73

50c
(Not 75c, not even 60c)

Amateur Radio

Amateur Radio Report Card

Public Service	**A**
International Good Will	**B**
Inventiveness	**B**
Activity	**A**
DXing	**B**
Moonbouncing	**A**
FCC	**F**

73

Magazine

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de W2NSD/1

never say diet

The Docket

There is, I am relieved to report, growing pressure to have the FCC put 15928 aside until some sort of study can be made of the whole situation. You can help this movement by sending a letter to the FCC requesting that 15928 be killed outright or that the time for filing comments on 15928 be extended for six more months. It will not hurt one bit if you send this letter via your own personal Senator or Congressman so that he can include a little note of his own when forwarding it to the FCC. The deadline for such a note is July 30th, so you'd better get going.

We've got major troubles fellows, and we're going to have to pull a strain to get out of them. We've got the FCC against us for one thing . . . and that's bad. Even worse, we've got the ARRL against us. That doesn't leave us much, does it?

I can hear you now . . . there goes Wayne Green running down the ARRL again. Who the heck does he think he is? OK, let me tell you who Wayne Green is and what he knows. My ham career started out in Brooklyn almost 30 years ago. I was a teenager on roller skates and I visited every active ham that I could find in Brooklyn . . . I still run into those old timers on the air who remember my visits. I got my ticket in 1940 . . . was active on 160-40-10-2½ meters . . . won the SS contest for my section in 1941 and was extremely active right up to and including December 7th. No one can buffalo me about the old days . . . I was there . . . I know what the hams then knew . . . how little they knew . . how they built rigs from the Handbook and Radio, but had to call in one of the local "experts" when a 6C5 crystal oscillator wouldn't perk. Sure there were a few complex rigs, but most of the gang were struggling with their 6L6 oscillator modulated by a 6L6 Don't hand me any guff about the technical level of the old timers . . . I was one . . . and I knew the rest of them.

The ARRL in RM-499 claimed that they had detected that we have been going down hil and apparently they have convinced the FCC of this too. My response to 499 was a lette asking the ARRL to give any facts they had to support their claim that something wa wrong with amateur radio. They did not an swer my request . . . they *can't* answer it fo there are no facts to prove this fallacy. On the contrary, all the facts indicate that ham radi is better and more valuable than it ha ever been.

Let me get down to brass tacks. One of th biggest complaints we've been hearing is abou "appliance operators." OK, I'm an applianc operator . . . my rig is a transceiver, com mercially made, even my antenna and towe are commercial products. I don't see any rea son to spend the time and effort needed t build a transmitter today any more than th hams of 30 years ago saw any need for build ing their receivers. But I do build my RTT converters and whip up anything else specia that I need. Between the VHF gang . . . tak a look at the July VHF issue of 73 again an see for yourself, the surplus users . . . see ou June issue, the RTTY gang, the TV gang, an a dozen or so other gangs . . . plus the fellow

Updating the R-S-T reports.

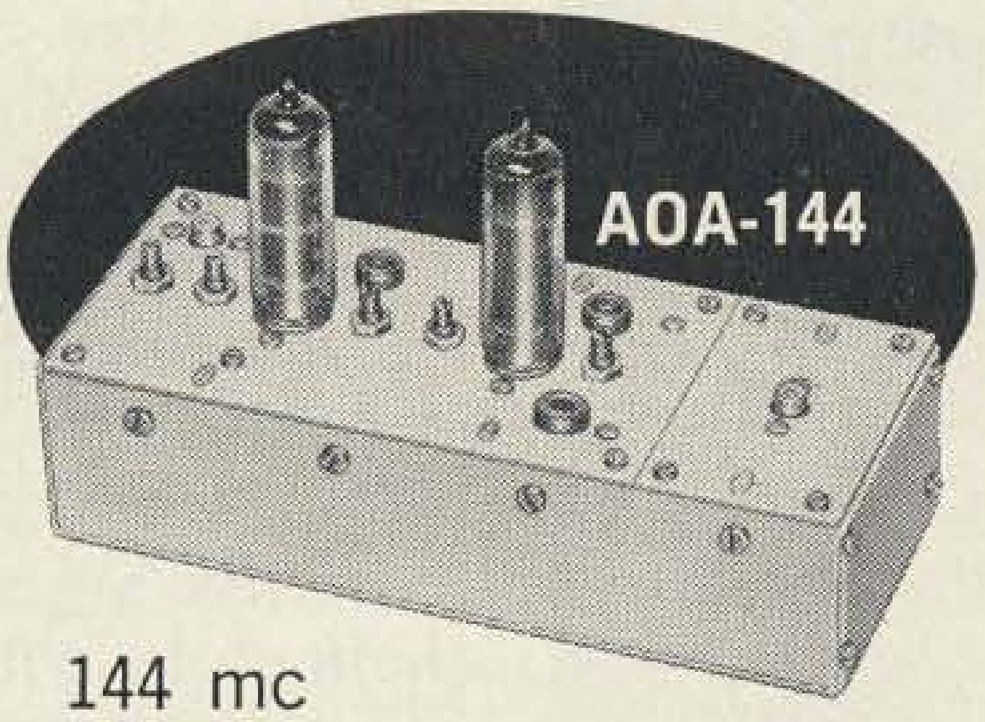
R means readibility.	
R-1 to R-4	Unreadable
R5	Readable with difficulty to armchair copy
S means signal strength.	
S-0 to S8	Too weak to copy or too much QRM to copy
S9	Readable with difficulty
S9-plus	Reasonably readable signal to thunderous signal
T means tone.	
T-0 to T8	Pulses or raw ac note
T9	Rough note or bad chirp
T9X	Anything from absolutely perfect signal to one complete with chirps, thumps, clicks, a bit of hum, buzz, parasitics, etc.

NEW FROM INTERNATIONAL

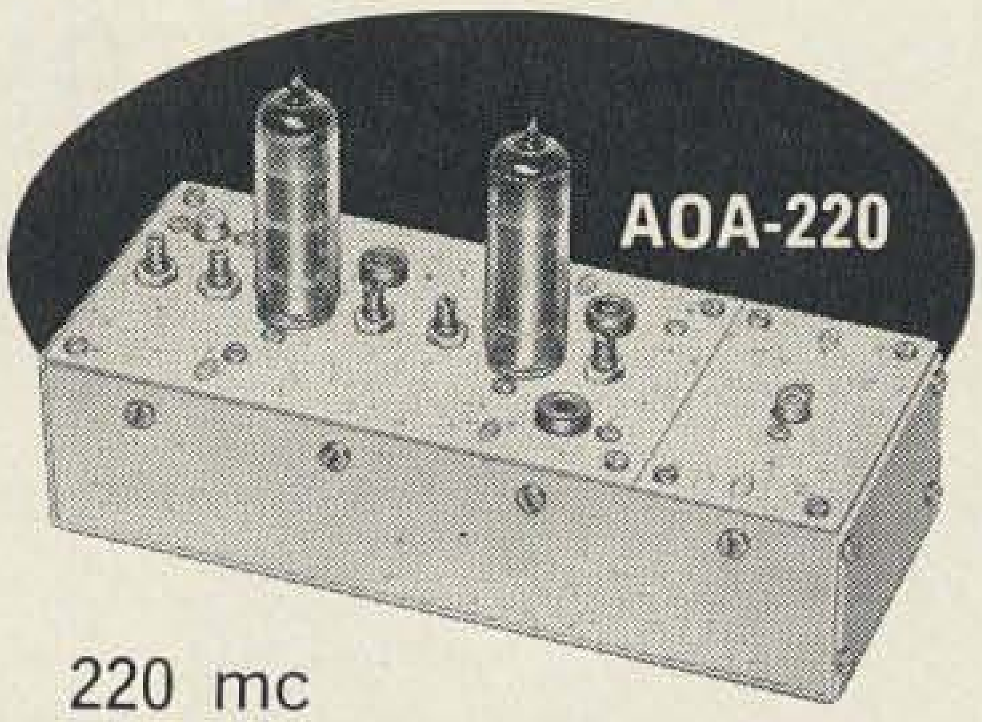
VHF/UHF UNITIZED TRANSMITTERS 50 mc – 420 mc

International's new unitized VHF/UHF transmitters make it extremely easy to get on the air in the 50-420 mc range with a solid signal. Start with the basic 50 or 70 mc driver. For higher frequencies add a multiplier-amplifier. All units are completely wired. Plug-in cables are used to interconnect the driver and amplifier.

50 or 70 mc
DRIVER/TRANSMITTER
The AOD-57 completely wired with one 6360 tube, two 12BY7 tubes and crystal (specify frequency). Heater power: 6.3 volts @ 1.2 amps. Plate power: 250 vdc @ 50 ma.
AOD-57 complete............$69.50



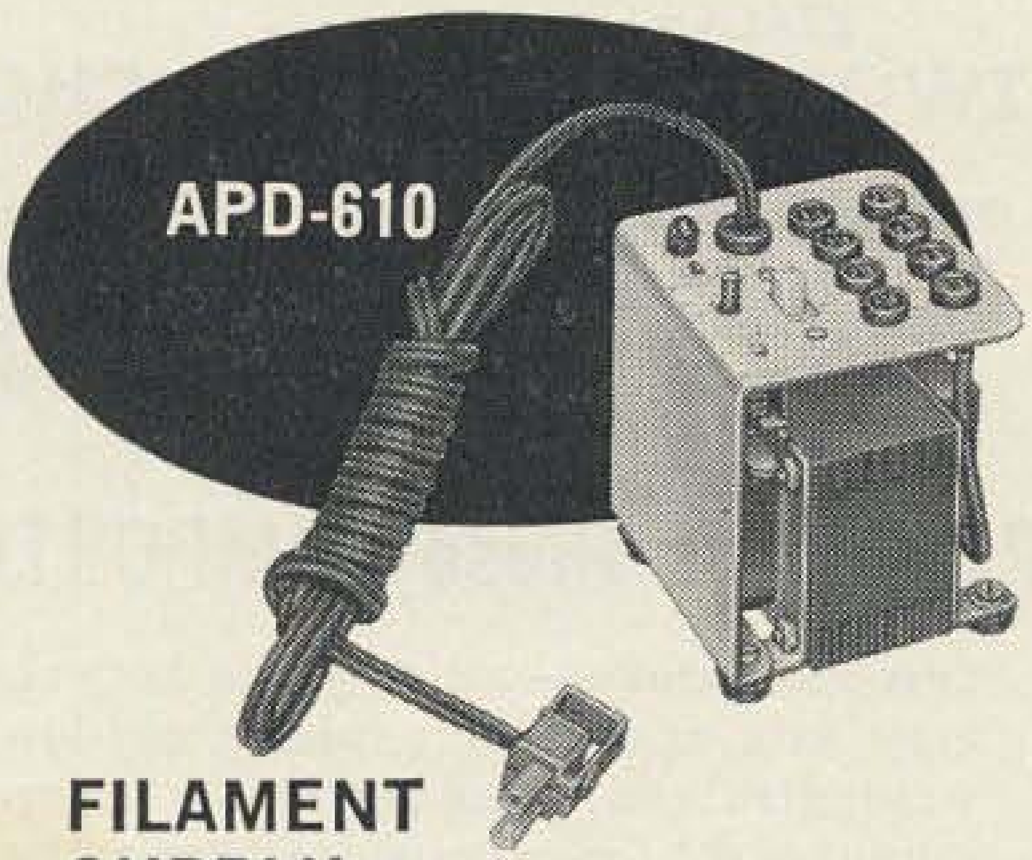
144 mc
MULTIPLIER/AMPLIFIER
The AOA-144 uses two 6360 tubes providing 6 to 10 watts output. Requires AOD-57 for driver. Heater power: 6.3 volts @ 1.64 amps. Plate power: 250 vdc @ 180 ma.
AOA-144 complete.........$39.50



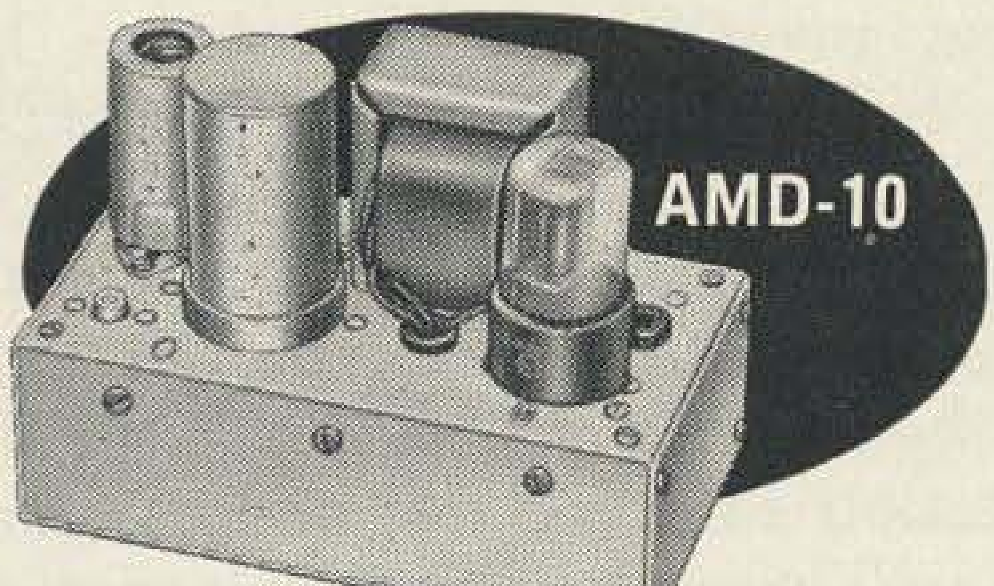
220 mc
MULTIPLIER/AMPLIFIER
The AOA-220 uses two 6360 tubes providing 6 to 8 watts output on 220 mc. Requires AOD-57 for driver. Heater power: 6.3 volts @ 1.64 amps. Plate: 250 vdc @ 150 ma.
AOA-220 complete.........$39.50

420 mc
MULTIPLIER/AMPLIFIER
The AOA-420 uses two 6939 tubes providing 4 to 8 watts output on 420 mc. Requires AOA-57 plus AOA-144 for drive. Heater: 6.3 volts @ 1.2 amps. Plate: 220 vdc @ 130 ma.
AOA-420 complete.........$69.50

RELAY BOX
Four circuit double throw. Includes coil rectifier for 6.3 vac operation.
ARY-4 Relay Box complete $12.50



FILAMENT SUPPLY
The APD-610 provides 6.3 vac @ 10 amperes.
APD-610 complete............$9.50



MODULATOR
The AMD-10 is designed as a companion unit to the AOA series of transmitters. Uses 6AN8 speech amplifier and driver, 1635 modulator. Output: 10 watts. Input: crystal mic. (High Imped.) Requires 300 vdc 20 ma, no signal, 70 ma peak: 6.3 vac @ 1.05 amps.
AMD-10 complete $24.50

COMPLETE TRANSMITTER

6 METERS	50 mc	AOD-57
2 METERS	144 mc	AOD-57 PLUS AOA-144
	220 mc	AOD-57 PLUS AOA-220
	420 mc	AOD-57 PLUS AOA-144 PLUS AOA-420

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all over the country like Bill Hoisingtor K1CLL who love to build and design things we are doing just fine. A look at the 1940 ham magazines in comparison to the 1965 will tel you the same story . . . even the average ham today is way way ahead of the average ham o 25 years ago. Way ahead.

I'm not trying to sell you a bill of goods . . these are facts. Check for yourself. Would you like an experience? Build up something from an issue of 73 and then take it around to a club or two and show what you've done. I'l bet you will find that a number of the club members will ask you questions that will amaze you about your unit. I've had this happen to me too many times . . . and the worst of al are the high school radio clubs . . . some o those kids are incredible. Don't believe m . . . ask anyone that has made the rounds o ham clubs with any kind of technical talk.

If we're all appliance operators then who is i that is buying all that surplus gear? I've bee trying to get Meshna to run bigger ads an he won't because he is selling all he ca handle right now. 85% of our readers say the buy surplus gear and our surplus advertiser back this up with some amazing stories c sales.

OK, what else? Bad manners on the air Sure . . . I run into 'em now and then. But i all the years I've been operating . . . and a the thousands of stations I've contacted, I'v run into darned few bad manners. Someho every time I do have troubles it seems to b from just a small handful of fellows, chap that I've gotten to know as troublemaker Unfortunately, we have virtually no way t get these jokers off the air. Bad manners is a exaggerated problem. I've operated from se eral rare DX spots and almost without excep tion I've found that everyone was as coopera tive as I could ask. When I operated well got good results, when I goofed it things g messed up . . . and I could take the easy wa out and blame myself, but experience ha taught me how to handle pileups so that ever one gets worked and everyone is happy . . when it doesn't work this way for me it is m own fault. I can sympathize with the DX cha who is sitting there dying a slow death waitin for the DX station to stand by and is afra that the band will go out before he can mak the QSO. This can be very nervewracking an lead to chaos if the DX station tries to igno it . . . bad manners? Baloney.

Hams don't invent things anymore. Yea Listen chum, before you start telling anyo

Turn to p. 86.

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This One Sounds Good – Like a Transmitter Should

For some reason or other, going mobile has meant spending a good sum of money for a rig that most likely offered three times the features that the average mobile ham needed. Or, if the ham was a build-it-yourselfer, it usually meant sacrificing audio quality or transmitter power or operating convenience. This may have been because of cost, space limitation, or just because no one, aside from a few commercial units, had taken the time to design a quality prototype, field test it for months to remove and bugs, and then re-build the final proven design.

Well, all you potential mobile hams, here is an article on just such a design: a mobile (or fixed-station) transmitter complete with all the features you'd like, the size you need (only 3 inches high), and even where to put each component and wire to assure identical results with the final prototype, which by the way was field-tested for three years with no breakdowns or operating problems.

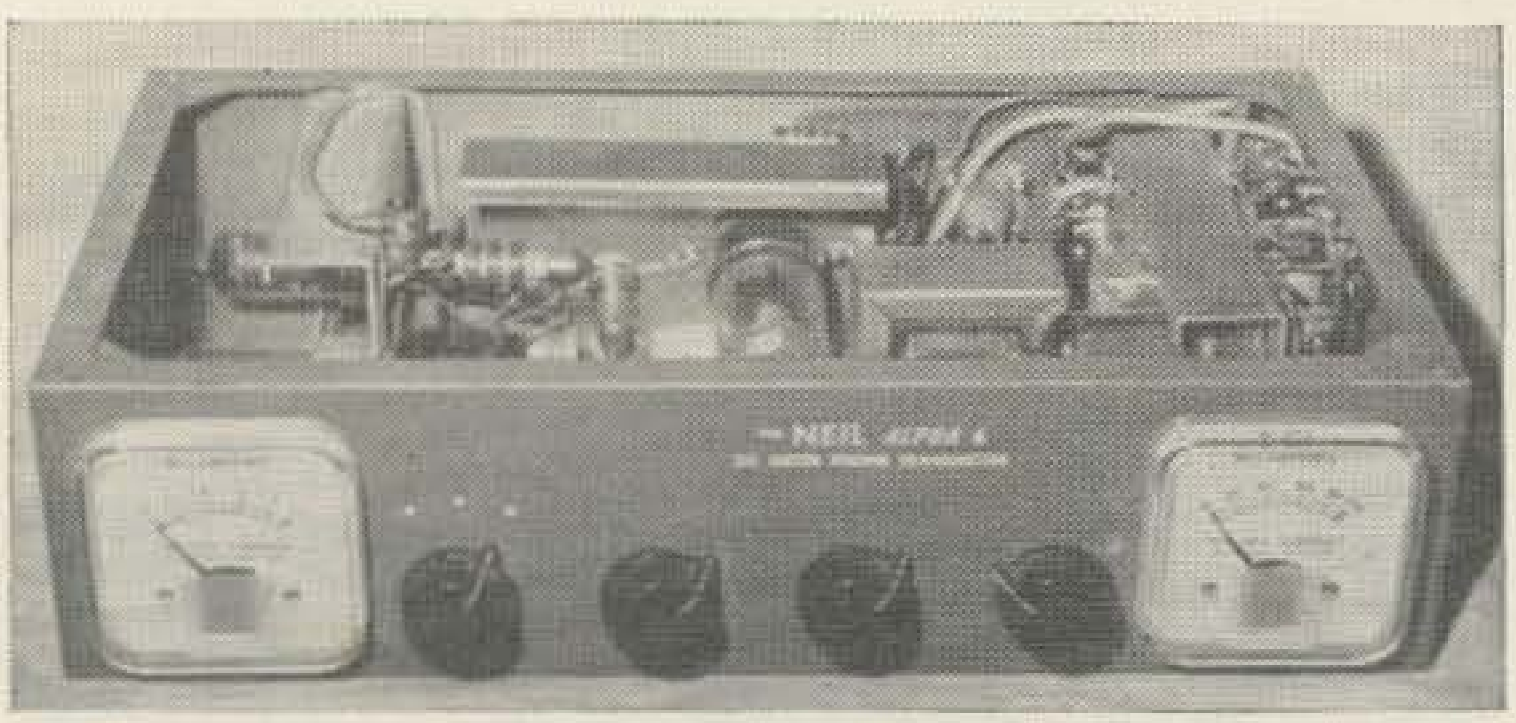


Fig. 2A—Front View: This is the original prototype, and does not have a crystal socket on the front panel.

It would be easy to write several pages on the superiority of this transmitter, but the outstanding features are that it tunes easily, and it "sounds better." This has been attested to by every signal report we've received. "It's the finest sounding rig we've ever heard," and, "I can't believe you're running only 20 watts—sounds better than any hundred watt rig I've heard." This is characteristic of the glowing reports we've had with this transmitter. And it happens every time we make a new QSO!

What makes this so? There are no gimmicks, no special components. The answer is that the rf section is *stable*, and a great deal of time was spent in designing and testing the audio section. The audio passband and power were carefully designed to provide superior audio, and were not merely "something" that would modulate the final stage. The speech amplifier is highly filtered, and stable. Yet it contains no tricks, is easy to build, and is not over-designed. In fact, the modulator by itself will improve the signal quality of most 20 watt AM transmitters in use today.

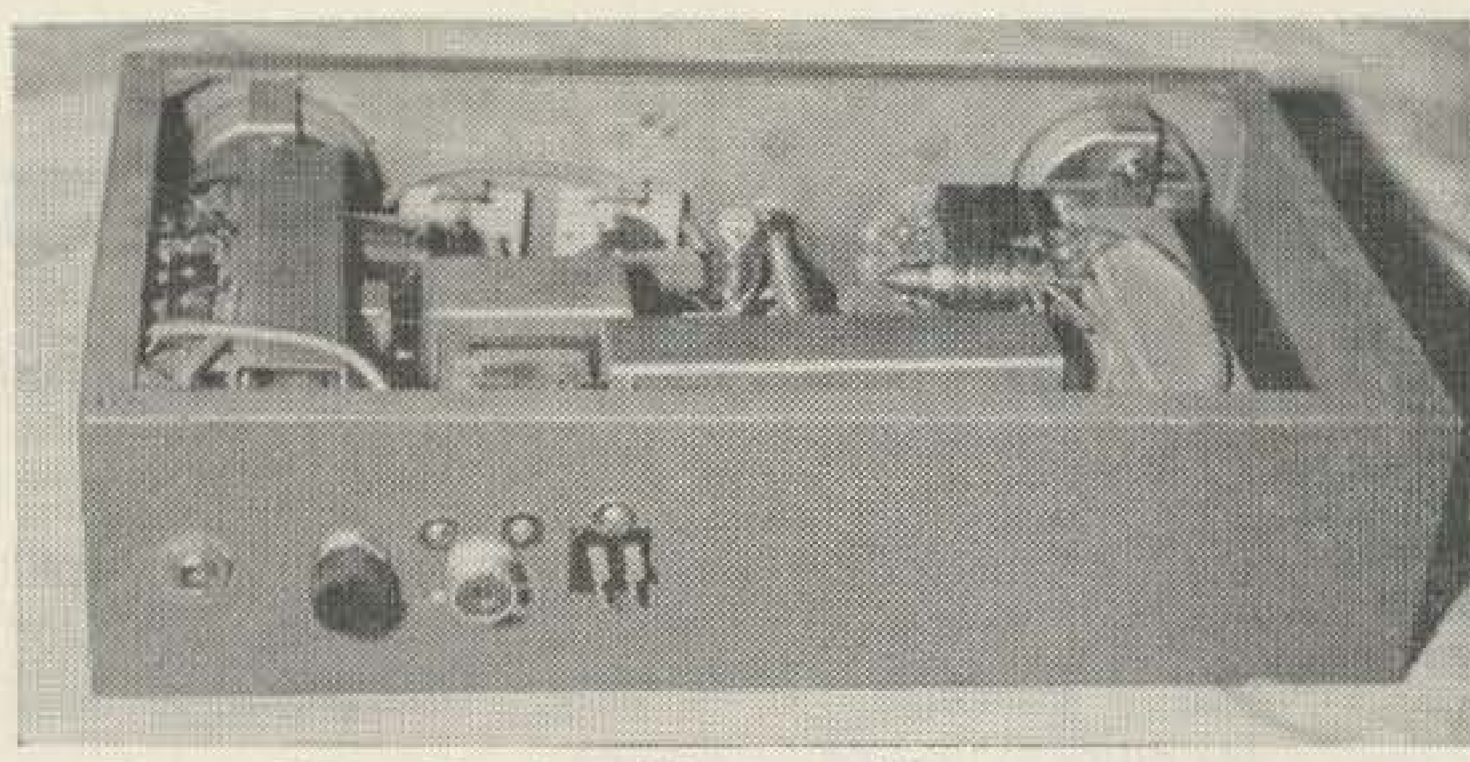


Fig. 2B—Back View: Note components mounted on back panel. From left, mike input, gain control, antenna output, 4-pin power input plug.

Design Philosophy

The transmitter was originally intended for mobile operation, but the finished unit performed so well that one is currently being used as the main 6 meter transmitter at W2BHT. Since the greatest local mobile activity is on 6 meters, the transmitter was designed to cover this band, though it may easily be converted to 10 meters by the proper choice of coils.

Single-band operation was selected mainly for simplicity, and because it was found that most of the local mobile hams on 6 meters rarely used any other band for mobile activity. Twenty watts input was chosen not because of size limitation, but because of intelligen

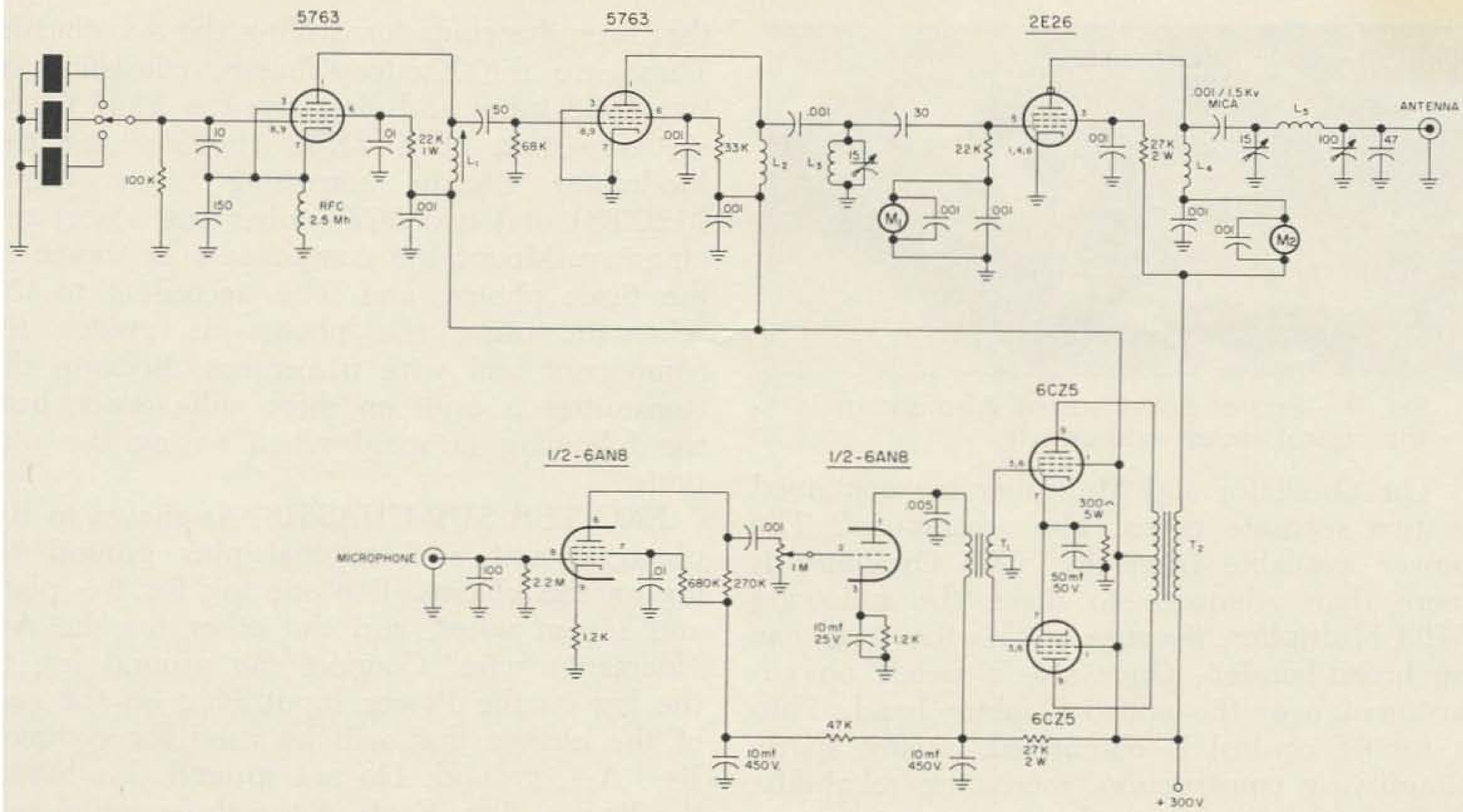


FIGURE 1

attery drain and power supply requirements. ınd, as has been borne out by all who have uilt this transmitter, it will out-perform ome-brew and commercial units with 2 or 3 mes the power. The unit we built contains 3-position crystal switch and socket in addion to a crystal socket mounted on the front anel. In this way we could seal in two net requency crystals with the third position iving us an additional crystal frequency from ıe front panel, or, as in our home station, roviding us with an easy vfo input.

The first reaction we received upon showing ıe transmitter was, as we anticipated, "why vo panel meters?" Simple. We're operating

Parts List

- L1 Approx. 2 microhenry slug-tuned coil, North Hills Electric 1300F or equivalent
- L2 7 microhenry RF choke, Ohmite Z-50
- L3 5¾ turns of B&W 3002 miniductor
- L4 2½ mh rf choke
- L5 5 turns of B&W 3010 miniductor
- M1 0-5 ma meter
- M2 0-100 ma meter
- T1 1 to 3 ratio interstage transformer, single plate to push-pull grids
- T2 10 watt modulation transformer, 8000 ohm primary to 5000 ohm secondary

The parts values are not critical, and any reasonable substitution can be made.

mobile. How nice to be able to read plate and grid current to the final stage constantly, without meter switching. A real boon when we want to either QSY quickly or make sure the drive is adequate when we crystal-switch without taking our hands from the steering wheel or microphone. Besides, a good rotary switch costs about a buck, plus resistors and wiring. The extra meter can be had for just over a buck. So why not put in this desirable feature, which by the way is also a good conversation piece.

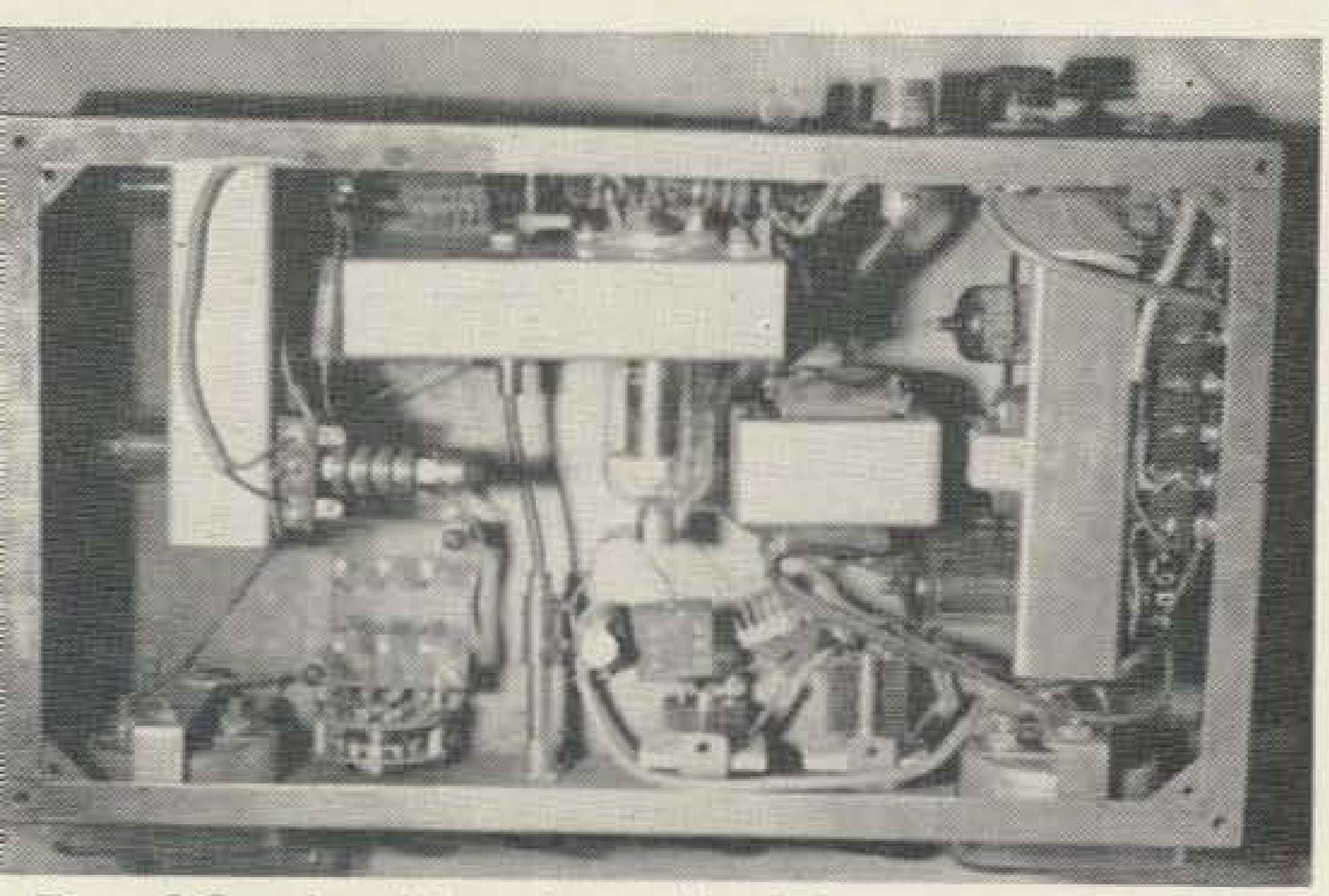


Fig. 2C—Looking into the Transmitter: The Exciter Sub-Chassis is the vertical chassis at the left. The Modulator Sub-Chassis is the vertical chassis at the right. The Final Chassis is shown near the back. Note placement of components on front panel and location of Modulation Transformer between the 2E26 tube and the Interstage Transformer mounted on the Modulator Sub-Chassis.

When tuning the transmitter, there are no screwdriver adjustments to make, and no coil adjustments which were so prevalent in other 6 meter transmitters when this one was designed. All tuning is done from the front panel, and instead of requiring minutes of tedious tuning, this little doll can be put on the air in less than five seconds, anywhere in the 6 meter band. And furthermore, no overtone circuits with their tricky adjustments are employed. Inexpensive 8 mc crystals can be used.

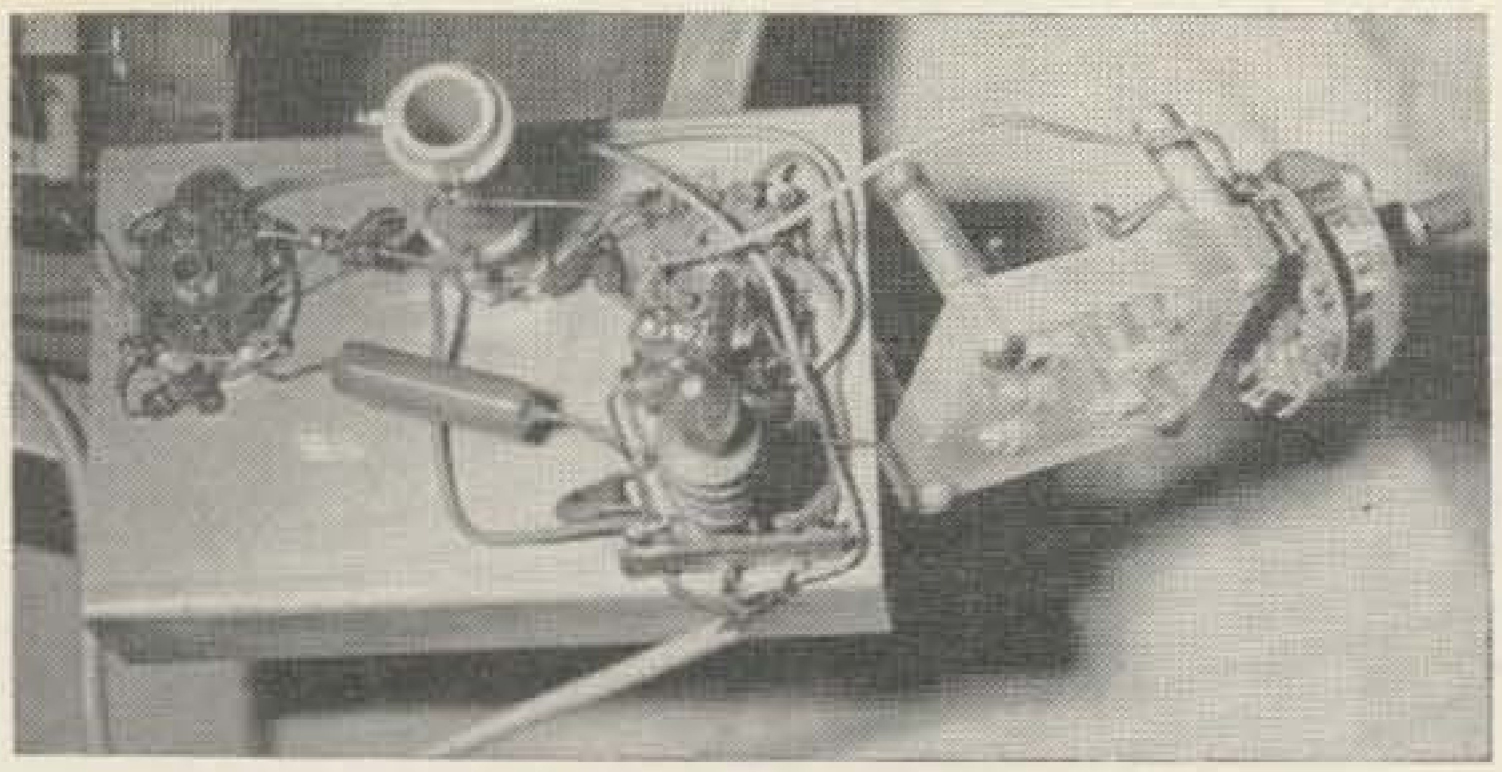


Fig. 3—Exciter Sub-Chassis: Also shown is the crystal socket and switch.

The Oscillator and Multiplier are contained in two separate tubes. The advantages? The power available from the 5763 Oscillator is more than adequate to drive the following 5763 Multiplier. Because of this the stage can be broad-banded. Once set, it needs no adjustment over the entire 6 meter band. Thus a tuning control is eliminated, saving space, simplifying construction, increasing reliability, and greatly decreasing the time spent in tuning or frequency changing. The two tubes are so operated that the total cathode current is no more than a suitable dual-tube would require.

All that need be said about the Speech Amplifier and Modulator is—wait until you receive your first signal report. You'll glow! There is plenty of audio to 100% modulate the transmitter, and the modulator automatically limits overmodulation by uniquely turning to square wave.

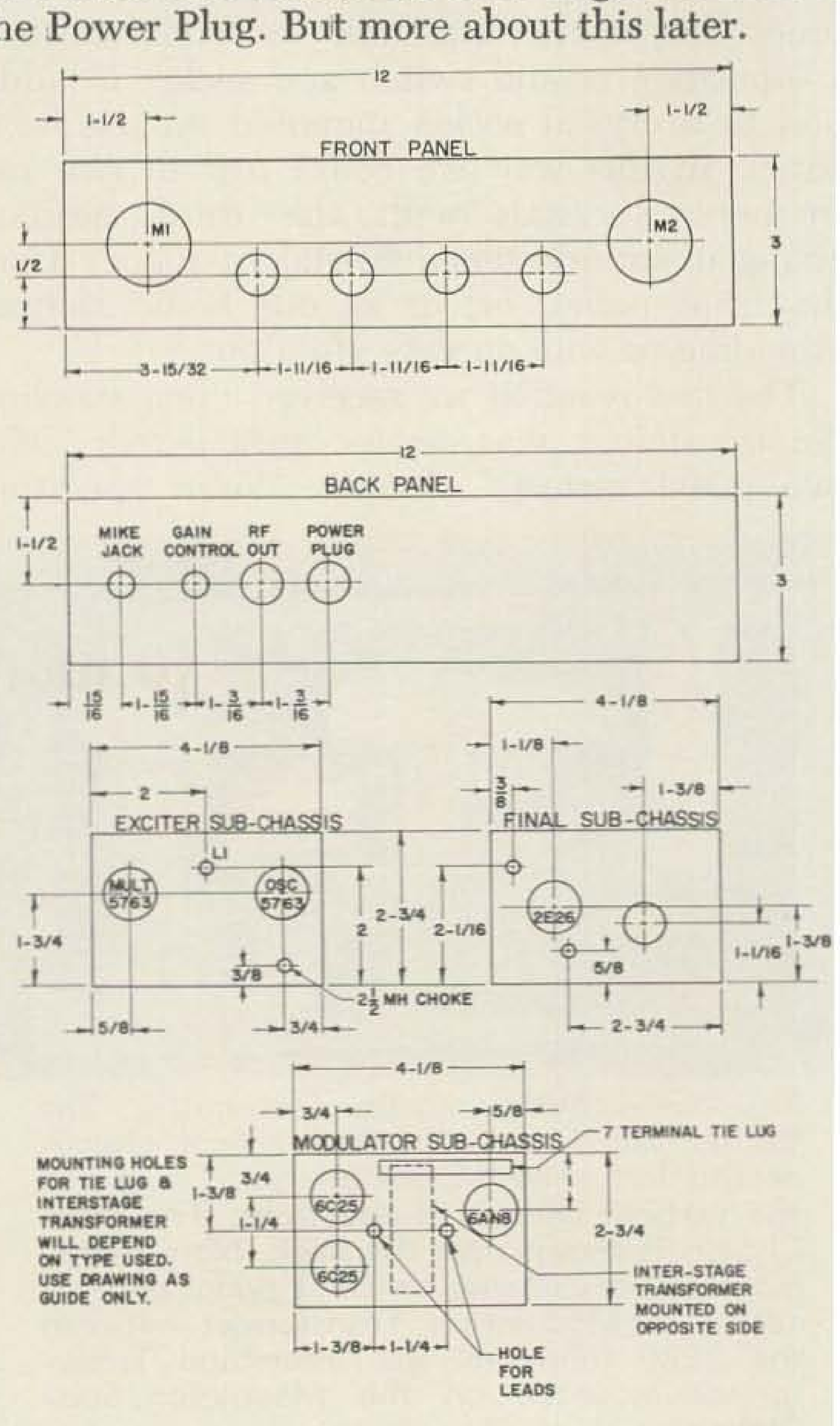
If by now you aren't eager to build and operate this amazing transmitter, either mobile or fixed station, it's probably because you're operating 400 watts right now. For once you get the pleasure of tuning up this rig, and hear the same high quality signal report every time, you'll never want to operate any other low power 6 meter rig again. And if you've just built or bought a 6 meter transmitter—well, you'd better build this one right away, while you can still sell the other one.

Simplified Construction

For a cabinet we used a chassis 3″ × 7″ × 12″ upside down. It could be made a little smaller, but this chassis is readily available commercially.

The schematic is shown in Fig. 1, but we've made it really easy for you. Fig. 2 shows a photo of the front and back panels and bottom section, along with a dimensional drawing so that you can easily mark out the holes to be drilled. The entire unit consists of three sections or sub-chassis, plus the larger chassis cabinet. Each of the three sub-chassis is an open-end aluminum chassis 2¾″ × 4⅛″ × 1″, available at any radio supply house. Follow the three drawings for drilling the sub-chassis. These are the Exciter Chassis, consisting of two 5763 tubes and circuitry; the Final Chassis, consisting of a 2E26 (6893); and the Modulator Chassis consisting of a 6AN8 (12CT8) and two 6CZ5 tubes and associated circuitry. Mount the components as shown in the three photos, and wire according to the schematic—using the photos as guides for component and wire placement. Because the transmitter is built on three sub-chassis, bear the following in mind when wiring the sections.

EXCITER SUB-CHASSIS—As shown in the photo, mount a 2-terminal plus ground tie lug on this chassis. Use one lug for B+ plate and screen wires, and the other for the A+ (filament) wire. Connect the ground lug to the lug on the Power Input Plug on the rear of the chassis that will be used for common B−, A−, ground. Do not ground this lug at the Power Plug. Each of the three sub-chassis must have its own ground wire connecting to the ground lug on the Power Input Plug even though each sub-chassis is used as common ground for its own circuitry. This will give each sub-chassis its own negative lead to the Power Plug. But more about this later.



DIMENSIONAL DRAWING

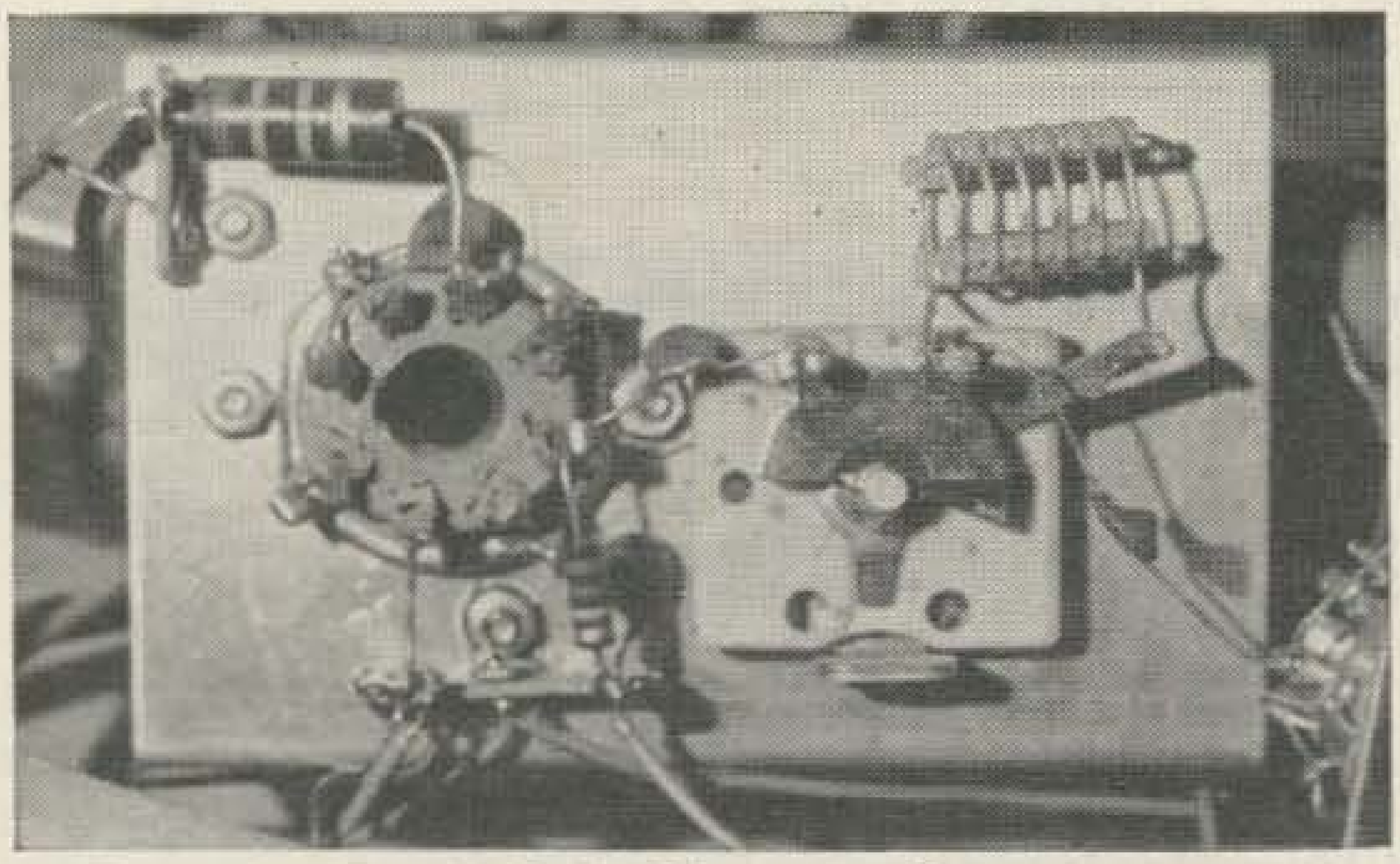


Fig. 4—Final Sub-Chassis: Screen resistor is shown at upper left. Coupling capacitor, .001 mfd mentioned in text, is shown at lower right.

When you connect the .001 mfd capacitor to the 5763 Multiplier plate, leave the other end hanging with a one inch lead. This will later be connected to the variable capacitor on the Final Chassis.

FINAL SUB-CHASSIS—Mount a 2-terminal plus ground tie lug as shown in the photo. The 22K ohm grid resistor will connect to one terminal along with a 15 inch length of wire which will later be connected to the Grid Meter on the front panel. Connect the filament wire to the other terminal. Also mount a 1-terminal tie lug, as shown, to which you will connect the screen resistor, and later on, the modulation transformer and Plate Meter wire.

MODULATOR SUB-CHASSIS – Connect the microphone jack to the 6AN8 socket on this chassis with a short length of wire. The jack will be mounted on the back panel at the same time the Modulator Sub-Chassis is mounted. The Gain Control on the back panel is connected to the Modulator Sub-Chassis by two 3 inch lengths of shielded wire. Do not cut the primary leads of the modulation transformer, but connect them full length to the 6CZ5 tubes. This transformer also will be mounted the same time as the Modulator Sub-Chassis.

Mounting

After wiring the sub-chassis, take the main chassis-cabinet. Mount on the front panel, from left to right as shown: Grid Meter; leave next hole open for crystal switch; panel bearing to which will be connected the variable capacitor mounted on the Final Sub-Chassis by a 3 inch flexible shaft; 15 mmfd variable capacitor; 100 mmfd variable capacitor; Plate Meter. On the back panel mount the Gain Control, Power Plug, and antenna coax connector as shown.

Mount the Exciter Sub-Chassis on the left as shown, mounting at the same time the crystal socket and crystal switch. Now back to the ground connections we were talking about. Using 3 separate wires or a 3-conductor cable, connect the 2-terminal plus ground tie lug to the B+, A+, and ground terminals on the Power Input Plug.

Mount the Final Sub-Chassis in the center rear as shown. Connect the .001 mfd capacitor from the Exciter Sub-Chassis to the variable capacitor on the Final Sub-Chassis. Connect the A+ filament terminal on the tie lug to the A+ lug on the Power Input Plug. Connect the ground terminal on the tie lug to the ground lug on the Power Plug. Connect the 15 inch lead to the Grid Meter. Ground the other terminal on the Grid Meter. The B+ will be connected later.

Attach a 3 inch flexible shaft from the variable capacitor on the Final Sub-Chassis to the panel bearing on the front panel. Connect a plate cap, output coupling capacitor, output coil, and 52 ohm coax to the front panel variable capacitors, antenna connector and rf choke. The photo of the top view will aid you here, using the schematic for exact connections. The rf choke connects from the plate cap to the Plate Meter. The other meter terminal connects to the 1-terminal tie lug on the Final Sub-Chassis through a shielded lead.

Mount the Modulator Sub-Chassis on the right. At the same time mount the microphone jack and modulation transformer. Connect the 2 shielded leads to the Gain Control. Select the wires on the secondary of the modulation transformer corresponding to 5000 ohms, and connect one to the 1-terminal tie lug on the Final Sub-Chassis. Connect the other to the B+ terminal on the Power Input Plug. Do not solder the lead to the 1-terminal tie lug until after the testing section.

Special Filament Consideration

If fixed operation is intended with a 6 volt filament supply, wire the filaments as shown. If mobile operation is considered with a 12

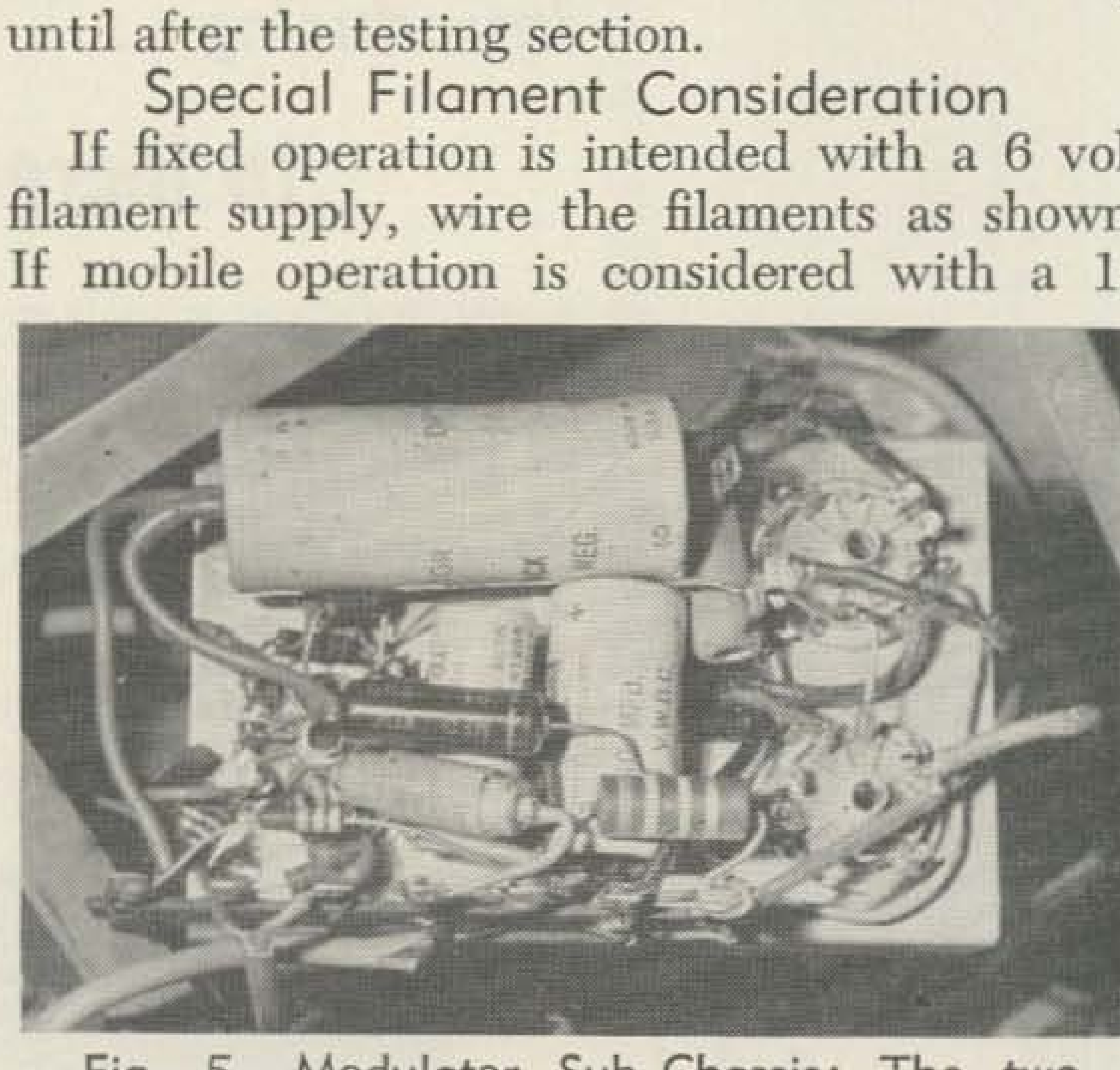


Fig. 5—Modulator Sub-Chassis: The two 6CZ5 sockets are at the left. The choke in the photo was wired in the filament lead of the 6AN8. It was later found not to be necessary, but was left in.

volt filament supply, make the following changes.

Wire the two 5763 tube filaments in series. Replace the 2E26 tube with its 12-volt equivalent, 6893. Wire the two 6CZ5 tube filaments in series. Replace the 6AN8 tube with a 12CT8 tube (direct replacement).

Testing

Install the Exciter tubes and the 2E26 (6893). Do not yet install the Modulator tubes. Plug in a crystal. Temporarily disconnect the modulation transformer wire connected to the 1-terminal lug on the Final Sub-Chassis. Connect a 300 volt, 200 ma, 6 volt, 3.6 amp (12 volt, 1.8 amp) power supply to the Power Input Plug and adjust the slug coil on the Exciter Sub-Chassis for maximum reading on the Grid Meter. If the recommended coil is used, the slug will be about ½ inch out of the coil. Disconnect the 300 volts. Re-connect and solder the modulation transformer wire. Install the tubes on the Modulation Sub-Chassis.

Tuning

The transmitter is extremely easy to tune. The general procedures are as follows: Close all 3 variable capacitors (full capacitance). With power applied, crystal or vfo connected, and antenna connected, turn the knob connected to the variable capacitor on the Final Sub-Chassis to get about 2½ ma reading on the Grid Meter. Then turn the 15 mmfd variable capacitor mounted on the front panel for minimum reading on the Plate Meter. If this reading is about 60 ma, tuning is finished. This will depend upon antenna being used. If this reading, however, is much below 60 ma (45-55ma) turn the 100 mmfd variable capacitor mounted on the front panel until the Plate Meter reads slightly over 60 ma, and again turn the panel-mounted 15 mmfd variable in the same direction as before for minimum reading on the Plate Meter. That's all there is to it. Easy? You bet!

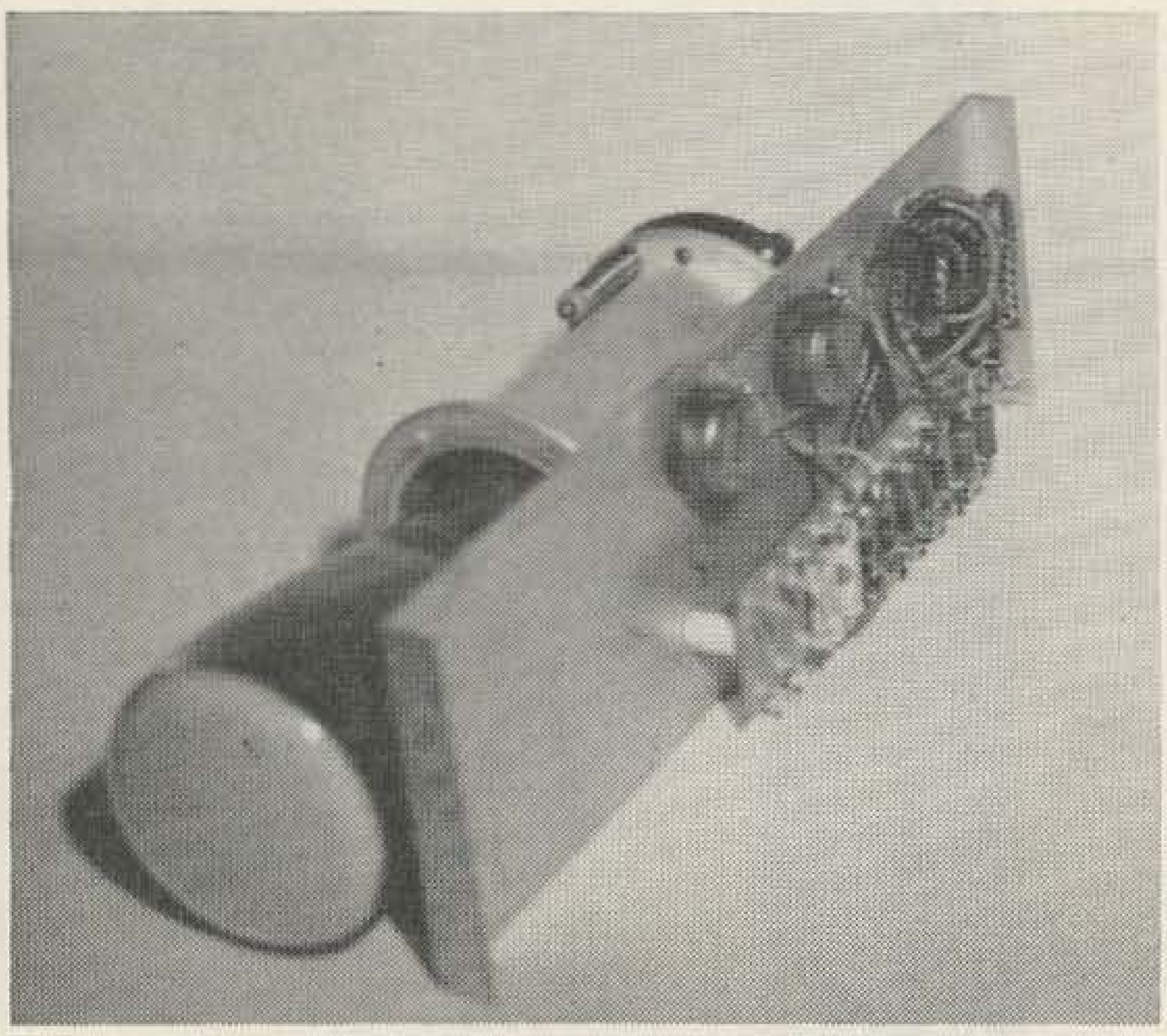
Use a high impedance crystal or dynamic microphone, and do not ruin the superior audio ability of the modulator by rewiring for a carbon mike. About a ¾ turn of the Gain Control should provide the correct gain with the average crystal microphone.

You now have a compact transmitter that will literally give you years of trouble-free, high-performance operation. And when your first QSO tells you you've got the finest sounding rig he's heard—and what? You're only running 20 watts?—Sounds like 60! Just sit back comfortably and smile. After all, it's not your fault he didn't build one of these units too. . . . W2BHT

Going RTTY: Part III

Fred DeMotte W4RWM
P.O. Box 6047
Daytona Beach, Florida

The Scope Monitor



Scope subchassis.

Tuning RTTY signals without the use of a scope monitor will be found to be a difficult job to say the least. In fact it is almost next to impossible, so every good RTTY set-up should include such a device.

In designing the complete converter we included a scope monitor and the photos shown with this article which appeared in 73 for December 1964, clearly indicate how it was fitted into the completed unit.

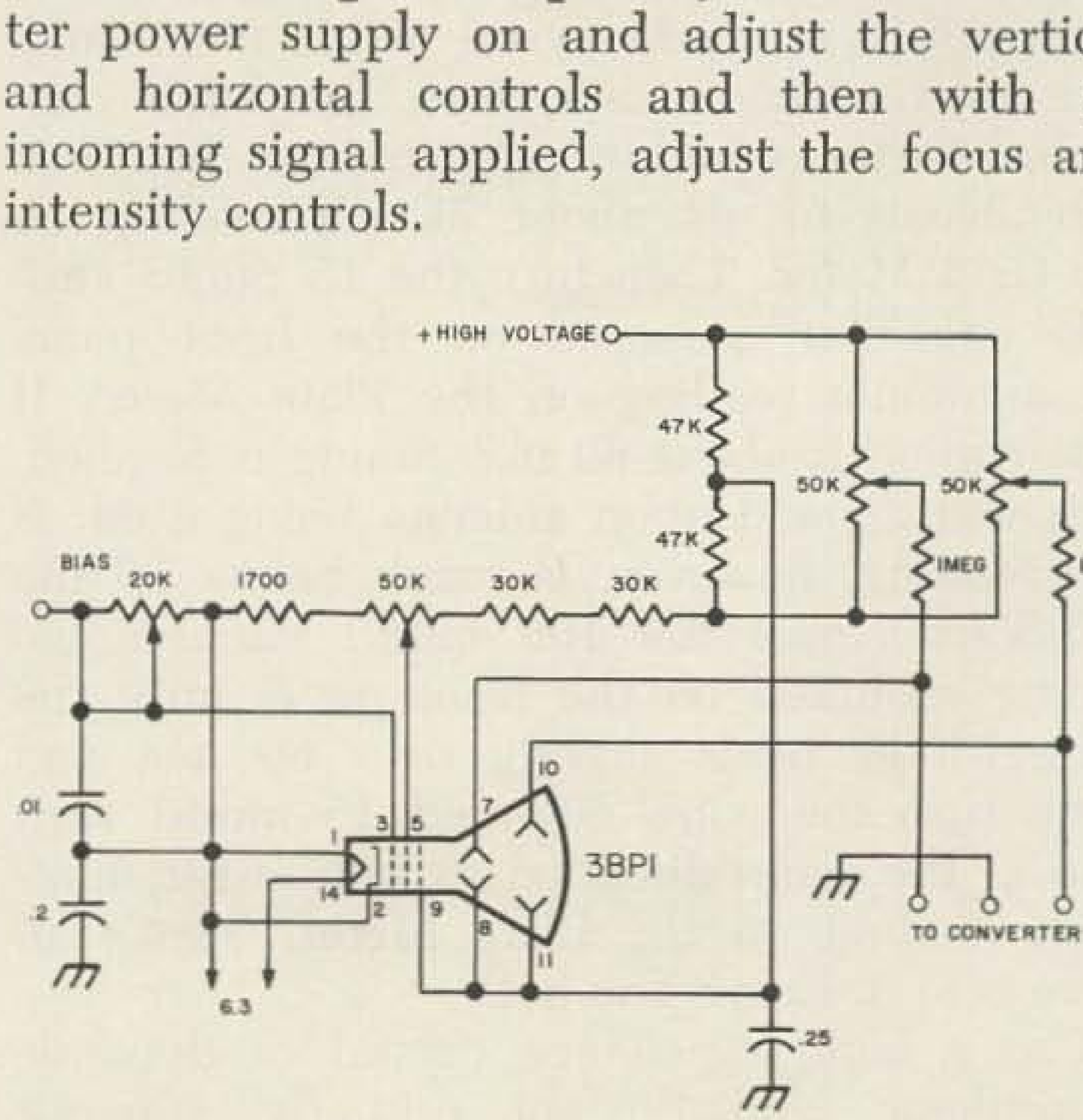
In order to make the circuit simple, no amplifiers are used since there is sufficient signal delivered to the deflection plates of the 3BP1 for good scope presentation.

In Fig. 1, the power supply connections are shown, since the power supply provided for the converter circuit is ample to handle the scope monitor. See Fig. 2 in the converter article. Simply make the connections at the right point on the original circuit and you are in business. Construction details can be seen in the accompanying photo. All wiring is done on one side of the sub-chassis to a terminal board. The two pots shown are the horizontal and vertical controls. The focus and intensity controls are mounted on the front panel.

The sub-chassis is three and three-quarters inches wide by 12¾ inches long, with a one half inch flange at each end.

After completing the wiring as shown in Fig. 1, fit the sub-chassis into the overall chassis and fix into position with self-tapping screws. This part of the converter is dressed up by using a Millen bezel No. 80073.

After wiring is completed, turn the converter power supply on and adjust the vertical and horizontal controls and then with an incoming signal applied, adjust the focus and intensity controls.



Schematic of scope.

The pattern which should appear when the signal is properly tuned is a cross.

Tuning by the scope monitor is easy, as you have a visible indication of when proper tuning is achieved since the scope presentation will be a perfect cross, if the shift of the transmitting station is correct. Here again a little practice will soon give you the necessary skill to quickly recognize the proper pattern when it appears on the scope.

. . . W4RWM

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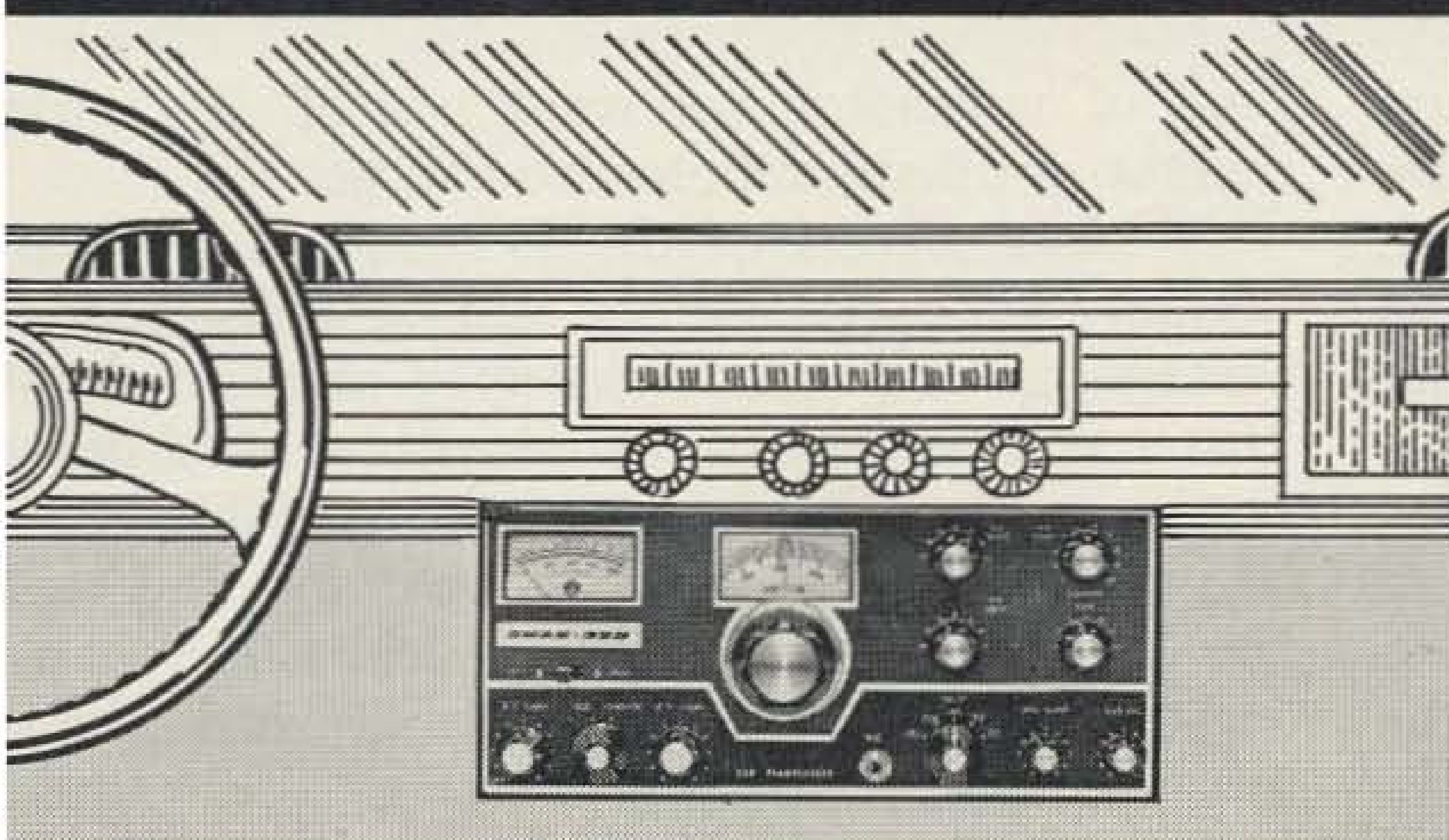
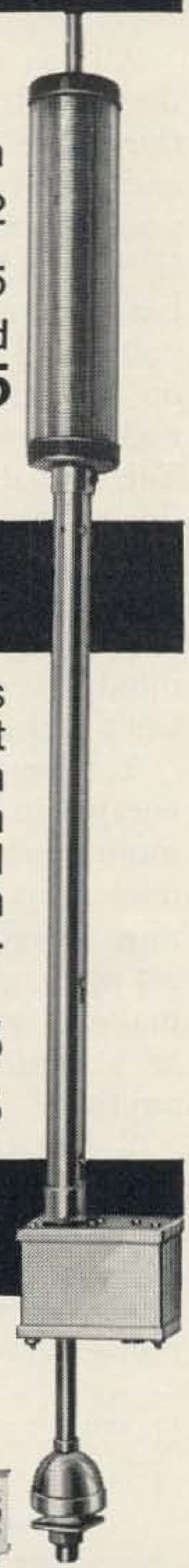
5 BANDS 400 WATTS

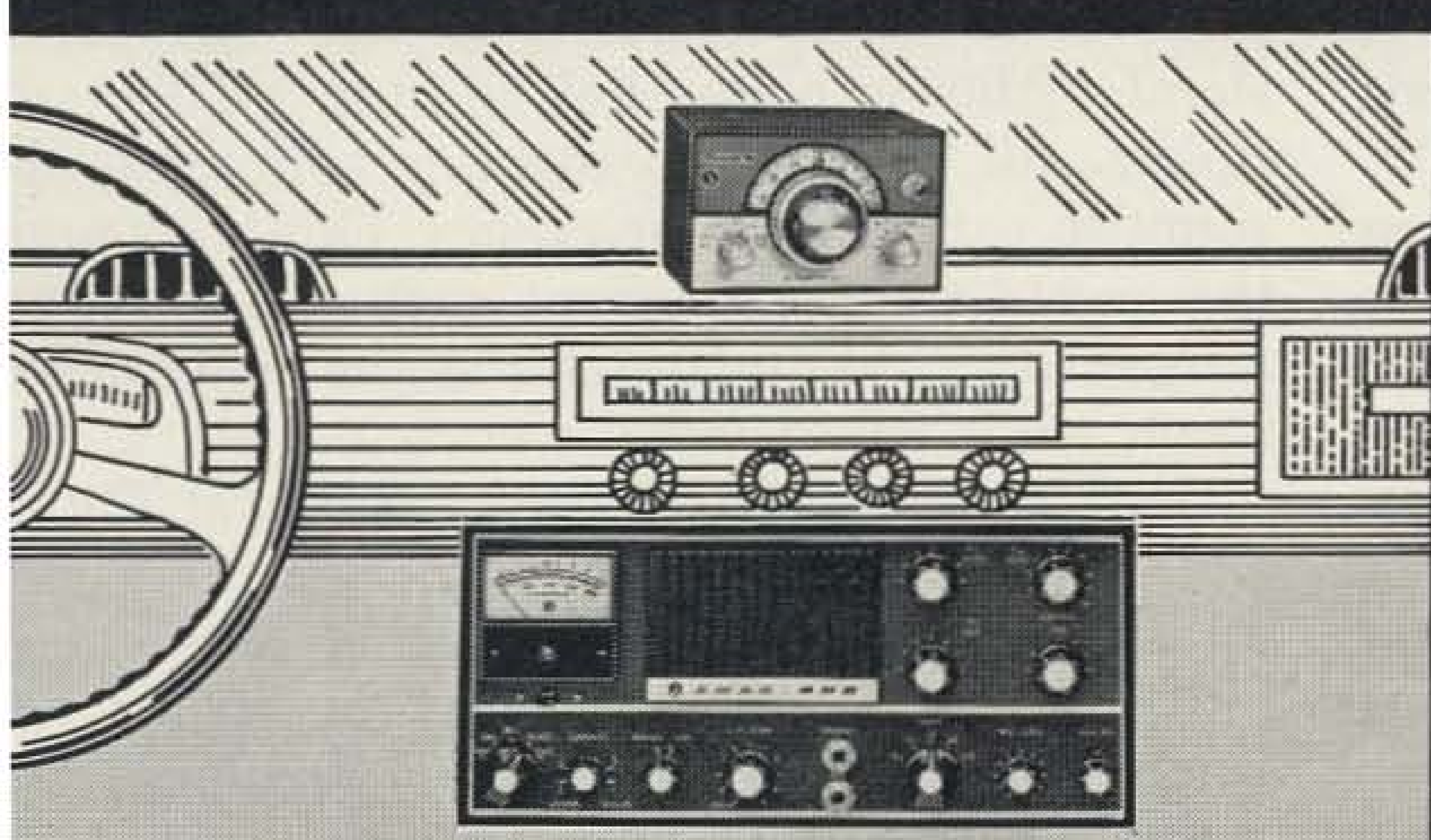
MODEL 350



Mounts under dash or on tunnel, or with a Model 22 Adapter and Model 405 mobile VFO can be mounted in the trunk. **$395**



MODEL 400



Particularly adaptable to sports cars with consoles and bucket seats. New Model 400 deluxe with outboard VFO can be mounted in trunk, under dash or on tunnel with Model 406 VFO mounted on dash or steering column for maximum ease of operation.

Model 400 **$395**

Model 406 **$ 75**

MODEL 55 SWANTENNA

eveloped specifically for use with Model 350 and Model 400 transceivers. Remote ontrolled band switching, mobile antenna covers all phone bands 75 through 10 ieters. Built-in output indicator for tune up to maximum efficiency. Rated 500 atts PEP input to transceiver. Complete with control unit. **$95**

IODEL 412 DC SUPPLY for either Model 350 or 400 **$130**

SWAN ELECTRONICS CORP.
Oceanside, California

Jack Bayha W8BPY

Imagineering with Meters

All too many hams seem to feel that when they need a meter to do a certain specific job, they have to have exactly the meter required, and don't realize that within certain limits you can make almost any meter do any job. If we had a buck for every meter someone has blown out trying to make it read kilovolts, and every meter someone has given up on, for being too slow when they tried to make it read heavier currents, I could buy the Taj Mahal. This doesn't happen because we don't have the knowledge, it's because we lack imagination, and refuse to apply the knowledge properly.

Bearing a few good basic principles in mind, we can do wonders with surplus meters. Let's look at the basics.

1. The more sensitive a meter is, the less energy it takes to go to full scale, and the more versatility we have. Don't sell a 100 microamp meter short. It can be made to read most anything. In general, we can make a meter read what we want it to, except we cannot make it more sensitive unless it has a shunt or a multiplier in it, then we can do most anything.

2. Use the fact that a one milliampere basic meter is rated at *1000 ohms per volt.* Thus a 100 microampere meter is 10,000 ohms per volt, and a 50 microampere meter is 20,000 ohms per volt. Remember the one mil is 1000 ohms per volt. This will allow us to make any kind of voltmeter we want out of any milliameter or microammeter we can get.

3. Most meters of the D'Arsonval type are actually millivolt meters and actually read a voltage, in millivolts, developed across a shunt. Often you will see a meter with a little designation in the lower left of the dial FS-50mv. This means that no matter what the dial says, the basic movement is 50 millivolts. By changing the shunt, you can make it read almost any range.

4. We have two ways, and herein lies a trick, or *combinations* of these ways, to alter a meter's range. We can use a multiplier; (this is a series resistor), or we can use a shunt; (this is a parallel resistor.) The multiplier will be used to make a voltmeter; the shunt to extend current ranges. Oddly enough the most common current meters for higher ranges use a millivolt meter as the basic movement, while voltmeters use current meters.

Now let's apply some basics. Look at Fig. 1. Let us first assume that the meter is a one milliampere unit. Remember that 1000 ohms per volt rating. (Incidentally the meter will usually have a resistance of 100 ohms, and unless you want to make a meter under 10 volts full range, forget it. Under 10 volts subtract this 100 ohms from the multiplier resistor value.) If we want to make this meter read 200 volts at full scale, we need merely to make R a resistor of 200,000 ohms. To make it read 500 volts, R must equal 500,000

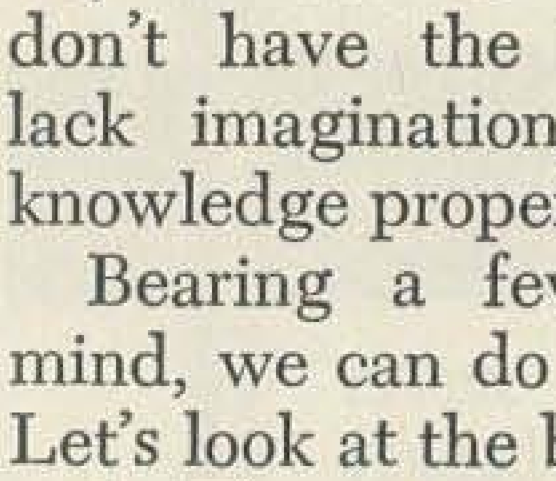


FIG. 1

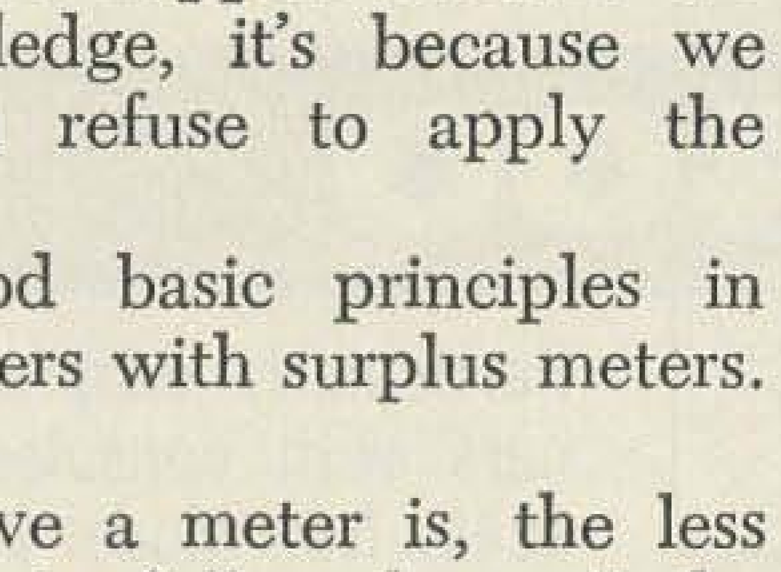


FIG. 2

Meter Multiplier Chart—Voltmeters
Meter Sensitivity

0-100 ma.—10 Ω per volt *
0-10 ma—100 Ω per volt *
0-1 ma—1000 Ω per volt
0-100 μA—10,000 Ω per volt
0-10 μA—100,000 Ω per volt

* Watch multiplier resistor wattages.

ohms. One caution to be observed is that it is a good practice not to allow over 300 volts to appear across one physical resistor; so, to make 500,000 use two 250,000 ohm units. Now if the meter were a 100 microampere unit, we would use 2,000,000 ohms to make it read 200 volts. Remember it is rated at 10,000 ohms per volt.

Simple application of the above principles will allow you to make an accurate voltmeter out of any reasonably sensitive meter you may have. When you get up above 10 milliampers full scale, or if you will, 100 ohms per volt, watch out for power ratings of resistors. Think in terms of ohms per volt for voltmeters and you have the problem licked. You may apply the same principles to extend the range of a voltmeter. Usually you will find the basic movement listed on the dial. You may also, if the basic range is adequate, go inside a meter rated at a much higher voltage rating and pull out the present multiplier and make it read what you want it to by calculating a new multiplier, and installing same.

Naturally, by installing the multipliers externally and switching them in, you can make a multiple range meter readily. See Fig. 2. (Note the 900 ohm resistor for the one volt range; in lower ranges, you must include the meter coil's resistance in calculating; in the higher ranges, this gets negligible so is forgotten.)

The above principles are very simple and a little imagineering on your part should take care of most voltmeter problems. Remember, keep the voltage drop across a resistor less than 300 volts, and put the resistor in the plus lead of the meter. (Viewed from the back, this is conventionally the left hand terminal.)

Extending the range of current meters, or making millivolt meters or microameters read currents of magnitude can be simple, or complex. It all depends what basic meter you start to work with. The easiest thing in the world is to take an existing meter, which reads relatively high currents, and extend its range. Measure its resistance, and put the proper shunt across it. This is the simplest kind of ohms law calculation. The meter meas-

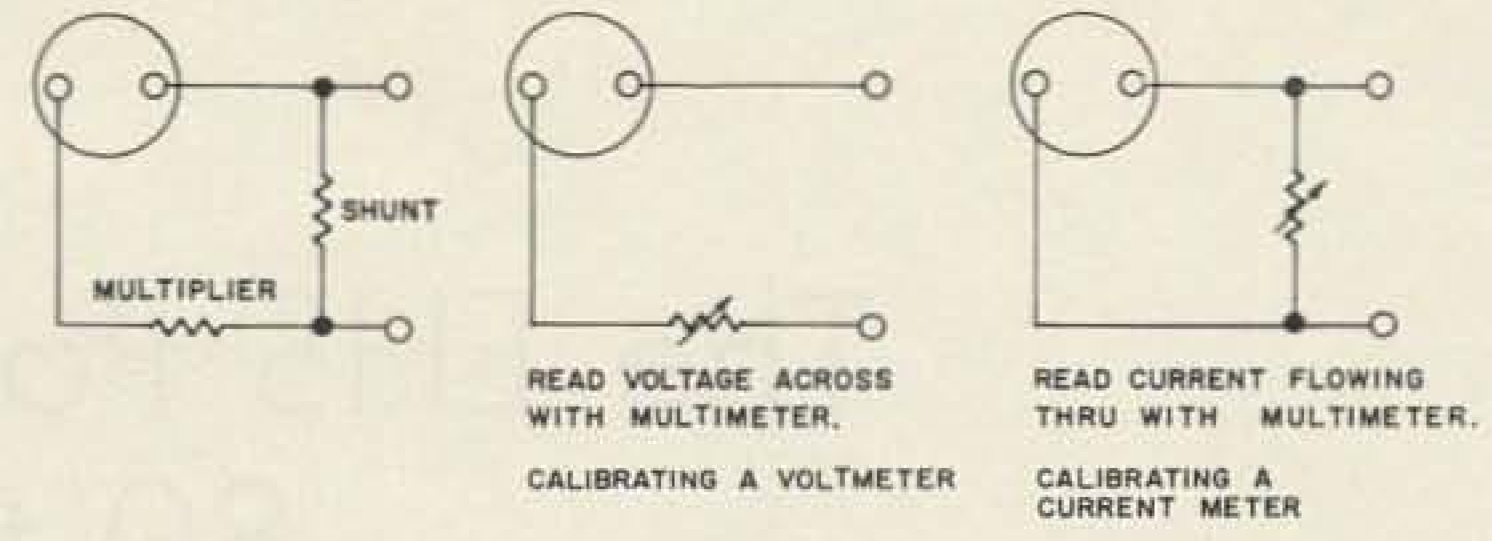


FIG. 3

ures 5 ohms, and reads 200 milliamperes at full scale. Want it to read 400 mils at FS? Put a 5 ohm resistor across it, and presto, half the current through the resistor, half through the meter, 400 mils full scale. This is as simple as calculating the value of two resistors in parallel, and we won't go into it. Apply this basic principle to extending the range of existing current meters, which are in the ball park area. Sometimes the only meter we can get is something which reads 50 microamperes full scale, and we want a meter to read 250 milliamperes. You can use the simple shunt technique, but you may have to stay around until your hair gets gray waiting for the meter to make a reading, since shunting meters with low resistance always slows down their response time, or the time they take to read . . . The trick here is to use a combination of shunt and series or multiplier resistances. You can almost always find a value of series, which can be used with a shunt as shown in Fig. 3, which will allow the meter to read the range you want, and with reasonable response time.

Calibrating these home converted meters is easy if you have a good multimeter. Just use it in series for current calibration, and in parallel for voltage measurements. For playing around with series parallel units to get response time, as well as desired ranges, pots, or decade boxes will do the job. Don't try to get the meters super-accurate, ball park figures are usually good enough for ham purposes. For some ranges you will have to wind your own shunts; these should generally not be of copper wire. Beg, borrow or ? some resistance wire.

Pots may be used for test purposes, then measured, and replaced with fixed resistances.

. . . W8BPY

Stanley Rohrer W9FQN
215 W. High St.
Elkhart, Ind.

The EHS Portable Dipole 80 thru 6

Several years ago the Elkhart High School Amateur Radio Club became interested in a portable dipole which could be used during emergencies and Field Day. It was decided that the antenna must meet the following specifications:

1. The antennas must be fed with either 72 ohm or 52 ohm coax.

2. It must be capable of operation on all bands from 80 meters through 6 meters.

3. It must be adjustable for an SWR of at least 1.2 to one at any desired frequency on any of the bands 80 thru 6.

4. The antenna system must be simple and most important the cost should be low.

5. The entire antenna system must be small enough to be easily carried in a pocket or the glove compartment of a car.

After many hours of searching through past issues of CQ, QST, and several ARRL publications (73 magazine was only several months old then) it was decided that we would have to come up with something new since none of the antennas would measure up to our five specifications. Traps are hard to adjust. Multi-wires are a mess to work with and commercial antennas are too expensive and too large for most of our pockets.

While looking through one of the local hardware stores we were able to locate a metal chalk line dispenser which is used by carpenters to make chalk lines on floors. We removed the chalk line and noted that we could replace the chalk line with small diameter wire. We bought two of the chalk line units and loaded each of them up with 100 feet of wire (say you want to broadcast on 2.34 Mc).

A quick check of the system on 21 Mc with the antenna ten feet off of the ground indicated an SWR of less than 1.3 to one with a hank of 72 ohm coax.

Construction

Go down to your local hardware store and buy two chalk line units which will hold about 100 feet of wire on each spool. You will probably have to open up the units to see what capacity the spools have since several of the units were found to have large diameter spools and would not have been able to store the proper amount of wire. We were able to find a chalk line unit which stored the proper amount of wire and had the added bonus of having a built in lock which will keep the wire on the spool when the antenna is erected. (Evans Chalk Line, CL-50, Elizabeth, N.J.)

Remove the chalk line and attach 100 feet of number 18 solid wire to the spool. There is some reason to believe that stranded wire might go on the spool easier but we have experienced practically no difficulity with the solid wire.

The other ends of the wire are connected to an SO-239 coax connector or insulator.

A hole is drilled through the end of each of the chalk line units and a loop of insulated wire is attached. This loop serves as the end insulator for the dipole.

It should be noted that insulated wire *must not* be used with these units since proper operation of the antenna can only be obtained when the wire automatically shorts out on the spool. Otherwise you will end up with a loading coil at the ends of the dipole. The loaded spools in the chalk line units contribute to the "end effect" and we found that our antennas had to be shorter than the calculated value

$$L = \frac{468}{Fmc}$$

. We found this to vary from two to eight percent with the greatest variation coming at the higher frequencies.

It is a rather simple matter to adjust the portable antenna to any desired frequency with an SWR meter. Different colors of paint can be put on the wire for each selected frequency so that further measuring need not be made in case of emergency operation.

This antenna works 80 through 6 meters and easily fits in two pockets. It is readily adjusted to any spot frequency with a low SWR. As an emergency antenna it is very hard to beat. If the antenna is used in damp weather it would probaby be wise to wrap the chalk line units in Saran Wrap to prevent rust damage.

. . . W9FQN

a KW ssb station | only 64½ cents per watt

The brilliant new **SB-34,** SSB 4-band transceiver serves as your receiver and exciter . . . the new matching **SB2-LA** Linear furnishes the big bang! This advanced design power combo costs you only 644.50, unquestionably the lowest cost per watt obtainable! But this is only part of the value story. **SB-34** has a **built-in power supply,** 117V AC **and 12V DC** . . . needs no separate inverter . . . connects directly to the 12V car battery when you want the added pleasure of 4-band mobile transceiver operation. **There's just no comparable value!**

SB2-LA LINEAR AMPLIFIER . . 249.50

Husky, heavy-duty, with 1KW P.E.P. input capability on 80-40-20-meters, 750 watts on 15 meters, this exceptionally compact amplifier matches SB-34 in general size and appearance. Operates perfectly with SB-34 but can boost the output of any SSB exciter to a full KW. AC power supply is built-in.

4-bands, 80, 40, 20, 15 meters • Full band switching • Passive grid input for resistive load to exciter. Drive: 60W or more depending upon the linear amplifier power output • **Low plate voltage** (800 volts) and high plate current • Easier on capacitors, rectifiers, power transformers • Safer under environmental extremes • **High filter capacity** for dynamic regulation • **Built-in antenna relays** (2), **internal blocking bias • HI/LO power and TUNE/OPERATE switches • Panel meters for output and plate current • Six parallel-connected 6JE6's are used in amplifier • 115V AC power supply (built-in) is all-solid-state. Size:** 5¼"H, 11¾"W, 11⅝"D. Wgt, 35 lbs. (apprx).

SB-34 TRANSCEIVER 395.00

New . . . advanced . . . with important plus performance features! Transistors and diodes replace vacuum tubes (except for the 2-6GB5's in PA and 12DQ7 in RF driver) — equipment size is reduced greatly — current drain lowered substantially. Example: **SB-34 draws only 500 ma on receive standby.**

Built-in supply for 12V DC and 117V AC • Power input: 135 watts P.E.P. (Slightly lower on 15 meters) • **Frequency range:** 3775-4025 kc, 7050-7300 kc, 14.1-14.35 mc, 21.2-21.45 mc • 23-transistors, 18-diodes, 1-zener, 1-varactor, 2-6GB5's PA, 1-12DQ7 driver • **No relays — solid state switching — breakthrough! USB or LSB selectable by panel switch • Collins mechanical filter — transmit/receive • Delta receiver tuning • Solid-state dial corrector • prewired for VOX/100kc calibrator accessories** — both units are optionally available. **Single-knob dual-speed tuning. Size:** 5"H, 11¼"W, 10"D. Weight 20 lbs. (Approx).

SIDEBAND SBE ENGINEERS

317 ROEBLING ROAD, SOUTH SAN FRANCISCO, CALIF.

RAYTHEON **Export sales:** Raytheon Company, International Sales & Services, Lexington 73, Mass, U.S.A.

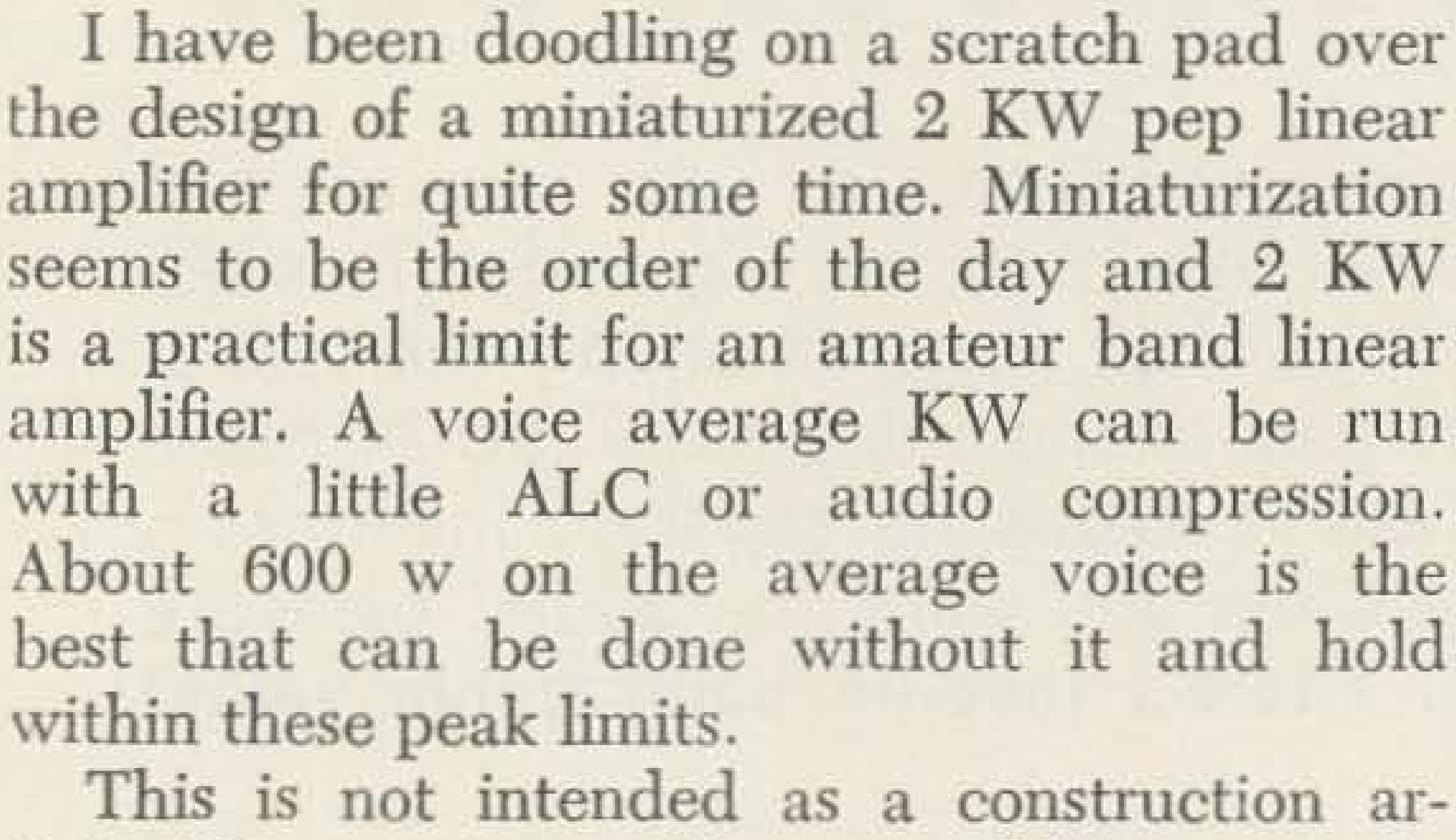
Wayne Cooper K4ZZV
9302 N.W. Second Pl.
Miami, Florida

A 8072 linear with many interesting ideas for the SSB ham who wants to step up to higher power.

Some Notes on Grounded-Grid Linear Amplifiers

I have been doodling on a scratch pad over the design of a miniaturized 2 KW pep linear amplifier for quite some time. Miniaturization seems to be the order of the day and 2 KW is a practical limit for an amateur band linear amplifier. A voice average KW can be run with a little ALC or audio compression. About 600 w on the average voice is the best that can be done without it and hold within these peak limits.

This is not intended as a construction article. The amateur with reasonable experience could duplicate the linear amplifier down to the last nut and bolt by looking at the accompanying photos. A self-addressed stamped envelope along with any queries to me might even bring some help. This article is intended to bring out a tube application and some circuit ideas for grounded-grid linear amplifiers



The 8072 Amplifier compared to a 4-1000A.

that the technical minded amateur might like to include in his own amplifier. The amplifier as shown is experimental to try out the tubes. It is used only for single band unattended operation. No adjustment is necessary over the top 100 kc of the 14 mc band so there are no dials to twiddle, no meters to watch and no on the air "hellooooo test" necessary once it is set up.

The tubes were the big miniaturization problem. Jo Jennings W6EI has long since taken care of the tank condenser problem with his small vacuum capacitors. The tank coil, well it has not progressed any since I wound them up for my first "TNT" in the early thirties. The ultimate of simplification is a hi-mu "zero bias" cathode type triode used in a grounded-grid circuit. According to my research, there seemed to be no tube to fit this requirement. The RCA type 8072, 812[illegible] and 8122 series came along that could be turned into "simulated hi-mu triodes". Other more common types have no cathode or cannot be hi-mu triode operated due to the low grid current ratings. The RCA tubes mentioned have a CCS rating of 100 ma of grid current which qualifies them for the application. All of the three tubes have the same electrical characteristics. The difference in the plate dissipation ratings is due to the cooling and the maximum rating is 400 w CCS, not the "ICAS" rating that the amateur is used to. I chose the type 8072 as it fit the miniatu[illegible]

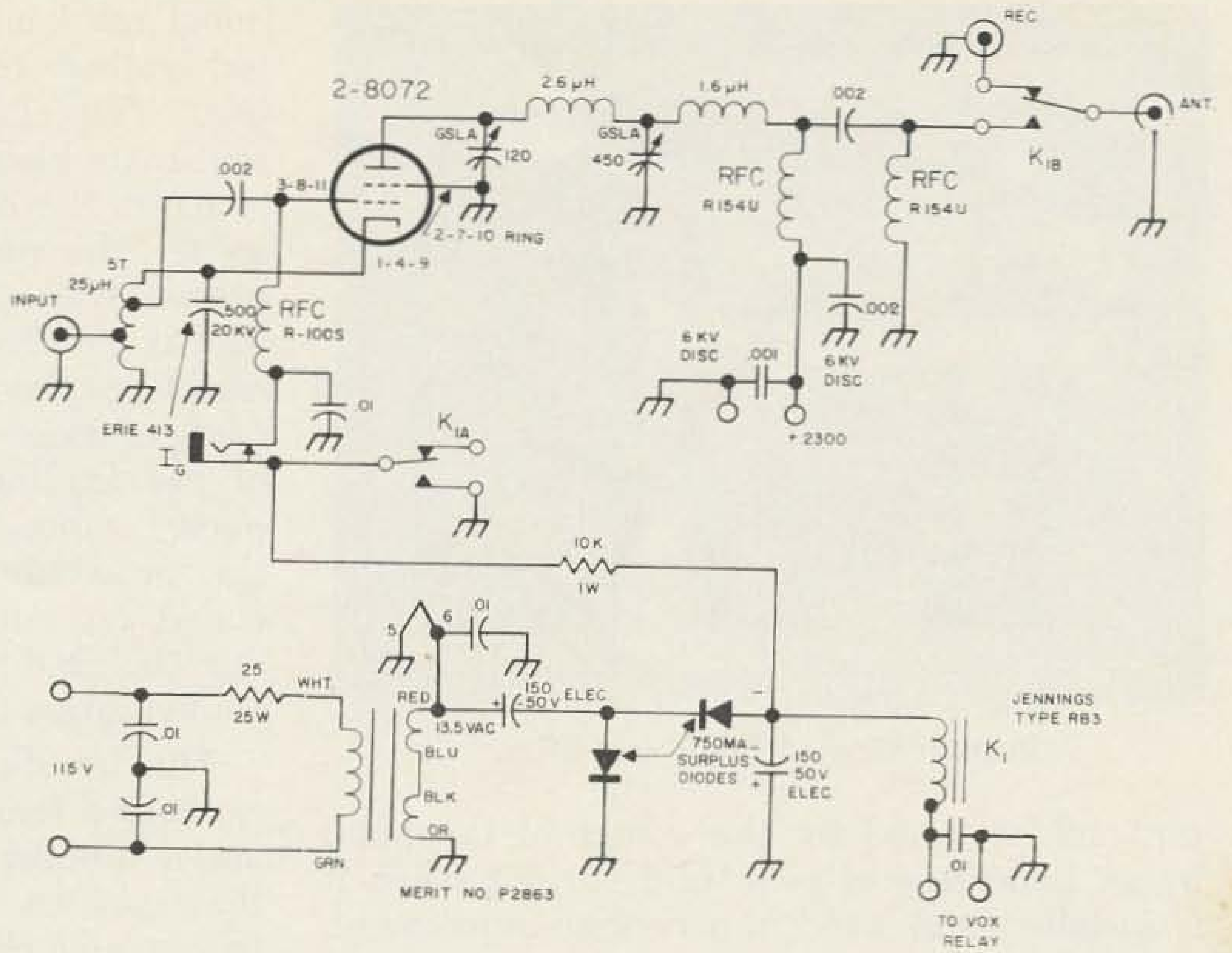


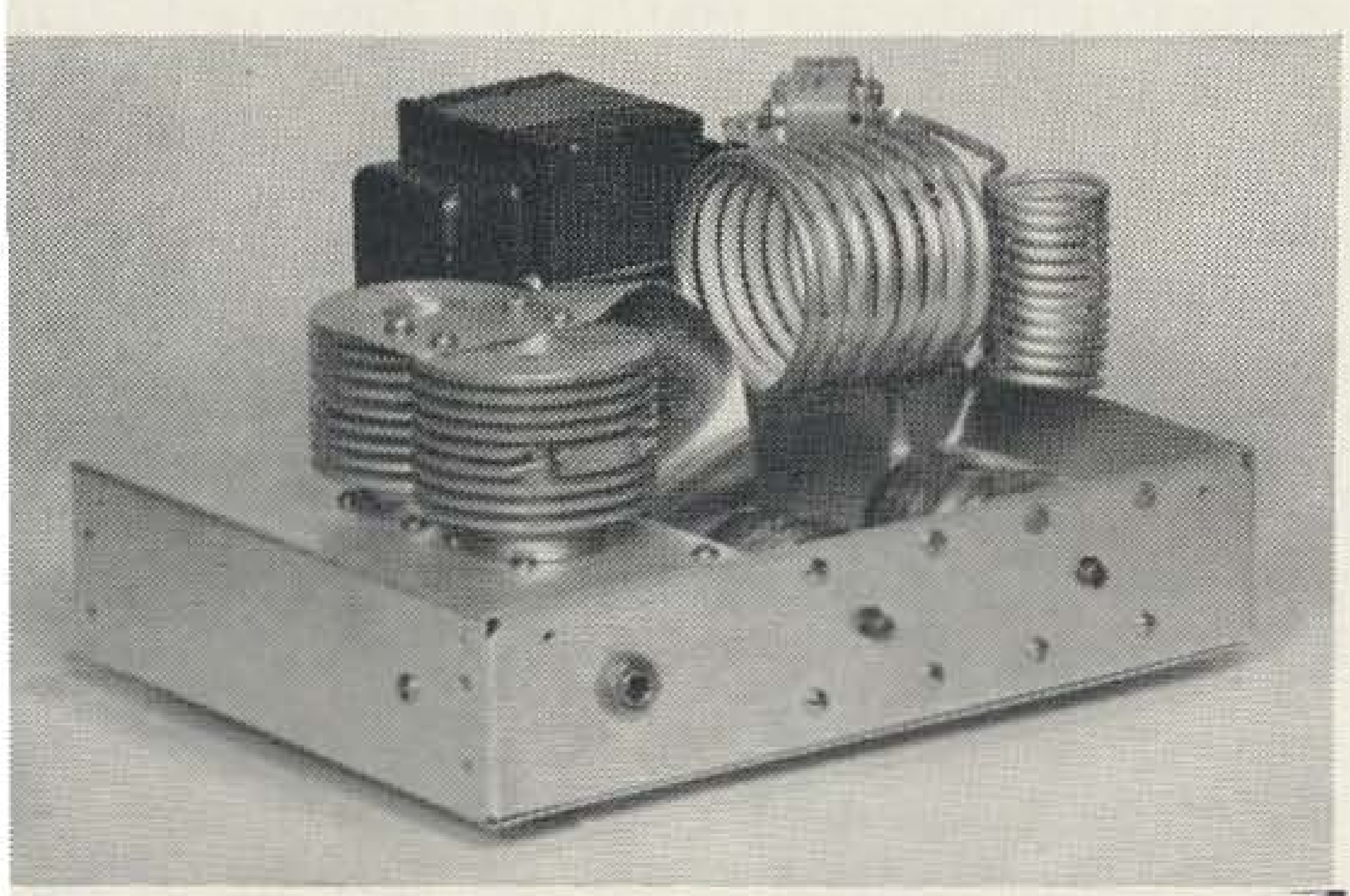
Fig. 1. Grounded-grid Linear Amplifier using 2 8072's.

zation application better though the nominal ·ating is only 100 w and it is the least expen- ;ive of the series!

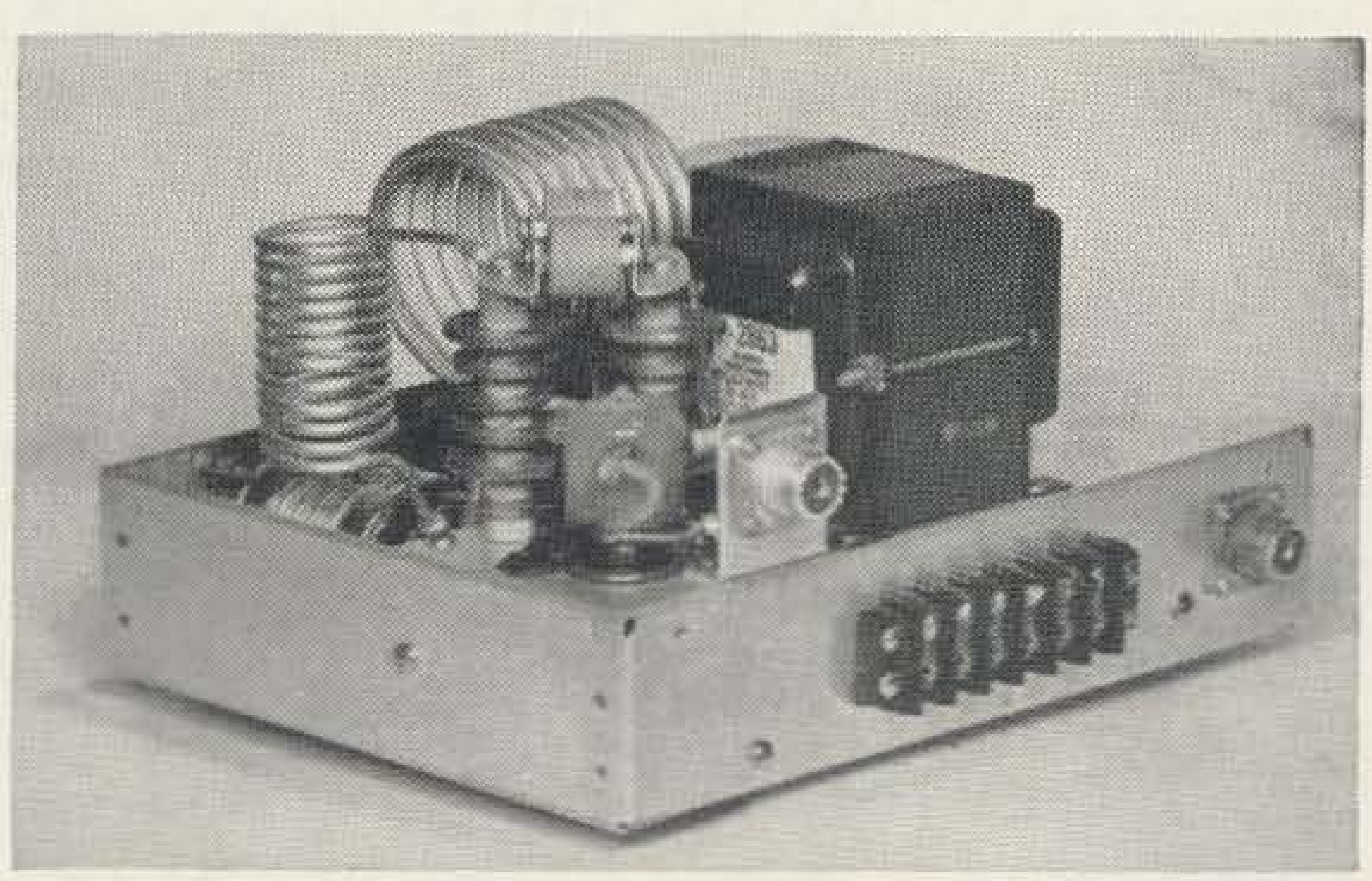
It is possible to reduce the size of the am- plifier down to a 7" × 9" chassis. The heat lissipation requirement could not be reduced. A study of the photos will show the over-sized ıeat sinks that were turned out and installed o handle the plate dissipation by circulation ·ooling. It will also be noted that the base ocket is recessed so that the screen ring seats irmly on the chassis. This turns the chassis nto a heat sink for the base of the tube. Adequate circulation cooling for the duty ·ycle involved with a SSB linear in amateur ervice is obtained from a 4" fan placed next o the tubes just outside the wide mesh pro- ective screen.

The type 8122 was not considered as re- uired blower and air chimneys would have oubled the size of the amplifier. Some people lso object to blower noise. Having a remov- able heat sink, one does not have to buy new ones when the tubes are replaced, not a small item in tube costs. 72% in this case.

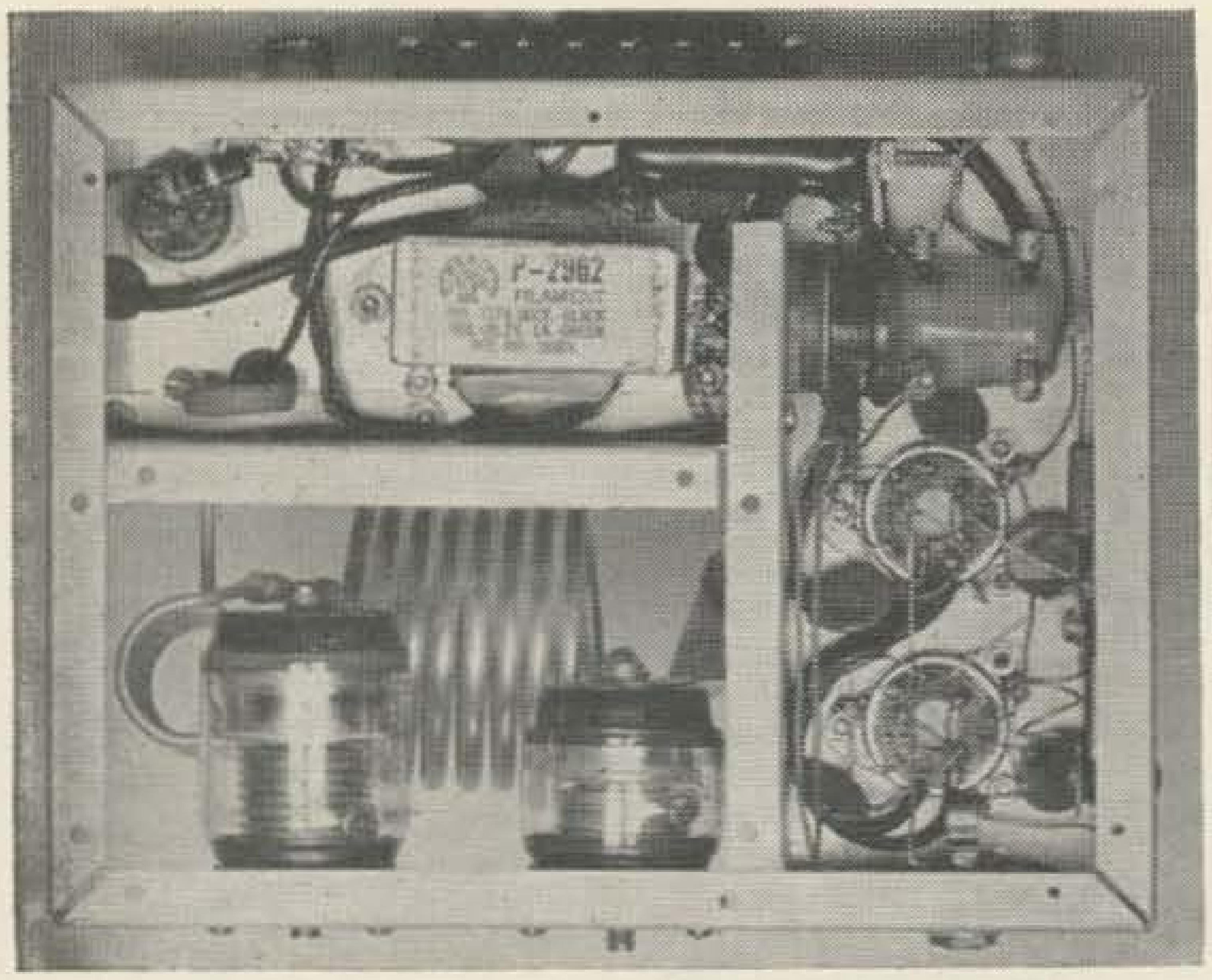
The input circuit shown is not particularly new but it does not seem to be too widely used either by the commercial or home-brew amateur band linear amplifier builders. The hi-C circuit from the cathode to ground gives a short direct path for the circulating rf current. If this is not provided, the current path is projected back to the driver tank load circuit. This can cause instability in the amplifier as well as making the driver hard to load. If the driver and final are together on the same chassis, one properly designed tank circuit will do very well. The usual set-up is for a separate exciter and amplifier where it takes a low impedance path from the cathode (or filament as the case may be) to ground to tie things down. The same LC ratio as shown for the input tank circuit has been used on all bands with good results. The in-



Front view of amplifier.



Back view of amplifier.



Bottom view of 8072 amplifier.

put tank is tuned for the center of the band by an indication of peak grid current when it is installed and needs no further adjustment.

Varying the spacing of the coil turns simplified things in the amplifier shown. A variable condenser can also be used. Preliminary calculations showed that the amplifier input impedance would not match the usual 52 ohm exciter output impedance. Experimentally the excitation was tapped up from ground to a point where the SWR approached 1:1, which worked out to be a center-tap on the coil. The grid tap on the input coil can also be calculated to equalize the grid and screen currents, but it provided only a starting point. The grid is closer to the cathode and when tied to ground with the screen, the grid current is much higher than the screen current and may exceed the plate current! The calculated point for the grid tap where the grid and screen currents would be equal is about 8.3% of the way down the coil from the cathode. The grid current at this point was well below the 200 ma rating of the two tubes and the amplifier was hard to drive. The tap was placed at one turn from the cathode end which raised the single-tone grid current to a little over 200 ma and brought the drive down to the range of the 100 w exciter. I have heard that distortion checks have been made on grounded-grid amplifiers and no improvement was noted with a tuned input circuit installed, so it was left out. This has never been checked here, but the results would depend on the test set-up. I have always included a low impedance input tank in grounded-grid circuits after having had a pair of 813's "take off" in an amplifier a number of years ago and ending up having to neutralize them.

The plate tank circuit is a little unconventional for ham equipment in that it is series fed rather than the parallel feed usually used. This eliminates the need of a high current plate blocking condenser and the rf choke is across the 52 ohm load, reducing the strain on it. The usual resistor-choke parasitic suppressor was not needed and the plate-to-tank lead is a 1½" wide flexible copper strap which really ties the two together. A pi-L tank circuit configuration was used as it reduced the size of the loading capacitor to an available capacity. Since a lead had to be connected to the pi section anyway it might as well be coiled up into enough inductance to attenuate the 2nd harmonic the 15 db that this configuration is supposed to give.

The transfer relays need not be the rather expensive Jennings vacuum relays used. There are a number of small relays on the market that can be built into the linear amplifiers that would eliminate the expensive (count all the fittings too), bulky and clacking coaxial relays on the wall or on the back of the amplifier. I never could quite understand why this was not done but then maybe everybody but me owns stock in a coaxial relay company! There is nothing coaxial inside of the amplifier so no discontinuities will occur. In this particular application the extra contacts came in handy to apply a blocking bias. The static Ip is about 120 ma with 2300 v on the plates. The -40 v (no load) bias in standby drops the Ip to about 40 ma which lowers the static dissipation and helps with the cooling.

The filament transformer used is the only one that could be found available. It is rated at a higher current than required which made the filament voltage a volt too high. This required the series 25 ohm resistor in the primary which would not be needed if a 13.5 v under load filament transformer can be found.

The adjustment of this linear amplifier or any linear amplifier is quite simple with a 'scope and envelop detector to produce a trapezoid pattern when a two-tone test signal is used. There are probably other methods of tuning up linears, judging from the carrier and "hello test" one hears on the air, but I do not know of any good ones. A dummy load is connected to the output and the load condenser is set near the high capacity end. Feed in enough two-tone signal to produce 200-250 ma of plate current. Tune the tank input condenser for resonance or maximum rf output as indicated on the 'scope or a meter on the dummy load. Now turn up the gain momentarily to 550 ma and see if there are nice clean peaks on the 'scope pattern

Ceep decreasing the output or load capacitor .nd repeaking the input or tuning capacitor ıntil the peaks start to flatten at the 550 ma ›oint then back off until they just do not. The ›oint is rather sharp. A few per cent change ı the load capacitor will make the difference vhether there is flat-topping or not. When la-er checking with the antenna it would be ›est to rotate the beam 360° and set the load-ıg at a point where there is no flat-topping t any point in the rotation in case there is ny load variation. Now remove the tone gen-rator, plug in the mike and set the gain to alk-up to about 400 ma or a voice average ⊂W. The peaks on the 'scope will still be of he same amplitude so there is still "2 KW pep ıput". Do not worry if the 'micro-match' on-/ averages a couple of hundred watts or so s it won't follow the peaks up to 1200 w r so, but they are there. In case somebody hecks my math, they will find 1800 w pep nd 900 w voice average input was used. 'his allows for the driver power input which dds to the amplifier input in series and the ›tal must be no more than 1000 w. Most of ıe drive power is fed through the amplifier nd adds to the output power. I once worked chap that said since he bought a KW trans-ıitter he wanted to see it indicated on the output meter. I am glad that I did not live next door!

The above tuning procedure can be applied to any amplifier at any power level. There was no curvature on the 'scope pattern so it was concluded the tubes have good linear characteristics connected as hi-mu triodes. The exciter that was used to drive the amplifier under test had 3rd harmonic distortion down 30 db. It was still 30 db on the spectrum analyzer, out of the amplifier. That is a usable figure so the tests were concluded.

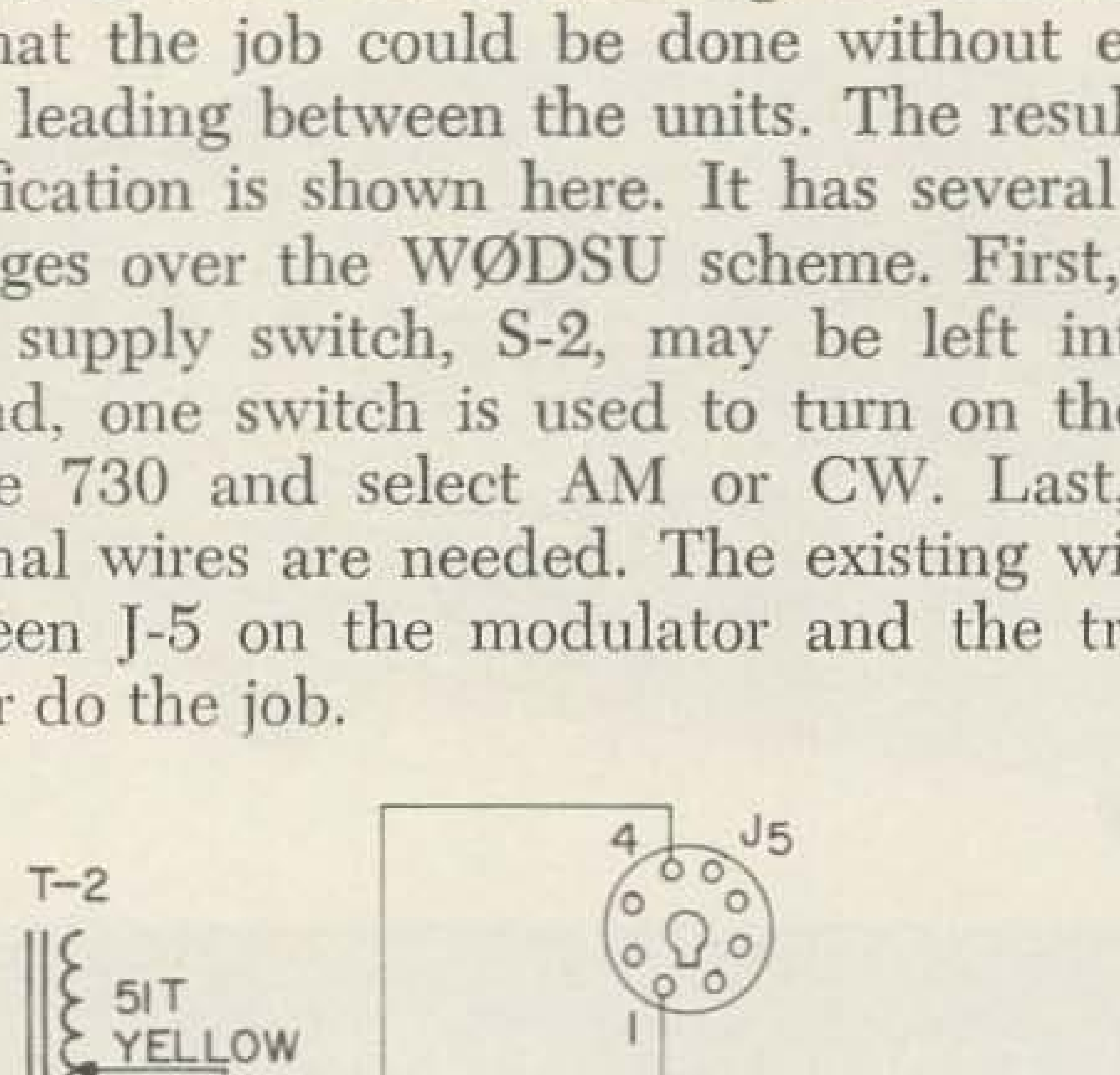
Prior to the final modification there was an input cut out relay in the circuit as shown in the underside photo. A switch turned ON in series with the VOX relay line at the control position allows a 10 db boost of the signal over the 100 w exciter. Leaving it OFF if it is not needed complies with good operating practice as well as the letter of the law. As shown in the final form any desired power reduction can be obtained by turning down the microphone gain control which can be calibrated in db.

Thanks for the helpful suggestions that guided the application of the RCA 8072 tubes goes to Mr. H. C. Vance, K2FF, Manager, Sales Engineering of the RCA Tube Division.

. . . K4ZZV

Eico 720-730

The article in the March, 1963, issue of 73 on the mode switch for the Eico 720-730 led me to do a little thinking. It seemed to me that the job could be done without extra wires leading between the units. The resulting modification is shown here. It has several advantages over the WØDSU scheme. First, the plate supply switch, S-2, may be left intact. Second, one switch is used to turn on the ac to the 730 and select AM or CW. Last, no external wires are needed. The existing wiring between J-5 on the modulator and the transmitter do the job.



Modifications to 720 and 730.

The only part needed for this modification is a dpdt switch to replace S-1 in the original 730. A two lug terminal strip is nice, but not necessary. First remove the original ac switch S-1. Replace it with a dpdt switch and reconnect the wires removed from S-1 so that when the new switch is in the on position, ac is provided to the modulator. Next disconnect the yellow modulation transformer lead from pin 4 of octal socket J-5. At this time I replaced the single lug terminal strip TB-5 with a two lug strip, using one lug as before and connecting the yellow lead to the other. This step can be eliminated, however, and a wire spliced directly to the yellow lead. In any event the yellow modulation transformer lead is wired to the dpdt switch on the *on* side of the switch. Wire pin 1 of J-5 to the *off* side and pin 4 of J-5 to the common lug of the switch and the modification is complete.

Now when the switch is off, the secondary of the modulation transformer T-2 is bypassed for transmitter B+. When the switch is on, ac is provided to the modulator and the secondary of the modulation transformer is placed in the transmitter B+ circuit.

. . . WA4DQS

Now! for discriminating amateurs who are satisfied with nothing less than *THE VERY BEST*

McCoy SINGLE SIDE BAND FILTERS

The GOLDEN GUARDIAN (48B1)

TECHNICAL DATA

Impedance: 640 Ohms in and out (unbalanced to ground)

Unwanted Side Band Rejection: Greater than 55db

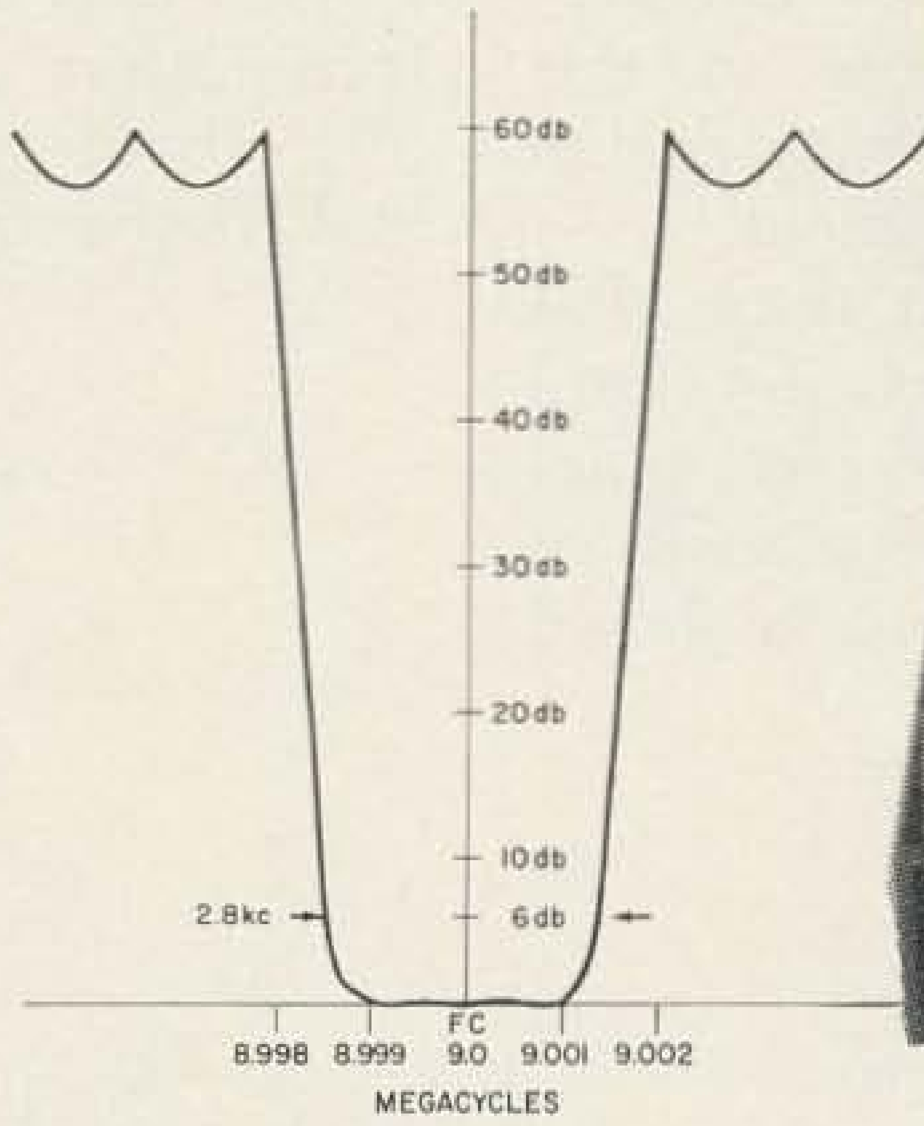
Passband Ripple: ± .5db

Shape factor: 6 to 20db 1.15 to 1

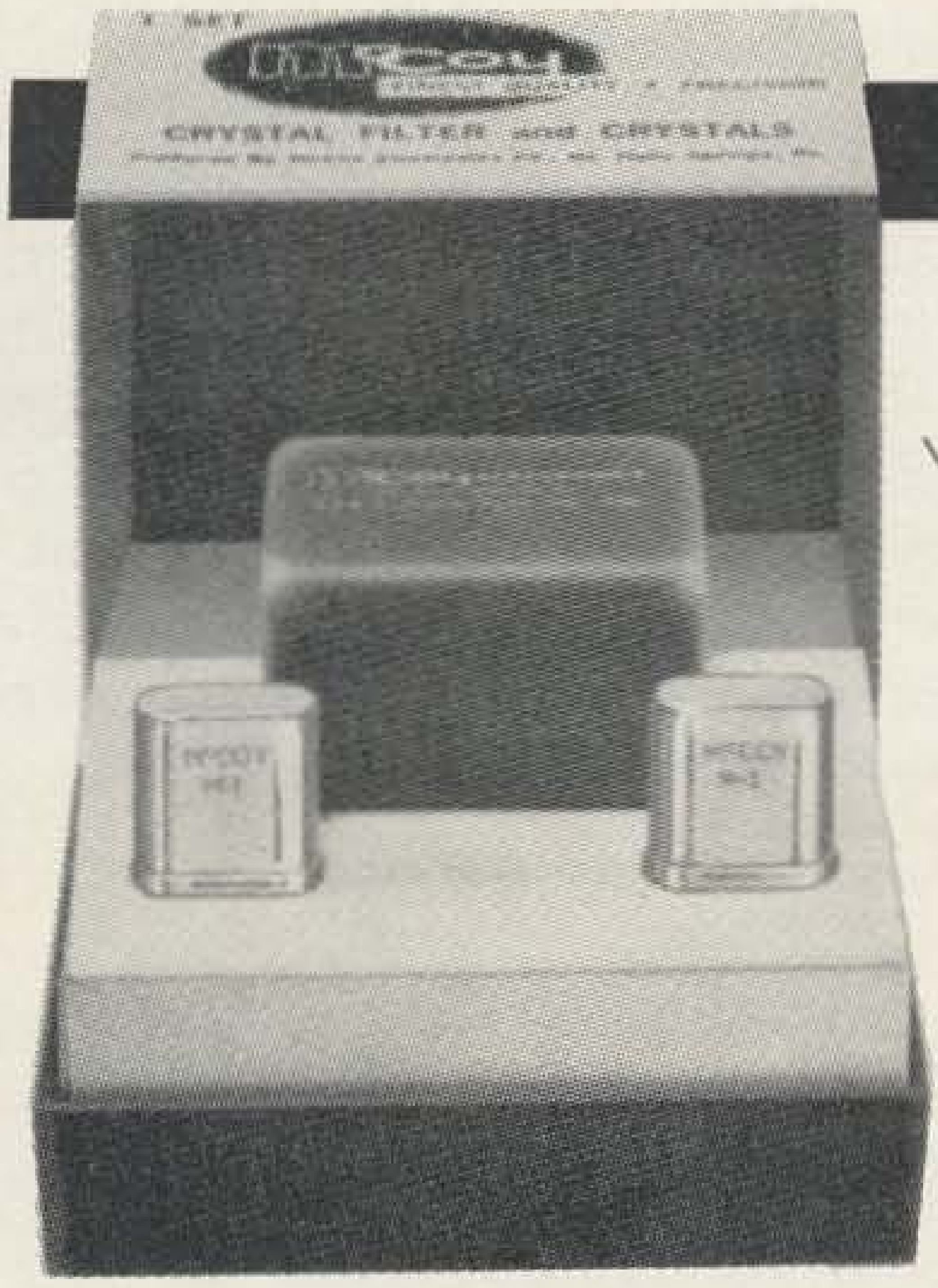
Shape factor: 6 to 50db 1.44 to 1

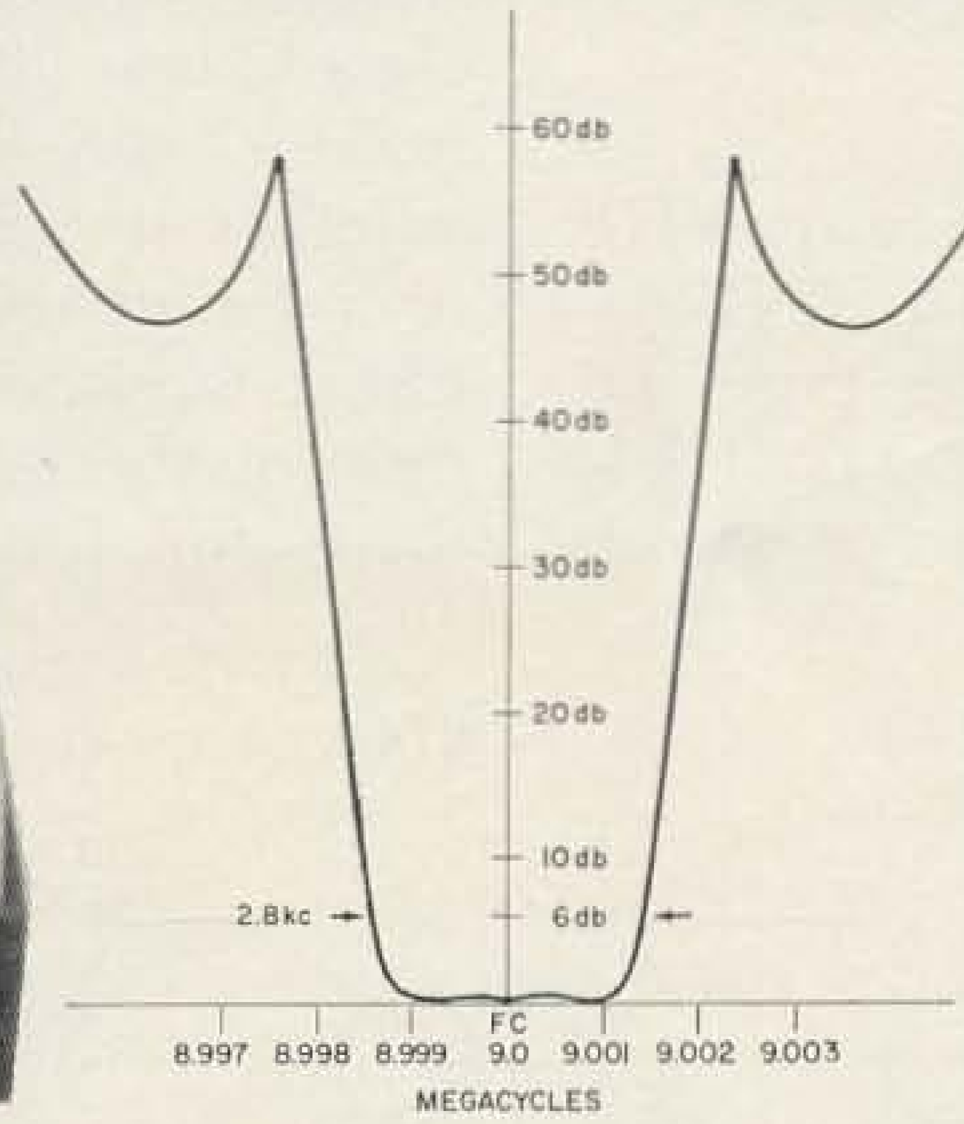
Package Size: 2 7/16" x 1 19/32" x 1"

Price: $42.95 Each



The SILVER SENTINEL (32B1)





TECHNICAL DATA

Impedance: 560 Ohms in and out

Unwanted Side Band Rejection: Greater than 40db

Passband Ripple: ± .5db

Shape factor: 6 to 20db 1.21 to 1

Shape factor: 6 to 50db 1.56 to 1

Package Size: 1 3/4" x 1 1/4" x 1"

Price: $32.95 Each

Both the Golden Guardian and the Silver Sentinel contain a precision McCoy filter and two of the famous M-1 McCoy Oscillator crystals. By switching crystals either upper or lower side band operation may be selected. Balanced modulator circuit will be supplied upon request.

Both sets are available through leading distributors. To obtain the name of the distributor nearest you, or for additional specific information, write: Dept. E-11

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Larry Levy WA2INM/1
Marlboro College
Marlboro, Vermont

Simplified Solid State

Transistor circuitry is really simple. It is not as complicated as vacuum tube circuitry for most applications. The purpose of this article is to show just how easy it is to design and build transistorized ham equipment.

For most rf equipment, the first thing that is needed is an oscillator. The overtone crystal oscillator is the easiest, cheapest and most practical way of generating stable rf signals in the VHF spectrum. The basic circuit is shown

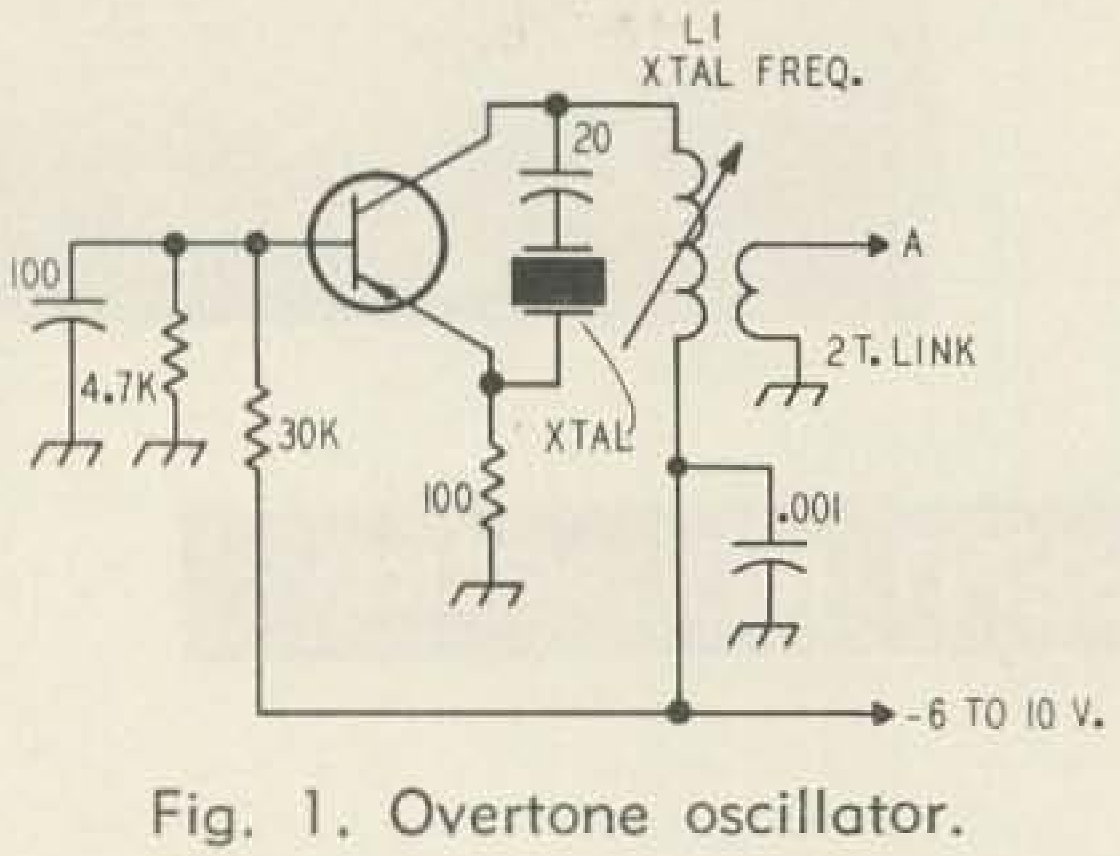


Fig. 1. Overtone oscillator.

in **Fig. 1.** The transistor can be any VHF oscillator type, such as the RT82, 2N1744, etc. The crystal is a third overtone type. L1 is a slug tuned coil tuned to the crystal frequency. A link of two or three turns of wire is wound over the coil for coupling to the next stage. This is the basic oscillator for VHF transmitters and converters. It is stable and just about idiot-proof. L1 is tuned to the xtal frequency to make it oscillate.

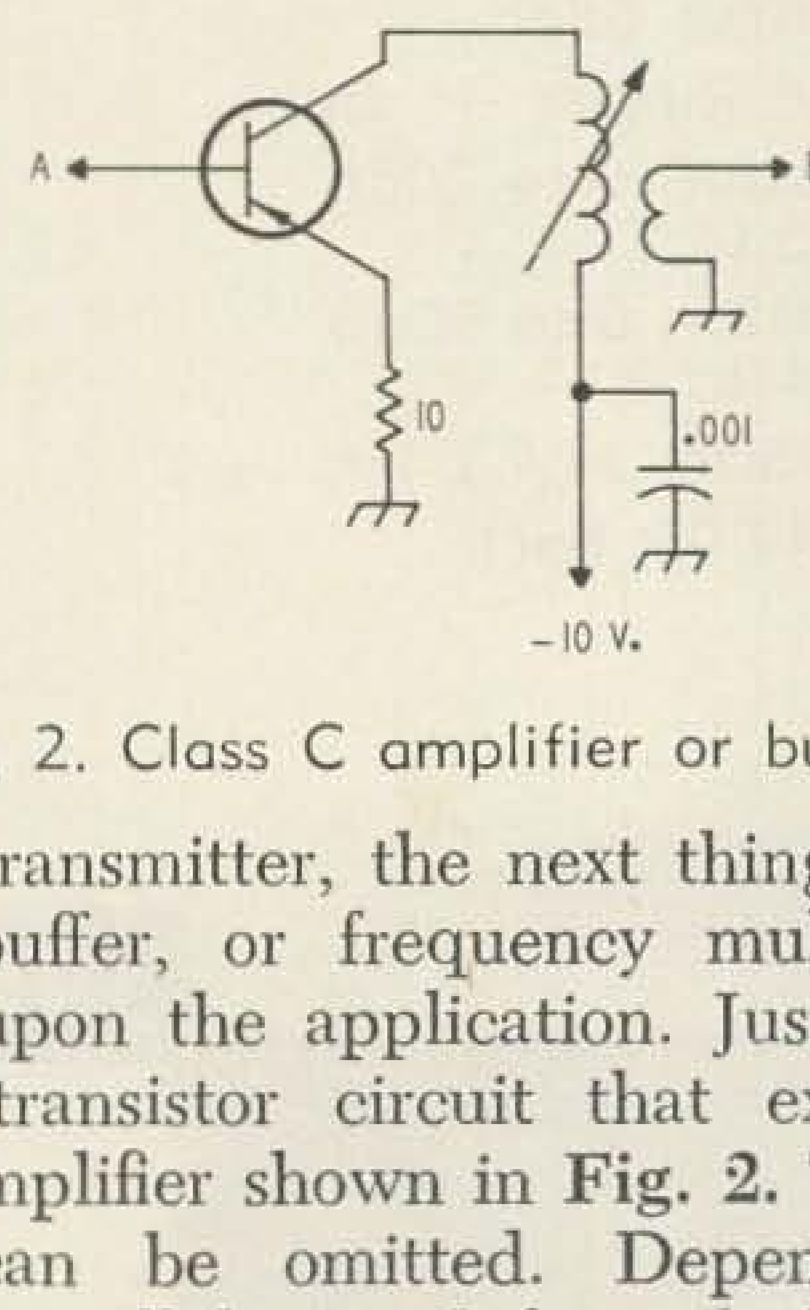


Fig. 2. Class C amplifier or buffer.

For a transmitter, the next thing needed is a final, buffer, or frequency multiplier, depending upon the application. Just about the simplest transistor circuit that exists is the class C amplifier shown in **Fig. 2.** The emitter resistor can be omitted. Depending upon whether it will be used for a buffer, a final, or a frequency multiplier, the tuned circuit is tuned to either the input frequency or a multiple of the input frequency. It is hard to get drive for future stages if the frequency is

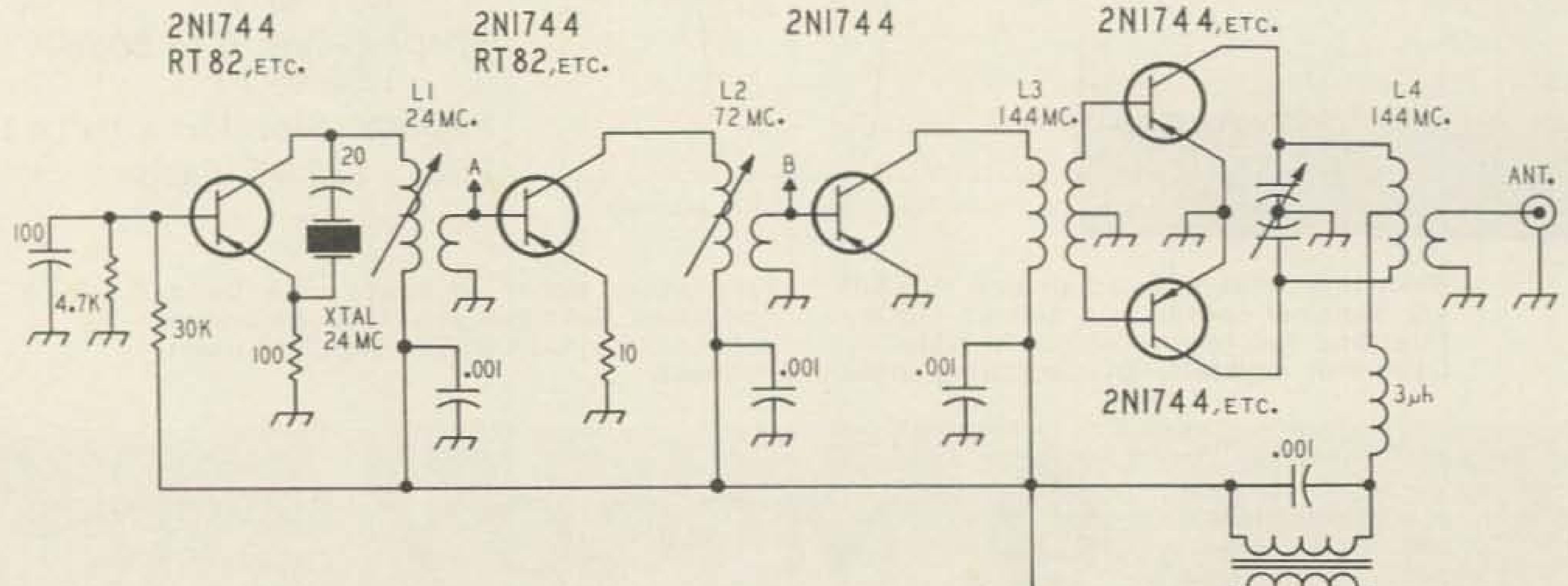


Fig. 3. Two meter transmitter.

being multiplied more than three times, so limit the frequency multipliers to triplers. The stage is biased beyond cutoff with no drive, so no additional protective bias is needed. Excitation is measured by collector current.

Fig. 3 shows a possible application of the previous circuits combined to form a two meter transmitter. It is a perfect example of solid state simplicity.

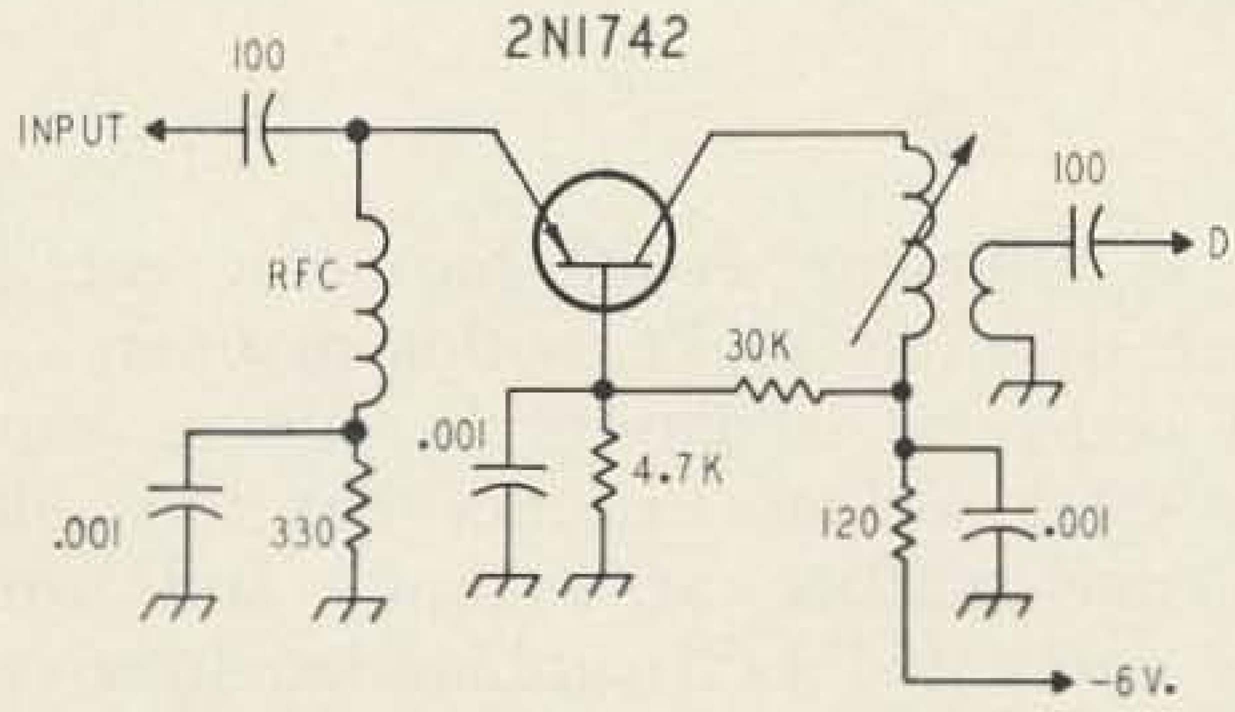


Fig. 4. Grounded base rf amplifier.

Converters are also simple. **Fig. 4** shows a grounded base rf amplifier. The rf choke and coil are chosen for the frequency being amplified. One or more of these rf stages may be used before the mixer.

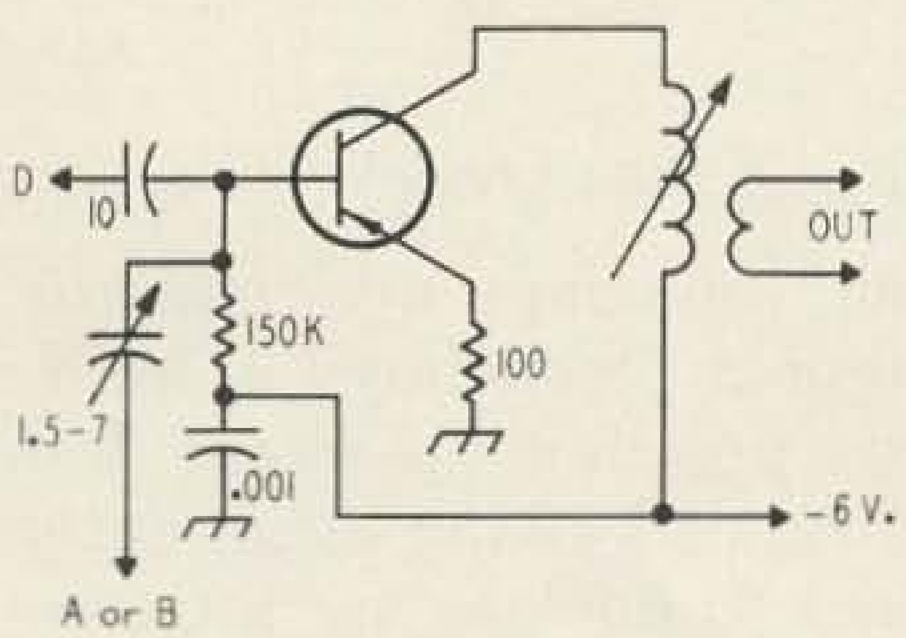


Fig. 5. Mixer.

The mixer is shown in **Fig. 5.** Point D is onnected to the preceeding rf stage. Point *a* or *b* goes to either an oscillator or a frequency multiplier chain as shown in **Fig. 1, 2** and **3.** The output can either go to a receiver or to another mixer for multiple conversion. These circuits are good up to about 250 or 300 mc. The values shown are typical values, although they may have to be changed slightly to get optimum performance from particular transistors.

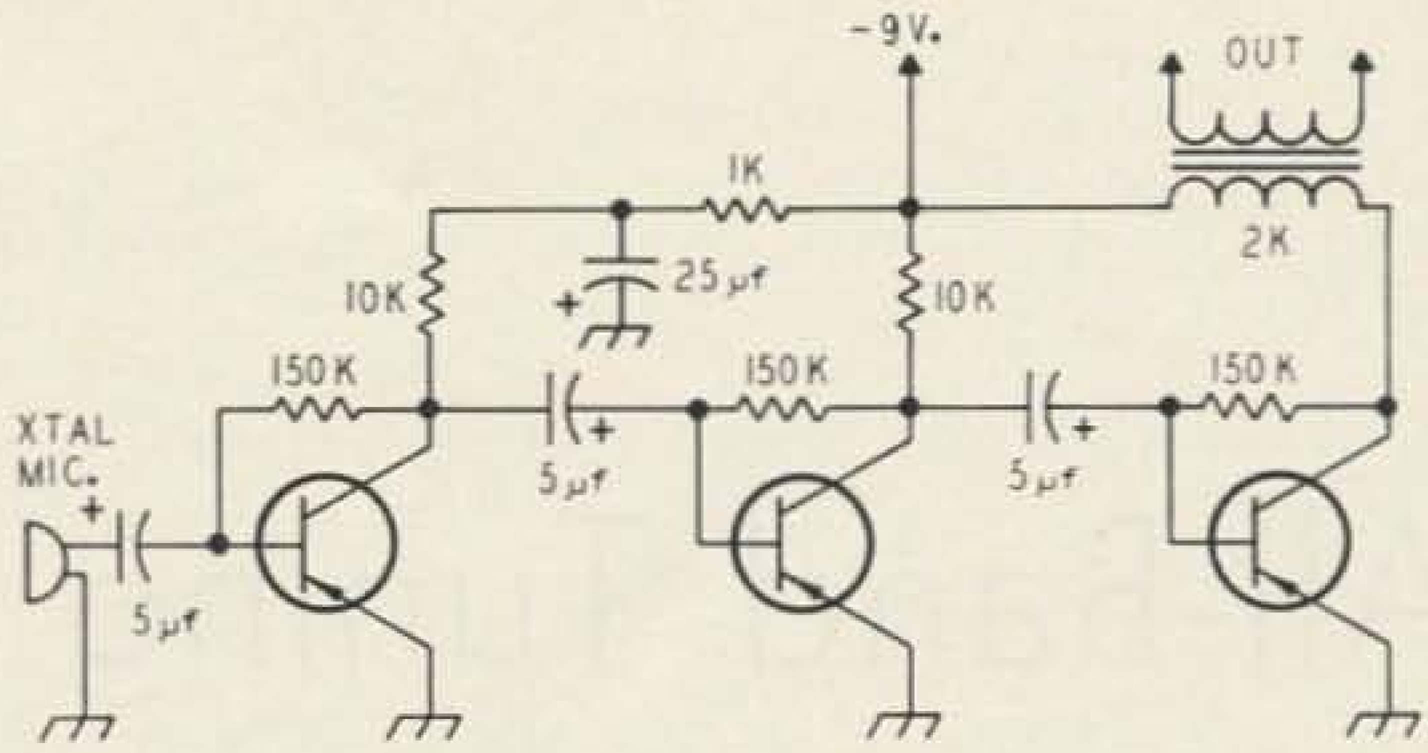


Fig. 6. Audio amplifier and modulator.

Fig. 6 shows a general purpose audio amplifier that can be used as a speech amp, a low power modulator, or an audio monitor amp for a receiver. The transistors are general purpose PNP audio types, available for a few cents. The secondary impedance of the transformer is chosen for the application.

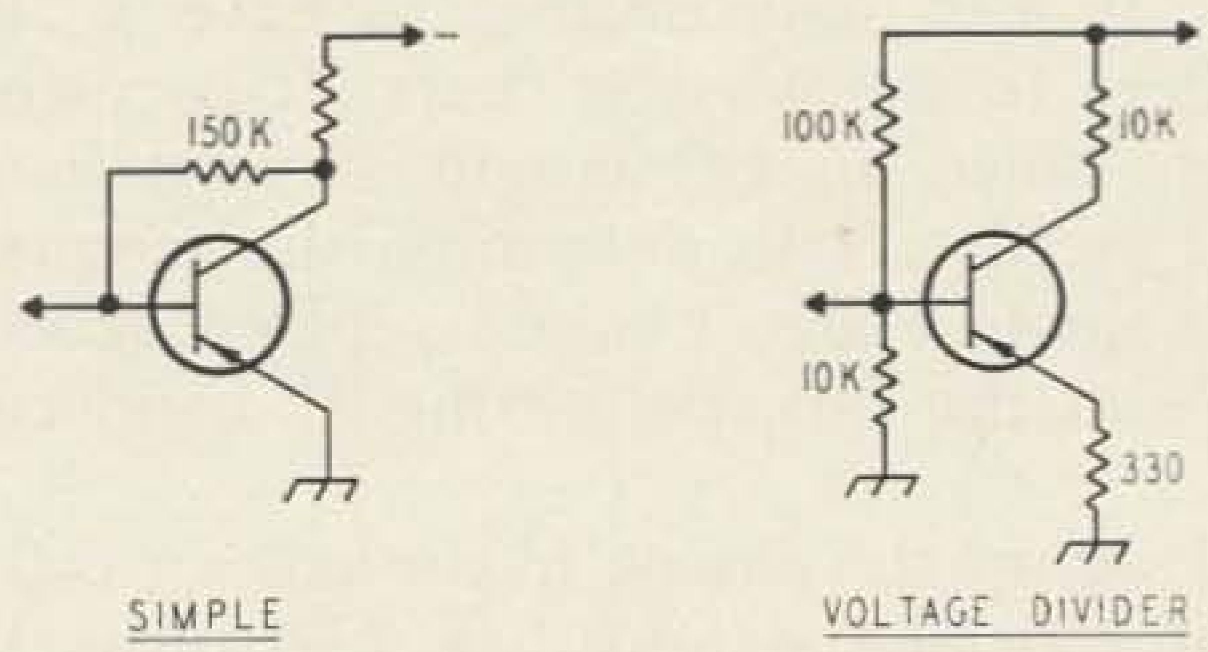


Fig. 7. Biasing methods.

Fig. 7 shows two possible methods of biasing a class A amplifier. The first is the simple bias resistor method, which is cheap and easy, although it does not have the dc and thermal stability of the second method. For audio amplifiers, etc., the first is adequate. For rf amplifiers, the second is preferable.

The above should be a useful outline for designing transistorized equipment. While it does not go into all the possible circuits or applications, or go into any great detail, it should provide a starting point for design work. When values are given, they are only typical values, to be used as a starting point in trying to optimize any design. I hope that this will be of value or at least give you a few ideas when you decide to design some solid state gear. . . . WA2INM/1

Vic Zane K9LTD
Connersville, Ind.

All-Band Tuning for the Drake 2B?

When I read WN4QGQ's item in November 73 about the use of the crystals supplied with the Drake 2-B to obtain band segments not originally intended, I was reminded of a similar article that appeared in the July '62 issue of QST. The crystal switching approach strikes me as a lot of monkeyshines for so little benefit if it is only desired to have a "look" elsewhere to see what is there. It occurred to me that since an LC circuit is used in non-crystal oscillators to determine the frequency, a variable LC circuit might replace accessory crystals in the 2-B, permitting all-band coverage.

Picking up the closest likely looking coil and capacitor from the junk box (19 turns B&W 3004 and a National 100 pf transmitting variable), I was pleasantly surprised to find that the combination would tune from about 8 to 27 mc. Adding about 18" of RG-58/U loused that up until I inserted a 33 pf disc ceramic in series with the center conductor. I still could not get above about 21 mc. I attached the other end of the coax to a piece of surplus circuit board, cut down to about ¾" × 1", as shown in Fig. 1. Of course the copper conductors were peeled off first, and then the holes drilled to support the wires. I used resistor trimmings (tinned #18) for the pins.

With the circuit tuned to 12 mc, I was able to copy both sides of a CB ragchew between a local and one about 30 miles from here. The preselector was at about 9¼, and it was the E position, I believe. This indicated to me that there is sufficient second harmonic energy to replace overtone rocks in this manner.

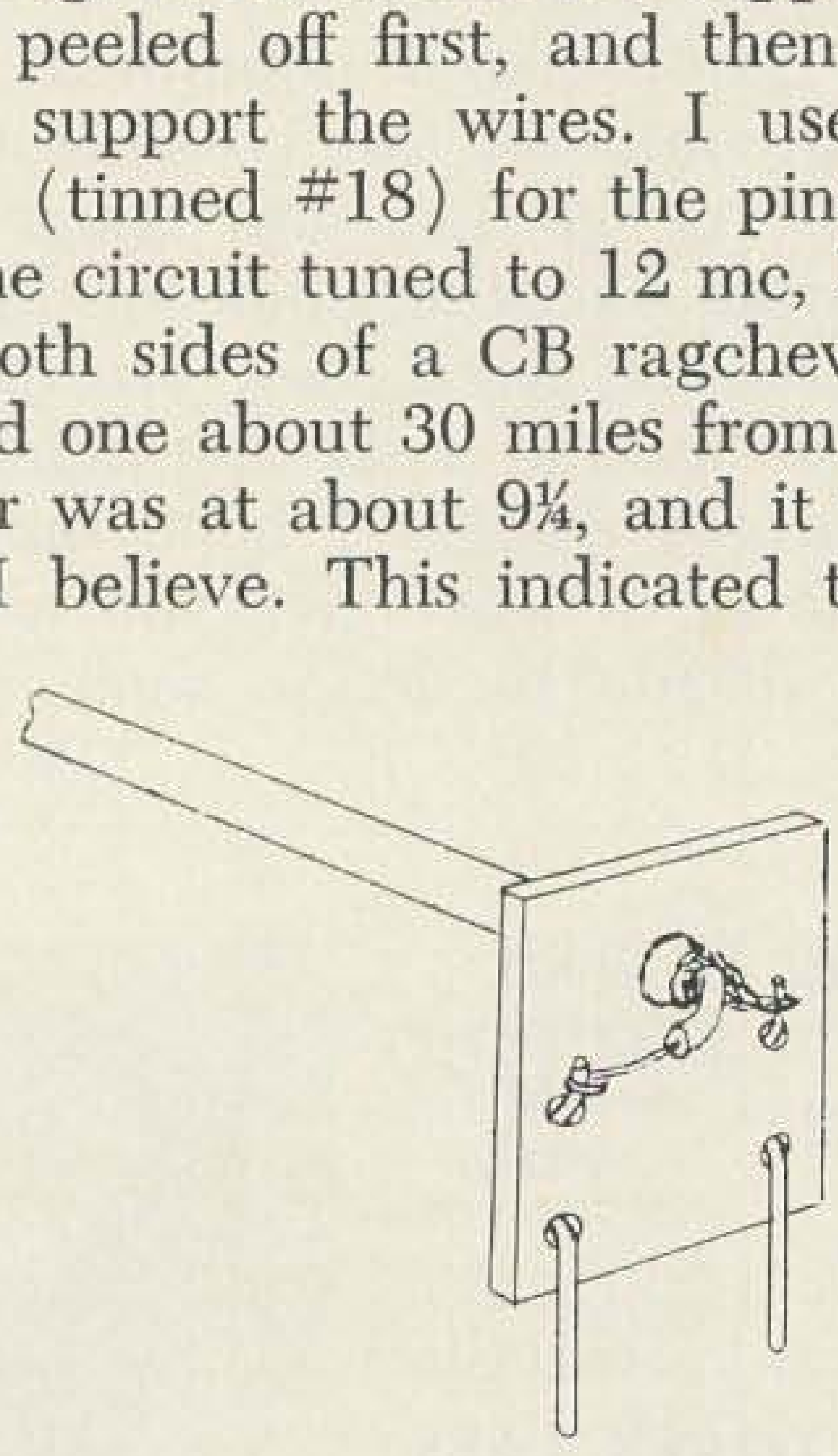


Fig 1. Single dummy crystal.

Of course it is natural to picture ganging the crystal sockets together (as the selector picks one position at a time) and using a single calibrated LC combination to give the full coverage desired. Just add (or subtract) the 3.5 to 4.1 mc *if* (I find 3.8 mc to band center easier) to the LC frequency. This could even be taken into account when calibrating.

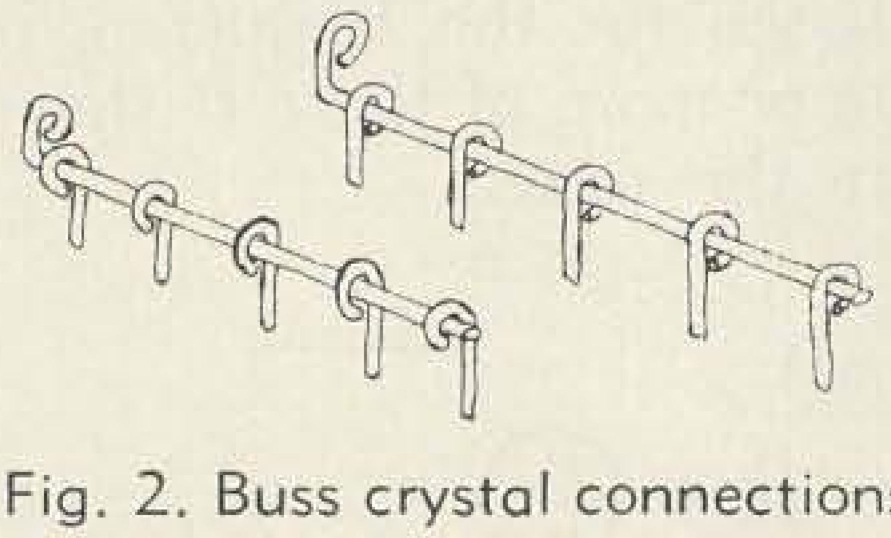


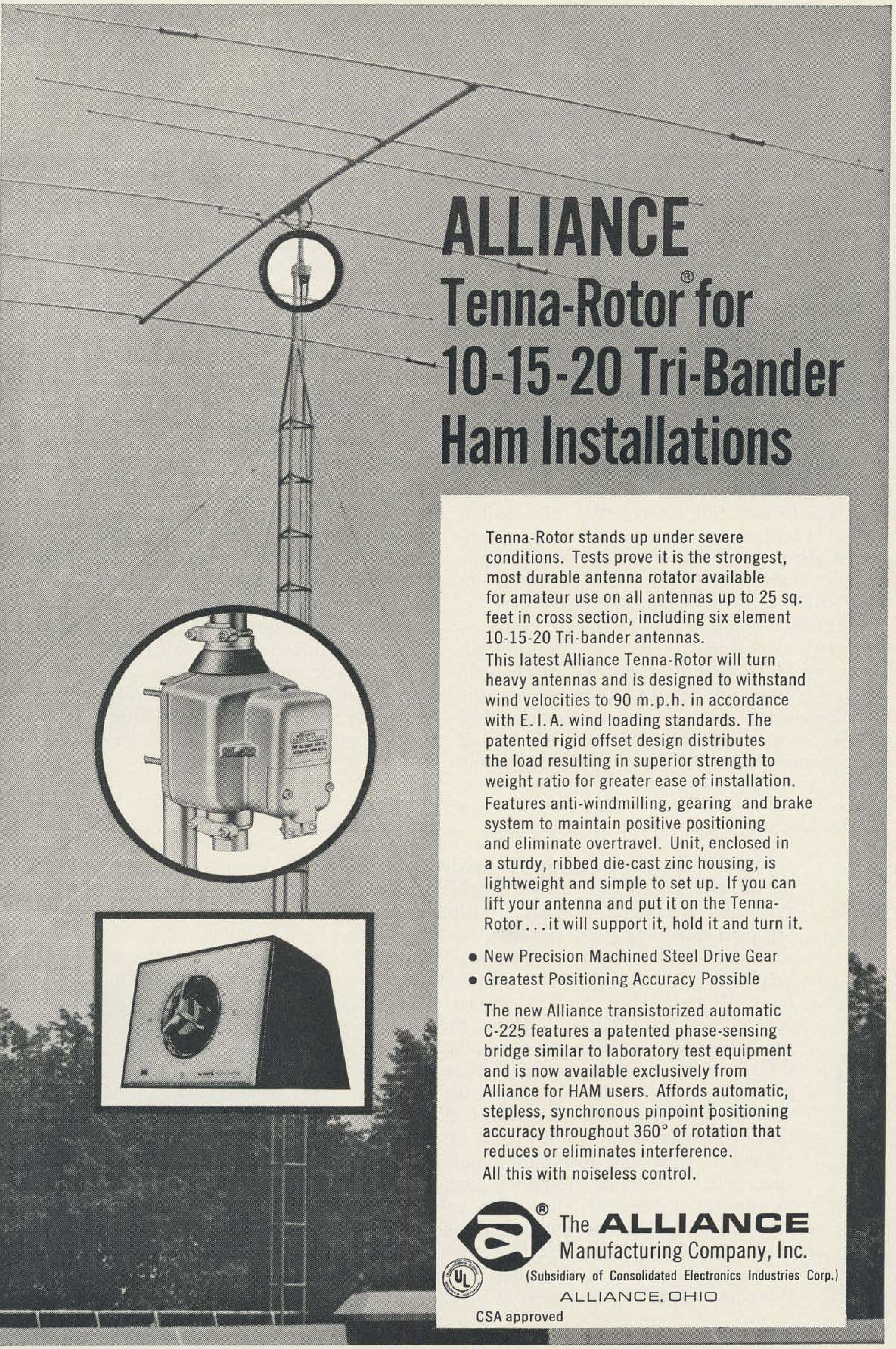
Fig. 2. Buss crystal connections.

You can imagine my chagrin when I couldn't repeat. Somehow a local 80 meter station kept popping up where I didn't want him. Was the coil acting as an antenna? I dug up a cabinet to enclose my little jewel. It still didn't work. In checking the Drake schematic, I learned that the "E" position is not connected as are the other 4, so I cut off the pins to the "E" socket. And it still wouldn't seem to work again. I removed my bus conductors from the crystal sockets, and tried the single dummy again. No better. That local on 80 was still in there pitching. So I switched to 80 and yakked a while.

While playing with this thing, I found that I could inject the grid-dipper oscillator frequency into the receiver through this combination, and come up with new band segments. Then in trying to rig up a transistor oscillator (on the same LC combination) I couldn't get it to take off.

But rather than let this project suffer the fate that seems to have befallen about 20 other projects that are in various stages of progress(?) in my shop, I felt that maybe someone who knows more about what he is doing would like to take it from here. Be my guest.

. . . K9LTD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When Standard Switches Won't Fit

Modification and updating of equipment almost invariably calls for addition of functions, which need more controls than were originally supplied with the equipment. In most instances, the panel does not have enough room for the added controls, and space inside the chassis is not too plentiful.

Back in the days when one Shicklgruber was still a struggling artist about one third of this problem was solved by the manufacturers of potentiometers, who attached a switch to their product, so that when the audio volume was turned full off (CCW), the switch opened. Combined potentiometers and switches are used on a wide variety of electronic devices, from your wife's "kitchen radio" to the GPR-90 you wish you could afford.

With the coming of the TV boom dual controls with concentric shafts were introduced. These range in quality from the mechanical abortions used on cheap TV sets to the beautifully-built and smoothly-working dual controls used on Tektronix oscilloscopes, and other items of premium equipment. In many instances, already-made dual concentric controls will solve your specific problem, with a minimum of labor and a minimum of cost. Check a good controls catalog before deciding to build a special control.

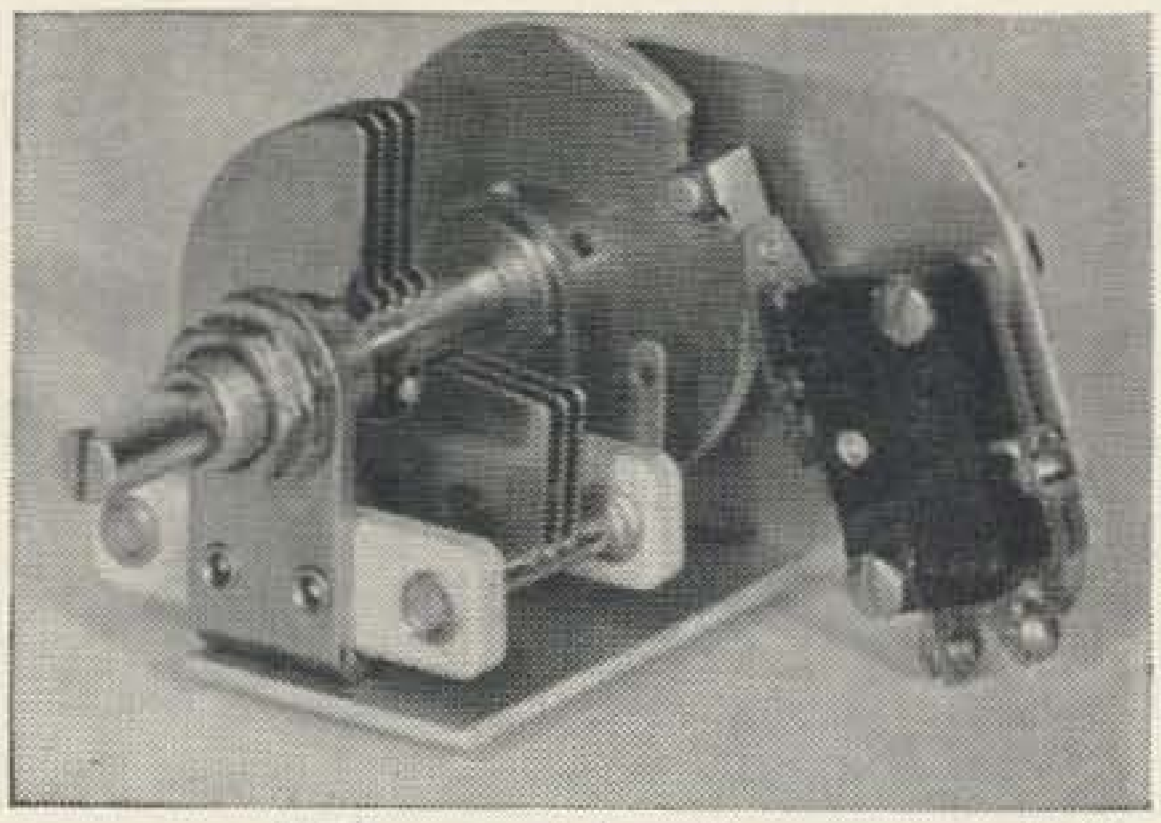
In some instances, however, no available commercially-made control will do the job, and something must be made to fit the special need. Even here, use of standard components will save a great deal of time and work, and will facilitate eventual repair and replacement.

Experience with a wide variety of special switching devices shows that most of them can be constructed from available standard components, without any very complex machine work, and that most of them can be made to work very well indeed. A little patience and ingenuity are a great help in designing such special switches; and a few minutes spent in lining up the components, after assembly, and before installation, will save many hours of "diddling" at a later date.

. . . Ives

1

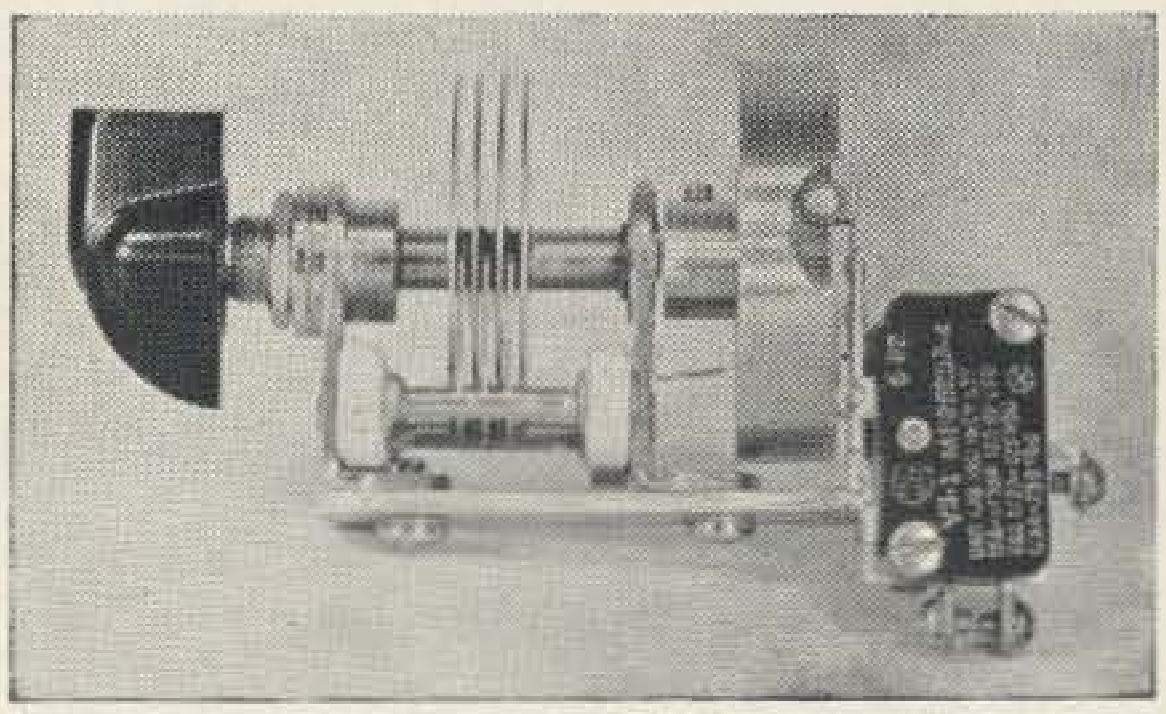
When additional switching is needed with a potentiometer, beyond that obtainable with an available "attachable" switch, a switch-actuating cam can usually be mounted on the front shaft extension (which is commonly about 2" long), and this can be made to operate one or more Microswitches. Such a special switched control is shown in Fig. 1. Here, the Ohmite pot (type CU) with its attached switch (type CS-1) is mounted on a small bakelite sub-panel. The cam actuator, a gear with its teeth turned off, and an operating notch filed in, is then placed on the shaft. In front of this, and separated from the rear sub panel by brass spacers is a second sub-panel large enough to support a Microswitch with a roller actuator. Bearing for the outer end of the pot shaft, and ferrule for mounting the assembly on the main panel, is provided by a conventional panel bearing (Johnson 115-255).



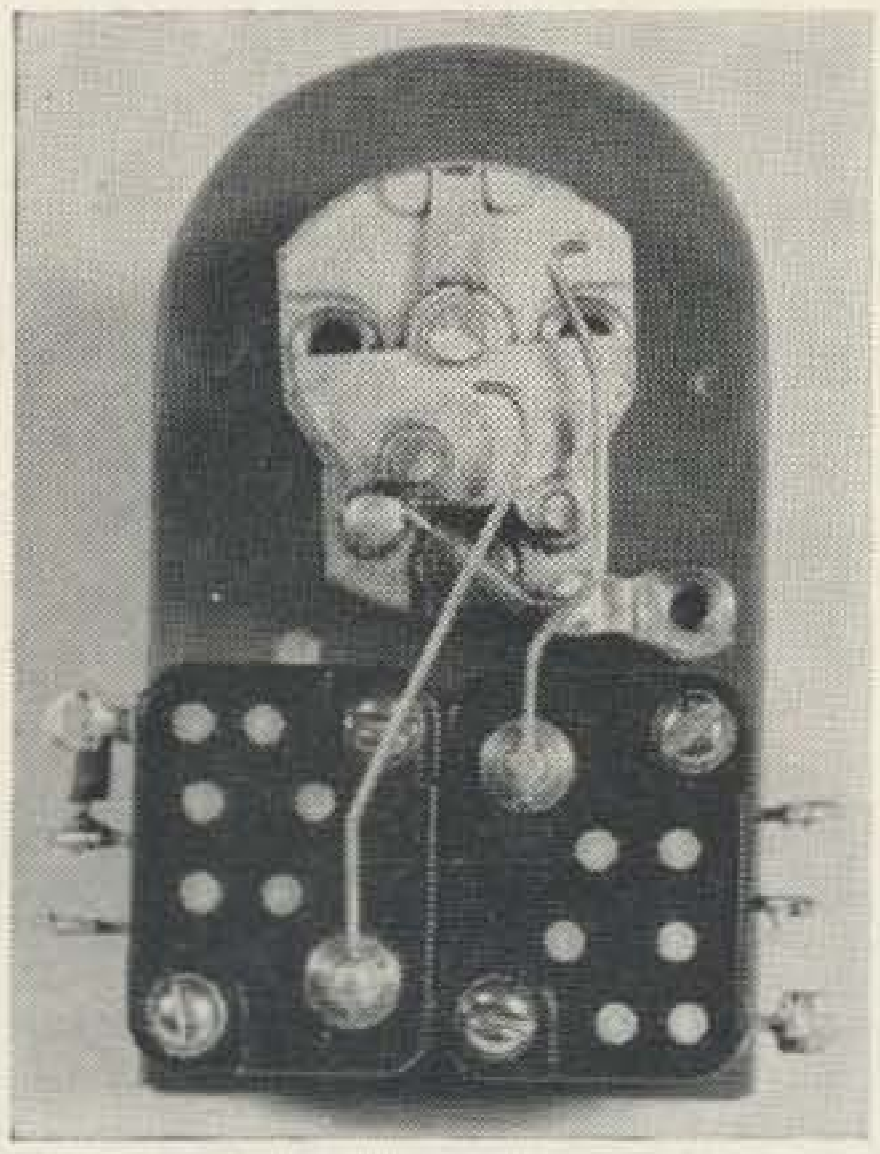
When a switch must be actuated by a capacitor shaft, the same technique can be used when the shaft length is adequate. In most instances, a capacitor with sufficient front shaft extension will not be available, and a capacitor with a rear shaft extension should be chosen. Actuating cam is attached to the rear shaft extension, and the microswitch is supported by a small aluminum or brass bracket as in Fig. 2. 2

Where side clearance is inadequate, the flat cam can be replaced by a cup cam (turned on a lathe), and the microswitch mounted in back of the capacitor, as in Fig. 3. As with the pot, more than one Microswitch can be operated by a single cam; and multiple cams can be used if necessary, although the capacitor bearings are not usually suited for large external mechanical **loads.**

3



With very small capacitors, such as the familiar APC types, neither front nor rear shaft is suitable for mounting a cam. With these, however, if the rotor is grounded (usual case), a stud can be soldered to the rear rotor plate, and this can actuate the extension wire of a type V-4 Microswitch, originally made for use in coin-operated equipment. Ordinary paper clips make good extension wires. An example of switch operation with an APC capacitor is shown in Fig. 4. Here, one switch turns on the BFO, which is tunable through 180 degrees of the capacitor shaft rotation. Further rotation of the shaft, beyond 180 degrees, actuates the second switch, which turns off the tunable BFO and turns on a crystal BFO. Returning the shaft to zero position (counterclockwise) turns everything off. Although the V-4 Microswitch, with its wire actuation, appears quite fragile, the illustrated assembly lasted for nine years of service with no maintenance whatsoever. It was taken out of service only because the related equipment became obsolete.



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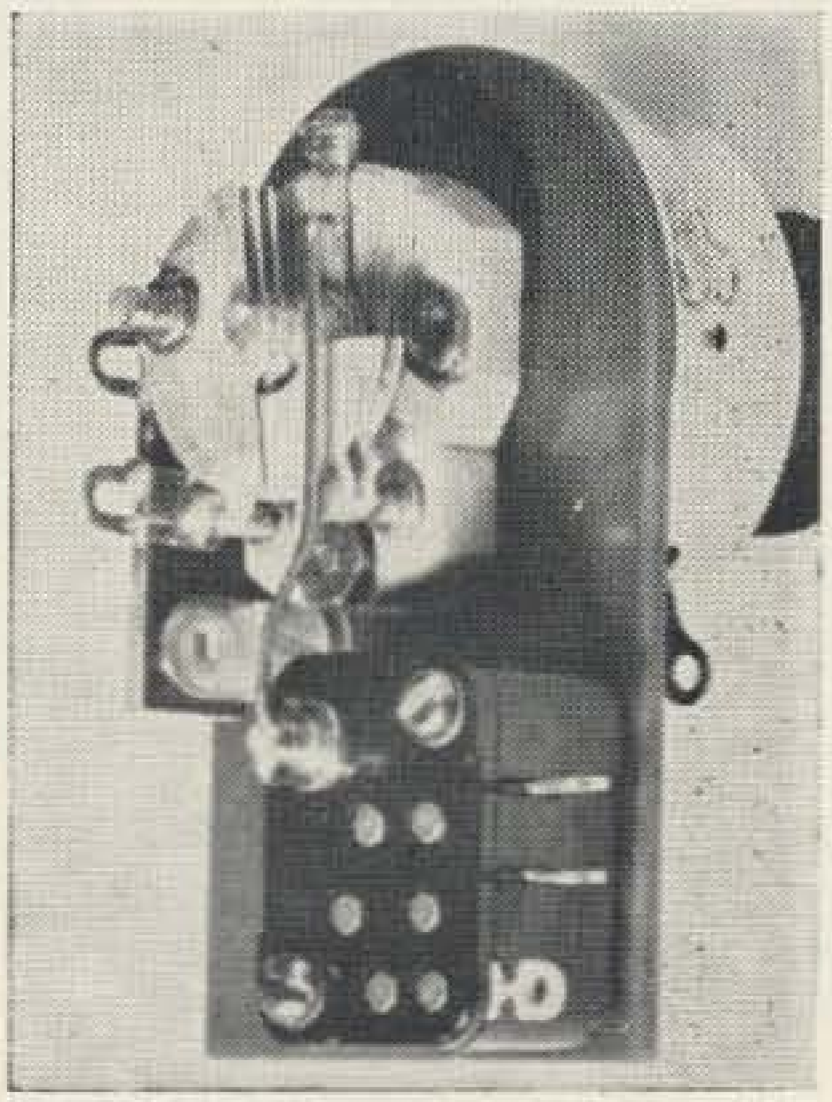
Another special switched control, this time using a dual concentric shaft, is shown in Fig. 5. This combination includes a switch, a capacitor, and a potentiometer. The switch is actuated by a stud on the rear rotor plate of the capacitor, and is controlled by the inner shaft (BFO tuning and off-on). The potentiometer is controlled by the outer (hollow) shaft (BFO injection). No special problems are encountered here, but care must be taken to align all the components exactly, so that the controls work smoothly, and have a correct "feel".

5



A CHU Time Receiver

Bob McGraw W2LYH
9 Peg's Lane
Riverhead, L. I., N. Y.

Radio station CHU, of the Dominion Observatory, Canada, broadcasts some very useful time signals on 3330, 7335, and 14670 kc. While anybody can use these signals for setting his watch, all of you hams who also have amateur astronomy for a hobby can do more with them if you have a receiver like the one described here. The set is crystal-controlled, to receive CHU on 3330 and 7335 kc, which happen to be the best frequencies at this QTH.

Side view of the CHU Receiver.

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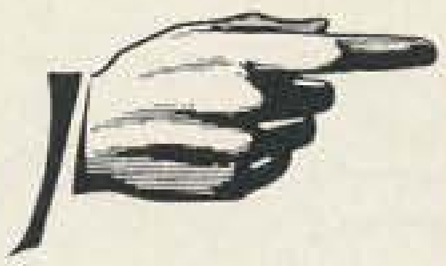

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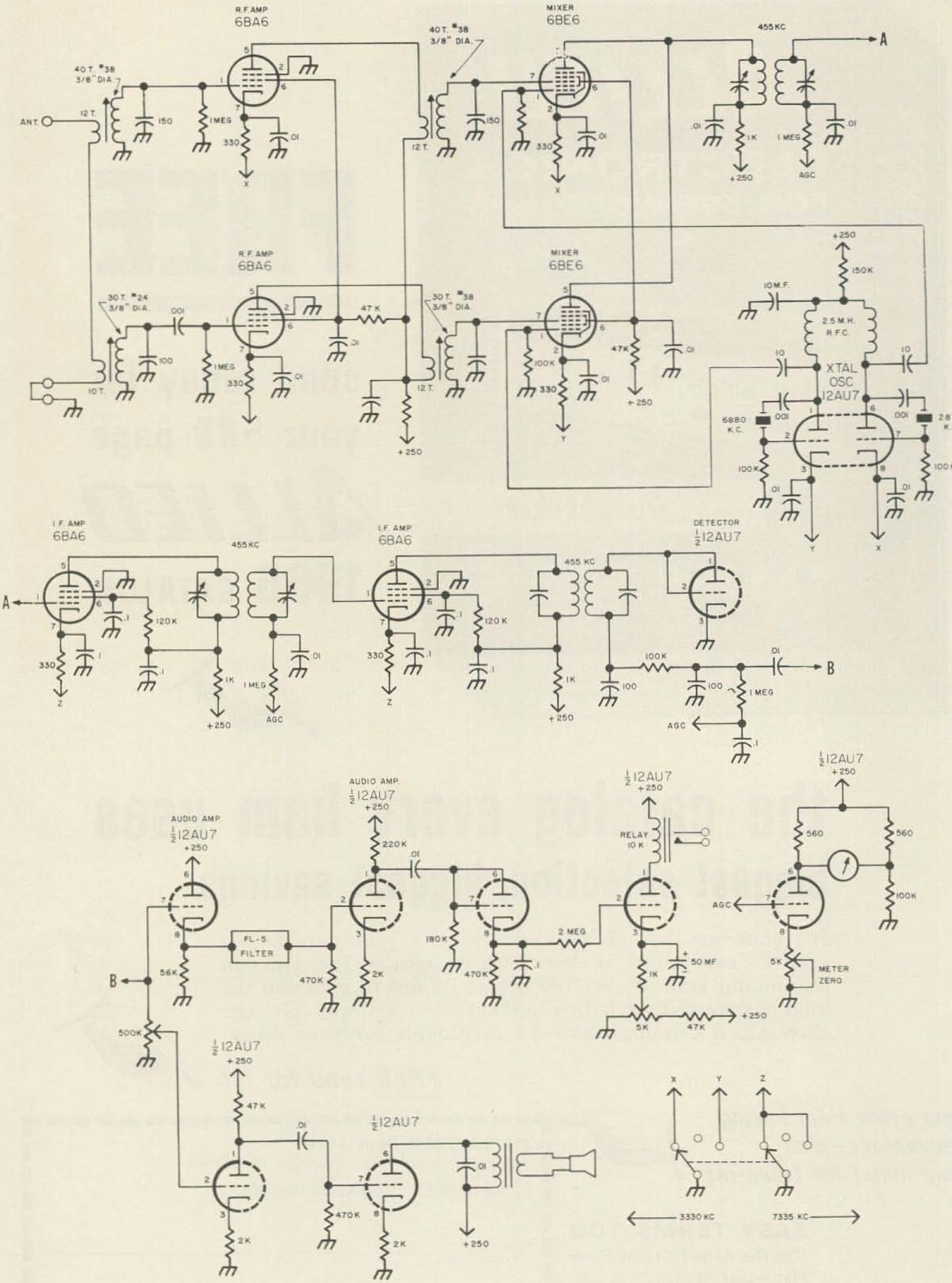
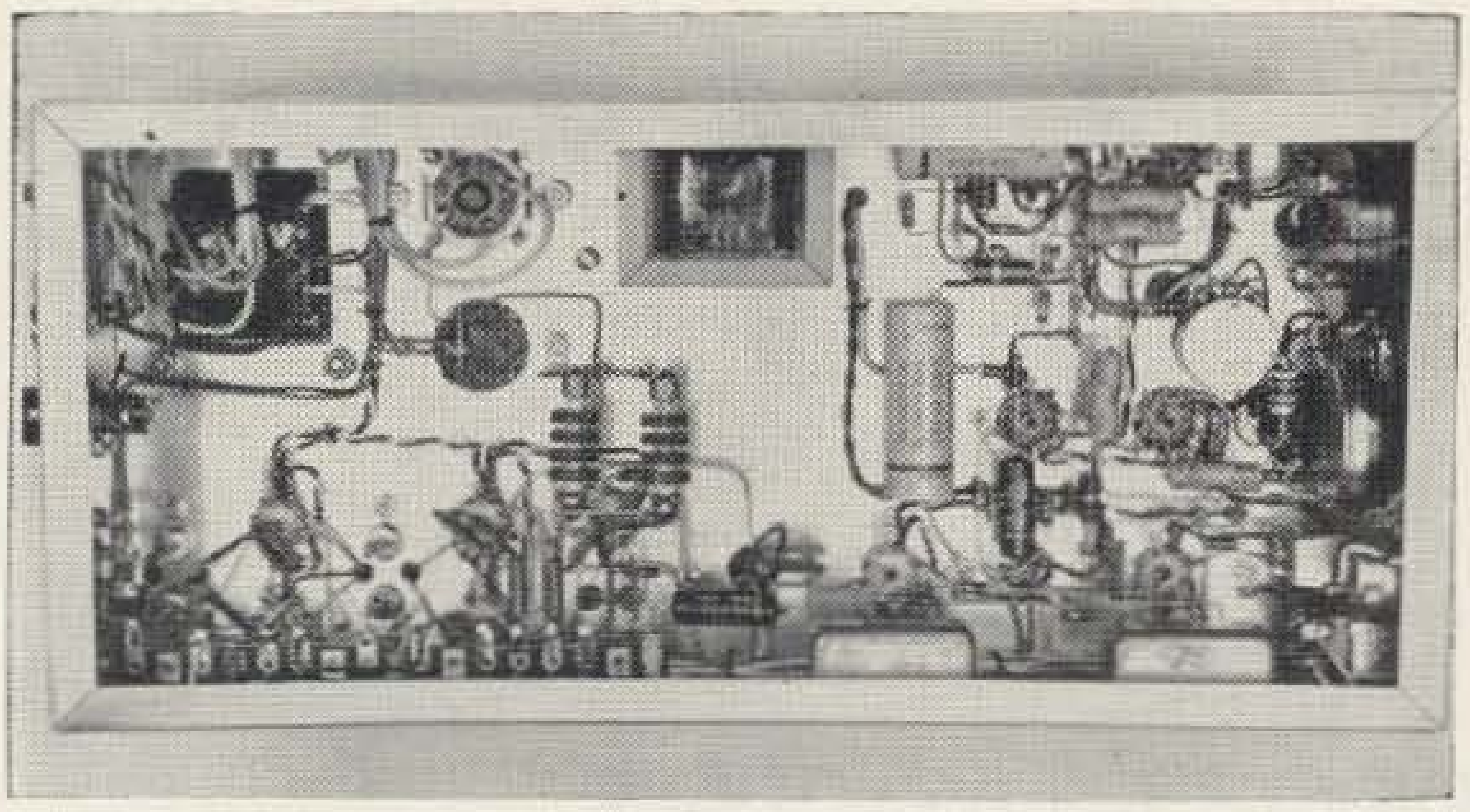
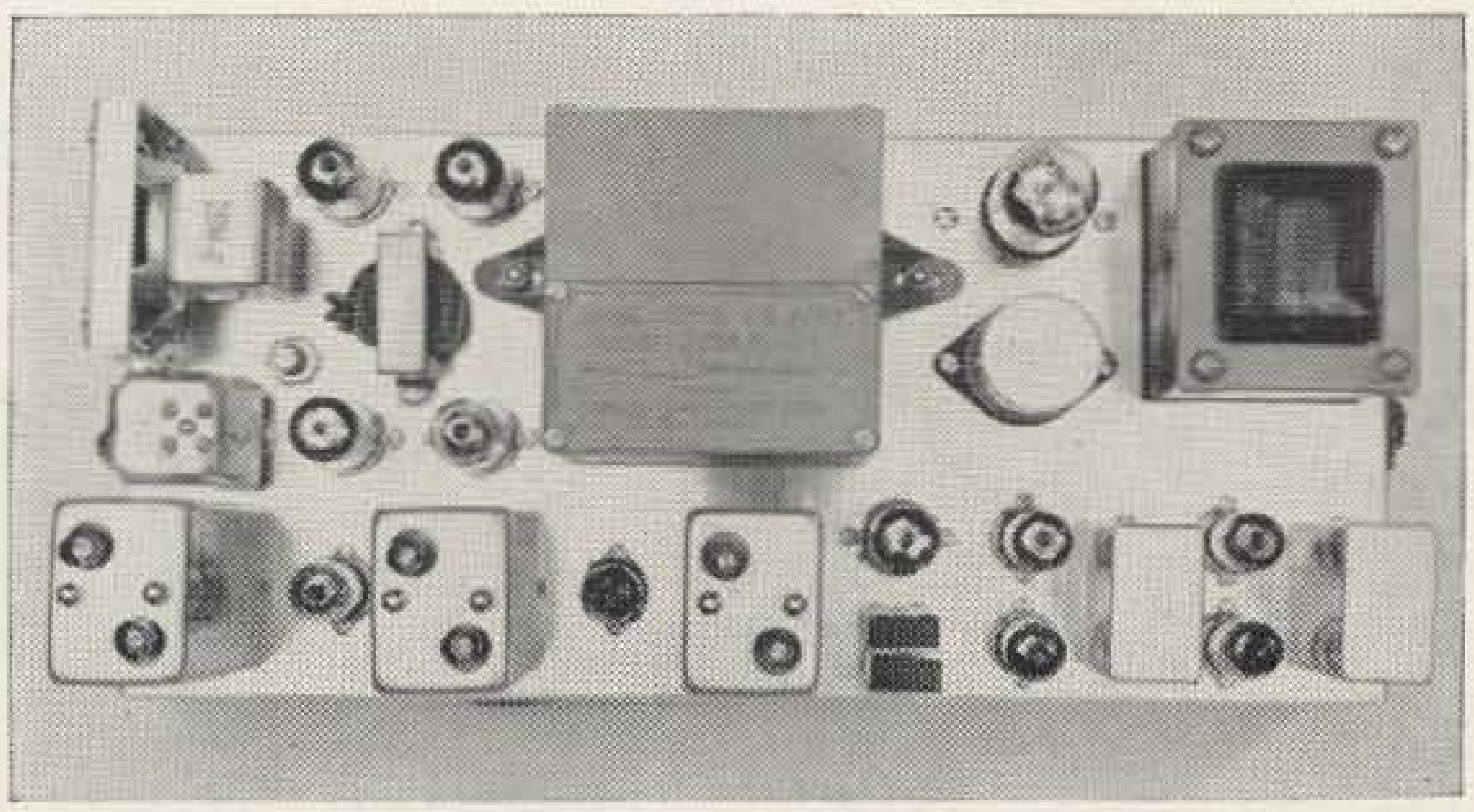


Schematic of CHU Receiver.



Bottom view.



Top view.

The time signals operate a relay in the receiver, which keys one pen of a two-pen recorder. The other pen is keyed by the local clock, through a photo-cell system which looks at the pendulum. This allows precise measurement of the clock rate, and either pen can be switched to a remote location for recording transit sightings against either the clock or CHU.

A separate rf amplifier, mixer, and crystal oscillator is used for each of the two frequencies, as this is simpler than switching the rf circuits, and allows the use of a regular toggle switch in the cathodes for selecting either frequency. The mixers feed a two-stage 455 kc *if* amplifier. A diode detector furnishes agc voltage, which controls the gain of the rf and *if* stages. A two-stage audio amplifier drives the small built-in speaker. The time signals consist of voice announcements every minute, and 1000-cycle tone beeps at one second intervals. These tone signals are filtered through a FL-5 range filter, which does an excellent job, even though it is centered on 1020 cycles. The filter output is amplified, rectified, and the resulting dc voltage used to control the relay tube. A meter circuit is included to indicate relative signal strength, and for peaking the rf and *if* circuits.

I will be glad to answer any letters from anyone who desires further information on the receiver.

. . . W2LYH

Paul Richter K1SDX
18 Libby Lane
Darien, Connecticut

Switching with Diodes

Many hams tend to think of the semiconductor diode only in terms of its use as a rectifier. This is understandable because the use of semiconductor diodes in much of the commercially manufactured ham gear is restricted to rectifying applications in power supplies, detector circuits, balanced modulators and clippers. In properly designed circuits, however, the diode may also function as a highly efficient and reliable non-rectifying switch. Diode switches may frequently be used to replace the conventional mechanical switch in ham communications equipment while offering a significant advantage in reduced size and cost and increased design flexibility and dependability. Before discussing practical switching circuits and associated design considerations, it might be helpful to briefly review the basic principles of solid state physics necessary for an understanding of the theory of semiconductor diode operation.

The basic materials currently being used in semiconductor manufacture are elements from Group IV on the chemical periodic chart, usually either silicon (Si) or germanium (Ge). The Group IV elements each have four bonding electrons (valence electrons) and in their pure, solid state are characterized by the formation of the tetrahedral crystal lattice. In the tetrahedral crystal lattice each atom is pictured as being at the center of a tetrahedron surrounded by four like atoms at the vertices of the tetrahedron. (See Fig. 1).

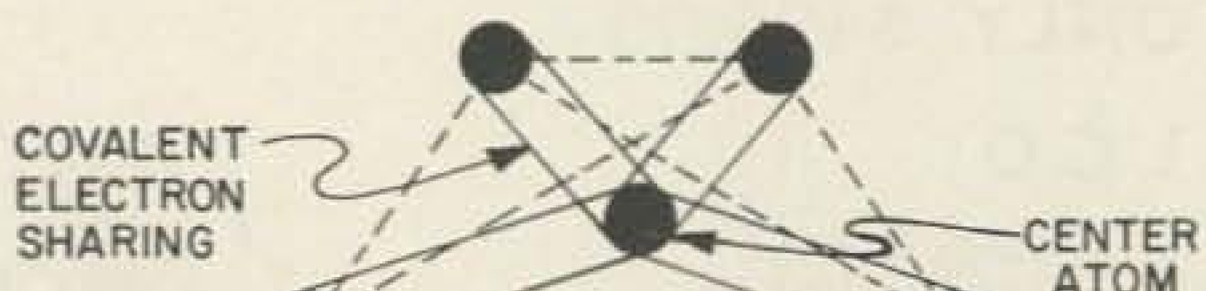


Fig. 1

Each atom in the lattice except those on the outside surfaces forms four covalent bonds by sharing one electron with each of the four adjacent atoms. This effectively results in giving each atom the highly stable octet arrangement of electrons in its outer shell. Thus all available electrons in the crystal lattice of the pure element are used in forming rigid covalent bonds and under normal conditions cannot be excited into the higher energy "conductive bands" for the conduction of electric currents. As a result, pure silicon and germanium are notably poor conductors.

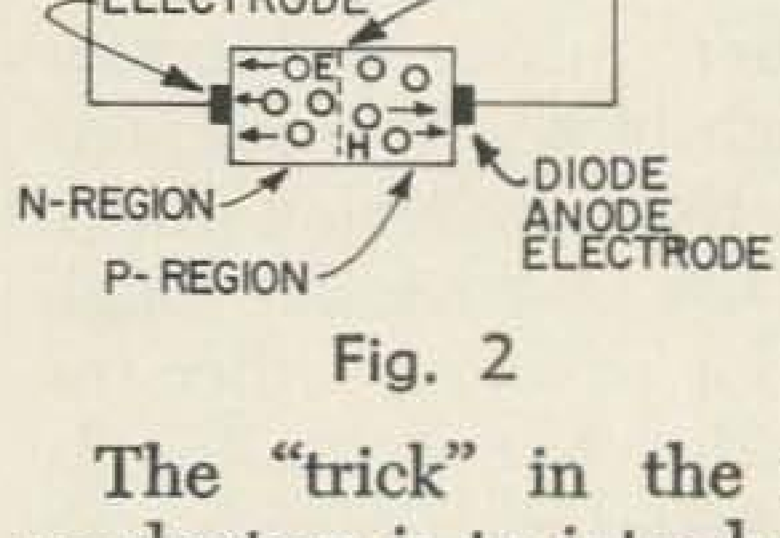


Fig. 2

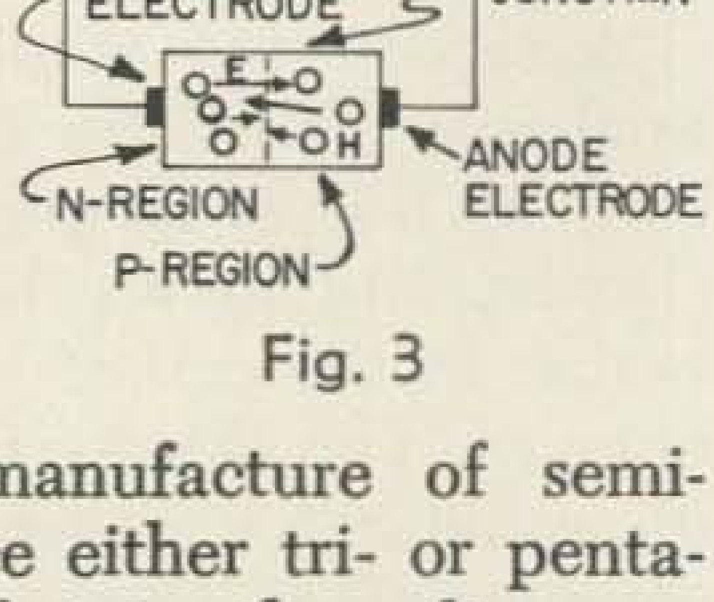


Fig. 3

The "trick" in the manufacture of semiconductors is to introduce either tri- or pentavalent "impurity atoms" into the silicon or germanium crystal lattice. In practice, certain chemical elements from Group III with only three bonding electrons or from Group V with five valence electrons are used as impurities. When a proper Group V impurity is placed into a tetrahedral silicon lattice, for instance, it is found that the impurity atom forms covalent bonds with its four adjacent atoms. However, the impurity atom has five valence electrons and only four of them are required for chemical bonding. As a result there is one electron which is "left over." Although the one unused electron for each Group V atom is electrostatically balanced out by the additional proton in the nucleus of the impurity atom, it can easily be excited into

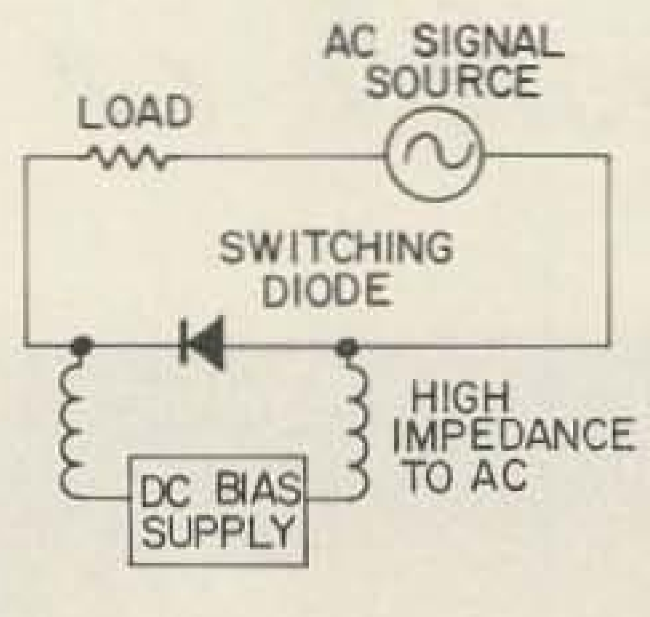


Fig. 4

the "conductive bands" where it can migrate as an electric current when only a small voltage is applied across the semiconductor crystal. Group V impurities produce a region of "freeable" electrons which is commonly called an "N" region. On the other hand, Group III impurities in a tetrahedral lattice produce a region of "electron deficiency" known as a "P" region. It is possible for a P-region as well as an N-region to conduct electric current because both freeable electrons and electron deficiencies (called "holes") can migrate through a semiconductor crystal lattice if the proper impurity density has been established.

A semiconductor diode is manufactured by forming a junction between a piece of N-type and P-type semiconductor crystal material. Because diode switch circuits, as we will see later, operate by virtue of changing bias polarity and voltage across the switching diode, it might be helpful to quickly examine the electronic operation of reverse and forward biased diodes.

Fig. 2 shows a reversed biased diode. The "holes" in the P-region are attracted by electrostatic forces toward the negative terminal of the applied voltage, a direction away from the P-N junction. At the same time the "free electrons" in the N-region migrate away from junction towards the diode electrode which is connected to the positive battery terminal. Remembering that the basic units for voltage ("volts") are joules per elementary charge, it follows that as the reverse bias voltage is raised, the electrostatic forces acting on the carriers (ie. freeable electrons and holes) increase. Thus as the bias increases, the concentration of carriers further decreases in the regions of the N and P crystals near the P-N junction. Under normal conditions current cannot flow through the reverse biased diode because a "depletion zone" of carriers exists at the P-N junction and there is no available mechanism for a transfer of charge. Under abnormal conditions (for most purposes), the reversed biased diode may be made to conduct by raising the bias voltage to the point where "break down" occurs in the crystal with chemical decomposition and the formation of movable ions.

In a forward biased diode, the situation is reversed. See Fig. 3. Due to the bias voltage polarity difference in the forward biased diode, the carriers migrate across the P-N junction instead of away from it. This permits current to flow through the diode.

So far, we have looked at forward and reverse biased diode circuits where the bias voltage or current has remained constant with time. In practical diode switching circuits where ac voltages and currents are being switched, however, the effective values of "bias" current and voltage vary with time. Fig. 4 shows a general diagram for a diode switch circuit where the diode is being used to switch an ac signal. The switching state of the diode depends upon both the value of its steady dc bias and the instantaneous values of ac current and voltage. If the value of dc bias is zero, we recognize the circuit to be identical to that of a half-wave rectifier. In this case, rectified ac in the form of pulsating dc appears across the load. We are interested, however, in switching the ac signal without clipping or rectifying it. With proper adjustment of the value of dc bias and polarity, it is possible to make the diode function as a switch without rectifying. The graphs in Fig. 5 show how this is accomplished. In graph A, the value of fixed dc bias is periodically exceeded by peaks in the waveform of the signal which is being switched. As a result clipping takes place whenever the instantaneous bias amplitude changes polarity. The ordinate axis,

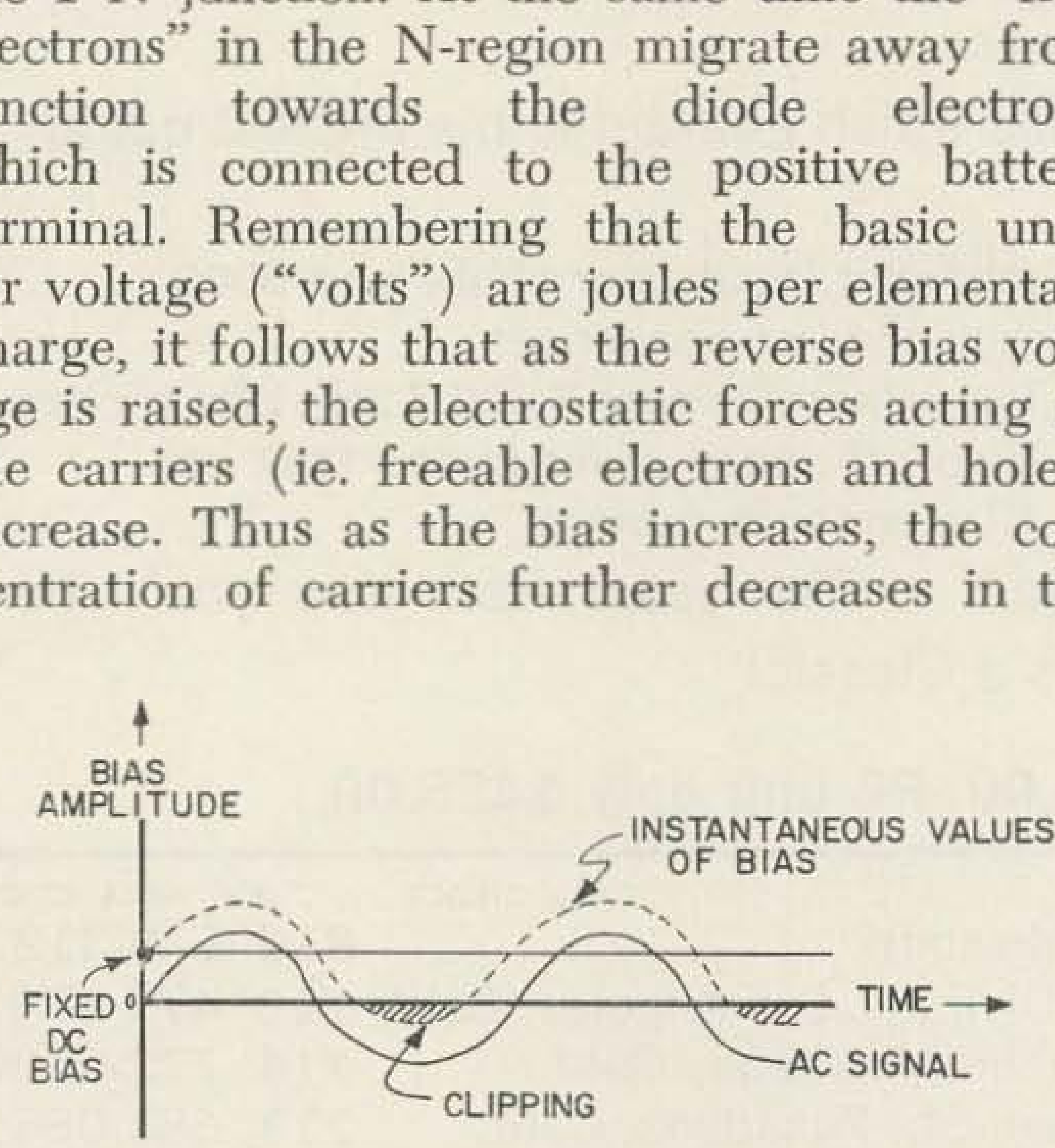


Fig. 5A

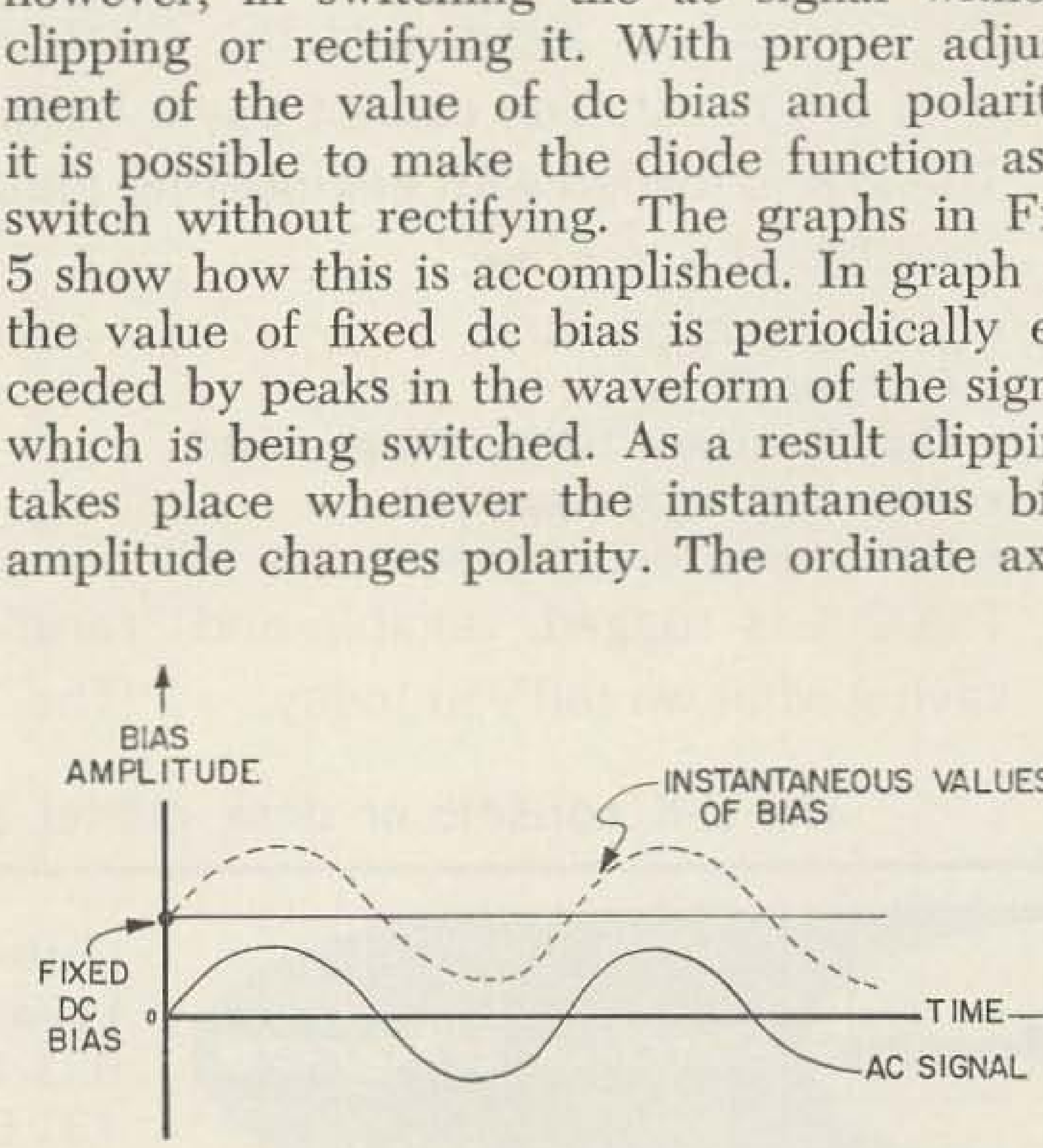


Fig. 5B

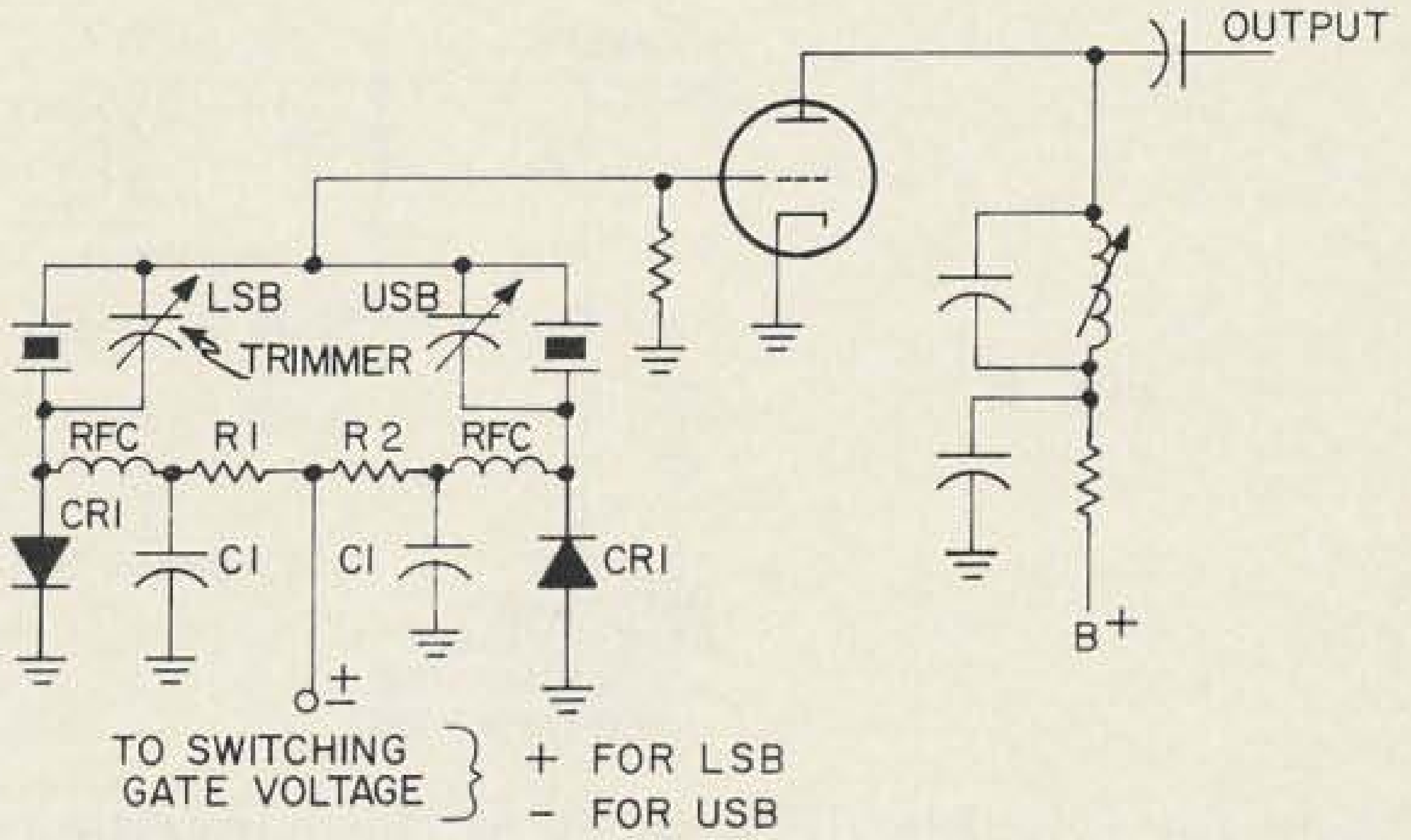


Fig. 6

"bias amplitude," can represent "current" in the case of the conducting ("ON") forward biased diode or "voltage" in the case of the non-conducting ("OFF") reverse biased diode. In graph B the fixed dc bias exceeds the peak values of the ac signal and as a result, the bias polarity never changes. Thus when the diode switch is on, the ac signal is passed without being rectified; when the switch is off, no ac signal appears across the load.

By now the reader has hopefully studied Fig. 4 and Fig. 5 and understands the theory of how diodes can be used as non-rectifying switches for ac signals. Therefore we will now go on and look at several practical working circuits employing semiconductor diode switching elements. Fig. 6 shows a method of using a diode switch to switch crystals in a crystal oscillator. The basic oscillator circuit shown here is similar to one used as the carrier oscillator for LSB and USB with a popular commercial sideband crystal filter. However, by using diode switches instead of a mechanical switch to switch LSB and USB crystals, an advantage is gained because it is no longer necessary to locate the carrier oscillator circuitry physically close to a front panel LSB-USB switch so that the wire leads from the crystals to the switch can be kept short. Furthermore, an rf quality LSB-USB switch is no longer required since it is only necessary to switch the diodes' bias voltage to select different crystals. Resistors R1 and R2 are selected to provide proper biasing for each diode. The rfc choke and by-pass capacitor (C1) are chosen to minimize rf voltages on the switching bias lead. Almost any diode with a high reverse–forward resistance ratio can be used for CR1. The positive and negative voltages needed for the diode switching gate lead can be selected with a single pole double throw switch from voltage dividers across the transmitter bias supply and across the transmitter B+.

Fig. 7 shows a method of using a diode

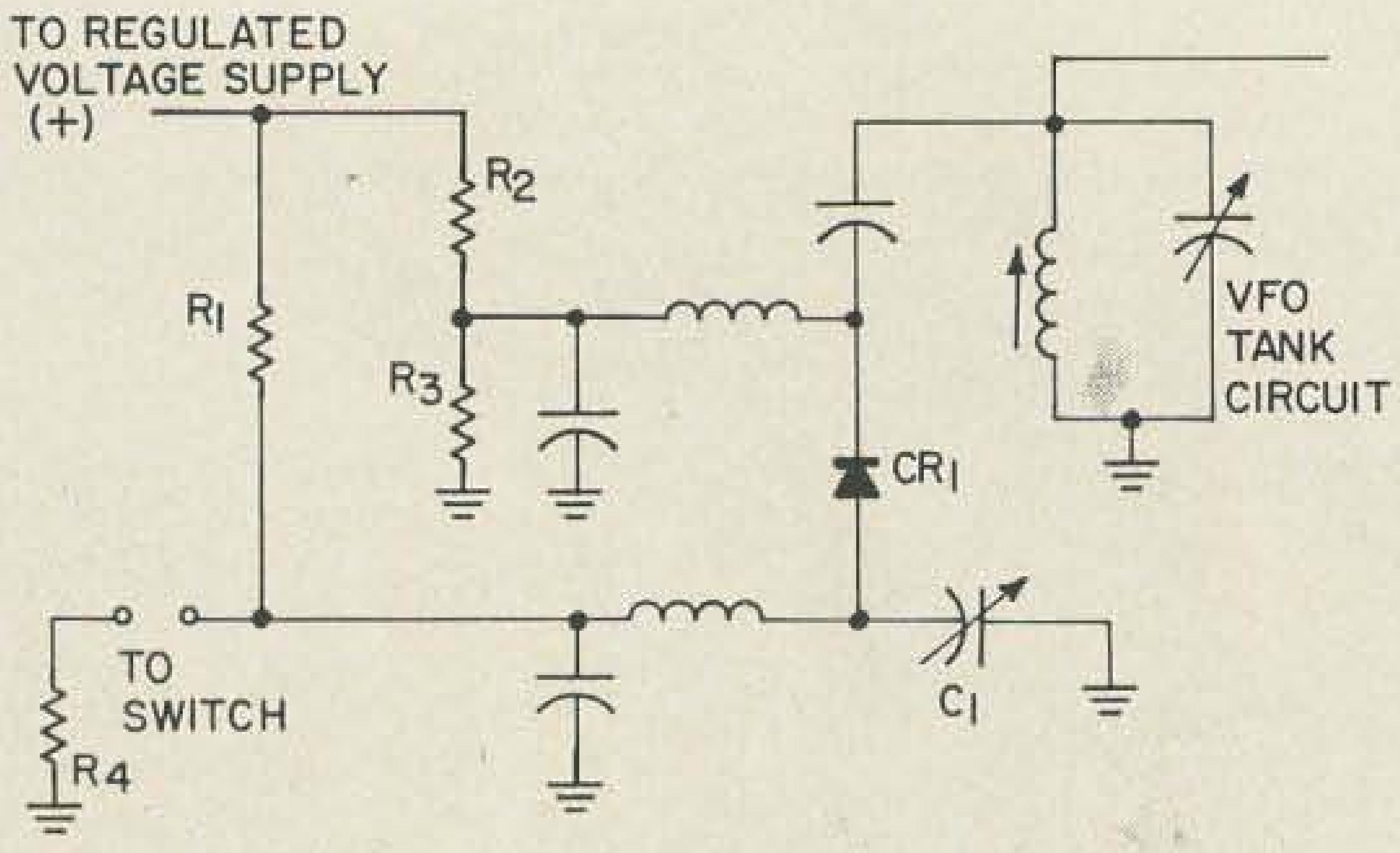
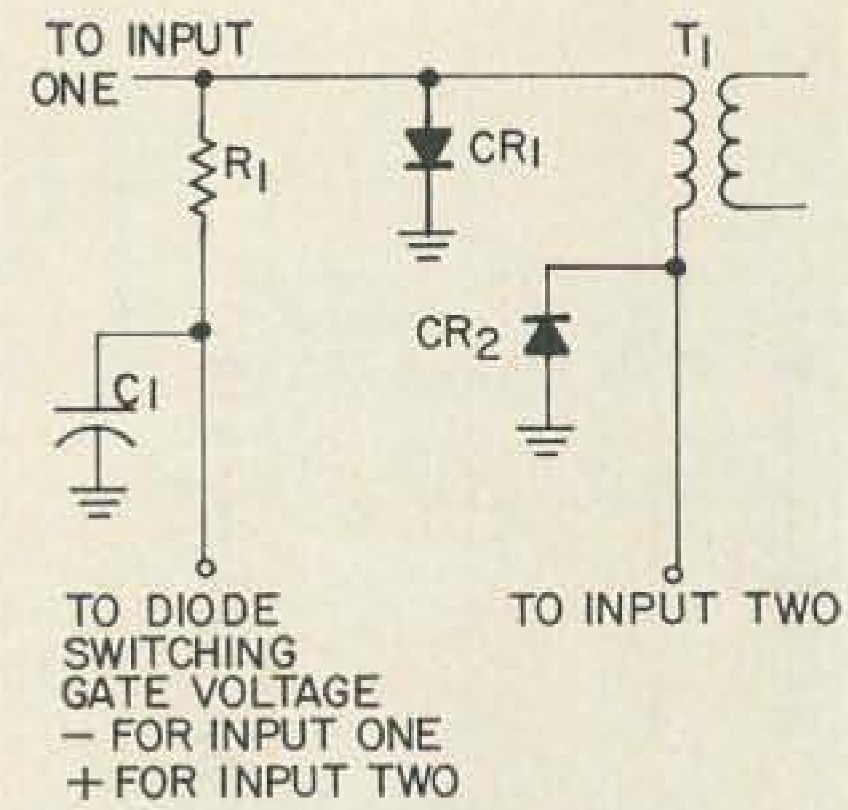


Fig. 7

switch to switch a capacitor across a vfo tank circuit to produce a frequency shift. Circuits similar to this one can be used to advantage for LSB-USB vfo dial correction in SSB transmitters or for FSKing for synchronous detection or RTTY. A regulated bias voltage which can easily be obtained with a zener regulator should be used in this instance because all diodes show a change in capacitance as their reverse bias changes. The values of R1, R2, R3, and R4 should be chosen for proper diode biasing and bias polarity reversal. It might be helpful to note that the biasing arrangement used here is identical to placing the switching diode across a Wheatstone Bridge composed of R1-R4. Capacitor C1 can be used to control the amount of frequency shift. Again, almost any good quality junk box diode may be used for CR1.

Fig. 8 is the diagram of a method for using diode switches to switch a transformer primary between two inputs. This circuit may readily be used for switching low level audio stages, for switching a receiver between various antennas or VHF converters, or for switching an *if* stage or a crystal filter. If transformer T1 happens to be a tuned transformer, it is recommended that trimmer capacitors be placed across both CR1 and CR2 to compensate for possible differences in the capacitance of each diode. If audio is being switched, R1 and C1 should be chosen to provide adequate decoupling without loading down "input #1" more than necessary. For rf or *if* stages, an rfc can be used in place of R1.

Fig. 8



Diode switching circuits are truly "cheap and easy." In practice it is possible to use just about any diode which is in reasonably good condition. This includes everything between crystal-set detectors and high power silicon rectifiers. The only requirement on the switching diode is that it be capable of conducting "forward" currents of two or three times the signal current and capable of withstanding an inverse voltage of two or three times the signal voltage. Other than this, the main thing to remember is that the diode bias resistors should be adjusted so that the bias current through the "ON" diode is not exceeded by the signal current and that the bias voltage across the "OFF" diode is not exceeded by the signal voltage. Switching gate lead filtering is not at all critical and bias supply regulation must be used only in special instances. Diode switches are readily adaptable to hundreds of different circuits in ham equipment. Next time you need something to switch low level ac, why not use one?

. . . K1SDX

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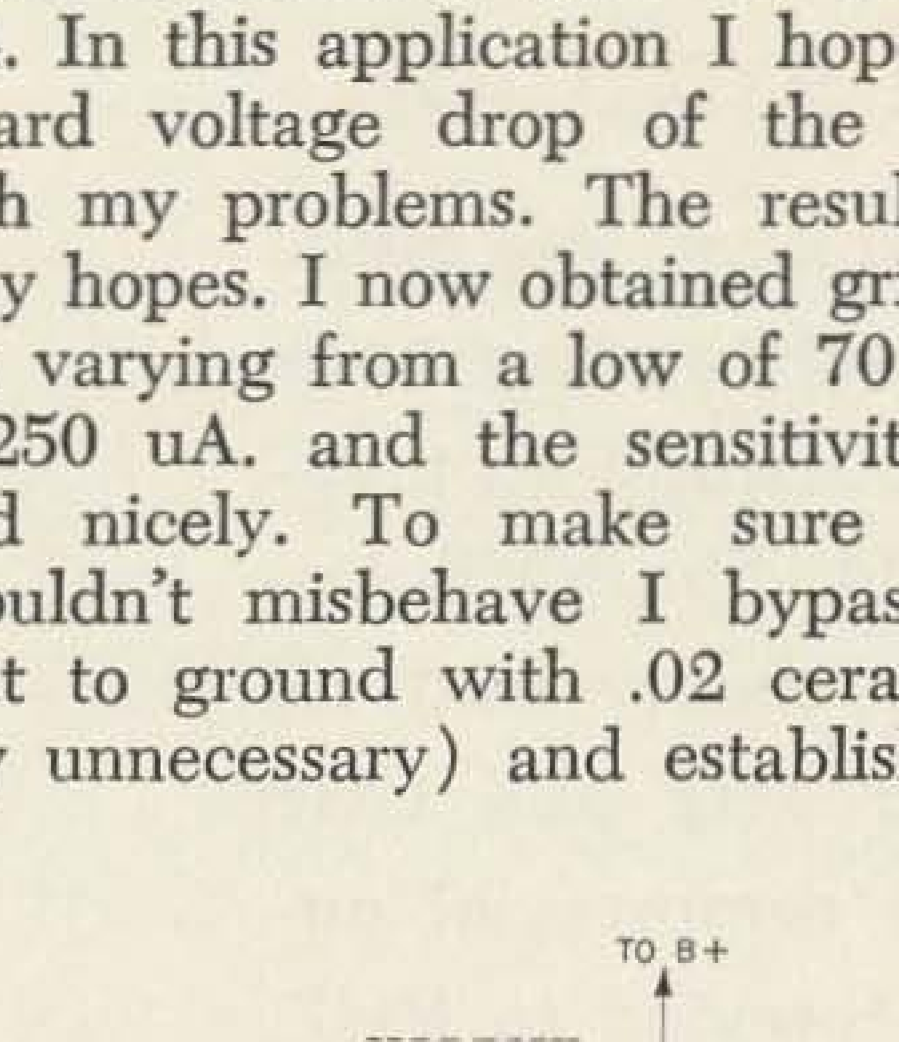
Improving the Paco GDO

I purchased the Paco G-14 grid dip meter in kit form about four months ago. I assembled it and found that it worked quite well on all but the highest frequency range (110-250 mc). There was very little indication of grid current over much of the tuning range. This was traced to a defective sensitivity control which left a small bias on the meter. When I shorted out the control I was able to get a usable reading, but now, I found so many spurious responses that the instrument was still of little use over this frequency range.

At this point it was back to the drawing board for a long look at the circuit diagram where a new problem became apparent. Even with the sensitivity control working properly the meter would be shunted with the 270 ohm resistor, R4, which would lower its sensitivity anyway. The problem was a twofold one. I had to kill the residual bias from the sensitivity control and also block the shunting action of the resistor, R4. I decided to insert a small silicon diode between the sensitivity control and R4 with its cathode towards R4. In this application I hoped to use the forward voltage drop of the diode to solve both my problems. The result far exceeded my hopes. I now obtained grid current indication varying from a low of 70 uA. to a high of 250 uA. and the sensitivity control functioned nicely. To make sure that the diode wouldn't misbehave I bypassed both sides of it to ground with .02 ceramic discs (probably unnecessary) and established a direct ground to the cover of the sensitivity control.



Partial Schematic of Paco G-15 grid dip meter. Added parts are enclosed by dotted line.

Now there were excellent meter readings but the many spurious dips throughout the tuning range left much to be desired. I examined the meter for possible clues. The most promising lay in the fact that the front end of the tuning capacitor rotor was grounded only by the ball bearings. The shaft extended through the chassis and connected to the large aluminum tuning dial. The top edge of the dial in turn was exposed to the plug in coil. I made a small wiping contact from spring brass and fastened one end under one of the condenser mounting screws. The other end was arranged to rub against the back side of the tuning dial. This proved to be the answer. There remained only a small dip at 190 mc and another small one at 250 mc. Both dips are smooth and so slight that they don't interfere with operation. Although one spring worked nicely, I placed two springs against the back of the dial and one against the capacitor shaft where it extends through the chassis.

With the electrical details corrected, I found that there remained a mechanical one. The plastic hairline indicator was threatening to wear away the graduations printed on the tuning dial. I solved this by cutting out a circular piece of thin, transparent plastic slightly smaller in diameter than the tuning dial. I clamped it between the hub and the tuning dial so that it rotates with the dial and takes the wear from the indicator.

I would also like to offer a suggestion to the manufacturer. The various coils supplied with the G-15 are very nicely color coded so that it would be much more logical and convenient to designate the corresponding bands numerically rather than alphabetically.

After making the changes outlined here, I have been very pleased with the performance of my G-15 and I hope others may do likewise. . . . K1AMN

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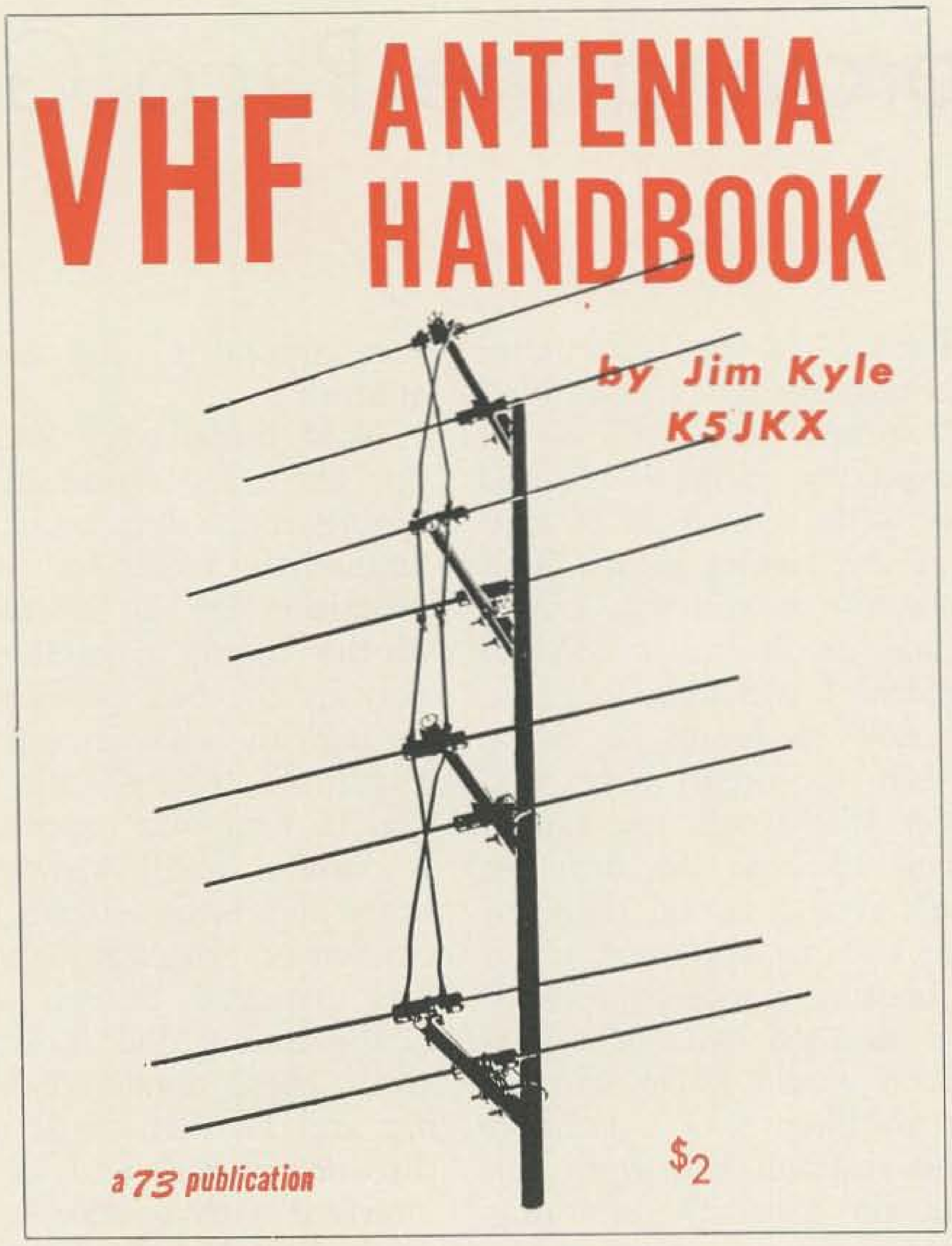

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Curing Distorted RTTY Patterns

The simplest means of tuning in a RTTY signal is with a scope. Most homebuilt converters obtain the mark and space signals directly from the toroid filters feeding the discriminator, similar to the circuit of Fig. 1. However, the main drawback in using this method is that the scope pattern is sometimes distorted as in Fig. 2-A and tuning is difficult.

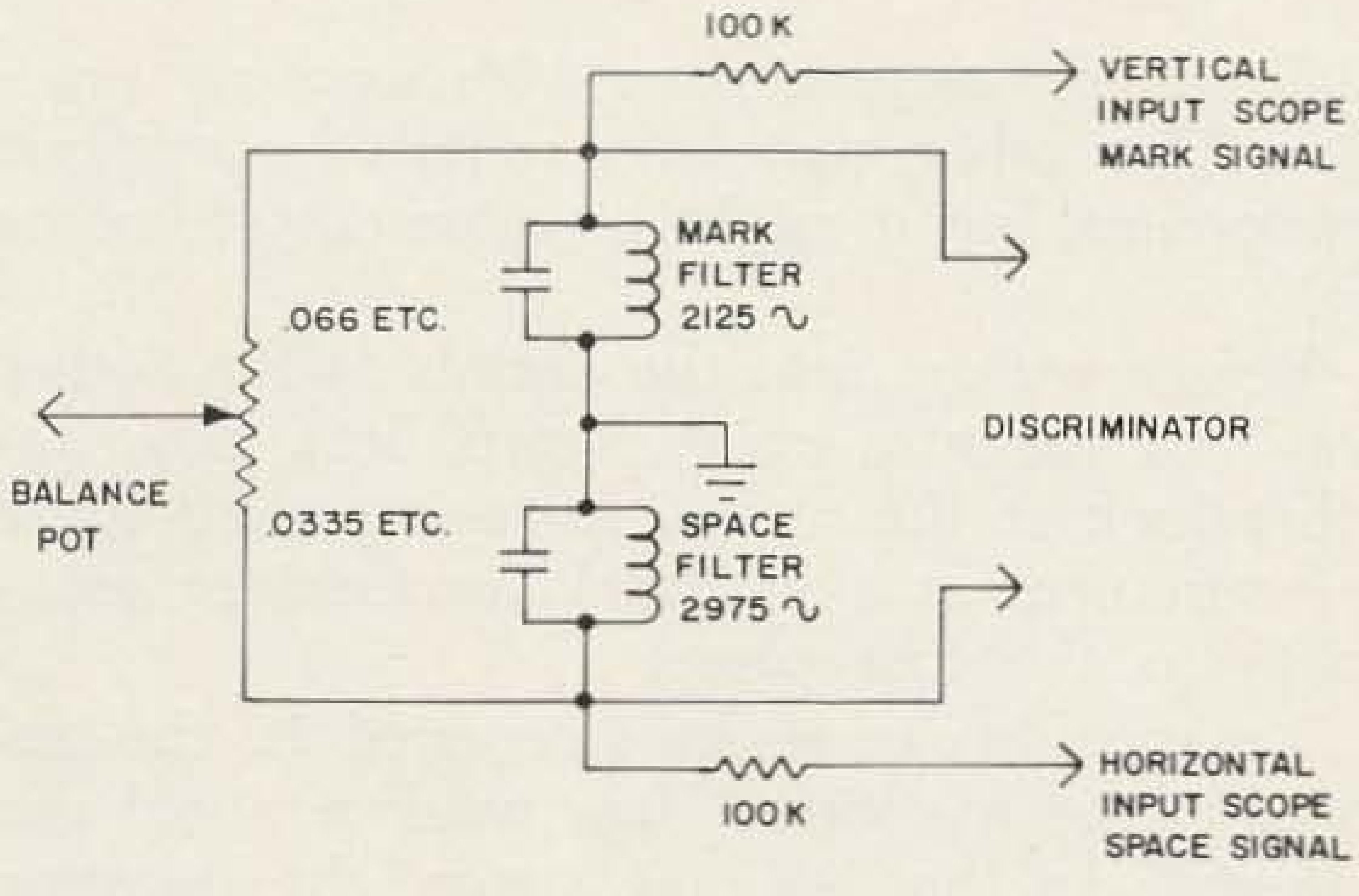


FIG. 1

If the converter is working properly an FSK signal will be only slightly elliptical, as in Fig. 2-B. In tuning in a mark or space signal the patterns should be similar to Fig. 3-A and 3-B.

The distortion can often be cured by putting two 100-K resistors in series with the toroid filters feeding the vertical and horizontal input of the scope.

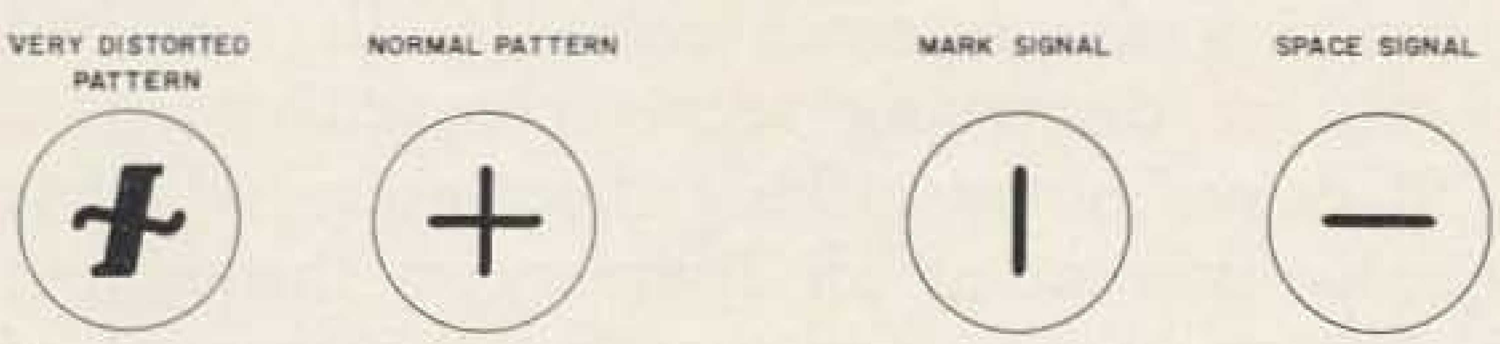


FIG. 2A FIG. 2B FIG. 3A FIG. 3B

Another cause can be ringing taking place somewhere in the unit as a result of poor layout of the converter. All circuits should be run in a straight line and under no condition should an input circuit be located close to its output circuit. Also—remember that aluminum is a poor shield where wiring is done close to power transformers, chokes, input transformers, and mark and space filters, so keep the low level circuits away from such hazards.

With care we can obtain the kind of performance stated in TU designs and our tuning becomes a pleasure with a clean scope pattern. BCNU on RTTY.

. . . K4GRY

Jim Kyle K5JKX
1236 NE 44th St.
Oklahoma City, Okla.

Another Way to Measure Noise Figure

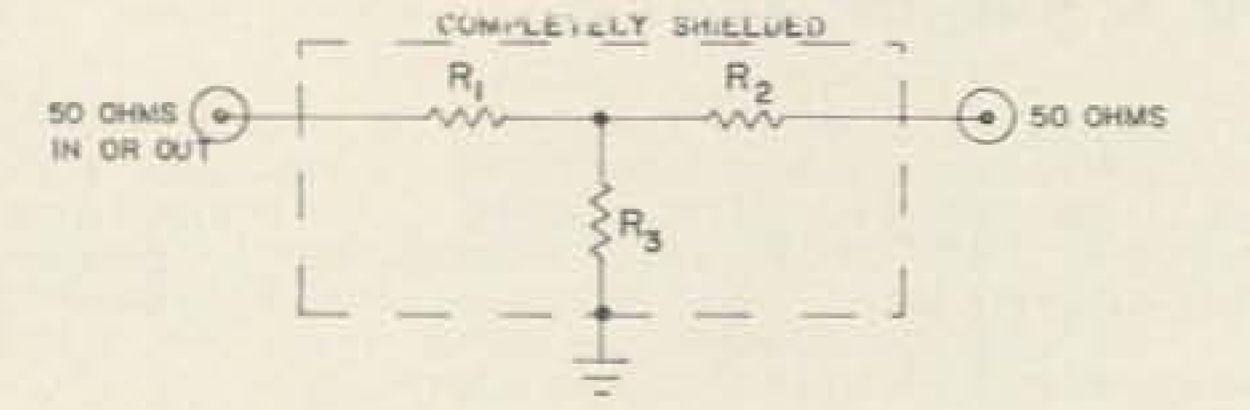
Many times it's been said, but it can always bear repeating. Noise figure is probably the least-well-known measurement in any amateur station.

At least a part of the difficulty with noise figure lies in the means usually employed to measure it. While it's not too difficult to figure out the power input to your final, or even the power *output* (often a surprisingly different figure), measurement of receiver noise figure tends to be a complicated and somewhat inaccurate process at best. It requires special equipment, and even then may be no more accurate than plus-or-minus 100 percent.

The classic means of measuring noise figure is to use a noise generator and crank in additional noise until receiver output is doubled. This means, of course, that the noise generator output is then exactly equal to the original noise, and if the noise-generator output is accurately known then the original noise is also known. All this has been gone into in detail in another article.

However, a noise generator with accurate calibration isn't so easy to come by, and an inaccurate noise generator doesn't do much good for measurement purposes (although it's fine for tune-up).

There *is* another way to do it, which is actually much more in line with amateur practice. This other way also requires some test equipment, but it might be more easy to come by.



DB Loss	R1, R2	R3
3	8.2	150
6	16	68
9	24	39
20	39	10

All resistors composition, ½ watt, 5%

Fig. 1. Construction of T-pads

Before we get into the details of the "other way" to measure noise figure, let's take another look at the reason for using noise-figure measurement as a yardstick for receiver sensitivity in the first place.

To start, we're really interested in the answer to the question "How weak a signal can I hear?" In the 3-30 mc range, the question can be answered directly—how many microvolts must the receiver have to give readable output?

As the vhf region is entered, though, the fractional microvolts become alarmingly small. Somebody figured out that most of the problem lay in the receiver's own internal noise, and came up with the idea of a "perfect" receiver which would have no noise at all. This is a noise figure of 0 db. Now by comparing existing receivers to this perfect ideal, and comparing the internal noise in db, we had a way of discussing receiver sensitivity.

Since we're now talking about noise, which is equally present at all frequencies throughout the spectrum, we can see that the amount of noise present in a receiver's output is at least partially determined by how much of the spectrum we are looking at. A broad receiver has more noise output than a narrow one, all other things being equal. If you don't believe it, fiddle with the selectivity switch on your own rig and listen to the change of noise output.

This dependence of noise on bandwidth is another reason for using noise figure as a comparison. The *actual* amount of noise is cancelled out in the comparison, leaving only the relative amounts of noise in the "perfect" receiver and the receiver under test to be measured.

When all this became established, nobody was paying much attention to receiver bandwidth and it was felt that a true determination of the effective noise bandwidth of a receiver was much more complicated than the comparison measurement. However, in these days of SSB and special filters, that's not so true any more.

As you may have guessed by now, the "other method" of determining noise figure depends on a microvolt measurement and knowledge of the receiver's effective noise bandwidth. The only reason for converting the results back to noise figure is to allow comparison with measurements made in the more conventional manner.

With typical ham measurement techniques, the results won't be of National-Bureau-of-Standards accuracy. However, if you're reasonably careful, results using this method will be at least comparable in accuracy to those made with a homebrew noise generator. Ready? Let's go:

You'll need two items of test equipment (only one if you're really lucky). These are an rf signal generator covering the desired frequency range on fundamental output, and an rf VTVM reasonably accurate at the desired frequency. If you have access to a "microvolter" or similar laboratory signal generator, you won't need the VTVM.

In addition, you'll need a whole handful of 50 ohm T-pads; these can easily be put together in a hurry by following the schematic in Fig. 1. You'll probably need about 8 20-db pads, as well as one each in 3-db, 6-db, and 12-db values.

Turn on both the receiver and the signal generator and let them warm up. For protection against any leakage from signal-generator to receiver through the power lines, it's best to supply them from separate circuits and to use a power-line filter such as that used to eliminate rf interference between the power line and the unit.

Connect a string of six 20-db pads to the signal-generator output as shown in Fig. 2, and adjust output of the signal generator to 0.1 volt. If you have a microvolter or equivalent, use only one 20-db pad and set generator output to 1 microvolt.

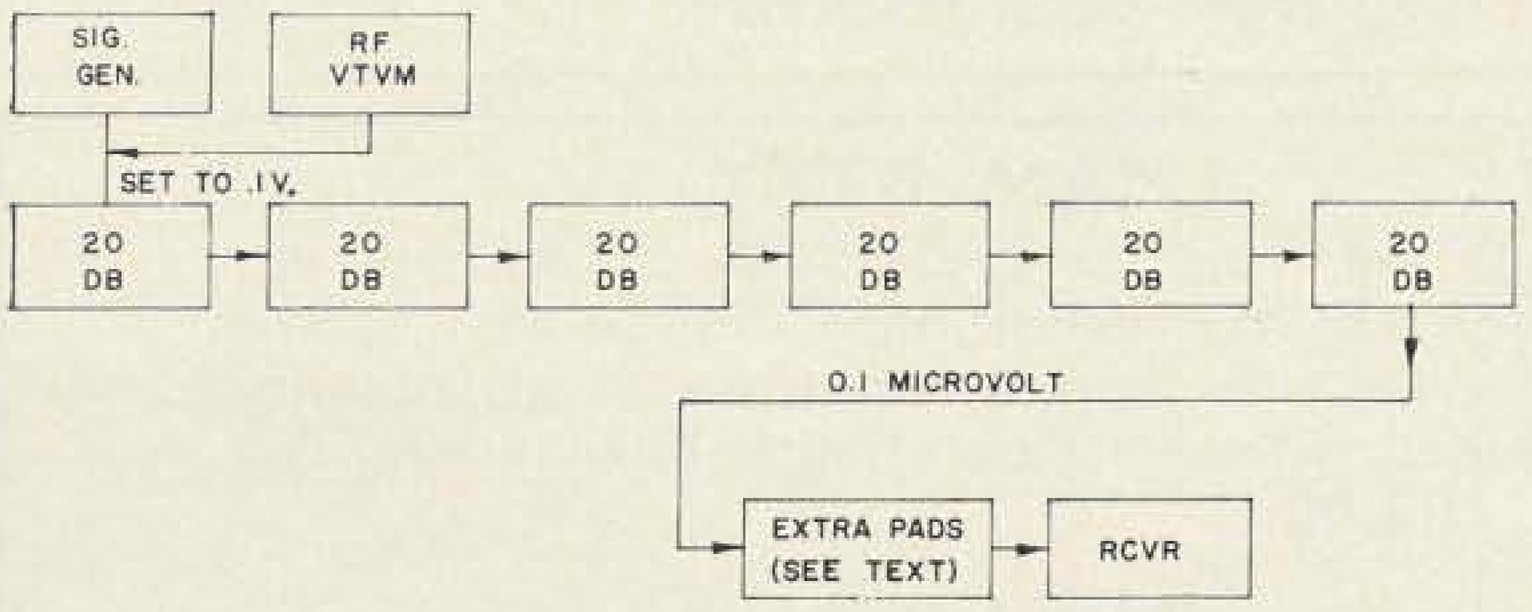


Fig. 2. Test set up.

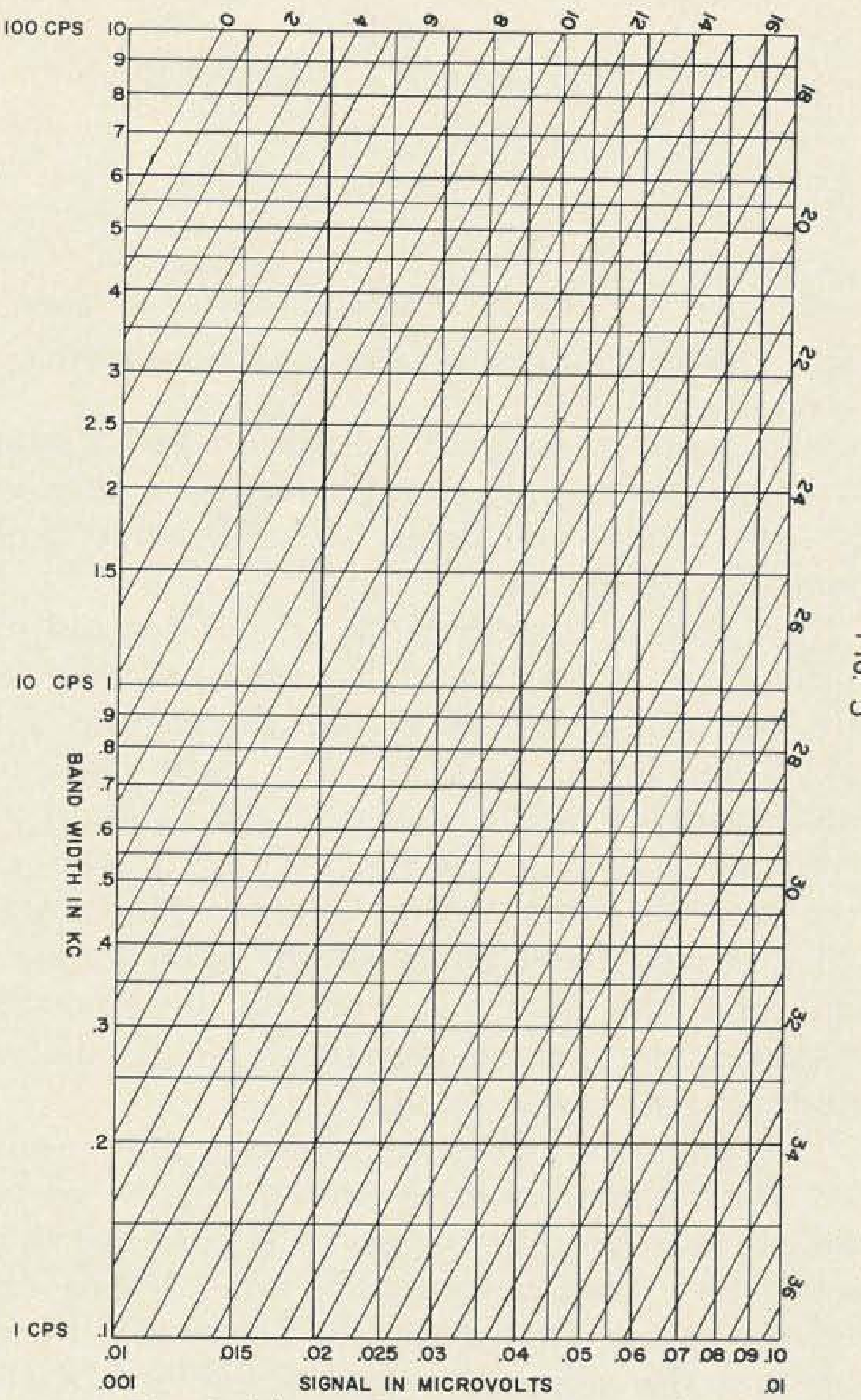


Fig. 3. Noise figure vs. microvolts.

In either event, the output of the final T-pad will be a 0.1 microvolt CW signal. This should be more than adequate for any reasonably-sensitive receiver to allow spotting of the signal.

Switch the receiver's avc off and the bfo on, and place the selectivity switch in any position for which the selectivity is accurately known. The selectivity marked on the front panel will not be the effective noise bandwidth, but you can use it as a starting point to guesstimate the noise bandwidth. If your receiver uses a mechanical filter or other device with approximately the same skirt selectivity, effective noise bandwidth will be about 1½ times the bandwidth marked on the front panel. If it is one of the older types with reasonably broad skirts, noise bandwidth will be about 3 times the marked value. Both these correction factors are approximate, of course; if you have any means of measuring effective noise bandwidth, use it instead.

For a start, use a fairly broad selectivity position; this requires more signal and makes things a bit easier.

Now tune in the signal from the generator,

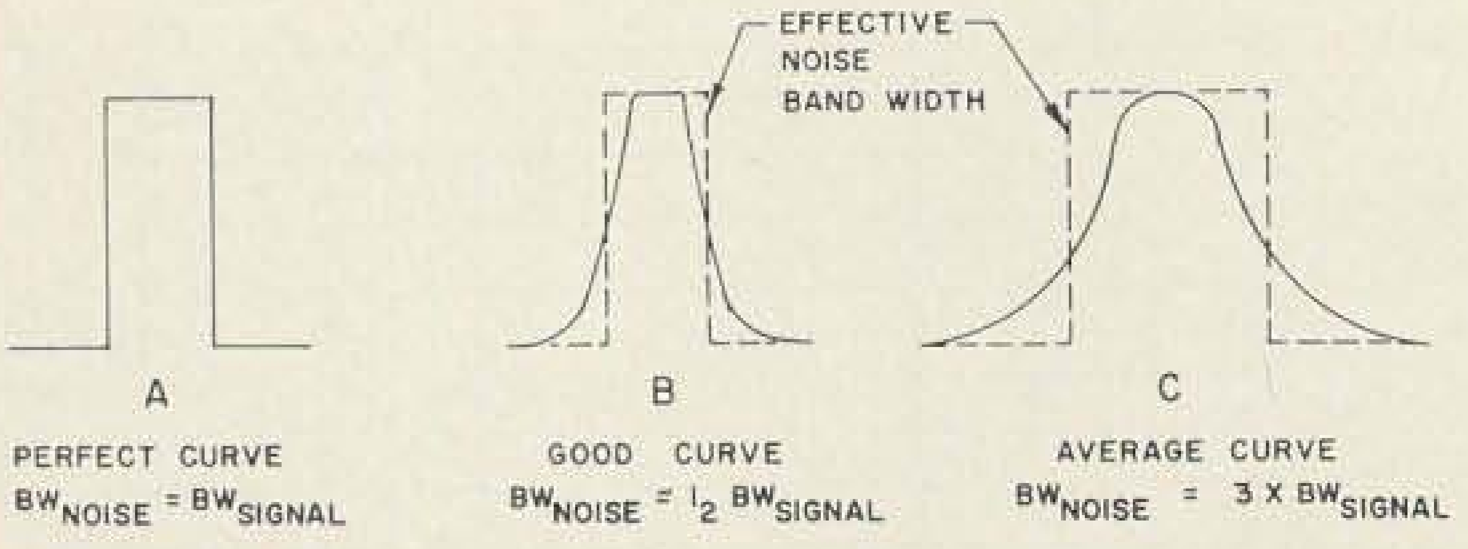


Fig. 4. Relation of noise and signal bandwidths.

leaving gain controls at maximum but tuning for maximum signal strength just as if it were the new state you need. The 0.1-microvolt signal should be easy to find.

Next step is to reduce the generator output by hooking in additional T-pads until you locate the point of "minimum discernible signal." The 3, 6, and 12 db pads may be hooked up in series in any combination to give you from 3 to 24 db additional attenuation in 3-db steps. Using another 20-db pad will give you from 20 to 44 db more attenuation, and the signal is sure to become too weak to copy before you reach 44 db below one-tenth of a microvolt!

The point of MDS is approximately equal to a 0-db signal-to-noise ratio for most of us, and is considerably easier to determine than would be a true output S/N ratio. When you find this point, record the db below 0.1 microvolt and the selectivity (in kilocycles) used.

Now switch to a different bandwidth on the receiver and repeat the test. Record its results also. For maximum accuracy, repeat each of the tests 10 to 12 times and average the result.

The signal level in microvolts corresponding to db below 0.1 microvolt is given in Table I. Locate it there and move to Fig. 3, the graph of signal versus bandwidth by noise figure.

Enter the graph from the side with effective noise bandwidth, and move across until you intersect the line corresponding to signal level in microvolts. The diagonal lines are noise figure; if one passes through the intersection point, read noise figure in db from it. If not, interpolate between the lines.

In reading Fig. 3, use the 10 kc-100 cps scale with the .01-.1 microvolt scale, and the 100 cps-1 cps scale with the .001-.01 microvolt scale. If your bandwidth-signal level combination falls off the graph to the left, use the *lower* signal-level scale with the *higher* bandwidth scale and subtract 20 db from the resulting noise figure.

In the happy event that all your errors (and our approximations) cancel out, you'll find the noise figure to be the same at both the narrow and the broad bandwidth positions. However, it's more likely that you'll measure different noise figures at different positions of the selectivity control. It's safest to take the highest noise figure measured as being closest to correct, but you can average them if you prefer. Either way, you will probably be within 1 db of the real figure—and this is as accurate as most noise-generator techniques can be, also.

That completes the measurement, but before we wind this up let's take a more detailed look at the idea of "effective noise bandwidth" which is such a key part of this measurement technique.

Most of us are familiar with the idea of a "perfect" curve for receiver selectivity such as that shown at A in Fig. 4. Here the receiver has equal response over the desired band, and response drops to zero at the band edge. Such a curve is said to have a shape factor of 1, and is of course impossible to achieve in practice.

Now back to noise; it's spread out equally over the spectrum. A noise bandwidth of 1000 cycles per second contains 10 times as much noise as one of 100 cps. Thus "noise bandwidth" inherently has a shape factor of 1.

Since such a shape factor is impossible to achieve, it follows that "noise bandwidth" and actual receiver bandwidth must differ. If receiver bandwidth is measured at the —60 db points, the noise bandwidth will always be smaller than this receiver bandwidth. If receiver bandwidth is measured at the points where response drops 1 db below peak, the noise bandwidth will always be greater.

The mathematical expression for noise bandwidth is an integral equation involving differential gain, which is a cumbersome thing to solve. In general, the noise bandwidth of a receiver is said to be approximately equal to the bandwidth between points which are 3 db down from peak response.

db BELOW 0.1 MICROVOLT	MICROVOLTS
3	.07
6	.05
9	.035
12	.025
15	.018
18	.013
20	.01
21	.009
23	.007
24	.0063
26	.005
29	.0035
32	.0025
35	.0018
38	.0013
41	.0009

Table I.

In practice, if the shape factor (6 to 60 db) of the receiver is 2, the effective noise bandwidth will be approximately 1.3 times the 6-db bandwidth. If shape factor is between 2 and 10, noise bandwidth will be approximately equal to the square root of the shape factor (6 to 60 db) times the 6-db bandwidth. Few receivers have shape factors greater than 10.

The approximations quoted earlier (1.5 times marked bandwidth for SSB-selectivity receivers, 3 times marked bandwidth for others) are based on these relations. If you're really interested in calibrating your receiver's noise bandwidth for using this measurement technique, however, you might take a converter and have it measured for noise figure by the generator technique, then run this technique backwards to determine the effective noise bandwidth of your receiver in each position of the selectivity control.

The technique described here, incidentally, assumes that no audio filters are used following the detector. If they are, all results are off, since the effective noise bandwidth will have been changed in an unpredictable manner by the audio filters.

However, you can remove the audio filters from the hookup for measurement purposes, determine noise figure, then return the audio filters to the circuit and run the measurement backward to find out your effective noise bandwidth with filters present. Don't be surprised if it comes out in the region from 1 to 10 cycles per second; a good audio filter can work wonders with weak-signal reception.

For additional details on this technique of measuring noise figure, you can consult Reference Data for Radio Engineers, 4th edition, published by IT&T and available from Radio Bookshop, or any good radar text.

. . . K5JKX

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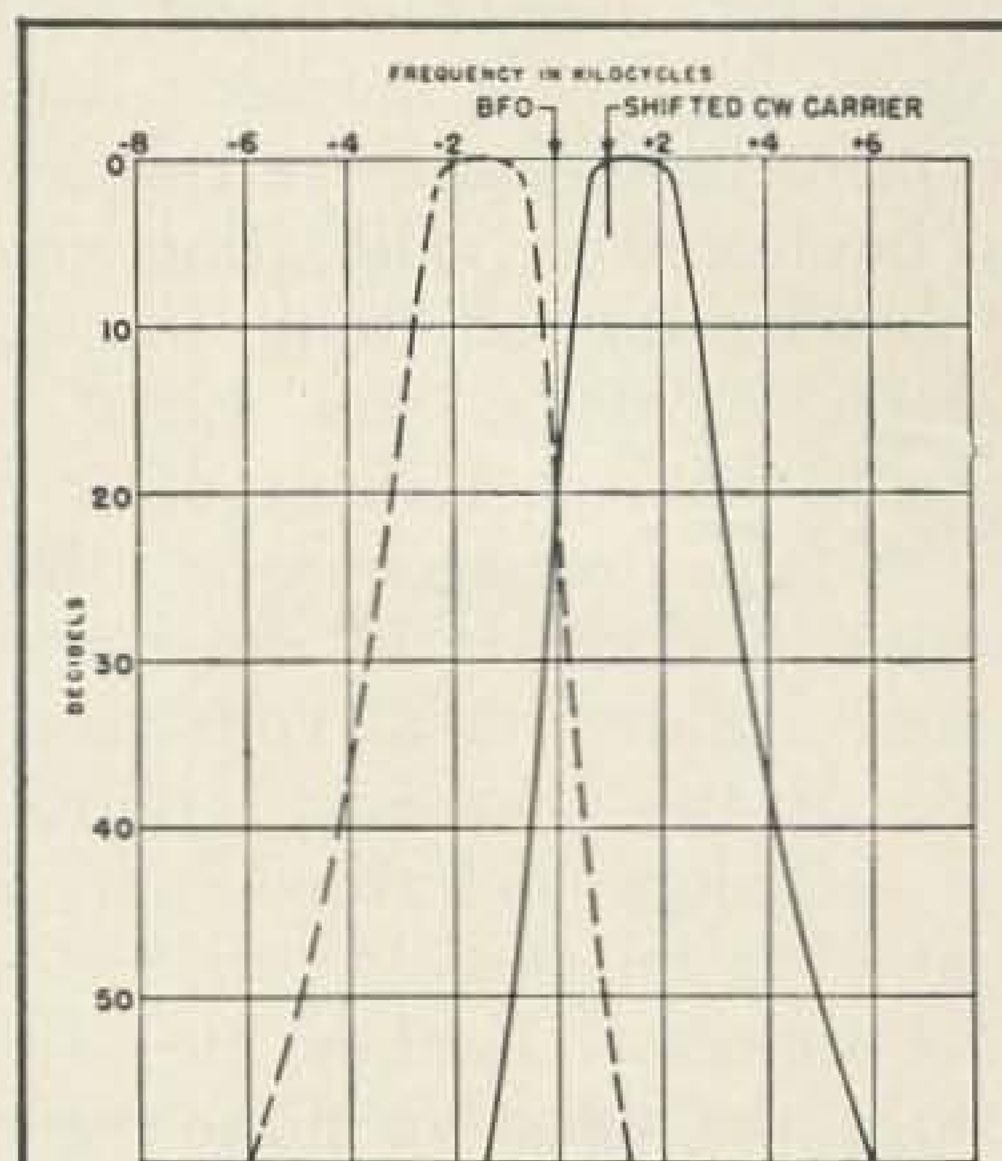

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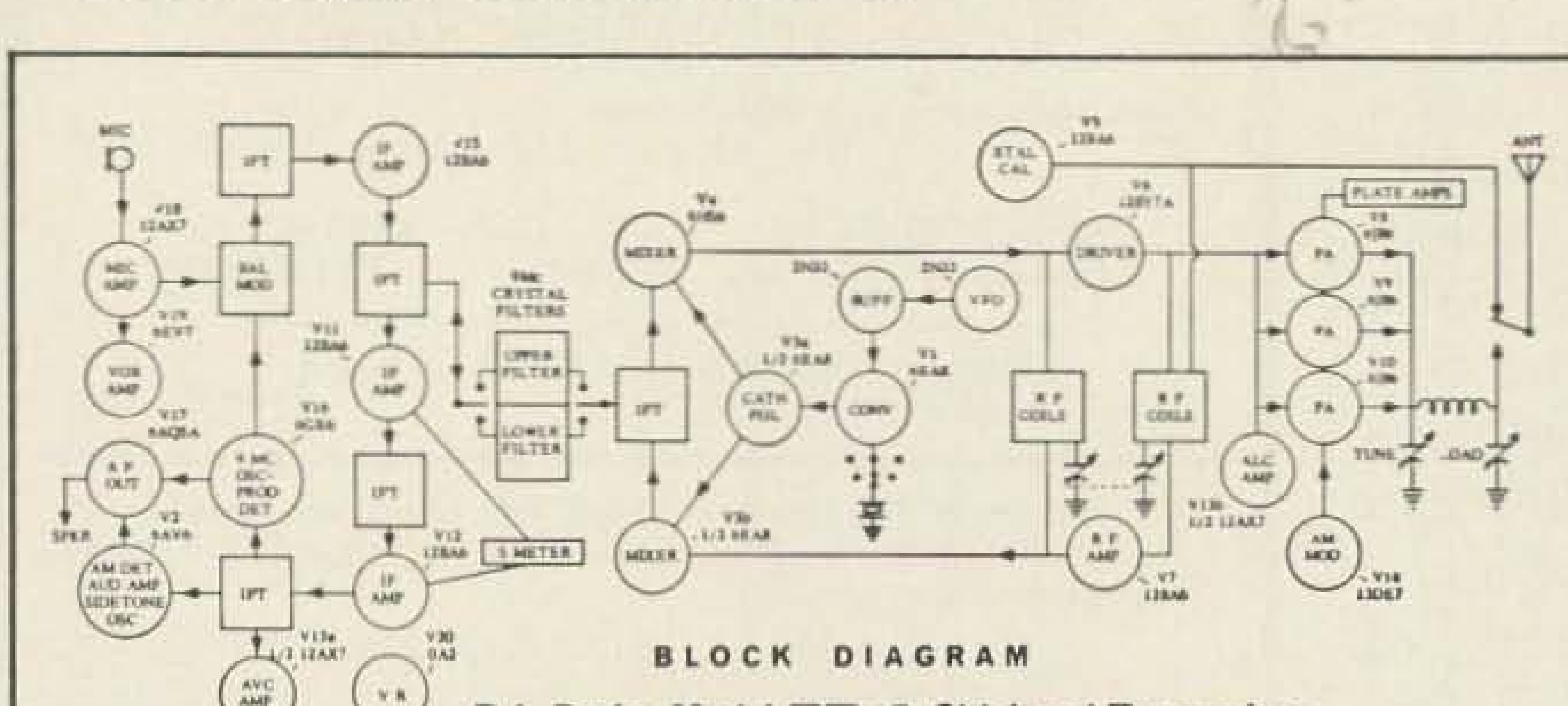

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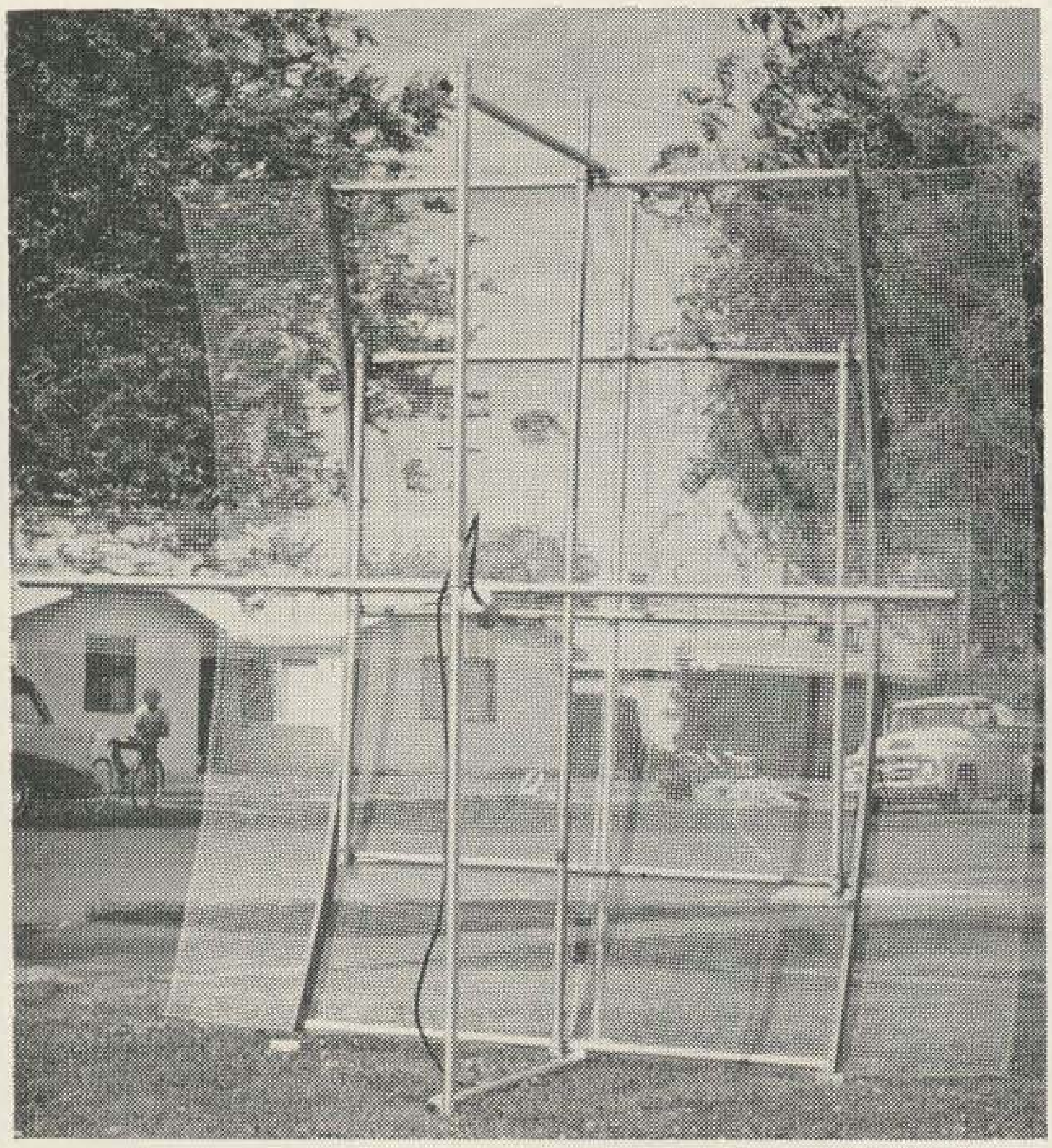


Photos by Joe De Young WA6CQL

Jim Kennedy K6MIO
2816 E. Norwich
Fresno 26, Calif.

The Big Sail

The Ultimate for 70 Cm.

The 432 Mc band has over the years, offered a fertile proving ground for antenna designs. However, building antennas for 432 involves some considerations and problems that are not evident at lower frequencies.

The close tolerances required by parasitic arrays such as the yagi become difficult to handle. Designs that work well at 144 Mc give very disappointing performance when scaled down to 432.

In many cases, the failure of such yagi layouts is the fact that the antennas are built "according to the book" and not on a test stand where the various parameters can be varied to compensate for factors the "book" failed to take into account.

However, even with yagis which have apparently been tuned properly, there are stories in circulation about antennas which showed good patterns but poor gain, though why this would be I don't know.

In any case, the yagi, even if working properly, is a delicate beast and suffers from rather severe bandwidth limitations.

True, if operation on 432.000 ± 3 Mc is all that is desired, then the 6 to 7 Mc bandwidth of the yagi would be acceptable—assuming you could get your antenna to peak on the *right* six megacycles. If TV or some other broadband operation is desired, even a working yagi leaves something to be desired.

Various types of colinear—broadside arrays can be made to perform quite well. The extended, expanded H arrays can and do deliver about 15 db of gain while 32 element

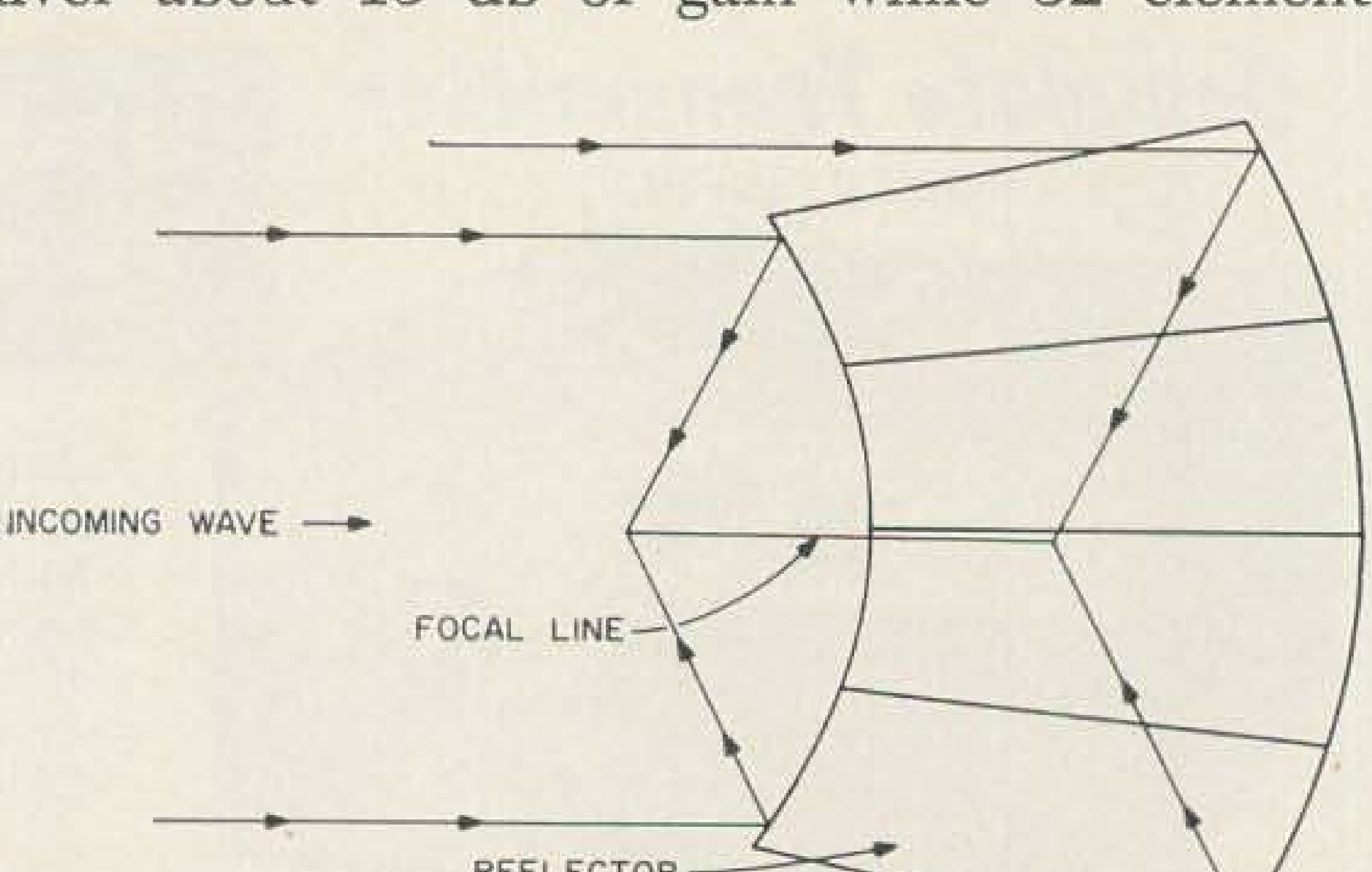
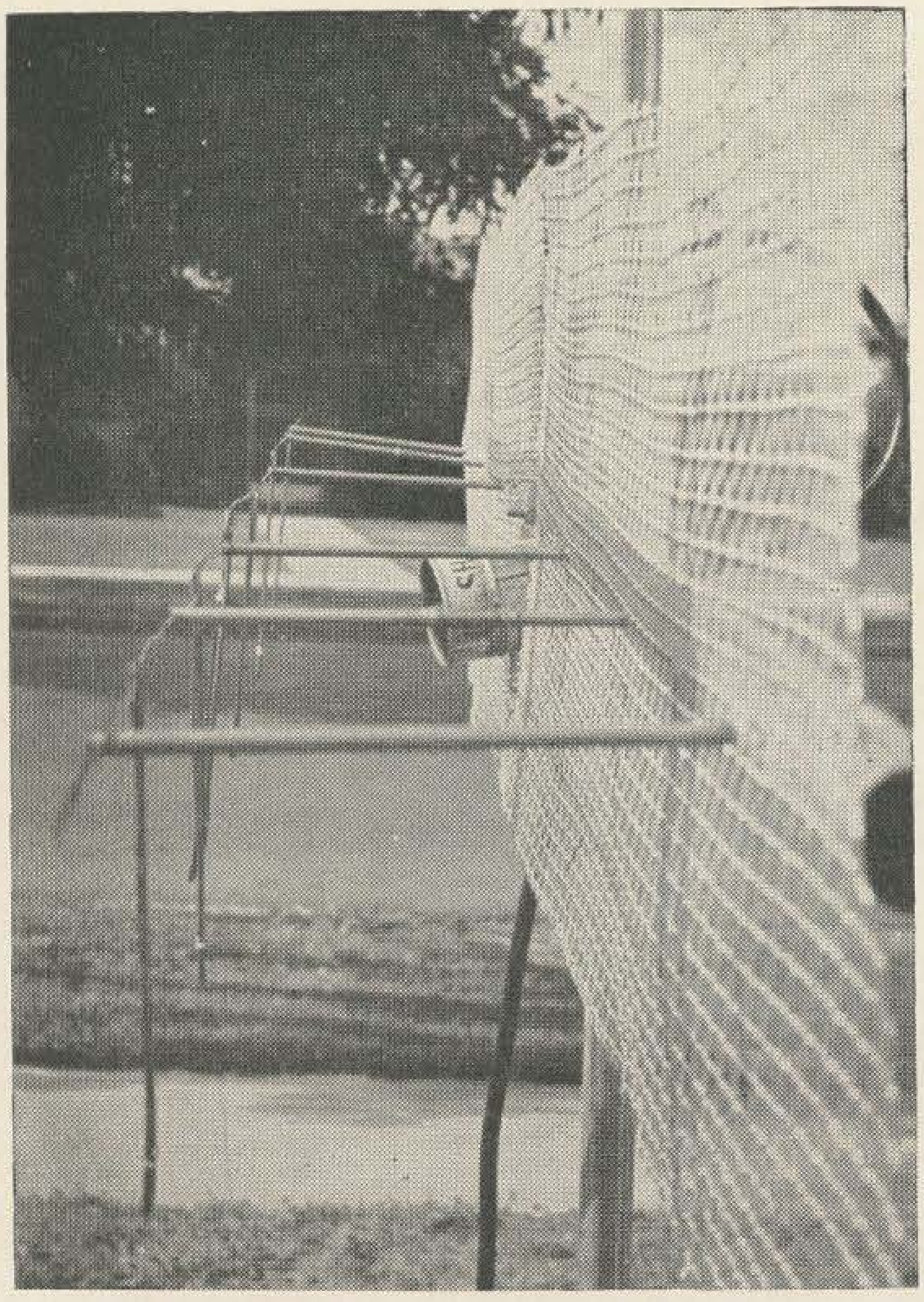


Fig. 1. Focus action of the cylindrical parabola.



Side view of collinear feed.

units have been measured at over 17 db.

Though they are much easier to make work than the yagi, the large colinears have one drawback in common with the yagi and any other multi-element array—the more elements, the higher the Q and the narrower the bandwidth. Unlike the yagi, you can reliably increase the gain of the colinear by adding elements. However, the bandwidth will be reduced, though it is difficult to say to what precise figure.

When it was decided to build some sort of "ultimate" antenna for 432, several basic requirements were established. It was concluded that the antenna should have a minimum honest gain of 18 db referenced to a dipole, the widest bandwidth possible up to the limit of the band edges; and electrical and mechanical simplicity that would guarantee ease of tune up and reliability of operation.

The yagis were immediatly discounted on the basis of a number of previously unsatisfactory experiments.

The collinear broadside was given considerable thought but the idea was set aside on the basis of the feed harness nightmare involved in feeding what would have to be a minimum of 64 elements.

The high gain, broad bandwidth requirement suggested a parabolic dish. Certainly nothing could be much simpler to feed than a single dipole and the reliability of the antenna should be considerably higher than any of the other types considered.

However, the conventional dish (paraboloid of revolution) is mechanically difficult to construct. The curve in two planes makes it difficult to get a smooth surface on the dish without considerable trouble.

Another, less familiar, form of the paraboloid reflector—the parabolic sheet or cylindrical parabola—was then studied. This is merely a sheet of reflecting material bent into a parabolic shape in one plane only. Mechanically, such a device is very easy to construct with simple tools and a minimum of expense.

As has probably occurred to many readers, the sheet parabola has a distinct electrical difference from the dish parabola, that is, its focus is not a point, but, rather, a line, as diagramed in **Fig. 1.** In order to extract the maximum amount of energy incident on the reflector, it is necessary to place an energy extractor (antenna) all the way along this focus line. Some sort of simple colinear or broadside configuration would seem ideal depending on whatever other considerations might arise.

The original gain requirement put forth was 18 db. A quick investigation of some antenna charts shows that a 9 foot circular dish would provide just about 18 db computed by radar formula. The area of a 9 foot circular dish is 63.6 square feet. A square parabolic sheet 8 feet on a side has an area of 64 square feet and should, if properly fed, produce about the same gain. The approach seemed to hold considerable promise and it was decided to build such an antenna and give it a try.

One of the first problems was the choosing of the focal length of the dish. In order to minimize electrical coupling between the reflector and the driven element, it is desirable to use a focal length of several wave lengths with all parabolic reflectors. Though a little short, a focal length of 4 feet—2 wave lengths— was settled upon. In order to operate properly at 432 Mc it is necessary that the "peak to peak" deviation of the dish surface from the true paraboloid shape not exceed 1/8 wave length or about 1½ inches. This is necessary, if the performance is not to be degraded by phase cancellation. This tolerence is very easy to maintain. In fact, the tolerence achieved on the sheet was better than ½ inch by a fair amount and no extrordinary care was necessary. The reflector itself would be quite satisfactory for 1296 Mc (and have about 28 db gain, but that's another story).

Reflector

Table 1 shows the measurements of the parabola at 6 inch intervals each side of the center. **Fig. 2** shows how these were laid out and marked on a sheet of 5/8 inch plywood eight feet long and 24 inches wide.

Several 10 foot lengths of inexpensive TV mast were obtained and four of them were cut in half, yielding eight pieces 5 feet long. Five of these pieces will, with the plywood slats, be used as the basic framework for the reflector surface. The mast should be of some material other than alumimum.

The mast tubing pieces are attached to the plywood at equal intervals by placing a 10 - 32 screw through the tubing about one inch from each end. The eye of a two inch eye bolt is threaded onto the 10 - 32 screw inside the tubing as the screw is placed through the tubing. The threaded portion of the eye bolt should then extend about one inch from the end of the tubing.

The eye bolts are then inserted into holes drilled into the plywood slats and held in place with a nut and large flat washer on the other side.

The mast pieces are attached so that their back edges are just flush with the back edges of plywood slats. This is necessary because the reflecting surface, when attached, will be applied to the back side of the framework and both the slats and the masts will be used to anchor the surface.

In order to minimize any twisting or skewing of the antenna two 5 foot masts are attached across the second and fourth masts in the framework next to the slats with TV antenna U clamps. This adds considerably to the rigidity of the antenna.

The next requirement will be about a 19 ft. length of 4 foot wide ½ inch mesh hardware cloth. This length is cut in half and the two 9½ foot pieces are laid side by side and tied together with tinned copper wire. The lacings should be soldered to the mesh to assure good electrical connection and mechanical stability, though this can be done later, if desired.

The framework should be laid on the ground, face down, and the mesh should be laid across it so that the seam in the mesh runs along the long dimension of the framework. Place the mesh so that one end comes flush with the tubing at the top (or bottom) of the framework. Tinned copper wire is then used to attach the mesh to the framework. The mesh should be pulled tight and it should be attached starting at one end (top or bottom) and proceeding to the other end.

When the mesh is attached there should be something more than a foot of hardware cloth left over at one end. This should be cut off and saved; it will be used later. The mesh can now be spot soldered to the tubing with a propane torch to insure that it is firmly in place.

The mesh will overlap the narrow dimension of framework by 1½ feet on each side. The corners of the mesh have a tendency to curl because of the lack of support. This can be corrected in a number of ways. One way which works quite well is to reinforce the top and bottom edges of the mesh by running 2 foot lengths of brazing rod along each side of the top and bottom masts in the frameworks. They are extended 1½ feet past the ends of the masts and soldered to both the mesh and the masts.

This procedure will add considerably to the rigidity of the corners of the mesh.

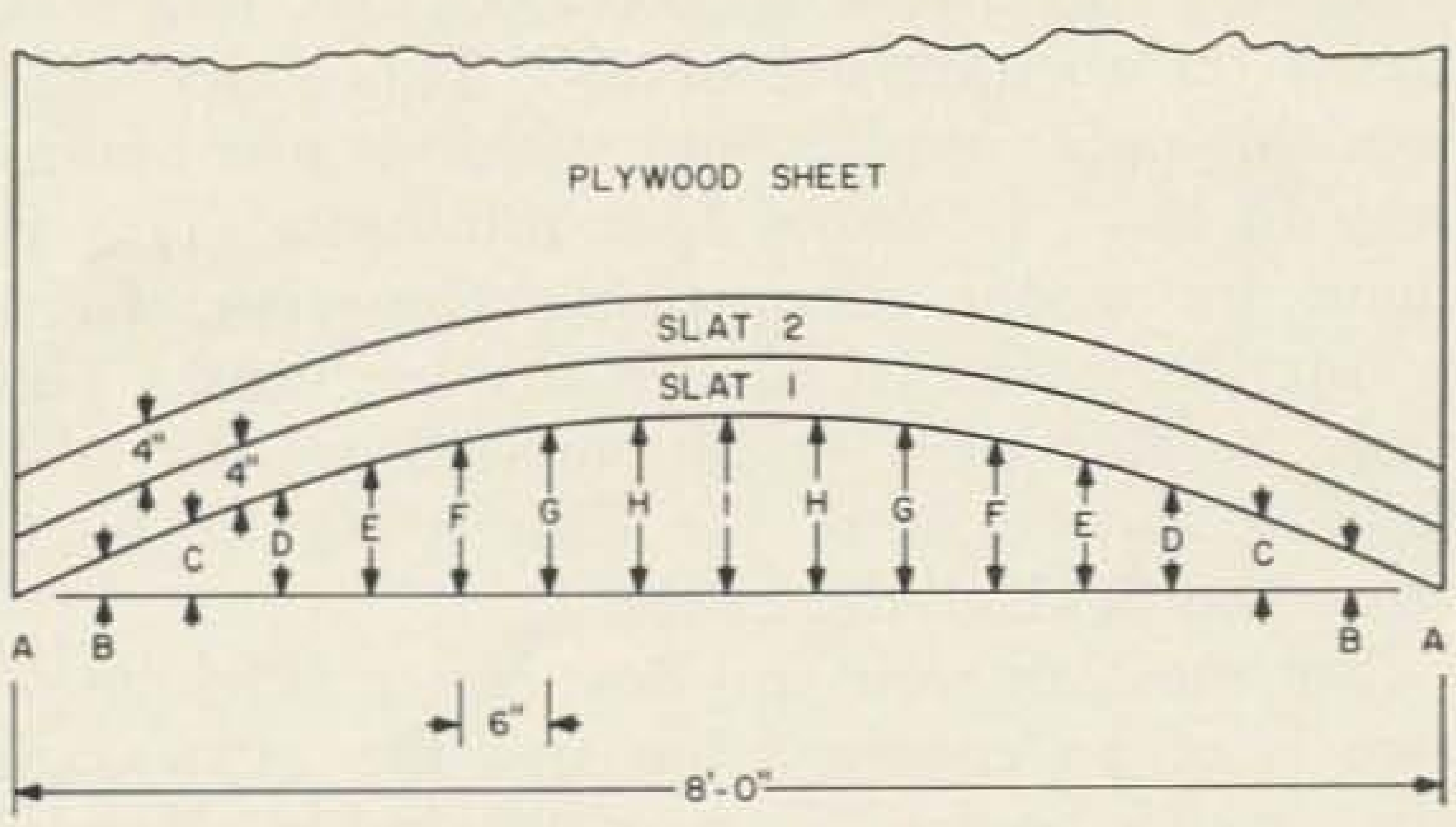
Several coats of lacquer applied to the plywood slats will help protect the wood from the elements.

Driven Array

The reflector now being essentially finished the next problem is to feed it properly. Some sort of an array must be constructed to extract energy from the focus line of the reflector.

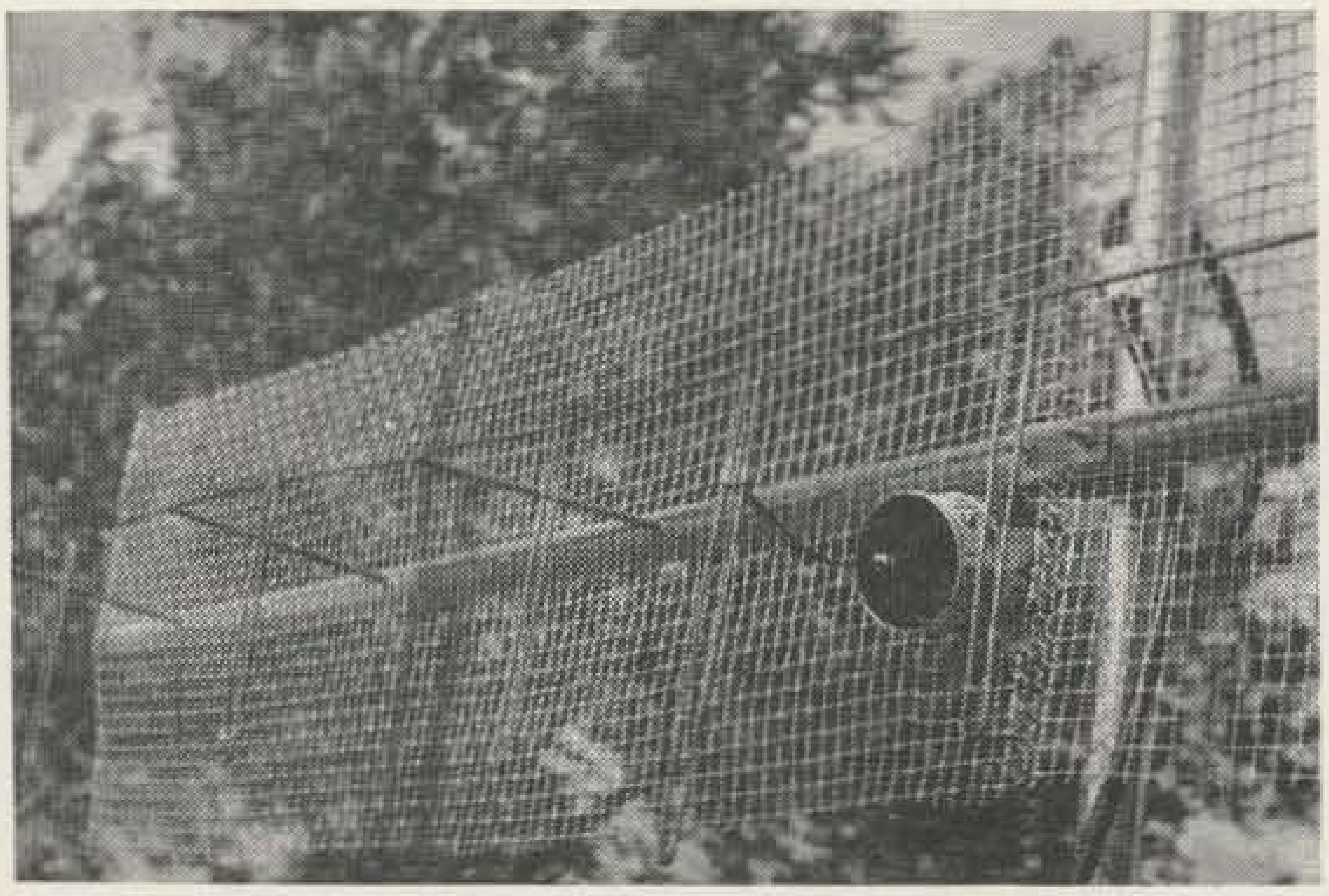
At this point it might be well to digress from the construction discussion and consider some of the theoretical aspects of feeding a parabolic reflector.

The basic problem in feeding the dish is



A	0"
B	2-13/16"
C	5-1/4"
D	7-5/16"
E	9"
F	10-5/16"
G	11-1/4"
H	11-13/16"
I	1'-0"

Fig. 2. Plywood layout. Table I. Values for parabolic curve.



Detail of balun.

one of illumination. That is, placing the energy on the dish surface in the most efficient fashion. The field pattern of the driven element (or array, as the case may be) should be such that a maximum amount of energy is directed at the largest possible amount of reflector surface. If the pattern of the driven element is too broad, then excessive amounts of energy will miss the dish entirely and be wasted. If, on the other hand, the pattern is too narrow, the full width of the reflector is not used and gain is therefore lost; the effect is the same as using a smaller dish to start with.

It is because of the necessity of a compromise between these two somewhat conflicting factors that the effective aperture or capture area of dish is always smaller than the physical area of the dish. Values of 0.5 to 0.7 are typical.

Several of the handbooks consulted indicated that the gain of a 9 ft dish was about 18 db. Some neglected to mention that this was based on an aperture of .55. This value was used for radar applications where it was necessary to limit sidelobes to a minimum. This is done by under illuminating the dish. Gain is sacrificed but sidelobes are reduced. The dish, in this case, is illuminated so that the field at the edges of the dish is 10 db down from the field at the center.

For most amateur applications, a sidelobe or two is of no consequence and the extra gain that could be had is most desirable. Hence, rather then feed the dish with the radar pattern—to the 10 db points of the feeder pattern—the dish should be fed for maximum gain. This requires that the dish be fed with the feeder pattern to about the 3 db points. This will result in maximum gain and an effective aperture of about 0.7.

The final result is a gain of not 18 db but closer to 19.3 db with reference to a dipole or about 21.5 db with reference to an isotropic radiator.

This discussion of illumination has been primarily concerned with the paraboloid of revolution. It is, however, likewise true of the parabolic plane of the parabolic sheet.

A little geometry will reveal that the 3 db beam width of the feeder in the parabolic plane should be in the neighborhood of 110 degrees.

This pattern will be compressed considerably by the parabolic shape of the reflector and the reflector will, by this compression, produce the final beam width of the sheet in the parabolic plane.

In the other plane, the "flat" or non parabolic plane, the feed should simply exist all along the focus, whatever beamwidth the feed itself has will simply be reflected by the sheet and will become the final beam width of the sheet in the flat plane.

The feed array which seemed most likely to satisfy these requirements was a seven element series fed collinear. This is, in essence, a string of dipoles laid end to end and end fed, in phase, by a series of half wave delay lines (quarter wave shorted stubs).

This type of array has several good points. The series feeding system elliminates the necessity of the usual feed harness, it allows very simple adjustment of the dipole phasing for optimum gain and it virtually elliminates the necessity of insulators and allows rigid all metal construction.

Fig. 3 shows the various dimensions of the array. The array is bent from a single piece of #10 soft drawn solid copper wire.

The dipoles are supported at their centers on the ends of ¼ inch brass tubes. The tubes are mounted in quarter inch holes through an 8 foot long piece of TV mast. The lengths of the brass tubes should be such that the dipoles are supported ¼ wave—6 3/8 inches—from the front edge of the mast.

After the tubes have been attached to the mast but before the dipoles are added, a piece of the left over hardware cloth 8 feet

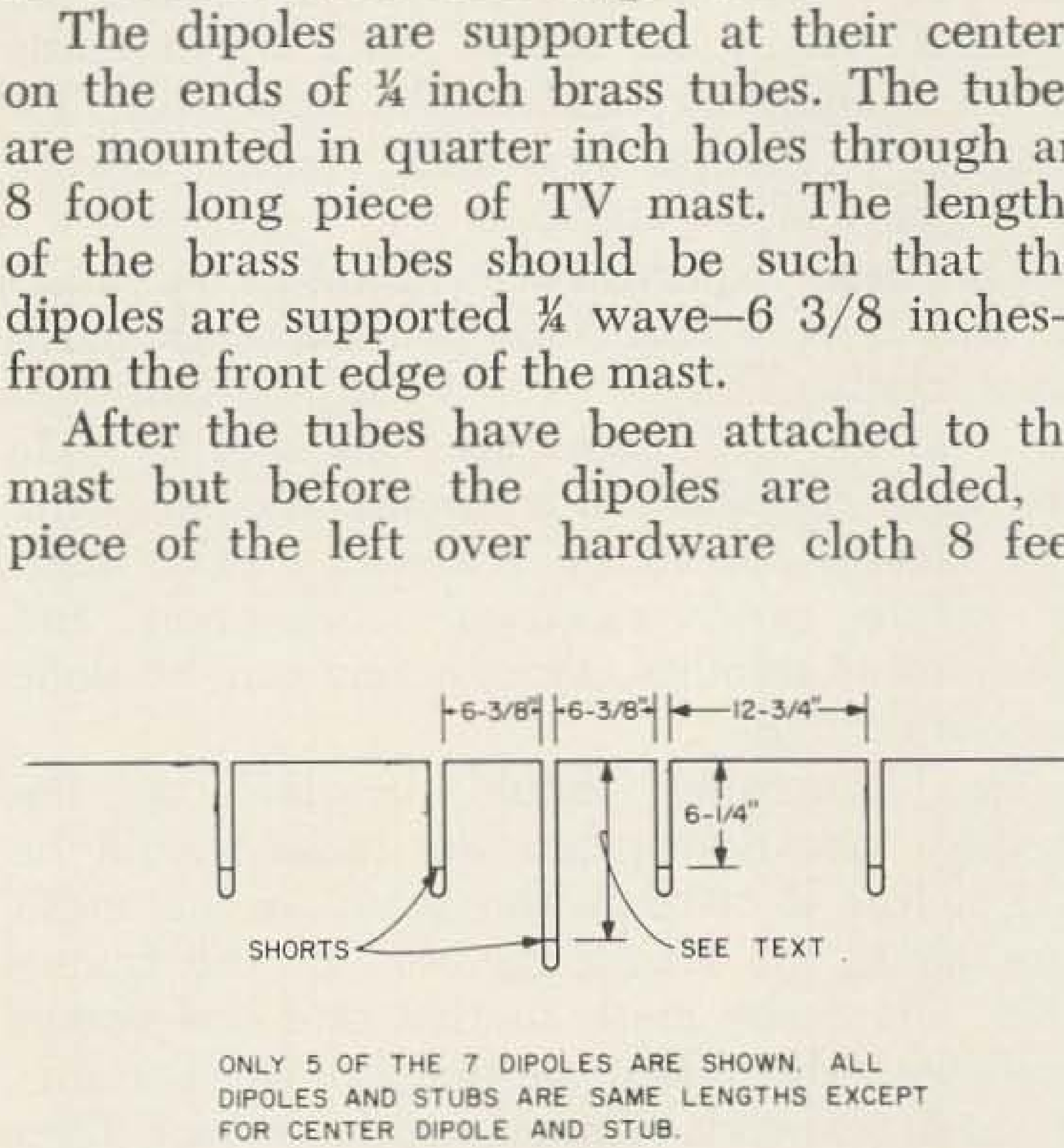


Fig. 3. 432 Mc collinear dimensions.

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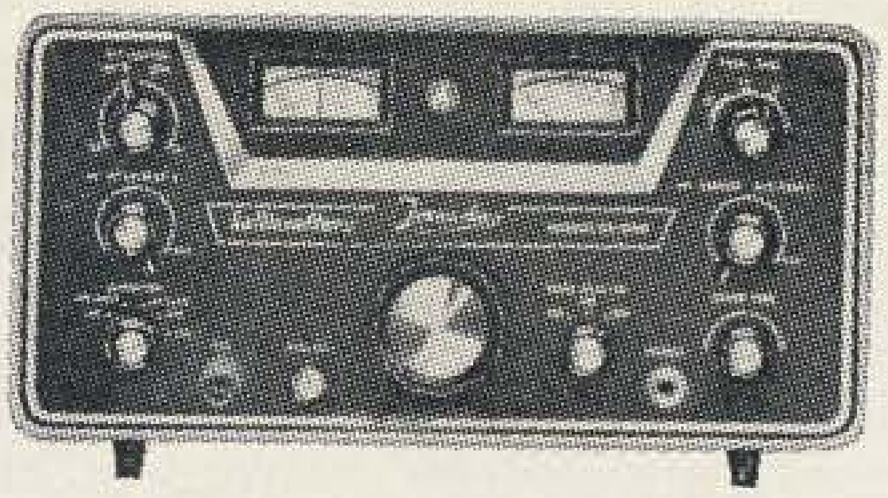

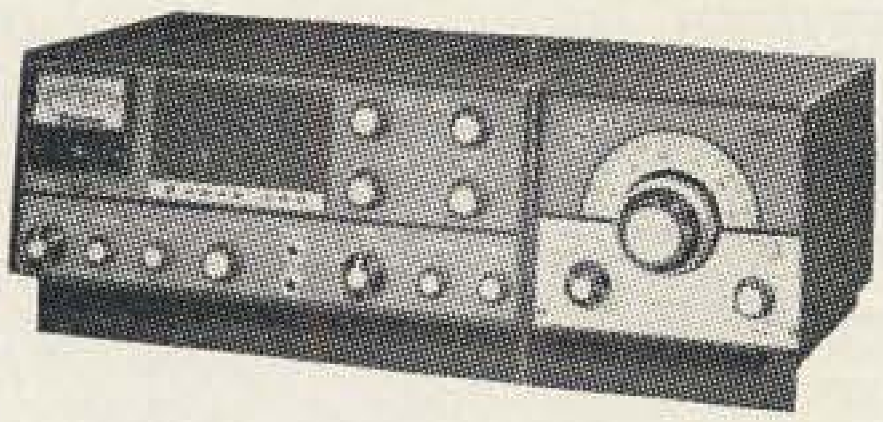

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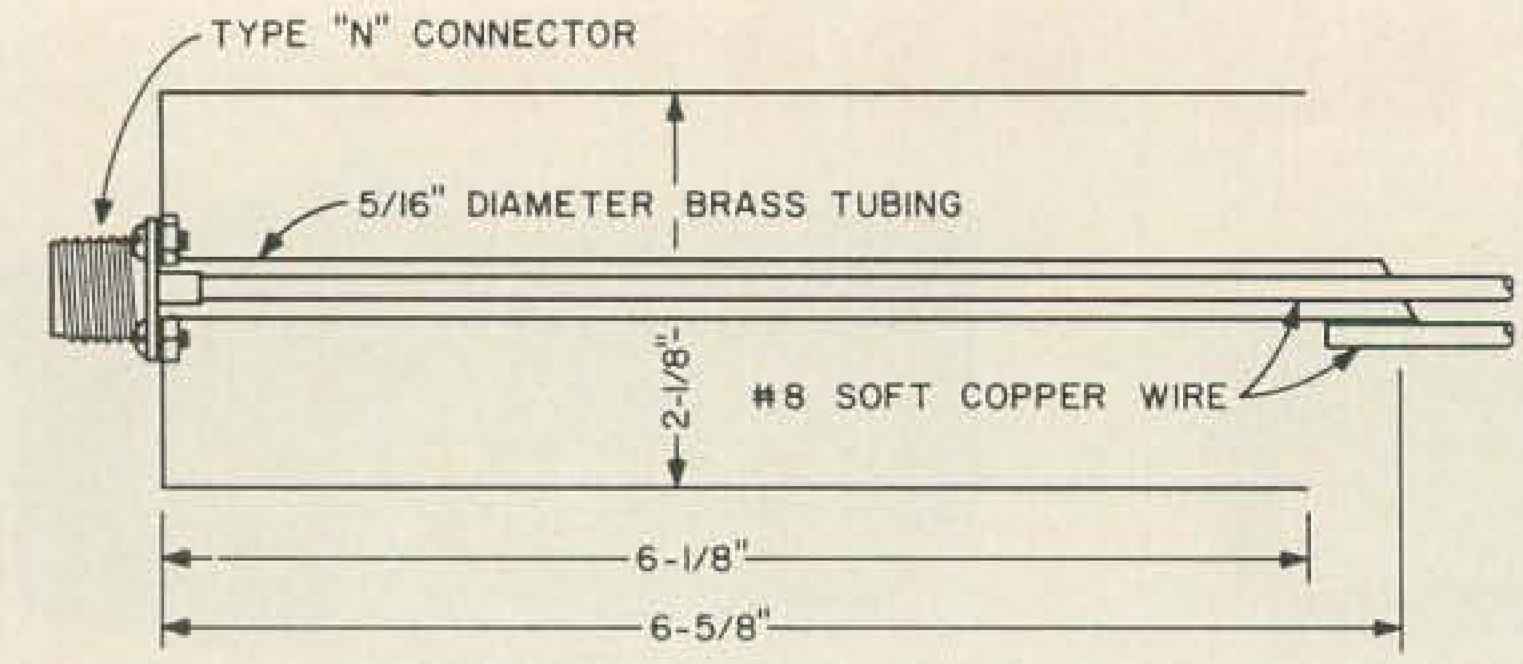

Fig. 4. Balun dimensions.

long and 14 inches high should be attached to the dipole side of the mast.

The mesh can be held in place with wire and then spot soldered to the mast with a heavy iron or propane torch.

The dipoles should then be soldered in place.

It will be noted from Fig. 3 that the ¼ wave phasings stubs are actually longer than the length required and that shorting bars are used to set the final adjustment. In all probability, this array will perform properly if the shorts are set to the measurements given, however, if the time can be spared, a simple diode test stand step up with a signal source of some sort will allow the array to be tweaked just to be sure.

If the test stand method is used, it should be found that, when the shorts are tweaked for maximum gain, the horizontal beam width of the antenna is at a minimum which should be about 16 degrees.

As with many antennas, the beam direction can be changed by altering the phasing balance among the dipoles. Be sure to set all the shorts the same distance. It is possible to achieve the proper beam width and then squirt the beam out sideways, if the shorts are not pretty close to the same length.

To illustrate the necessity of proper phasing, Fig. 5 shows the E plane pattern of the first trial collinear which was built "by the book." The screen reflector was not used in this test. The unidirectionalness of the pattern was apparently due to the reflecting action of the length of tubing used to support the dipole string.

In contrast, Fig. 6 shows the pattern obtained in the E plane with the second trial collinear, which was also without screen reflector. In this case, the phasing stubs were made longer and the movable shorting stubs added and adjusted for maximum gain.

It can be seen that the second antenna has a much cleaner pattern, lower sidelobes and narrower beamwidth.

Though not shown, the H plane beamwidth of this antenna is much too broad to satisfy the feed requirements of the parabolic sheet.

Fig. 7 shows E plane plot the final array. This was built like the second trial except that the reflector screen was added and the stubs retuned as required.

The sidelobes are further reduced and the back lobe is almost completely suppressed. The H plane beamwidth is reduced to about 100 degrees which is a quite satisfactory value for the feeding sheet. In fact, the array is, in itself, a fairly decent antenna, which, if used without the parabolic reflector, will have about 10 db gain.

The collinear is mounted at the focus of the sheet by using four additional lengths of TV mast. Two 5 foot lengths and two 8 foot 4 inch lengths are used to form the collinear support which is held together and to the sheet by antenna U clamps.

Reference to the photographs will provide the details of this construction. The U clamp which ties the mast behind the sheet to the center tubing in the framework is particularly important if the collinear support is to remain rigid.

The collinear is then clamped at the focus of the sheet.

Two lengths of nylon rope were tied between the edges of the framework and the ends of the collinear to insure against the collinear twisting on its mount. If this were to happen the pattern would be upset and, if carried to an extreme, the effectiveness of the antenna would be destroyed altogether.

To this point, nothing has been said about the matching scheme used. It will be noted that the middle dipole in the array is split at the center and a shorted stub has been inserted.

The center impedence of the array is rather low and requires a balanced feed. The simplest matching arrangement seemed to be the "beer can balun," in this case, a soft drink can balun" and shorted stub match.

The balun is used to transform the 50 ohm unbalanced transmission line to a 50 ohms balanced shorted line. The 50 ohms balanced line is tapped onto the shorted stub. The tap point and the short are positioned for minimum VSWR.

The details of the balun are shown in Fig. 4. These details vary slightly from the balun shown in the photographs, however, they are essentially the same. It is also well to note that the short 50 ohm balanced line is not actually 50 ohms but somewhat higher,

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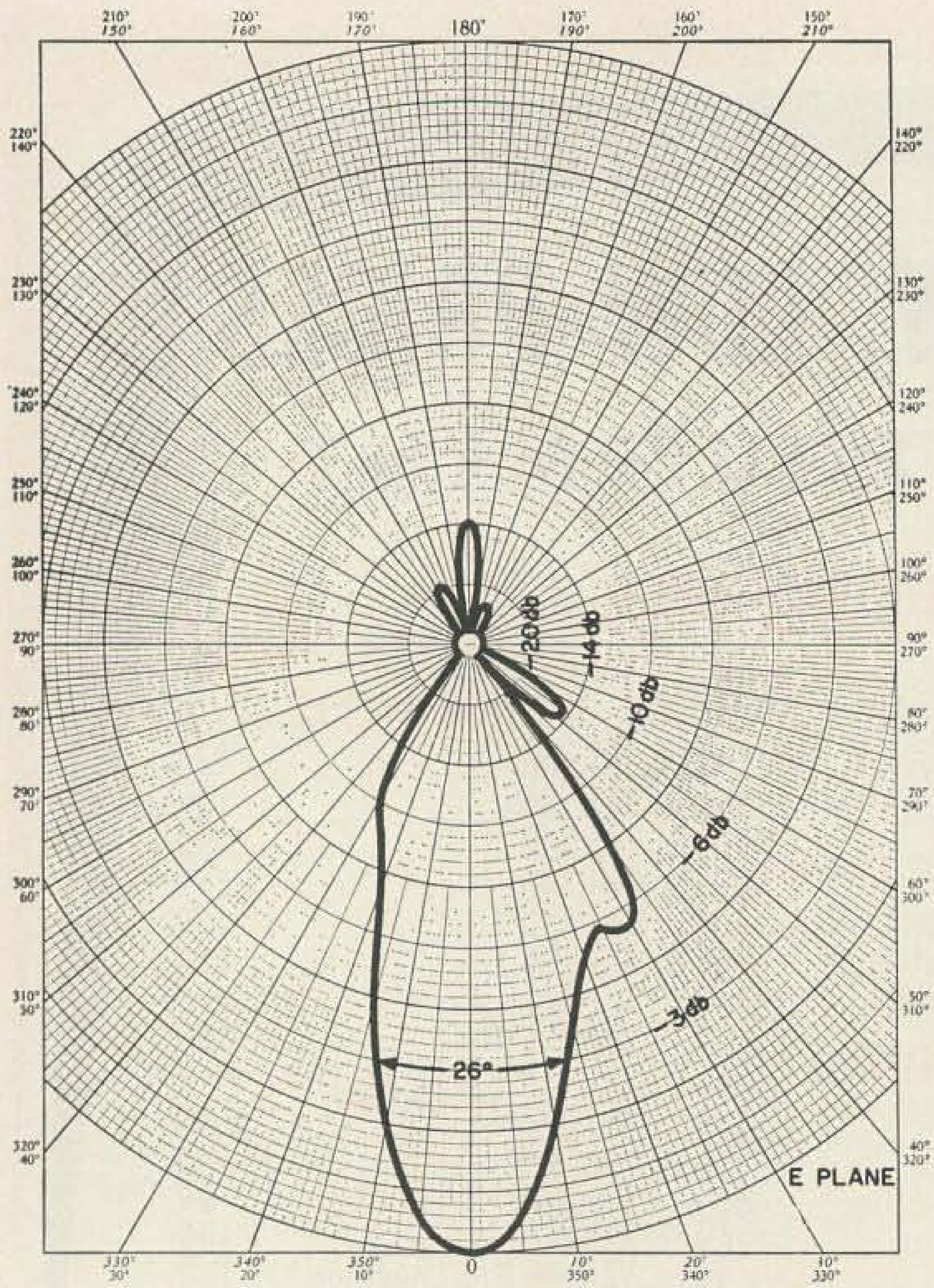


Fig. 5. First trial array.

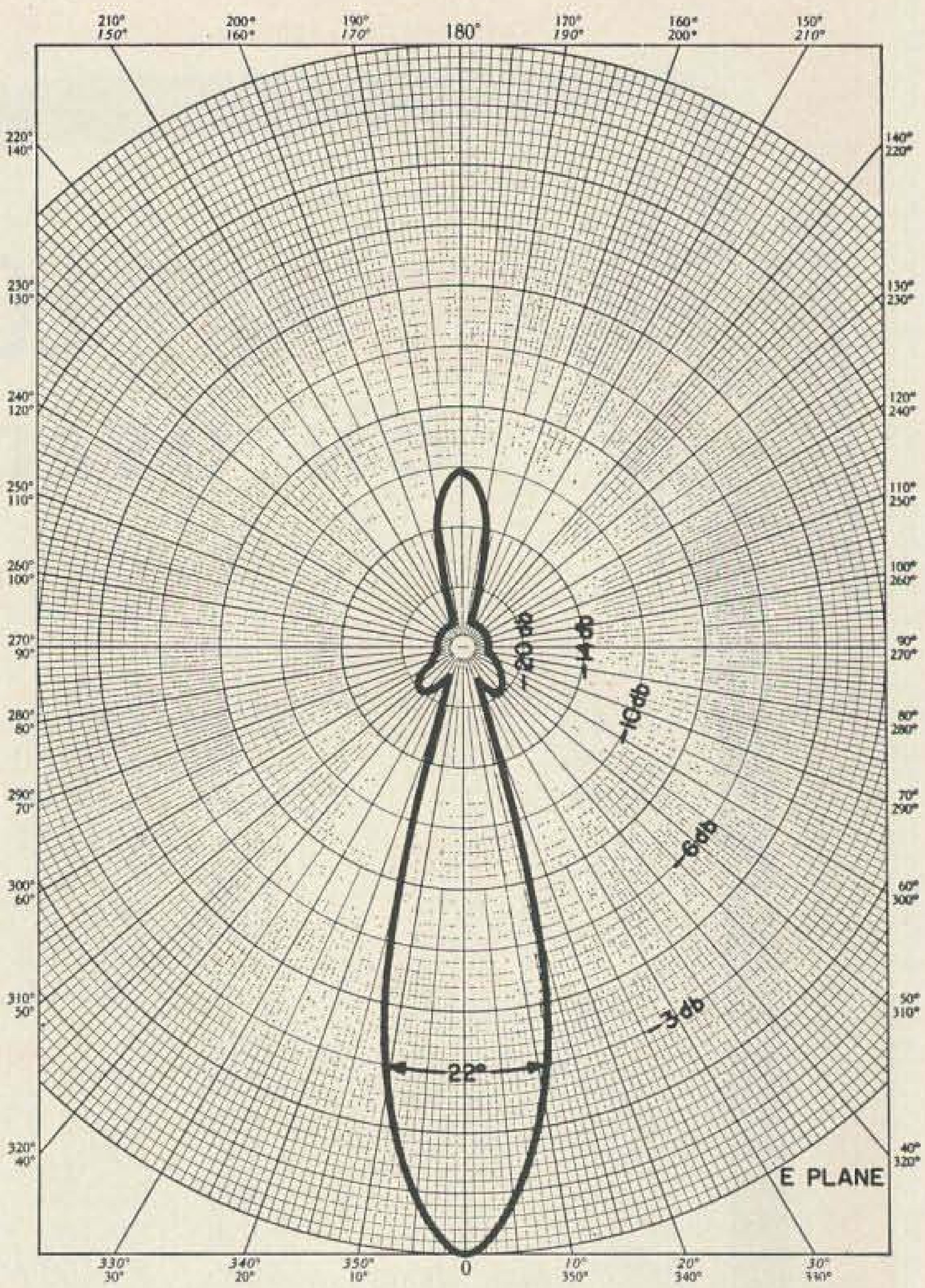


Fig. 6. Properly phased array without screen reflector.

but the discontinuity is short and can be tuned out in the normal stub matching procedure.

Once the stub is tuned for minimum VSWR, it is well to check the match with several different lengths of transmission line to be sure that the line itself is not acting as a part of the matching network—it can happen. If the VSWR remains low with varying lengths of line, then the match can be assumed to be proper.

When the line is matched the balun can be bolted to the dipole mast.

Quick checks showed that with the antenna tuned for 436 Mc, the VSWR was below 1.5/1 across the entire band and below 1.2/1 from 425 Mc to 445 Mc.

Though less thoroughly checked, indications are that the gain was acceptable over the band. Very little difference was noted between the gain at 436 Mc and 432 Mc.

Transmission line losses at 432 Mc can present a formidable problem, however, if the shortest possible length of RG-8 foam line is used losses can be kept to a minimum. Needless to say, if RG-17 is available, a substancial decrease in losses can be wrought, if the line is lengthy. It is sometimes possible to obtain lengths of used RG-17 quite reasonably from commercial two-way radio communication companies.

The weight of the antenna poses a problem in mounting the antenna atop your tower or mast. The fully assembled antenna weighs about 60 pounds.

Conventional TV mast, even the heavy duty variety, will result in disaster. Instead, a length of one inch heavy wall rigid pipe was used. This has a one inch inner diameter and a 1/8 inch wall.

The photographs show the temporary main support mast across the face of the sheet which was used in the test stand checks.

The antenna should be mounted very close to the rotator to allow a minimum amount of sway. The wind resistance of the antenna is fairly high and every practical precaution should be made to insure it doesn't end up a pile of junk in your backyard, or, worse yet, a neighbor's yard.

A rotator with an external thrust bearing should be used. If possible, the bearing should be mounted three feet or more below the rotor to minimize sway strain on the rotor and the top of the tower.

It was found that, if the thrust bearing was true with the rotator, my seven year old Alliance Tenna Rotor would turn the sheet and the 6 element six meter beam mounted directly beneath it, without seeming unreliable.

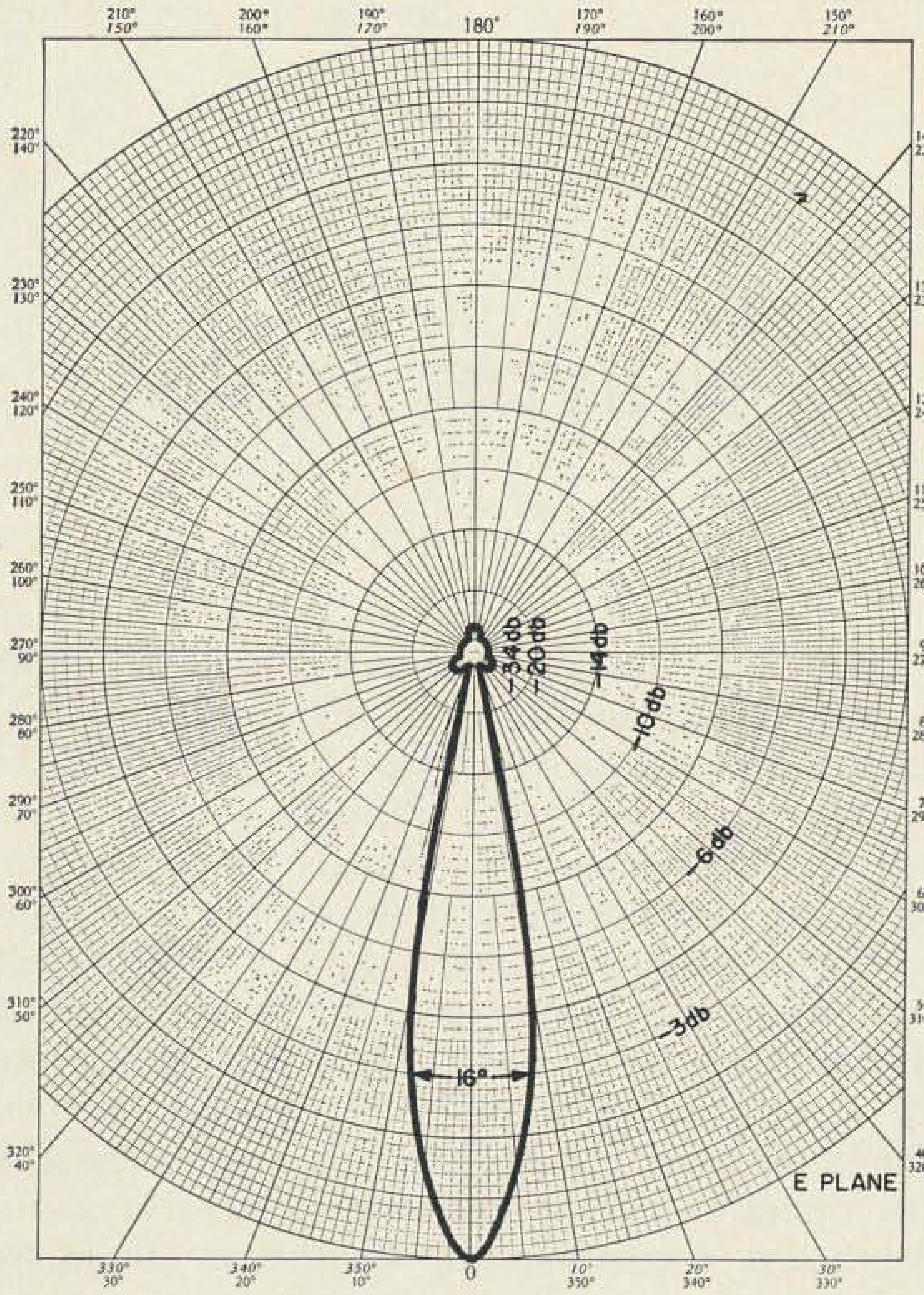


Fig. 7. Array with λ/2 screen reflector.

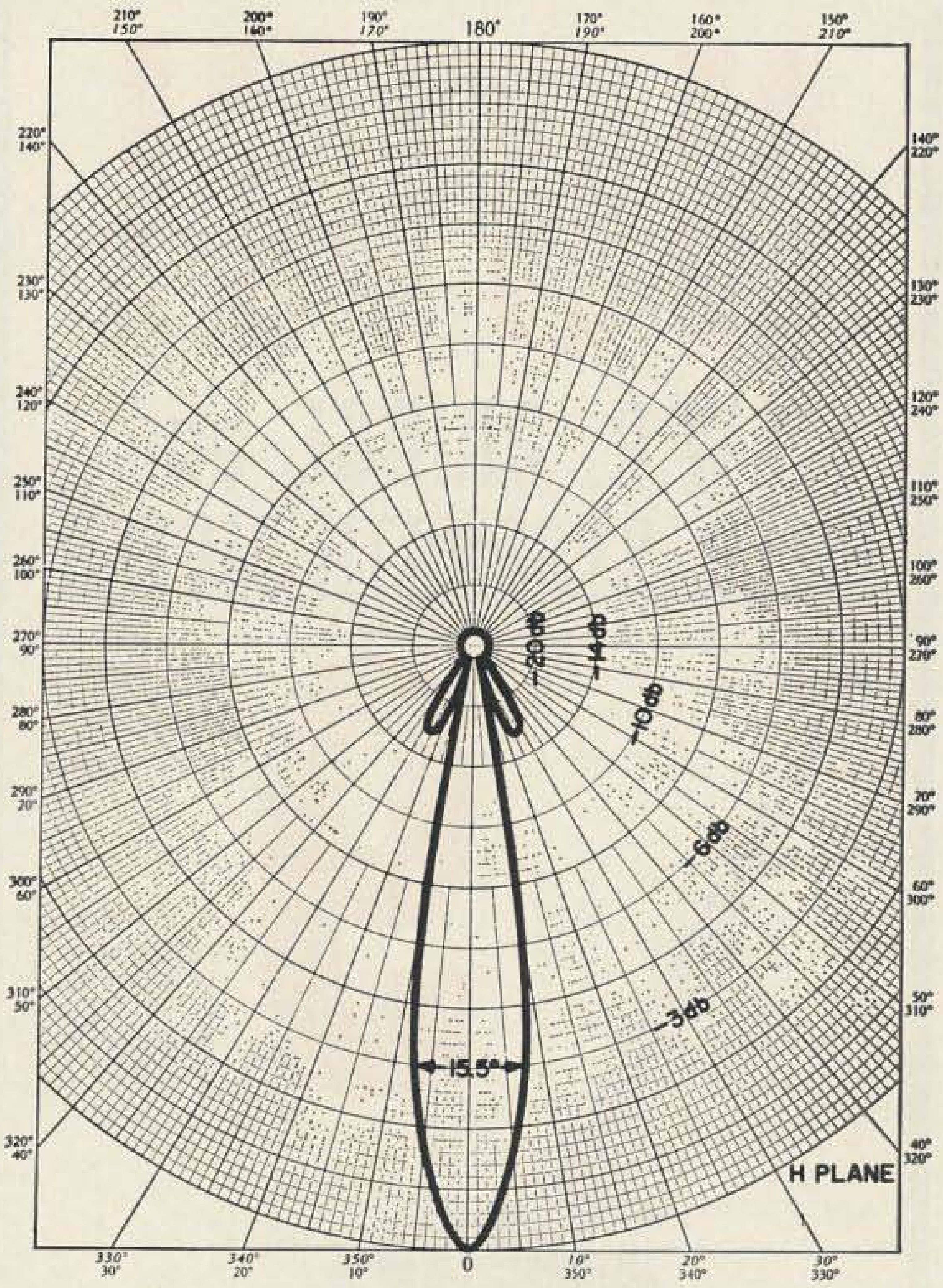


Fig. 8. H plane plot of the parabolic reflector.

Fig. 8 shows the plot of the H plane pattern of the sheet reflector. The E plane plot was observed to be almost identical to the E plane plot of the driven array (Fig. 6) except that the F/B was better and sidelobes were slightly stronger.

Using conventional gain, beamwidth formula the forward gain, based on the measured beamwidths, is 19.3 db. This is almost exactly the predicted value and is a happy place to stop.

To be scientifically correct, a statement of measurement tolerences would be appropriate at this point. The instruments used in these measurements were not laboratory calibrated, but rather were homebrewed and not at all fool proof. However, I believe that the measurements were accurate within a degree or so. If both beamwidths were off by as much as 3 degrees (20%) the gain would still be over 18 db. Though, regardless of "paper gain," on the air results are the most important criterion for a judgment of performance.

The front to back ratio seems to be in excess of 40 db on the test stand. When the antenna was actually put into service, the front to back ratio seemed to be less than this value, in some cases, by a considerable amount. Later tests seemed to indicate that the f/b was actually quite high but the strong forward lobe was picking up signals reflected by ground objects in the general vicinity of the antenna. By observing television sync pulse phase comparisions, indications are that objects at least as far away as 5 miles from the receiving antenna could and did cause fairly strong reflections.

The antenna has withstood the rf of the KW transmitter for long periods of time with no apparent ill effects. There were no thermal hot spots on the antenna. The high current points on the dipoles were warmed perceptably above the ambient but the effect was just noticable. The small wire used in the shorts in the phasing stubs seemed to be no problem at all.

At this writing the antenna has produced among others an R5 CW QSO over a 180 mile path obstructed by a 7000 ft mountain chain and an R5 S2 CW reception report over 270 mile path obstructed by two mountain chains, one about 8,000 feet high. In both cases, these results were obtained in spite of cross polarization.

Why call the article the Big Sail? Well, that's a local joke, but, it does look more like something that belongs on a boat than on a radio tower, or so some of the neighbors say.

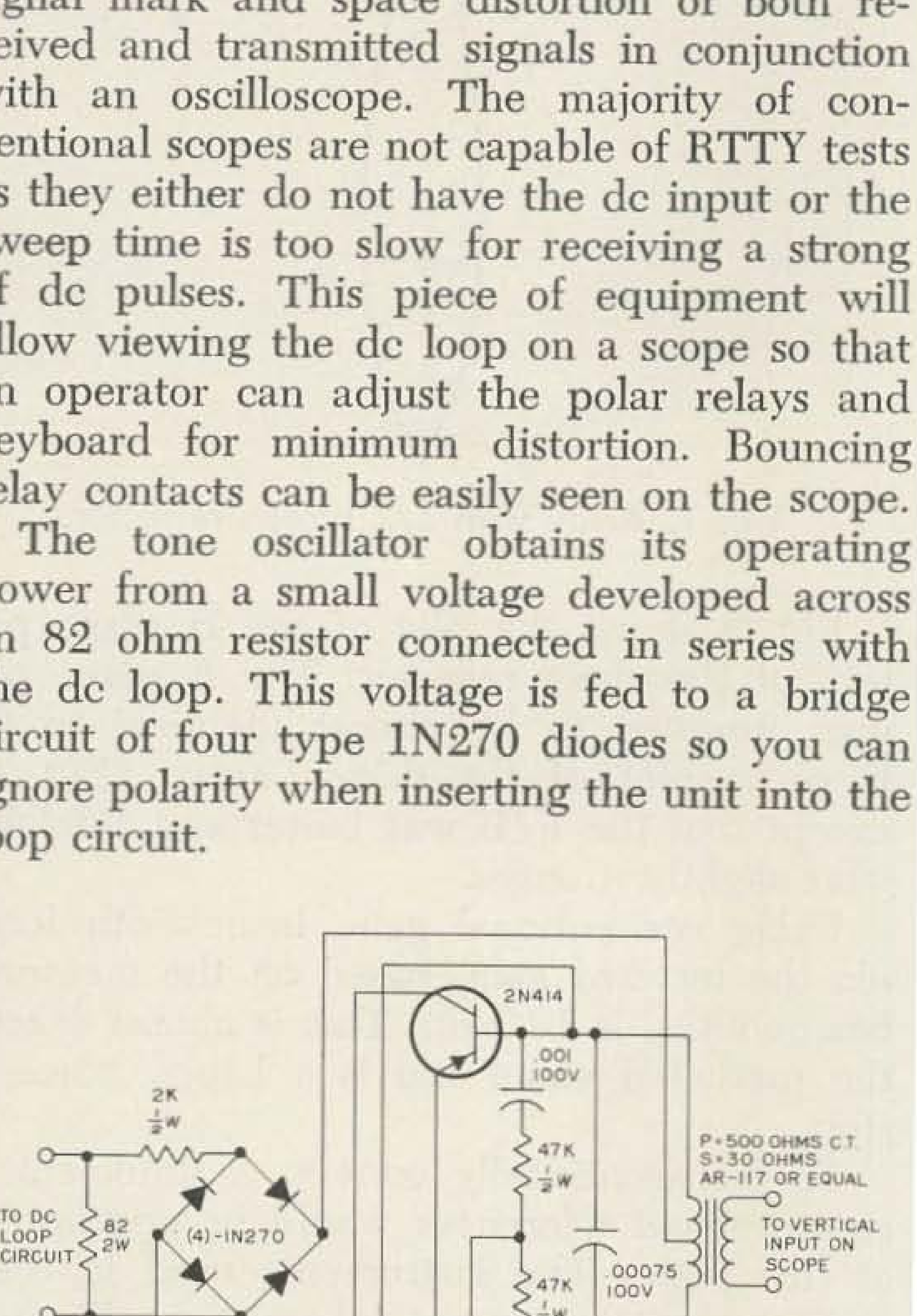
. . . K6MIO

Gordon Hopper W1MEG

Teletype Tester

Here is a useful piece of RTTY test equipment which can be built very easily. It is a transistorized tone oscillator for testing RTTY signal mark and space distortion of both received and transmitted signals in conjunction with an oscilloscope. The majority of conventional scopes are not capable of RTTY tests as they either do not have the dc input or the sweep time is too slow for receiving a strong of dc pulses. This piece of equipment will allow viewing the dc loop on a scope so that an operator can adjust the polar relays and keyboard for minimum distortion. Bouncing relay contacts can be easily seen on the scope.

The tone oscillator obtains its operating power from a small voltage developed across an 82 ohm resistor connected in series with the dc loop. This voltage is fed to a bridge circuit of four type 1N270 diodes so you can ignore polarity when inserting the unit into the loop circuit.



A pair of 2N414 transistors oscillate around 20 kc and their output is coupled to the input of the scope through a small output transformer.

Pulses containing no distortion will appear on the scope as evenly spaced rectangles. Pulses containing mark distortion will appear as evenly spaced square boxes. Pulses containing relay contact bounce will appear as pairs of rectangles on the oscilloscope.

. . . W1MEG

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Gus: Part IV

In planning my first DXpedition one of the first problems I faced was getting equipment to use. I had been told by lots of fellows that getting equipment for a DXpedition was very easy. Well, maybe it's easy for some fellows but in my case it was not. I wrote a nice letter to every manufacturer I knew of telling them my plans. Only one bothered to answer my letter! That was the equipment I took with me and it must have been good gear because I had no trouble with it at all.

I began to write letters about then to the fellows who said they had spare bedrooms for visiting hams. I mean to tell you I really wrote letters, getting telephone numbers, street addresses, and directions as to how to find their homes. I also wrote many letters to the licensing people in many countries too. Let me add right here I have found that this (in my case) is *not* the best thing to do—it gives them too much time to read the fine print in their regualtions. To this day I think the "out of a clear sky" approach is the best—don't even give them any warning that you are on the way. In fact, it's best to not tell anyone where you are going, because then someone will try to beat you there, or foul you up!

I was in a lucky position that I had a good partner with me at our broadcasting station. Things were going smoothly (as smoothly as they usually go at a BC station) and it was OK for me to stay away from my station any reasonable length of time. It would operate all OK whether I was there or not. My wife had her own radio and TV shop with a good technician working for her. All the children were out of school and one or two of them were about to get married. My wife had given me the Official Nod. (I told you I had one out of a thousand wives—didn't I?)

The news of my DXpedition was really getting around by this time. The "LW" gang helped lots (14050 KC—Sundays at 1300 GMT) Oh yes, let me tell you how W5UX and I organized this "LW" net. I had always heard about these big city 2 meter and 6 meter DX nets—I think most of them have one by now. I once made a trip to Philly to visit my in laws and found out about that big club meeting there.

I sneaked into their meeting and sat down in the back row where it was dark. I heard the trial of one of their members. Up on the platform were the club's secretary, president, vice president, and a few of the club's officials. After reading the minutes of the last meeting, calling the roll, and discussing other run-of-the-mill business, they called one certain ham up to the platform to be tried. They first asked him if he were at home the past Tuesday night. He answered yes. Then they asked him if he worked a VR3 that night at about 3 am. He said yes, he had. Then they asked him if his 2 meter DX net station was in working order—he said no. Then they asked him if he had a telephone. He answered yes. They asked if he had his list of the club members who needed VR3 and he said yes. Then they asked him why he did not telephone the boys who neded VR3, and he said his telephone was in his bedroom and he did not want to wake their baby. They asked him if he had ever read the by-laws of the club about having the telephone placed where it could be used anytime day or night without disturbing anyone. I think his answer to that was that he was planning on having it moved to a better location in the house soon. Well, I think it was a $50.00 fine given to him. Right then I said to myself, boy, us fellows in small cities just don't have a chance to work lots of good DX with clubs like this being organized like they are.

When I got back down to South Carolina I gave lots of thought to how to overcome our disadvantages of not having a big club and all their members to act as our ears for alerting us fellows in small towns across the USA. I had a QSO with Bob and told him that we fellows in towns with no DX 2 meter nets should get organized. I suggested that we start a "Lone Wolf" (LW) DX club and for us to meet every Sunday. So the LW got going—this was a number of years ago—and it still is going strong.

For a DXpedition to understand the problems the USA gang faces in working DX, I think it's the best training in the world to chase DX from the USA for a number of years. Then you see how things go with them and hear the problems that they face when working DX. Anyone not living in the USA just can't picture the sounds of kilowatts QRMing each other, or understand how eager most of the gang is to work DX. They can never understand the strength of those KW's when we have short skip; they can't picture the competition between the fellows. They just don't know how badly a DX station can get covered up with QRM especially if the DX station is in the USA portion of our phone bands. All of this knowledge has helped me to see how a DXpedition should be run, especially when the W/K's are coming through. It's even good to know of the 2 meter net boys alerting each other when something good is coming through. The odd part is that many of the DX stations don't realize thet they have the situation in their control—if they will control things right! Danny Weil (VP2VD) taught me lots about handling the pile-ups and I think old Dick (KV4AA) taught Danny! I have heard so many DX fellows trying to handle things the wrong way that I made up my mind that I most certainly did not want to make their mistakes.

I will admit some of them don't show "good bringing up" and they do get downright dirty at times, but I figure it's all in the game. You know the old saying, "all's fair in love and war and chasing DX." With me it's no holds barred, do what you want, you can't make me mad and I won't Black List you either. Course I just might not "hear you"! hi hi. And if I work you, your call might not get into the log, and then no QSL and that's bad! You will be surprised how fine 99.99999% of the fellows are though.

When the news really gets around that you are going on a DXpedition, you begin to get lots of mail. Everyone tells you where to go, how to operate, what frequency to use, to listen for them. Some fellows offer you things to take along with you, some fellows suggest what medicines to take with you.

You can make all the plans you want when you are sitting down in your office or at home, but when you get to the rare spots, all of your plans seem to change. Things just don't work out like you thought they would. A lot of the time you just have to go along with the wind. Lots of fellows asked me if I had ever traveled much and I told them I once drove to Mexico and had also driven to Niagra Falls on my honeymoon. Then they asked me if I had ever been out at sea in a boat. My answer to that was a flat no—but I was sure I would not get sea sick. They usually answered "Brother, you have a lot to learn," or something like that. I was pretty sure that I could control things OK at sea because I had too much at stake to do otherwise—and to this day I still believe what I said! I even believe that I can control myself with mild sickness too. You have just gotta say to yourself—"Look here, you cannot afford to get sick." And if you really mean what you say, you just won't get sick—or at least you can pull yourself out

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of it before it gets you down.

Things were coming along nicely on my DXpedition plans. Buck W4TO over in Atlanta, told me he would be glad to handle the QSL cards and would assist with funds. In fact, we both put money in the bank. Buck matched what I had and said he would see if he could get some contributors lined up in case their help was needed. Buck did a very splendid job in keeping me going too. It's very rough to get over-seas and have to worry about your funds running out on you. Before you do anything in the line of a DXpedition, get rid of your money troubles and worries. Stay home if that problem is not solved, unless you are filthy rich!

After a number of meetings with Buck I was ready to depart—I wanted to get going! But there were a number of things I had to do yet. For instance, I had to get my passport, and visas for the countries I wanted to visit. Don't ever mention the word radio or radio amateur to those Consulates in Washington, because they will tell you they will have to write to their home government to get your visa approved. Just tell them you will be a tourist. Tell them you want to buy—*BUY*—lots of pretty things in their country (they like that word BUY) and you will be surprised how fast you get your visa. Act like you have no money worries at all (that was hard for me to do).

At last I was all fixed with visas, all my clothes were packed (much too many too), my little address book was in my pocket, my little money was changed to Travelers Checks and my health card was OK. I had the little electronic keyer W3KVQ had built for me and that fine paddle Sandy W5AZB had made. The equipment was to be shipped to me in Amsterdam. Even a getting-together date was arranged, to meet Lee WØAIW, Mike WØ-MAF, and Mac WØUQV in Nairobi. We four were going to VQ9 land together. I could see a lot of interesting developments in the wind.

The BIG ADVENTURE was about to commence. I was going to be on the other end of the DX pile ups, and I was going to see some of the world and meet some of the DX fellows I had been talking to all these years.

When the plane left New York at 4:30 pm I decided I would let my wrist watch just stay on E.S.T. I found that Cokes were free on the plane, so I more than drank my share. I saw other people on the plane sleeping, but there was none for me. I guess I was excited too much and had too much on my mind to think about sleep. I just kept drinking Cokes and watching my watch and at 1:30 (by my watch) the sun came up., I said to myself, boy, that sure was a short night. The plane came in and landed—I was in PAØ land! Immediately I took another plane for Hamburg, Germany and then I was in DL land. Things were going just fine with me, no trouble with Customs at all (Boy I had a lot to learn)!

I was met at the Hamburg Airport by DL6ZZ—good old Brother Gus, whom I had QSO'ed many, many times and his nice XYL-Helene. Just like I had told him I would do, I ran up and planted a big kiss on Helene. I think they were both surprised when this happened, because people over there just don't run around kissing people at airports. Over the air Gus had used almost perfect English, but when we met in person I found that I really had to talk very, very slowly for him to even almost understand me. Gus and Helene went all out to treat me very, very good. They wanted my stay in Hamburg to be a memorable occasion. It seemed like we were always eating and drinking at their house. The best darn sauerkrout I had ever had, and boy, those German weiners were out of this world. (Here in Bhutan where I am now, I do good to even get yak meat. Oh yes, we do have yak butter tea a few times each day—I guess just to keep the taste in your mouth—and let me tell you, that taste sure sticks with you a long time after you have had a cup of that stuff—hi hi).

Gus evidently had taken a few days off from his work just to show me around. We went everywhere in Hamburg, which is a very nice city. I met many of Gus's and Helene's friends and many of his relatives. All of them were real down to earth kind of people and very friendly. Of course, at each house we had to be served coffee and cakes, and even at times a Coke would appear. Gus had two sons, one away in the army and one at home. The one at home had a very pretty girl friend who I got to sit on my lap and we took a picture of that. This picture was discussed at length with my ZYL when I got back home—I mean it was discussed and discussed, and a little hard to explain I must say. (Boys, be very careful of those pictures you take!)

After staying with Gus and his family about 5 or 6 days my allotted time finally ran out, and it was time for me to depart. The time was much too short and I would have liked to have stayed much longer, because I was having such a nice time. They asked me where I was going when I left, and I said East Berlin—that did it! Helene cried and Gus tried his best to discourage me going there. He told me all kinds of things that might happen to me and said it might even be a one way trip! But I told them I had promised some of the boys in East Berlin that I was going to visit them and that was what I was going to do regardless of the consequences. I told them I was not afraid of anything that anyone would do to me. I had not done anything to anyone and I was no spy. Against their better wishes they finally more or less gave in. Then they asked me how was I going to get to East Berlin and I said by train, since it was the cheapest way and the cheapest way was all I could afford. This brought tears in the eyes of Helene again. They told me that I should not go by train because the train has to run nearly all the way from Hamburg to Berlin through East Germany with police all over the place and everybody suspecting almost everyone of being a spy.

All this time, I was telephoning Amsterdam Airport daily asking them if my equipment had arrived there from New York. Up to the day I departed for Berlin it had not arrived, which probably was best or I might have had it with me when I arrived in Berlin, and then the fun would have started sure enough.

Gus, Helene, and their son came down to the train to see me off. They were not happy seeing me leaving for East Germany.

After the train left the Hamburg station it was not long before it stopped and the West German conductors and train crew along with got off the train, and the East German officials the immigration officials got off the train, and of course their Police and special officers took over the train and it was under their jurisdiction from then on, until the train arrived to the border of West Berlin and East Germany. They gave me the eye any number of times. I was asked why I was going to West Berlin and what business I had there. My answer was always "I am a tourist, and I want to see as much of Europe as possible." They really went through my little suitcase, even looking in the pockets of every garment. At every stop along the way they made every passenger getting off the train show their identification pass and a few questions were asked of each person with a nod or two from the official asking the question. Police were everywhere at each stop along the way. I was at last seeing a police state in operation. Sometimes two or three of their Police would look at me and say something to each other. I was a little concerned about this and I wondered what would happen before I got to West Berlin. Here was old Gus in the middle of Communism—these fellows did not smile at all. What was in store for me?—Next month, boys—

. . . Gus

Ralph Hanna W8QUR
3023 Emmick Drive
Toledo, Ohio 43606

The SB-34

When the SBE 33 came out, I knew that it was the ideal transceiver for me. I was looking for a rig that would be convenient for use on a cabin cruiser. Boat mobile is a bit different than car mobile. The boat is not usually kept at home. Once you get on it you stay at least for the weekend. This means that you have to lug most transceivers out to the car with the speaker and two power supplies and then everything from the car to the boat. Two power supplies are usually necessary because commercial power is used dockside and batteries are used when underway. But a 250 watt inverter was already installed on my boat, so with the SB-33 all that had to be carried was the one little 18-pound package and the microphone, as the speaker and AC power supply are built in.

The SBE 33 is a fine transceiver and has some real clever design features. It was covered quite well by W1CUT[1] some time back. But as with any piece of ham gear, the user will wish for improvements. Several had been thought out and were considered for a winter project when SBE came along and announced the SB-34. Here were all the improvements you could ask for: slower tuning rate, incremental tuning, provisitions for a calibrator, a dial corrector and best of all, a built-in 12 volt DC power supply, and all this at no increase in size or weight and no sacrifice in any of the plus features of the SBE 33. The new dial is marked in 5 kc division and the set covers 50 kc more of each band.

The dial corrector is a much needed improvement. It uses a varactor diode (voltage variable capacitor) in parallel with the VFO coil and tuning capacitor. Varying the voltage on it with a conveniently located pot varies its capacitance enough to shift the frequency as much as 10 kc. The delta tuning is effective only in the receive position. The same varactor diode is used by changing the voltage a bit more for about 1 kc change in the receiver tuning. Properly biased diodes cut out the effect in the transmit position so that the transmitter is always on the same frequency as originally set. This is an ideal feature for round tables and when working other transceivers that are not as stable as they might be.

The most unique feature of the SB-34 is the method of switching from receive to transmit without the use of a relay. This is real tricky. Two transistors perform this function. The base of one is coupled through a resistor to the cathode of the driver tube. In the receive condition, because of the high negative bias on the grid of the driver tube, no current is drawn and therefore the base of the first transistor is at ground potential and it too is cut off so that its collector is at +12 volts. This voltage is applied to the receive control line. This same 12 volts is supplied to the second transistor which causes it to conduct to saturation so that its collector is at ground potential. This ground potential is applied to all the controls requiring ground potential.

When the push-to-talk button is depressed, the high negative bias on the driver is grounded so that the tube begins to conduct and build up to about 6 volts at its cathode. This voltage will now cause the first transistor to conduct and thus reduce the 12 volts to zero to cut off the receiver. With zero volts on the second transistor, it will be cut off so that its collector is now at 12 volts for the transmit

1. The SBE 33, E. L. Campbell W1CUT, QST, April 1964, p. 52.

function. A third transistor will energize an external relay to control a linear amplifier. Clever, huh?

The main feature of the power supply is that it will function on either 115 volt 60 cycle or 12 volt DC. Changing power cords does the switching. This feature makes the SBE 34 a truly universal transceiver that can easily be used mobile or fixed. And it will eliminate the fuss I had with Virginia, out in the middle of Lake Erie, as to who got to use the inverter on the boat—she to watch the noon time soap operas on TV or me to keep a 1200 sked. Incidentally, there was no TVI even on the small boat.

Just to see how really good the SBE 34 is, Ray Abain K8NBQ and I took it over to Rowe Industries and put it through its paces on the Panaramic Corp. Panalyzer, the Bird wattmeter, the distortion meter and all the other good things. Here is what we found using a single cycle tone:

Power Output–	80 meters	62 watts
	40 meters	77 watts
	20 meters	78 watts
	15 meters	57 watts

Carrier Suppression–56 db down from output signal

Unwanted Sideband Suppression–58 db down from output signal

Distortion Products–28 db down from output signal

Spurious Responses–42 db down from output signal

Sensitivity–0.9 mv for 10 db signal plus noise ratio

Selectivity–2.1 kc at 6 db down 4.6 kc at 60 db down

The SBE 34 has a dual speed Jackson Brothers tuning drive that moves the dial at a high rate of speed in one direction, then goes into a fine tuning speed when backed up. The high speed is 90 kc per turn and the low speed is 20 kc per turn. The slow speed moves the dial 17 kc then goes back into high speed. For someone who likes to scan the bands as I do, I think the Jackson Brother continuous 6-to-1 dial drive would be better.

The usual accessory items are available, the most important of which is the 100 kc calibrator. This is a small two transistor unit that plugs in the back and only sticks out about ¾ of an inch. A switch on the front panel turns it on and off.

Dollar for dollar you will have to look a long way to find such a small package with so many features as the SBE 34 for under $400.

. . . W8QUR

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A DC Dummy Load

How many of us have built power supplies and tested them by plugging them in and turning them on—if they don't blow up or start smoking, then they're O.K.? Probably all of us have done this at one time or another. Usually, when the supply checks out OK by this method, then all is truly well, and one can plug in the rig or whatever and get on the air.

But there are always the exceptions to the rule, such as the time recently when I built a power supply for an ultrasonic cleaner. The cleaner was to use a pair of 811-A's in class B, drawing about 350 watts dc from the power supply. The only plate transformer that I had anywhere near that rating was one of the standard 2400 volts center-tapped at about 220 ma types. This meant that the dc output from the power supply after filtering would be about 1100 volts at 220 ma—very definitely *not* 350 watts. Therefore I wanted to test the supply at a rather large overload without running the cleaner (which was not built yet anyway). This meant a large load resistor—about 3K at 300 or so watts. I had no resistors which could possibly be combined to make such a value, and a swift look at the box containing the light bulb collection told me that a lamp bank was not the answer either. A look at the local distributor's catalog decided me against buying the necessary resistors.

Just as I was about to give up, it occurred to me that a vacuum tube was really nothing more than a variable resistor. With this thought in mind, I grabbed an old 304TH off the shelf and set up the circuit in Fig. 1.

From the tube curves, I found that with about 1000 volts on the plate, I needed about 100 volts negative on the grid to make *sure* that the tube was completely cut off. When I had the load tube connected to the power supply, I then lowered the grid voltage until the tube was drawing the desired current.

While I set up the circuit originally as a breadboard-haywire affair, I thought that it was sufficiently useful to warrant its being built in a small (well, big enough to get the 304TH in) metal cabinet with the meters built in and a built-in bias supply, rather than using the laboratory power supply. Not all of us are lucky enough to have 304TH's in our junk box, and often one doesn't have any other power tube than the one in the final. Actually, any tube can be used as a load, so long as the ratings are not exceeded too much (note that I was dissipating 350 watts in the 304TH, which is rated at 300 watts dissipation). I would recommend the use of triodes, both because they are often cheaply obtained and because there are fewer problems involved in using them in the circuit. The following tubes are suggested, since they are common: 304TH, 304TL, 6C21, 450TH, 450TL, 250TH, 250TL, 810, 805, 811 or 811-A (note that the last two tubes mentioned are zero bias triodes, and that they will probably draw grid current. Design the bias supply accordingly). Naturally, any tube can be used, and if you are really desperate, you can use the one in your final but be careful not to blow the grids out of it or melt the plate. . .

Fig. 2 is the circuit of the final version as mounted in the cabinet. I grounded the center of the filament transformer to the chassis, as the transformer was only rated for 2500 volts

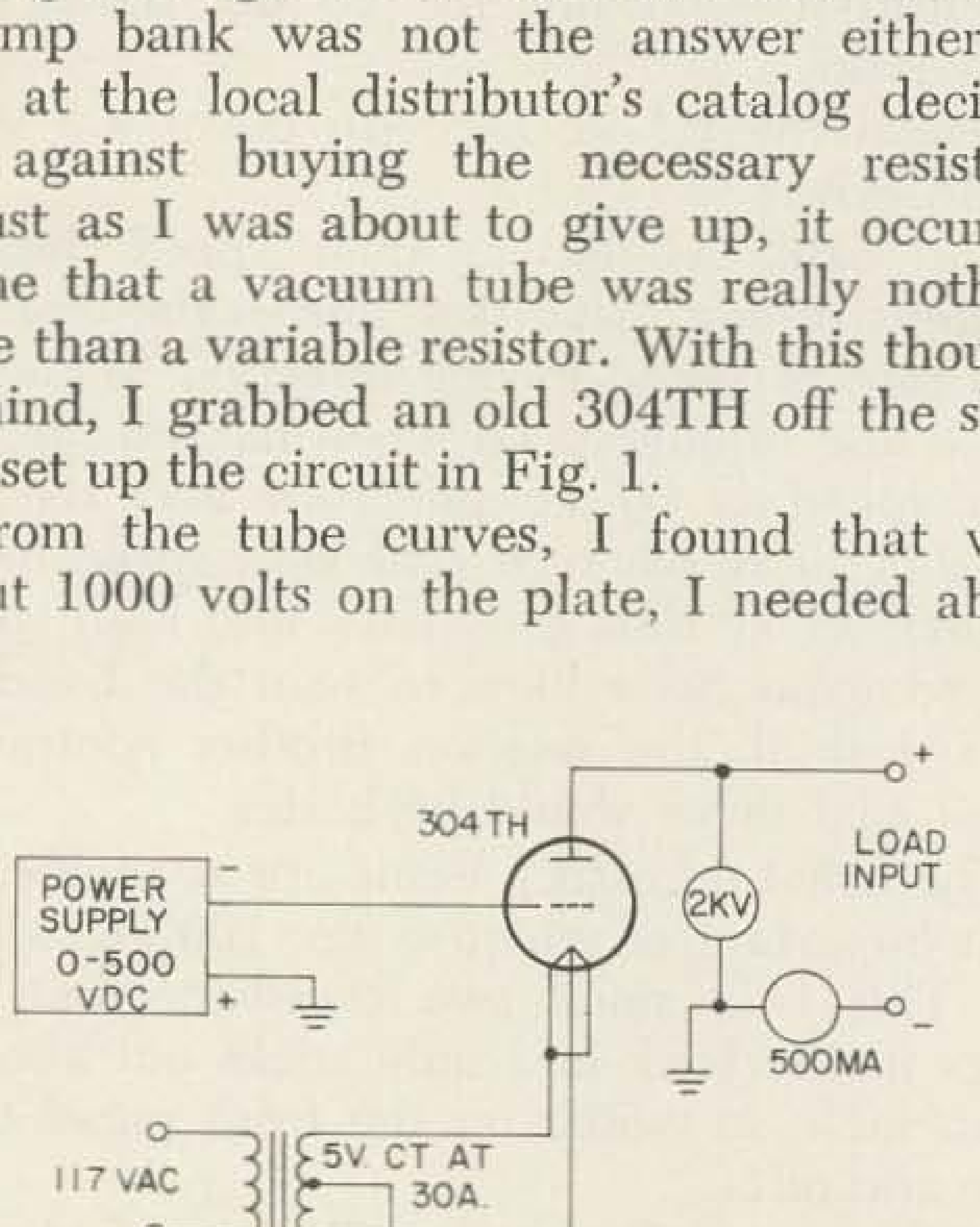

Fig. 1.

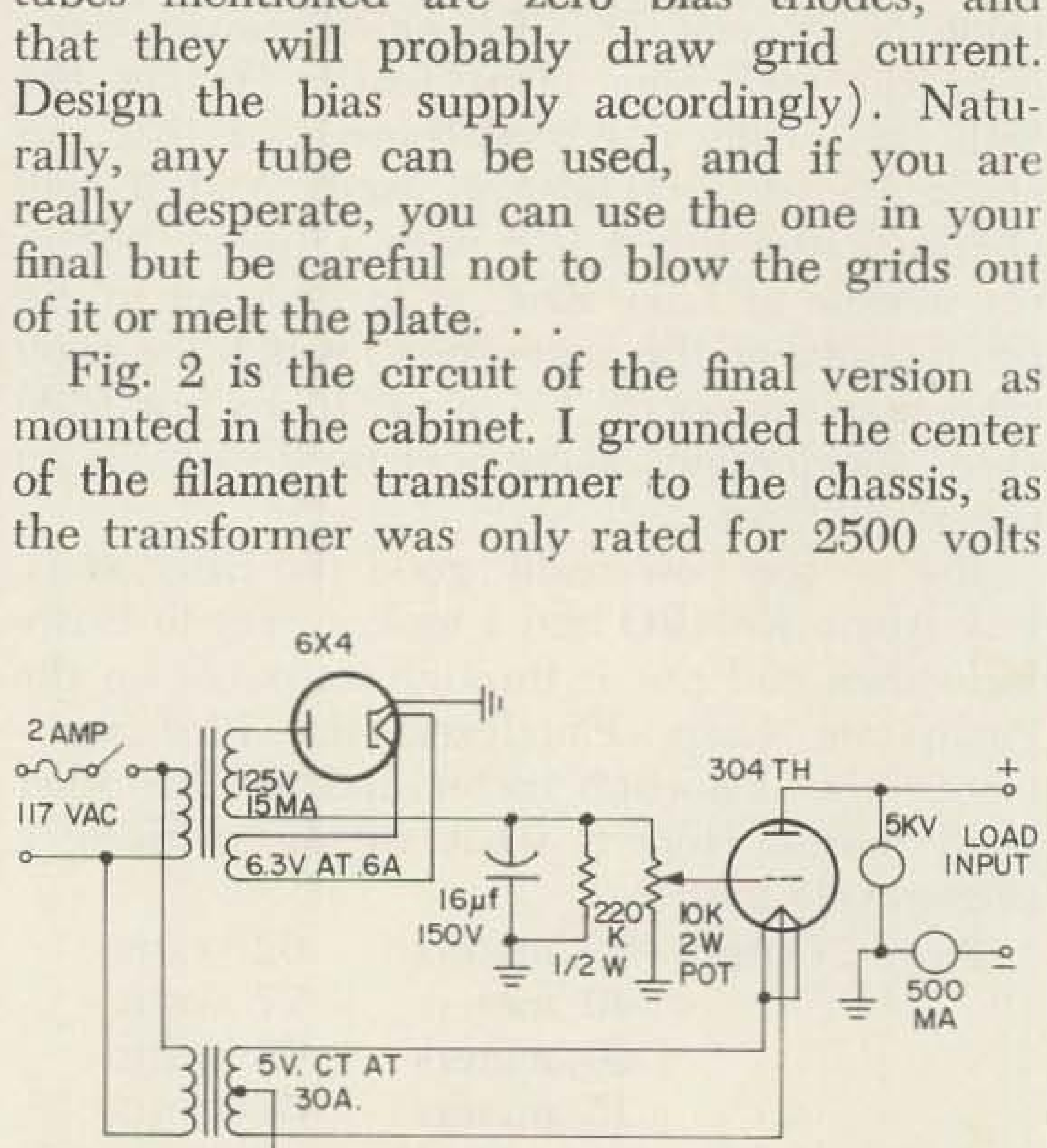

Fig. 2.

insulation to ground, and I was not in a mood to play around with that kind of fire. If you have a better transformer, it might be advantageous to isolate the entire circuit (*including the bias supply*) from the chassis. The bias supply is standard, and delivers from 0 to −120 volts. None of the values are critical. Note the 220K resistor across the filter capacitor. This is a safety bleeder and is there for the following reason: when I started to build this thing, it was about one in the morning, and as a result I chose a chassis which was too small to simply build sides around in order to make a cabinet—the meters wouldn't fit. So I had to make the cabinet larger and put the meters and controls (including the bias control pot) in the front panel with some space between the panel and the chassis. The controls were attached to the chassis by means of a cable with a plug on the end, and to make sure that the filter capacitor discharged if the plug should be pulled out, the resistor was added. A more wide-awake constructor will probably avoid most of the pitfalls into which I fell that morning. Note that since one should start to test a supply with no load (to make sure that you haven't got too much load), the counter-clockwise position of the bias control should give maximum bias voltage to the tube, and the control should be adjusted for the desired current on the meter *after* the supply is hooked up to the load.

Since this circuit will probably be used close to hand, on the bench, rather than across the room in the rack cabinet, it is worthwhile bringing up a few of the well worn but true sayings regarding safety: don't adjust the meter zero set screw when there is voltage applied to the circuit—there isn't much between you and the HV—just a little piece of plastic (and some meters use metal adjusting screws). Keep one hand in your pocket when playing around with live wires, etc. The tube is HOT—don't touch it or spill water or other liquid on it.

The circuit mentioned above is not new, but it is seldom used due to the need for more components than a simple resistor bank contains. For the experimenter, however, it has the advantage of being variable, and the parts used are such that most hams and experimenters can readily obtain them. The circuit could also be used as a bleeder resistor and could be built into a power supply if desired. Also, while the tubes mentioned have been in the 100 to 600 watt range, there is no reason why larger or smaller tubes could not be used. . . . Lyman

Bill Hoisington K1CLL
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Quick and Easy Add-on Neutralization

Ever build what you thought was going to be "just a simple straightforward amplifier" when you found you needed a little more gain, a little more isolation, a little more power, or all three and then find you can't eliminate self-oscillation? I just did. And it oscillated. Bad. Lit a bulb with no rf input, just from it's own nasty little internal grid-plate capacity.

This was a 5763 amplifier on 50 megacycles driven by half of a 12AT7 crystal oscillator. Nothing to it. Done every day. But, after it was built with great care to make a nice input circuit, which tuned well out on both sides of 50 mc, very complete shielding, and an equally nice tuning plate circuit, it had self-oscillation.

Now I've fought this sort of thing since 1938, and that's about 26 years, but I find there's still a lot to learn. So young lads starting out today probably need a little assistance. I sure did. Now what do the books say? Some of the "best" are worse than useless! Listen to this one. "Any amplifier will oscillate if sufficient energy having the same frequency and the same phase as the grid voltage is fed back from the plate circuit to the grid circuit."

If you think a little about the energy fed from a plate to a grid by the internal Cgp of the tube, you will see that this is in *phase* or nearly so. And this is not the proper phase for a vacuum tube oscillator, which as I'm sure you know, should be *out of phase*. Grid going positive, plate going negative, etc. Actually a tube which is self-oscillating does so in spite of the phase effect. There is some phase shift in the small Cgp and the frequency of the plate and grid circuits are *not* exactly in tune either. Remember how a crystal oscillator tunes "up one side" and then jumps out of oscillation?

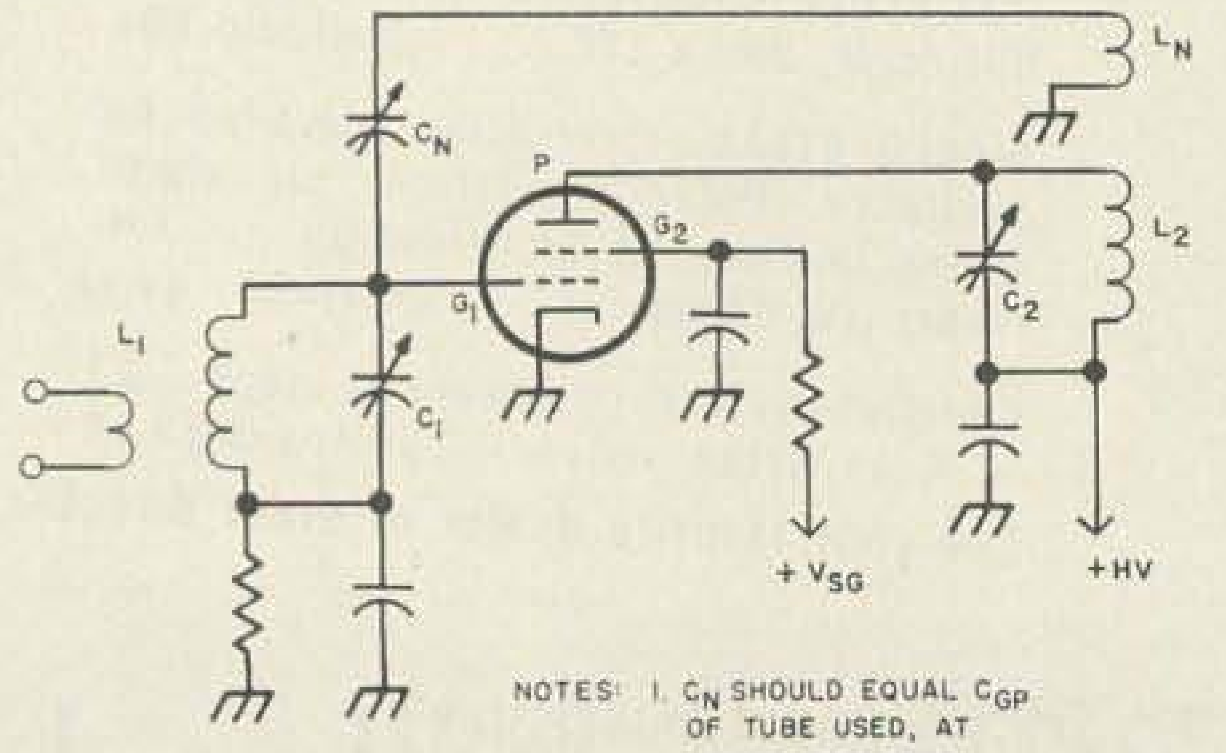

Fig. 1. "Outboard" neutralizing circuit.

Now the funny thing is that proper neutralizing energy which is fed back by the neutralizing circuit is in the correct phase for oscillation! That is, 180 degrees out of phase. Of course, if you will look back at the previous paragraph you will see that the nuisance feedback from plate to grid through the GP capacity is in phase, so that neutralizing energy would have to be out of phase to cancel it.

Let's take the tube I used above, the 5763. Here's a good tube. Used in loads of circuits. Does anyone tell you whether or not it has to be neutralized? No Sir. I haven't found a word on that yet. You look up the Cgp and find that it is listed as only .3 (three tenths) of one micro-micro-farad. That's pretty small isn't it? Or is it? Will it self oscillate? Should you first build a split tank with a neutralizing capacitor over to the grid? You'd think the handbookers suddenly ran out of ink! Let's look at a tube which we know is generally not neutralized. The 6BA6, for example. Ah hah! The Cgp is only .0035 max. Thirty-five ten thousandths of a micro-micro-farad. That's real small!

The 807 has a Cgp of .2 mmf which is where a lot of that tube's instability comes from. In the 2C39, a triode, but generally used in grounded grid circuits, with the cathode the active element that could generate trouble, we find that the Ckp (note, plate to *cathode*) is .035 max. Not quite as good as the 6BA6 but a good deal better than a lot of other transmitting tubes.

So, how do you know when to build a neutralizing circuit in or not? You don't really. The books don't tell you. I generally figure that when the Cgp is in two decimal places or less, like .05, you *may* not need to neutralize. If it's in the tenths, like .2 or more, you probably will. You can also see that due

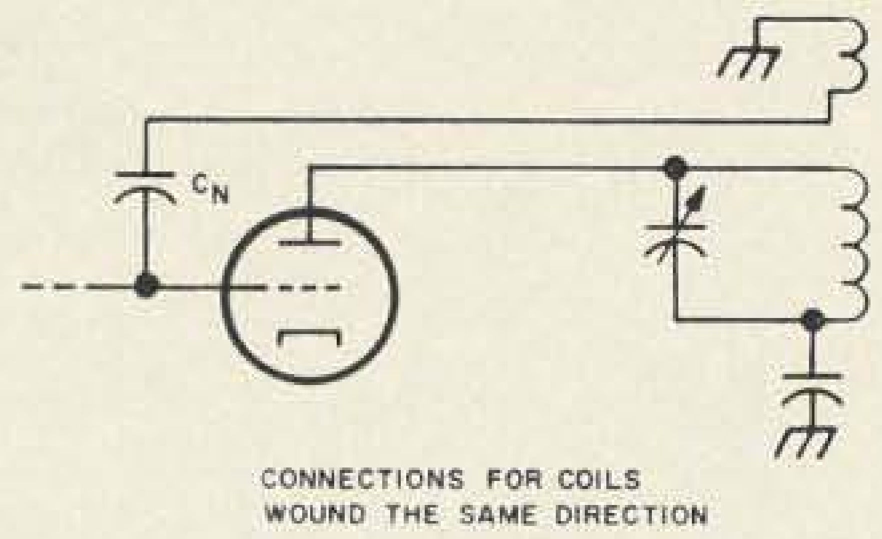

Fig. 2

to the natural-born increase in power through a small capcitor with increasing frequency where this will lead you to on VHF or UHF.

Note that the 6AK5 has a Cgp of .02, quite a bit more than the 6BA6. The 6AK5 was found in lots of places where perhaps it should not have been, but all's fair in love and war, and that was a war tube.

One of my favorite transmitting tubes is the quick-heating 7 watter, the 5618. However, its Cgp is .24 so I have always had to neutralize it.

So by now you get the general idea, and if you did build that amplifier without the usual neutralizing tank circuit, or can't make up your mind, or just plain don't want to, never mind. We are about to show you how to add it on later as an after thought. Easy like. You know, "No time like the future for things that don't stuit yer." Of course, you *may* belong to the "No time like the present for things that aren't pleasant" school.

Actually, this neutralizing circuit works even with a high-gain grounded cathode triode on two meters, so I'm going to try it every time from now on myself. Even on 432 I hope.

So far it has worked every time. Just build up a good grid circuit, use good shielding, a good plate circuit, fire it up, watch your grid drive go as you tune through resonance with the plate circuit, and then go to work and neutralize it. Of course you can build it in first, if you insist.

Just put a few turns of reverse phase winding (Ln) in or around L2 and couple it over to the grid, through the shield, with Cn for amplitude adjustment. Remember that this reverse phase is just what the doctor ordered

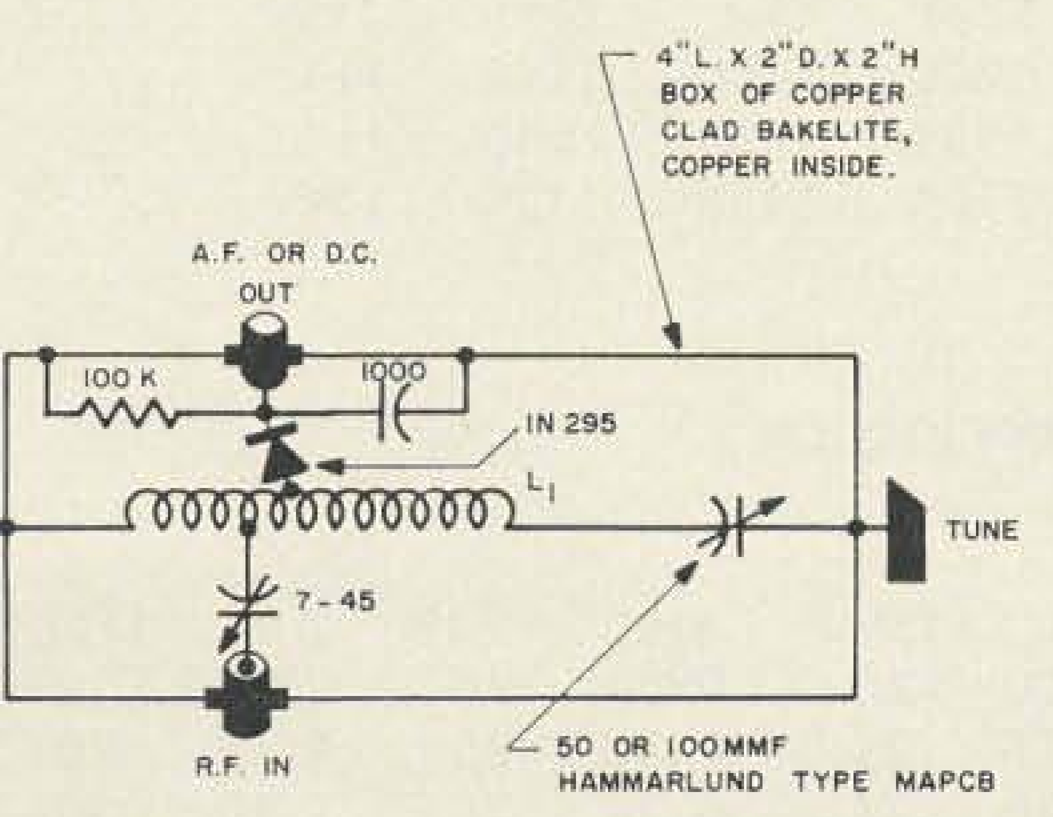

Fig. 4. Tuned detector.

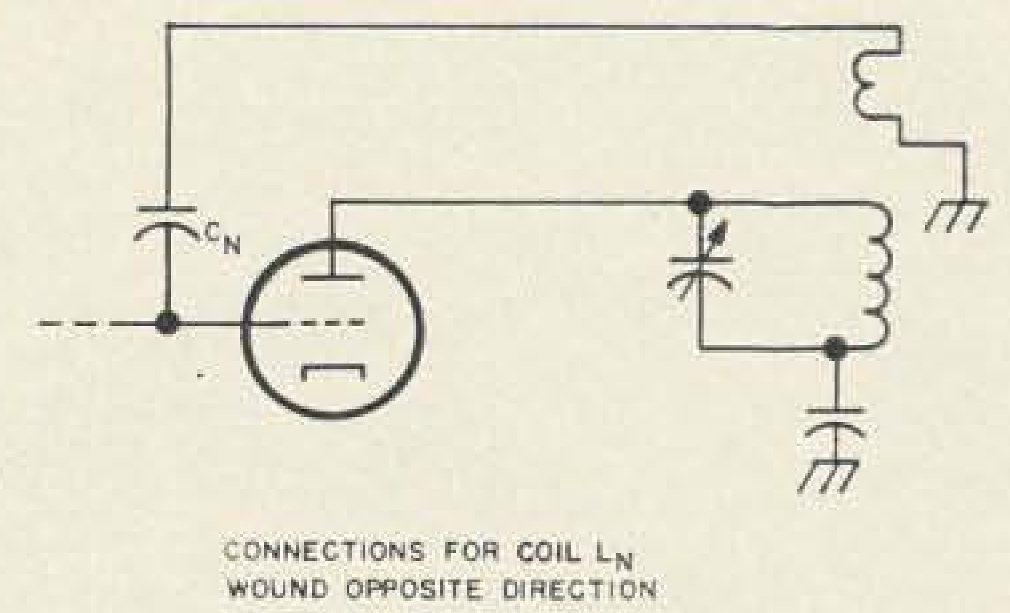

Fig. 3

to make an oscillator and can be done in more ways than one. If you wind Ln in the same direction, that is clock-wise, or counter-clockwise, as L2 is wound, use the opposite end from the plate to get the out of phase energy. See Fig. 2.

If you wind it in the opposite direction from the plate coil L2, use the same end to get the out of phase energy. See Fig. 3.

There's a real fancy deal going on here in fundamental magnetic coupling like left and right hand snail shells, but we'll leave *that* to the *Scientific American*. Some smart transformer people can wiggle three fingers so as to point in three different directions at once, and call this the magnetic rule of thumb. Never mind, just remember "with a tube oscillator coil, put the plate on one end and the grid on the other."

Also, you can put Ln almost anywhere and it will work. On the end of L2, interleaved, inside L2, or outside. I've tried it.

To adjust Cn, do like the books say. I use a tuned circuit detector. It helps to be sure just what frequency you *are* neutralizing. Plug the detector right into the output jack, but, unless you have lots of spare diodes, don't turn on the amplifier plate and screen supply!

It is really helpful to watch that meter (the diode meter) go down to, or near, zero, in the neutralizing null. It kind of restores your confidence in the fact that, if the theory you're using is correct and if your circuit is built right, it is a law of nature that it must work! And, I almost forgot, you can use that same detector, with a little transistor amplifier and a pair of "Hi-Fi" padded earphones, the kind with the real big large pads on them, to listen to your own modulation. But don't plug it into the rf output with the power on! Just have it nearby! And be sure it's the *diode* you're listening to. The af amplifier can pick up rf and rectify it plenty loud, but you won't like that modulation. Another reason for the tuned detector. It works FB for almost any purpose. It also goes to 432, with a strap for L1. Also ditto for a 1215-1296 megacycles detector.

I hope this helps you to make better rigs easier, especially on VHF and UHF.

. . . K1CLL

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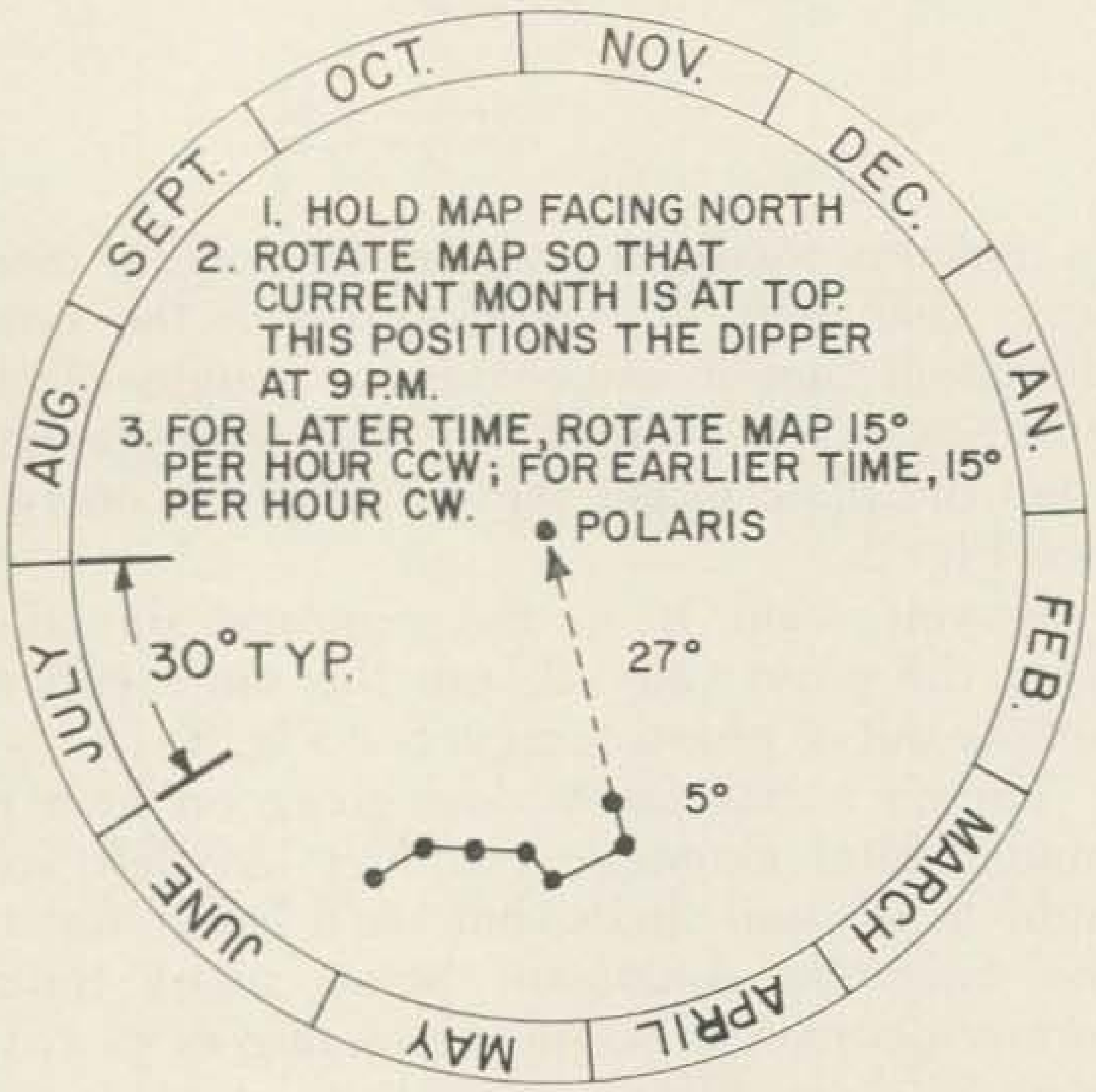
Burlingame, Calif.

DIAGRAM A



Polar vs. Solar Beam Orientation

One of the common methods of orienting a beam antenna is to align the boom in the direction of the Pole Star. Since Polaris rotates daily counterclockwise around the north celestial pole in a circle whose radius is approximately 1°, the error in true north indication need not exceed 1°.

To assist in locating the Pole Star, the "Pointers" of the Big Dipper are often used as a guide. Instructions are given in Diagram A for proper identification of the Pole Star.

Using the angular distance of 5° between the Pointers as a yardstick, one easily identifies Polaris as a fairly bright star (second magnitude) 27° from the top Pointer at an altitude above the north point of the horizon corresponding to the observer's latitude.

The Polaris method of beam orientation is not available to observers in the southern hemisphere because there is no accommodating star of comparable brightness close to the south celestial pole. One shaft of the Southern Cross (Gacrux to Acrux) points roughly to the south celestial pole and could be used in a pinch. On the other hand, the solar method is good anywhere in the world

TABLE I LMT OF SUN'S MERIDIAN PASSAGE

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	1203	1214	1212	1204	1157	1158	1204	1206	1200	1150	1144	1149
10	1207	1214	1210	1201	1156	1159	1205	1205	1157	1147	1144	1153
20	1211	1214	1208	1159	1156	1201	1206	1203	1154	1145	1146	1157

TABLE II DIFFERENCE OF LONGITUDE CONVERSION
(time in minutes)

ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME	ARC	TIME
0°00'	0	1°00'	4	2°00'	8	3°00'	12	4°00'	16	5°00'	20	6°00'	24	7°00'	28
0 15	1	1 15	5	2 15	9	3 15	13	4 15	17	5 15	21	6 15	25	7 15	29
0 30	2	1 30	6	2 30	10	3 30	14	4 30	18	5 30	22	6 30	26	7 30	30
0 45	3	1 45	7	2 45	11	3 45	15	4 45	19	5 45	23	6 45	27		

at any latitude and longitude.

All one need know is his approximate longitude and the local mean time (LMT) of the sun's meridian passage. Table I lists this LMT on the first, tenth, and twentieth of each month. These values do not vary by more than about one minute from year to year. Even if the time is in error by four minutes, the angular error of the sun's direction is only 1°.

Since our clocks are based on standard or zone time, it is necessary to apply a longitude correction, converted to time units by mean of Table II, to the nearest standard meridian. The standard meridians are theoretically spaced 15° apart to the east or west of the Greenwich prime meridian. If the station longitude is east of the standard meridian, subtract the difference in longitude in time units between your station and the nearest standard meridian from the LMT; if the station longitude is west of the standard meridian, add the longitude difference in time units to the LMT. Thus, Standard Time or Zone Time = LMT ± Long, Dif. to Stand. Mer.

To demonstrate the simplicity of the solar method, two examples are chosen.

1) What is the standard time of meridian passage of the sun at Longitude 118°20′ W on June 15?

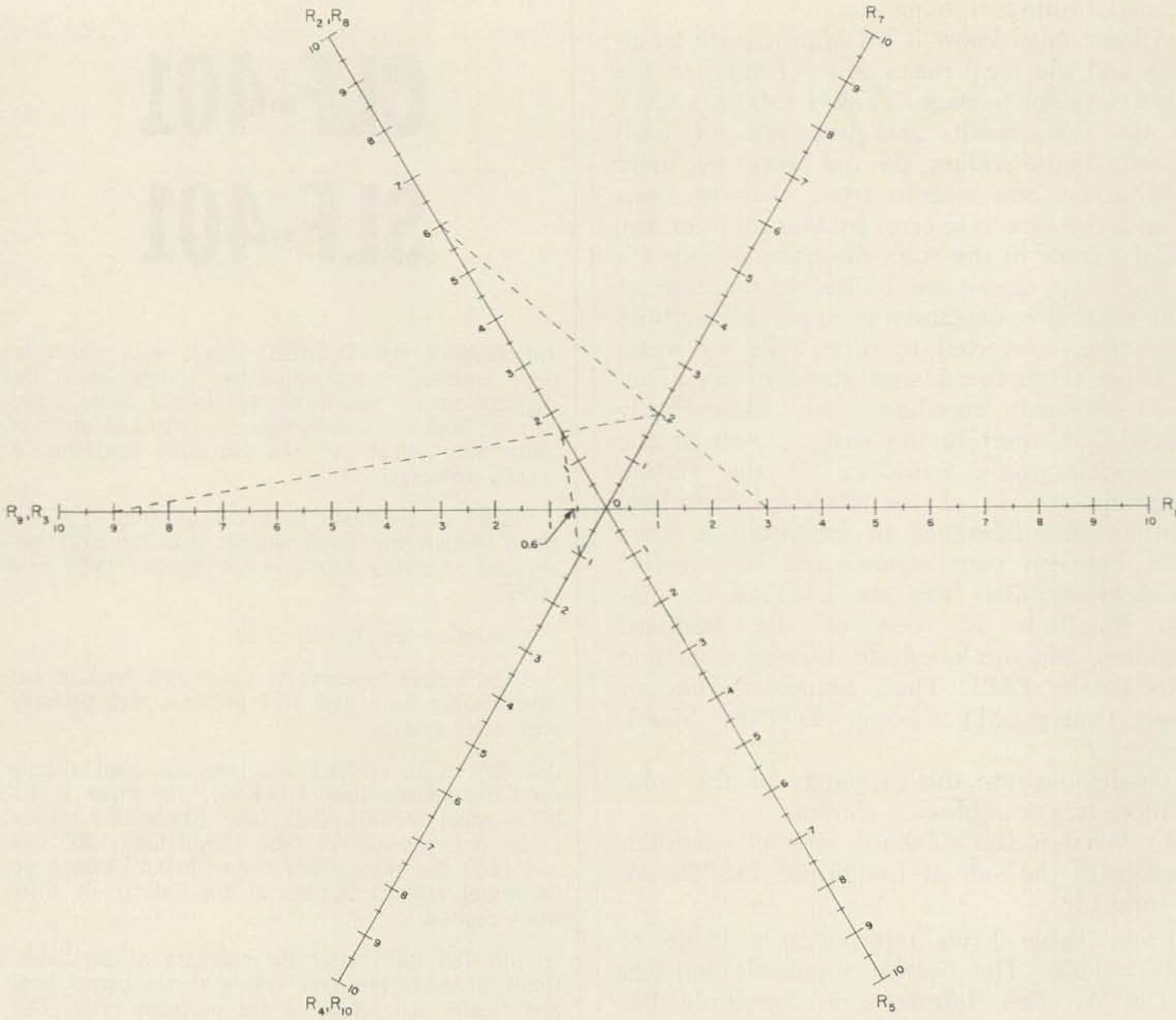
From Table I we interpolate a value of LMT = 1200. The nearest standard meridian is 120°W. The difference in longitude between the station and the nearest standard meridian is 1°40. From Table II this amounts to 7 minutes. Since the station is east of the standard meridian, Pacific Standard Time of the sun's meridian passage is PST = 1200-0007 = 1153.

2) What is the standard time of meridian passage of the sun at Longitude 40°19′E on December 8?

From Table I, LMT = 1152. The difference in longitude between the station and the nearest standard meridian of 45°E is 4°41′ which by Table II is equivalent to 19 minutes. Since the station is west of the standard meridian, Standard Time of sun's meridian passage is 1152 + 0019 = 1211.

About one minute before the sun is due south or north depending on your latitude, put on your dark glasses, stand back, point your antenna boom toward the sun as it crosses the meridian, and set your direction indicator. It's so simple; why bother to orient your beam at night with a fumbling flashlight?

. . . W6TAQ



Parallel Resistance Nomogram

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Solving for the resistance of a parallel resistance combination can be a tedious job, especially if there are more than two resistances in the combination. Series capacitors present exactly the same problem. The equation

$$R = \frac{R_1 \quad R_2}{R_1 + R_2}$$

is fine for two resistances, but even this requires computation. The above nomogram allows solution of this type of problem in seconds, with an accuracy of 3% (most resistors have tolerances of 5% or 10%). In addition, this nomogram can be used for any number of parallel resistors or series capacitors.

A glance at the nomogram will reveal that the scales are calibrated from 0 to 10. It is very important to use resistors whose multipliers are the same (same number of places after the first number). Cases where the multipliers are different will be explained later. The operation of this nomogram will be best explained by the following example.

Suppose we have a parallel combination of resistors with characteristic numbers of 3, 6, 9, and 1. These could be, for example, 3,000 ohms, 6000 ohms, 9000 ohms and 1000 ohms, or, 30000 ohms, 60000 ohms, 90000 ohms and 10000 ohms. Let us take for our example the parallel combination of $R_1 =$ 3000 ohms, $R_2 =$ 6000 ohms, $R_3 =$9000 ohms and $R_4 = 1000$ ohms. To solve for the equivalent resistance of the circuit: connect "3" on the R_1 scale with "6" on the R_2 scale. From the point where this line crosses the scale between these two, draw a line to "9" on the R_3 scale. Again, from the point where this line crosses the intermediate scale (R_2 scale) draw a line to "1" on the R_4 scale. The point where this crosses the intermediate scale is the equivalent resistance, which in this case is 0.6. Since each resistance was one thousand times the characteristic number, the equivalent resistance is 600 ohms. If there were more resistors in parallel, we would continue in this manner, always in a counterclockwise direction.

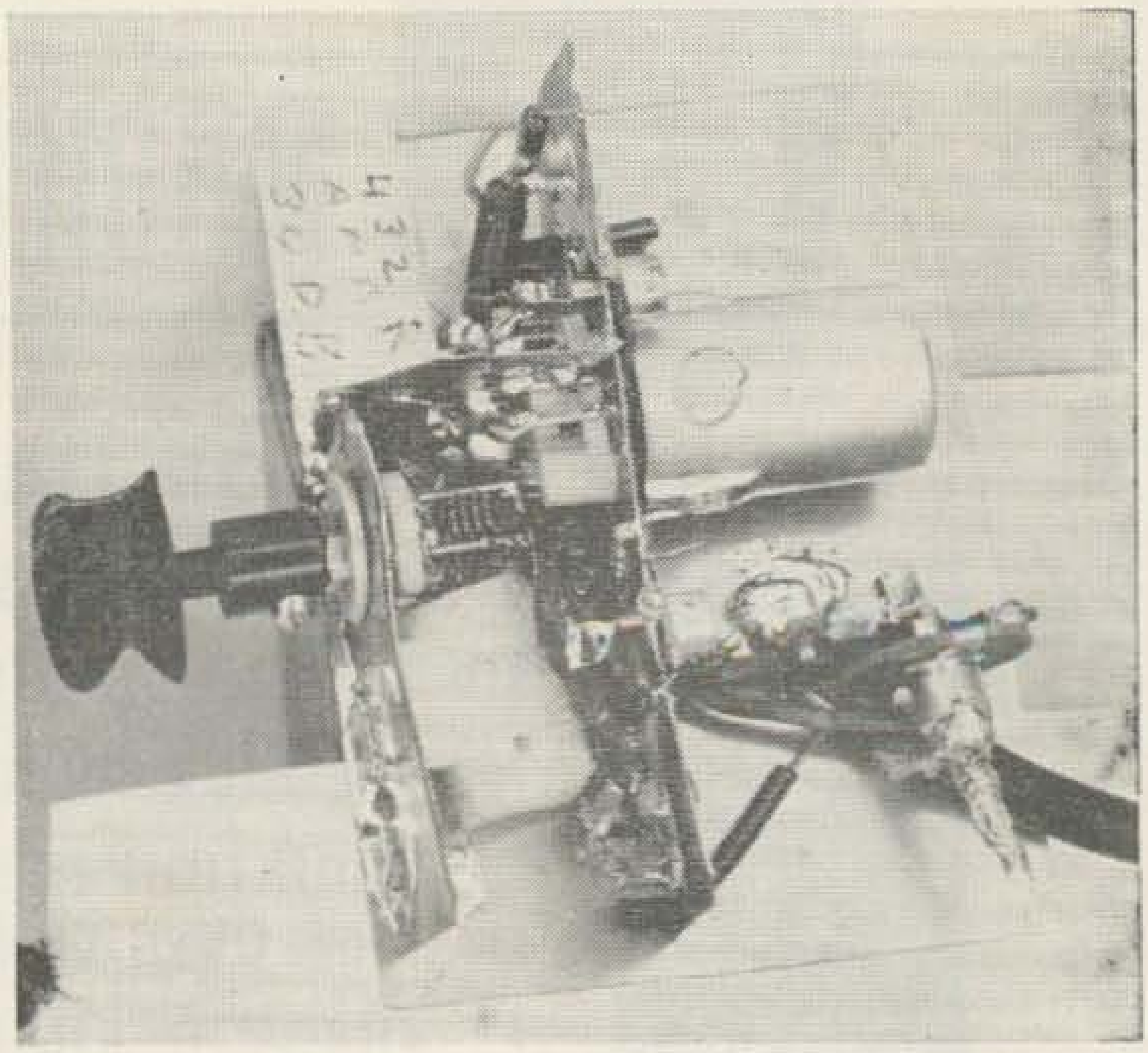
If we were working with series capacitors of values, for example, 3 pf, 6 pf, 9 pf, and 1 pf the result would be 0.6 pf.

Going back to our resistor problem, suppose in addition to the four resistors above, we also had in parallel a 200 ohm resistor. Since this is just like having a 200 ohm resistor in parallel with a 600 ohm equivalent resistor, we simply connect the "6" point on R_1 with the "2" point on R_2 and read off 1.5 or 150 ohms. Doing it takes less time than explaining it.

. . . WA2BWQ

Another RF amplifier for the 432'er in July '64.

RF Amplifier for 432



Bill Hoisington K1CLL
Peterborough, N. H.

Digging hard into the practical possibilities of low-cost amplifier tubes for 432 megacycles, we found (after building an odd ½ dozen or so amplifiers) that well over 20 db gain is possible with a 6AM4 tube at this frequency, with a stable circuit. Including this high gain unit, we are thus describing three 432 megacycle amplifiers using tubes, which should be enough to choose from.

This one, (see Figs. 1 & 2) using a straight ¼ wave line beginning with the grounded end of the plate strap line, through the socket pins, on through the plate structure itself, and ending up with the top of the plate as the hottest to rf (or open end portion of the line), seems to have more gain than the previous one described in which the plate was tapped on to the plate line. You have to be more careful with unwanted grid inductance though, due to the gain. This is the inductance you *don't* want, and that you thought you eliminated by grounding all those five grid pins!

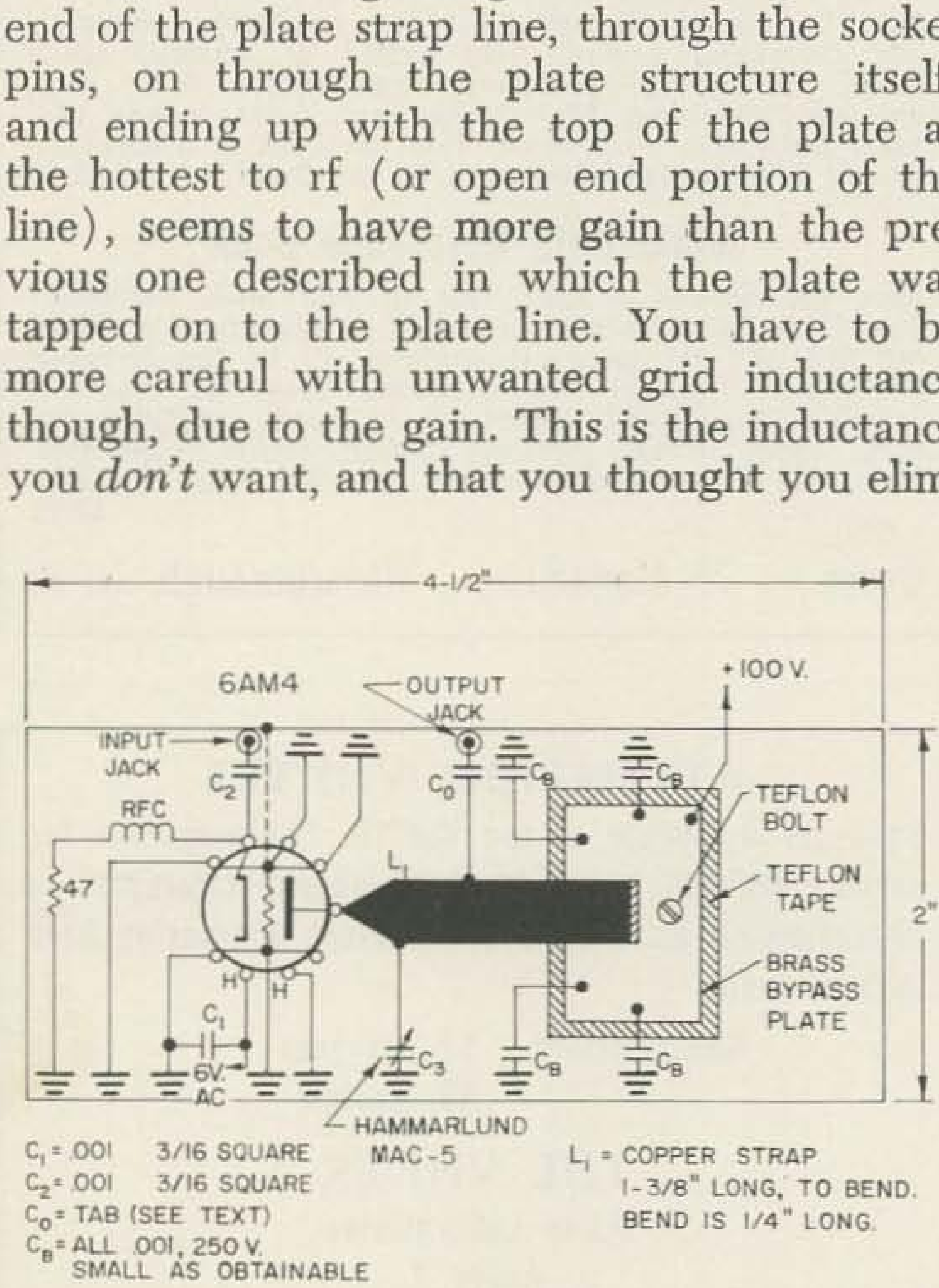


Fig. 1—Front "inside" view of rear wall—high gain 432 mc Amplifier

Also, just as a confirmation of the old warning about bakelite on high frequencies, I built one of these units with a bakelite 9 pin socket. Gain of about 9 db! Ugh! Nuff sed.

It really pays off at 432 to look up and get the thin version of the porcelain sockets. This thin version allows the socket pins to grab the tube pins way up close to the glass.

Note that the plate structure of the tube (to a certain extent) along with the shield of the tube, forms a partial cylindrical cavity for the plate cicruit.

Fig. 1 shows a view of the back wall of the unit. In a sense, everything except the tuning capacitor is referred to the back wall as ground. It is hard enough to find a "ground" at 432 megacycles, so I'm mentioning this one. It is quite efficient also. Items needing such rf reference to ground are: the input jack outer conductor, the five grids, the two heater connections, the rf output jack outer connections, the plate line cold end bypass capacitors, and the tuning capacitor. This last is actually referred to the *front* wall, but that is still OK, if used as shown.

Still talking about grounding, I also used on one of the units a socket which was definitely *not* UHF. It was of good porcelain, but the pins were quite *long*. With everything buttoned down tight I still got feedback oscillation at one spot on the dial (without plate load). With all the five grids grounded, one of them made a loop about an inch long—starting from the wall, up to the pin, and down through the tube base to the actual grid structure. This was enough to cause the feedback. Note (as mentioned before) this is a high gain, high Q job. Operating without the plate load is, of course, done intentionally in order to *find* the feedback. With the over 20 db gain, this means that one microvolt coming back to the grid circuit (supposedly grounded) can produce over 100 microvolts in the plate, etc., etc. The remedy was to strap over all the grids. Better, of course, is a thin UHF socket.

The results with this amplifier were worth the effort. A good tuning range is obtained with (for this frequency) a large "store-bought" parallel tuning capacitor, running from under 400 megacycles to over 475. This can be trimmed later if you wish. No oscillation occurs, even with the over 20 db gain. The nice thing about this much gain is that you can throw away some by overcoupling the output circuit if you want to, for greater bandwidth. Co does this. Co is a small copper tab about ½ inch long soldered directly to the output jack center conductor. It lies flat against L1, which has Teflon tape over it at this point, and can be bent closer or further from L1 as needed. This adjustment depends on mixer loading, cable, etc.

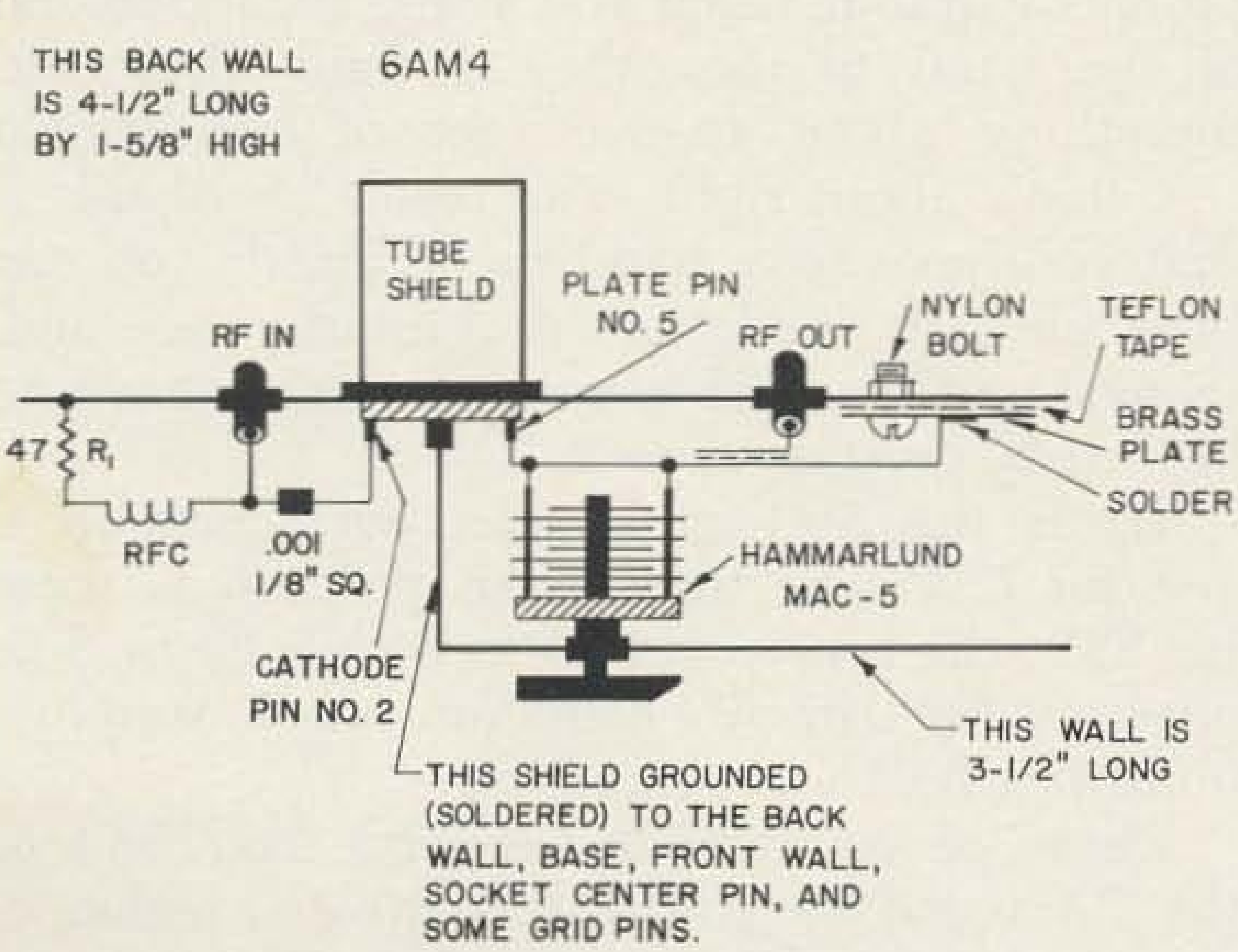


Fig. 2—Top view, 6AM4 high gain wide range 432 mc Amplifier

The high Q of this circuit should keep out lots of unwanted signals. Don't forget 70 more Tee Vee channels are coming up! And all of them *above* 432!

The plate return or B plus bypassing, has now become a "science" here. A thin brass plate about ¾ inch by one inch is bolted onto the wall, with Teflon between. Then four 1000 mmfd discs are soldered on. These must be the smallest you can get that will take 250 volts, and the leads must be about 1/16 of an inch long. No more!

Just a reminder here of another tube choice, the 6AN4 job, also in 73 Mag. So now you have a choice of three amplifiers for 432. Solid state ones being written up also. More coming. . . . K1CLL

The National HRO-500

Wayne Green W2NSD/1

Perhaps I'm not the best person in the world to test something as expensive as this. When the original HRO came out some thirty-odd years ago I looked at it with awe and longing. By the time I finally could afford one they were just a little out of date . . . about two years ago.

But here I sit, through the kindness of National, with an HRO-500. True, it has to go back, but in the interim I will be able to mention to a few hundred fellows quite casually that, yes, I'm using the 500 here.

The more I use the 500 the more convinced I am that all ham receivers will eventually have to adopt the one kc per division type of tuning. The old HRO had that on some bands . . . as did the NC-101, and it is awfully easy to get used to. Collins cottoned on to this idea too.

The 500, being transistorized, snaps on immediately when you flick the switch. I like that. It gets me on the air a lot more than when I have to turn on my receiver and wait for it to warm up so I can hear what is happening. Perhaps I am more impatient than most people. Of course not only is the warm up period almost instantaneous, so is the warm up drift period. Brings to mind my old SX-28, which used to drift about 50 kc on 20 meters as it warmed up to its task. When I remember that, I guess I'm not quite as furious over the garbage eating W2 that borrowed it one day and proceeded to sell it and pocket the money.

The general coverage receivers that I've used in the past were never quite adequate for optimum ham band usage . . . the 500, which tunes continuously from 5 kc to 30 mc, seems to sacrifice nothing for this flexibility.

The most unusual aspect of the 500 is the frequency synthesizer which permits you to tune any 500 kc segment of the five bandswitching bands. The basic bands are:

0-1.5 mc; 1.5-4.0 mc; 4.0-10 mc; 10-20 mc; 20-30 mc.

As you tune the synthesizer the first numbers of the frequency you are tuning light up over the dial. The PW dial is calibrated to one kc and the 10 kc readings are indicated in the PW windows. By the way, one turn of the outside PW knob equals 10 kc, which makes tuning in QRM a snap, though it gives you a bit of a workout when you swing from one end of the band to the other. I think they said something about twelve feet of bandspread . . . that's about right. The result of all this is that you have sixty bandspread bands you can tune, all with one kc per dial division . . . and, thanks to the synthesizer, you don't have to have sixty crystals to do it.

While the 500 cycle selectivity position is fine for CW and the 2.5 kc position is great for SSB, the receiver does have a 5 kc to 8 kc position for "hi fi" listening or, I suppose, multiplex RTTY or something.

Those of you who have used the 75A4 or the 2A receivers will appreciate the value of the passband tuning on the 500. This is wonderful for SSB and CW work where QRM is a problem . . . something not altogether foreign to our amateur bands. Another handy gadget when the interference piles up is the "Rejection Tune" control which swings a deep notch (50 db) across the passband for you, removing heterodynes.

The Automatic Gain Control system keeps the output steady within less than 10 db with a variation in input of from 5 to 50,000 microvolts: There is also an adjustment for matching the action of this circuit to various levels of background noise.

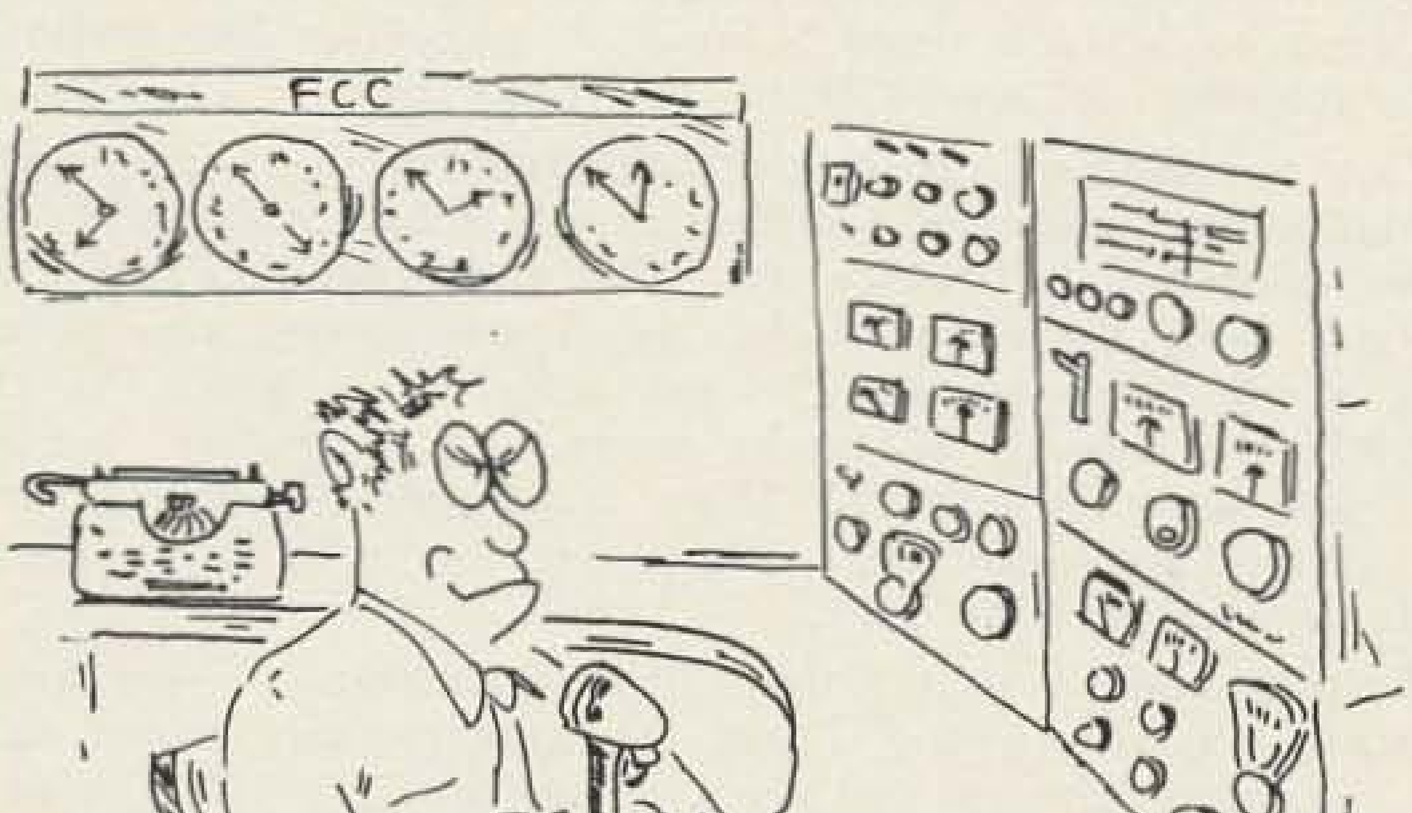
The S-meter is calibrated accurately. Who knows what will happen to us when we can believe S-meters. Imagine the impact on DX stations when you tell them what their signal strength really is! I've been doing this and for some strange reason many of them have taken a second look at their S-meters and lowered my signal reports. Hmmm. Honesty is the best policy and the 500 *is* honest.

Another nice feature of this receiver is that it will operate directly from a 12 volt source if you want to use it in the car or on a trip. The 200 ma that it draws doesn't even strain a small lantern battery . . . imagine, you can get far away from all line noise and hear what a radio should really sound like.

Oh, there are a lot more interesting features to the 500, but if you go out and spend $1300 for a receiver you certainly want to have a few surprises waiting for you.

I dunno who is responsible for making the HRO-500 look so good, but they should get a raise.

. . . W2NSD/1



"OK on this being your 496th skip contact on CB, OM. We do QSL . . . as a matter of fact, I'm making out a card for you right now . . . ."

Letters

advised by my lawyers that
don't you ever proofread y
are a bunch of crooks and
th... for
have no other recourse but
should be tarred and feath

Dear Wayne:

In reference to the June issue of the 73 magazine, Letters, portion, many of us of the Yakima Amateur Radio Club, have read the letter from the person who calls himself the Yakima Ham, and wish to state the following:

First, a person who uses such words as hell, you nut, and etc., apparently does not have any other way to express himself.

Second, we feel sure that the said letter would never have been approved by the club, while we may or may not agree with statements you have made in the past.

Third, we strongly feel that anyone who does not have the decency to sign his name to a letter, should not be allowed to have the letter published. As, even in court, the one has the right to face his accuser.

Fourth, to our knowledge, no so called CHECK has been made on your so called charges.

Garrett Derrey W7ZMS, Pres.
Yakima Amateur Radio Club

P.S. This letter has been read and approved by the Board of Directors of the Yakima Amateur Radio Club.

1. Hell nut, etc., are expressive. 2. Thank you. 3. Signed or unsigned the chap who sent the letter has a view which should be considered. 4. Check the "charges" and see if I'm lying. Many others have verified every statement that I have made.

Dear Wayne:

I just don't understand how a person that can put out such a wonderful technical magazine can be so far off base in the field of amateur radio politics! Referring to your June editorial I can agree with only a very few of the points you are trying to make. I do not feel out of line in making these statements because in all my conversations with other hams the majority of them feel the same —i.e., that you are some kind of nut! !

At a recent club meeting there were over 85 members present and Docket 15928 was discussed. There was no hostility to it at all. With two exceptions most people appeared to accept it. The Call Letter changes and Advance Class Downgrading were the only exceptions. They didn't feel like the ARRL had pulled any kind of swindle. From monitoring many QSO's here on the West Coast I get the impression that the greatest majority of the people feel the same way.

Now the question is—are we out here on the West Coast getting an incorrect picture of the overall opinion—or are you indeed "some kind of nut"?

I certainly don't like you to be the spokesman for the group if you are not reflecting the true picture.

Please take stock of this thing again, are you just trying to sell magazines or are you truly doing the best thing for amateur radio?

Ed Munsell W6PCP
Los Angeles, California

Dear Wayne:

I would like to see you champion some CW privileges on one or more of the low bands for Technicians. It seems to me this goes along with increasing the Novice to two years and incentive licensing. Despite the FCC's intent, the Technician license has become an intermediate step to the General. Now it is extremely difficult to improve one's CW (on the air) on the VHF frequencies alone.

John Ott K9AHX
Lafayette, Indiana

John, when someone comes up with a good reason why we should continue the CW test, I might go along with you.

Dear Wayne,

Got to looking at ARRL/QST leadoff idiotorial in April QST. This is probably their April fool item. It does not flatter those that read it. Like "In fact, by the power of his ballot, the member can *require* that his representative take the time and make the effort to become adequately informed as to membership needs and desires."

Like Mort Kahn didn't do for the last few years of his directorship, maybe?

Wonder what you can make out of this:—I wrote Dick Baldwin some time ago and getting a reply was startled to note that he was now "Assistant General Manager." This got me to thinking . . . went thru QST's back to mid year of 63 (I think) and he was still listed in QST as Editor, but not A.G.M. for June QST of said year (June mag going to press sometime in mid-May I reckon) . . . but looking thru later issues found that the switcheroo took place in 2nd half of said year . . . got to looking up the minutes of ARRL Bored of Directors, also Executive Committee minutes (as reported in Q-ST) but no information. Looked up all notes about changes in staff (Parenthetical thought: did you ever notice that they tell of upward changes in their staff, but seldom if ever tell that Joe Blough left to go to work elsewhere?))

Anyway, I looked all around in those "Happenings of the month" and while they reported about some office-clerk going up by half-a-notch, no news about Dick Baldwin and his elevation to AGM. I responded to DB's letter by the way & offered up congrats upon his elevation to heir-apparent status & asked "when did it happen?" but he was mum about this 110%. Hmmm . . . I wonder . . .

Wrote to League a month ago. Said please send annual report (copy or summary) so I can see how we're doing. Got reply as follows: "Dear OM: Enclosed is our statement for 1963. The 1964 one is now in the works, but won't be available until after the annual meeting of the ARRL Board of Directors in May. 73, Gary L. Foskett, W1ECH Assistant Secretary" I responded last week, but I felt that maybe you could put the thought to greater function. I commented, in effect: Thanks, but I still would appreciate a copy of the 1964 annual report. . . . I own stocks in a couple small corporations, belong to a couple of fraternal & charitable organizations, etc. and they all depend upon my interest and confidence in their operations for my continued support. With annual reports coming out in June (After B o D annual meeting & approval, plus trip to printers) when everybody's thinking of vacation, how can the typical Joe Blow League member think intelligently with 6 month old information (even if bona-fide)?? *In short, how can the guys in the League tell the Directors what to do in the year ahead, if the HQ gang says you can't have 64 report until mid-65, after the Board meeting?* In newspaper game, saying sez: "Nothing so dead as YDA's news." So . . . get your hot rreports here fellows, get em 150 to 180 days old!!

Got to thinking, it might be advisable for some righteous-looking member to inquire of ARRL, "Kin I see your contribution books for the new Bldg Fund?" I wonder who these wonderful gentlemen were who promised to pony-up on the 2-for-1 offer. You know, if the ARRL put up 10 K bucks more, the "mystery donor" will put up another 10K. Who could the mystery donors (mystery sponsors) be?? They say he who pays piper calls honorable tune . . .

Firmly believe that your editorial balance is *very good*. I sense (maybe wrong) that the average guy won't take too heavy a diet of criticism, even tho it's 100% right. That's human nature for you. Look what the English people did for Winston Churchill. He did everything right most of the time during WW2, but the British voters still "turned him out" at the polls in '46, or rather the party he headed. Hi.

Believe strongly that your main rock-of-support is in having an excellent technical journal . . . keep the FB technical stuff flowing & you'll see that the readers will not object to your continual fault-pointing!

I apprehend—from reading between the lines—that this must have been your decision already. . . .

Neil Johnson W2OLU
Tappan, New York

ARRL VHF Manual

I just received a long awaited copy of the ARRL *Radio Amateur's V.H.F. Manual* by Ed Tilton W1HDQ. It's quite a bargain—over 325 pages for only $2. The book is written particularly for beginners, so it's perfectly understandable, but contains plenty of interest to the most advanced VHF ham as well. The first part of the book gives a brief history of VHF hamming and a discussion of the capabilities of the VHF bands. Then chapters are devoted to theory and practical construction of receivers, converters, preamps, transmitters, antennas, test equipment, etc. Most of the projects and information in the book are adapted from *QST* articles (In fact, the extensive bibliography doesn't even hint that other electronics magazines exist), but many of the projects are new and interesting. I have a few small criticisms, such as the scarcity of transistor projects and the great amount of space devoted to condensation of the recent *QST* articles on UHF pulse systems in contrast to nothing practical on the simple duplex system that is more likely to appeal to beginners. Antennas seems to be shortchanged, but the 73 *VHF Antenna Handbook* will take care of that for you.

But these are minor criticisms. All in all, it's an excellent book and one that every VHF'er and prospective VHF'er will want to have. The newcomer will find that it contains a tremendous amount of practical information. The old-time will find some new projects, valuable reference and lots of opinions to argue about in time-honored ham fashion.

. . . WA1CCH

". . . and dear, Rodney's been the best little boy. He went into your hamshack three hours ago to play and I haven't heard a peep from him since."

Letter from Gus

Bhutan, June 13, 1965

This is being written on my last day in Bhutan. During the past 5 months I have been into ALL the AC areas. I have had (without counting them exactly) over 30,000 QSO's on this trip, over 5,000 from AC3 and about that same number from AC4. Over 2,500 QSO's from each AC spot. If anyone needed AC spots for a new one I surely hope that they have worked me by now. With the total of something like 20,000 or so QSO on my first stop here a few years ago, the total is now something like 50,000 QSO's from AC lands. I believe I have had more QSO's from AC land than I have had from W4BPD!

I want to tell you of operating here. This is certainly the hardest spot in the world to work the USA. W4 this time was the hardest place to QSO, W8 was second hardest, then the rest (starting with the easiest): W6, W7, VE8, VE7, W2, W1, W3, VE2 and 3, W5, W9, WØ. It was not due to the fact that I was not on the air, you can bet your last buck I was there trying my very best to open up the band. Every day I was on starting at 2300 until 0330, then again at 1100 until 1830 GMT or until the band folded up completely. Boys, it was not ME, it was conditions. I tried my very best to dodge what QRM I could. Those commercial RTTY stations on 14035 and 14065 caused me lots of trouble but I would try and sneak as close to them as possible, usually just below them a kc or two. On this portion of my trip I was stuck with transceive. I altered a transceiver here by adding a small trimmer condenser to it so I could tune about 12 kc below my operating frequency. It worked fairly well, but was NG to work the boys in the USA ssb portion. I did have an old beat-up BC-348 that I had pepped up somewhat and this was used when I worked the ssb boys. The best frequency seemed to be around 14101 or another fair frequency towards the end of my stay was around 14135 to 14140 kc. During the past week or so I have had to stop trying to work the USA boys on ssb because the power transformer went up in smoke in the BC-348. I have found that this 50 cycles gives a regular power transformer a fit. I suppose if the rig I were using was operated as a regular ham would operate it, maybe 3 or 4 hours each day, it would be all OK for a long time. But when you operate each day 4 to 5 hours in the morning and then again 9 to 10 hours every night, and 50 cycles (maybe even 40 cycles—they do this to conserve petrol) then you can expect things really to heat up—and brother they DO. After the first 2 hours you can't hold your hand on the power transformer—I don't see how it takes it. Of course, I turn the rig off everytime I get a chance, even when I say QWC one boys, or gas in putt-putt, or chow time. If turning it off these few minutes cooled it down I certainly could not feel the difference BUT theoretically it should—so I did it every chance. Maybe the one in this rig is fire proof! You should see this poor old Hy Gain model 14AVQ antenna I have. The boys out in Lincoln, Nebraska made this one up specially for me, the maximum length of any portion of it is about 3 feet, with every section slipping into the next section. The spot to stop at on each section was marked with a Markall. This one now has gone up and down I suppose 20 or more times. It's been mounted many different ways, on many different supports: it's had a real beating, let me tell you. Usually the support is a big. bamboo pole about 60 or more meet high. These bamboos when they are green are quite heavy. The people who help me put it up usually cannot speak English, they have had no experience at all in putting up or taking down poles, so about 25% of the time they will let the pole get out of control, especially while taking it down, and then it's slam-bang and the whole works flat on the ground. It's murder to the antenna: it's been bent (a few that will never come out), the traps are pushed in: in other words, it's a MESS, the darn thing still works FB and the SWR is still very, very low. It works a lot better than it looks.

Something I just cannot understand is why at almost every place I operated that it's very easy to work the W2 boys. If you take a map of the world and look at it and place a circle around W2 area and another around the AC area all you have is two small dots on a map. Can anyone explain to me why it was possible to have QSO's with just this W2 area without any difficulty at all, practically every day? Do you think maybe that the W2 boys have a better organized group to hunt the DX and a better system to alert them to the fact that DX is on and coming through on such and such a frequency?

On this trip into the AC lands I got to know the people a lot better and really saw the country. They have lots of strange customs up there. What do you think of trying to chase evil spirits or devils out of a power plant by burning yak butter lamps in each corner of the room: burning all kinds of very bad smelling things all around the power plant and then pounding on the plant itself, then praying to it, sprawling out flat on the floor? Well I have seen this done and many many more such things are done in AC lands. This applies to transmitters and receivers also. After seeing and hearing of such things they begin to get you down and it looks like a lost battle when you are doing your very best to assist them in getting things repaired and in good working condition.

I found a few very fine spots to operate from up there. Take AC8 area. You come into a big wide valley that's about 5 miles wide. Right in its middle there is a hill about 2.500 ft. high with no trees on top at all. You climb up there and then pull out your compass and BOY oh BOY the valley runs exactly NORTH and SOUTH, which is in the exact direction for the USA, either by Short Path or Long Path. There are any number of spots here and there you come across. Well, it's 9N1MM land next fellows, and after that, plans are not definite yet. Sure hope to work you all from every spot even if you don't need it for a NEW ONE! I like lots of QSO's!

. . . Gus

VHF

Bill Smith K CER
1301 Churchill Ave.
Sioux Falls, S. D.

Last month I said that we would look at circular polarized antennas this month. Unfortunately, a heavy work load and never-ending weekend rains have prevented raising the antennas. Will try again next month.

From my participation in the ARRL June VHF contest, it seems that six meters was open for all areas of the country, far different from last year. There should be some excellent scores.

Tropospheric conditions are finally starting to come around in the midwest. The large stationary front which brought rain and devastation by flood waters in Colorado during the third week of June led to the first tropo opening in the midwest since January sixth. Stations in South Dakota and Minnesota worked south to Texas, east to Arkansas and all points in between. K5WXZ, W5AJG and W5JWL put good two meter signals into the upper midwest boosting states-worked totals. The signal levels were not especially strong but they were in for parts of three days. Better start watching the stationary fronts from now until late September.

Sam and Helen Harris (W1BU, W1FZJ, W1HOY) have moved to Arecibo, Puerto Rico, where Sam will be working with the 1000 foot reflector. KP4BPZ was to have been active on 432 mc moonbounce July 3. Another test is scheduled for July 24 beginning at 1110 GMT with a two minute CW CQ on 432.000 mc. The test will last for just over two hours with calls being accepted between 432.010 and 432.1000. SSB may also be tried. No two meter operation is planned. Sam said here in Sioux Falls during the April meeting that he doubted that KP4BPZ would operate on two because of the inconvenience in moving equipment, etc.

On the west coast W6DNG is continuing his 144 mc EME (Earth-Moon-Earth) skeds with OH1NL and UA1DZ. Several of the west coast gang have reported hearing the UA1 calling Bill.

More reports on Oscar III have been received. Oscar is still sending back HI's erraticly as the beacon goes on and off depending on the charge of the solar cells. The Oscar Association still would like your report if you haven't sent it in.

W1QKA and W1DUB in Nashua, N. H., have been running some interesting tests on 2415 mc. They are three miles apart, but have been bouncing CW pulses signals off Pack Monadnock Mountain (2310 feet) for a 48 mile otal path. W1QKA says that the signals were about 30 db above the noise using modified APG-5's (2C43 oscil-ator) into four foot dishes at both ends. Both also used uperhets with 1N21F mixers, 6CW4 cascode if preamps, nodified APG-5 local oscillators, four stage 6AK5 if mplifiers and threshold detectors a la K1 JIX.

Don't forget to send in your reports on interesting ctivities.

. . . KϕCER

SEMICONDUCTORS

Paul Franson WA1CCH
Peterborough, N. H.

As promised last month, here is a quick look at the most ommon parameters that transistor manufacturers use in ating their transistors:

The maximum voltage that can be applied between lements of a transistor without risk of damage (breakdown oltage):

BV_{CE} Collector to emitter with the base open (not con-ected to anything). Sometimes called BV_{CEO}.

BV_{CES} Collector to emitter with base shorted to the mitter.

BV_{CER} Collector to emitter with a resistor connected om base toemitter.

BV_{CB} Collector to base. Sometimes called BV_{CBO}.

BV_{EB} Maximum reverse voltage from emitter to base.

The *B* standing for breakdown is often omitted if there no possibility for confusion in specifications.

I_C Collector current.

P_T Total transistor power dissipation.

I_{CBO} Current leakage between collector and base with e emitter open.

f_{ab} Frequency at which gain in common base configura-on drops to 70.7% of that at a low frequency (usually 1 c.)

f_T Gain-bandwidth product. Frequency at which the rrent gain drops to one, i.e. no longer amplifies.

f_{MAX} Maximum frequency at which the transistor cillates.

Some of these can be a bit tricky unless you know how interpret them. Your best bet is to use the specification eets that you can get from the manufacturer or distribu-r. These spec sheets give typical circuits, noise figure, ssible gain, power outputs, etc., depending on the use e transistor is tended for.

A new RCA transistor of considerable interest is the N3866. It's a silicon NPN triple-diffused planar transis-r which provides considerable power output at VHF d UHF with a reasonable price. It will put out as much two watts on two, and one on 432. Even more impor-nt, one watt is possible on two with 18 db of gain. On 2, gain is about 9 db for one watt out. V_{CER} is 55 volts, the 2N3866 is ok for automobile AM service, though s cutting it close. P_T is five watts. Price is only $4.95 gly, considerably less than previous transistors with ese specs. Write RCA Electronic Components and de-ces, Commercial Engineering, Section 738, Harrison, J., for spec sheets on the 2N3866. May as well get e on the 2N3478 while you're at it.

. . . WA1CCH

Continued from p. 4.

that jazz you should ask around a little bit. Perhaps I am more in touch with this than many of you, being an editor, but surely you know that the first working parametric amplifier in the world was built by W1FZJ on six meters. Read Scientific American . . . or read the article I ran in CQ by Sam at the time. Everyone thought it was a humor article . . . imagine, a receiver using a UHF pump oscillator . . . how ridiculous. Another even more recent first was the K2TKN Flying Noise Lock receiver which was a breakthrough in under-the-noise detection. This was in 73 first. Many of K1CLL's UHF techniques are finding their way into commercial applications. The RTTY gang have advanced the design of converters considerably during the last few years and many of the current commercial designs are right out of 73.

When the ITU wanted to conduct a propagation study of the world who did they turn to for facts and reports? The hams, of course. By the way, if you'd like to help with this project just drop a letter to OK1WI, Propagation Study, ITU, Geneva 20, Switzerland.

Have I covered all of our so-called bad points? Isn't it about time that the League stopped poor-mouthing ham radio and spent some time and maybe even a little of our money in promoting us with the FCC? The FCC has no way to get a broad picture of ham radio . . . they get the TVI complaints . . . the petitions . . . the bickering letters . . . the grumbles. Sure, they read about our great work in Alaska. But they don't read about the hundreds of other public services that we accomplish. The FCC doesn't have a news clipping service to let them know all the things we are doing to help all over the country . . . they don't see the hundreds of reports that come into League HQ on our successes. Isn't it about time they got a truer picture of ham radio? Isn't it way past time?

Before we let the FCC make major changes in ham radio we should take the time to see just what is really necessary. Write to the FCC and ask them to extend the filing time on Docket 15928 until January 31, 1966. Let's have some time to work out our own future instead of plunging into massive call changes, new exams for everyone, 20 words per minute, wholesale changes in most of our bands, etc.

I make a motion that Herb Hoover find out what ham radio is like in this day and age and then that he go to Washington and visit the FCC Commissioners and staff and tell them what he has found so we can get out of the trouble we are in. Herb will get to know ham radio by spending about a month on twenty and eighty meters, several hours a day, plus some time on six and two, and don't forget a little 160 and 40. Ten and fifteen probably won't be open much this summer. Now, about 1000 QSO's later, he should zip down to Serrana Bank with WA6WTD who has a license and is looking for company and taste DXing from the DX viewpoint for a few days. Next he should bone up on some technical topic and visit about ten ham clubs giving a technical talk . . . and not the usual apologies for 499 and viva ARRL speeches. Then he should try to grapple with the appliance operators as they pop technical questions at him. A one month subscription to a newspaper clipping service will round out his portfolio and he will be ready to answer every critical question the FCC can ask. By the time he is through 15928 will be in the wastebasket where it belongs.

Things Are Good

Lest we get too wrapped up in our little problems with the FCC that the League has visited upon us, a look at the prospects before us is in order. I think we will get our license problems straightened out all OK . . . so what's cooking elsewise?

432 More and more activity on this band. The advent of low cost front end transistors will, I think, revolutionize this band. Converters that used to cost hundreds of dollars can now be surpassed with inexpensive simple units. I wouldn't be surprised to see some come commercially available for around $20 soon. Add to this the removal of Mr. Moonbounce W1FZJ to Arecibo, which is like giving a kid a job in a candy factory, and I think 432 will be blossoming. The first skeds are for July 3rd and 24th . . . and there will probably be a lot more in the future. The day is here when anyone who wants to work Puerto Rico on 432 can make it using a simple transistor converter, a reasonably sized beam (say 100 elements) and a medium powered transmitter. Now if we could just get a few more hams with 1000 foot dishes around we could have a few more moon contacts.

144 Activity is quite high on this band and sideband activity is growing rapidly. The increasing sunspots will probably bring us a lot more aurora activity this year, which is a real ball on both CW and SSB. It does take a fair antenna for consistent results . . . sixteen elements or more, and 200 watts or better.

50 Tropo is going strong on six meters these days with openings almost every day. From up here in New Hampshire we can s

and talk with the Bahamas, Cuba, every state east of the Mississippi and plenty west of it several days a week. I think we're up close to 45 states already this year. California comes popping through every now and then. And you don't need a lot of power or antenna on six to get through . . . we work too many Sixers to believe that. Not that high power and a good beam don't get you in there first every time. It's nice not to miss anything coming through and a five or ten element beam with 200 or so watts will rarely miss.

28 Sunspots are perking things up on ten and some good DX has been popping up. This band will be hot quite a bit this fall so you would be prudent to be set for it with at least three elements and sideband.

21 Activity is high on fifteen already, with several rare DX stations coming through only on this band. If you don't like to fight the QRM you can often have nice DX contacts on this band.

14 More and more twenty is staying open all night. Despite all the gripes about QRM and everything, this isn't that much of a problem if you don't insist on operating during the peak activity hours. Anyone with a three element beam and a sturdy sideband signal can work his 100 countries during a two week vacation. Conditions are going to nothing but improve on this band for the next few years.

Thanks Vote

If we are able to fight off 15928 all of you who sat by and let this happen to you without a whimper owe a lot to the few hundred hams who took the time and trouble to file their comments with the FCC and to complain to Senator Magnuson and Chairman Henry of the FCC. It should have been thousands. Fellows, stop waiting for someone to come to your door with a petition you can sign and write at least one lousy letter telling the FCC, Washington 25. D.C. that you personally think their proposals are preposterous.

Field Day

Luckily for me I didn't get into the Field Day contest until quite late, otherwise I might have gotten hooked into seeing it through. As it was I made 301 contacts in 300 minutes, including one new country (FP8CK) and a VK. Judging from the activity I found on 20 meterphone . . . the only band I tried . . . interest was high this year in this contest. Good show. Activity was widespread too . . . outside of the states too close in for 20 during the day I worked everything except Idaho. Hmm, maybe I'll go in the Sweepstakes Contest this fall.

Maryland VHF Society

This is a swinging outfit down Baltimore way. They were kind enough to invite me down for their annual Dinner in May and even gave me an opportunity to air my views on VHF as well as our current crisis. I tried to talk more of them into big arrays and kilowatts so I could get to talk with them from up in New Hampshire. VHF'ers around that area would do well to drop a line to Box 8554 in Baltimore and join up.

Good Idea

XE1NNN has been sending QSL cards to ham manufacturers that are not advertising in 73 telling them that his subscriptions to the other magazines have run out and if they want to reach him it has to be through 73. Olé!

Fame and Fortune Available

Fame, anyway. 73 still needs someone to take over as Advertising Manager. Salary details are classified, but the take should run around $8-10G as a starter and maybe double that eventually. Advantages? Well, you get to live where it is so wonderful that people come as a vacation both summer and winter (as well as spring and fall). Prices are reasonable, taxes as low as they come, and the people are wonderful. Hamming is great up here too.

We need someone who is a good talker, presentable, educated, intelligent, has a good background in ham radio and sales, has initiative and who is looking for a job that will allow him to grow. He should be making around $10G right now, at least.

Write, if you think we need you.

Lobby Group Formed

The National Association of Business and Educational Radio (Naber) just recently formed. They want more frequencies. From offices in Chicago and Washington, D. C., this association of two-way radio users will seek representation in FCC rule-making procedures and attempt to provide representation on Government/Industry committees relating to two way communication. Where, in a spectrum already crowded, will they get them? They already got our 11-meter band. Will they take more?

Only one amateur radio groups exists tha can deal with Congress and lobby for amateu radio: the Institute of Amateur Radio. Th ARRL can't do it, the law prevents; shoul they try, they face heavy fines. (They woul first need proper certification which they surel can't get with their present organization). Re member, organized pressure brings results. Join the IoAR. Don't let a recently formed Citizen group beat our sixty-five-year-old amateur radio hobby out of more frequencies.

The Institute takes your problems right to Congress. You need the Institute's *voice*; the Institute needs your *support*. A mere membership fee of $5 a year satisfies both. Naber charges $15 per first base station plus $10 for each additional base station per member per year. But even at the price, 4000 joined before planned promotion started just from word-of-mouth and phone calls. When promotion starts, they expect the total to swell to 30,000. Unless the members of the Institute campaign harder to recruit more members, Naber will get the new frequencies. Get the population up! *Our frequencies need protection.* Naber predicts over a million transmitters by the end of '69.

Moonbounce

Now that Sam W1FZJ is in residence down at Arecibo Puerto Rico it was only natural that he would tune up that 1000 foot 56 db dish on 432 now and then. The first test came on July 3rd and was remarkably successful. Sam started out on CW, went to SSB, and stayed on SSB for about an hour and then finished up on CW again. The following contacts were reported for the first hour or so of the marathon: W1BU, W1HIV, W3SDZ, HB9RG, W9GAB, DL3YBA, K1IGY/1, G3-LTF, WA4BYR, W7ORG, W9HGE, W8TYY, OZ8EME, W2CCY, W4HHK, W1OUN/1, W7AUB, DJ4AUD, W1HGT, W2ROP, K2-CBA, K3GYF, K6MIO, K2MBA, K1SDX/1, LX1SI, W1OOP . . . etc. Worked on two way sideband were HB9RG, W1BU, G3LTF, WA-4BYR.

There were an awful lot of fellows that didn't make the hop . . . fellows that were hearing Sam fine. The problem is the same as it was with Oscar . . . signals fading up and down by 20 db or so, and terrific QRM. Sam suggests that those without dishes get out of the low end QRM bin and spread out a bit. Drop him a line and tell him what frequency you are using so he can look for you and will know from even a fragment of your call who he is hearing. This will speed things up tremendously. The next test is July 24th, so get right at it. W1OOP worked through with a 64 element colinear and 200 watts, but this is a minimum. The signals from the dishes stood out like sore thumbs on the band and everyone else was in there, fading in and out, with weak signals.

I'm planning on being on the Arecibo end for the 24th test . . . say hello.

That Building Fund

Many amateurs felt that the League had sort of given them a kick in the . . . er . . . teeth with RM-499 and its resultant Docket 15928 and quite a few have expressed to me their regret over having contributed to the ARRL Building Fund. A letter from John Huntoon says, "As participation in the Building Fund Drive is purely a voluntary matter, under no circumstances would we want any contributor to be dissatisfied with his action. Accordingly, I am enclosing our check for $2.00 in refund of your donation." In another letter John writes, "I repeat I would not want to have any part of our Building Fund made up of contributions from people who have regretted their actions." These letters were forwarded to me along with the refund checks endorsed over to the Institute.

This certainly is a very commendable thing, though the refunds may get out of hand.

73 Hamfest

How many do you expect, they kept asking me. I have no way to guess, I'd reply. Probably be over a hundred and it might run to a thousand. Well, we counted a little over 1200! Pretty good for a little hamfest way up in the mountains of New Hampshire, eh?

Scattered showers on the third cooled us off and gave us a bright shining clean New Hampshire on the 4th of July with magnificent visibility from the mountains.

Among the events to keep people busy during the day we had a two meter transmitter hunt, an antenna measuring contest for both 144 and 432 mc, a home brew contest, exhibits of manufacturers, twelve tables of bargains spread out to browse over, and an auction that lasted a good part of the day and sold over $30,000 worth of equipment! All sorts of home brew and commercial gear went, from an NCX-3 on down to 25c grab bags. We had about an hour discussion of Docket 15928. A great many took out an hour or so and visited the 73 headquarters building and the 73 mountain ham shack.

Bill Hoisington K1CLL was on hand to show off his home brew UHF gear and mc the antenna measuring contest. Bill did a splendid job and the winner of the contest was Jud K2CBA with a 432 mc colinear.

There was a considerable clamor for us to have another hamfest next year. I wouldn't be surprised if we did. If anyone didn't have a good time, I didn't hear about it.

. . . Wayne

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- ★ Price—$2 per 25 words for non-commercial ads; $5 per 25 words for business ventures. No display ads or agency discount. Include your check with order.
- ★ Type copy on standard size paper. Phrase and punctuate exactly as you wish it to appear. No all-capital ads. Include your signature with order.
- ★ We can only accept ads related to ham radio. We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.
- ★ For $1 extra and an SASE, we can maintain a reply box for you.
- ★ We cannot check into each advertiser, so Caveat Emptor . . .

CONVERTERS $10 and up. World's largest selection of frequencies. Ham TV vidicon cameras and parts at low factory-direct prices. See them all now in our full page ad in this issue. Vanguard Labs, 190-48 99th Ave., Hollis, N. Y. 11423.

YOUR CALL LETTERS and name in gold, on your very own coffee mug. $2.00 (helps me through college). Latterman K7ZOV, 2511 N. 68th Street, Scottsdale, Arizona.

TOOOOOBES, TRANSMITTING-SPECIAL PURPOSE, New, Boxed, Guaranteed....6CW4 — $1.40, 6146B — $4.75, 417A — $3.95, 826 — $6.90....Free Catalog....Vanbar Dist. Box 444, Stirling, N. J. 07980.

DUMMY LOAD, 50 ohms. All bands up to legal limit. Size, 3 x 4 x 7. Coax connector. Kit $7.75, wired $9.75 pp. Ham Kits. Bx 175, Cranford, N. J.

NORTH ALABAMA HAMFEST sponsored by the Huntsville ARC, Community Center in Big Spring Park on Sunday August 15. Contact William Probus WA4DBQ, 2607 Woodview Drive, SE, Huntsville for more information.

SCARA HAMFEST Sunday August 29th at Lake Lenape Park, Mays Landing, New Jersey. Get more dope from Charles Bengal W2TUR, 815 Seaside Avenue, Absecon, N. J.

SIX METER MOBILEER HAMFEST. Sunday August 8, Weymouth Fairgrounds, Weymouth, Mass. More info from P. O. Box 94, Wollaton, Mass.

HENDERSON ARC HAMFEST: Sunday August 8 at the Audubon Raceway Park, Henderson, Kentucky. You can find out more from Larry Yates WA4PMA, P. O. Box 83, Henderson.

DELAWARE HAMFEST. August 15, Harrington, Delaware. Write Pete Robinson K30CI, 304 Kesselring Ave., Dover, Del.

WARREN ARA HAMFEST. Sunday August 29th, Newton Falls Community Center, Newton Falls, Ohio. Get more information from K8BXT.

DRAKE 2B RECEIVER, 2BQ Q Multiplier, 2AC calibrator, Knight V-66 VFO. All excellent, all for $200. Brian Kassel K3LSB, 976 South Hills Blvd., Pottstown, Pa.

LPA1 KW LINEAR AND LPS1 power supply. Brand new, never used. $450. L. J. Maggora, 575 Pierce St. San Francisco, Calif.

GONSET G-50: 10 hours use. $210 postpaid anywhere n U. S. Check or money order. Dick Sullivan, Box 156, Boone, Iowa.

PH565 HAM-TV camera converted and airtested UHF converter included $65.00 prepaid. Al Johnson, K7VQI 5018 E. Cooper Street, Tucson, Ariz. 85711

TOROID BALUN KITS—2" core & #14 Formvar. 4:1 or 1:1 Z ratio. Handles Kilowatt. $5 plus 25c postage. Ami-Tron, 12033 Otsego St., North Hollywood, Calif.

SCHEMATICS of surplus electronics, ham gear, and test equipment. Send dime or stamps for list to Hill Enterprises, RD #1, Box 241, Kingtown, Pa. 17967

SRT14 SYNTHESIZER MODULES . . . . UNIT 11C now available . . . Also Units 6, 8, 9, 10, 11A, 11B. All New, Less tubes, With Schematic . . . $8.00 each or any three $6.50 each. Also schematics any unit, one thru twelve, Fifty cents, or full set of Fourteen $3.00 . . . RITCO Box 156, Annandale, Virginia.

WANTED: All types, Military, Commercial, Airborne, Ground, Electronic items—Testsets, GRC, PRC, Collins, Bendix, Others . . . We Pay Freight . . . RITCO Box 156, Annandale, Virginia.

WANTED Hy-Gain 18-HT Vertical. Have 14-AVS Vertical and TH-3 10-15-20 beam for sale. WAØEJF. Box 41, Cedar Rapids, Iowa.

COLLINS 75-A-4 OWNERS: Don't trade up! Investigate our conversion that makes the 75-A-4 a real dream. W2VCZ—30 Pitcairn Ave., Ho-Ho-Kus, N. J. 201-652-494.

NAVY TCS transmitter, receiver, 115 volt power supply, PTT microphone, loading coil, and extra tubes $85.00 FOB. Model 15 teletype very good condx $70.00 FOB. Robert N. Hogaboam WB6KNN, 374 Elder Ave., Imperial Beach, Calif.

DX-60 Perfect unused. Estate of W1QJ. FB 2nd rig, ok for new ham. $60 plus shipping. W1KSB Cushing, Bickford Rd., Malden, Mass. 02148

HANGING 'EM UP. Complete Collins Station for sale. 75S-3, 32S-3, 30L-1, 312B-4, 516F-2 all Rack Mounted in Collins rack mounts, on 61 inch Bud Deluxe Relay Rack with Trans-Aire Blower Mounted in top. Complete KW station will roll right in closet. Not just good, but the best. A $2400 value. Best offer over $1800. F.O.B. Also KWM-2, MP-1, PM-2, CC-2, 351D-2, $1050. J. B. Holmes, Jr., P. O. Box 36146, Houston, Texas 77036.

BIGGEST, Nope. BEST? Heck yes! Warren ARA Hamfest, Aug. 29. Newton Falls. Arrows from Rt. 534, Turnpike Warren Exit 14. Details: WARA Hamfest, Box 09, Warren, Ohio.

20 MC. EQUIPMENT, ERCO AM Xmitter/Mod. 6252 nal $70.00, R-48/TRC-8 receiver AC, converted to 220 M $30.00. W1HMT, 25 W. Union St., Goffstown, N. H.

HEATH 1 watt CB handy-talkies, model GW-52, professionally wired, rechargeable batteries, channel 3, excellent, $125.00/pair. I. Gray, 25 W. Union St., Goffstown, N. H.

PEORIA HAMFEST September 19, Exposition Gardens, Peoria Area Amateur Radio Club, advance registration .00 until Sept. 11. Ferrel Lytle, W9DHE, 419 Stonegate d., Peoria, Illinois

SBE-33 very little use, guaranteed to look and operate like new, with manual and cables, $200. Stan Flegler 8RPA, 1400 Poxson, Lansing, Mich., 48910.

COLLINS 75A2 $160, National NC-183D $100, Johnson Ranger I $60. This gear requires minor repairs but is clean. We box, you pay shipping. WØEBE Memorial, Southwest Missouri Amateur Radio Club Inc., P. O. Box 1, Springfield, Missouri 65801

ONE TS-47/APR, see June "73", VG $40. Two T23/AR-5 Xmtr (2-832A's) new $14. ea., both $24.00 FOB, G. wick, 26 Ridge Rd., Smithtown, N. Y.

GOLD Mine. See 73, June 1965 page 78. R105/ARR15—5. Brand new M19 RTTY. $225. I-193 Polar Relay Test et, see CQ May 1965 p. 66, $14. Loop supply for M15 .50. All FOB Maywood. Send SASE for list of other stuff. J. Cooper, W2BVE, 834 Palmer Ave., Maywood, N. J.

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New E. F. Johnson Tube Sockets 122-101-100, Aluminum Shell with 3/8 vent. holes submounts tube 1" below Chassis, takes 5894, 829B, '32A, etc. $1.80 value **$75c ea.**
Type 122-247-100 top mount 7 pin steatite, same tubes **50c ea.**
Transmitting Caps CRL #851, 25 mmf, 15 KV New **2/$1.25**
Clear Plexiglass Strips 9" x 2½" x 1/16" **5/$1.00**
2" speakers, large magnet, used as microphone and speaker in Hallicrafters CB-4 **2/$1.75**
New Plate Current Meter 0-200 used in Hallicrafters HA-2. Keep a spare **$3.50**
New 'S" Meter used in Hallicrafters SX-115 **$3.50**
Sarkes Tarzian Diodes F-6 (1N2484), 600PIV, 750Ma. **10/$3.75**
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HP 200 I Interpolation Audio Osc 6cy-6Kc 6 Bands EX $95
Ferris 32-B RF Noise and Field Strength Meter ....EX $195
Tektronix 121 Wide Band Preamp for 511 Scope ....EX 47.75
Ballantine 300 AC VTVM in 19" Rack Panel ....EX 38.50
Ballantine 316 AC VTVM .05cy-30Kc .02-200V P-P. EX $135
315SP Similar except 2cy-20Kc .02-200V P-P & RMS. EX $85
Lambda 28 200-325VDC @ 100ma 1% Reg. 6. 3VAC EX 19.50
Lambda 32 200-325VDC @ 300 ma 1% Reg.2X6.3VAC EX 29.75
TS147B Sperry 38A Sig Gen & Freq Mtr. 8.5-9.6 Kmc EX $95
TS155E Signal Generator 2700-3400mc .... EX $60
T61/AXT2 TV Xmtr W/Video & Sync Modulators NEW 17.50
RT82/APX6 Converts to 1215-1296 mc X'ceiver ..NEW 21.75
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Same Reconditioned by US Government ....LIKE NEW 19.75
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Reflectometer SWR Sridge w/Meter, 30-1000mc ....EX 8.25
R23/ARC5 The Q-5er tunable IF. 190-550kc ....EX 11.25
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RT18/ARC1 100-156mc Xceivr. W/Tubes & DY9 ....EX 19.75
Same less tubes and Dynamotor DY9 ....GOOD 9.75
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Schematic for T465/ALT7 with parts values 1.00
Tube type 6161 w/connectors.. 65W to 2000mc ......EX 7.50
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Set of 120 Xtals Type FT243 5675 thru 8650kc. 120/17.50
CU119A Coupler 13 one-tube amplifiers w/tubes ....EX 6.25
R122A/ARN12 75 mc Superhet w/9 Tubes & Xtal. ..EX 2/7.00
Rt. Angle Drive w/Gears & Universal. ¼" Shaft. . EX 3/5.00
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HQ-170C with speaker, unblemished, $200. NC-100 receiver general coverage. $30. Benson Gyro Glider, $250. 4X250B new, unused. Will trade all but HQ-170. Want Band Spanner, Heath HP13 or similar mobilepower supply. Art Linehan, 124 A. Street, Manchester, N. H.

SELLING OUT: Tremendous bargains in equipment, tubes, parts. TBS50D xmtr with PS, $35. Knight VFO, $15. Stamp for list. W3CNS, Box 1, Rheems, Pa.

NCX-3 AND NCX-A, $325. K1AJE Jesse Bryant, Box 829, Trafton Lane, Kittery, Maine.

GONSET COMMUNICATOR IIB. 6 Meters, 12 v, mike, xtals, halo. Mint, never used mobile. Selling for widow of ham. $135. E. Christie W1GGI, 72 Martin St., W. Roxbury, Mass. 02132.

STAMP COLLECTORS: Will swap stamps (your choice) for amateur and military radio equipment, supplies, tech manuals, etc. J. J. Reilly, 3519 167 Street, Flushing, New York 11358.

WANTED: W3DZZ Tri-Band Beam. Jean LeBorgne W6LZV, 12022 Celine St., El Monte, Calif. 443-8500. Long distance collect calls not accepted.

FREE! Blue book list. Leo has over 1000 bargains in used gear. KWM2 $675; Galaxy 300 $215.10; Viking 500 $350.10; NCL 2000 $485.00; SX101A $229.50; Collins 62S1 $625.00; King 500A $259.00; SB400 $299.95 SX117 $260.10; Drake 2A $189.00; and many more Free 1965 catalog-WRL, WøGFQ, Box 919, Council Bluffs, Iowa.

NEW MOTOROLA miniature seven tube, 455 KC IF amplifier and discriminator with circuit diagram. Complete postpaid, $2.75 each. R and R Electronics, 1953 South Yellowsprings, Springfield, Ohio.

WE WILL PAY CASH OR TRADE . . . On popular clean unmodified amateur gear. World Radio Laboratories Box 919, Council Bluffs, Iowa.

NATIONAL NCX-5 TRANSCEIVER. Brand new. Never opened factory sealed box. $555. Joe Duffin W2)RA, 24 Kings Highway, West, Haddonfield, N. J.

4CX250B TWO METER FINAL, Johnson 6N2, Eico modulator and all power supplies including HV. $250 for all or sell separately. Hy Gain 15 element 2 meter yagi Hy Gain 10 element 2 meter yagi, Gain Skybeam 10 element yagi, W2AZL 417A 2 meter converter. Want R and H model 2-150. Bill Smith KøCER, 1301 Churchill Ave., Sioux Falls, S. D.

ANNUAL NETTERS PICNIC Frantz Grove, New Ringgold, Pa. Sunday July 25. K3YVG can give you more information.

WABASH VALLEY VHF PICNIC. Sunday July 25 at Turkey Run State Park near Terre Haute, Ind. K9WHI is the chairman.

SX101 III in very good condition only $200. Will deliver within 50 miles. A. E. Frisbie WB6AYV, 161 N. Thompson, Hemet, California 92343.

GOOD NOVICE STATION—HQ 110C, matching speaker, $125; Globe Scout 680A, $45; both, $160. Prefer local buyer. Ken WA2FPV, 75-46 190 St., Flushing, N. Y. HO 8-3234.

TELCO WILL PAY FOR HELP . . . we want to get the names of people who buy equipment for military and commercial applications. Our new 1 kw linear with bandwidth of 2-30 mc is a natural for commercial use. We'll buy you a one year subscription to 73 if you'll send us the names and addresses of six commercial buyers. TELCO, Inc., 575 Technology Square, Cambridge, Mass. Current Events—

TELETYPE MODEL 30A PRINTER. Tiny light weight unit (19 lbs). Has 28 type keyboard, 115 vac motor end-of-line indicator, aluminum case. Excellent condition. Just the thing for portable operation and demonstration. $90. Box 152, 73 Magazine, Peterborough, N. H.

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More Letters

Dear Wayne:

I have been an avid reader of your magazine for the past two years. Technically, it cannot be surpassed. However, it has just occurred to me that seldom is any mention made of the important role that our hobby may play in our everyday family relationships. I would assume that there are just as many "rig widows" as "golf widows."

With the above thought in mind, I thought your readers might be interested in the program our local mobile radio group initiated. Each month, of course, we had our usual business meeting. However, the following weekend was our "family" meeting; in other words, a road trip with our families.

Scenic Arizona has many educational and historical landmarks, and we had no difficulty deciding where to go. We have many one-day trips to places such as Miami, where there is open pit mining for copper, to Globe to "dig" for "Apache Tears" (Obsidian), to Colossal Cave, the only cave in the U. S. where the temperature always remains at 73°. Also, there were several overnight camping trips to such places as Grand Canyon, Tombstone, etc. When mobile to and from these sites, we were in direct communication with one another by our rigs.

We found these trips not only valuable from a technical standpoint, but also, it acquainted the XYL with what we were doing and why we enjoyed doing it. It brought families closer together because we shared a hobby; we enjoyed being out in the woods, the mountains, the desert, wherever the road led us.

Our Club feels that our mobile cavalcades have brought the family more closely together, and that our hobby now is better accepted by our XYL.

Alex J. Kenwright K7JNY
Mesa, Arizona

Dear Wayne:

Please advise if an IoAR cut is available for imprinting on my QSL cards. My present card which bears the insignia of another amateur organization has suddenly become obsolete!

George Firmin WA4FSK
Atlanta, Georgia

Yes indeed George. The IoAR cut is available for only $1.

Dear Wayne,

Just read your April 1965 editorial. I want to add my name to that long list of people who never received payment for articles printed in ham magazines. My case was an article published in CQ in October 1957, the title was All Band Mobile (Almost). It was a very poor article, but CQ printed it and I never received any payment. I really enjoy your 73 magazine and I would really enjoy visiting you this summer and seeing 73 Mountain, etc. Hope I can.

L. L. Chilton W5THI
Fort Worth, Texas

Doc, I checked my records. Your article was in October 1958 and I had you down for $16.00 in payment for it. I'm sorry you never received your money, but that was up to the bookkeeper and the publisher.

Wayne:

June was a very good issue. In this day of commercial rigs it is about time that a magazine has the foresight to encourage the use of surplus equipment. The FCC proposal might not have been if more ham magazines published information on home-brew and surplus conversions. More power to you and your convictions, there are lots of hams behind you. A check will soon follow for the Institute. I have one thing to say about the FCC proposal: one cannot legislate incentive!

Jack Swords WA6WTH
Fresno, California

BACK ISSUES AND OTHER JUNK

73 Magazine Back Issue Grab Bag
An assortment of 20 different back issues of 73 from 1961 to 1963. No choice at this low price. We send what's available. $5

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Eight back issues of 73 for a puny $2.

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Individual copies of back issues from March 1961 to present are available for 50c each. Earlier ones (except the unavailable January 1961) are $1.

ATV Experimenter
Five or more back issues for 50c. No choice. They're running out fast.

6 Up
We don't have any more 6 Up. Write Parks Labs, Beaverton, Oregon.

Binders and Bound Volumes
Beautiful red binders for each year of 73 are available for only $3 apiece. Years are 60-61, 62, 63, 64, 65. A few 62, 63 and 64 bound volumes are occasionally available for the incredible price of only $15.

73 Magazine Peterborough, N. H. 03458

PRICE INCREASE

Due to the rising cost of printing, postage, salaries, rent, heat, electricity, water, food, property taxes, etc., the cost of individual copies of 73 has been increased effective with this issue to 50c. Notice that that is $6 per year if you buy 73 at the newsstand or parts distributor (not including sales tax). Subscriptions are still only $4 per year (no sales tax). Why pay 50% more for each copy? Subscribe.

73, Peterborough, N. H. 03458

INDEX TO ADVERTISERS

Propagation Chart

August 1965

J. H. Nelson

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7*	14	14	14	14
ARGENTINA	21	14	14	7*	7	7#	14#	14	14	14*	21	21*
AUSTRALIA	14	14	14	7#	7	7	7*	7	7#	7#	14#	14
CANAL ZONE	14	14	7	7	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	7*	14	14	14	14	14	14
HAWAII	14	14	7*	7	7	7	7	7#	14#	14	14	14
INDIA	14	7#	7#	7#	7#	7#	14#	14	14	14	14	14
JAPAN	14	14#	7#	7	7	7	7*	7*	7#	7#	14#	14
MEXICO	14	14	7	7	7	7	7#	14	14	14	14	14
PHILIPPINES	14	14#	14#	7#	7#	7#	7#	7*	14	14	14#	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7#	7#	14	14	14	14	14	14	14#
U. S. S. R.	7	7	7	7	7	7#	14#	14	14	14	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	7	7	7	7	7	7*	14	14	14
ARGENTINA	21	14	14	7*	7	7#	14#	14	14	14	21	21*
AUSTRALIA	14	14	14	7#	7	7	7	7*	7#	7#	14#	14
CANAL ZONE	21	14	7*	7	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	7	7*	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7#	14	14	14	14
INDIA	14	14#	7#	7#	7#	7#	7#	14#	14	14	14	14
JAPAN	14	14#	7#	7	7	7	7	7*	7	7#	14#	14
MEXICO	14	14	7	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14#	7#	7#	7#	7#	7*	14	14	14#	14
PUERTO RICO	14	14	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	14	14	14	14	14#
U. S. S. R.	7	7	7	7	7	7#	14#	14	14	14	14	7*

WESTERN UNITED STATES TO:

ALASKA	14	14	14	7*	7	7	7	7	7*	14	14	14
ARGENTINA	21	14	14	7*	7	7	7#	14#	14	14	21	21*
AUSTRALIA	21*	21	21	14	14	7*	7	7	7	7*	14*	14
CANAL ZONE	21	14	14	14	7*	7	7	14	14	14	14	21
ENGLAND	7*	7	7	7	7	7	7#	14#	14	14	14	14
HAWAII	14	21	21	14	7*	7	7	7	14	14	14	14
INDIA	14	14	14	7#	7#	7#	7#	7#	14#	14	14	14
JAPAN	14	14	14	14	7	7	7	7	7	7#	14#	14
MEXICO	14	14	7	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14	14	14#	7#	7	7	14	14	14#	14
PUERTO RICO	14	14	7*	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	7*	7#	7#	7#	7#	14	14	14	14	14#
U. S. S. R.	7	7	7	7#	7#	7#	7#	7*	14	14	14	7#
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

Very difficult circuit this hour.
* Next higher frequency may be useful this hour

Good: 1-6, 25-27, 29-31
Fair: 9-14, 16-19, 23, 24, 28
Poor: 7, 8, 15, 20-22
VHF DX: 4-7, 13-15, 22-26

BREAK THROUGH

$450.00 Includes Separate POWER SUPPLY

MORE "TALK POWER" PER DOLLAR Than Ever Before!!

WRITE US NOW
FOR KING SIZE TRADE-INS ON
YOUR PRESENT GEAR!

NOW FOR THE FIRST TIME

2KW+ TABLE TOP LINEAR FOR UNDER $500.00 GUARANTEED! 2KW+ PEP SSB INPUT and *1200 WATTS PEP OUTPUT*, ALL BANDS 80 THROUGH 10 METERS.

EXCLUSIVE GALAXY LINEAR FEATURES

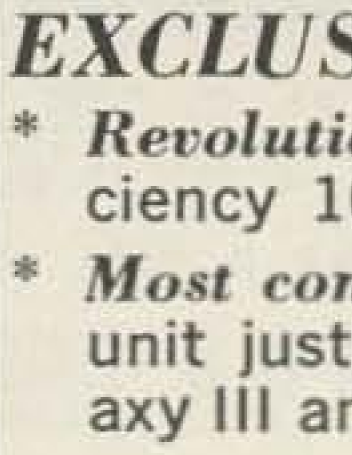
* ***Revolutionary new circuit.*** Sustains Hi-Efficiency 10-80 Meters.
* ***Most compact 2KW Linear ever made.*** R.F. unit just 6" x 10¼" x 11¼". Same as Galaxy III and V.
* NEW ***ALS!*** (*A*utomatic *L*inearity *S*ystem) An improvement over conventional ALC.
* ***MOST TALK-POWER EVER*** in this small size.
* ***Operates*** AB_1 at all times.
* Built-in ***antenna switching relays.***

MORE OUTSTANDING FEATURES

* ***INPUT: 2,000 Watts PEP-SSB***, 1,000 Watts-CW, 1,000 Watts-RTTY.
* Complete tube replacement cost under $30.00.
* Uses ten 6HF5's in new, efficient design.
* Full Power from any 100-200 watt output exciter.
* Tubes fan cooled for longer life.
* SIMPLIFIED, reduced power tune-up.
* One knob bandswitching, 80 through 10 meters.
* High efficiency PI-NET, matches 40/90 Ohms impedance.
* Built-in, adjustable low-pass filter.
* 3rd order distortion - 30DB.
* 115/230 VAC power supply.
* Shipping weight (Linear and Supply) Approx. 55 lbs.

POWER SUPPLY

Heavy duty power supply has 115/230 VAC primary, conservative 2KW CCS rating with grain-oriented silicon steel core, solid state rectifiers. All cables supplied. Power supply can be placed under desk for operating convenience. Protected by attractive cover.



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☐ Send quote on separate sheet.
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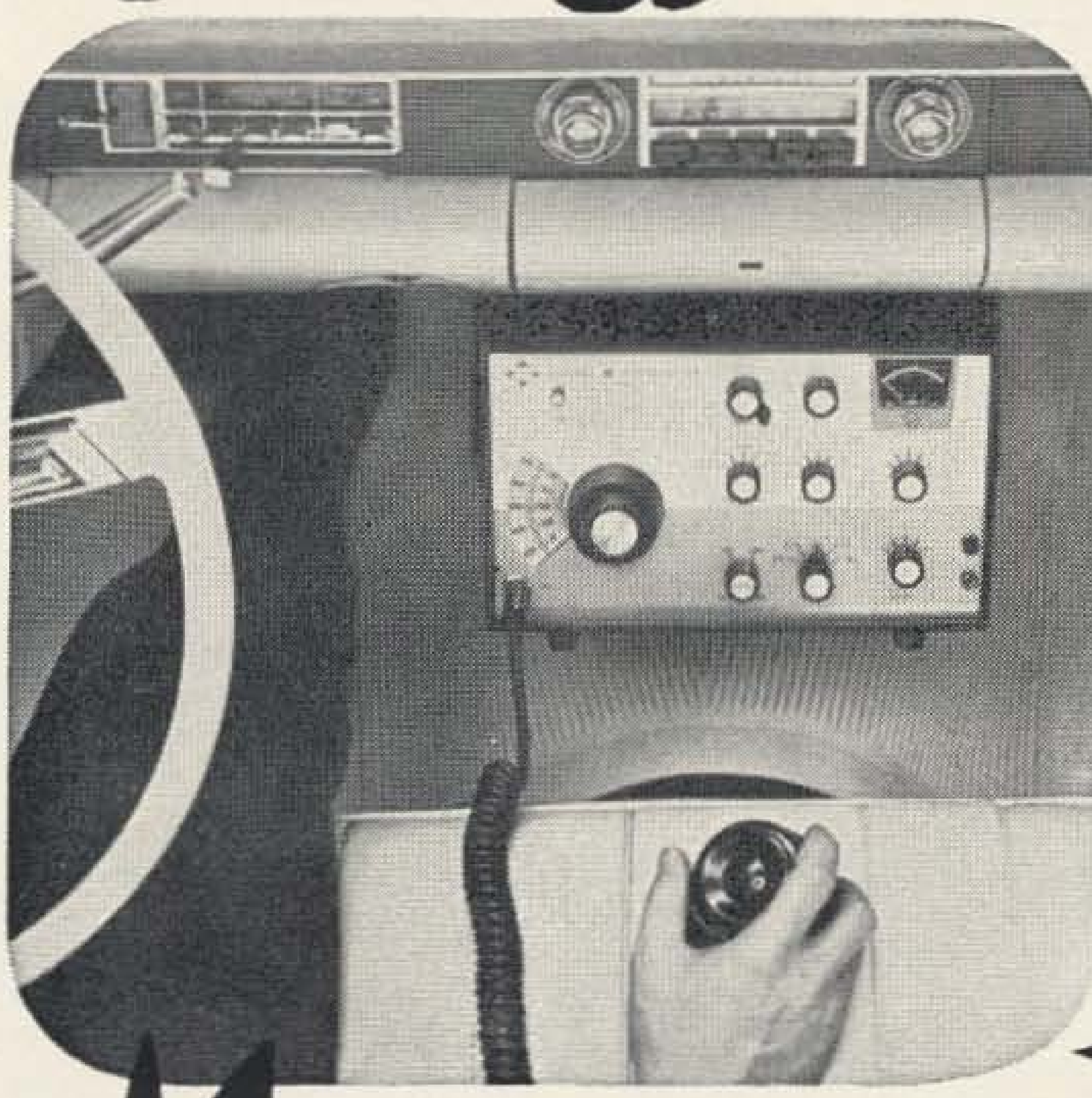

SAVE $70.00 . . . If you buy now . . . A NEW *GALAXY V TRANSCEIVER* . . . featuring 300 WATTS PEP SSB/CW; FULL BAND COVERAGE on 80-40-20-15-10 meters . . . and it boasts the BEST — SELECTIVE RECEIVER (because of its 6 Xtal filter); and UPPER and LOWER selectable SIDEBAND!

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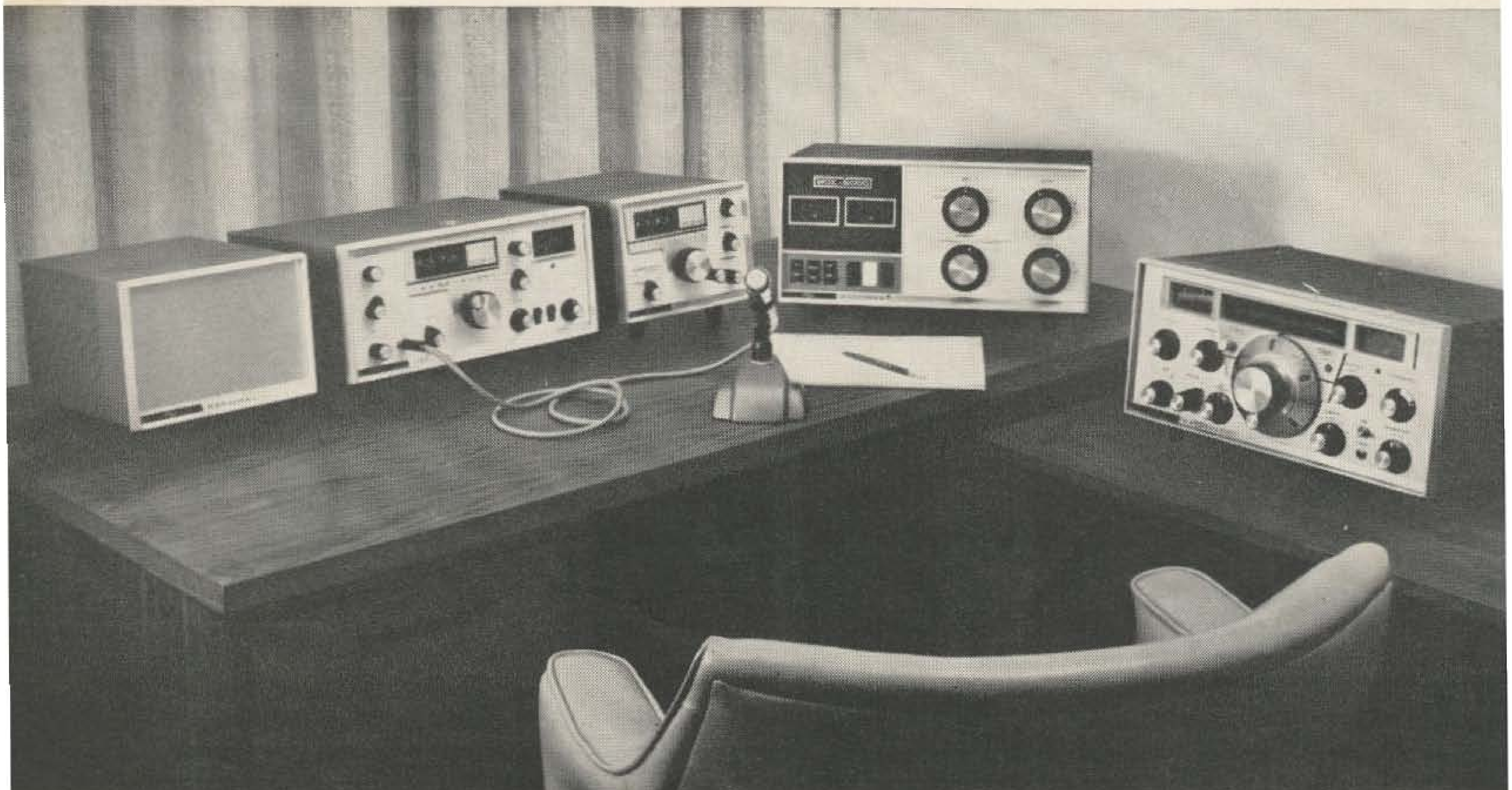

This desk-top amateur station by National includes the NCX-5 all-band transceiver, with digital counter read-out accurate to 1 Kc on each band and **Transceive Vernier** control to provide up to ±5 Kc separation of receive and transmit frequencies. Transmit-receive selectivity is provided by National's 8-pole crystal filter with greater skirt selectivity than any filter ever manufactured for amateur equipment. The NCX-5 provides operation on upper or lower sideband, compatible AM, or break-in CW. $685 ■ The NCX-A power supply/speaker console operates from either 115/230 V.A.C. and provides all operating voltages for the NCX-5. $110 ■ The VX-501 VFO console provides choice of completely independent transmit-receive frequency control of the NCX-5, as well as transceive operation from either VX-501 or NCX-5, and also offers five crystal channel positions for net or novice use. $249.95 ■ The NCL-2000 is a completely self-contained 2 Kw SSB PEP linear amplifier for the 80 through 10 meter bands, with minimum peak output of 1300 watts. It may also be operated for CW, AM, or RTTY at 1000 watts DC input. $685 ■ The HRO-500 is a frequency synthesized and phase-locked solid state receiver covering the five kilocycle through 30 Mc frequency range with identical 1 Kc calibration, high stability from turn-on, and 10 Kc per turn tuning rate throughout. **Passband Tuning** is offered for SSB and CW operation, and IF bandwidths up to 8 Kc are included. Operates from either 115/230 V.A.C. or 12 V.D.C. sources. Power drain from a 12 V. battery (with pilot lamps switched off) is 200 Ma. $1295 ■ Not pictured is the popular NCX-3 tri-band transceiver, at $369.

NATIONAL RADIO COMPANY, INC.