Hints and Kinks

Conducted By Larry D. Wolfgang,* WA3VIL

SIMPLER RTTY DIVERSITY COMBINER

☐ I was intrigued by George Woodward's RTTY Diversity Combiner in the September 1982 Hints and Kinks column. After giving some thought to the circuit, I realized that it included more parts than necessary. There are two logic inputs, A and B. If they agree (both 1 or both 0) then the output is the same. If they disagree, however, the desired output must be the opposite of what it was the last time the inputs agreed. This requires another variable, C, representing the value of A and B the last time they areed. The Schmitt trigger hysteresis in W1RN's circuit provides this function.

I did some work with truth tables and Karnaugh maps to show that the logical function of Eq. 1 provides the desired result:

$$AB + (A + B)\overline{C} \qquad \text{(Eq. 1)}$$

C can be generated by a simple R-S flip-flop, which can be implemented using NAND gates.

Fig. 1 shows a RTTY Diversity Combiner that requires 8 NAND gates. My unit uses two SN7400N quad NAND gates, with no other parts. The total cost was about $1.20. — *Carl Hayes, KD5BH, Dallas, Texas*

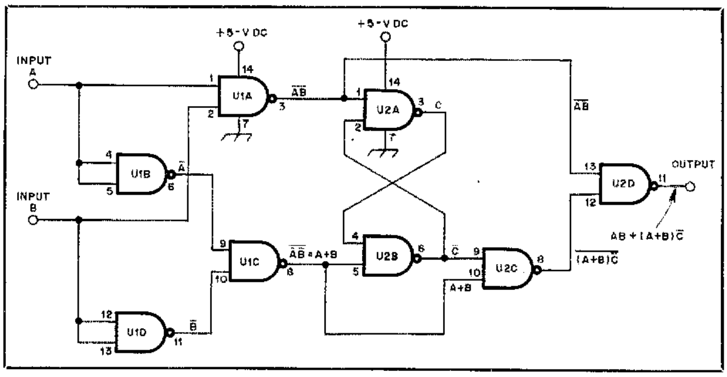

Fig. 1 — Schematic diagram of a simplified RTTY Diversity Combiner requiring only two ICs.

INEXPENSIVE 30-METER BEAM ANTENNA

☐ In about two months of operating on the new 30-meter band I have worked all 50 states and over 50 countries. My antenna is simple but effective. It is a rotatable inverted V beam. Fig. 2 shows the construction details. The antenna boom is suspended from a tree branch about 50 feet in the air.[1] The antenna can be rotated 360° simply by moving the two ground stakes. All of the materials to build this antenna cost me less than $25.

Eq. 2 gives the driven element length, Eq. 3 gives the director length, and Eq. 4 gives the element spacing that I used.

$$\text{D.E. length} = 476/f_{MHz} \qquad \text{(Eq. 2)}$$

$$\text{Dir. length} = 450/f_{MHz} \qquad \text{(Eq. 3)}$$

$$\text{Spacing} = 120/f_{MHz} \qquad \text{(Eq. 4)}$$

The feed-point impedance is around 30 ohms. I used a matching transformer made by connecting two 1/4-λ sections of RG-59/U coaxial cable in parallel. One end of the transformer connects to the antenna, and the other end goes to 50-ohm cable to the shack. Fig. 2B shows how this is wired. Perhaps the easiest method to join the two pieces of 75-ohm cable is to use coaxial T connectors. You should use a balun at the antenna feed point to prevent rf from flowing on the outside of the shield braid.

I also built an antenna of this type for 40 meters, and it works great. I guess the key word is rotatable! — *Jon Ferrara, N9DWR, Chattanooga, Tennessee*

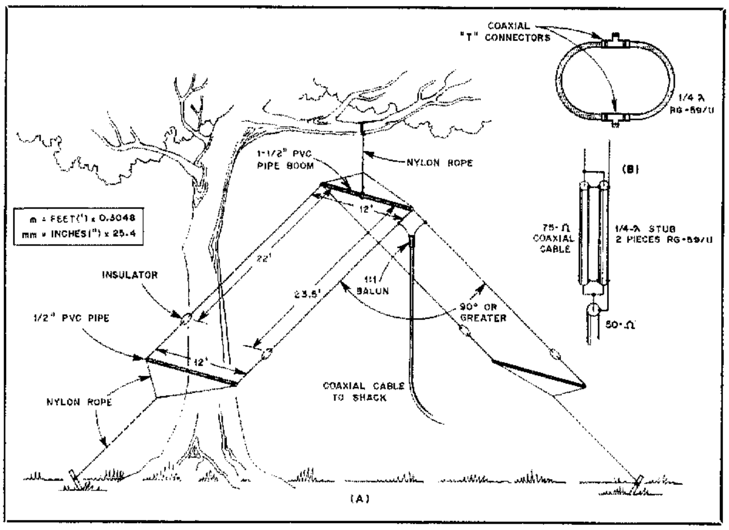

Fig. 2 — Construction details for a 30-meter inverted V beam are given at A. A coaxial-cable impedance-matching transformer is shown at B.

LOW-COST ANTENNA WIRE

☐ Radio amateurs frequently need low-cost copper wire for use in antenna systems. The wire is needed for radiators as well as for on-ground or buried radial systems. Having faced that need a number of times myself, and being a chap who objects to paying premium prices for such ordinary material, I sought some low-cost sources of suitable wire. You may find this information useful when you begin to accumulate material for that next antenna project.

Multiwire rotator cable for TV antennas is an excellent source of wire for many amateur antenna systems. The five-conductor cable from Radio Shack (15-1201) contains no. 20 wire. A 100-foot length sells for $10. By separating the five lines from one another you end up with 500 feet of insulated wire, which calculates out to 2 cents per foot. I have used this cable many times to put down a radial system. The conductors pull apart easily, and each retains a coating of plastic insulation.

Another type of wire that I have used extensively for the radiating elements of antennas is two-conductor speaker or "pot" cable. It has a heavy plastic insulating material that lends strength to the wire. This is especially useful for dipoles or similar antennas. As is the case with rotator cable, the individual conductors can be pulled apart to form separate insulated wires. Radio Shack light-duty cable (278-1387) costs $5.99 per 100 feet. The roll provides two lengths of no. 20 wire, which equates to 3 cents per foot. Not bad! Heavy-duty speaker wire (16 gauge) is also available from Radio Shack in 100-foot rolls at $11.95 (278-1384). I have used this vinyl-insulated, two-conductor wire for balanced feeders with dipole antennas and 3-element wire Yagis during DXpeditions. I never measured the loss, but it seemed to perform okay at power levels up to 100 W.

Those wishing to put up long spans of wire (Beverage antennas and such) may want to con-

[1] mm = in. × 25.4; m = ft × 0.3048.

*Assistant Technical Editor

sider using aluminum electric-fence wire. It is available from Sears, Roebuck and Co. in 1/4-mile-long rolls for a very low price. Another fine low-cost wire from Sears is no. 8 solid-aluminum wire with vinyl jacketing. It is listed as overhead power wiring for farms. The price per foot is very low. I have used this wire for buried radials. The insulation helps prevent corrosion of the aluminum conductor caused by soil acids or alkalies. Electric-fence wire, on the other hand, can dissolve in a few months when buried in some soils.

Finally, when seeking low-cost wire, don't overlook those deflection yokes from junked TV sets. They contain plenty of formvar-insulated magnet wire that is useful for winding coils and making lightweight antennas. — *Doug DeMaw, W1FB, ARRL Hq.*

TAGS FOR SHACK-WIRING IDENTIFICATION

☐ Recently, I was redoing my station wiring. I was making small tags to identify the interconnecting coaxial cables and affixing them with masking tape. My XYL Florence, WA1IKR, watched for a while, then left. She was soon back with a jar full of the plastic clips used to close bread wrappers. These clips have a small opening that is just right to fit over RG-58/U or RG-59/U coaxial cable. They can also be attached to power cords or to external speaker leads. Florence used a felt-tipped marking pen to write on the clips. The ink from most pens of this type will rub off, but we used a piece of clear cellophane tape over the tag to protect the label. [The ink from a Pilot permanent-marking pen will not rub off. — Ed.] Now it is easy to connect the individual cables that run from the receiver to antenna switch, between the amplifier and exciter, and the many other interconnecting wires that occupy the cable trough behind my operating table. This idea should prove especially useful for those who change equipment often, or for setting up a temporary station such as for Field Day operation. — *Stirling Olberg, W1SNN, Waltham, Massachusetts*

QRP TRANSMITTER REMOTE CONTROL

☐ My transmitter is a version of the W7ZOI "Universal QRP Transmitter."[2,3] I use this rig, along with a direct-conversion receiver for 40, 20 and 15 meters, at my home station and for portable operation. Trying to optimize the setup, I became concerned about the signal loss in the more than 50 feet of coaxial cable to my antenna.

I decided to mount my transmitter in the tree that supports the antenna and to key it from my operating position. A length of RG-59/U and a single + 12-V dc lead go to the transmitter. A 12-V spdt relay in the transmitter connects the RG-59/U to the antenna for receive, or to the key lead on transmit. A dpdt switch on the receiver cabinet completes the control circuitry. On receive, the coaxial cable is connected to the receiver; on transmit, it is connected to the key. The second pole of the switch provides + 12 V to the receiver or transmitter. Fig. 3 shows the wiring details. By mounting the transmitter close to the antenna more of the power is radiated, and that is important for successful QRP operation. — *Bert Halfpap, WØKOA, Denver, Colorado*

[2]D. DeMaw, "Experimenting for the Beginner," QST, Sept. 1981, pp. 11-15.
[3]Feedback, Nov. 1981 QST, p. 50.

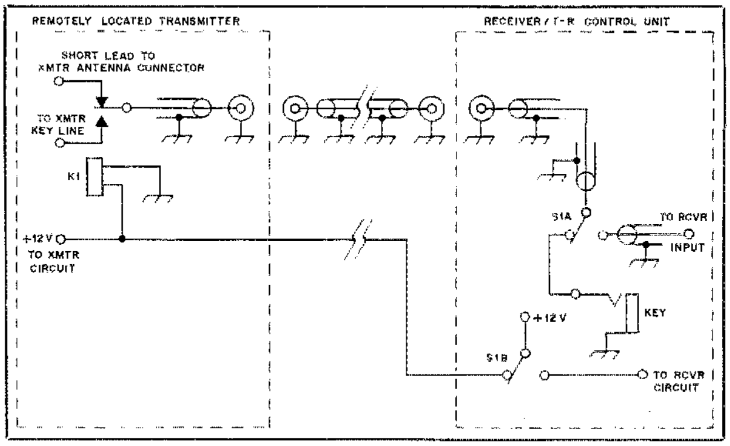

Fig. 3 — T-R control wiring used by WØKOA with his remotely mounted QRP transmitter.

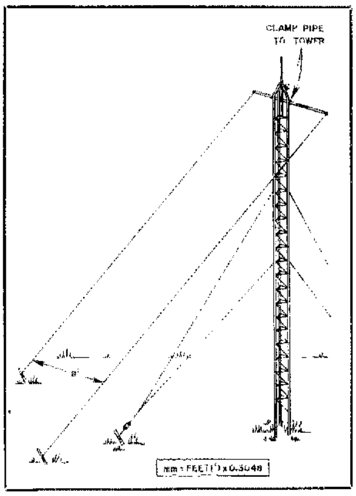

Fig. 4 — The method used by WA1OEZ to raise a beam antenna without the guy wires getting in the way.

RAISING BEAM ANTENNAS

☐ I decided to replace a Mini-Quad antenna with a 4-element triband Yagi on top of my 50-foot tower. A set of guy wires at the 35-foot level prevented pulling the new antenna straight up the side of the tower. My plans also included installing a 2-meter beam above the Yagi. I clamped a 6-foot pipe to the top of the tower and stretched ropes from each end of it to the ground (Fig. 4). I secured the ropes with stakes about 8 feet apart on the ground.

By removing the rotator, I was able to lower the mast until about 1 foot extended above the top of my tower and secured it at the thrust bearing. The new beam was laid on the ropes and pulled to the top of the tower. I placed it over the mast, but did not tighten it in place. I raised the mast, secured the 2-meter beam, then slid the mast up to the final position. I installed the rotator and positioned the triband antenna. One or two ground assistants are helpful to steady the slide ropes. — *Robert Mims, WA1OEZ, Taunton, Massachusetts*

TS-820S GOES TO MARS

☐ Those interested in MARS activity must find a way to tune their rigs to frequencies just outside the amateur bands. For those using a TS-820S, with or without the VFO-820, a simple adjustment will allow almost full-band coverage, plus coverage of several MARS frequencies.

Either the VFO-820 or the TS-820S VFO can be adjusted in the same manner. The lower frequency limit will be 10 to 15 kHz above the lower band edge, but this would only affect Extra Class licensees. The upper frequency limit will be approximately 40 kHz above the amateur-band edge.

The modification procedure should take no more than 15 minutes, and requires no instrumentation. Remove the top of the VFO or '820S cover. Looking at the VFO with the dial facing you, remove the silver tape covering the two access holes on the top-left side of the enclosure. Set the band switch to 3.5 MHz and turn the power on. Rotate the main tuning knob to the upper limit (reading 4.000 on the display). Adjust the analog dial on the front of the VFO to read "blank 40" using the dial-calibrate knob behind the main tuning knob. Turn the rear adjustment screw until the digital display reads 4.040. Now, turn the main tuning knob to the lowest-frequency stop, and adjust the front screw so the digital display agrees with the analog dial (about 3.500 to 3.550). These two adjustments are interactive, so you will have to repeat the process several times. With some persistence, the digital readout will be synchronized with the analog dial from 3.510 to 4.040 MHz, or whatever limits are set. Do *not* adjust the exposed adjustment screw on the right side of the VFO top.

This adjustment will affect the other bands in a similar manner. If you ever want to reverse the modification, the band limits are returned easily with a similar procedure. — *E. Benson Scott II, M.D., AE5V, West Monroe, Louisiana*

Technical Correspondence

Conducted By
Dennis J. Lusis,* W1LJ

The publishers of QST assume no responsibility for statements made herein by correspondents.

COLLINS 32S AND KWM TRANSMITTERS IN THE WARC BANDS

□ When this classic series of transmitters is first placed on the 30-meter band, it is often found that the transmitter has practically no grid drive to the final amplifier. It is tempting to simply trim the inductor nearest the rear of the tuning gang — the most critical one of the group. Unfortunately, this can create a parasitic oscillation near 17 MHz, detectable only with a second receiver.

A better solution is to obtain whatever grid current is available at a dial setting of 3 on the preselector logging scale (Fig. 1). Then peak the grid current by rotating each inductor *no more than one-half turn.* Next, peak the capacitors on 20 meters, as prescribed in the Collins manual, and then return to 30 meters for a second try with the inductors. By making no more than one-half turn at a time, you will avoid trouble. Be sure the receiver preselector is peaked correspondingly if you are in transceive operation.

If a general-coverage receiver is available, tune in the parasitic oscillation near 17 MHz and vary the driver plate inductance and the mixer capacitance, noting that the "parasite" occurs only when both these adjustments are not peaked at the same position of the tuning gang.

The 10-MHz power output may be less than that obtainable on 20, 15 and 10 meters, as the tank circuit Q is somewhat high for good efficiency (high circulating current). Reasonable output usually can be obtained with 225 mA of plate current. Do not tune for more current than this, or discoloration of the final tank coil may occur, indicating excessive values of circulating current. — *Cliff Buttschardt, W6HDO, Los Osos, California*

*Assistant Technical Editor

ABOUT "RUBBERING" CRYSTALS

□ Inductance-loaded VXO design is facilitated by the use of the graph in Fig. 2. The operating frequency varies from series resonance, ω_s, downward. C_0 is the equivalent parallel capacitance of the crystal; r is the ratio of C_0 to C_1 (equivalent series-branch capacitance of the crystal) and is the electrical equivalent of the mechanical elastance of the vibrating plate. L is the equivalent load inductance; it is made continuously variable by various configurations of adjustable capacitors.[1] HC-6/U fundamental crystals have a C_0 in the range of 5 to 9 pF and an r value in the vicinity of 250. Almost all fundamental high-frequency crystals have r values between the limiting values of 125 and 500, as shown by the dashed lines in Fig. 2. Stability varies roughly with the slope of the curve. For r = 250, the best compromise of range versus stability occurs at about 1.5 kHz/MHz. Stability at unregulated room temperature is about one part per million per hour. — *Frank Noble, W3MT, Bethesda, Maryland*

[1]F. Noble, "Phantom-Coil VXO," *Ham Radio*, Jan. 1982, p. 66.

NOTES ON COAXIAL BALUNS

□ [Editor's Note: The following is taken from a letter by John Belrose, VE2CV, to D. A. Christie, WB5KFP, who asked Belrose if the antennas he modeled in his Dec. 1982 *QST* article, "The Effect of Supporting Structures on Simple Wire Antennas," were fed using a balun or not, and what the effects of this were.]

The model antennas we built were all connected to the feed line through a coaxial balun of either a 4:1 or a 1:1 type. For the inverted-V dipoles, a 1:1 coaxial balun was constructed by sliding a decoupling sleeve ($\lambda/4 \times 0.95$ long) over the RG-174 coaxial feed line. This arrangement proved to be unacceptable at 200 MHz.

We noticed a problem while making impedance measurements. When the rf bridge was "balanced," bringing one's hand near the feed line unbalanced it. The decoupling sleeve, which was formed from the braid of a coaxial cable, was then made "solid" by soldering; after this the bridge no longer became unbalanced when a hand was brought near. We did, however, notice asymmetry in the vertical-plane pattern of the inverted V, for vertical polarization measured in the plane of the antenna. This effect was more noticeable when a conducting support tower was employed (Figs. 3 and 4). The effect was attributed to an imperfect transformation in the balun.

We subsequently learned how to make better coaxial baluns for use at vhf and uhf, but we did not repeat our measurements while using them. The outer sleeve should be made of solid material and the coaxial cable should have a solid outer sheath, or be constructed from tubing of a similar size, with an insulated wire (of proper diameter for the desired impedance) running down the center. There should be sufficient air space between the coaxial cable and the inner wall of the sleeve so that dielectric material can be inserted to electrically "lengthen" the inner sleeve.

I mention *inner* sleeve because it has different electrical lengths on the inside and outside. The outer surface is excited by the radiated field, so from a radiation point of view the physical length is shorter than the electrical length by a factor that depends on the electrical diameter of the

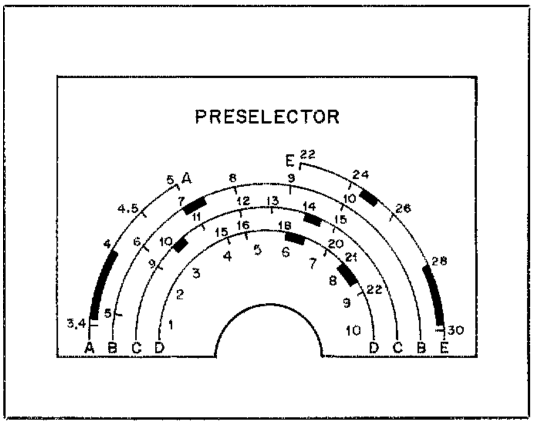

Fig. 1 — New preselector template (including WARC bands) for Collins S-Line and KWM transmitters.

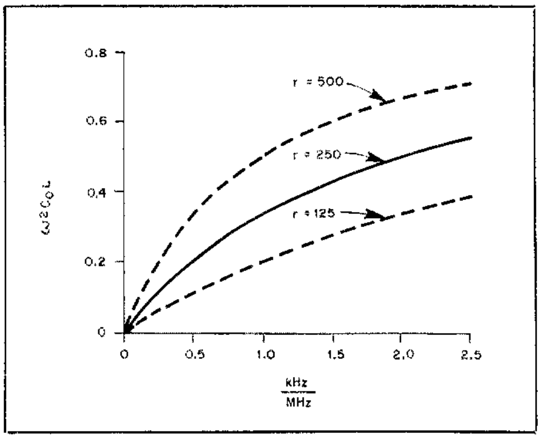

Fig. 2 — Graph used to aid in the design of VXOs.

sleeve. At vhf, this factor is 0.7-0.85. On the inside, the sleeve behaves like a transmission line. So for air dielectric the physical length is shorter than the electrical length by a factor of about 0.975. Hence, if the sleeve is "cut" to the right outside length, it is too short to be an electrical 1/4 λ on the inside. By dielectric loading (dielectric material should be low loss and have a constant of about 1.8), the electrical length on the inside can be made equal to that of the outside.

Let us now look at the effect of supporting towers on the patterns for an inverted-V dipole. In my *QST* article I showed only "symmetrical" smoothed patterns. In Figs. 3 and 4 are the unsmoothed, measured vertical-plane patterns for vertical polarization, measured in the plane of the antenna for △ = 90° and 127°. You will notice that there is indeed some asymmetry, which is more marked for a conducting tower and at low elevation angles.

This effect is attributed to a slight unbalance in the feed to the dipole, and therefore I decided (for my *QST* article) to plot a smoothed symmetrical pattern. The field strength plotted was the geometric mean value at each elevation angle. Since care was taken to construct the balun, and yet the pattern unbalance at low elevation angles (say 10°) can be as much as 5 dB, I conclude that without a balun the bidirectional nature of the antenna would be completely spoiled . . . but I do not have any measurements to verify this.

Incidentally, I have been reexamining our notes on these antenna measurements, and I have noticed that the inverted-V having a △ = 127° was almost a perfect match for the 50-Ω feeder. The impedance of the half-wave dipole was 67 Ω (should have been 72 Ω), and the impedance of the inverted-V for a △ = 90° was 36 Ω. My statement in the *QST* article that a configuration of △ = 90° provides a better match to 50-Ω feed line than a horizontal dipole does was therefore not correct. However, if you wish to work DX, the configuration of △ = 90° provides better low-angle radiation in the plane containing the antenna.

I should emphasize, so that there will be no misunderstanding, that the extreme sensitivity to any unbalance is only for the vertically polarized field. The balun was "plenty good enough" for the horizontally polarized field in the orthogonal directions . . . the pattern was symmetrical. — *John S. Belrose, VE2CV, Aylmer, Quebec*

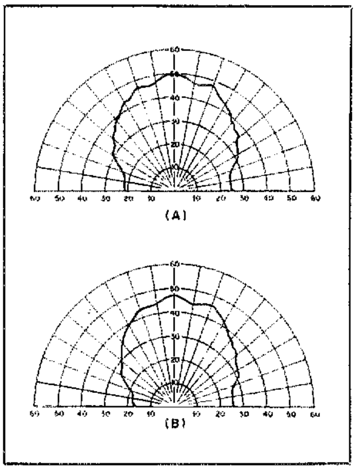

Fig. 3 — Vertical-plane polar diagrams of 1/2-λ inverted Vs, for vertical polarization measured in the plane of the antennas. The angle between dipole arms (△) is 90° in both cases. A nonconducting support tower is used in A, and a conducting support in B. Note increased asymmetry in B. [The patterns are drawn on a *linear* scale and are not in *QST* style. They are included for relative comparison only. — Ed.]

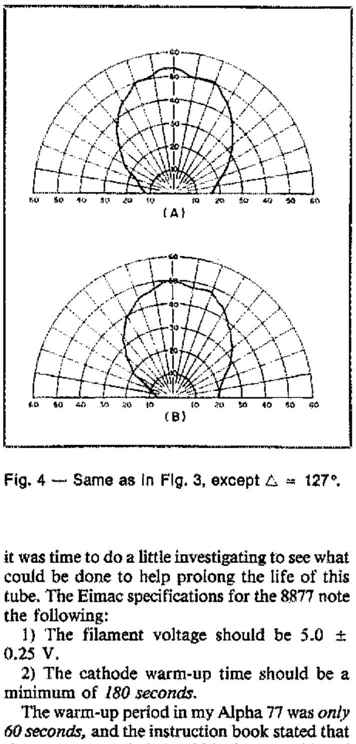

Fig. 4 — Same as in Fig. 3, except △ = 127°.

LEGAL WIRE SIZE

☐ Over the years, I have read numerous articles concerning so-called "invisible" antennas made of small-diameter wire. The appearance of a recent article in *QST* prompts me to observe that many hams are apparently unaware of the National Electrical Code Table 810-52 — which specifies that the minimum size of antenna conductors be *no. 14*.

Amateurs should consider the possible implications of presenting a claim to an insurance carrier as the result of a liability caused by an antenna erected in violation of this code. — *William H. Tilton, K7OKC, Centralia, Washington*

POWER-TUBE FILAMENT CONSIDERATIONS

☐ When the filament opened up on my 8877 tube, I found that I couldn't pick up a $1.98 replacement at the corner drug store. I figured it was time to do a little investigating to see what could be done to help prolong the life of this tube. The Eimac specifications for the 8877 note the following:

1) The filament voltage should be 5.0 ± 0.25 V.

2) The cathode warm-up time should be a minimum of *180 seconds*.

The warm-up period in my Alpha 77 was *only 60 seconds*, and the instruction book stated that the warm-up period should be between 80 and 120 seconds (still too short!). I changed the R-C network in the timing circuit to over 180 seconds — assuring I didn't apply drive too soon.

Page 192 of the 1977 ARRL *Handbook* specifies 6-V ac for the 8877 filament. [Later editions have been corrected. — Ed.] I also did not notice any mention of tube warm-up time.

The bottom line is a warning that anyone designing or using an amplifier using the 8877 tube should be aware of the proper filament voltage. Also, the required warm-up period is at least 180 seconds before drive power is applied. — *Howard A. Miller, W4KXE, Luray, Virginia*

Feedback

☐ Please note these corrections to "Amateur Use of Solar Electric Power — Part 2," November 1982 *QST*. Fig. 3 should have a connection dot joining the negative output line of module 17 to the BANK 2 negative bus. In Fig. 10, the 20- and 50-A breaker labels should be swapped.

☐ The book review "Three New Directories For Amateurs," in March *QST*, page 35, should have made clear that the *Amateur Radio Call Directory* is the type with which we are all familiar. That is, call signs, names and addresses are listed by districts. The other directories are a *Geographical Index* and a *Name Index*, respectively.

☐ Two items in the April 1983 Hints and Kinks column have apparently confused a number of readers. We know of no way to produce a 24-hour-format display on the small stick-on clocks. Dave Geiser, WA2ANU, suggested setting one to 12-hour-format UTC. If anyone does know of a simple modification to provide a 24-hour display on these clocks, please send details to the Hints and Kinks Editor.

☐ Sharp-eyed readers have been quick to point out references that are appropriate to append to the list on page 27 of April 1983 *QST* for the article "The Search for a Simple, Broadband 80-Meter Dipole" by J. Hall, K1TD. They are:

Lawson, J. L. "160/80/75-Meter Broad-Band Inverted-V Antenna." *QST*, Nov. 1970, p. 17 (considers parallel-fed dipoles of different lengths).

Vissers, W. "Build a Double Bazooka." *73*, Aug. 1977, p. 36 (indicates the broad-band characteristics of the parallel-connected coaxial dipole, a more apt name for what Hall calls a "double bazooka with crossed connections at the feed point").

Harbach, A. B. "Broad-Band 80-Meter Antenna." *QST*, Dec. 1980, p. 36. (treats number of conductors versus equivalent diameter in a cage antenna, and mechanical and other considerations).

Strays

SSCs — WE HEAR YOU!

☐ When applying for the Special Service Club program through your section's Affiliated Club Coordinator (see December 1982 *QST* or contact Hq. for further information), you may now list your club's ARRL members by *call sign* instead of by membership number. We hope this will ease the process of applying so that your club can more quickly and easily get down to the business of working more effectively within your community for the betterment of Amateur Radio.