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AUGUST 1978 / $1.25

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- How to Design your own Station
- More on the HORIZONS 50-watt Rig

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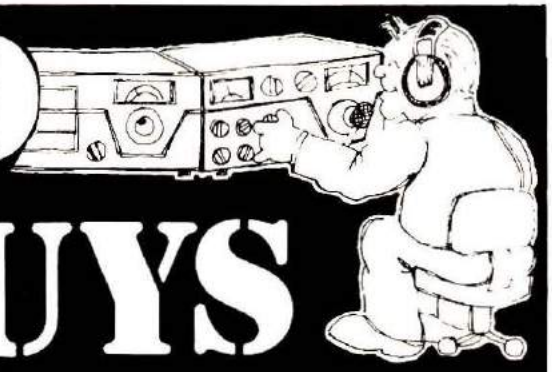

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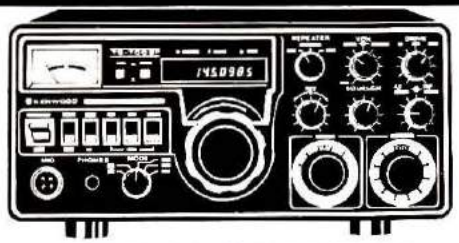

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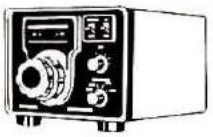

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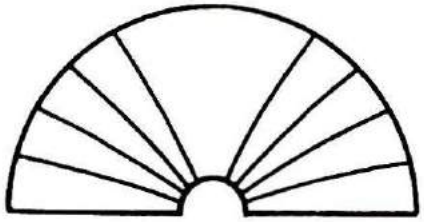

HORIZONS

Sailing and Hamming

The tingle of salt spray, the hum of taut rigging on a close tack, and the schedule on 20 meters with home base — all add up to an exciting vacation that would be the envy of almost anyone. If you'll shop around you might find a way to get in on the fun — author West tells you about communications for short and long races, and how to earn your keep aboard committee boats and racing craft.

Now That You've Got it Home, Your Flea-Market Rig Doesn't Work — Don't Give Up Hope

Many of us buy radio equipment at swap meets because the rig looks like a "good deal." Maybe so, maybe not. If you are the owner of such a piece of gear and it doesn't play when you turn it on, the cause may be something simple, such as dirty contacts. Joe Carr, K4IPV, who is wise in such matters, provides some good advice on how to get your bargain into working order.

Antenna Pointing

Working DX stations is one of the great pleasures of amateur radio. But to many, antenna pointing seems to be a mysterious job that hampers successful operation. Aiming an antenna toward a DX station is quite simple. Here are some ideas from N5KR that you can use to put the business end of your antenna in the direction that will do the most good.

Beginner's Rig

Much of the design theory was covered in Part One last month, but there wasn't room to cover all of it. This month W8YFB talks about keying and key-click filters, metering circuits, and switches. Since you're probably eager to start putting parts on a chassis, he gives you a few tips on proper layout techniques for trouble-free operation. Some wiring details are given, too, so you can see how the transmitter begins to take shape.

Planning Your Ham Station

After you've received your license and are ready to operate, what then? It's a good idea to have a plan for your station — its location on your lot, the arrangement of its equipment, its correct electrical and rf connections and wiring, and its safety from electrical hazards. In this issue we present the first of a four-part series on *Station Design for Application* — choosing a location for your ham rig.

Getting On The Air

You've decided to take the plunge and set up an amateur radio station. What next? One ham who has gone this route gives you some advice you can benefit by.

Broad-Band Vertical

Vertical antennas are the old standby for a lot of amateurs, but they're often made of thin wire or small-diameter tubing. Here's a vertical antenna that gets around the usual limited-frequency response of thin vertical antennas. The authors decided that if one was good, two would be better, so they tell you about a directional array as well.

Notebooks

Sometimes progress is achieved so gradually that it's hard to detect until you turn around and look back at the steps you've taken. Today's radio equipment, ham shack, and operating modes will have an entirely different glow when you look at them a few years from now. A simple notebook for today will become your history lesson of tomorrow.

The Cover

Sailboat racing is a great summertime activity pursued on lakes as well as the oceans. It's a lot of work and a lot of fun — and Amateur Radio can fit right in to help with the communications needed. Look on page 12 for the story. Photograph by H. Armstrong Roberts of Philadelphia.

HAM RADIO HORIZONS August, 1978, Volume 2, No. 8. Published monthly by Communications Technology, Inc., Greenville, New Hampshire 03048. One-year subscription rate, $10.00; three-year subscription rate, $24.00. Second-class postage paid at Greenville, New Hampshire 03048 and additional offices.

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A new efficient airwound inductor (12 positions) gives you less losses than a tapped toroid for more watts out.

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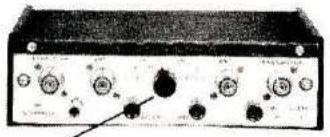

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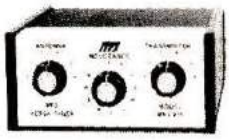

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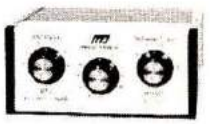

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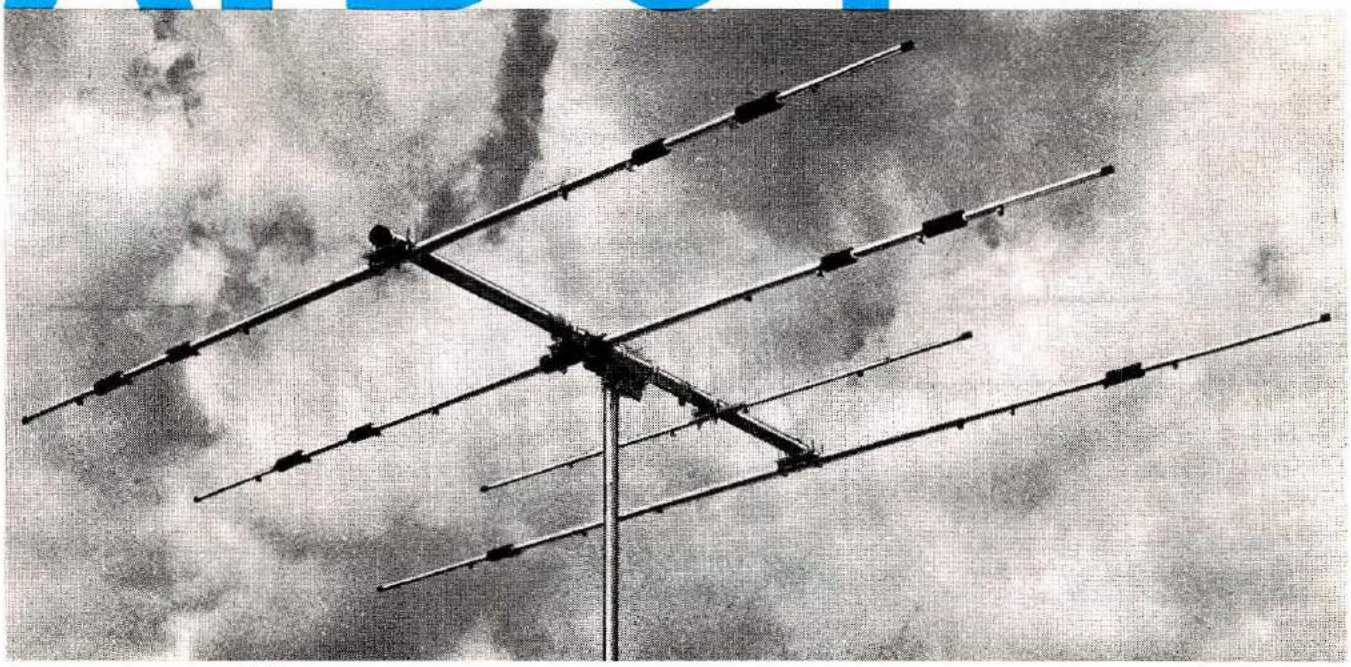

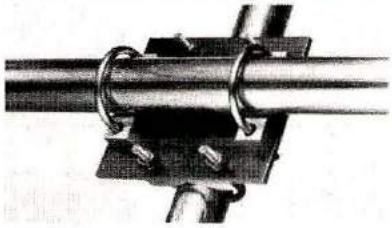

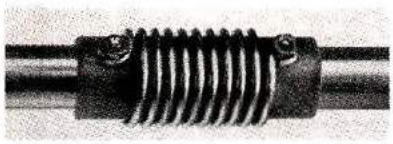

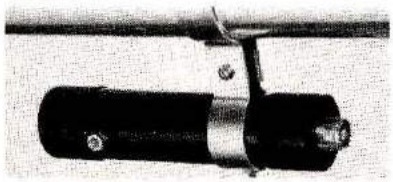

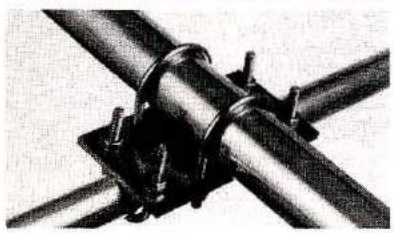

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HAM RADIO HORIZONS

Subscription rates are $10.00 per year, worldwide

Microfilm copies are available from University Microfilms, International Ann Arbor, Michigan 48103

Cassette tapes of selected articles from *Ham Radio Horizons* are available to the blind and physically handicapped from Recorded Periodicals 919 Walnut Street, 8th Floor Philadelphia, Pennsylvania 19107

Ham Radio Horizons is published monthly by Communications Technology, Inc Greenville, New Hampshire 03048 Telephone 603-878-1441

CONTENTS

In our modern-day world of solid-state electronic gadgets and centralized urban living, it's the rare amateur who hasn't been troubled at one time or another by interference complaints. As often as not the interference is caused by some other source, but if you have an outside antenna, you're a likely suspect and the first one to whom they turn when the local taxicabs (or whatever) tear up your neighbor's favorite television show or come booming through their quadraphonic stereo system.

The rf interference (RFI) problem that all amateurs are faced with can be completely and effectively cured *only* by proper design and construction of home-entertainment equipment at the manufacturing level. The consumer electronics business is highly competitive, however, so the manufacturers are reluctant to add filtering and lead bypassing that would increase the sales price of their equipment. For many years the manufacturers contended that less than 5% of home-entertainment equipment operated in an rf environment which required special attention — but with the proliferation of two-way radio systems as well as higher power a-m and fm broadcasting stations, I doubt that many consumers would agree.

Several bills have been introduced into Congress which would give the FCC authority to regulate the manufacture of home-entertainment devices to reduce their susceptibility to interference from nearby radio transmitters, but none have passed. Now Senator Goldwater is sponsoring a Bill which would require better RFI rejection; that Bill, S-864, has been referred to the Senate Subcommittee on Communications and hearings began in Washington on June 14th. Among those invited to testify were the ARRL, FCC, Institute of High Fidelity, and Electronics Industry Association. Although there's no chance that the Goldwater Bill will make it to the Senate floor during this session, the hearings will help pave the way for speedier action on future RFI legislation.

Consumers are becoming increasingly disturbed by radio interference, so the time is right for legislation such as that proposed by Senator Goldwater. Radio amateurs have known for a long time that the majority of RFI problems are not due to interference *per se*, but are caused by interception of radio signals by devices which were not designed to operate in a strong rf environment. The only way to eliminate 90% of the RFI problems is through legislation such as S-864 which would eventually require the manufacturers to correct those design deficiencies which lead to unnecessary interference.

Individual amateurs can help toward the eventual passage of a bill requiring better RFI rejection by letting their Senators know of their support for S-864, particularly if one of their Senators is a subcommittee member. In addition to Chairman Hollings (South Carolina), the members are Griffin (Michigan), Magnuson (Washington), Cannon (Nevada), Inouye (Hawaii), Ford (Kentucky), Durkin (New Hampshire), Zorinsky (Nebraska), Riegle (Michigan), Stevens (Alaska), Packwood (Oregon), Schmitt (New Mexico), and Danforth (Missouri). Letters to the Senators addressed to the United States Senate, Washington, D.C. 20510, will reach them promptly and may help considerably.

The letters do not have to be long, although background information on your (or your neighbors') RFI problems could be important. Even a note to the effect that you support S-864 would be a valuable contribution. Remember that previously introduced RFI legislation never made it through Congress — now that Senator Goldwater has started the ball rolling again, let's make sure it has enough momentum to become law. Now is the time to lend your support to this vital effort; write today and make your voice heard.

Jim Fisk, W1HR
editor-in-chief

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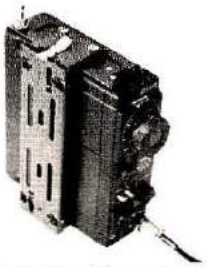

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FOCUS & COMMENT

Almost from the first issue of *Ham Radio Horizons*, we have been receiving letters that ask, sometimes gently, sometimes emphatically, about building projects for the beginner. In case you haven't noticed, we now have a beginner's transmitter, starting with last month's issue.

There are innumerable gadgets that could have been chosen for the project, and most likely they will be described in due time, but things like keyers, swr bridges, field-strength meters, and code-practice oscillators just don't get at the heart of what amateur radio is all about — transmitting and receiving signals over the air.

Then, too, in making the selection of a project to present we had to be sure that the end product was useful to a great number of amateurs, and that most of those who attempted to build it would be successful. All things considered, the most likely choice seemed to be a two-stage transmitter built with vacuum tubes, and with enough output power to do a decent job of making contacts on the most common beginner's bands, 80 and 40 meters.

Not that there is anything wrong with transistors — there's still plenty of time for them. However, tubes are much more forgiving of mistakes in wiring or in applied voltages. Further, the circuitry that accompanies most vacuum tube transmitters is more straightforward and does a more creditable job of suppressing harmonic radiation — a major concern in today's interference-prone world.

Some of you, upon reading Part 1 of the article, may have come to the conclusion that it provides an awful lot of theory and very little "meat and potatoes." Well, it had to be that way in order to acquaint the newcomer with the principles involved. Those who will take the time to digest the theory and background presented will be the ones who'll successfully complete the rig, and will also enjoy using it most when it is all done. Those of you who already know all about Pi-L networks, neutralization, capacitive divider networks, and the like — have patience. Or, go read the other articles in the issue while the rest of the world catches up. This month's issue contains the second portion of the series, and you'll see more of the hardware and instructions for putting the rig together. Next month's *Horizons* will tell you how to tune up the transmitter, after carefully checking it out for wiring and proper resistances at important parts of the circuit.

Admittedly, a lot of theory discussion had to be omitted from the article — such things as selecting the proper bypass capacitors, grid-return resistors, screen-voltage dropping networks, and so on. It's good stuff, but I know the feeling of having to sit through too many hours of theory class while itching to get my hands on a soldering iron. I hope that what we have presented will give you just enough insight into the why and wherefore of transmitter design.

In the pre-packaged world we live in, finding the parts for a transmitter is another achievement close to a miracle. This was another weighty factor in our decision of what type of project to present to you. Fortunately, the rig's designer, W8YFB, has an eye for bargains and also makes notes of what can be bought, and where you can find it. As you'll learn in time, half the fun in building something is in cutting the cost by shrewd bargaining or trading, flea-market shopping, scrounging, or salvaging something from the scrap-pile. Bill's discussion of the important parts of the rig will help you decide where you can safely use a substitute.

And, I'm happy to say, there's more to come. No, we're not turning *Ham Radio Horizons* into a technical journal; we're just trying to help you newcomers who would like to learn by "hands-on" experience to satisfy your urge. There's a receiver in the works, so you'll be able to point with pride to a complete station you've built yourself. There's also some accessory gadgets that will be useful in the shop and shack, such as a wavemeter, grid-dip meter (at almost no cost), and, as a concession to modern technology, a digital volt-ohmmeter.

You're too busy with summer activities to build a rig? Fine, enjoy your holidays, but take the parts-list along in your flea-market rounds and pick up the things you'll need to build the rig this winter. Combine pleasure with pleasure.

Thomas McMullen, W1SL
Managing Editor

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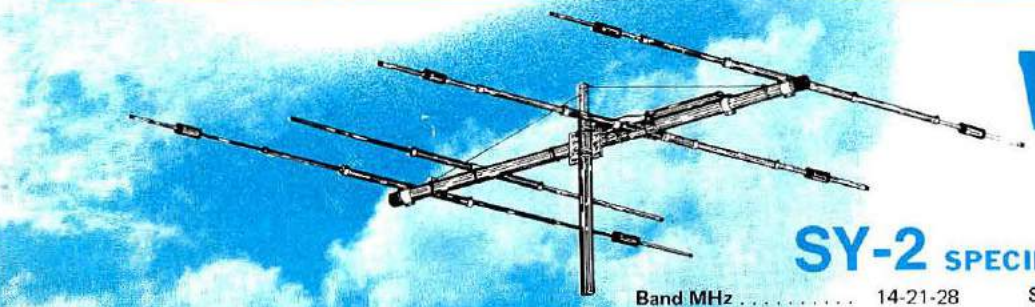

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Delivers outstanding performance on 20, 15 and 10 meters. Features Wilson's large diameter High-Q Traps, feeds with 52 ohms coax, a beta match method presents tapered impedance which provides most efficient 3 band matching and DC ground to eliminate precipitation static. The result is SWR less than 1.5 to 1 at resonance on all bands and maximum front-to-back. An added feature is the separate 10 meter reflector for correct monoband spacing. Add to this the rugged boom to element mounting, heavy duty taper swaged elements, and you have

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SY-2 SPECIFICATIONS

Band MHz	14-21-28
Maximum Power Input	4 Kw
VSWR (at Resonance)	1.5:1
Impedance	50 Ohms
F/B Ratio (dB)	20-25
Boom (O.D. x Length)	2" x 18'6"
No. Elements	4
Longest Element (Ft.)	26'7"
Turning Radius (Ft.)	16'4"
Mast Diameter	2" O.D.
Boom Diameter	2" O.D.
SHIPS BY U.P.S.!!!	

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Assembled Weight (Lbs - Approx.)	47
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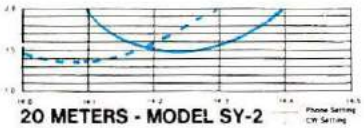
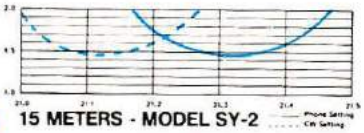
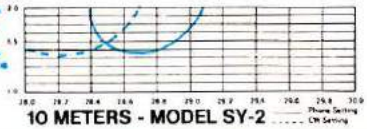
Matching Method	Beta
Only One Feed Line Required	



20 METERS - MODEL SY-2



15 METERS - MODEL SY-2



10 METERS - MODEL SY-2

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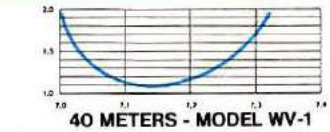
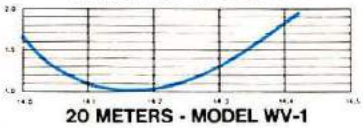
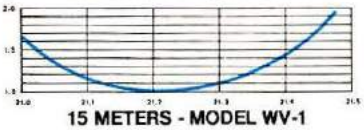


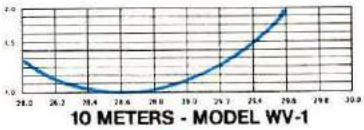
40 METERS - MODEL WV-1



20 METERS - MODEL WV-1



15 METERS - MODEL WV-1



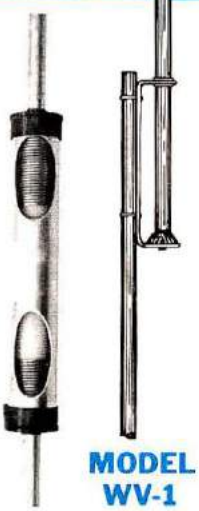
10 METERS - MODEL WV-1

WV-1 WILSON VERTICAL TRAP ANTENNA

No bandswitching necessary with this vertical. An excellent low cost DX antenna with an electrical quarter wavelength on each band and low angle radiation. Advanced design provides low SWR and exceptionally flat response across full width of each band. Featured is the Wilson large diameter High-Q traps which will maintain resonant points with varying temperatures and humidity. Easily assembled, the WV-1 is supplied with base mount bracket to attach to vent pipe or to mast driven in the ground. The new WV-1 Antenna is priced at $65.00 . . . and ships via UPS!

SPECIFICATIONS

Input Impedance: 50 Ohms • Powerhandling capability: Legal Limit • Two High-Q Traps with large diameter coils • Low Angle Radiation Omnidirectional performance • Taper Swaged Aluminum Tubing • Automatic Bandswitching • Mast Bracket furnished • SWR: 1.5:1 on all Bands • 1½" O.D. Heavy wall aluminum tubing • Does not require guying • Overall length: 25' 1½".



MODEL WV-1

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NEWSLINE

CB'S THREAT TO 220 MHZ is far from dead, as indicated by an in-depth study just published by the FCC. "Alternatives for Future Personal Radio Services" is a two-volume set produced by the Commission's Office of Plans and Policy following a 20-month study by the Personal Radio Planning Group. After weighing all possible factors, the study concludes that 220-225 and the 900-MHz land mobile reserve bands are the best spots for a new CB service, and economics, performance, timing, and possible medical considerations all lean toward 220 MHz.

One Factor That Shouldn't be overlooked is that this study was done when Carlos Roberts headed the Office of Plans and Policy — and he's now head of the Safety and Special Services Bureau which includes Personal Radio Services (Amateur Radio and CB) among its Divisions.

CREDIT FOR PASSING THE CW exam can now be retained by an FCC license applicant even though he failed the written test. In a decision reached May 31, the Commissioners agreed to allow an applicant such credit for up to one year after he takes an exam. To receive the CW credit the applicant will be given an FCC Form 845 by the Field Office at the time of the exam. He turns it in when he returns for another try and receives credit for the CW portion of the exam.

Form 845 Will Be Honored only by the Field Office that issued it. The forms and instructions for their use have gone to all FCC Field Offices, and the Rules change becomes effective immediately. However, to be on the safe side, it would be wise to check with your local Field Office to see if they've implemented the new procedure before going in for an exam.

ALIEN AMATEURS SEEKING permission to operate in the United States should now send their Form 610-A applications direct to Gettysburg (FCC, Box 1020, Gettysburg, Pennsylvania 17325) instead of to Washington as in the past. Part 97.305 (b) of the Rules has just been revised to permit the change, which accelerates processing.

THE FCC IS RECEIVING REQUESTS for new call signs from amateurs not yet eligible for new calls. The new calls are now available only to Extras who request them, other licensees who are upgrading to a higher class, and those applying for their first license.

Note Also That No Exception will be made to the FCC's rule prohibiting the issuance of special call signs. All requests for special call signs are being denied, including those of amateurs interested in an old call they might have held in the past.

THE PROPOSED REVISION OF THE 1934 Communications Act unveiled in June held no surprises for Amateur Radio, though it would abolish the FCC in favor of a "Communications Regulatory Commission" and delegate frequency allocation to the "National Telecommunications Agency." The only obvious effect on Amateurs would be the increase in license terms to 10 years, and reintroduction of license fees. Passage of the revised act is a long way off, however.

2-METER WORKED ALL STATES was achieved by NØJA and K9HMB in May thanks to N6NB/7, who operated his portable moonbounce station from both sides of the Utah-Nevada border. NØJA was only the third Amateur to contact all 50 states on 144 MHz, with K9HMB number four. KØMQS was the first, back in August, 1976, thanks also to N6NB (then K6YNK/KL7).

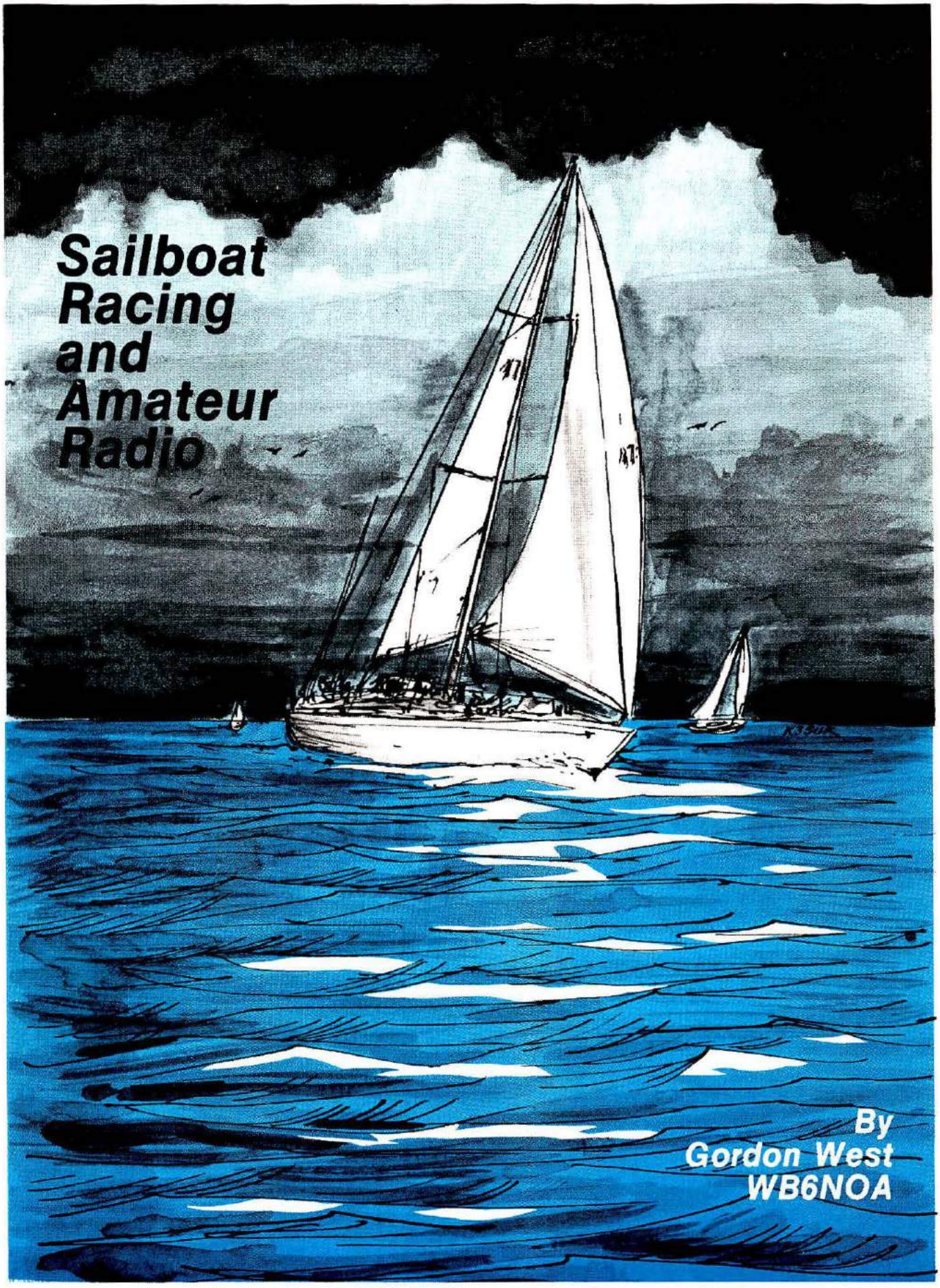
W2BXA RECEIVED SATELLITE DXCC number 1 when he arrived at ARRL Headquarters on May 16 with cards proving he had worked 101 countries via the OSCARs! W6VPH/VP5, VP2EFZ, and a special handmade FOØXA card from the recent Clipperton DXpedition pushed Ben over the top. Congratulations for an outstanding accomplishment.

NO HEALTH HAZARD exists from operating a 2-meter hand-held close to your face, even with high power and a "rubber ducky" antenna, conclude three Motorola engineers in the May, 1978, IEEE Transactions on Vehicular Technology. Their well-documented research shows 150-MHz rf penetrates the body much less than previously supposed, with a temperature increase of less than 0.1°C measured after one minute's exposure to six watts radiated from a helical antenna only 0.2 inch from the body!

20-KHZ CHANNEL SPACING for the new 144.5-145.5 repeater subband is reported to have been approved by the ARRL VRAC, but at the same time the advisory group voted to maintain 30-kHz channels above 146 MHz. Further discussion on the 20 vs 30-kHz spacing argument is expected.

RADIO CONTROL in Canada will be moved shortly from 27 MHz to 310-320, 350-360, and 380-400 MHz.

NEW VICE DIRECTOR for ARRL's Southwest Division is WB6UIA, replacing W6EJJ who became Director after W6KW's resignation.


Sailboat Racing and Amateur Radio
By Gordon West WB6NOA

Looking for some exciting travel for your next vacation? How would you like to sail to the South Seas for an all-expenses-paid three-week stay? Some lucky amateur radio operators working with local yacht clubs are doing just that — enjoying a great vacation while providing necessary communications for a yacht club ocean-sailboat race. Yacht clubs throughout the country host both local and long-distance races. Some of these races might be just a day or a weekend affair, such as a run around Long Island Sound, or a race to Catalina Island and back. On short-haul races like these, the club will be looking for radio amateurs to provide race-standing results as the vessels round their check points. Other clubs may sponsor a three-week, 2400-km (1500 mile) race where they will be looking for high-frequency amateur radio communications along the race route, as well as communications at the finish line to transmit the results.

Marine communications channels on vhf or ssb are used whenever possible. Most committees on long-distance races require vessels to have both high-frequency and very-high-frequency marine equipment, with emergency antennas for each band. Most communications are coordinated on precise schedules throughout the race.

Typical communications for a long-distance race might include weather reports and forecasts, calculated positions of participating boats, roll call, bed check (to ensure that all is well for the night), and race standings. Most of this work is done on 2 and 4 MHz ssb maritime frequencies. When a sailboat is near an escort vessel, they use vhf channels. The whole idea is for escort vessels to keep a close check on each participant to ensure safety while traversing the long race course. There is usually one escort for each ten race participants.

As soon as the escort vessels pool their information about the participants, the relative standings are transmitted back to the host yacht club and to the officials at the finish line. Here is where amateur radio can take over to relieve the marine frequencies of nonessential traffic.

One amateur radio station can be located on the escort vessel that has all of the weather-reporting equipment. This station will be manned by a guest amateur radio operator who can have some exciting times at sea while providing a useful service. A second amateur radio station can be located aboard the finish-line committee boat. This can be a bit tricky if the end of the race is at a location within the jurisdiction of a foreign country. For instance, Mexico does not have a reciprocal operating agreement with the United States, so amateur operations from finish-line vessels must be done from the high seas. This is something that you'll have to check on

On short races, not too far from shore, a small vhf transceiver can do the job with ease.

This is not the best location for a vhf transceiver, but it shows that even the smallest craft can have communications (*photographs by West, WB6NOA*).

before you leave your home port. The amateur radio operator picked for finish-line duty usually has the most fun — he gets to relax until all the vessels are in sight, and then he earns his keep as each vessel crosses the finish line. When it's all over, he can go ashore with the rest of the crew and have a great time.

A third amateur radio station is usually set up at the host yacht club. This may not be the most desirous location to operate from, in that you daily have to answer hundreds of questions as to where the racing vessels are, and "Is Jerry aboard the *Mahia* having a good time and would you mind communicating a short message from his wife?"

Temporary installation of equipment

For the lucky amateur radio operators picked to man the communications package aboard the escort vessel and the finish-line vessel, a good installation is essential. If you're going to be operating on 2-meters for a short race, you'll have no problem with either portable or mobile equipment; plug it in, run your coaxial cable, and feed your signal into a good half-wave antenna that requires no ground plane. Try to stay away from beam antennas because you never know which direction the captain is going to be heading the vessel. Remember, mobile antennas, such as a 5/8-wave whip, generally require a good ground plane to effectively radiate a 2-meter signal, and the chances are you're not going to find a good ground-plane surface aboard modern day yachts. If you need that type of antenna, provide it with a ground plane beforehand.

If you're using a 2-meter portable, be sure you never loan it to someone else who may in turn loan it to an unlicensed operator. Sometimes race committee members feel that since you're the guest, they can just grab a unit and go on the air. Don't let them! Before you start, explain that the only time a nonlicensed person is allowed to speak over the amateur-radio microphone is in the direct supervision of the licensee, and that the licensee must start and end all communications. Make this a firm rule lest you get non-hams on 2 meters.

"Race-committee communications are not necessarily limited to men," comments Susie Foster, WA6BWH. "You just have to be firm when the men want to talk over your ham equipment. They get a bit carried away when there is a close finish. Although I keep my hand-held unit in a plastic bag to keep out the salt spray, that will not prevent the bad language from

Competition is stiff, and emotions are tense when a large number of participants near a check point or a finish line. Amateur radio operators aboard the committee boat can relay the results back to the host yacht club.

creeping through when someone else gets on the microphone. I try not to let it happen!"

For high-frequency operation, 80 and 40 meters are usually chosen for races that may run out as far as 2400 km (1500 miles). On 4800 km (3000 mile) races, such as the Trans Pacific Yacht Race from Los Angeles to Hawaii, 20- and 15-meter capability might be added. Installing a temporary station aboard a race-committee escort vessel or finish-line vessel must be done with some forethought.

The first consideration is where can you go to get away from everyone else. You want to be close enough to the marine ssb equipment so you can hear the participants check in, yet you want to be separated enough so that you may carry on your own communications without interfering with theirs. Remember that everybody onboard will crowd around your ham radio installation as you transmit the race results back to the yacht club. They'll be talking, smoking, drinking, setting their cocktails atop your equipment, and knocking ashtrays over into your antenna tuner; be prepared! Find a corner that will be almost inaccessible to the casual observer, and try to install your amateur-radio equipment there.

Senator Barry Goldwater, K7UGA, enjoys operating on the ham bands from his boat. "Several dB signal improvement when I operate aboard," Barry comments from his *Tobikin* at the Balboa Bay Club.

Equipment selection

For temporary ship assignments, I prefer solid-state transceivers, rather than tube-type separate units. The Atlas, Swan, Tempo, Ten-Tec, Yaesu, and Heath units are excellent pieces to bring aboard. They're compact, some are completely transistorized, and they consume small amounts of power at 12 Vdc — the voltage usually found on committee boats. Make sure the equipment you select can take a bit of spray and abuse.

I recommend running the equipment from the ship's 12-volt system, rather than depending on the 110-volt ac generating system that can fail when you need it most. On important races, I usually bring along my own sealed 12-volt battery in case their battery system should fail or be run down by a refrigeration system that went wild, or was overworked by cooling too much refreshment! Thus, I'm always assured of power independent of the ship's system.

Once the equipment is in place and securely lashed down, anticipating 40-degree rolls, make sure you have a good plastic cover that will fit over it. You can plan on having water leak down from the top of the cabin — it's bound to if seas get rough — and it always seems to leak exactly where you place your equipment. Run your dc power leads, and locate your extra 12-volt battery in a convenient location so that you may make your power switch immediately if theirs should fail.

Amateur radio aboard a race-committee boat has many times saved the lives of those aboard when the other radio gear failed. One incident occured after the conclusion of a popular Los Angeles to Puerta Vallarta, Mexico, yacht race. Skipper/ham operator Jordy Saunders, operating one of the first FCC temporary calls, WT6AAM, aboard his 45-foot power cruiser, Sonrisa, *recalls, "We got into a 70-mile-per-hour blow you wouldn't believe — it was so wicked it blew overboard our Avon inflatable life raft, my 2- to 8-MHz marine whip, my life rings, and finally my Mosley vertical for 20 and 40. One big wave loomed out of nowhere and crashed into our windshield, completely knocking it out and overboard.*

We knew we were in trouble, and had to get a message out that we were turning tail into the wind and heading for shore 100 miles away. When the wave broke the windshield, it completely took out our marine radios — ssb, vhf, and even our emergency unit, which was destroyed by a hatch cover that fell on top of it. The ham rig, a Kenwood TS-520, was below, and dry, covered by a plastic bag. I fired it up, and then went up on deck to find out why there was no reception. I found we had no antenna — just a broken piece of RG-8/U swinging in the gale winds. I hooked up the center conductor to my lifeline cable that runs completely around the deck, and tried to load up the rig into it with a DenTron tuner. No go — something was wrong.

I then went out on deck to see why I couldn't get even so much as a miniscule signal

and found that the lifeline was grounded at one end to a ship's ground chain plate. I took our fire ax and chopped away the connection to ground. My receiver leaped to life with signals all over the band.

A fellow on 20 picked up my weak signals and connected me to the San Diego Coast Guard through his phone patch. We maintained communications all through the night until we were sure we were out of danger. The lifeline — ungrounded — makes a great emergency antenna in a pinch," comments Saunders of the Del Ray Yacht Club.

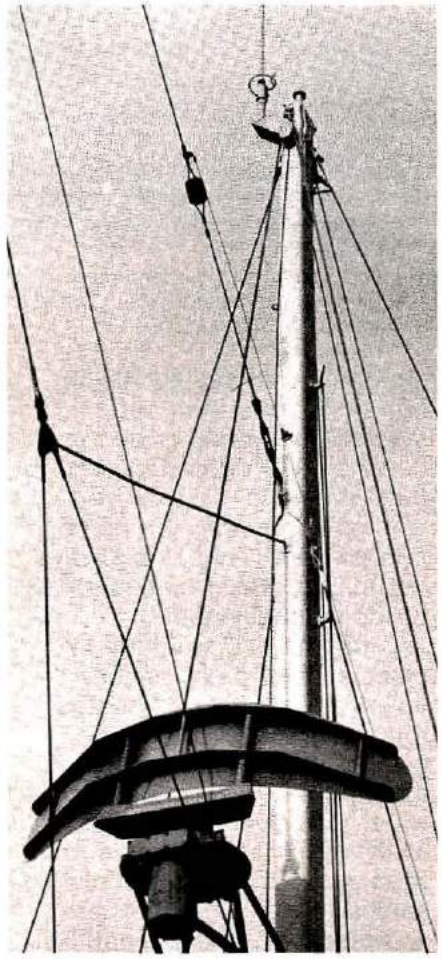
Ground connections

You're going to get some poor results unless you can connect to a sizable ground conductor. If it's a sailboat, and if they have high-frequency marine ssb equipment aboard, take a look at how that equipment operates. If their marine equipment seems to operate well on 4, 6, and 8 MHz, try to tap into the ground system they use. It usually terminates at the keel of a sailboat — an excellent ground point.

However, to the chagrin of the amateur radio operator, most race-committee boats in large and long races are power boats. They usually have a poor ground system because they don't have a large keel surface to use. Again, look for the marine equipment ground connection, and make use of it. If you find that their gear performs poorly because of an inadequate ground system, it's up to you to make your own. Look around for large metal surfaces, preferably those below the water line of your host's power boat. Water tanks are generally located below the water line and offer a sizable amount of coupling to ground. Lifelines that connect to one another around the outside of the vessel are another possibility. Some fiberglass power boats have a metal ground plate — add this to your system. Finally, you can add the engine and shaft assembly to the total ground, remembering that the engine can be somewhat isolated from the sea water through the oil in the gear box. Make sure that each ground connection is separately run to your transceiver — don't hook them in series. Once you've picked up every bit of metal for your ground connection, then it's time for your antenna run.

Temporary antenna systems

Your first consideration is to keep your high-frequency antenna away from the ship's marine-equipment antenna. This will help prevent cross modulation and splatter on your receiver when they are transmitting, and vice-versa. Most temporary installations work out well if you can use a mobile antenna in conjunction with a good ground. This means you must take along a ball mount, the long aluminum mast section, and a pair of resonators for each frequency you plan to operate. I say a *pair* because sooner or later during the trip one of your helpers is bound to lose one overboard! Try to find a good location to mount your antenna system so that crew members will not inadvertently use it as a hand hold while you're transmitting, but also consider that you need a location convenient enough to change resonators when the band goes dead in the early evening. Once the antenna and ground system are ready to go, resonate each whip on the predetermined frequency you plan to use. Make sure your extra whip is also tuned up, ready for immediate replacement when the first one goes overboard.

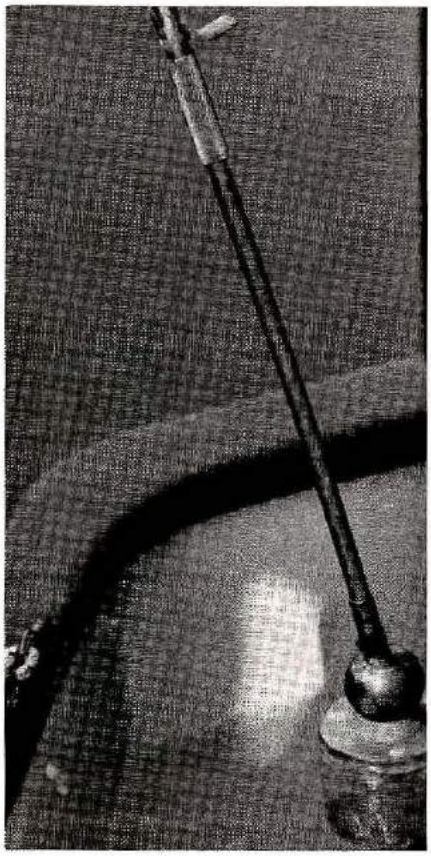


Masts on sailboats usually make ideal mounts for either high-frequency or vhf antennas, but you must keep coaxial cable away from trouble spots such as the radar scanner. A 2-meter Ringo antenna has been installed atop the mast for increased range.

"I carry three of everything on deck," quips David Metz, of Laconia, New Hampshire. "Three of each coil, three mobile masts, three springs, three of everything when I go out on these committee boats. If I don't lose the coil overboard, the guy I send up on deck will! Last time I went out to do race-committee communications, I dropped my whole 2-meter hand-held rig overboard — and, no, I didn't have three of those!"

Don't be overly concerned about water and spray decreasing the antenna's efficiency when it coats the ball mount. The rf voltage is low at the base section so the effect will be minimal.

Finish-line vessels, permanently anchored in one position with a stern anchor out to prevent swinging on the hook, may use beam antennas.

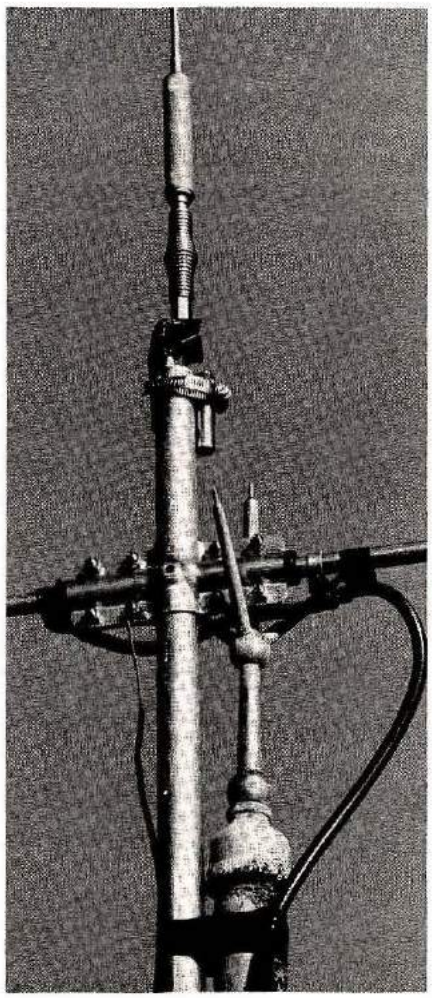


A mobile ball mount provides a versatile system of fastening the whip assembly at a convenient location. You can angle the whip to keep it away from swinging booms.

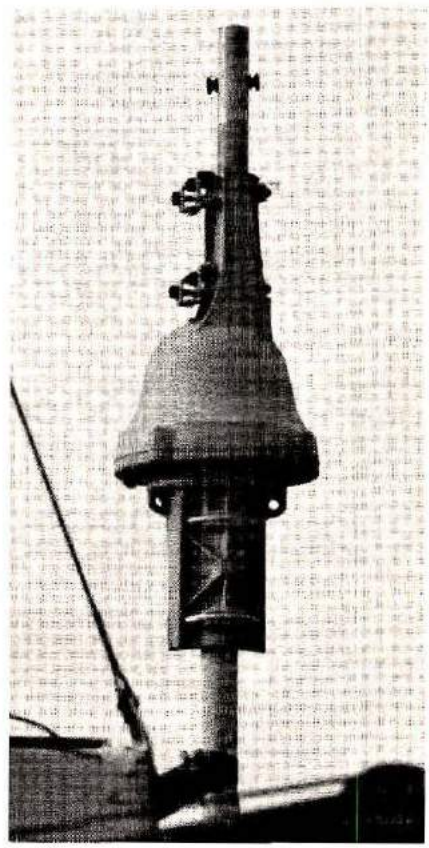
Small, efficient, beams for portable operation are ideal, and, if mounted on a rotator, will enhance communications back to the yacht club or the escort vessel.

After you've checked out your antenna system and it performs well, apply some silicone sealing compound to prevent corrosion of the copper braid and other connections. Also, make sure that a wayward foot won't inadvertently separate the coax from the antenna. Remember, most mariners and race committee men are not anticipating new obstacles aboard their craft. You're the guest, and an important one, but even so, keep your installations neat and out of the way.

Technician-class ham operator Rod Koral, WB6ORK, recounts a close call when working with his local yacht club aboard their race committee boat, Dry Lines: *"We couldn't quite reach the other ham operator at the club from the distance of our race-committee boat, using two meters simplex. We could hear each other, but not as clearly as I wanted. I decided that my 2-meter whip needed a bit more height, so, with an extra hunk of coax, I started up the small mast of the boat. Reception improved dramatically with the added height, so the top of the mast would do fine. I could hear the club come in loud and clear, and the folks said that the needle was now at S9, up from a low of S1. Just as I was ready to fasten the whip aloft, the captain decided to fire up the radar. No problem, I thought — I was well clear of the rotating scanner but the coax wasn't! Each revolution of the scanner antenna coiled up about 1 foot of coax. I could see what was going to happen, so frantically I began to undo the extra length of coax draped over and around my shoulder. Time and coax ran out — the scanner pulled all the coax taut, I began to lose my grip, and BANG, the RG-58/U parted! Luckily, I remained aloft. Lesson: watch out for coax runs around radar antennas, especially if you are integrated with that coax!"*



Your temporary installation at the yacht club can use existing structures for antenna support. Here a lightning arrester serves as a mount for both high-frequency and vhf antennas.



If your finish-line boat is anchored to prevent swinging, you can use a rotator and small beam antenna for improved communications with the yacht-club station.

Another, similar incident occurred to Bill Alber, WA6CAX, as he was scaling a mast with a long wire coiled over his shoulder. "Someone down below turned on my Atlas 210 and whistled into the

microphone. The rf went up the long wire, around the wire coiled over my shoulder, and gave me an rf burn you wouldn't believe. To add insult to injury, the mariner who whistled into the mike complained that he had never seen such a large CB rig with such poor reception!"

Essential accessories

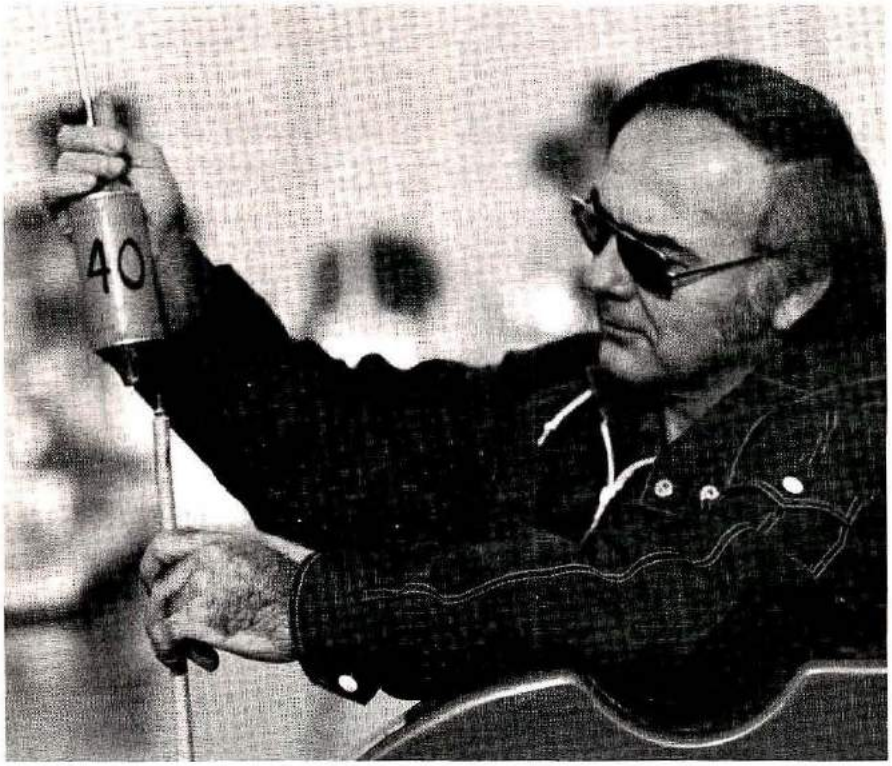
Here is a list of some essential equipment to complement your amateur radio installation:

- Tools, including a battery-operated soldering iron
- Flashlights and batteries
- Extra coaxial cable and grounding straps
- A small back-up transceiver
- Headphones
- Spare microphone
- Fuses
- Power and vswr meter
- Volt/ohm meter
- Antenna tuner
- Extra log books
- Binoculars
- Phone-patch or message forms

I also strongly recommend motion-sickness pills. I know, you never get seasick, but try operating below decks for any length of time in heavy seas and with five people blowing cigarette smoke in your face. If you didn't get seasick before, you will now. Be prepared!

Frequencies and traffic

I generally stay off the popular marine-mobile net frequencies because yacht-race communications is not what they want on their agreed-upon frequencies. Before you start, determine what you feel will be a quiet segment in the 80, 40, 20, and 15 meter bands, and agree on schedule times, bands, and alternatives if the first band might be dead. Make sure you have several set frequencies and set times for each band of operation so you're not chasing each other up and down the spectrum when you lose contact.



Even aboard a sailboat you can find room for a vertical whip and some radials — if you can convince the captain that it will not interfere with handling the sails.

You will be besieged by crew members, committee men, and yacht-club commodores, all wanting to place phone-patch traffic. Expect at least ten phone patches a day, and make sure you have an agreement with a shore station ahead of time so that they will be happy to pass the traffic. Most yacht clubs have a member who is an amateur radio operator and who likes to stay ashore and handle this type of traffic. No amateur radio operator enjoys getting hit with ten successive phone patches. Don't even ask — it'll save you the embarrassment of being turned down after the second call.

Be careful who you allow to talk over the microphone. Exuberant people talking to their loved ones back home sometimes get carried away. Concerned businessmen many times will ask about office affairs. The yacht club commodore may want to check with his answering service to pick up any important business-call traffic — don't let them! Don't jeopardize your service.

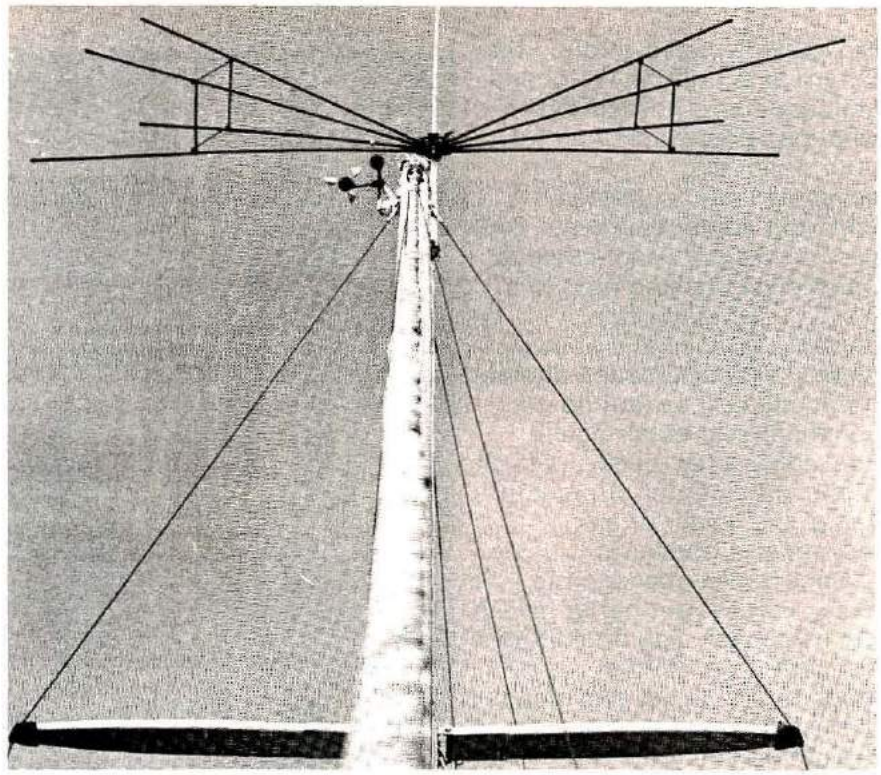
Try to set up some way of managing the phone patch problem; I guarantee it's going to be a problem when you're far out at sea and everybody wants to call home for free. One remedy is to limit phone patches to *very important* matters. Have a sign-up sheet for messages only, and tell everyone aboard you're happy to pass along their message, but will reserve direct phone patches for only the most vital communications. This saves problems at both ends of the radio circuit.

Bon voyage

Once you are out on the briny deep, you're going to find that, although your ship may have medium-frequency and high-frequency ssb marine channels, your amateur radio setup will be the most

important link back to the yacht club. If there is an emergency, try the maritime Coast Guard frequencies first. If you can't get through, then amateur radio is right there ready to help. In 1969 on the Trans Pacific Yacht Race, it was a very water-logged Swan transceiver that saved the life of a crew member who had been smacked in the head with a spinnaker pole aboard the vessel *Mahia*. Our sideband gear on maritime frequencies couldn't get the message across to the Coast Guard because of band conditions. We then switched to amateur radio, and through the expert help of Dave, W6VX, we were able to contact the Coast Guard and save the victim's life. It might be up to you on this next cruise to do the very same thing. Be sure that, at any time and at any hour, you know what frequency and what band you can use to contact a station for immediate help ashore.

After the race is over and your committee boat ties up, you can relax and receive congratulations for a lot of hard work that may not have seemed much like a vacation at sea.



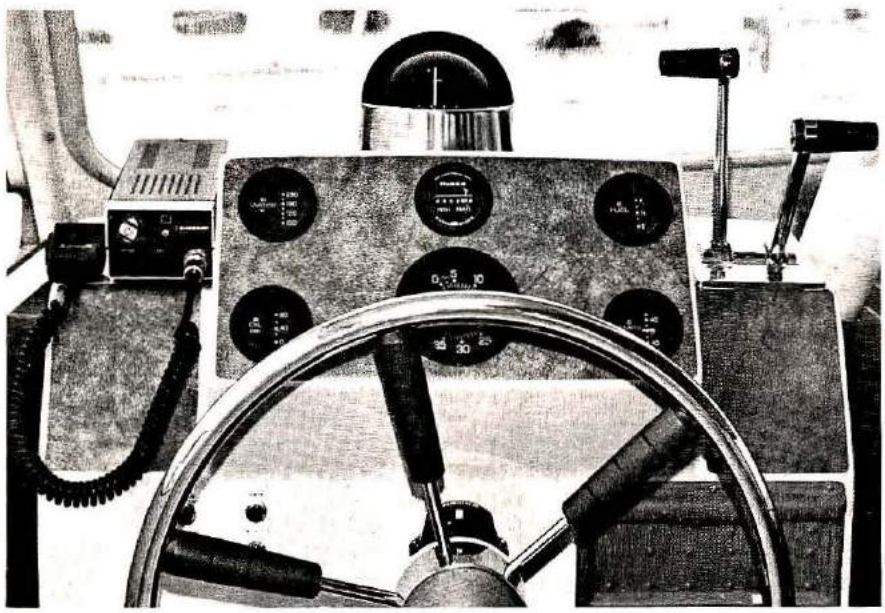
Take along spares of everything, especally those items that could be lost overboard. Loading coils and whips should be pre-tuned for fast band changes.

You'll find that your amateur radio operating has been made known to every mariner who participated in the race, and they will now have high esteem for amateur radio operators. The yacht club will probably invite you back again. If the communications work out, other yacht clubs may contact you to help man their communications in one of their races.

"You hams have a way with the airwaves," states Dr. Tom Redler of the Del Rey Yacht Club. "When we can't get through with all our expensive marine sideband gear, you folks just twirl a few knobs and have us patched through loud and clear. How you do it, I don't know, but that's why we keep inviting you back every year for these races."

Every week I receive at least one phone call from a Pacific Coast yacht club looking for an amateur radio operator who wants to set out on a three-week cruise to help out on communications. Does that sound interesting? If so, check with yacht clubs in your area and tell them you have equipment, will travel!

HRH



On some of the power craft there is a convenient and safe spot for a small vhf transceiver near the control area. Velcro pads or flexible straps should be used to keep the equipment in place during rough seas.

NOW THAT YOU'VE GOT IT HOME

BY JOSEPH J. CARR, K4IPV

Your radio doesn't work when you bring it home and try it out. It's a flea-market bargain.

So you've slogged through the fairgrounds fighting October's chill and snow flurries to see what goodies can be had for little or nothing, hoping the season's final hamfest will bring out some real gems. You spot an old but venerable ssb transceiver stacked next to a box of used (and often unmarked) tubes and approximately 200 back issues of electronic magazines (but no complete year sets). You're hooked — a few back-and-forth offers and counter offers later you're the owner of an inexpensive phone rig.

Once you've managed to sneak it past your better half to the hamshack, you hook it up and turn it on. Hmmm . . . so much for bargains. Why doesn't it make a noise?

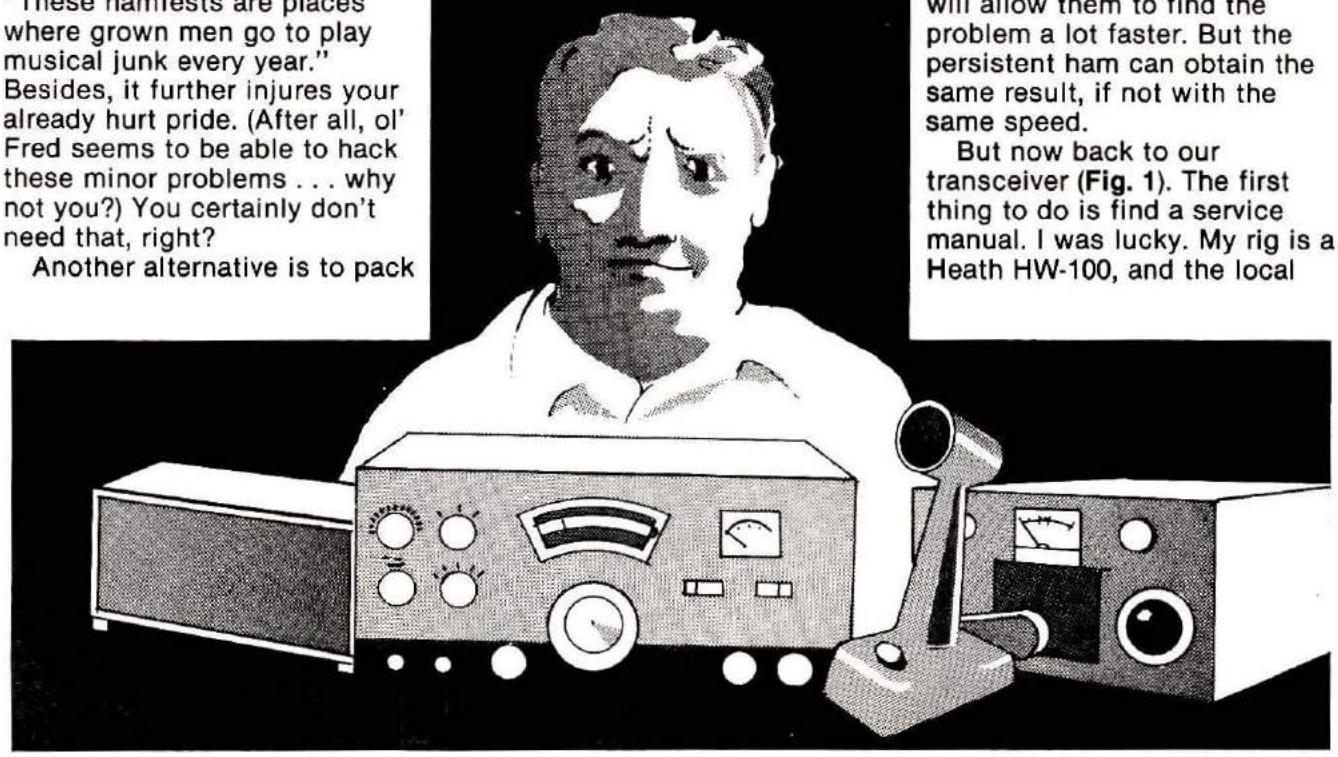
At this point you have several alternatives. First, you *could* open a six pack and mutter some candid wisdom such as "I always *knew* ssb was . . .," or you could kick the piece of, uh, gear, over into the corner until next October and pawn it off on some other sucker. But that perpetuates the cynical view of the XYL that "These hamfests are places where grown men go to play musical junk every year." Besides, it further injures your already hurt pride. (After all, ol' Fred seems to be able to hack these minor problems . . . why not you?) You certainly don't need that, right?

Another alternative is to pack up the equipment and send it to the manufacturer or to a ham-radio service shop (of which there are mighty few). Not too good, because it's expensive and time consuming. Good professional communications equipment service can be quite costly and the old rig might not be worth it.

Another alternative is to try *fixing it yourself*. To many, this seems like asking one to try walking on water, and many hams won't even attempt to troubleshoot their own equipment. They seem to feel that electronic trouble-shooting is an arcane art practiced by professionals and others schooled in occult goings on. Not so — read on!

For some time now I've been offering the opinion that *most* amateur equipment repairs are well within the capabilities of most amateurs with a Technician/General class or higher license. Of course, there are some repairs that take a lot of sophisticated multikilobuck equipment and a lot of years of experience. There are other repairs where the troubleshooting acumen of the professional will allow them to find the problem a lot faster. But the persistent ham can obtain the same result, if not with the same speed.

But now back to our transceiver (**Fig. 1**). The first thing to do is find a service manual. I was lucky. My rig is a Heath HW-100, and the local



Heathkit service center had a copy of the manual for sale. If a manual is not part of the hamfest deal when you obtain the transceiver, try contacting the manufacturer. (Lesson number 1; insist on a manual as part of the deal.) Most companies maintain a stock of manuals for several years after the model is no longer sold, so you'll probably be in luck. In many cases, though, the manufacturer no longer is in business or the model is simply too old to expect them to have a manual for sale. In that case try advertising in a ham magazine and in your local newsletters and club publications.

In the several instances where I've had to acquire a manual by advertising, the results were quite good. For example, I once needed a manual for an old Hammarlund receiver and my single ad brought in four Xerox copies (free) and an original. One of the copies came from a prominent West-coast ham-equipment dealer.

Fig. 2. The first thing is to inspect the chassis against the service manual and make a list of missing or broken parts such as switches, insulators, or electronic parts. Check each component thoroughly. Use a magnifying glass to look for small components. Probe around the wiring with a pencil to ferret out missing or broken components.

Preliminary chores

While awaiting your manual you can do some clean up and evaluation that will, often as not, put the rig back on the air with almost no troubleshooting. Many electronic equipment problems are caused by dirt interfering with the operation of circuits. When this dirt is removed, the rig works.

The first thing is to examine the innards (**Fig. 2**). If any components are missing or obviously broken, make a list of them and try to obtain replacements. Examine the rig for missing screws (a critical ground not making contact?), burned-out or missing tubes and lamps (lamps often ballast series-parallel filament strings in vacuum-tube sets), and any other component that seems to be missing. In ssb rigs there should be at least one filter. A friend of mine brought home a popular Collins rig and found all filters missing. That act of cannabalism by a previous owner kept the rig from working!

Fig. 1. Author's acquisition during a buying spree in a local hamfest flea market. It's a popular Heath transceiver, one of the many such radios you'll find offered for sale. Maybe it works; maybe it doesn't. It's easy to find out with some simple checks.

Cleanup

Next, remove the dirt from inside the set. This isn't a trivial "make work" activity. It often results in restoration of an older set. Many defects and faults are a direct result of the assorted debris that seems to infest electronic apparatus after a while.

The first step in the cleaning process is to use a small paint brush (see **Fig. 3**) to loosen and whisk away surface dust. Be gentle, though, because you don't want dust to settle into tube sockets and between variable-capacitor plates. A

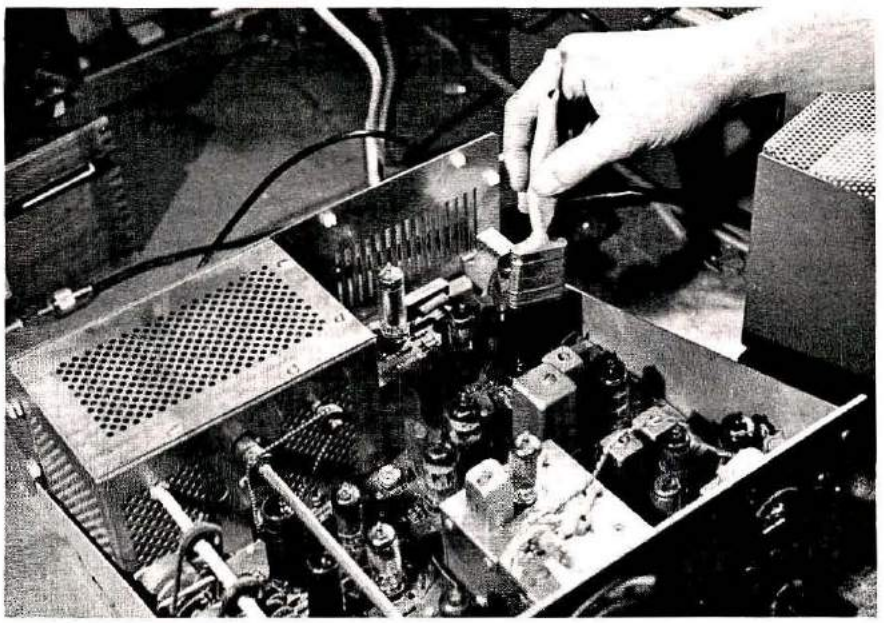


Fig. 3. Cleaning out accumulated dirt is essential. A small paint brush can be used. For cleaning inaccessible areas, use a stiff toothbrush. Blow out the loosened dirt with a compressed-air blast. Easy does it with delicate components!

small vacuum cleaner (for example, I use my wife's *electric broom* with attachments) is good for removing the dust loosened by the paint brush.

If dust and junk are found between variable-capacitor plates you may have a bit of a problem. The dust may short out stator and rotor plates, causing problems that vary from annoyances to spectacularly destructive arcing. One method for removing the dust particles is to blow them out with compressed air (Try your local gas station.) Compressed air in aerosol cans is available in several forms, one of which is the portable air-blast horns used by boating enthusiasts and bicyclists.

Liquid solvents

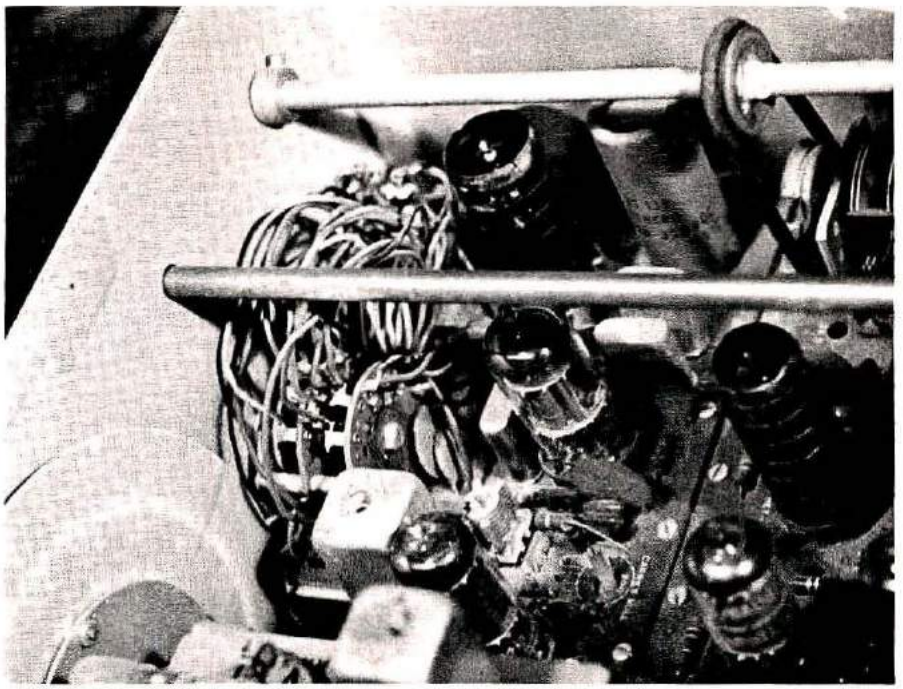
Never use liquid solvents on variable capacitors, and never disassemble a variable capacitor "for cleaning." Some who have done this have regretted it evermore . . . it seems that the dial calibration was never the same!

Liquid and aerosol preparations have their uses, however, and part of the cleaning process makes use of them. If the rig is more than a few years old, or was located near the kitchen, it's a good bet you'll find a thin film of grease on the chassis, printed circuit boards, and most tubes. If the tubes look and feel sticky, grease is present. The grease film retains dirt, so the set will take on a very cruddy appearance and that dirty film will conduct electrical currents! Rarely will the film have so low a resistance that the results are spectacular. However, the film will form unwanted feedback paths that can cause oscillations, reduced gain, and other problems.

Choose a solvent such as Freon TF, or a radio-TV-electronic circuit *degreaser*. Do *not* use switch-contact cleaner or TV-tuner spray for this application, especially the foam types. These preparations have their uses but are not recommended for general cleaning. Make sure that the preparation you select is safe for use on plastics and painted surfaces and that it doesn't leave a residue. Check it yourself. Don't trust the labels completely.

Next, clean all of the switches and controls (potentiometers) (see **Fig. 4**). Here is where you use those contact cleaner preparations. If you ask professional servicers about any given brand or product, you'll receive answers all the way from "it stinks" to "great stuff." Many have their

Fig. 4. An aerosol solvent can work wonders in cleaning rotary switches and pots. Make sure the solvent you use is approved for use with electronic circuits.



prejudices, but most brand-name cleaners work just as well as any other, even the cheapie house-brand stuff.

Spray the cleaner into the openings of the potentiometer housing and onto the surfaces of the switch contacts (rotary switches). Operate each control or switch vigorously for a few seconds immediately after applying the cleaner. Where the dirt is really bad and is hard to cut, it may be necessary to use a pencil eraser to scrape away the filth and corrosion. The operation should result in a nice, shiny metallic surface where there had once been nothing but black grunge. Be careful, though — those switch contacts are made of light-gauge metal and are easily damaged. They are delicate!

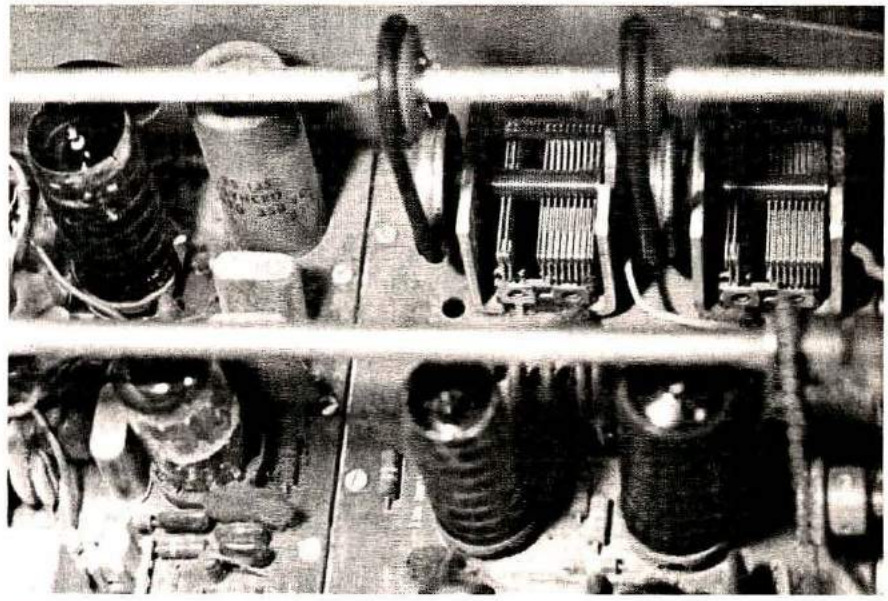


Fig. 6. Inside my transceiver, showing drive belts on capacitor-tuning shafts. If these belts are worn or have cracks, replace them with new ones. Don't compromise — you'll be ahead in the long run with new hardware.

Checking tubes

After the cleaning is finished, test all tubes. Even if the only tube tester available is a drug-store special (an emission rather than transconductance tester), you'll be able to spot the more gross conditions, such as very low gain and interelement shorts.* These problems tend to show up on even the simplest testers. I am *not* a fan of automatically "retubing" the set just because it has some age on it, for the simple reason that the largest number of premature faults tend to occur in tubes that are less than 90 days old! So just replace those which are bad, and do yourself a favor: don't use any hamfest auction specials of uncertain origin. Buy new tubes and you'll find fewer oddball problems to solve later.

Be sure to replace any missing tube shields. Many rigs have most of their tube shields missing. This can cause all manner of strange symptoms that are especially difficult to troubleshoot. Tube shields are used for a purpose. They

Fig. 5. Test all tubes. Don't forget the final-amplifier tubes, which may be easy to overlook. It's easier and safer to replace these essential tubes with new ones than to rely on supermarket tube checkers.

*Don't forget to check the final-amplifier tubes. These tubes are easy to overlook in many transceivers because of packaging, **Fig. 5**. Most drug-store tube checkers probably don't include these tubes in their tube lists. Even if they do, the results obtained are not necessarily indicative of such tube performance in a radio-frequency amplifier. You can take your final tubes to a fellow ham whose set uses such types and ask him to check them out in his rig. If his final tubes are working ok, it's easy to compare results with your tubes. Filament emission is probably the biggest cause of low output in final-amplifier tubes. If you're still in doubt, it's best to buy new final tubes.

isolate stages to reduce mutual interaction because of coupling between the tubes. The shields will keep one tube's field at home, while preventing fields from other tubes from getting into the circuit. Some types of tube shield are difficult to reinstall, so many servicers simply forget them — a very bad practice!

Miscellaneous hardware

The last step is to perform a general check of set screws, knobs, shaft couplings, fiber or nylon fittings, and rubber drive belts (see **Fig. 6**). Tighten screws and replace those that are missing. Make sure everything is tight and shipshape. If replacement rubber belts are not available from the rig's manufacturer, try using one from a phonograph or tape player. These are often available in sizes close enough to perform adequately. Check local wholesalers who deal with the radio-TV service trade.

Old drive belts can often be reclaimed unless they're deeply cracked and on the verge of breaking. Those same wholesalers sell a liquid rubber rejuvenator called *Vita-Drive*, which does a good job. It's intended for refurbishing tape-recorder and phono-drive components. Smear it on and let it soak in for a few minutes, then wipe off the excess.

The moment of truth

Once cleaning is finished, test the rig to see if it works properly. Don't be terribly surprised if the rig works a lot better now than it did before you started! This is not just a psychological boost of the sort that claims your car actually runs better following a wash and wax job. The dirt and grease really *do* deteriorate performance, even to the point of killing operation altogether. Dirt on those switch contacts, for example, can render the switch effectively "open." Nondecoupled current paths over a film of dirt and grease can cause regeneration that shows up as birdies and other audible oscillations, as well as silent oscillations, which reduce stage gain by quieting the receiver. Remove the dirt and grease and you remove the source of the problem.

But what happens if the set still refuses to resuscitate? At *that* time, a more detailed and sophisticated troubleshooting procedure is required. But even that's not an insurmountable task. It indicates that the rig should be sent to the shop. If troubleshooting proceeds, usually by signal injection or signal tracing in an orderly and logical manner, success should be close at hand.

Before doing anything, however, "desk check" the set by analyzing the block diagram and schematic in terms of known symptoms. Some stages are used in the transmitter only, others in the receiver only, and still others in both receiver and transmitter. If a trouble is known to exist in either or both sections, then about one third to one half of the stages can be excluded from consideration.

Remember, all electronic-circuit troubleshooting involves one or both of two things: finding a *missing* path for current or an *unwanted* path for current. It's in finding these open and short circuits that the successful troubleshooter excells. **HRH**

"Oh we have a very small apartment. It's decorated in early ham."

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MADE IN AMERICA

BY WILLIAM D. JOHNSTON, N5KR

All antennas have some form of directivity (**Fig. 1**). Shown are three popular amateur antennas. The vertical antenna radiates equally in all directions; hence it's called an omnidirectional antenna. The dipole antenna radiates most of its energy broadside to the plane of the dipole elements. A beam antenna (the Yagi in this example) is designed to radiate most of the energy in one direction. It can be shown mathematically that the antenna, whatever its configuration, transmits and receives energy equally. This property is called the reciprocity theorem. For those who wish to pursue the subject further, **Reference 1** is recommended.

Obviously, the beam antenna is ideal for DX work since it has desirable directional qualities and can be rotated to the appropriate position. Nevertheless, the wire dipole should not be neglected; it's easy to construct and is inexpensive. Although it can't be easily rotated (unless it's built from rigid tubing), it can be permanently mounted in a direction that favors a particular part of the world. The fact that it radiates and receives equally well in two directions can be a nuisance at times, but its mechanical simplicity and low cost outweigh many of its disadvantages.

There are, of course, many other types of antennas, but most are variations of the three types shown. Each has its own directivity pattern, which ultimately determines how it will be mounted and aimed.

Determining antenna pointing direction

Now that we've seen why it's desirable to not only have a directional antenna, but also to point it in the right direction, let's take a look at how to determine the exact direction to point the antenna for maximum benefit.

High-frequency radio waves, you will recall, travel around the earth by reflecting between

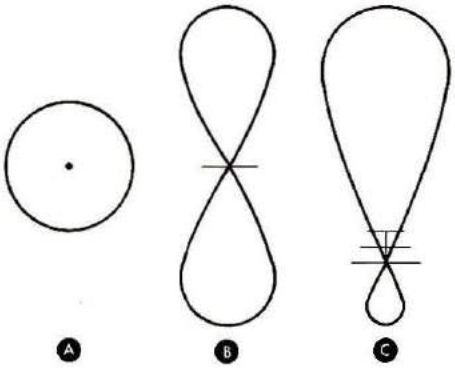


Fig. 1. Horizontal radiation patterns of three common antennas, vertical **A**, dipole **B**, and Yagi beam **C** (view looking down).

the ionosphere and the surface of the earth, (**Fig. 2**). The farther the signal travels, the weaker it becomes because of absorption and scattering. Consequently, we wish to point the antenna so it will be aimed along the shortest possible path between the two stations. The problem is that the earth has a curved surface, and the shortest distance between the two points (for our purposes) is not a straight line but curved (**Fig. 3**). This line is called the great-circle path, and the angle (measured clockwise, from 0 to 360 degrees) that it forms with a line running due north through your station is called the *great-circle bearing*. That's the bearing on which we want to set the antenna.

The great-circle path between two points on the earth's surface is often difficult to visualize. You can prove this to yourself with a globe and a piece of string. Hold one end of the string on Tokyo, Japan, and the other end on San Francisco, California. Pull the string taut (while making sure you're still holding it on San Francisco and Tokyo), and it will automatically line up on the shortest path between the two cities. Surprisingly, the path passes almost directly over the Aleutian Islands in Alaska. For that matter, the great-circle path between Tokyo and any part of the continental United States (except the extreme Southwestern corner) passes through Alaska. In other words, to talk to Japan, a ham in the U.S. should point his antenna toward Alaska!

The ionosphere is highly variable. At any given time, some parts of it may be in better condition for radio propagation than other parts, so at that particular time radio signals will travel better in some directions than others. If the ionosphere above the desired great-circle path happens to be in a bad condition, the signals will have to travel over some longer, more round-about route to reach their destination. Extensive studies[2] have been made on non-great-circle radio propagation; but as far as the ham radio operator is concerned, these variations are usually quite small. Extreme pointing precision is not justified, and finding the bearing to the nearest degree is more than adequate.

Long and short paths

If we extend the great-circle path beyond the distant station, the rest of the way around the world, it will return to the point of origin and complete the great circle (**Fig. 4**). So there are actually *two* great-circle paths between the two stations — a short and a long one.

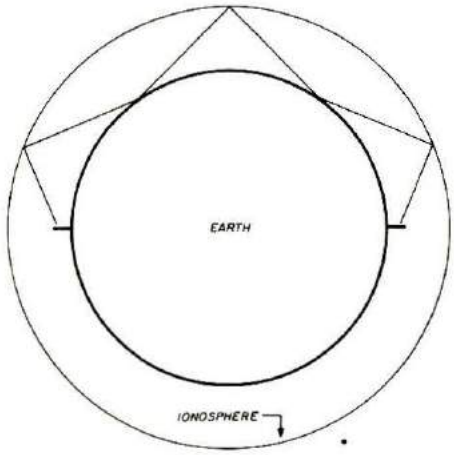


Fig. 2. Radio signals are reflected between the ionosphere, which is approximately 40-400 km (25-250 miles) from the earth's surface. The farther the signal travels, the weaker it becomes because of absorption and scattering.

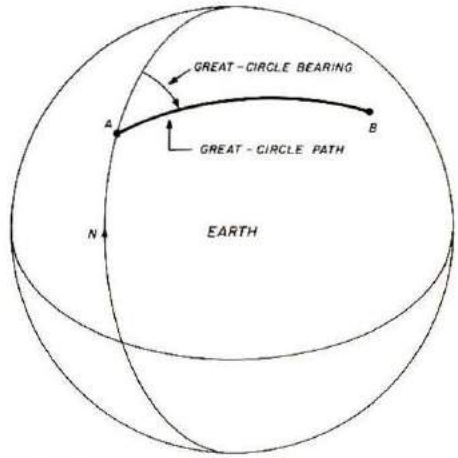


Fig. 3. The shortest path between two points, A and B, on the earth's surface is a curved line, called the great-circle path. The angle that this path forms with a line running due north through your station location, A, is called the great-circle bearing, which is the bearing to which you want to set your antenna to point at the distant station.

These are referred to, respectively, as the *short path* and *long path*; when we speak of the great-circle bearing, it's understood to mean the bearing that places the signal along the short path.

There are rare occasions when the band is simply not open (in other words, the ionosphere is not in good condition for propagation) in the direction of the short path but is open over the long path. In this case the bearing to be used is called the reciprocal or long-path bearing. It is simply the reciprocal (180° opposite) of the short-path bearing.

Let's now clarify something often misunderstood, even by experienced hams: what about the bearing that the *other* station should use to point *his* antenna toward you? Isn't it simply the reciprocal of the outward bearing from your station? The answer is an emphatic "No!" The bearing to which he must set his antenna is called the return bearing. Because the earth is spherical, the return bearing has no direct numerical relationship to the outward bearing. Depending on the relative locations of the two stations, the difference can be

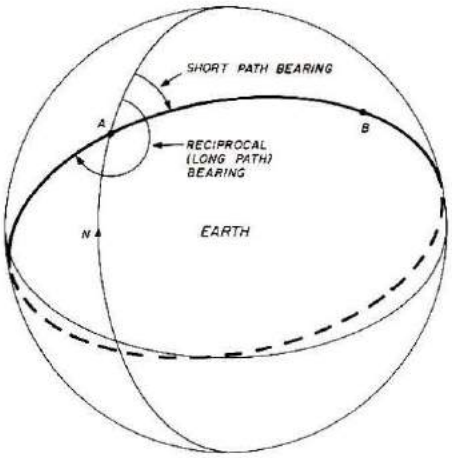


Fig. 4. If the great-circle path is extended beyond the distant station, B, it will complete the great circle and will return to the point of origin, A. Thus there are two great-circle paths between the two stations: a short path and a long path.

anywhere from 0 to 180 degrees.

An example of a difference of less than 180 degrees is easy to see. Suppose, for example, the great-circle path between two stations (on opposite sides of the world) happens to pass directly over the North Pole. Then both stations would point their antennas due north (a bearing of 0°) to line up with the great-circle path. Not only is the difference less than 180°, but there is no difference at all; both stations use the same bearing!

So be sure to remember the distinction: The *outward* bearing, usually called the *great-circle bearing*, is used to point your antenna toward the distant station over the most direct route (the short path). The *reciprocal*, or *long-path*, bearing is used to point your antenna toward the distant station over the long path and is 180° opposite the short-path bearing. The *return* bearing is used by the distant station to point his antenna toward you, over the short path, and it has no simple numerical relationship to your own antenna bearings. Finally, a bearing 180° opposite the return bearing would be the bearing the distant station would use to point his antenna toward you over the long path. Of course, the bearing you call the return bearing is that which the distant station calls his own outward bearing, and vice versa.

Finding directions with maps

An easy method of finding antenna directions involves the use of maps. Not just any map will do, however. To be useful for antenna pointing, the great-circle path between the two points should be easy to plot — preferably with a straight line. Of the many types of map projections only a few satisfy this requirement. The most common are the gnomonic, the Lambert conformal conic, and the azimuthal equidistant projections.

On gnomonic maps, all straight lines are great circles, and you can easily draw a line between the two points in question, then use a protractor to measure the angle (that is, the great-circle bearing) between that line and a line running due north through the location of your station. The measurement *must* be made at the point of your station location to get the correct bearing. You can also find the bearing on which the other station should set his antenna (the return bearing) by making a similar measurement on the map at the point of *his* station location. (Don't forget that the great-circle bearings are always measured clockwise, from 0 to 360 degrees, from due north). Unfortunately, distances are highly distorted on this type of map projection, and there's no easy way to determine accurately the distance between the two stations. Gnomonic maps are used in

An azimuthal equidistant map with a rotating transparent overlay for finding great-circle bearings and distances from the map center to any other location.

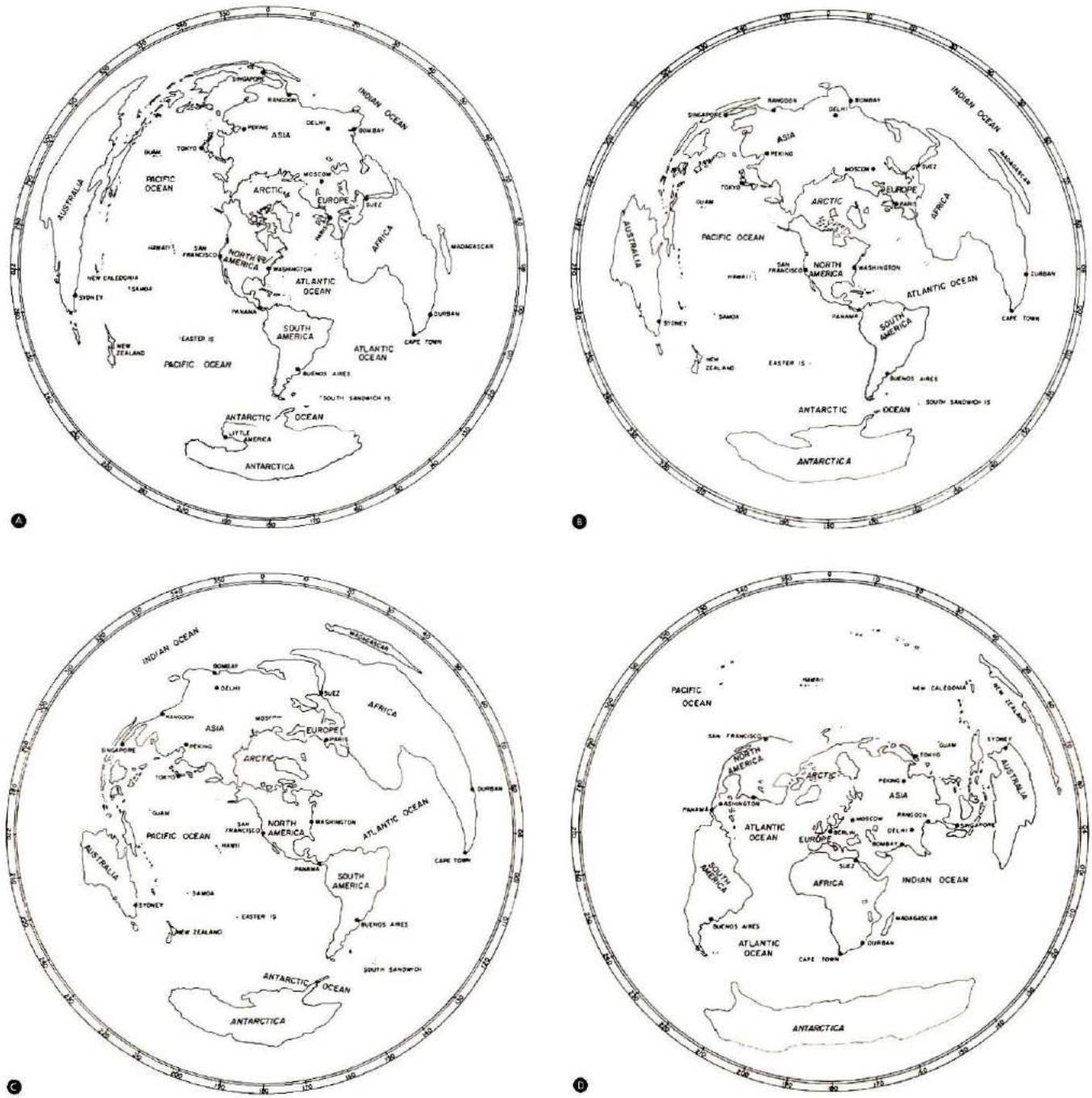
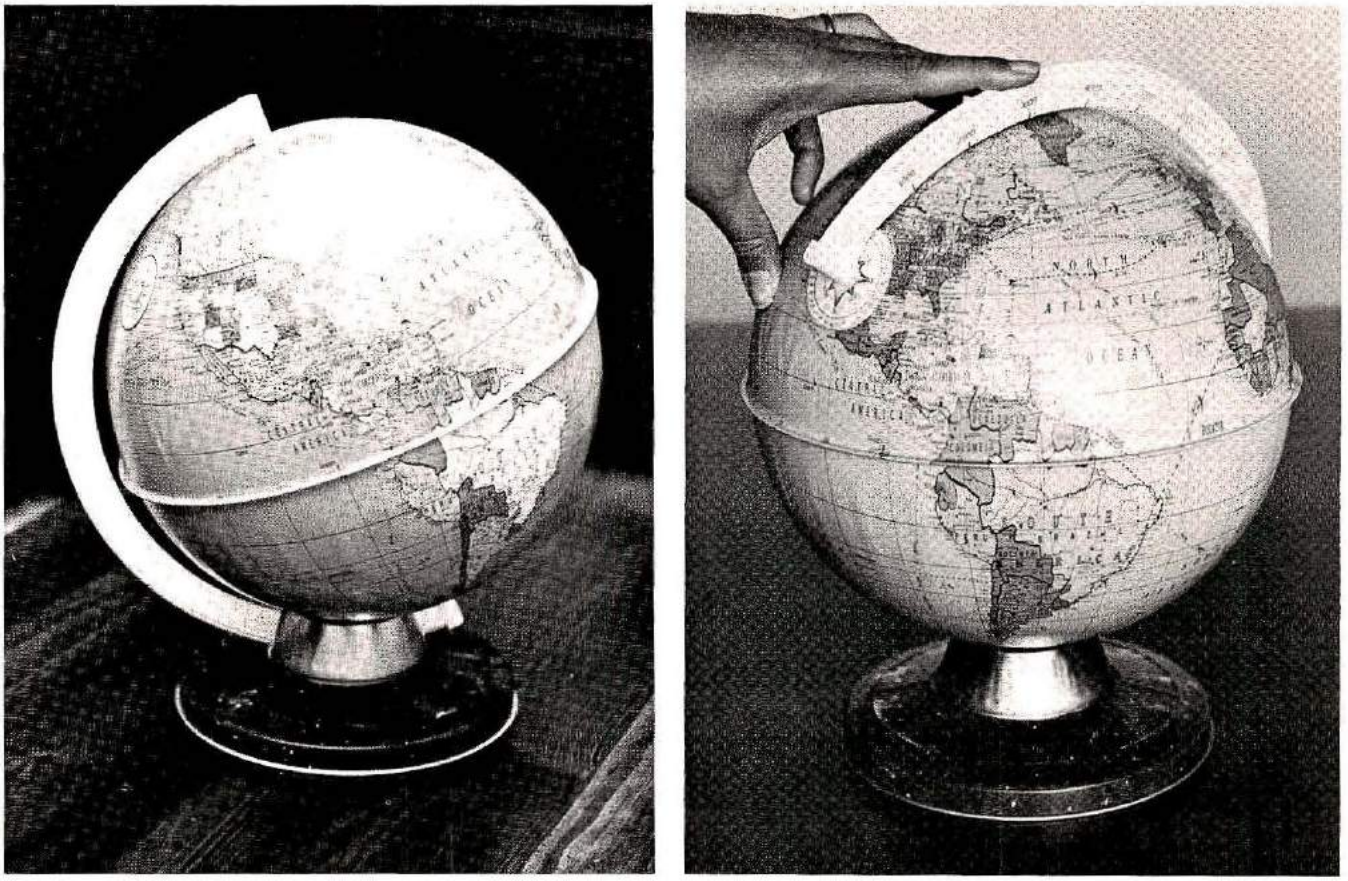


Fig. 5. Examples of azimuthal equidistant maps centered on various world locations. These maps are used by many amateurs for pointing their antennas toward foreign stations.

marine navigation, and are usually available through large marine supply outlets.

On Lambert conformal conic projections, a straight line closely *approximates* a great circle (the error is so small it may be neglected for our purposes), and the great-circle bearings may be measured in the same manner as described above. Additionally, distances are portrayed accurately and can be measured directly from the map. This projection is quite common and is used extensively in atlases. Sectional aeronautical charts and world aeronautical charts use the Lambert conformal conic projection. They may be obtained (for about $2.00 each) at any airport where light aircraft are rented or sold. If you have a friend who's a private pilot, he may be able to give you some used ones, as these maps are updated every six months and the old ones are discarded. One disadvantage of these maps is that they seldom cover an area more than a few hundred miles (or kilometers) across, and as such are not useful for long-range DX work.

We've seen two types of maps that can be used to measure both the outward and



The direction-finding globe before and after modification.

return antenna bearings (from which the reciprocal, or long-path, bearings can also be calculated if desired); and in the case of the Lambert maps, we can also measure the distance between the stations. This is faster than making the calculations by hand but requires plotting the line and measuring the angle with a protractor. The third type of map we'll look at speeds up the process by eliminating some of the work we have to do.

The azimuthal equidistant map

This map is made especially for use in finding radio bearings, and the map you should have has its center based on your station location. **Fig. 5** shows some typical azimuthal equidistant maps, each of which is centered on a different location. A scale of great-circle bearings is printed around the map perimeter. To use the map simply draw a line from the center (that is, from your station location), through the location of the distant station, out to the edge of the map. The correct great-circle bearing may be read directly from the scale at that point. Assuming a distance scale is provided with the map, the distance between the two stations can also be measured.

The map can be made even more elaborate with a minimum of effort. A piece of clear acetate can be cut to the appropriate size, with a distance scale made of chart tape placed on it. A pin is inserted through the origin (the zero point) of the scale then through the map center. The scale on the clear overlay can then be quickly rotated to line up with the DX station and the bearing can be read at the edge of the map. The distance is read directly from the rotating distance scale. If desired, the overlay can include a small mark in the opposite direction of the main scale to indicate the long-path bearing. Of all the available maps, the azimuthal equidistant map with a rotating overlay provides the simplest and fastest means of finding the outward bearing and distance to the DX station. It's probably also the cheapest map method.

Using a globe for finding directions

A great-circle-bearing and distance indicator can be made from an inexpensive world globe with only minor modifications. For best results the globe should be metal or rigid plastic and 20 to 30 cm (8 to 12 inches) in diameter. **Reference 3** provides instructions for making such a globe.

To duplicate the globe shown in the photos, proceed as follows: first remove the globe from its semicircular holder, then remove the holder from the base. Mount a threaded rod through the hole

in the base and attach a nut on each side of the hole to secure the rod. Mount the globe on the rod, using the existing holes at the north and south poles. Adjust the rod so that it emerges from the north pole just enough to accommodate a thin nut, which should be no more than 3 mm (1/8 inch) thick.

Now remove the globe from the rod. Drill a hole into the globe at the location of your station, then drill another hole at the antipodal point on the globe. The antipodal point is exactly opposite your station location on the globe. Drill these holes carefully to avoid marring the globe finish and to make sure they're properly placed.

The antipodal point is easy to find in terms of latitude and longitude. The antipodal latitude is the same as your own latitude but in the opposite hemisphere. For example, if your latitude is 38 degrees north the antipodal latitude point would be 38 degrees south. To find the antipodal longitude, subtract your longitude from 180 degrees, which will be the antipodal-point longitude, but in the opposite hemisphere. For example, if your longitude is 106 degrees west, your antipodal longitude would be 180-106 degrees, or 74 degrees east.

Next draw a compass rose (bearing indicator) on a sheet of paper about 4 cm (1 1/2 inch) in diameter. Cement the compass rose over the location of your station on the globe. Align the zero mark so that it points to true north on the globe; the 180-degree mark should point to true south. Make sure the compass rose is centered exactly over the hole you drilled for your station location. Smooth the paper compass rose so that it's flat. When the cement is dry, punch a hole in the center of the compass rose, so that the hole drilled previously will be open.

To remount the globe, run the threaded rod through the north and south poles and turn the top nut down so it almost, but not quite, touches the top of the globe. You may have to put a drop of cement on the top of the nut to hold it in place. The globe should turn freely. Now snap the original semicircular holder into place, picking up the two holes just drilled, and you're finished.

To find the great-circle bearing from your station to any other point in the world, turn the semicircular bracket until it's directly over the distant location. Read the correct antenna bearing from the compass rose at the point directly beneath the semicircular bracket.

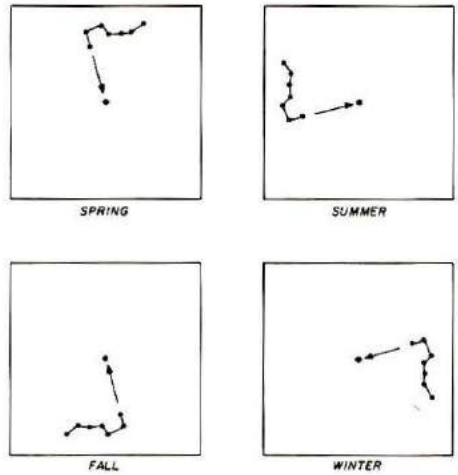


Fig. 7. The constellation known as the Big Dipper, in the Northern sky, is used to locate the North Star (Polaris). The constellation changes position with season and time, but Polaris does not move. The sketches show the approximate location of the Big Dipper constellation at 9 PM local time during the seasons. Note how the two outermost stars of the constellation always point to Polaris.

Fig. 6. Abbreviated example from a computer-generated great-circle bearing chart. Each chart is made for the user's exact location (available from the author at nominal cost — see footnote). This method of DX antenna pointing is the fastest, least expensive, and easiest to use of all those discussed.

NEW HAMPSHIRE, GREENVILLE
42:46N 71:49W

		BNG	MI	KM	RBNG
FW8	WALLIS AND FUTUNA ISLANDS	270	7631	12281	49
FY7	FRENCH GUIANA, CAYENNE	150	2872	4622	338
G	ENGLAND, LONDON	53	3282	5282	289
G	ENGLAND, MANCHESTER	51	3157	5080	286
GD	ISLE OF MAN, DOUGLAS	51	3058	4921	284
GI	NORTHERN ISLAND, BELFAST	50	2994	4819	283
GM	SCOTLAND, GLASGOW	48	3039	4891	282
GU	CHANNEL ISLANDS, GUERNSEY	57	3231	5199	290
GW	WALES, SWANSEA	54	3125	5028	287
HA,HG	HUNGARY, BUDAPEST	51	4176	6721	302
HB	SWITZERLAND, ZURICH	55	3752	6039	297
HBO,HE	LIECHTENSTEIN, VADUZ	55	3801	6117	298
HC	ECUADOR, QUITO	190	2997	4823	7
HC8	GALAPAGOS ISLANDS	206	3205	5158	19
HH	HAITI, PORT-AU-PRINCE	181	1674	2694	1
HI	DOMINICAN REP, STO.DOMINGO	176	1682	2707	357
HK3	COLOMBIA, BOGOTA	184	2635	4240	3
HKO	MALPELO ISLAND	195	2745	4417	11
HKO	SAN ANDRES ISLANDS	199	2167	3487	14
HM,HL	KOREA, SEOUL	345	6760	10879	14
HP	PANAMA, PANAMA	194	2396	3857	10
HR	HONDURAS, TEGUCIGALPA	209	2181	3510	22
HR6	SWAN ISLANDS	206	1889	3041	20
HS	THAILAND, BANGKOK	9	8497	13675	353
HV	VATICAN CITY	59	4107	6609	302

Computer-generated great-circle bearing charts

We've now come to the ultimate method for DX-antenna pointing in terms of speed, accuracy, and ease of use. It's

Table 1. Comparison of the various DX-antenna pointing methods showing advantages and disadvantages of each.

Method	gives outward bearings	gives distances	gives return bearings	shows intervening territory	accuracy	cost	speed
Mathematical solution by hand	yes	yes	yes	no	very good	very low	extremely slow
Mathematical solution with calculator	yes	yes	yes	no	very good	high	very slow
Gnomonic map	yes	no	yes	yes	good	low	slow
Lambert conformal conic map	yes	yes	yes	yes	good	low	slow
Azimuthal equidistant map	yes	yes	no	yes	good	low	fast
Direction-finding globe	yes	yes	no	yes	fair	moderate	fast
Computer printout	yes	yes	yes	no	very good	very low	fast

also the least expensive method! This pointing method has been used by hams throughout the world for a number of years and has been reported in amateur magazines.[4,5,6] The system uses the direct mathematical solution, but the work is done by digital computers. The result is a printed chart listing hundreds of distant locations with great-circle bearing, distance, and return bearing for each location. Each chart is generated by the computer for the user's exact station location.

A segment from a typical computer printout is shown in **Fig. 6**. The DX locations are listed alphabetically by international radio prefix and location followed by four columns of information. The first column, BNG, is the great-circle bearing in degrees for your antenna. The next two columns show the distance in miles, MI, and kilometers, KM. The fourth column, RBNG, is the return bearing, which you can give to the other station for pointing his antenna. The long-path (reciprocal) bearings, of course, are 180 degrees from the listed bearings. This type of printout can be placed in a looseleaf binder or in plastic document protectors, which are secured with a plastic 19-ring binding strip, to keep it handy. The chart takes up no more space than a single sheet of paper, and when a DX station is heard you can quickly look up the prefix and swing your antenna to the proper bearing. Once contact is established, you can let the other station know where to point his antenna and you'll have the maximum possible signal in both directions.

If you're interested in obtaining a computer-generated great-circle-bearing chart of the type shown in the table for your station, these charts are available from the author.* The chart will be made for your station location by an IBM 360 computer and lists 660 distant locations (half U.S. and half DX), along with bearings, distances, and return bearings. Be sure to include your mailing address and the location for which the chart is to be made. If you live in a rural area or in a town of less than 10,000 population, carefully describe your location with respect to other nearby towns so your latitude and longitude can be determined.

*Bill Johnston, N5KR, 1808 Pomona Drive, Las Cruces, New Mexico 88001. Send $1.00 for surface mail or $2.00 for air mail.

Finding true north

We've looked at some ways to find antenna bearings, but we must have a way to make sure the antenna is pointing in the wanted direction. Most antenna rotators have some sort of indicator mechanism. It's standard practice to turn the rotator until the indicator shows due north (0 degrees) then loosen the clamps on the antenna mast and turn the antenna so it's also aligned due north. The mast clamps are then retightened and the antenna is in proper calibration.

This is an easy procedure; however, what is not always so easy is finding true north. Note that I said *true* north, not mag-

netic north. All methods of finding antenna bearings are based on true north, so the antenna and its direction indicator must also be referenced to *true* north. Let's take a look at some ways to find it.

Those of us who live in the mid-northern latitudes have a ready and accurate reference — the North Star, also called Polaris, or the Pole Star. Polaris, for all practical purposes, is due north. It's a simple matter to sight down the boom of a beam antenna to align it with the star. Unfortunately, those who live in the Southern hemisphere can't see Polaris (and there is no equivalent south polar star). Those who live in the high northern latitudes (Alaska, for example) will find that Polaris is so high overhead that it's difficult to sight on. Nevertheless, most everyone in the U.S., Europe, and central Asia (where most hams in the world live) will find this a handy method.

Identifying Polaris is easy. **Fig. 7** shows how the outermost two stars of the Big Dipper constellation point to Polaris. As shown, the Big Dipper changes position with the season and the time of night, but Polaris always stays in the same spot. Don't expect Polaris to look like a lighthouse beacon; it's not a particularly bright star, but depending upon the time of night, it will be about the same brightness (or perhaps not quite as bright) as the stars in the dipper.

For those who live where Polaris isn't visible, there are several other possible solutions. An accurate street map of your town or a good topographic map can be used to sight on some prominent landmark, *if* you can accurately pinpoint your own location on the map. That bearing can be measured with a protractor, then the rotator indicator can be set on the same bearing while the mast is clamped into position with the antenna pointed at the selected landmark.

Summary

We've seen how the directional characteristics of antennas can be used to enhance both the received and transmitted signals by alignment with the shortest path (that is, the great-circle path) between stations in contact with each other. The angle that the great-circle path forms with a line running due north through your station is called the *great circle bearing*, which is the bearing to which the antenna should be set for maximum signal strength. To use the long path, your antenna should be set on the *reciprocal* (or long-path) bearing, which is simply 180 degrees opposite the outward bearing.

On the other hand, the bearing to which the distant station should set *his* antenna to point at you is called the *return* bearing, which has no simple numerical relationship to your antenna bearings. A bearing 180 degrees opposite the return bearing is that which the distant station would use for long-path operation. The bearing that you call the return bearing is that which the other station calls his own outward bearing, and vice versa.

We've also looked at a number of ways to determine the great-circle bearing to a given DX location; each method has its advantages and disadvantages. **Table 1** summarizes the features of the various methods.

Finally, we've looked at some methods to find true north and to calibrate the antenna direction indicator so that all bearings will be correctly referenced to true north. Polaris is an excellent reference for many, while others may find the magnetic compass or another alternative method more suitable.

Effective DX antenna pointing is not only simple but also improves both received and transmitted signals while reducing interference. So whenever you hear distant signals rolling in, swing your antenna to the *correct* great circle bearing — and happy DXing!

References

1. Frederic E. Terman, *Electronic and Radio Engineering*, McGraw-Hill Book Company, Inc., New York, 1955, pages 924-929.

2. Jurgen Rottger, DJ3KR, "The Determination of Some Parameters of the Equatorial Spread-F by Means of Trans-Equatorial HF Propagation on the Path Lindau, West Germany — Tsumeb, South West Africa," Technical Report, Max-Planck-Institut fur Aeronomie, (Germany) December 1972.

3. *The ARRL Antenna Book*, American Radio Relay League, Newington, Connecticut, 10th Edition, 1964, pages 292-294.

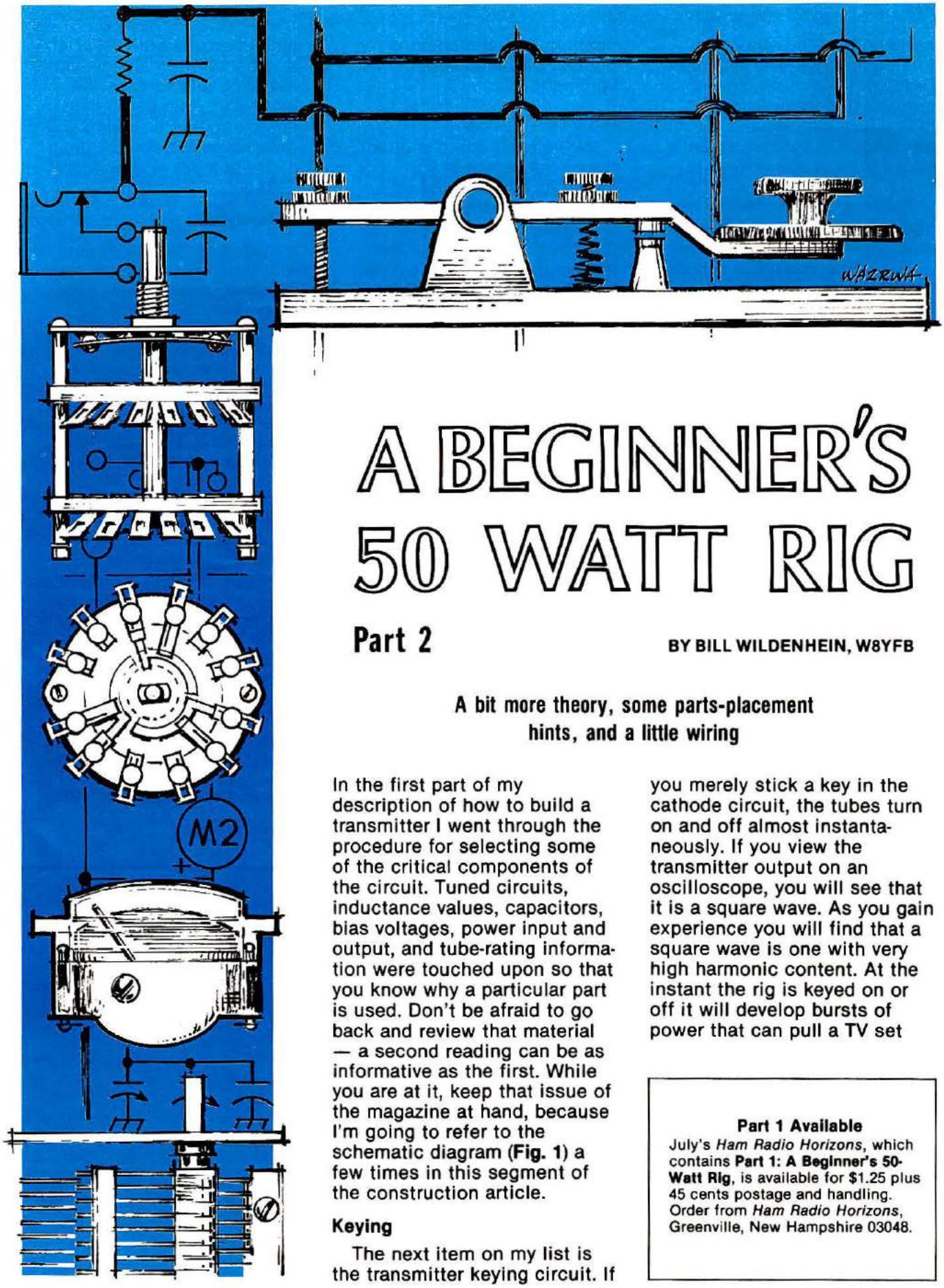
4. William D. Johnston, N5KR, "A Handy Chart for Great-Circle Bearings," *Radio Communications*, Radio Society of Great Britain, November, 1972, page 740.

5. Irvin Hoff, W6FFC, "Beam Antenna Headings," *ham radio*, April, 1972, page 64.

6. William D. Johnston, N5KR, "Great-Circle Bearings," *Break-in*, New Zealand Association of Radio Transmitters, September, 1973.

HRH

"He's not going to charm me by calling CQ!"



A BEGINNER'S 50 WATT RIG

Part 2

BY BILL WILDENHEIN, W8YFB

A bit more theory, some parts-placement hints, and a little wiring

In the first part of my description of how to build a transmitter I went through the procedure for selecting some of the critical components of the circuit. Tuned circuits, inductance values, capacitors, bias voltages, power input and output, and tube-rating information were touched upon so that you know why a particular part is used. Don't be afraid to go back and review that material — a second reading can be as informative as the first. While you are at it, keep that issue of the magazine at hand, because I'm going to refer to the schematic diagram (**Fig. 1**) a few times in this segment of the construction article.

Keying

The next item on my list is the transmitter keying circuit. If you merely stick a key in the cathode circuit, the tubes turn on and off almost instantaneously. If you view the transmitter output on an oscilloscope, you will see that it is a square wave. As you gain experience you will find that a square wave is one with very high harmonic content. At the instant the rig is keyed on or off it will develop bursts of power that can pull a TV set

Part 1 Available

July's *Ham Radio Horizons*, which contains **Part 1: A Beginner's 50-Watt Rig**, is available for $1.25 plus 45 cents postage and handling. Order from *Ham Radio Horizons*, Greenville, New Hampshire 03048.

out of sync every time you press the key.

By adding a little filter circuit (R9, C19), the problem is eliminated. C19 is a large-value capacitor, so it takes a relatively long time to charge and discharge; this rounds off the corners of the square wave. R9 can be from 15 to 27 ohms; C19 can be from 4 to 10 μF, and should have a voltage rating equal to the plate-supply voltage. C20 is a small ceramic disk capacitor (470 to 1000 pF) right at the key jack. Its purpose is to prevent any rf energy from sneaking out on the key leads. The leads should be shielded, with shield connected to the ground side of the plug.

Metering circuits

Most rigs have only a plate-current milliammeter; this is a mistake. If you include a means of measuring screen- and control-grid current, you now have "trouble shooting" meters, and, at the same time, you can continuously monitor the rig well enough to ensure maximum output. You will find a screen-current meter is far more useful than a plate-current meter in indicating amplifier conditions. You need to measure plate current to know your "watts input," but the screen-current meter warns of overload on the screen grid, is a far more sensitive indicator of correct loading, and indirectly will indicate variations in control-grid current.

The screen grid is easily damaged by overcurrent, so you must know what the allowable maximum screen current is. The RCA tube manual doesn't give a maximum screen current, but does list maximum screen dissipation in watts. Specifications for the 6DQ6 shows a value of 3.6 watts for screen grid dissipation. We have 165 volts on the screen, so the maximum current is:

$$I = \frac{W}{E} = \frac{3.6}{165}$$

$$= 0.021\ A\ (about\ 20\ mA)$$

In simple rigs you also see the screen-grid voltage obtained through a dropping resistor connected to the plate-voltage supply. This is bad, because as screen current goes up, the screen voltage goes down. When this happens, it becomes hard to guess what the screen dissipation is. Also, it is very difficult to optimize tuning for maximum output. So, I use a regulated screen-voltage supply. This requires only two voltage-regulator tubes, available new or surplus, plus one resistor. Then your screen meter will give a very positive warning of overload, and tuning becomes smoother.

Grid-current metering is necessary to indicate how well the oscillator stage is working, and to be sure that you are not under- or over-driving the amplifier tube. As you see, I have suggested three circuits that should be metered, but it can be done by two meters and a selector switch.

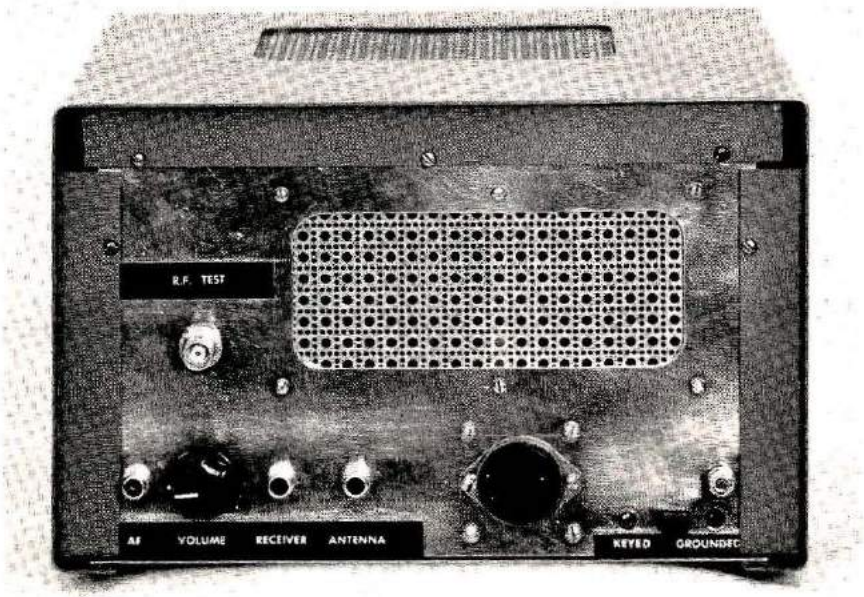
I've chosen inexpensive surplus meters of the type used as "tuning" indicators in home-entertainment equipment. These are generally very sensitive microammeters, so the circuit can be adapted to use them. In **Fig. 1 (Part 1** of this series), notice that the plate-current meter, M2, has a full-scale range of 250 mA. Resistor R19 is called a "shunt" resistor — it shunts most of the current around the meter. A small voltage drop will occur across it when plate current flows, and the meter can be made to indicate this voltage. If the value is 10 ohms, the voltage will be:

$$E = IR\ or\ 0.25\ A \times 10\ ohms$$

$$= 2.5\ volts$$

Therefore, the meter must function as a voltmeter with a full-scale range of 2.5 volts. The meters I used have a full-scale value of 300 microamperes, so a multiplier resistor (it *multiplies* the voltage reading) must be added to the circuit. This is R20; its value can be found by:

This rear view of the transmitter shows the connector for the cable from the power supply, lower right, and the switch for oscillator keying nearby. The BNC connector labeled "rf test" should be replaced with a phono connector like those used for af, receiver, and antenna. The volume control regulates the loudness of the tone from the built-in cw monitor circuit, which enables you to hear your code as you transmit.



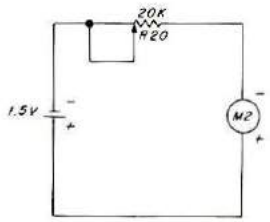


Fig. 10. This is the basic setup for calibrating the meters used in the transmitter. Start with the potentiometer set at *maximum* resistance to avoid damage to the meter. The calibration can be performed with the meter in the circuit, but with all power removed from the transmitter.

$$R = \frac{E}{I} = \frac{2.5\ V}{0.0003A} = 8333\ ohms$$

This resistance includes the internal resistance of the meter, so you could get by with slightly less than 8333 ohms. An adjustable resistor will do the trick — I used multi-turn "trimpots" from surplus computer boards. This provides a very simple way to set the exact value. You can use the ordinary single-turn PC-board type trimmer potentiometers if you have them. A 5000-ohm potentiometer in series with a 6800-ohm fixed resistor is a good arrangement that provides a smooth vernier adjustment.

When you calibrate this meter, always start with *maximum* resistance in the circuit for R20, otherwise the meter may be destroyed. The method used to calibrate the meter is shown in **Fig. 10**. Notice that the shunt resistor is not included. The voltage of a new common carbon-zinc cell (flashlight battery) is 1.55. Alkaline or mercury cells are different. If you connect the meter as in **Fig. 10**, and if you use the meter illustrated in the article, reduce the value of the resistor (R20) until the meter reads just a little bit above the third graduation (**Fig. 11**). This reading represents 155 milliamperes. R19 should, ideally, be a precision resistor — perhaps 1 per cent tolerance. You can use a new 5 per cent resistor and be reasonably accurate. You want R19 to run cool so the calibration will remain accurate. To do that, figure the wattage as:

$$W = EI,\ or,\ 2.5\ V \times 0.25\ A$$

$$= 0.625\ W$$

Use a 2-watt resistor. When switch S4 is in the "screen-current" position, the circuit is the same as for M2, and the shunt resistor is R18. To get a full-scale range of 25 mA, make R18 ten times as large as you made R19, or 100 ohms. This can be a new 5 per cent, 1-watt resistor. The multiplier resistor will be the same value as used before, since you are again making the meter read 2.5 V.

When you switch S4 to the "control-grid" position, the full-scale range is 2.5 mA. The shunt resistor is R7 in the amplifier control-grid circuit. This time you cannot use the same calibrating technique! In the screen- and plate-current circuits, the meter itself consumed an insignificant part of the total current. In the control-grid circuit, the meter will pass about 30 per cent of the total current, so another milliammeter must be used in series to calibrate the circuit. **Fig. 12** shows the calibrating setup. Be sure the "set pot" and R16 are both at *maximum* before connecting the battery. Adjust the set pot so the test milliammeter reads 1 mA. This may slightly upset the reading of the test milliammeter; the set pot is again adjusted so the test milliammeter reads 1 mA, and R16 again reset so M1 reads 1 mA. These adjustments interact, so it may be necessary to make two or three adjustments to get both meters to read 1 mA at the same time.

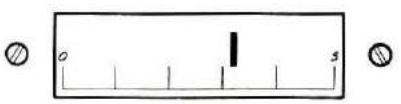


Fig. 11. If the meters are of the same type used by the author (purchased from Weinshenker, see parts list in **Part 1**), the initial calibration should place the pointer just above the third graduation.

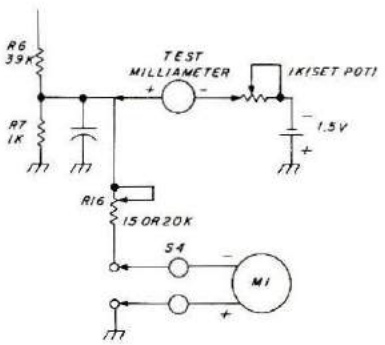


Fig. 12. Calibration of M1 in the "grid-current" part of the circuit requires placing another meter in series with it. You are, in effect, replacing the grid of the tube with the 1.5-volt cell, then adjusting R16 so that it agrees with the test meter. See text for detailed procedure.

Controls

Next, look at the station-control switch, S5 in **Fig. 1**. Only three positions are needed: transmit, receive, and spot. The spot position allows your receiver to operate and the crystal oscillator to run, so you can tune the receiver to the frequency of the crystal. Switch sections S5A, S5B, and S5C are on one wafer of a rotary switch; they all are handling dc voltages. Sections S5D and S5E are switching rf voltages; they are on a separate switch wafer to minimize coupling of the rf into the dc lines. You want your receiver to be inoperative while you are transmitting, so S5A breaks the receiver circuit. On both receive and spot positions, this switch turns the receiver on. On the receive and spot positions the amplifier screen is grounded. Before you go to the transmit position, you must be sure that your crystal oscillator is providing adequate drive. With the switch in the spot position, the oscillator and amplifier are keyed but the amplifier cannot operate because it has no screen voltage. Amplifier grid current can be adjusted if S4 is set to read control-grid current.

Some "soggy" crystals may occasionally stop working, and

then your plate-current meter would instantly hit the upper stop. Under these conditions, plate current will reach 300 to 350 mA, and the poor tube is dissipating 100 to 150 watts! It won't last for too many seconds at that power level, so it is essential to go back to the spot position and key the rig while watching the control-grid current. In my transmitter, one crystal refuses to run at 1 mA, although it works fine at 1.3 mA on the grid-current meter. Plate voltage is applied all the time to prevent the amplifier tube from damage in case a switch section fails and you end up with screen voltage on and plate voltage off. This means you must be careful! The only way to remove plate voltage is to turn the power supply off. *This voltage can be lethal!* Even if it doesn't kill you, the supply packs an awful wallop, and can slam you against a wall like a professional boxer.

Switch section S5D connects the antenna to the transmitter on the transmit position, to the receiver on the receive position, and leaves the antenna off on the spot position. Section S5E grounds the receiver antenna in the transmit position. If you leave the receiver antenna lead "open" when you are transmitting, enough rf voltage could be coupled to the receiver to possibly cause damage. Notice that the shields of each piece of coax connect to the same point; this helps to prevent stray coupling. Poor grounding here can cause signals to be coupled into the receiver even though the input is shorted.

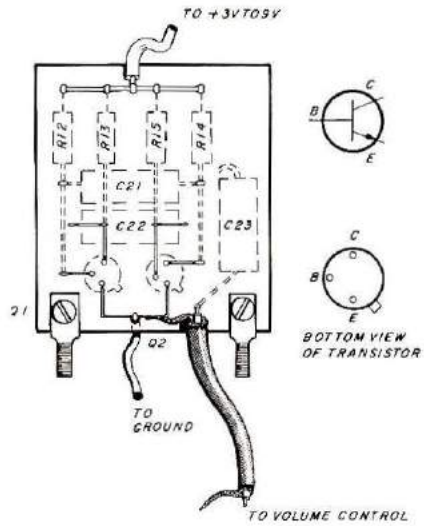


Fig. 13. A CW monitor can be made from a scrap of phenolic or perforated board. The components are mounted as shown, and the board is then fastened to the main transmitter chassis by means of the two spade bolts at the bottom of the board. Voltage to operate the oscillator is supplied by a small amount of rectified and filtered rf output energy, thus it will follow the keying of the transmitter. See **Fig. 1** in **Part 1** for component values.

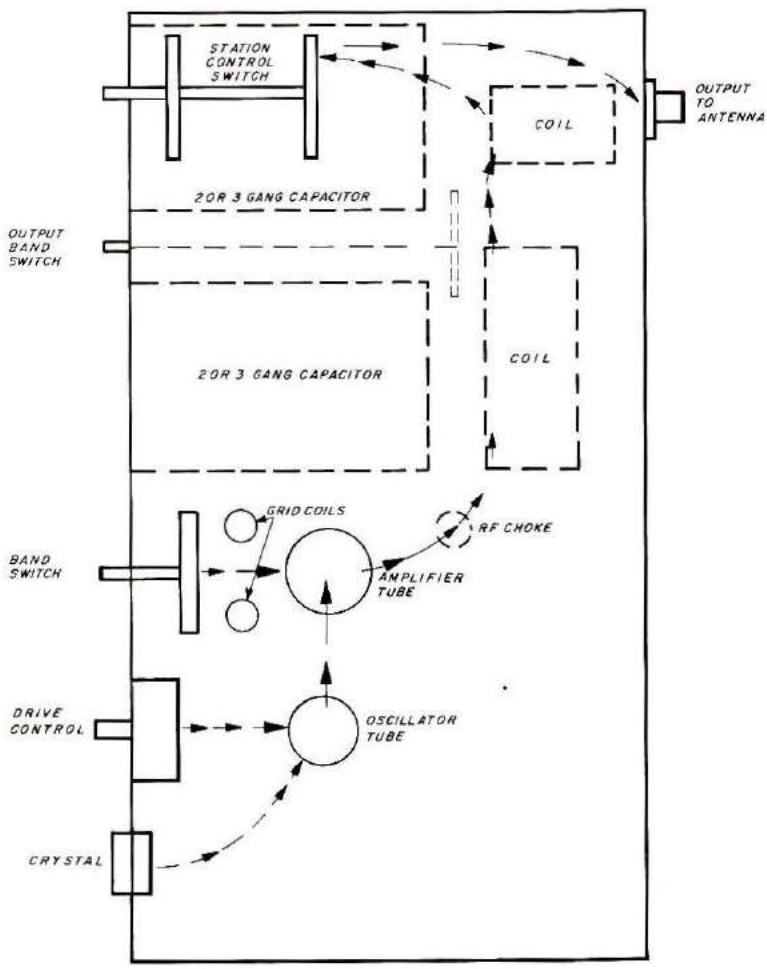


Fig. 14. It is important to consider the rf signal path when you start placing parts on the transmitter chassis. The arrows show the route from the crystal to the output jack. You should have all of the major parts before starting to plan the layout, and the initial one should be done on paper or cardboard. Only after everything seems to fit should you obtain a chassis and start to drill holes.

TVI prevention

Next is TVI filtering. Earlier, we discussed the use of bypass capacitors to prevent the rf voltages from going the "long-way around," back through the power supply. Bypassing is never 100 per cent effective. This rig is well bypassed, but if you leave out this filtering, you will find the power supply leads act as an antenna, and will radiate signals quite well. At the low power levels present in this transmitter, this simple filtering technique is quite effective, although it would be unsatisfactory at high power levels. The main concern here is radiation of harmonics in the TV range, so the coils and capacitors must be effective at high frequencies. The coils are simple, home-made, and self-

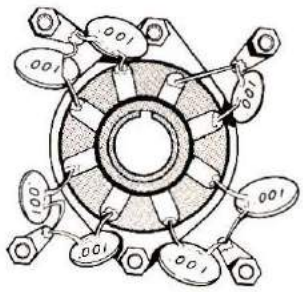


Fig. 15. Wire the power socket first. Mount all of the TVI-preventing capacitors as shown, keeping the leads short. The reason for doing this step first is that other parts will be mounted in front of this socket, making it difficult to get at later on.

supporting. The capacitors can be 470 to 1000 pF disk ceramic units with short leads. You can use capacitors on both ends of each coil, as with C28 and C30, if you wish. This will provide even better suppression of harmonic radiation. The layout as shown represents the minimum desirable bypassing.

You might think that the leads going to S5A do not connect to any part of the transmitter, and therefore shouldn't require filtering. However, those leads will act as an antenna and pick up rf signals inside the transmitter! The lead from S5E to the receiver antenna is not filtered! This lead is coax cable all the way, so it is shielded, and thus should not require filtering. In the same category, the lead from the key jack to the key is also unfiltered, except for C20 and R9. For this reason, use shielded cable to connect to the key, and make sure the shield goes to the ground side of the key jack.

Monitor

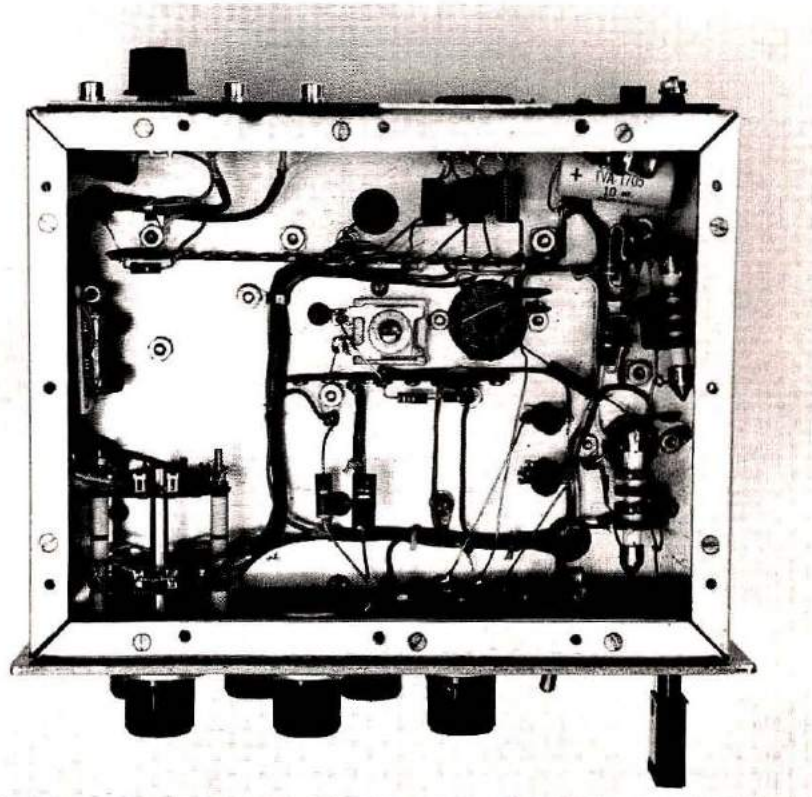
I've included a keying monitor in the transmitter. Many beginners' stations have no provision for monitoring the keying or output. Referring to **Fig. 1**, you find R11 and R10 form a voltage divider to drop the relatively high rf voltage to a low value. This is rectified by diode CR1, and filtered by C18, to make a "dc power supply" that will turn on and off with the keyed output of the rig. This power feeds the transistorized oscillator circuit. The suggested circuit values should be followed; the parts placement is shown in **Fig. 13**. Resistors can all be 1/2 watt; capacitors can be any type. R21 is the volume control. If you wish, you can mount two output jacks instead of the single one marked "keying monitor signal." One jack could run over to the phone jack on the receiver, and the earphones can be plugged into the other jack. Another very handy use for this circuit can be to add still another jack, and connect the center pin of the jack to the junction of CR1 and C18. You can plug a 0-6 or 0-10 Vdc meter into that jack and read the monitor power supply voltage. That voltage is a good indication of the transmitter output power.

In tuning and adjusting the transmitter, it is best to use a good dummy load such as described in October, 1977, *Ham Radio Horizons*. Such a dummy load can be an excellent standard. Using it, and a voltmeter connected as described, you can be very sure which combination of grid current, screen current, and plate current will produce maximum output. If you use a light bulb as a dummy load, you are kidding yourself in thinking you are actually setting up the correct conditions for maximum output, because the bulb's resistance changes radically as power is increased.

Chassis layout

Sooner or later you'll come to the moment where you must start fastening parts to the chassis. The process involves more than just making things look neat — sometimes symmetry has to be ignored in order to make the rig perform properly. Most layouts are a

This bottom view of the W8YFB transmitter shows the neat wiring and good separation of critical components. The mica trimmer capacitor near the center is part of the neutralizing circuit. The small section of perf-board along the left edge of the chassis contains the two-transistor cw monitor oscillator.



compromise between parts availability, good appearance, and clean performance. In **Fig. 14**, I have shown the rf path from the crystal, through the other parts of the circuit, to the coaxial output jack. Note that the path flows generally in one direction and does not loop back upon itself. This is the secret to a parts layout that will not cause instability in any equipment — transmitters, receivers, or even audio amplifiers. Remember that as the signal is passed from one stage to another, it is increasing in amplitude, and by the time it reaches the output connector, it has grown from milliwatts to several watts. If any portion of this high-powered signal reaches the sensitive first stage, it will oscillate at a frequency of its own choosing!

Your first move is to obtain all necessary parts so you can "play checkers" with them to get a good physical layout. **Fig. 14** shows some basic principles: the amplifier output components, operating at high power levels, are located on top of the chassis to shield them from the low-power-level components mounted inside the chassis. Equally important is the route of the rf energy from crystal to antenna; the arrows in **Fig. 14** show this path.

Only after you get a good layout should you consider a chassis or enclosure. The rig I built uses a 17 x 22 x 5-cm (7 x 9 x 2-in.) chassis. This is the smallest size you should use for your first rig. As you plan the layout, refer to **Fig. 1** of the theory article (**Part 1**). The heavy lines indicate leads which can be long, can be cabled together, or run strapped down to the chassis. The thin lines in the section marked "basic transmitter" should be short and direct, and mounted well clear of the chassis or large metal areas. Your layout should be largely planned around these thin lines. It helps to make a rough drawing to plan these wire runs. For example, it would be wise to orient the oscillator tube socket so the plate pin faces the control-grid pin of the amplifier-tube socket. Then space them so the coupling-capacitor leads, C5, will reach between the two points.

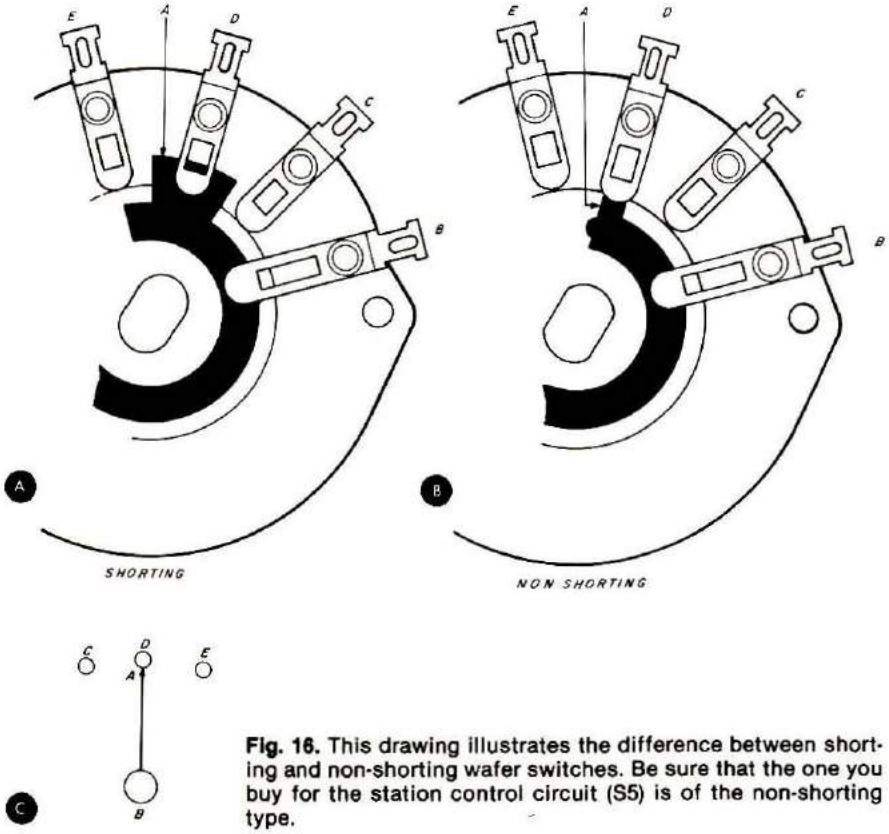


Fig. 16. This drawing illustrates the difference between shorting and non-shorting wafer switches. Be sure that the one you buy for the station control circuit (S5) is of the non-shorting type.

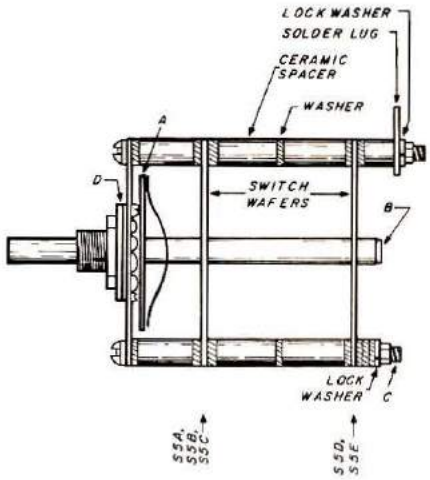


Fig. 17. Sometimes you can buy switches in kits, and assemble your own. This will help you identify the parts of a typical wafer switch. The washers are usually of a fiber or phenolic material, and are used to cushion the ceramic spacers against mechanical strain.

As you do the layout, plan things so mounting screws aren't in inaccessible places. At all times, keep these questions constantly in mind: "Can I later easily replace this part? Can I get test probes on this connection?" Having decided on the appropriate chassis size, the next consideration is shielding for TVI. There is a lot of harmonic energy present in the various circuits. You want to bottle up the entire transmitter to keep the rf inside, and allow it out only through the harmomic-reducing amplifier-output network. Almost no commercial enclosure will meet this requirement, so if you wish to use one, use it only for looks, but slide a completely shielded transmitter into the enclosure. The shielding and enclosure must also provide adequate ventilation, because the tubes generate a great deal of heat. One simple solution is to build a box to cover the tubes and above-deck components.

The enclosure can be built from aluminum angle and perforated sheet aluminum commonly available from

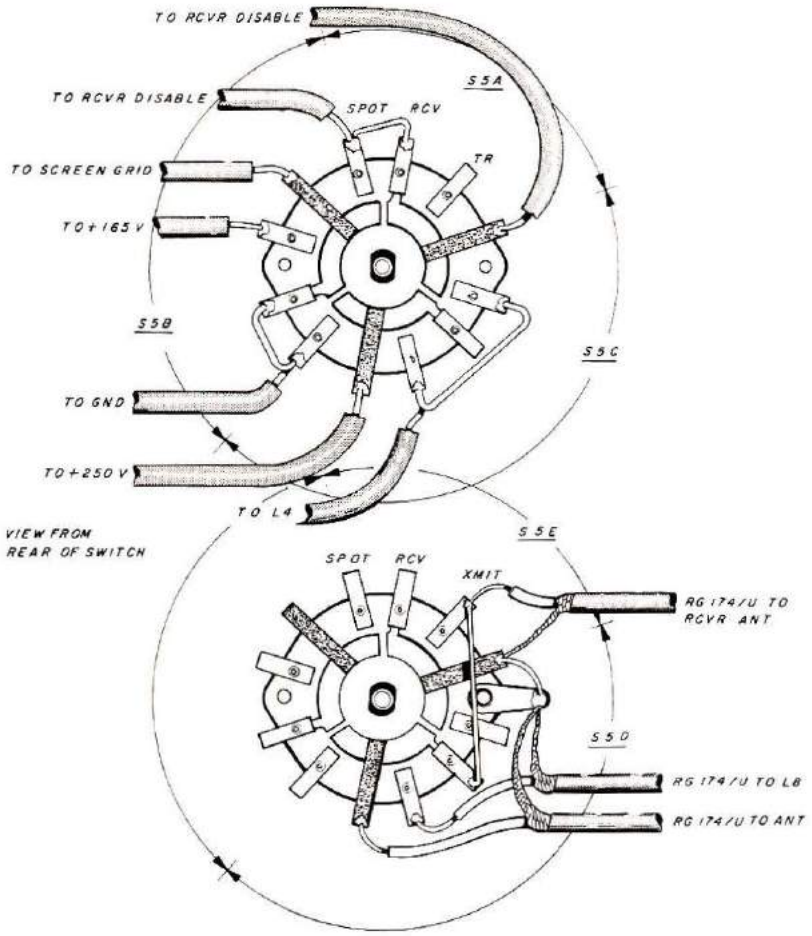


Fig. 18. A wiring guide for the wafers in S5, as seen from the rear of the switch. Note that S5D is wired with miniature coaxial cable; other sections are wired with ordinary stranded hookup wire.

hardware and discount stores. If you have a choice, use perforated aluminum with the smallest diameter holes. A common rule of thumb in this work is to use holes no larger than 3 mm (1/8-inch) diameter for most effective shielding. A second technique is to bolt strips of aluminum angle stock to the sides and top of a front and rear panel, then bend a "U" shaped perforated-aluminum piece to completely cover the entire chassis area. Thus, the entire shielded assembly can be slid into an enclosure with assurance that the harmonics are well enclosed.

The chassis should be fitted with a bottom plate. Normal practice is to fasten the bottom plate and any shielding with screws 5 to 6 cm (2 or 2-1/2 inches) apart. For instance, if the bottom plate is secured with just one screw in each corner, the metal surfaces would form a slot between the screws that can easily radiate vhf signals. To get proper alignment of the many screw holes, use several C clamps to secure the bottom plate to the chassis before drilling. In the same way, clamp a panel to the chassis and drill through both to ensure alignment of shaft holes.

If you use standard-sized rotary switches for S1 and S5, be very careful to keep the switch mounting holes carefully centered in the chassis, because the switch has very little clearance, top and bottom, in the chassis. When drilling the mounting holes for L2 and L3, remember that these have to be nice, clean, round holes, accurately sized. The best solution is to use a tapered reamer available at most houses supplying parts for the TV service trade. Start with a smaller hole, then carefully ream it to desired size. The variable capacitors mount to the chassis, and the shaft is usually offset from the capacitor center line. If you are in a hurry, you might lay out that offset on the wrong side, or locate holes so the shaft binds, warps the capacitor frame, and shorts the plates.

Finally, complete all drilling and mechanical work before wiring is begun. Chips have a nasty way of hiding, only to later drop out and cause short circuits. I find that most beginners, and many old timers, are in too much of a hurry to do the mechanical work — as if it were only a necessary evil. If you take pains to do each part with care, you can have a "commercial" looking piece of gear that is far easier to assemble, wire, and service. Don't expect to complete it in an evening or two. Figure on a solid week of spare time at least! Listen to yourself think. If your thoughts say, "That celluloid rule my kid has ought to be good enough," or, "That capacitor shaft is a little over 3/4 inch above the chassis — 3/4 ought to be close enough," you will probably build a rig just good enough to get a solid signal report out of the FCC!

Now you can begin wiring; this work starts by wiring the power socket as shown in **Fig. 15**. Mount all those TVI-proofing capacitors while the chassis is empty to save later grief. Second, pre-wire the station control switch, S5. This switch must be a "non-shorting" type. **Fig. 16** shows how to identify this type of wafer. Notice in **Fig. 16A** that the moving contact (marked A) has a broad blade that will short two adjacent terminals together during the time the switch is moving from position to position. Compare this to the very narrow contact in **Fig. 16B**. This switch will break

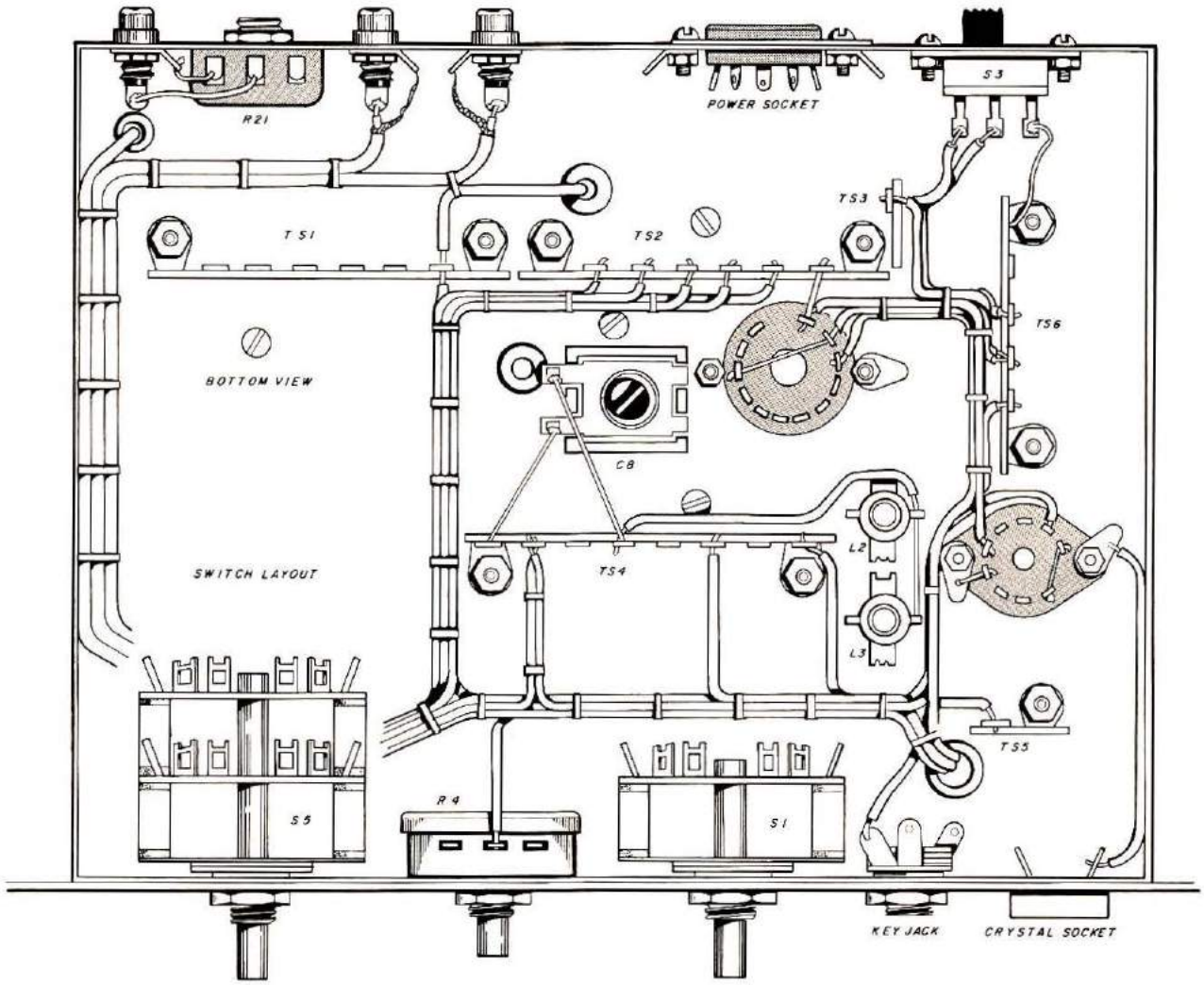


Fig. 19. You can use this drawing as a guide to placing the major components under the chassis, as well as a wiring guide. The wires shown here bundled into cables are the non-critical ones that can be placed neatly out of the way or flat against the chassis. Double-check each connection against the schematic diagram (**Fig. 1** in **Part 1**).

contact before moving to the next position. This is very important in the station control switch. You do not want the transmitter to remain on when the receiver is connected!

All sections of the station-control switch *must* be non-shorting; the other switches can be either type. If you can't find the desired switch in surplus, you can purchase new Centralab switches. You will need a Centralab P270 index assembly (the shaft and hardware); the inexpensive phenolic switch wafers are completely adequate. The Centralab type LD wafer is a 3-pole, 3-position switch; you need two of these. For S1 you can use the same P270 index, and a Centralab type KD or CD wafer; these are 2-pole, 5-position wafers. The same wafer and index assembly is used for S2. **Fig. 17** shows how the switch is assembled. Certain precautions are essential: if you wish to shorten the shaft, **B**, it can be done with a hacksaw, but be sure to file the burrs from the end of the shaft! File a slight chamfer on the end of the shaft to enable the wafer to easily slide on. Never force a wafer onto a shaft! The delicate switch parts will be distorted, leading to an intermittent or short-lived switch.

The P270 kit has many phenolic washers which should be used as shock absorbers at the ends of each ceramic spacer, as shown in **Fig. 17**. If these are not used, the slight shock when switching, or pressure when tightening the assembly screws, can crack the ceramic spacers. Also, there is almost zero clearance in the tolerance between the detent ear and the spacers (Point **A** in **Fig. 17**). When assembling the switch, slightly tighten the assembly screws, then insert a small screwdriver tip at point **A**, and gently pry the spacers away from the detent ear before tightening the screws fully; do this on each screw. Next, set the detent stop disks (**D**) to limit rotation to only the desired switch positions. Rotate the switch to see if the detent ear sticks as it passes the spacers. If it does, loosen the offending screw, slightly

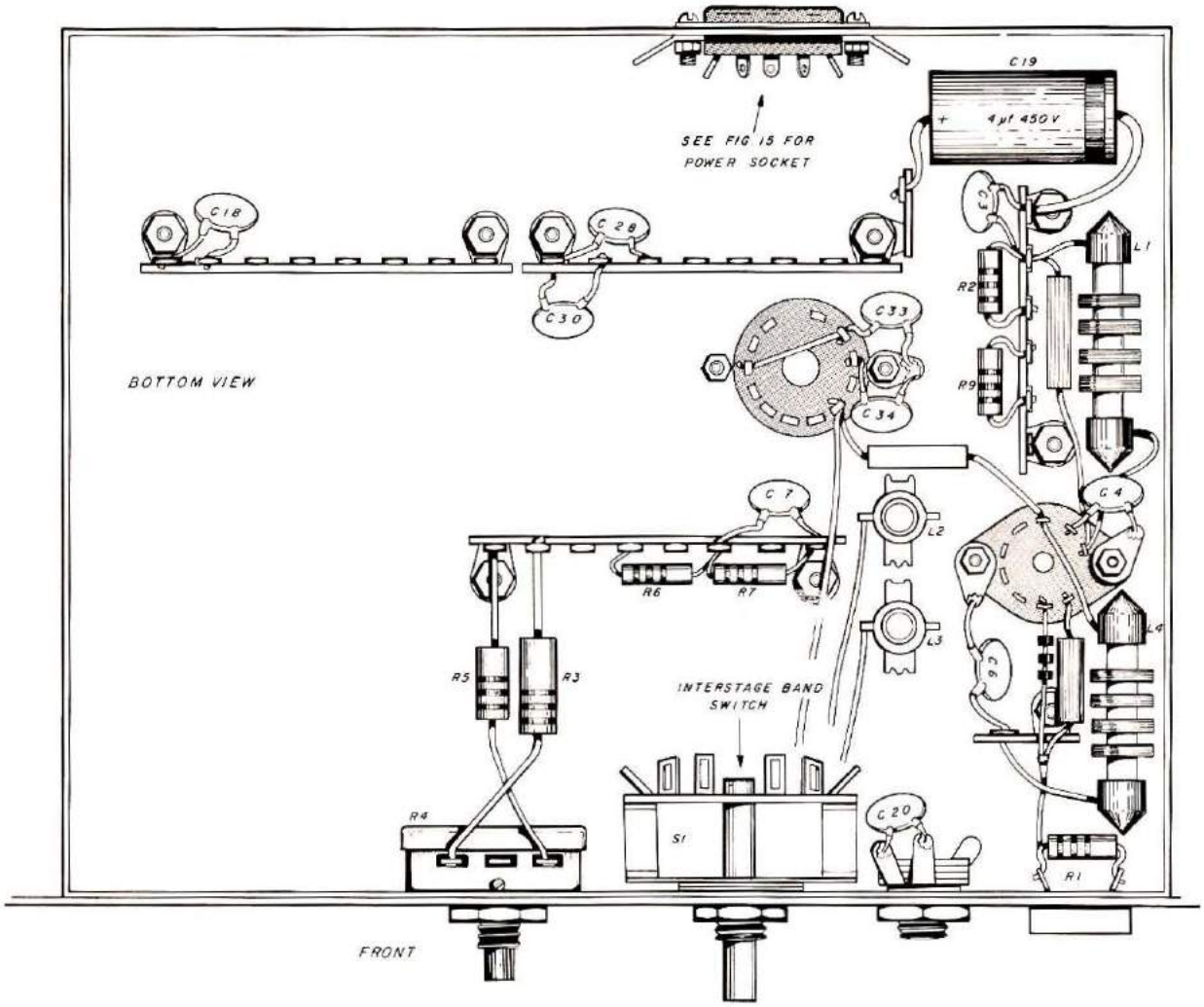


Fig. 20. The components shown are the critical ones, which should be mounted away from the chassis and each other. Lead lengths and parts placement are very important here, so check yours against this drawing and the photographs to be sure you have it as much like the original as possible.

rotate the ceramic spacer, again pry gently, and tighten.

In a few cases I have had to disassemble a switch and slightly file the detent ear. For that reason, use care in cutting off excess assembly-screw length. Use a fine-toothed hacksaw, then carefully file the screw ends so the tiny nuts can be easily screwed on and off; you might have to replace a wafer sometime!

Fig. 18 shows how to pre-wire the switch before mounting it in the transmitter. Use lengths of No. 22 (0.6 mm) stranded, plastic-covered wire of different colors (identify each wire end), as you pre-wire sections S5A, B, and C. A handy trick here is to first bare about 6 mm (1/4-inch) of the wire end, re-twist the strands, and tin it. Bend a tiny hook in this wire end, hook it into the switch-lug, and you can get a neat solder joint without a wild strand of wire that can short out a switch segment. Another important precaution: wafer switches, some variable capacitors, and other radio parts have silver-plated solder-lug points. When new, silver plating solders very readily; used or surplus components may have oxidized silver plating which will not take solder. Use a small brush with fine steel bristles, or a small wad of fine steel wool, to polish these surfaces before you attempt to solder them. S5 in particular must be wired with extreme care, because once it is mounted, it will be difficult to re-solder a poor joint or make any circuit corrections. Similarly, when terminating the other end of the wires from the switch, be sure the point is the correct point. If the wire is cut to proper length and is the incorrect wire, the entire wire may have to be replaced.

S5D and S5E in **Fig. 18** are prewired with lengths of RG-174/U miniature coax. Notice that each shield braid goes to a small solder lug fastened to the end of the switch-assembly screw. It is helpful to slide short lengths of insulating sleeving on these braids before soldering to prevent shorts later. Label each coax before mounting the switch.

Now you can add all the other components. Regardless

of whether new or old components are used, take time to clean the leads before soldering. Used TV parts always have a coat of grime; a rag dipped in 91 per cent isopropyl alcohol (drugstore kind) will restore their appearance. **Figs. 19** and **20** show how components are placed. If you wire the chassis in this manner (long leads cabled against the chassis, components and rf wiring up in the air) you'll have a neat rig. If you are sloppy it will look like a backlash on a fishing reel, and work just the way it looks.

At this time you can wind the little TVI-filtering coils. These are about 30 cm (12-inch) lengths of No. 18 to 22 (1 to 0.6 mm) enameled wire close-wound on a 6-mm (1/4 inch) diameter form such as a drill shank. The exact number of turns is not too important. While the coil is still on the drill shank, carefully scrape the enamel from about 6 mm (1/4-inch) of each wire end, all the way around the wire. It is easier to do this while the wire is still on the drill, as it allows the coil to be held firmly without crushing it. Now tin the wire ends, slide the coil off, and mount it between the lug strip and the power socket. If you are using parts from scrap TV sets, be sure to check each and every part.

That's all there's room for this month. In the next part of this series I'll go over the details of the power supply with you, and talk about the transmitter tune-up and test procedures. Remember, go slowly, and refer to the schematic diagram and the photographs to be sure you have the right parts in the right place. If you cannot find the exact chassis size that I used, you can use one that is larger. Remember the rules for parts placement and lead length, and you'll have a transmitter that looks great and works so well you'll be proud to say, "The rig here is home brew!"

HRH

station design

BY KARL T. THURBER, JR., W8FX/4

How to plan the site for your ham station and set up your equipment

Now that you've gone through the rigors of studying for, and passing, the FCC amateur exams, whether for Novice, Technician, or General class, and have your license, the next problem arises. It's one that may not really hit you squarely until the long-awaited ticket arrives in the mail: what to do about the ham shack?

Some newcomers meticulously plan for months in advance for that first radio contact: they find a suitable operating location, buy and install equipment and accessories, and generally are ready to go when the time comes. Others give it little thought until the license arrives. Regardless of your approach, a carefully designed and planned station will contribute much to your operating pleasure and convenience.

This is the first in a series of articles on setting up the ham shack: where to put it, how to arrange it, how to connect equipment, and how to make the station safe. We'll also take a look at getting set for emergency operations. We *won't* be looking closely at basic equipment and accessory selection — this subject has been covered in other articles.[1]

The ham shack

You might wonder just *where* the term "ham shack" came from. The origin of "ham shack" is clouded in the annals of radio history. Guglielmo Marconi is frequently credited with establishing the first "radio shack." An avid experimenter, Marconi established laboratories in England, Newfoundland, and Long Island, New York around the turn of the century. Marconi's Newfoundland shack was installed in 1901 in an abandoned military barracks overlooking the St. John's

[1]See Bibliography at end of this article.

harbor. In it, Marconi received the first wireless signals to span the Atlantic on December 12 of that year, setting the stage for the development of radio communications as we know it today.*

The 1901-version shack, obviously, didn't resemble a modern installation at all. Much of the early wireless equipment was noisy, dangerous, and smelly, so that experimenters were frequently relegated to outdoor facilities such as barns, sheds, and *shacks*. Most early installations were characterized by their rough-hewn nature and frequently were unheated, drafty, poorly lighted, and generally undesirable quarters. Since these small structures hardly deserved to be called "buildings," it was common to invite other experimenters over to see the "shack." Gradually, over a period of time, this term was commonly accepted as slang applying to any "radio room" in general, even after advances in technology made it practical to move all that messy stuff indoors.

Today, the "shack" still refers to the radio room, whether a dedicated building or a corner of a tiny bachelor apartment. Regardless of the quarters, it appears that the concept of the "ham shack" will always be with us.†

The shack: where to put it

Not everyone has the opportunity to build his own specially designed ham shack, which doubles as house and home for the XYL (wife) and harmonics (offspring). But for those who have the opportunity to build their own home, here are a few observations as to what makes for a good ham location. They should be helpful, too, in shopping for a home with ham radio in mind.

Naturally, the site is the first consideration. In general, the more elevated sections of the city or town are more desirable (and expensive) from a residential standpoint. They also offer better locations for antennas — this is especially important for work on higher hf and vhf/uhf frequencies. A location fronting on major highways and busy through streets carrying heavy traffic should be avoided, unless you like to operate with your noise blanker on all the time! The dead-end street is often a good bet, since it's usually far enough from sources of man-made noise (as from autos, stores, and industry). A separate ground-floor wing in the rear of the house is probably the ultimate in ham shacks.

Choosing a site

Local restrictions on land use and zoning ordinances may preclude installing a first-class "antenna farm," so check into this aspect before signing on the dotted line. Also bear in mind that the trend today is toward tighter and tougher restrictions on anything that adversely affects the environment — and this includes antenna towers as well as the radio-frequency energy you generate. Of course, these restrictions impact even more strongly on the ham who must look for housing in apartments, town houses, condominiums, and mobile-home parks.

Even if you're able to build or buy with ham radio in mind, your ultimate choice will probably be a compromise that will depend, as for most of us, on price, distance from work, personal finances, and transportation. The ham shack will be a secondary consideration.

Choosing your station placement in your home

Assume your choice of home-site has been determined. The next problem is to decide on the shack location within your home. Its location depends on several factors, not the least of which is the space available for its installation. Few amateurs can devote space for a specially designed and custom-finished room dedicated to hamming. Many stations must be installed in a corner of a bedroom, attic, garage, or basement — not necessarily bad locations, but possibly a bit restrictive. Not a few hams have installed their stations inside large hall closets when all else has failed!

If you intend to spend only a small amount of time on ham radio, consider designing your shack to serve multiple purposes, such as a recreation room or den. But if you're an avid hobbyist, it's best to dedicate an area *strictly* for ham use if at all possible — one in which you may be able to combine transmitting station, study area, technical library, and possibly even a workshop.

If you're severely limited as to space, consider breaking up the station into: 1) an operating core, which contains only transmitting and receiving equipment and accessories

*An excellent review of Marconi's early work appears in Jim Fisk's editorial on page 4 of *ham radio*, January, 1978.

†As author Thurber points out, the origin of the term "radio shack" is uncertain. In the early days of wireless communications (or radio as we now know it), stations were required on board ships by law. The ships had no place for wireless stations, so early radio sets were installed in a makeshift manner wherever it was convenient on the vessel. Usually the wireless station was built in a small area abaft the bridge on the top deck of the ship. If it was a large vessel, a bunk was included for "Sparks," the wireless operator. But more often than not, the wireless room was tacked onto existing superstructure and consisted of a small cabin just large enough for the operator and a spark transmitter. Hence it was called a "shack." Generally it was large enough for one man, his wireless equipment, and no more. So the "radio shack" still exists. It contains much more today than it did 75 years ago. Who knows what the radio shack will be like in another generation? **Editor.**

(which can be tucked into a corner of a bedroom or family room); and, 2) a workshop with its peripheral equipment such as test gear, tools, books, technical data, and files. The workshop can be located in the basement, attic, or garage. If the attic is uncomfortable because of summer heat and winter cold, or if the basement is damp and musty, it's not a good idea to install your station there anyway.

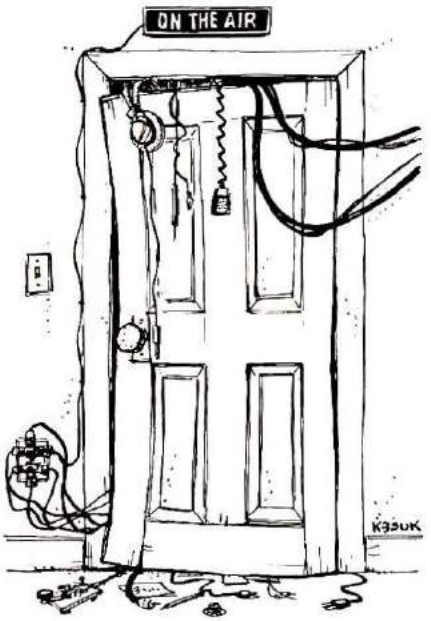
I've found that a ground-floor den makes about the best all-around station location. It can be shared with other family members for hobby purposes yet allows privacy for late-night DXing and construction projects. Also, a ground-floor location is usually best for access to power cables and station grounding. For many hams, available space is severely limited, as in the small apartment. In such cases, ingenuity in "making it all fit" is necessary. Thanks to present-day solid-state technology it's possible to get what constituted the "room full of radio stuff" of twenty years ago into a relatively small space.

Those who live in restrictive apartment complexes and condominiums may suffer from legal problems that make it impossible to erect an outside antenna, especially one for high-frequency work where antenna dimensions are large. Even in such cases, all is not lost. You can always confine your operating to mobile work, making your car, van, or RV your shack. A nearby vacation cabin or retreat is another possibility. And you can always set up a workshop in your apartment if space is available. In most cases, too, you can enjoy vhf-fm operation using an indoor antenna working through repeater stations.

If all attempts at fixed-station operation fail, you can install a good multiband communications receiver and be a shortwave listener. I have fun with a vhf scanner and general-coverage communications receiver just listening to the bands. The point in all this is that you can usually operate, one way or another, under the most adverse conditions.

The basement location

Earlier I mentioned the possibility of installing your shack in your basement. If you decide to use the basement you should be aware of two problems: 1) moisture and mildew, and 2) water seepage and overflow.



In my opinion the most serious problem in a basement location is caused by moisture and mildew. Excessively damp locations cause your equipment to corrode and rust. A dehumidifier may help; however, I once had a shack that was so damp that I had to move the equipment to the attic to prevent its reaching a premature old age! Bear in mind that commercially made amateur equipment isn't usually built to military packaging and preservation standards and won't tolerate excessive dampness.

The other problem with a basement location concerns water seepage. Water can enter through the walls and from the corners where the walls and floors meet. This problem can be resolved with some difficulty using professional techniques. It can be a tough problem involving drainage, location of the house, water table, and several other factors. You'll want to cure the seepage problem to protect the investment in your home — but it's best not to have the ham gear installed in the basement until that is done.

Along with problems of water seepage are those of flooding from drains and backed-up sewers, leaky pipes, and overflow from washing machines. To protect against these kinds of problems, don't install any equipment *or wiring* directly on the floor. Instead, use wooden platforms or other means to allow some clearance to avoid serious safety problems from seepage and minor flooding. If your basement has these problems, from a practical standpoint it's best to locate the shack elsewhere within your home.

So far, I've made little mention of the workshop. It's best to have a separate work area if you have the space. Thus you can work on extended construction projects or repair jobs without interference to station operation. Setting up a workshop is a subject in itself, which won't be covered here. Whether to combine shack *and* shop depends on considerations such as the extent of the construction work you'll be doing. I've always tried to reserve a corner of the shack for light repair work while keeping the main shop area separate — and then usually locating it in the garage or basement.

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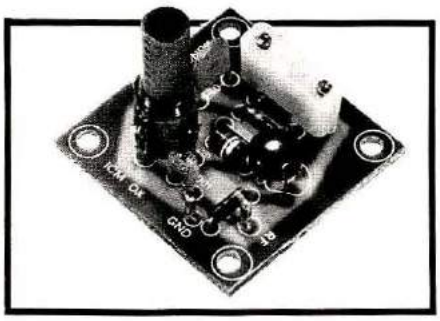

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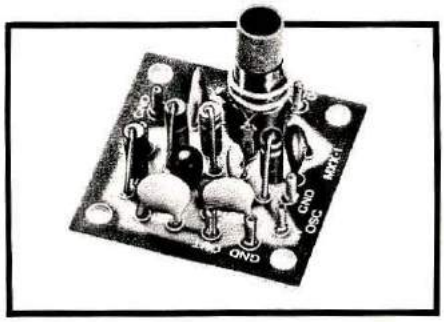

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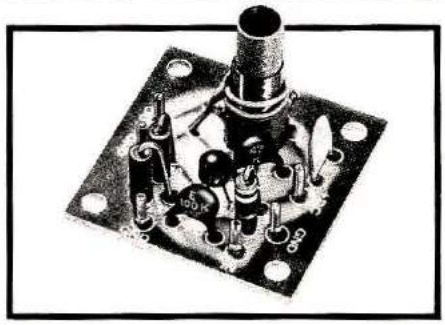

PAX-1 TRANSISTOR RF POWER AMP

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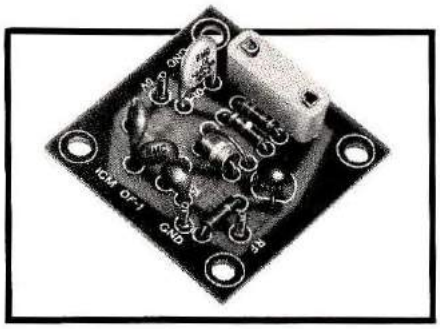

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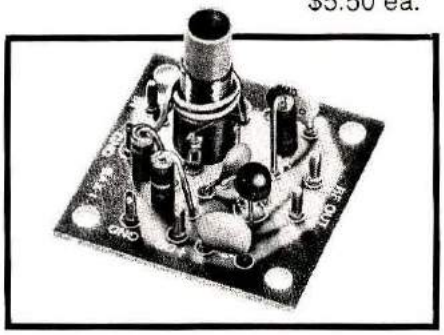

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GETTING ON THE AIR

the practical approach

BY KEN POWELL, WB6AFT

First things first

After reading Jim Fisk's article "Get On The Air On A Budget" in the first issue of *Ham Radio Horizons*, I decided to do just that — put some theory into practice while keeping track of cost, results, and the thoughts incurred along the way. No doubt we've all had different ideas as to what an amateur station should be, what equipment it should contain, and what our ultimate or ideal station would consist of. A multiplicity of equipment is available, with price limits that know no bounds. This leaves us with many things to ponder. Before thinking of how much we should spend, we should think of how much we *really need* in terms of equipment for the type of operating we wish to do. It's not just the receiver and transmitter or transceiver, but also the antenna and other accessories, that can add up to as much as the rig itself. We might also look at our prospective operating room and the area available for the antenna.

We should think about our commitment to the hobby. If it's a new venture, perhaps we should go cautiously at first. Once armed with all these facts, we can buy the most expensive gear we can possibly afford and worry about the accessories later.

I had set the following requirements for my station based on my own opinion developed through reading,

listening, and talking to many amateurs, both at work and at the local radio club. First of all, I felt that a good understanding of CW was important if progression through the amateur licensing structure was to be achieved. In this vein, I thought that a CW-only rig was needed to eliminate the ever-present temptation to slip into the phone bands. Secondly, the initial equipment investment would be limited in an effort to keep harmony on the domestic scene should a change of interest occur in favor of tennis, photography, or whatever. Third, I would not have an "antenna farm" to begin with, but rather a simple wire antenna to which the neighbors could adjust gradually. The antenna farm could come about later after the initial shock wore off.

These were my viewpoints and others may think differently on many of them; but I think we should consider them, particularly if you are trying to stay within reasonable bounds on an initial station. First time around I would definitely purchase used ("previously owned", says the expensive-car dealer) equipment, because in today's economy the price is not going to go down. A good illustration is the Drake 2B receiver. It sold for about $175 three years ago and will still bring the same price today. Of course we must assess our individual situations and go from there. Enough theory — let's start setting up that station.

Saturday morning seems to find every amateur in town in the local radio outlet, so there I was with the rest of the gang turning the tuning dial on every piece of gear in the place. I watched for a while and — it's a fact — everybody that came down the rows of gear cranked on the tuning dial of each piece of gear. That seems to be the usual approach, so keep it in mind when shopping!

Getting back to the real world, the equipment seemed to be in two major categories: transceivers that started at $300 and climbed and low-power crystal-controlled CW rigs with no matching VFO. The CW rigs started at about $35 and went to $95 for the Drake 2NT. A good selection of receivers was available, but again there seemed to be two categories. The hamband-only type with crystal controlled front ends were in the $175 price class; the second category was either a very old general-coverage type or a $59 import that didn't seem to perform as well as the very old Hammarlunds, Hallicrafters, and Nationals.

As I looked and pondered, I concluded that if I wanted adequate performance, I'd have to spend at least $300. It seemed that the transceiver was the only way to go. The better grade receivers were fine, but there really were no transmitters to go along with them. The market had been flooded with some very fine transmitters that were a-m/CW rigs when ssb came along, but these seemed to have disappeared when the FCC changed the ruling on VFO operation. They just were not on the shelves anymore.

I thought about the transceivers with the ssb capabilities and the $300-plus price tag. Then I thought of the limited capability of the crystal-controlled rig with its $50 price tag. I decided that I'd better think about it over the weekend. One more pass down the aisle to turn a few more tuning dials and I was about to leave. Then I noticed a little rig I'd not seen on my first pass through the goodies: a Heath HW-16 and its matching HG-10B VFO. I'd seen these little rigs before but didn't think about them at all while shopping around for a station.

This one looked like new, and the instructions manuals were included with it. I looked through the manuals and realized this little combination would do everything I wanted. The receiver section had a crystal-controlled front end, a very nice linear tuning dial, crystal filter i-f circuit, and covered the lower 250 kHz of 80, 40, and 15 meters. The transmitter ran 90 watts input, had built-in transmit/receive switching, side-tone oscillator, and an output meter. With the matching VFO you could zip around the bands in fine fashion. Then, the best part of all, the price tag was $144 for

If you find an RME-6900 receiver, you'll note that it offers good band-spread coverage of the amateur frequencies, and has ssb, CW, and a-m operation on the mode switch. A unique feature is the variable injection for the bfo, which allows you to optimize weak-signal reception. Also there is a heterodyne-null adjustment, which helps eliminate interference.

Don't let the appearance fool you — it may look similar to a piece of laboratory test gear, but it really is a pretty good ssb receiver. This Drake model 1-A receiver does show up at auctions and flea markets, and should not be overlooked as an inexpensive receiver for the beginner. It will do an excellent job on CW as well as ssb.

the pair! Keeping in mind that I still needed an antenna and some other accessories, this equipment certainly seemed to fill the bill. No doubt there could be some shortcomings to the little rig, but it did fit most of the requirements I'd set up when I decided to try getting on the air on a budget.

Try before you buy

In looking at the dealer's test benches and the other amateurs trying out very expensive gear such as Collins, I felt somewhat sheepish about asking to have this little used rig hooked up for an on-the-air test, but the dealer seemed to think nothing of it and treated me just as if I were looking at one of the big rigs. He connected an antenna and speaker to the rig, showed me how to switch over the dummy load — wattmeter combination for a transmit test, said, "Have fun," and that was it.

The receiver section really surprised me. I'd been using an old, war surplus ARC-5 receiver with just a piece of wire for an antenna to copy code practice sessions. But this was a whole new world! Saturday on the Novice band is a real test for any receiver, and this one could really separate the stations. As for sensitivity, I wasn't sure if the receiver or the antenna were very good, but the stations were rolling in. I asked what kind of antenna I was using and the dealer told me it was just an inverted V up about 40 feet (12.2m) in the middle of the antenna farm on the roof. The dealer said that if I wanted to listen on the triband beam, he could switch it over for me. I told him that wasn't necessary and went on with my listening. It seemed great to me.

I switched over to the dummy load/output meter combination to see what the transmitter section of the rig would do. Now it was time to try a little keying. The sidetone worked fine and I was sold. I had found just what I wanted .

Antenna thoughts

When I arrived home I hooked up the HW-16 with a 6-foot (1.8m) piece of line cord for an antenna, plugged in an old pair of Brandes phones, and the stations came rolling in: W5s, W6s, and W7s. I just couldn't put up an antenna fast enough.

While talking with amateurs in my area and listening to some of the problems they encountered with radio interference with home entertainment equipment, it seemed to me that most problems were encountered by amateurs using vertical antennas. (This just seemed to be the concensus of opinion, however.) While listening to other amateur stations, some of the best signals heard seemed to be radiating from verticals. After a little reading, a lot of thinking, and some measuring of my lot I decided to try an inverted V. This antenna would fit just perfectly on my lot, with the center support just outside the station, and with the ends tied to the side fences. All this, and the angle subtending the legs worked out to just about 45 degrees! This, of course, providing I could get the center of the antenna 35 feet (10.7m) above ground. I'd read that a dipole (and an inverted V is really a dipole antenna) should be fed with a balun. Since I had such a small investment in the rig, I decided to buy a balun. I made a list and headed back to the dealer's.

Next Saturday morning, with shopping list and checkbook in hand, I was back at the friendly dealer's. A 40-ft. (12.2m) telescopic mast, $40. Balun

Another quality Drake receiver that can be found for less than $200 is the model 2-C, which will work fine on CW, ssb and a-m. It has a built-in calibrator and a noise blanker as well. The design has passed the test of time, and maintenance should consist of replacing a tube now and then, with occasional cleaning and alignment to keep it in top shape.

transformer, $11. A set of Rayco 15-meter traps, $15. A set of Rayco 40-meter traps, $15. A wall mount for the mast, $3. Copper clad antenna wire, $9. Two end insulators (thrown in free for such a good customer). Coax cable, $9. Chalk up another $102 to the initial cost of the station; total so far, $246. I began to feel glad I didn't start out with a $300 transceiver.

The moment of truth

I carted my goodies home, got out the ladder, cut my wire lengths a little longer than the instructions called for that came with the Rayco coils, and in a couple of hours realized I needed coax connectors and nylon guy rope. Back to the store, dropped another $10, and back home again.

I put the telescopic mast base on the ground and mounted the mast to the wall mount at the peak of the *facia* board at the roof line. I strung the antenna and nylon guys, and there it was. Total outlay now, $256. Next, I borrowed an swr meter from a friend and put it in the antenna feed line. Much to my surprise, the swr was not too bad and the lowest reading was at the low end of each band. A little pruning and the antenna resonant frequency was right in the center of the CW portion of 80, 40, and 15 meters. Things worked just like in the book!

In pruning the antenna I started with the 15-meter traps until an acceptable swr was obtained in the center of the CW band. Then to 40 meters using the same procedure, and finally to 80 meters, then back through the bands again for a final check. An swr of less than 1.5 to 1 was obtained.

Now, it was time for some listening. The 15-meter band sounded great, but 40 and 80 were very noisy. Back to the store for a ground rod and some no. 12 (2.1mm) wire. Nine dollars and one hour later, the ground rod was driven and the wire connected to the ground terminal on the rear of the

It's hard to go wrong with good brand-name equipment. This Hallicrafters SX-122A receiver covers the amateur and short-wave bands from the bottom of the broadcast band up to 34 MHz. In addition to ssb and CW coverage, it has an a-m position on the function switch, which means that you can listen to foreign and domestic broadcasting stations when you don't feel like hamming it up.

HW-16. The heavy electrical noise on 40 and 80 was gone now, and the reception was excellent. By this time it was getting dark, and the 15-meter band was going out, so the ground really paid off on 40 and 80. Stations were just pouring in, and I really appreciated the selectivity and tuning rate on the little transceiver.

Easy does it

My first impulse was to get on the air and call CQ. But with a degree of willpower I didn't know I had, I resisted, and made up my mind to wait until I could get one of the local boys to listen for me and check out the rig on all three bands and to look for harmonics while I fired up. Sunday I ran a check on all three bands, got a clean bill of health, and was ready to give the new rig the real test. All this amounted to $265 till air time. The key and phones I had from code-practice days, so I didn't include them in the initial cost of the station. Well, let's see what we get for $265 today!

I fired up on 15 meters and listened for a CQ. Tuning was smooth, separating the stations was easy, and transmitter tuning was very easy, with only one knob and the output meter to tune against. The VFO spotting switch made it a simple matter to put the receiver and transmitter on the same frequency and breakin was terrific. Operating from San Jose, California, I listened and heard a good strong CQ from W4 land, which I answered, and I received a 559 report from North Carolina.

After a very enjoyable contact, I listened some more and soon worked New Jersey, Florida, Illinois, Texas, and finally Japan! This little rig was really making a first-day showing.

Time for a dinner break, then a tryout on 40 meters. Forty was jammed that first night, but after some careful listening, I answered a WB7 and received a 569 report from Oregon. Then on to Indiana, Alaska, Missouri, and West Virginia.

Now to 80 meters. The noise level was higher on this band, so the weaker stations were more difficult to copy. The first contact was a VE7, then a W7, followed by two more VE7s. I was satisfied that the little rig and the antenna were a good choice. Jim was right — you can get on the air on a budget!

Some personal observations

Some conclusions I've come to after a month of operating the "Budget" station are perhaps *apropos*. Starting with a low-cost CW rig is a good idea in two respects. First it'll

keep you on CW long enough to develop a degree of proficiency in that mode. Secondly, if you have family, business, and social commitments you won't feel guilty about $1000 worth of ham gear sitting idle for a week or two at a time. (It may also prevent comments from the XYL about new furniture the $1000 could have purchased.) For a "first time" in amateur radio, the budget approach could prove to be most comfortable.

In the area of antennas, the inverted V seems to work out fine. I've made a good number of contacts and have had no TVI, BCI, or associated problems. If space limitations were more severe, I'd eliminate the 80-meter portion of the antenna to reduce its size, as I find operating on 40 and 15 meters more comfortable due to the lower noise levels on these bands. I also found that the ground made a very favorable difference on the two lower-frequency bands and is well worth the investment.

On the rig itself, I found the break-in operation to be a real pleasure. It is much easier to just press the key than to throw a transmit/receive switch. The VFO is an absolute necessity for ease of operation and to achieve those desirable contacts. The side-tone oscillator seems to vary in frequency between contacts and band changes and prevents the addition of an active audio filter such as the MFJ units. Hi-fi type speakers or phones do not function well with the rig because of low-frequency hum and noise.

The best audio quality seems to be with high-impedance phones and a small matching transformer to match the low-impedance output of the transceiver. I think the next addition in my setup will be a keyer with built in side-tone oscillator. This gear will allow me to disconnect the built-in side-tone oscillator and add an audio filter to improve quality under rough conditions. Then on to a 15-meter beam such as the low cost Gotham type. I think these additions will make the little station a real tiger. Based on the enjoyment I've had with the little rig to date, I think I'll be happy with it for some time to come.

In summation I'd say that you can put an excellent station on the air for under $300 including antenna and accessories, and the station will prove to be comfortable to operate and will turn in a good account of itself in the log book. Also, time spent in looking for the gear you want, figuring out the available space for your antenna, and reading about some of the basics on antennas, receivers, transmitters, and operating is time well invested. I'll be looking for you on the air real soon! **HRH**

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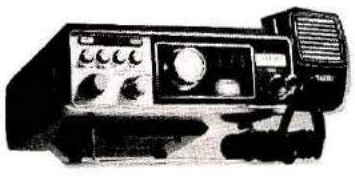

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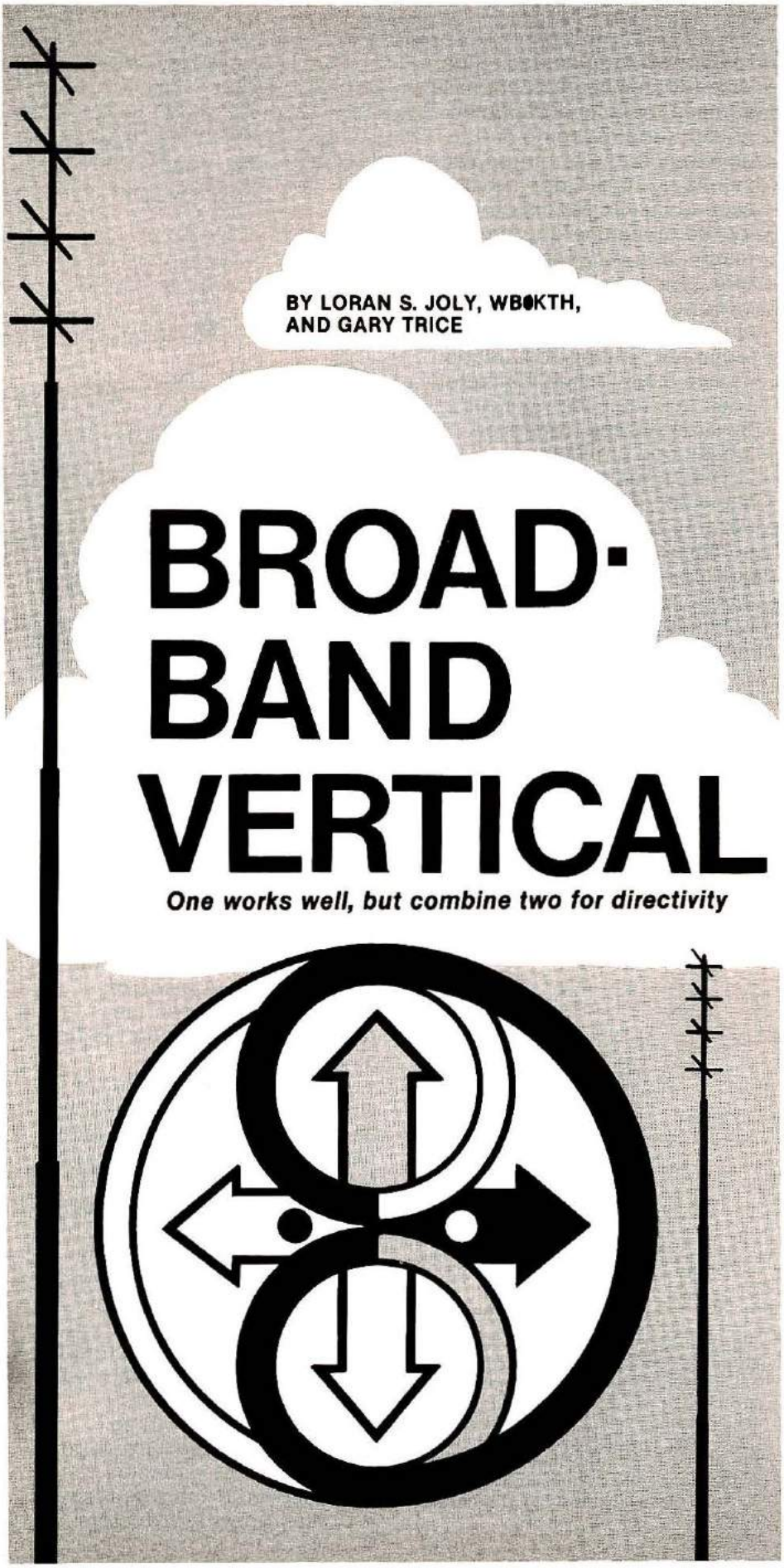

BY LORAN S. JOLY, WB0KTH,
AND GARY TRICE

BROAD-BAND VERTICAL

One works well, but combine two for directivity

Vertical antennas are probably the most popular types among amateurs who cannot string up a dipole or install a rotary beam. They're easy to erect, inexpensive (especially if made of wire and wooden supports), and do a creditable job of getting your signal out into the ionosphere. However, they are somewhat narrow in frequency response — if made for a particular part of a band, the vswr climbs as you move to the other end.

We've found a way to decrease the swr problem while at the same time retaining the good radiation characteristics of a vertical system. **Fig. 1** shows how we did it. Some crossed "elements" were added to the vertical portion. These spikes or spines add some capacitance from the upper end of the radiator to ground, and at the same time, have the effect of increasing the cross-sectional area of the antenna.* This combination produces a low-Q antenna, which allows you to move across the band without worrying about an extreme vswr change. A thin wire antenna is a high-Q device, and is quite sharp in frequency response.

Construction

The distance from A to B (**Fig 1**) is about 1.5 to 2 meters (6 feet). Spacing between crossed spikes (C-D) is about 38 cm (15 inches). It could be 45 cm (18 inches) with the spines being

*This arrangement should not be confused with the very short vertical radiator that has a loading coil and high-capacitance top hat. These short, loaded, vertical radiators are in a different category altogether, and work over a very narrow frequency range before they must be retuned. The author's version shown here is not much shorter than a normal quarter-wavelength antenna, and the added capacitance is distributed over a portion of that length, which contributes to its broadband characteristics. ***Editor.***

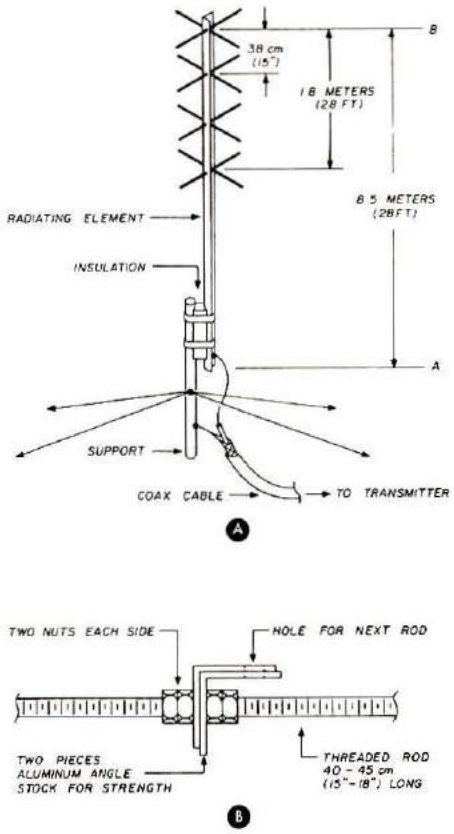

Fig. 1. The vertical radiating element can be of telescoping sections of aluminum tubing, with the top section made of aluminum angle and threaded rod, as shown in the detail at **B**. Insulation, such as a section of PVC pipe, should be placed between the support and the bottom of the radiator. Hose clamps or muffler clamps can be used to fasten the radiator to the support. The radials are wire, and can serve double duty as guy lines if necessary.

that long as well. Just remember, the longer they are, the lower the *Q*, thus the greater frequency spread and lower vswr. The top section is composed of two pieces of aluminum angle stock 1.8 meters (6 feet) long. The angle stock is 12 mm (1/2 inch) wide and its thickness is about 1.5 mm (1/16 inch). Two of these are used together for additional strength. Threaded rods are used for the spines in the tip section of the vertical. A total of eight is needed.

In the original installation, the spines were fastened with a single nut on each side. After learning a little more about mechanics and strain, I decided to use two nuts on each side. When the measurements have all been made and the holes drilled, the first spine is centered, and one nut on each side is tightened up, then the second nut on each side is locked up against the first. This results in a very secure structure. The supporting structure, or bottom sections, can be aluminum tubing; use your own judgment. The bottom section can be 5 cm (2 inch) diameter. Then use telescoping sizes towards the top; whatever looks good and secure!

The bottom of the aluminum-angle section at **B** should be secured to the tubing with two or more muffler clamps of the correct size. These will produce a good electrical bond at the joint, along with high mechanical strength.

The antenna can easily be mounted on a roof top via brackets or a wooden framework. For mounting it

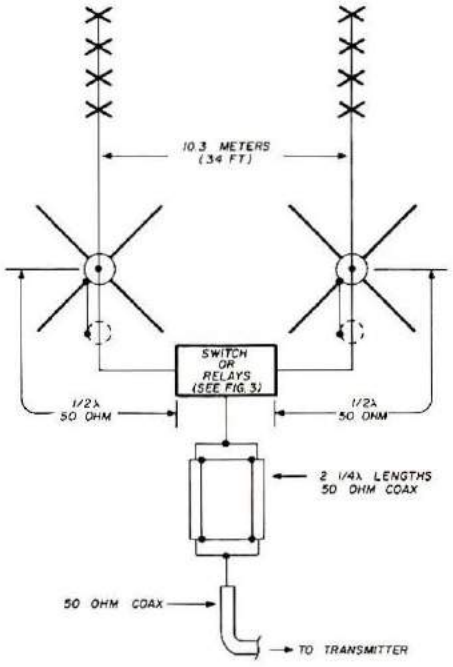

Fig. 2. Two of the broad-band vertical antennas can be mounted approximately 1/4-wavelength apart and provided with switches or relays to change their directivity. The parallel sections of coaxial cable help to provide a match between the antennas and the transmission line to the station. Be sure to allow for velocity factor when measuring the coaxial cable.

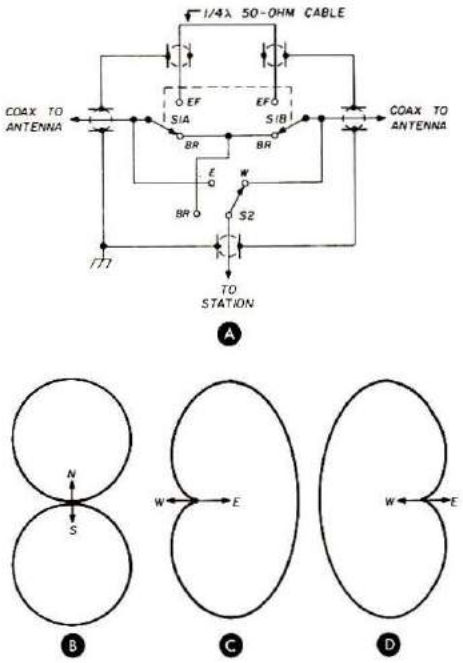

Fig. 3. The arrangement of switches or relays inside the control box of **Fig. 2** allows you to select East or West cardioid patterns, **C** and **D**, or a broadside north/south pattern as in **B**. Note that the section of cable used between switch positions EF must be 1/4-wavelength.

next to a house, or in the clear, a simple telescoping push-up mast from Radio Shack, Lafayette, Olsons, or wherever, will do a good job. Just pull the whole thing up into place, with the base of the radiator well insulated from the top of the push-up mast. A piece of plastic pipe between the radiator and the support is fine as an insulator.

As far as the height of the support mast is concerned, it should be a 15 meter (50 foot) type extended to 12 meters (40 feet), or a 12-meter mast extended to 9 meters (30 feet). This will give added strength and safety, too. The system should be very well guyed, no matter what your choice of mast height.

The vertical antenna on top of the mast should have Nylon rope to guy it in place. It should be guyed in three places. Do not use wire, for it can destroy the radiation pattern, even if the wire length is broken up with insulators.

An array for directivity

A single vertical antenna does a great job radiating a signal in all directions and, because it is mounted well above objects and has a radial system of its own, the angle of radiation is quite good toward the horizon. However, we decided to try a pair of them for directivity and gain on 40 meters. As shown in **Fig. 2**, we mounted two vertical radiators at a height of 10.6 meters (35 feet). They were spaced almost the same distance (10.3 meters, or 34 feet) apart. Each was fed through a half-wave section of 50-ohm coax from a switch that allowed the operator to change the radiation pattern, **Fig. 3**. With the switch in one position the radiation pattern is a cardioid, **C**, which can be reversed to the other direction as shown at **D**. The cardioid pattern provides approximately 3 dB gain over a dipole. A broadside pattern, **B**, with a gain of 2 to 3 dB is obtained with the switches set to "BR." A matching section made of two parallel quarter-wave pieces of 50-ohm cable is used to prevent a high vswr on the transmission line to the transmitter.

Performance

This array was used with a Drake T-4XC/R-4C combination in Ohio. The low-power and mobile stations buzzing around in W6 land were worked easily, using the broadside position. Bear in mind that the east-west broadside figure-8 pattern is not the pattern with maximum gain, yet Australian, New Zealand, and South African stations were worked on both CW and ssb! Working South American stations was simply effortless.

Working 40 meters in the daylight hours was indeed most interesting. There appeared to be a nice high-angle content as well as the low-angle stuff that came flowing through. Later on, in the evening, Texas stations would just bomb in. The front-to-back ratio was observed on local signals, long-haul DX, and foreign broadcast stations as well. Usually it was about 13 to 20 dB, just as the textbooks predict.

This type of vertical antenna is recommended to anyone who is at all interested in working DX. It will outperform the ordinary dipole by far because of its low angle of radiation. If you think one is good, try two! **HRH**

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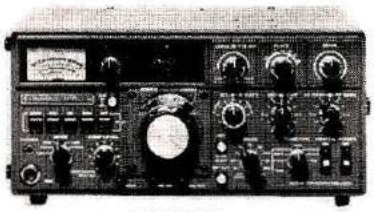

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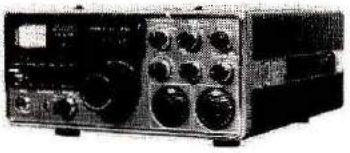

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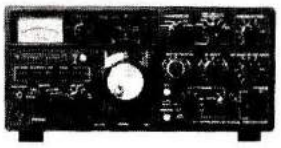
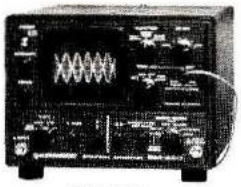


R-820



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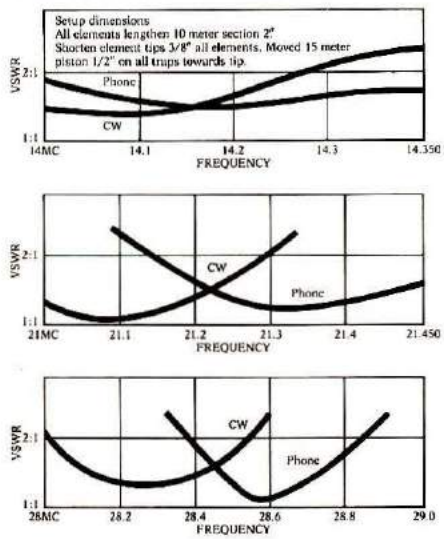

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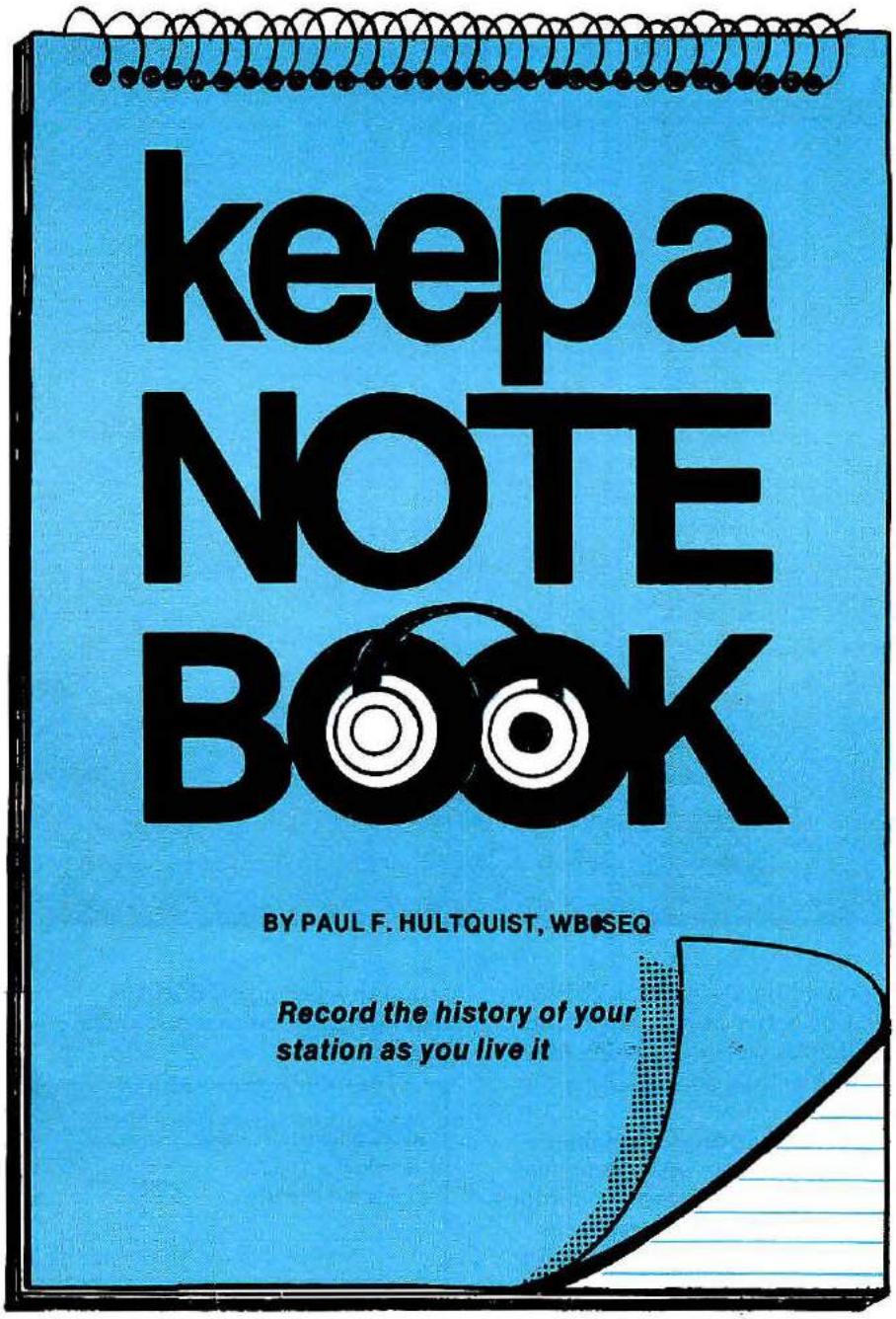

Say — that's a nice layout you have in your shack. You've fixed up that old transmitter from the flea market so it really shines. I see you found a VFO to go with it, too. Great! And look at the wall full of QSL cards . . . when was 40 meters open to Alaska? I guess I missed that one. So, go ahead, see what's coming through on 15 meters today, and I'll just look over your shoulder.

Uh, I hate to bring this up, OM, but are you keeping a record of these, your golden days of amateur radio? Twenty years from now will you be able to remember when you got your first license? Will you be able to find one of your original QSL cards? You can if you plan ahead — with very little effort — you'll have an interesting and useful record of your own development as a ham.

What I'm suggesting is that you start keeping a notebook. Logbooks are fine, but they really don't have space for the kinds of things I have in mind. So maybe you should go looking for a bound book in which to store the memorabilia that may brighten your day a few years hence.

An 8-1/2 x 11 notebook is ideal — a spiral-bound model is fine, but don't settle for a loose-leaf notebook. Why? Because the pages can be removed and that defeats the whole idea. Get a notebook with several dozen pages, and don't fret if it doesn't seem to fill up very fast. A so-called quadrille-paper notebook (squares instead of horizontal lines) is what I like to use because the vertical lines help me neatly arrange things on the page.

What kinds of things should go in it? Let me tell you what I put in mine and maybe that will give you some ideas. The first thing is a photocopy of my first Novice license. That's followed by the original of my Technician license, plus the "interim DV" card the FCC gave me when I upgraded again. Out of curiosity, I kept track of the dates when I took the exams and the dates when the tickets arrived in the mail. Those were exciting days and I'd like to remember them. (Also, it's handy to know how fast the FCC operates!)

Then there are the QSL cards. When the first batch of "WN" cards from that famous tiny printing company were about to run out I salvaged one of each color to mount in the pages of my notebook. I'm glad I have them now, otherwise I'd have forgotten what they looked like. From each new batch (if they are different) I take a sample to mount in the notebook by means of "photo corners." The cards form an interesting and colorful display by themselves.

Equipment is another subject. I have recorded the type, model number, and serial number of each piece of ham gear that I have had, and when I bought it. In addition, if I've sold a piece of gear I have recorded the name of the person to whom I sold it and the date of the sale. Having that information recorded is sometimes useful — extremely so in case there should be a fire or burglary.

Maybe it would be interesting to take some photographs of your shack and mount them in the notebook. If you have a change of equipment or location, a new set can be added to the old to show how your shack has progressed. The photos, along with your records, are very good to have for insurance purposes (keep extra copies in your safety deposit box).

Perhaps you'd like to record the log information from your first QSO; maybe you have a QSL card from that same QSO to mount in the book. Record your first DX contact. Keep track of your progress toward WAS, and then record when you got it.

I keep several notebooks. One is the "memoirs" notebook containing the kinds of things I've just mentioned. The others are technical notebooks in which I keep many different things. In one I keep data on the spare parts that I have — a list of the more valuable items in the junkbox. (Do I have a 6L6GB? It's easier to look in the notebook than to go through the several cardboard boxes filled to the brim with spare parts.) Another contains design data — circuits, descriptions, and such — for things I have built or plan to build. Still another is a loose-leaf notebook containing service manuals, assembly manuals for antennas, and instruction manuals that I don't want to lose. If I have to lend a service manual to a serviceman, or need to find it for any other reason, I know where it is. In some of the manuals I had to punch holes to fit the rings of the notebook, but in no case did this destroy the value of the manual; rather it became more useful because now I know where it is at all times!

I've gotten a lot of pleasure from looking back through my notebooks, particularly the historical one. I'm sure you will too. **HRH**

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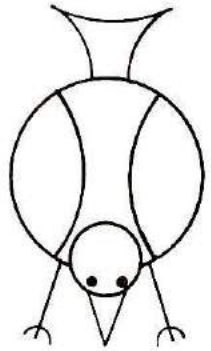

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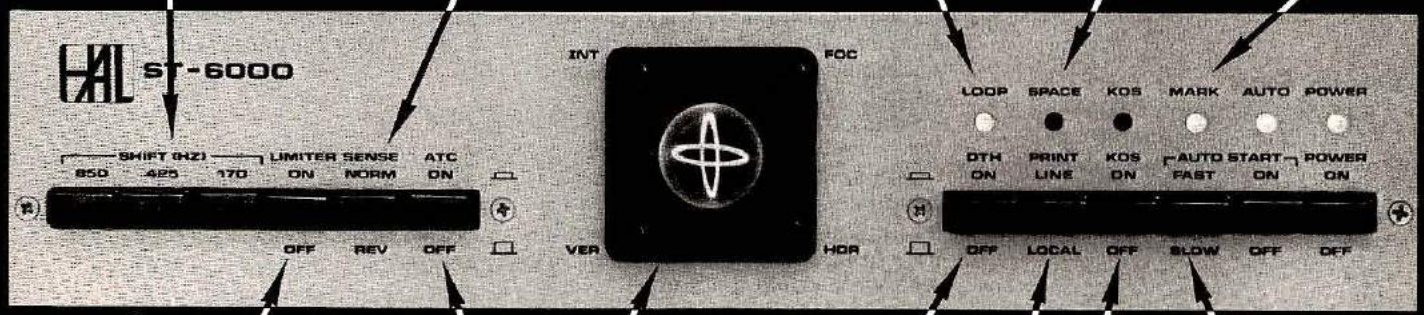

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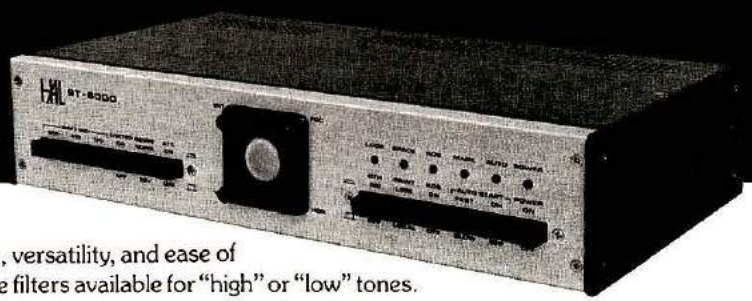

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Dear Horizons:

I am a 48-year-old bricklayer and I also collect vintage radios as a hobby. I am now enjoying ham radio. On August 5, 1977, I received my Novice ticket, and on February 24, 1978, I passed my Extra class exam. My purpose in writing you is the hope that perhaps a ham somewhere will take it as encouragement to upgrade to stay in ham radio, with the knowledge that it is possible to obtain the coveted Extra ticket with hard work and dedication to purpose . . .

I'm now working 20-meter DX!

Carl Elkins, WD4KWO
Nashville, Tennessee

Dear Horizons:

I really enjoy the DX articles by Bob Locher, W9KNI, and I think he should be in every month, whether or not he works a new one. He really does a great job. Bob already has me hooked on 20-meter CW once I pass my General test. I have an Ameco theory book and the 1977 ARRL Handbook from your store. Right now I am working on a keyer for my TS-520. I have been on the air for about 6 weeks and have 25 states for my WAS. Thanks again for the great magazine.

Ken Claerbout, WD9DEE
Cedar Grove, Wisconsin

Dear Horizons:

After reading the article by K4IPV, about dangers of operating a transceiver in a hospital, I just had to comment. My husband, Don, WB8JYX and I, WA8QPN, have both used our TR22Cs in the hospital this year, and found great pleasure in this! No matter what the article says, I'd do it again.

Before I had my baby, it gave me comfort to talk to friends and relatives that are hams I've known some twelve years. My room partner had her baby to coo over, while mine remained in my pouch. Talking on 2 meters gave me company, and relieved my tensions and anxiety.

While my husband was in an isolated private room for five days, radio gave him something to do besides paint-by-numbers. The nurses seldom entered his room as they thought he had a contagious disease.

My many friends in this area have used their rigs in the hospital. It isn't very pleasant to be blind or a paraplegic and not be able to operate amateur radio, when you could get some companionship and enjoyment out of your favorite pastime.

Really, I think any ham would consider the morale value when ill, over the dangers that K4IPV has presented.

Until it can actually be proven with humans, not animals, that a few microamps can be dangerous to my health or others that operate amateur radio, let's take our rigs to the hospitals. Ham radio passes the time, even just to listen.

Mrs. Verline Ferris, WA8QPN
Hazel Park, Mississippi

Thousands of hams have operated their equipment from hospital beds, and many more will do so, with no resulting problems. However, author Carr is quite correct in pointing out some of the danger areas. He has done this so that the unsuspecting ham will realize that operating radio equipment is a privilege, granted on the condition that such operation cause no problems with vital monitoring equipment in the hospital. It's not that microamperes cause problems by being enough to injure someone, but rather that microamperes can upset the function or readings of some delicate piece of life-sustaining or vital-signs monitoring equipment. Many hospital staffers are not aware of the dangers, are too busy to make the tests, or have had false (or not so false) alarms caused by radio-frequency interference (not necessarily from amateur equipment in every case). Thus, many are reluctant to grant permission, and are within their rights in refusing. You, and many other hams, were most fortunate in being in a facility with an understanding staff and that had no delicate equipment nearby that could be upset by your two-meter signals. I cannot argue with your premise that amateur radio is a morale booster, and, where it is safe, I am all for it. Thanks for sharing your thoughts with us.

Editor.

Dear Horizons:

I have just finished reading the article in the August issue, *Mechanics — Insight to Electronics*," by Norman S. Land, W4KOM. It was the best I have seen on explaining the mysteries of electronics to a beginner. I would like to see more like this on other phases and parts of electronics. I understand mechanics, but electronics comes harder. Mr. Land did a good job of putting it in my language.

I like *Ham Radio Horizons* for articles such as this. I want to learn about electronics, at least enough to be able to operate my rig. Keep up the good work.

Henry O. Davis, WB4CNF
Louisville, Kentucky

Dear Horizons:

I have just finished reading the article concerning the Happy Flyers in the March, 1978, issue of your fine magazine.

Before I go any farther, I would like to state that the name of the game is to find the crash site or the lost person and save as many lives as possible. Who gets the credit is surely not important.

I am the Safety Officer of the North Carolina Wing of the Civil Air Patrol. As such, I am concerned about the safety factor when aircraft which are not coordinated by Search Mission Headquarters start flying around a search area, no matter how motivated.

Civil Air Patrol personnel spend many hours in training for their

search and rescue function. This includes training in *effective* DF procedures, both ground and air. The CAP personnel are very competent.

It is going to complicate things greatly if we have to worry about the possibility of having uncoordinated aircraft in our search areas with the danger of mid-air collisions.

I would like to suggest to the Happy Flyers that they join the CAP. We can certainly use their expertise and enthusiasm. Many CAP members are also Amateur Radio operators and pilots. As an added incentive, the United States Air Force reimburses the cost of all fuels and lubricants expended during authorized missions.

Joseph M. Meserve, WA4HFF
Lt. Col., CAP
Weaverville, North Carolina

Dear Horizons:

I have enjoyed reading *Ham Radio Horizons*, and as a fairly new ham have benefited from the technical material. I would like to see more articles covering more advanced electronics though, as I am now beyond the beginner stage.

The one thing that bothers me is that the last two issues were on the newsstand two weeks before my copy arrived at home.

David J. Adamy, WB1DMM
Reading, Massachusetts

Ah, yes, the perennial problem with mail delivery of magazines. It happens to all of us — I sometimes get bent out of shape when my buddies tell me over the air what is in the newest science-fiction magazines, which they bought at the drugstore last week, while my mailbox remains empty. Thanks, David, for your thoughts, and we'll try to keep Horizons *good enough that you'll think it's worth waiting for.* ***Editor.***

Dear Horizons:

Just received my first copies of your magazine. They are very interesting. I appreciate especially the large type. Perhaps this is due to my age; I've been licensed since 1919 and it's nice to have something I can read easily.

In your 1977 Wrap-Up issue, how did you happen to miss the magazine *Pacific Radio News* published in the 20s? I think it was the forerunner of *Radio*. You also should have mentioned the Hamilton-Carr Company in Chicago, which later became the Allied Radio Company.

In your article on surplus equipment, along with the BC375 and other stuff — you should have mentioned the ART-13.

Charles L. Barker, W7GND
Pullman, Washington

I would guess that author Nagle didn't have one of those magazines in his collection, or else he would have mentioned it. He's doing research for more of the same, so your information will be added to the file. As to the Surplus Equipment — well, a list of all of the surplus stuff that was on the market would fill a year's worth of magazine space, so the author used what he thought was of greater interest. Besides, I know of some people who are still using an ART-13 . . . and they sound like it. ***Editor.***

Dear Horizons:

The *Ham Radio Horizons* article on the "Happy Flyers" is great. We appreciate W6NIF's labors in putting it together for the cause.

Inquiries are being received from all over the country — for the forming of squadrons, DF training, assembly and installation of DF units, repeater-site monitoring, etc. The response is genuinely heart-warming. Thanks for stimulating the interest.

Paul Hower, WA6GDC
International Vice-Commander
Happy Flyers

Dear Horizons:

I thought you might like to know the latest from the Rapp family ("The Youngest Ham," May, 1977 *Ham Radio Horizons*.) Rusty now has his Technician class license, which he passed while he was still 6 years old! He's really overjoyed about it, and serves as net control once a month on the Old Post Amateur Radio Society two-meter net.

I've joined the wonderful world of hams too — as WD9HEE. I'm really enjoying amateur radio, it's more than I dreamed it could be. Perhaps because I worked so hard for it, it means more to me. My thanks go to you people at *Horizons* for all you've done.

Margie Rapp, WD9HEE
Vincennes, Indiana

Dear Horizons:

I was a Morse operator for 20 years, prior to 1936. We used a lot of Phillips Code on the Broker Wire. I wonder if you might be able to tell me where I could obtain a Phillips Code book.

Glenn A. Burdick, WBØTVX
Edina, Minnesota

Glenn, you might try writing to Radiographics Books, P.O. Box 18492, Cleveland Heights, Ohio 44118. They have some old radio books, and I've heard that they occasionally have copies of the Phillips Code. ***Editor.***

Dear Horizons:

If you ever find out who wrote "Other Countries Please Stand By," (February, 1978, *Ham Radio Horizons*) pass along my congratulations. The author has a great sense of humor. More, maybe?

Steve Gibson, WB4NBI
Vienna, Virginia

Dear Horizons:

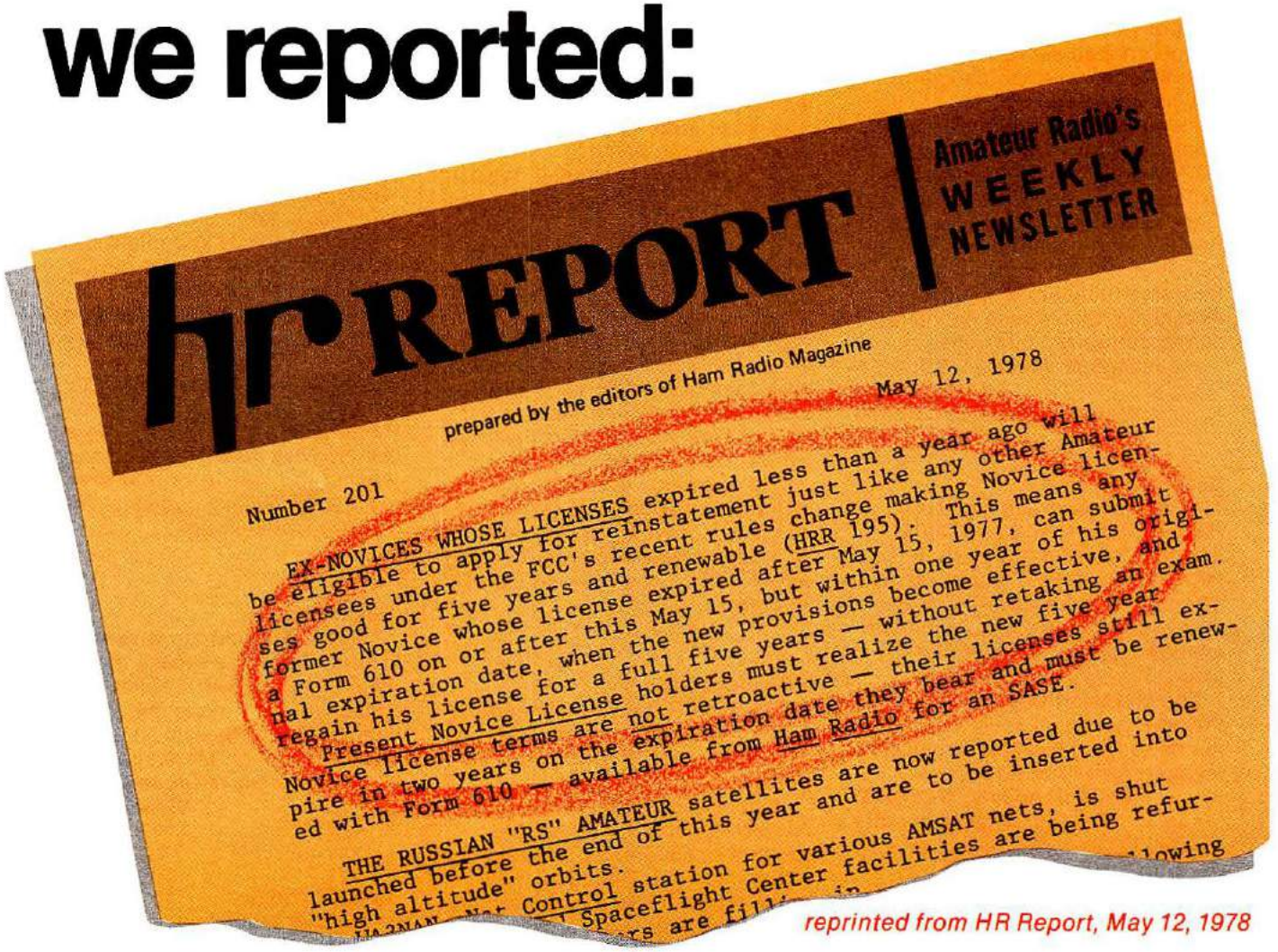
I was greatly pleased, and a bit astonished, to receive the reminder about my impending license renewal. The fact that I have already applied doesn't take away one bit from the kindness and thought put into your effort, and I sure do thank you. That's just one more reason why I have renewed my charter subscription. You're doing a great job.
Thank you!

Fred Westervelt, W4NO
Charlottesville, Virginia

*Thank you for your kind words, Fred. The license renewal reminders are part of our effort to make amateur radio more enjoyable for everyone. To borrow a slogan from TV-land, "*Horizons *cares."* ***Editor.***

When the FCC acted

we reported:



hr REPORT

Amateur Radio's WEEKLY NEWSLETTER

prepared by the editors of Ham Radio Magazine

Number 201 May 12, 1978

EX-NOVICES WHOSE LICENSES expired less than a year ago will be eligible to apply for reinstatement just like any other Amateur licensees under the FCC's recent rules change making Novice licenses good for five years and renewable (HRR 195). This means any former Novice whose license expired after May 15, 1977, can submit a Form 610 on or after this May 15, but within one year of his original expiration date, when the new provisions become effective, and regain his license for a full five years — without retaking an exam. Present Novice License holders must realize the new five year Novice license terms are not retroactive — their licenses still expire in two years on the expiration date they bear and must be renewed with Form 610 — available from Ham Radio for an SASE.

THE RUSSIAN "RS" AMATEUR satellites are now reported due to be launched before the end of this year and are to be inserted into "high altitude" orbits.

Control station for various AMSAT nets, is shut Spaceflight Center facilities are being refur-

lowing

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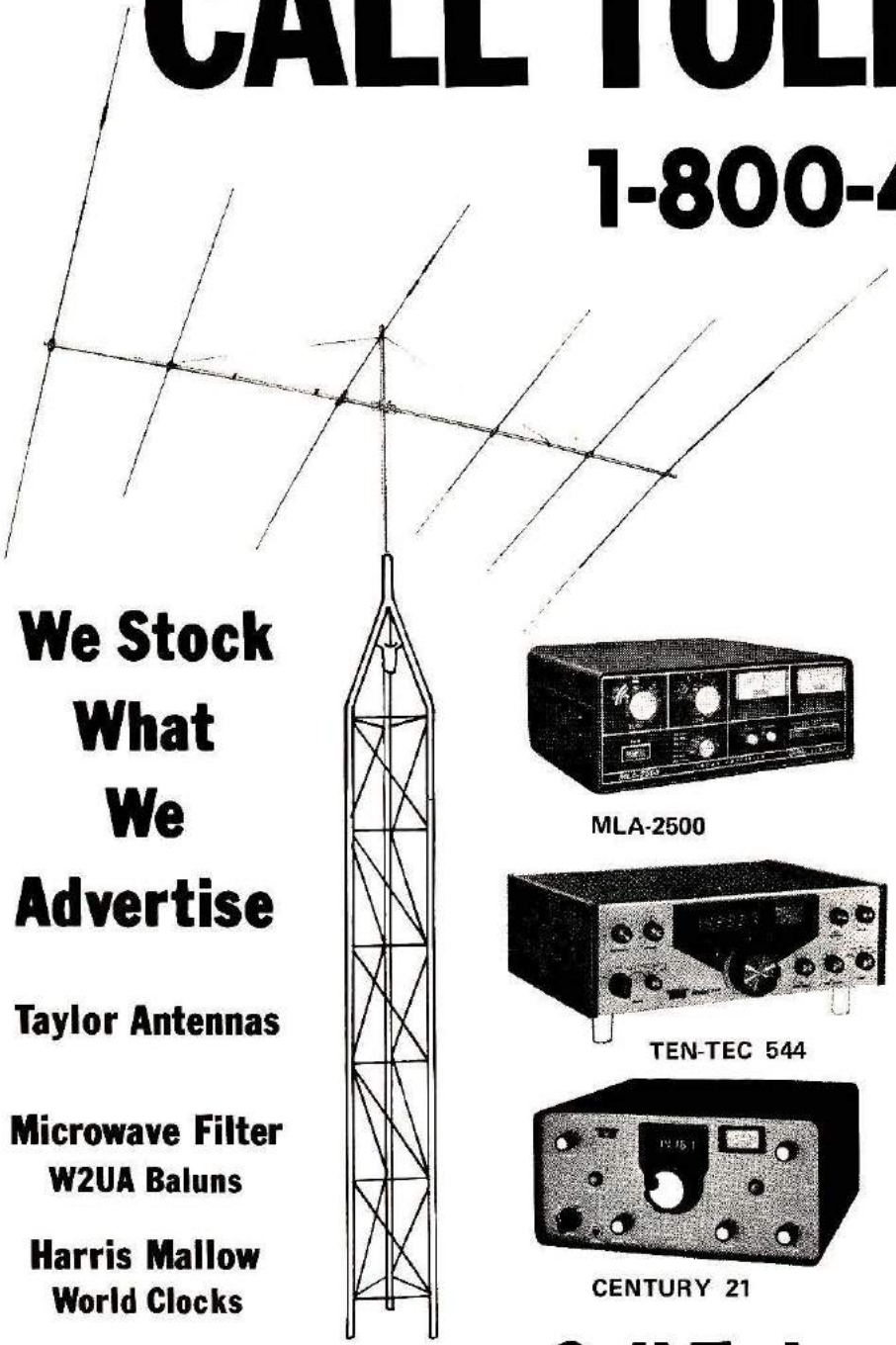

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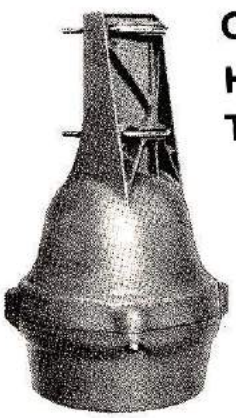

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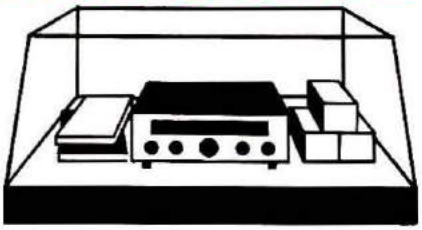
PRODUCT SHOWCASE



New Drake Transceiver

The new TR-7 transceiver from the R.L. Drake Company is the first commercially available amateur transceiver that uses a 48-MHz i-f. This concept allows great flexibility in frequency coverage as well as providing greatly improved image rejection.

Reception through the entire range of 1.5 through 30 MHz is provided by the TR-7, and, with the use of an Aux-7 Range-Program board, the range can be expanded to cover from 0 to 30 MHz. The up-conversion technique, along with the synthesized/PTO frequency control makes this extended frequency coverage possible.

Full passband tuning is another feature of the receiver portion of the unit. It is possible to tune from the top edge of one sideband, through zero, to the bottom edge of the other sideband. The range is also wide enough to allow tuning through RTTY signals. This ability to place a wanted signal at the proper spot in the filter passband is a great aid when working the crowded amateur bands.

Further improved reception can be obtained by installing optional receiving-selectivity filters in the rig; you can select the desired filter by pushbutton switches on the front panel. Also, a unique system permits you to select the receiving filter independently of the transmitter mode or function. Thus you can transmit on CW but receive with an ssb filter, or even transmit on one sideband while receiving the other. Optional filter widths include 300 Hz, 500 Hz, 1.8 kHz, or 6 kHz.

On the transmit side of the unit, optional programmable coverage for non-amateur-band parts of the spectrum is available. Proof of license for operation out of the amateur bands must be submitted to the R.L. Drake Company before obtaining these options, however. This feature also takes care of any possible later expansion of the amateur frequencies.

The all-solid-state design and broadband tuned circuits mean that there are no preselector or peaking circuits to contend with in the TR-7. The power amplifier is designed for continuous-duty ssb and CW operation. The efficient internal heatsink provides enough dissipation in free air for full power on all modes except SSTV or RTTY. These high-duty-cycle transmissions are provided for by an optional fan for extra cooling. The transmitter is rated at 250 watts input on all modes, and the PS-7 ac power supply is designed to provide continuous-duty power for any mode. This supply also accepts input voltages of 90-132 Vac, 180-264 Vac, at 50 to 60 Hz, which makes it ideal for overseas locations. The TR-7 transceiver may also be operated from any nominal 13.6 Vdc supply capable of providing 3 A on receive and 25 A on transmit.

Additional features of the TR-7 include a digital frequency readout which will provide accuracy of ± 100 Hz, or an analog readout with ± 1 kHz accuracy when properly calibrated. The digital frequency display can be used as a test instrument with frequency capability of up to 150 MHz, with access to the counter input through a rear panel connector. Power-output metering is obtained by making the standard S-meter double as a built-in wattmeter/swr indicator.

Some of the specifications from the TR-7 brochure are:

Dimensions, height, width, and depth: 11.6 x 34.6 x 31.7 cm (4.6 x 13.6 x 12.5 in.).

Receiver sensitivity: less than 0.5 μV for 10 dB S + N/N ratio.

Image and i-f rejection: greater than 80 dB.

Power input: 250 watts PEP ssb; 250 watts CW.

Spurious output: greater than 50 dB down.

Harmonic output: greater than 45 dB down.

Intermodulation distortion: 30 dB below PEP.

Undesired sideband suppression: greater than 60 dB at 1 kHz.

A wide range of optional features is available, including a noise blanker, mobile mounting kit, and crystal filters. A speaker in a matching cabinet, and a similarly matching remote vfo, will combine with the TR-7 transceiver to make a complete, attractive, and state-of-the-art amateur station that will set the pattern for years to come.

For more information, see your authorized Drake dealer, or write R.L. Drake Company, 540 Richard Street, Miamisburg, Ohio 45342; or use *ad check* on page 94.

VIZ Wattmeters

The Test Instruments Group of VIZ Manufacturing Company has introduced two new easy-to-use wattmeters that are ideal for testing vhf, fm, and even uhf transmitters as well as popular high-frequency and CB units.

The WV-551A dummy-load rf wattmeter has a broad frequency range — from 1.9 to 512 MHz. Its power range is 0.5 to 15 watts

with full-scale accuracy better than 5 per cent. Input impedance is 50 ohms, and vswr is less than 1.15:1 at 500 MHz. It is simple to use: the transmitter output line is connected directly to the unit and readings are taken from the scale on a taut-band meter. The user price for the WV-551A is $60.

The WV-552A in-line rf wattmeter is a dual unit used to measure both forward and reflected power — especially useful in matching and adjusting antennas, or for tuning transmitters for maximum output. Readings are taken from the two easy-to-read meters.

Measurements with the WV-552A are possible over three selectable frequency ranges: 20-40 MHz, 40-100 MHz, and 100-230 MHz. The meter's power ranges are 0-20 watts and 5-100 watts (forward), and 0-5 watts and 1-20 watts (reflected); full-scale accuracy is better than 5 per cent. The vswr is less than 1.15:1 over the entire frequency range, and input impedance is 50 ohms.

Both wattmeters are supplied with type M connectors; M-to-N and M-to-BNC adapters are available.

The user price is $150.00. For further information and data sheets, contact Bob Liska, VIZ Test Instruments Group, VIZ Manufacturing Company, 335 East Price Street, Philadelphia, Pennsylvania 19144; telephone (215) 844-2626; or use *ad check* on page 94.

Whitehouse Parts Catalog

A new catalog is available from G. R. Whitehouse & Co., of Amherst, New Hampshire. It lists many of the parts for amateur projects which have been described in *ham radio*, *Ham Radio Horizons*, and other amateur literature.

A scan through the pages reveals such items as a kit of parts for Noise Bridges, Transmatches, and Computing SWR Indicators. There are several pages of individual component listings, such as toroid coils, ferrite beads and rods, and an assortment of cores for the experimenter.

A number of Barker & Williamson items are carried by Whitehouse, including coaxial switches, air-wound coils, multiband plate circuits for high-power final amplifiers, and attenuators and filters.

The catalog shows a good selection of variable capacitors, including those made by E. F. Johnson, James Millen, and some Cardwell and Hammarlund types. Another section reveals Jackson Brothers dials and drives, James Millen knobs and

shaft couplers, and aluminum cases. There is also a large section listing the J. W. Miller inductors and the Cushcraft line of antennas and accessories.

To obtain your copy of this free catalog, write to G. R. Whitehouse & Co., 16 Newbury Drive, Amherst, New Hampshire 03031, or use *ad check* on page 94.

Wayne Bracket

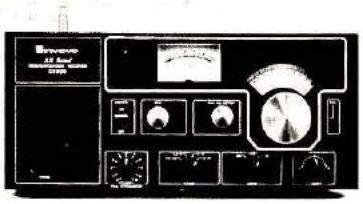
The Wayne Bracket Communications Command Console provides a way to mount and install expensive communications equipment in any vehicle. The rugged, solid-aluminum bar-stock frame and crossmembers allow you to position all sorts of electronic equipment for convenience and safety. An investment in this infinitely practical bracket makes the installation neat, quick, easy, and economical. It fastens over the drive shaft tunnel in any non-console, column-shift vehicle using only four sheet-metal screws. Models are available for flat-surface installations.

The bracket provides an ideal place for a first-aid kit, fire extinguisher, and flashlight. It completely eliminates dash-mount hassles and mickey-mouse floor rigs. The Wayne Bracket's low center of gravity and central location protects expensive equipment while providing maximum front-seat room. For more information, request our "10 basic benefits" brochure at no obligation. Write to E. Lee Reid, Wayne Communications, Inc., Post Office Box 57, Doctors Inlet, Florida 32030; or use *ad check* on page 94.

Erratic Errors

The AMCOMM S-2-25 writeup, featured in the Product Showcase portion of the May, 1978 issue of *Horizons*, contained an unfortunate error. The correct price of the S-2-25 should actually be $399.95 and not $499.95.

Standard C-6500 General-Coverage Receiver



The Model C-6500 is a synthesized, general-coverage, communications receiver; a new "Standard" with high-quality, low-cost performance that will please the most critical listener. Reception capability is provided for a-m, CW, and ssb. Unusual stability is achieved by using a synthesized, drift-cancelling injection system in 30 tunable ranges, covering the entire broadcast band starting at 500 kHz through 30 MHz. A 10-MHz reference oscillator provides the frequency stability necessary for excellent ssb reception. Dial accuracy is better than 5 kHz which is sufficient to locate and identify stations on known frequencies.

There are two separate detectors, product and diode, to provide excellent performance for both ssb and a-m signals. A mode switch provides wide or narrow selectivity. A tunable preselector allows the user to adjust for maximum sensitivity and interference rejection. Completely solid-state in design, the Standard C-6500 operates from ac mains as well as eight internal type "D" flashlight cells. Automatic switchover to battery operation is accomplished if the ac power should fail. For information write Standard Communications Corporation, Post Office Box 92151, Los Angeles, California 90009; or use *ad check* on page 94.

EMI Power Purifier Pack

Now you can obtain a three-in-one package that will eliminate over 90 per cent of your mobile electrical-noise problems. Called the *Power Purifier Pack*, the kit from Marine Technology includes a power-line filter for use between the battery and your transceiver or other equipment; an alternator filter to reduce or eliminate alternator whine; and an ignition filter to clean up noise from that source.

The EMI-ACE, while not offered as part of the kit, can be obtained separately for use with fuel pumps, windshield wiper motors, cooling or heating blowers, and the like. The ACE may not be necessary in all cases.

For more information on the EMI *Power Purifier Pack*, and other Marine Technology products, write to Marine Technology, 2780 Temple Avenue, Long Beach, California 90806; or use *ad check* on page 94.

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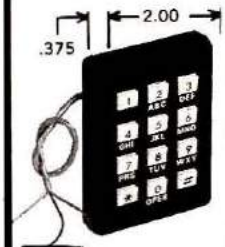

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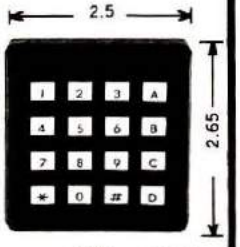

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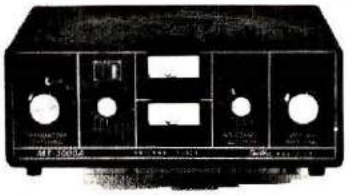

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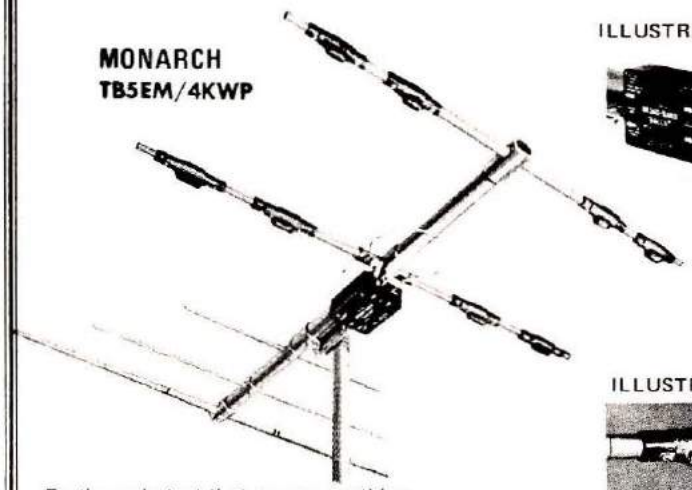

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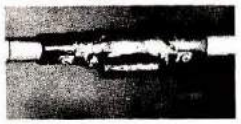

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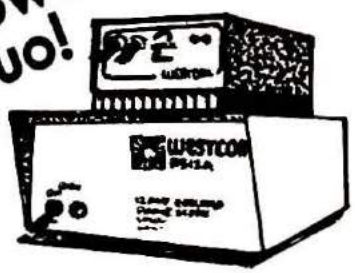

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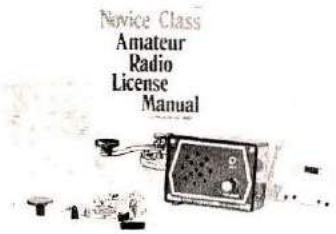

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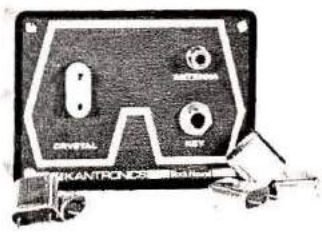

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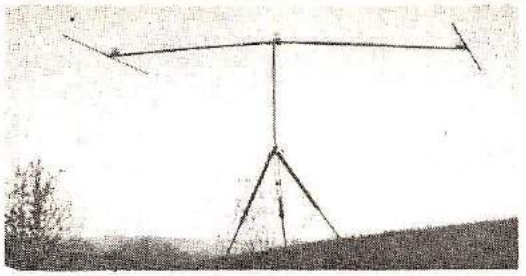

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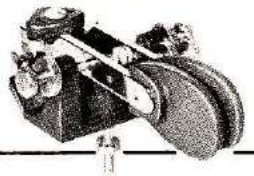

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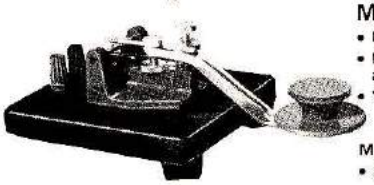

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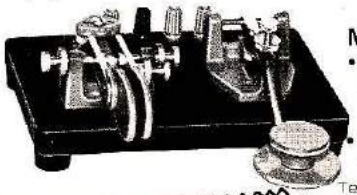

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NEW YORK: Mt. Beacon ARC 5th Annual Hamfest, Saturday, August 19th, 9AM to 5PM at Stewart Field, Newburgh. Talk-in 37/97 and 52. Admission, $1; sellers, $2; under 12 free. Additional information: Ron Perry, WA2CGA, RD 1, Glen Ave., Fishkill, N. Y. 12524.

CODE PRACTICE OSCILLATORS, hand keys, electronics keyers, other products. Free catalog. Globalman Products, Box 388HO, El Toro, CA 92630. 714-533-4400.

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CONNECTICUT: WELI ARC'S SECOND ANNUAL FLEA MARKET & AUCTION Sunday, August 20 (rain date August 27) from 10:00 AM to 4:00 PM at Radio Towers Park, Benham Street, Hamden, Connecticut. General admission 50¢, vendor spaces $5 each. For more information, contact Mike, WA1PXM, at (203) 943-1063, or Dave, WA1ZWB, at (203) 467-3258.

FLORIDA: 5th ANNUAL JACKSONVILLE HAMFEST, sponsored by the six Amateur Radio Clubs of the Greater Jacksonville Area, August 5th and 6th at Jacksonville Beach Municipal Auditorium. Information: N4UF, Jacksonville Hamfest Association, 911 Rio St. Johns, Jacksonville, Florida 32211.

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WIMU (WYOMING, IDAHO, MONTANA, UTAH): The 46th Annual WIMU Hamfest is scheduled for August 4, 5 and 6, 1978 at Mack's Inn, Idaho; 25 miles South of West Yellowstone, Montana. Talk in 146.34-94 and 3935. Advance registration: $6.00 for adults and $2.00 for children, before July 25th, 1978. Late/regular registration: $7.00 and $2.50. SPECIAL PRIZE DRAWING FOR PRE-REGISTRATION. Please send pre-registration to: WIMU Hamfest, 3645 Vaughn Street, Idaho Falls, Idaho 83401. Phone 522-9568.

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ILLINOIS: HAMFESTERS 44th Annual Picnic and Hamfest, Sunday, August 13, 1978 at Santa Fe Park, 91st and Wolf Road, Willow Springs, Illinois, Southwest suburb of Chicago. Exhibits for OM's and XYL's, FAMOUS SWAPPERS ROW. Tickets at gate $2.00, Advance $1.50. For Hamfest info or Advance tickets (send check or money order, SASE appreciated) to Bob Hayes, W9KXW, 18931 Cedar Ave., Country Club Hills, IL 60477.

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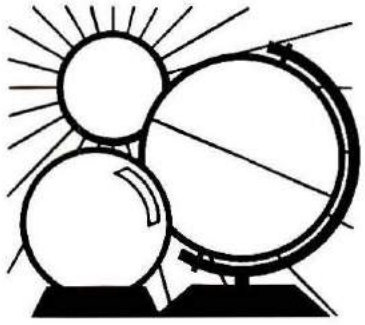

DX FORECASTER

Ionospheric activity this month is likely to be uneventful, with the possibility of a disturbance early in the month, probably around the 7th. Conditions for the rest of the month are considered to be fair for DX, provided you plan your excursions at frequencies above 14 MHz. This is a mid-summer month with generally high signal-absorption levels and considerable electrical storm static. This means that 40-meter DX is likely to be poor because of noise, while the higher bands will slump and tend to show conditions that will make you wish for an early fall. Eighty and one-sixty will be substantially impossible, except on the rare days when noise levels permit you to listen for DX. Unfortunately, you won't hear much, even then.

The bright spot for mid-summer propagation is *short skip* — a boon to county hunters on all bands. Virtually all of the higher bands will exhibit short skip conditions during daytime hours and into the early evening, so plan to look around a lot, hopping from band to band in your quest for that elusive county.

It would be best to look at the chart to find the appropriate time and beam direction to pick up the DX you need. With a blah ionosphere for the most part, surprises may be rare. You will notice that some of the spaces in the chart have positions filled with two numbers, one of which has a dagger (†) superscript. This means that the *long path* to the area of your choice may be open on the band indicated. When using your beam, turn it in the *opposite direction* from the normal one shown on the chart! Long-path signals may be somewhat weaker than you might expect from short path DXing, but can be very steady and clear, and may offer you a good opportunity to snag some rare DX. Alert DXers will also look along the gray-line paths at dawn and dusk for DX opportunities.

Special information

The Perseid meteor shower is a highlight of August, and will occur on August 12th. If the night is clear, expect to see up to one a minute, with average duration of each lasting about four seconds. VHFers can "look" with their antennas and take advantage of the unusually long bursts for better-than-average scatter propagation from the ionized trails.

New moon occurs August 4th, perigee on the 17th, and full moon on the 18th.

Tips on using the chart:

The asterisks (*) mean to look at the next *higher* band, because it, too, may be open on the path and at the time indicated. The arrows indicate general beam-pointing directions, with north at the top.

HRH

GMT	PDT	WESTERN USA N	NE	E	SE	S	SW	W	NW	MDT	MID USA N	NE	E	SE	S	SW	W	NW	CDT	EDT	EASTERN USA N	NE	E	SE	S	SW	W	NW
0000	5:00	20	40	—	15	15	15	15	20	6:00	20*	20	—	15	—	15	15	20*	7:00	8:00	15	—	—	—	15	20	20	15
0100	6:00	20	40	—	15	—	15	15	20	7:00	20*	20	—	15	—	15	15	20*	8:00	9:00	15	—	—	—	15	15	15	15
0200	7:00	15	—	20	15	20	15	10	20	8:00	15*	20	—	20	—	15	20	20*	9:00	10:00	15	—	—	—	20	20	15	15*
0300	8:00	15	—	20	15	20	15	10	20	9:00	20*	20	—	20	20	15	20	15	10:00	11:00	15	—	—	—	20	20	20*	15
0400	9:00	20	15	20	15	20	15	10	20	10:00	20*	20	—	20	20	20	20	20	11:00	12:00	20	20	—	—	20	20	20	20
0500	10:00	20	20*	20	20	20	15	15	20	11:00	20	20	—	20	20	20	20	20	12:00	1:00	20	20	—	—	20	20	20	20
0600	11:00	40	20*	15	20	20	15	15	20	12:00	—	20	—	20	—	20	20	20	1:00	2:00	20	—	—	—	20	20	20	20
0700	12:00	40	20*	20	40	20	20	20	—	1:00	—	20	—	—	—	20	20	20	2:00	3:00	20	—	—	—	—	20	20	—
0800	1:00	40	—	20	40	—	40*	20	—	2:00	—	20	—	—	—	20	20	—	3:00	4:00	20	20	20	—	—	20	—	—
0900	2:00	40	—	20	40	—	40*	40	40	3:00	—	—	—	—	40	—	—	—	4:00	5:00	—	20	20	20	—	—	—	—
1000	3:00	40	—	20	—	40	40	40	40	4:00	—	—	20	20	80*	—	—	—	5:00	6:00	—	20	20	20	20	—	—	15
1100	4:00	—	—	20	—	80*	80*	40	40	5:00	—	—	20	20	80*	—	—	—	6:00	7:00	—	20	20	20	20	40	40	40
1200	5:00	—	—	20	—	40	80*	80*	80*	6:00	20	20	20	20	40	40	40	—	7:00	8:00	20	20	20	20	20	80*	80*	80*
1300	6:00	—	—	20	20	40	40	40	40	7:00	20	20	20	20*	—	80*	80*	20	8:00	9:00	20	15	15	20*	15	—	—	—
1400	7:00	20	20	20	20	—	40	40	20	8:00	20*	15	20	20*	—	20	20	20	9:00	10:00	15	15	15	15	20	—	—	—
1500	8:00	20	20*	20	20	—	—	20	20	9:00	20*	15	20	15	—	—	—	15	10:00	11:00	20	15	15	15	20*	20	—	—
1600	9:00	20	20*	20	20	—	—	20	20	10:00	20*	20	20	15	—	—	20	20	11:00	12:00	—	20	15	15	15	20*	—	—
1700	10:00	20	20*	20	15	—	—	20	20	11:00	20*	20	15	15	—	—	20	20	12:00	1:00	—	20	20	20*	15	15	—	—
1800	11:00	20*	20*	20*	15	—	—	15	20	12:00	15	20	20	15	—	20	20	—	1:00	2:00	—	20	20	20	15	15	15	—
1900	12:00	20	20	20*	15	—	20	15	20	1:00	20	20	20	15	—	20	15	—	2:00	3:00	—	20	20	20	15	15	20*	20
2000	1:00	20	20	20	15	—	20	15	20	2:00	20	20	20	15	—	20	15	20	3:00	4:00	20	20	20	20	15	20	20	20
2100	2:00	20	20	20	15	—	20	15	20	3:00	20	20	20	15	—	20	15	20	4:00	5:00	20	20	20	20	15	20	20	20
2200	3:00	20	20	—	15	—	15	15	20	4:00	—	20	—	15	15	15	15	20	5:00	6:00	20	—	—	—	15*	20	20	15
2300	4:00	20	20	—	15	—	15	15	20	5:00	20	20	—	15	—	15	15	20	6:00	7:00	15	—	—	—	15	20	20	15
	AUGUST	CENTRAL ASIA	EUROPE	S. AFRICA	S. AMERICA	ANTARCTICA	NEW ZEALAND	W. AUSTRALIA OCEANIA	FAR EAST		CENTRAL ASIA	EUROPE	S. AFRICA	S. AMERICA	ANTARCTICA	NEW ZEALAND	AUSTRALIA	FAR EAST			FAR EAST	EUROPE	CENTRAL AFRICA	S. AFRICA	S. AMERICA	OCEANIA	W. AUSTRALIA NEW ZEALAND	AUSTRALIA

HAM CALENDAR

August 1978

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
*All International events such as contests are shown on the GMT days on which they take place even though they may actually begin on the evening of the preceding day in North America.	See August 5, 7, 19, 21, 26 	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) 1	2	3	Houston Echo Society — Texas VHF-FM Convention — Galleria Plaza Hotel — Houston, TX 4-6 W1MU Hamfest — Macks Inn, ID Info: W1MU Hamfest, 3645 Vaughn Street, Idaho Falls, Idaho 83401 — 4-6 4	Central Arkansas Radio Emergency Net Ham-A-Rama — Arkansas State Fairgrounds — Little Rock, AR — WB5TSH — 5-6 Illinois QSO Party — By the RAMS, the Radio Amateur Megacycle Society 1800Z 8/5 — 2300Z 8/6 — with a rest period from 0500Z - 1200Z 8/6 Jacksonville Hamfest Association's Hamfest — Jacksonville Beach Municipal Auditorium — Jacksonville, FL — 5-6 Straits Area RC Swap-N-Shop — Emmet County Fairgrounds, Charlevoix Avenue — Petoskey, MI 5
Arrow AR Repeater of Washtenaw Swap-N-Shop — Fairgrounds, Saline Road — Saline, MI South Hills Brass Pounders & Modulators, Inc., Hamfest — St. Clair Beach — Upper St. Clair Township, PA Zero-Beaters ARC Hamfest — Washington City Park — Dutzow, MO — WA0FYA 6	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB WEST COAST BULLETIN Edited & transmitted by W6ZF 9PM PDST 3540 kHz, A-1, 22 WPM 7	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) 8	9	10	Panhandle ARC Golden Spread AR Convention — Info: Golden Spread Amateur Radio Convention, P.O. Box 10221, Amarillo, TX 79106 — 11-13 11	ARRL Pacific Division Convention — Reno, NV — 12-13 ARRL UHF Contest — 12-13 Delaware ARA Hamfest — Springwater Park — East of Muncie, IN on Country Club Road International Field Days & Hamfest — Old Lantern — Charlotte, VT — 12-13 Spokane ARC Hamfest — Eastern Washington University — Cheney, WA 12-13 12
Bluegrass ARC Central Kentucky Hamfest — National Guard Armory, Airport Road — Lexington, KY Cedar Valley Hamfest — Polk County Fairgrounds — Cedartown, GA HAMFESTERS Picnic/Hamfest — Santa Fe Park — 91st & Wolf Road Willow Springs, IL — SASE to W9KXW Jackson County ARC, Inc., Hamfest — West Virginia FFA-FHA Conference Center — Ripley, WV St. Cloud RC Hamfest — Sauk Rapids Municipal Park — St. Cloud, MN WA0OTO 13	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB 14	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) 15	16	Central States VHF Conference Midway Motor Lodge — Rochester, MN — 17-20 17	ARRL Saskatchewan Prov. Convention — Regina, Saskatchewan, Canada 18-19 18	Beaver Valley RA First Hamfest — Brady's Run Park — 5 miles N. of Rochester, PA on Route 51 — WA3ZMS Can-Am Contest — 19-20 Mt. Beacon ARC Hamfest — Stewart Field — Newburgh, NY — WA2CGA SARTG World-Wide RTTY Contest — 0000-0800Z 8/19 — 1600-2400Z 8/19 — 0800-1600Z 8/20* Info: SASE to Ham Radio Horizons, Greenville, NH 03048 19
Iowa 75-Meter Net Potluck Picnic/Hamfest — Riverside Park Marshalltown, IA Lafayette Hamfest — Tippecanoe County Fairgrounds — Lafayette, IN North Alabama Hamfest — The Mall — Huntsville, AL Warren ARA Hamfest — Trumbull KSU Campus — Ohio Route 45 at the Warren Outerbelt — Warren, OH — K8JLK WELI ARC Flearmarket/Auction — Radio Towers Park, Benham Street Hamden, CT — WA1PXM or WA1ZWB 20	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB WEST COAST BULLETIN Edited & transmitted by W6ZF 9PM PDST 3540 kHz, A-1, 22 WPM 21	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) 22	23	24	25	All Asian CW Contest — 26-27 ARRL Anchorage ARC Convention — Anchorage, AK — 26-27 550 ARC Flearmarket — American Legion Hall, Oak Street — Oakland, NJ WA2HLE 26
Fox River Radio League Hamfest — Kane County Fairgrounds Exhibition Hall — St. Charles, IL — WB9PAC LaPorte County Summer Hamfest — By the Michigan City & LaPorte Amateur Radio Clubs — LaPorte County Fairgrounds — LaPorte, IN St. Charles ARC Hamfest — Wentzville Community Club — Wentzville, MO Union County ARC Hamfest — Plain City Fairgrounds — Plain City, OH W8BJN 27	FLORIDA HAM NEWS — SWAP NET By the Broward ARC 146.31-91 at 7:30PM GLENHURST RADIO SOCIETY Transmits Amateur Radio News — 222.66/224.26 MHz via WR2APG and 21.400 MHz USB 28	AMSAT Eastcoast Net 3850 kHz 9PM EDST (0100Z Wednesday Morning) AMSAT Mid-Continent Net 3850 kHz 9PM CDST (0200Z Wednesday Morning) AMSAT Westcoast Net 3850 kHz 8PM PDST (0300Z Wednesday Morning) 29	30	31		The Tioga Amateur Radio Society, Monticello, Indiana will sponsor a Ham Radio Cruise Day on Lake Freeman, Sunday, August 27, 1978, aboard The Madam Carroll Boat. 4 rigs aboard — work Amateur Radio from a Marine Mobile — Special certificates and QSL cards for this operation. Decks open at 1:00 PM — 2 Cruises — 2:00PM and 4:00PM. Advance tickets $2.00 — at dock $2.50. Send SASE to Byron Robbins, WD9EXI, Secretary, 571 South Bluff Street, Monticello, Indiana 47960 for advance tickets or further details.

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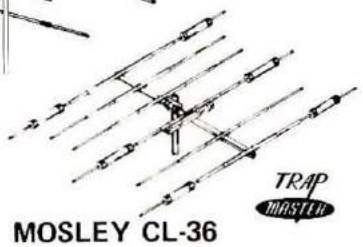
CUSHCRAFT ATB-34



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203	3 ele. 2 Mtr. beam	12.95	
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214	14 ele. 2 Mtr. beam	26.95	
	MOSLEY		
Classic 33	3 ele. 10, 15, 20 Mtr. beam	232.50	189.95
Classic 36	6 ele. 10, 15, 20 Mtr. beam	310.65	249.95
TA-33	3 ele. 10, 15, 20 Mtr. beam	206.50	169.95
TA-36	6 ele. 10, 15, 20 Mtr. beam	335.25	279.95
TA-33 Jr.	3 ele. 10, 15, 20 Mtr. beam	151.85	129.95
TA-40KR	40 Mtr. add on	92.25	74.95
	CUSHCRAFT		
ATB-34	4 ele. 10, 15, 20 Mtr. beam	259.95	209.95
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A147-20T	2 Mtr. Twist	59.95	52.95
A144-10T	10 ele. Twist 2 Mtr.	39.95	32.95
A144-20T	20 ele. Twist 2 Mtr.	59.95	52.95
	HUSTLER		
4BTV	10-40 Mtr. Trap Vertical	99.95	82.95
RM-75	75 Meter Resonator	15.50	13.50
RM-75s	75 Meter Super Resonator	30.00	26.50
G6-144-A	6 db. 2 Mtr. Base Colinear	67.55	57.95
	WILSON		
System One	5 ele. 10, 15, 20 Mtr. beam	274.95	239.95
System Two	4 ele. 10, 15, 20 Mtr. beam	219.95	189.95

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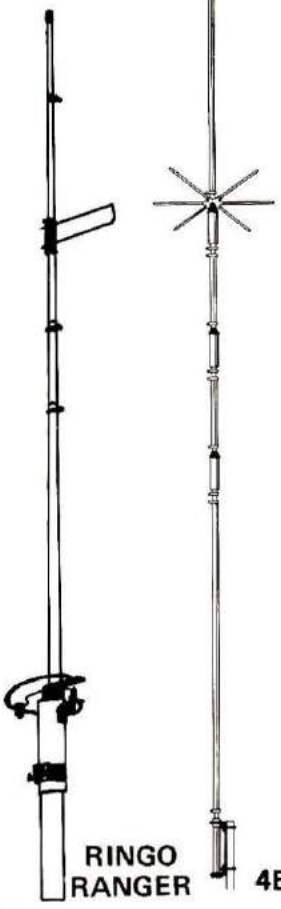

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AUGUST, 1978

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New HFM-200 VSWR—Power Meter: Out in front for HF band operations, 1.8-30 MHz. Measures power and 1:1 to 3:1 VSWR more accurately than wide frequency range meters. Separate Directional Coupler simplifies installation. Illuminated meter for mobile operation. **$49.95**

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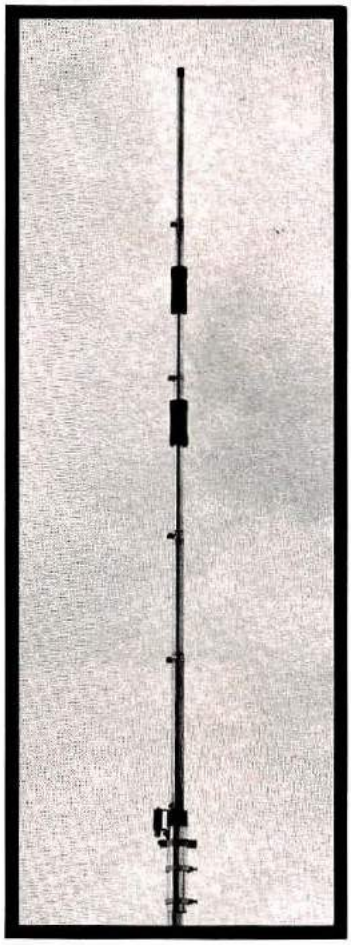
NEW

HF VERTICALS BY CUSHCRAFT

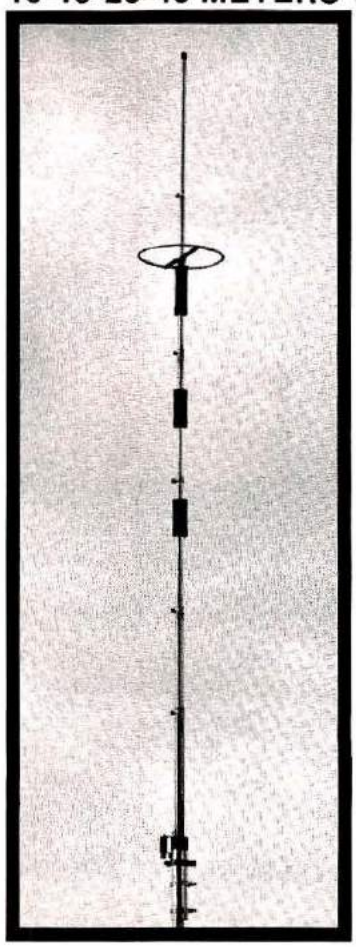
Cushcraft's new multiband vertical antenna systems have been optimized for wide operating bandwidth and provide the low angle of radiation which is essential for long-haul DX communications on the high-frequency amateur bands. The high Q traps which were designed especially for these verticals use large diameter enamelled copper wire and solid-aluminum air-dielectric capacitors; the trap forms are manufactured from filament-wound fiberglass for minimum dielectric loss and high structural strength. High strength 6063-T832 aluminum tubing with 0.058" (1.5 mm) walls is used for the vertical radiator. The massive 2 inch (50 mm) OD double-walled base section and heavy-duty phenolic base insulator ensure long life and durability. For maximum performance with limited space, choose a Cushcraft multiband vertical; all models may be roof or ground mounted on a 1¼" - 1⅞" (32 - 48 mm) mast.

10-15-20 METERS



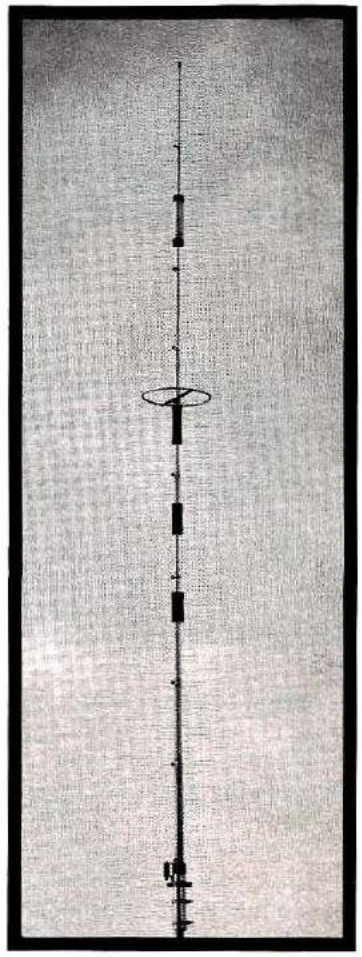
ATV-3 Cushcraft's ATV-3 multiband vertical provides low VSWR operation for both SSB and CW on 10, 15, and 20 meters. Matched to 50 ohms; built-in connector mates with standard PL-259. Stainless-steel hardware is used for all electrical connections. The ATV-3 is a compact 166 inches (4.2 meters) tall. Rated at 2000 watts PEP.

10-15-20-40 METERS

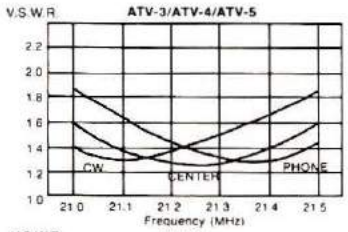


ATV-4 The Cushcraft ATV-4 four-band vertical antenna has been optimized for wide operating bandwidth on 10, 15, 20, and 40 meters. SWR is less than 2:1 over the CW and SSB segments of 10, 15, and 20. The 2:1 SWR bandwidth on 40 meters is approximately 240 kHz; may be quickly and easily adjusted to favor any part of the band. Coaxial fitting takes 50-ohm transmission line with PL-259 connector. Overall height, 233 inches (5.9 meters). Rated at 2000 watts PEP.

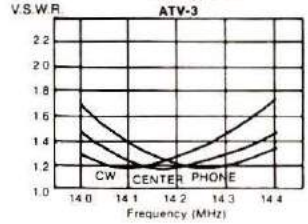
10-15-20-40-80 METERS



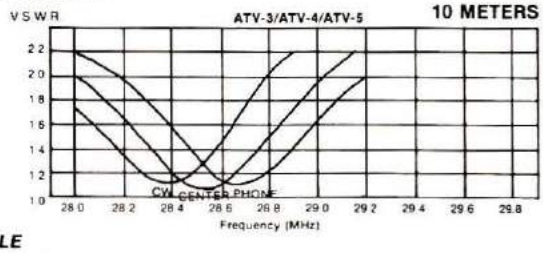
ATV-5 The ATV-5 trapped vertical antenna system has been engineered for five-band operation on 80 through 10 meters. The high Q traps are carefully optimized for wide operating bandwidth: 2:1 SWR bandwidth with 50-ohm feedline is 1 MHz on 10 meters; more than 500 kHz on 15 and 20 meters; 160 kHz on 40 meters; and 75 kHz on 80 meters. Instructions are provided for adjusting resonance to your preferred part of the band, CW or SSB. Built-in coaxial connector takes PL-259. Nominal height, 293 inches (7.4 meters). Rated at 2000 watts PEP on **all** bands.



15 METERS



20 METERS



10 METERS

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As of May 31, 1978

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AM-362

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