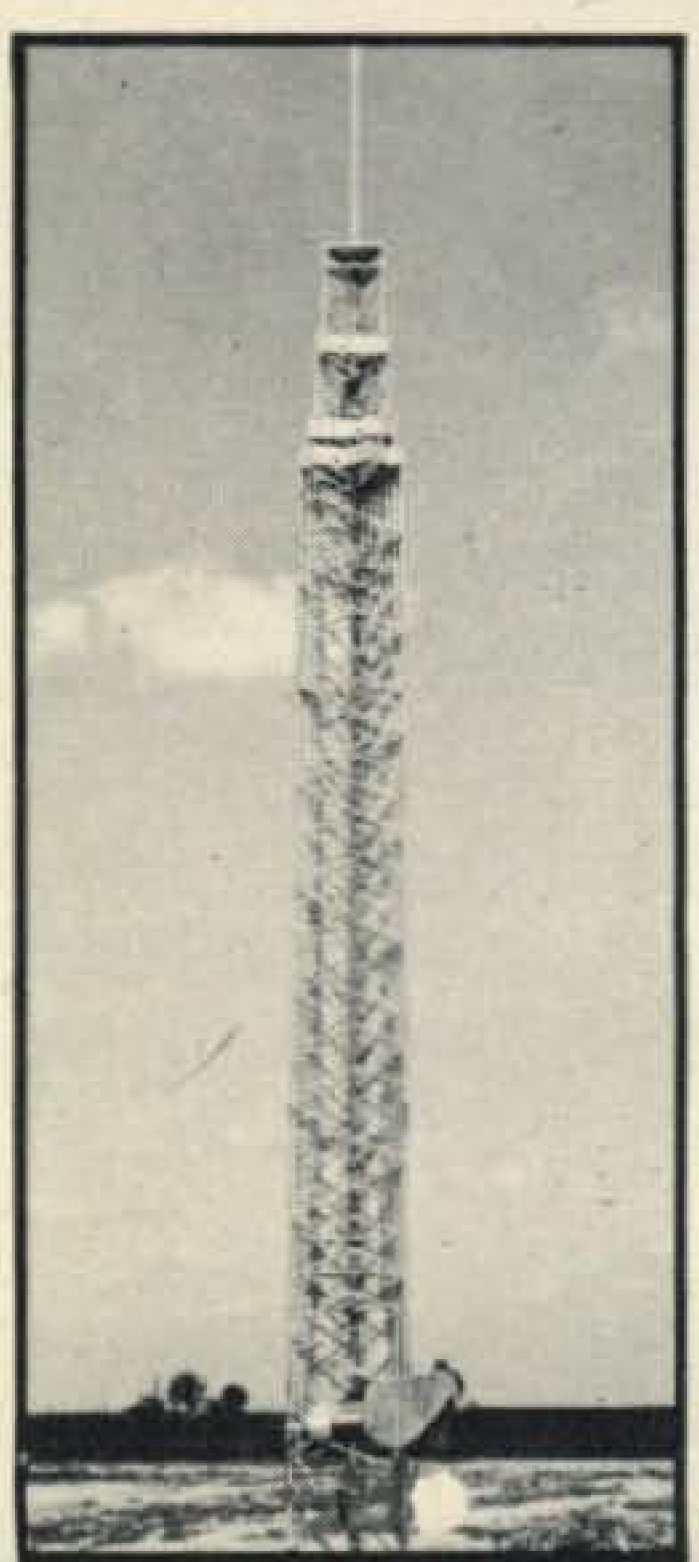


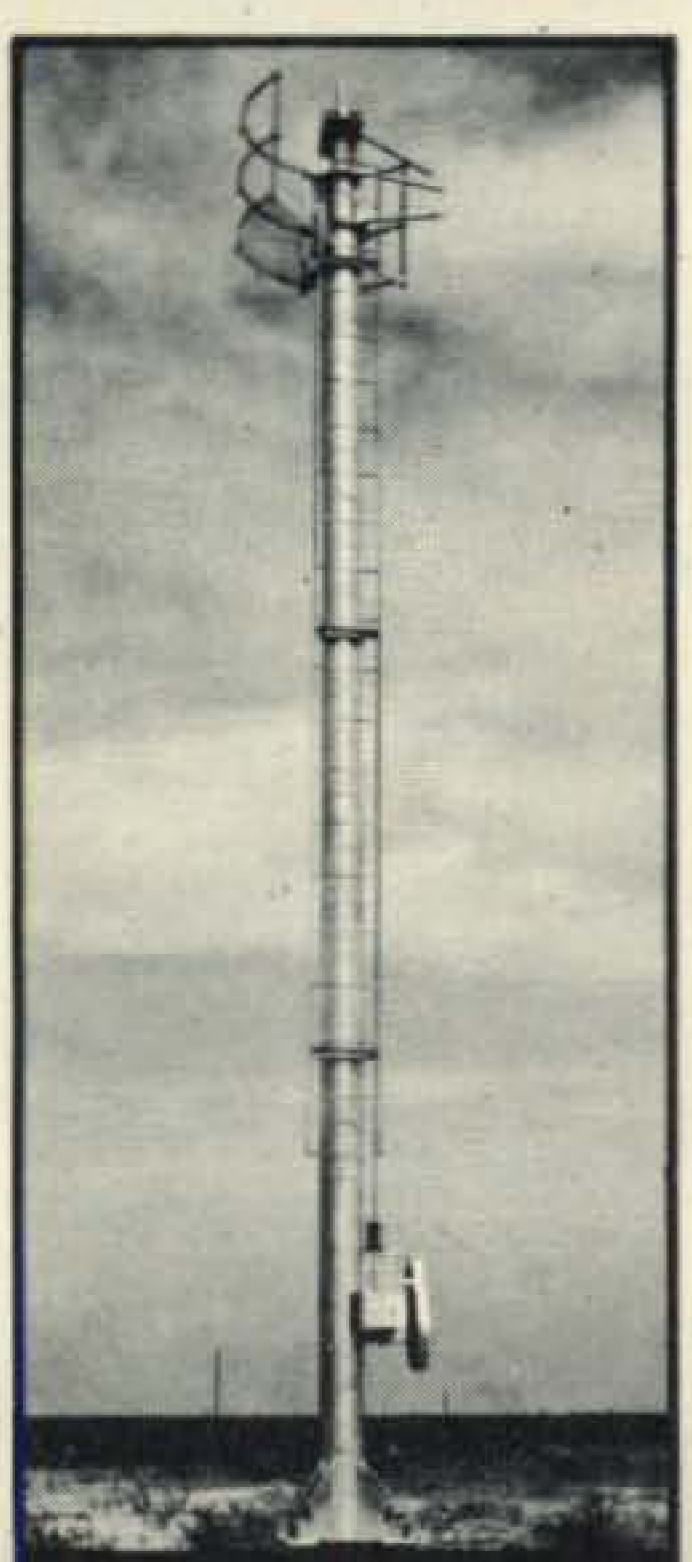
W-51



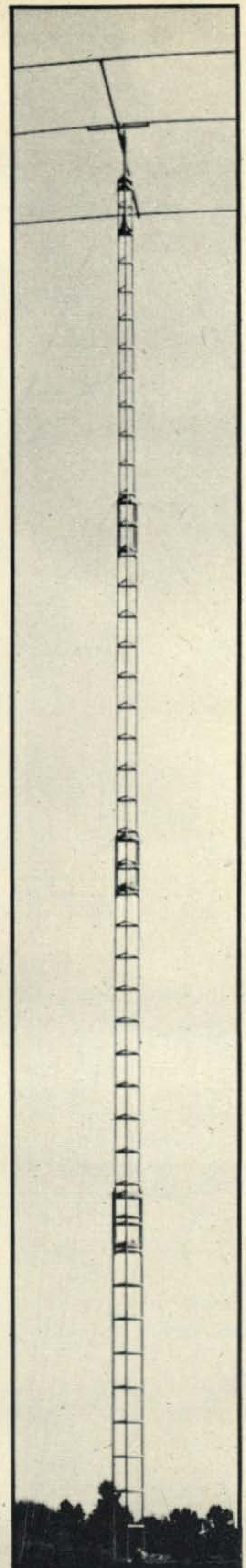
MW-65



LM-470D



TM-370



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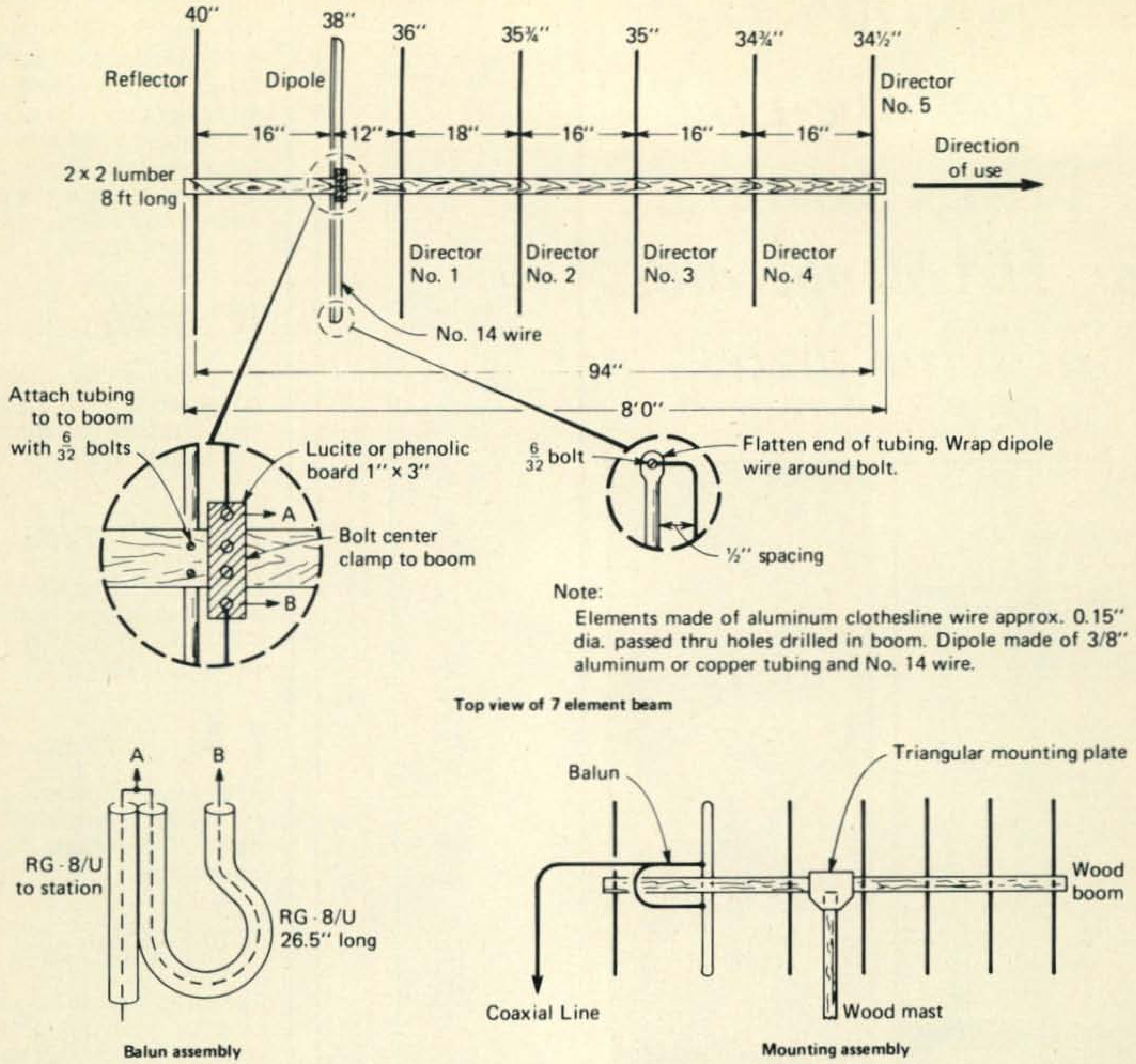


Fig. 2—Seven element beam for 2 meter f.m. provides about 11 decibels power gain over a ground plane. Beam is mounted in vertical plane. Parasitic elements are made of aluminum clothesline wire about 0.15" diameter. Driven element is made of ⅜-inch tubing with a #14 wire used as the matching section. A simple half-wavelength balun is made of coaxial line and transmission line and balun are attached to the folded dipole at points A-B. The beam is mounted to a short wood mast with a triangular, plywood plate and heavy wood screws. The mast, plate and boom are given a protective coat of paint. Elements are left unpainted, as the paint may detune the beam. Coaxial line to station should be kept as short as possible to reduce transmission loss.

"Mercy!!!," said Pendergast. "Have you ever tried 2 meter f.m. with a repeater?" Before I could reply, he continued, "Lotsa more fun than standing in line to work some crazy nut on an island that is submerged at high tide."

He paused, then continued, "I'm a member of the WR6YAK repeater club. Why don't you join up and become a YAKKER?"

"The idea is mind-boggling, to say the least," I replied.

"Let's face it," Pendergast said forcefully, "Ten meters is on the way out, fifteen is pretty bad and soon everybody will be uptight on 20 and 40 meters, six layers deep. That's not for me. I'll get my jollies with this rice box."

I shifted uncomfortably in my chair, and Pendergast continued. "That's why I dropped by. How about some *great* ideas for 2 meter antennas for a newcomer to f.m.? What should I use for the car and for the base station?"

"Why don't you go out and buy an antenna?," I replied uncharitably. Pendergast ignored the thrust. There was a moment's silence, then I sighed deeply. "OK. Let's take the car first. A lot of fellows stick to the

Coaxial Line	Impedance (ohms)	Attenuation (db per 100 feet)						
		3.5 mHz	7.0 mHz	14.0 mHz	21.0 mHz	28.0 mHz	50.0 mHz	144.0 mHz
RG-58/U	53	0.7	1.0	1.5	1.9	2.2	3.1	5.7
RG-59/U	73	0.6	0.9	1.3	1.6	1.8	2.4	4.2
RG-8/U	52	0.3	0.5	0.7	0.8	1.0	1.3	2.5
RG-11/U	75	0.4	0.6	0.8	1.0	1.1	1.6	2.8

Fig. 3—Chart of transmission line loss in h.f. and v.h.f. amateur bands. The loss is expressed in decibels per 100 feet of line, the loss being directly proportional to the line length. Line loss also increases as s.w.r. on line increases.

simple quarter-wave whip mounted at random on the car. This is like washing your feet with your socks on. A much better scheme is to use a 5/8-wavelength whip and mount it near the center of the trunk lid (fig. 1). Field strength measurements have shown that such an installation is about equal to a quarter-wave whip mounted in the center of the roof of the vehicle. The trunk lid installation is a lot easier to work with and you don't run the danger of snapping off the antenna when you pass under tree branches. Then, too, you'll appreciate the ease of installation, especially after you have tried to snake a coaxial line to the center point of the roof of a car."

"The 5/8-wavelength whip uses a base resonating coil, which is simplicity in itself. Adjust it for lowest s.w.r. on the transmission line. Most manufactured 5/8-wavelength whips have fixed coils and are adjusted by trimming the whip length. Either the whip, or the coil, can be adjusted. The adjustment, in fact, is not particularly critical, either."

"Sounds like a good approach," said Pendergast.

"Agreed," I replied. "A good way to start out your mobile operation is with a 5/8-wavelength, extended whip. Mount it on the rear trunk lid. You can buy a clever little mount that clips to the edge of the lid and the antenna is ready to go in 2 minutes."

"Now, for home operation, you can use the same rig, pardon me, rice box, with an a.c. power supply. Since your QTH is in a rather poor v.h.f. location, you may run into trouble breaking the WR6YAK repeater on Mount Pandemonium."

Pendergast looked worried. "I hadn't thought of that," he said, almost to himself. He gazed out of the shack window, his eye following my feedline across the yard and up the side of the garage. He spotted the 2 meter beam atop a short mast at the rear of the garage. "Well," he said, "How about a simple version of your beam?"

"That would do the job for you," I replied. "It's good, cheap and easy to build." I hunted about in the drawer of the operating desk and fished out a drawing (fig. 2).

"Here it is. This inexpensive seven element Yagi beam will put you on 2 meters with a big signal. You can build it for a few dollars and it will provide a power gain of eleven decibels over a ground plane antenna. The beam is mounted with the elements vertical to provide vertical polarization and it's fed with a 50 ohm coaxial line and a simple coaxial balun. The driven element is a folded dipole and you can make the parasitic elements out of aluminum tubing, aluminum wire, or defunct TV antenna parts."

Pendergast peered at the sketch and finally asked, "What's the boom made out of?"

"Wood," I replied. "I used a rug pole that I got for free at a rug cleaning outfit. You can buy 2-inch diameter dowel rod at some large lumber supply houses, or you can use a piece of 2″ × 2″ square stock. Perhaps even a long broom pole."

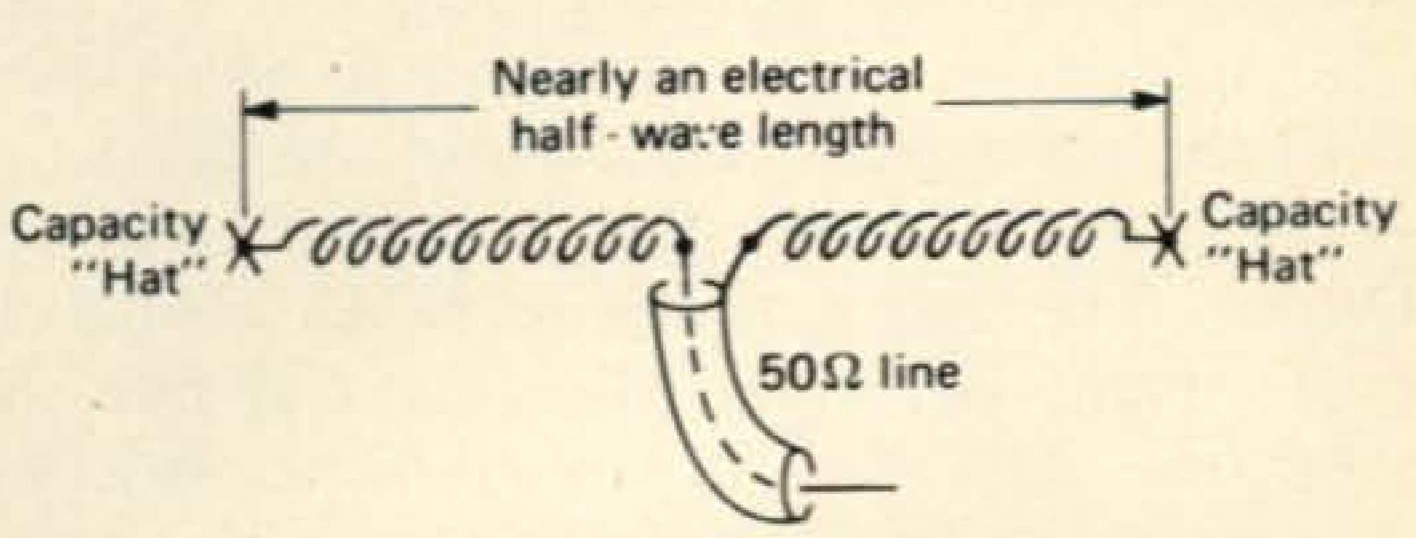
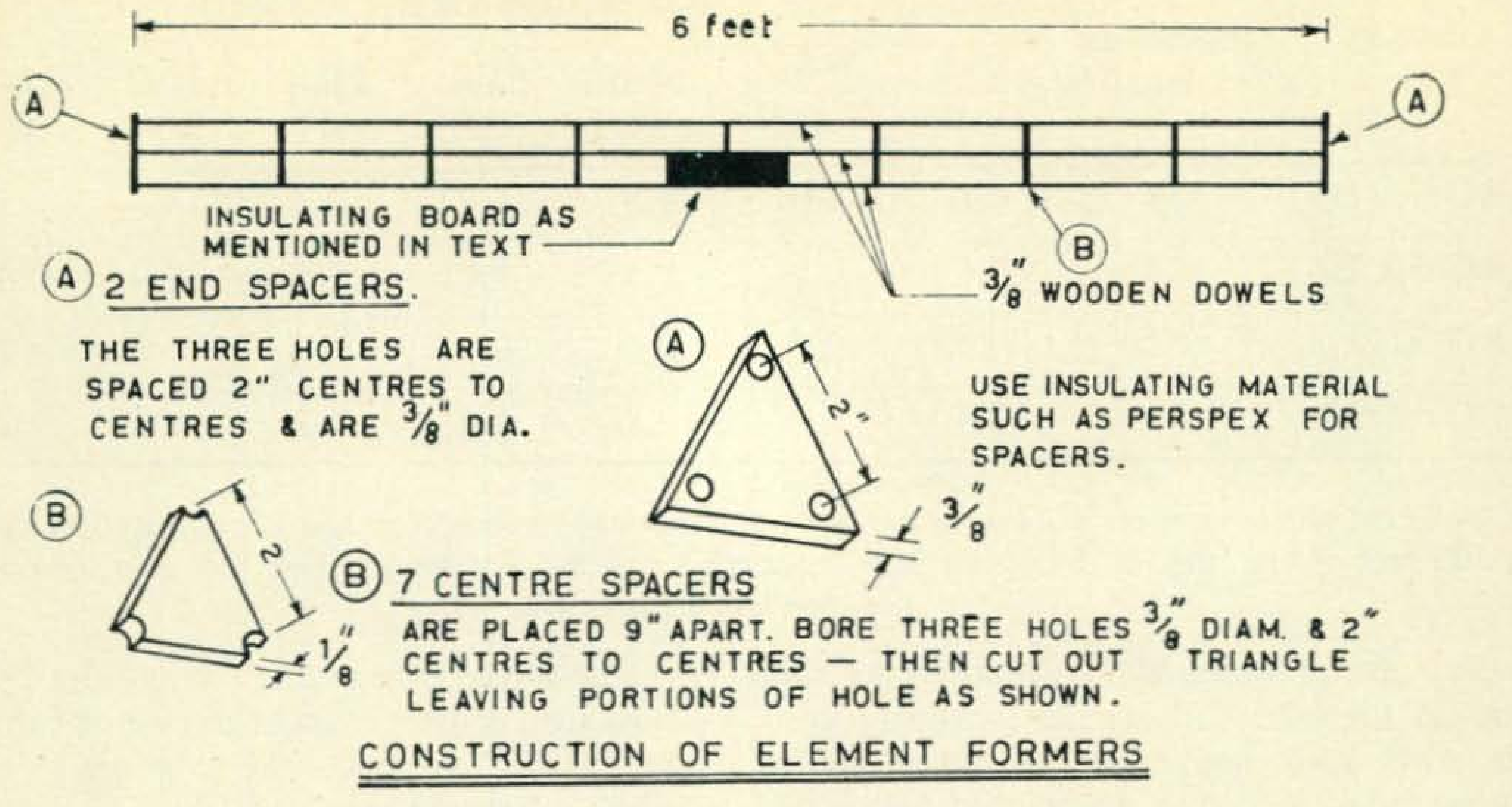


Fig. 4—The compact dipole. An effective, short dipole can be made by helically winding a length of wire and end loading it to resonance. For an electrical half-wavelength, nearly ⅝-wavelength of wire is required in the helix. Antenna is adjusted to frequency by positioning of capacitive hats with respect to the winding of the helix.



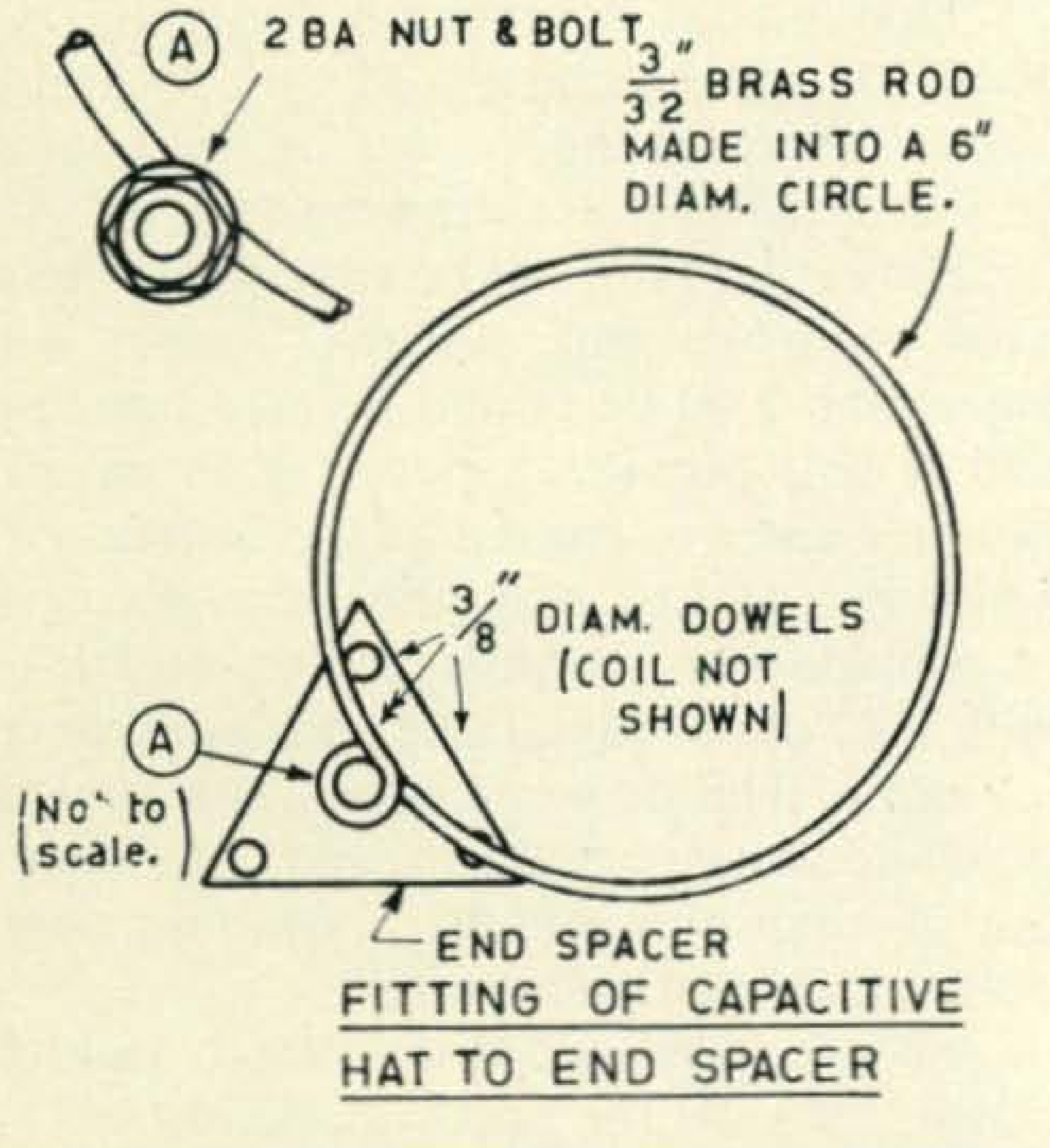


Fig. 5—The VK5YS compact dipole for 40 meters is only six feet long! Two 120 turn coils are wound on a wooden form (A) made up of wooden dowel rod and spacers. An insulating board is placed at the center of the framework for the connecting points to the dipole. The triangular spacers are cemented to the dowels and the form is wound with #14 insulated, solid conductor wire. The capacity hats are made up of wire loops, 6" in diameter which are bolted to the end spacers of the framework and connected to the ends of the windings of the helix. Antenna tuning is accomplished by bending the hat to vary the angle between hat and helix. (Drawing courtesy of *Amateur Radio* magazine and the Wireless Institute of Australia.)

As Pendergast looked at the sketch, I continued. "The parasitic elements pass through holes drilled in the boom. Mark the holes carefully and use a little finnesse in drilling them or the beam will look sloppy. A little epoxy cement will hold the elements in place. The folded dipole is mounted to the boom with the arrangement shown in the drawing. A simple mounting plate is all that is required. The balun is made of an electrical half-wavelength of 50 ohm coaxial line, of the same capability as the transmission line you intend to use. It is folded back along the boom and taped to it."

I paused, and waited for a reaction from my erstwhile 20 meter DX companion. It seemed as if he had passed into a catatonic trance, as he continued to stare at the sketch. Finally, he said, "Why do you bring the feedline out the rear of the beam instead of letting it drop down in the usual manner?"

I pointed at the drawing of the beam with a pencil. "Remember, dummy, this is a vertical beam. If you drop the feedline down from the feedpoint at the center of the folded dipole element, the line will run parallel to the driven element, and parallel to all of the parasitic elements, too. This is an un-good idea and I don't like it at all. It can cause all sorts of unpleasant things to happen. Much better to run the feedline back along the boom and out the rear of the beam. Then you can bring it down *behind* the reflector, as I do." I pointed out the window towards the antenna mounted on the garage.

"Moreover," I continued, "I don't like the

[*Continued on page 73*]

QRPp

LOW-LOW POWER OPERATING

BY ADRIAN WEISS,* K8EEG

ONE of the most satisfying aspects of QRPp operation is meeting up with another minipower station on the air. Everyone enjoys meeting someone who shares his enthusiasm for a particular thing or activity, and QRPp'rs are no exception. Indeed, before the advent of *The Milliwatt* and this column, about the only way to find out what was happening in our "alternate life style" was through on-the-air contacts. Most of us were startled to find that others shared our enthusiasm for QRPp. Some fellows, like W4ZRJ, had operated strictly under five watts since the late '20's and early '30's without really meeting many other QRPp nuts. These contacts remain one of the most important means of exchanging information about techniques and so forth because they involve personal communications. The weekly QRPp QSO Parties announced in the last column are an effort to expedite personal communication between low power operators. Be sure to take advantage of this opportunity of meeting others who share your interests.

Receiving Capability

During the recent QRPp Contest (November, 1973), I was disappointed at the number of QRPp station who called each other in vain. In every instance noted, I was able to copy both stations with ease, so signal strength was not the problem. Probably the fault lay with the receiving capabilities at both ends of the circuit.

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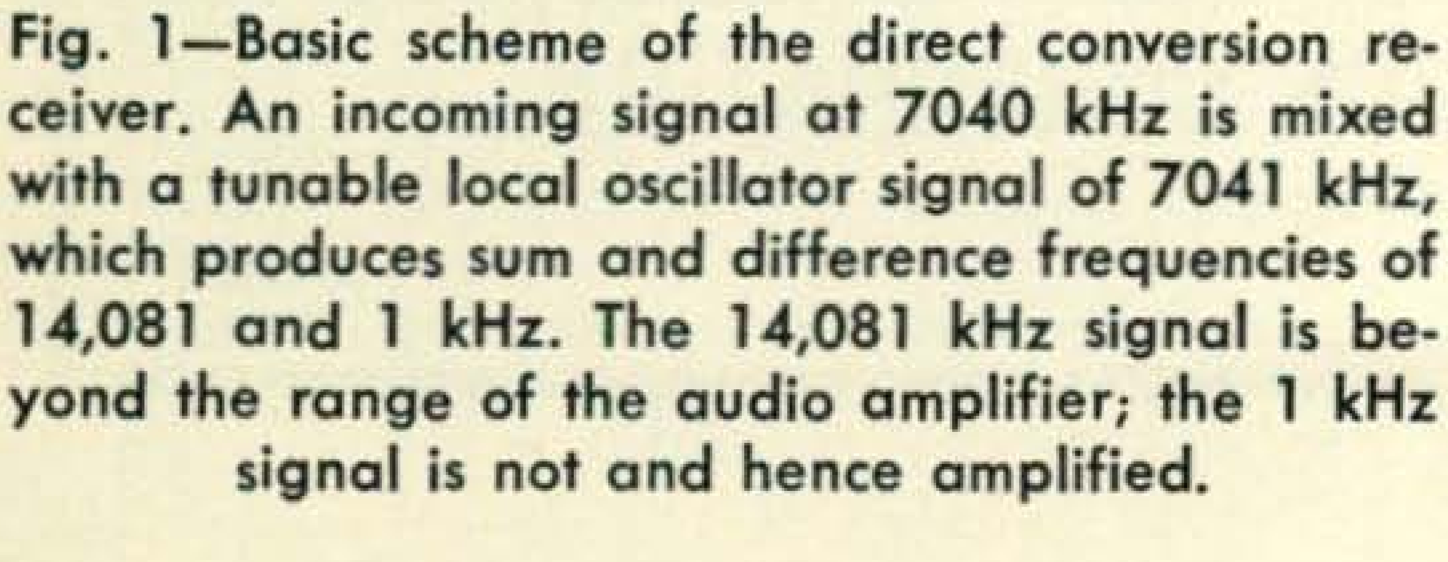

Fig. 1—Basic scheme of the direct conversion receiver. An incoming signal at 7040 kHz is mixed with a tunable local oscillator signal of 7041 kHz, which produces sum and difference frequencies of 14,081 and 1 kHz. The 14,081 kHz signal is beyond the range of the audio amplifier; the 1 kHz signal is not and hence amplified.

Oftentimes the newcomer to QRPp becomes lax with respect to his receiving capability. He figures wrongly that since he is only putting out a couple of watts to a dipole, he won't have to worry about copying weak signals, because his rig won't reach out that far anyhow. Keep an eye on the results being published in this column and see how wrong such an assupmtion is! Pith W9PNE working 28 countries with 500 *milliwatts* to a dipole, there can be no mistake about the question: very low power *will* go a long way!

It is high time, I think, that we as a group begin to pay more attention to receiving capability. Remember that a DX or a QRPp signal will be a weak signal, and poor receiving capability and/or technique will not suffice! We'll explore the question in this and the next column.

Direct Conversion Receiver

Quite a few homebrew QRPp rigs, and the HW-7 and Ten-Tec PM-series, use the simple direct conversion — or "synchrodyne" — reception technique. The input signal is fed directly to a mixer stage, heterodyned by a tunable local oscillator signal at the same frequency, producing an output in the audio range, which is then amplified to a useable level. This is shown in fig. 1. There is nothing inherently inferior about this reception technique in comparison to the superheterodyne technique. In fact, a properly designed, constructed, and operated direct conversion receiver will prove superior to most medium priced tube-type superhets built in the past decade. Very sensitive IG's or OSFET's (such as the CA3028A or 40673) are generally used in the mixer stage, and while the sensitivity is superior in most cases, the low internal noise factor of these devices in comparison to tubes puts them in another class entirely! Sensitivity on the order of one microvolt is easily attained in practice, even without a front-end r.f. amplifier stage!

A basic principle applies here: even a Collins R-391A or a Signal/One CX7A is only as effective as the operator can make it! Hence, an intimate knowledge of how the direct conversion receiver works and a practical understanding of how to capitalize on its operating characteristics is essential to effective use of the type.

Operational Characteristics

Unlike the superhet which uses a mechanical or crystal filter to eliminate all signals in one sideband (*i.e.*, all signals on one side of zero beat), the direct conversion receiver passes both sidebands equally. Reference to figure 2 will make clear how this aspect of direct conversion operation affects proper receiving techniques.

Suppose that an operator wishes to copy a c.w. signal and prefers a 1000 Hz tone. Let's call this signal "A". In a direct conversion receiver the audio note is equal to the difference between the local oscillator frequency and the frequency of the desired signal. If the receiver is tuned to either 7041 kHz or 7039 kHz, therefore, it will produce the desired 1000 Hz audio note. Now, suppose there is an interfering signal at 7042 kHz. If the direct conversion receiver's local oscillator is tuned to 7041 kHz, the interfering signal will also appear in the output as a 1000 Hz tone, the same as the desired signal, since both are equal distances from the local oscillator frequency. Two options are open. First, the receiver can be tuned in one direction or the other to make signals A and B produce different audio notes; *i.e.*, if the receiver is tuned to 7040.5, signal A will appear as a 500 Hz tone and signal B as a 1500 Hz tone. The two are easily distinguished. However, if the receiver includes a very sharp audio filter which passes only a very narrow set of audio frequencies, such a move will put both signals A and B out of the audio passband. The second option is to re-tune the receiver to the opposite side of the desired signal and hope that you won't encounter another interfering signal there.

Many operators accustomed to the ability of a good superhet with filter to eliminate signals in the unwanted sideband will view this aspect of direct conversion operation as a disadvantage. However, the case is not that simple. While the superhet can be tuned to the other sideband equally well, most superhets use a crystal controlled b.f.o., and switching from upper to lower sideband, or viceversa, produces a frequency shift with respect to the receiver frequency. After switching sidebands, the receiver must be retuned to locate the desired signal.

In a really difficult case where the interfering signal is only 100 Hz or so from the desired signal, both the superhet and direct conversion receiver will require a really sharp audio filter to eliminate the unwanted signal. The crystal filter is no help in such a case.

Continuing this comparison approach, the superhet with filter is actually a liability when it comes to tuning for a response to a CQ. For example, if one calls CQ at 7040, with the filter switched to allow only lower sideband signals to pass, and a response comes on 7041 kHz, it will be eliminated by the filter. The direct conversion receiver will detect the response.

This ability to monitor both sidebands is essential in QRPp operation. On the one hand, many QRPp rigs are crystal controlled, and may respond in the eliminated sideband of a superhet receiver. Likewise, many operators do not correctly understand the transmit-receive frequency relationship operative in the HW-7 or TenTec PM-series transceivers, with the result that they tune onto a CQ in such a way as to displace their transmit frequency up to 3 kHz away from zerobeat. Hence, if a QRPp operator uses a superhet with a good filter, he must institute the practice of tuning *both* sidebands after calling CQ. Likewise, he must habitually tune ±3 kHz to insure that the crystal conrolled respondent won't be missed.

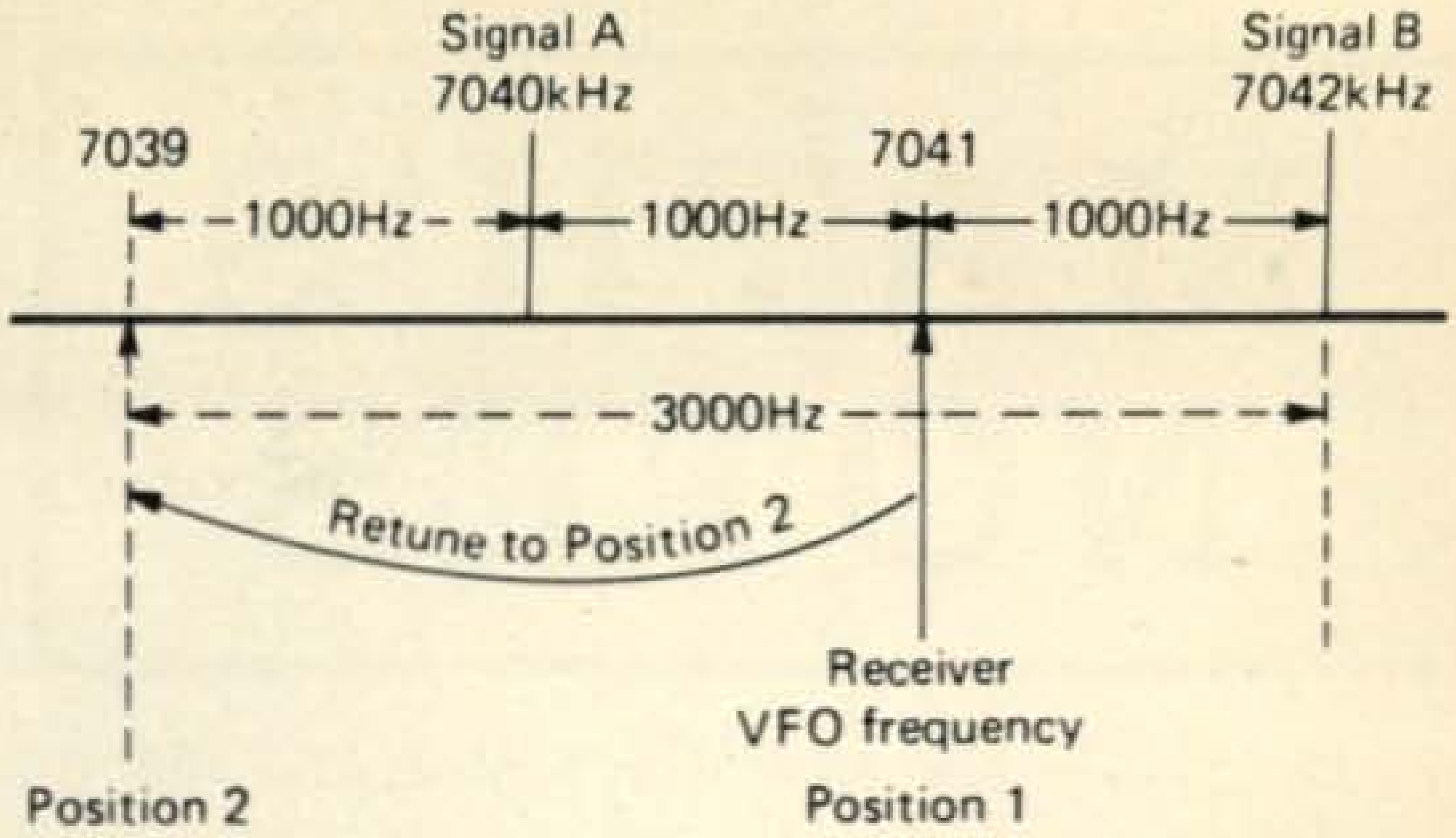

Fig. 2—The direct conversion receiver passes both sidebands equally. How this affects proper receiving techniques is explained in the text.

Next month, we'll go with this discussion of the direct conversion receiver, covering the proper methods of insuring front-end selectivity.

Weekly QRPp QSO Parties

As announced in the last column, we are instituting weekly QRPp QSO Parties to facilitate communications between QRPp stations. Session 1: Mondays, 2000-2200 CST (Tuesdays, 0200-

[*Continued on page 72*]

MATH'S NOTES

BY IRWIN MATH,* WA2NDM

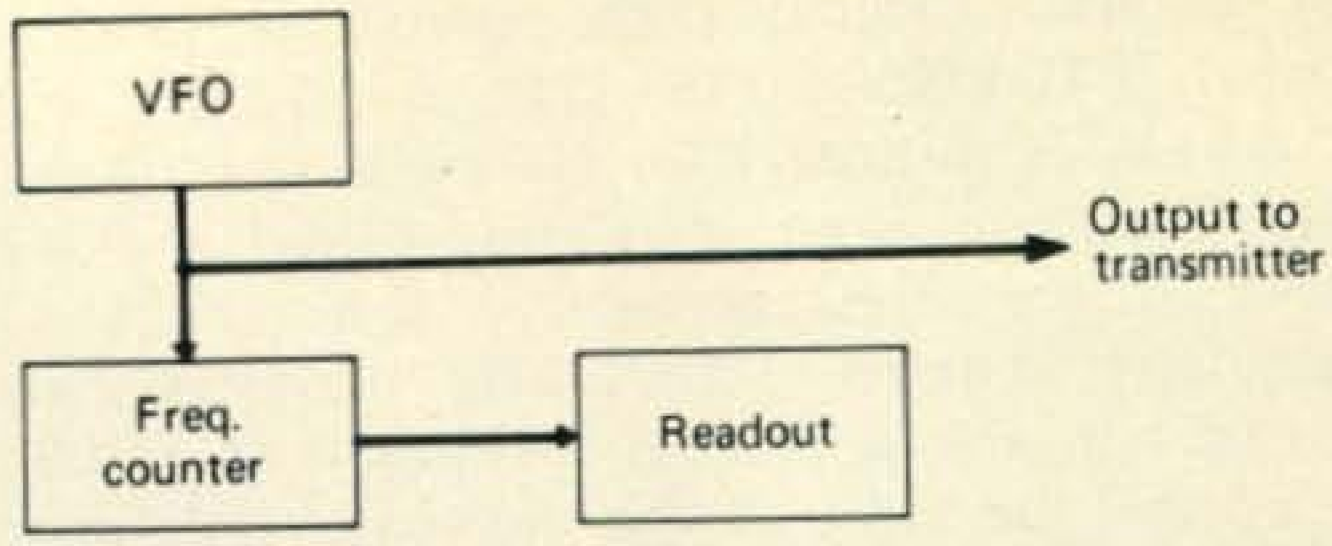

Fig. 1—A fundamental "digital v.f.o.".

IN this author's profession, which happens to coincidentally be electronic research and development, there are many new ideas and techniques that one either develops or becomes aware of. One such idea that I have considered for the past several months, I have chosen as the topic this month in the hope that some enterprising experimenter will be adequately interested to "give it a try"!

We are all familiar with frequency techniques from simple variable crystal oscillators (v.x.o.'s) to mixers, phase locked loops and the like. We are also quite aware of the benefits of a crystal controlled frequency synthesizer; among them stability of the same degree as the crystal oscillator used as the primary reference.

In fact, at the current state of synthesizer techniques as far as amateur radio is concerned, there seems to be only two small problems. One of these is the fact that all synthesizers cover their various ranges in steps of 1 kHz or 100 Hz or even 1 Hz. If one can afford the additional phase locked loops (quite expensive for let us say a 2 meter synthesizer that tunes the whole band in 10 Hz increments). The second problem is that of ease of rapid tuning. Sure, the 2 meter f.m. TX/RX synthesizer with channelized thumbwheel switches is fine for repeater operation, but did you ever try to tune the band in numerical sequence from 144.000 mHz to 148.000 mHz with thumbweel switches? Or for that matter, can you conceive of the annoying problem of using a 15 or 20 meter synthesizer to QRX or quickly zero-beat a rare DX station? Impossible!

There may be a technique however, for having one's cake and eating it too. At this point I would like to apologize to my "not-so-technically inclined" readers for the description that follows as it will be of a level higher than that usually achieved in this column. It is the only way to get the point across quickly however.

Consider fig. 1. Here we have a standard, good quality v.f.o. for some particular amateur band or bands and a frequency counter of as many digits of information as we desire. We have readout resolution in this scheme but no stability or

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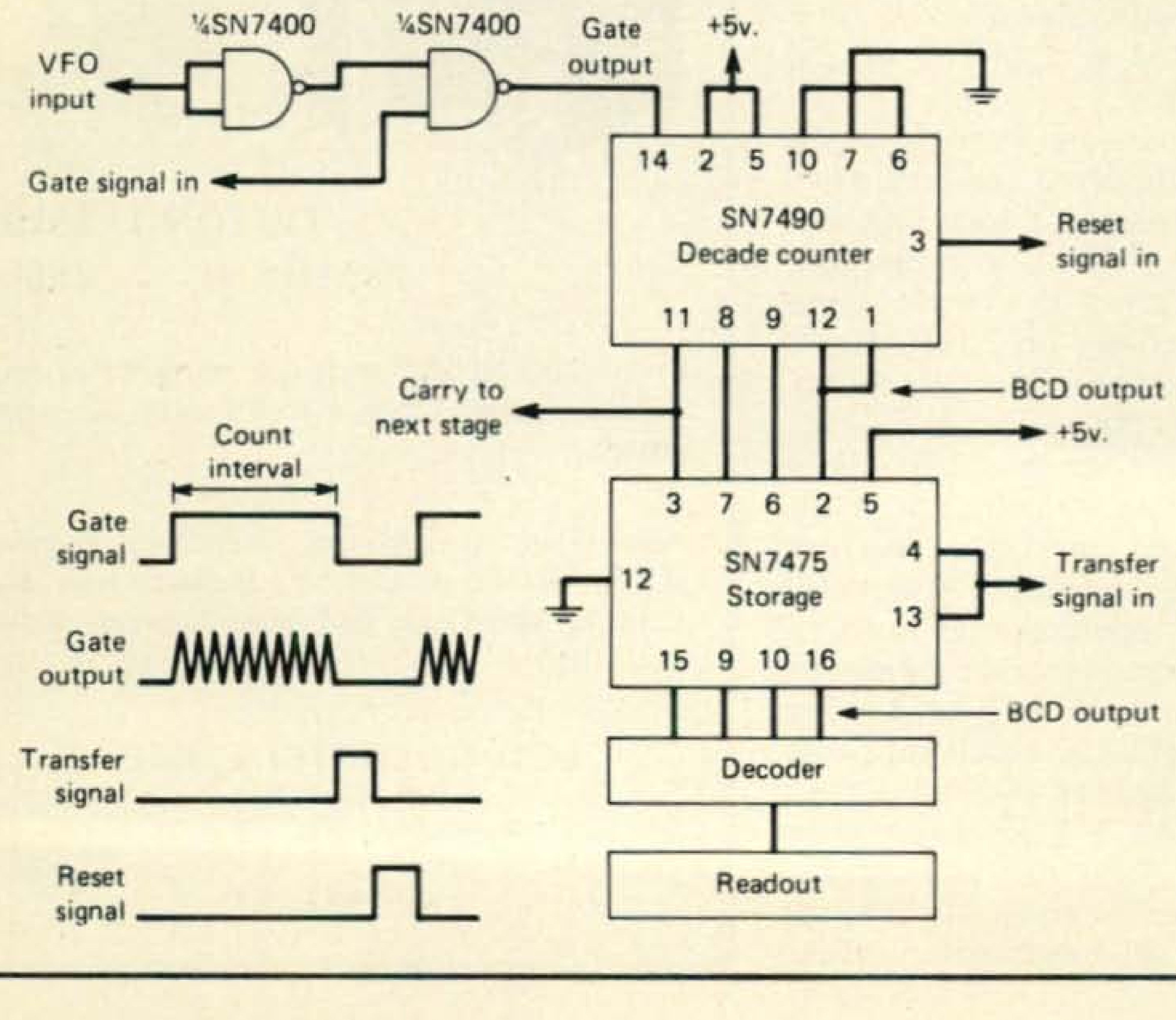

Fig. 2—A simple counter with a timing diagram.

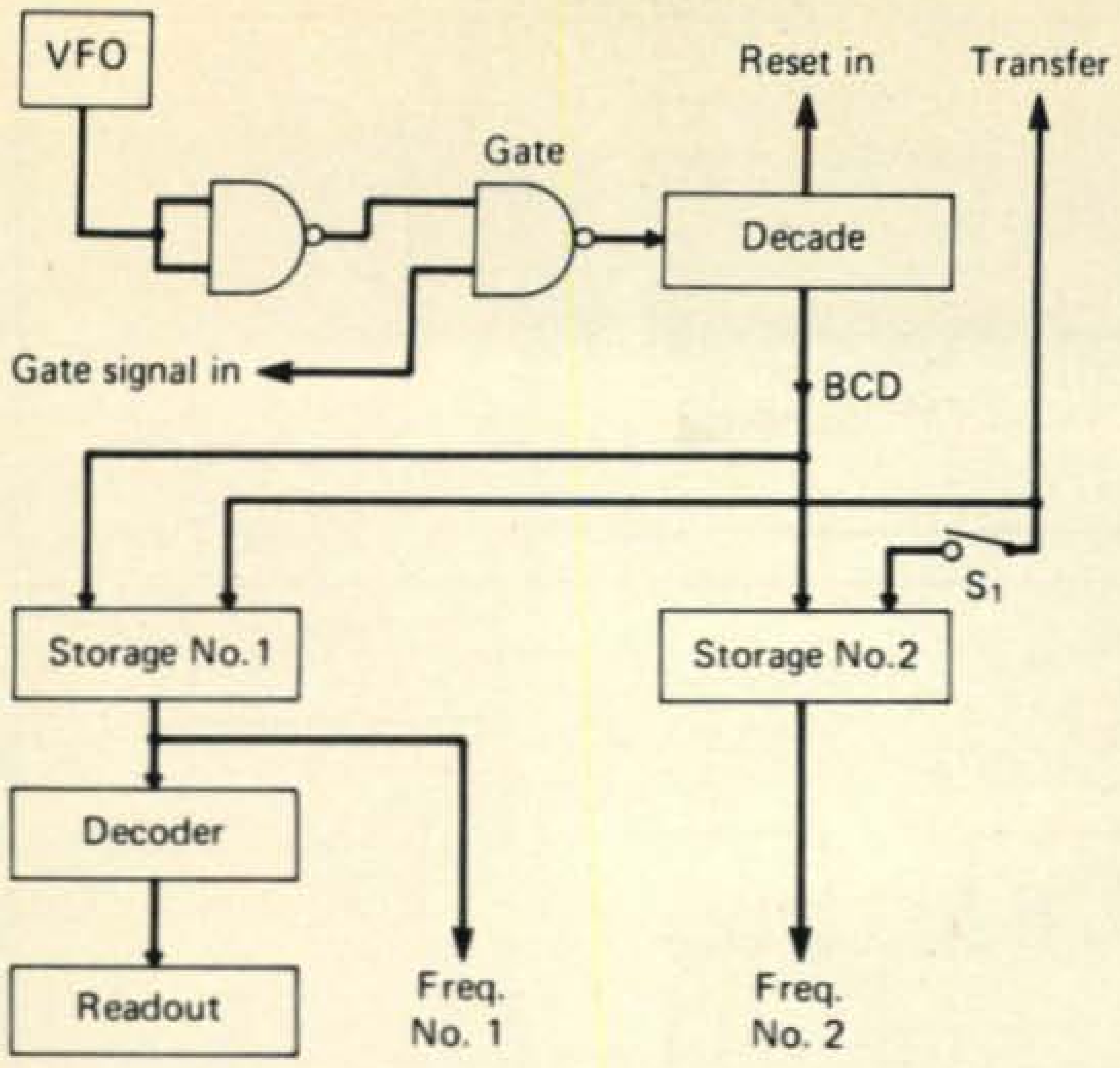

Fig. 3—The addition of a second storage chip to fig. 2.

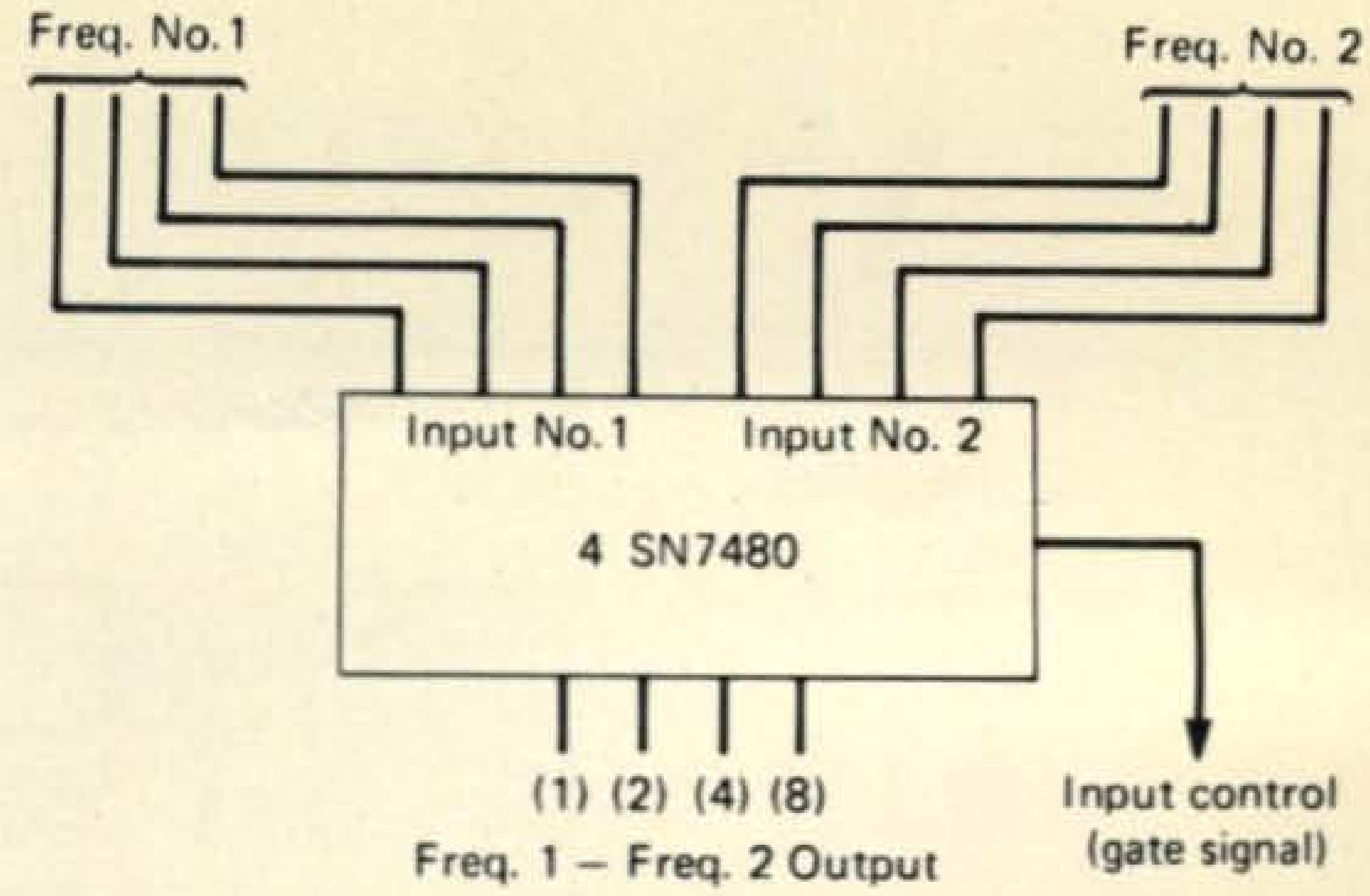

Fig. 4—A digital subtractor chip. See SN7480 or similar chip data sheet and/or application notes for details.

at least not crystal stability. Now let us expand fig. 1 somewhat to look at the elements of the counter. For simplicity we will only discuss the first digit of the counter and the signals necessary to drive it. A complete description of counter techniques is available to those who require it in past construction articles in *CQ* and other similar publications.

Fig. 2 shows the elements of the frequency counter as well as the appropriate wave shapes. Operation is as follows: The gate signal (assume it is 1 Hz) opens the gate allowing as many v.f.o. frequency cycles to pass as can during the 1 second gate interval. The decade counter and its following stages count the number of cycles passing through and produce a BCD signal corresponding to the number counted by each decade. This BCD signal is stored by a SN7475 quad latch integrated circuit until the end of the count interval when a transfer pulse feeds it to a decoder and readout[1]. After this transfer, a reset pulse is fed to the decade, setting it to zero, and a new count interval begins. Since the gate time was chosen to be 1 Hz, the counter displays cycles per second directly.

We can now say that our knowledge of the exact v.f.o. frequency (to the stability of the crystal oscillator in the counter used to produce the gate signal) is completely known with an updated number every second.

Now, if we change the count interval to .1 seconds, we will have an updated indication of the frequency 10 times per second but, since $1/10$ the number of cycles will pass through the gate from the v.f.o., we only will have a resolution of 10 Hz. Similarly, a .01 second gate will give us a 100 Hz resolution.

Let us now look at fig. 3. All that we have done here is to add another storage chip to the counter of fig. 2. By means of switch S_1, however, we can disconnect the transfer signal from the second storage chip.

If we now tune our v.f.o. until we reach some desired frequency (with S_1 closed) and then quickly open S_1, storage chip #2 will always produce a BCD output equal to the desired frequency. Storage chip 1 will, however, continue to supply the readout with new frequencies (at the gate rate) as the v.f.o. drifts.

Now let us add one more function to this hookup. Fig. 4 shows the two BCD frequency

[1]See MATH'S NOTES *CQ* Dec. '72 and Jan. '73 for a more detailed explanation of this.

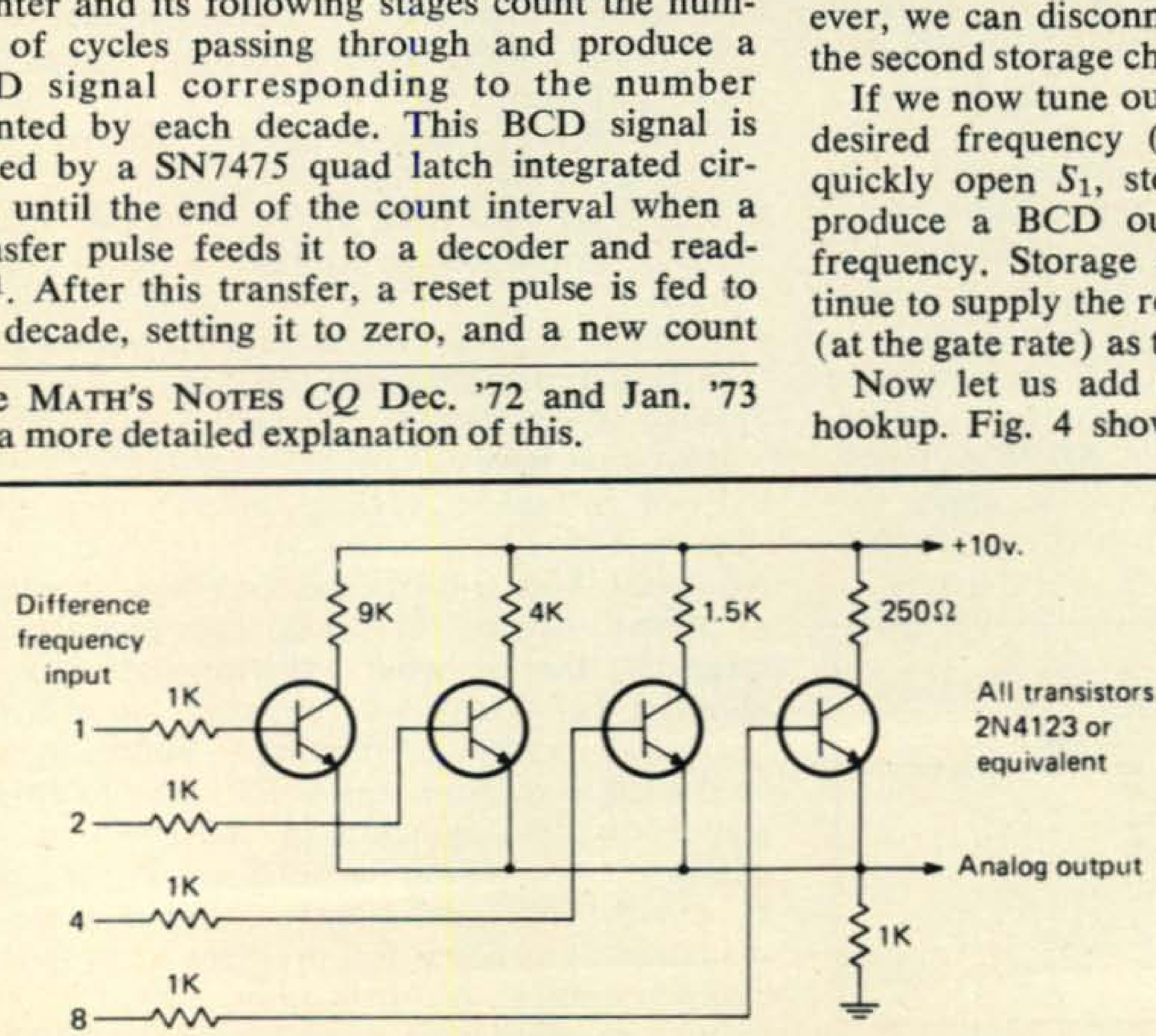

Fig. 5—The digital-to analog converter discussed in the text.

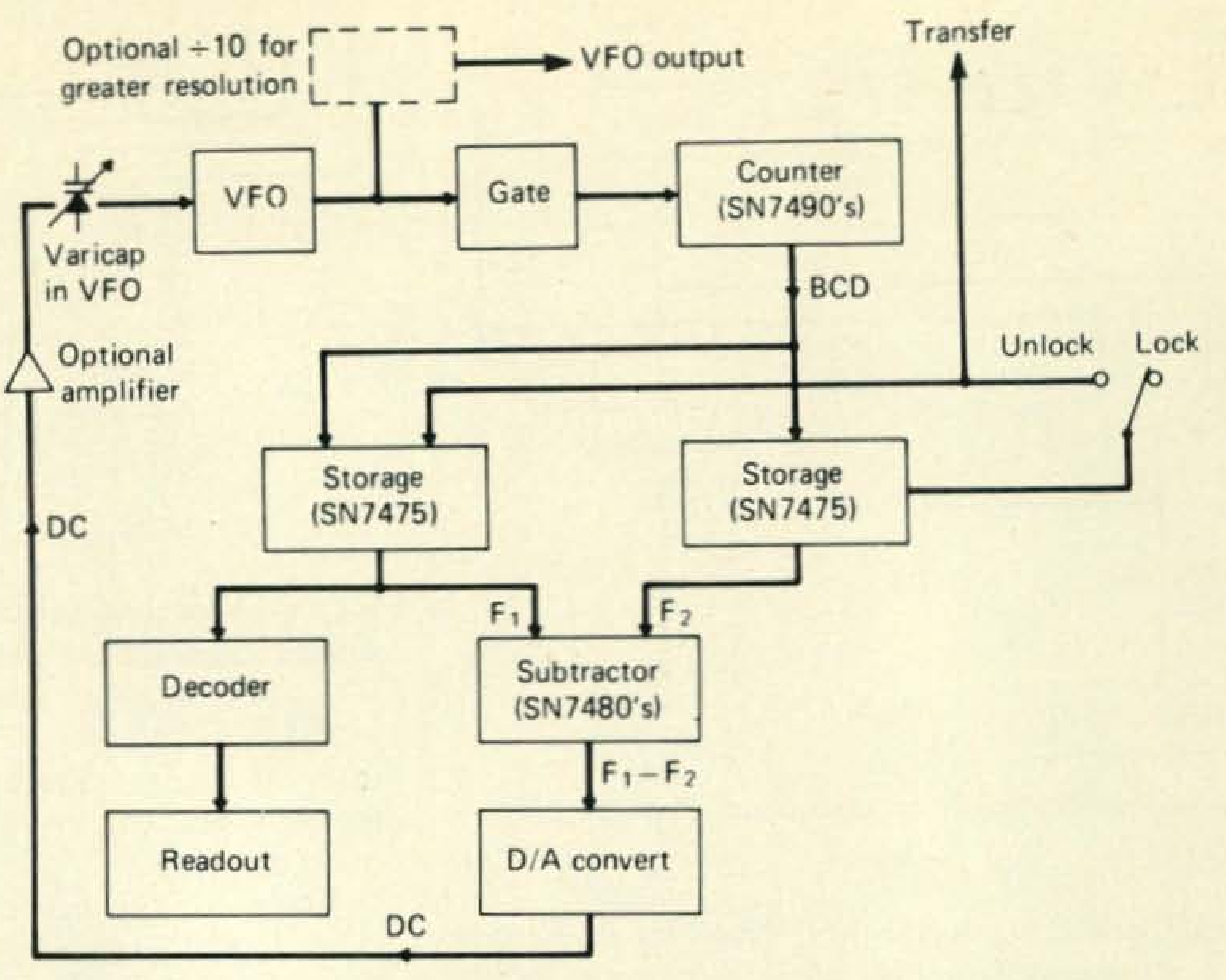

Fig. 6—The complete experimental synthesizer discussed in the text.

signals applied to a subtractor circuit composed of 4 SN7480 gated full adder chips. The hookup of these chips is left to the reader as it is given on the SN7480 data sheet from Texas Instruments and probably others. Returning to fig. 4, we now see that the output consists of the difference between the two frequencies in digital form. If we now remember that frequency 2 was the one we desired then the output can be considered to be a changing digital number (changing at the gate rate) equal to the difference between what we want and what we have.

Now, on to fig. 5. Here we have a simple digital to analog converter. Depending on which transistor conducts, the output voltage will go from 0 to 10 volts, limited in accuracy only according to the tolerances of the resistors, transistor drops, etc., although potentiometers will enable one to trim the unit exactly. We have now produced an analog, d.c. voltage directly related to the error between the frequency we desire and the frequency we have, up-dated according to the gate interval. All that is now necessary to "close the loop" is to apply this d.c. error voltage to a varicap back in our original v.f.o. Fig. 6 shows the complete diagram. Fig. 7 is a sketch of what the front panel of such a synthesizer might look like. Operation would be quite simple. All one would have to do would be to switch to the resolution required, unlock the system, tune to the desired frequency, lock the system and be "rock-bound".

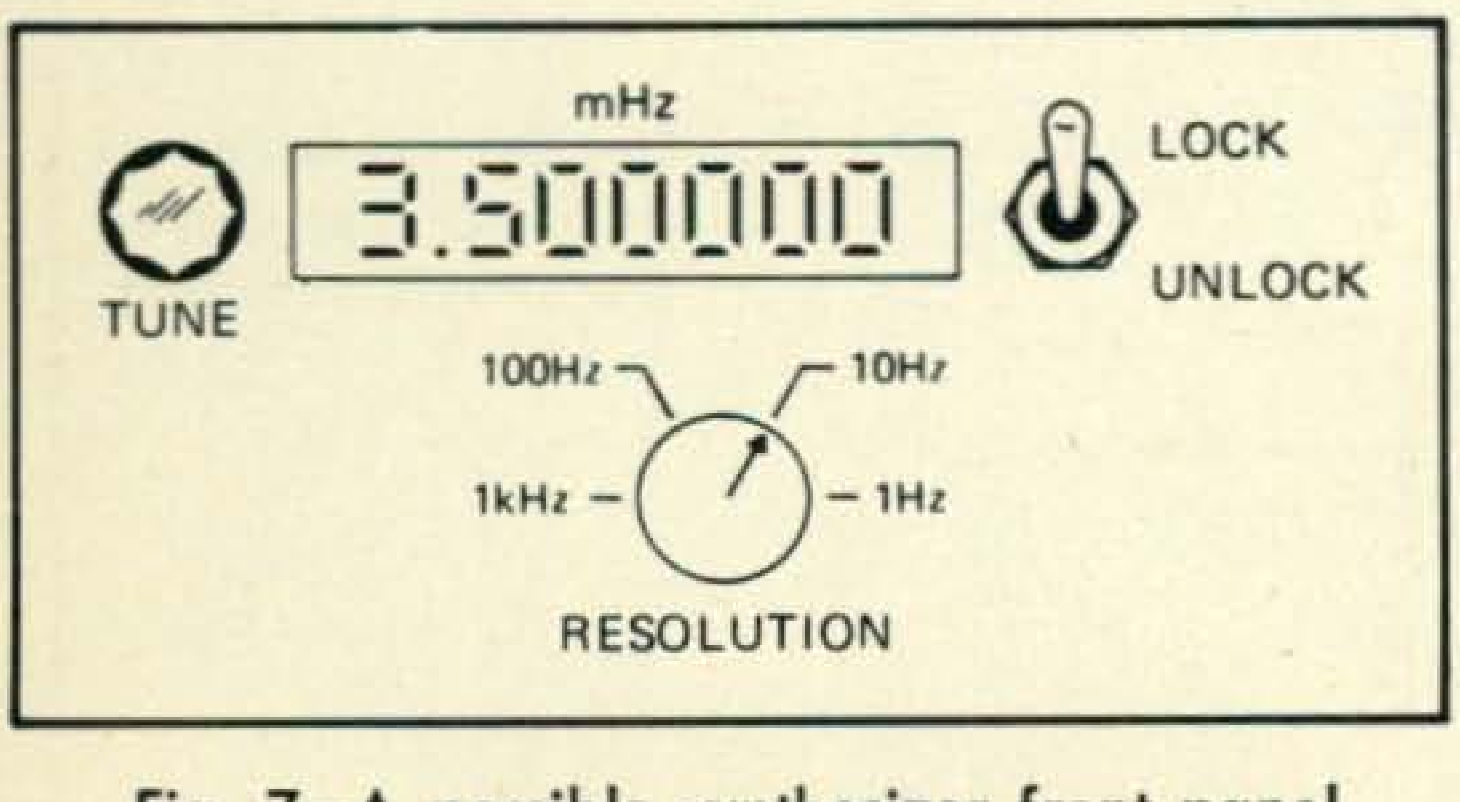

Fig. 7—A possible synthesizer front panel.

There are several problem areas, however, that will need further development and experimentation if such a scheme is to succeed. Some of these, the more obvious ones at any rate, are:

1. What will a periodic 1 second, .1 second or .01 second jump in v.f.o. frequency (as it is being updated) sound like?
2. What effect will drift during the counting interval have?
3. Will heterodyned or multiplied v.f.o. signals really be as stable as they look like they might?
4. When opening S_1, the storage chip must have fully completed a count interval.
5. What effect will a noise pulse producing a mis-count have?
6. Error voltage vs. varicap linearity may prove to be a problem.

No doubt there will be other problems in getting a scheme such as this to operate properly but after all, that is what experimentation is all about! I personally will be most interested to hear about persons attempting to build a synthesizer such as this one, and will be glad to publish promising developments in this column. All comments, including "it won't work!" will also be greatly appreciated as long as adequate explanations are given for problem areas and, if enough interest is forthcoming, we will even publish excerpts from some letters.

73, Irv, WA2NDM

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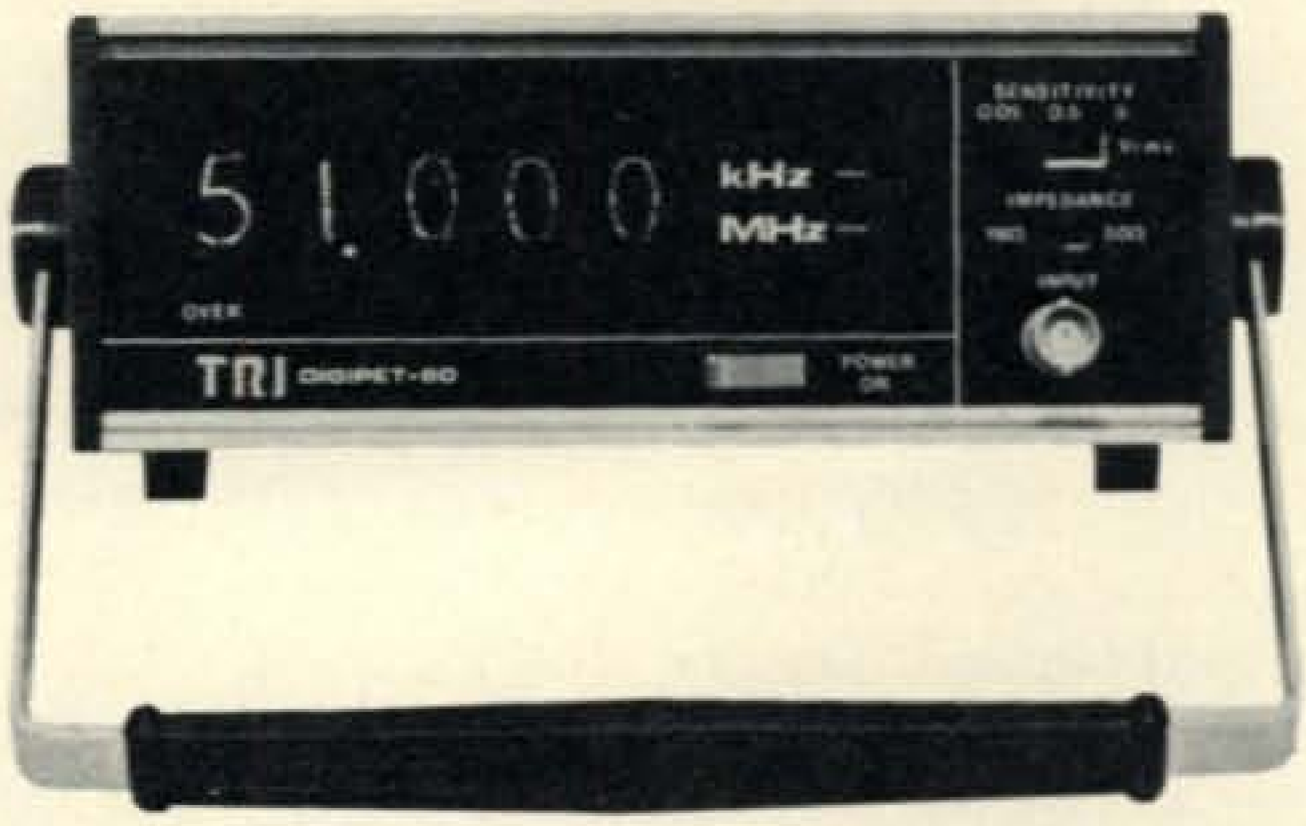

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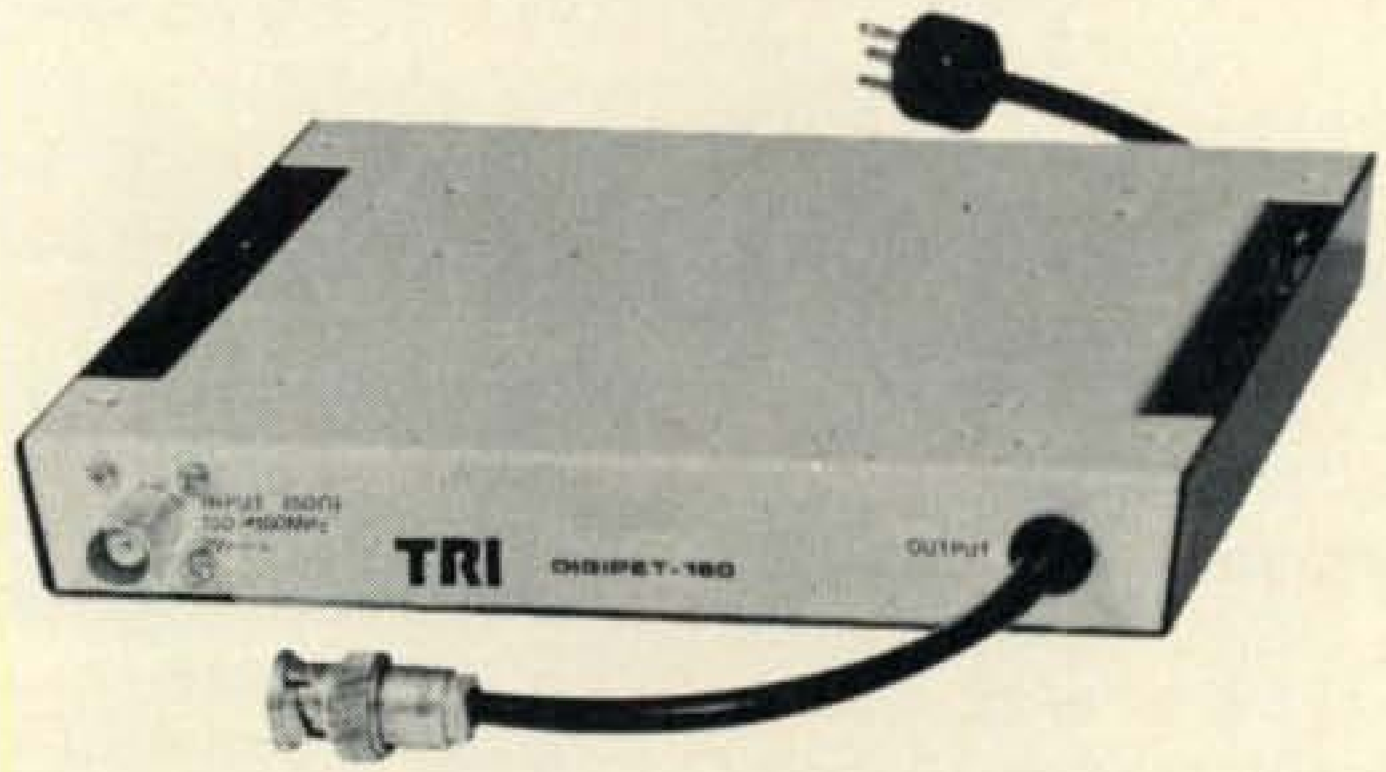

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DX

BY JERRY HAGEN,* WA6GLD

As Spring approaches we can look for some longer openings on the higher bands with hopes of catching that elusive country or prefix. On the west coast, the daylight saving time conversion in January made it difficult to catch the long path to Europe and the Near East as most DXers were due to work before the band opened! Don't forget the WPX Contest on March 30 and 31 as some special prefixes are normally heard.

DXTRA

Our DXtra for March concerns WPX Rule 3A and is the "other side" of the argument voiced by WA2EAH in the September, 1973 issue of *CQ*. Mike, VO1KE provides the conservative position as he writes; "Don't change WPX Rule 3A! There are already 9720 possible prefixes. If a second numeral is allowed, that number plus 9720 × 10 possible prefixes which makes a total of 106,920 could exist. If a third numeral is allowed such as HA1ØØ, the total of possible prefixes increases to something like 1,069,200—give or take a few thousand. Giving status to HA1ØØ, VU25, IT57 or even C29 as separate from C21 is like calling Long Island or Arizona a country! India could have issued VU3, VU8 or VUØ rather than VU25 as they are not using those prefixes. If prefixes are to be regarded as having any significance there has to be a reasonable limit to their number. I believe that 9720 is a reasonable limit, whereas 106,920 or 1,069,200 is not! I suggest that Rule 3A remain as is!"

It should be noted that the original intent for the WPX award was that prefixes should represent separate geographical areas. In fact, the WPX Certificates reads "has presented proof of contact with 300 amateur radio stations, each having call letters with a different prefix, each prefix normally indicating a *different* geographical area of the world."

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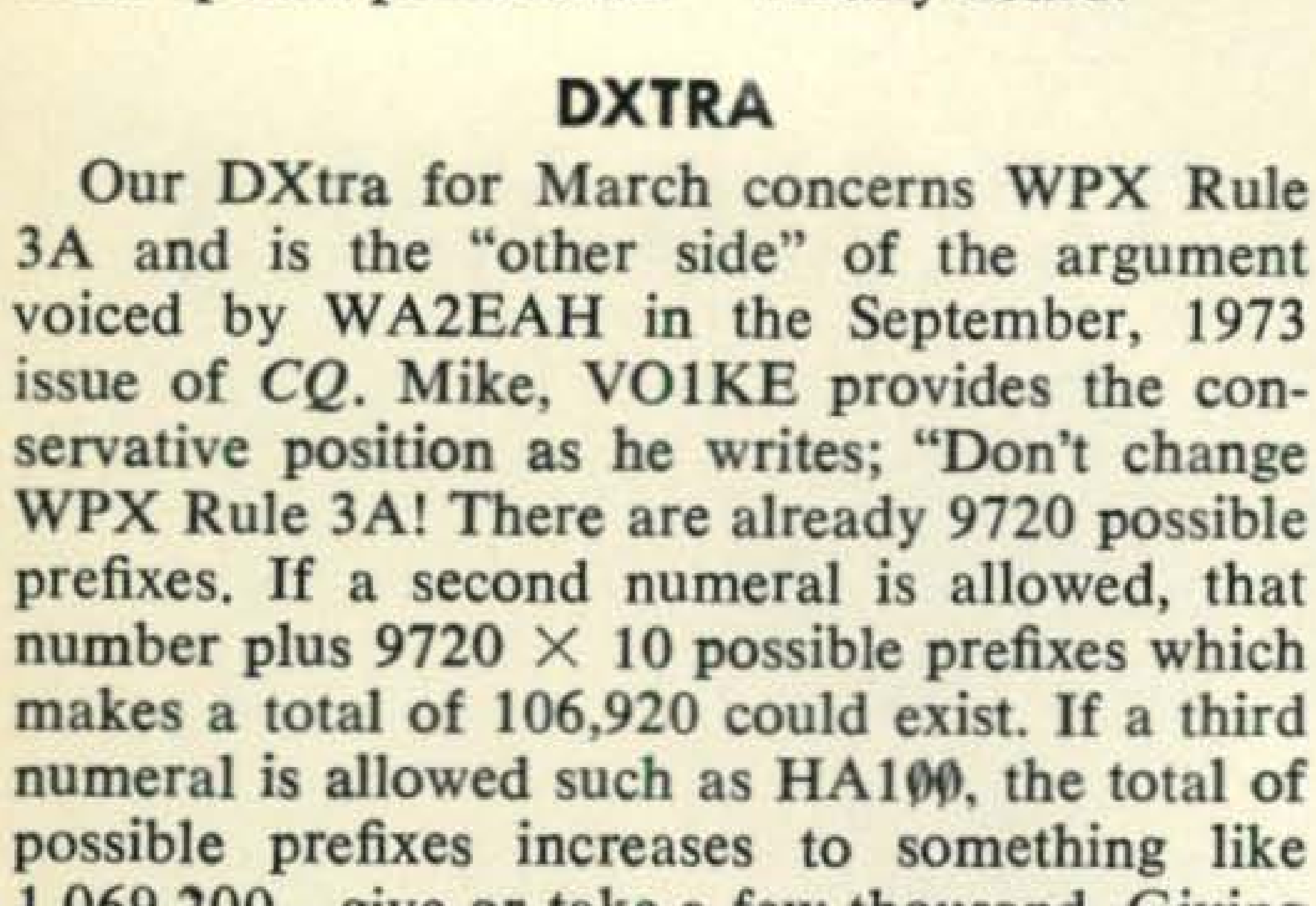


Mrs. Joe Hiller, XYL of the late W4OPM was presented with the CQ DX Hall of Fame plaque at the Virginia Century Club Dinner meeting on October 9, 1973. On the left is W4OM and on the right is K4AE, President of the Virginia Century Club. *(Photo by W4JVU)*

LG5LG and SJ9WL—Morokulien

Morokulien is an existing, fictious country on the border of Norway and Sweden. It was established in 1959 during the International Refugee Year in connection with radio and TV programs by the Norwegian and Swedish Radio and Broadcasting Corporations which were promoting national charity funds. The campaigns were so successful that the governments of both countries decided to provide 2 square km's to Morokulien where a monument was erected in 1914 to commemorate 100 years of peace between Sweden and Norway. In Morokulien there is a post office where both Norwegian and Swedish stamps are valid, plus camping sites, weekend huts for rent, restaurant, gas station, theater and the amateur radio station which has the call signs LG5LG or SJ9WL! The radio cottage has four beds, kitchen, veranda and radio room with antennas. Any licensed amateur of the world may operate the station and income from the rental of the cottage as well as donations received with QSL cards are donated to handicapped radio amateurs in Norway and Sweden. QSL's for SJ9PL go to the SM Bureau while LG5LG QSL's are handled by LA4YF.

The CQ DX Award Program

CW DX

134—DL1ES
135—WB9DRE
136—DJ1PQA
137—OK1DVK
138—OK1IAG

SSB DX

311—F9RM
312—WA4NRE
313—W4SSU

Endorsements

C.W.: DL1ES—150, Low Band 28 M Hz
SSB: SM6CKS—310, W4SSU—310, F9-RM —310, Low Band & 28 M Hz

Complete rules for the *CQ* DX Award Program may be found on pg. 58 of the January 1971 issue. Application blanks and copies of the rules may be obtained by sending a business size, self-addressed stamped envelope to DX Editor, P.O. Box 1271, Covina, CA 91722.

WPX Report

Clem, W4LRN has agreed to provide a WPX report on a fairly regular basis. As reported in the March 1973 DX COLUMN, information on USA special prefixes continue to be scarce. Clem hopes that some good means of notification can be made to alert WPX enthusiasts of impending special prefix operations. During the months of November and December KX1MUM was active from the Bristol Mum festival while KH4NC was activated to commemorate the historic flight of the Wright Brothers. The special call KF2NYS was also active, but no information has been received. During the *CQ* WW CW Contest the following prefixes were heard:

CN8BO, CR6IK, CV1B, CV5AR, CV7B, CV8B, DT3QO, DT2CRM, FB8XA, FM7WU, FPØBG, HI8LPN, HW-2-3-5-6-8-9, IC8CQF, TG9YN, VA7MM, VA7WJ, VP8JV, ZD3X, ZE8JN, 4C5AA, 4M5ANT, 9Z4AA.

THE WPX PROGRAM

Mixed

416—KØZFL, 417—PAØINA, 418—SK6AW, 419—YU1OBA

C.W.

1287—K2HYM, 1288—DJ1PQA, 1289—OK1TA, 1290—SMØCCM, 1291—SM5AYY, 1292—SM5QG, 1293—SM6CEP, 1294—SM7JZ

S.S.B.

778—W7HKI, 779—JA2UYS, 780—SM6DHU

WPNX

65—WN6RLK, 66—WN4BNU

WPX ENDORSEMENTS

Mixed: W3PVZ—1000, G3DO—900, K2-AAC—850, OK3EA, PAØINA, SH6DHU—700, SK6AW—650, WB4SIJ—600, K4-ZYU, YU1OBA—450

C.W.: K7ABV—800, K2AAC—750, DL1ES—650, OK3EA, OK1TA—600, WB4KZG—400, VO1KE, SMØCCM, SM5AYY—350

S.S.B.: OK1MP, G3DO—750, SH6DHU, WB4KZG—550, G3OLY, OK3EA—500, WA8TDY—450, ZI1AMN, W7HKI, G3-TLV—400, PAØLVK—350

80 Meters: DL1ES

40 Meters: DL1ES

20 Meters: PAØLVK, DL1ES

15 Meters: DL1ES

10 Meters: DL1ES

Africa: DL1ES

Asia: DL1ES

Europe: DL1ES, SMØCCM, SM5AYY, SM-5QG

Complete rules for WPX, WPNX and VPX may be found on pg. 67 of the February 1972 issue. Application blanks and reprints of the rules may be obtained by sending a business size, self-addressed stamped envelope to DX Editor, P.O. Box 1271, Covina, Ca 91722.

Perhaps North Carolina's most enthusiastic DXer is Les, K4ZCP. Les holds WPX, WAZ, DXCC, 5 Band DXCC and many other DX Awards.

Novice DX

Our Novice DX reporter, Jim WN7UMU has provided a roundup of 40 and 80 meter DX with the help of WN2LVV, WN4EDQ, WN9LMT and WNØGTJ. Activity reported includes:

Station	Frequency	GMT
KG6AAY	7103	0830
KZ5VV	7110	0300
PY7IE	7105	0850
PY7BXC	7108	0905
XE1LH	7120	0330
XE2LP	7105	0940
VK3MR	7115	0920
VK4FH	7103	0830
VK6BQ	7102	0930
YV4AGP	7100-7150	0400
YV5TT	7125	0930
ZM4NH	7103	0850
PJ8NLO	3712	0615
YV4AGP	3745	0830
WP4DQP	3701	0200

As Spring approaches activity should swing to the 21 mHz Band!

Here and There in the World of DX

Claude, F9MS has turned over the *REF* DX editorship to F3AT, due to heavy business tra-

Bud Whitney, 9V1OI, calls the roll while Paddy Gunasekera, 4S7PB, logs for 9V1SEA on SEANET, 14.320, 1200 GMT, 9 November 1973, at the opening of SEANET Convention, Marco Polo Hotel, Singapore.

CQ DX Award Honor Roll

The CQ DX Award Honor Roll recognizes those DXers who have submitted proof of confirmation with 275 or more countries for the mode indicated. The ARRL DXCC Country List, LESS DELETED COUNTRIES, is used as the country standard. The total number of current countries on the DXCC list as of this listing is 321.

CW

W6ID	316	W4YWX	304	W0AUB	301	W6NJU	295	WA8DXA	287
K6EC	316	K6LEB	304	DL3RK	300	K1SHN	291	DJ7CX	278
W8LY	308	VK3AHQ	303	W6ISQ	300	WA6EPQ	290		
W4IC	305	ON4QX	302	W4BQY	296	WA6MWG	289		

2XSSB

W2TP	320	K4MQG	313	OZ3SK	307	W9KRU	298	W8ZOK	284
TI2HP	318	W4SSU	313	K6EC	307	ZL1AGO	298	K1KNQ	283
WA2RAU	318	I8KDB	312	W9OLD	307	G3RWQ	297	WØSFU	282
I0AMU	317	SM5SB	312	KH6BB	306	YV1KZ	297	OE3WWB	281
K2FL	317	W6EL	312	VE2WY	306	K1SHN	296	DJ7CX	281
W2RGV	317	W6NJU	312	W2CNQ	305	YS1O	296	HP1JC	281
DL9OH	316	K6WR	312	WA6MWG	305	ZL3NS	296	WA2VEG	281
W3NKM	316	ZS6LW	312	G3DO	304	WB6DXU	295	OK1MP	280
W9ILW	316	F9RM	311	K3GKU	304	WØYDB	293	W6FET	280
G3FKM	315	SM6CKS	311	WA6AHF	304	I8YRK	291	DL6KG	279
W3AZD	315	VE3MR	311	K4RTA	303	G3KYF	290	OE2EGL	277
W6EUF	315	W3DJZ	311	VE3ACD	303	WB2RLK	290	K6GUY	276
IT9JT	314	W4IC	311	SM6CWK	302	XE2YP	290	W6TCQ	276
W6KTE	314	W6[illegible]V	311	W6KZS	302	YV1LA	290	I1WT	275
W6REH	314	W9DWQ	310	VE3GMT	302	OE1FF	287	WAØCPX	275
W6RKP	314	I0ZV	309	WA2HSX	301	K8GQG	287	VE7HP	275
W9JT	314	F9MS	308	WA3IKK	300	WAØKDI	287		
I8AA	313	XE1AE	308	W6FW	299	W9OHH	285		
WA2EOQ	313	F2MO	307	K4HJE	299	W3CRE	284		

vel. Claude hopes to be active from Reunion Island (FR7) in mid-1974.

Nearly 100 amateurs and guests from all over the world attended the third SEANET Convention at the Marco Polo Hotel in Singapore, November 9, 10 and 11, 1973. Mr. Khoo Chek Ngee, Manager (Maintenance), Telecommunications Authority of Singapore, officially opened the meeting by greeting the participants in person and on the air—Convention Station 9V1SEA was operational from the Hotel at SEANET time, 1200 GMT, on 14.320 mHz, and throughout the session.

DXers and ragchewers alike had a unique chance for relaxed, informal eyeball QSO's, many for the first time. Activities included a visit to the Singapore Telecoms satellite communications station and to the Hy-Q crystal manufacturing plant. Ten manufacturers and distributors of amateur and electronic equipment participated in a display of products—a first for amateur meetings in Southeast Asia.

The 1972 operating crew of a rare country and prefix is shown in front of their trap vertical. Left to Right are Pat (F6BIB), Pierrot (F6BPS), Maurice (F6APG) and Patrick. *(Photo via F2MO).*

The real highlight was the visit to 9M2JB, a royal prince of Malaysia and an amateur since the twenties. Ta, as he calls himself on the air, personally conducted the visitors on a tour of the palace of the Sultan of Johore, including the rare privilege of viewing the crown jewels. The day was capped by a Malaysian style barbeque—satay, fried rice, and cold beer under a thatch hut served by Ta's retainers at the site of his new shack under construction.

The next SEANET Convention will be held in 1974 in Manila. Hosts will be the Philippine Amateur Radio Association, Box 4083, Manila, Philippines.

Ed, W3KVQ/2 has begun his 13th year of QSL Managership for Father Moran, 9N1MM. Ed is also handling cards for his operation in the Marshall Islands as KX6EB for the past two years.

The SVØWL Club Station at Navcommata Greece has been reactivated with members including SVØWC, SVØWCC, SVØWPP, SVØWSS, and SVØWTT. QSL's for any of these stations may be sent to P.O. Box 5, Navcommsta, FPO NY 09525.

Arnie writes that he has given up the call T12AAC after 12 years and is now T12SW. His QSL Address is P.O. Box 708, San Jose, Costa Rica.

Bob, WAØTNW is now signing GM5BCV

after 2 years of operation as DA1SU. Bob hopes to add a quad to his QTH before closing as GM5BCV.

CQ DX Awards

Questions are often received about the *CQ* DX Award Program which was initiated in 1971 as the successor to the SSB Awards originally sponsored by the SSB COLUMN of *CQ*. These awards are awarded for working and confirming 100 countries using the DXCC Country List. There are two separate certificates; one for all 2 way s.s.b. and one for all c.w. Both certificates are highly attractive and utilize the *CQ* Zone Map as a background such as the WAZ Award. The c.w. award has a light yellow background and the 2×SSB Award has a light green background, while both have red lettering. In early 1973 several special endorsements were added to encourage multi-band usage and special operating skills. The *CQ* DX rules do not recognize deleted countries; therefore, applicants should check the DXCC List before completing the application form. Recent deleted countries are Ryukuku Island (KR6 or KR8), Swan Island (KS4), and Germany (QSO's before 18 September 1973). QSL's are required for these awards and must be verified by a *CQ* DX Committee Member (see *CQ*—November 1973) or sent to the Award Manager.

QSL Information

CQ6AA—via W8CNL
CR6AA—via W8CNL
CR6II—via W8CNL
CR6MT—via W8CNL
CR6YY—via W8CNL
TR8SS—via DJ5IO
TY5ABK—via W8CNL
WB2KLL/VP7—via WA1HAA
WB2KEA—via WA1HAA

The WAZ Program

S.S.B. WAZ

1151......JR1TSH	1156......JA8BAR,
1152......W1COA	1157......W4BKP
1153......K6HTM	1158......WB4KZG
1154......UK9AAN	1159......F2YT
1155......K9LKA	1160......JA2HGA

C.W.—Phone WAZ

3625......K3TUP	3632......UB5NM
3626......K4FRM	3633......UK1AAQ
3627......G3VDW	3634......DU1EL
3628......JA2CZS	3635......DL9RT
3629......UK4WAZ	3636......W2UBJ
3630......UL7GW	3637......W1AM,
3631......UA9NN	

Phone WAZ

491......W4CK	492......ZL1AMN

Complete rules for the Single Band WAZ program are shown on pgs. 57-58 of the December, 1972 issue. Complete rules for regular WAZ may be found on pages 64-66 of the June, 1970 issue. Application blanks and reprints of both sets of rules may be obtained by sending a self-addressed, stamped envelope to the Assistant DX Editor, P.O. Box 205, Winter Haven, FL 33880.

CQ Contest Committee member Bernie, W8IMZ operated from the Vatican prefix HV3SJ in July of 1973. Pileups for the operation were terrific!

CV4C—via CX4CR
EI7CJ—via W8CNL
EL7F—via DK5BH
GM5BCV—via R. Sullivan, Box 674, FPO NY 09518
KA2AI—via WB6WXO
SJ9WL—via SM Bureau
TI2BEV—via K4VW
XX6A—via W8CNL
YJ8BL—via W6NJU, 7632 Woodland Ln, Fair Oaks, Ca 95628
ZF1TSW—via WB2JYM
3V8DM—via VE6HN
4C5AA—via W2GHK
8R1CB—via W2MIG

ADDITIONAL QSL INFO

A2CAE—via Box 49, Gaborone, Botswana
A6XF—via Box 1057, Charjah, United Arab Emirates
A4XFJ—via Box 981, Muscat, Oman
A4XFF—via Box 981, Muscat, Oman
CR5AJ—via Box 261, Sao Thome, West Africa
CR6QR—Box 568, Luanda, Angola
K5QHS/CE0Z—via Box 218, Broken Bow, Okla. 74728
CT2AZ—via J. L. Ritzen, USN/AF, Box 15, APO New York 09406
DA1QN—via Box 412, OPSC, APO N.Y. 09611
DM8THI—via Box 9, Ilmenau, East German Democratic Republic
EA8FE—via Box 860, Las Palmas, Canary Islands
EA8FF—via Box 260, Las Palmas, Canary Islands
EA8JE—via Box 81, Puerto Osario, Canary Islands
EL2CQ—via Box 192, Monrovia, Liberia
HC8SB—via Guayaquil Radio Club, Box 5757, Guayaquil, Ecuador
FR7AX—via Box 109, LePort, 97420 Reunion Island
FG0ZZ/FS7—via R. Gemehl, 95 Rue H Larbusse, 92700, Colombes, France
FG0AFA/FS7—via John Irwin, 578 Morris Ave., #A-6, Elizabeth, New Jersey 07208
IT9BWO—via Box 18, Termini, Sicily
JY5HC—via Box 2353, Amman, Jordan

[*Continued on page 72*]

The 1973 WPX Contest operation at VP2MYA was by Mike, W5MYA (l.) and Joe, W5QBM (r.) Almost 7,000 QSO's were made during the DXpedition.

NOVICE SHACK

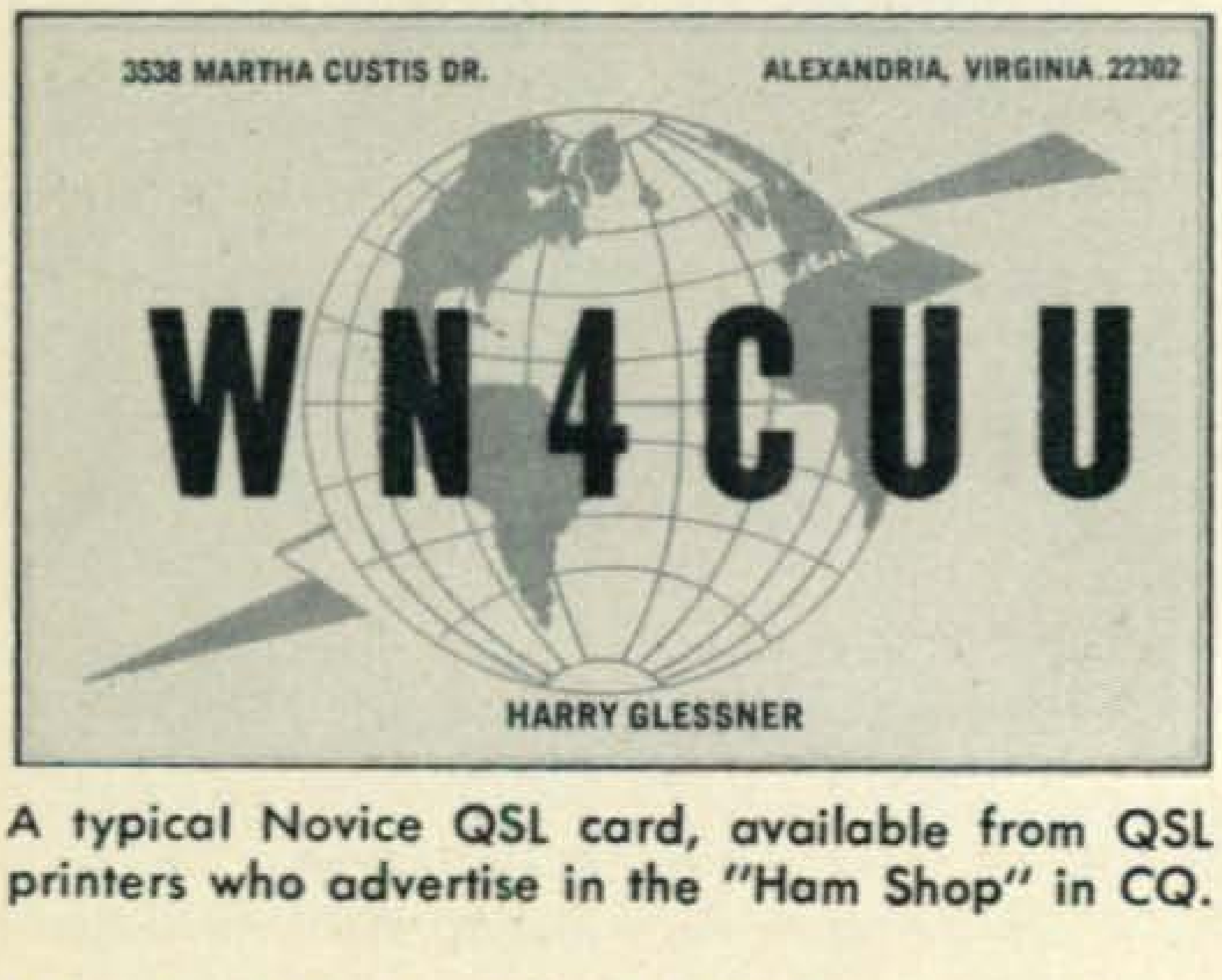
BY HERBERT S. BRIER,* W9EGQ

Sending And Receiving QSL Cards Basic Information

AN eye-catching feature of many amateur stations are the QSL cards from amateurs covering the walls and sometimes even the ceiling, each one representing a successful 2-way radio contact. The cards are usually of United States postal-card size (other sizes cost more to mail) with the sender's call letters emblazoned across their faces. The station location country, city, state, and county is also usually printed on the face of the card. Some cards are given individuality by having their call letters printed over a map or a schematic diagram, or possibly a cartoon. Some amateurs have even been known to display a pretty girl on their QSL cards. But whatever expedient is used to catch the eye, it is the small print, either on the front or the address side of a QSL card, that determines its ulitmate value as a confirmation of a successful radio contact. Seven pieces of information are required. They are:

1. A clear statement that a 2-way radio contact tion worked. 3. The mode employed — c.w., is being confirmed. 2. The call letters of the staphone, etc. 4. The frequency (band) used. 5. A signal report. 6. The date and time of the eontact. 7. The call letters and the name and mailing address of the sender. In addition, if the operation was from a plane, ship, or car, or from a portable location, that information

*385 Johnson St., Gary, Indiana 46402



A typical Novice QSL card, available from QSL printers who advertise in the "Ham Shop" in CQ.

should be included on the card.

Accuracy in filling out QSL cards is especially important on QSL cards that may be submitted as evidence when applying for an operating award, because the sponsors of most major awards immediately cull out cards that show signs of erasure or change or do not satisfy the requirements. Item 2 is often negated by the sender inserting his own call letters, instead of the call letters of the station worked. Items 3 and 4 are most important to operators striving for single-band or single-mode goals. Item 5. What good is a QSL card without a signal report? Item 6. Suppose you receive a QSL card from Australia dated 12:30 A.M., 3-11-73. Under what month, day, and time would you find the corresponding entry in your station logbook? Does 3-11-73 mean March 11 or November 3, 1973, in Australia? How many hours ahead or behind Australian time is your clock? Is the date in Australia a day ahead or a day behind the date in the United States?

Foreign amateurs have as much trouble with United States local times and dates as you probably did with that little quiz. Simplify the matter for all of us by spelling out the names of the months and use a 24-hour clock set for Universal or Greenwich Mean Time (GMT) to time all your station activities. Setting the clock to GMT merely entails setting it five hours ahead of Eastern Standard Time or Eight hours ahead of Pacific Standard Time. Your station clock is then in synchronization with every other GMT clock in the world. The GMT clock also reduces the confusion over what day it is over there. If your local clock shows P.M. and the GMT clock reads less than 1200 hours, it is tomorrow in GMT land.

Mailing QSL Cards

The best way to insure getting a good return on the cards you mail is never to mail a card without a complete address. The time lag between a new amateur getting his license and his address appearing in the *Call Book* and the relatively high cost of *Call Books* tempts many amateurs to ignore this rule. Once in a great while, the Post Office delivers a QSL card addressed simply "Amateur Radio ______, Some City, Some State," but the odds against it are overwhelming. If, however, you have a complete address which you are not quite sure of, you might try it by mailing your card in an envelope with your return address on it. If not deliverable, the Post Office will return the letter to you for further action.

There are several methods for QSL'ing foreign contacts. The obvious method of sending your card to the foreign amateur's *Call Book* address works, of course. Usually faster and less expensive is via a U.S. QSL Manager. If the DX station instructs, "QSL via ______," followed by a call sign, fill out your card in the normal manner and mail it and a stamped and addressed return in care of the QSL Manager. He will then send your return card in your envelope. If you forget the envelope, your reply will come via the ARRL QSL Bureau, discribed below. Incidently, only normal United States postage is required on the return envelope.

If the foreign amateur does not have a QSL manager (that you know about) and you do not know his mailing address, you can send his card via his national QSL bureau. Its address usually heads each country listing in the foreign Call Book. Some countries do not publish the addresses of their radio amateurs, making their QSL bureaus the usual way to get QSL cards to them. The major disadvantage to using the overseas QSL bureaus is that they are not famous for their speed. In fact, you can usually figure upon waiting a couple of months up to a year or more for DX cards to trickle through from some countries, which is one reason some amateurs think that foreign amateurs are poor QSL'ers.

Another reason for this belief is the way the ARRL QSL Bureaus work. The great majority of incoming DX cards for United States and Canadian amateurs are routed through them. To get the cards, each operator must keep a supply of No-8 (business size) envelopes on file with his call-area QSL bureau. Address the envelopes to yourself and clearly print your call letters in the upper, left-hand corner of the envelope, affix postage, and mail to your bureau. Its address is listed at the top of each call-area listing in the Call Book and is printed periodically in *QST*. There is no charge for the service, except to provide the post-paid envelopes, and only incoming cards can be handled. Outgoing cards can be routed via the QSL services operated by W3KT, W6KG, and others for a few cents a card.

Simple Crystal Oscillator And Band—Edge Marker

The self-contained crystal oscillator pictured here will help you comply with the Federal Communications Commission regulation that requires a means independent of the transmitter to check frequencies. It is based on a simple "Ox" printed circuit oscillator kit from the International Crystal Manufacturing Co., 10 North Lee, Oklahoma City, Okla. 73102, for $2.95, less crystal. Matching crystals in HC-6/U holders are available at $3.95, each. The LO oscillator i used on frequencies between 300 and 19,999 kHz, and the H1 oscillator for frequencies up to 60 mHz. The HI model appears in the picture.

Assembling and wiring the kit requires less than an hour. It is mounted over a 1¼-inch hole in the top of a 5 × 2¼ × 2¼" aluminum "minibox" found in the "junk box." Four pen-

The Palomar Engineers (Box 455, Escondido, Calif. 92025) will produce accurate marker frequencies every 5, 10, 25, 50, or 100 kHz across the radio spectrum to over 20 mHz. A panel switch controls the marker spacings. $32.50, postpaid.

light cells in series power the oscillator through an s.p.s.t. toggle switch, and oscillator output is fed to a coaxial connector on the front of the box. A short length of wire plugged into the output connector radiates a strong signal into a nearby receiver.

To check the calibration of a receiver, plug a crystal of the desired frequency, or a submultiple thereof, into the crystal socket and tune the receiver to "zero beat" with its signal or for maximum receiver S-meter indication. To check the calibration of a v.f.o., turn off the receiver b.f.o. and tune the v.f.o. to zero beat with the crystal oscillator signal while listening to the receiver.

The Ox oscillator is not a precision unit, but its rated calibration accuracy of .02 percent when used with the matching crystals—its actual accuracy is greater than this—is sufficient for the assignment.

[*Continued on page 72*]

Battery-powered, crystal-controlled frequency marker described in these pages. The battery is mounted inside the box.

THE awards PROGRAM

BY ED HOPPER,* W2GT

Special Honor Roll
All Countries

#113—Walter Orville Carr, W3LDD, 11-12-73.

USA-CA HONOR ROLL

1000		500	
WB9ELH	319	F9MD	983
		OK1FF	984
		DJ2VZ	985

THE "Story of The Month" for March is:

Arnold C. Bachmann, K9DCJ

(All Countries #86, 11-1-72)

Arnie did not give me much information about himself, but here it is.

He was born October 4, 1914 and graduated from high school in 1932. Served in the Air Force 1943-1946 as a crew chief on a radar installation and maintenance unit.

Received his amateur ticket in 1956 after putting it off since 1929.

In 1964, Arnie ran across a county hunting net in Illinois and got a mild case of County Hunting. He finally discovered the busy County Hunting Net on 14336 and really went to town. Yes in the last 3½ years he has given out well over 13,000 mobile contacts.

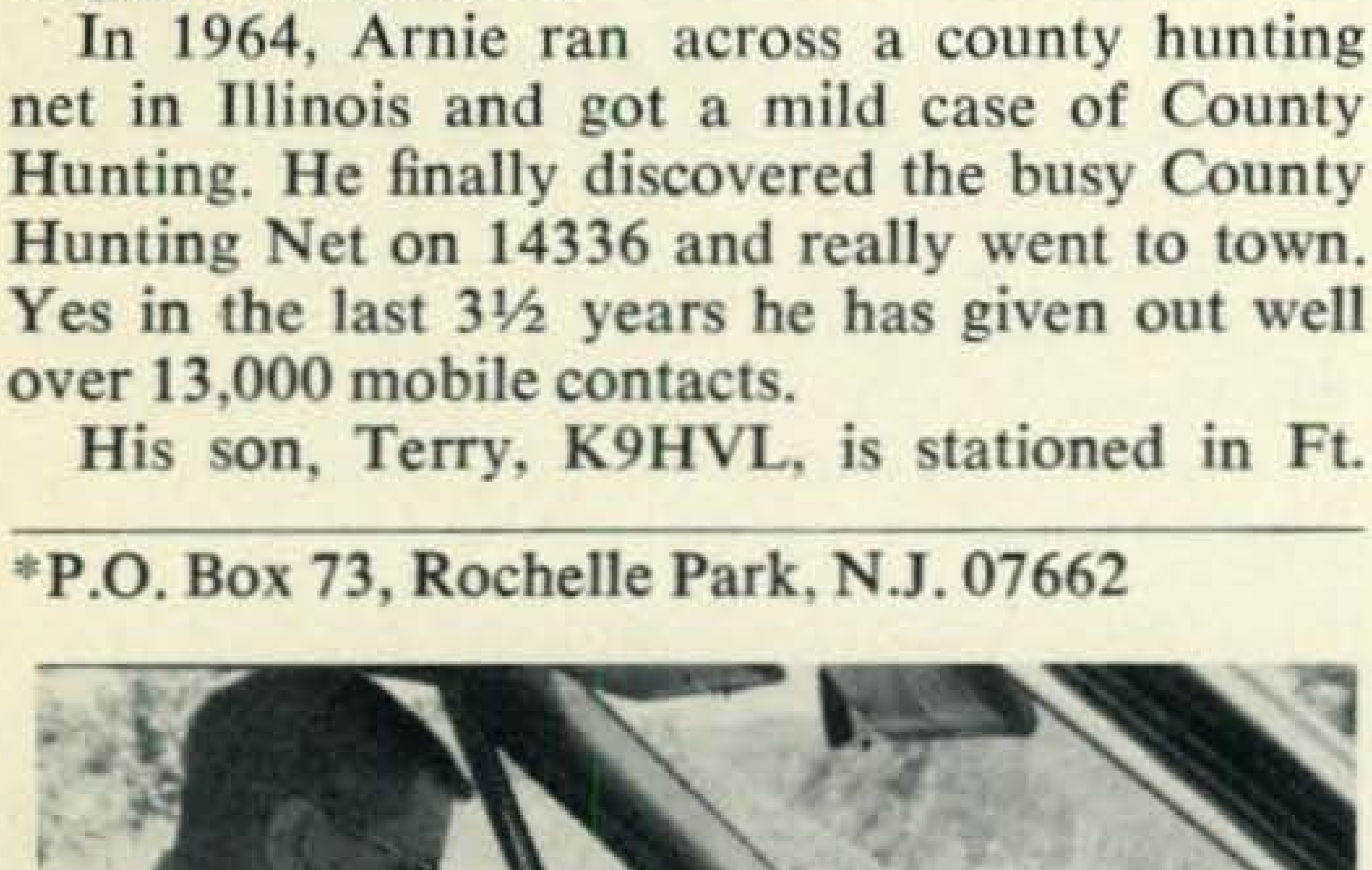
His son, Terry, K9HVL, is stationed in Ft. Meade, Maryland and has given out quite a few counties in that area.

Arnie is employed in the communications department of Satterfield Electronics in Madison, Wisconsin.

Arnie wants to express thanks to *all* who helped him get all the counties and especially to Ed, WAØSBR who gave him the last five needed ones, all in the state of Nebraska. Also thanks to his XYL, Lorraine, who put up with the 3X3s and the many thousands of miles they traveled giving out Wisconsin Counties.

Our records show that Arnie applied for USA-CA-500-#627 on 7-22-67 and then waited until 11-1-72 at which time he acquired USA-CA-1000 through *All Counties*!

*P.O. Box 73, Rochelle Park, N.J. 07662



Arnie, K9DCJ exchanging reports with John, W4HA.

Awards Issued

Walt Carr, W3LDD found time to catch them *All*.

Marcel Pouchoux, F9MD (Awards Manager for R.E.F.) was issued USA-CA-500 endorsed All Phone.

Vladimir Kott, OK1FF won USA-CA-500 endorsed All A-1.

Herb Koehnor, DJ2VZ acquired USA-CA-500 endorsed All s.s.b.

This month's applications being slow, will give me some room to try to catch up on awards information.

Awards

New Custodian for all Massachusetts Chapter, The National Awards Hunters Club Awards: William C. Holliday, WA1EZA, 22 Trudy Terrace, Canton, Mass. 02021. This due to the sad passing of a well liked, active County Hunter, George J. Hayes, W1DOM on November 12.

North Carolina Counties Award: Sponsored by the Alamance Amateur Radio Club, Inc., who also now have all the "Tarheel" Award records and materials from the Morganton ARC of Morganton, N.C.

This North Carolina Counties Award is issued in 4 classes:

	Counties Required	
Class	DX (Including KH6 & KL7).	ALL OTHERS.
Class D	25	30
Class C	40	50
Class B	60	75
Class A	90	100

Fee for basic award is $1.00, additional awards after basic s.a.s.e. only. GCR, TCR, MER apply. Send GCR list of stations worked and confirmed to: Alamance Amateur Radio Club, Inc., P.O. Box 503, Graham, N.C. 27253.

They are prepared to honor requests for a higher "Tarheel" award from any qualifying station that already holds the basic "Tarheel" award as issued by the Morganton ARC, if such qualifying station so desires. All qualified applicants for new basic or higher awards will receive certificates issued by the Alamance ARC, Inc. Mr. Joseph Benesh, K4AI, 118 Falls Road, Morganton, N.C. 28655, former custodian of the "Tarheel" award, will forward any requests, he receives, to the Alamance ARC, Inc.

Worked All Wisconsin Counties Award: Now sponsored by the Neenah-Menasha Amateur Radio Club. Basic award for 40 Wisconsin Counties, endorsement seals for 60 and 72. Available to s.w.ls. No time nor band or mode restrictions. Send GCR list, data from your logs and $1.00 or 10 IRCs to: Robert A. Thorne, K9DAF, 1743 N. Clayton Ave., Neenah, Wisconsin 54956. Award free to B/P. Send s.a.s.e. for endorsement seals.

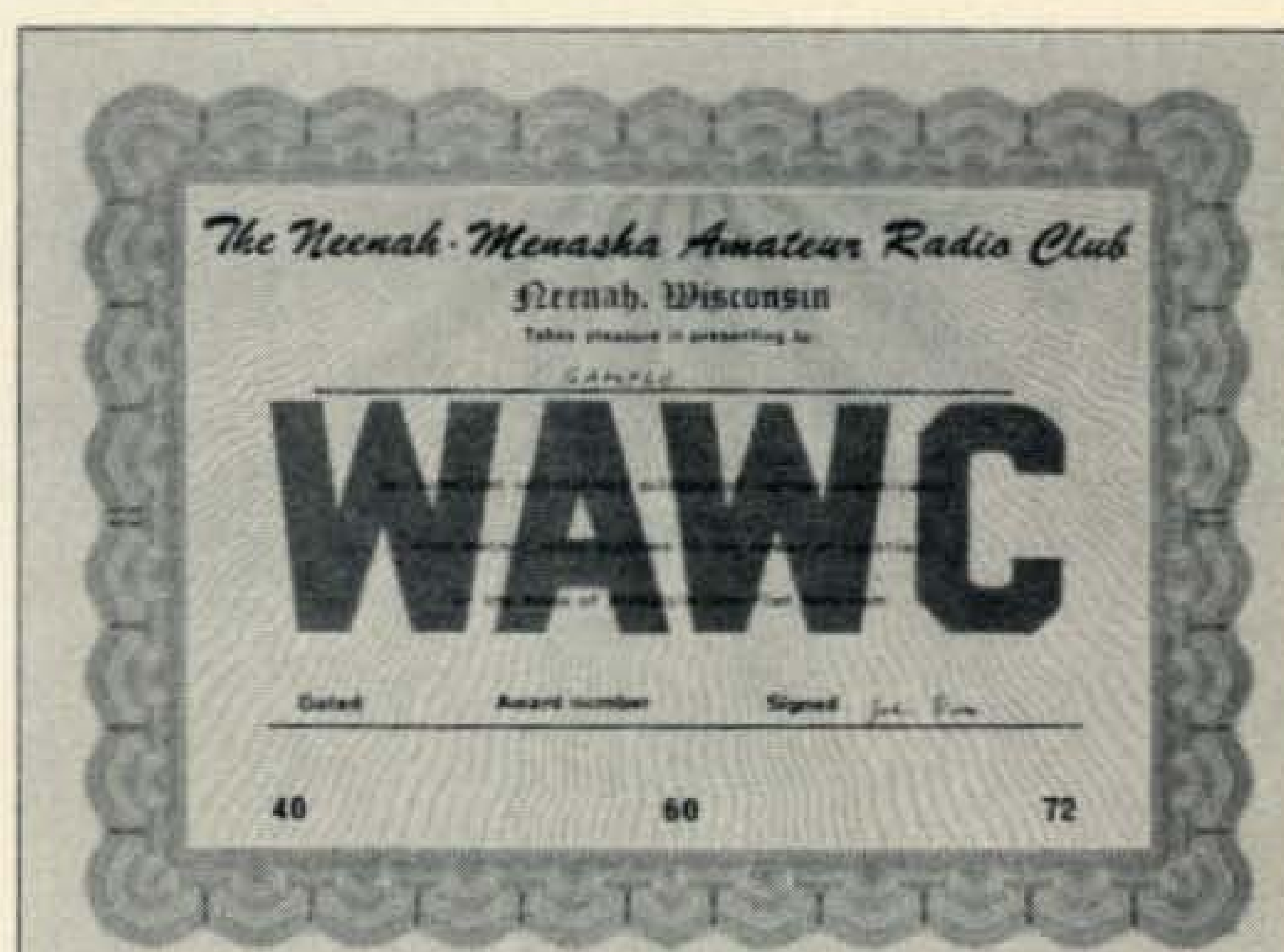
SCCARC VHF Award: Sponsored by the Southern Cayuga County Amateur Radio Club of New York. Issued free for working Southern Cayuga County Stations, to help promote more VHF activity. Rules:

Local stations (25 miles) work 4 stations, all others work 2.-6 meters. Local stations (25 miles) work 9 stations, all other work 2-2 meters. Local stations (25 miles) work 3 stations, all others work 2-1½ meters, or local stations work 2 stations, all others work 1-¾ meters. Apply to: Leslie J. Shattuck, WB2IPX, Sec. SCCARC, Moravia, N.Y. 13118.

SCCARC VHF Award.

Worked All Plymouth County Award: Issued for confirmed contacts with the 27 Cities/Towns in Plymouth County, Massachusetts and awarded in 3 classes: Class C for 9; Class B for 18 and Class A for all 27. Fee for basic award is $1.00 and higher class for s.a.s.e. Send GCR list and fee to: Robert W. Jennings, W1DKD, 15 Cliff Avenue, Scituate, Mass. 02066. All profits over and above printing and postage costs benefit Boy Scout Troop #94 of Scituate. Additional endorsement fee is 25¢ as an additional certificate is issued for new band and mode. Plymouth County City/town check list: Abington, Bridgewater, Brockton, Carver, Duxbury, East Bridgewater, Halifax, Hanover, Hanson, Hingham, Hull, Kingston, Lakeville, Marion, Harshfield, Mattapoisett, Middleboro, Norwell, Pembroke, Plymouth, Plympton, Rochester, Rochland, Scituate, Wareham, West Bridgewater, Whitman.

North Carolina Counties Award.



Worked All Wisconsin Counties Award.

Worked All Plymouth County.

The Family Award: Sponsored by the Massachusetts Chapter of the National Award Hunters Club. Issued for confirmed contacts with members of a ham family. Each pair counts 2 points, 3 points for 3 members worked, etc. In-laws do not count unless both husband and wife are worked. Award is issued in 3 classes. Class C for 20 points; Class B for 40 points; Glass C for 60 points. Submit GCR list showing calls, dates, times, band, mode, QTH, and full name of operator. No date or time limit on contacts. Fee for basic award is $1.00. Seals for higher class cost 10¢ except no charge for them at time of application for basic award. Free to B|P. Available to SWLs on a heard basis. Apply to New Custodian: William C. Holiday, W1-EZA, 22 Trudy Terrace, Canton, Mass. 02021. 02021.

Editor's Notes

Sad to report the loss of an active County Hunter, George Hayes, W1DOM. Please note that the new custodian for all Mass. Chapter of The National Awards Hunters Club awards is Bill Holliday, WA1EZA.

Sincerely hope that Bob, W6QPF and Lou, W9ZHD are in better condition by the time you read this.

The Family Award.

May I recommend the story about a QSL by Dr. J. Blasi, KA6IX (exKR6IX, W5ROP, W4NXO) in December 1973. Reminds me of the story that I heard happened in WW2. During the invasion of Germany, as our troops neared the Russian troops, there were those who desired to leave the Red troops and we had agreed to turn them back to the Russians. An American Captain (a ham) in talking to one of those seeking freedom, discovered they had exchanged signal reports and QSLs, a few years before the war. Needless to say, *that* prisoner was never returned to the Russians.

Marv, WB2SJQ is acting as QSL Manager (for County Hunting QSLs only) for G4JZ, GM3BCL, SM3BCZ, SM6CKU, SM6DHU and TI2WX.

A reminder that the 1974 MRAC ICHN Convention will be held in the Prom-Sheraton Motor Hotel in downtown Kansas City, Missouri July 4th to July 7th.

How was your month? 73, Ed., W2GT.

New Amateur Products

MODPAK Enclosures

High quality miniaturized electronic packaging is now available from MODPAK, Waltham, Massachusetts. Each MODPAK package consists of a nickel-plated aluminum case, a choice of four connector types (BNC, TNC, N, SMA), top and bottom covers (with Rivnuts), all hardware, and self-adhesive blank labels. The 701 series has a 1.8 square-inch cross-section with internal volume of 0.5 cubic inches. A choice of 2, 3, or 4 r.f. connectors or 2 connectors and a feedthrough (especially suited for amplifiers) are available. The 702 series is slightly larger, with a 1¼" x 2½" rectangular cross-section and 1.4 to 2.1 cubic inch capacity. Prices range from $10.50 to $14.50 in single unit quantities.

For a MODPAK catalog sheet write: Guy Huse, Division Manager, MODPAK, 31A Green Street, Waltham, Mass. 02154 or check **(B)** on p. 94.

Contest Calendar

BY FRANK ANZALONE,* W1WY

Calendar of Events

Mar.	2-3	ARRL DX Phone Contest
Mar.	10	WAB HF Phone Contest
Mar.	9-10	YL-OM C.W. Contest
Mar.	9-10	Worldwide VHF Activity
Mar.	9-10	RSGB BERU C.W. Contest
Mar.	9-11	Virginia QSO Party
Mar.	16-17	ARRL DX C.W. Contest
Mar.	24	WAB HF C.W. Contest
Mar.	23-25	BARTG RTTY Contest
Mar.	23-31	IARC Propagation Phone
Mar.	**30-31**	**CQ WW WPX SSB Contest**
Apr.	6-7	SP DX C.W. Contest
Apr.	6-7	VHF Space Net Contest
Apr.	7	WAB LF Phone Contest
Apr.	12-14	Novice QSO Party
Apr.	12-15	County Hunters SSB Contest
Apr.	14	WAB LF C.W. Contest
Apr.	20-21	Bermuda Phone Contest
Apr.	20-21	WAEDC RTTY Contest
Apr.	20-22	Zero District QSO Party
Apr.	27-28	PACC DX Contest
Apr.	27-28	Florida QSO Party
Apr.	27-28	Helvitia 22 Contest
May	4-5	Bermuda C.W. Contest
May	11-13	Georgia QSO Party
May	11	World Telecomm. C.W.
May	18	World Telecomm. Phone
June	2	Minnesota QSO Party

ARRL DX Contest

Phone: March 2-3 C.W.: March 16-17
Starts: 0001 GMT Sat. Ends: 2359 GMT Sun.

This is the second half of this 4 week-end marathon so if you missed the activity last month you can catch up this month.

The December *QST* had all the details. Logs go to: ARRL Communications Dept., 225 Main Street, Newington, Conn. 06111

Worldwide VHF Activity

Starts: 3:00 P.M. Saturday, March 9
Ends: 10:00 P.M. Sunday, March 10
(Local Time)

Mailing deadline is April 15th and logs go to: Itchycoo Park VHF ARS, WA3NUL, P.O. Box 1062, Hagerstown, Maryland 21740

RSGB BERU Contest

Starts: 1200 GMT Saturday, March 9
Ends: 1200 GMT Sunday, March 10

*14 Sherwood Road, Stamford, Conn. 06905.

Logs must be received before May 13th and this year go to: A. V. Davies, G3MGL, 41 Gainsborough Road, Tilgate, Crawley, Sussex, England RH10 5LD

YL-OM Contest

Starts: 1800 GMT Saturday, March 9
Ends: 1800 GMT Sunday, March 10

This is the c.w. section, the phone section took place last month. Full details in last month's CALENDAR. This year logs go to: Christine Haycock, WB2YBA, 361 Roseville Ave., Newark, N.J. 07107

Virginia QSO Party

Starts: 1800 GMT Saturday, March 9
Ends: 0200 GMT Monday, March 11

Logs must be received before April 15th and go to: Don Wiles, W4IML, 9801 Lomond Drive, Manassas, Virginia 22110

Above four events were covered in last month's CALENDAR.

IARC Propagation Contest

Starts: 0001 GMT Saturday, March 23
Ends: 2400 GMT Sunday, March 31

This is the Phone section of this activity, and keep in mind that contacts with stations in other contests may be credited for this one by indicating the correct IARC zone number.

Complete rules in last month's CALENDAR. Log sheets, CPR zone may and IARC country list are available from K4ZA.

Logs and all inquiries go to: L. M. Rundlett, K4ZA, 2001 Eye Street, N.W., Washington, D.C. 20006

Worked All Britain Contest

The "WAB" contests are 12 hour affairs from 0900 to 2100 GMT on the dates listed in the Events Box.

The following rules are for over-seas stations, outside the British Isles. Contacts made during the contest may be applied for the WAB awards.

Bands: l.f.—1.8, 3.5, 7 mHz. h.f.—14, 21, 28 mHz

Exchange: RS/RST and QSO number. Stations in the United Kingdom will also give their county and WAB area number.

Scoring: Each contact is worth 5 points. The same station may be worked on different bands for QSO points, but not a multiplier.

The multiplier is determined by the number of different UK areas worked.

Final Score: Total QSO points times the WAB area multiplier.

Awards: Certificates to the leading stations in each country and each VE, VK and W/K call areas. There are also awards for s.w.l. logging stations in the contest.

Logs go to: J. E. Hodgkins, G3EJF, Bridge House, Hunton, Bedale, Yorks, England.

BARTG Spring RTTY Contest

Starts: 0200 GMT Saturday, March 23
Ends: 0200 GMT Sunday, March 25

The British Amateur Radio Teleprinter Group again sponsors this contest which is open to all amateurs and s.w.l.'s.

All bands 3.5 thru 28 mHz may be used, but not more than 36 hours out of the 48 hour contest period may be used for scoring. The 12 hours of non-operation may be taken any time but in not less than 2 hour periods. Indicate on/off times in your log.

Exchange: Time GMT, QSO no., and RST.

Points: Contacts within one's own country, 2 points. Contacts with other countries, 10 points. A bonus of 200 points will be earned for each new country worked on each band, including own. The same station may be worked on different bands for QSO and multiplier credit.

Multiplier: Is total sum of countries worked on each band. And the number of continents worked. (counted only once, max. of 6)

Final Score: (a) QSO points × country multiplier. (b) Bonus points × continents. (c) Add totals from (a) and (b) for final score. The ARRL country list plus VO is the standard.

Awards: Certificates to the leading scorers, and s.w.l. RTTYers. Scores made in this contest are valid entries for the "World Champion of RTTY" competition. There are also awards for working 25 countries or 6 continents.

Logs must be received by May 31st and go to: Ted Double, G8CDW, 89 Linden Gardens, Enfield, Middlesex, England EN1 4DX

SP DX C.W. Contest

Starts: 1500 GMT Saturday, April 6
Ends: 2400 GMT Sunday, April 7

It's the world working the SP's in this one, in as many Polish powiats as possible, on all bands 3.5 thru 28 mHz on c.w. only.

There are three categories; single operator, single and all band; multi-operator, all band only. There is a s.w.l. division too.

Exchange: RST plus a 3 figure QSO number. The SP's will send RST plus their powiat letters. (ie: 579 WA and etc).

Scoring: Each QSO with a Polish station counts 3 points. Score a multiplier for each different powiat worked.

Final Score: Multiply the total QSO points by the number of different powiats worked. The same station may be worked on each band for QSO points, but a powiat may be counted only *once* as a multiplier.

Awards: Certificates to the top scorer in each category, in each country, with 2nd and 3rd place awards where returns justify.

Contest contacts may be credited for the PZK 100 Powiat award in lieu of QSL cards. Provided they are verified in the logs of the SP stations. Make your application with your contest log, include a fee of 7 IRCs.

Use a separate sheet for each band and include a summary sheet with the scoring information and a signed declaration. The usual disqualification rules including excessive duplicate contacts will be in force.

Mailing deadline May 1st to: PZK Contest Committee, P.O. Box 320, Warszawa 1, Poland,

Novice QSO Party

Starts: 1800 GMT Friday, April 12
Ends: 0600 GMT Sunday, April 14

This one is organized by the International Novice ARA and open to all class amateur stations. The object of course is to work Novice stations in the US Novice bands.

Exchange: RST and name.

Scoring: Total number of QSOs by the number of different Novice prefixes worked. i.e. WN4, WN8, OA3, OA2, and etc. The same station may be worked only once.

Novice Bands: 3.700-3.750, 7.100-7.150, 21.100-21.200, 28.100-28.200.

Awards: Appropriate awards for Novice and non-Novice operators.

Following prefixes will identify Novice stations: EL-N, HC-N, HI-N, KG4N, KZ5-N, LB, OA-N,) L, VU2-Z, WH6; WL7, WN, WP4.

Logs go to: Andi Anderson, WB9FGM, RR #3, Box 85-26, Belvidere, Ill. 61008. Mailing deadline May 1st.

County Hunters SSB Contest

Starts: 2200 GMT Friday, April 12
Ends: 0500 GMT Monday, April 15

This is the 3rd annual contest sponsored by the Mobile Amateur Radio Awards Club to activate U.S. counties for the County Awards program.

A fixed station may be worked only once regardless of the band. Portable stations that change counties may be worked again for QSO and multiplier credit. Mobiles may be worked from each county or county line. Stations worked on a county line count for one QSO but two or more multipliers.

DX to DX contacts do not count. Mixed mode permitted providing one station on s.s.b.

Exchange: Signal report, county and state. (country for DX stations).

Points: Contacts with a fixed U.S. station, 1 point, 5 points if its a DX station. (DXCC list) Contacts with a mobile station count 5 points on 14 mHz and up, 10 points if its on 7 mHz and lower. (Portable considered fixed).

Multiplier for fixed stations is total U.S. counties worked. For mobile stations its total U.S. counties plus counties given out.

Final Score: Total QSO points from all bands times the county multiplier.

Frequencies: Low end of General phone section in each band. (Avoid 3943, 7243 and 14336 Net frequencies. Contacts not valid).

Awards: Plaques to the highest scoring fixed, mobile and DX station. Certificates to the top ten mobile and fixed stations, and highest scorer in each DXCC country. Only single operator stations eligible. A station may enter as both fixed and mobile but must submit separate logs. Multi-operator awards may be given if merited.

Log Data: Time in GMT, call, RS, county, state, band and QSO points. Indicate each new multiplier as worked. It is recommended you use official MARAC log and summary sheets which are available free by sending a large s.a.s.e. (or IRC's) to KØARS.

All entries must be received by June 1st and go to: James L. Willingham, KØARS, Route 2, Bevier, Missouri 63532

Zero District QSO Party

Starts: 2000 GMT Saturday, April 20
Ends: 0200 GMT Monday, April 22

This one organized by the TRA ARC of Iowa State University covers a lot of territory and therefore should create a lot of activity.

Stations outside the Zero district will work Zero stations only, but Zeros may work both in and out-of-district stations. Each station may be worked once per band and mode, mobiles in each county change.

Exchange: QSO no., RS(T) and QTH. County and ARRL section for Zeros, ARRL section only for all others.

Scoring: *For Zeros*: Total QSOs × Sections + Zero counties + DX counties worked. *For non-Zeros*: Total QSOs × Zero counties + Zero sections worked.

Frequencies: 3570, 7070, 14070, 21070, 28070, 3900, 7270, 14300, 21370, 28570. Novice, 3725, 7125, 21125.

Awards: Appropriate certificates to leading scorers in each section.

Mailing deadline May 17th to: Zero District QSO Party, 14519 Lake Street Ext., Minnetonka, Minn. 55343

CQ WW WPX SSB Contest

Starts: 0000 GMT Saturday, March 30
Ends: 2400 GMT Sunday, March 31

Complete official rules were published in last month's issue.

The c.w. contest activity out of Uruguay has been on the decline since Ricardo, CX2CO dropped out of competition, but it looks like we have a new champion to hold up the honors. This is Manuel Castelo, CX9BT who took top honors in the single band category, on 21 mHz as CW9BT in last year's WW DX C.W. Contest.

Same format that has been used the past few years. Only 30 hours out of the 48 hour contest period can be used for contest credit by single operator stations. Contacts on 40, 80 and 160 are worth double QSO points, and the prefix multiplier is counted once only, *not* once per band.

Be sure to indicate the number of valid contacts on your summary sheet and include a prefix check sheet if possible. Your mailing address should be one that is valid 8 to 10 months after the contest. It is advisable that APO locations give their home address.

Mailing deadline for your logs is May 1st. To: *CQ* WPX SSB Contest, 14 Vanderventer Ave., Port Washington, L.I. N.Y. 11050

Editor's Notes

A reminder that DIAL-A-PROP will have an up dated forecast the week of the contest so make use of this free service by dialing, 516-883-6223, any time day or night.

That ice storm that hit southwestern Conn. and Long Island the middle of December wrought havoc at W1WY's location. Lost power and heat for two days and all my antennas. (Some local areas were out from 5 to 6 days). At this writing, three weeks later, I have patched up the 40 and 80 inverted V's and put up a temporary dipole on 20, but the tri-band Quad and 160 dipole are completely out of service. Hope to patch up the dipole in time for the 160 contest but there is little hope of having something suitable on 10/15/20 in time for the WPX. Its going to be a s.w.l. log this year.

73 for now, Frank, W1WY

Propagation

BY GEORGE JACOBS,* W3ASK

H.F. propagation conditions usually undergo noticeable change during March, as the sun appears higher in the northern sky and the length of daylight increases in the northern hemisphere. Spring propagation conditions, which begin during March, are typified by *fewer* east-west DX openings on the 10 and 15 meter bands (to Europe and the Far East, for example); a *greater* number of hours in which DX openings can occur on 15 and 20 meters; *fewer* hours for DX openings on 40, 80 and 160 meters; a seasonal *increase* in the level of static on all h.f. bands, and an *improvement* in v.h.f. ionospheric propagation.

During March and continuing through April, a considerable improvement is expected in propagation conditions over long paths between the northern and southern hemispheres. This results from the relatively similar h.f. propagation conditions that exist in the temperate regions of the northern hemisphere (where it is spring) and the southern hemisphere (where it is fall) as compared to the more extreme conditions that exist when it is summer in one hemisphere and winter in the other. A similar condition occurs when it is fall in the northern hemisphere and spring in the south.

Good inter-hemisphere openings are expected this month on 15, 20 and 40 meters from the USA to Australasia, South America, southern Africa, and similar areas. Some improvement on these paths may also be noticeable on 10, 80 and 160 meters.

The following is a brief summary of h.f. propagation conditions forecast for each amateur band for March, 1974. For more specific information, refer to the *DX Propagation Charts* which appeared in last month's column. This month's column contains *Short-Skip Propagation Charts* which are valid for March *and* April, as well as *Propagation Charts* centered on Alaska and Hawaii. The Short-Skip Charts contain band opening forecasts for predominantly one-hop paths, ranging in distance between approximately 50 and 2300 miles.

For day-to-day propagation conditions expected during March, see the "Last Minute Forecast", which appears at the beginning of this column.

10 Meters: A few fairly good openings should be possible between the northern and southern hemispheres from a few hours after sunrise through the late afternoon, but not much else. An occasional short-skip opening may also be possible during the afternoon hours between distances of 1300 to 2300 miles.

15 Meters: The band should open to most areas of the world sometime during the daylight hours. Fewer openings to Europe and the Far East are expected, but there should be an improvement on paths to southern Africa, South America and Australasia. Fairly good short-skip openings are expected during most of the daylight hours, ranging between 1000 and 2300 miles.

20 Meters: This will probably be the best band for DX during March. It should open in almost all directions for an hour or two after sunrise, and remain open to one DX area of the world or another until Midnight. Excellent short-skip conditions are expected during most of the daylight hours over distances between approximately 750 and 2300 miles. Short-skip openings may often continue through much of the darkness period as well.

40 Meters: Fairly good DX is forecast from shortly after sundown to shortly after sunrise, with conditions peaking during the hours of darkness. Excellent short-skip openings are ex-

*11307 Clara Street, Silver Spring, Md. 20902

LAST MINUTE FORECAST

Day-To-Day Conditions Expected For March, 1974

	Rating & Forecast Quality			
Propagation Index	(4)	(3)	(2)	(1)
Date *March*				
Above Normal: 1, 8, 10, 19-20, 26, 28	A	A	B	C
Normal: 2-7, 9, 11, 16, 18, 21-22, 25, 27, 29-31	B	C	D	E
Below Normal: 12, 13, 15, 17, 23-24	C	D	E	E
Disturbed: 14	D	D	E	E

Where *forecast signal quality is:*

A—Excellent opening, exceptionally strong, steady signals.

B—Good opening, moderately strong signals with little fading or noise.

C—Fair opening, signals between moderately strong and weak, with some fading and noise.

D—Poor opening, signals weak with considerable fading and noise.

E—Opening probably not possible.

HOW TO USE THIS FORECAST

1. Find *propagation index* associated with particular band opening from Propagation Charts appearing on the following pages.

2. Using the above table, locate the appropriate *forecast signal quality* at the intersection of the *propagation index* found in step 1, and the appropriate date. For example, all openings shown in the Propagation Charts with a *propagation index* of (3) will have a *forecast signal quality* of A on March 1, C on March 2-7, etc.

For updated information dial Area Code 516-883-6223 for DIAL-A-PROP, or subscribe weekly to MAIL-A-PROP, P.O. Box 86, Northport, N.Y. 11768 pected during the daylight hours over distances between approximately 150 and 750 miles; increasing to between 600 and 2300 miles during the hours of darkness.

80 Meters: Fair DX conditions are forecast to many areas of the world during the hours of darkness and the sunrise period. DX conditions usually peak on this band when it is dark at the *westernmost* terminal and sunrise at the *eastern* terminal of a path. Excellent short-skip should be possible during the daylight hours, over distances of approximately 50 to 250 miles. During the hours of darkness, short-skip should be possible for paths between 500 and 2300 miles in length.

160 Meters: No openings are expected during the hours of full daylight because of intense solar absorption. Short-skip openings up to a distance of 2300 miles, and an occasional DX opening may be possible during the hours of darkness and the sunrise period.

V.h.f. Ionospheric Openings

The possibilities for ionospheric openings on the v.h.f. bands usually improve during March and the spring months.

A seasonal increase in short-skip openings due to sporadic-E propagation generally begins during March, and an occasional 6-meter opening may be possible by this mode during the month. Sporadic-E openings most often occur during the daylight hours, over distances between approximately 1000 and 2300 miles.

Trans-equatorial scatter propagation (TE) is expected to pick up during March, and some 6 meter openings may be possible. TE openings must cross the magnetic equator at or near a right angle, and the optimum time for TE openings is between 8 and 11 p.m., local daylight time. Conditions favor openings between the southern third of the USA and the southern half of Latin America, but some other openings may also be possible.

Auroral activity often increases during March, especially during periods when h.f. conditions are below normal or disturbed. Best dates to check are March 12-16, 17, 23-24.

Not much meteor activity expected during March, although some v.h.f. meteor-type openings may be possible for very brief periods during minor showers that should occur March 15-16 and 25-26.

Contest Info.

Three major DX Contests are scheduled during March. Conditions are forecast to be NORMAL during the ARRL DX Phone Contest on March 2-3. NORMAL conditions are expected on the first day of the ARRL DX C.W. Contest on March 16, but they should be no better than BELOW NORMAL on March 17, the second day of the Contest. It looks like NORMAL conditions for the *CQ* WW WPX SSB Contest on March 30-31. Check with DIAL-A-PROP or subscribe to MAIL-A-PROP for an updated and more complete forecast.[1]

How To Use The Short-Skip Charts

1. In the Short-Skip Chart, the predicted times of openings can be found under the appropriate distance column of a particular Meter band (10 through 160 Meters), as shown in the left hand column of the Chart. For the Alaska and Hawaii Charts, the predicted times of openings are found under the appropriate Meter band column (10 through 80 Meters) for a particular geographical region of the continental USA, as shown in the left hand column of the Charts. An * indicates 80 Meter openings. Openings on 160 Meters are likely to occur during those times when 80 Meter openings are shown with a *propagation index* of (2), or higher.

2. The *propagation index* is the number that appears in ( ) after the time of each predicted opening. 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. The index indicates the number of *days* during the month on which the opening is expected to take place, as follows:

(4) Opening should occur on more than 22 days
(3) " " " between 14 and 22 days
(2) " " " between 7 and 13 days
(1) " " " on less than 7 days

Refer to the "Last Minute Forecast" at the beginning of this column for the actual *dates* on which an opening with a specific propagation index is likely to occur, and the signal quality that can be expected.

3. Times shown in the Charts are in the 24-hour system, where 00 is midnight; 12 is noon; 01 is 1 A.M.; 13 is 1 P.M., etc. On the Short-Skip Chart appropriate *daylight* time is used at the *path midpoint*. For example, on a circuit between Maine and Florida, the time shown would be EDT; on a circuit between NY and Texas, the time would be CDT, etc. Times shown in the Hawaii Chart are in HST. To convert to standard time in other USA time zones, *add* 3 hours in the PDT zone, 4 hours in MDT zone; 5 hours in CDT zone; and 6 hours in the EDT zone. *Add* 10 hours to convert from HST to GMT. For example, when it is 12 noon in Honolulu, it is 15 or 3 P.M. in Los Angeles; 18 or 6 P.M. in Washington, D.C.; and 22 GMT. Time shown in the Alaska Chart are given in GMT. To convert to *daylight* time in other areas of the USA, subtract 7 hours in PDT zone, 6 hours in MDT zone, 5 hours in CDT zone, 4 hours in EDT zone. For example, at 20 GMT it is 16 or 4 P.M. in NYC.

4. The Short-Skip Chart is based upon a transmitted power of 75 watts c.w. or 300 watts p.e.p. on sideband; The Alaska and Hawaii Charts are based upon a transmitter power of 250 watts cw or 1 kw p.e.p. on sideband. A dipole antenna a quarter-wavelength above ground is assumed for 160 and 80 meters, a half-wave above ground on 40 and 20 meters, and a wavelength above ground on 15 and 10 meters. For each 10 db gain above these reference levels, the *propagation index* will increase by one level; for each 10db loss, it will lower by one level.

5. Propagation data contained in the Charts has been prepared from basic data published by the Institute For Telecommunication Sciences of the U.S. Dept. of Commerce, Boulder, Colorado, 80302.

Sunspot Cycle

The Swiss Federal Solar Observatory reports a monthly mean sunspot number of 24.2 for December, 1973. This results in a running

[1] Two minute recorded propagation forecasts are available at any time from DIAL-A-PROP by dialing Area Code 516-883-6223. Sample copies of the comprehensive weekly MAIL-A-PROP Newsletter are available from MAIL-A-PROP P.O. Box 86, Northport, N.Y. 11768. Enclose an s.a.s.e.

smoothed sunspot number of 39, centered on June, 1973. A smoothed sunspot number of 23 is forecast for March, 1974, as the present cycle continues to decline slowly towards a minimum.

For a special computer analysis, and a prediction for the course of the remainder of the present cycle as well as a peak at what the next several cycles might be like, see "The Sunspot Cycle-Analysis and Prediction" by Cohen and Lintz, which appears elsewhere in this month's issue of *CQ*.

Anniversary

This month marks the beginning of my 24th year as Propagation Editor for *CQ*. I want to thank all of you, who, over the years have taken the time to drop me a line expressing an interest in radio propagation and in this column in particular. During the years ahead I intend to continue to keep radio amateurs advised of propagation conditions in this column and to explain some of the behavior patterns of the natural phenomena that make h.f. communications possible. 73, George, W3ASK

CQ Short-Skip Propagation Chart

March & April, 1974

Local Daylight Savings Time

At Path Midpoint

Band (Meters)	*Distance Between Stations (Miles)*			
	50-250	*250-750*	*750-1300*	*1300-2300*
10	*Nil*	*Nil*	09-20 (0-1)	09-14 (1-0) 14-17 (1) 17-20 (1-0)
15	*Nil*	09-17 (0-1)	10-13 (1) 13-18 (1-2) 18-19 (0-1)	09-10 (0-1) 10-11 (1) 11-14 (1-2) 14-15 (2) 15-18 (2-3) 18-19 (1-2) 19-21 (0-1)
20	*Nil*	08-09 (0-1) 09-10 (0-2) 10-15 (0-3) 15-17 (0-2) 17-00 (0-1)	08-09 (1) 09-10 (2) 10-11 (3) 11-15 (3-4) 15-17 (2-3) 17-19 (1-4) 19-20 (1-3) 20-21 (1-2) 21-00 (1) 00-06 (0-1)	07-08 (0-1) 08-09 (1-2) 09-10 (2-3) 10-11 (3) 11-16 (4-3) 16-19 (4) 19-20 (3) 20-21 (2-3) 21-22 (1-2) 22-06 (1) 06-07 (0-2)
40	08-10 (0-1) 10-11 (0-2) 11-13 (2-3) 13-18 (3-4) 18-20 (2-3) 20-21 (1-2) 21-23 (0-1)	07-08 (0-2) 08-10 (1-4) 10-11 (2-4) 11-16 (4-3) 16-18 (4) 18-20 (3-4) 20-21 (2-4) 21-23 (1-2) 23-01 (0-2) 01-07 (0-1)	07-08 (2) 08-09 (4-2) 09-16 (3-1) 16-18 (4-2) 18-20 (4-3) 20-21 (4) 21-23 (2-4) 23-01 (2-3) 01-07 (1-2)	07-09 (2-1) 09-16 (1-0) 16-17 (2-0) 17-18 (2-1) 18-20 (3-2) 20-22 (4-3) 22-23 (4) 23-01 (3-4) 01-03 (2-3) 03-07 (2)
80	08-09 (2-3) 09-12 (3-4) 12-19 (4) 19-21 (3-4) 21-23 (2-3) 23-01 (1-2) 01-07 (1) 07-08 (1-2)	08-09 (3-2) 09-12 (4-1) 12-17 (4-0) 17-19 (4-2) 19-21 (4-3) 21-23 (3-4) 23-01 (2-4) 01-07 (1-2) 07-08 (2)	08-09 (2-1) 09-12 (1-0) 12-17 (0) 17-19 (2-1) 19-21 (3-2) 21-01 (4) 01-06 (2-3) 06-08 (2)	08-09 (1-0) 09-17 (0) 17-19 (1-0) 19-21 (2-1) 21-23 (4-2) 23-01 (4-3) 01-06 (3) 06-08 (2-1)
160	06-08 (4-2) 08-10 (3-1) 10-18 (2-0) 18-20 (3-1) 20-21 (4-2) 21-06 (4)	06-07 (2-1) 07-08 (2-0) 08-10 (1-0) 10-18 (0) 18-20 (1-0) 20-21 (2) 21-23 (4-3) 23-04 (4) 04-06 (4-3)	06-07 (1) 07-20 (0) 20-21 (2-1) 21-23 (3-2) 23-04 (4-3) 04-06 (3-2)	06-07 (1-0) 07-20 (0) 20-21 (1-0) 21-23 (2) 23-04 (3-2) 04-06 (2-1)

ALASKA

March & April, 1974

Openings Given in GMT†

To:	*10 Meters*	*15 Meters*	*20 Meters*	*40/80 Meters*
Eastern USA	*Nil*	22-01 (1)	22-00 (1) 00-02 (2) 02-04 (1)	06-13 (1) 07-12 (1)*
Central USA	21-23 (1)	20-22 (1) 22-00 (2) 00-02 (1)	23-01 (1) 01-03 (2) 03-04 (1)	07-09 (1) 09-12 (2) 12-14 (1) 07-12 (1)*
Western USA	21-00 (1)	20-22 (1) 22-00 (2) 00-03 (1)	19-22 (1) 22-00 (2) 00-02 (3) 02-04 (2) 04-06 (1)	06-08 (1) 08-09 (2) 09-12 (3) 12-13 (2) 12-15 (1) 08-10 (1)* 10-12 (2)* 12-14 (1)*

HAWAII

March & April, 1974

Openings Given in Hawaiian Standard Time†

To:	*10 Meters*	*15 Meters*	*20 Meters*	*40/80 Meters*
Eastern USA	12-15 (1)	08-11 (1) 11-13 (2) 13-15 (3) 15-16 (2) 16-17 (1)	02-05 (1) 05-07 (2) 07-13 (1) 13-15 (2) 15-17 (3) 17-19 (2) 19-21 (1)	18-19 (1) 19-21 (2) 21-00 (3) 00-02 (2) 02-03 (1) 19-21 (1)* 21-00 (2)* 00-02 (1)*
Central USA	11-16 (1)	07-08 (1) 08-13 (2) 13-16 (3) 16-17 (2) 17-18 (1)	03-05 (1) 05-08 (2) 08-13 (1) 13-15 (2) 15-16 (3) 16-18 (4) 18-19 (3) 19-21 (2) 21-23 (1)	18-19 (1) 19-21 (2) 21-01 (3) 01-04 (2) 04-05 (1) 19-21 (1)* 21-01 (3)* 01-02 (2)* 02-03 (1)*
Western USA	10-12 (1) 12-14 (2) 14-16 (1)	07-08 (1) 08-09 (2) 09-11 (3) 11-15 (4) 15-17 (3) 17-18 (2) 18-19 (1)	02-04 (1) 04-06 (2) 06-09 (4) 09-11 (3) 11-13 (2) 13-15 (3) 15-17 (4) 17-19 (3) 19-22 (2) 22-00 (1)	17-19 (1) 19-20 (2) 20-23 (4) 23-05 (3) 05-06 (2) 06-07 (1) 19-20 (1)* 20-21 (2)* 21-04 (3)* 04-05 (2)* 05-06 (1)*

†See "How To Use Short-Skip Charts" in box at beginning of this column.

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

Note: The Alaska and Hawaii Propagation Charts are intended for distances greater than 1300 miles. For shorter distances, use the preceding Short-Skip Propagation Chart.

SURPLUS sidelights

BY GORDON ELIOT WHITE*

ONE of the most useful items around a ham shack or an experimenters lab is a good test set, and particularly for those involved in amateur or s.w.l. RTTY. It's surprising how good a signal can sound, but still not print anything intelligible.

I find that having really good test gear is vital in RTTY work, if only to keep one's sanity when the signal is apparently loud and clear but the copy is terrible. There are so many variables—speed, shift, propagation, bias, code, synchronous, etc. etc. that it is important to be able to look at the receive loop with gear that can show what's going on. Conversely, there are a few things that can go wrong with one's own signal on the send side, and it is necessary to examine it occasionally for speed, shift, and distortion.

Most of the better test equipment for RTTY is, naturally, surplus, aside from counters and frequency meters for working on the carrier and shift at the transmitter, there is almost nothing on the commercial market within reach of most of our pocketbooks.

This column, and the next, will go into some of the available test sets in surplus, ranging from the simple to the exotic, but all of them familiar to the surplus man. Obviously there are other sets, particularly late commercial solid-state units, but they are too rare in surplus to be much use to us.

The oldest of the comon RTTY tests units is the DXD, (military TS-383/GG), built by the Teletype Corporation way back before World War II. This, sometimes known as the Iron Horse *(there is another Iron Horse, but that's another story)* is a fine, reliable, but rather heavy set that doesn't really fit the decor of a modern shack.

The Stelma DAC-V is one of the more recent test units. It definitely makes the shack look like a Mission Impossible set, and is a bit more costly, even surplus, than the DXD, but more than 100 DAC-V's have turned up in surplus in the last few years.

These are the premier sets, but the Stelma TDA-2 (TS-917/GG in JAN nomenclature) (see *CQ*, Nov. 67 p. 106), the TS-2, TS-660, TS-658, TS-659, and some others, are useful. The SCI-I, and other similar units will show if there is abnormal distortion on a circuit, but they are not really much more than alarms. They don't

*1502 Stonewall Rd., Alexandria, Va. 22302

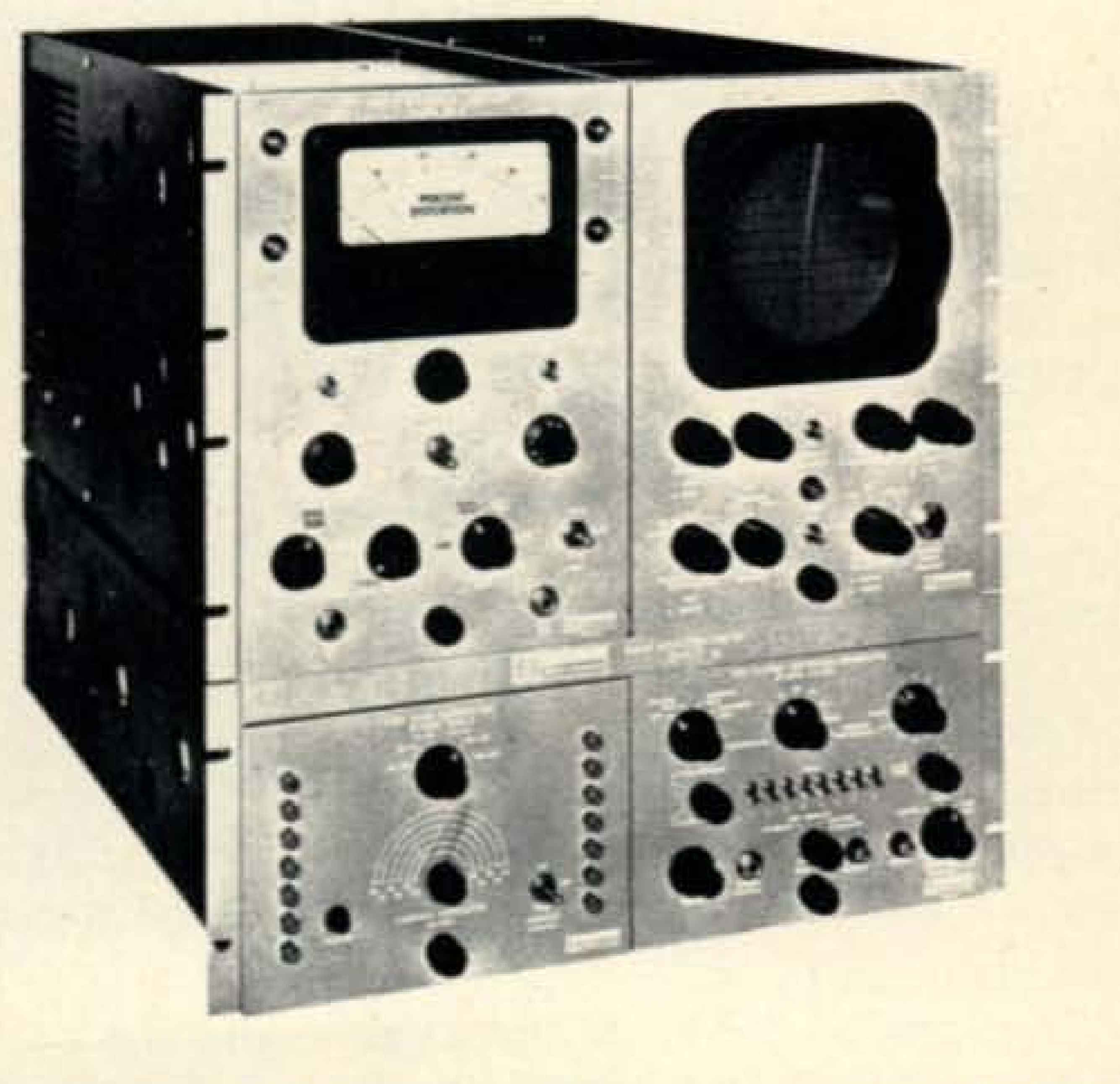
One of the oldest RTTY test sets around still in active use. This is the Teletype DXD also known by its military nomenclature TS-383/GG.

help solve the trouble. The TDMS, a British design (*CQ*, Jan. 1970 p. 88) is seen commonly in surplus, but often canabalized or in poor shape. Its spiral trace is not as easy to interpret as it might be, either.

There are other less-well-known military sets, some of them variations on the ones listed. Table I indicates their nomenclature, manufacturer, and basic specs.

For my money, the DXD (TS-383) is the most for the money. It's old and heavy, and even noisy if its rotating disc scrapes its housing as it occasionally will, but it offers three excellent features at a price that is within almost anyone's reach.

As the photo shows, this set consists of a large motor-driven disc. It is a mechanical stroboscope, with a neon bulb attached at a point on the disc's circumference and wired in series with the Teletype loop under test. The motor turns the disc at the Teletype speed desired. The face plate is calibrated in seven segments, represent-



The Stelma DAC-V is rather more exotic looking and complex than the DXD and has been turning up in the surplus market during recent years.

Nomenclature	Manufacturer	Description
TS-2/TG	Teletype Corp.	a modified Model 14 T.D. sending a quick brown fox test message. Generally governed motor
TS-193	Western Electric Co.	polar relay test set
TS-383/GG	Teletype Corp.	military version of DXD strobe and FOX unit
TS-577/FG	Western Electric Co.	circuit monitor, distortion indicator
TS-611/FG	Western Electric Co.	distortion monitor
TS-612/FG	Western Electric Co.	multiple transmitter — sends distortion-free test signals
TS-652/GG	Teletype Corp.	same as TS-383 excpt synch motor
TS-657/FG	Western Electric Co.	circuit tester
TS-658/UG	Teletype Corp.	small portable unit, motor-driven distributor sends selected test character, synch motor
TS-659/UG	Teletype Corp.	same as TS-658 but uses governed motor
TS-660/UG	Western Electric Co.	checks distortion on cables
TS-676/U	Deutschmann-Tobe Co.	CRT display of transmission line faults
TS-836/UGM-1	—	solid-state replacement for TS-2, TS-658, etc.
TS-800/UGM-1	Western Electric Co.	solid-state distortion measuring set to replace TS-917
TS-386/UGM-1	Western Electric Co.	polar relay test set
TS-917/GG	Stelma Inc.	distortion-measuring scope; portable unit, known also as TDA-2; does not display square TTY signal
TS-1373/FG	Stelma Inc.	sends FOX message at 60-75-100 wpm.
TS-1374/FG	Stelma Inc.	same as 1373 except call letters
TS-1375/FG	Stelma Inc.	same as 1373 except call letters
AN-GGM-1, -2, -3, -4, -5	Stelma Inc.	DAC-V solid state test set, distortion meter, FOX generator, etc.
TS-1512/GGM	Stelma Inc.	DD-5 distortion meter section of DAC-V

Table 1—Nomenclature, manufacturer, and basic specification of lesser known military RTTY test equipment.

ing the seven elements of Baudot stop-start teleprinter code: start, five intelligence bits, and a 1.42 unit stop pulse.

The result is that the character bits are displayed around the rim of the disc, in clear and unmistakeable form. (The rim is built so that it can be rotated until it is in phase with the signal, i.e. the start pulse is displayed opposite the stop mark.)

If there is bias (lengthening or shortening of spacing pulses and corresponding shortening or lengthening of the mark pulses) it shows as a longer or shorter segment of light on the rim of the disc. "Holes," or spikes on the signal, caused by dirty contacts or bad loop power supply regulation, are clearly shown. Speed errors are seen as drifting of the signal around the disc.

As long as the neon light glows and the motor turns at a known speed, there is nothing that can give an embiguous reading on the DXD. No faulty tubes or instrument bias, no inoperative "gates" to throw off the display. What you receive is what you see. With surplus gear of unknown condition, this is an important point.

Along with the strobe disc, the DXD has a "FOX" generator consisting of discs coded to send "the quick brown fox jumped over the lazy dog's back 1234567890 NSS sending" or something of that sort. This is an excellent RTTY test feature by itself, particularly when the set has a syncronous motor turning at a known speed.

If repeated single characters are desired, the DXD offers selection of "Blank", "T", "O", "M", "V", and "letters,"—characters using, in order, no message bits, then one, two, three, four, and finally all five. This is of great help in finding problems which affect only one code bar or transfer lever in a machine.

The third feature is a distortion section, by which marking or spacing bias or end distortion, in measured amounts, can be introduced on the test signal.

As one can see, a great range of test signals can be produced on the DXD. It is simple and

CQ Country Chart

A two color, wall-sized country chart is available on poster stock and in large type for only $1.25 per copy postpaid. Address request to: CQ DX Country Chart, CQ Magazine, 14 Vanderventer Ave., Port Washington, N. Y. 11050.

reliable, and quite good on "believability."

A couple of points should be noted, however. Many military TS-383's and similar surplus DXDs come with series-governed motors. These are less well-regulated, and their signal traces flutter and "creep" because of the inherent short-term instability of the motor. I find them almost useless as strobes. Best thing is to junk the governed motor and replace it with a Model 15 synch unit. The gears for the synch motor are different, and can be costly, since they are not as common as printed gears. They are available however, in the several common speeds, from several sources.

Also, the neon light requires the full voltage of the teleprinter loop, and almost all the loop resistance must be adjusted out to get it to light. If you do that, then pull out the DXD plug and forget to readjust, you get smoke from the printer magnets . . . You might build a neon "driver" with transistors, but used directly, it can be a hazard.

Some DXDs have built-in loop power supplies, or one can be added easily, for sending the "FOX" message. This is a great convenience.

RBK Update

Last December I described the Navy RBK receiver. As several readers noted, it has a World War II history, although it was purchased under RBK nomenclature in the early 1950's. This is of course is pretty much a Hallicrafters S-27, circa 1940. The S-36 Hallicrafters had the same frequency range. By 1945 there were some modifications which led to the RBK contract I referred to in 1950. Thanks to W9RJH and W4LDB for additional data on the retreaded RBK. ■

Novice Shack [*from page 59*]

As Others See The Picture

Art Geyer, K8SWW, 860 South Main, Milford, Mich. 48042, has made over 5650 Novice QSO's since eliminating the "N" from his own call sign. Art returned at Christmas from Grand Cayman Island, where he operated as **ZF1AG.** He acted as his own state-side QSL manager; and, of the 132 Novices he worked, ony 10 forgot to include stamped return envelopes with their QSL cards. Many of the higher class amateurs neglected that detail. Art lamented over the excessive postage many of the Novices put on their return envelopes, however. K8SWW was the second amateur, years ago, to obtain an all-Novice Worked-all-States certificate, and he has just pushed his Novice county total to 1000 . . . **Jack Johnson,** P.O. Box 26037, Jacksonville, Fla. 32218, with only irregular hours to study, needs help in getting his Novice ticket . . . **Jurgen Nittner, DJ6RD/W9,** Rural Route 5, Box 247, Valparaiso, Ind. 46383, confused the four Novices he tried to work and became frustrated himself during the December 10-meter contest. Not one of the four came even close to getting Jurgen's call sign correct! He suggests that they probably copied it correctly but didn't believe what they wrote . . . **Steve Drager, WN3UXZ,** 906 Fairview Rd., Hagerstown, Md. 21740, has 37 states but now knows the meaning of that "TV" commercial that claims you begin to slow down after 35. Steve is 14. He transmits on an old Heathkit DX-40 and receives on an old Knight R-100. His 40-meter, inverted-V antenna works on all Novice bands, but he prefers "40."

We are still waiting for your letter and station/operator picture. Mail them to the address at the head of the column.

73, Herb, W9EGQ

DX [*from page57*]

PZØAA—via Box 566, Paramaribo, Brazil
TI3QH—via Box 703, San Jose, Costa Rica
TR8AF—via Box 208, Librevīlle, Gabon
TR8PB—via Box 13122, Libreville, Babon
TG8GI—via Box 115, Guatemala City, Guatemala
TN8BK—via Box 2217, Brazzaville, Congo Republic
VQ9s/Farquhar—via Box 193, Mahe, Seychelles
VP1SYL—via 6365 Kingston Court, New Orleans, La. 70114
VP2LAW—via Box 91, St. Lucia, BWI
KP4DMA/VP7—via ETN1 Howard Robbins, USN Facility, FPO N.U. 09556
VP7BK—via Box 8688, Nassau, Bahamas
VK9ZC—via c/o Post Office, Croydon, 3136, Australia
XW8FB—via U.S. Embassy, APO San Francisco 96352
XW8FA—via USAID/PMB, APO San Francisco 96352
YB7AAU—via Box 47, Balikpapan, Indonesia
ZD7SS—via Box 16, Jamestown, St. Helena Island
ZD9GC—via F Nel, 12 Morgan St., Delville, Germiston, Republic of South Africa
ZK1DX—via Box 269, Rarotonga, Cook Islands
ZB2BL—via Box 292, Gibraltar
ZF1WE—via Box 440, Grand Cayman Island, BWI
3E1KC—via Box 1074, Panama City, Panama
5T5FP—via Box 42, Nouadhibou, Mauritania
5W1AN—via Box 1147, Apia, Western Samoa
5N2ESH—via Eric Sherlock, Box 3034, Lagos, Nigeria
5U7BA—via Box 877, Niamey, Niger
5U7BB—via Box 302, Niamey, Niger
5H3AP—via Box 5, Kilamanjary Apts, Moshi, Tanzania
5Z4NH—via Box 871, Thika, Kenya
5Z4KL—via Andre Saunders, West Coullie Croft, Udny, Aberdeenshire, Scotland
5V7GE—via Box 196, Atakpame, Togo
7P8AB—via Box 389, Maseru, Lesotho
8R1X—via Box 164, Georgetown, Guyana
8P6ES—via Box 814E, Bridgetown, Guyana
9G1AR—via Box 194, American Embassy, Accra, Ghana

73, Jerry, WA6GLD

QRPp [*from page 49*]

0400 GMT), 3540 kHz (±3 kHz); session 2: Saturdays, 1300-1500 CST (1800-2100 GMT), 14065 kHz (±3 kHz). Plan to make these sessions.

We're out of space, and will have to save QRPp Contest Results until next month. Keep the cards coming, and any suggestions about improving HW-7 receiver performance will be appreciated.

73, Ade, K8EEG

Letters *[from page 8]*

pioneering work. I think the world's DX record (reception only) is held by W8JK, who has made fundamental discoveries in antenna design. One of the radio sources picked up by Dr. John Kraus's Ohio State radio telescope has a redshift (change in wavelength divided by the normal wavelength) of 3.5, which, if taken at face value (you probably can't, but that's a long story in itself) corresponds to a distance of 68,000 million light years!

Modern DXing, which is becoming more and more phone rather than code, is forcing a universal language on us—namely, English. I have talked with hundreds of Japanese hams on the air and I continually marvel at their courage and ability in *communication* in a language so different from their own.

The challenges of today's DXing are greater than ever. The 30 db gain antenna for 10-15-20 meters is still to be built. EME is only in its primitive beginnings as are television, teletype and satellite communications. DXing is far more than just a Numbers Game.

John B. Irwin, K6SE/2
Elizabeth, NJ

It Doesn't Work *[from page 31]*

"It's just a question of using the same equations but putting in differing . . . I mean different . . . values of current gain for each condition. Why didn't I think of that?"

Fred was so excited that he spilt his coffee over the napkin. That broke the spell. It was then that both Fred and Dave looked up to find that to their surprise, all the club members were standing around them and had been following their conversation.

"Say Dave," said Mark, who was also the club president, "what you say is very true. Most of us find that our unit works, do one or two calculations and assume that because our unit works, so will any others. Why I can remember an article years ago in which the author had built a piece of RTTY equipment full of gassy triodes and other such stuff. Lots of people tried to duplicate his design and couldn't get it to work. He had to publish another article a few months later to explain."

"I remember that," said Dave, "but don't blame the magazine. They can't worse-case-analyze all the designs that they publish."

"Worse case what?"

"Worse case analysis," replied Dave. "That's the fancy name for these calculations."

With that the meeting came to a close, the coffee cups were collected up, the ashtrays emptied and the members dispersed into the parking lot.

Fred drove home happily that night, he didn't even turn on his two meter f.m. unit. He was too involved in thinking over his conversation with Dave. His XYL was pleased to see him cheerful again. When she inquired as to the reason, he replied "always do a worst case analysis on both the operating and the non-operating conditions of any circuit."

Of course she didn't understand a single word. ■

Antennas *[from page 46]*

idea of a metal mast getting tangled up with the antenna. So my beam is mounted on a vertical, wood mast about three feet high which is supported by the rotator. That way, there's no vertical metal structures in the immediate field of the antenna."

Pendergast carefully tore the page out of my log book and put the sketch in his pocket. "Thank you, thank you, thank you," he said. "Do you have any more pearls of wisdom to impart to me before I go and help out another fellow amateur?"

"Only one," I replied. "Make sure that you don't lose your 2 meter signals in your feedline. Coax line can be pretty lossy at that frequency, if you have a long run of the stuff Here's a chart of line loss that can help you in this respect, fig. 4). The big stufl has less loss than the small stuff. Remember that."

Pendergast sighed. "Very well." He moved towards the door as if to slip into the night. "One more topic of conversation. I'm on my way over to a new ham in the neighborhood. Just got his General class license. His name is Larry Lovelace."

"Does he have a sister named Linda?," I asked quickly.

"No, said Pendergast," but he does have an antenna problem. Maybe you can give me an idea or two to take along to him."

"Too bad," I replied. "About the sister, I mean. What's Larry's antenna problem?"

"It's the old story," said Pendergast. He lives in an apartment and wants to get on 40 meters. He has the OK to put an antenna on the roof, but it is very, very small. And a 40 meter antenna is very, very big. See the problem?"

"Very clearly. He should move," I replied.

Pendergast shook his head. "No, no. Can't do that. You'll have to come up with a better idea than that."

"Well, the problem's not a new one," I said. "Lot of fellows have been caught in the

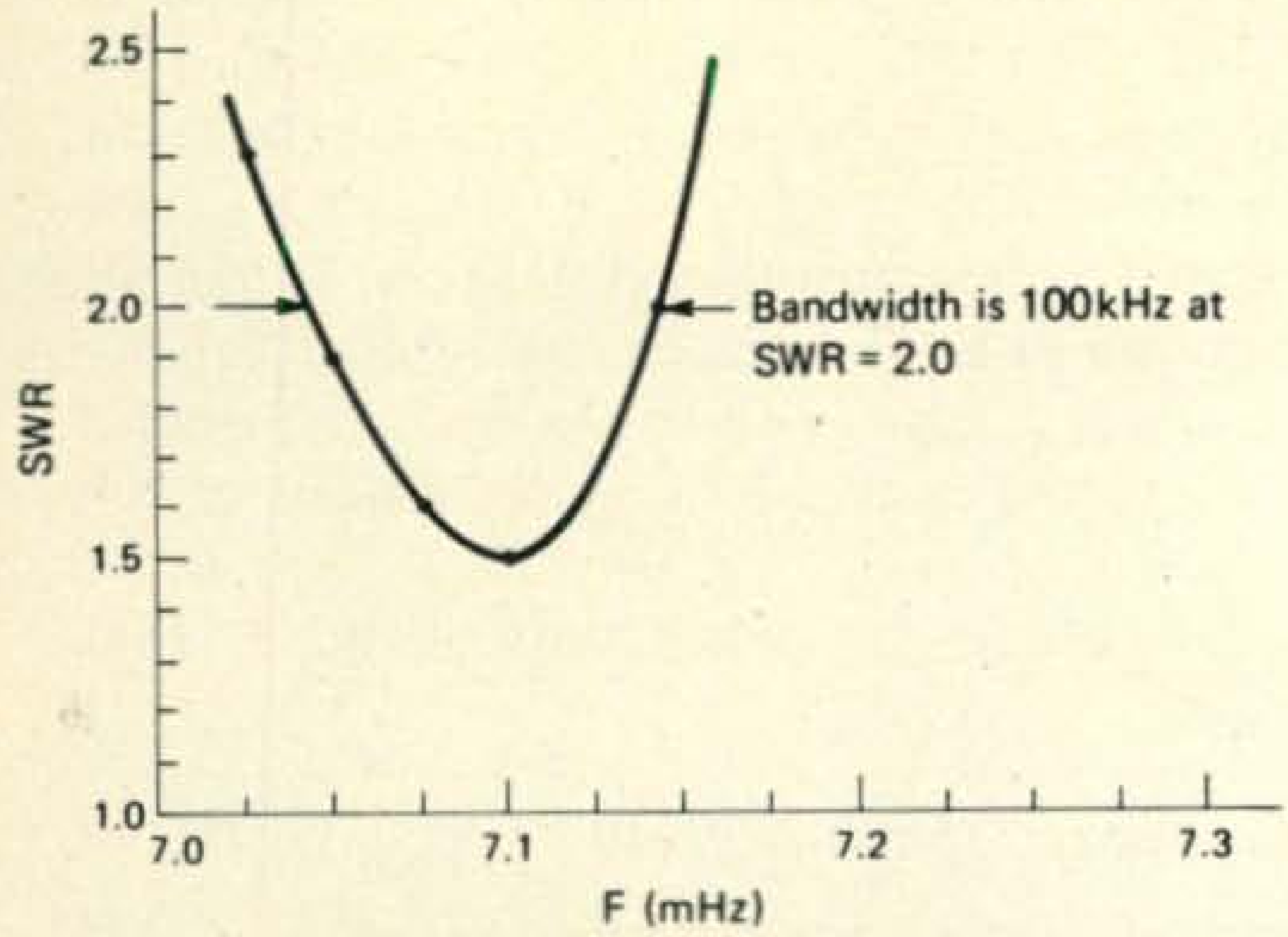


Fig. 6—Helical-wound dipole of VK5YS provides 100 kHz bandwidth between 2:1 s.w.r. points on 40 meter band. This particular model was tuned to 7.1 mHz and could actually be used between 7.0 and 7.15 mHz before s.w.r. value became excessive. For phone operation, the antenna should be tuned to a center frequency of about 7.25 mHz.

same boat. I have a description of a small 40 meter antenna in my file. The original material was in the April, 1972 issue of *Amateur Radio* magazine, which is the excellent publication of the Wireless Institute of Australia. The antenna is a simple version of the compact, helical wound radiator. The idea isn't new, and other articles have described other forms of this antenna. However, VK5YS did a lot of work with his antenna and his ideas seem sound to me (fig. 4). The antenna is simply a 40 meter dipole, wound up into a slim coil about six feet long. Capacitive hats are placed at each end of the assembly to bring it into resonance at the desired frequency in the 40 meter band."

"VK5YS found by experiment that each half of the coiled dipole required about ⅝-wavelength of wire in it. He used #14 insulated house wire, winding it at four turns per inch. Each half of the antenna has 120 turns, making the windings each 30 inches long. Both coils, by the way, are wound in the same direction."

Pendergast, his interest aroused, sat down again and smiled. "This sounds like a great idea," he said. "How did VK5YS mount his coils?"

"Here's a copy of the drawing that was in *Amateur Radio*," I replied (fig. 5). "He made an open, wooden framework out of ⅜-inch diameter dowel rods, six feet long. Triangular spacers were fitted to the ends of the rods (A) and the other spacers (B) were clipped into place along the framework. The whole assembly was firmly glued and given a coat of waterproof epoxy paint. An insulating board was mounted at the center of the framework for the terminals of the dipole."

"Very clever," admitted Pendergast. "I see he made capacitive hats out of loops of heavy copper or brass wire and mounted them to the ends of the antenna framework."

"Right," I replied. "He resonated the antenna to frequency by bending the loops so that the angle to the antenna adjusted the capacitance to the right value. A classic cut-and-try operation. It worked fine, as his s.w.r. curve is very acceptable (fig. 6)."

"I'll pass this information along to Larry," said Pendergast. He got up once again and headed towards the door. As he was about to leave, I asked, "You're sure Larry doesn't have a sister?" ■

SSTV [*from page 40*]

input signal are large enough, the collector voltage will drop while the emitter voltage rises until they meet. Then the transistor will saturate, clipping the negative peaks of the output voltage. (In other circuits you will often use this clipping capability to good advantage.) When designed for maximum output swing and a.c. coupled, the peak-to-peak input voltage can approach $2V_E$ before clipping occurs. Since the voltage gain of the stage is A_V, the peak-to-peak output voltage at the clipping point will be A_V times 2 V_E, when driving a high-Z load.

The remaining steps are fairly straightforward. One thing to keep in mind if the output is a.c. coupled to a load, is that the actual a.c. voltage gain will be something less than A_V. The actual gain value can be calculated by finding the equivalent value of R_C and the load resistance in parallel, and dividing this by R_E. The difference is small if the load resistance is much higher than R_C. (If the load resistance is low, so low for example that it equals R_C, then the gain will be cut in half.)

Let's work out a typical example. Assume that you have an audio signal source of about 2000 ohms impedance and 0.35 volts RMS amplitude. You also have a bandpass filter designed for 600 ohm source and load impedances. You'd like to design an amplifier that will present a high enough impedance to the signal source so as not to load it down, and having sufficient gain to produce a 0.7 volt RMS signal across the 600 ohm load at the output of the filter. An amplifier of the type we've just been discussing looks like a

The 2 meter leader that's crystal clear!

The modified Clegg FM 27B transceiver now covers the entire range of 146-148 MHz . . . and needs NO additional crystals. It's the only 2 meter rig *available now* with built-in total coverage that also offers greater than 25 watts output power, uses 10 IC devices, and has Teflon* wiring throughout. Not a single bi-polar device is in the RF path in transmitter or receiver . . . ensuring greater reliability. Accessory power supply and sub-audible tone on transmit are available too. At home or in your car, the FM 27B gives you the ultimate in total 2 meter performance. See your Clegg Dealer NOW or write or phone us today for detailed data sheet on our 2 meter leader. *Amateur Net* **$479.95**

CHECK THESE SPECIFICATIONS

GENERAL

POWER REQUIREMENTS: 12 to 14 VDC
Current Consumption at 13.5 VDC:
Receive: 4 amps squelched, 1.2 amps unsquelched.
Transmit: 6 amps max.

DIMENSIONS: 7⅜" x 3½" x 9¼" deep; 4 lbs. net weight.

RECEIVER

TUNING RANGE: 146.00 to 148.00 MHz, continuously tuneable with reset capability of approx. 1 KHz to any frequency in range.

SENSITIVITY: .35 μv max. for 20 db quieting; .1 μv for reliable squelch action.

SELECTIVITY: 11 KHz at 3 db; Less than 30 KHz at 70 db. Adjacent (30 KHz spaced) channel rejection more than 70 db.

AUDIO OUTPUT: 2.0 watts (min.) at less than 10% THD into internal or external ohm speaker.

TRANSMITTER

TUNING RANGE AND CONTROLS: Same as RECEIVER.

POWER OUTPUT: 25 watts Min. into 50 ohm load. P/A transistor protected for infinite VSWR.

MODULATION: Internally adjustable up to 10 KHz deviation and up to 12 db peak clipping.

*DuPont trademark

(seven convenient locations)

NEW YORK CITY, N.Y. 10007, 97 Chambers Street, 212 349-4411, Between Broadway and Church Street
NANUET, N.Y. 10954, 195 West Route 59, Half Mile East of Thruway Exit 14
FARMINGDALE, L.I., N.Y. 11735, 900 Route 110, One Mile South of Republic Aviation

ARROW ELECTRONICS, INC.

BAYSIDE, QUEENS, N.Y. 11361, 207-02 Northern Blvd., 212 423-0910, Half Block East of Clearview Expressway
MINEOLA, N.Y. 11501, 525 Jericho Turnpike, One Half Block East of Herricks Road
TOTOWA, N.J. 07511, 225 Route 46, 201 256-8555
NORWALK, CONN. 06850, 18 Isaac Street, Shopping Pl., 203 838-4877

SEND MAIL ORDERS TO DEPT. SQ-1
207-02 Northern Blvd. BAYSIDE, QUEENS, N.Y. 11361

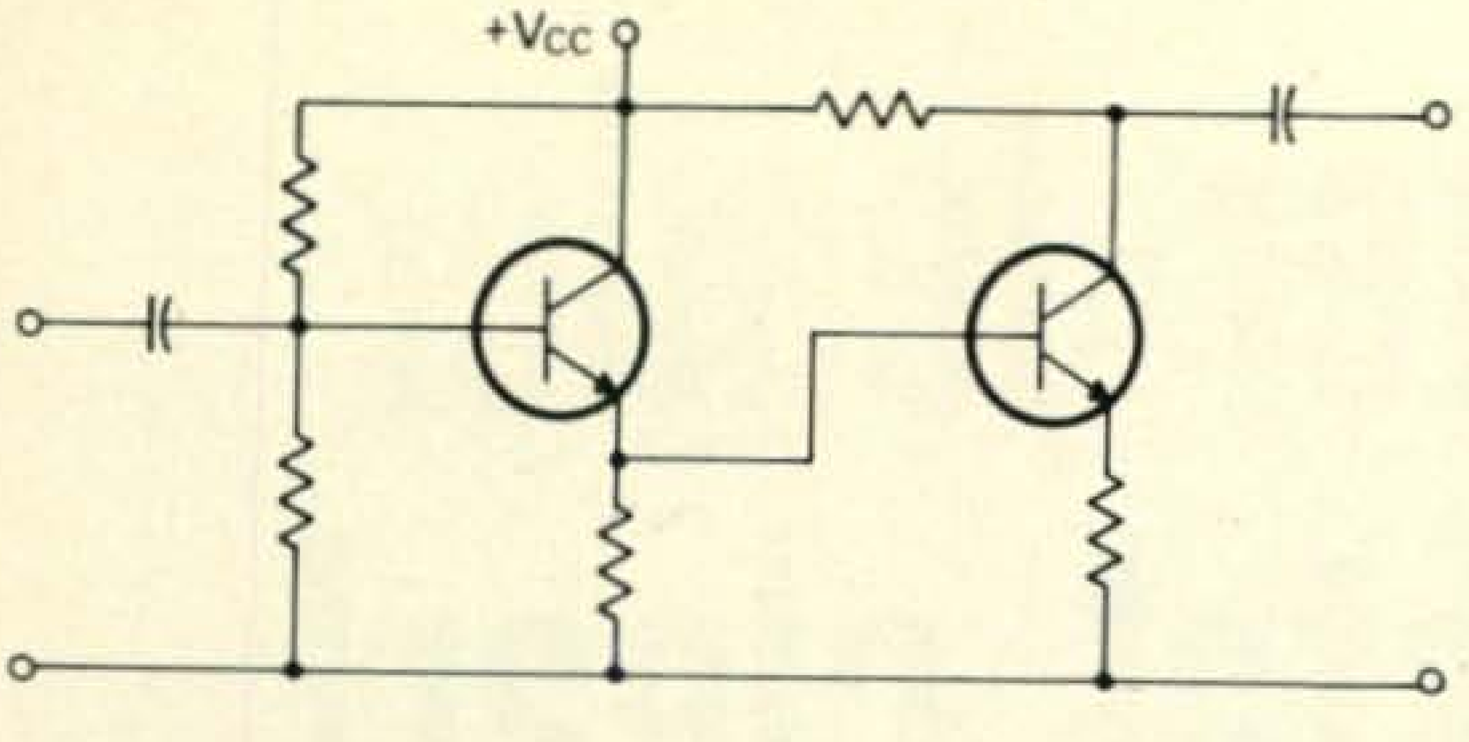


Fig. 3—Emitter-follower direct coupled to the input of a voltage amplifier to raise the input impedance.

possibility, so you draw the circuit of fig. 2(a), including all parts and voltage values that are predetermined. (In this case we'll assume that +15 volts is available for the supply voltage.) When this is done, stop and look at the diagram for any obvious problems. None are immediately apparent so you start through the design steps.

1. You need an overall voltage gain of 2, but since the filter presents an additional a.c. load equal in value to the collector resistor, the stage itself should be designed for a gain of 4.

2. Since R_C is already determined as 600 ohms, we simply calculate R_E:

$$R_E = \frac{R_C}{A_V} = \frac{600}{4} = 150 \text{ ohms}$$

3. The peak-to-peak collector swing with the stage loaded will be 2.8 times the RMS value (0.7 volts) or 2 volts peak-to-peak. This is far less than the supply voltage, so you know that biassing will be non-critical. You decide to use the step 3 equation anyway.

$$V_E = \frac{V_{CC}}{2(1+A_V)} = \frac{15}{2(1+4)} = \frac{15}{10} = 1.5 \text{ volts}$$

Then you calculate V_C:

$$V_C = V_{CC} - A_V\, V_E = 15 - 4 \times 1.5 = 15 - 6 = 9 \text{ v.}$$

4. $$I_C = \frac{V_{CC} - V_C}{R_C} = \frac{15-9}{600} = \frac{6}{600} = 0.01 \text{ Amp} = 10 \text{ ma}$$

5. You decide to try the 2N5828 which is an inexpensive, high beta, NPN transistor. (See February '74 column for data.) The V_{CEO} rating is 40 volts; plenty high. Calculating power dissipation, P_D:

$$P_D = I_C\,(V_C - V_E) = .01\,(9 - 1.5) = .075 = 75 \text{ milliwatts}$$

This is way under the maximum rating of 360 milliwatts, so no problems here.

Checking Z_{IN} to the transistor base:

$$Z_{IN} = h_{FE} \times R_E = 400 \times 150 = 60\text{K}$$

So far, so good.

6. Maximum base current:

$$I_{B\,MAX} = \frac{I_C}{h_{FE\,MIN}} = \frac{10 \text{ ma}}{400} = 25\ \mu\text{a}$$

7. $$R_T = \frac{V_{CC}}{10\, I_{B\,MAX}} = \frac{15}{250\ \mu\text{a}} = 60\text{K}$$

$$R_2 = \frac{V_{IN}}{V_{CC}} \times R_T \text{ where } V_{IN} = 1.5 + 0.7 = 2.2 \text{ volts}$$

$$R_2 = \frac{2.2}{15} \times 60{,}000 = 8.8\text{K}$$

$$R_1 = R_T - R_2 = 60\text{K} - 8.8\text{K} = 51.2\text{K}$$

Thus you'd use a 9.1 K resistor for R_2 and a 51K resistor for R_1. If you have other values in the junkbox giving about the same ratio (10K and 56K for example) they will work fine.

The next thing to check is the input impedance of the entire stage, including R_1 and R_2. Here we simply use Ohm's Law to find the parallel combination of 60K, 9.1K, and 51K. This calculates out to be 6.8K which should not be an excessive load on our 2K signal source impedance. (If it had been too low, we could have used a direct-coupled emitter-follower at the input, as shown in fig. 3.)

You may already be familiar with the groundrules for selecting coupling capacitors. Basically, you add together the source and load resistances coupled by the capacitor, and then select a capacitor whose reactance is low compared to the resistance value at the lowest frequency to be coupled. At the frequency where the reactance is equal to the resistance, the response will be 3 db down. In our example let's assume that we want to pass 300 Hz without appreciable attenuation. C_1 sees a total resistance of 8.8K, (6.8K + 2K). Using the equation $X_C = \frac{1}{6.28\, fC}$, or more simply, using the reactance nomographs in the ARRL or ITT handbooks, we see that a capacitance of about .06 mf gives a reactance of 8.8K at 300 Hz. Since we want very little attenuation, not 3 db, we'd pick a capacitor 3 to 5 times this size, and might settle on a .22 or .33 mf unit. A small 1 mf electrolytic would also work well.

The output capacitor, C_2, "sees" 600 ohms on each side, or a total of 1200 ohms. Checking the value of capacitance that gives 1200 ohms at 300 Hertz, we find it to be roughly 0.4 mf. A small 2.2 mf electrolytic would thus be a good choice. In fig. 2(b) we have recorded the numerical parts values we intend to use, and the circuit is ready to build. 'Til next month.

Vy 73, Cop, WØORX


STOP
(in)

Announcements *[from page 8]*

and 146.94 Simplex and 146.19/79 Repeat. Prizes galore. For additional information, contact Mark Schontz, WB8NUA, 601 Perry Dr. N.W., Canton, OH

Southern Cal. RTTY Group Formed

A new group named The Southern Counties Amateur Teleprinter Society, has been formed in Southern California to stimulate RTTY operation on both h.f. and v.h.f. bands and to assist in surplus equipment procurement. Also, an open 2m. repeater has been set up in the Los Angeles area for use by RTTYers. For additional info, contact Fred Wright WB6EIE, 11421 Garden Drive, Garden Grove, CA 92640.

St. Joseph, Michigan

Blossomland Amateur Radio Association announces Spring-Thing '74 Swap-shop and Auction March 16, 9-5. Set up times 7:30-9, at St. Joseph (MI) High School. Talk-in W8MAI/8, 22-82, 94 Simplex. Tickets $1 in advance, $1.50 at the door. More info from BARA, P.O. Box 175, St. Joseph, MI 49085.

Fort Walton Beach, Florida

The Playground Amateur Radio Club of Fort Walton Beach, Florida, announces the Fourth Annual North Florida Swapfest to be held March 31st, from 8 a.m. to 5 p.m. at the Community Center located on U.S. Highway 98 in the downtown Beach area. Tickets and details are available from the P.A.R.C., P.O. Box 873, Fort Walton Beach, FL 32548.

Woodward, Oklahoma

The Great Plains Amateur Radio Club of Woodward, Okla., announces its second annual Woodward Hamfest-Swapfest to be held March 30-31. For more info, contact: Tyler Todd, WA5YQP, P.O. Box 893, Woodward, OK 73801.

EIA Standards *[from page 34]*

two tone signal power, which can be continuously applied to the antenna for 15 minutes without degrading its performance.

2.9.2 *Minimum Standard*

The maximum power rating and type of emission, CW or two tone SSB, shall be stated by the antenna manufacturer.

2.9.3 *Method of Determination*

Full-size antennas shall be tested at the rated (not the dc input of the final stage of the source feeding the antenna) RF power.

2.10 BANDWIDTH

2.10.1 *Definition*

The bandwidth of the antenna is the frequency range over which the standards shall perform within all the electrical performance specifications.

3. STRUCTURAL STANDARDS

The following structural standards are in consideration of bending stresses only with no consideration given loadings generated by axial compression.

3.1 FACTOR OF SAFETY

3.1.1 *Definition*

The factor of safety of a member under stress is the number which results by dividing the yield point of the material by the actual unit stress on the section area.

3.1.2 *Standard*

The factor of safety for antenna assemblies shall not be less than 1.2 based on the yield point of the material.

3.1.3. *Method of Determination*

The factor of safety shall be determined by dividing the yield stress by the maximum working stress of the material. The maximum working stress shall be measured or calculated.

3.2 WIND LOADS

3.2.1 *Definition*

Wind loading on an antenna assembly should be those moments and forces caused by the specified wind pressure acting in the direction which produces the maximum value of those forces and moments.

3.2.2 *Standard*

Antenna assemblies when fully loaded shall be designed for a wind pressure of not less than 30 pounds per square foot on flat surfaces without ice coatings. The manufacturer of antenna assemblies shall furnish the maximum calculated forces and moments of points of attachment upon request of the user.

3.2.3 *Method of Determination*

Maximum forces due to wind loads on the assembly shall be calculated. If the area includes several members of different shapes, the appropriate shape factor shall be used. The shape factor for round surfaces is ⅔ of that of flat surfaces. Maximum torque due to wind loads shall be calculated, assuming that the direction of the wind pressure is that which produces the maximum torque on the antenna support.

NOTE: Wind pressure is proportional to the square of the actual wind velocities expressed as a formula, $P = KV^2$ where P is the wind pressure in pounds per square foot, K is the wind conversion factor assumed to be 0.004, and V is the wind velocity at the antenna in miles per hour.

3.3 GALVANIC CORROSION

3.3.1 *Definition*

Galvanic corrosion is the acceleration of corrosive action due to dissimilar metals in contact in the presence of moisture. The action is that of a galvanic cell, in which the metals act as electrodes, with the metal that is corroded acting as an anode with respect to the other metal.

3.3.2 *Standard*

Good engineering practice shall be followed in design using compatible materials. The qualitative tables and the latest MIL-E-16400 may be used as a guide.

3.4 RESISTANCE TO WEATHERING, FATIGUE AND COLD FLOW

3.4.1 *Definition*

Resistance to weathering, fatigue and cold flow is the ability to operate in exposed positions over prolonged periods of time without appreciable degradation of structural strength or electrical characteristics due to corrosion or other chemical decomposition, or fatigue or cold flow.

3.4.2 *Standard*

The composition of materials and finishes used shall be a characteristic of the antenna model (or type) which is claimed by the manufacturer to meet this standard. These compositions shall be available from the manufacturer and shall not be changed without changing models (or type) number, unless such changes do not degrade resistance to weathering, fatigue or cold flow.

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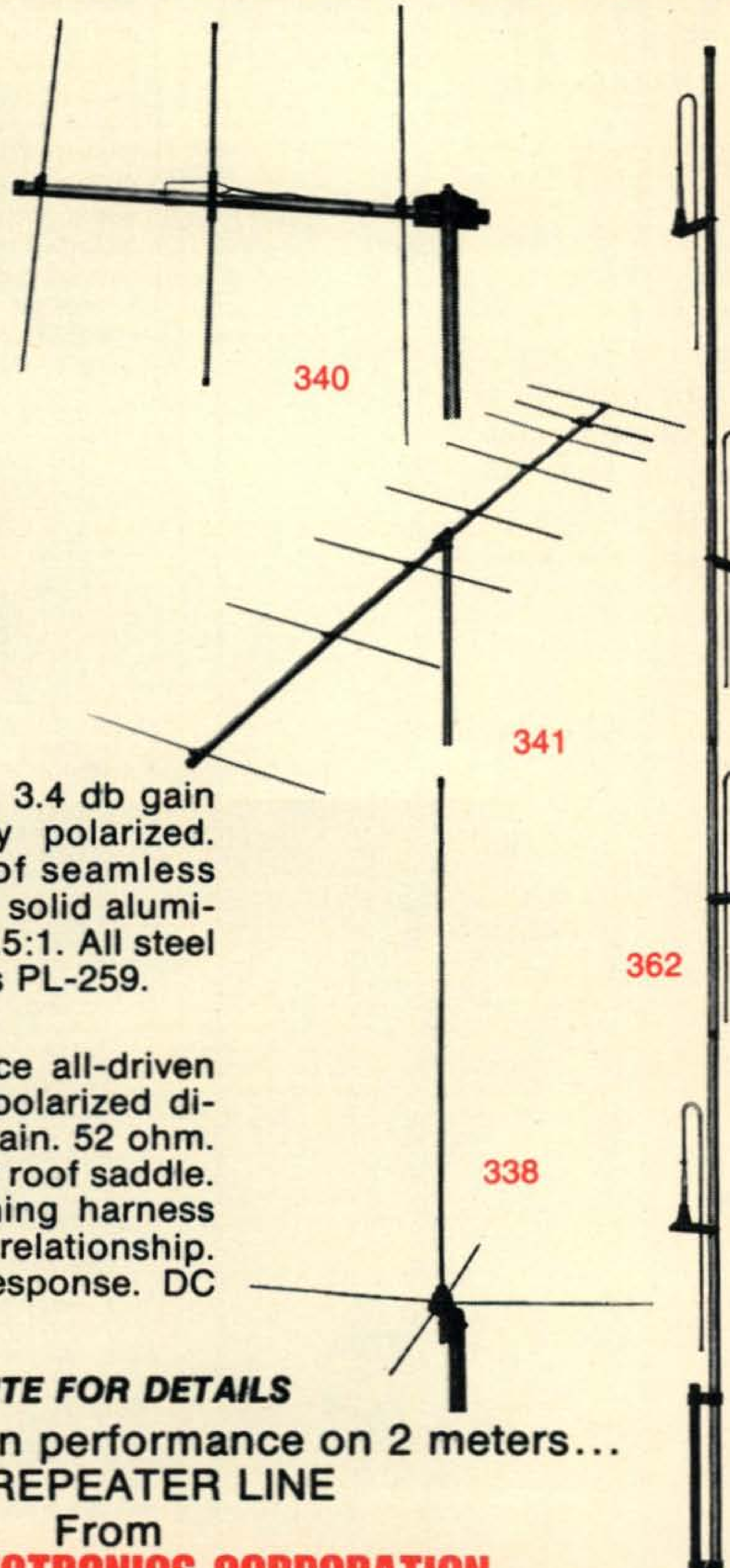
Antennas with real PUNCH!



340 3 element high performance beam. 9 db gain. Coaxial balun. Special VHF Beta Match configuration. Unidirectional pattern. VSWR 1.5:1. 52 ohm impedance. Heavy gauge aluminum tubing and tough aluminum rod construction.

341 8 element high performance beam. 14.5 db gain. Coaxial balun. VHF Beta Match. Unidirectional. Boom length 14′. VSWR 1.5:1. 52 ohm feedpoint. Heavy gauge commercial type aluminum construction.

338 Colinear ground plane. 3.4 db gain omnidirectionally. Vertically polarized. 52 ohm match. Radiator of seamless aluminum tubing; radials of solid aluminum rod. VSWR less than 1.5:1. All steel parts iridite treated. Accepts PL-259.

362 SJ2S4 high performance all-driven stacked array. 4 vertically polarized dipoles. 6.2 omnidirectional gain. 52 ohm. May be mounted on mast or roof saddle. Unique phasing and matching harness for perfect parallel phase relationship. Center fed. Broad band response. DC ground.

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TRADE VW BUG '67, one owner, runs well, licensed; need new (NO AC plug in time) 30L1 or SB220 linear in warranty. Radio WA0GYX, (816) 252-2434, 1422 So. Pearl, Independence, MO.64055.

DAYTON HAMVENTION expands to three days April 26, 27, 28, 1974 at HARA ARENA and Exhibition Center. Brochures mailed March 15th. Write for information if you have not attended the last two years. P.O. Box 44, Dayton, OH 45401.

SURPLUS TEST EQUIPMENT, VHF and microwave gear: bulletins; D. Edsall, 2843 St. Paul, Baltimore, MD 21218.

WANTED: Any information on Western Electric Micro-Wave transmitting, receiving and monitoring equipment used in Bell Telephone Systems in 1950's. Cecil Bounds, Pine Springs Rte., Carlsbad, NM 88220

WANTED: Urgently need several heavy bronze weatherproof Type CWS-60047 RF monitor cases used with Navy Model YG-1 shipboard radio equipment sold as surplus by Dayton Aircraft Products, Fort Lauderdale, FL, early 1960's. Bob Knutson, Box 243, Austin, MN 55912.

FCC type test answers general advanced extra $10 specify. DixieTec, Box 8352, Savannah, GA 31402.

NAME BRAND digital test equipment. Discount prices. Free catalog and price list. Salen Electronics, P.O. Box 82, Skokie, IL 60076.

DAVENPORT Radio Amateur Club Hamfest, Feb. 24, 1974, National Guard Armory, 3615 Brady St., Davenport, IA. Prizes, large flea market. For details and tickets, write: David Johannsen, WB0FBP, 1027 W. Lombard St., Davenport, IA 52804.

FAX PAPER: For Desk-Fax, new (not surplus), precut (not rolls), $15 per thousand sheets, postpaid worldwide, Bill Johnston, 1808 Pomona Dr., Las Cruces, NM 88001.

2-MTR FM WANTED. Swap new $150 Calendar Watch, lizard skin band, boxed. W0BNF, Box 105, Kearney, NB 68847.

CAPACITORS WANTED: Computer-grades, Tantalums, Mylars, Discs. Write for top cash offer. National Electronic Supply, Dept. Cl, 7231-B Garden Grove Blvd., Garden Grove, CA 92641. Phone: (213) 597-7010 or (714) 893-2900.

PORTABLE ANTENNAE: Band master all coax antenna. Hear one on 14345 or 7240. Make a sked-Charlie. Box 1531 Lake Isabella, CA 93240. (714) 379-8101.

LOOKING FOR old Lionel trains. Interested only in "O" gauge, excellent to like-new condition. Primary interest is locomotives prior to 1952, but will consider complete sets or more recent models. Am willing to buy outright for cash or swap radio gear to meet your needs. Write Dick Cowan, WA2LRO, c/o CQ Magazine, or call (516) 883-6200.

WORKED SO. AMERICA CERTIFICATE. Work all 13 countries. Send list and $1. HC1TH, 4805 Willowbend Blvd., Houston, TX 77035.

FOR SALE: Spectra Physics 2.0 mw 071-2 HeNe laser tube, brand new with power supply schematic, $110.00. WA2NDM, 5 Melville Rd., Great Neck, NY 11023.

Did you know that supplements to the book, "CQ YL," are available? They bring the book up to date with YLRL Officers through 1973 and the 6th YLRL Convention, held at Long Beach in May '72. If you have a copy of "CQ YL" and would like to add the new supplements (the pages are "slotted" so they fit directly into the "CQ YL" spiral backbone), drop a note with your request to author/publisher, W5RZJ, Louisa Sando, 4417 - 11th St., NW, Albuquerque, NM 87107. Please enclose two 8 cent stamps to cover cost of mailing. The one and only book about YLs in ham radio, "CQ YL," contains 21 chapters, over 600 photographs. Order your autographed copy, or a gift copy, from W5RZJ, $3.00 postpaid.

FOR SALE: Standard 145, xtals, charger, whip, mike, case, $200; Tempo DKT keyer, mint $50; Hustler mobile whip, mount, 80-10m resonators $35. Hank Stechler, 1347 Judy Rd., Mohegan Lake, NY 10547.

SELL: REL T-102 Transmitter, REL R-104 receiver, REL P-109 Power Supply and M-135 Control Unit (speaker, SWR bridge, phone patch and controls). Same as early Collins S line but manufactured by Eldico, $475.00. Heath SB-101 transceiver, factory wired, integral speech compressor, $325.00. Joseph Marshall, 147 Middleville Rd., Northport, NY 11768.

GREATEST of them all! That's the ARRL 1974 National Convention, sponsored by Hudson Amateur Radio Council. Remember the dates: July 19, 20, 21 at the Waldorf-Astoria, New York City. Three days of exciting events!! Wide array of demonstrations, exhibits and forums featuring latest in FM, SSTV, ATV, RTTY, FAX, Satellites, Antenna design, Transistors, Integrated Circuits, DX, MARS, ARPSC and much more. Something to do every exciting minute for YLs & XYLs -- Tours, New York sightseeing, visits to popular TV shows, Parties, Fashion shows. Meet the ARRL President, Vice-Presidents, and all 16 Directors! Famous-name Speakers at Saturday night Banquet! Everything for the Non-Ham, New Ham and Old Timer. For info, contact: ARRL Convention, 303 Tenafly Rd., Englewood, NJ 07631.

WANT: Good, clean Squires Sanders 701 series SS-1R rcvr. Lee, 1217 Westerly Terrace 2, Los Angeles, CA 90026. (213) 666-5832.

WANTED: R-1051/URR rcvr. Will pay $800. Lee, 1217 Westerly Terrace 2, Los Angeles, CA 90026. (213) 666-5832.

WANTED: Good used electronic hearing aids, Box 8352, Savannah, GA 31402.

FREE: 18 crystals of your choice with the purchase of a new Genave GTX-200 at $259.95. Send cashier's check or money order for same-day shipment. For equally good deals on Drake, Swan, Standard, Clegg, Regency, Hallicrafters, Tempo, Kenwood, Midland, Ten-Tec, Galaxy, Hy-Gain, CushCraft, Mosley, Sony, and Hustler, write to Hoosier Electronics, your ham headquarters in the heart of the Midwest. Become one of our many happy and satisfied customers. Write or call today for our low quote and try our individual, personal service. Hoosier Electronics, RR Number 25, Box 403, Terre Haute, IN 47802. (812) 894-2397.

North Florida Swapfest March 31, 1974 Community Center, Hwy 98, Write PARC Box 873, Fort Walton Beach, FL 32548.

Lightning arrestors, Joslyn 969 DMA feedthru, rated 10 amps, 9kVp 2-32 mHz. $50.00. Vacuum capacitors: MMC1500, $150.00; MMC3000, $200.00; MMC5000, $350.00. All unused. H.G. Husbands, 6626 Talmadge, Dallas, TX 75230.

FOR SALE: Hallicrafters HT-40 transmitter, HQ-110A Hammarlund rcvr and Lafayette HE-74 VFO. All items in excellent condition with owners manual, original cartons. No reasonable offer refused. J. Schneiderman, 140-14 Erdman Pl., Bronx, NY 10475 (212) 320-1696.

QSL'S - New hobby ideas, samples 25 cents. WA2BQI. Burdette's Elite Printing, 15 Bush St., Jamestown, NY 14701.

STANDARD 146-A (1-2) $238.70, (3-11) $212.30, Ni-Cad batteries $1.58. Stubby Antenna $5. Standard 826M (1-2) $324.50, (3-11) $306.90. Standard 851T 25 watt mobile $420.20. Standard RPT - 1 Repeater $600. HM-175 antenna $16.00. Base Station antenna, HM-191 8.25dB (list $169.50) net $119.95. Send check and we'll pay postage or we'll ship COD. Electronics Communication Co., P.O. Box 17222, Nashville, TN 37217. 24HR. (615) 834-8999.

RUBBER ADDRESS STAMPS. Free catalog. 45 type styles. Jackson's, Box 443F, Franklin Park, IL 60131.

BUY-SELL-TRADE. Write for monthly mailer. Give name, address, call letters. Complete stock of major brands, new and re-conditioned equipment. Call us for best deals. We buy Collins, Drake, Swan, Etc SSB & FM. Associated Radio, 8012 Conser, Overland Park, KS 66204. (913) 381-5901.

TECH MANUALS for Govt. surplus gear, $6.50 each: URM-25D, URM-32, R-220/URR, R-274/FRR, R-390/URR, TS-497B/URR, TS-382D/U LM-21, PRC-10. Thousands more available. Send 50 cents (coin) for large list. W2IHD, 7218 Roanne Dr., Washington, DC 20021.

WANTED: Hammarlund HX-50 (with 160 meters), in good condition. Pete Turbide, K1VGR, 42 Washington St., Newburyport, MA 01950.

RETIRED NYC AREA HAM -- have fun, earn extra money by selling, part-time, line of popular amateur books to dealers in greater NYC-NJ area. Please send personal data and experience to Radio Publications, Box 596, Rye, NY 10580.

WANTED: C.B.'ers Everywhere!: to sell the world famous "Rambling Redskin." Goodies at breaks and jamborees. P.O. Box 564, No. Bergen, NJ 07047.

Organize & enhance your QSL's with 20 pocket plastic holders. Two for $1.00, seven for $3.00. TEPABCO, Box 198Q, Gallatin, TN 37066.

WANTED: Wireless gear, old receivers, msc. parts, catalogs, etc., regardless of condition. Horvath, 522 Third St., San Rafael, CA 94901.

SIDEWALK SALE-Every first Saturday-now in its fourth year. Turn your surplus electronics into cash at the Southwest's leading ham store-it's FREE! Electronics Center, Inc., Dallas, TX 75204.

TEN LB. ELECTRONICS PARTS, $10, tubes for sale too. Williams, P.O. Box 7057, Norfolk, VA 23509.

SURPLUS. Giant bargain-packed catalog, $1. Etco Electronics, Dept. CQ, Box 741, Montreal, A,H3C 2 V2.

MAGAZINES FOR SALE: CQ/73/QST/HAM RADIO issues at 10 cents each (plus shipping) from Lockheed Ham Club, 2814 Empire, Burbank, CA 91504. Send list and check. Available issues and any refund will be sent promptly.

WANT skeds for 5BWAS and 160M. K5MHG16, 419 Westbourne Dr., Los Angeles, CA 90048.

SELL: Heath SB-630, HO-10, Clegg 22er, Kirk 2 el. Super Quad, 50 ft. E-Z-Way crank-up, tilt tower, SASE for data. Semonavick, 71 Saxton Rd., Dover, DE 19901.

SELL, NJ area, will not ship. Teletype 33 TBE Page Printer, Perforator Reader, Pair type N 110V Synchros, Tel-Instrument UHF Wobbulator type 1211S, Hewlett Packard 610B UHF Signal Generator. Send no money. Make offer by mail. I may be at sea. W2ACK, 925 W. South Ave., Westfield, NJ 07090.

QSLS. SECOND TO NONE. Same day service. Samples 25 cents. Ray, K7HLR, Box 331, Clearfield, UT 84015.

FOR SALE: Package Deal — TR6 transceiver along with noise blanketer, A/C power supply, MS4 matchingspeaker cabinet with AM crystal filter and upper sideband filter. Machine under 2 years old and never used in a mobile. T.S. Jacobsen, 3371 Decatur Ave., Bronx, NY 10467.

WANTED: All models of Tunaverters and coupling loop. Fred Haines, 132 Rural Ave., Lewisburg, PA 17837.

HYDROPONICS for XYL while QRL. Build-yourself garden components, books, nutrients. 5-page catalog, send 40 cents, refundable. Incorporated 3-1971, BURWELL GEOPONICS, Box 125-DC, Rancho Sanfe, CA 92067.

SONAR 2301 Commercial F.M. "Handi-Talkie." New, but needs some work. $60.00 or best offer. P. Murricane, WN2SGT, 200 E. 63rd St., New York, NY 10021.

SELL: Technical Material Communication Receiver GPR-90, 1.4-31.0 in 6 bands, xtal phase, rf selectivity, 100 KC. xtal, limiter; GSB-1 single sideband adapter; Heath SB620 visual scanner, manuals, $350. You pick up (near Disneyland). Keith LaBar, W6-KX, 9626 Maureen Dr., Apt. 6, Garden Grove, CA 92641. (714) 539-5508.

LAFAYETTE HA-144 2 Mtr Portable Transceiver with case, ant, mic, manual xtals. $85. WB6VHH, 641 East "J", Ontario, CA 91764.

HAMFEST! Indiana's friendliest and largest Spring Hamfest. Wabash County ARC's 6th Annual Hamfest, May 19, 1974, 4-H Fairgrounds, rain or shine, admission still only $1.00 for advanced tickets ($1.50 at gate). Large flea market, technical session, bingo for XYL's, free overnight camping, plenty of parking, bonus for carpools (4 or more adults per car). For more information or advanced tickets, write : Jerry Clevenger, WA9ZHU Rte. 4, Wabash, IN 46992

SELL: Drake R-4B rcvr and MS-4 spkr $345; T-4X B xmtr and AC-4 power supply $450. Excellent condition. Frans Liem, WB8EPJ, 5732 Rosebury Dr., Dayton, OH 45424. Phone: (513) 236-2050.

WANTED: Regenerative Receiver's Homebrew or factory made tube or transistor type. External BFO. Fred Haines, 132 Rural Ave., Lewisburg, PA 17837.

SELL: Brand new 4-1000A, $60. Hallicrafter S-38C, good condx, $25. New Dynamic mike, $5. B. Nastoff, 320 W. 56th Pl., Merrillville, IN 46410.

SALE: 2M FM mobile Motorola 80D w/solid state p.s., 3 freq. $115. Anthony E. Bodo, WA9YOZ, 4259 Harrison St., Gary, IN 46408.

SALE: HW101, HP23A, SB600, desk mike, 50 RG8U, Mosley V46 vertical, 10-40 mtrs, all manuals, mint. $290. You ship. Pohorence, 2334 Regal Ct., Lawrenceville, GA 30245. (404) 963-0464.

WANTED for receiver project: 239 Kc. IF transformers and front end coils from Command Broadcast receiver. L.E. McCown, Box 416, Martin, KY 41649.

SELL: Heath Mobile Mount and Supply HP-13 SBA-100-1, Both $50 ppd. Carl Ebhardt, 22 Rowan St., Raleigh, NC 27609.

SELL: Johnson 6N2 VFO, P.S., mod., manuals, mint condx. $150. WA1FEI, 35 Liszt St., Roslindale, MA 02131.

SELL: 1st Class FCC License Course, $25. Will trade for what have you. Buy old radio parts. T.G. Soukup, 161 Bob Hill Rd., Ridgefield, CT 06877.

FOR SALE: Heathkit Model T3; $10. Heathkit TS4 TV Align Gen, $10. Ameco CB6 converter for 6 mtrs., $5. Others. W8YLJ, Del Carlin, RR 1, Bryan, OH 43506.

KENWOOD TS511S, 500 watt transceiver. Used little. Gd. condx. $350, cash. No trade. W6VSQ, 5321 Sawmill Rd., Paradise, CA 95969. (916) 877-6302.

RCVRS: FM, SCA Multiplex for backgrd. music. McMartin & Browning, $25 to $65. SASE for specs. W4JGO, 643 Diamond Rd., Salem, VA 24153.

WANTED: 2 mtr. F.M. commercial transcvr, more than 1 chan, not over $125. State condx, price, mobile or base sta in 1st letter. K7GHZ, 501 S. Ash St., Centralia, WA 98531. 736-2383.

SALE: SWR bridge HM-11 $10 Heathkit, Hallicrafters HT32 for $150, SX101 $125. Johnston TR switch, $12. Others. You pay shipping. WA2KDB, J. Macari, 138-23 59th Ave., Flushing, NY 11355.

SELL: Barker Williamson 5100-B, plus Mod. 51-SB sidebandgen., plus B&W model L1000-A linear amp. with 2 extra 813's. All 3 in mint condx. $325. Will crate, you pay shipping. Instruc. Manual for all.Wnt Slo-scan TV equip. W6FPH, Ballard, 558 "A" St., Yuba City, CA 95991.

NCX5 - Mark II w/NXA sup, orig. packing unused 3 years (Cliff Dweller) $350. H. Lowenstein, W2-HWH, 60 Parkway Dr., East Orange, NJ 07017.

MINT SX115 Rcvr w/man w/spk. Pick up only, $195. HT44 xmtr w/ps w/man, $170. Both $350. J. Pluth, 6092 Chase Ave., Downers Grove, IL 60515

FOR SALE: Heath Apache xmtr, $60. SB-300 rcvr, w/cw filter, $125. WA6DGQ, 1504 S. Santa Anita Ave., Arcadia, CA 91006. (213) 446-6475.

SALE: 30S-1; 51-S1, 55G-1, 312B-4, 32S-3, 516F-2, Hallicrafter Keyer: vibroplex key. Pkg. $2,875. You pay ship. Cert. check or money ord. Excellent physical functional order. K8ACF, 15317 W. Brant Rd., St. Charles, MI 48655. (517) 585-2966 nites.

WANT TO JOIN TV-FM-BCB DX Club. WA8MLV 1008 Englewood, Parma, OH 44134.

QST 1917/1919 few 1921-22 wanted by serious collector. Letters answd airmail. Jock, ZL2GX, 152 Lytton, Gisborne, NZ

SALE: FT-101 with 160 mtr under warranty. Best offer. Webb, P.O. Box 6, Morganton, NC 28655.

NATIONAL HRO50TI with A,B,C,D, AC & AD coils, $50. JX100 $50. Viking Valiant II with D104 ppt mike, $125. You pay ship. or pick up. W2AAF, 20 Midwood Rd., Stony Brook, NY 11790 (516) 751-8236.

SELL: KWM2A, $725. PM2 AC sup. $85. CPI xtal pack, $185 (110 xtals). Others. Shapiro, WA3IFQ, (215) 884-6010.

SALE: NC303, $250. HT32 $150. Radio News Radio Electronics Magazines 500 copies $50. 275 W Johnson MB, $70. M. DuPont, 15 Fitchdale Ave., Bedford, MA 01730.

SALE: HT-32A, $140. Heath HW-32A, $95. HP23 Pwr. supply, $40. R.H. Cherrill, W3HQO, 519 Lincoln Ave., Hulmeville, PA 19047.

PROG LINE: MT/33, NB, 5 ch, Gold Chas, 07/67 16/76 94/94, Super clean, $200. John, K3NXU, 9118 Kilbride, Balto., MD 21236. (301) 256-2333.

SELL: R391, 75A-4, 270B, 14A, SW120, 200 XCVR, NCXA, HT32A, HA10, HP10, HP20, Eisenberg, 3356 Demott, Wantagh, NY 11793.

WANT: Motorola, precision selective P8116D and FMT5-ODC2 Rcvr and xtmr in good condition. WB8NLM, 146 Schonhardt, Tiffin, OH 44883.

SALE: Viking Valiant and Gonset Twins both $150 Floyd Fetterly, 2114 5th Ave. NE, Austin, MN 55912.

WANT: Central Electronics VFO for use with 10B/20A. W7JI, 235 E. 15th St., Tempe, AZ 85281.

SELL: K4KN Keyboard keyer less than yr. old. $80 Stan Talago, W8PRM, Rt. 3, Box 130A, Bridgeport, WV 26330.

WANT: SB-200 any condx, prefer without tubes. Dennis Hoffman, 1291-A Garden Terr., Ft. Dix, NJ 08640.

SALE: DX60B novice xtyls. VFO not working. $50 or trade. A. Vail, WN2KHN, 29 Prospect St., Amityville, NY 11701.

WANT: QST for 1920/21/22; ARRL Handbk Vol 5. Letters answd airmail. ZL2GX, 152 Lytton Rd., Gisborne, New Zealand.

SELL: Virgin 7203's at $15 each. Need CV253 and book. R.A. Kajma, Jr., 308 Florida St., Farrell, PA 16121.

SELL/TRADE: New 4-400A, 250TH, VT4B, 100 TH, RCH Navy Rec., 6 mtr transceiver. Wasiewicz, W2DQC, 229 Sarles Ln., Pleasantville, NY 10570.

SELL: Heath SB-301, spkr, SB-401, $420 and ship. WA6BVY, 26835 Ortega Dr., Los Altos Hills, CA 94022.

SELL: NC-303 and converters, SX-99, TX-62 and VFO w. FM, Sixer dc p.s. Want SB2-LA, good gen. cov. rcvr. WA9CYW, Box 163, Cannelton, IN 47520

SELL 1/2 price: Clegg Zeus Transmitter, cost $675. Sell $335. Clegg Intercepter rcvr w/spkr, cost $465, sell $235. All equip. purchased new. Less than 50 hrs. of operation. Complete tech. documentation. Mint con. E. Schaad, 3916 Braddock Rd., Alexandria, VA 22312. (703) 256-2239.

SELL: Heath "Sixer" $30, Knight Fire-Police fm rcvr, $35. Tecraft 2 mtr xmtr, $25. Bob Sherman, 350-65 St., Brooklyn, NY 11220.

WANTED: New or used 4-1000A tube. State condx and price. All inquiries answered. Ron MacKinnon, WA2JRY, 7722 64th Ln., Glendale, NY 11227. (212) 456-1576.

SB303 and SB401, $525 firm Ups. Trade? Ringo $8 UPS. Pete O'Dell, WB8NAS, 409 Spring St., Saline, MI 48176.

NEED schematics of Morrow MB-560 xmtr and MBR-5 rcvr. Will pay any reasonable price. A.T. Botler, 1157 Rivermont Dr., Eau Gallie, FL 32935.

SELL: Galaxy V Mk3, remote VFO, station/console, AC and DC supplies. Clean, Ray, K0CVA, 14006 W. 94 Ter., Lenexa, KS 66215. (913) 888-5454.

CHESS NET meets Sun 1100 and Mon at 1930. Check ins on 3.928 welcome. Details for SASE to K2SYJ.

FOR SALE: HT37 mint condx. $150. Also SX101 -A, perfect, $125. W2SGA, 284 St. Cloud Ave., W. Orange, NJ 07052.

MINT HW17 w/FM Adaptor, $110 FOB. Gordon, WN3VGS, 240 E. Main, Mechanicsburg, PA 17055.

HEATH HW-17, HWA-17-1 and Johnston 6N2 VFO and all manuals. $125. WB9JEI, (312) 426-6224.

RECEIVER. National NC125 550kc to 34mc. Ideal for amateur or SW listener. A. cond, $85 FOB. H.S. Lowry, K4VFA, 915 Madison St., Manchester, TN 37355.

SALE/SWAP, as a lot. Wm. B. Duck Catalogue. Bucher, Goldsmith, Leutz, Smith. '73' complete, CQ from 1947. W6QV, 10912 Sherman Grove, Sunland, CA 91040.

100WATT ERCO 361 xcvr w/6 ft. rack, 225-400 Mhz w/manuals. Prefer local. L. Rivard, W8PMI, 11 Parkview, Mt. Clemens, MI 48043.

FCC 1st and 2nd Class Test Study Guide. Memorize. $4.00. CRD Associates, Box 291, Western Spgs., IL 60558.

HEATH: SB-220 Pwr xfmr mtd separately $275. HW-20-2 meter xcvr $90. O-12 scope, $35 or best all with books. Kusterman, W1GJE, Pinecrest Dr., RFD 1, Goffstown, NH 03045.

WANT: Swan Model 410 VFO - 312B4 stn control. SELL: Swan Mobile P/S. RTTY TD. Obsolete radio tubes. W7KSG, 1876 E. 2990 So. SLC, UT 84106.

HYGAIN TH4, Ham-M, 45 ft. Tower guyer disassemble, $150. W2GRK, 87 Valley St., Malden, MA 02148.

SELL: Sams folders 223 to 1084 120 for $50. $1 each for ones covering ham rcvrs; Robert Ireland, Pleasant Valley, NY 12569.

28 KSR Floor console cabinet with or w/o LESU and cabling. D.C. Harrington, 1620 Garden Ave., Fridley, MN 55432.

HALLICRAFTER S-40 $75. 12V-DC-to 120 AC V-AC pow supply. 350 watts. nev. used, $65. Ken Hand, WB2EUF, Bridgehampton, NY 11932. (516) 324-4666.

TRADE: Two level transits. One Berger or one David White for Heath Counter or HW12A. WA5-HAP, Box 781, Houma, LA 70360.

HALLICRAFTERS HT-37 SSB-CW-AM exciter for sale. In operating condx, but has no case. 200 watts SSB/CW input on 80-10. A. bargain at $90, or best offer. Rick Lindquist, c/o VCI, P.O. Box 159, Skowhegan, ME 04976. (207) 474-5173.

MODEL 19 transceiver (May 1969 CQ), all cables, $30. BC344, $35. K7MOK, 16762 NE 12th, Bellevue, WA 98008.

SALE: Lafayette HA650, all transistor transceiver. ARC5 for 40 & 80 mtrs. Xcvr & xmtr. K6THQ, P.O. Box 3344, Industry, CA 91744.

SALE: SB-313 SWL Receiver covering 80, 49, 40, 31, 25, 20, 19, 16 and 13 meter bands. $275. W8-TXX, 1733 Santa Maria, Stevensville, MI 49127.

HX10 Marauder, SB1-LA Linear Amplifier, HW-32 with power supply. Group price, $200. Douglass P. Bacon, WA7UJK, 3735 140th, SE, Bellevue, WA 98006.

6 METER FM RIGS. RCA CMV-3E5, all acc. and cables. Working cond. $50. Mot. 140D, $50. C. Moore, 3329 March Ln., Garland, TX 75042. (214) 272-9996.

SELL: 160 Mtr HW-18-3, VFO, HP-23 AC supply, $100; DX-100B, $60; NC-98, $40. All like new. I deliver 100 mi. Johnson, 1238 W. 12, Oshkosh, WI 54901.

2 MTR FM - SBE144 solid state transceiver, 9 channels crystalled, $200 or best offer, want SB610, 640. WA1MCY, 53 Old Ames Line Rd., Haverhill, MA 01830.

MAGNUM SIX for Heath SB-401 $100 postpaid. K9HJU, (312) 349-9002. Orland Pk., IL 60462.

WANTED: Wide band oscilloscope, reasonable. W2ISL, Allen Porterfield, 41 Winnebago Rd., Yonkers, NY 10710. (914) 779-6145.

SALE: Collins 75S-3A rcvr, clean. Crystals installed for 14 ham plus 8 other 200 KHz bands. Asking $200. WA6KGP, Box 1251, Imperial Beach, CA 92032.

SALE/TRADE: Heath HW-16 w/HG-10 VFO and 10 xtals 15-40-80. Also EICO 753 w/752 pow. sup. Want 2 m or 6 m gear, no broken equip, preferably station-ready. Banjo, Stone Orchard, RD2, Gouverneur, NY 13642.

SELL: Yaesa FLDX400 xmtr. FRDX 4005D and match speaker. Used 4 hr only. First cer. check or m.o. gets it. H. Vanderwaarden, 66 Meridian Rd., Levittown, NY 11756. (516) 735-5804.

RELAYS: New, lge., small, AC-DC. High current, low current. 100 for $25.00. Shipped frt. collect. W.R. Hempkins, 100 E. Main, Denison, TX 75020.

WANT: Donation of linear amplifier for use in So. American Missionary contacts. Can give tax deductible receipt. Arthur Norris, W0ODW, Rt. 1, Box 7, Cortez, CO 81321. (303) 565-3290.

Money Back Guarantee

Don't *buy any 2 meter mobile antenna until you've considered this offer!!!*

We're so confident that the GAM TG-4-MS will outperform every other 2 meter mobile antenna on the market, that we're willing to put our money on the line to prove it.

Order the TG-4-MS, either direct or from one of our local dealers, and accompany your order with a copy of this ad. Test the antenna on your own car and compare the results with the antenna you now use.

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6.7 db gain over an isotropic; 4.5 db gain over a dipole.

The proof of the antenna is in the testing.

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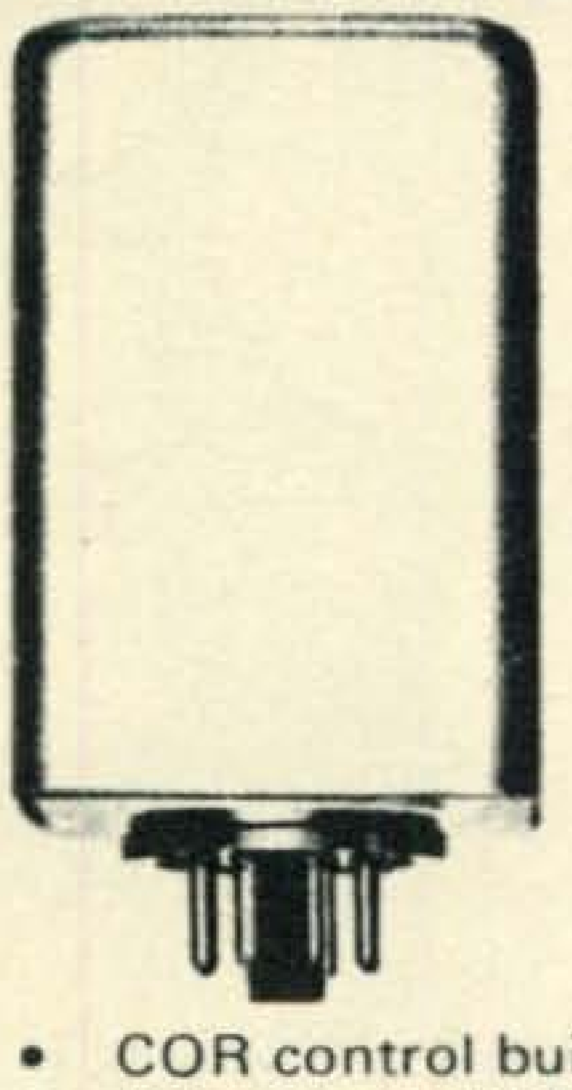
TOUCH—TONE DECODER



- Dual tone decoder decodes one Touch-Tone digit.
- Available for 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, #, * and other dual tones 700-3000 Hz.
- Latch and reset capability built-in.
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- Relay output SPST ½-amp.
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- Compact 1-¾" square, 3" high.
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T-2 Touch-Tone Decoder ... $39.95 PPD.
Specify digit or tone frequencies.
(Include sales tax in Calif.)

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SALE: Miniproducts Hybrid Quad HQ1 $59. Reflector RK3, $29 practically new. WA6GCJ, 5408 Simpson Ave., No. Hollywood, CA 91607.

TR-6, RV-6, AC-4, N.B., LSB & CW filters, $725. Want Drake TC-6 Clem Duval, K8HWW, 33727 Brownlea, Sterling Hts., MI 48077. (313) 268-2467.

SALE: DX-100 xmtr, $90. Ameco TX-62 xmtr, $95. Both gud cond. No ship. F. Kurz, P.O. Box 347, Zion, IL 60099. W9VTQ.

SELL: Mint HQ-170C, $150, Viking Navigator exc cond $75. Both w/manuals. WB9LCA, R. Barrett, RR1, Box 310A, Evansville, IN 47712. (812) 985-2988.

SELL: UCS-300, $20. Plantronics Aircraft Headset - MS50/T30-3, $40. Also Plantronics Headset Capsules, MS30, $9. Receive only capsules, $4. Trammell, 1507 White Oak Ct., Martinsville, VA 24112.

GALAXY III w/AC pwr suppl. In working condx. Best reasonable offer. You pay shipping. W4TG, Wayside, GA 31032.

SALE: HRO60 with crystal calibrator and coils A, B,C,D,E,F,G,J,AA, AC,AD, positively mint condx. Second HRO60 inside perfect and oper. well. Make offer for all or any. W8GI, Wells Chapin, Box 176, Kingsley, MI 49649.

NEW ICOM 22 w/AC pow. sup. $330 or best offer. R. Hansen, WN7TZU, 26 S. State, Preston, ID. 83263.

SELL: Variacs: 110V/20A $20. 110V/42A, $42. 220V/8A, $20. 110V/2-25A, $3. Also xfmrs. Trammell, 1507 White Oak Ct., Martinsville, VA 24112. WA4RGL.

1973 50th Anniv. Edition USA Callbk. Mint condx. $3 plus postage. Geo. Clark, 123 Davis Ave., Hackensack, NJ 07601.

WANT: 455 kHz quartz crystals. Metal cased Advise quantity and price. Worcester, RD1, Frankfort, NY 13340.

WANTED: CV-89A/URA-8A, will accept with missing or non-working sub-units. Bill Barr, K4KZP, 305 Alpine Dr., Roswell, GA 30075.

FOR SALE/TRADE: Hallicrafters SR-150, PS-150-AC, PS-150-DC. Exlnt condx. WA9HEU, Rt. 2, Box 284, Marinette, WI 54143.

WANTED: SSB/CW Xcvr, pwr supply; antenna tuner. E. Leviton, 1817 N. Quinn St., Apt. 407, Arlington, VA 22209.

HW101 HP23 SB600 HM15 GH12A Viroplex, phones, ant. switch, wire, phone patch, dipole. Must sell for school. $400. complete. Contact Dave Solt, 1061 Lancaster Ave., Syracuse, NY 13210.

Add FM to your transverter! Hallicrafters HT-18 80-10M Exciter includes FM $45. List similar gear, SASE, sell/trade. W4API, Box 4095, Arlington, VA 22204.

HEATH HW101, scope Mod. 0-10, capacitester Model CT-1. HQ129X, Mod. 15 RTTY Printer, W5GJU, 1001 Electra St., Longview, TX 75601.

SELL: Heath SB-303, cw, am filters, $300. Philip Petix, WA2RPG, 408 Thomas Ave., Lyndhurst, NJ 07071.

COMPLETE SET "73" issue 1 thru Dec. '72, bound volumes and binders included. Best offer. Sochor, Box 552, Arlington Hts., IL 60006.

WANTED: Swan 117XC power supply, Swan NS-1 Noise Silencer, EIMAC Sk-800 socket, SK-806 chimney. Swap or sell: New, fac. sealed 4CX1000A, Simpson 260 V.O.M., with probes & leather case, TR-44 rotator. Richardson, 1109 Dakota S.E., Albuquerque, NM 87108.

WANTED: EICO 752 D.C. power sup. for EICO 753 xcvr, 40M. mobileant and bumper mount. State price & condx. Leon Bow, 2704 S. Cypress, Plano, TX 75074.

WANT: Heavy duty aluminum tower, 50/90! Also H.D. Steel crank - UP. W4WAH, Plymouth, FL 32768.

LINEAR BLDRS: 30 AMP filament chokes for GG linears. Perfect for pair 4-400A's, 3-500Z's, or single 4-1000A, 3-1000Z, etc. Sat. guaranteed. $5.50 ea., 2 for $10. V. Murrell, Rt. 6, Newport, TN 37821.

COLLINS S-line, sell 75S3, 32S3, 312B4, 516F, DL-1, 10-D mic, 12 cables, and manuals. Mint condx. GBC TV Camera, SB-620, call (516) 368-1610.

SELL: HW-12A, HP-13B, HP23B, excellent condx. $200. All or none. Dave Barber, 23020 Lk. Wilderness Dr., Maple Valley, WA 98038.

Brand new factory sealed 4-400's, $35 ea. Also one factory sealed 4-1000A $100. Only three 4-400's and one 4-1000A's to sell. W4AIS, 306 Thornwood Dr., Taylors, SC 29687.

German OM wants R390 and R390A, CV597 SSB-converter. DK4EB. K. Tetzer, D-4033 Hosesel Bruchnauser Str. 5A, W. Germany.

NEED Rcvr tuning cap. for Knight TR-108. C-8 Part No. 286104 TRW No. 273 6707 293. WB2-OZA, 716 Calhoun Ave., Bronx, NY 10465.

SALE: Earphones; Brandes Superior Trimm reg. & lightwt. Cannon Chief. $2.50 per set. FOB. Douglas, 2254 Pepper Dr., Concord, CA 94520.

SALE: Collins R-388 (51J3) w/manual, gd. condx. $375. E. Richards, WA6LBA, 518 Sutter St., Salinas, CA 93901. (408) 449-3395.

MOVIE equipment for sale/trade. Transcvr, matchbox, keyer or what have you. Interested? Write W6AT, 367 Northwest, Vacaville, CA 95688.

24 HR CLOCKS are an invaluable aid in any shack. Batt. or electric. Steve Antosh, WB5BNM, 1524 N OK, Shawnee, OK 74801.

WANT: Set of 9 Mhz stal filters, 8 pole with 5 kHz, 2.4 kHz, 400 hz bandwidths. G.R. Wardleigh, W7-OSP, 950 - 23rd St., Ogden, UT 84401.

SELL 15 M, 4 EL beam, $20 shipped. Want Magnum 6 or Processor for TR4. Joe Pluth, 6092 Chase Ave., Downers Grove, IL 60515.

COLLECTORS: Meissner Mod. EX Signal Shifter with FMX phase modulator, pwr supply and orig. book of instructions. Cash/trade. WB9IQC, 3314 N. 83 St., Milwaukee, WI 53222.

NATL N.C. 270 rcvr 80-6 meters, $110. Globe Cf. 90-A transmtr 160-10 mtrs, $30. both with manuals. $125 for both, or best offer for either one. D. Allen, WA1FXY, 66 Goddard St., Athol, MA 01331.

SALE: Vacationer Portable Antenna, with coils & counterpoise. $15 and I pay postage. Hugh, WA1-FBE, 85 Dana St., Amherst, MA 01002.

WANTED TO BUY: A copy of schematic for a "Dumont" Model 5894 - A2 Transceiver. Elmo Baese, 826 E. College St., Sequin, TX 78155.

WANT: Mark Mobile 80 mtr Heli-whip antenna. Also 40 mtr Heli-whip. Days: (516) 574-2873, W2LFZ.

SALE: AC adaptors, 6VDC 150MA, Standard plug, new, $3. Postpaid. K2MFY, 2 Nutley Ct., Plainview, NY 11803.

SALE: Lafayette all transistor HA650 6 mtr xcvr, $75. Knight 2 mtr TR108 and VFO, $89. Box 3344, K6THQ, Industry, CA 91744.

SALE: Drake 2A, cal, 2BQ Qmult, all ham xtals plus WWV $140 & P.P. B. Ostrofsky, W9HTF, 670 N. Tippecanoe St., Gary, IN 46403.

SALE: Plechtron monitor freq. 45.02 which is Connecticut State Police. Cash. $25. J. Savonis, 410 Blake Rd., New Britain, CT 06053.

MOBILE body mount, 2 springs (hi and lo spring constant) $10. Frank, 131 Thorn Ln., Apt. 1, Newark, DE 19711. (302) 368-7711.

HEATH GR-78 Solid state portable general coverage receiver with rechargeable Ni-Cad batteries. Like new. $89.50. J. Hardman, K2MVR, 50 Mtn. Rd., Verona, NJ 07044.

100 KC calib with xtal $7. Drake CC-1 conv. console plus CPS-1 supply plus SCC-1 VHF calib, $80. Vanguard 6 & 2 mtr conuts, $50. Vito, WB2WTJ, 1720 77th St., Brooklyn, NY 11214. (212) 331-6634.

WANT: Science & invention & electrical experimenter mags. Have spare copies. K7NER, 172 Freihage Dr. N.E., Sierra Vista, AZ 85635.

WANT: Urgently need tuning unit for 40 mtr for BC610E. Will purchase or trade other units. W7FNI, Ketchum, ID (R.O. Jefferson).

Ranger I with PTT. Excell. condx. Few scratches. $95. WA2KWB/3, 131 Thorn Lane, Apt. 1, Newark, DE 19711. (302) 368-7711.

STAMP COLLECTION of several yrs. 2000 diff 53 countries in glassine envelopes by countries $20. W2RUK, 7 Charles St., Auburn, NY 13021.

SELL: NC173, AR22 rotor, Royal typewriter, Eico tubechecker, power converter, 8 mm projector. Local only. K2VGV, (212) 461-3632.

Transtenna Model 102A T-R Switch. Like new, $40. A. Emerald, 8956 Swallow Ave., Fountain Valley, CA 92708.

WANT: Ranger II. Good wkg. condition. W6ZI, 595 Midway Blvd., Novato, CA 94947.

FISHERMEN: Attract fish to your line with our transistorized electronic fish callers. Sm., lightwt., and battery operated. $4 postpaid will swap one or more for any ham gear. James Shank, 21 Terrace Ln., Elizabethtown, PA 17022.

HEATH: EC-1 analog computer, new, $150. Mohawk RX-1 rcvr., $100. J. Wagner, Rt. 2, Box 142A, Caro, MI 48723.

SELL: B&W5100, Ten Tec PM3A, both mint. Best offer. Freight prepaid. R.H. Drake, Box Y, Conneautville, PA 16406.

MINT COLLINS 75S1 rcvr. $275 FOB, $300 PPD 48. 2215 Housley, Dallas, 75228. (214) 328-2526.

SALE: Drake T4-X, new finals. R4-A with AC-3. All in good shape $575 or make offer. Homebrew lin., 1200 w. PEP works great. Contact WA7PGA, 95 W. 6 N. Logan, UT 84321. (801) 752-7253.

SALE: 4-1000A linear w/tubes $600. 75A-4 $395, R-4B, T-4XB AC-4, MS-4, MN-4, $875. Want S-line. Tom Neill, 1321 Merimac Cove, Memphis, TN 38134.

WANT: Johnson matchbox with directional coupler and indicator 275 or 1 kw. W0TKK/6, 25191 Ericson Way, Laguna Hills, CA 92653.

NEVER USED new Hy-Gain TH6 DXX tri-bander $120. Shipped prepaid. WB4UYJ, R. Tappehorn, 2536 Kings Hwy., Louisville, KY 40205.

ATTN: The McKean Cty. ARC will hold an auction--Sat., Apr. 20 in Bradford, PA. For further details, see next issue CQ or contact WA2BRX, 129 No. 19th St., Olean, NY 14760.

SP-600, $150. BC-348, Rcvr with P.S. & Sp., $50 Ranger I, $70. All excellent. Phil Bieglecki, W8GV, 11820 Engleside, Detroit, MI 48205.

TRANSFORMERS Rewound. Jess Price, W4CLJ, 507 Raehn St., Orlando, FL 32806. (305) 425-7251.

SELL: HT-37 w/manual, $125, 275 wt Johnson matchbox, $25. HM-15 Heath SWR, $10. SB-300 w/cw filter, $180. Ranger I, $75. WB2FGA, 234 Valley Rd., Ithaca, NY 14850.

SELL: TTY Mainliner converter, 14 rotr, 19ASR plus paper and spare parts, SX117. Send SASE. M. Sorochka, 95-01 243 St., Bellerose, NY 11426. W2HAJ.

COLLINS 32S-1, 516F-2, $400. Drake 2-NT Johnson 122 VFO, 2-C Rcvr, $275. Ameco TX-62, $50. National NC-300, $85. WA3HMQ. (717) 761-1107.

LINEAR AMP-Hunter Bandit 2000 w/manual and extra finals. Conservative Kilowatt, $260. Ralph Gebhard, W9JBY, Plato Center, IL 60170.

WANTED: HA5 VFO (W5RQZ) 1330 Curtis, Berkeley, CA 94702. (415) 526-7345.

HEATH COUNTER & Scaler not too cheap. WA5-CMC, 2309 Bullington, Wichita Falls, TX 76301.

WANT: Knight T-175 6-10 meter linear amplifier. Will sell or trade Knight T-60 xmtr. Wesley Taylor, WN5ISK, Box 4391, Wichita Falls, TX 76308.

WANTED: Battery radios and crystal radio sets of the early 1920's. Need not be in working condx. Also want old catalogs. Give Mod. and price. McKenzie, 1200 W. Euclid, Indianola, IA 50125.

MODULATION xfmr wanted, multi-tap, 125 watt orbetter. K1PUA, Frederick Wasti, 470 Forest Ave., Brockton, MA 02401.

FOR SALE: Heath HW22A with mobile pow. sup. $100 FOB. WA9BZY, 230 Stanley St., Chippewa Falls, WI 54729. (715) 723-9054.

SELL: Apache and sideband adaptor with manuals. Excell. condx. $110. WA2MPS, Bronx, NYC. TA2-7263.

ANTENNA INSULATORS, military in 86, small, extremely strong, metal ends. 100 for $25. Postpd. W.R. Hempkins, 100 E. Main, Denison, TX 75020.

WANTED: 1.5 Khz Collins mechanical filter for 75S3-B. K6AEZ, 150 Geneive St., Camarillo, CA 93010.

HEATH IM-17 VOM for $15, mint condx. Heath PM-2 mobiletuning meter, $8, also mint. WA5ETK, 817 West 11th, Littlefield, TX 79339. (806) 385-4167.

WANT: 24 HR CLOCK for HQ180 K7HGZ, Walt, 6410 West Sells Drive, Phoenix, AZ 85033.

HALLICRAFTER HT32A in mint condx with manual, $225. W1JSS, 9 Winter Terr., Westwood, MA 02090. (617) 762-5252.

SELL OR TRADE KNIGHT T-60 xmtr; Hammarlund HQ110C with clock; both mint w/manuals. Will buy Knight T-175 6/10 meter linear amp, and CB gear. Col. Taylor, WN5ISK, 4304 Univ. Dr., Wichita Falls, TX 76308.

SELL: Swan TV-2 2m transverter, mint condx w/ manual, $175 or offer. C. Mathis, 310 Channing Way, San Rafael, CA 94903.

HEATH GP11 mobile power supply for sixer & twoer, $9. Vertical whip for 6&2 meters, $8. Both in good shape. J.G. Swaney, 10534 California, Aurora, OH 44202.

2MTR FM Transceiver SBE144, 9 chan. crystalled, free mobile ant., excell. condx. Best offer. Will trade for Heath SB series equip. [illegible] 1MCY, 53 Old Amesbury Line Rd., Haverhill, MA 01830.

COLLINS30S1 Plate Transformer, new, $60. 75A4-3.1 plug-in filter, $25. WA4LXX, 251 Collier Av e., Nashville, TN 37211.

WANTED: 51S1, serialabove 500, excell. condx w/ manual, boxed, divrd to airline. State serial and condition. Arthur S. Cohen, Risco No. 437, Mexico 20 D.F., Mexico. XE1LL.

MECHANICAL FILTERS: F455J-08, 75A4 cw $40. F500B-14, 51J4 sharp $32. Others. A.C. Ford, 56 Gildare Dr., East Northport, NY 11731.

TRANSFORMERS: Plate - Filament - Audio - IF, New, 100 lbs., $25. Shipped frt. collect. W.R. Hempkins, 100 E. Main, Denison, TX 75020.

WANTTOBUY: Old wireless parts. Code Keys, etc. T.G. Soukup, 161 Bob Hill Rd., Ridgefield, CT 06877.

FOR SALE: New unopened Heath kits Wattmeter HM102, coaxial switch HD1234. HW7QRP. Transmitter operating and good condx. Make offer. Want HW12 will swap above. Wells Chapin, W8GI, Box 176, Kingsley, MI 49649.

DRAKE R4B with MS4, $295. Lampkin 105B freq. meter recent 6h, $75. Micro-match Commercial Wattmeter and Case, like new, $60. K8UZX, Rt. 2, Box 10, Washington, WV 26181.

HEATH PAWNEE HW20 2M exc cond, $125. WWV comparator gen micro 550, $75. National URR27 VHF 105 to 190 MC. John Murray, W2-OAP, 40-33 61st St., Woodside, NY 11377.

WANTED: Ext. spkr/S-Meter or 23 ch. synthesizer for Intn'l. Executive 100A. 306 Diamond Ave., Rocky Mount, VA 24151.

SELL: Heath SB-300 with cw filter. $150. V. Abell, W9RGB, 1715 Summit, W. Lafayette, IN 47906.

ART 13s — $10 each. BC348, $15 ea. less tubes, as is, intact, but condition unknown. W.R. Hempkins 100 E. Main, Denison, TX 75020.

INT. SIG. 2M FM Xmtr. 200 mW with 16, 28, 34 xtals, Mic. case, battery, xtal swx. etc. $39.95. WA4TJJ, 5204 Penelope, Knoxville, TN 37918.

PHONE/CW TYPE FL-8-A 3-position audio filter, $7.50 postpd. H. Anderson, 639N Wahsatch, Colo. Springs, CO. 80903.

AMECO PT TRANSCEIVER Preamp, w/manual, $40. Solid State Digital Keyer, $15. WA3LMY, 11 Lea Rd., New Castle, DE 19720.

WANT: Swan accessories; phone patch, VOX, 508 VFO, speaker, 45 mobile ant., Cygnet carry case. State price & condx. T. Coddington, WB6AWC, 7825 Scotts Valley Rd., Lakeport, CA 95453.

SELL: R4B, T4XB, MN2000, AC4, MS3 plus delux 3-1000Z linear. All mint. Write for price. Jim Warren, WA3LSN, Rt. 1, Box 130, Delmar, DE 19940.

HW202. 2m. with crystals 94/94, 16/76, 10/70, 52/52, 34/46 and encoder. $190. G.L.B. Synthesizer. 143-148.3 MHz in 5 KHz steps, $200 or both for $370. WB2ZVQ, 306 W. Lenox Ave., Elmira Hts., NY 14903. 732-9647.

WANTED: SB-110, SB-110A; any condx. WB5-KTH, 537 Gordon Ave., Harahan, LA 70123. (504) 737-6841.

WANTED: Motorola HT-100. Send condx and price. SELL: Heath 2 mtr convertor SBA-300-4 for SB-300. WB8OQC, 1447 Old Salem Ct., Birmingham, MI 48009.

TRADE: Old tubes from my collection for tubes I do not have. Send me your list. Wasiewicz, W2-DQC, 229 Sarles Ln., Pleasantville, NY 10570.

WANTED: Heathkit W-4AM or W-5M mono power amp or stereo power amp. B. Clinthorne, 5419 Mason, Midland, MI 48640.

SELL: Heath HR10 rcvr, $35. Heath HW12 xcvr $55. Eico 717 keyer $30. W9RQT, 341 Illinois Ave., Glenwood, IL 60425.

SALE: Aluminum office chair, $65. Brown covering. Adjustable height and back. Estate W8IMU, 7390 Bartholomew, Cleveland, OH 44130.

FREE: Pick up only, one Acme Telephoto Transceiver Model FNP-1S. N.C. Mosley, Beechwood Dr., Tarboro, NC 27886.

FOR SALE: ECS8 Vacuum Variable, 2 to 8 mmf. Ideal for neutralizing capacitor, $17 postpaid. A. Dorhoffer, K2EEK, CQ Magazine, 14 Vanderventer Ave., Port Washington, NY 11050.

WANTED: Telequipment Type A,B,C,G,H, etc. Plug-in vertical amplifiers (any condx) and/or manuals for Type D43, D53, and S43 oscilloscopes. L.J. Lustyk, W2PZU, 50 Cinnabar Rd., Rochester, NY 14617.

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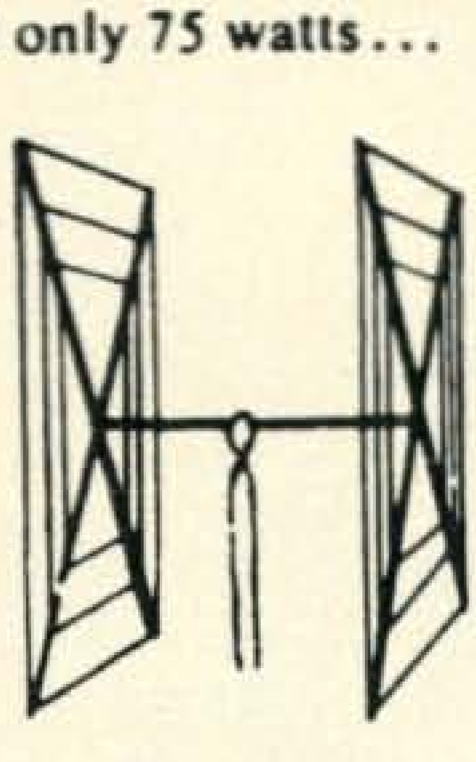
ADVERTISER'S INDEX

WHICH ANTENNA WINS THE CONTEST ?

In open competition against thousands of commercial and home-brew antennas, WA1JFG won the New England championship with a Gotham beam, by a margin of 5,982 points! WB2JAM won the sectional award for the Sweepstake contest in 1969 and 1970 with a Gotham 4-element 15 meter beam! Hundreds of unsolicited testimonials from grateful hams are our proof that Gotham antennas give you the best design, and the best materials. Forget our low prices - rely on the results of open, competitive contests. Ask yourself: Why do Gotham antennas win?

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	$41.00
10-15 CUBICAL QUAD	36.00
15-20 CUBICAL QUAD	38.00
TWENTY METER CUBICAL QUAD	31.00
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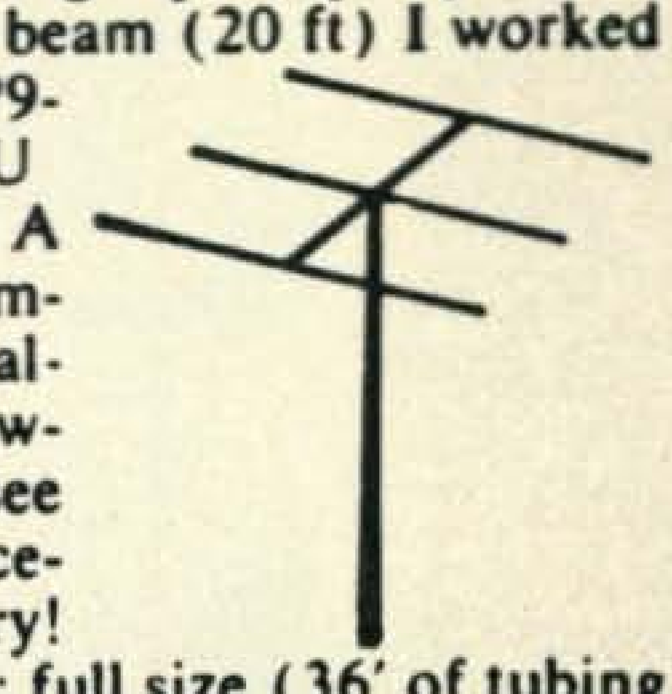
(all use single coax feedline)

BEAMS

The first morning I put up my 3 element Gotham beam (20 ft) I worked YO4CT, ON5LW, SP9-ADQ, and 4U1ITU THAT ANTENNA WORKS! WN4DYN Compare the performance, value, and price of the following beams and you will see that this offer is unprecedented in radio history!



Each beam is brand new; full size (36' of tubing for *each* 20 meter element, for instance); absolutely complete including a boom and all hardware; uses a single 52 or 72 ohm coaxial feedline; the SWR is 1:1; easily handles 5 KW; ⅞" and 1" alumnium alloy tubing is employed for maximum strength and low wind loading; all beams are adjustable to any frequency in the band.

2 EL 20	$25	4 EL 10	24
3 EL 20	31*	7 EL 10	38*
4 EL 20	38*	4 EL 6	24
2 EL 15	21	8 EL 6	34*
3 EL 15	25	12 EL 2	31*
4 EL 15	31*	*20' Boom	
5 EL 15	34*		

ALL-BAND VERTICALS

"All band vertical!" asked one skeptic. "Twenty meters is murder these days. Let's see you make a contact on twenty meter phone with low power!" So K4KXR switched to twenty, using a V80 antenna and 35 watts AM. Here is a small portion of the stations he worked: VE3FAZ, TI2FGS, W5KYJ, W1WOZ, W2-ODH, WA3DJT, WB2FCB, W2YHH, VE3-FOB, WA8CZE, K1SYB, K2RDJ, K1MVV, K8HGY, K3UTL, W8QJC, WA2LVE, YS1-MAM, WA8ATS, K2PGS, W2QJP, W4JWJ, K2PSK, WA8CGA, WB2KWY, W2IWJ, VE3-KT. Moral: It's the antenna that counts!
FLASH! Switched to 15 c.w. and worked KZ5-IKN, KZ5OWN, HC1LC, PY5ASN, FG7XT, XE2I, KP4AQL, SM5BGK, G2AOB, YV5-CLK, OZ4H, and over a thousand other stations!

V40 vertical for 40, 20, 15, 10, 6 meters	$18.95
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A High Performance AUTO SCAN
2 Meter Mobile or Fixed Station
Transceiver with Built-in AC Supply.

TRANSMITTER

RF Output:
10 watts (HI) or 1 watt (LOW) into 50-ohm load at 13.5 volts DC.

Frequency Stability:
$\pm 0.001\%$

Crystal Multiplication:
8 times.

Modulation:
F3 (phase modulation).

Deviation:
Up to ± 15 kHz (factory adjusted at ± 7.5 kHz).

Audio Response:
$+1, -3$ dB of 6 dB/octave pre-emphasis characteristic from 300 to 2500 Hz.

Spurious Emissions:
60 dB below carrier minimum.

Tone Burst:
Nominally one second at 1800 Hz (adjustable between 1300 and 3000 Hz).

RECEIVER

Type:
Double conversion superheterodyne (crystal controlled).

Intermediate Frequencies:
10.7 MHz first IF; 455 kHz second IF.

Sensitivity:
0.3 uV for 20 dB S+N/N ratio.

Selectivity:
± 15 kHz at 6 dB; ± 25 kHz at 60 dB.

Audio Output:
2 watts at 10% distortion.

Price - $379.00

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Frequency coverage 146-148 MHz, 8 channels, 3 simplex channels furnished — 146.76, 146.82, 146.94 MHz. Scan speed: 20/sec. Priority channel at 2 sec. intervals, even when locked on another channel. 4 ohm dynamic speaker, AC power supply built in. DC current receive .53 amps. Transmit .92 amps. Low power. 2.1 amps High power. Signal strength and relative output meter on front panel. Discriminator metering available at accessory plug. Size: 8¾ x 4¼ x 11⅝. Weight: 9 lbs. All plugs and cables furnished.

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