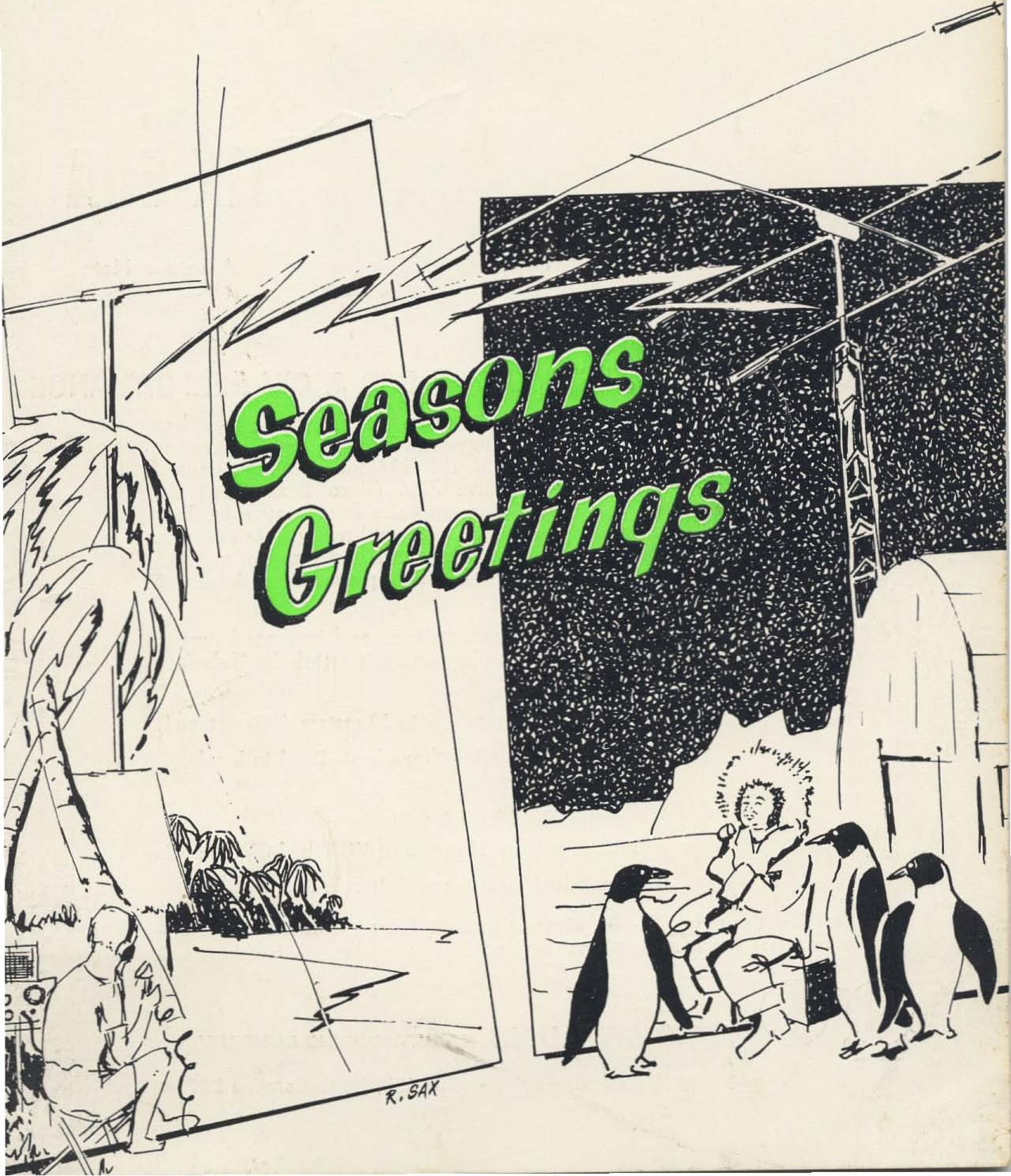
73

Amateur Radio

DECEMBER 1964

40c



73

Magazine

Wayne Green W2NSD/1

Editor & Publisher

Paul Franson WA4HWH/1

Assistant Editor

December, 1964

Vol. XXVI, No. 1

Cover:
Merry Christmas
WA2TKY

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de
W2NSD/1

never say die

Christmas:

Remember, every dollar you spend on ham equipment will make for a merrier Christmas for your distributor and the manufacturer. Spread cheer. To help you in your selection I've inveigled an unusual number of advertisers into this issue. 73, along with the foliage, went red this fall . . . this burst of green was needed so don't grumble.

ARRL:

My November editorial still stands. Ham radio won't be able to hold up its head until the League top brass stops its petty politicking and dictatorial actions. It doesn't look as if the latest director elections are going to give us any hope for a replacement of the top officers with men who are more mature and stable.

FCC:

Apparently the FCC intends to ram their docket to eliminate the Conditional Class license through. We'll watch this one carefully.

IoAR:

Look for some big news next month.

NOW

DIRECT CRYSTAL CONTROL TO 160 mc
With AOC Plug-In Transistor Oscillators

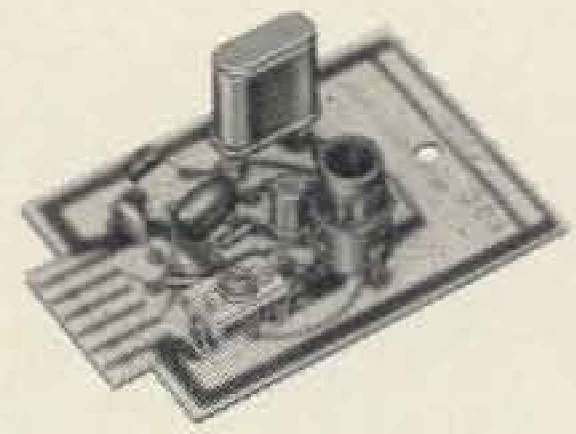
• Portable Signal Standards • Signal Generators For Receiver Alignment • Band Edge Markers
• Frequency Markers For Oscilloscopes • Quick-Change Plug-In Oscillators • Accessory Cases

HIGH FREQUENCY (20 mc — 160 mc)

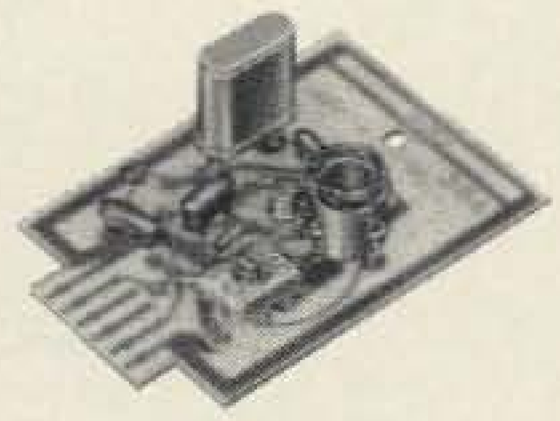
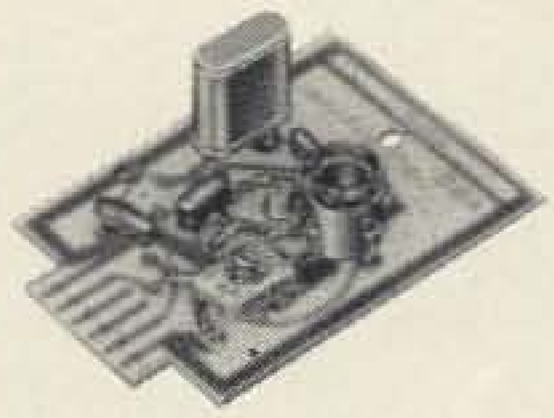
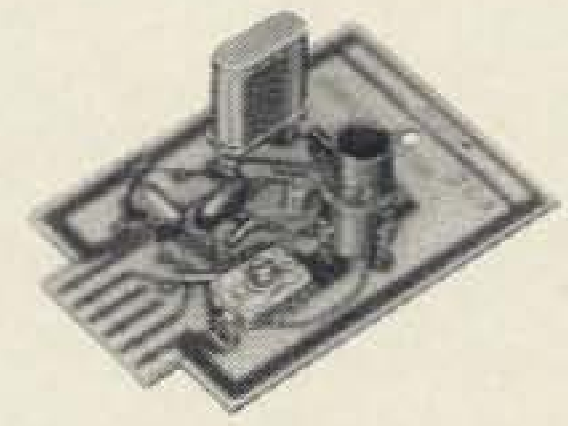
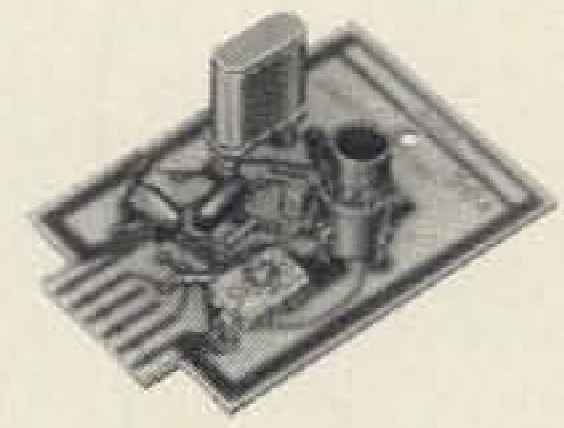
Five transistor oscillators covering 20 mc - 160 mc. Standard 77°F calibration tolerance ±.0025%. The frequency tolerance is ±.0035%. Oscillator output is .2 volts (min) across 51 ohms. Power requirement: 9 vdc @ 10 ma. max.

OSCILLATOR TYPE	OSCILLATOR RANGE	CRYSTAL TYPE	TEMPERATURE TOL. —40°F to 150°F	OSCILLATOR (LESS CRYSTAL) PRICE
OT-24	20-40 mc	CY-7T	±.0035%	$ 9.10
OT-46	40-60 mc	CY-7T	±.0035%	9.10
OT-61	60-100 mc	CY-7T	±.0035%	15.00
OT-140	100-140 mc	CY-7T	±.0035%	15.00
OT-160	110-160 mc	CY-7T	±.0035%	15.00

CRYSTAL FREQUENCY	CRYSTAL PRICE
20-60 mc	$ 6.90
60-100 mc	12.00
101-140 mc	15.00
141-160 mc	18.00



Order direct from International Crystal Mfg. Co.

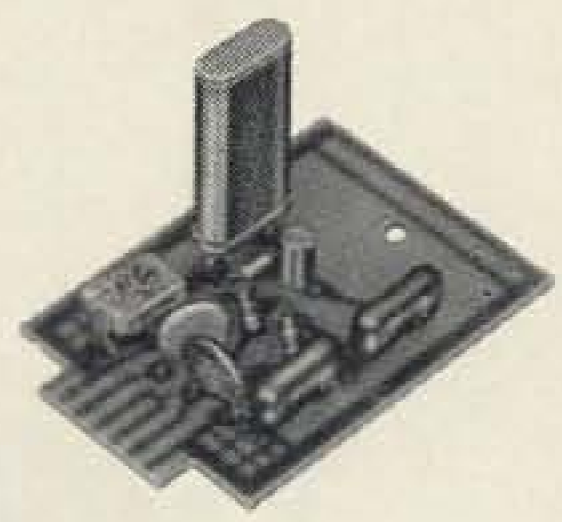





LOW FREQUENCY (70 kc — 20,000 kc)

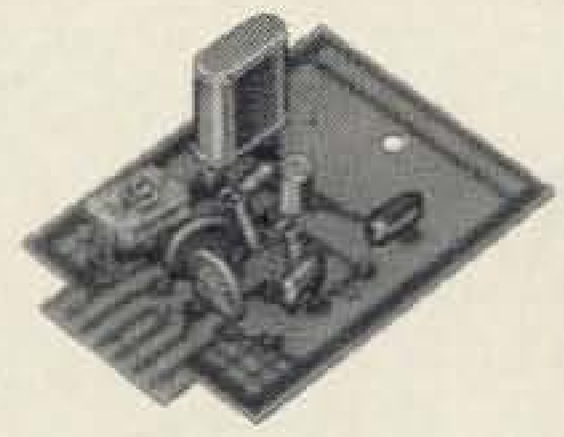
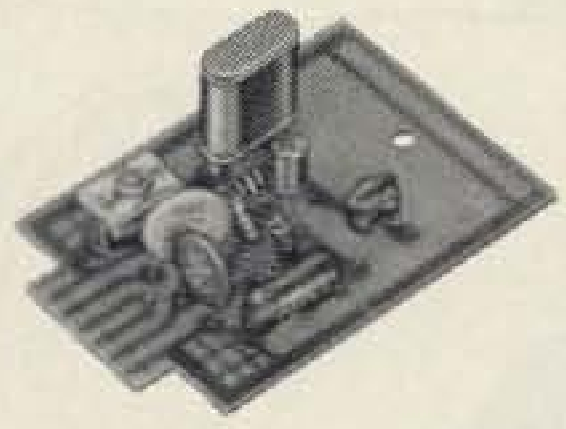
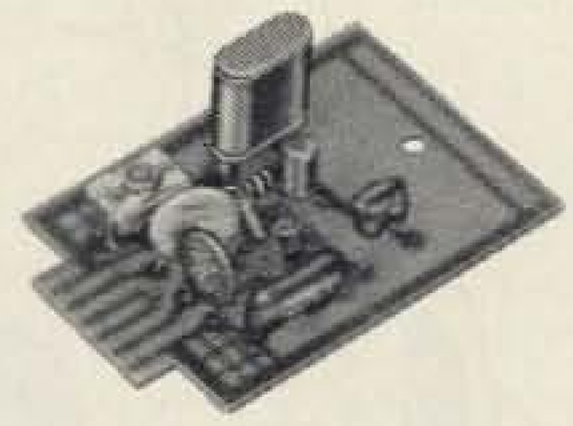
Four transistor oscillators covering 70 kc - 20,000 kc. Trimmer capacitor for zeroing crystal. When oscillator is ordered with crystal the standard will be ±.0025%. Oscillator output is 1 volt (min) across 470 ohms. Power requirement: 9 vdc @ 10 ma. max.

OSCILLATOR TYPE	OSCILLATOR RANGE	CRYSTAL TYPE	TEMPERATURE TOL. —40°F TO + 150°F	OSCILLATOR (LESS CRYSTAL) PRICE
OT-1	70-200 kc	CY-13T	±.015%	$7.00
OT-2	200-5,000 kc	CY-6T	200-600kc ±.01% 600-5,000kc ±.0035%	7.00 7.00
OT-3	2,000-12,000 kc	CY-6T	±.0035%	7.00
OT-4	10,000-20,000 kc	CY-6T	±.0035%	7.00

CRYSTAL FREQUENCY	CRYSTAL PRICE
70-99 kc	$22.50
100-200 kc	15.00
200-499 kc	12.50
500-849 kc	22.50
850-999 kc	15.00
1,000-1,499 kc	9.80
1,500-2,999 kc	6.90
3,000-10,999 kc	4.90
11,000-20,000 kc	6.90



INTERNATIONAL CRYSTAL MFG. CO., INC.

18 NORTH LEE OKLAHOMA CITY, OKLA.

AOC OSCILLATOR CASES

Small portable cases for use with the OT series of plug-in oscillators. Prices do not include oscillators. (When oscillator and crystal are ordered with FOT-10 case a 77° F tolerance of ±.001% may be obtained at $2.00 extra per oscillator/crystal unit. When oscillator/crystal units are ordered with FOT-20 case, a single unit can be supplied with temperature calibration over a range of 40° F to 120° F. Correction to ±.0005%. Add $25.00 to the price of FOT-20 and oscillator/crystal unit.)

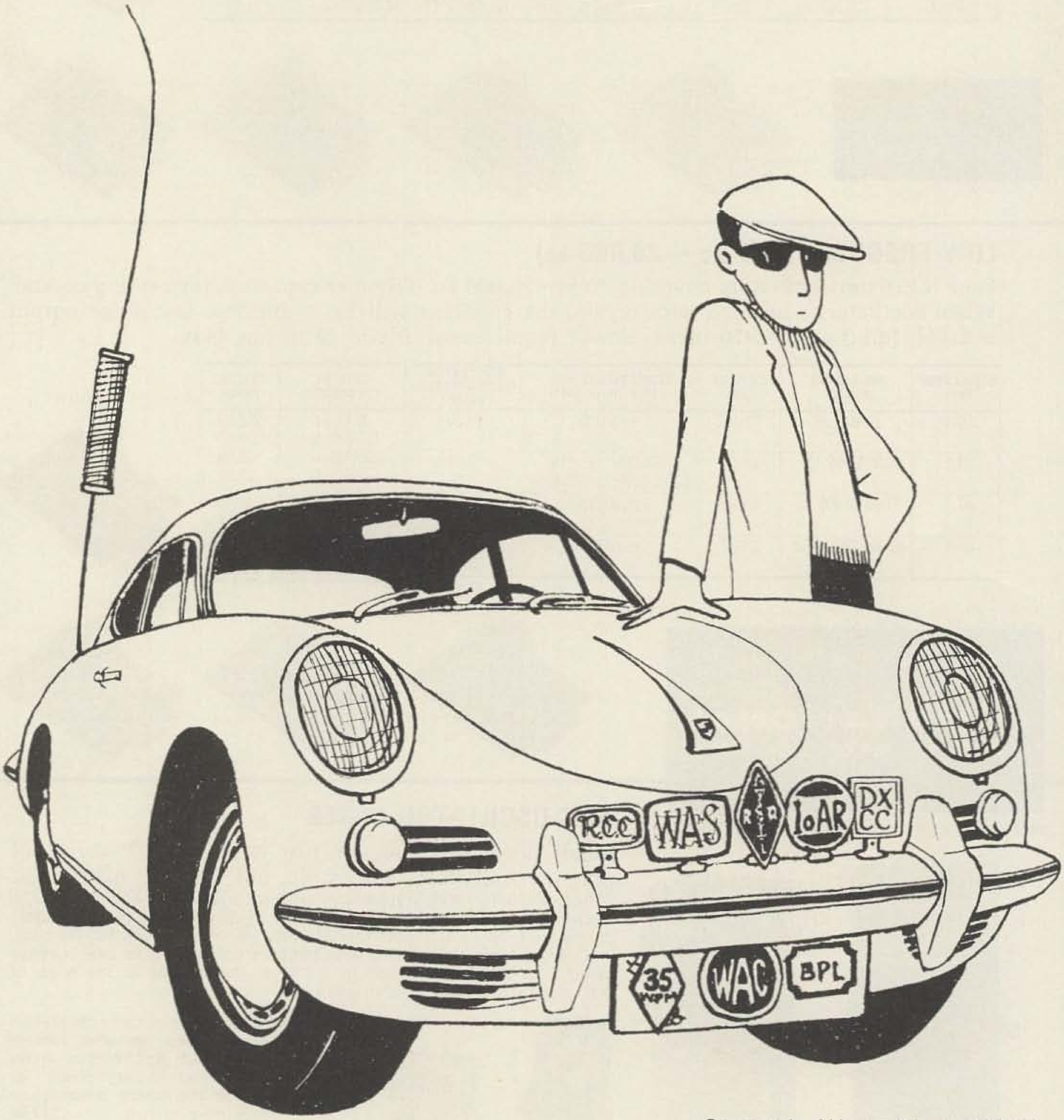
FOT-20

FOT-10


FOT-20 For high accuracy calibration requirements. Includes battery and output jack, output meter circuit and battery check, as well as thermistor temperature measuring circuit. **$87.50**

FOT-10 Basic case with battery and output jack for general wider tolerance applications. **$14.50**

MT-1 Oscillator board mounting kit. **$4.95**



Cartoon by Wayne Pierce K3SUK

William H. Kennedy W3ZFJ
1520 James Street
Monroeville, Pa.

A 2 band mobile SSB Receiver with many unique features.

HO-2080SSBMR-1OT

This receiver was conceived, designed, and constructed with one aim in mind, mobile single sideband. It is now and has been operating in this manner for over one year with superb success. Sensitivity and selectivity are excellent. Dozens of comparitive tests have been made with other receivers and this receiver hears everything my 75A-4 hears or a KWM-2 hears. It's now being used with a companion 200 watt transmitter in the same size package which, incidentally, was an afterthought when the receiver was completed.

Since most constructing hams are familiar with basic operation of receivers, I will not go into a detailed explanation of each stage, but will hit only a few highlights and problems encountered.

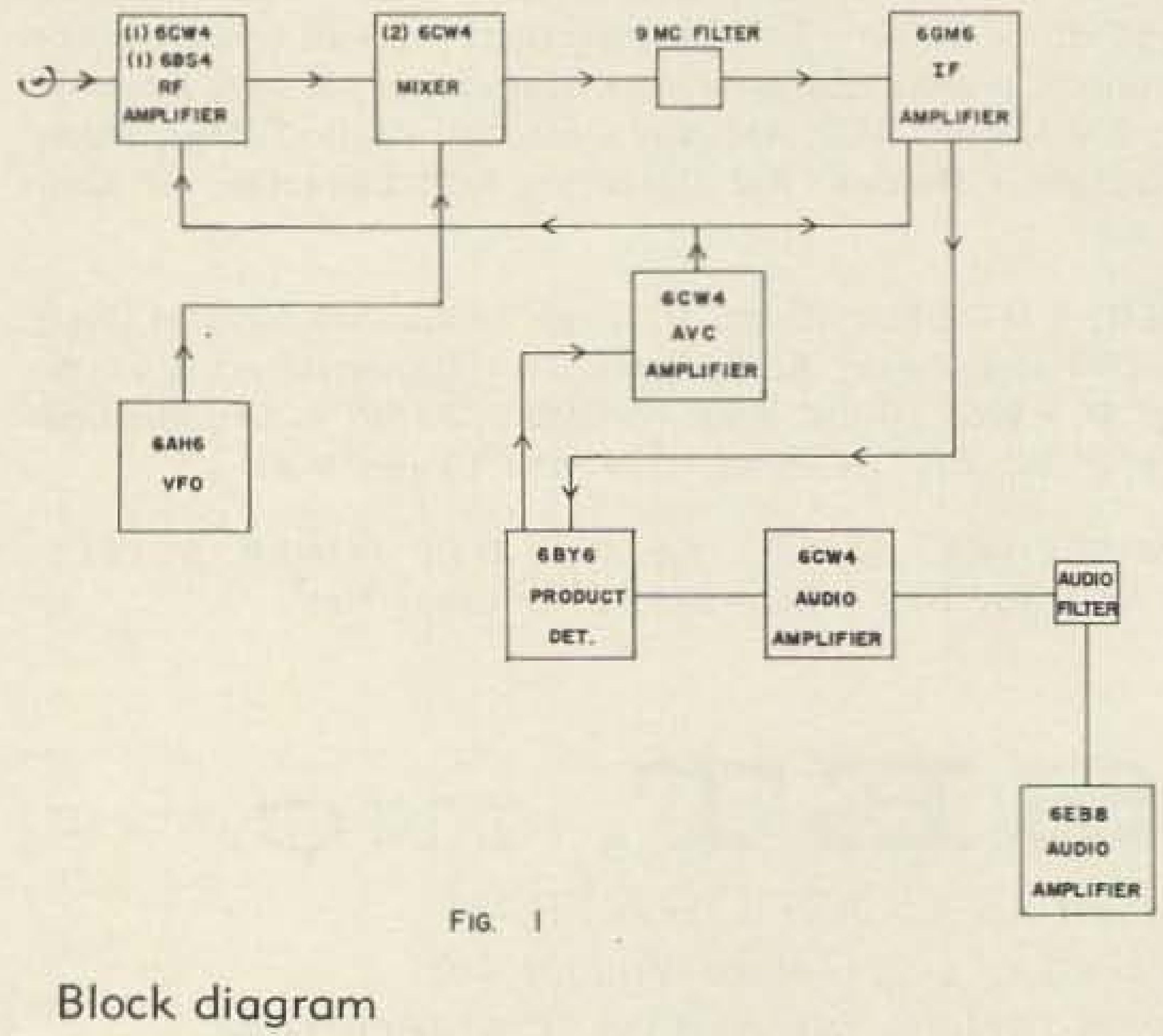
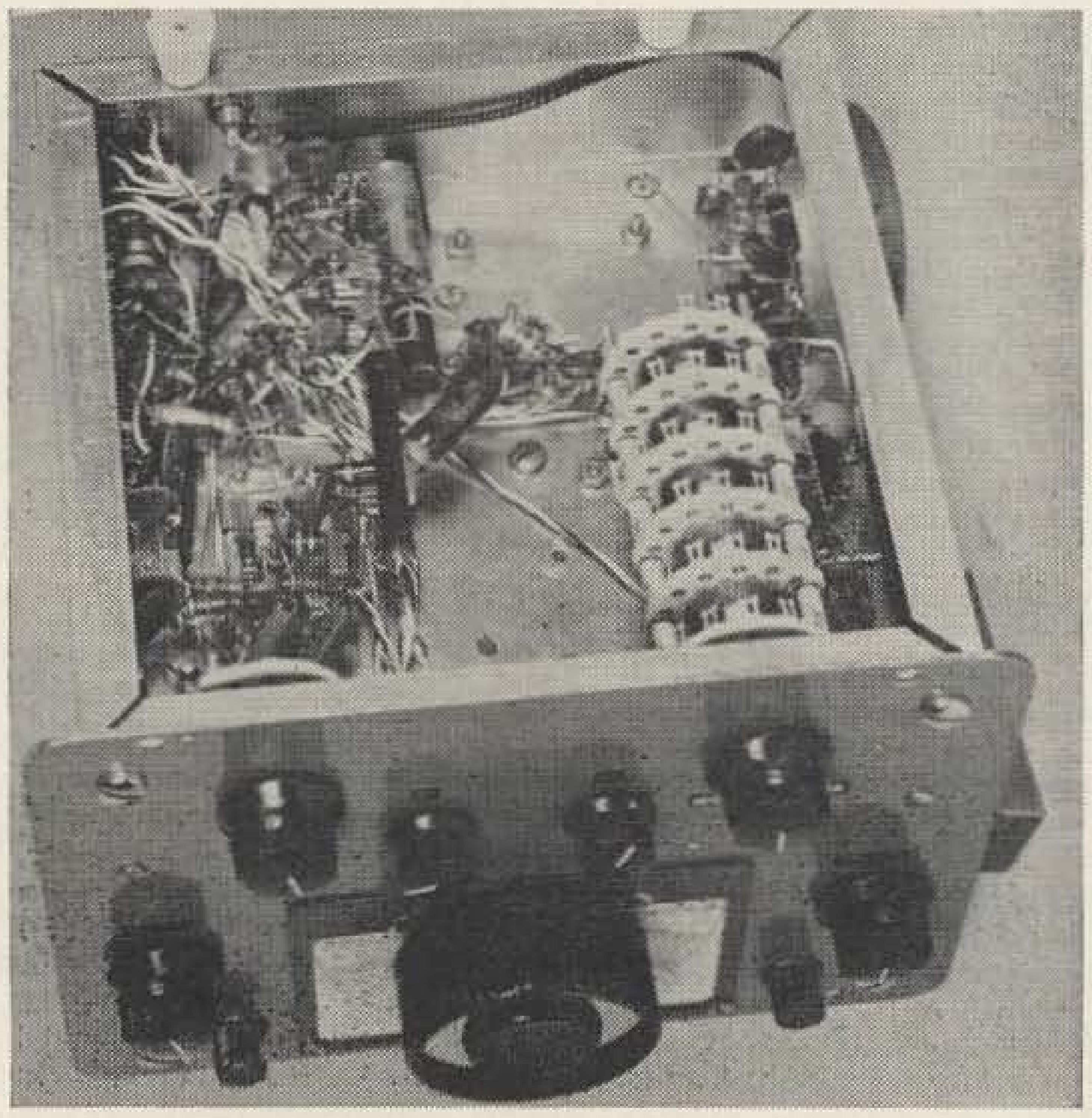


FIG. 1

Block diagram

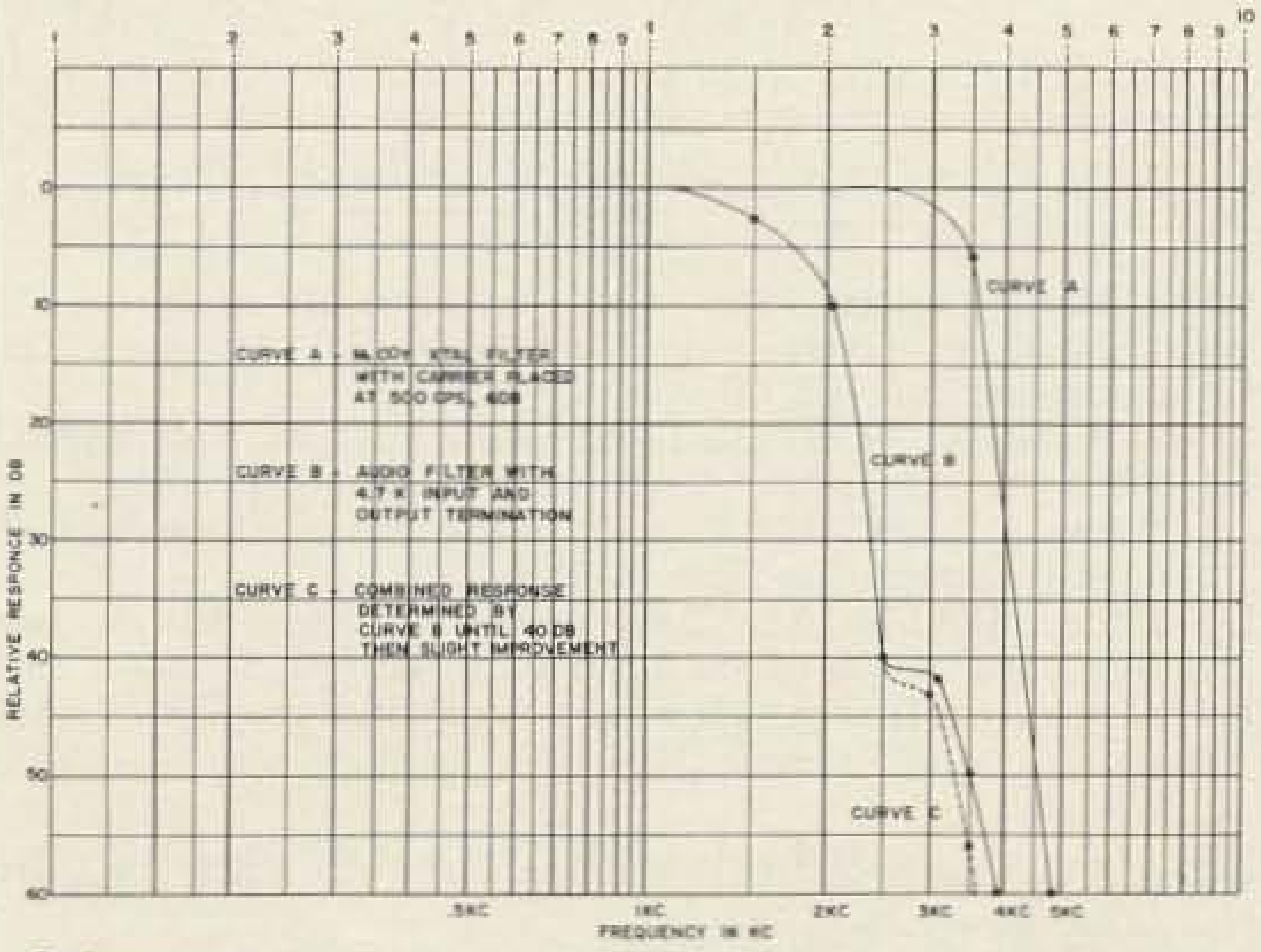


Bottom view of receiver

The block diagram (Fig. 1) shows only 8 stages, including the avc amplifier. Power requirements are necessarily slim for mobile service. Filament requires only 2.5 amps. at 12v and 200v at 70 ma.

The rf stage is a high gain cascode amplifier.

Already the communications engineers are screaming "cross modulation." Granted at full gain this receiver is no exception, however, when listening to a weak signal at full gain a strong local signal 20kc away is just barely detectable. Backing off on the rf gain just a little removes any trace of the strong signal. Measurements indicate that at this point the gain of the rf stage is approaching unity. You need only to use this receiver to fully appreciate the advantage of front end gain control. Most receivers control three or four stages and the front end is still operating at fairly high gain and therefore is susceptible to overload on strong signals. Of course in order to use this method the mixer must be of the low noise variety, as this one is, rather than a noisy 6BE6 or 6BA7. The bottom of the cascode stage is a remote cutoff 6DS4 nuvistor triode. This configuration will give you the characteristics of a remote cutoff pentode except without the noise of a pentode.

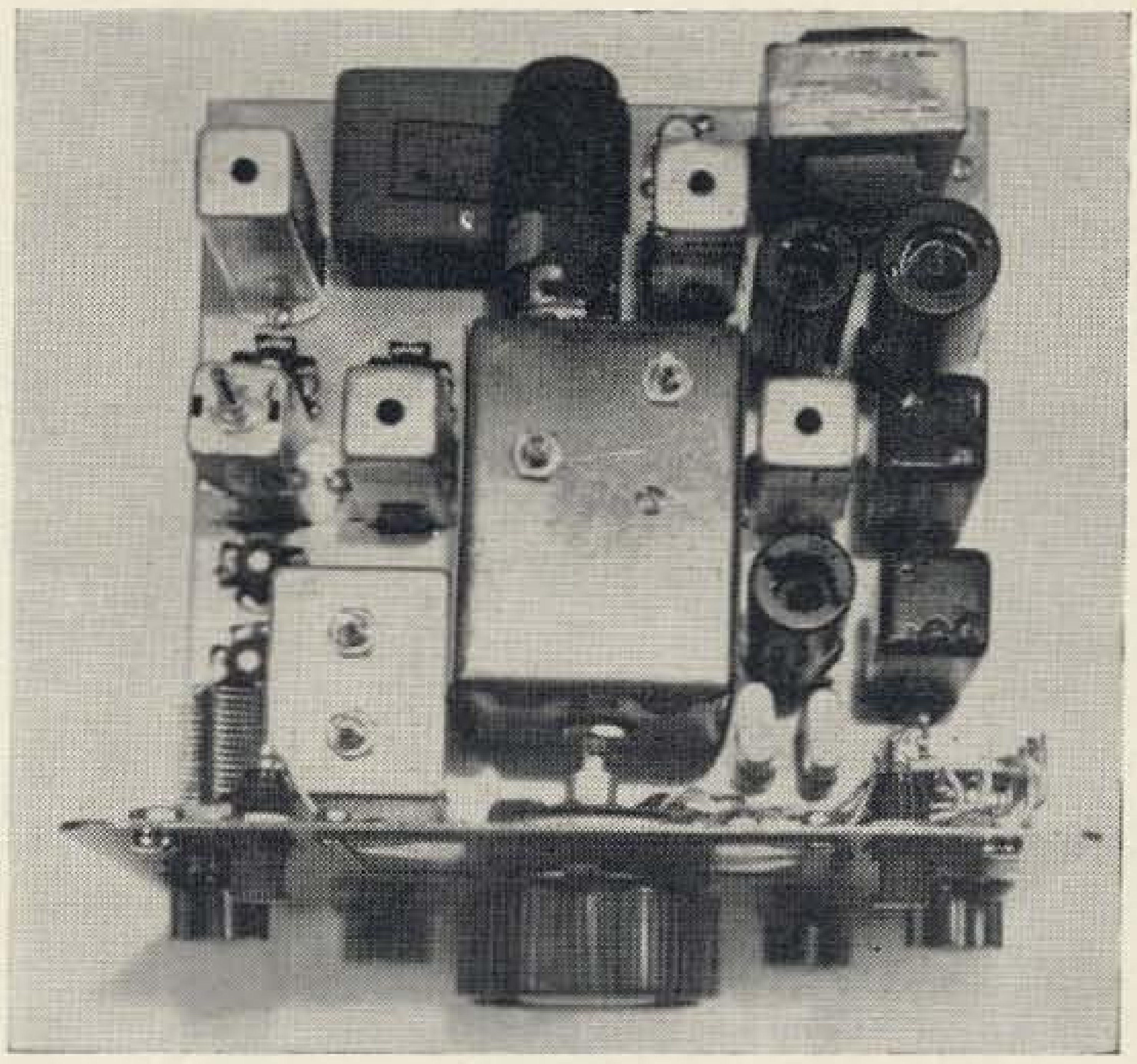


Selectivity

The mixer is the same high gain, low noise, and low cross modulation circuit described in the October 61 issue of 73. It works as well as the original 12AT7, but is scaled down in voltage for the nuvistors.

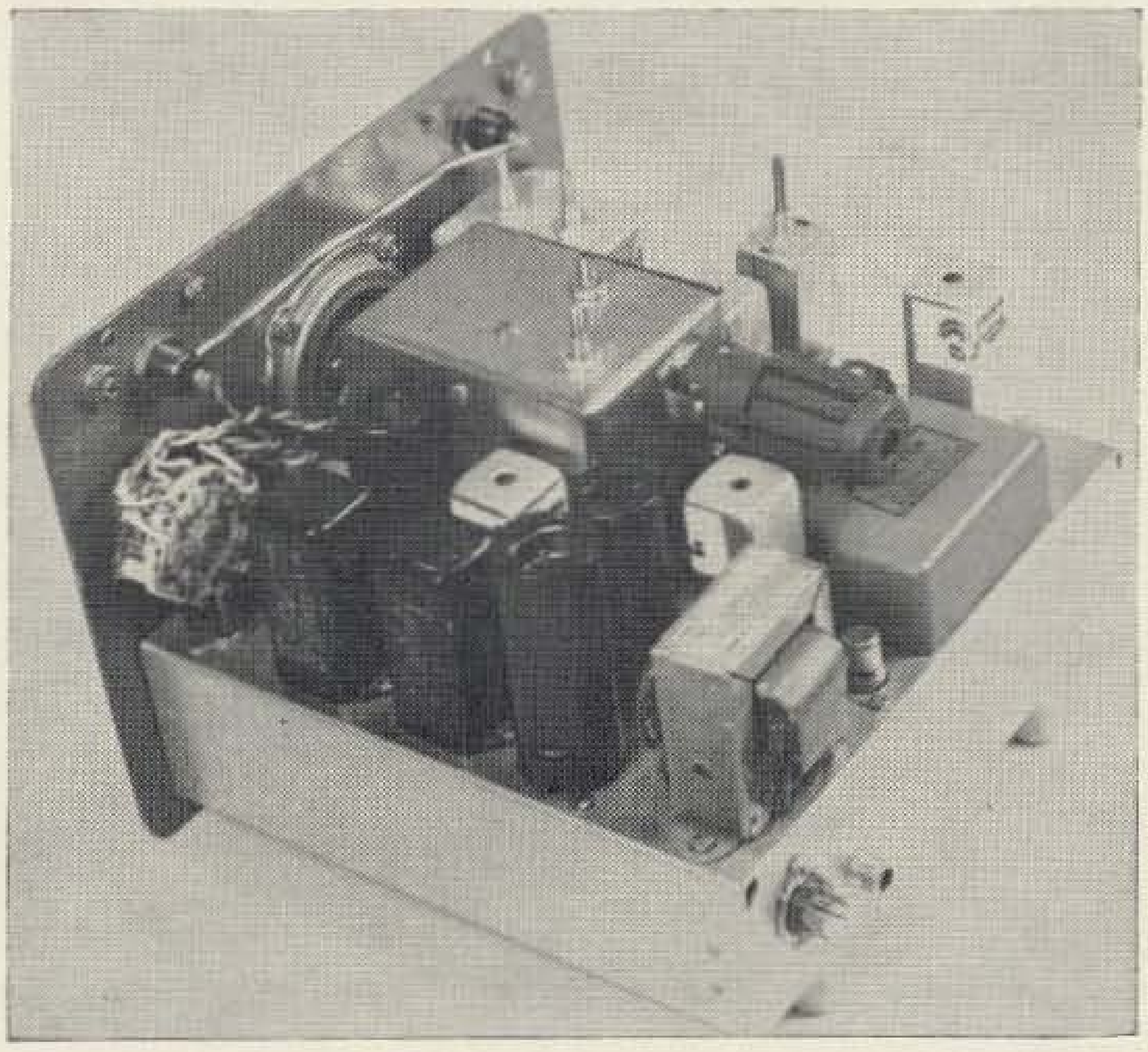
Please notice there are two filters in this receiver. The total bandwidth of both filters is 1400 cps at the 6db points. Actual audio response, however, at the 6db points is 500 cps to 1900 cps. Too narrow for phone operation? You should hear it. The xtal filter selects only one sideband and sets the lower audio limit to 500 cps. The audio filter alone sets the high end at 1900 cps.

One must be careful when defining selectivity and bandwidth. You may have more bandwidth than you think. For example the Collins 75A4 normally has a 3.1 kc filter, but when you position your passband tuning properly the lower audio limit is about 400 cps. This places the upper limit at 3500 cps, almost



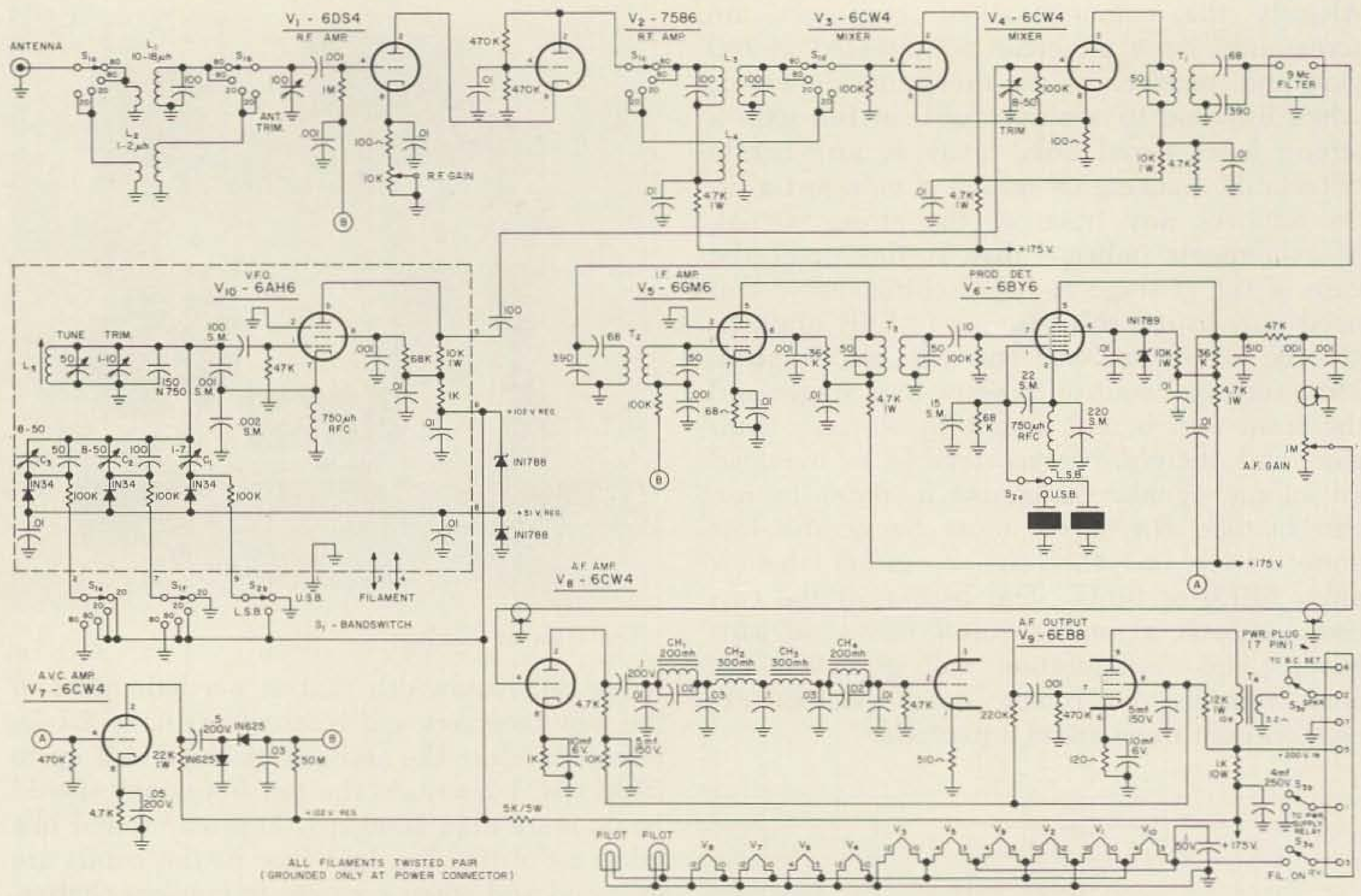
Top view of receiver

twice the bandwidth that is needed. Most of the new receivers and transceivers have 2.1 kc filters therefore the audio response is still up to 2500 cps. I maintain the top frequency should be no more than 2000 cps. This may sound like gilding the lily, but let's face it, the bands are crowded and when it comes to monkey chatter, "Every litter bit hurts." (ouch)



¾ view of receiver

The curve in Fig. 3 will show the combination of the filters. The bfo frequency was set at the 25 db point on the curve, setting the low frequency to 500 cps. Since the audio filter reaches its maximum depth before the xtal filter starts to roll off, the af filter is the high frequency defining aperture. Matching to the xtal filter is accomplished by modification of the standard Merit 10.7 mc *if* transformers as seen in the parts list. The audio chokes used in this audio filter were surplus units, obtainable from Olsen Radio Co., Penn Ave., Pgh., Pa. A



T1, T2 Merit 10.7 mc *if* transformers modified by removing the 33 mmfd and replacing one side with 50 mmfd and the other side with 68 uuf and 390 uuf ceramics.
T3 Merit 10.7 mc *if* transformer modified by adding 20 mmfd ceramic to existing 33 uuf.
T4 10 K to 4η output trans.
CH1, CH4 225 mh chokes.
CH2, CH3 300 mh chokes.
CH1-4 audio chokes are surplus Rola Co. GH-1226-2 available at Olsen Radio Co., Pgh., Pa. Substitutes are VIC-8 and VIC-9 UTC variable inductors.
Filter McCoy model 48B1 with matching bfo xtals.
Heat shield on 6AH6 vfo is model CFM7 by Cool-Fin Electronics, So. El. Monte, California.
L1 Miller 41A155CBI 10-18 μh with 10 turn link added.
L2 Miller 41A156CBI 1-2 μh with 5 turn link added.
L3 Miller 41A155CBI. Two coils one mounted on top of can, one mounted on bottom of can.
L4 Miller 41A156CBI. Two coils one mounted on top of can, one mounted on botton of can.
L5 10 turns #16 enamel wire wound and an XR-50 coil form.

good substitute would be the VIC-8 and VIC-9 UTC variable inductors.

The vfo is constructed in a heavy welded copper box. The mechanical and electrical stability is excellent. The drift in the first 30 minutes is 900 cps, after which it will sit on zero beat with the Collins for hours. This initial drift is very slow so you may use the receiver almost immediately after turning it on, a necessary requirement for most mobile work.

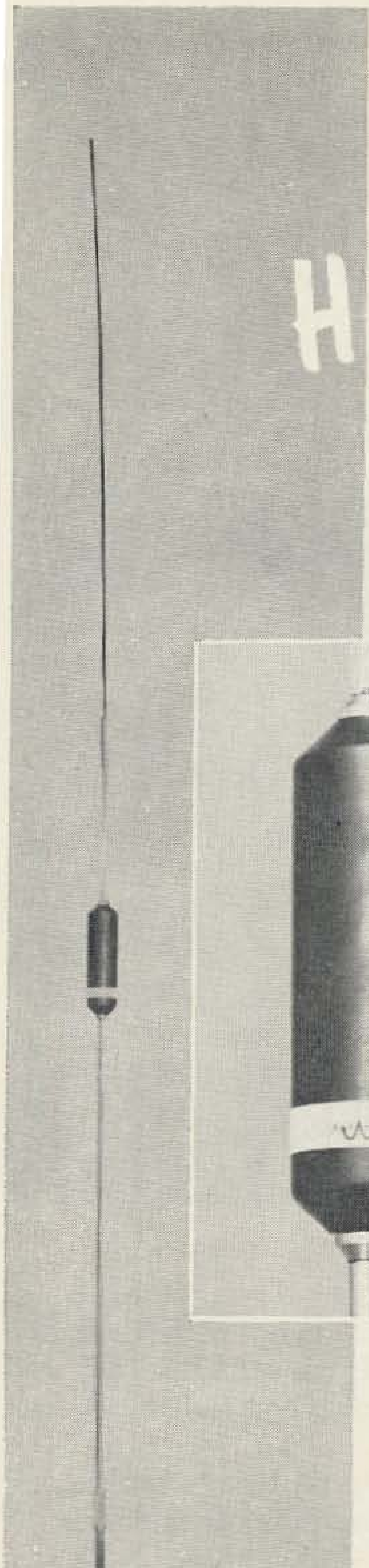
The dial calibration is not very well defined from the photos, but the dial is marked only with the 100 kc marks in each band. The vfo covers 14.25 to 14.35 and 14.00 to 14.10 on twenty and 3.90 to 4.00, 3.50 to 3.60 on 80 meters.

Band changing is done with diode switching and the four 100 kc segments are accomplished with only three changes in vfo freq. The dial shows 5 bands, but only four are used. A diode switch is used to shift the frequency 3 kc when changing sidebands so the input frequency remains unchanged. Voltage regulation is accomplished with Zener diodes as can be seen in the schematic.

The avc system employed works very well. It has none of the initial 'pop' common to a good many receivers. The attack time is approximately 300 μsec as measured on a Tektronic 585 ocilloscope. Release time is determined by the back resistance of the diodes and the 50 meg resistor. The 50 meg resistor is returned to B+ to provide a delay. An unexpected problem developed when the receiver was first tried mobile. Every time I would release the accelerator the B+ voltage would drop about 10v. This drop was seen as a large change on the plate of the avc amplifier and would cut the receiver off for about 5 seconds. This was corrected by returning the avc plate load to the regulated 102v on the vfo.

This receiver has given me a lot of enjoyment in the time I have used it. I have received a lot of compliments from friends and enemies alike, and I can say without reservation this receiver does not cause TVI.

. . . W3ZFJ



Hold Everything...!

Here's *Waters* NEW AUTO-MATCH!

4db Stronger Mobile Antenna

Combine stronger structural strength with stronger signal strength and **voila** .... Waters New AUTO-MATCH Mobile Antenna!

Frankly, we hadn't expected to announce AUTO-MATCH for several weeks. But with completed field tests corroborating our every engineering expectancy of operating superiority and structural durability, we decided to beat the gun.

Briefly, the Specs:

AUTO-MATCH operates with only a coil-change on every ham band with its maximum radiation efficiency giving up to 4 db more signal strength than is found in other commercial mobile antennas. The tapered radiator tip is of drawn 17-7 PH stainless steel and adjusts to all frequencies. Interchangeable Top-Center loading coils are molded in low-loss Epoxy and are completely sealed against moisture and water seepage. High Q stable inductance handles 500 watts of RF and at resonance presents an "Auto-Match" of 50 ohms for the coaxial feedline. The sturdy lower mast is made of 6061 ST6 aircraft aluminum tubing with a stainless steel mounting stud welded in standard base-mount thread. The upper mast is of solid tapered drawn aluminum rod to provide added strength and ease of upright mounting. The built-in foldover for garaging drops AUTO-MATCH to car-top level. AUTO-MATCH fits any standard mounting base or bumper mount without change or modification. And remember .... AUTO-MATCH is rugged, very rugged — designed to last for car after car, rig after rig! You can place your order with your distributor now.

PRICES

Mast 370-1	**$12.95**
Radiator Tip 370-2	**$ 9.95**
Coil 370-75	**$15.95**
Coil 370-40	**$14.95**
Coil 370-20	**$13.45**
Coil 370-15	**$12.75**
Coil 370-11	**$11.95**
Coil 370-10	**$11.95**

WATERS

MANUFACTURING INC.
WAYLAND, MASSACHUSETTS

Clark Anderson W6NKZ

A Cheap Pair of Socks

The 6JB6 is a Novar tube with the suppressor grid brought out separately, not connected internally to the cathode (the common practice) and is supposed to have ratings similar to the 6DQ6. The recollection of the 6AG7 and the price invited the trial of the 6JB6's in a grounded grid linear.

Frankly, I was not too confident so a strictly junk box version was built. The results were very gratifying and should encourage others to give the tubes a try.

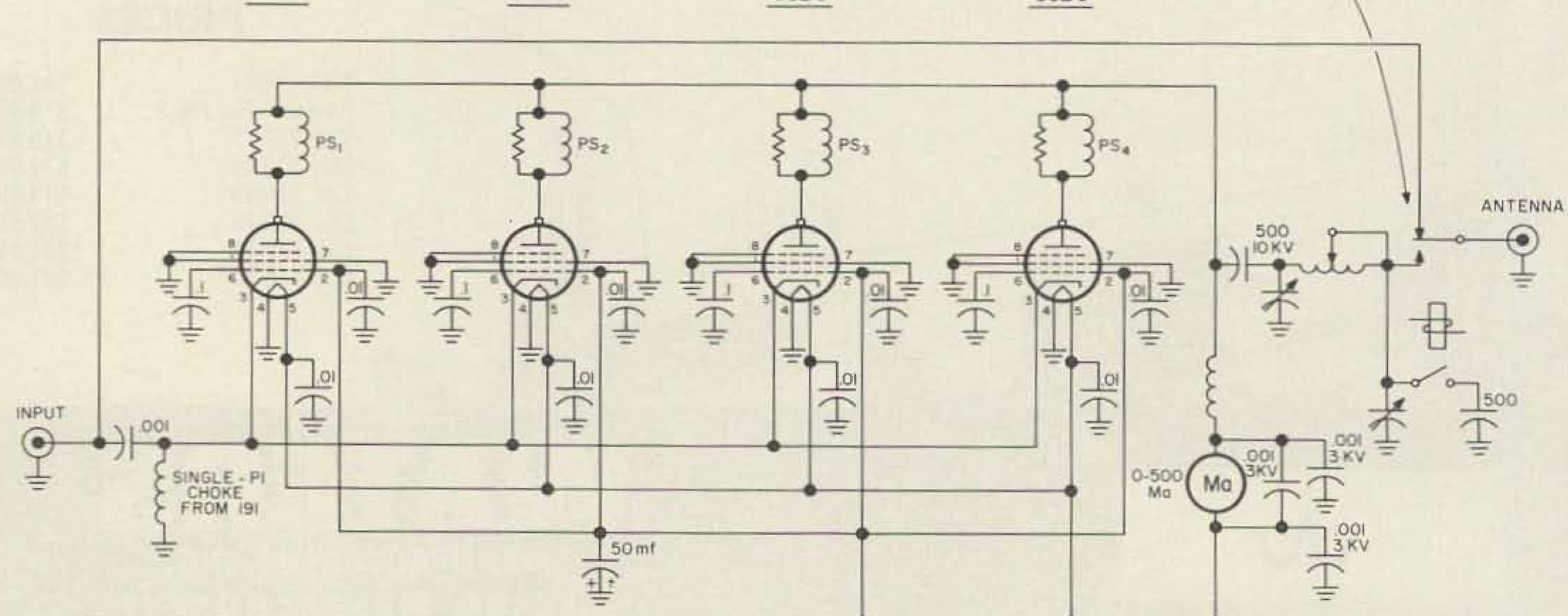
Four 6JB6's were paralleled and mounted in a BC191 tuning unit cabinet. The old holes were plugged with "Bondo", used for the new parts, or covered by the relocated tuning chart. The plate meter, roller coil and plate tuning condenser were all salvaged from the BC191. The loading condenser is a three gang TRF broadcast condenser and will probably require additional padding on 75 meters.

Construction was straight forward with no particular precautions except to place brass discs in the center of the novar sockets to provide better grounding and isolation; no trouble was encountered (which is unusual for W6NKZ, believe me). W6JPU gave encouragement to the project and the first trial at his QTH with a Variac showed that about 1200 volts was the limit without using bias. At this point the four tubes were dissipating 160 watts and beginning to blush. Forty watts apiece and one tube was beginning to get

6JB6 Linear Amplifier

quite red, but would cool down with excitation. Tubes were interchanged with the same tube being the weak sister, which eliminated the possibility of a stray parasitic in one socket.

At this stage a power supply was built using a healthy TV transformer in a tripler circuit



Power

Supply

described in 73, June 1961.

Tripler is a slight misnomer; the switch was thrown and 1900 volts appeared to make the electrolytics sound like a rattlesnake. Two more condensers were hastily added and some voltage checks were made.

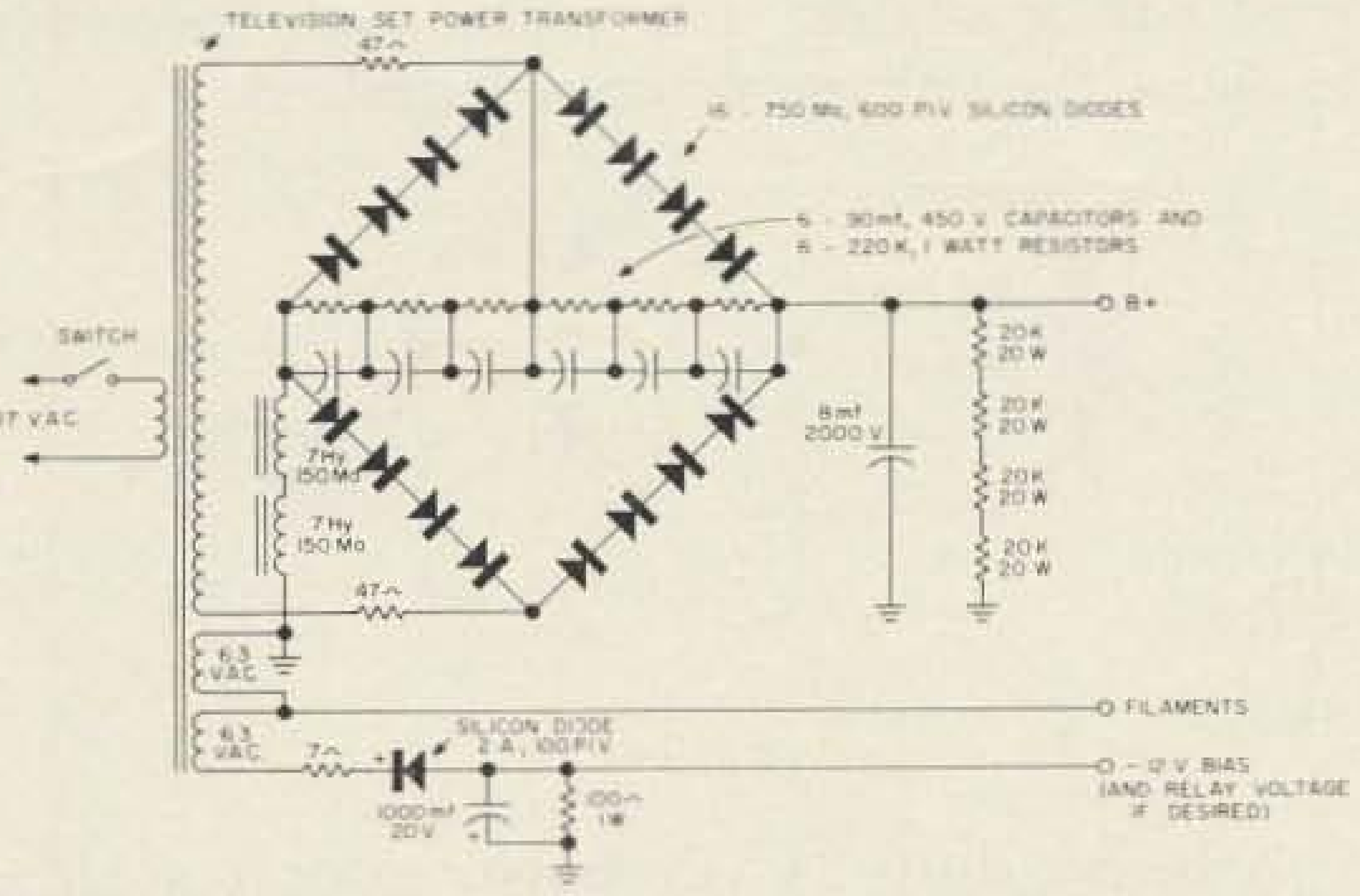
65 mils steady load—1900 volts

150 mils steady load—1620 volts

220 mils steady load—1600 volts

At this point resistors were smoking and I decided this was fair enough for the size and price.

With the power supply completed and 12 volts bias applied to the grids, the amplifier idled at about 40 mils—10 mils per tube. When properly loaded it would easily peak 400 mils and was very easy to drive with the untuned cathode circuit. On the air reports have been most complimentary and local checks have shown a very clean signal on the scope.



At a sustained 400 mils the tubes are just beginning to show color, which would indicate 1600 volts to be about the limit for the "conservative amateur" or a confirmed whistler.

This article was written with the hope of encouraging a little experimentation and not with the idea of this being the last word.

. . . W6NKZ

Photo by E. C. Current

L. F. Kiner K6VNT
1213 Pacific St.
Santa Monica, Cal.

Build a 28 Volt Power Supply

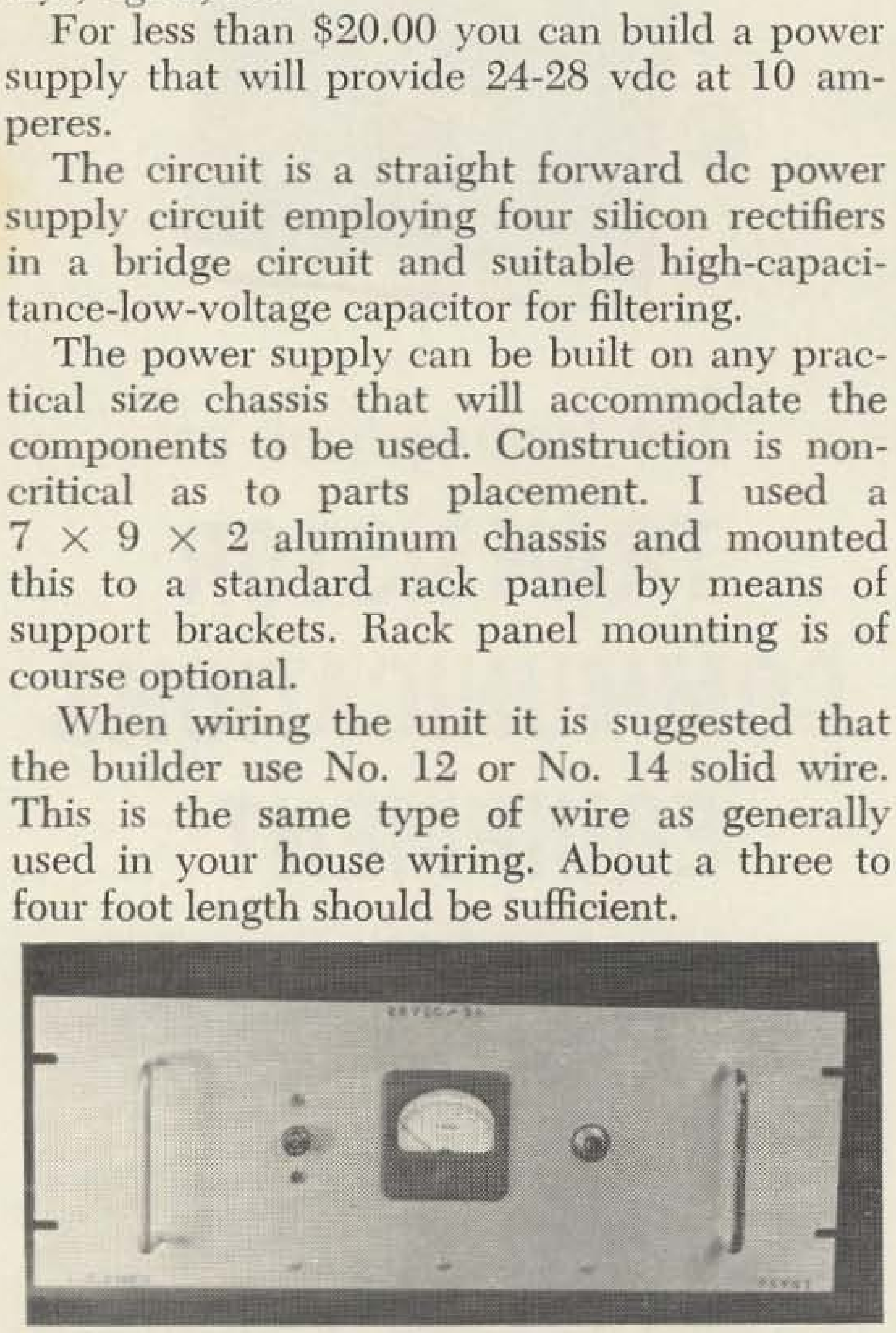
There is really no need for you to be passing up those surplus 24-28 volt dc transmitters, receivers, relays, switches, coaxial relays, lights, etc!

For less than $20.00 you can build a power supply that will provide 24-28 vdc at 10 amperes.

The circuit is a straight forward dc power supply circuit employing four silicon rectifiers in a bridge circuit and suitable high-capacitance-low-voltage capacitor for filtering.

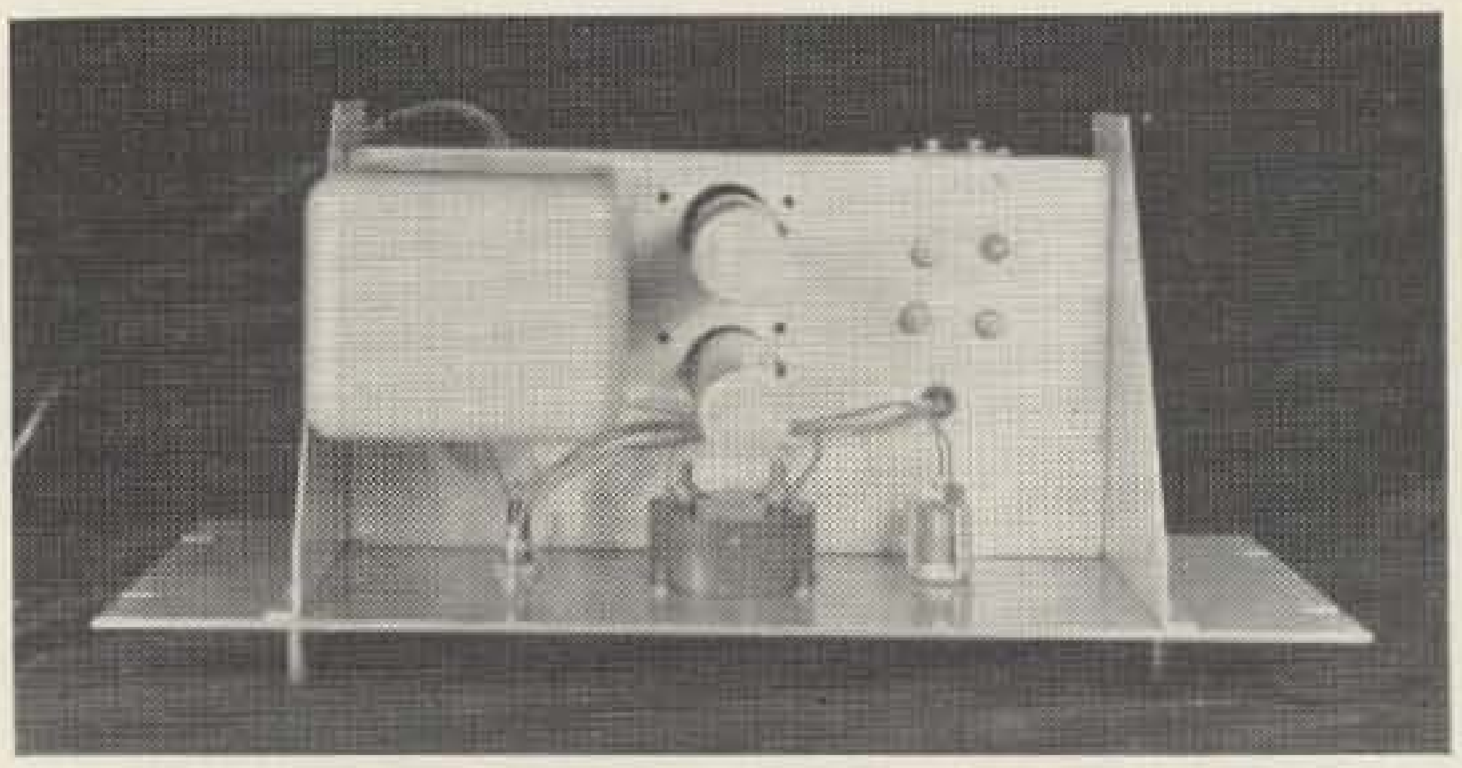
The power supply can be built on any practical size chassis that will accommodate the components to be used. Construction is non-critical as to parts placement. I used a 7 × 9 × 2 aluminum chassis and mounted this to a standard rack panel by means of support brackets. Rack panel mounting is of course optional.

When wiring the unit it is suggested that the builder use No. 12 or No. 14 solid wire. This is the same type of wire as generally used in your house wiring. About a three to four foot length should be sufficient.



Most of the surplus stores can supply a power transformer that will do the job very nicely. Price? The range is from $5.00 to $10.00 each depending on condition and current carrying capacity. One that will do the job is available from Hiway Company (1147 Venice Blvd., Los Angeles 15, California) for $7.25 prepaid. This particular transformer will deliver 24 vac and 10 amperes from 115 vac 60 cps source.

Of course you can also obtain your 24 vac by wiring the secondaries of two 12 vac filament transformers in series (or the secondaries of four 6.3 vac filament transformers). The primary windings would be paralleled and a check with an ac voltmeter will tell you whether you have the secondaries connected properly. Be sure to check the secondaries with an ac voltmeter to insure that your connections are series aiding (adding) and not cancelling.



The rectifiers (diodes) used in the original unit were purchased from TAB (111-54 Liberty Street, New York 6, N.Y.) for $1.15 each. The units selected are the 12 ampere, 70 vrms (100 piv) silicon power diode studs. Be sure to use mica (or equivalent) insulating washers when mounting the diodes to the chassis.

Metering of the current drain and output voltage is optional. I had a dc ammeter that wasn't in use and installed it on the rack panel. Since a dc voltmeter of suitable range was not available, pin jacks were provided to check the voltage whenever desired.

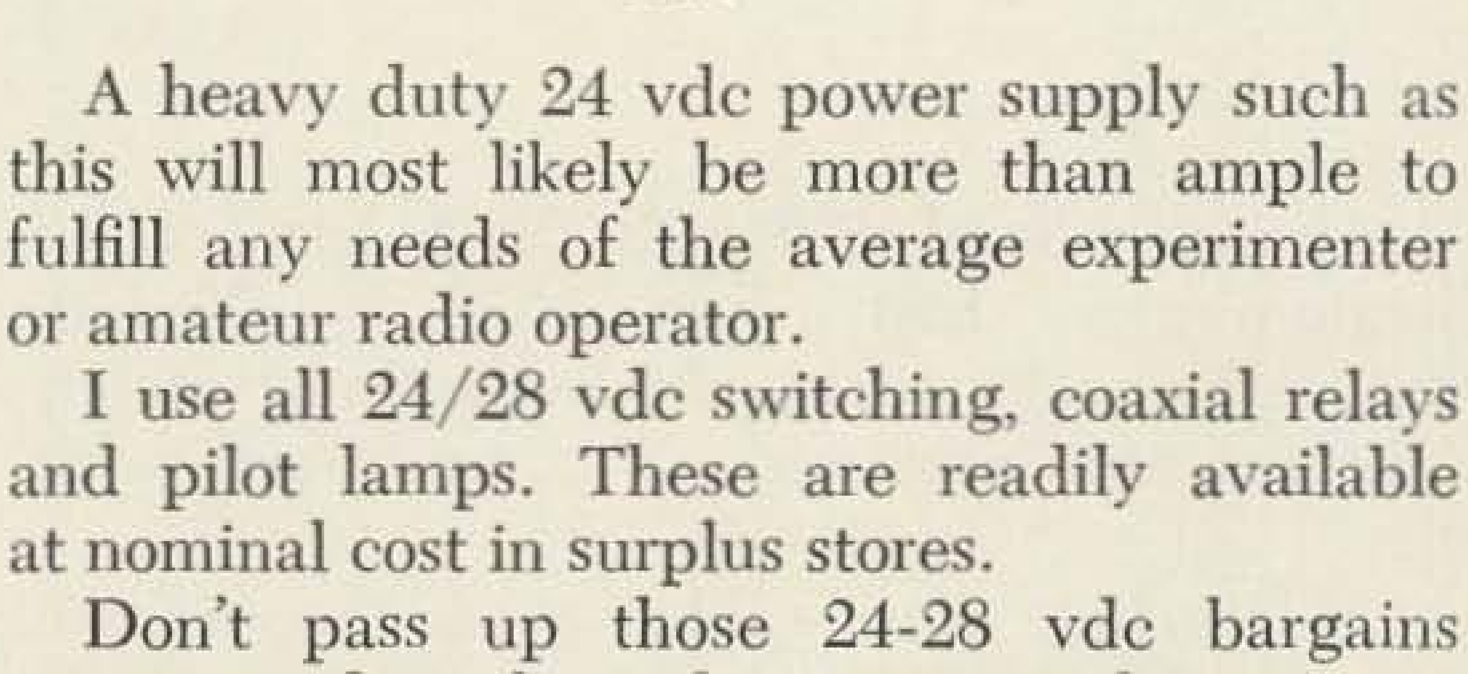


FIG. 1

A heavy duty 24 vdc power supply such as this will most likely be more than ample to fulfill any needs of the average experimenter or amateur radio operator.

I use all 24/28 vdc switching, coaxial relays and pilot lamps. These are readily available at nominal cost in surplus stores.

Don't pass up those 24-28 vdc bargains anymore; the relays alone are worth investing in a power supply.

. . . K6VNT

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

Weather Detector

Here in the tornado-prone Southwest, one of the most spectacular feats of public service performed by hams has been the group of "Weather Nets" which aid the weather bureau and news services in keeping track of severe weather. A number of lives have been saved by the action of such nets.

But while this aspect of severe weather, public service, and ham radio, appears to have been confined principally to the tornado and hurricane belts of our country, the potential of mixing the three ingredients is available almost anywhere.

One of the more interesting recent examples is suggested by an article appearing in the May, 1963, issue of *Scientific American* magazine, in the publication's department devoted to "The Amateur Scientist."

Described is a complex-appearing (but actually far simpler than a SSB exciter) device which when completed tells you the direction and intensity of thunderstorms. Its range is some 600 miles; its azimuthal accuracy is limited only by the care in construction. It's no weather radar—but it does much the same job.

And at the conclusion of the article, almost as an afterthought apparently, the author comments that two or three such azimuth stations, separated by 100 miles or so, could obtain accurate fixes on thunderstorms "if the problem of establishing communications between stations can be solved. Perhaps the solution can be found in amateur radio."

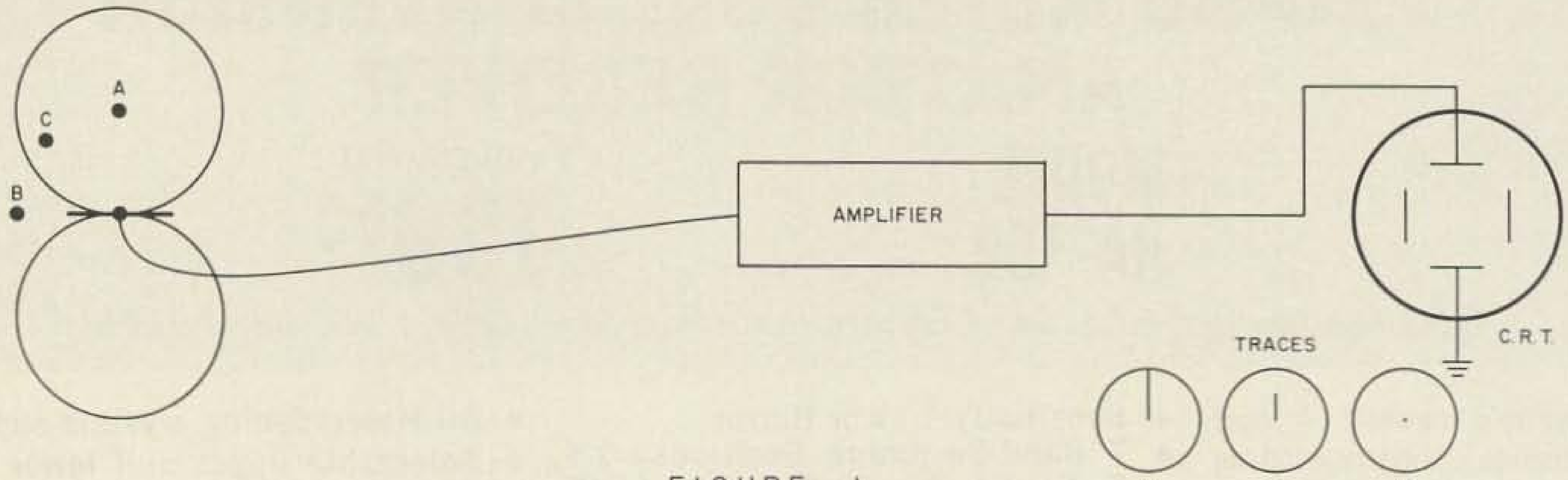


FIGURE 1

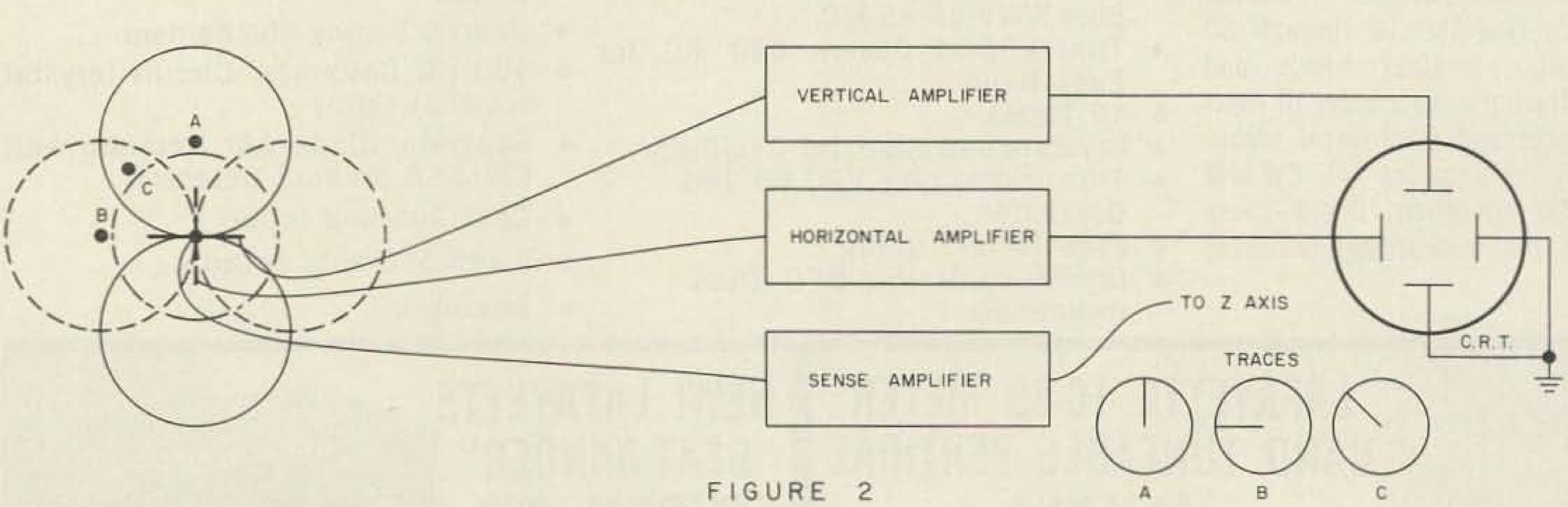


FIGURE 2

So if you're looking for something new, different, and a little bit out of the way to spend your construction talents on for a spell, you might consider the weather detector. If you and just one buddy 100 miles away from you each build one, you'll have the virtual equivalent of a weather radar station so far as locating thunderstorms is concerned. And there's a chance that your observations might uncover some of the unknown details about thunderstorms which the professionals haven't discovered yet!

Actually, the weather detector as developed by Mr. Thomas P. Leary, an Omaha, Neb., attorney, consists of a radio-compass with oscilloscope readout. Complete constructional details appear in the *Scientific American* article mentioned previously, but most hams will be able to build a working model from the block-diagram description which follows:

Input to the weather detector comes from three antennas. Two of these antennas are shielded loops, identical to those used for transmitter hunts (Leary used 50 turns of No. 20 Formvar covered wire on a 3-foot form, shielded with a wrapping of aluminum foil). The third antenna is a vertical "sense" antenna to remove ambiguity.

The loops are positioned at right angles to each other, and feed identical amplifiers. The amplifiers have frequency range from 100 cps to 12 kc; any hi-fi or phono amplifier should work but high gain is essential. Leary used a 12AU7 feeding a 6AU6 to achieve sufficient gain.

The "sense" antenna feeds a similar amplifier; all three amplifiers are provided with gain controls to allow balancing, and a special "stereo-matched" twin gain control for the loop amplifiers might not be out of place to avoid rebalancing.

Outputs of the two loop amplifiers go to the horizontal and vertical plates of the scope tube, respectively, while the output from the sense amplifier goes to the grid or the "Z" input of the scope.

Operation of the system can best be understood with reference first to the single-channel block diagram, Fig. 1, and then to the complete diagram, Fig. 2.

Fig. 1 shows only the vertical-deflection channel loop, amplifier, and scope circuit. A thunderstorm producing QRN at point A will be picked up strongly by the antenna; the QRN will be amplified and applied to the deflection plates, and the result will be a vertical line whose height is proportional to the strength of the QRN.

However, an identical thunderstorm at point B will lie in the null of the antenna and will not be picked up, while a third similar storm at point C will be received but with only about half the strength of the one at point A.

Now turn to Fig. 2 to see how addition of the horizontal channel changes things. Now the storm at point A is in the horizontal null and the vertical peak, so it still produces a vertical line on the scope face. But the storm at B is in a vertical null and horizontal peak, so it produces a horizontal line. And the storm at C produces signals in both channels; the strength in each channel is proportional to the angle of the radial line to the storm, and this effect results in a diagonal line pointing directly toward the original storm.

The Sense antenna's output, fed to the grid of the CRT, blacks out the "tail" half of the trace produced by each storm, so that the appearance on the screen is simply a line from the center of the tube (observer's position) indicating azimuth to the storm.

Most lightning discharges are vertically polarized, and the weather detector produces the line on the screen when receiving vertical-polarized energy. However, some cloud-to-cloud strokes are horizontally polarized, and some distant strokes received by sky-wave will be simultaneously vertical and horizontal. The horizontal component produces a sort of spade-shaped trace, with the tip at the rip of the screen, while the combination of both vertical and horizontal results in an oval with a straight line down the middle.

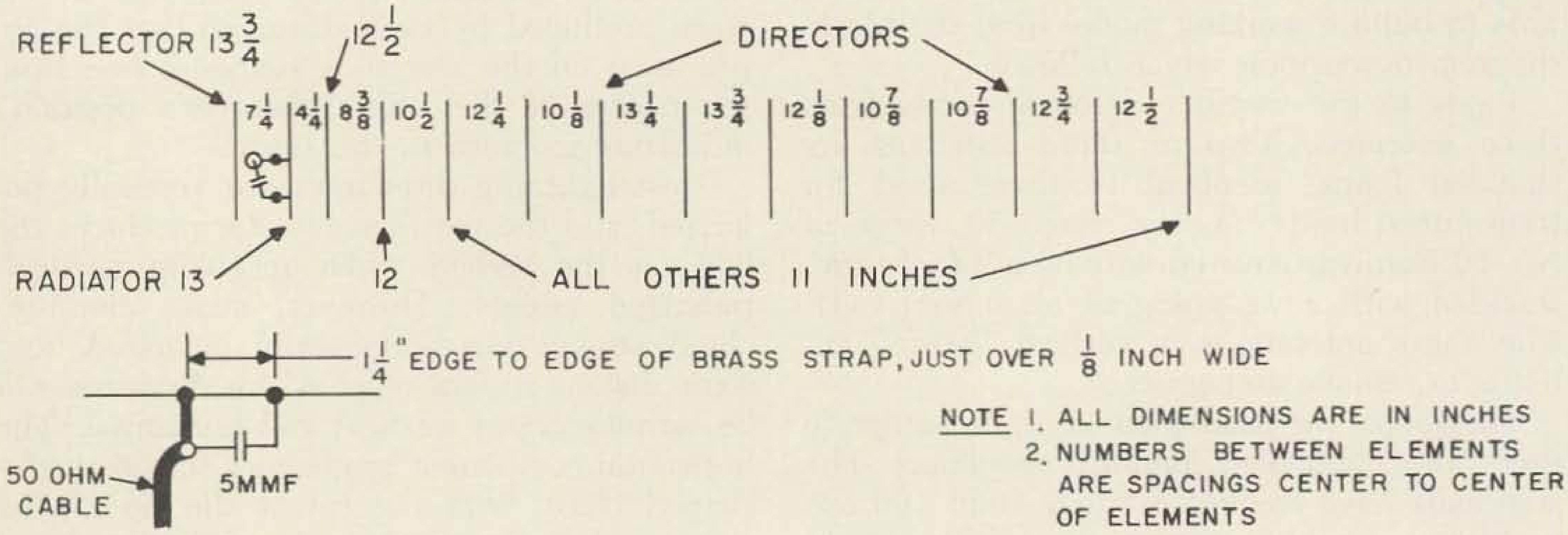
Only a few precautions are necessary when constructing a weather detector. One of the most important is to make all antenna feed cables the same length to preserve exact phase relationships. The Sense antenna should be connected to a "lightning arrestor" since the equipment will be operating during thunderstorm conditions. The loops should be oriented on N-S and E-W lines although this refinement is not necessary if they are at accurate right angles to each other; however they should be at least 20 feet above ground.

This weather detector can also be used to spot probable tornadoes, since the twisters are invariably accompanied by strong thunderstorm activity and turbulence. To quote Mr. Leary: "My station has produced an elliptical display with rapidly recurring sferic pips on the azimuth of a small tornado 24 miles away." He adds that any storm producing repeated pips on the identical azimuth is suspect.

. . . K5JKX

14 Elements on 432

K1CLL



RADIATOR DETAIL

Just to jog your memory, remember that as you go up in frequency the absolute necessity for an antenna designed for the band grows by leaps and bounds. This was already evident in the good old 5 meter days, 30 years ago. On ten meters, you could use a "long wire antenna," (generally the 160 meter "flat-top L") some 270 feet long and as high as you could get it. If it was pointed towards Europe, it also pointed West. But not on 5! You had to do something then.

Now that we're on ¾ of a meter take my word for it: Build at least one good multi-element Yagi to start off with. I built two, because from past experience it was nice to have two complete stations. You could loan one of them to a friend and thus be sure of at least some QSO's.

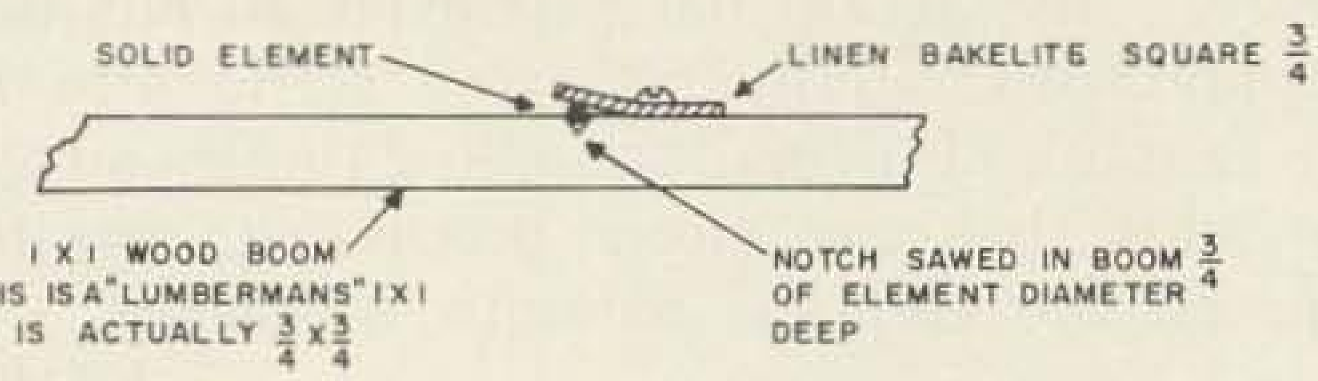


FIG. 2

So just make up one for now. Unless you want to live it up with a 14 over 14! It uses 1″ by 1″ red cedar or redwood, small squares of bakelite to hold the elements on, wood-screws, and aluminum clothesline for elements. It has 14 of these wide spaced for maximum gain, a fixed capacitor Gamma match, nearly 20 db gain, and it works!

This beam is not a copy of any other. I tuned this one up myself over weeks and weeks on the antenna range here. With some 23 years experience in back of that. Some handbooks claim that all the directors after the first few can be equally spaced. You can. But if you want to be sure of the gain of this one, make it up precisely as indicated. Note

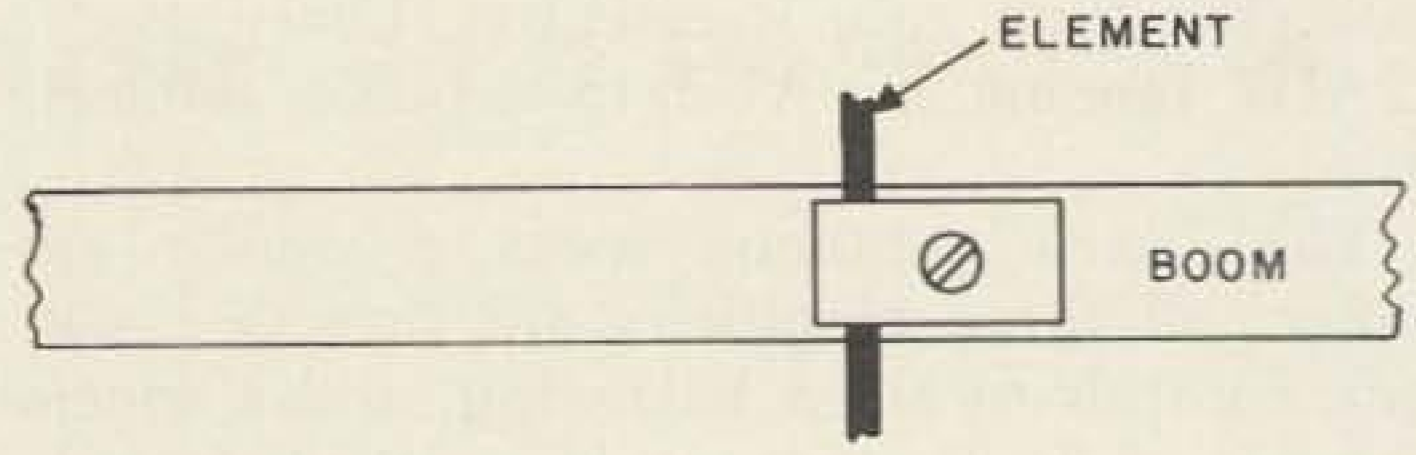


FIG. 3

that they came out pretty near equal but not quite.

Figs. 2 and 3 show element mounting detail. Fig. 4 shows material details. One nice feature about the thin solid aluminum elements. They *bend*! Several times if need be. You can use this beam as a "standard" also for your own antenna range, etc., as you go to more elements later. The construction is light but with a little varnish sprayed on, it will do for a while. You'll probably want to put up two or four a little later, anyway.

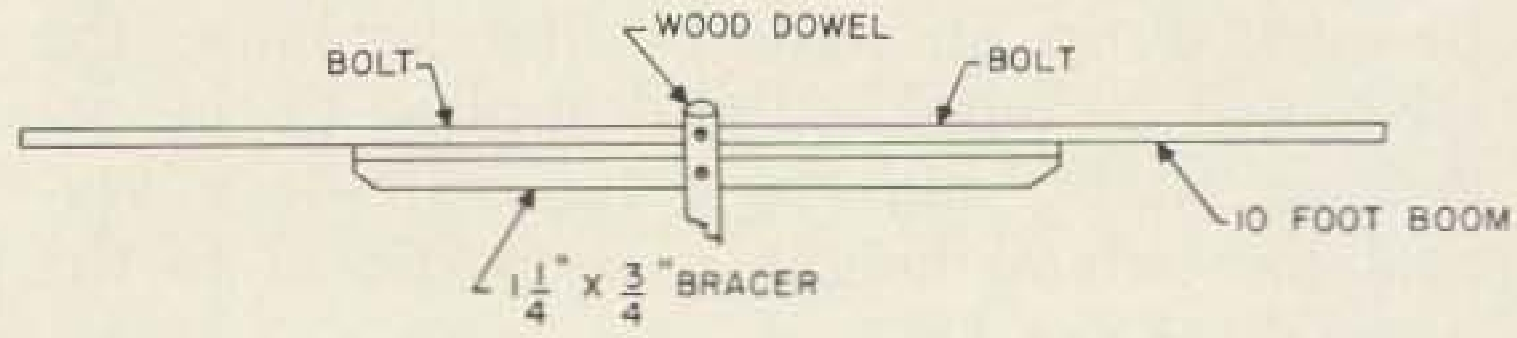


FIG. 4
SIDE VIEW, BOOM AND BRACER

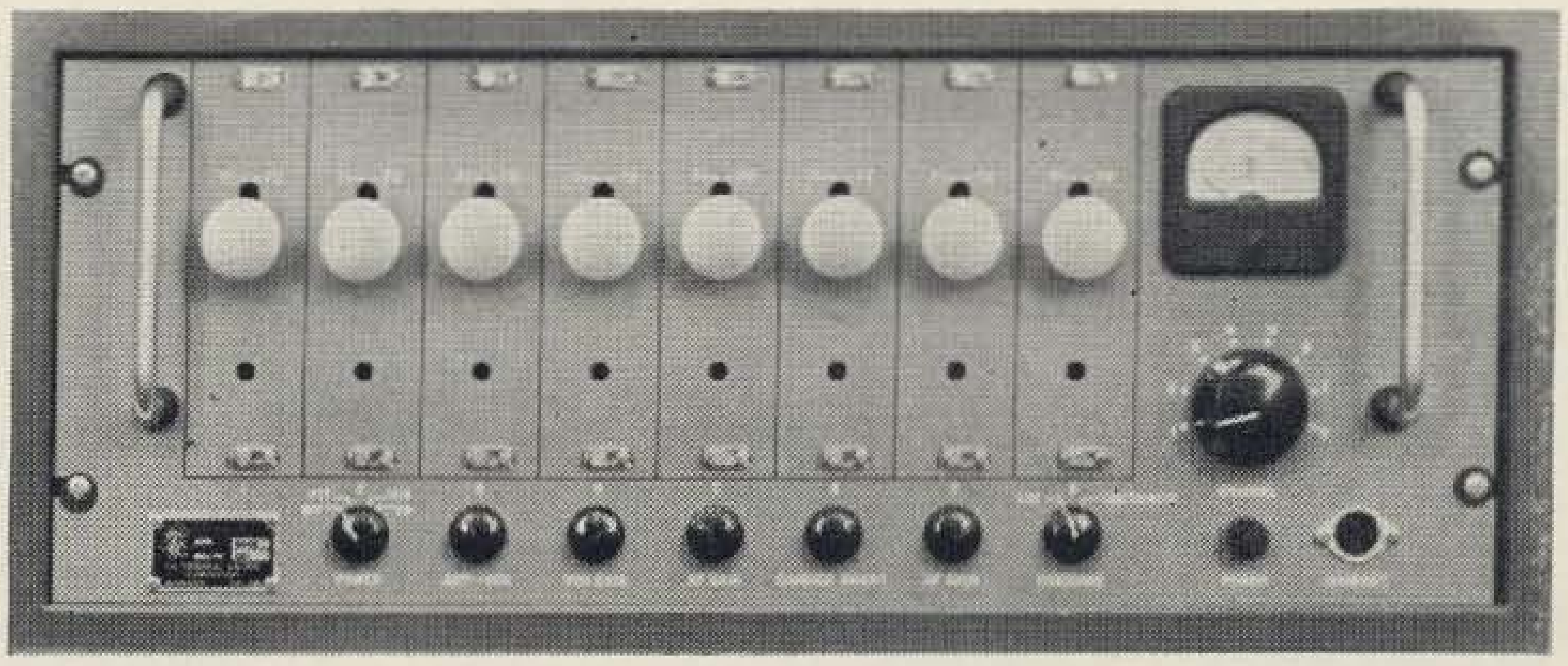
I used a one inch dowel for the first part of the mast, (that is, the part attached to the boom) plus a length of black plastic ABS (acrylic butadiene styrene) pipe over it. This just happens to be a good fit into the ends of the very useful 5 and 10 foot sections of aluminum Tee Vee masts—that are sold in every "radio store."

Seems like that's enough detail. See you *soon* on 432. There's quite a few on the band already, I find.

. . .K1CLL

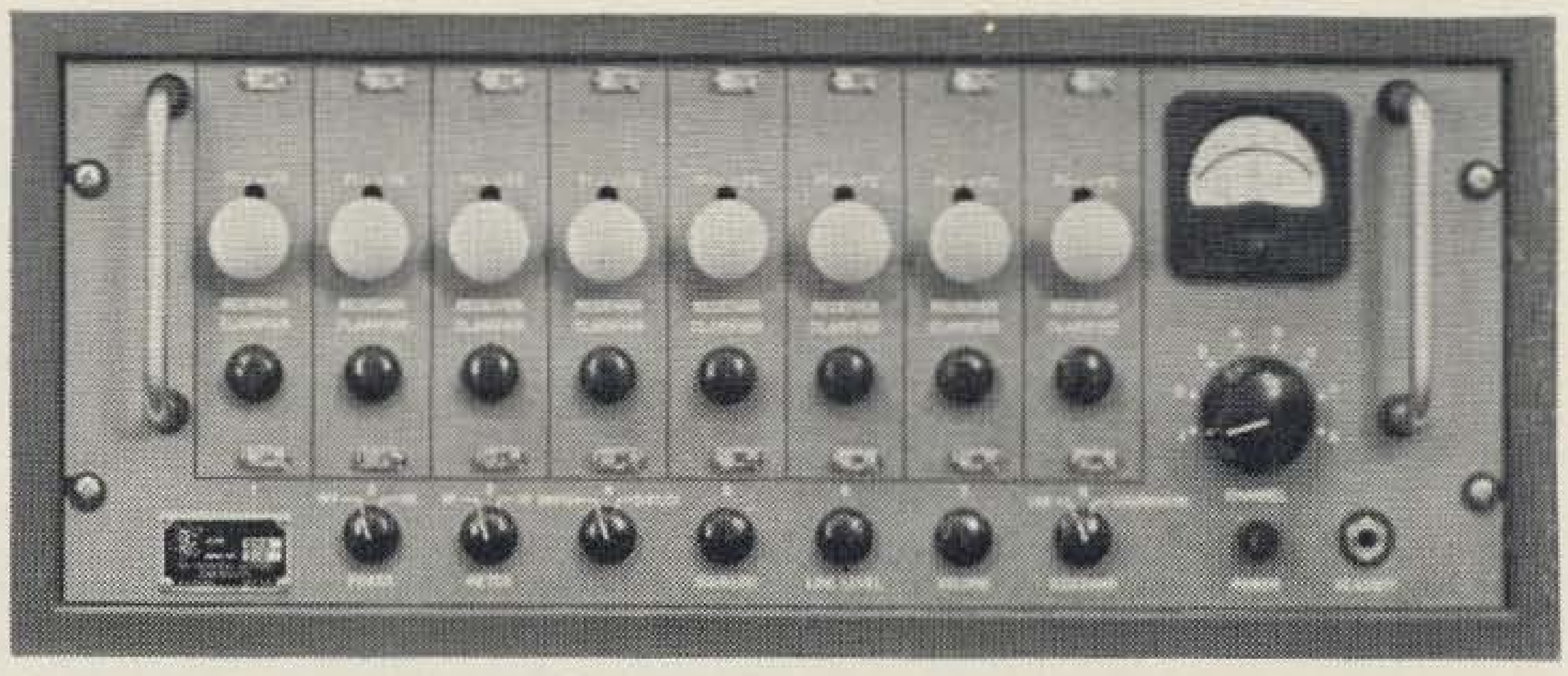
A COMPLETE SOLID STATE SSB EXCITER SME-1

and . . .



A COMPLETE SOLID STATE SSB RECEIVER SMR-1

providing



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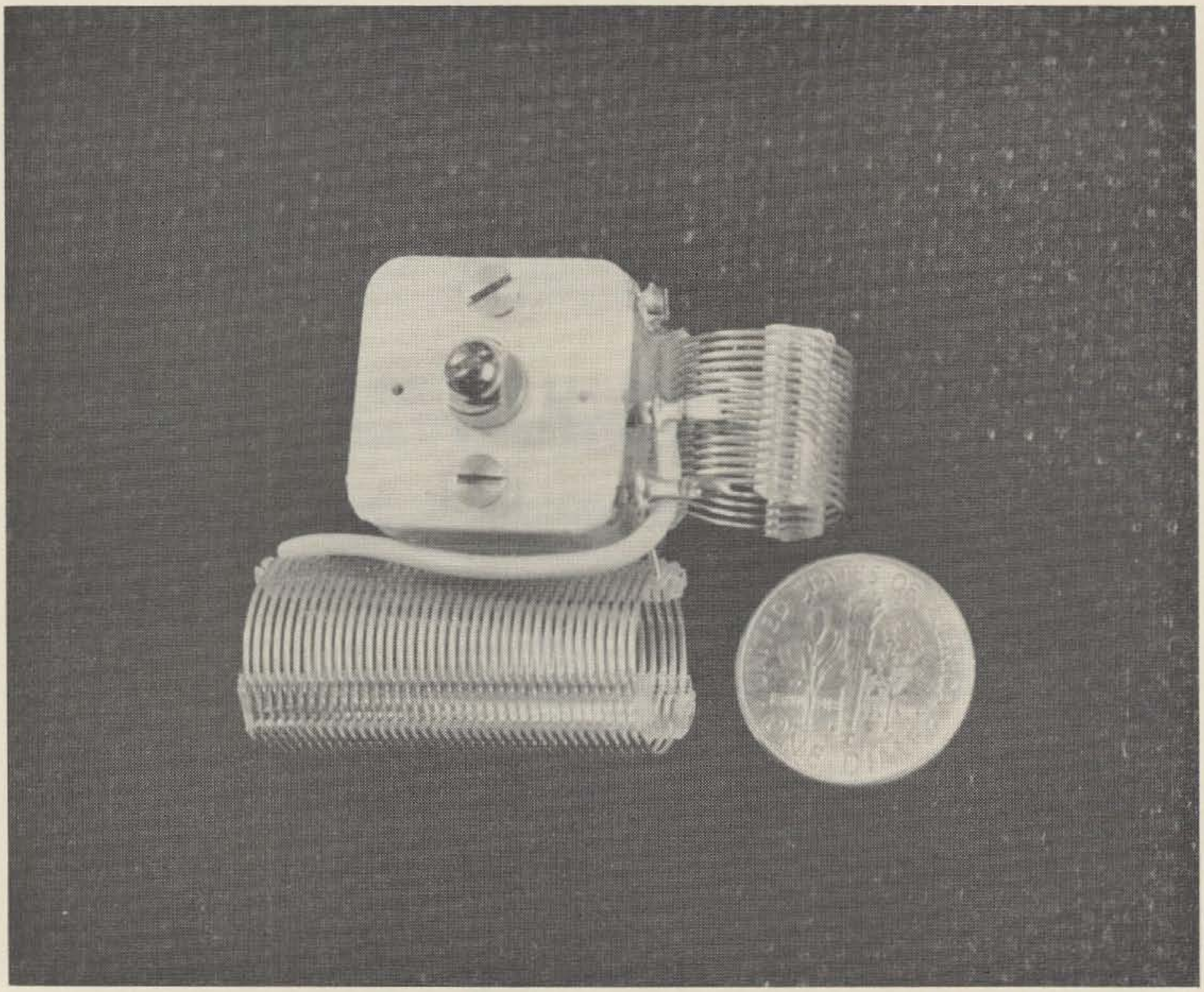
The Miniature Multiband Tuner

Joe Williams W6SFM
4150 Beck Ave.
North Hollywood, Calif.



Multiband tuner construction data has been yellowing in the pages of amateur literature for a long time and hasn't really received the attention that it deserves. There was a time when the typical hamshack needed a shoe box full of plug-in coils to keep it going and some of them were of the type that were wound on a tube base and doped with a bit of fingernail polish. That was back when the Zepp antenna was the end-all and a store bought rf inductance was a glossy showpiece. Since then, the ARRL handbooks have described some interesting and functional all-band rigs using multiband tuner circuitry. A typical handbook version of the single ended MBT employs a dual 140 mmfd variable capacitor and inductances of 1.5 and 8.9 microhenries. In the commercial field, the National Company markets the MB40 and the MB150 multiband tuners which are popularly accepted home brew ingredients.

In essence, the multiband tuner works like this: two right angle mounted inductances are tuned with one split stator condenser. (Fig. 1). The hook up is such that the smaller

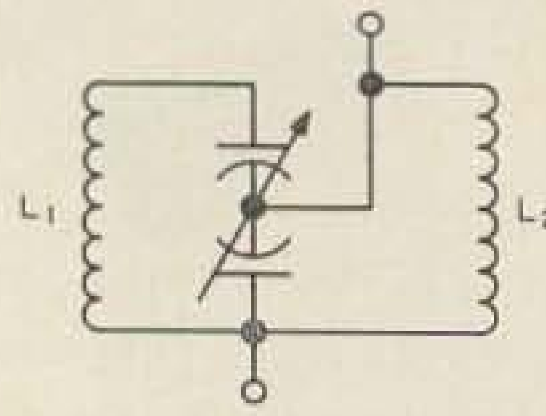


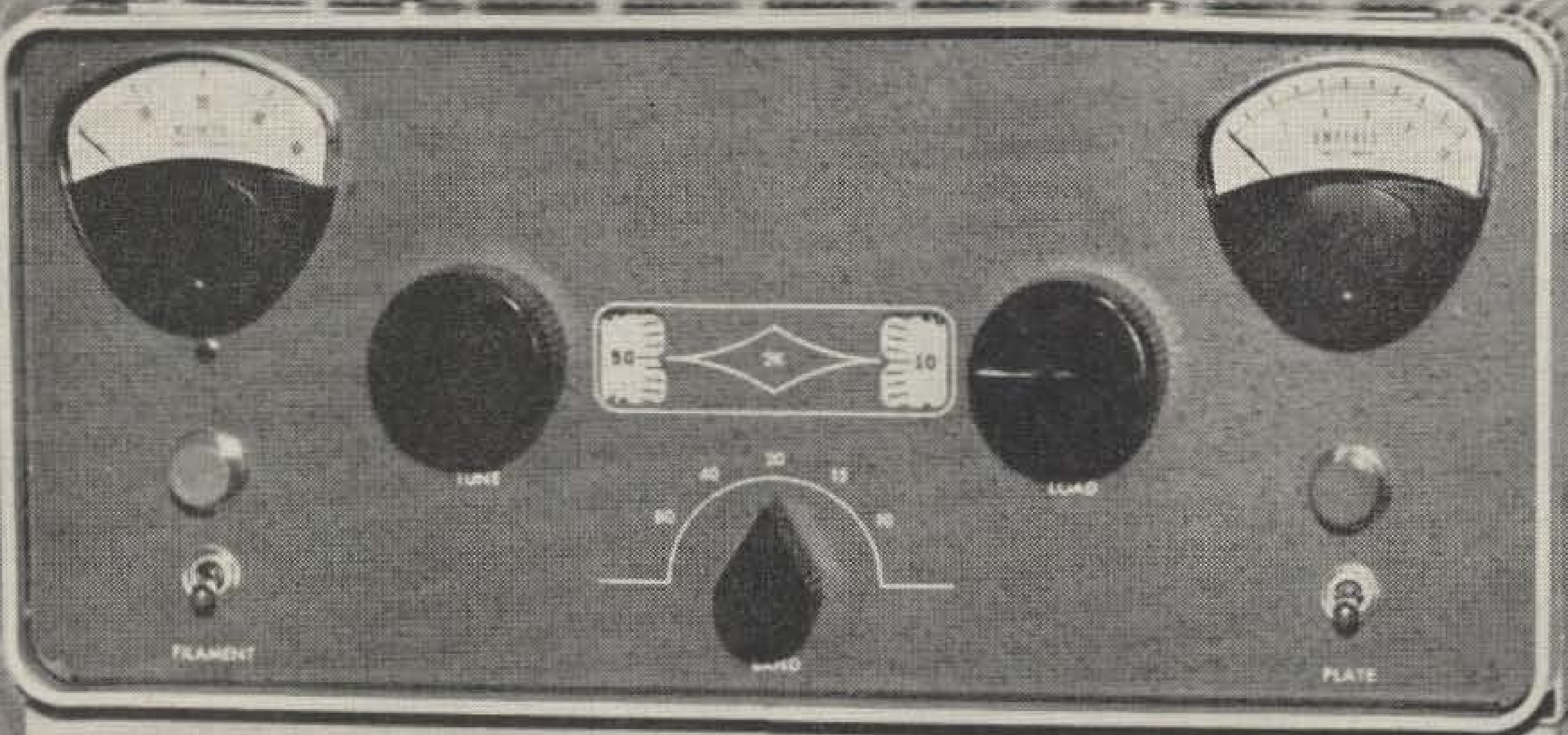
FIGURE 1

coil, L 1, is tuned by connection to the variable low value series capacity existing between the stators. The large coil, L 2, which is connected from the rotor to one stator, is of such size as to be seen by the small coil as an rf choke and therefore nonexistent. To the larger inductance, the small coil appears as a short circuit between the stators and the two sections of the capacitor are thus shunted. This combination of effects enables the tuner to provide a parallel-resonant, high impedance, tuned circuit for each of the five popular ham bands from 80 through 10 meters.

The miniature tuner shown in the photograph was assembled for use in some Nuvistor projects and is infinitely useful where the power involved is 5 watts or less. The tuning condenser, which measures ¾ × ¾ × ½ inch, is a CalRad model CR 201 and is of the type used in the smaller transistor radios. The antenna section is 11 mmfd to 235 mmfd and the oscillator section covers 11 mmfd to 111 mmfd. The inductances, L 1 and L 2, were made from one stick of Air Dux 432 T. (The Barker & Williamson equivalent is #3004). This coil stock has an outside diameter of ½ inch, runs 32 turns per inch and has molded plastic bindings. L 1 is 16 turns and L 2 is 40 turns. First, L 1 was solder tacked to the stators and pruned to tune 10, 15 and 20 meters. After L 2 was cut to include 40 and 80, each coil was cemented to a rear edge of the dust cover of the condenser. In this case, Testor's Polystyrene Cement seemed a good chemical match for the dust cover and the coil plastic. When the cement had set, the coils were properly soldered to their respective connections. The CR 201 has small trimming pads on the back and these were used to make sure that the tuner didn't 'hit' two bands at the same dial setting. The plastic frame and the mounting screw arrangement on the front of the condenser permit the tuner to be chassis, bracket or thin panel mounted. When an MBT is used in a plate circuit, or other scheme involving above chassis voltages, the rotor shaft should be insulated. The builder can fabricate shaft extensions of plastic or other material and will find that Epoxy cement is handy for attaching them solidly once the mechanical details of the application have been worked out. A vernier dial makes it easier to re-set the MBT and as the capacitor is meshed, the bands should resonate in this sequence: 10, 40, 15, 20, and 80.

Where link coupling is desired for the midget tuner, the link coils can be made up of 2 to 5 turns of small gauge insulated wire. These may be wound so that they will fit inside L 1 and L 2. Normally, a link is required for each coil and the links are switched when going from one range to the other. Sometimes, however, it is possible to get good results by linking to L 1 only. The presence of a link coil in L 1, or in L 2, will lower the res-

It's a Merry "2-K" Christmas . . .



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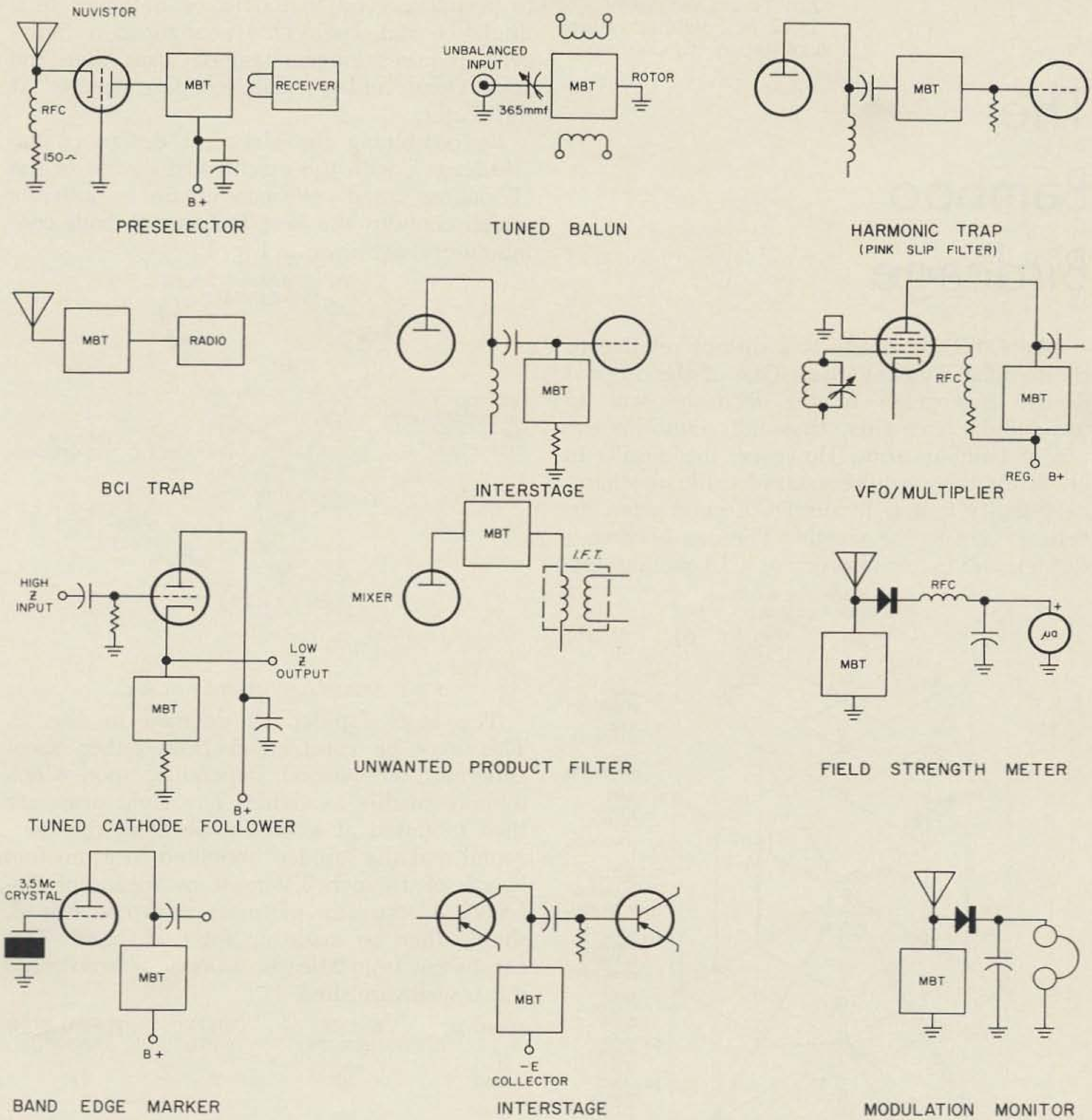


onant frequencies somewhat and calibrations should be made with that fact in mind.

A Chinese copy of this tuner can be made in your shack for a few bucks; but you can easily fake an MBT with on-hand components from the junk box. A Grid Dip Oscillator is convenient for measuring the frequencies as construction proceeds but is not a necessity. A multibander can also be checked by inserting it between an antenna and the station receiver. When the tuner coincides with the receiver frequency, it will knock a hole in the incoming signals or noise. This way, one's calibration goofs can be blamed on the receiver manufacturer. It will be found that the lower frequency coil can not be calibrated until the smaller coil is installed, so L 1 should be checked out first. Another bear trap that can bring out the builder's best dial cord repair language is the temptation to tune an MBT by shorting coil turns with solder. This short cut *will* raise the frequency—but it will also strangle the "Q" and will steal a lot of signal energy. If a multiband tuner is to be enclosed in a metal box or mounted on a panel, final calibration should be made with the tuner in its working position.

Fig. 2 shows some MBT circuit application prototypes; these diagrams are not designs and have been made sketchy on purpose. Doubtless, other uses for the multibander will suggest themselves to the builder.

. . . W6SFM

Photo credit: Robert Jensen

Jim Young W6WAW
1412 N. Fairfax Avenue
Hollywood 46, California

The Bamboo Birdcage

The G4ZU Birdcage is a distant relative to the familiar Cubical Quad. One of the original design approaches of the Birdcage was to use tubular elements, thus not requiring the use of bamboo arms. However, this results in an array that requires considerable mechanical rigidity if it is to survive a good wind, in turn adding to the weight. The can become a detrimental factor in erecting a 14 mc antenna atop a mast of reasonable height. The Quad on the other hand is of sufficiently light weight so that under most conditions a 14 mc model can easily be erected by two persons. However, the basic Quad design suffers from a lack of rigidity unless an exceptionally strong boom is used. The boom length in turn makes the array somewhat hard to handle.

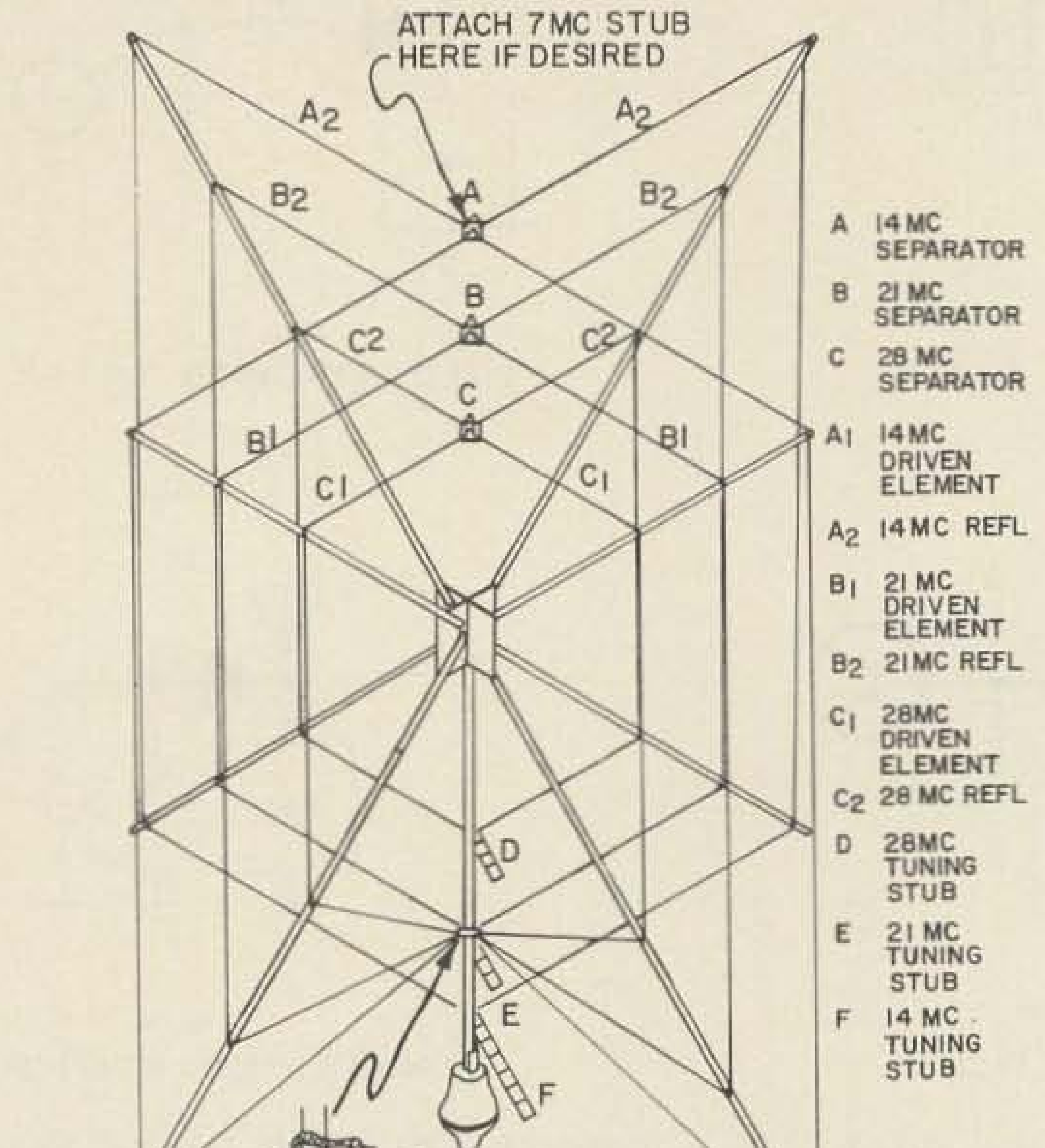


FIG.1 BAMBOO BIRDCAGE

The use of a "Boomless Quad" has therefore become quite popular, with the added advantage of providing proper spacing between elements on dual and tri-band versions to permit a good match to be obtained to a single coaxial line. This configuration, however, requires longer bamboo arms than the basic Quad, and a rather complex "spider" at the center.

By combining the electrical design of the "Birdcage", with the mechanical design of the "Boomless Quad", we can obtain an antenna which contains the best features of both configurations, as shown in Fig. 1.

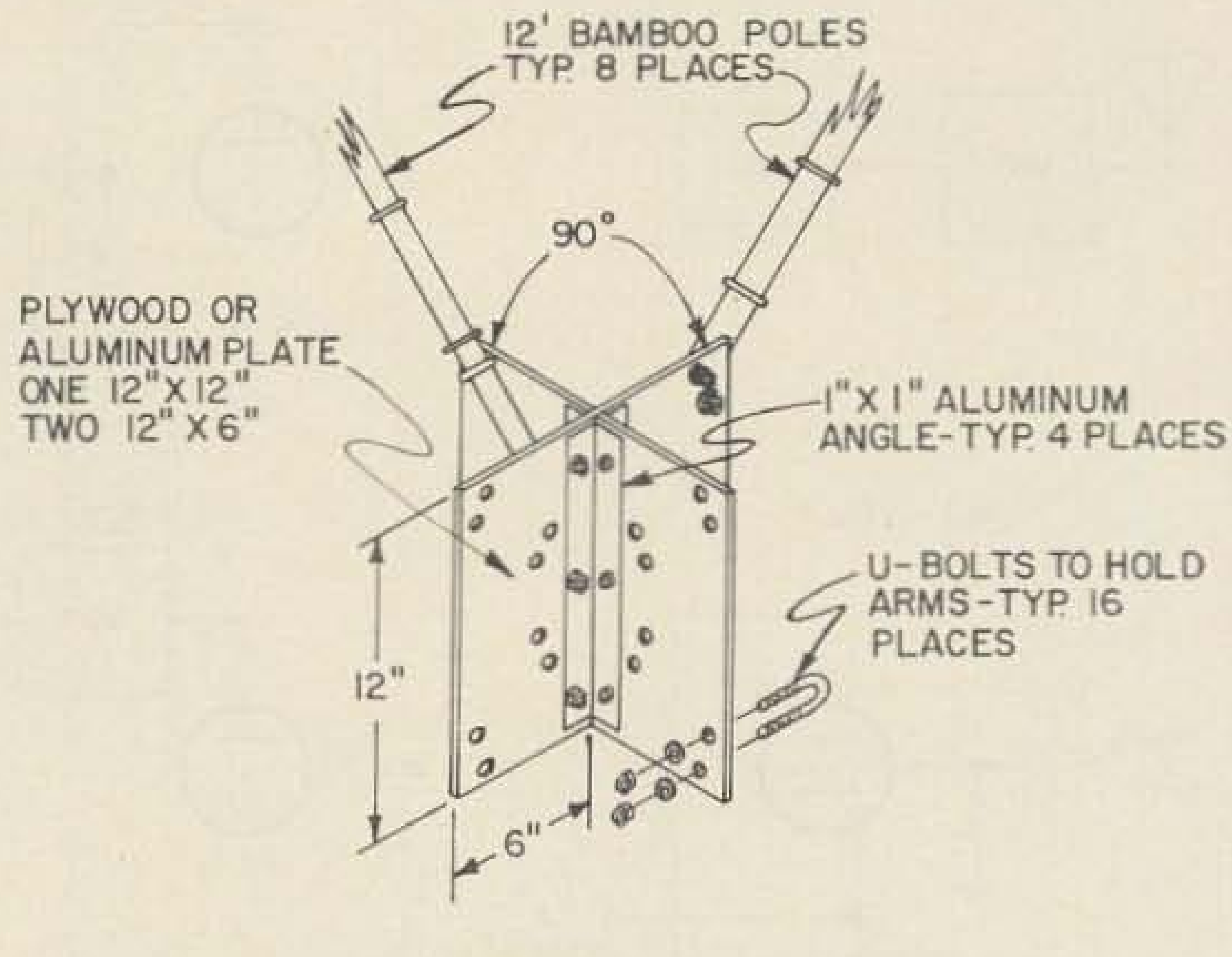


FIG.2 SPIDER CONSTRUCTION DETAIL

The basic "spider" is detailed in Fig. 2. This may be constructed from either sheet aluminum or plywood, depending upon which is more readily available. The eight arms are then mounted at a 45° angle from the horizontal and the "spider" mounted to a ten foot length of 1¼ inch TV mast by means of "U-bolts". A separator plate, as shown in Fig. 3, should then be made up for each band. This can be cut from Micarta, Lucite, or even wood if it is well varnished.

BAND MC.	ELEMENT LENGTH	TWISTED LOOP	TUNING STUB LENGTH*
14	36'	9'	48"
21	23'	6'	36"
28	18'	4' 6"	24"

* Two #14 wires spaced 3 inches apart. (not shorted)

The elements are cut from #14 wire, to the lengths given in Table 1. Cut four elements for each band (two for the driven element and two for the reflector) and solder a lug to both ends of each element. Twist a single loop about ¼ inch in diameter and solder well, at the distance given in Table 1 from each end of the elements. Also make up two jumpers and a reflector tuning stub for each band. The jumpers are used as shown in Fig. 3, while the tuning stubs are attached as shown in Fig. 1.

Connect the element ends for each band to the separator plates and install the jumpers.

Using two of the 28 mc elements, center the separator plate over the top of the mast section, so that the twisted loops are the same distance from the ends of the bamboo arms. Using several turns of #14 wire, secure the loops to the bamboo arm and solder well. Now secure the other two elements the same way.

Attach the 21 and 14 mc elements in the same manner, making sure that the jumpers for all three bands are in the same plane. If 7 mc operation is also desired, do not use a jumper on the 14 mc driven element. Instead, connect a 28′ length of 300 ohm twin lead between the driven elements at the separator plate. Short the other end of the stub and tape for insulation.

Connect the ends of the drive elements to a length of 50 ohm coaxial line as shown in Fig. 1, and attach the tuning stubs to their respective reflector elements. The antenna is now ready to be mounted on the rotator and tuned.

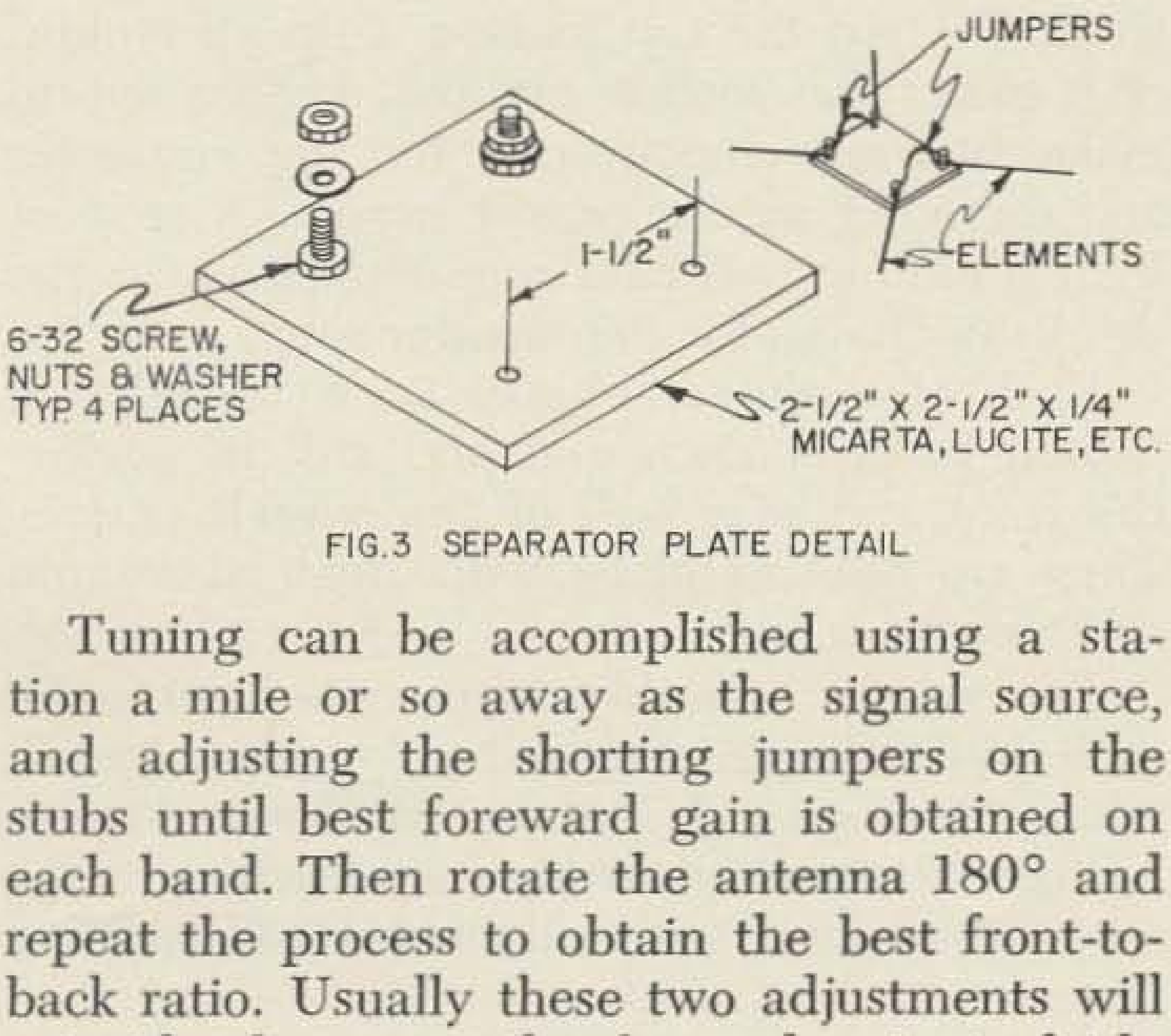


FIG.3 SEPARATOR PLATE DETAIL

Tuning can be accomplished using a station a mile or so away as the signal source, and adjusting the shorting jumpers on the stubs until best foreward gain is obtained on each band. Then rotate the antenna 180° and repeat the process to obtain the best front-to-back ratio. Usually these two adjustments will coincide; however, the forward gain is fairly broad, while the front-to-back adjustment is somewhat more critical.

The coaxial line can be passed thru an eye-bolt to bring the center of the elements in at the mast, while the tuning stubs can be folded back up the mast if desired. The 7 mc stub can be dropped inside the mast, or taped to the outside, whichever is more convenient.

The completed antenna should provide about 7 db of forward gain, which is approximately 2 db better than the average two element Quad, while the front-to-back ratio should be at least 25 db. The turning radius for the "Bamboo Birdcage" is also slightly less than the Quad, while the whole assembly weighs less than 20 pounds.

. . . W6WAW

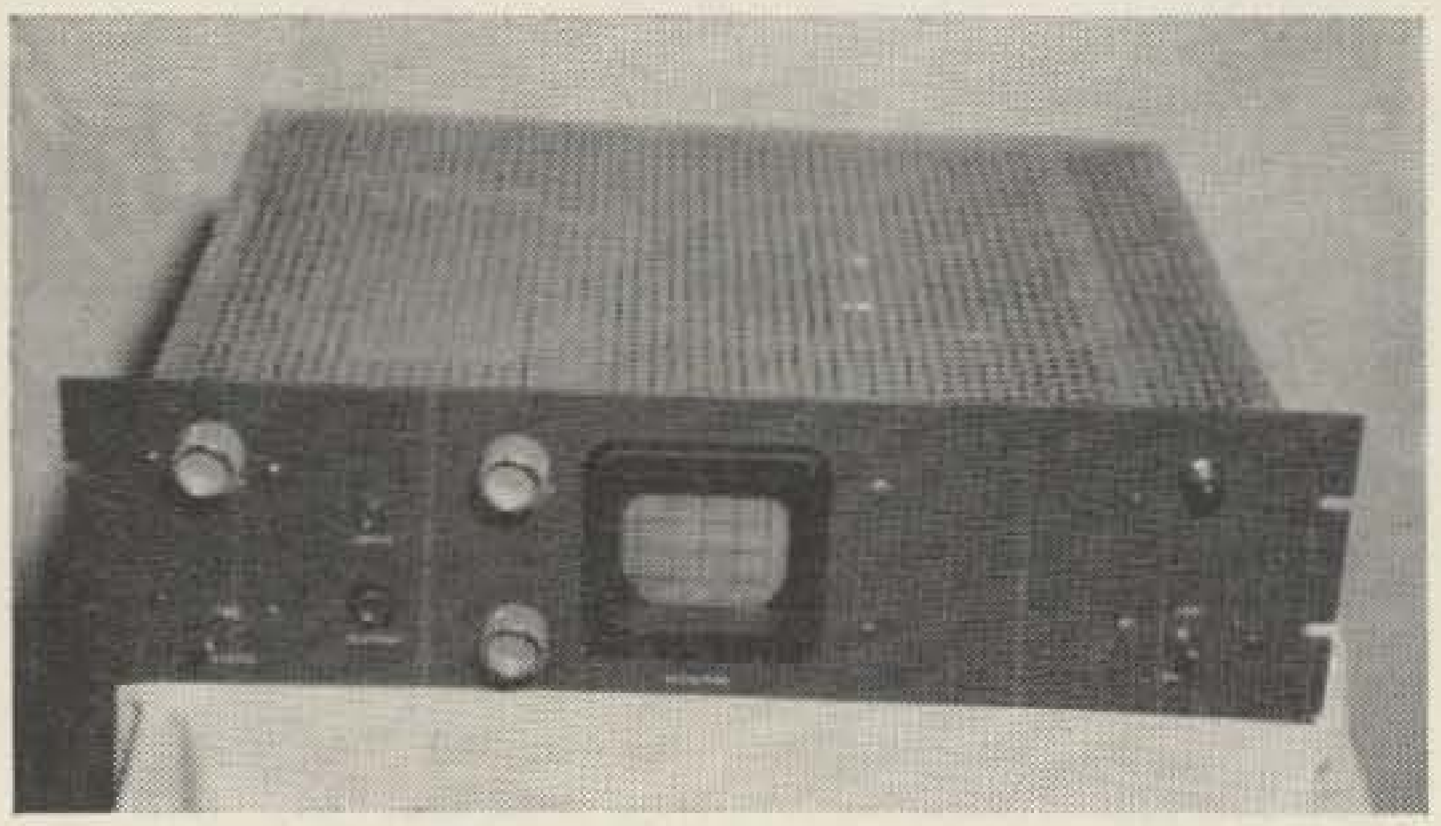
Fred DeMotte W4RWM
P. O. Box 6047
Daytona Beach, Florida

Going RITTY—Part Two

Now that we have convinced you that RTTY is not expensive, that no special technical knowledge is required and you have acquired a machine, it is assumed that you want to get to printing.

Your question now is . . . what do you need?

If you will refer to the block diagram that appeared in the article "Going RTTY" in the January 1964 issue of 73, you will see that you need a converter to complete your receiving setup.



RTTY Convertor.

Let's look at the converter situation and see just what is required. There are two types of converters and in both types their main function in the overall circuit is to change incoming signals into dc pulses that operate the selector magnets on the machine.

Since our purpose here is to get you copying RTTY signals, we will not deal with the technical aspects of converters. You can find a wealth of material on this subject in the HAM-RTTY handbook.

So let's get right on with a simple converter that does an excellent job. The circuit in Fig. 1 uses only the necessary parts to do the job and all frills omitted.

You will note from the photos that I have employed a "progressive" type of construction. That is, the converter is wired in one complete section. The monitor scope, which can be added at any time, is built as another section. The power supply also is constructed as another unit and all three are removable from the overall chassis for servicing or adding additional circuits as required.

For those interested in the construction details, a 4" × 13" × 17" aluminum chassis was used. Cut out the top leaving a lip all around of ½ inch. The section cut out is then cut to make two sub-chassis; one for the converter and the other for the power supply. A strip of light aluminum will be required to make the third sub-chassis for the monitor scope.

Each of these sub-chassis is cut to allow a ½ inch bend at each end and still fit against the front and rear wall of the overall chassis. They are held in place with small aluminum self tapping screws.

The whole assembly is mounted on a 5¼ inch by 19 inch standard relay rack panel, while the top and bottom are covered with perforated aluminum which is attached to the edge all around with aluminum self tapping screws.

As to the converter itself, there is nothing new about it. It has been used by RTTY'ers for some years in this or some modified form, and was selected because it is easy to as-

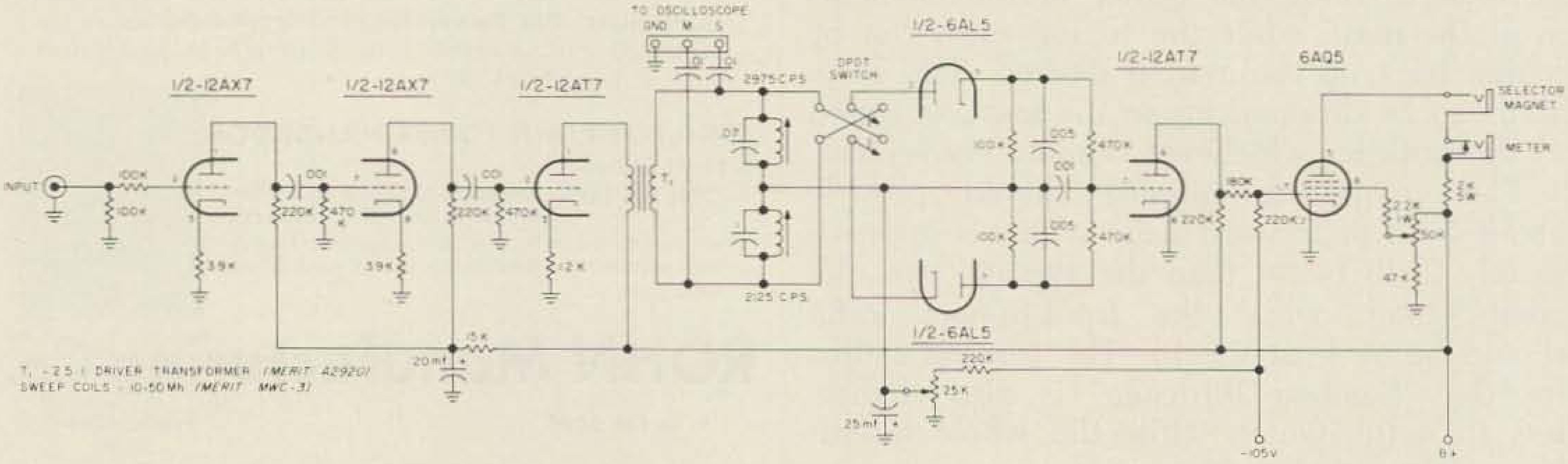
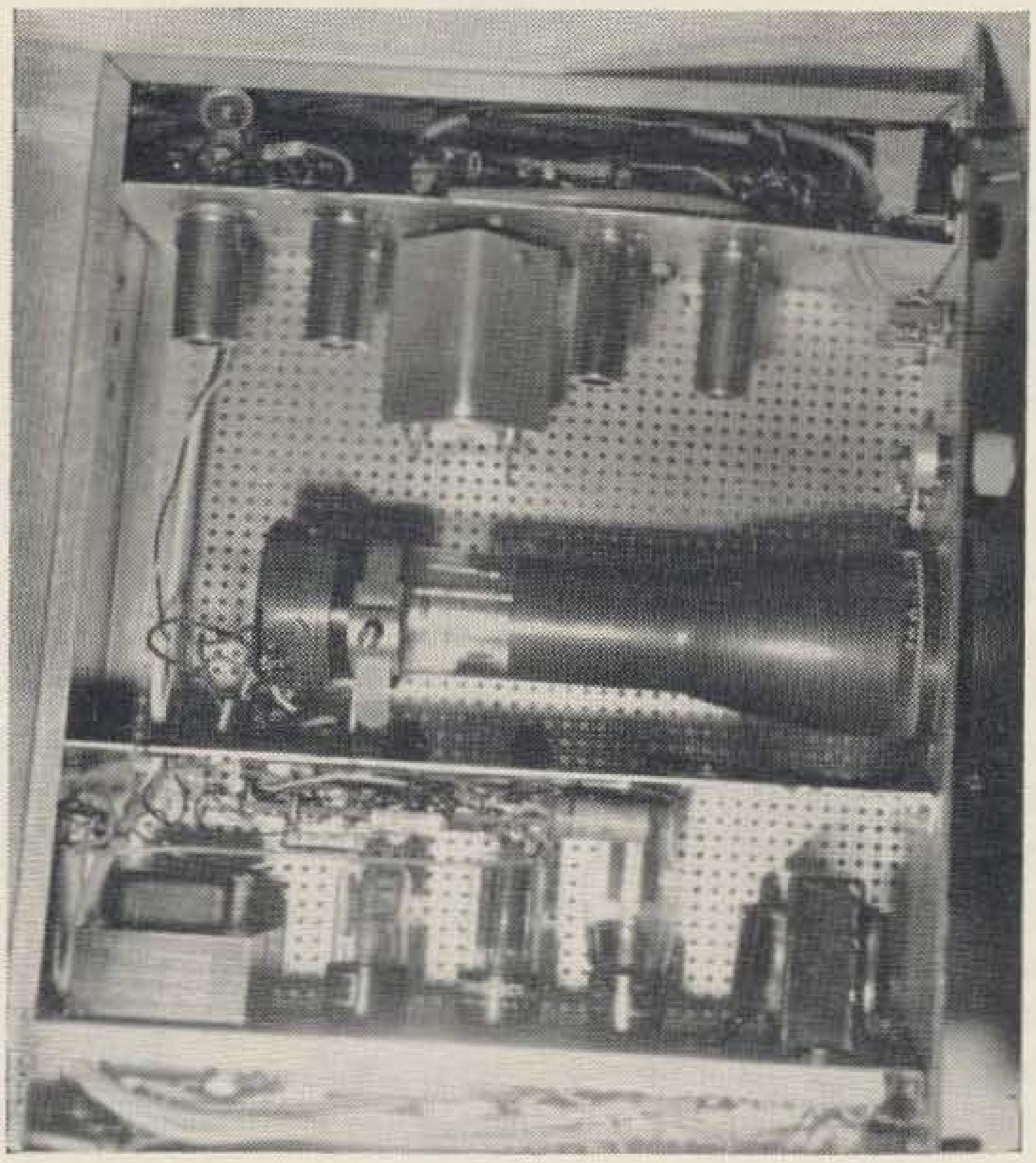


FIGURE 1

The 1 mfd capacitor in the 2125 cps circuit should be .1 mfd.

semble and uses parts that are on hand in most junk boxes or can be picked up from local surplus houses. As can be seen from the schematic, the wiring is easy and since there is nothing critical about it, it should work the first time it is hooked up. Just a few simple instructions are offered:



Top view.

Be certain that the meter jack is of the closed circuit type. The output jack is open when the plug is removed. Both of these jacks are insulated from the chassis since there are about 200 volts present in the circuit at this point.

A 100 milliampere meter should be inserted in the meter jack for making adjustments. It may be left in the circuit after adjustments are made or may be removed, since the closed circuit jack will close and current will pass.

In the final adjustment of the converter turn the control bias down to zero and the current adjust down to minimum screen voltage. With your machine connected at the output terminals of the converter, apply line voltage and turn on the power.

After warmup, without any audio input being applied to the converter, there will be no output current indicated. At this point feed a 2975 cps audio signal to the input and adjust the coil with the .07 mfd condenser across it for maximum indication on the scope, which of course is connected to the scope terminals on the converter.

Reset your signal generator to 2125 and adjust the other coil slug for maximum scope presentation. This presentation will be at right angles to the first.

Now with no audio input, start your machine and adjust the bias control until the loop current reaches a steady value. It should read about 18 or 20 mills with the current adjust pot set to minimum.

Now you can adjust the current control for the printer current desired. You may find that you will need to back off on your bias control slightly and reset it until the magnets pull in.

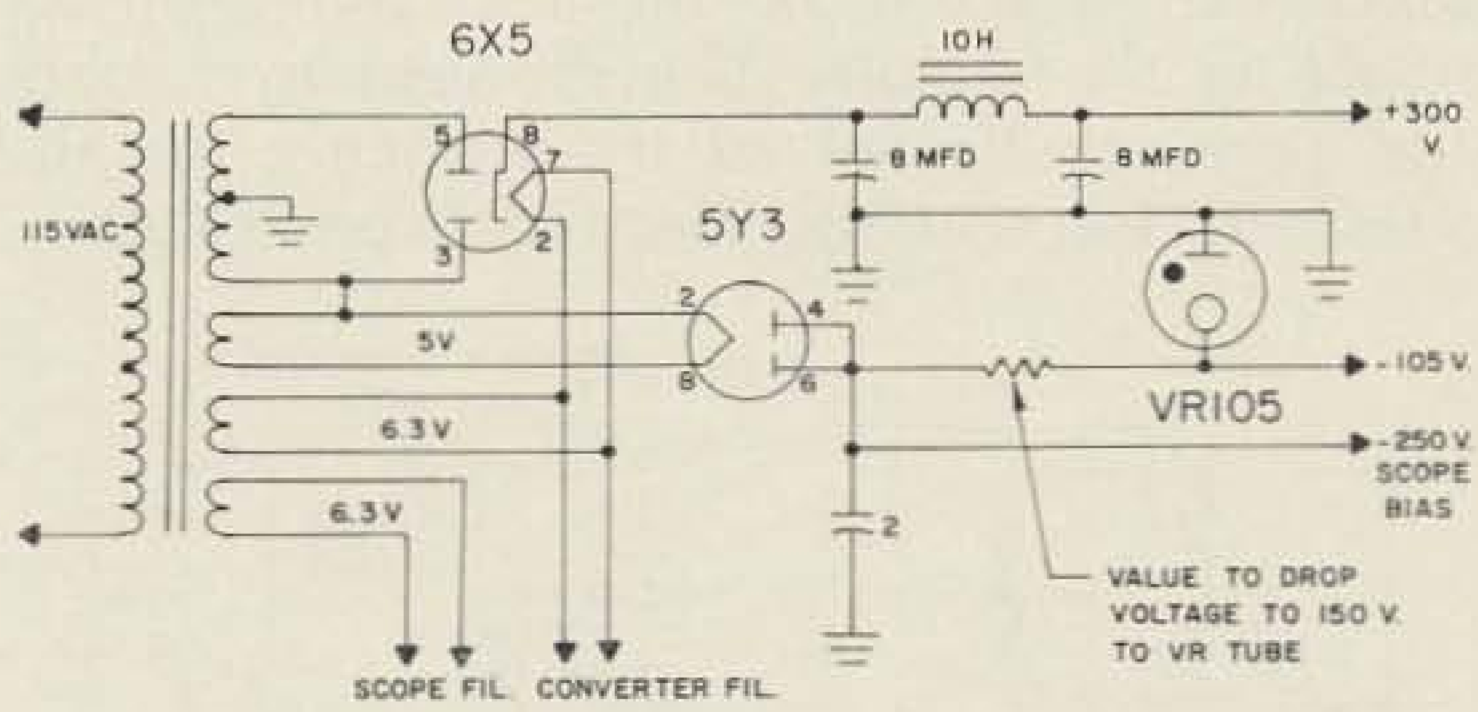
The meter should read about 30 mills at this point. When a signal is fed to the input of the converter, the meter current will show a sharp swing up to about 50 mills, and will continue this swing as the signal is received.

A few tries will give you the proper adjustent know-how and you will soon find the machine rattling away with perfect copy being received.

Details of the monitor scope will be the subject of another article, so leave room to build the scope as part of the overall assembly.

Credit is given to W4TJU for the basic converter circuit which is used here.

The power supply shown in Fig. 2 was designed to provide power for both the converter and the monitor scope, and voltages in-



T-1 ANY 600 VOLT CENTER T
80 M
FILTER CONDENSERS 8 MFD 450 V

FIG. 2

Power supply.

dicated should be closely followed since if they are much different than those indicated, the dc amplifier in the converter will not operate correctly and as a result the converter will not function properly.

. . . W4RWM

Frank Gallinelli K1GHO
758 Summer St.
Stamford, Conn.

SIXER to the Nth

The Heathkit Sixers and Twoers are well known as fine and flexible pieces of gear. With a few additions and modifications, however, a good deal more operating ease and efficiency can be obtained from these rigs.

Power Supply

Going first to the power supply, I found that the trouble-free operation enjoyed at the home QTH had a habit of literally going up in smoke in the mobile. The problem is quickly and permanently solved by replacing the diodes with International Rectifier type SD-92.

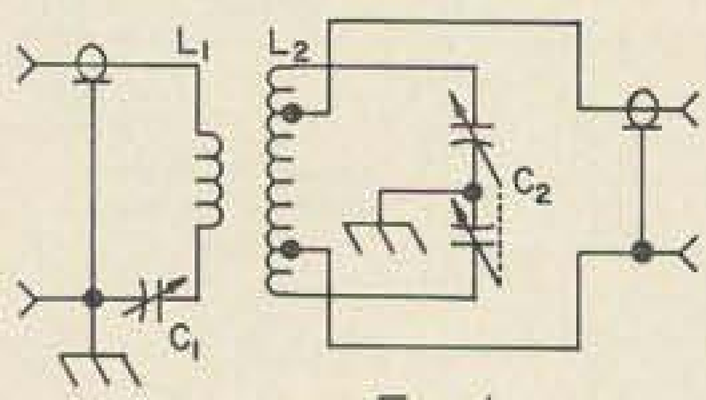


Fig. 1

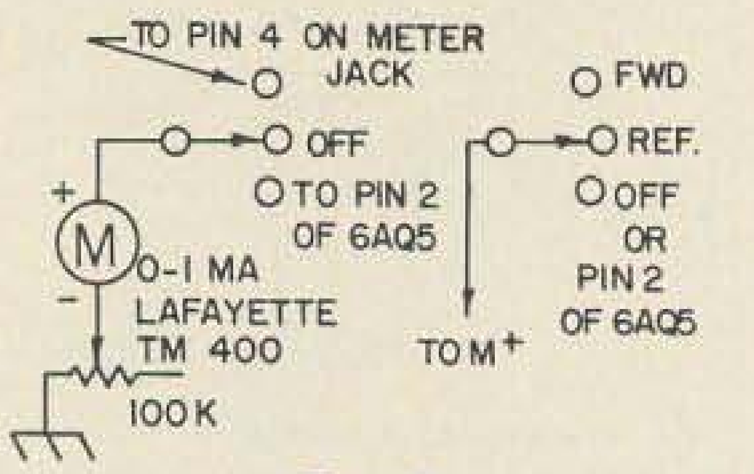


Fig. 2

Fig. 1. Coupler diagram.
Fig. 2. Two of the possible switch combinations, using three position rotary. If spdt toggle switch is used instead, an off position is recommended.
C1-100 mmfd variable for 50 mc, 50 mmfd for 144 mc (Hammarlund MC100, MC50)
C2-35 mmfd per-section split stator variable, .07" spacing (MCD-35SX). Reduce to 4 stator and 4 rotor plates per section in 144 mc coupler for easier tuning.
L1-50 mc: 4 turns, #18 tinned, 1" diameter, 1/8" spacing. (Air-Dux #808T)
144 mc: 2 turns #14 enam., 1" dia., 1/8" spacing. Slip over L2 before mounting.
L2-50 mc: 7 turns #14 tinned, 1 1/2" diameter, 1/4" spacing (Air-Dux #1204). Tap 1 1/2 turns from each end.
144 mc: 5 turns #12 tinned, 1/2" diameter, 7/8" long. Tap 1 1/2 turns from each end.

Receiver

The Sixer receiver, as known to anyone who has ever used a super-regen, is not the epitome in receiving excellence. More than one normally timid soul has been moved to acts of violence during a band opening thanks to its lack of selectivity. Efforts to relieve this situation electrically did not bear enough fruit to merit mention. Mechanically, however, I have found that a 2" vernier dial (Lafayette F-347) (99c) is of considerable help to the poor OM with coffee nerves who can't tune the ungeared dial onto the best side of the squealing signal. Two months of tinkering convinced me that the tuning condenser should not be pushed back into the rig. Success was finally achieved by cutting the condenser shaft, leaving only about 1/8" protruding from the panel surface, and cutting the vernier dial shaft through the set-screw hole. Mount the dial without the top mounting screw or set screw and you're set. The pressure of the dial on the condenser has held everything in place perfectly for me, but if any slipping is experienced, a drop of glue (or chewing gum maybe?) will hold it tight. Due to different design, this mounting system is not applicable to the Twoer.

The only other addition to the receiver was a closed-circuit phone jack mounted in the upper left-hand corner of the panel and wired in series with the hot lead to the speaker.

Transmitter

The transmitter was attacked next, and, if you'll pardon my Caesar, *utrimque acriter pugnatum est.*[1] Having become fed up with futile attempts to tune the tank without removing the rig from the case, I first devised an external tuning method. Start by soldering the threaded sleeve from an H. H. Smith type 105 phone tip to the screw head on the ceramic trimmer. Next scrounge for a screw (approximately 3/4" in length) that will fit the sleeve and replace

[1] Translation: "It was fought fiercely on both sides."

its head with a small knob. Finally, mount a rubber grommet in one of the air holes opposite the trimmer. Simply push the "screw-knob" through the grommet, and screw it into the sleeve. All this nonsense will give continuous clockwise and limited counterclockwise rotation of the condenser.

Undoubtedly the smartest thing I did all week was to add an antenna coupler to the Sixer. For the benefit of anyone too cheap to own a *Handbook*, the schematic, adapted for coaxial output, is reproduced here. This innocent looking gadget, built into a 3″x4″x5″ grey hammertone box, will load into practically anything; in fact K2LLC used it to load his Poly-Comm 62B into a window screen with a 1:1 swr. You should find it particularly useful in the mobile, where standing waves often run amuck. If used in conjunction with a low pass filter, it should be mounted on the left side of the rig with the filter screwed onto the case at one end and onto the coupler (with a spacer) at the other.

Naturally, some method was needed for adjusting the coupler. No problem. Mount a 0-1 ma meter, a 100,000 ohm pot, and a spdt toggle or three position rotary switch as shown in the photo. The popular little "Monimatch" swr bridge should fit nicely inside the coupler box, with phone tips coming from the switch, through the air holes near the coupler, and into jacks on the box. Or, if you're as lazy as I am, you can do what I did: monitor the so-called "power output" device in the Sixer or Twoer (tuning C1 on the coupler for maximum and C2 for minimum), and use the other switch position to monitor the "kick" in your modulation. Or you can monitor the filament current and pilot-lamp voltage and say the heck with the coupler.

Operating convenience was jacked up one last notch with the addition of a crystal socket on the front panel (see photo). Simply run shielded leads from the panel socket and plug them into the chassis socket.

When the smoke cleared, I decided to rewire the transmitter section with shielded grid wire. The apparent increases in harmonic suppression and circuit efficiency were more than worth the effort (the neighbors got off my back and the dummy load burned out).

Finally, I replaced the Sixer's 6CL6 final with a 5763, which squeezed another watt or two of rf out of my Benton Harbor Kilowatt. Don't forget to rewire the tube socket.

That about sums it up. By now, your Sixer or Twoer should be operating more efficiently than ever. . . . K1GHO

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Two'er Talk

During the past 4 years, I have had occasion to chat on 144 mc with several stations using Heath TWOers. Some of these useful little transceivers deliver excellent results for their owners. There are, however, a number of these TWOers which are suffering from transmitter instability, TVI, bassy audio, abnormally low output and audio distortion. A few of these ills are caused by poor workmanship when the kit was assembled. The bulk of the ailments mentioned result from engineering problems which can quite readily be corrected.

Numerous articles have been written and dedicated to circuit modification of these handy little portable packages. Little has been said about the more predominant problems which exist in them. Some of these articles described the addition of push-to-talk relays, panel meters, squelch circuits, etc. The basic ailments which relate to efficient operation have not been presented. While sitting back on the sidelines, watching many of the fellows struggle with these common problems, I decided to acquire a TWOer of my own and attempt to resolve these more troublesome circuit bugs. After studying the circuit diagram, applying standard procedures and sweating over a moderately hot soldering iron for a short period of time, I ended up with a TWOER which possessed all of the attributes common to a well engineered VHF transmitter.

Analysis

The final tank circuit could be modified to provide much greater efficiency and reduced TVI.

The P.A. stage would no doubt benefit from neutralization inasmuch as both the driver and P.A. are in a common envelope, operating on the same frequency.

Capacitor values in the speech amplifier and modulator stages could be changed to reduce bass response and give the signal greater "punch."

High level-negative peak clipping could easily be added, to further increase audio punch and aid in the elimination of possible "overmodulation."

Conventional coax fittings could be added to the rear apron of the TWOer, to facilitate use with other station equipment and antenna feedlines.

Removal of the diode metering circuit could prevent bleeding of rf power from the transmitter output and reduce TVI caused by the harmonic action typical with diodes.

With great enthusiasm, the above changes were made. The results were well worth the small amount of effort.

The Modifications

P. A. Tank—Replace the final amplifier tank coil with 4 turns of #12 wire, ½" in diameter × 1" long. (Silver plate if possible.)

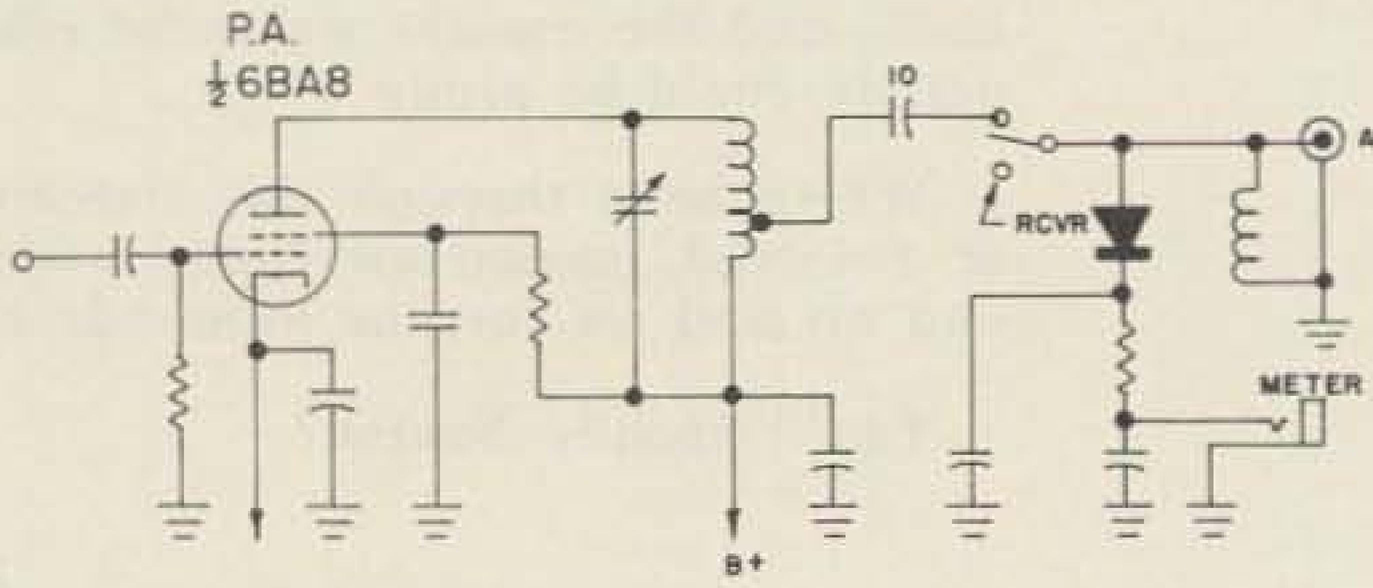

FIG. 1-A

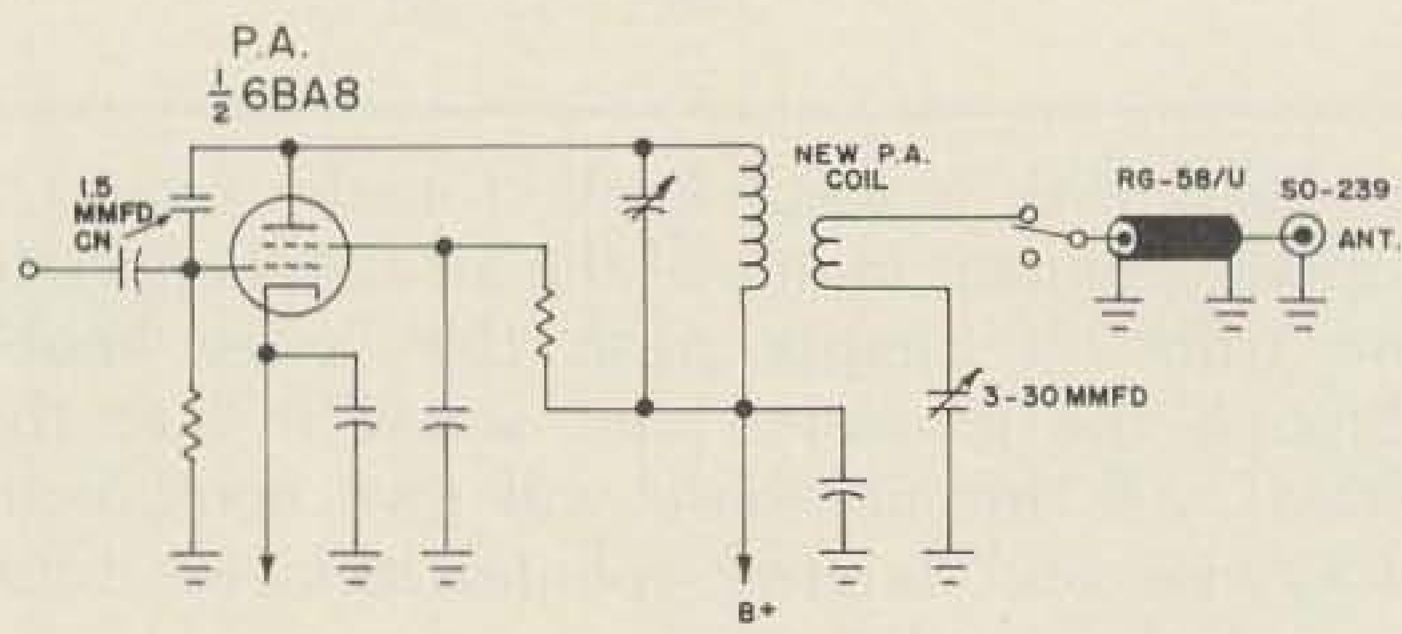

FIG. 1-B

Remove the 10 mmfd output coupling capacitor from the P.A. Tank coil. (This will reduce TVI and permit a better match to the feedline.) Replace the capacitive output circuit with a 2 turn link of #20 formvar or nyclad wire, inserted in the B+ end of the new tank coil. (Make certain the link is wound in the same direction as the tank coil.) Return this new link to ground through a 3-30 mmfd mica trimmer. This will be used to effect a proper match to the feedline and reduce reactance.

Replace the bus wire connecting the antenna fitting to the TRANSMIT-RECEIVE switch with a short length of RG-58/U coaxial cable. Be sure to ground the shield at both ends of the new cable. (See Fig. 1-B.) This further improves feedline matching and circuit isolation.

Neutralization of the P.A. Stage—Due to the self neutralization frequency of the 6BA8

P.A. tube, it became necessary to employ POSITIVE neutralization. This is actually less complicated than the conventional methods of neutralization. Add a 1.5 mmfd ceramic capacitor from pin 7 to pin 9 at the tube socket, keeping the pigtails as short as possible.

This modification eliminated all signs of instability, cleared up all signs of FM, downward modulation and audio distortion and roughness. TBI was further reduced until it could no longer wipe out channel 7. Faint cross hatch remained. (See Fig. 1-B.)

Replace the .01 mfd coupling capacitor between the 12AX7 plate pin and the 6AQ5 control grid, with a .005 mfd disc ceramic. Replace the 25 mfd cathode by-pass electrolytic on the 12AX7 stage, with a 10 mfd 25 volt unit. Replace the .01 mfd 3 KV by-pass condenser connected from the modulation transformer tap to ground, with a .005 mfd 3 KV ceramic unit. These changes resulted in better high frequency characteristics in the audio system. Readability under weak signal conditions was improved. (See Fig. 2-B.)

Clipping—There is no audio gain control for the modulator. This means that it is necessary to remain a proper distance away from the microphone to prevent "overmodulation." This can be a source of annoyance when operating mobile. This extra audio which is available, can be put to use in the form of "clipped modulation" which will increase the weak signal readability of the transmitted signal. To add this High Level Negative Peak Clipping, simply add a 500 ma top hat type silicon diode to the modulator output circuit, as shown in Fig. 2-B. You can now "move in" on the mike without fear of distortion, etc.

Antenna Fittings—Replacement of the present antenna connector with a standard SO-239 chassis type receptacle, will permit use with standard cables and other station accessories. This is easily done by enlarging the existing mounting hole with a ⅝" chassis punch.

Metering Circuit—In some TWOers I have tested I discovered that the metering diode and allied circuitry bled a portion of the rf output energy away from the feedline. Removal of the entire network increased the transmitter output considerably. In addition, the metering diode encouraged harmonic output, which in turn contributed to TVI. Once this circuitry was removed, the remaining TVI disappeared. Without this metering provision, it becomes necessary to tune up by a different means. In my case, I tune for maximum forward power as noted on my SWR bridge. This should be no handicap, inasmuch as most well equipped VHF stations have an SWR bridge as standard bill of fare.

Conclusion

Before modification of the circuitry, as noted above, the measured output of the TWOer was .78 watts. Similar readings were taken with other TWOers. Following modification, the output increased to 2.4 watts into the same dummy load. No trace of TVI could be found. Prior to modification, channel 7 was wiped out. Reports of excellent audio quality and quantity were received following the circuit changes.

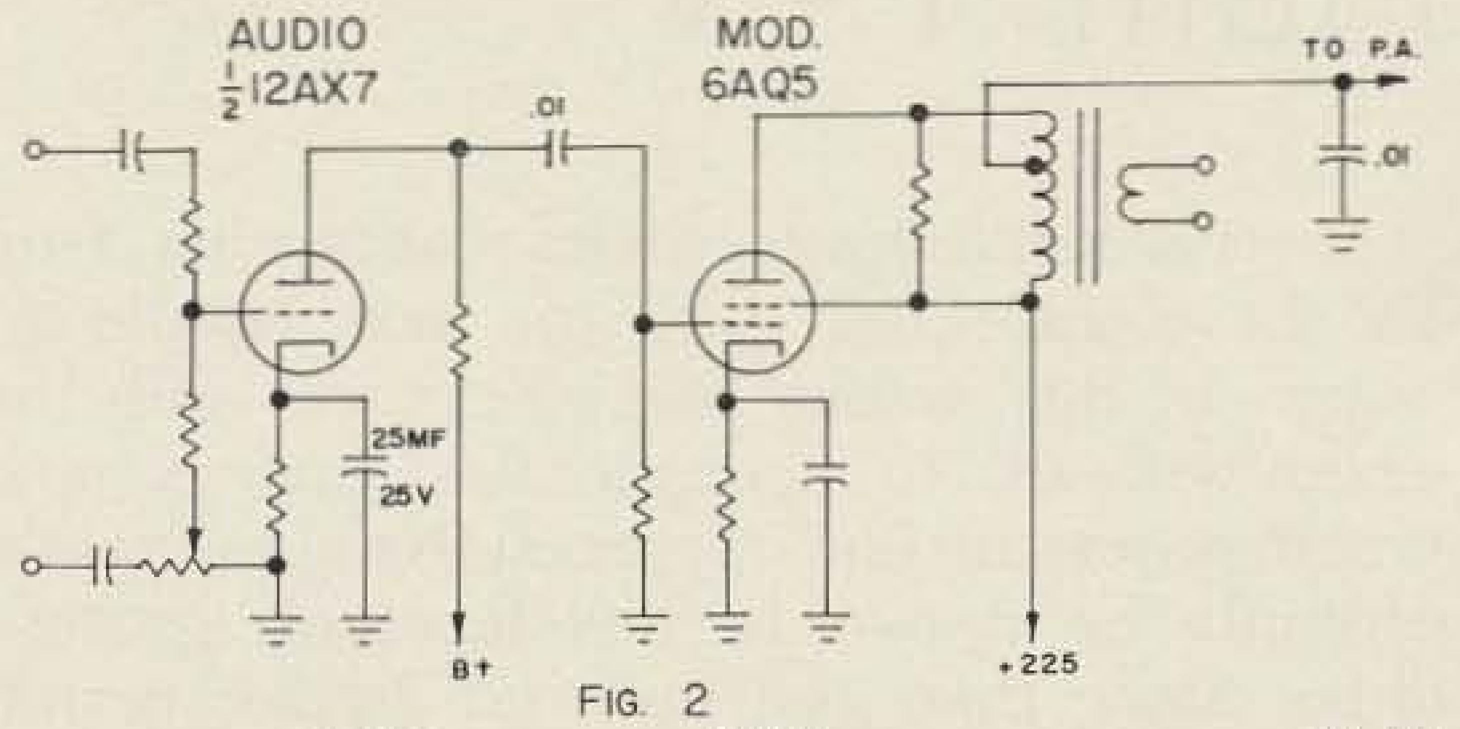

FIG. 2

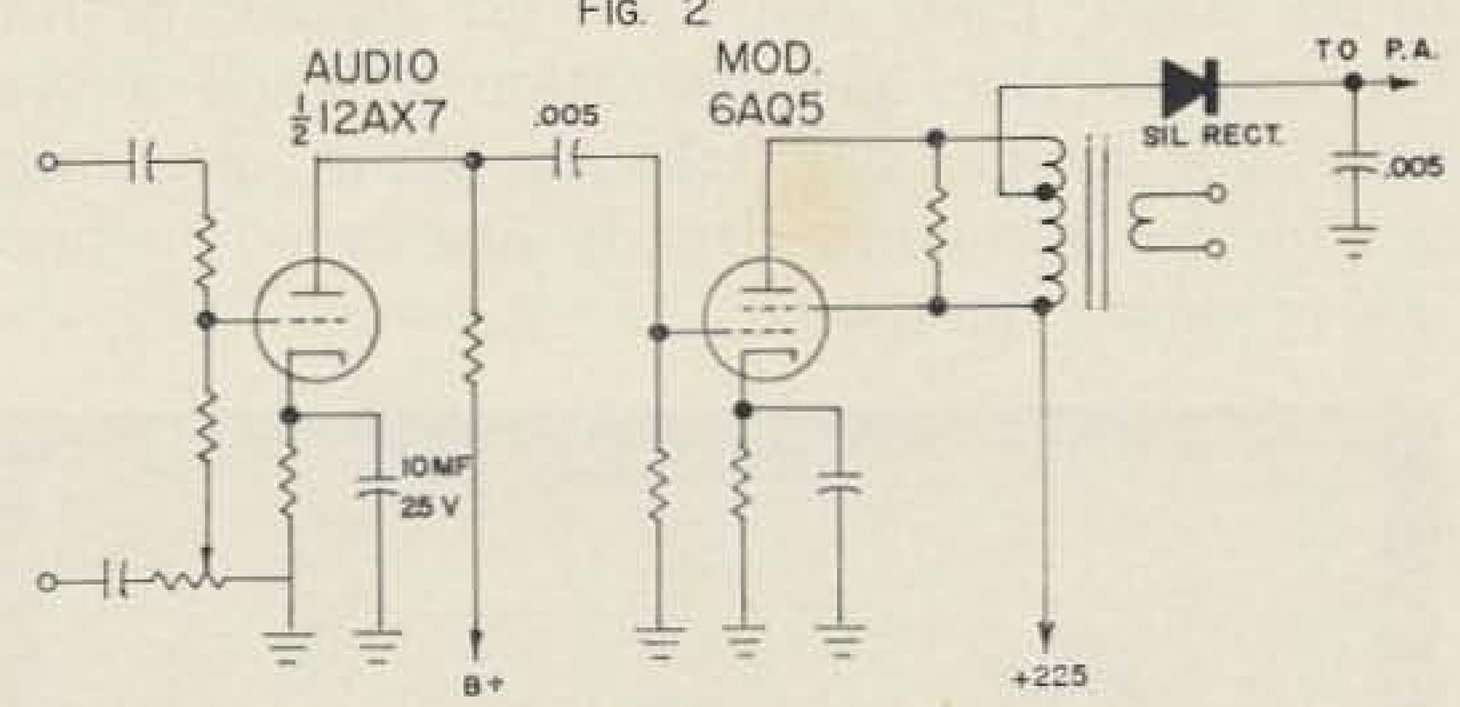

FIG. 2B

Regardless of the manner in which the multiplier stages and the P.A. are tuned, no instability would occur. Audio distortion and downward modulation completely disappeared.

Other refinements could have been made to the TWOer, but the ones mentioned in this article were of greater importance.

No changes were necessary in the receiver portion of the transceiver. Having built several regen type 2 meter receivers, I must say that the one contained in the Heath TWOer is the best I have seen in such simple circuitry. It is stable, sensitive and exhibits no "dead spots" in the tuning range.

With my modified TWOer, I have been able to work considerable distances over the rough terrain common to Northwestern Lower Michigan. I am using stacked A-62 Finco antennas on a 75 foot tower and feeding them with low loss balanced feedline and a VHF type Matchbox. I have been able to hold regular Q-5 schedules with WA9DOT in Grafton, Wisconsin. The distance is 165 miles, airline. Other similar contacts have been made without the aid of band openings.

Good luck on your TWOer changes!

. . . W8HHS

An Idea Article

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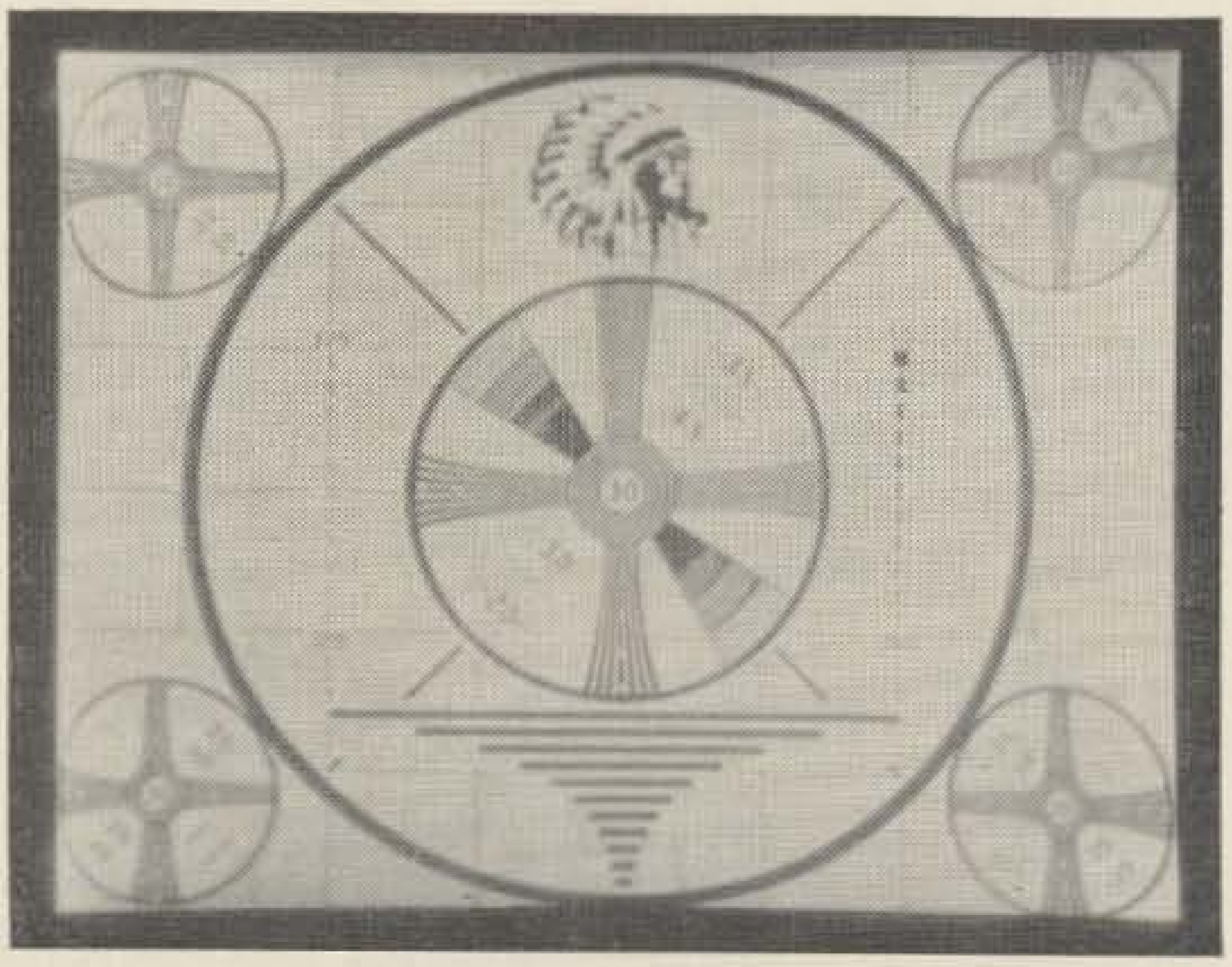
High Level Modulation for Ham T-V

Several interesting articles concerning ham TV have appeared over the last couple of years. If this writer had the time and the where-with-all to finance the camera and synch generator end of the system, he would certainly be drawn to this facet of amateur radio. Since time and material do not permit the construction and operation of such a system, this article will take the form of a suggestion for someone already engrossed in ham TV to experiment with.



Types of video modulation commonly used: All of the articles investigated, and in fact, all commercial TV transmitters in this country, use some form of low level modulation. RCA has built some transmitters that actually modulate the last stage, but even so, it is still grid modulation. Technically this is low level modulation. (Fortunately, in TV the amplitude modulation is mostly negative which does permit higher efficiency in the modulated stage than under normal AM as used for sound.) Why hasn't high level plate modulation been used? The answer is quite simple. Most people think of plate modulation as being transformer coupled between the modulator and the modulated stage. So far nobody has come up with a modulation transformer that will pass frequencies on the order of 10 cycles to 4 megacycles.

A possible solution: The series modulator will be found in the literature as far back as 1918 when an original patent was held by Heising. However, the series modulator has been a subject of academic interest only, because it has been regarded as a very inefficient method of modulation and one calling for too much power supply. This writer has been told that there are certain European TV transmitters that have used the system quite successfully.

Referring to Fig. 1, let us see what the series modulator actually does. The series modulator tube is nothing more than a variable resistor which varies at the modulation frequency. It makes no difference to the plate modulated stage whether the series modulator is on the plate or cathode side of the tube. But since the previous video stages refer to ground it is most convenient to place it on the cathode side. In standard plate modulation, for sound, it is necessary that the series modulator have more plate voltage than the plate voltage of the modulated stage. This is necessary so that on the positive half of the audio cycle the modulated stage will have twice the unmodulated value of plate voltage, to get 100% positive peak modulation. Thus the supply for a modulated stage requiring 1000 volts would have to be something in excess of 2000 volts when the series modulator is added.* Furthermore, the modulator tube itself would have to be quite large.

As indicated above, a series modulator seems rather impractical from the standpoint of regular AM. But how about TV? In TV the AM is very non sinusoidal; in fact,

* For example: An unmodulated stage requires 1000 volts at .1 amp. At 100% positive peak modulation the same stage requires 2000 volts at .2 amp. Since the series modulator does not have an internal resistance of zero at this point there will be from 300 to 500 volts still across it.

standard commercial TV uses a positive modulation of no more than 15% and the negative peaks are on the order of 85%. This puts the use of a series modulator in quite a different light. We no longer have the problem of very high voltage supply. For the forementioned amplifier requiring 1000 volts, the total voltage could be less than 1500 volts: 300 to 500 volts for the series modulator, and 1000 for the modulated stage. Negative peaks are no problem since as the voltage goes up across the modulator tube the current goes down. So a tube with relatively small plate dissipation could be used.

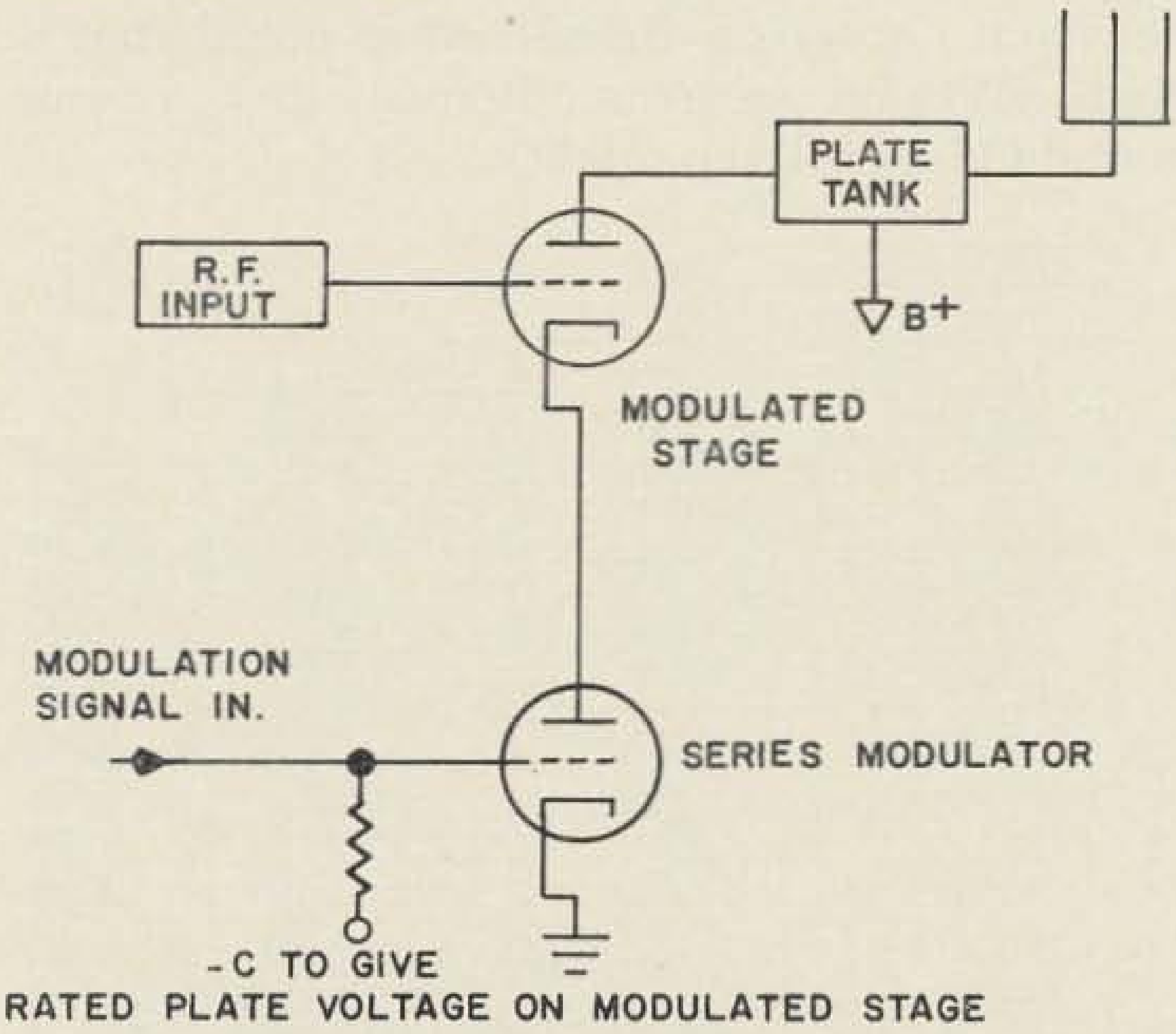


FIG. I

Suggestions for trial: It is thought that satisfactory results will be afforded for ham purposes if a triode series modulator tube is used. If the very high video freuqencies are attenuated, some form of inverse feed back or high frequency peaking may be necessary. If loss of highs due to the Miller effect is too great, a screen grid type series modulator might be used.

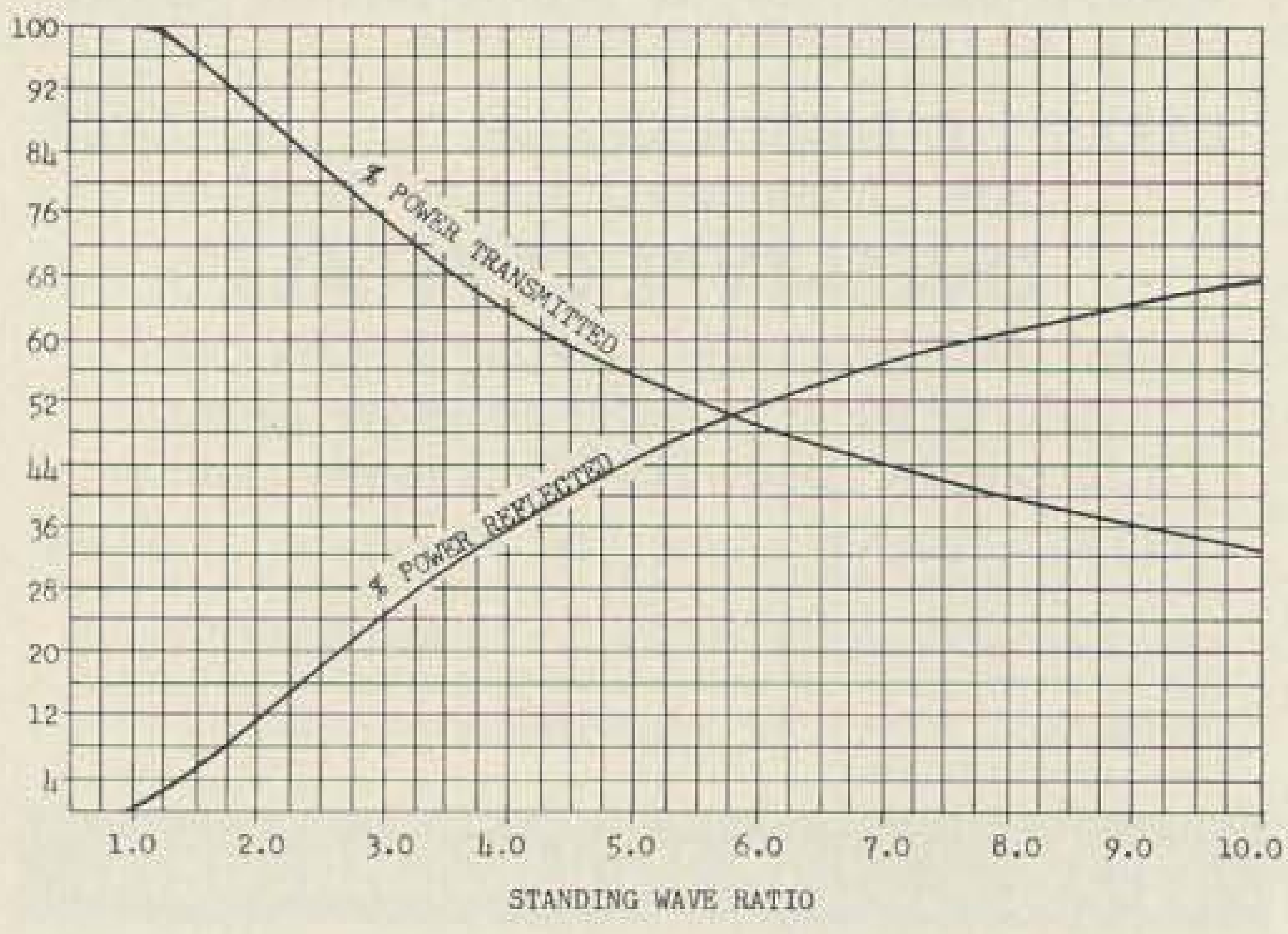
Actual case: As was stated at the begnning of this article no equipment has been constructed, so test results are not available. However, sometime back for entirely different reasons the author had occasion to build a very small transistorized TV transmitter. For commercial reasons the circuit is not included here but series modulation of one transistor by another transistor was used. One photograph of a test pattern transmitted by this milliwatt sized rig is shown. If it can be done at the milliwatt level with transistors, surely it is within the realm of possibility that it can be done at the kilowatt level with tubes.

. . . W7CSD

J. R. Fisk WA6BSO

That Elusive SWR

Although the virtues of operating transmission lines with low standing wave ratios (SWR) have been discussed many times in the past, evidently the economics of maintaining low SWR's are not readily apparent, particularly if the frequency of operation is low and the transmission line short. This has been reflected in various pseudo-technical QSO's where many have been led to the utter disregard for standing wave ratios. Most members of the amateur fraternity exist on limited budgets at best and when a significant portion of that precious transmitted power is eaten up by transmission line losses and misinterpreted standing wave ratios for naught, something should be done.



SWR vs % Power Transmitted and Power Reflected

Figure 1

A look at the graph in Fig. 1 will show you the percentage of power reflected for various standing wave ratios. For instance, if you are presently tolerating an SWR of about 5.8:1 (not uncommon in many ham shacks), 50% of the power which reaches the antenna is actually reflected back down the transmission line, heating up the final tank and causing TVI. Nor is only the transmitted signal effected, a high SWR will similarly degrade the received signal. This is particularly important in the reception of the extremely low level signals often encountered in DX and VHF operating. Stereophonic buffs should take heed too. A recent report by the IEEE (Institute of Electronic and Electrical Engineers) Professional Group on Broadcasting noted that a high SWR on receiver antenna inputs causes a reduction of stereo quality.

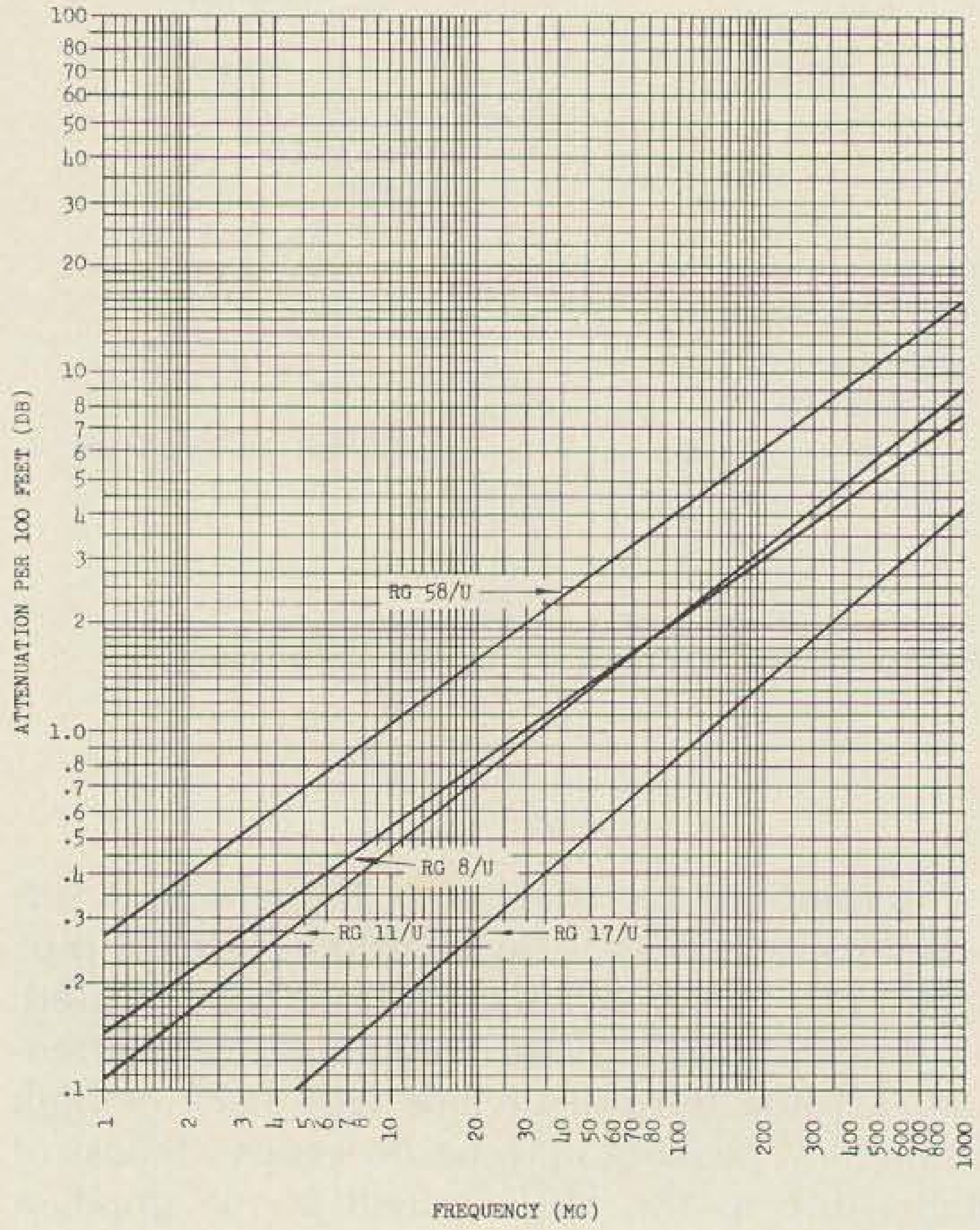


Figure 2

Attenuation vs frequency.

Many of the amateur stations on the air today make use of RG8A/U coaxial cable. Its excellence is proven out by its extensive use by the military, but a look at the loss graph (Fig. 2) for this cable indicates that it is not completely lossless! Even at 4 mc it has approximately 0.3 db loss per 100 feet, and on six meters there is a loss of 1.4 db for the same length. A look at Fig. 3 indicates that on 75 meters only 94% of the transmitted power is delivered to the antenna if 100 feet of RG8A/U is in use. At 50 mc the loss has sky rocketed to 26% for the same length of line. However, there is one big hooker for

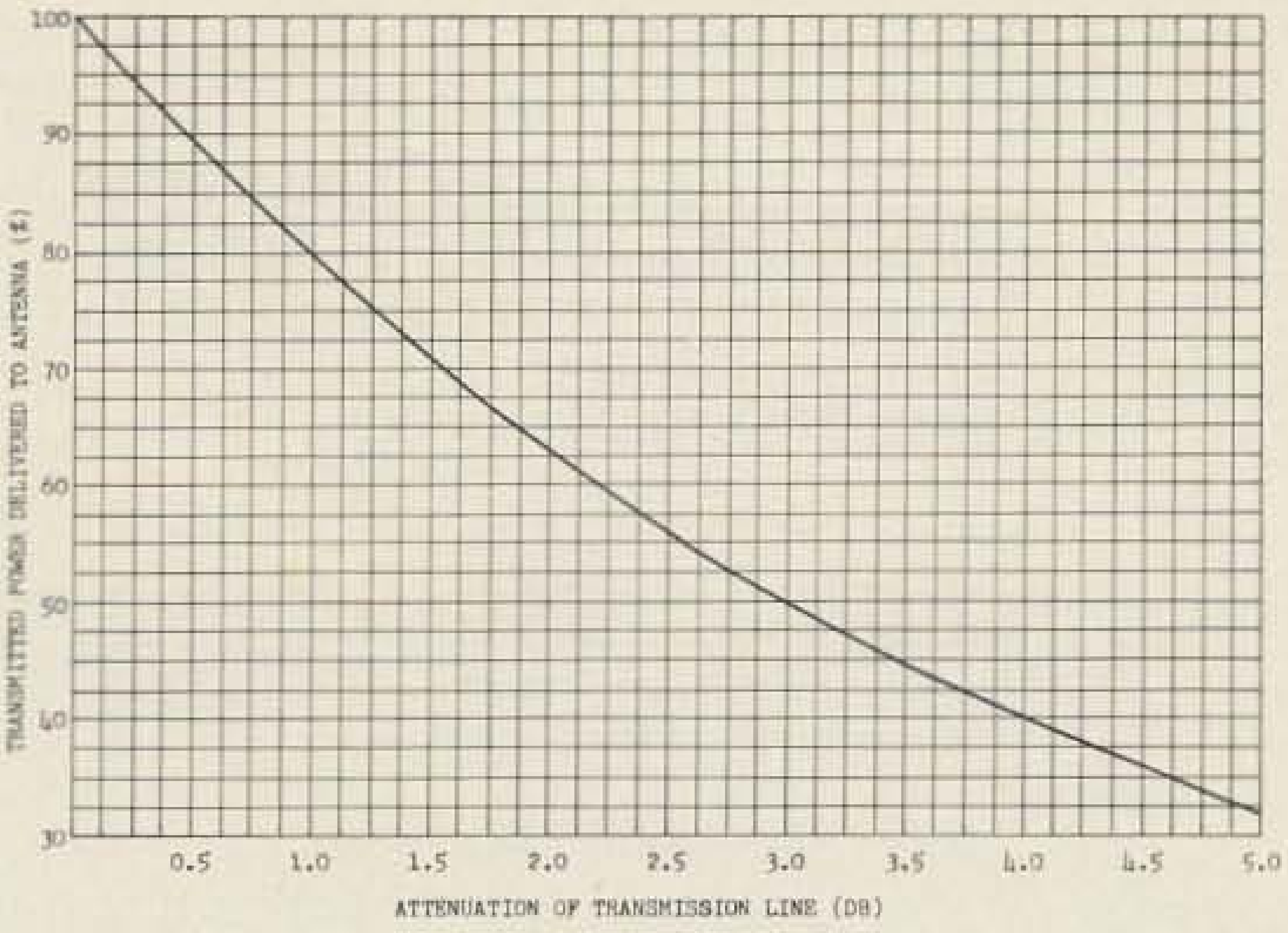


Figure 3

Attenuation vs Power transmitted.

these conditions to exist: the SWR must be 1:1. For any other value of SWR there will be further line losses as shown in Fig. 4 because standing waves have the property of multiplying attenuation. This graph indicates that if a transmission line is operating at an SWR of 3.7:1, the line loss will be multiplied by a factor of two. For the previously mentioned situation on 50 mc, an additional 24% loss could be expected with an RG8A/U line operating at an SWR of 3.7:1.

It should be obvious by now that the use of an SWR bridge in the line at all times is very advantageous in the maintenance of a low SWR at the operating frequency. However, contrary to popular belief, the SWR bridge does not tell all. Since there is loss or attenuation in any length of transmission

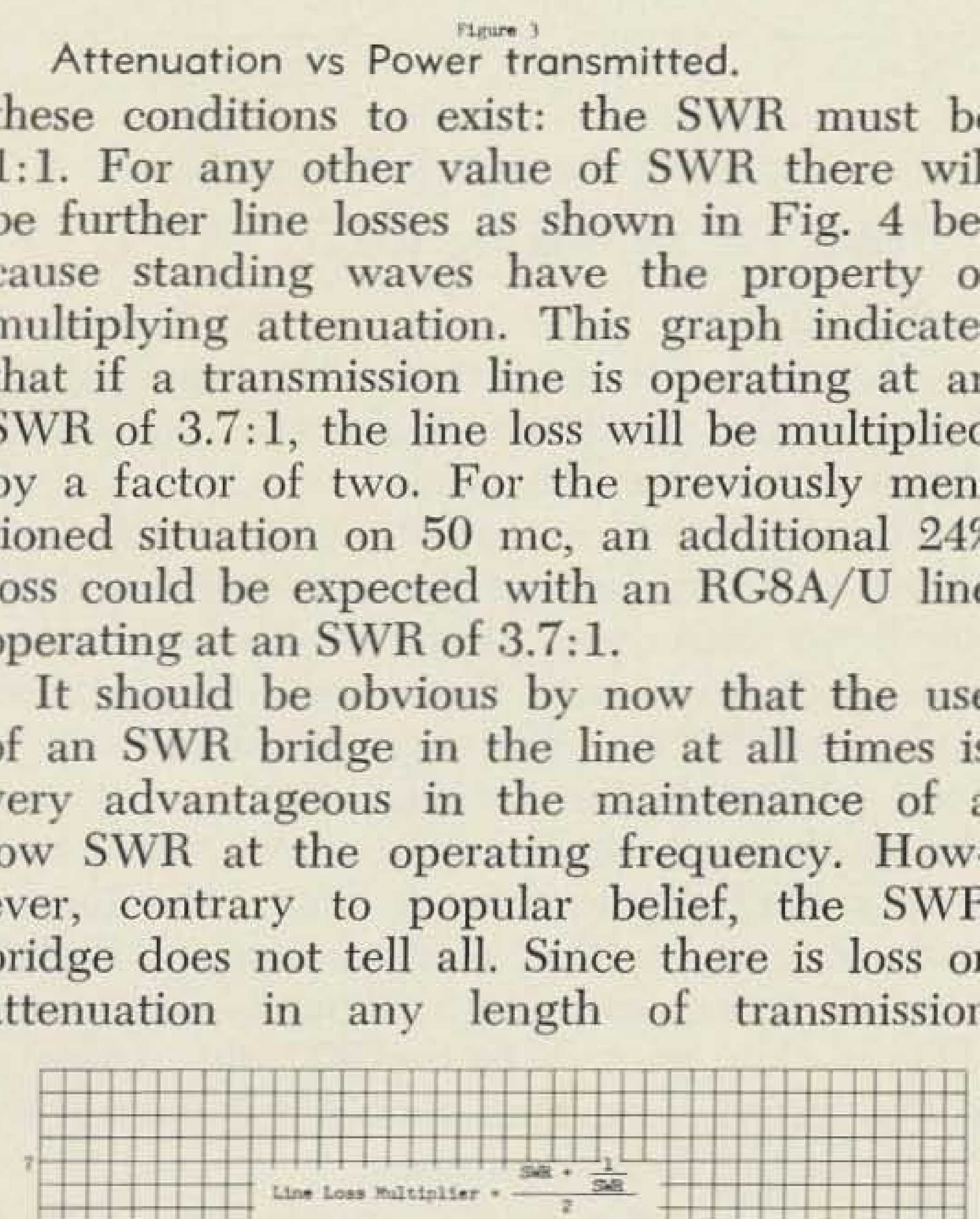


Figure 4

Line loss multiplier vs SWR.

line, the reflected wave will be attenuated in the same matter as the transmitted or incident signal. Because the standing wave ratio is the ratio of the incident wave to the reflected wave, attenuation of the reflected wave will give erroneous SWR measurements when the SWR bridge is conveniently located at the transmitter. In this location the bridge will see the full power of the transmitter, but only a portion of the reflected signal. In some cases where the length of the transmission line is excessively long, the reflected wave will be attenuated to such a degree that the SWR will appear to be very close to 1:1, while in reality it will be a good deal higher. This fact is graphically represented in Fig. 5.

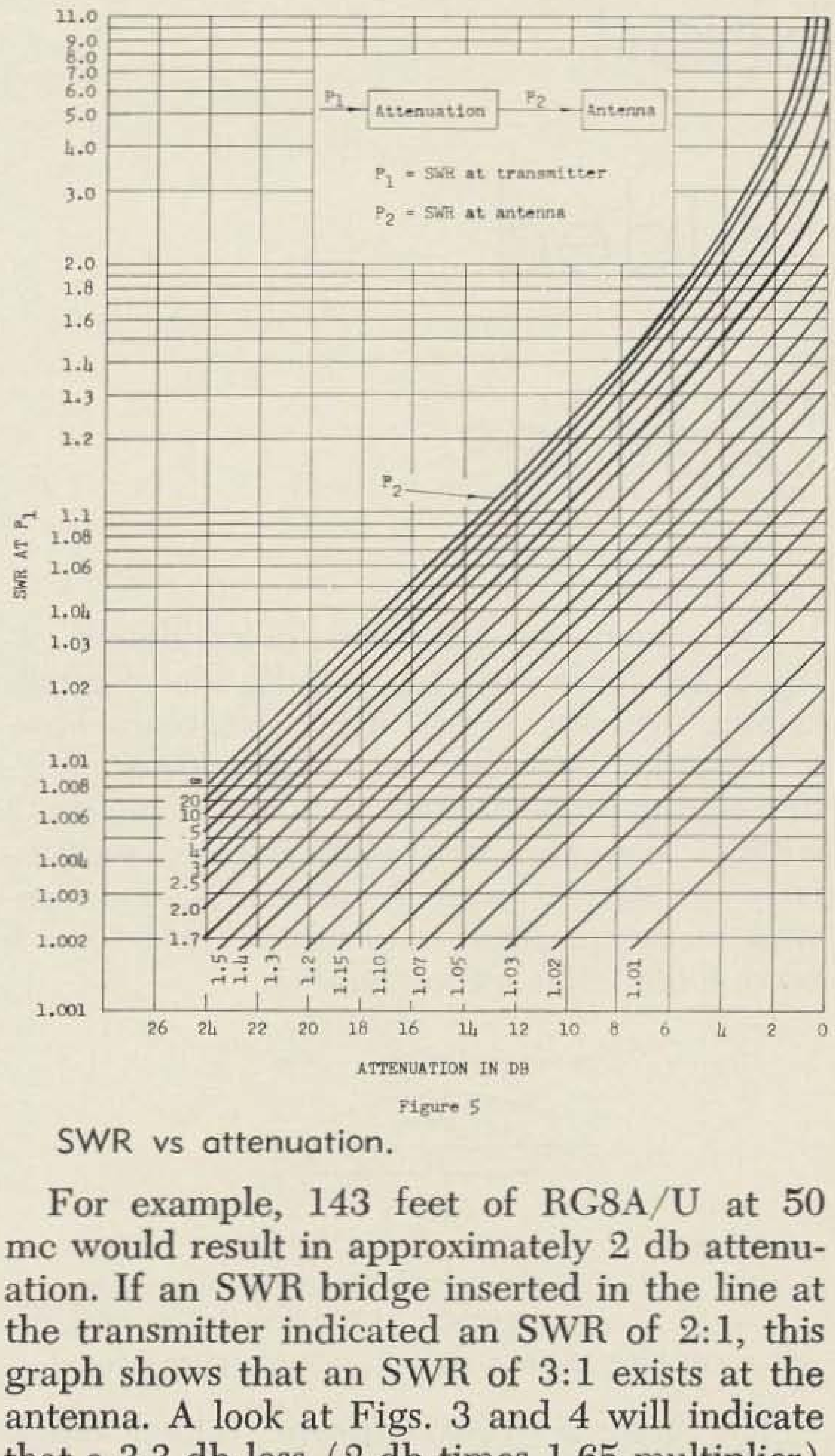


Figure 5

SWR vs attenuation.

For example, 143 feet of RG8A/U at 50 mc would result in approximately 2 db attenuation. If an SWR bridge inserted in the line at the transmitter indicated an SWR of 2:1, this graph shows that an SWR of 3:1 exists at the antenna. A look at Figs. 3 and 4 will indicate that a 3.3 db loss (2 db times 1.65 multiplier) occurs, amounting to 47% loss of transmitted power in transmission line losses. Of the remaining 53% power arriving at the antenna, 24% will be reflected back down the line. A little simple arithmetic will show that of the total power transmitted, only 30% will be radiated! This simple mathematical fact should make the merits of low standing wave ratios immediately obvious if we wish to get the most out of our equipment. By keeping transmission lines short and by insuring that the SWR is as close to 1:1 as practicable, line losses will be minimized, maximum power will be delivered to the antenna and more successful and reliable radio communications will result.

. . . WA6BSO

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Short Folded Dipoles

The conventional ½ wave folded dipole antenna has been used for a multitude of applications over the years. There are times however when space limitations require a radiator considerably shorter than ½ wavelength without compromising performance, particularly on the 3.5 and 7 mc bands. One answer to this problem is to use either a ⅜, or ¼ wave folded dipole configuration.

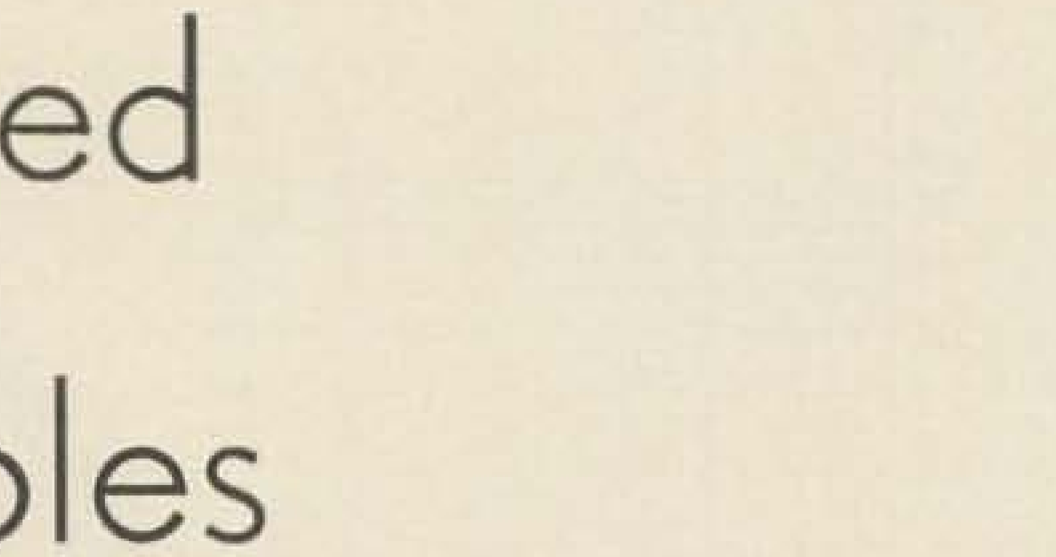


FIG. 1 CURRENT DISTRIBUTION IN 1/2λ FOLDED DIPOLE

The basic ½ wave two-wire folded dipole is shown in Fig. 1. When both conductors are of equal size, the currents in each are equal and in phase with each other. The impedance of this antenna is nominally 4 times that of a single dipole, or 280 ohms. If we add a third conductor in parallel, the impedance becomes 9 times that of the dipole, or approximately 630 ohms. Thus for a ½ wave folded dipole having all conductors the same diameter and equally spaced, the impedance step-up ratio is N^2, where N is the number of conductors.

If we use a shorter physical length than ½ wave for the folded dipole, the current magnitudes and phase relationships change considerably however. If we first consider the ⅜ wave configuration shown in Fig. 2, we

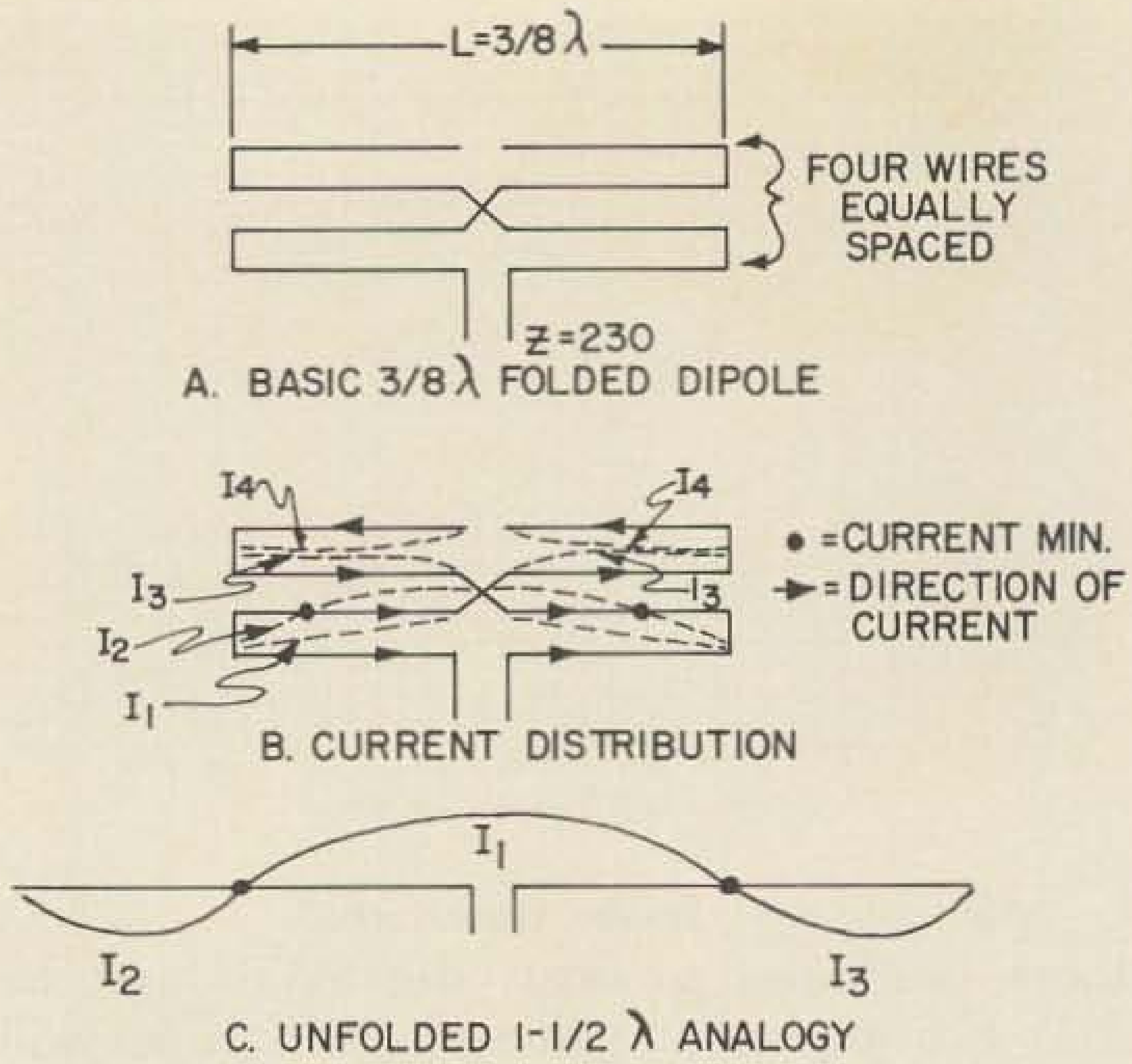


FIG. 2 THE 3/8λ FOLDED DIPOLE

find that the basic current distribution is the same as for an antenna 1½ wavelengths long, or the condition when a 7 mc folded dipole is resonated on 21 mc.

The analogy is not exactly true in this case however, as by folding the conductor back on itself we introduce phase reversals between the conductors, with their resulting additions and cancellations. The overall effect gives a total current in the antenna that is very similar to the one we find in a conventional two-wire folded dipole ½ wave long. The impedance step-up in this configuration is slightly over 3 times, and approximates 230 ohms. This is close enough to the 300 ohm value of common twin lead that the SWR is well below 1.5:1 for the ⅜ wave antenna.

Thus a ⅜ wave folded dipole for 7 mc is only 50 feet long, as opposed to 65 feet for the ½ wave version. The overall length could probably be reduced to 35 to 40 feet by drooping the ends without too much of a loss in efficiency if necessary.

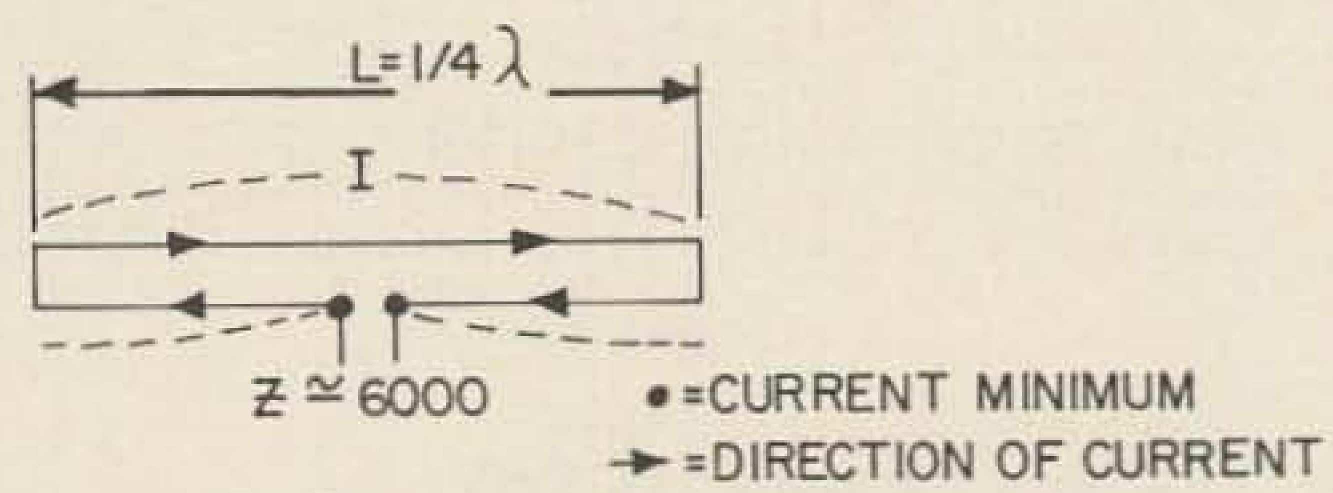
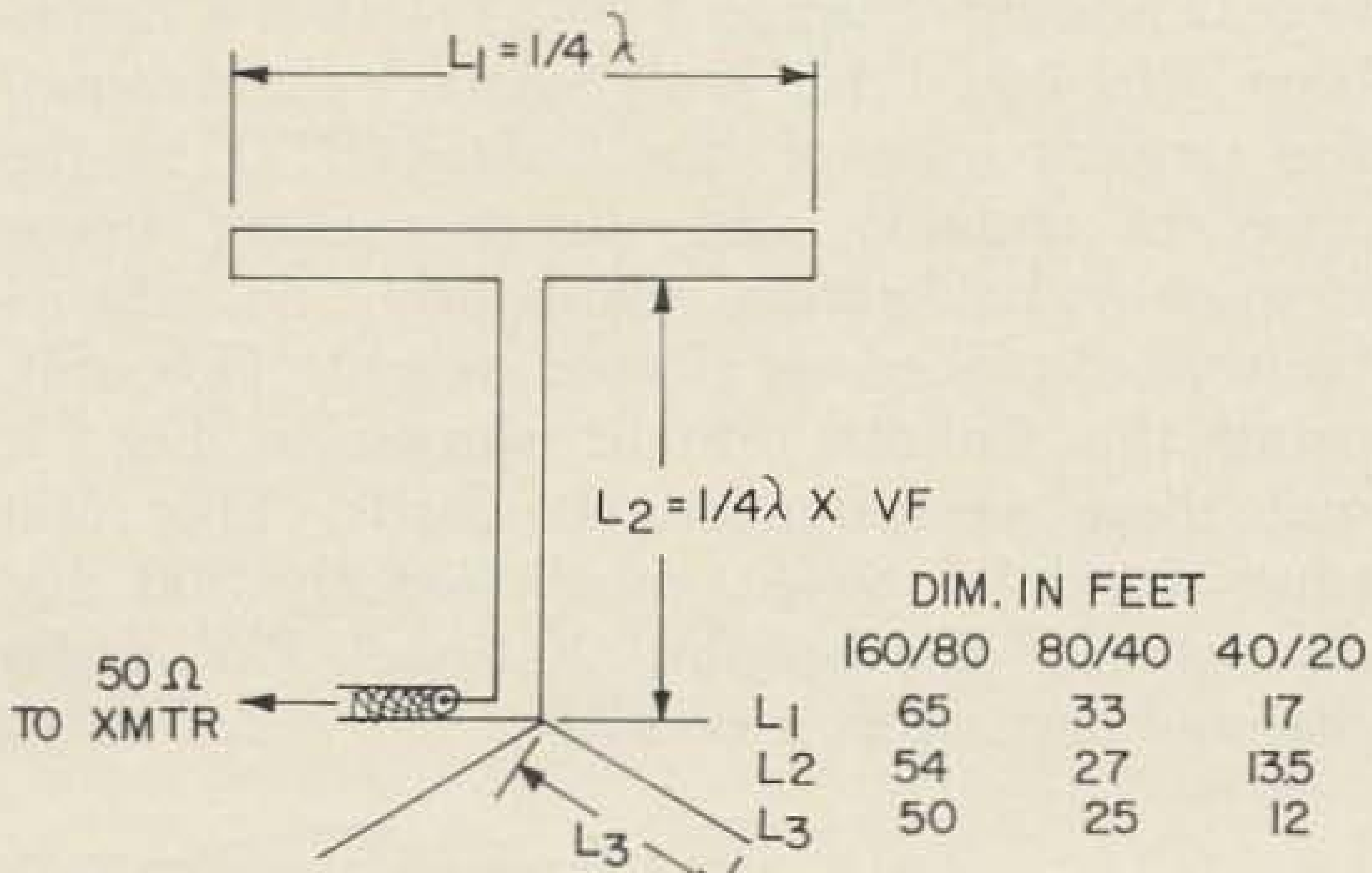


FIG. 3 THE 1/4λ FOLDED DIPOLE

Now for the ¼ wave folded dipole. How does it work? Well the answer to this is that the antenna is really ½ wave long. This can be seen clearer if we again consider the regular ½ wave folded dipole. In the ½ wave configuration the antenna is operating on its second resonance, or in actuality the current distribution is the same as for a full-wave antenna before we folded it to bring about a phase reversal.

The ¼ wave folded dipole then is equivalent to an end fed ½ wave radiator, operating on its first resonance. As the ends are folded back, the efficiency suffers a bit from out of phase current cancellation, as shown in Fig. 3. However, this normally only amounts to about 0.5 db loss in the system, and is a small price for shrinking the antenna 50% in overall length.

There is a sour note to this antenna though, which has discouraged many potential users. This is that the antenna exhibits a feed point impedance of around 6000 ohms, which certainly does not conform to our standard feed line impedances. This problem can be cured easily however by use of a ¼ wave matching transformer section. For a 75 ohm feed line, the matching section is 670 ohms. Similarly for a 50 ohm line it becomes 385 ohms, and conceivably could be made from either 300 or 425 ohm open wire TV line with a resulting low SWR.



NOTE: 4 RADIALS ARE USED, MAY BE LAID ON GROUND OR BURIED.

FIG. 4 THE MULTEE ANTENNA

The ¼ wave folded dipole was used successfully in an antenna popular several years ago, known as the "multee". This antenna was fabricated from 300 ohm line for both the flat top and matching section, as shown in Fig. 4. The main feature of the "multee" was that it provided two band operation in a restricted space. On the lower frequency, the antenna functions as a top loaded vertical, while on the higher frequency it becomes a ¼ wave folded dipole, fed thru a matching transformer from a 50 ohm line. The use of radials at the base serve two purposes: first, to provide a ground return when the antenna is used as a vertical, and second, to de-couple the unbalanced/balanced effect of feeding with a coaxial line.

. . . W6WAW

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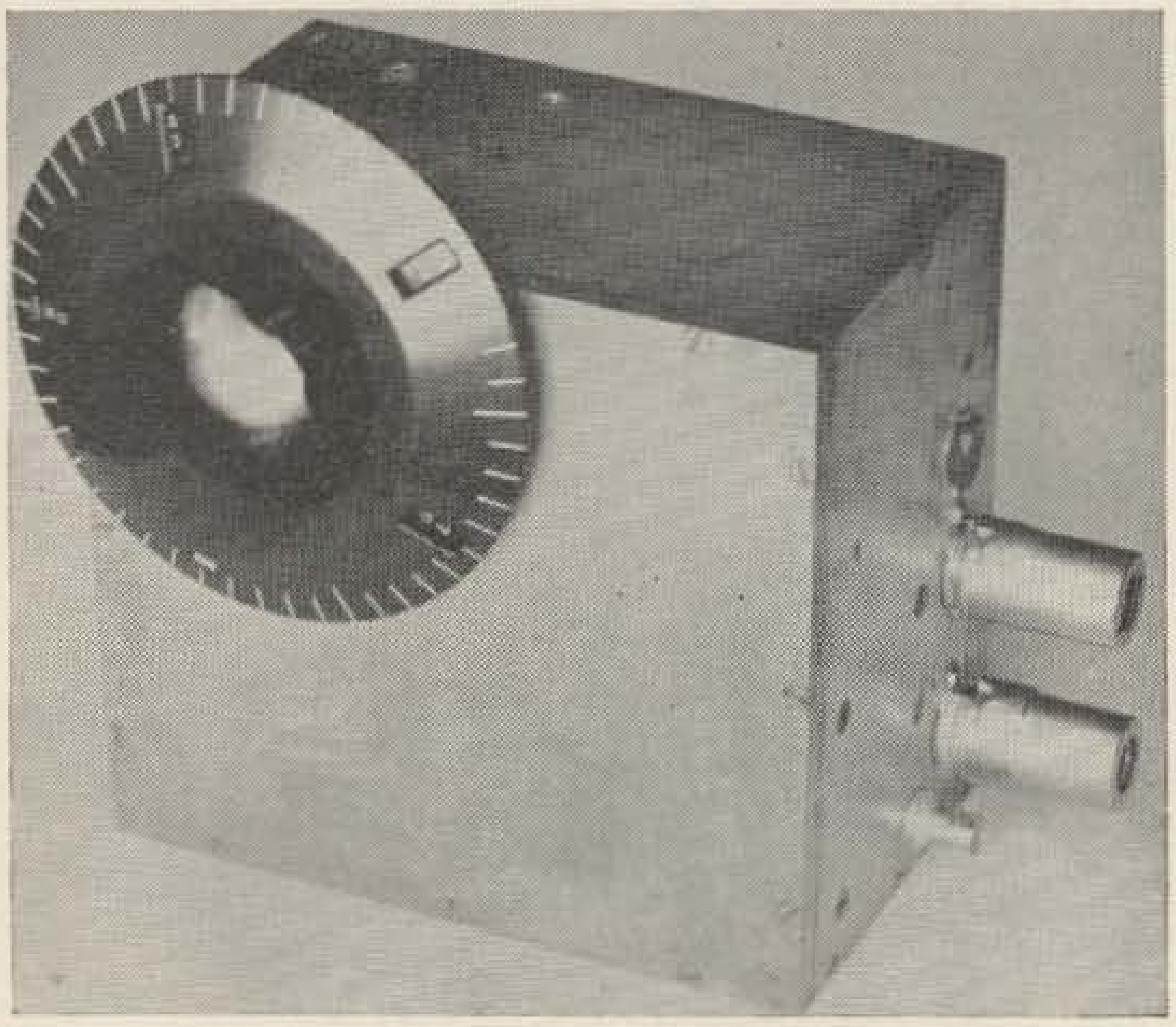
VFO Construction Techniques

Use of the variable frequency oscillator or vfo in amateur transmitters has a long and interesting history. The vfo goes back to the wide-open, breadboard construction of the MOPA transmitters used in the Twenties and the early Thirties. Improved circuits, better components and modern construction techniques have resulted in the present commercial availability of high performance oscillators. A good example of this development is the Collins Radio Company Permeability Tuned Oscillator (PTO). Highly stable and accurately calibrated, these units provide performance that would have been considered impossible a few years ago.



Amateur construction techniques have also improved and many fine vfo units have been described in the various amateur radio magazines and handbooks. Several "pet" circuits have been presented as providing the ultimate in stability. Other articles have stressed the requirement for sturdy mechanical construction. Obviously, any method of construction that will permit the movement or vibration of frequency determining components will result in undesired shifting or modulation of the output frequency. Despite the universal knowledge of this fundamental concept, many published articles describing construction of "high-performance" vfo's specify the use of light-weight, thin-gauge commercial cabinets and chassis. Inadequate mechanical design and the selection of inferior capacitors and inductors have contributed to the generally poor performance of many commercial and amateur constructed vfo's. Finally, the performance of a vfo can be no better than the performance of the tuning dial drive.

Almost any circuit will provide satisfactory performance if truly rigid mechanical construction is employed, high quality parts are used, a precision dial used and if the circuit is operated at low level with adequate isolation between the oscillator and the higher power transmitter stages. The wide variety of circuits used in the best commercially available equipment proves that no one circuit has a decisive advantage over others. All the better commercial units have one characteristic in common—they use the best available components and drives and they are built like a battleship.

The vfo shown in the photographs was designed and constructed along these lines. This vfo was constructed several years ago to prove to a Doubting Thomas (W4SYJ) that a home-brew vfo could be built which would equal the performance of the Collins PTO in the areas of stability and direct reading linear frequency calibration. Obviously, no restrictions were placed on size or weight. This unit, using the Colpitts circuit shown in Fig. 1, met these performance standards. This unit tunes from 3.5 to 4.0 mc in exactly 500 dial divisions of the surplus National PW series dial and capacitor assembly.

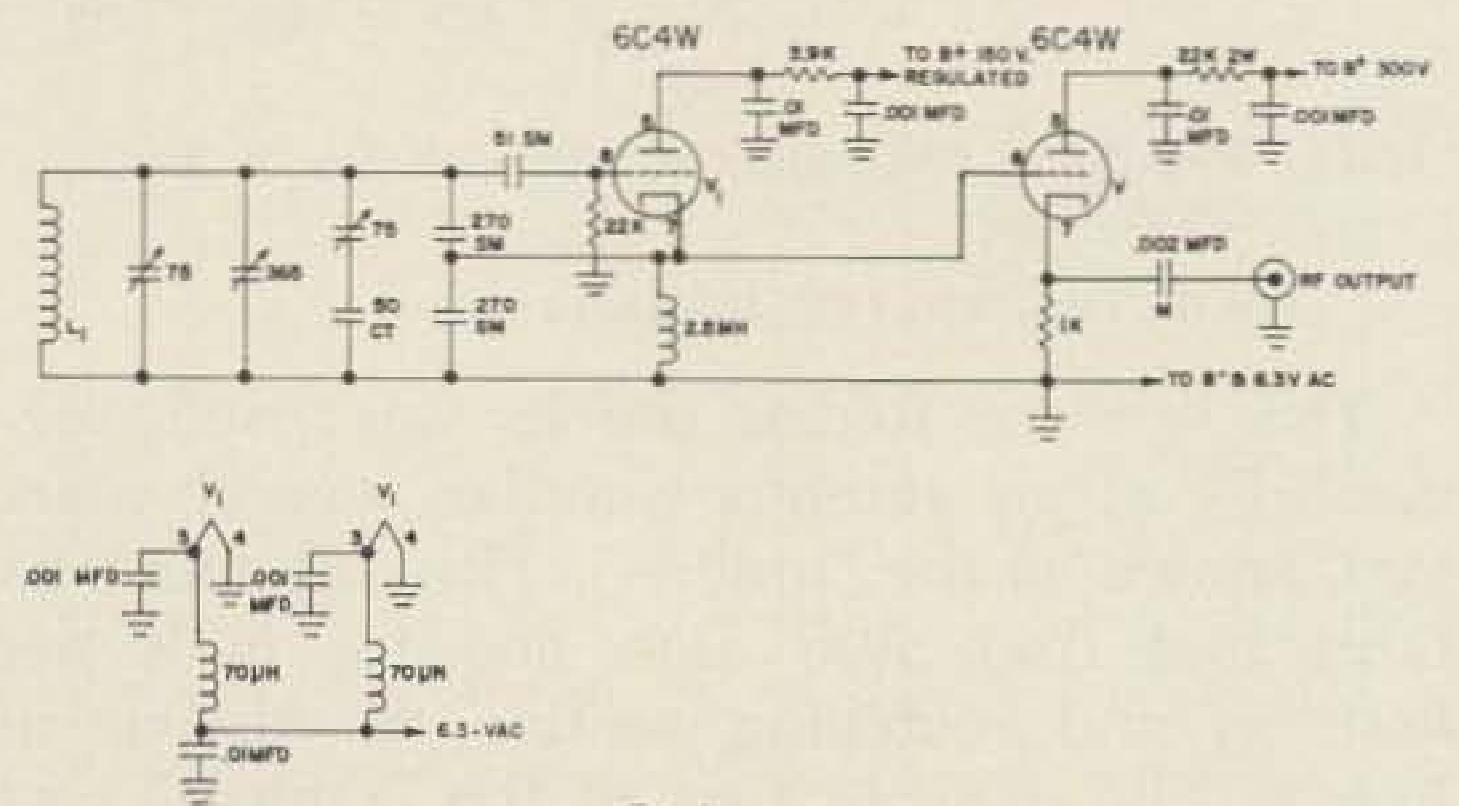
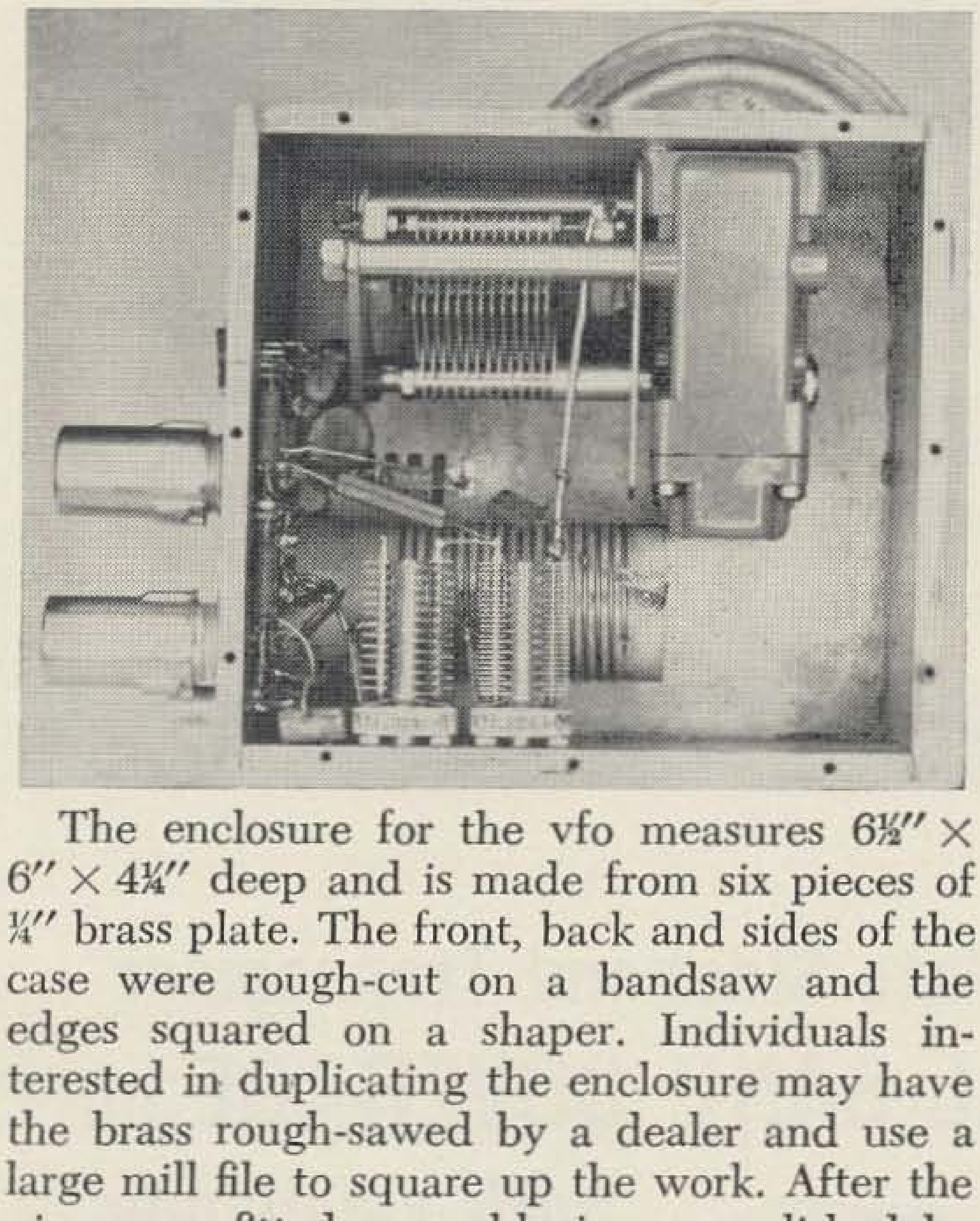


FIG. 1

NOTES:

1. Unless otherwise noted, all resistors are ½ watt composition.
2. Fixed capacitors designated "M" are mica, "SM" are silver mica and those not designated are disc ceramic. Capacitor Ct it N750 temperature compensating ceramic capacitor.
3. With capacitor values shown and L1 consisting of 10 turns on 1½" form, circuit tunes from 3.5 to 4.0 mc.

While few if any readers will attempt to duplicate this unit exactly, circuit and construction details will be discussed in sufficient detail to permit inclusion of desirable design features in existing or future vfo's. For convenience, the circuit was lifted almost exactly from a commercial variable frequency oscillator, the Technical Material Corporation Model VOX. This circuit consists of a parallel-tuned Colpitts oscillator with a direct coupled cathode follower. The only significant circuit change was the use of a 6C4W in lieu of the 6C4 oscillator and the use of a second 6C4W in lieu of the ½ 12AU7 cathode follower. Plate and filament decoupling circuits were added to permit the use of an external power supply.



The enclosure for the vfo measures 6½" × 6" × 4¼" deep and is made from six pieces of ¼" brass plate. The front, back and sides of the case were rough-cut on a bandsaw and the edges squared on a shaper. Individuals interested in duplicating the enclosure may have the brass rough-sawed by a dealer and use a large mill file to square up the work. After the pieces are fitted, assembly is accomplished by drilling and tapping for 4-40 flat head machine screws. A total of 36 screws were used to assemble the enclosure shown in the photographs. Components were layed out and the various required mounting holes drilled. Larger holes were cut with a hole saw in a drill press. After all drilling and cutting was completed, the unit was disassembled and the brass sanded smooth. The brass was then silver plated, using one of the available "rub-on" silver plating compounds. The case was then reassembled. The result is an absolutely rock-solid enclosure that will not deform under any anticipated use condition.

Use of a precision dial and capacitor assembly is mandatory for good vfo performance. Use of a straight-line frequency capacitor is required if linear calibration is to be obtained. The National PW series of drive-capacitor units meets this requirement. Many of these units were available on surplus and may still be obtainable. If direct calibration is not required, units such as used in the BC-221 Frequency Meter are suitable. As a last resort, the drive and capacitor out of one of the Command Set receivers will provide acceptable performance. Next in importance is the use of a high quality inductor. The coil shown is a surplus unit consisting of 18 turns of #14, silver plated wire wound on a 1½" diameter, grooved ceramic form. The coil was tapped at 10 turns to provide the desired frequency coverage. The unused portion of the coil caused no noticeable adverse effects. Use of such a coil, firmly mounted, is strongly recommended for vfo construction.

High quality parts are used throughout the vfo. Except for the temperature compensating capacitor, Ct, silver-mica capacitors are used in the oscillator circuit. The 75mmfd trimmer capacitors are silver plated brass units with locking nuts. All components are mounted using the heaviest permissible hardware. Wiring is all point to point and the largest size tinned solid wire that will fit the terminals of the various components is used. The 6C4W tubes are rigidly held in position by the use of ELCO heat dissipating inserts in the tube shields. The tube envelopes and shields thus become an extension of the massive case and relatively immune to vibration and shock.

Adjustment and calibration of the vfo will be dependent on the frequency coverage desired and the inductor and tuning capacitor selected. VFO calibration and adjustment has been described in the handbooks and in numerous magazine articles so the procedures will not be discussed here. The only departure from standard procedures is in adjustment of the temperature compensation circuit. Two trimmer capacitors are used. A temperature capacitor is connected in series with one of the capacitors to allow precise compensation for drift due to temperature change. Adjustment of the second trimmer allows the oscillator to be reset to the desired frequency.

Performance of this vfo is truly outstanding. The calibration is within three kc over the complete tuning range. With the dial locked in position, the unit may be picked up and dropped to the bench with a barely perceptible shift in frequency. After a ten minute warm-up, drift is so small as to be completely unnoticeable. Tuning is extremely smooth and reset accuracy is very good. The superior performance of the unit is directly attributable to the massive construction and the use of a high quality capacitor and drive. Battleship construction pays off . . . give it a try!

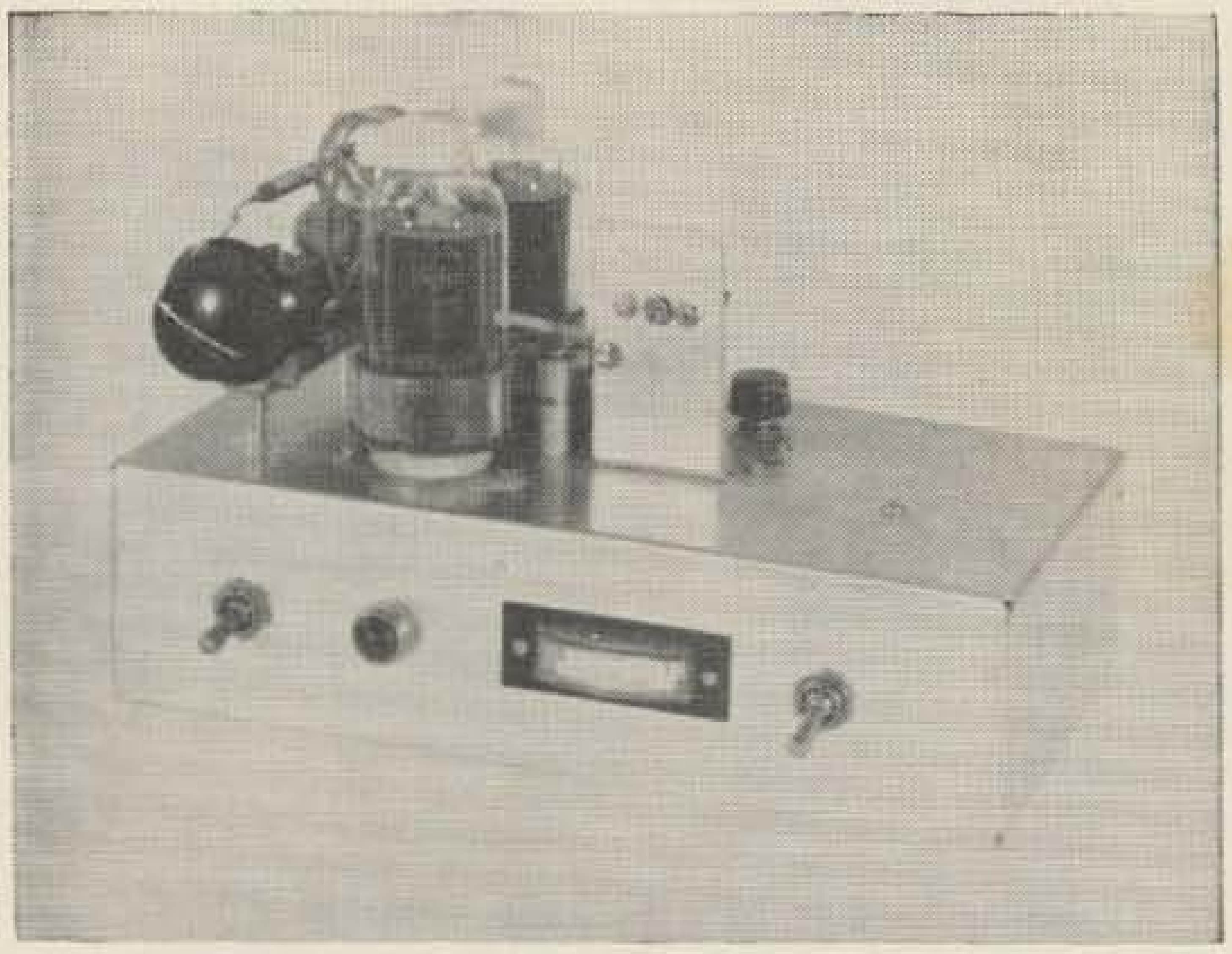
. . . W4WKM

Richard Van Wickle W6TKA
P. O. Box 4051
Santa Barbara, Calif.

A 2 Meter Double-sideband Adapter

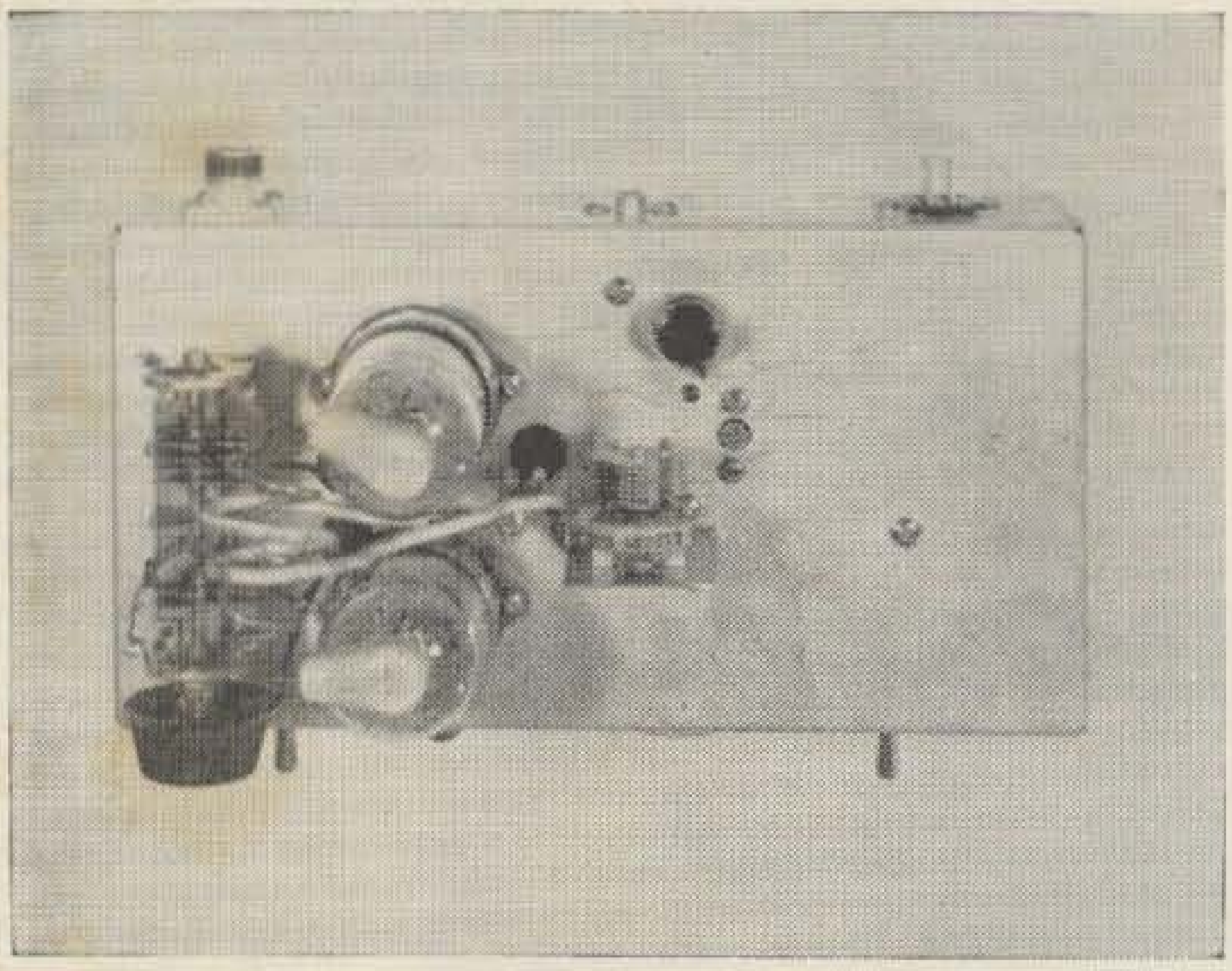
That single-sideband will eventually be the predominant mode of voice transmission for all amateur frequencies cannot be seriously denied by even the most staunch advocates of AM and FM. However, with many amateurs, like myself, double-sideband suppressed-carrier may well be the stepping stone to VHF SSB. If it is not a matter of laziness—or perhaps more correctly, a desire for simplicity of construction—it may also be an economic problem in which case DSB is ideal—if the amateurs on the receiving end will be tolerant of the fact that a DSB signal is often more difficult to correctly tune in than an SSB signal.

Before beginning the description of my two-meter DSB adapter, I must in all honesty, warn you that DSB (or SSB) contacts on two-meters may be not too frequent. You should not, at least at the present, disable your AM or CW equipment in favor of DSB or SSB. In fact, therein lies the beauty of this DSB adapter. It uses your existing two-meter gear and allows you to return to AM or CW operation quickly and easily.



2M DSB Adapter

This adapter will have you on two-meter sideband with only a few hours of construction. It utilizes your two-meter transmitter as the source of rf drive. The plate and screen voltages for the 6146's are provided by rectifying the output of your existing modulator. No other high voltage is supplied to the adapter. The adapter shown in the photographs uses 6146's simply because I had them on hand. For the power level achieved with this system a more economical approach would be to use a pair of 2E26's, or for lower power, a pair of 5763's. It should be stressed that twin-tetrode tubes (such as the 832, 832A, 829B, 3E29, and 6360) are not suitable for this application since the screen grids have a common terminal and hence cannot be used in this push-pull-output circuit.



Top View

The rectifiers V3 and V4, rectify both positive and negative voice peaks and cause audio voltage to be applied to the balanced-modulator 6146's. When the top end of the modulation transformer secondary goes positive, the plate of the top 6,146 (V1), is driven positive, and the ground return circuit is through rectifier B4. On negative voice peaks, when the bottom end of the secondary goes positive, the plate of the lower 6146 (V2) is driven positive, with the return through V3. Positive voice peaks thus supply plate and screen power for the upper 6146, and negative voice peaks supply the power for the lower 6146.

A balanced modulator results when we have (as shown in the schematic) the grids of the tubes in parallel and the output circuit in push-pull. Applying audio voltage alternately to the plates and screens of the 6146 balanced modulators results in a carrierless double-sideband signal. A small advantage of this circuit is that, since only one tube works

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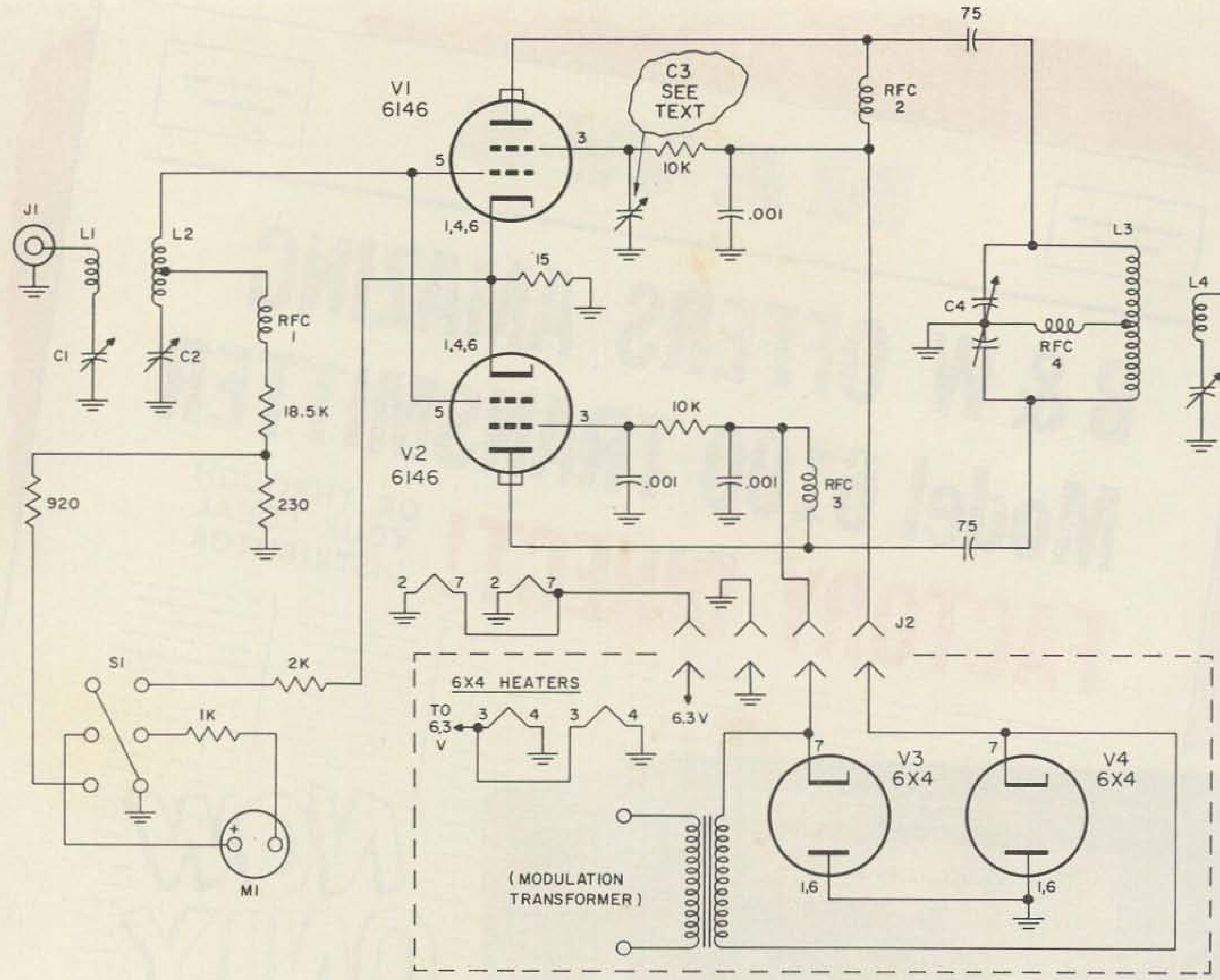


at a time, the non-conducting tube is an effective "neutralizing capacitor" for the other tube.

Reports on audio quality with this adapter have been quite good, and we believe that the plate-and-screen modulation is part of the reason for these reports. As you know, most high-level double side-band transmitters utilize screen modulation which, when not properly adjusted, often results in less-than-the best audio quality.

The modulator used with this adapter is designed to limit the audio frequency response by using .002 coupling capacitors, a 100 mmfd capacitor across the microphone input, a 470 mmfd capacitor across the grids of the 807 modulators, and a .002 capacitor across the secondary of the modulation transformer. Too many lows in a double-sideband signal result in increased difficulty in tuning in the signal, and a strange "growling" sound.

The 6X4 rectifiers were chosen after making comparisons with silicon rectifiers. So little difference was noted in this application between silicon and tube rectifiers, that it was decided to stay with the 6X4's since they have a peak inverse voltage rating of 1250 volts, a peak current rating of 210 ma, and cost about 90c each. Silicon rectifiers of equivalent PIV and current ratings are far more expensive. The 6X4's should be quite adequate for use with modulators having a power output in the vicinity of 100 watts. Silicon rectifiers can, of course, be used if you prefer.

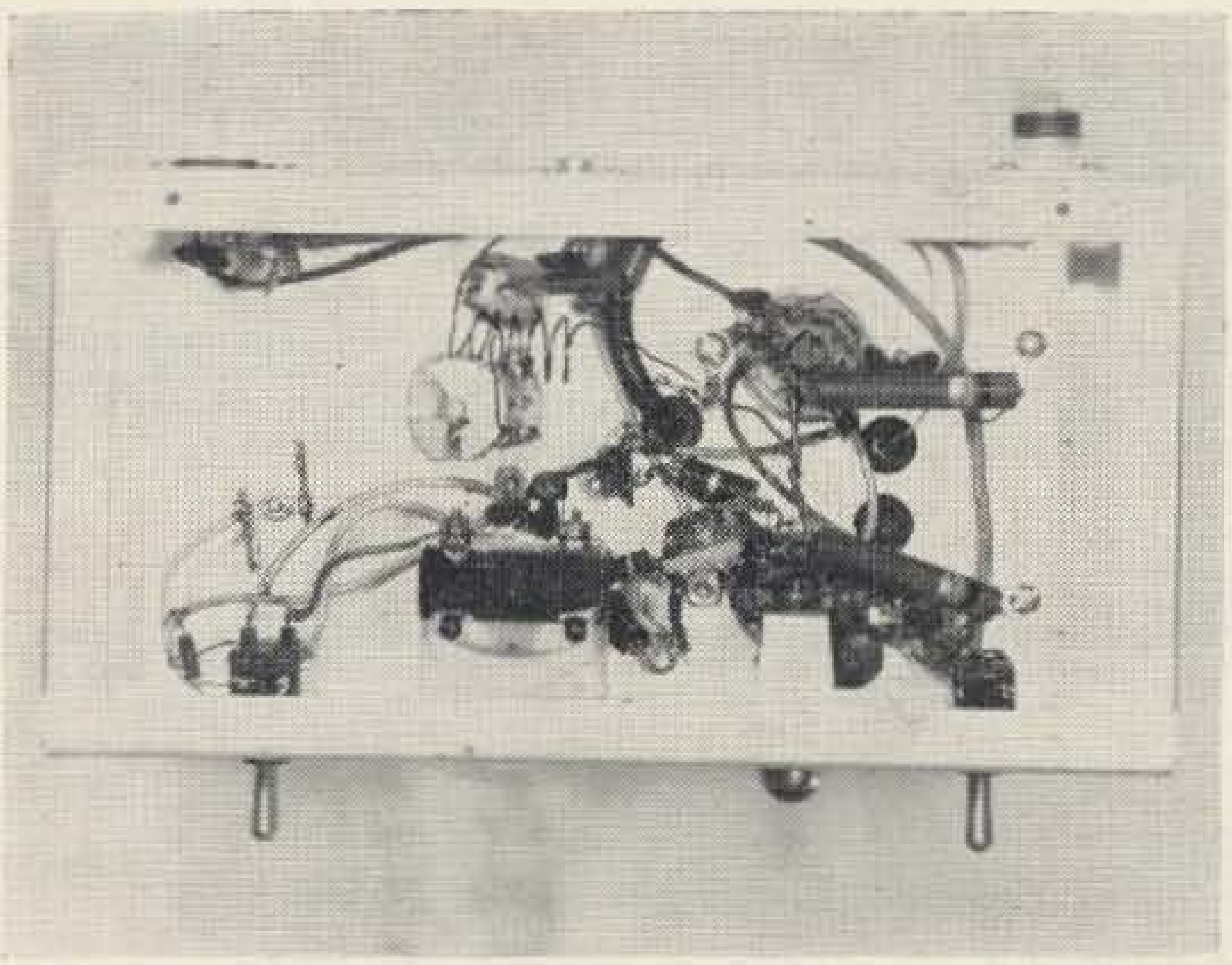
You will note that the screen resistor value is lower than customarily used with 6146's or 2E26's. Don't let this frighten you because the tubes operate on a very low duty cycle in this application, and can easily stand the increased screen voltage and resulting greater plate current. The heavier plate current thus drawn also offers a greater load to the modulator, and in my case, resulted in better

Parts List

C1—7-7 mmfd air variable capacitor
C2—5-50 mmfd air variable capacitor
C3—Mica trimmer capacitor, 7-40 mmfd (see text)
C4—HFD-15X (Hammarlund) dual variable capacitor; four rotor plates removed from each section; no stator plates removed.
C5—5-50 mmfd air variable capacitor
J1—RCA-type phono jack
J2—Four-contact Cinch-Jones #S-304 socket
J2—UHF-type coaxial panel-type connector
M1—0-1 ma meter, Shurite Model 350 "edgewise" type
RFC1, 2, 3, 4—Ohmite Z-144 rf choke
S1—dpdt switch
V1, V2—6146, 2E26, 5763, etc. (see text)
V3, V4—6X4

sounding audio than when screen resistors of more conventional values were used.

The meter is an inexpensive Shurite "edgewise" Model 350 0-1 ma meter. It is quite adequate for the application, and, incidentally, is surprisingly accurate for such an inexpensive instrument. With the resistors shown in the schematic, the meter reads 10 ma full scale in the "Grid" position, and 200 ma in the "Cathode" position. Remember when reading cathode current you are reading both plate and screen current.



Bottom view

A means of balancing out the last trace of carrier is highly desirable in any SSB or DSB transmitter. I found that in this adapter the carrier could be nulled out by using a 30 mmfd maximum trimmer in place of the usual .001 mfd screen bypass capacitor for *one* of the 6146's. There was a sufficient difference between the two 6146's that by placing the trimmer capacitor from the screen grid to ground of first one tube and then the other, I was able to find the tube with which the trimmer would null out the carrier quite nicely. A .002 mfd capacitor is connected from the other tube screen grid to ground.

The unit shown in the photographs was experimental, to determine if this system was feasible on two meters. As a result, several things would be done differently if I were to do it all over again. First, the grid input circuit should be arranged so that the coils and capacitors are closer to the grid connections of the tube sockets. Secondly, the output circuit of the tubes should be similarly arranged closer to the plate caps. You will note that there is an unused switch on the front of the chassis; this was installed during experiments to determine if the circuit could be sufficiently unbalanced to allow AM operation. To date, this has not been possible with any degree of audio quality.

. . . W6TKA

Moritz Shollmier WA5EFL
45 White Oak Lane
Little Rock, Ariz.

When Good Losers Get Together . . .

Mortiz (WA5EFL) who hobbies around with mechanical engineering in his space time, got into one of those Sugar Bowl games of chance with ham radio operators from a half-dozen other states. It started in the pre-game gab. Moritz naturally knew that Arkansas was going to whip the pants off of Ole Miss. Alligator Bill (K5SQS) over at Alligator, Miss. was just as certain the Rebs would win. Others joined in.

Before the kick-off, about fifty hams were in on an agreement, which, although it certainly was not gambling, would see all the losers send $1.00 to the winner.

To explain the procedure, so that nobody will get the idea there was any gambling—far be it fromthat!— all the hams had one fairly trustworthy fellow over at Memphis, Bill (W4IIY) draw for them out of a hat.

What he drew for Alligator in Mississippi, for a ludicrous example, was a number indication that the Rebels would defeat Arkansas by four points. What he drew for Moritz, for another example, was that Arkansas would flail Mississippi by twenty-two points.

If we remember the final Sugar Bowl score—it was 17 to 13 for Alligators Ole Miss team.

Despite this flukey outcome, Moritz sent his buck and a second one for his Dad, who had also become involved, over to Alligator. Actually, he didn't just put a couple of bucks into an envelope. First he had them changed into 200 pennies. Then he whipped up a mixture of sawdust, graphite and heavy duty motor oil and stirred the pennies up in it. Then he constructed a box about three inches by three inches and spooned the money mixture inside. He sealed the box with glue, cleats, nails and everything else in sight. Around this he constructed another box of the same description. It fit like plywood on the first, which gave the good loser another idea; a third layer. This was so satisfactory it called for a fourth.

When the project was finally finished several hours later, Moritz had put together a dandy little container that Alligator could open any time he could find a jackhammer and a couple of days off. Meanwhile, throughout surrounding states, other good losers were graciously settling up. Another sent a check made payable to Alligator for "The Football Swindle".

Moritz's little package (sixty cents for mailing) arrived with a cluster of these pay offs. Alligator took it down to his basement hamshack and attacked it with a hammer and screwdriver—two ridiculously ineffective devices. From that he turned to hacking and sawing and kicking and loudly reciting garbled call letters. Finally Alligator got a hole through all the layers, which enabled the oily sawdust mixture, but none of the money, to spew out on the floor.

The XYL didn't think this was so funny. They say that hams clear out in Oklahoma who didn't even have their sets on could hear her laying into Bill. So he had to get back to Moritz. Alligator got on his radio and called Harry (W5HFQ). Making sure Moritz was not on frequency, he then asked Harry to call Moritz in Little Rock and report that Alligator had cut his finger trying to open a crazy box of some sort.

This was a good plan except for two reasons: A local ham overheard the plot and let Moritz know immediately. And also no one else on the frequency got in on the fact that it was a hoked up story. Each telling magnified the story and by the time it had circulated through six states, Bill (W4IIY) heard that Alligator was on the verge of losing an arm over some freak accident. Being close personal friends, he called Alligator long distance to check on his critical condition.

"Even if he lives through it, they'll send him to prison," Moritz said cheerily. For Bob (K5KMK) who is a banker, made his check payable to Alligator but neglected to sign it. Alligator informed Bob on the next QSO about this matter. Bob was all apologetic and said, "You just go ahead and sign my name, Alligator, and I'll clear the check when it comes through."

Bob is waiting on this evidence to clear so he can hold Alligator for check forgery.

This just goes to prove that you can't win them all!

. . . WA5EFL

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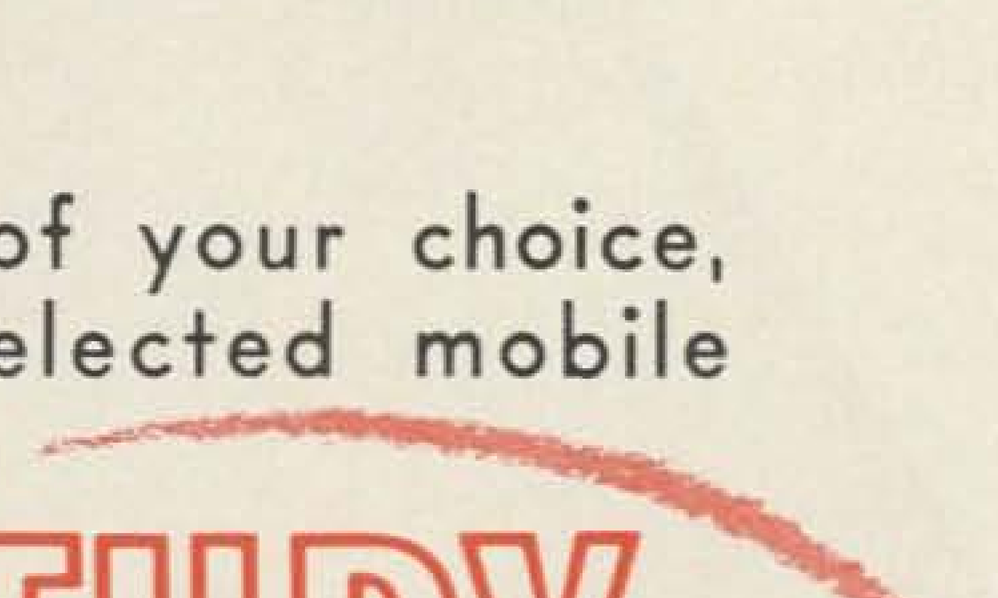

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In the market for a new receiver? This article will help you decide which to buy.

Jim Kyle K5JKX
1236 N. E. 44
Oklahoma City, Okla.

Evaluating Receivers

About ready to replace the tired old receiver in your shack, with either a new or "like-new" one? Or thinking of adding a second one for standby?

Either way, you won't want to make the acquisition blind—unless you happen to be the rare type who prefers to purchase his pigs in pokes. Most of us at the very least like to read over the specs of a receiver before buying it.

But the "like-new," as well as the "surplus-bargain" variety, won't have a specification sheet with it unless it really did belong to a little old lady from Pasadena who only used it to listen crosstown on Sunday afternoons. And even then, you might like to know just what shape the frailly feminine previous owner left the rig in.

Here are some tips on receiver evaluation, based in part on typical checkout tests and in part on years of experience in receiver trading (and years of getting lemons until some of these tricks were learned).

The first step is, of course, to turn it on and connect an antenna. If you can't do that, any purchase will have to be on the basis of "caveat emptor" and brother, you'd do well to caveat!

With the rig warmed up, tune in a weak and known stable signal. WWV will do nicely, as will a harmonic of the 100-kc calibrator if available. Next, lift the receiver lid and let it drop a couple of times. This is just a warm-up to see if the receiver is really unstable; for the real test, turn on the BFO and adjust it for as low a beat note as you can comfortably hear. In any event, it shouldn't be much above 100 cycles. Then drop the lid again and listen for any trace of warble.

This is a tough test; as little as 50 cycles change in either local oscillator or BFO frequency will show up as a one-octave change in beat-note tone! If you get no warble when the lid is dropped, pound the side of the receiver gently. Do not, however, drop it 5 feet onto a concrete floor. It might dent the floor.

Assuming that this test is passed (and fully half the receivers around may flunk out right here) open the lid and blow across the tuning capacitor. If it's buttoned up tight in a shield box, blow across the oscillator tube. Again you don't want to hear any warble, but you quite possibly will. At least one highly regarded current-production receiver flunks on this one. The real question, of course, is does the warble sound suspicious enough for you to say "No, thanks" or does it appear to be within bounds—and only your own insistence on perfection will supply the answer to that.

Now that we've established that the receiver has frequency-meter stability—and if it passes both the preceding tests, it does and then some—we can check the selectivity. You can use the WWV signal for this, but a rocking 50-kw broadcast transmitter or California kilowatt is better. Tune across it and note how wide the signal appears to be.

To be more scientific about this, you might hook up a signal generator and tune its signal in. Adjust generator output until the signal registers 20 db over S9 when tuned for maximum strength. Then tune across it, and note how many kc it is between S2 on one side of center and S2 on the other; this will be your approximate 60-db bandwidth. Reduce signal generator output until you have a peak reading of just S9 and note the width between S8 points; this is the 6 db bandwidth. Dividing the 6-db bandwidth into the 60-db bandwidth will give you a shape factor, which may turn out to be nice to brag about if you buy the unit.

But for an in-the-store examination, the BC station will do as well; if it takes out some

40 kc or so of spectrum, the selectivity is not good. If, on the other hand, the BC station starts sounding like SSB when you're off-tune just 3 or 4 kc either side, the selectivity is very good indeed.

To check out a crystal filter, do the same thing. In the maximum-selectivity position of the crystal switch, the signal should have a distinct ringing sound. Many older receivers which are out of adjustment or have defective crystals won't produce this ringing.

To make a check of sensitivity, remove the antenna. See if you can peak up the receiver noise with the antenna trimmer, with the antenna disconnected and the bandswitch set to 10 meters. If you can't, the front end is pretty poor. If you can, put the antenna back on and if possible switch to 11 meters. The 5-watt wonders there provide an almost ever-present source of weak signals so you can tell where noise leaves off and signal begins.

So far as other controls are concerned, you will probably have twiddled them all in the course of performing these tests. Any sputterings or pops from the speaker with rotation of a gain control indicates probable trouble in either the control involved, or the circuits associated with it. Jerky tuning will make itself obvious in the selectivity test as an inability to find the S2 points accurately.

The noise limiter may not have received a good workout. Fortunately, most ham stores are located near busy streets and many cars still have unsuppressed ignition systems. A rough check of ANL action may be made simply by switching it in and out while checking on-the-air sensitivity.

Should you live near a powerful transmitter other than your own, cross-modulation might be worth checking into. This will require a modulated signal generator, which may not be available in the store. Set the signal generator for maximum output. Tune to a fairly weak (S4 or S5) signal on your favorite band. Set the signal generator to approximately the same frequency and tune the generator back and forth. If you hear the 400-cycle modulation from the generator on the weak signal, tune the receiver to the geneator frequency. If the frequency is very close (50 kc or less) the effect is normal and to be anticipated. If it happens to be a possible image response, it should be considered as one. But if the modulation shows up whenever the signal generator is on, then you have cross-mod problems which are going to have to be cured if that receiver is to be usable.

If, like most of us, you tend to be a bit on the lazy side then you'll certainly want to check the avc action. This divides into two real parts: one is the avc characteristic on CW and SSB, while the other is the simple question "does the avc work right at all?"

Older receivers for the most part make little or no provision for avc when the bfo is on, and many even gang the switches so that avc is always off when bfo is on. In these, obviously, no use of avc for CW or sideband is going to be possible without some major receiver changes. In newer ones, though, you can get a pretty good idea by tuning to a medium-speed CW signal on whatever band is coming in best at the moment, and listening for "thumps" and apparent chirps on the beginning of each character. If all is well the thumps and chirps will be absent, yet the background noise will rise between characters. In some units, background noise will stay down—and this is a matter of preference. Most CW ops like to have it come back up in a hurry so they can work break-in easily, while the SSB gang likes to have it stay down between syllables but come back up quickly at the end of a phrase.

For a general avc test, turn everything but the audio up to maximum and tune in the strongest broadcast signal you can find. If anything is going to clobber the avc, this will be it—and BC stations are required by law to keep their audio pretty clean. Thus by simply listening for distortion while cutting back the rf gain you can find out if the avc is working. If distortion disappears suddenly as rf gain is reduced, something's wrong in avc!

Those of us who anticipate spending long hours at the rig have two "must" items for checking, unless we like to resemble the morning after the night before, following a 3-to-4-hour session on the air. These "musts" are power-supply hum, and audio distortion.

Neither of these possible defects is particularly objectionable during short sessions, but after some 90 minutes of listening to a background of raw ac the temptation to take up philately becomes strong!

To test for hum, plug in a pair of phones and turn the af gain all the way up. Turn rf gain fairly well down, and tune off signal. Listen for any hum. Some will undoubtedly be detectable, but the question is whether it's loud enough to be objectionable.

To determine whether it's the power supply or possibly a poor tube, turn the af gain down while listening. If hum goes away, it's originating ahead of the af gain and the power supply is probably pretty clean. Possible culprits are bad rf or *if* tubes, or a single poor filter capacitor. If, on the other hand, it goes up, then the power supply is at fault.

Audio distortion is most readily checked by comparison against a known good receiver, but this may not be possible. Next best way is to repeat the general avc test but turn rf gain down and set audio gain wide open. If distortion shows up, reduce audio gain and see if it goes away. At the same time, compare to all

TEST	BANDSWITCH	RF GAIN	AF GAIN	SELECTIVITY	AVC	CALIB	ANL	BFO	ANT	RESULT
SENSITIVITY	10 Meters	Max	Any	Widest Band	Off	Off	Off	Off	None	1
									On	2
STABILITY	10 Meters	Max	Any	Any Setting	Off	On	Off	On	Any	3
SELECTIVITY	80 Meters	Max	Any	Approx 6 kc	On	Off	Off	Off	On	4
XTAL FILTER	80 Meters	Max	Any	Narrowest	Off	On	Off	On	On	5
ANL	10 Meters	Max	Any	Widest	On	Off	Off	Off	On	6
							On			7
AVC ACTION	Best Band Broadcast	Max	Any	2 to 6 kc	On	Off	Off	On	On	8
								Off		9
Power SUPPLY	Any Band	Any	Max	Any Setting	Any	Off	Off	Off	Any	10
			Min							11
AUDIO QUALITY	Any Band	Any	Max	Any Setting	On	Off	Off	Off	On	12
ALIGNMENT	Repeat Test 1 at each end of each band covered									13
TUNING RATE	Best Band	Any	Any	2 to 6 kc	Any	Off	On	On	On	14

Test Procedures and Results

1–Peak antenna noise with antenna trimmer, with no antenna connected. Failure to find noise peak indicates poor sensitivity.

2–When antenna is connected (noise still peaked) noise level should rise. Failure to find noise rise indicates poor front end.

3–Tune calibrator signal for 100 cps beat-note. Lift and drop lid. Warble in beat-note indicates poor mechanical stability. Blow into tuning-capacitor compartment. Warble in beat-note indicates poor temperature stability. Attach "Variac" in power line and vary line voltage. Warble in beat-note indicates poor line-voltage stability.

4–Tune across strong signal; note apparent width of signal between S2 points. This is approximately 60-db bandwidth of receiver.

5–Tune calibrator signal to peak of crystal-filter response. Zero-beat BFO. Tune slowly either side and look for notch. Check to see that phasing control moves notch position to either side of peak. Failure to find notch indicates poor alignment of crystal-filter circuits or defective crystal.

6–Check loudness level of ignition noise from passing cars. When particularly loud one approaches, proceed to test 7.

7–Check to see how much ANL reduces level of ignition noise. Do not expect much in reduction of neon-sign noise or QRN.

8–Tune to strong CW signal about 15 to 25 WPM. Listen for "thumps" at beginning of each character. Noise should rise between characters but no signal should overload receiver. This test is applicable only to newer receiver models.

9–Tune to strongest available signal and listen for audio quality while reducing RF gain control. Audio quality should not change as RF gain is reduced. Any fuzziness of audio which disappears as RF gain is reduced indicates insufficient AVC.

10–Use headphones; listen for power-line-frequency hum. Level of hum should not be objectionable; some is permissible.

11–If hum disappears when AF gain is reduced, it originates ahead of gain control. If level remains constant, insufficient power-supply filtering is indicated.

12–Tune in strongest available signal and reduce level by RF gain leaving AF gain wide open. Listen for any trace of distortion or fuzziness. Compare to other receivers on same signal at same time. Distortion indicates high IM, which results in extreme listener fatigue during contest operation, etc.

13–Repeat Test 1 at each end of each band; failure to achieve noise peak at each end of band indicates receiver is out of alignment on that band. Defect is not serious but should be considered as alignment can be a tough job with some receivers.

14–Tune in SSB signal. Note whether it is easy to tune, "sliding in," or comes in quickly and jerkily. Tuning rate is matter of personal preference; most like it slow, however, for easy SSB tuning.

other available receivers for distortion. If possible, compare against a Collins 75A4; this has about as little audio distortion as any receiver tested in our experience (but steer clear of S-line!).

Alignment of the receiver can be checked by repeating the sensitivity test at each end of each band; if you can't peak up front-end noise without the antenna, or if noise doesn't increase when the antenna is connected, the receiver is not properly aligned at that point. Most used receivers, unless they have just been reconditioned, are not in proper alignment; putting them back in isn't difficult but it may be time-consuming, especially if you don't have the instruction manual and have to figure out which slug or timmer controls which circuit on which band. It's something to keep in mind while dickering.

Dial calibration can be checked with a 100 kc calibrator; like alignment, it's not hard to restore but may take some time. Frequency readout from the dial is another matter. If you like to know the other fellow's frequency to the nearest cycle, you're not going to be happy with a dial in which the marks are 1/16 inch apart and each of them indicates 50 kc segments! While it's more a matter of personal preference than anything else, don't forget to take a look at the dial calibrations. The Collins line, of course, has virtually frequency-meter readout; many other makes approach this ease-of-reading condition. A few, however, do not. Check before you buy.

If your line voltage fluctuates widely, you'll want to run all of the tests at three different line-voltage conditions. One, of course, is at normal rated voltage. The other two are 10 to 15 per cent above and below normal, respectively. A Variac or similar adjustable autotransformer is handy, or you can put together a "voltbox" for such testing. The stability tests, in particular, may be severely affected. Distortion may also suffer at low voltage.

To make all this a little simpler and clearer, we've whipped up the accompanying "Receiver Checklist" which summarizes the tests, positions of receiver controls for each test, and test procedures and expected results. With it, you can pull a complete analysis of any receiver in a very few minutes. You can also check out the big station rig, to find out if it's still doing its best. Some top DX hounds check the receiver out thoroughly every 30 days, on the theory that a few minutes spent checking is more than paid back if any defect which might make them miss that rare one shows up. Try it. You may be surprised!

. . . K5JKX

Bill Reynolds K2ZEL/8
56 East Woodruff Ave
Columbus 1, Ohio

The RK 715-B on 6 Meters

The RK 715-B is a tube which has been by-passed by amateurs because of its filament voltage and the lack of specifications in recent handbooks. The tube is an indirectly heated tetrode originally designed for pulse service in early sonar and radar equipment. It requires 26 to 28 volts for the heater, 1500 vdc for the plate and 300 vdc for the screen grid. With a grid drive of 15 milliamps in class "C" service the amplifier will provide 500 watts input at six meters. The plate of the 715-B operates under these conditions with a slight tinge of red.

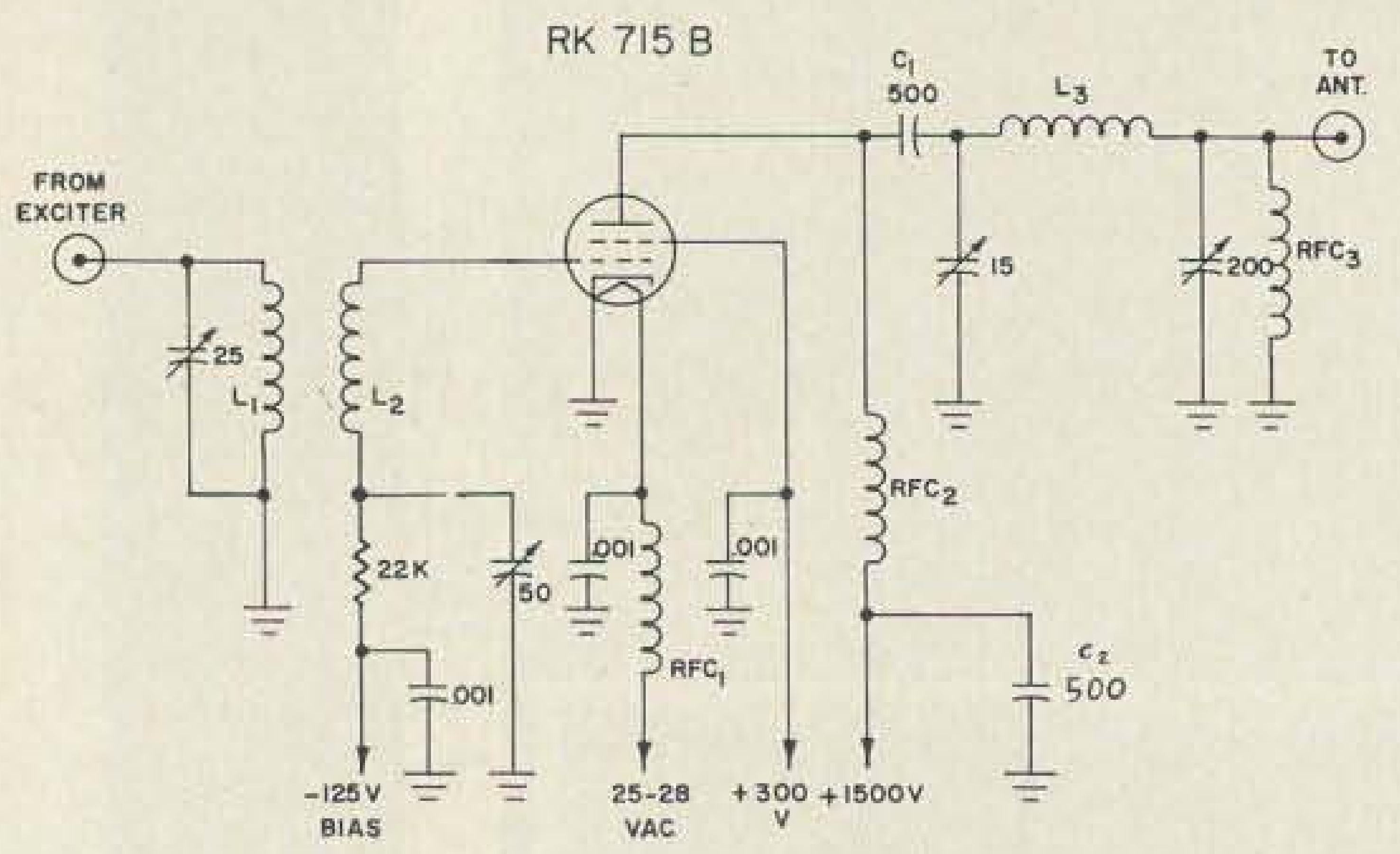


FIG. 1

RFC$_1$ 10 turns #22 enamel close wound
RFC$_2$ 42 turns #22 enamel close wound on ½" ceramic insulator 2" long.
RFC$_3$ ohmite Z-50 or equivalent
L$_1$ 4 turns #18 ½" dia. close
L$_2$ 8 turns #18 ¾" dia. close
L$_3$ 4 turns 3/16" copper tubing, 1½" diameter, 1½" long
C$_1$, C$_2$ 500 pf 20 kv TV doorknob type ceramic

Measuring the input capacity between the cathode and grid reveals that the old handbook is correct in listing a value of 30 mmfd. Because of the large value it is necessary to use an unusual grid circuit to permit tuning to the six meter band. The result is an inexpensive half gallon which is compact and easy to build.

1. The filament is heated by two 12.6 volt filament transformers with their primaries in parallel and the secondaries in series, making it unnecessary to search for a hard-to-get special 28 volt transformer from surplus.

2. The amplifier is built on a 6 x 9 chassis following the usual layout for a final. Bias may be provided by any number of circuits and is set at 125 volts negative to insure that the amplifier is cut-off when no signal is applied.

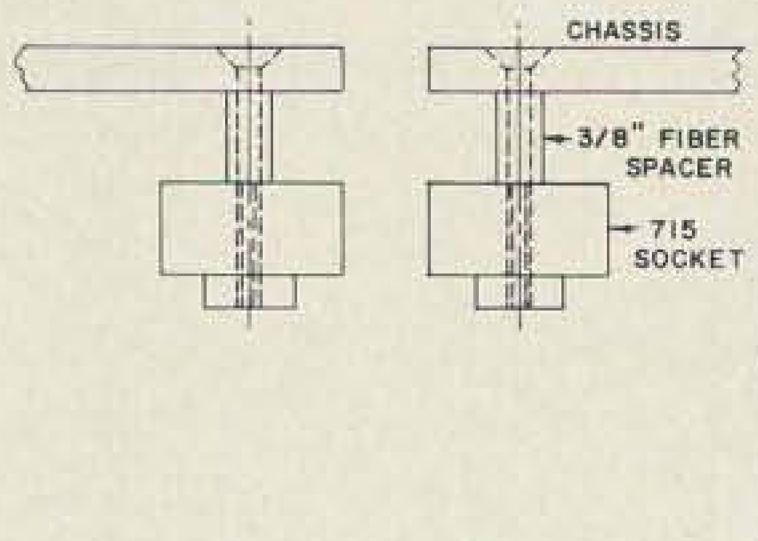


FIG. 2

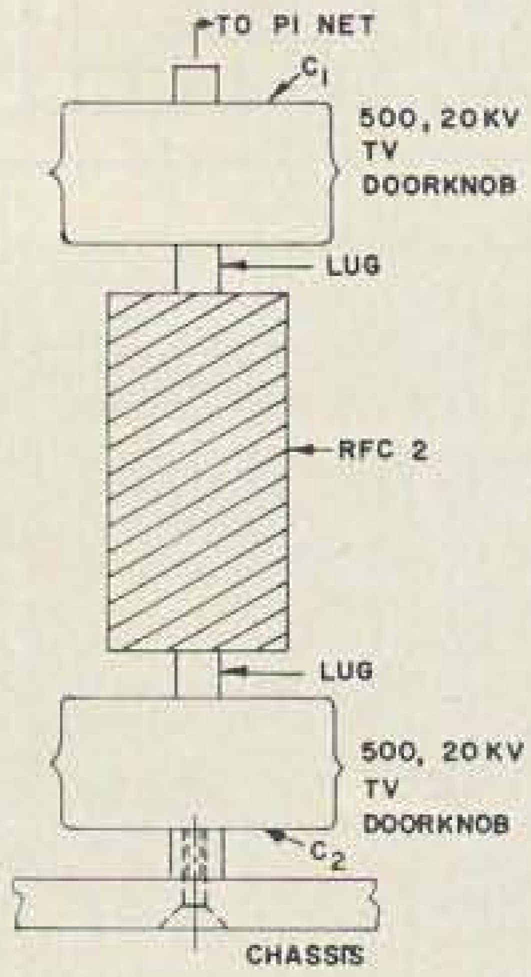


FIG. 3

3. The tube socket is recessed with ⅜" fiber spacers. This procedure permits the amplifier to self neutralize at six meters with no difficulties. If mounted on the chassis the circuit becomes almost impossible to neutralize. (see Fig. 2)

4. The grid is series tuned, permitting the amplifier to be tuned to six meters. The input coil is close coupled to the grid coil for maximum drive.

5. The plate choke is wound on a half inch ceramic insulator two inches long with the TV doorknob capacitors threaded into the ends of the insulator and then bolted to the chassis. (see Fig. 3) The plate cap is of the heat radiating type and the straps from the cap to the choke are either ¼" braid or flexible strap.

6. The Pi-net capacitors used at K2ZEL came out of a BC-191 tuning unit. The final has been used here for four years and, from reports, puts out a nice wallop. It is easily switched out of the line-up when going from ground wave work to local rag-chewing.

. . . K2ZEL

New Product

New 1965 Heathkit Catalog

The new 1965 edition of the Heathkit catalog, illustrating over 250 easy-to-assemble electronic kits, is now available free upon request from the Heath Company, Benton Harbor, Michigan.

This 108 page kit-builder's treasure, with 16 pages of beautiful full color, boasts a kit for every interest, every budget. The catalog represents Heath's biggest kit offering yet, and features many new products including a bounty for the ham. New amateur products from Heath will make you drool.

The much-acclaimed Heathkit SB amateur radio series now hosts a new KW linear amplifier. A new speaker for mobile operation, and a new "Ham-Scan" Spectrum Monitor that adds sight to the sounds of ham and CB communications are also shown.

A post card or note with your name and address is all that's needed to get your free copy. Write the Heath Company, Benton Harbor, Michigan 49023.

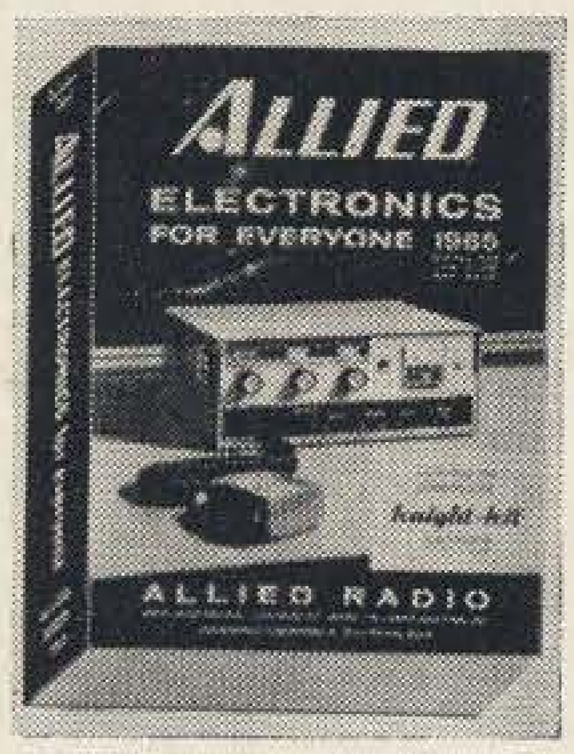
New Product

Quement Dip Meter

Any ham who builds his gear (or fixes it) needs a grid dip meter. And no ham wants to bother with a tube type GDM any more. The slow warm up and cumbersome line cord are a nuisance. Not to mention the high output which can blow out transistors. But Quement's new GDM-3 all-transistor dip meter eliminates these problems and provides a host of unique features as well. It operates immediately (and on a cheap 9 volt battery). It covers 500 kc to 150 mc. It's very compact and light. It's accurate and stable. It's well built and has vernier tuning. The coils are coated with a sturdy epoxy. An earphone is included for monitoring and frequency measuring.

One of the outstanding features we found on the one we received for test is the very strong and accurate dip. We were able to get two deep dips about one megacycle apart in a bandpass coupler at 50 mc. Another dip meter only shows one broad dip in the same circuit—and it has to be very closely coupled to get that! The sensitivity control needs very little adjustment when changing frequency, too. It's quite a gem and the price is only $29.95. Be sure to drop some hints—it would make a mighty nice gift for Christmas.

New Products



1965 Allied Catalog

Allied's 1965 catalog is now available. Marking the company's 44th year, the new 490-page catalog presents the greatest selection of ham equipment in the company's history.

Space devoted to transceivers and VHF gear has been greatly expanded. The new products in the lines of the leading manufacturers are illustrated and described in detail. There are feature-packed transmitters, new single sideband transceivers, VHF equipment for 6 and 2 meters, linear amplifiers, transmitting and receiving antennas, towers, mobile antennas and accessories, code practice aids, ham station clocks, crystals, adapters, TVI filters, coaxial cable and every kind of ham station accessory. The catalog also lists thousands of other electronic products produced by hundreds of manufacturers.

The 1965 catalog #240 is available free on request from Allied Radio Corp., 100 N. Western Ave., Chicago, Illinois, 60680.

Powermaster Inverter

Topaz has announced their new Powermaster 300 watt inverter. It changes 12 volt dc from your car battery to 110 volt 60 cycle power. Because of its high power rating and high efficiency, it can operate most ac ham equipment directly and economically without the necessity for a special dc power supply for each piece of gear. The Powermaster is very compact (only 5⅝ x 5⅝ x 5⅝ inches) and weighs but 12 lbs. It comes complete with all cables and instructions. Available from the factory or from distributors. Price: $44.95 plus shipping.

Famous Hy-Gain Thunderbird Tribanders have been improved...to give you even greater total performance. Each new Thunderbird is equipped with separate new Hy-Q Traps for each band—to give you peak performance on each band whether working phone or CW. New advanced design Beta Match insures optimum transfer of all available energy—allows precision broadband matching and a high degree of electrical and mechanical reliability...comes to you completely factory pre-tuned. Mechanically, new Hy-Gain Thunderbirds are rugged...large diameter, heavy gauge aluminum boom...taper swaged seamless aluminum elements...heavy gauge, machine formed boom to mast and element to boom brackets...non-corrosive full circumference compression clamps at tubing joints. They're available in four models...

1 ALL NEW 6-ELEMENT THUNDERBIRD DX MODEL TH6DX

Superb DX performance. Features wide spaced elements on a 24 ft. boom. New Hy-Q Traps provide true full-sized performance. Feeds with 52 ohm coax—Beta Matched for optimum gain—maximum F/B ratio without compromise. SWR less than 1.5:1 on all bands. Longest element, 32 ft.—weight, 47 lbs. Model TH6DX, **$139.95** Net.

2 NEW, IMPROVED 3-ELEMENT THUNDERBIRD MODEL TH3Mk2

Outstanding performance on 10, 15 and 20 meters. Separate and matched new Hy-Q Traps for each band. Feeds with 52 ohm coax—Beta Matched for optimum gain—maximum F/B ratio without compromise. SWR less than 2:1 on all bands. Boom length, 14 ft. Longest element, 26 ft. Weight, 36 lbs. Rotates with heavy duty TV rotator. Model TH3Mk2, **$99.75** Net.

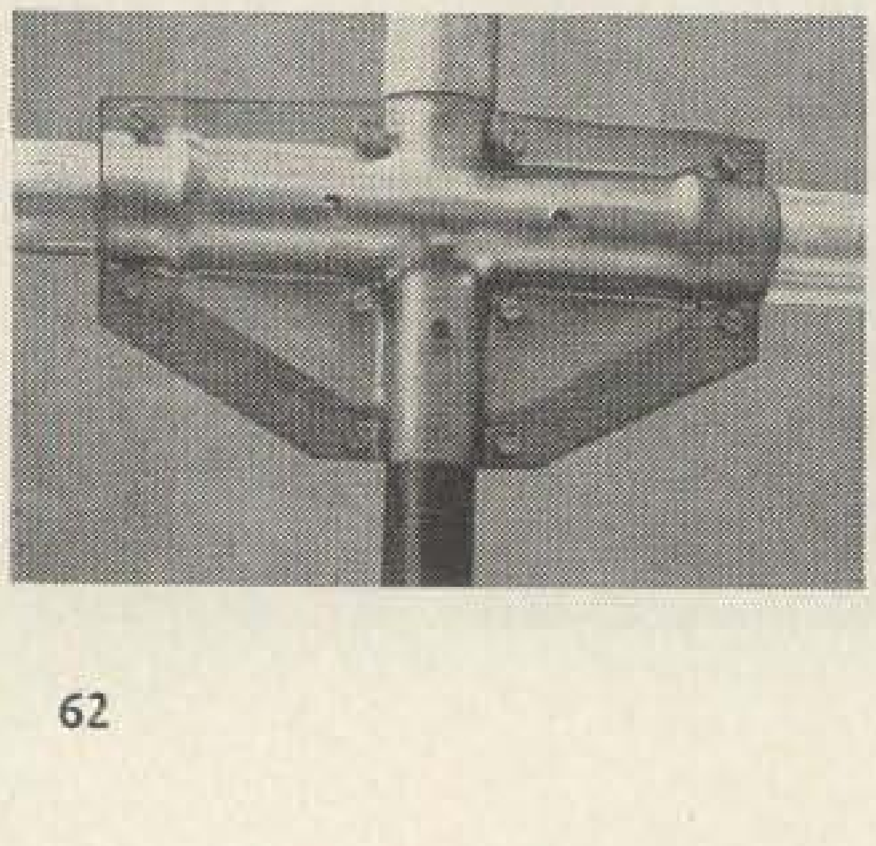
3 NEW, IMPROVED 2-ELEMENT THUNDERBIRD MODEL TH2Mk2

Compact...installs almost anywhere... delivers excellent performance. Features new Hy-Q Traps. Feeds with 52 ohm coax—Beta Matched for maximum gain. Rugged lightweight construction compatible to rotating with standard TV rotator. Boom length, 6 ft. Longest element, 26 ft. Weight, 21 lbs. Model TH2Mk2, **$69.95** Net.

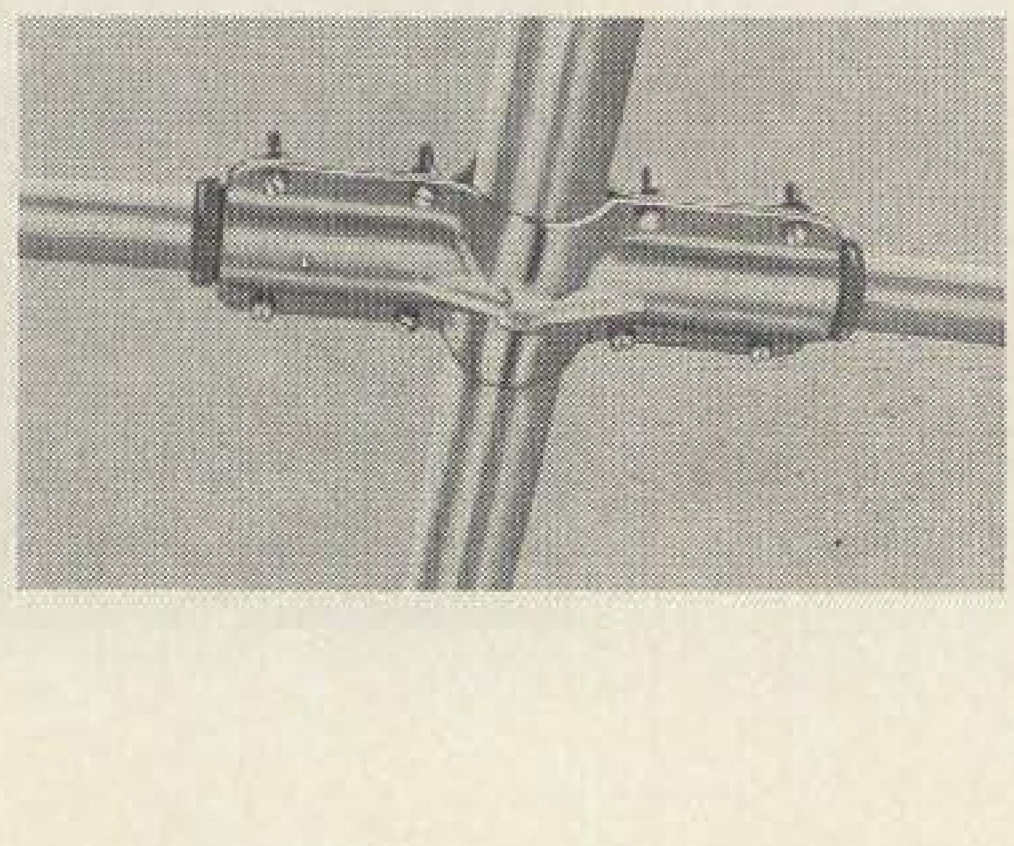
4 IMPROVED 3-ELEMENT THUNDERBIRD JUNIOR MODEL TH3JR

A compact 3-element beam that delivers outstanding performance. Up to 20db of directivity. SWR less than 2:1 at resonance. Hy-Q Traps—Beta Match—seamless heavy gauge aluminum construction. Rotates with standard TV rotator. 12 ft. boom. Longest element, 27'6". Turning radius, 15'11". Model TH3JR, **$69.95** Net.

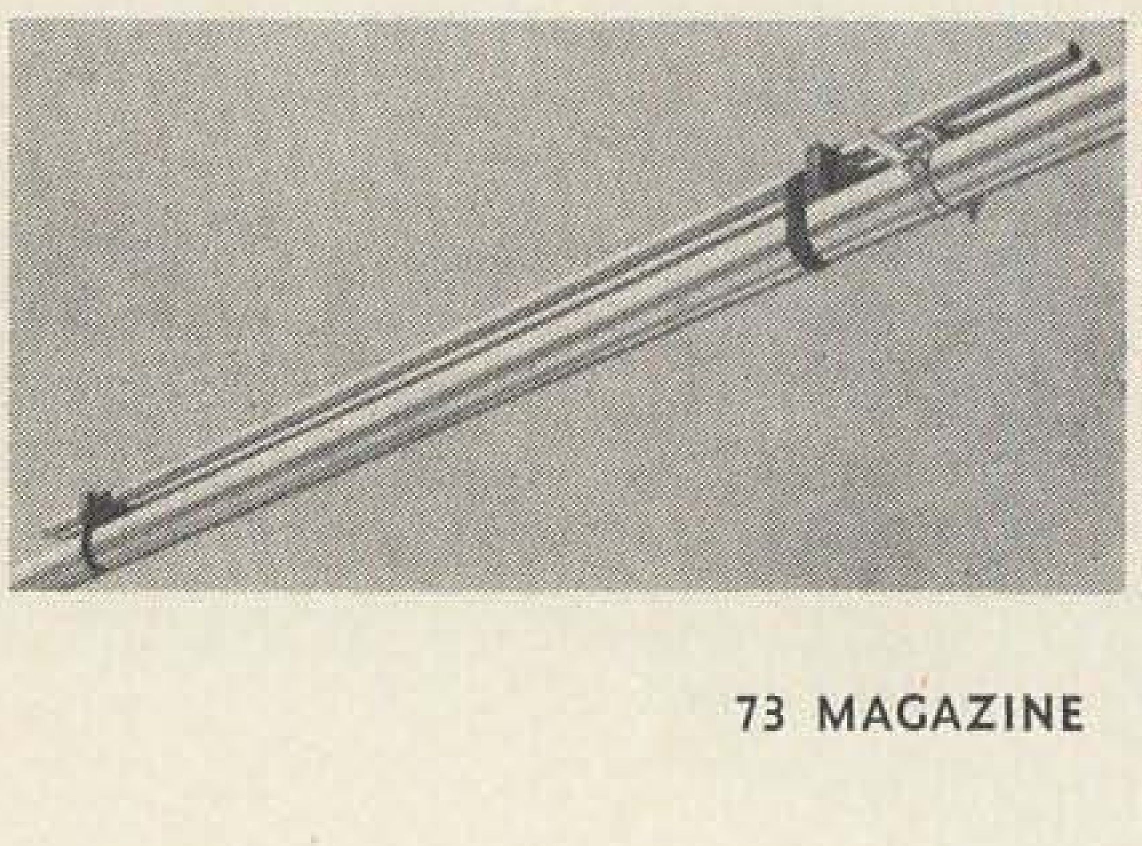
THUNDERBIRD
Boom to Mast Bracket



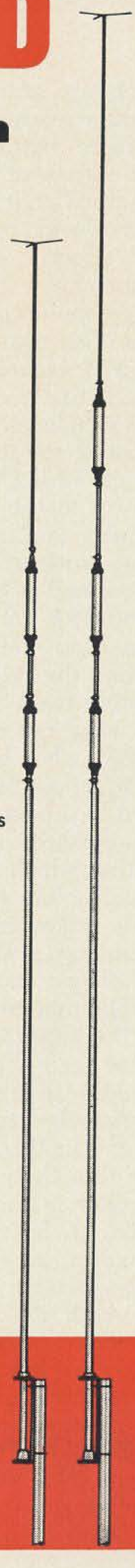
THUNDERBIRD
Driven Element to Boom Bracket



THUNDERBIRD
Beta Match



2 NEW MULTI-BAND TRAP VERTICALS from hy-gain



■ New Hy-Q Traps ■ New 12″ Double-Grip Mast Bracket
■ Taper Swaged Seamless Aluminum Construction

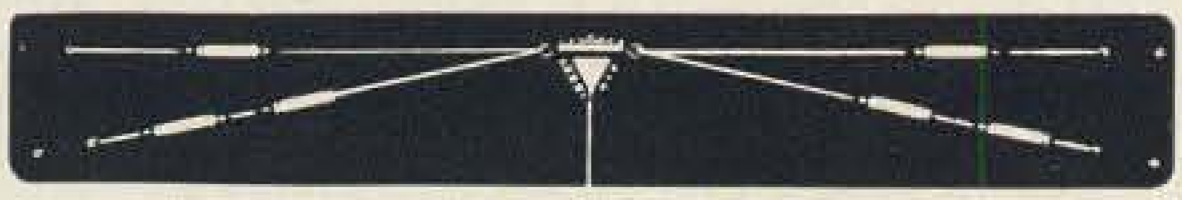
1 **HY-GAIN'S MODEL 14AVS,** the world's most popular Ham antenna, has a new, improved successor...the Model 14AVQ. Three separate new Hy-Q Traps...completely factory pre-tuned...provide peaked performance on 10 through 40 meters. Outstanding low angle radiation pattern for DX. New 12″ double-grip mast bracket insures maximum rigidity whether roof-top or ground mounted. New total performance construction... heavy gauge taper swaged seamless aluminum radiator—full circumference compression clamps at tubing joints non-conducive to corrosion or wear. Unsurpassed for portability ...outstanding for permanent installations. Overall height, 18 ft. Weight, 10 lbs. Adapts to 80 meter operation using Hy-Gain's Model LC80 loading coil. Model 14AVQ, **$29.95** Net.

Loading Coil for 80 Meter operation—Model LC80............................**$ 7.95** Net
Roof Mounting Kit—Model 14RMK..**$11.95** Net
Decoupling Stub adds 6 Meter operation—Model 6MK........................**$ 4.95** Net

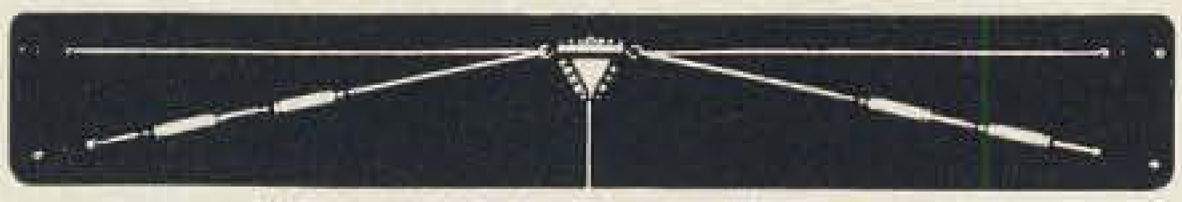
2 **For 10, 15 and 20 Meters...Hy-Gain's New Model 12AVQ.** Companion to the new Model 14AVQ, the Model 12AVQ, for 10-20 meters, incorporates new Hy-Q Traps—a new 12″ double-grip mast bracket—taper swaged seamless aluminum construction. It delivers outstanding low angle radiation. SWR is 2:1 or less on all bands. Overall height is 13′6″. Weight, 9 lbs. Model 12AVQ, **$21.95** Net.

Roof Mounting Kit—Model 12RMK..**$11.95** Net
Decoupling Stub adds 6 Meter operation—Model 6MK........................**$ 4.95** Net

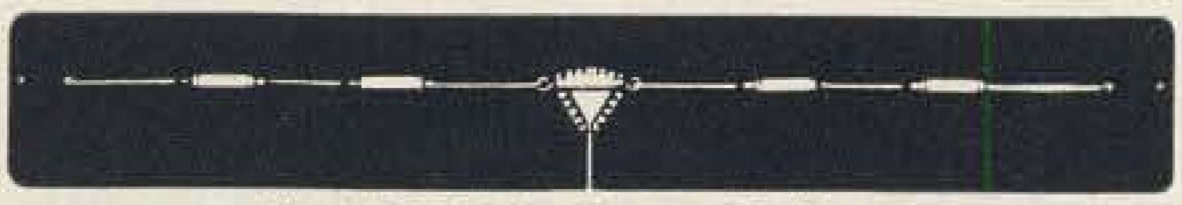
5 NEW HY-GAIN DOUBLETS...TAKE MAXIMUM LEGAL POWER



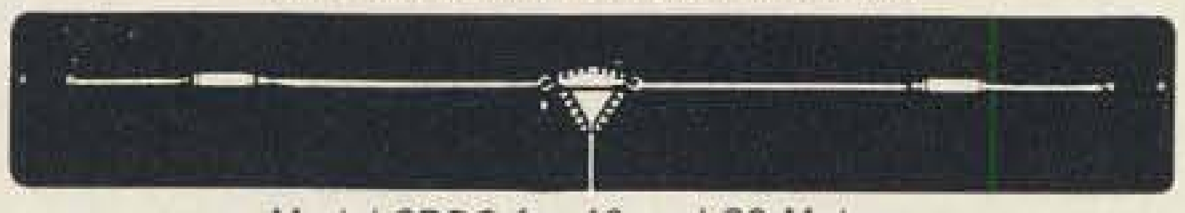
Model 5BDQ for 10 thru 80 Meters



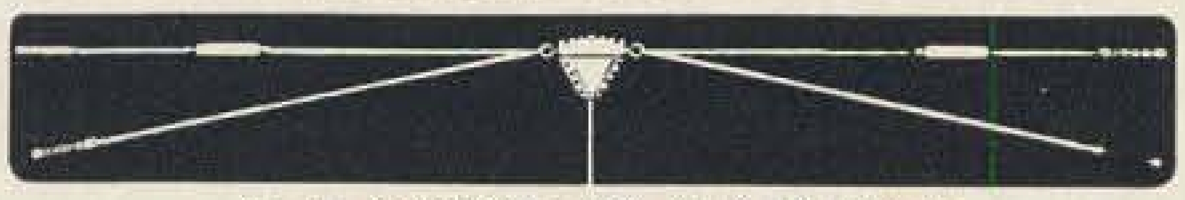
Model 4DBQ for 10 thru 40 Meters



Model 3BDQ for 10 thru 20 Meters



Model 2BDQ for 40 and 80 Meters



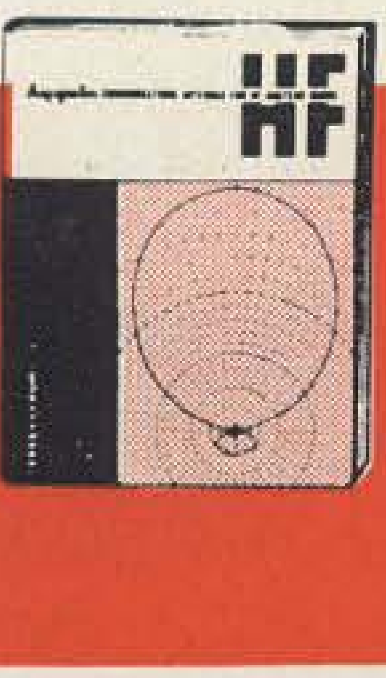
Model 248BDQ for 20, 40 & 80 Meters

- **New Hy-Q Traps**
- **Super-Strength Aluminum Clad Steel Wire**
- **Install Horizontally or as Inverted V**
- **Weatherproof Center and End Insulators**

Installed horizontally or as an Inverted V, new Hy-Gain Doublets with Hy-Q Traps deliver true half wavelength performance on all bands. Completely factory pre-tuned ...SWR less than 1.5:1 on every band. Super-strength aluminum clad single strand steel wire defies deterioration from salt water and smoke ...will not stretch...withstands hurricane-like winds. Easily installed with famous Hy-Gain molded high impact cycolac plastic center and end insulators.

Model 5BDQ 10 thru 80 M... **$34.95** Net
Model 3BDQ 10 thru 20 M... **$17.50** Net
Model 4BDQ 10 thru 40 M........................**$24.50** Net
Model 2BDQ 40 and 80 M... **$19.95** Net
Model 248BDQ 20, 40 & 80 M..........................**$22.50** Net
Model 2TQ Matched Trap Kit for building 40 & 80 Meter Doublet..........**$12.95** Net
Model 2BDP Trapless Fan Doublet for 15, 40 & 80 Meters....................**$19.95** Net

AVAILABLE NOW FROM YOUR HY-GAIN DISTRIBUTOR



NEW Hy-Gain Full Line H.F. Antenna Catalog—Beams, Verticals, Doublets, Mobile Toppers, Base Station and Mobile Accessories. 16 pages picturing and completely describing the finest antenna line available. It's FREE: Write for your copy today...

HY-GAIN ELECTRONICS CORPORATION
8470 N.E. Highway 6 - Lincoln, Nebraska

Testing the Venus di Clegg

Back last spring, when we were getting 73 Mountain ready for the big June VHF scramble, there was considerable discussion over which rigs were best for which bands. Everyone agreed that, if we could get it, a Clegg Venus would be the last word for our six meter effort.

Somehow I managed to talk Clegg into sending one up on loan. When it arrived everyone was so anxious about it that they had it unpacked before the carton ever got off the delivery truck.

What a beauty!

I could see that nothing further would get done on 73 if I left it around here, so I drove it on up to the mountain, plugged in the ac, the mike, and an antenna and started talking to the growing mob of sidebanders down at the low end of six. I found I was getting out so well with the Venus that it was hard to tell if the band was open or not.

While the AM boys were fighting RM and changing band conditions I found that I could have long rag chews with sideband stations. VP7CX, who, by the way, has a Venus and is wild about it, called me one day and we talked for about a nhour. He has been carrying on daily skeds with Panama and crazy things like that which no one would even have considered before the advent of sideband on six.

One fellow called in and said he had been considering a Venus, but that the transceive type of operation worried him. He wanted to be able to tune his receiver separately from his trasnmitter. I pointed out how simple it was to feed the 14 mc output of the Venus' converter to his regular station receiver and use that for tuning off the transmitter frequency. In this way you get all the extraordinary sensitivity of the grounded grid nuvistor converter in the Venus as well as its stability (it *has* to be stable to be good for SSB).

Tuning the Venus is a dream. Those Eddystone dials may be expensive, but they sure are worth it.

Since a lot of the six metter gang still are using receivers without bfo's, it is handy to be able to switch to the AM position at times. The receiver has both AM and SSB detectors, switchable AVC and a very effective noise limiter. The Venus was able to give perfect copy of signals under QRM conditions that just about stopped every other receiver we had available. Between a two meter kilowatt in the next room and a six meter kilowatt on a nearby mountain top, the pressure was really on.

Grid block keying is used on CW, though we only were able to make a few contacts on this mode. There sure isn't much CW activity in that bottom 100 kc, even when the band is open. If it ever developes, the Venus will be ready for it.

The Venus kicks up to 85 watts PEP (all modes), which is plenty for most operation. If you want to always be first there is a nice linear available from Clegg, the Apollo, which plugs right into the Venus and boosts you to 700 watts.

The Venus normally tunes from 49.975 to 50.475, though it takes just a quick crystal replacement to change this range to any other 500 kc you want to tune. Since the great bulk of six meter activity is in the lower 500 kc this will hardly ever cause much of a problem . . . and if you stick to sideband, which is almost completely between 50.1 and 50.2, you'll never know there is part of the band you're not using.

The stability of the Venus is attributable to the carefully built 5.0 to 5.5 mc oscillator. This is mixed with the 14 mc output of the converter to give a 9 mc signal which is fed through the 9 mc crystal filter and results in 3 kc selectivity. The final *if* is 450 kc. The transmitter heterodynes the 14 mc signal up to 50 mc with a 6883 (twelve volt 6146) in the final. The unwanted sideband is down over 50 db at 1000 cycles and the carrier is suppressed more than 56 db. Distortion products are down over 30 db at full output. Since all circuits except the final are broadbanded the tuneup process is simple. Even the final doesn't have to be touched for small frequency changes (say 100 kc or so).

During the two months that I used the Venus I worked 43 states, VE1-2-3-4, VP7, and CO2. What a world of difference there was using this rig as compared to a small AM job! . . . Staff

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Comm IV 220 MC	409.95	249.00
HALLICRAFTERS		
HT-40K Trans. Kit	89.95	69.00
HT-41 K.W. Linear	395.00	295.00
SR-160 Transceiver (Demo)	349.50	299.00
JOHNSON		
VIK Valiant II	495.00	379.00
Navigator	199.50	149.00
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VIK Invader "200"	619.50	399.00
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NC-105 Receiver	129.95	99.00
NC-140 Receiver	189.95	149.00
NC-155 Receiver	199.95	159.00
SBE		
SB-33 with SB2 P.S.	469.45	379.00

NOTE

Space does not permit complete listing of all models available in Year-End Clearance. For models not listed, write for quotation.

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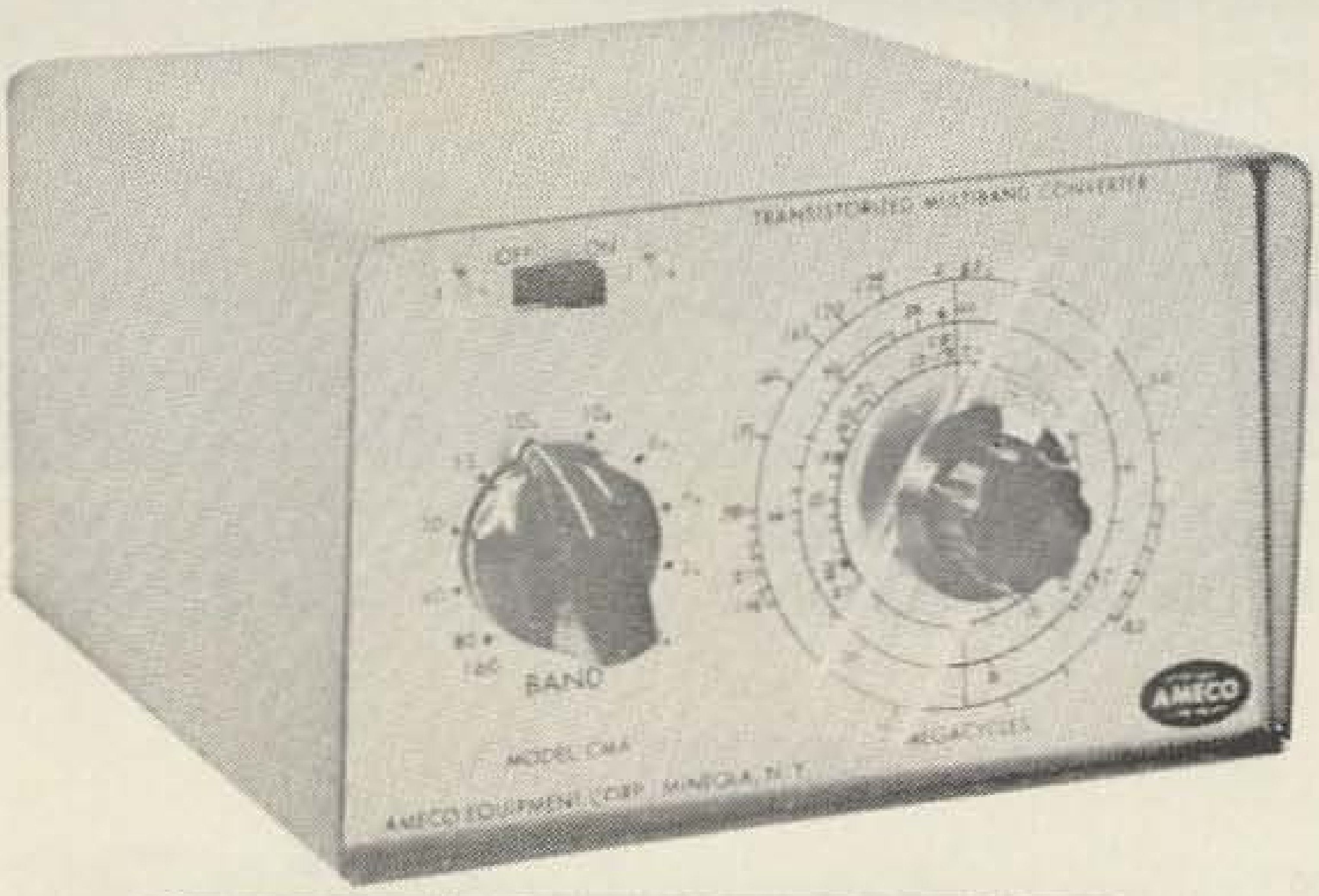
ALL BANDS . . 2 THRU 160 METERS IN ONE CONVERTER

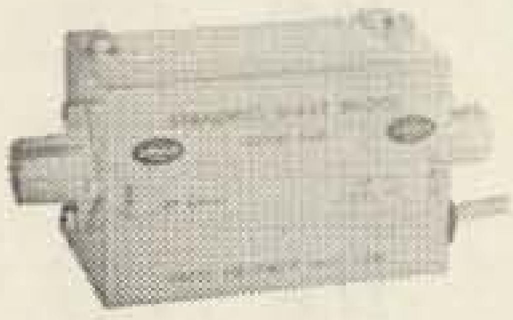


- TRANSISTORIZED
- CRYSTAL CONTROLLED

Model CMA

Model CMA is a crystal controlled, transistor, all band converter that covers all bands from 160 through 2 meters (1.7 Mc. to 54 Mc. and 108 Mc. to 174 Mc.). The output of Model CMA can be fed to a standard broadcast set or to any communications receiver up to 30 Mc. It can be used for mobile or fixed operation. The CMA has better than 1 microvolt sensitivity. It can be operated from an internal battery or from the 12 volt car battery with the Ameco BS-9 adapter. It has a tuned RF stage, tuned by the dial on the panel, to obtain best image and spurious rejection. Up to ten crystals can be selected by the band switch on the panel. Model CMA is also available for special shortwave broadcast, police, fire, aviation and commercial frequencies between 1.7 Mc. and 54 Mc. and between 108 Mc. and 174 Mc. Size: 3¾" by 6" by 6¾". For more detailed information on the CMA and other Ameco converters, write for the special "Information Sheet on Ameco Converters."

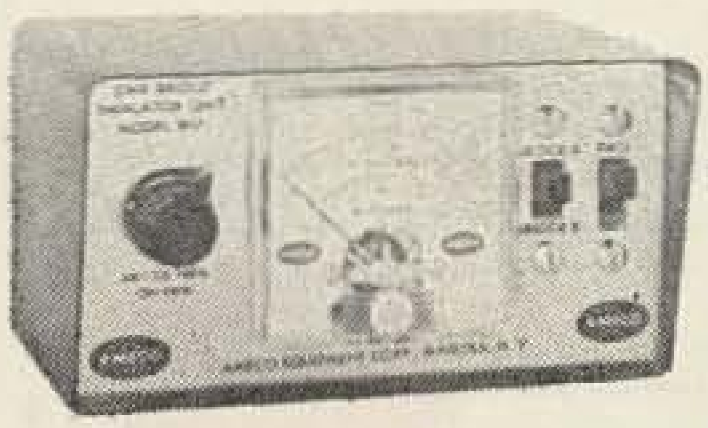
Model CMA, wired and tested, less crystals $64.95
Crystals, each $ 3.50



STANDING WAVE BRIDGE MODEL SWB

Model SWB is a high quality bridge that will accurately read SWR's from 1.8 Mc. to 225 Mc. (including Ham, CB and Commercial bands). It can handle up to one thousand watts. Model SWB uses the superior type of inductive coupling and can therefore be left in the line continuously without insertion loss. It contains two SO-239 VHF connectors and is attractively packaged in a satin copper case. Size 1⅝" x 2¼" x 4½".

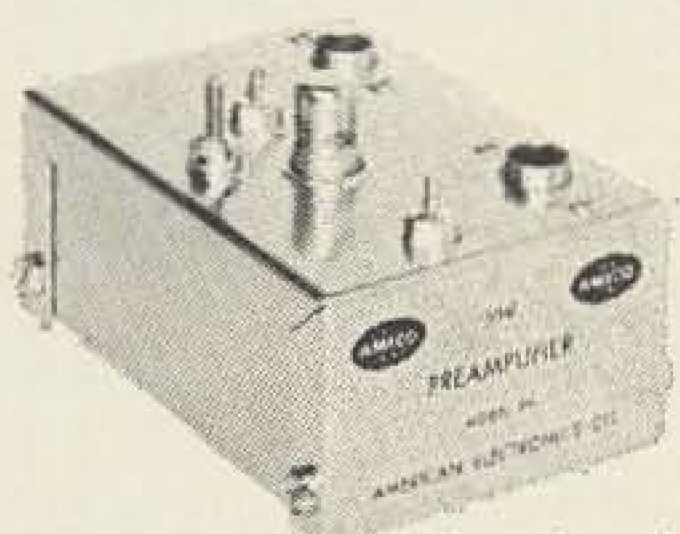
Model SWB — Wired and tested $9.95



BRIDGE INDICATOR UNIT MODEL BIU

Model BIU, when used with the Ameco SWB or other make of bridge, will accurately read SWR, percentage power and percentage voltage (3 scales). It contains a sensitive 100 microampere 2⅛" square American made D'Arsonval meter. A feature not found on any other make of indicator is a switching circuit that provides for reading either one of 2 bridges. Attractively packaged in a charcoal grey cabinet with a satin copper panel. Size 2¾" x 5" x 3".

Model BIU — Wired and tested $15.95



NUVISTOR PREAMPLIFIERS SINGLE BAND FOR 27 (CB), 28, 50, 144 OR 220 MC. OVER 20 DB Gain

The Nuvistor Preamplifiers will improve your gain and noise figure considerably when used ahead of your present converter, receiver, or transceiver. 2 tuned circuits and a 6DS4 Nuvistor are used. The noise figure is 2.0 db at 27 Mc., 2.5 db at 50 Mc., 3.0 db. at 144 Mc. and 4.0 db. at 220 Mc. Power requirements are 100-150 V. at 8 ma. and 6.3 V. at .135 A. Specify frequency desired.

Model PV—Wired and tested $13.95

COMPACT 6 THRU 80 METER TRANSMITTER

Model TX-86

Handles 90 watts phone and CW on 6 thru 80 meters. Final 6146 operates straight thru on all bands. Size — only 5" x 7" 7 7" — ideal mobile or fixed. Can take crystal or VFO. **Model TX-86 Kit $89.95 — Wired Model TX-86W $119.95. Model PS-3 Wired $44.95. Model W612A Mobile Supply wired $54.95.**

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The NEW AMECO TX-62

In response to the demand for an inexpensive compact VHF transmitter, Ameco has brought out its new 2 and 6 meter transmitter. It is easy to tune because all circuits up to the final are broadbanded. There is no other transmitter like it on the market!

SPECIFICATIONS AND FEATURES

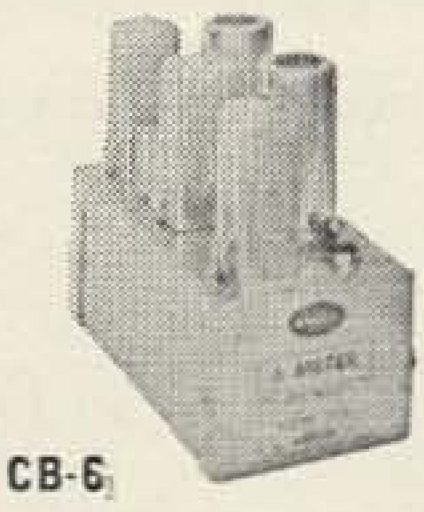
Power input to final: 75W. CW, 75W. peak on phone.
Tube lineup: 6GK6—osc., tripler, 6GK6 doubler, 7868 tripler (on 2 meters) 7984-Final. 12AX7 and 6GK6 modulator.
Crystal-controlled or external VFO. Crystals used are inexpensive 8 Mc type.
Meter reads final cathode current, final grid current and RF output.
Solid state power supply.
Mike/key jack and crystal socket on front panel. Push-to-talk mike jack.
Potentiometer type drive control. Audio gain control.
Additional connections in rear for key and relay.

Model TX-62 Wired and Tested only $149.95

NUVISTOR CONVERTERS FOR 50, 144 AND 220 MC. HIGH GAIN, LOW NOISE

Model CN

Has 3 Nuvistors (2 RF stages & mixer) and 6J6 osc. Available in any IF output and do NOT become obsolete as their IF is easily changed to match any receiver. Average gain — 45 db. Noise figure — 2.5 db. at 50 Mc., 3.0 db. at 144 Mc., 4.0 db. at 220 Mc. Power required 100-150V. at 30 ma., 6.3V. at .84A. See PS-1 Power Supply. Model CN-50W, CN-144W or CN-220W wired. (specify IF.) **$49.95.** Model CN-50K, CN-144K or CN-220K in kit form. (specify IF.) **$34.95**



CB-6

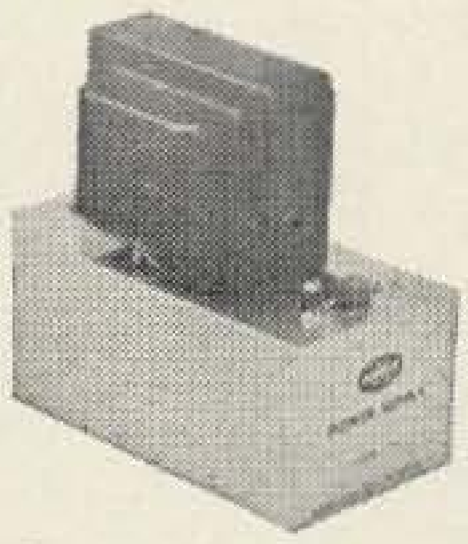
CB-6K — 6 meter kit, 6ES8-rf Amp., 6U8-mix./osc. $19.95
CB 6W — wired & tested $27.50
CB-2K — 2 meter kit, 6ES8 1st rf amp., 6U8 — 2nd rf amp/mix. 6J6 osc. $23.95
CB-2W — wired and tested. $33.95
Model PS-1 — Matching Power Supply — plugs directly into CB-6, CE-2 and CN units. **PS-1K — Kit ... $10 50**
PS-1W — Wired $11.50

ALL BAND NUVISTOR PREAMP 6 THRU 160 METERS

MODEL PCL, Wired, $24.95
MODEL PCLP with built-in power-supply, wired, $32.95

2 Nuvistors in cascode give noise figures of 1.5 to 3.4 db. depending on band. Weak signal performance, image and spurious rejection on all receivers are greatly improved. PCL's overall gain in excess of 20 db. Panel contains bandswitch, tuning capacitor and 3 position switch which puts unit into "OFF," "Standby" or "ON," and transfers antenna directly to receiver or through Preamp. Power required—120 V. at 7 ma. and 6.3 V. at .27 A. —can be taken from receiver or Ameco PS-1 supply. Size: 3″x5″x3″.

AMECO POWER SUPPLY MODEL PS-1



Model PS-1 will supply more than enough power for any of the above converters. It is housed in an attractive two-piece satin copper chassis that mates with any of the converter chassis without a cable. It can deliver 50 ma. at 125 V. DC and 2 A. at 6.3 V. AC. from 115 V. AC. input and can supply power to many other ham accessories.

PS-1K—in kit form $10.50
PS-1W—wired and tested 11.50

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Barrie Hiern K5SGP
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SSB with the 6N2

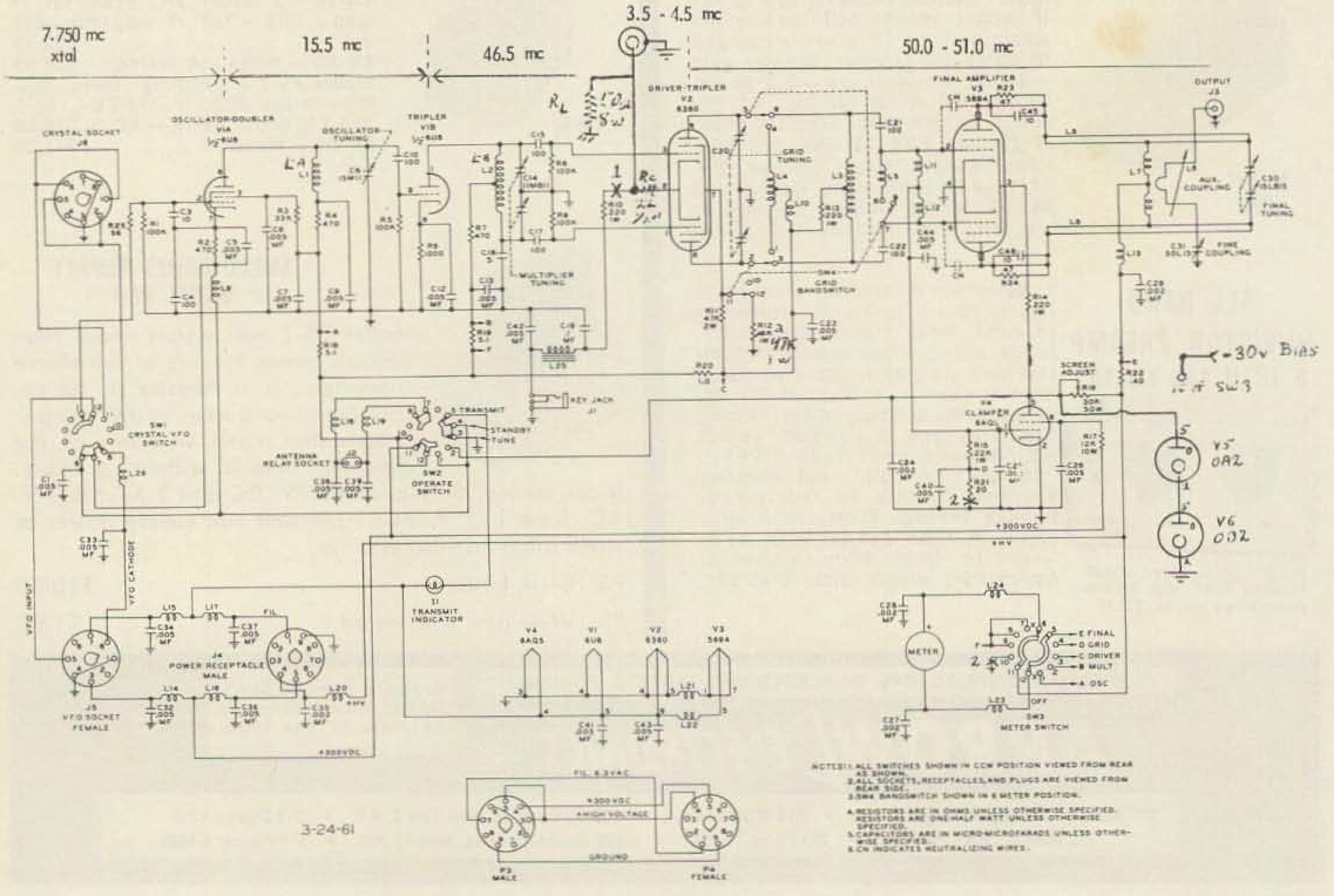
Changing the Johnson Viking 6N2 Transmitter into a heterodyne unit for 6 meters is a very simple modification which can be made for a cost of about ten dollars. The only tools needed are a drill, a ⅝" chassis punch, solder gun, a nibbling tool or file, and a minimum of patience.

The parts necessary for the conversion are as follows:

1. 7750 kc crystal in an FT-243 holder.
2. 1 coax panel mount.
3. V-5, an OA2 voltage regulation tube, socket, and shield.
4. V-6, an OB2 voltage regulator tube, socket, and shield.
5. L-a, 21¼ turns, B & W Miniductor # 3012.
6. L-b, 10 turns, B & W Miniductor # 3010.
7. R-16a, see text.
8. R_L, four 200 ohm, 2 watt carbon resistors in parallel.
9. R-12a, 47K, 1 watt resistor.
10. Rc, 22 ohm, ½ watt resistor.

Now let's proceed with the modification. (After making the modification the unit may be changed to operate as originally with a minimum of time and effort, since the modification involves no major changes).

First, remove all tubes before drilling. Install a coax panel mount in the rear of the chassis between the power plug and the adjacent terminal strip. Disconnect R-10 at pin 2 of V-2 only, and simply bend the resistor away from the tube socket. Connect one end of Rc, a 22 ohm, ½ watt resistor to pin 2 of V-2, the cathode of the 6360. Then connect the center conductor of a length of RG-58/U to the free end of Rc. Connect the other end of the RG-58/U to the coax panel mount. Ground both ends of the braid of the RG-58/U. Next, make R_L by connecting four 200 ohm, 2



watt carbon resistors in parallel; making the connection on each end of the resistors close to the resistor bodies. Cut off excess wire from each end, leaving one lead at each end to make the connections. Now connect and solder one end of R_L to the junction of Rc and the RG-58/U. Solder the other end of R_L to the ground lug next to the V-2 socket.

The next step is to replace L-1 with L-a, so that it will tune 15.5 mc, instead of the original 16-18 mc. Then replace L-2 with L-b, so that it will tune 46.5 mc, instead of the original 48-54 mc. R-7, formerly attached to the midpoint of L-2, is now attached to the midpoint of L-b.

Next, make a hole in the chassis on each side of the Fine Coupling control shaft immediately behind the front panel for each of the two VR tube sockets. Install the sockets so that the VR tubes will be above the chassis. Bring a piece of hook-up wire up through the grommet with the wiring harness for connection to the terminal on R-16a, the screen adjust resistor which has an orange wire already attached. The value of R-16a is discussed under Adjustments. Leave the orange wire attached. Solder the other end of the hook-up wire to pin 5 of V-5, one of the two sockets which was just installed closest to the 6N2 meter. Connect pin 2 of V-5 to pin 5 of V-6, the other socket which was added for the VR tubes. Ground pin 2 of V-6.

Referring to Fig. 2 in the 6N2 Operating Manual, the bottom view of the 6N2, locate R-12 on the left hand side of the figure. Replace R-12 with R-12a, the 47K ohm, 1 watt resistor.

We need a − 30 volts of bias from an external source for the grids of the 5894, V-3. Since the antenna relay and accessory relays may be controlled by the exciter, the antenna relay socket J-2, on the 6N2, may be used for the bias line after disconnecting from it the wires which go to SW-2. Connect a wire from J-2 to the position 10 of SW-3, after having disconnected position 10 of SW-3 from ground. Simply disconnecting position 10 of SW-3 makes both disconnections depicted on the schematic vy "2 X." Since R-21, the shunt resistor, is mounted on the meter switch it is taken care of in the above step. This step applies bias to the grids of the 5894 and also takes care of the metering circuit.

With the exception of R-16a, the modification is now complete.

Adjustments

I am using the Heathkit model HP-20 power supply which provides 600 volts to the plates of the 5894. At this voltage the screens of the 5894 are regulated at 258 volts. R-16a with this supply is a 12,000 ohm, 50 watt resistor. For other values of high voltage, the value of the screen-dropping resistor must be calculated. The VR tubes draw 5 ma and the screen current varies from 0 to 25 ma; a total current through the screen-dropping resistor. In calculating the value of the screen-dropping resistor, do not forget that when the 6N2 is in Tune or Standby positions, the screen-dropping resistor R-16a, is shorted to ground, so do not exceed the power rating of the resistor under this condition.

Install V-3, and the VR tubes, V-5 and 6. Adjust the bias so that V-3 resting plate current is 35 to 40 ma. This will be from − 26 to − 30 volts of vias. Then install the 7750 kc crystal and the 6U8 and the 6360. The clamp tube is left out of the unit in this mode of operation.

In order to adjust the bias from the Heath HP-20, install a 50K, 2 watt wire-wound potentiometer in place of R-6 in the HP-20. The middle terminal of the pot. is connected to pin 1 of the HP-20 power socket.

Operation

If the exciter has more than 12 watts rms output, a pad must be used between the exciter and the 6N2 to limit the input to the 6N2 to 12 watts rms.

Tune the oscillator and the multiplier of the 6N2 in the usual manner. Tune the exciter on the 80 meter band, 3.5 mc corresponding to 50.0 mc, and 4.0 mc heterodyning to 50.5 mc. Then apply exciter power to the 6N2 and tune the final grid and the final plate of the 6N2 with the exciter in the CW position. Then switch to SSB on the exciter and join the fun on 6 meter SSB.

The reason for using a 7750 kc crystal and 80 meter input is that the crystal multiplies to 46.5 mc, far enough away from 50 mc so that the tuning circuit of the 5894 will reject it. With a 6 mc crystal and 20 meter input, a harmonic occurs at 48 mc which might cause difficulty. It is easier to use the 7750 kc crystal than to use the 6 mc crystal and have to build traps.

Further information on the 5894 may be obtained by writing to Amperex. . . . K5SGP

DOW-KEY

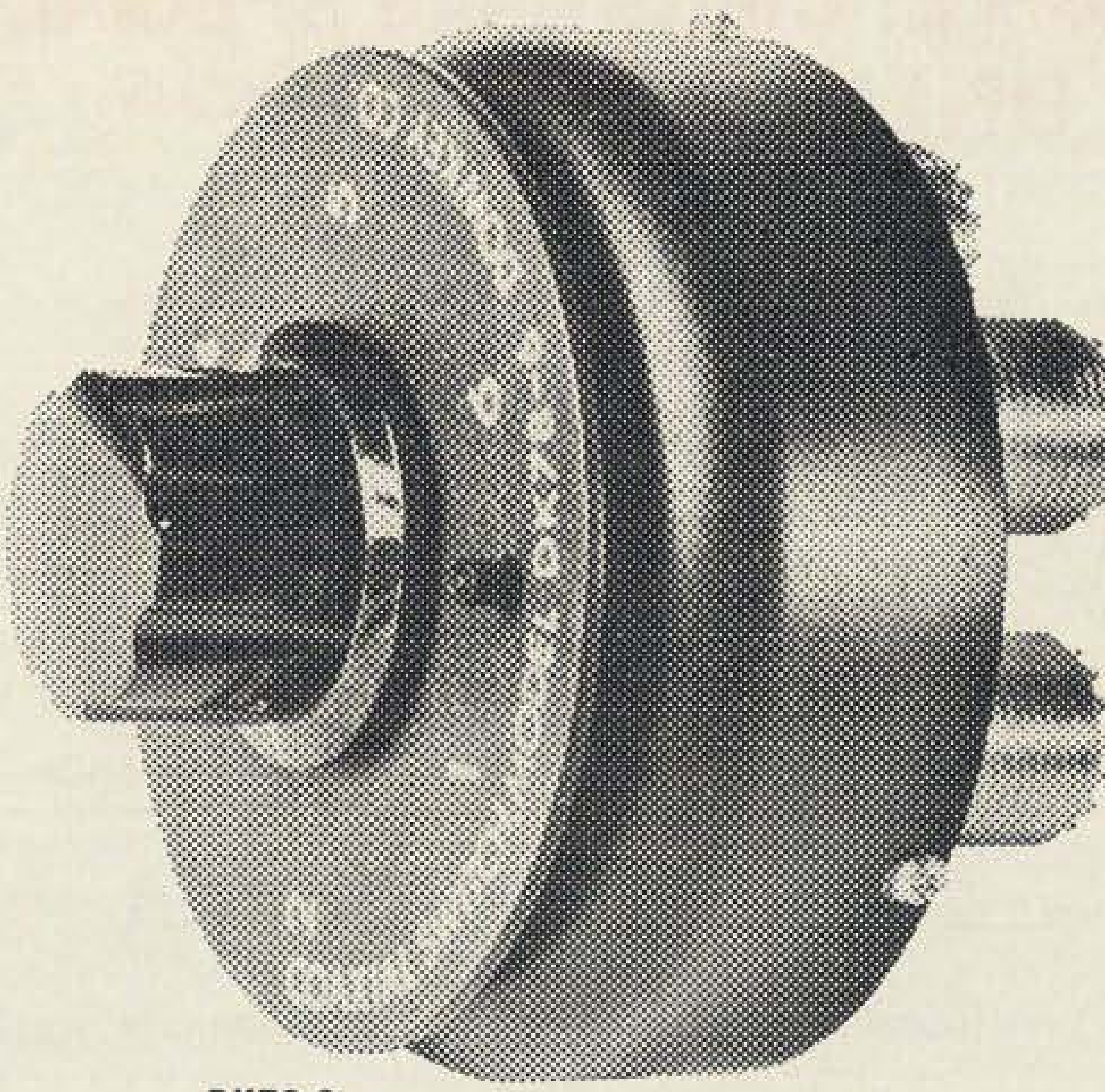
DK78

SERIES

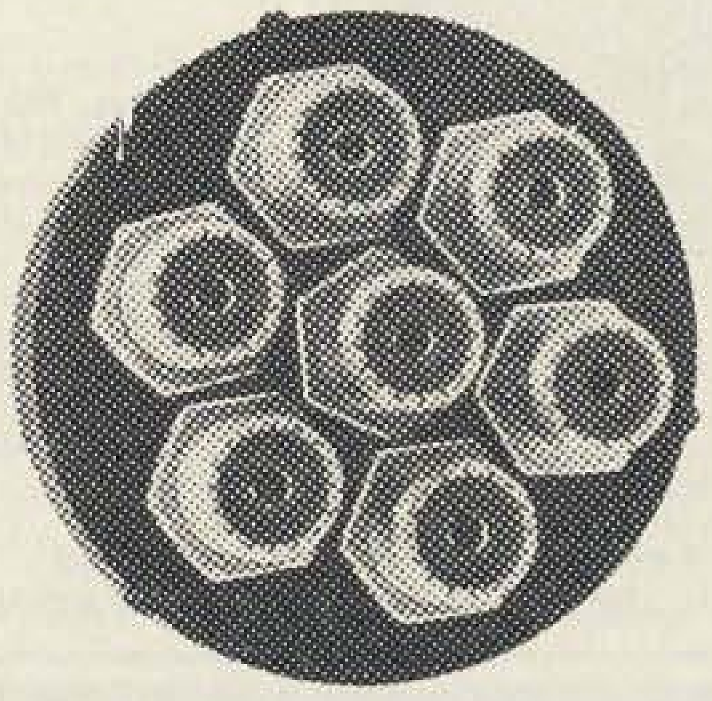
MANUAL

COAXIAL SWITCHES

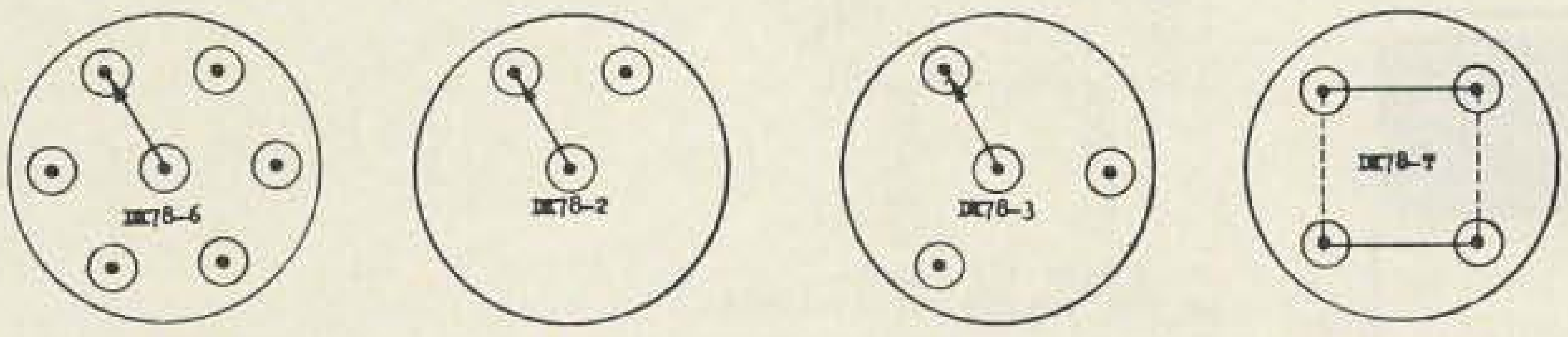
(NOT WAFER SWITCHES)



DK78.6



Dow-Key Company's new manual series of coaxial relays with excellent R.F. characteristics. Available in four configurations—single pole two throw, DK78-2; Single pole three throw, DK78-3; Single pole six throw, DK78-6; and transfer switch, DK78-T.

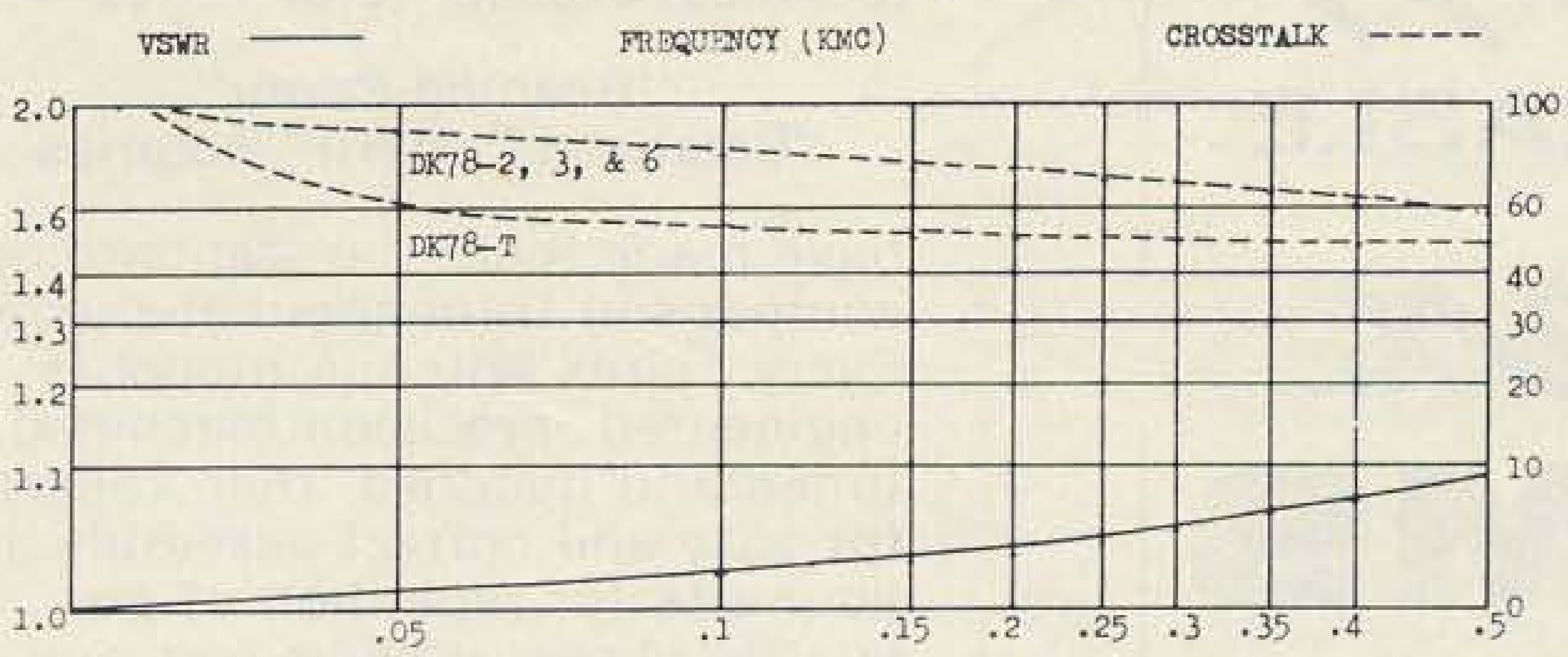


1P6T   1P3T   1P2T   Crossover

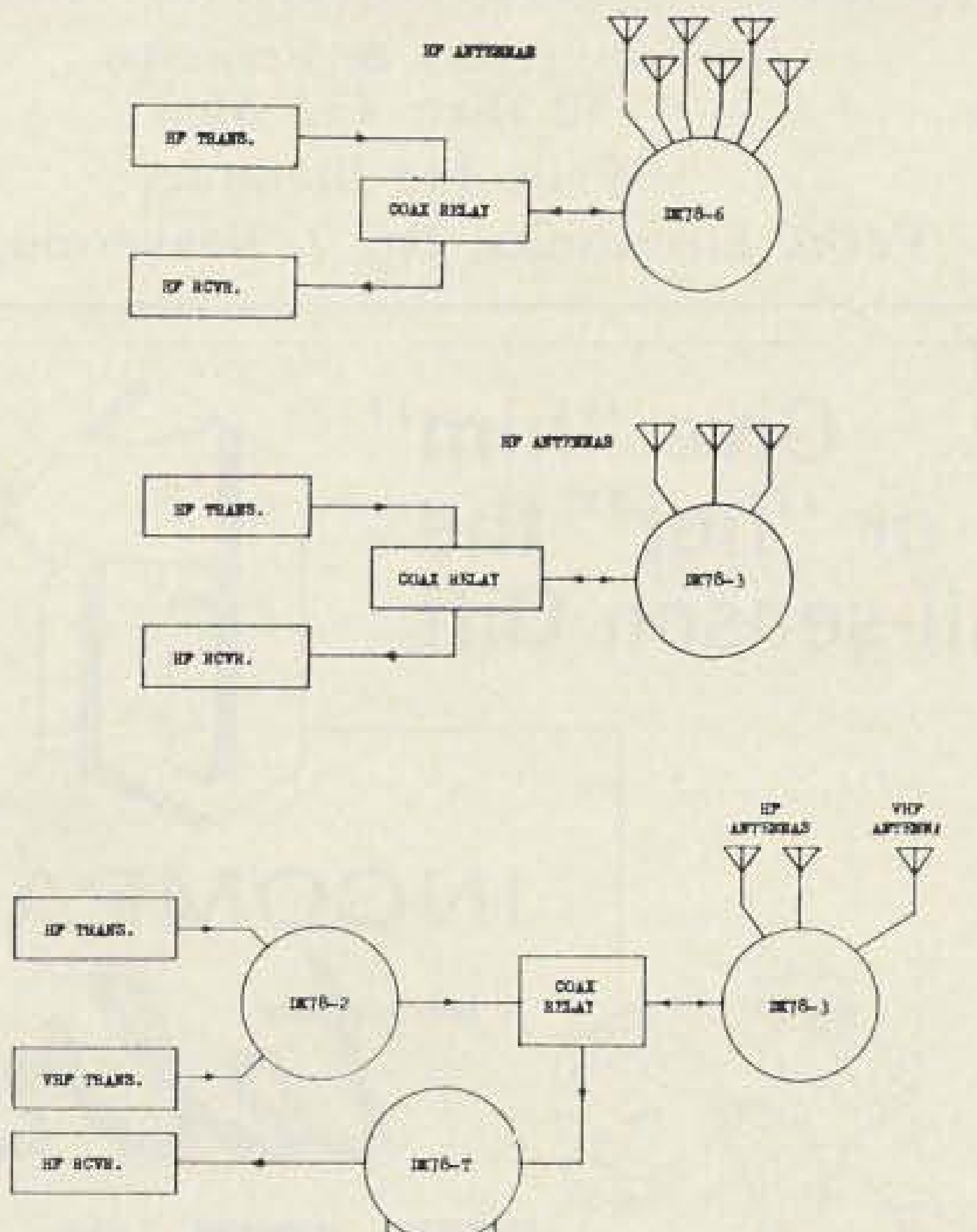
SPECIFICATIONS

r.f. ratings: 1 kw to 500 mc. VSWR less than 1.05:1 at 150 mc (see curves below). Isolation greater than 50db at 500 mc and greater than 80 db at 30 mc (see below). Impedance: 50 ohm. Contacts: Fine silver, others upon request. Connectors: UHF are standard, types N, BNC, TNC and C are also available. Operating Temperature Range: 55 degrees C. to +85 degrees C. Finish: Coaxial connectors silver plated. Body black anodized. Mounting: Requires one 7/16″ dia. hole and one 5/32″ dia. hole. Wt. 10 oz. Size 3″ diameter x 1⅛″ deep.

- Guaranteed for one year. If faulty within one year the switch will be repaired at no charge other than 75c for handling and mailing.



Typical Application



Model	St. UHF Connectors	Type N,BNC,TNC or C.
DK78-2	$12.75	$15.75
DK78-3	$12.75	$15.75
DK78-6	$15.75	$21.75
DK78-T	$15.75	$18.75

- Specify type of connectors, if other than UHF.

- Dow-Key products available at dealers or write:

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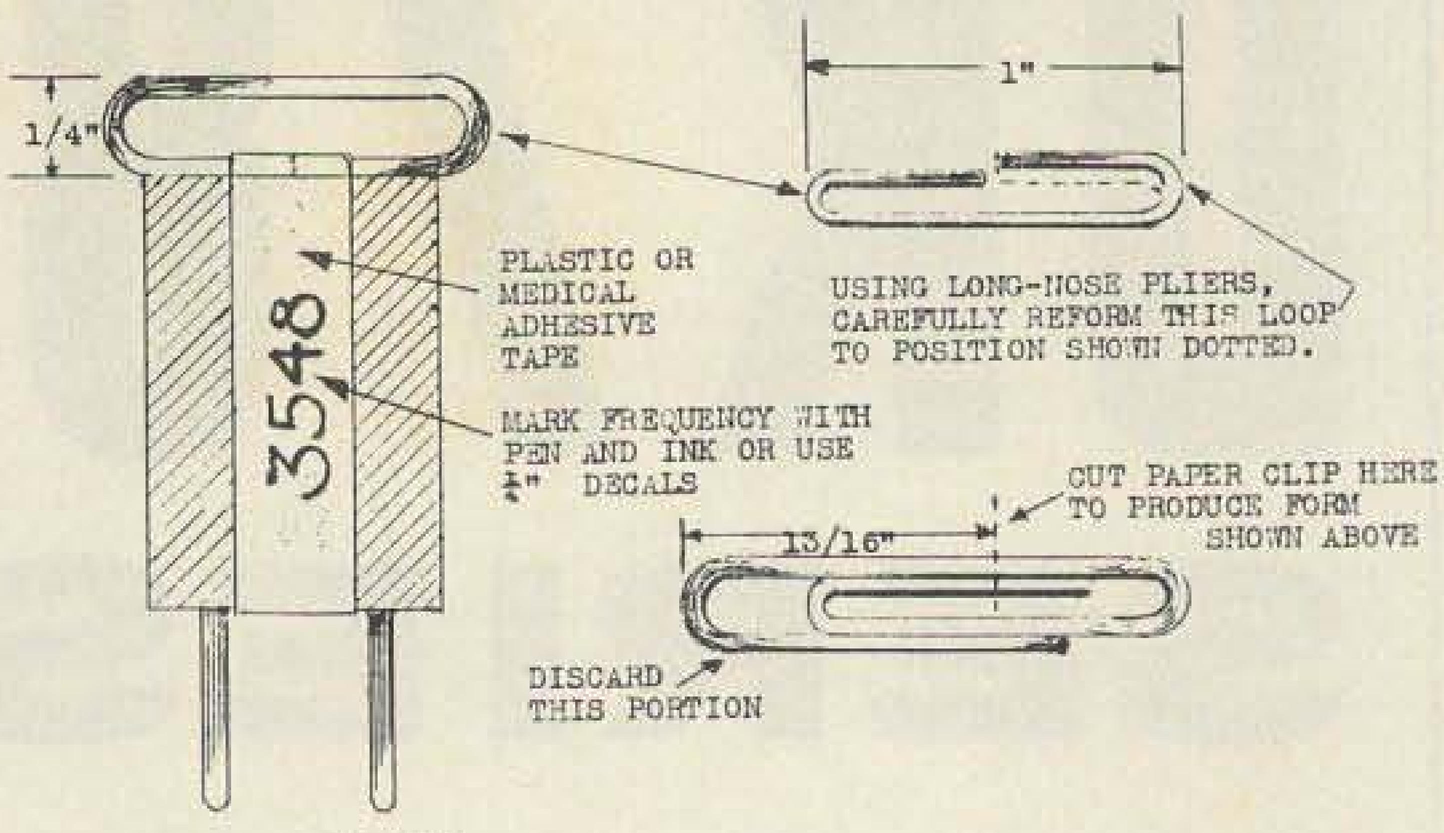
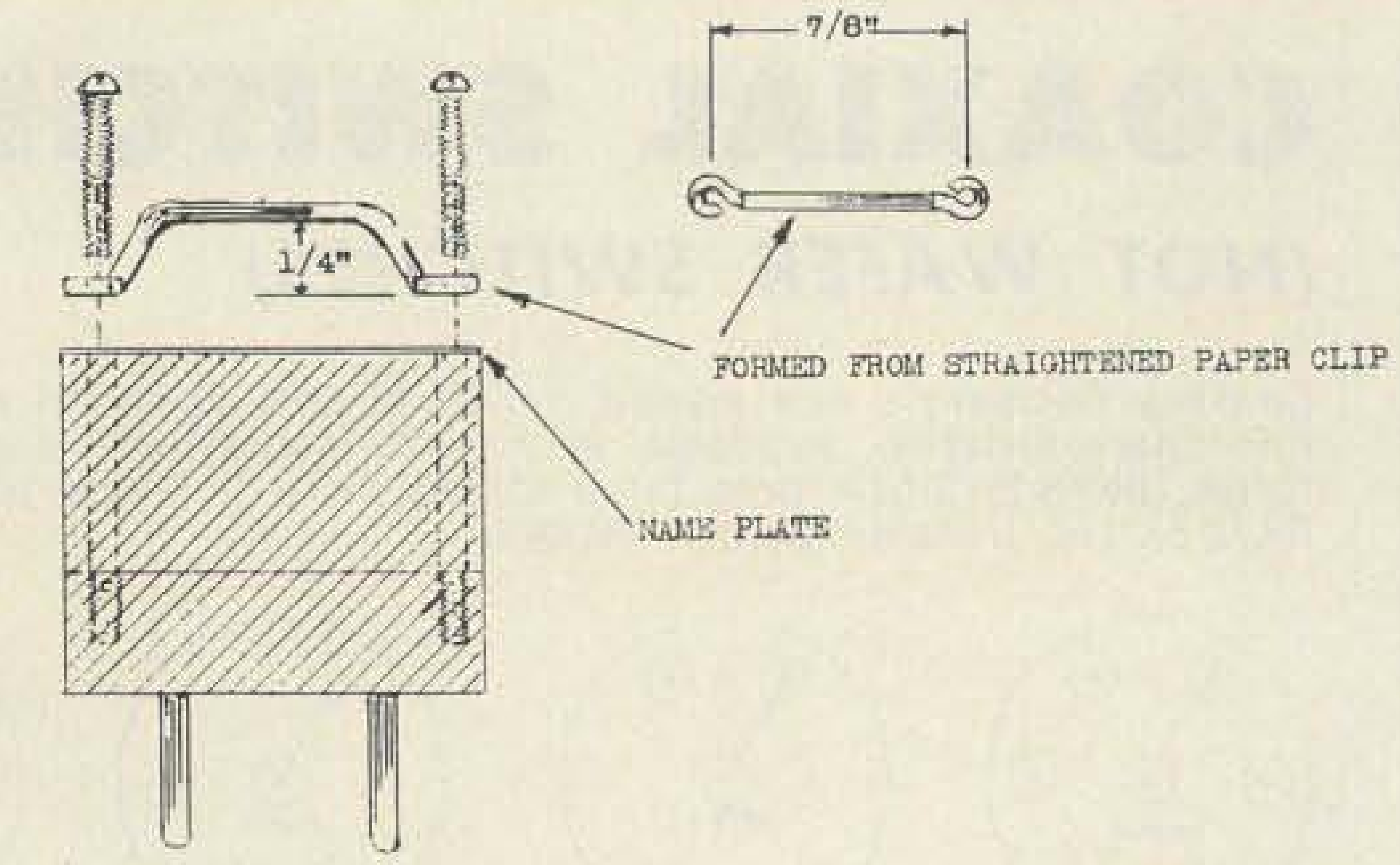
Thief River Falls, Minnesota

Crystal Holder Tips

Tired of breaking finger nails or fishing with tweezers or long-nosed pliers to dig a crystal out of a socket recessed in the panel



PETERSEN TYPE Z-2 CRYSTAL HOLDER (or similar)



BLILEY TYPE AX-2 CRYSTAL HOLDER (or similar)

face in the manner in which some manufacturers persist in equipping their amateur radio transmitters? You can really make it easy

to change crystals in a hurry with nothing more than a paper clip, a few inches of medical adhesive or plastic tape, and a few odd minutes of your time.

The illustrations tell the story. Note that in the Peterson Z-2 holder or those of similar type, the tape will cover the frequency marking on the name plate on the face of the older. Simple; merely letter the frequency on the tape with pen and ink, or, for more professional appearance, use the little decals available at any ham radio supply house.

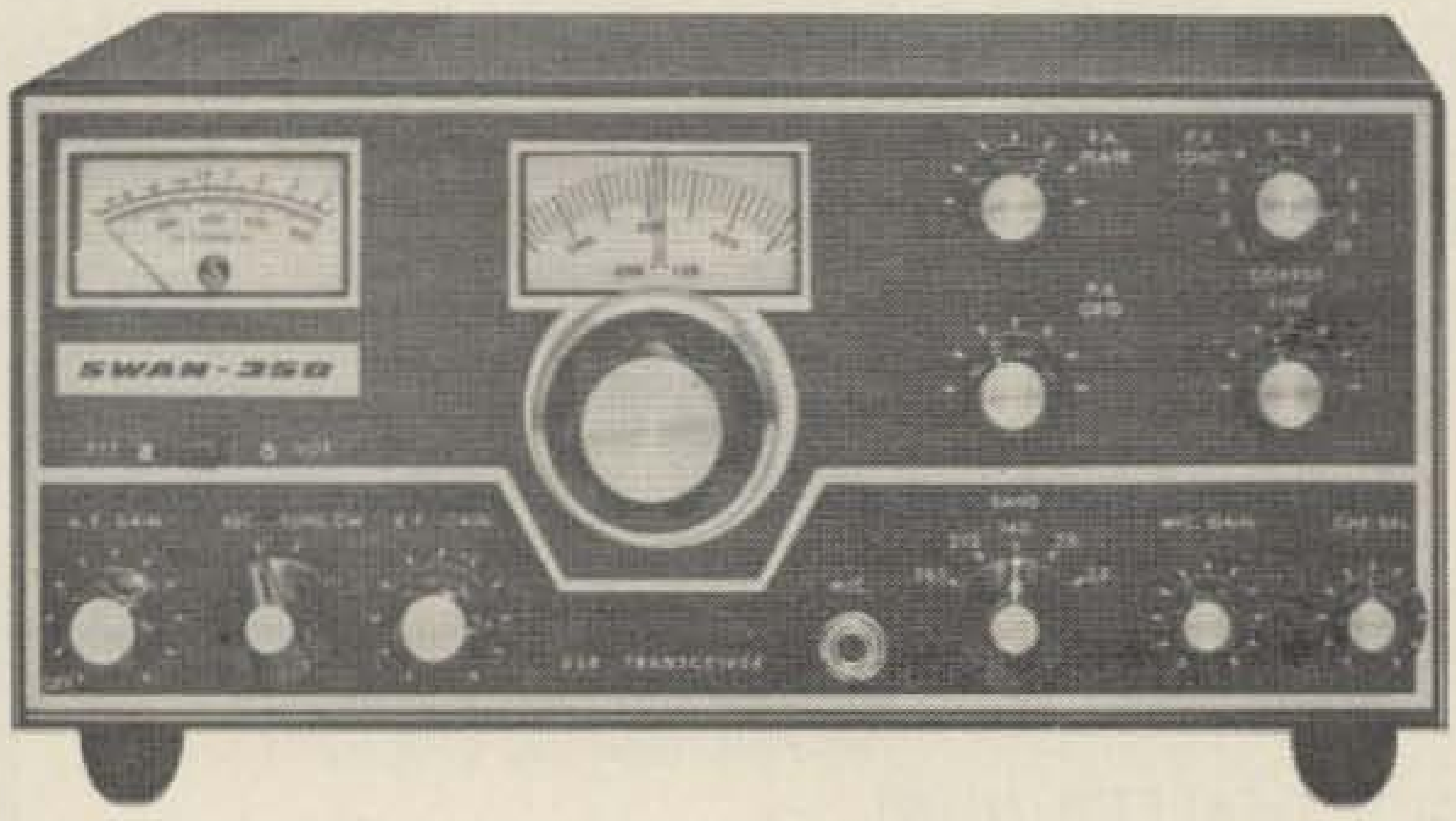
And, speaking of frequency markings, most crystal holders carry tiny stamped figures which make you squint and peer when searching for the frequency you want. Again, using the small decals, mark the frequency on the edge or face of the holder; you can tell at a glance which crystal is which. . . . W7OE

THE NEW SWAN-350 TRANSCEIVER

Another featured transceiver by

"THE KID FROM TEXAS"
(BRYAN EDWARDS, JR.)

W5KFT



5 BANDS
400 WATTS
$395

OTHER FEATURES

- 3.5 - 4.0 mc, 7.0 - 7.5 mc, 13.85 - 14.35 mc, 21.0 - 21.5 mc, 28.5 - 29.0 mc (10 meter full coverage kit available).
- Transistorized VFO.
- Crystal lattice filter.
- ALC . . . AGC . . . S-Meter.
- 5½ in. high, 13 in. wide, 11 in. deep.
- 400 watts SSB input.
- Lower sideband on 80M and 40M. Upper sideband on 20M, 15M, and 10M. (Opposite sideband kit available.)

ACCESSORIES:

- AC power supply, matching cabinet with speaker. Model 117-C .... $ 85
- 12 Volt DC Power supply. Model 412 .... $130
- Plug-in VOX. Model VX-1 .... $ 35

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Peterborough, N. H.

Unit Power Oscillators

Low cost oscillators from 200 to 650 megacycles. High power (25 to 50 watts) units are described for experimental line or cavity testing, antenna experiments, and transmitter drive work. The technician and the UHF experimenter particularly, should be interested in this helpful information which is the result of many years of work.

Introduction

As one works up into the UHF region, two facts become more and more apparent. One, it is much better to double, and two, it is also much better to start at the final and work back through the drivers and multipliers. Too many times I have blithely followed the carefree words "Then tripling to 432" (or 1296). By the time I tried to triple to 1296 the drive was way way down from what it should be. A great help in this situation is doubling instead of tripling. Don't forget, the first "big bang" you come to as you frequency multiply up is the *doubling* frequency! Further up you find a little weak spot of energy. *This* may be the tripling spot.

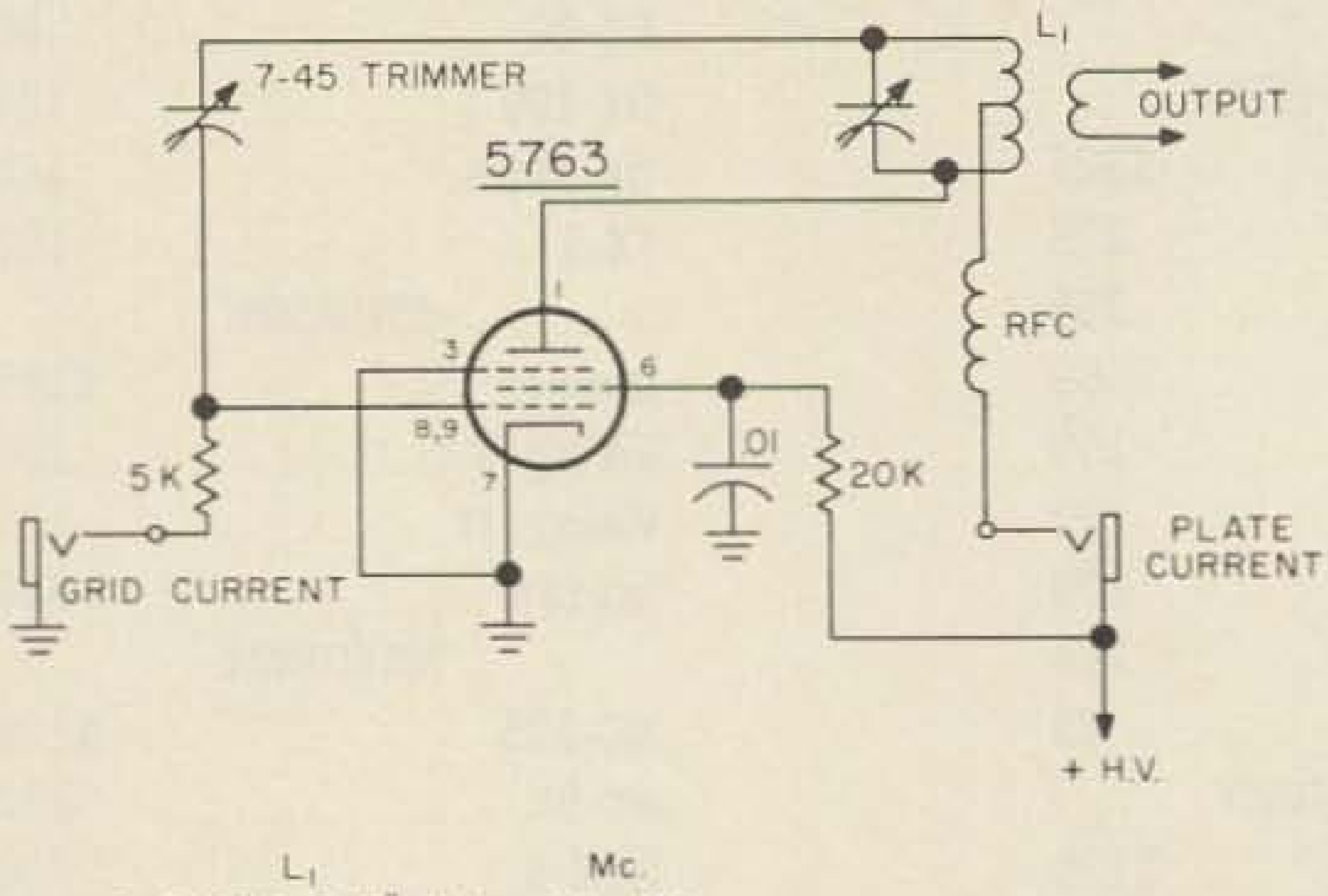
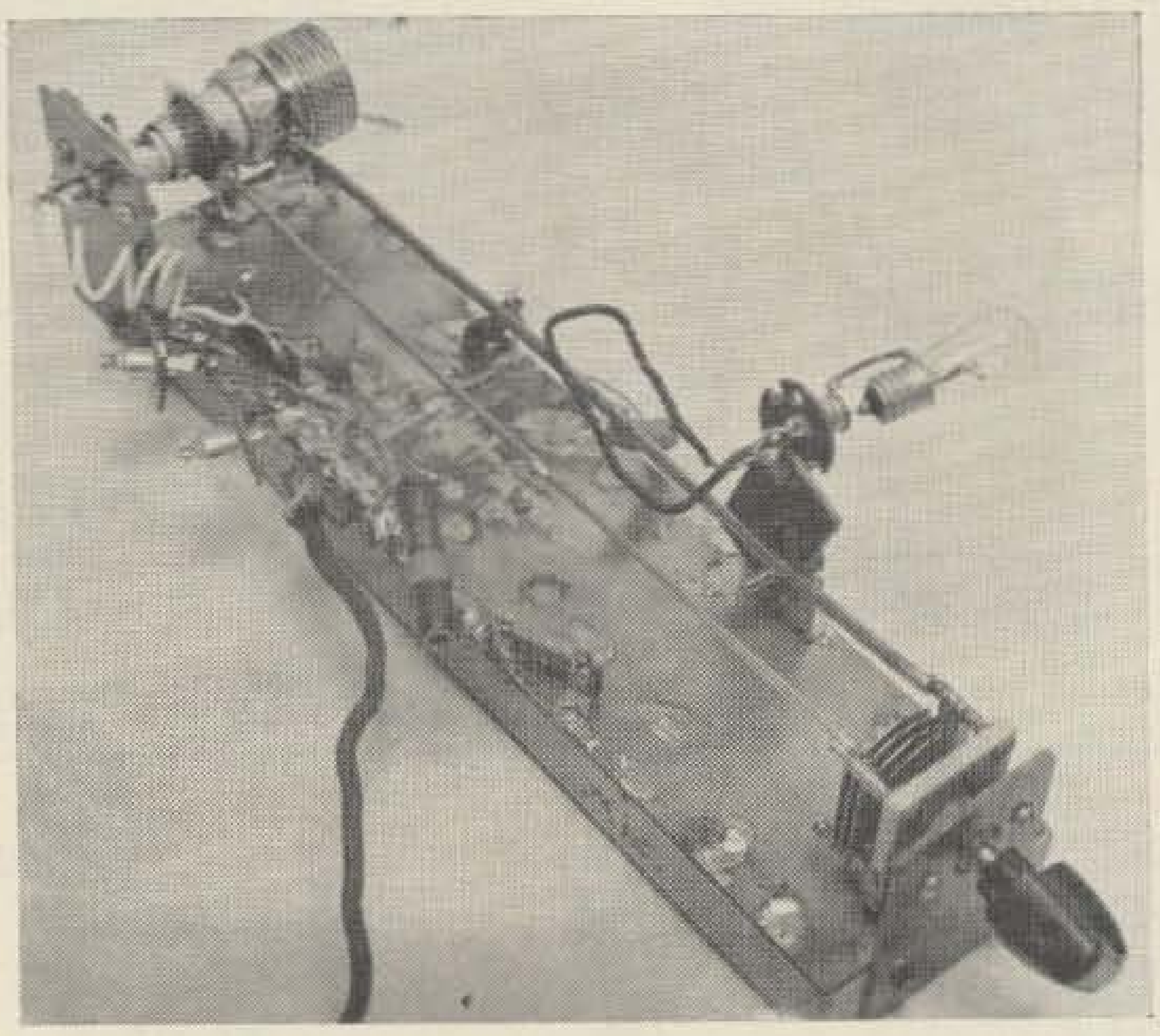


Fig. 1. 85 to 170 mc oscillator

Granted, doubling only throws out *some* of the harmonic relations found on 144, 432, and 1296 megacycles, but from a power and operating standpoint you may find it obligatory. All harmonic relationship is not lost by any means. One 27 mc crystal (CB unit) goes to 54, 108, 216, and then 432 megacycles. The same xtal will go to 81 megacycles (tripling is still not too bad there) 162, 324, 648 megacycles, and then to 1296! Suit yourself. At least the oscillators to be described (Yes, I'll get to them eventually) will help you work it out.

Remember, if you have some four or five multiplier stages set up and then have to rework them it may be quite a deal when you find that you have insufficient drive to the final. Especially as such reworking will generally mean bigger tubes or an in between amplifier stage. You will see these amplifiers quite often in commercial rigs, where they had to use one in order to get sufficient drive for the next stage. This is OK when all you have to do is call the purchasing department for another UHF tube!



190 to 250 mc oscillator

Working *backward* from the final, you know just where you are as regards drive, one stage at a time.

The oscillator of Fig. 2 covers 190 to 250 megacycles. This can be used to check doubling circuits from 216 to 432 megacycles.

The next, Fig. 3, covers 400 to 500 megacycles. This is useful for decisions on whether to use lines or cavities on your 432 stages.

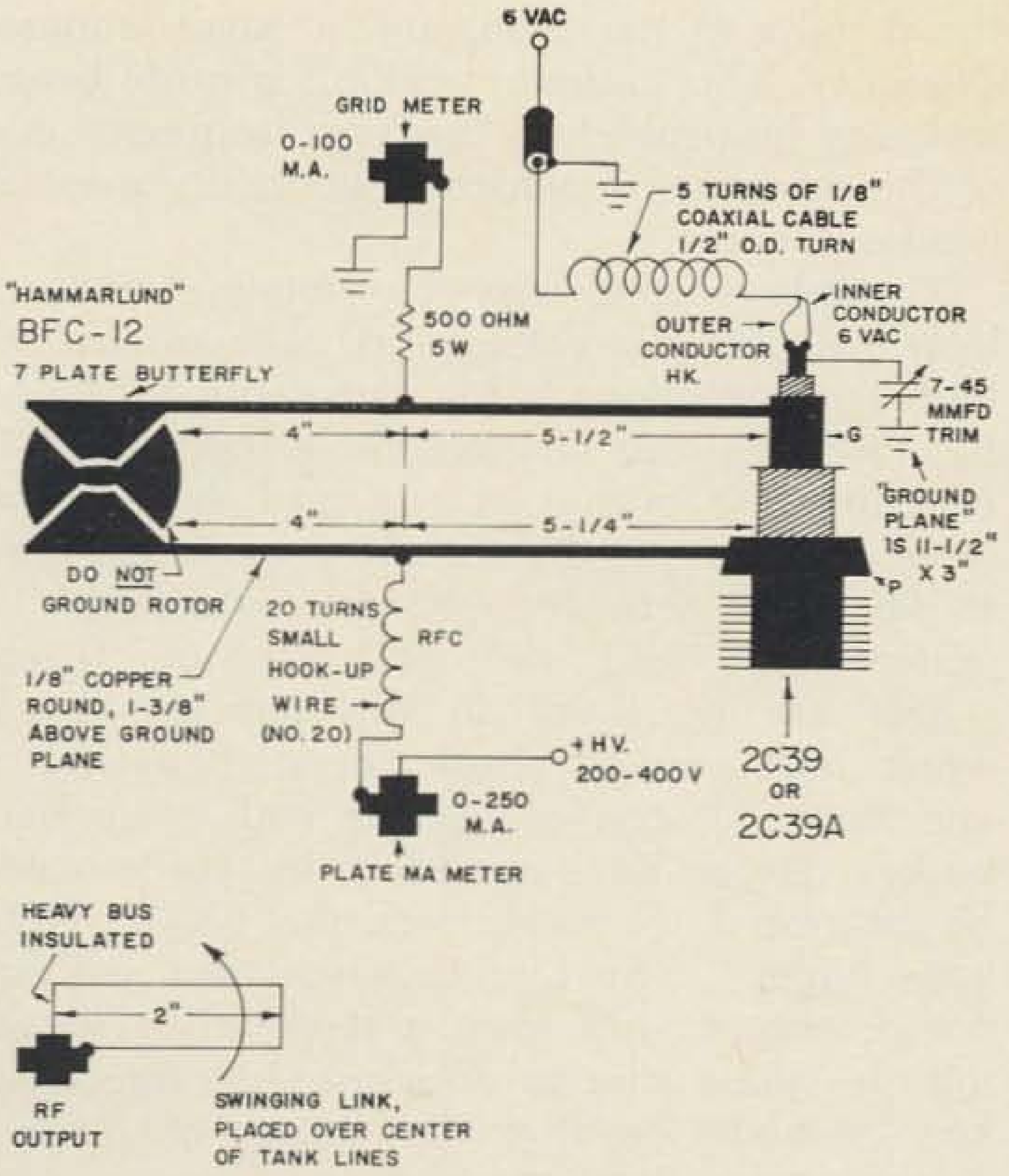


Fig. 2. Power oscillator 190 to 250 mc.

The highest frequency of this economical series runs 600 to 650 megacycles and is mainly for checking 1296 megacycle doublers. I have even used it to check transistor doublers (don't scream, please!) This may seem fantastic, to drive a little transistor with a 100 watt tube, but you just run low voltage, 50 to 100 or so on the plate and use very loose coupling. Works F.B.!

1200 to 1300 power oscillators will be investigated at a later date. I have almost decided that perhaps a 600 megacycle oscillator driving a 1200 megacycle doubler would be best. Less FM when you modulate it and you are ready for crystal control later if needed.

By using a high-powered oscillator one can ascertain what grid drive will produce what output in the final; maximum grid mils can be set up; etc. Don't forget that if you are using grounded grid, plate output will go on increasing even though the allowable grid mils are being exceeded! Oscillators are shown for some of the most useful frequencies such as 216, 432, and 600 to 650 megacycles. Numerous antenna tests can be more easily made with more sock in the oscillator. Of course, watch those operating rules and regulations! Personally there have been plenty of times on UHF when *any* signal would have been greeted with joy. In fact, this is still usually the case "up there." VHF-UHF helix type coils, line and strap circuits, and cavities can be handily adjusted for size, length, and resonance, with these units.

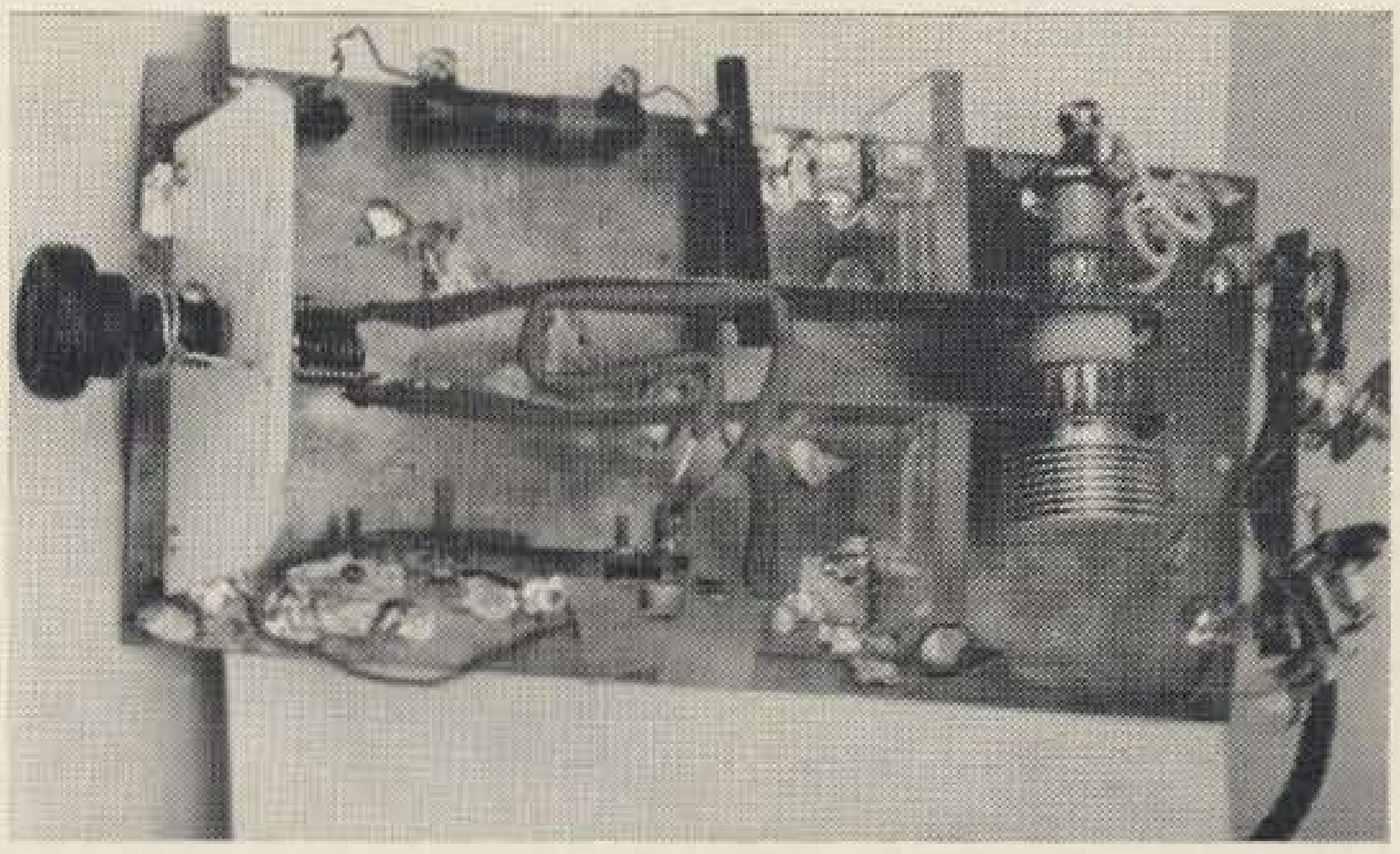
Reasons for Different Types of Oscillators with Increasing Frequency

There seems to be some "Law" operating here. This business of "Laws" is of course buried in Antiquity. (Where is that? Africa? Asia?) From 50 to around 150 megacycles, using a good tube such as the 5763, the old reliable Ultra-Audion circuit does FB. Fig. 1 shows an old version that works well. You can push it a little higher in frequency, at which time putting chokes in the cathode and heater leads will help, but why bother when you can use the circuit of Fig. 2 which "takes off" with as little as 9 volts on the plate!

With all the "2'ers," Gonsets, etc. around, the assumption was made that there is plenty of rf available for 50 and 144 mc tests of all kinds.

200 Megacycles and Up

Things begin to change a little after 150 megacycles. The "plate coil" gets real small and nasty like. Quite a different type of oscillator now enters the scene. See Fig. 2. This oscillator uses a half-wave in each line. One half-wave in the grid line and one half-wave in the plate line. This allows the first quarter wave on each line to be well up inside the tube. It appears to be a "natural" for the region between 100 and 700 megacycles. Look at the size of it on 400 to 500 megacycles! Easy to work with; no need of short leads. Of course this does *not* mean that you can *change* anything shown in the circuit. This oscillator is so good frequency-wise that I had to change the plate and grid lines from one inch brass strap down to "wire." When I say *down* I mean just that. With the brass strap I couldn't get it down below about 280 megacycles. That is, without using longer lines —and look at 'em now. With the wire lines it immediately jumped down to under 200 megacycles. A good live demonstration of strap versus wire.



400 to 500 mc oscillator.

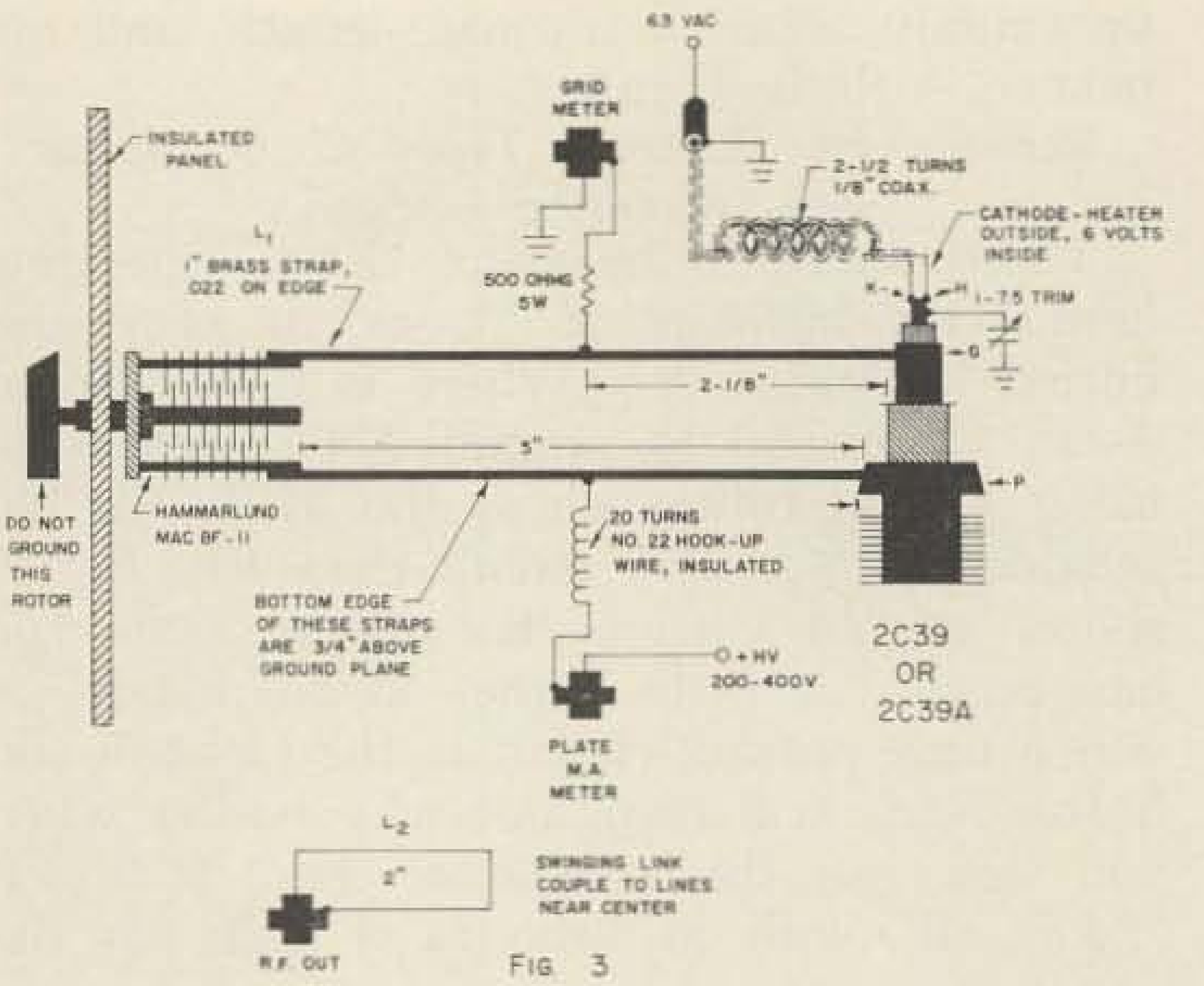


Fig. 1. 400 to 500 mc oscillator.

It also is so good efficiency-wise that I checked it out for low plate voltage—always a good test for high-frequency oscillators. It oscillates with *only* 9 *volts* on the plate of the 2C39!

The question of a coax cavity with one quarter wave, or three, or more, does not enter yet into this picture. That comes later, over 1000 megacycles.

Note in Fig. 2 that the plate and grid are at the correct position where the rf voltage is highest, and that they have the proper phase relation to each other. When the plate is at a positive peak (instaneous) the grid is most negative, etc. The tuning capacitor is also at the proper point of high rf voltage, being a half-wave away from the grid and plate end. This is another advantage of this circuit, that the tuning capacitor does not have to be attached at the same end as the plate and grid. The B plus lead with it's choke and the grid resistor are also attached at the best place, which is the *low* voltage point of each line at the highest frequency used. There remains the question of the cathode. Little is usually said about this point in the books, but it gets to be very important up at these frequencies. Chokes are generally installed in the cathode and filament leads and that is about all that is done. More efficiency and power will result, however, from doing something about it—mainly because of the internal tube capacities of a triode when used in an unshielded oscillator circuit.

Using a groundplane at an equal and certain distance from the grid and plate lines (that is, equal from each line) as shown, the cathode connection to the base plate (ground plane) may be broadly tuned with a relatively small inductance made of ⅛ inch coax cable. Use the inside wire for the heater lead to carry the 6 volts to the tube, and a small trimmer capacitor. This cathode peaking is quite broad and may be peaked on the high frequency end of the range used, which is generally most in need of a boost.

Variable output may be obtained with a loop over the *low* voltage (rf voltage, that is) high current region. This can easily be found by touching the lines with a pencil while watching the output or the grid meter. This same method should already have been used to find this zero rf point for attaching the plate choke and the grid resistor. These points are indicated in the figures, but it won't hurt you to check them. (That is, if you don't hit the plate line with your bare pinky). If you have not tried this yet you will be interested. (I mean with the pencil, NOT your finger). The fact that you can get full power output with even a screwdriver touching the plate line is of course an important key to understanding the action of electro-

600 to 700 mc oscillator.

magnetic waves on conductors and resonators. These waves are *not* motions of *electrons*. They couldn't go that fast, even if they tried, which they don't! I have also heard mentioned the quaint idea that "One electron pushes the next, etc." *This* would mean that each electron down the length of wire would have to accelerate faster than the speed of light.

Nobel prize winner Louis De Broglie had the correct words: "The displacement current of Maxwell, which always exists, is absolutely independent of the motion of electricity." This "motion of electricity" was previously defined as the movement of the electrons themselves. I generally use the term "electron wave" myself, but this could be mistaken for the electrons moving too, so I guess the term "electromagnetic wave" would be best. There is of course, a difference when this wave travels on a conductor and when it travels through (more or less) empty space.

Well, anyway, this wave travels back and forth from one end of the line to the other, much like a spring clamped at it's center. The travel (voltage swing) of each end of the spring is changed to elastic strain (current swing) at the center. The old business of potential energy and kinetic energy in a pendulum. The momentum principle is well recognized by the term "flywheel effect" in an electronic tank circuit. As applied to a half-wave line it means that at the exact electrical center, there is an extremely small variation in voltage from one instant to the next. It theoretically gets to be "infinitely" small, but remember, as the old German professor said about Infinity "Dis ve don't got!" Don't forget, at UHF "ground" is only a place that has the *same* voltage potential all the time. However, at the center of this half-wave line there *is* a *maximum* of *current*, so this is the place for low-impedance magnetic current loops to

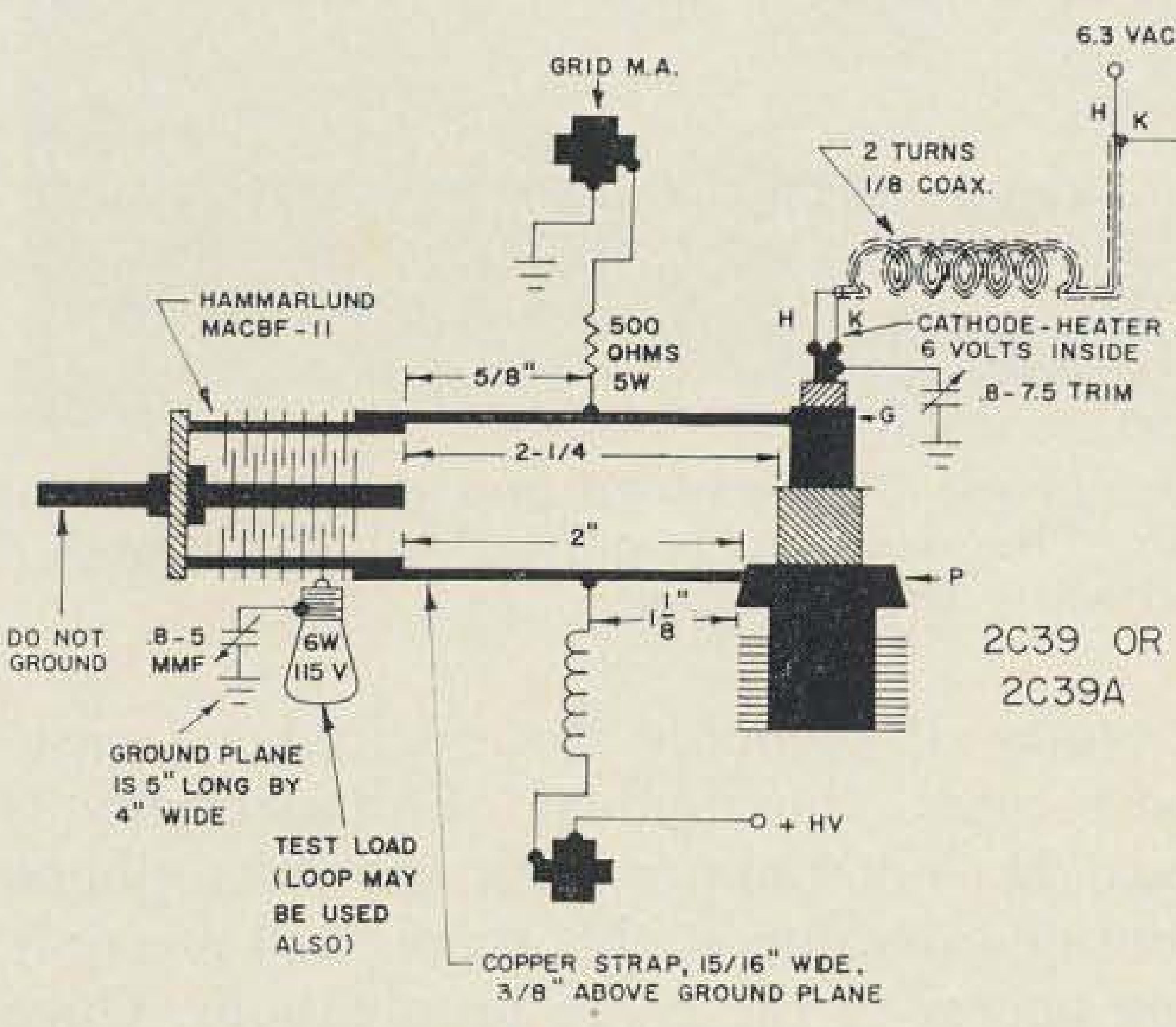


FIG. 4

Fig. 4. Power oscillator 600 to 700 mc.

match to low impedance cables, etc.

Construction Details and Components

As can be seen in the figures, these units can be made up rather quickly providing that you have the following items in your "junk box";

1. 2C39 plate and grid rings and heater-cathode connection. The ones used here are surplus items, from WW2 gear. You can get them brand new from the Instrument Specialties Co., Little Falls, N.J.
2. Butterfly capacitors. These are standard Hammarlund type MACBF or BFC.
3. Copper-clad bakelite. You can use a chassis, but this stuff goes a lot quicker. From Meshna's, or Insulating Fabricators of Watertown, Mass.
4. 2C39 tubes. Just look in the surplus lists if you haven't any on hand.
5. Incidentals. Get copper strap and sheeting from your plumber. I use phono plugs and jacks in the B plus and grid current leads.

I might mention in passing that with certain tuning of the cathode inductance, and only 500 ohms of grid resistor, you can get as much as 100 mils in the grid. I use the low value of grid resistor mainly because you can get good output with low plate voltage that way. As I have mentioned, you can run much more voltage and increase the grid resistor. Suit yourself on that one. Also, all my experimental power supplies have had 4 pin power sockets, so all my test rigs have 4 pin power plugs. B plus, 6 volts ac, and ground. This is just handy. If you need lots of watts you should run a blower on the 2C39's. They are right out in the open so it's easy. If you want to go for *maximum* watts, like near 100, look in the book first and then juggle plate volts, plate mils, grid mils, and grid resistor. A 10 watt wire-wound 2000 ohm job helps there.

That's about all there is to say about construction. The schematics should tell you the rest of the story. Hope this helps you with your UHF work.

. . . K1CLL

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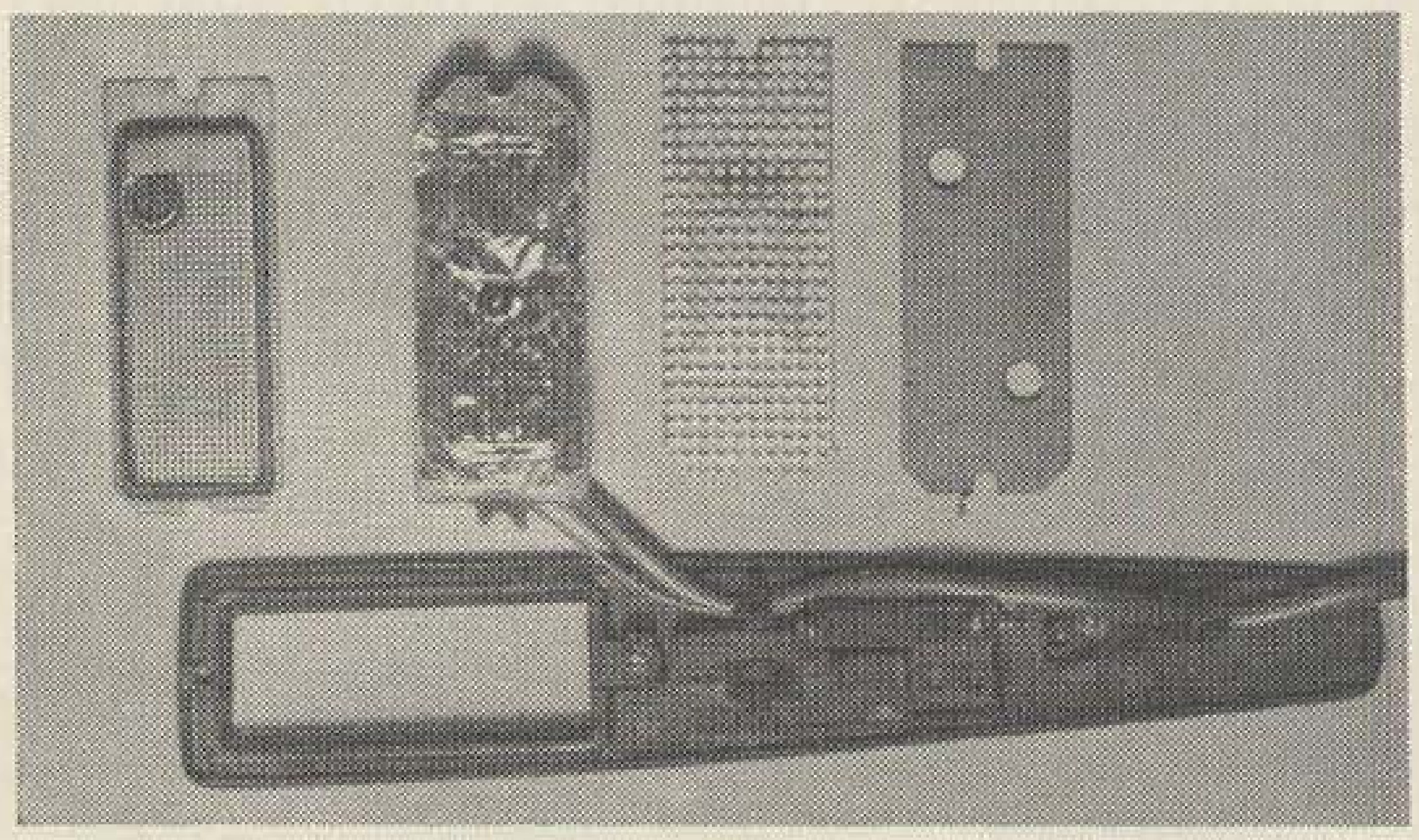
Fairfax, Virginia

Repair That Mike

You fire up the rig in plenty of time to keep that schedule and are looking forward to a full evening of rag-chewing. Everything looks O.K. so you press the push-to-talk switch and start calling. Plate power comes on but that's all—no modulation. You plug the phones in the monitor and crank up the audio gain but, aside from a slight increase in hum level, nothing happens. You, my friend, have a problem. You can either return to the family and try to convince the XYL that, even after all of these years, you still prefer to spend a quiet evening with her or you can try to find the trouble. The balance of this article is for the latter breed of ham.

Typical inexpensive replacement cartridges available from many distributors (Lafayette in this case).

The first step is to localize the trouble. Disconnect the microphone connector and switch the transmitter to transmit. Touch a screwdriver to the "hot" contact of the transmitter mike connector. If the transmitter jumps off the table and the monitor blasts your ears, you have localized the trouble. However, at this stage, do not be dismayed. Many microphone defects occur in the cable or connectors. Connect the mike cable back to the transmitter and, if your mike has a connector at the microphone end, unplug this connector. Now perform the touch test again. If the transmitter still jumps off the table, flex the cable, especially near the connectors. If still in doubt as to the condition of the cable, remove the connector shells and examine the cable terminations. If the cable seems in good condition, you have isolated the trouble to the microphone proper. Reconnect the cable to the microphone and move on to the next step which also applies to mikes which have the cable permanently attached.



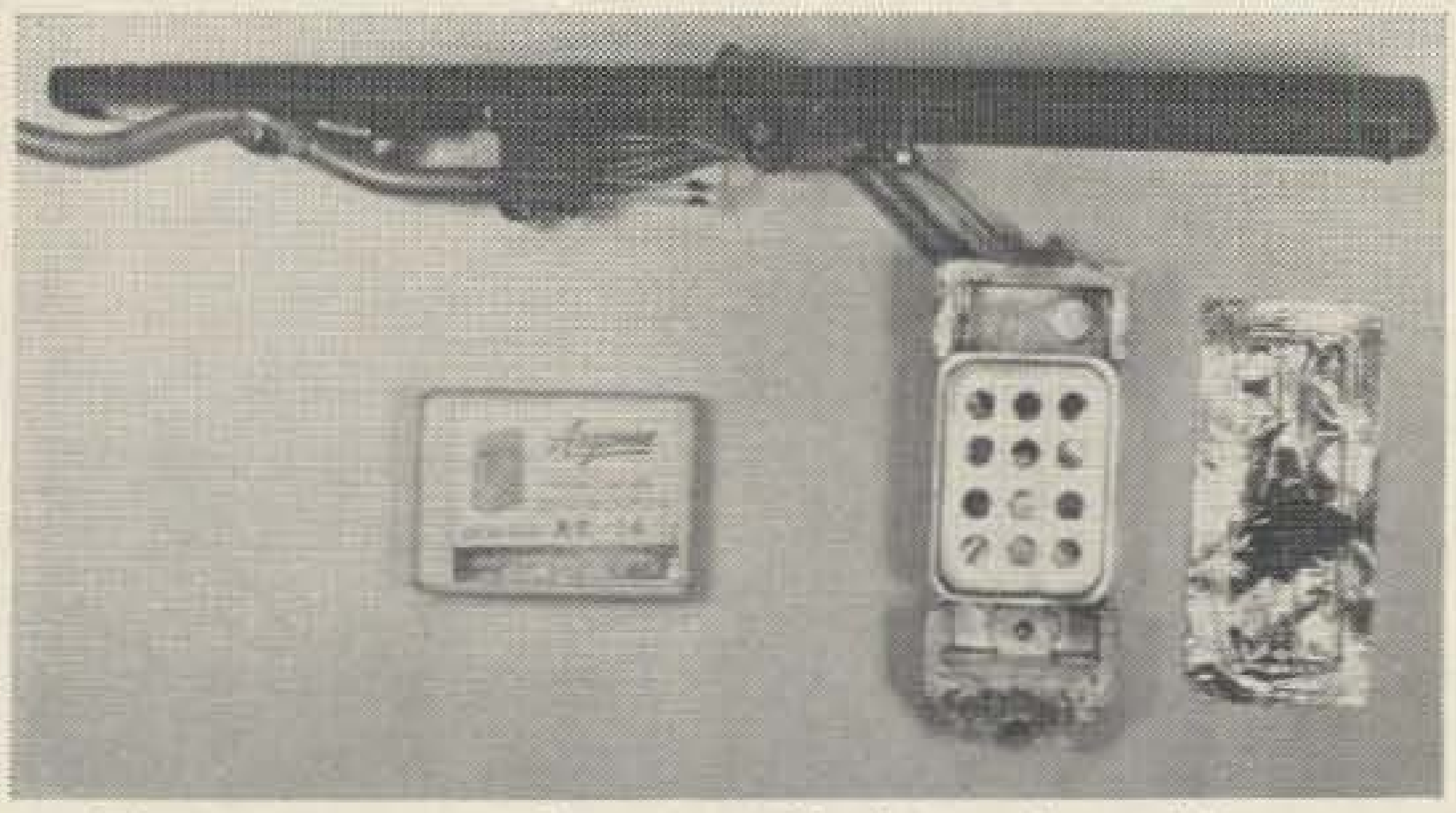
Microphone disassembled and ready for repair. The rectangular object with leads attached is the cartridge.

Carefully disassemble the microphone case. In most cases, the method of disassembly is obvious. Do not tamper with the microphone element or cartridge at this stage. You are only gaining access to the cable terminations. Once more perform the touch test and if you obtain the same result, the microphone element is definitely defective. If the hum test has provided doubtful results, unsolder the hot lead from the cartridge and try again. This test will isolate a partially shorted cartridge which the touch test would not otherwise disclose.

Assuming you have isolated the trouble to the microphone element proper, you now have a decision to make. The primary factor in reaching this decision is the replacement cost of the mike. If it is a $2.95 home recorder special, salvage the cord, heave it in the ash can and buy another. It is not worth repairing. However, if the microphone is of good quality, with a good stand push-to-talk switch or other desireable features, you will be well advised to consider repairs. Check your catalogs for a direct replacement cartridge for your particular mike. If you have no luck, check with your distributor; his catalogs may show a replacement cartridge. Assuming you have no luck in finding a direct replacement, you can still repair the mike for a very nominal sum.

A wide variety of imported crystal microphone cartridges and microphone units usable as replacement cartridges is now available at low cost. The photograph shows the range of units that is available from just one national distributor—Lafayette Radio Electronics of New York. These units range from almost exact replacements for a large number of U.S. manufactured microphones to miniature mike units that may be housed in the case of your defective mike. The photo caption gives the Lafayette catalog number, description, physical size and price for each of the economical units shown.

If one of these units is a direct or almost direct replacement for your microphone, you are in luck. For a very nominal sum and with very little effort, you can restore your mike to new condition. Even if a direct replacement is not available, do not despair. You can still use one of the other cartridges if it will physically fit in the microphone housing. The photographs show the installation of one of these cartridges in an Electro-Voice Type 927 Crystal Microphone. This mike is the property of W3JHN and after the unit failed, he unsuccessfully tried to locate a replacement cartridge. As is common with many of the newer "slim-line" mikes, none of the commonly available replacement cartridges would fit into the available space.



The new cartridge installed in the old cartridge housing and ready for assembly.

Disassembly of the microphone is shown in the photograph. The existing cartridge is a heavy die-cast unit and the mounting screws also secure the grill and the acoustical baffles. Careful measurement showed that the Lafayette PA-40 Subminiature Crystal Microphone could be fitted into the original cartridge. The inside of the cartridge was cleaned out and the die-cast case cut out with a file to accept the Lafayette unit. The attached leads of the Lafayette unit were then soldered to the existing terminals (hot-to-hot and ground-to-ground) inside the old cartridge. The case of the PA-40 mike was then cemented in place with one of the commonly available, "two-part" epoxy cements. After the cement dried, the unit was given a quick talk test and then reassembled with the original baffles and grill.

Now came the problem of matching the acoustics of the microphone to the new cartridge. This was strictly a trial and error proposition and I am convinced that, even for the manufacturers, this is more of an art than a science. The assembled microphone was carefully tested and the results were less than satisfactory. The lower frequencies were "muddy" and the higher frequency components had an undesireable echo effect. The first step was to stuff the remaining space inside the original cartridge case with cotton. This eliminated the high-frequency echo effect but the low frequency response was still unsatisfactory. As shown in the photograph, a cardboard baffle plate with two small holes is used in the original assembly. Additional holes were punched in this baffle and the mike reassembled but without a fiber-glass cloth acoustical filter (not shown) which was also used in the original assembly. Performance was greatly improved with the sole remaining problem of excessive sibilance and breath noise. Reinstallation of the fiber-glass cloth cured this problem. The results of this repair were quite satisfactory and the defective microphone returned to service at a fraction of its original cost.

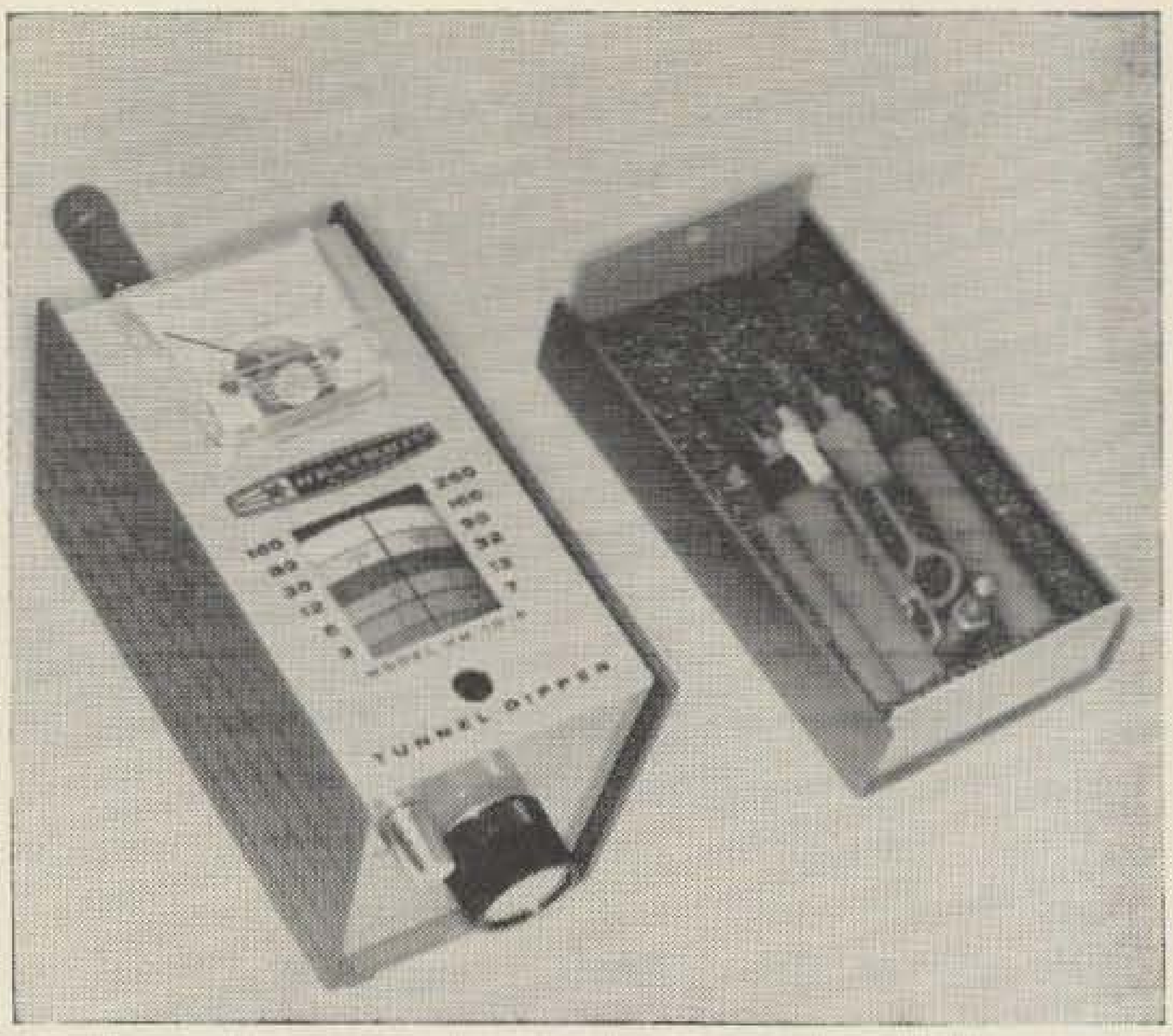
While the specific procedures described above may not be directly applicable to other microphones, the general techniques are. Select a replacement cartridge that will fit in the available space. Follow as closely as possible the original mounting method. That is, if the original unit is shock mounted, then shock mount the replacement. If the original cartridge has a high mass and is rigidly clamped in place, then attempt to duplicate the mounting method. In the case described, the weight of the original die-cast cartridge is retained and the replacement fitted in the available space. As mentioned, the acoustics of the microphone will probably be altered. Achieve the desired response by the judicious use of padding and/or baffles, vented or solid. A little trial and error effort will show you what is required to achieve satisfactory performance.

Next time you are faced with a defective microphone, consider repairs. A very modest investment, a little work and small amount of luck will restore your mike to good-as-new condition.

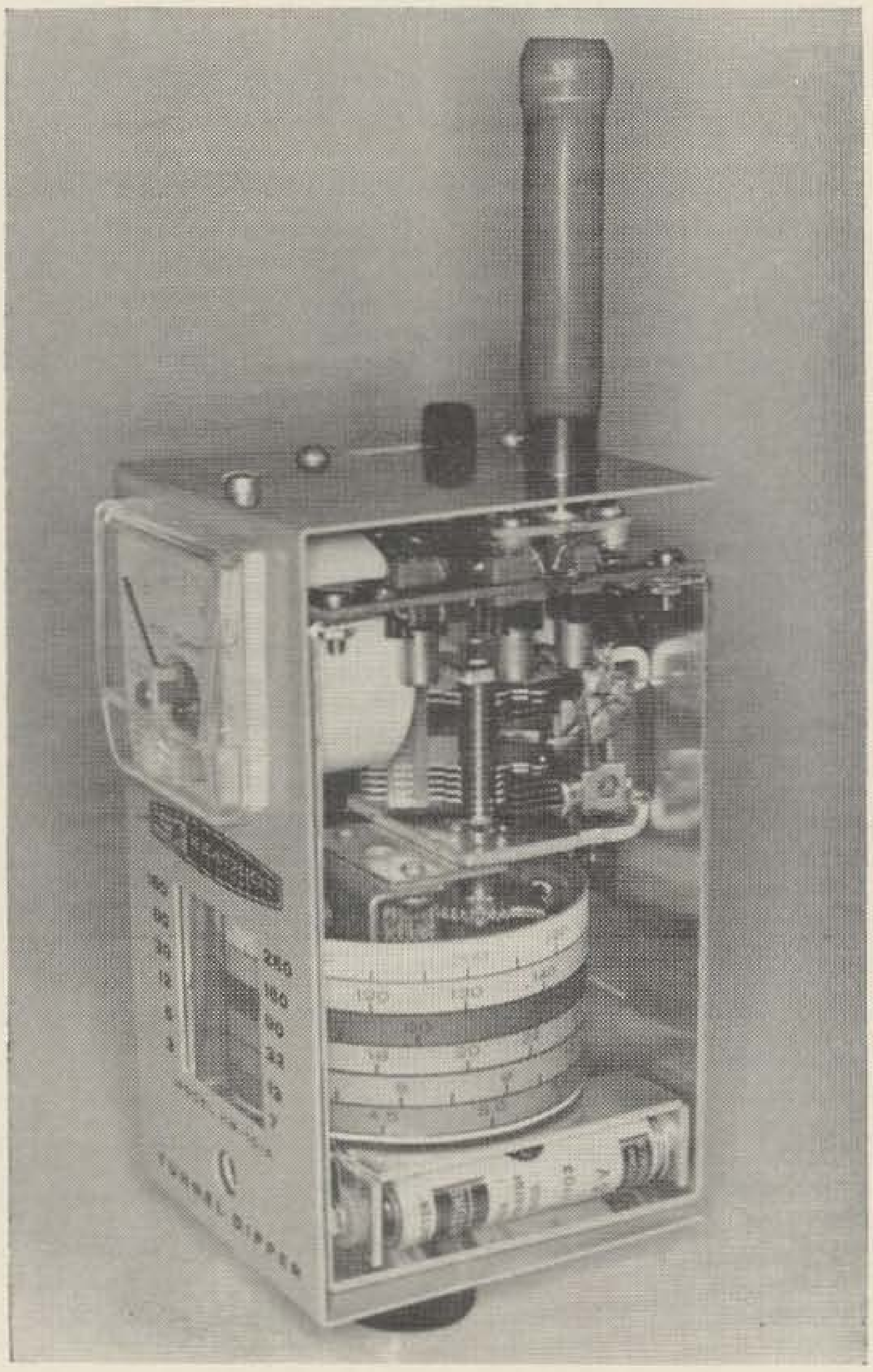
. . . W4WKM

Donald Smith W3UZN
Kent Mitchell W3WTO

The Heath Tunnel Dipper



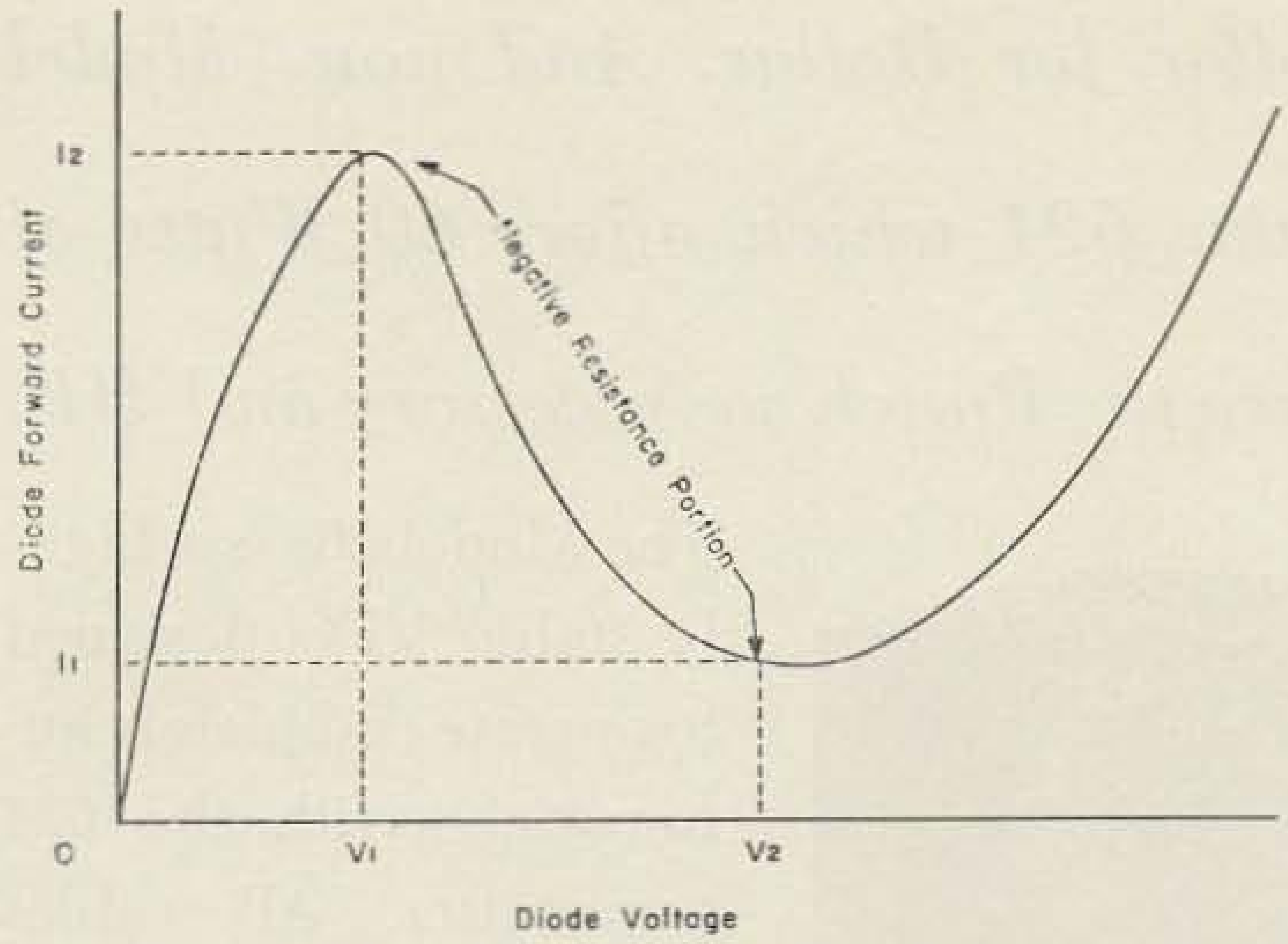
Relatively little time passed between the announcement of Dr. Leo Esaki's research with his specially doped germanium diode junction with its unique "negative resistance" characteristics and Heath's announcement of their replacement for the familiar grid-dip meter. Anyone who has seen the Tunnel Dipper will be quick to agree that Heath has added another winner to their long and growing list.



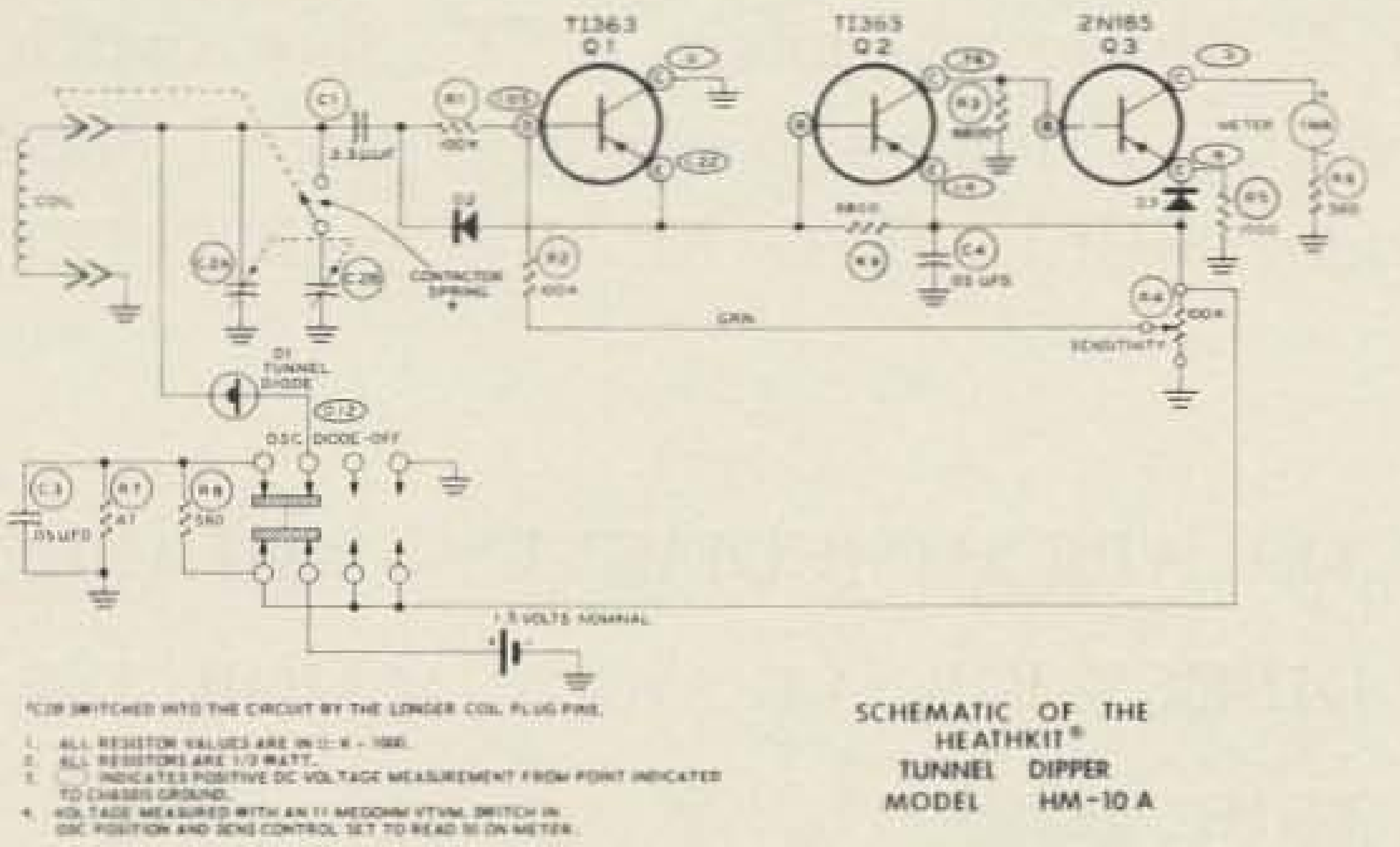
Retaining all of the features of the now familiar conventional grid-dip meter, this instrument provides an additional advantage . . . freedom from external power requirements. This opens up new areas of utilization which previously have not been convenient, such as tuning antennas on the house roof or at the top of a tower, and adjusting mobile rigs and antennas.

Covering a frequency range of 3 to 260 mc, the Tunnel Dipper contains a completely solid-state circuit requiring only a 1.5 volt battery and draws only 5 mils! The complete schematic is shown in Fig. 1. The tunnel diode functions within the oscillator circuit, the frequency of which is determined by the inductance of the plug-in coil in parallel with variable capacitor C2. The oscillating voltage developed across this tank circuit is rectified by D2, an ordinary diode, applied to the base of transistor Q1 operating as an emitter follower, and amplified by the dc amplifier consisting of transistors Q2 and Q3. The meter is in series with the collector of Q3 and measures the current, which of course is proportional to the amount of rf voltage being developed at the other end of the circuit, the oscillator tank. When the tank circuit coil is placed adjacent to a tuned circuit of the same resonant frequency, inductive coupling results in absorption of energy from the tunnel diode oscillator circuit, in turn producing the characteristic dip of the meter, indicating resonance.

For those who are puzzled about how a diode is able to function as an oscillator, a few brief words of explanation might be justified at this point. Ohm's law tells us that when voltage across a resistance is increased, the current through the resistance also increases. The same law also applies to an ordinary diode which is, after all, a resistance too. However,



a tunnel diode, due to its special doping during manufacturing, displays a characteristic resistance curve as shown in Fig. 2. Notice that between voltage levels of 0 and V_1 the diode current increases as would normally be expected. However, as the voltage increases between V_1 and V_2 the diode current defies Ohm's law and decreases! The diode is actually displaying "negative resistance!" Increasing the applied diode voltage beyond V_2 produces a normal current response. Therefore, it is the region of "negative resistance" that interests us and in which the oscillation is produced in the tank circuit in the following manner: as the voltage supplied by the 1.5 volt battery reaches its maximum across the tank circuit, consisting of the plug-in coil and C2, the voltage across the tunnel diode is at a minimum, operating near point V_1 of the curve shown in Fig. 2. This results in a large current flow to the tank circuit from the battery. Conversely, when the voltage across the tunnel diode becomes maximum, near point V_2 of the curve, the current through the tank circuit becomes minimum. By this process, each cycle of current in the tank circuit is replenished by current from the battery. The tunnel diode itself does not actually oscillate, but simply acts to maintain the oscillations in the tank circuit.



Specifications

Frequency Range . . 3 to 260 mc. (using six plug-in coils)
Circuitry . . . . Solid State:
1 tunnel diode
1 silicon diode
1 crystal diode
3 transistors
Controls . . . . Tuning, Switch (Off-Diode-Oscillate)
Power Supply . . . . . . AA penlite cell (1.5 volt) not furnished
Dimensions . . . . 5⅞" long, 2 13/16" wide, 4 3/16" high
Weight . . . . 1½ pounds
Price $34.95

Construction of the Tunnel Dipper is relatively easy, thanks to a small etched circuit board and a well written assembly manual. Approximately 4 to 5 hours are all that is required to perform the 73 (how about that!) construction steps and operation checks.

Operation of the unit is simple, requires no warm-up, and employs vernier gear-driven tuning. Other features of the instrument well worth mentioning are the color coded plug-in coils and corresponding colored dial scales, built in storage space for the coils, and sturdy RCA type phono plugs and sockets for the coils . . . an improvement over earlier model grid-dip meters whose coil-socket arrangements sometimes became intermittent after extensive use.

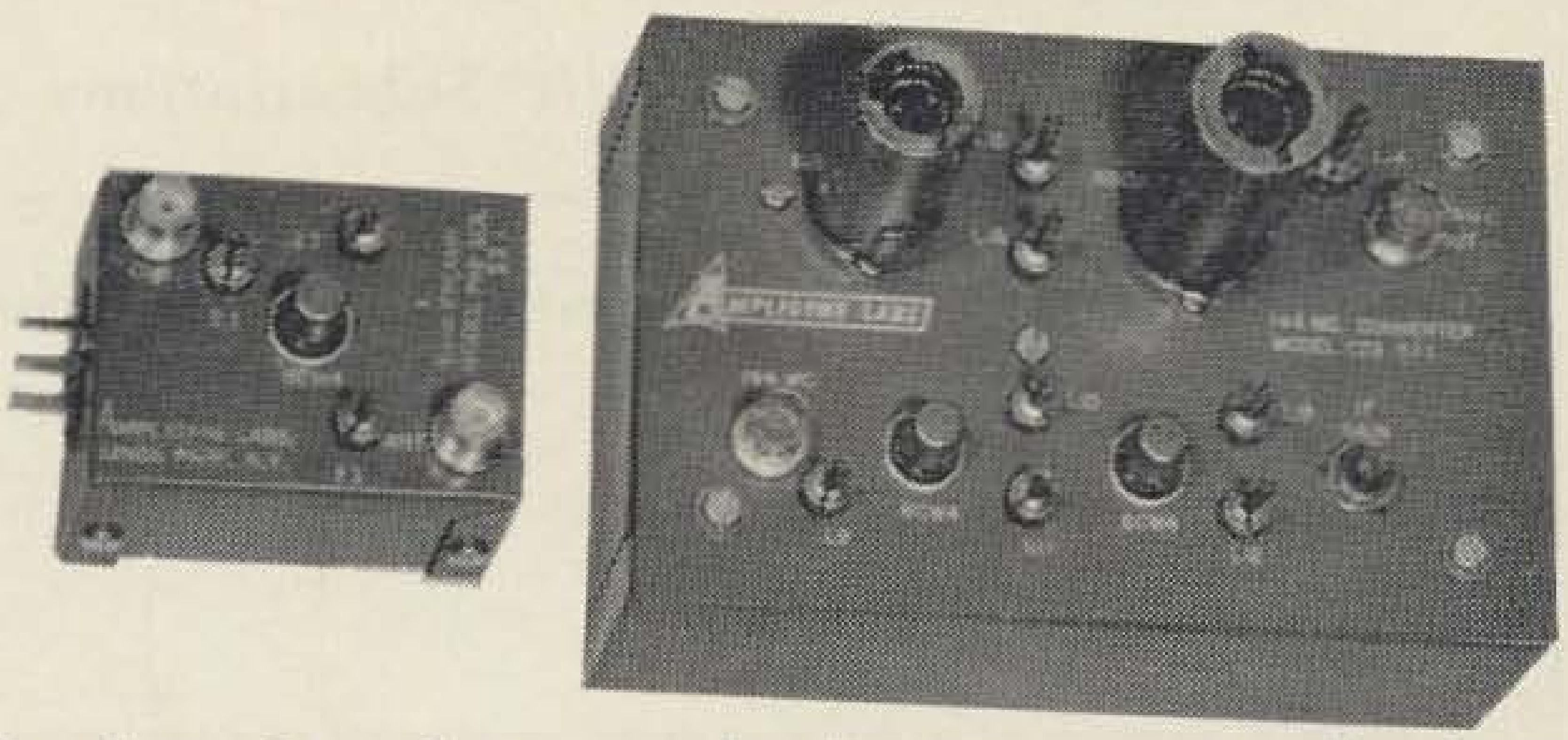
Priced at $34.95, Heath's Tunnel Dipper is a worthwhile addition to any ham shack . . . and will cause you to wonder how you ever got along without one.

. . . W3UZN

WHAT DO YOU LOOK FOR IN A CONVERTER?

APPEARANCE? PERFORMANCE?

We consider appearance important to the point at which it burdens the performance of the converter, preamp or transmitter. Our first aim is to use top quality material and the newest design concepts. We try to make our equipment look functional, from the bottom as well as the top. The electrical aspects, such as gain, noise figure and overload are those necessary for the band on which they are used. The specifications listed are not claims, they are actual performance figures which we guarantee. Our use of BNC connectors was based on the fact that they are the best connector for low power use at the VHF-UHF frequencies. We have learned that many of our customers have installed phono jacks because of simpler cable connection. For this reason, we will supply any unit with phono connectors if you add the prefix S to the model number. Listed below are complete specs and cost.



ALL OUR CONVERTERS ARE OVERLOAD RESISTANT AND STABLE.

Model	C61	C23	C14	PS4
Noise Figure	2.5 DB	3.0	4.0	Matching
Gain	25 DB	30	30	Power
Frequency	50-54	144-148	220-225	Supply
Price	$35.25	$41.25	$42.50	$12.00

I.F.s available: 7-11, 14-18, 28-32, 30.5-34.5, 50-54

NUVISTOR PREAMPS, P62-50mc., P25-144mc., P15-220mc. .... $11.75 ea.

These are typical 30 DB gain preamps, nothing special except of course, AMPLIDYNE builds AND guarantees them.

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SPECIAL EQUIPMENT? Write us for a quotation on a piece of equipment that you need. We will build it and/or design it.

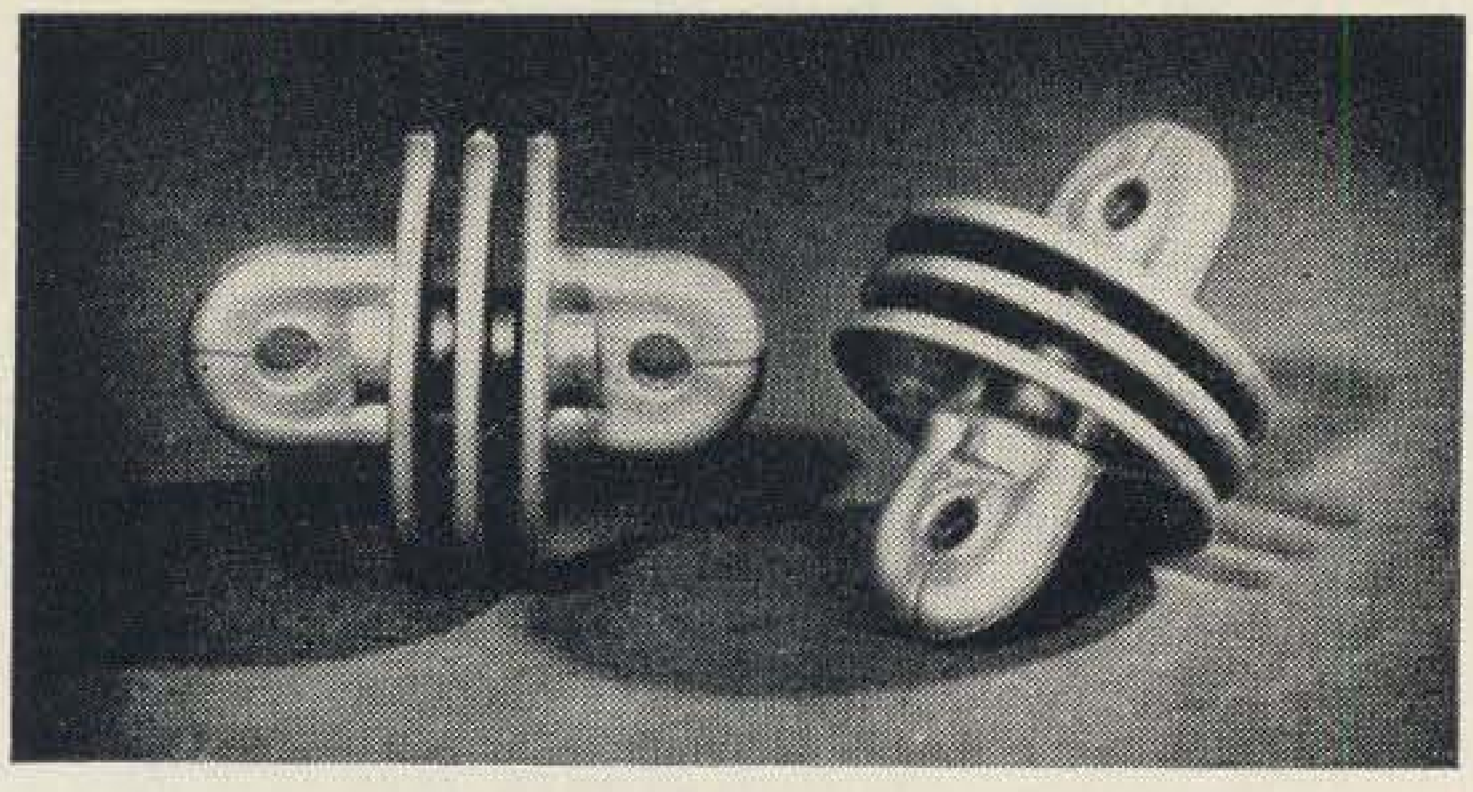
IN MEMORIAM

The Maskwoosicut Mules Radio Club in Sharon, Massachusetts has come up with an idea that seems well worth while passing along. When their founder John B. Morgan WB2LZG/ ex K1RHP died recently they decided to establish as much of an amateur radio and electronic theory collection of books in the local library in his name as they could afford. They wanted to do something useful.

CLOTHING NEEDED

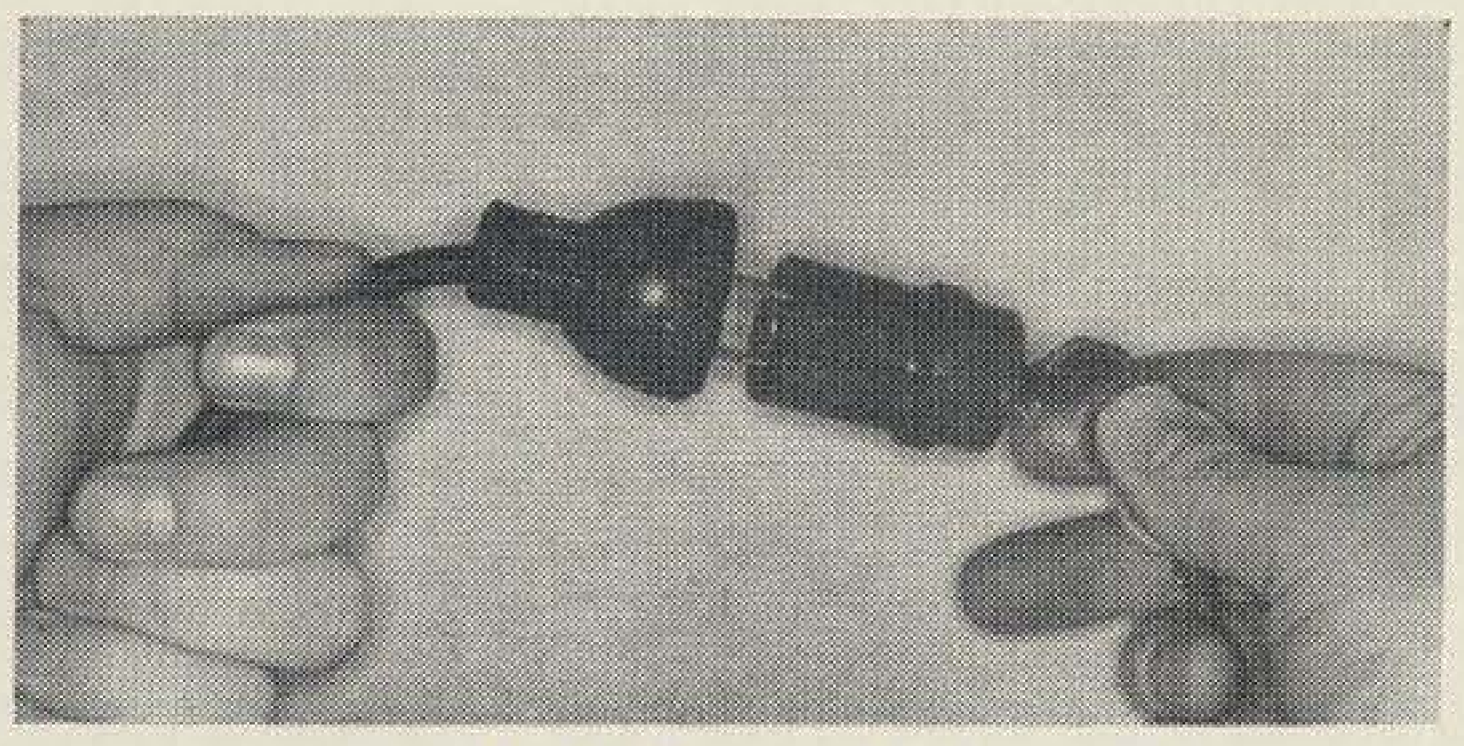
The Moonlighters of Eastern Tennessee Amateur Radio Club is helping out with a clothing drive and hopes that all amateurs will take a close look through their attics and closets for clothes which still can be of service. Send them to Save The Children Federation Processing Center, Knoxville, Tennessee by prepaid parcel post and mark the contributions with your call letters, name and address. The clothes will be cleaned and mended, where needed, and distributed in Virginia, Tennessee and Kentucky or put aside for emergency use in time of disaster in the U. S. or in free countries overseas.

New Products



HiQ Plastic Insulators

Model HQ-2 insulators offer all the electrical and chemical advantages of molded acrylic plastic. They combine high tensile strength and extreme resistance to weather and temperature changes, while providing excellent insulating properties. The insulators have reinforced rib structure surrounding the tie points to assure extra strain and vibration resistance for long-wire antennas over one kw input. The insulators measure 2" x 1½". Details about the insulators, list priced at 99c a pair, are available from Budwig Manufacturing Co., P. O. Box 97, Ramona, Calif.



Hurd Power Lock

According to FCC regulations, an Amateur radio station may be operated only by a person holding a valid amateur operator license. To prevent unauthorized use of your equipment, and also prevent accidents with power tools involving children, invest $1.49 in this locking device manufactured by the Hurd lock company.

Designed to fit either 2 or 3 pronged AC plugs, the lock is simply mated with the plug, and with a twist of the key two internal pins extend through the holes present in the prongs of every plug. Very clever.

Available in any hardware-electrical type store.

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(Act of October 23, 1962: Section 4369. Title 39. United States Code)

Publisher: File two copies of this form with your postmaster.

1. DATE OF FILING: October 1, 1964
2. TITLE OF PUBLICATION: 73
3. FREQUENCY OF ISSUE: Twelve times per year
4. LOCATION OF KNOWN OFFICE OF PUBLICATION *(Street, city, county, state, zip code)*: 73 Pine Street, Peterborough, Hillsboro, New Hampshire, 03458
5. LOCATION OF THE HEADQUARTERS OR GENERAL BUSINESS OFFICES OF THE PUBLISHERS *(Not printers)*: Peterborough, New Hampshire

6. NAMES AND ADDRESSES OF PUBLISHER, EDITOR, AND MANAGING EDITOR

PUBLISHER *(Name and address)*: Wayne Green, Peterborough, N. H.
EDITOR *(Name and address)*: Wayne Green, Peterborough, N. H.
MANAGING EDITOR *(Name and address)*: none

7. OWNER *(If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given.)*

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Stock: Wayne Green	Peterborough, N. H.

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POD Form 3526 Aug. 1963

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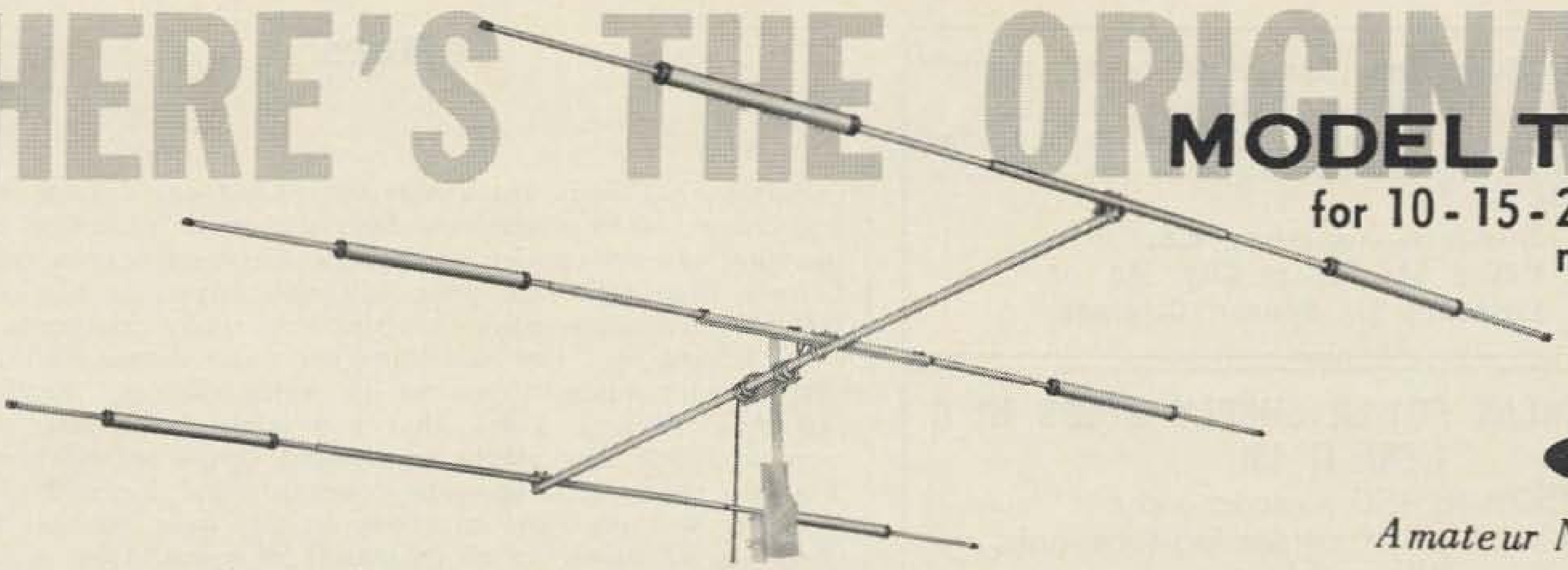

MODEL TA-33
for 10-15-20 meters.

TRAP MASTER

Amateur Net $104.75

Three element beam provides outstanding performance on 10, 15 and 20 meters. Exceptionally broadband for excellent results over full Ham bandwidth. Exclusive MOSLEY trap design provides resonant frequency stability under all westher conditions. Easily handles full KW, amplitude modulated. Traps enclosed in aluminum are weather and dirt proof. Element center sections of double thickness aluminum, minimizing sag. Boom requires no bracing. Heavy duty universal mounting plate fits masts up to 1½ inch O.D. Feed with one coax line. RG-8/U is recommended. See your nearest amateur equipment dealer or write for literature describing the TA-33, only one of the famous TrapMaster family of fine amateur antennas.

SPECIFICATIONS AND PERFORMANCE DATA: ■ Fwd. gain up to 8 db. ■ Front-to-back is 25 db. ■ SWR, 1.5 or less, at resonant frequencies. ■ Maximum element length is 28 feet. ■ Boom length is 14 ft. ■ Turning radius is 15.5 ft. ■ Assembled weight is 40 pounds. ■ Wind surface area is 5.7 square ft. ■ Wind load is 114 pounds. ■ Shipping weight is 53 pounds.

Mosley Electronics Inc., 4610 N. Lindbergh Blvd., Bridgeton, Mo., 63044.
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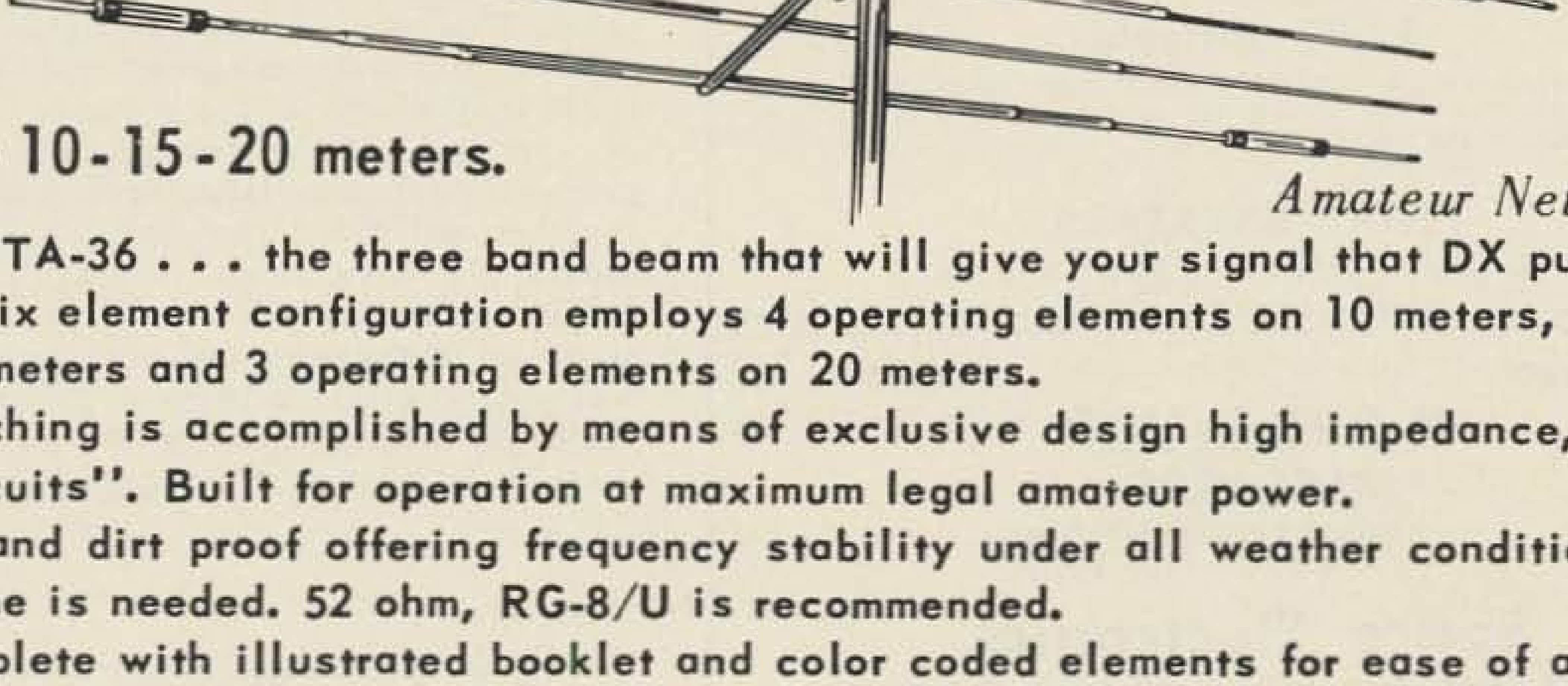
HERE'S THE ORIGINAL!

MODEL TA-36



TRAP MASTER

for 10-15-20 meters.

Amateur Net $132.10

The new Clean-line TA-36 . . . the three band beam that will give your signal that DX punch! This wide spaced, six element configuration employs 4 operating elements on 10 meters, 3 operating elements on 15 meters and 3 operating elements on 20 meters.

Automatic bandswitching is accomplished by means of exclusive design high impedance, parallel resonant "Trap Circuits". Built for operation at maximum legal amateur power.

Traps are weather and dirt proof offering frequency stability under all weather conditions. Just one coaxial feed line is needed. 52 ohm, RG-8/U is recommended.

Antenna comes complete with illustrated booklet and color coded elements for ease of assembly.

SPECIFICATIONS & PERFORMANCE DATA: ■ Fwd. gain, 10 meters - 9 db., 15 meters - 8.5 db., 20 meters - 8 db. ■ Front-to-back, 20 db. or better. ■ SWR, 1.5/1 or better at resonance. ■ Transmission line - 52 ohm coaxial. ■ Maximum element length, 29 ft. ■ Boom length, 24 ft. ■ Turning radius is 19' 3". ■ Assembled weight - 69 lbs. ■ Wind load (EIA Standard), 210.1 lbs. ■ Wind surface area, 10.7 sq ft.

Mosley Electronics Inc., 4610 N. Lindbergh Blvd., Bridgeton, Mo., 63044.
Export Division: 64-14 Woodside avenue, Woodside 77, New York.

Letters

Dear Wayne:

Surprise! This is not a hate letter, but one I hope will encourage you to continue to fight with your editorials and the right of your opinion and others. The past year or more I have been following your editorials plus the big one, RM-499, and am positive that you have many thousands of hams behind you. I'm sure there are many thousands more that haven't taken time out to write to you. Reading Octobers' editorial I felt that you might be a little distressed. I felt that maybe you might throw in the towel. You are appreciated on your comments and ideas. Please. Whether you are right or wrong on any issue you are the champion of hundreds of thousands of hams. How would they be able to voice their opinions or fight for their rights if you did not take the position you did.

You are our source of information. Now *we* know what the other side is doing. You are in a position to have mail crossing your desk from all parts of the country (you still have that five dollar desk?). You, like Drew Pearson, must have many spies across this country to get this info. How are we to know if you don't tell us. Don't let it be hidden in other magazines where you need a microscope to read the print.

I agree as much as any one that ARRL has done a great deal for the ham. But let us not go back to the great deal for the Ham. But let us not go back to the good ole days but forward and don't sit back on our laurels. I am a sales rep. In our business it's not what we did yesterday but what we did today and what we plan to do in the future. I can't see why any organization can't take criticism unless some of the things said are true.

I believe, as in business, you need to have competition to keep everybody honest. I feel sure that there is room for ARRL and IoAR. This is keeping the other guy honest and it's the way things should be. You have been accused of dividing the hams but this is not so. I think you have strengthened us. You have taken issue with that dirty ole RM-499 and other issues. Whether we agree with you or not you have opened up our minds not to be hogwashed by what our leaders have to say. Now we can learn what both sides of the story are. Now we can read between the lines. Now we can smoke Viceroys and be thinking men. Now we don't fall hook line and sinker for anything that is said until we have the facts. Is it wrong to ask about and discuss issues or do we have to take it like other countries that can't voice their opinions? We want to stand on our own two feet and not let somebody else do the thinking for us. This is a democracy.

There has been a great deal of name calling on both sides. This sort of reminds us of our present presidential race. This is not weakening or dividing the country. I also think that what you are doing is not weakening ham radio, but putting a little strength into it. In event of a emergency I am sure the two political parties would act together and I feel the same way in our hobby of amateur radio. We have room for another organization such as IoAR. As mentioned before, you have had the GUTS to stand up under pressure with your convictions and ideas. Let your conscience be your guide and I am sure you will come out on top. Keep up the good work.

Ray Gianchetti WA2CUB/W3QLZ

Dear Wayne,

You are a crusader and I would sure like to get someone like you to join me in a war to the bitter death, hi! What is really bugging me is all the clicks, clacks, buzzes and horrible noise in general on the amateur bands. Serious offenders are television horizontal oscillators and thermostatically controlled devices such as electric heating pads, blankets and butter warmers in refrigerators. The best solution to this problem is Canada's—make the radiation illegal! So we need some lobbying. General Electric has a heating pad Model P36 retailing for $6.95 that says on the package "radio and television interference free." Every amateur should know about this either for the use by his own family or to suggest to a noisy neighbor.

Ideally, we need a law that states something like: "any device generating any electromagnetic radiation at any frequency such that the intensity at 50 feet exceeds a level of 2 (?) microvolts per meter must be licensed by the Federal Communications Commission." Penalty for non compliance should be at least $500 per day or 30 days in jail for each day of non compliance. It would be amazing how quickly power line insulators, neon signs, diathermy, theromostats etc., etc., would be replaced. If there are applicable existing laws, they either are inadequate or not enforced.

Curtis W. Reedy, W6YTA

How about the chair?

Dear Wayne,

As it must to all hams, silence came to the key and voice of our fellow amateur, William E. ("Wimpy") Turner, K4ECJ, on September 29, 1964.

As a ham "Wimpy" asked for nothing but he gave much. His friendship and his vast technical knowledge were always yours for the taking. His wit and good humor were always quick and razor sharp, yet never failed to be filled with the milk of human kindness. Although he had been blessed with little formal education, the depth of his knowledge and erudition exceeded that of many a college professor. He could, and did, discourse with great intelligence and understanding on any subject, yet he always kept his mind open to consider an opposing point-of-view. In short, "Wimpy," more than most of us, was truly a ham's ham.

We who knew him well will never be able to fill the void left by his passing and the angels should forever rejoice for his arrival. His big signal and kindly voice will never be forgotten.

"Grant" W8NZQ

Sir,

I am in need of data for my research at the University of Wisconsin, Department of Meteorology, on any occurrences of six meter band openings during the period from August 25 to September 25, 1964. Information desired is, stations heard or worked, time and date, QTH if known, and the time at which the band opened or closed, if known. In my study periods periods during which the band is closed is of importance also.

Thomas D. Damon W9HAQ
1125 Northland Drive
Madison, Wisconsin 53704

Dear VHF Editor,

Since I am VHF/Technical editor of the "FEAR(M) NEWS" I thought I should fill you in on VHF operation in Japan.

We have only two VHF bands here, 50-54 Mc. and 144-146 Mc. Power input is limited to 50 Watts. The normal microwave bands (starting at 1231 Mc.) are available also with 50 watts maximum input.

Almost all of the operation here is on 50 Mc. AM. KA2's CM, DF, JW, KS, LD, MB, NA, PA, RD, RJ, SF, YP, and KA9's AB and FH are on six meters. KA2KS, KA2RJ, and KA9FH are on two meters also. KA2RJ is on SSB with transverters.

Six meter DX from Japan includes Korea and Okinawa via sporadic E in the summer and Australia via Transequatorial skip in the Fall and Spring.

I hope this info will be of interest to those who are contemplating duty in Japan soon.

Ron, KA2RJ (W9VCH)

QUAKER-THE CRYSTAL KING

CRYSTALS IN HERMETICALLY SEALED HC-6/U HOLDERS. Pin spacing .486 in, same as FT-243. Pin diameter is .050 in. Freq Tol. is .005%. All crystals guaranteed. CRYSTALS SELL AT $1.05 each postpaid USA.

10.39166	10.66666	11.61852	12.60000	20.53333	21.43575	22.15000
22.15556	26.12083	26.16250	27.12000	27.72500	27.78333	28.62000
35.55555	35.66667	35.88889	35.85185	35.96296	35.92593	36.07407
36.33333	36.37037	36.40741	36.44444	36.48148	36.51852	36.55556
36.59260	36.66667	36.70370	36.74074	36.77778	36.81481	36.85185
36.88889	36.92593	36.96296	37.00000	37.03704	37.07407	37.11111
37.14815	37.18519	37.22222	37.25926	37.29630	37.33333	37.37037
37.40741	37.44444	37.48148	37.50000	37.51852	37.55556	37.59259
37.62963	37.66667	37.70370	37.40741	37.74074	37.77778	37.77770
37.81481	37.85000	37.85185	37.88889	37.92593	38.00000	38.85000
39.51850	39.51852	39.55550	39.55555	39.59259	39.59260	39.62963
39.62960	39.66670	39.66667	39.70370	39.74070	39.74074	39.77780
39.77777	39.81480	39.81481	39.85000	39.85185	39.85190	39.88890
39.88888	39.92590	39.92593	39.96296	39.96300	40.07400	40.11110
40.14810	40.14814	40.18518	40.18520	40.22220	40.22222	40.25925
40.25930	40.29629	40.29630	40.33330	40.33333	40.37037	40.37040
40.40740	40.44444	40.48148	40.48150	40.51850	40.55550	40.55555
40.59260	40.59259	40.62960	40.62963	40.66667	40.70370	40.74070
40.74074	40.77780	40.77778	40.81480	40.81485	40.85000	40.85185
40.85190	40.88890	40.88888	40.92590	40.92596	40.96296	40.96300
41.03700	41.03703	41.66667	42.33333	42.59259	42.62963	42.66667
42.70370	42.74074	42.77778	42.81481	42.85000	42.85185	42.88889
42.70000	42.90000	42.92593	42.96296	43.03704	42.07407	43.25926
43.29630	43.11111	43.14815	43.18519	43.22222	43.37037	43.40741
43.44444	43.48148	43.51852	43.55556	43.59259	43.62963	43.70370
43.74074	43.77778	43.81481	43.85000	43.85185	43.88889	43.92593
43.96296	44.03704	44.07407	44.11111	44.14815	44.18519	44.22222
44.25926	44.29630	44.33333	44.37037	44.40741	44.44444	44.48148
44.51852	44.55556	44.59259	44.62963	44.66667	44.70370	44.74074
44.77778	44.81481	44.85185	44.88889	44.92593	45.27500	46.10000
46.30000	46.70000	46.85000	47.85000	47.90000	47.93750	48.27500
48.85000	49.85000	50.85000	51.27500	52.27500	53.27500	53.85000
55.27500	56.27500	57.27500	73.78333	82.33333		

LIMITED QUANTITY AVAILABLE - - - - - - GIVE SECOND CHOICE

9.32250	9.33750	9.53750	9.62250	9.84167	10.15833	10.05500
10.43840	10.40000	10.43750	10.44167	10.44625	11.28125	11.30625
11.25625	11.53125	11.35625	11.38125	11.40625	11.43125	11.45625
11.48125	11.50625	11.58125	11.54074	11.56296	11.58518	11.60625
11.65625	11.70625	11.62962	11.65185	11.67407	11.73125	12.30000
12.76666	14.45000	15.00000	16.82500	15.95000	15.50625	16.00625
17.50625	18.00600	19.00600	19.93575	17.93575	17.25500	17.85500
18.00625	19.50625	20.75350	21.50350	25.70000	26.60600	26.22083
26.66667	26.70000	27.00600	27.62916	27.70000	27.87222	29.22500
29.62500	29.47500	29.72500	30.00000	30.55000	30.72500	30.87500
30.92500	28.84500	28.88889	28.97500	29.70000	31.00000	31.11111
31.70000	32.00000	32.22222	32.70000	33.70000	33.90000	33.95000
34.00000	34.44444	34.05000	34.10000	34.15000	34.20000	34.25000
34.30000	34.35000	34.45000	34.65000	34.70000	35.00000	36.11111
36.14815	36.18519	36.29000	36.22222	36.25926	36.29630	37.20000
37.85000	38.00000	38.19580	38.33333	38.36250	38.88889	39.00000
39.11250	39.59260	35.85000	40.00000	40.66667	40.74074	40.81481
40.85185	40.88889	40.18518	40.29629	40.48148	40.25925	40.03700
40.07407	40.66670	41.11111	42.85000	42.91667	43.10000	43.30000
43.33333	43.90000	44.10000	44.30000	44.50000	44.70000	45.10000
45.50000	45.70000	45.90000	46.25000	46.61250	46.81250	46.90000
46.93750	47.06250	47.10000	47.18750	47.27500	47.46250	47.50000
47.30000	47.56250	47.66250	47.70000	47.81250	41.92700	48.10000
48.01250	48.18750	48.31250	48.50000	48.55200	48.70000	48.27500
49.70000	49.30000	49.27500	49.90000	54.85000	62.22200	61.33300
61.33301	59.44440	69.50000	70.66700	70.83330	77.33300	81.45800
81.83333	82.66700	83.12500	83.33330			

Special: 100kc crystals in HC-6/U holder **$3.00**

AVAILABLE LOW FREQUENCY CRYSTALS IN FT-241 TYPE HOLDERS. Crystal frequency tolerance .02%. All crystals guaranteed. PRICES AS FOLLOWS,

3 for $1.00, 12 for $3.00 and 25 for $5.00. All postpaid on below listed channels.

QUANTITY — 100 or more in stock. Listed by channel number

ϕ to 39; ALSO 53 to 69 AND 71 to 79

The channels listed below SELL FOR 55c each postpaid USA.

Quantity — 50 or less.
43 44 46 47 49 50 (also 200 Kc)

Limited quantity give 2nd choice. selections.

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19.380	340.000	268.000	412.000
244.000	388.000	356.000	859.375
292.000	773.958	404.000	236.000
332.000	131.104	226.000	284.000
428.000	308.000	276.000	324.000
1400.000	348.000	316.000	372.000
252.000	396.000	364.000	420.000
	380.000		

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P.O. BOX 215 **HUNLOCK CREEK, PA.**

QUAKER - THE CRYSTAL KING

CRYSTAL ETCHING AND GRINDING KITS

These kits contain the following materials,

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- 12 - Crystals in Misc. holders
- 6 - Assorted crystal blanks
- 1 - Pkg. Ammonium Bifluoride flakes
- 1 - Packet grinding compound
- 2 - Plastic containers
- 2 - Wooden crystal blank holders
- Instructions

ONLY $3.95 postpaid USA

Kit #2
- 20 - Crystals in Misc. holders
- 12 - Assorted crystal blanks
- Large package Ammonium Bifluoride
- Large packet of grinding compound
- 3 - Plastic containers
- 4 - Wooden crystal blank holders
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- 35 - Crystals in Misc. holders
- 15 - Assorted crystal blanks
- Extra large package of Ammonium Bifluoride flakes
- Extra large packet of grinding compound
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- 2 - Plastic spoons
- 6 - Wooden crystal blank holders
- Instructions

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TM 11-2234 Teletypewriter TT-4/TG **$1.50**

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Many, Many other manuals available. Send 5c stamp for listing.
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ANY 3 OF THE ABOVE KITS FOR **$5.00**

All kits are postpaid USA

These kits contain our assortment. Do not request specific frequencies

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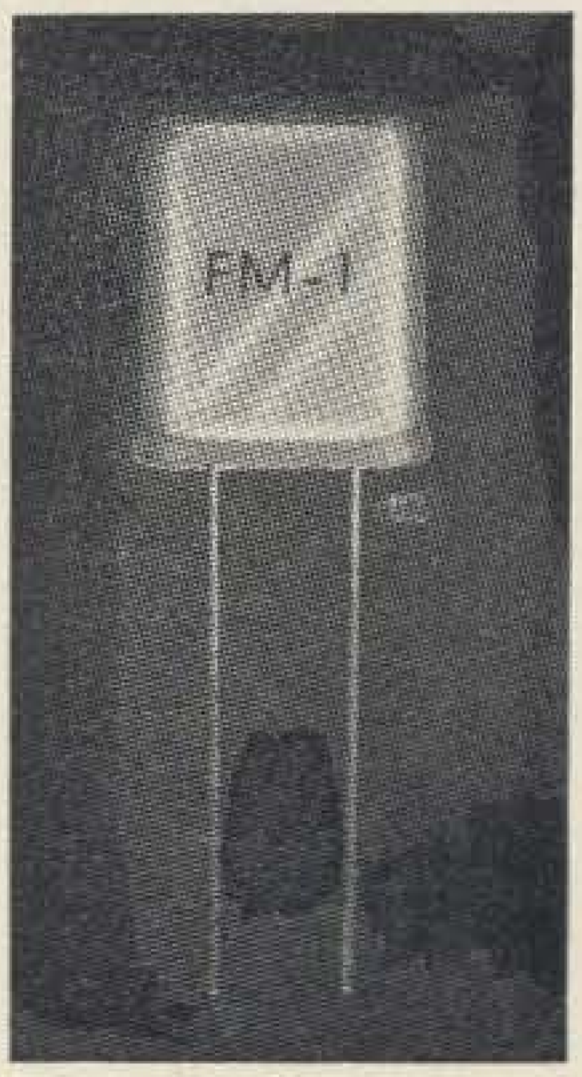
CRYSTALS IN SUB-MINIATURE HC-18/U TYPE HOLDERS at a price no one else can sell at. Brand new, fully guaranteed. These crystals are hermetically sealed and have wire leads 1½ inches long. Crystals sell at $1.05 each postpaid USA. Ideal for transceivers and limited space applications. These crystals oscillate at low drive current.



Quantity available **Frequency in Mcs.**

16.000	18.000	48.716	52.383	65.992	72.000	90.000	103.46
16.250	30.000	49.716	53.050	66.992	73.000	96.000	103.66
16.500	32.000	50.050	53.383	67.992	74.000	97.000	103.86
16.750	32.500	50.716	53.716	68.992	75.000	98.000	104.06
17.000	33.000	51.050	55.050	69.992	76.000	100.00	104.26
17.250	36.000	51.383	55.383	70.992	78.000	102.86	104.46
17.500	48.050	51.716	61.050	71.992	79.000	103.06	104.66
17.750	48.383	52.050	64.992	72.992	80.000	103.26	

Limited quantity available Give 2nd choice selections

25.000 25.250 25.500 25.750 28.500 28.750 29.000 29.250 29.500 50.716

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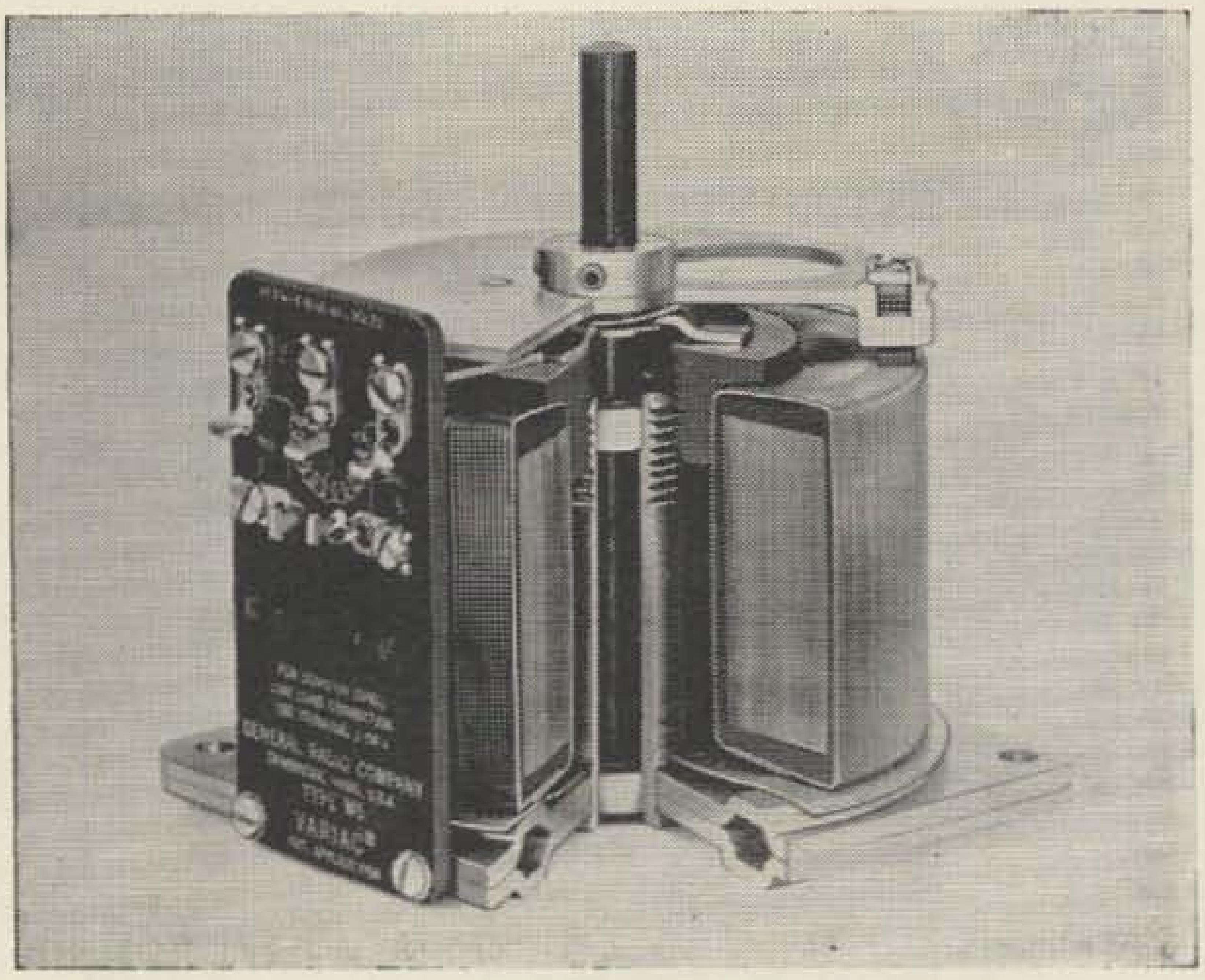
Acton, Mass.



More Power to You: The Autotransformer

The variable-ratio autotransformer, more commonly known by trade names such as Variac(R), Powerstat(R), etc., has been with us for many years. Recently the surplus and "second-hand-new" outlets have begun to offer them at very attractive prices. Most of us are aware of its usefulness when used by itself to provide a variable ac voltage from the 60 cycle line. There are methods of greatly extending its usefulness which are not so commonly known, however, and some of these will be presented here.

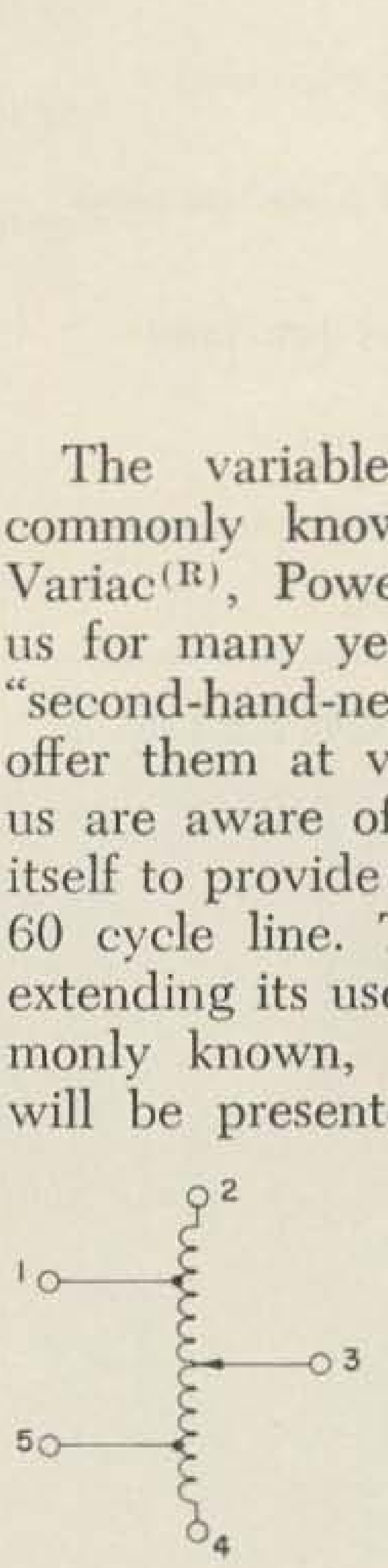


FIG. 1

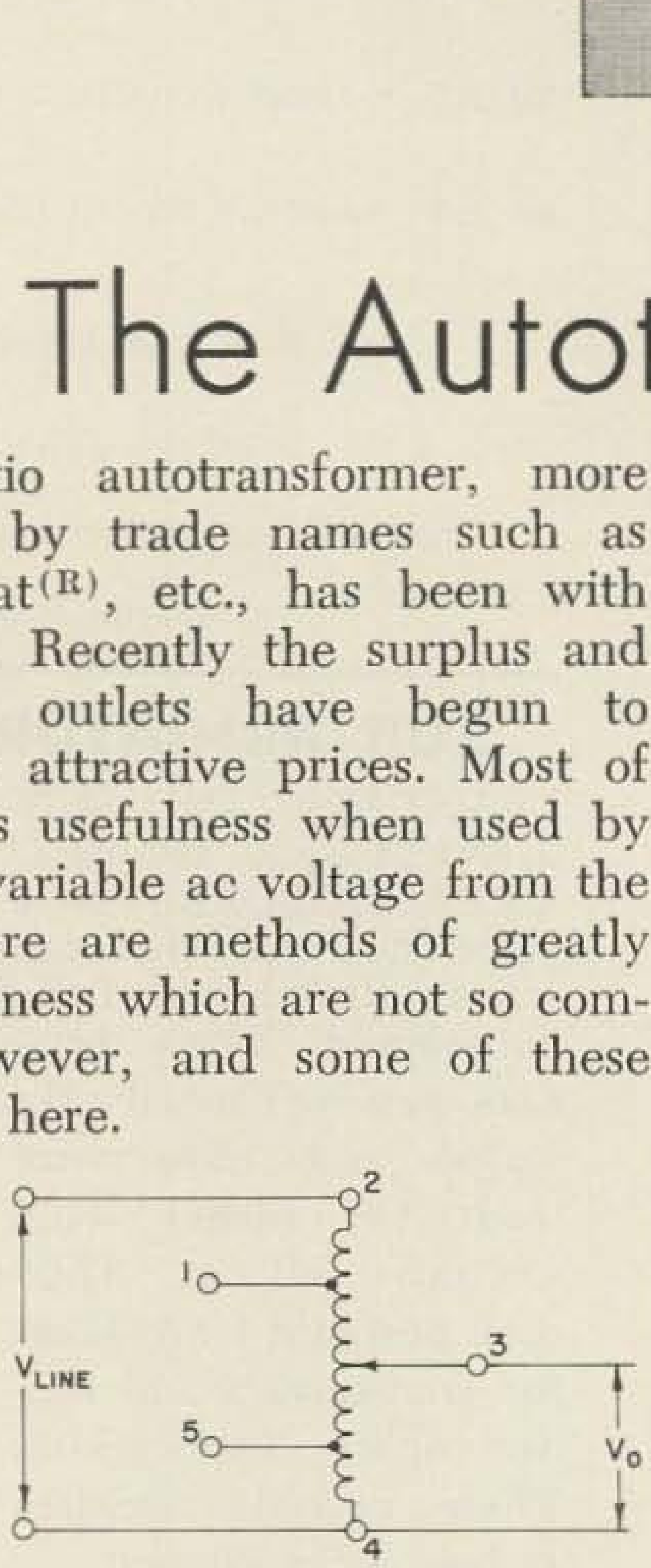


FIG. 2

Fig. 1. Basic variable-ratio autotransformer circuit.
Fig. 2. Illustrating the line-voltage connection.

The Variac

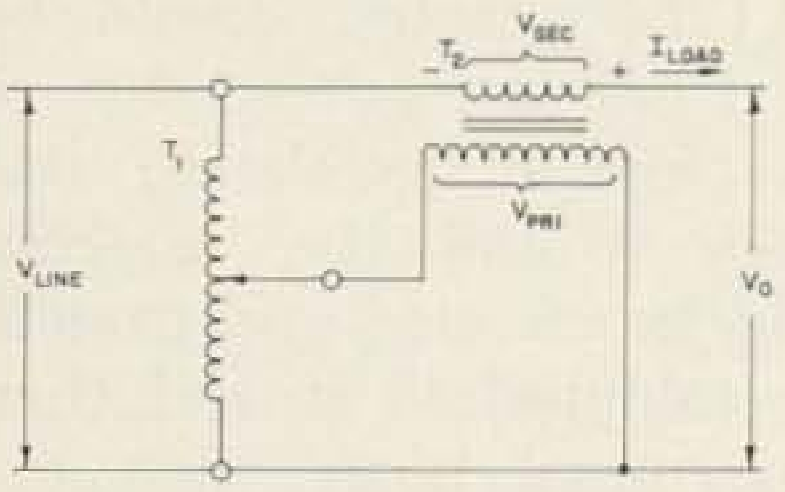
Perhaps we first should know what the variable-ratio autotransformer is and how it works. A note of caution is in order here. In addition to standard catalog models, each manufacturer builds an almost unbelievable number of "specials." Both types often appear later as surplus at very attractive prices. It pays to be sure of what you are ordering, and such information is free for the asking. Although the General Radio Variac(R) will be used as an example, the principles involved will apply to variable-ratio autotransformers of all manufacture.

A cut-away view of a typical Variac appears in the photo. The corresponding schematic diagram appears in Fig. 1. Basically, it consists of a doughnut-shaped iron core on which is a single-layer toroidal winding. The winding is tapped near each end, with the end and tap connections brought out to a terminal plate. The insulation is ground off the winding at one end of the doughnut to provide a track on which a carbon brush makes contact. Electrically, the brush is connected to a terminal on the terminal board. Physically, it is attached to the shaft. The shaft may be rotated through about 320°, sufficient to allow the brush to travel from one end of the winding to the other.

In an autotransformer, the single winding acts as both a primary and the secondary. If the ends of the winding are connected across the power line as shown in Fig. 2, the line voltage will be equally divided by the number of turns. This results in a fraction of a volt across each turn. All the turns are utilized as the primary. The turns across which the output is taken correspond to the secondary of a conventional transformer. The number of these "secondary" turns, each with its volts-per-turn contribution to V_o, is selected by the brush. Thus, as the control knob is rotated, the brush contact traverses the winding, tapping off a portion of the total voltage across the winding, and the output voltage,

V_o, is continuously adjustable from 0 to as large V_{line}. If V_o is taken between terminals 2 and 3, operation is the same except that the direction of knob rotation for increasing or decreasing V_o is reversed. In either case, Fig. 2 illustrates the so-called "line-voltage" connection.

The second basic connection is illustrated in Fig. 3, the "over-voltage" connection. By connecting one side of the input line to the end of the winding and the other side of the input line to the tap near the far end of the winding, V_o is continuously adjustable between 0 and the input line voltage as the brush moves from Tap 4 to Tap 1. As the brush moves from Tap 1 toward the end of the winding labeled 2, additional turns and, thus, additional volts, are picked off. Variacs presently are tapped to provide a maximum output voltage 17% greater than the input voltage with this connection.



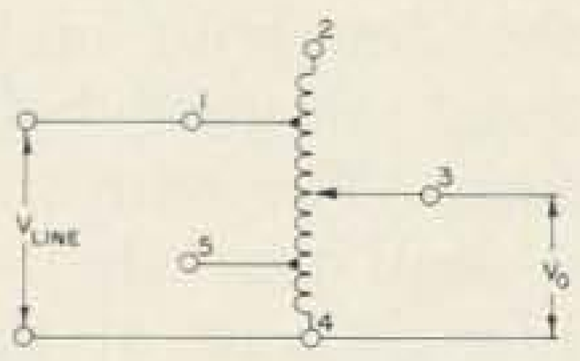


Fig. 4 Fig. 3

Fig. 4. The buck or boost scheme. Transformer T2 effectively multiplies the Variac current capacity and dial resolution.

Fig. 3. Illustrating the over-voltage connection.

In the majority of cases it is not too difficult to determine the necessary ratings. If the Variac is to be used as described, only the line voltage and load current need be considered. The permissible load current is not the same for both connections, being slightly higher for the line-voltage connection. In either case, many times the rated current may be drawn momentarily (such as in motor starting), but brush life will be considerably reduced if the Variac is overloaded for any length of time. Manufacturers usually publish permissible overload data in the form of time-current curves.

The Variac finds innumerable applications in the two connections previously described. Another very useful circuit is shown in Fig. 4. Here the primary of transformer T2 is supplied with the continuously adjustable output voltage of T1. The secondary voltage of T2 is related to its primary voltage by the turns ratio.

$$V_{sec} = \frac{N_{sec}}{N_{pri}} V_{pri} \qquad (1)$$

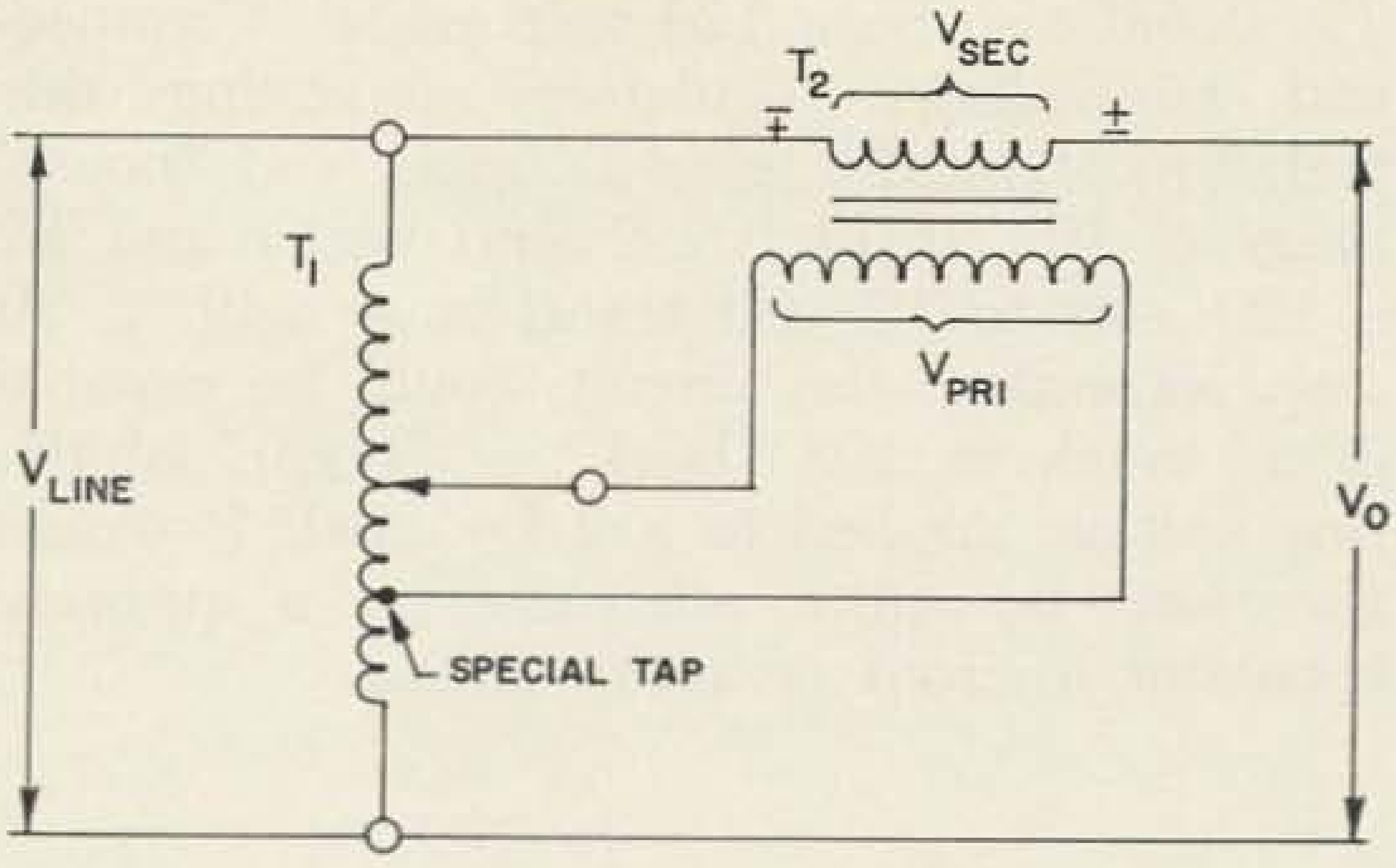


FIG. 5

Method of obtaining both buck and boost operation without switching.

The secondary voltage of T2 is then connected in series between the line and the load. The polarity signs in Fig. 3 are used to indicate that the secondary voltage adds to the input line voltage to give the output, or load voltage.

$$V_o = V_{line} + V_s \qquad (2)$$

Since from simple transformer theory the primary and secondary currents (neglecting losses) of T2 are related by

$$I_{pri} = \frac{N_{sec}}{N_{pri}} I_{sec} \qquad (3)$$

we achieve some rather interesting results. First, if we assume that T2 is a step-down transformer of say 10-to-1 ratio and for T1 connected in the line-voltage connection, V_o may be caused to vary from V_{line} to 1.1 V_{line} as the output of T1 varies from 0 to V_{line}. Thus, we are now able to push V_{line} up by as much as 10%. So what, you say. We could boost the line voltage by as much as 17% by simply using the over-voltage connection on T1 without using T2 at all. True, but the real hooker shows up in equation 3. Plugging in the numbers and turning the crank, we find that the Variac must now supply only 1/10 the load current. Thus, by using the additional transformer, we effectively multiply the current rating of the Variac (and thus the permissible load power) by the inverse of the turns ratio of T2! If we want V_o to be lower than V_{line}, it is only necessary to reverse either the primary or the secondary connections of T2. Simulating line-voltage fluctuations and line-voltage correction are only two of the many applications for this technique. The increased resolution of the Variac dial greatly simplifies the accurate setting of V_o. For a typical application where the line voltage is approximately 120 volts, T1 would also be a 120 volt model. Commercial line-voltage regulators employing this technique typically have a "buck" and "boost" range of 10%. If T1 is a 2 amp Variac and T2 a 120 volt to 12 volt transformer with a 20 amp secondary, this circuit would be capable of as much as 10% "buck" or "boost" of the line voltage applied to a 2 kw load. It would therefore be quite adequate as a primary regulator in front of a full gallon.

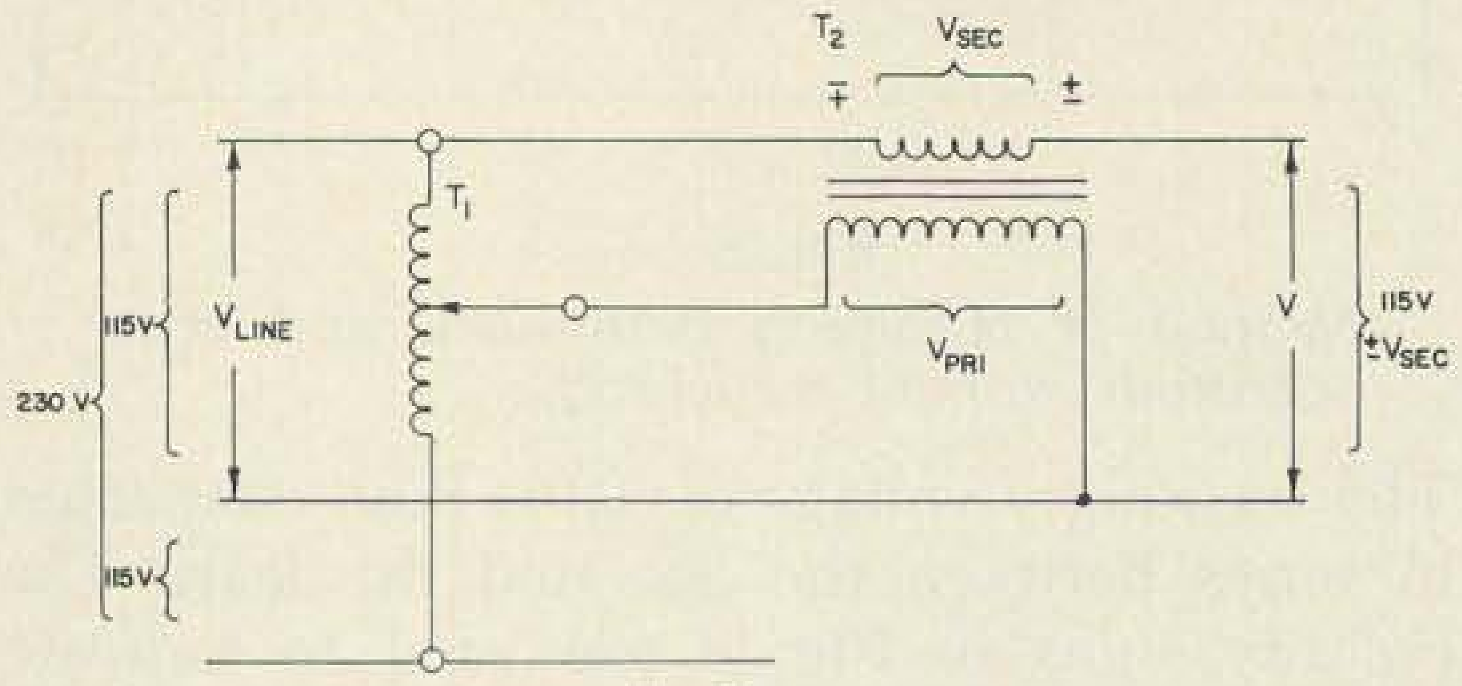


FIG. 6

Buck and boost scheme wherein no tap is required on T1 and T2 may have a 120v primary.

The trouble with most power lines is that the voltage is seldom where it should be, and it is not even there for very long. At best we may consider it usually within a certain voltage range. This may mean that some days you want to "boost" the voltage and other days you want to "buck" it, in which case, reversing the phase of the secondary voltage of T2 (in Fig. 4) could get pretty tiresome. There is a very simple way out as illustrated in Fig. 5. Here we insert a special tap in the electrical center of the Variac winding. Now the voltage applied to the primary of T2 is 0 when the Variac knob is in the center of its travel. Rotating the knob in either direction from this point will increase the voltage applied to the primary. However, rotating the knob in one direction will cause a secondary "buck" voltage, while rotating it the other way will cause a secondary boost voltage. Thus, we get our buck or boost voltage without switching, merely by adding a tap to the center of the Variac winding. Of course, there is a catch to it, and we still don't get something for nothing. Notice that now the maximum voltage we can apply to the primary of T2 is only half the line voltage. If we want to utilize the maximum power capability of T2, we require a transformer with a 60 volt primary winding (when V_{line} is 120 volts). Granted, these are a little hard to come by. Such animals are in existence, and you might be lucky enough to come across one. Otherwise, there are two possibilities if you think the work is worth it. One is to start from scratch and build your own from data such as that given in the Amateur Handbook; the other possibility is to unwind a transformer, such as a large TV power transformer, carefully noting the number of turns on each winding. The primary and secondaries may then be rewound to get exactly the voltages and ratios you want. Again, you should consult the Handbook if you are not sure of what you are doing. One little trick here is to effectively break the original primary in half and then connect the two halves in parallel. It is very important that the number of turns on each half be identical, so you still have to unwind the primary and count the turns. The winding is then broken when rewinding the primary. Tapping the Variac is a very simple operation. Though not essential, the exact center turn of the winding may be located if you're a purist. The center of the winding will be halfway around the doughnut from the terminal board. The turn selected should be lifted carefully away from the outer edge of the doughnut and a piece of insulating material slipped between it and the adjacent turns. The wire should be cleaned and tinned. A lead may then be soldered to it and then brought out at the terminal board.

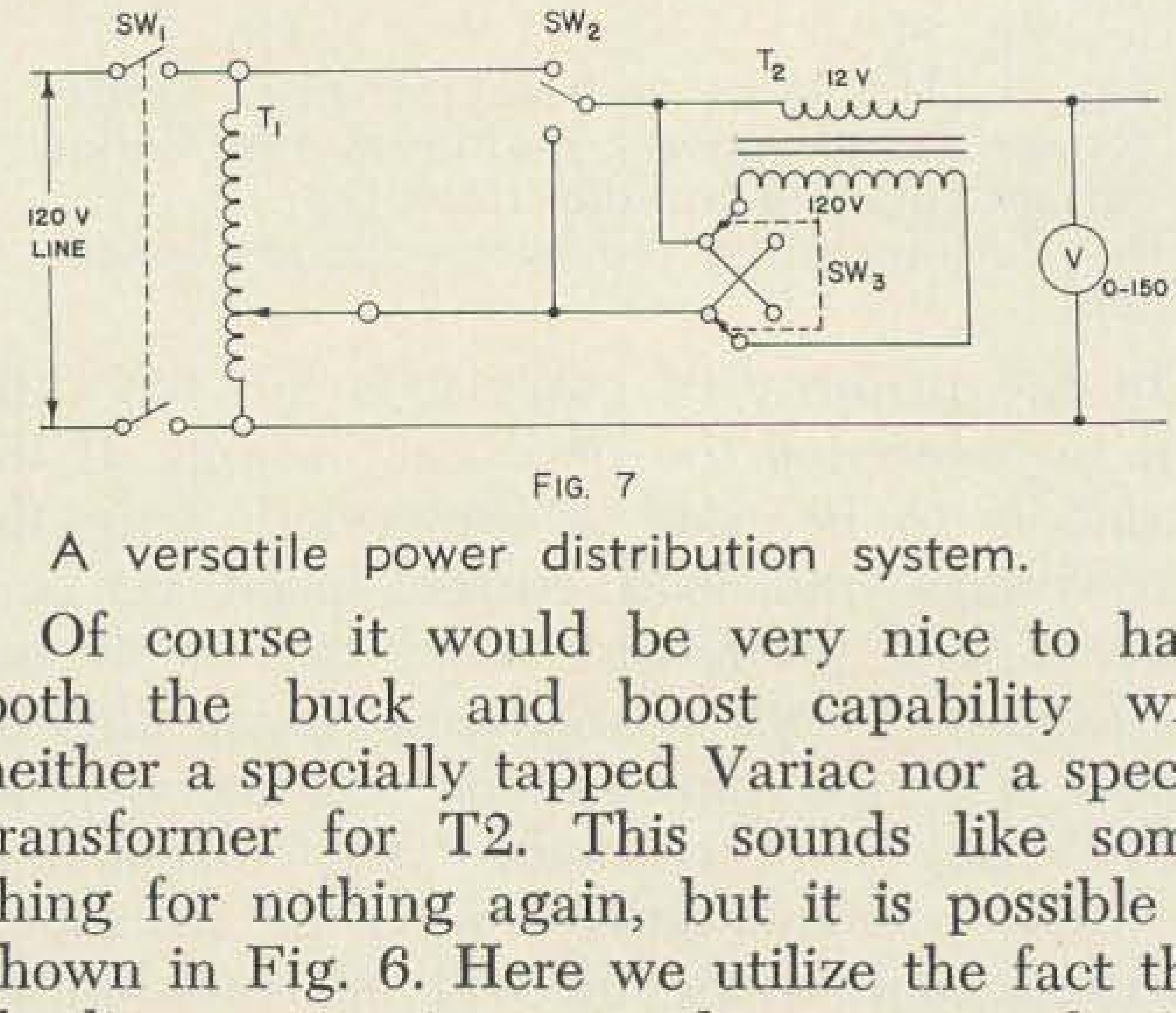


FIG. 7

A versatile power distribution system.

Of course it would be very nice to have both the buck and boost capability with neither a specially tapped Variac nor a special transformer for T2. This sounds like something for nothing again, but it is possible as shown in Fig. 6. Here we utilize the fact that the line coming into most homes is a split 230 volt circuit with a common center. If T1 is now a 230 volt Variac, we may use the center tap on the input line where we formerly required a center tap on T1. Additionally, since the maximum voltage which may be applied to the primary of T2 is again 115 volts, we are back to the garden-variety transformer for the "buck-boost" voltage. Wired as shown, we do get both "buck" and "boost" operation without switching transformer leads. The only problem now is to watch out for the ratings of T1 and the availability of the split 230 volt line. In using such a system, remember there are such things as building codes. As to the rating of T1 and T2, there should be no problem if you just revert back to our simple equations (1 through 3).

A Versatile Distribution System

One fairly useful combination of techniques previously described is illustrated in Fig. 7. In this circuit, T1 is a standard 120 volt Variac and T2 is a 12 volt filament transformer. With SW2 in the position shown, V_o is adjustable from 0 to V_{line}. With SW2 in the upper position, V_o is adjustable from V_{line} to 10% above or below V_{line}, depending on the setting of SW3. This system is quite useful for bench work, and if the loads to be encountered are relatively small, either the "line voltage" or the "over-voltage" connection may be used for T1. Another particularly useful application for this system is for primary power control for a single sideband transmitter. The lower position of S2 permits the dc to be brought up slowly to charge the normally high value of filter capacitance in the power supply. The upper position of S2 then allows the line voltage to be maintained at the desired fixed level. In this application it might be desirable to be able to switch the voltmeter between the input and output line to determine which position of SW3 will be required. Switch SW3 should be set with SW2 in the lower position and T1 set for zero output. This prevents T2 operating as a current transformer and burning up the contacts of SW3. In determining the ratings of T1 and T2, the following should be remembered. With SW2 in the lower position, T1 supplies only the current drawn by the power supply in charging the filter capacitors and to make up for transformer losses. It is the combination of T1 and T2 together as described for Fig. 4 which supplies the full transmitter operating load. Also, remember that the contacts of S1 and S2 must now be capable of carrying the full output-load current.

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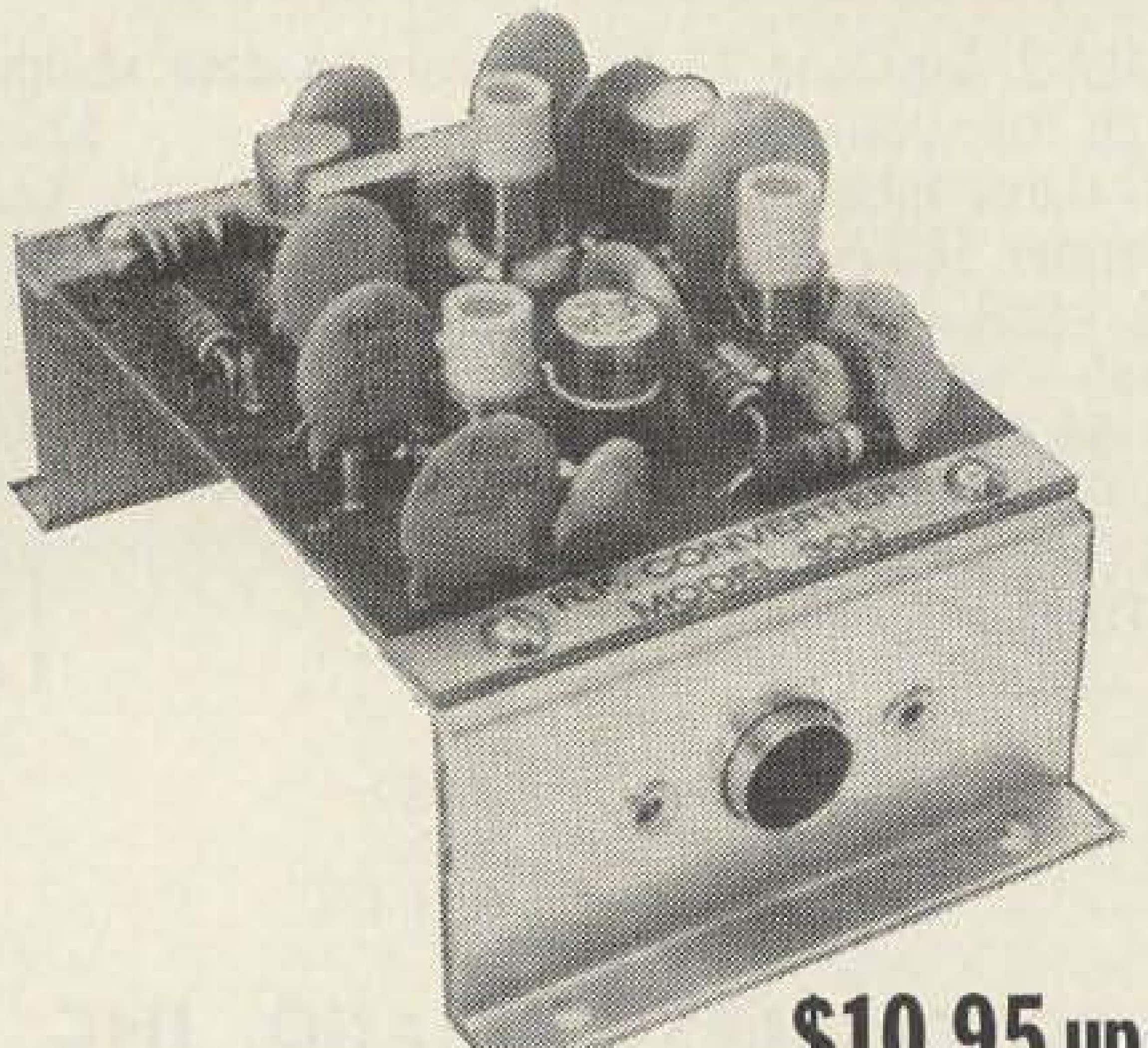
VANGUARD



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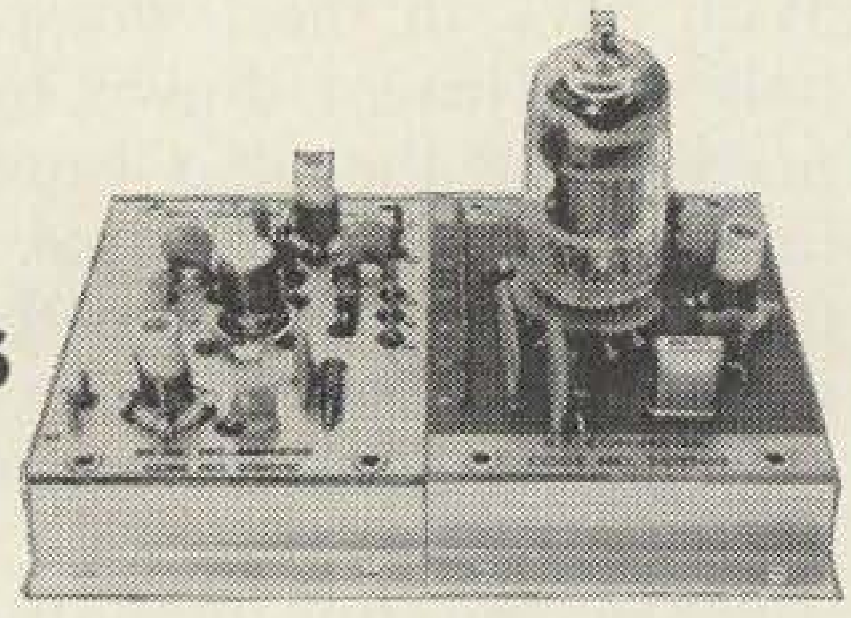

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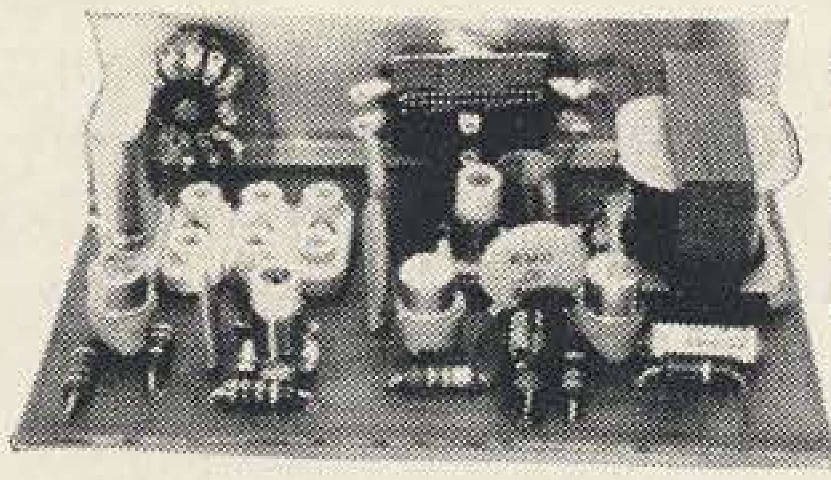

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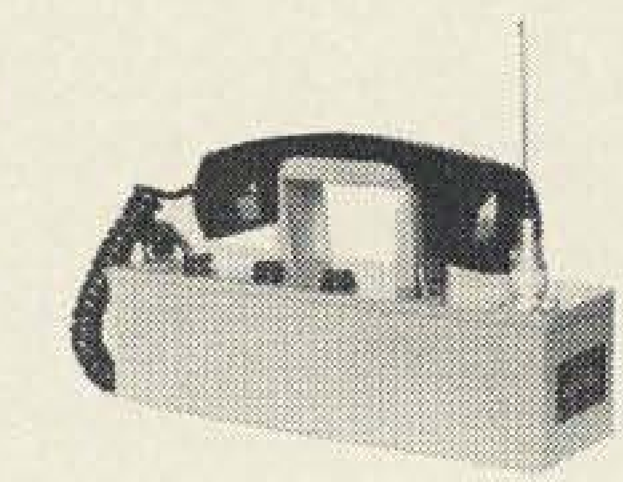

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Bandpass Coupler Design

"Some commercial and amateur transmitters and receivers too have employed 'broadband' tuned circuits, but few articles for home construction incorporate such conveniences. Can you help me find out how to design these?"

That was the gist of a letter from W5TIR, which sparked this article. He commented that he had been totally unable to obtain any data at all—and when we went looking through our reference library, sure enough there was virtually nothing on the subject.

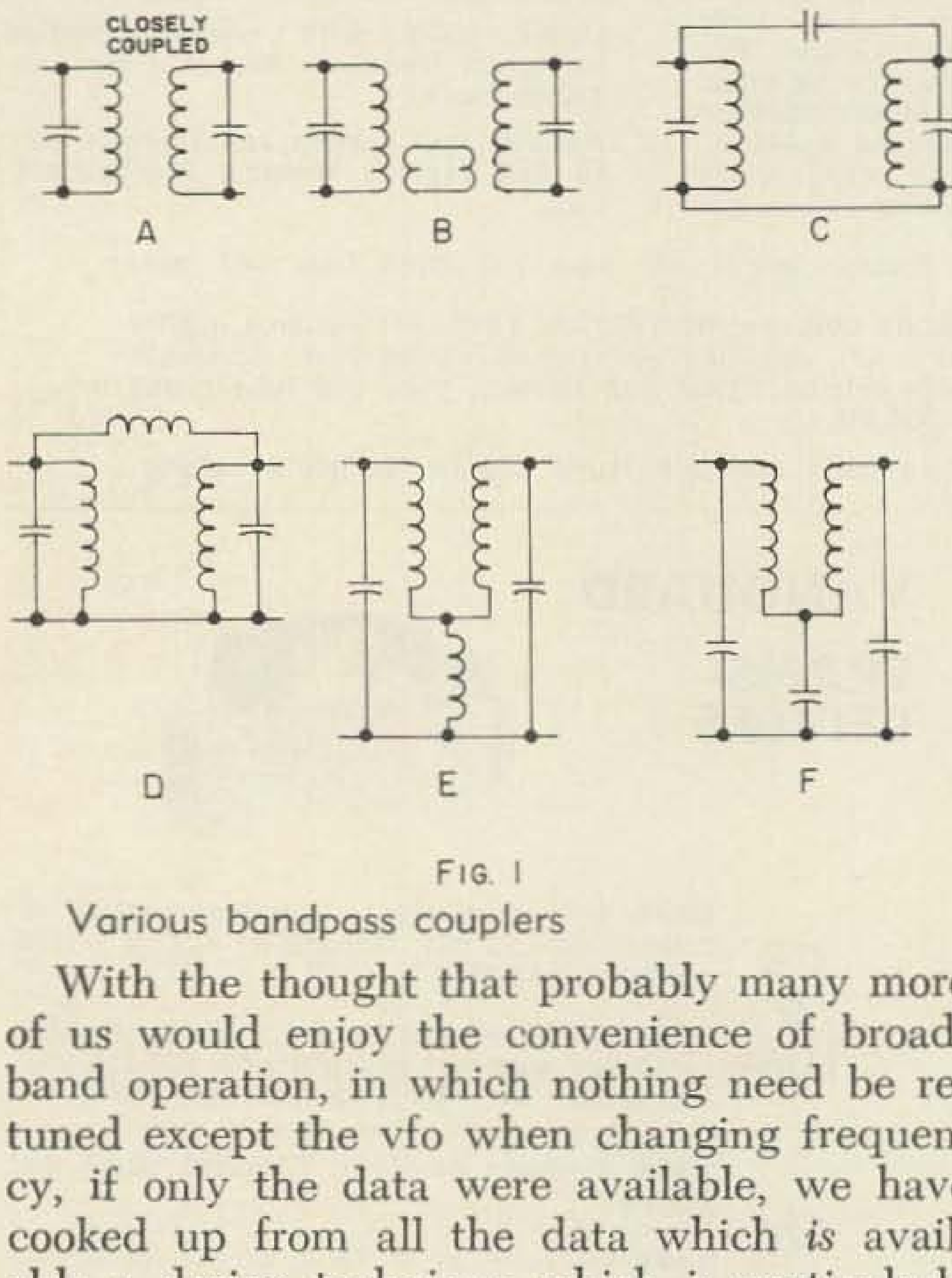

FIG. I
Various bandpass couplers

With the thought that probably many more of us would enjoy the convenience of broadband operation, in which nothing need be retuned except the vfo when changing frequency, if only the data were available, we have cooked up from all the data which *is* available a design technique which is particularly adapted to ham use. It's somewhat involved, but nothing more than ordinary arithmetic need be used to work it out. The result is still subject to a bit of "cut and try", but brings you out closer to target than if no design at all were done in advance. And the result is almost effortless operation, with a bandpass-coupled transmitter.

Before we get into the details of the procedure, let's take a quick look at the various types of bandpass couplers available. All of them are simply overcoupled double-tuned circuits; the differences are in the ways in which the tuned circuits are coupled together.

Fig. 1 shows the six recognized types of bandpass couplers. That at A is both the most widely used and the least simple to work with; it consists of a pair of tuned circuits with only inductive coupling between them. At B is approximately the same circuit except that the inductive coupling has been replaced by a pair of links. Though popular, neither of these couplers lends itself well to predetermined design techniques.

The couplers from C through F may not be so familiar to most of us. They rely upon having a reactive element which is common to *both* tuned circuits, and the coupling factor is determined solely by the ratio of this coupling element to its similar reactances in the rest of the circuitry. For instance, in the top-coupled capacative circuit of C the coupling factor is equal to the ratio of the coupling capacitor to the geometric average of the two tank capacitors. For small coupling, the coupling capacitor must be very small. At D is the top-coupled inductive circuit, while E shows the bottom-coupled inductive circuit.

The one we will be working with, however, is the bottom-coupled capacitive coupler shown at F. This one uses reasonably large-value coupling capacitors (the larger the capacitor, the less the coupling) and is most adaptable to general ham applications. In this circuit, the coupling factor is the ratio of the geometric average of the tank capacitors to the coupling capacitor. If both tank capacitors are equal in value, say C_a, then coupling factor k equals C_a/C_c.

For any of the mutual-reactance couplers to work properly, inductive coupling between the coils involved must be eliminated. This can usually be achieved by mounting the coils at right angles to each other; adding an aluminum shield between them helps too.

The coupling in this circuit works this way: At resonance, circulating current flows back and forth through the input tank circuit made up of L, C_a, and C_c in series. The voltage developed across C_c depends both upon the current and upon the reactance of C_c; the larger the reactance, the less voltage. However, C_c is also a part of the output tank, and any voltage developed across it is also applied across L and C_a (on the output side) in series with each other. This in turn causes current flow, which results in circulating current in the output tank.

TOP RIPPLE	TANK Q	COUPLING FACTOR k	TUNEUP FREQ.	—20 db
0.8 db	$\frac{3(F_h+F_l)}{4(F_h-F_l)}$	1.41/Q	$F_{av}-\frac{F_{av}}{2Q}$	$\frac{11 X F_{av}}{4Q}$
3 db	$\frac{8(F_h+F_l)}{5(F_h-F_l)}$	2.45/Q	$F_{av}-\frac{F_{av}}{Q}$	$\frac{22 X F_{av}}{4Q}$
6 db	$\frac{11(F_h+F_l)}{4(F_h-F_l)}$	4/Q	$F_{av}-\frac{19 F_{av}}{10Q}$	$\frac{27 X F_{av}}{4Q}$

F_h = Upper Desired Frequency Limit
F_l = Lower Desired Frequency Limit
$F_{av} = \frac{(F_h+F_l)}{2}$

TABLE I. Tank Q, coupling factor, tuneup frequency, and —20 db bandwidth for bandpass circuits.

The bandpass action comes from overcoupling of the two tanks. If each tank has the same Q, and coupling factor *k* is less than 1/Q, then the two are "undercoupled" and power transfer will be less than maximum. When Q is held constant and *k* increases (by reducing the value of C_c and returning the tank to resonance) until the product of *k* and Q equals 1, we reach "critical coupling" where power transfer is maximum. As *k* is increased still more, we find a dip in power transfer at the resonant frequency, but two new peaks spaced approximately equally on either side, which are about the same amount of power transfer that we had at critical coupling. Moving out past the peaks, we find power transfer dropping off again; after it passes the resonant-frequency level, it drops rather rapidly. This is the "overcoupled" condition.

By holding the product *k*Q to 4 or less, the "top ripple" or difference between resonant-frequency power level and peak power level can be held to less than 6 db. In the design procedure outlined here, a choice of 0.8 db, 3 db, and 6 db is give for top ripple.

The more violent the top ripple, the narrower will be the out-of-band region. Also, the higher the operating Q must be. In practice, the top rippple of 0.8 db will usually provide plenty of out-of-band rejection while keeping the passband reasonably flat and permitting reasonable values of Q in the tanks. For these reasons, it's recommended that this value of top ripple be used unless there's a special need for one of the other values.

With the circuit of Fig. 1-F, as coupling is increased the lower peak tends to stay fixed in one spot while the upper peak moves higher in frequency. This requires that tune-up of such a circuit be done at a frequency *other* than the generally used mid-frequency.

At this point, we're ready to sneak a look at the design procedure. Basically, we're going to pick a working Q to suit the passband we want, then adjust the value of k to put the passband limits at the right place. It's quite possible for this procedure to dictate an impossibly high value for Q, or an impractically low value. In such a case, you may have to modify either your passband or the level of top ripple.

For the same passband, higher top ripple and higher Q go together. If you design for 0.8 db top ripple and find yourself coming up with a Q of 4.3, you can move to 3 db top ripple and the required Q will increase. Similarly, if you're designing for 6 db top ripple and need a Q of 10,000, moving to 0.8 db top ripple may bring the Q value down to a reasonable point.

For a fixed amount of top ripple, a narrower passband requires higher Q. If Q is too low, you might try settling for a little less bandwidth. If too high, expand the bandwidth.

To use the design procedure, now, we must first decide upon our frequency limits, the amount of top ripple, and the tube operating conditions (plate voltage and current at resonance).

Use Chart 1, the frequency limits, and the top-ripple specification to determine required tank Q. Then use the Q and Chart 1 again to determine k. Finally, with Q and the frequency limits, determine the "tune-up frequency". In the rest of the procedure, when solving for reactance, this will be the frequency to plug into the formula.

Now, with Q and k settled, drag out a big sheet of paper and some sharp pencils. We have some arithmetic to do. There are at least six steps—usually eight are required:

1—Calculate effective load resistance R_1 from the tube operating conditions and the formula $R_1 = Eb/2Ib$.

2—Calculate X_c and X_1 from Q and R_1 by using the formula $X_c = X_1 = R_1/Q/$.

3—Calculate the value of L from X_1, tune-up frequency, and the formula $L = 6.28\ f/X_1$. This is a final value.

4—Calculate C from X_c, tune-up frequency, and formula $C = 1/(6.28\ f\ X_c)$. This is an intermediate value only.

5—Calculate C_a from k and C, and the formula $C_a = (1 + k)C$. This is a final value, including tube and stray capacitances.

6—Calculate C_c from C_a and k, using formula $C_c = C_a/k$.

For those applications in which the input and output see equal values of load resistance, the design is complete at this point. However, in most cases the output load resistance is much less than the input R_1; in such cases, matching is most easily done by capacity taps, and the values of capacitors making up the tap point must be calculated.

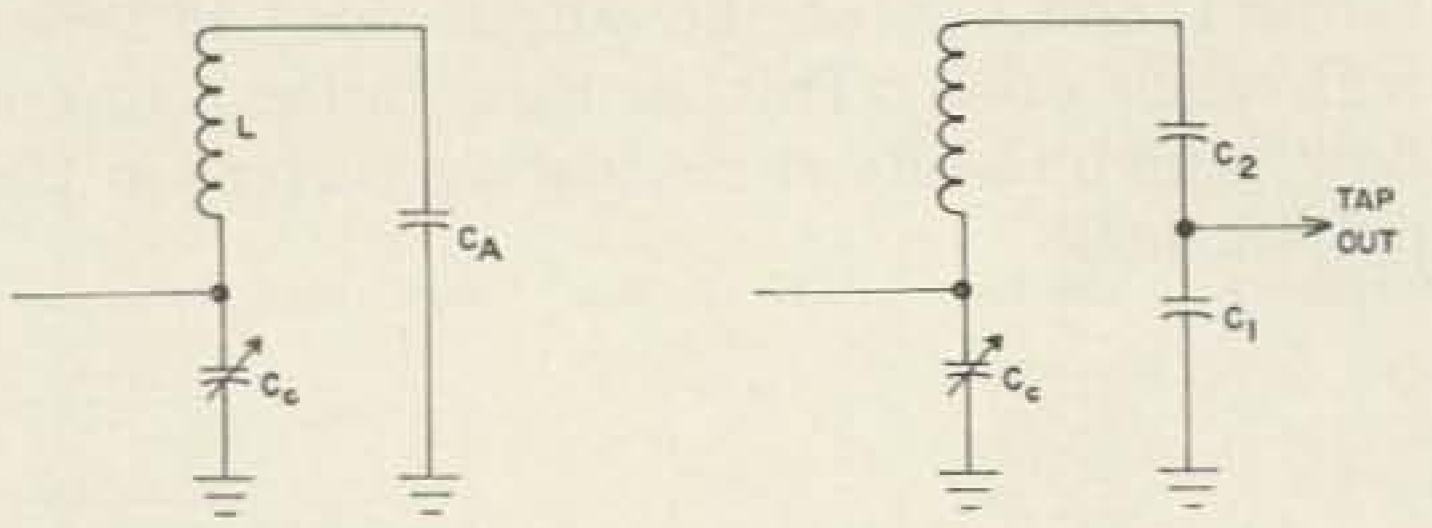

FIG. 2

Output tap

These calculations are done using reactance rather than capacitance values, and the reactances are then converted back to capacitance using the formula of step 4 above. The two reactances which must be calculated are X_1 and X_2 (See Fig. 2).

To find these reactances, we must know the resistance of the load, the R_1 for which we designed the circuit, and the reactance of C_a. The only one of these three which we may not have readily available is the resistance of the load.

If the load happens to be an antenna, its resistance will be known. If it is, however, the grid of a following Class C amplifier stage, we're going to have to find out what the average resistance is. It *won't* be simply the value of the grid leak, though, since the grid draws some power whenever grid current flows.

The simplest way to determine this resistance is to measure the RMS value of the RF grid voltage, and the grid current, then use Ohm's Law in its $R = E/I$ version to get the effective load resistance. RF peak voltage will be approximately equal to the actual DC bias voltage developed; you can take the developed bias and the DC grid current, and you won't be too far wrong. Thus if the next stage develops 90 volts of bias with 3 MA of grid current, the effective resistance is about 30,000 ohms.

Now that we have all three factors known, let's figure the reactances involved. X_1, the reactance of C_1, must be equal to X_{Ca} times the square root of the ratio (R_{next}/R_1). X_2 on the other hand is merely X_{Ca} minus X_1.

If a 50-ohm antenna is to be tapped onto a coupler designed for an R_1 of 2500 ohms, in which the reactance of C_a is 18 ohms, then X_1 would equal 18 times the square root of 50/2500, or 18 times 1/7.1. This comes out to 2.54 ohms. X_2 would then be 18 minus 2.54, or 15.46 ohms.

Should the actual load resistance offered by the next stage be larger than the value of R_1 for which you designed the coupler, then a shunt resistor must be added to reduce the total load resistance to design value. The value of this shunt resistor is found by multiplying the actual load resistance times R_1, then dividing the product by the difference between actual load and R_1. If actual load is 30,000 ohms and R_1 is 2,500 ohms, then R_{shunt} would be $30{,}000 \times 2{,}500/27{,}500$, or 2,730 ohms. A 2700-ohm unit would be suitable.

However in this case most of the power will flow through the resistor, rather than the true load. The ratio of power in the two branches will be the same as the inverse of the ratio of their resistances; if 3.27 watts is flowing in the output of the previous example, 3 watts will be going through the resistor and only 27/100 of a watt will go to the actual load. There's no way around this drawback; the only thing you can do is to change operating conditions of the next stage so that its input resistance is more close to the design value of R_1. For instance, grounded-grid amplifiers always have low values of input resistance.

To see how all this comes together in practice, let's work out an example now. Let's assume that we have a 6146 which we're going to use in a 60 watt (or so) exciter, and we want output essentially constant over the range from 48 to 54 mc. We intend to run 600 volts to the tube, at 120 ma, and it's going to feed a 50-ohm load which will be an antenna from 50 to 54 mc and a flat link to a triper in the 48-49.333 mc region.

We said output should be "essentially constant" so let's use the values for a top ripple of 0.8 db. This varies only about 10 per cent over the passband. With our frequency limits set at 48 and 54 mc, and top ripple set at 0.8 db, Chart 1 gives us a value for Tank Q of ¾ times $(Fh + F1)/(Fh - F1)$. This comes out to be ¾ of $54 + 48/54-48$, or ¾ of 102/6, and a bit of cancellation brings us to 51/4. The slide rule solves this for us and yields a Q value of 12.75.

Now let's get *k*. Chart 1 tells us it's 1.4/Q, so back to the slide rule to find that 1.4/12.75 equals 0.1105.

Now to our six steps of calculation. R_1 comes out to 600/.240 or 2500 ohms. X_c and X_1 come out to 2500/12.75 or 197 ohms. To get L we must know the tune-up frequency, which in our case is 52–52/25.5) or 52–2.04, or 49.96 mc. Plugging this into our equation for L gives $6.28 \times 49.96/197$, or 0.62 microhenries.

Using X_c and tune-up frequency we find that C is equal to $1/6.28 \times 49.94 \times 197$, or 16 mmf. C_a equals 1.1105 times 16, or 17.8 mmf, while C_c equals 17.8/0.1105 or 161 mmf.

Since we're feeding a 50-ohm load and R_1 is 2500 ohms, we must calculate X_1 and X_2 also and obtain from them values for C_1 and C_2. For X_1 we plug in values: reactance of C_a is 176 ohms at tune-up frequency, so X_1 equals 176 times $(50/2500)^{1/2}$ or 176/7.1, which comes out to be about 24.8 ohms. X_2 is simply 176 minus 24.8, or 151.2 ohms. Capacitances equal to these reactances at tune-up frequency are 127 mmfd for C1, and 20.8 mmfd for C2.

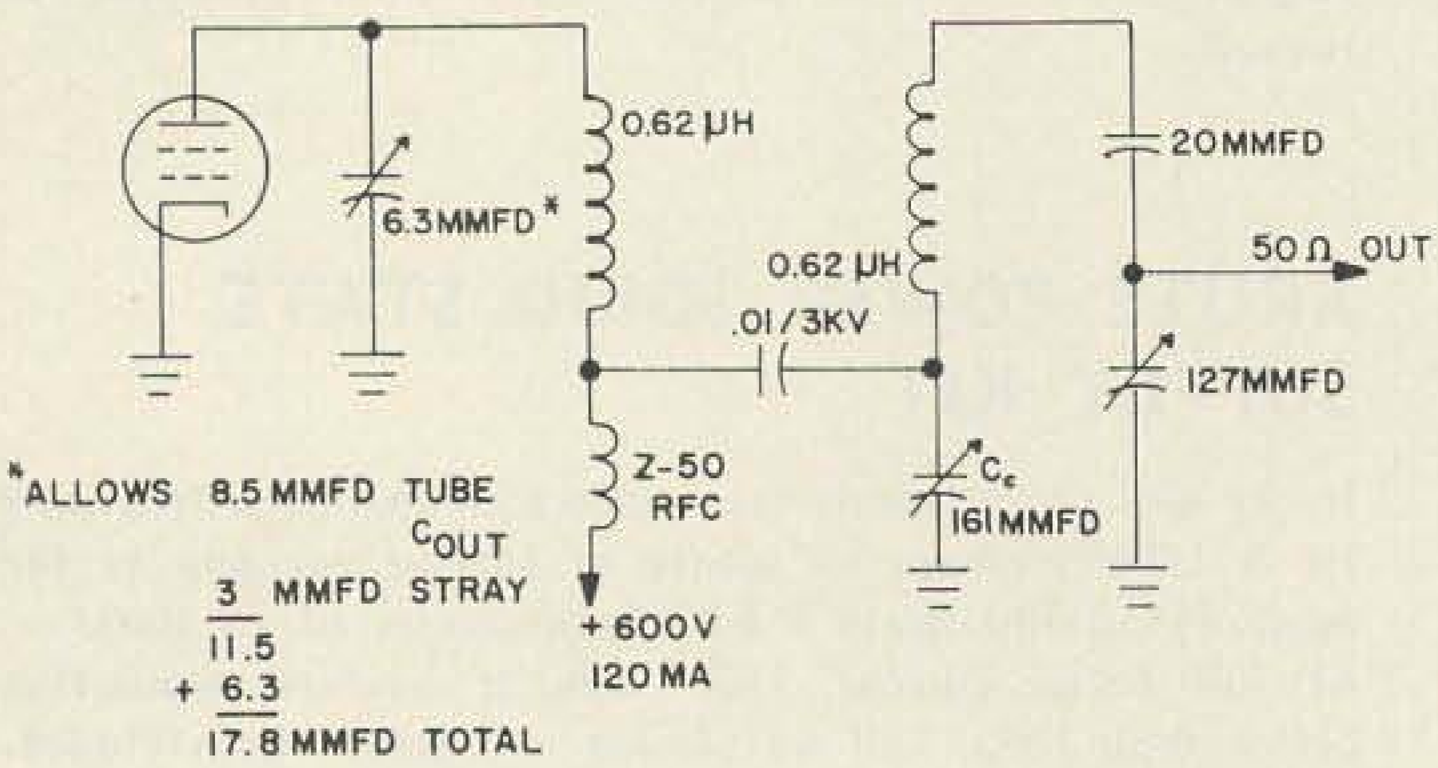

FIG. 3

Sample design

The completely designed circuit appears in Fig. 3 with all component values marked.

Once designed, a bandpass coupler of this type is simpler to tune up than a conventional single-tuned circuit. Start by setting all adjustable elements as closely as possible to the calculated values, with the exception of C_c. This one should be set to maximum, and then shorted out with a very short jumper wire as well. Feed in some drive at tune-up frequency, and adjust either C_a or L (on the input side) for the best possible dip. This should be a very small adjustment; it's better to adjust C_a if you're reasonably certain that L is at the design value, since C_a is affected by stray capacitance which cannot be estimated accurately. The dip should be deep and you should find no trace of output on the far side of the coupler.

Now unshort C_c but don't change any other settings. Adjust the output-tank tuning in the same manner for a peak in output. C_2 is the one to adjust on this tank if you're reasonably sure of the setting of its inductance.

Next step is to "rock" the drive frequency by about 10 per cent either way to make sure that you have only one peak in the output, and that it's at tune-up frequency. If you have two peaks, add some temporary shunt capacitance across C_c and repeat the output tank tuning adjustment. The dip in plate current should still be fairly sharp and output should be very small.

Now return to tune-up frequency and reduce the setting of C_c until plate current reaches design value. Rock drive frequency across the entire passband. You should have a peak at tune-up frequency and a slight (about 10 per cent) dip in output at the frequency midway between band limits. Another peak should be present as far above mid-frequency as tune-up frequency is below that point, and output at the band limits should equal that at mid-frequency. If all these conditions are met, tune-up is complete.

However, don't be disappointed if it doesn't quite work out this way first time around. As we said at the start, some cut and try is still necessary.

If the peaks are less than 10 per cent above mid-frequency output and the output at the band limits is down below that at mid-frequency, coupling is too loose. Reduce the setting of C_c a bit more until output at both band limits and at midfrequency are all equal. Output at tune-up frequency should then be 0.8 db higher.

If the peaks are too high and the band is too wide, the coupling is too great. Increase the capacitance of C_c and recheck.

If peaks are too high and the band is too narrow, the Q of the circuit is too high and the coupling is also off. Increase coupling until plate current is correct. If band is still too wide and peaks too violent, return to original settings and shunt both tanks with equal-valued resistors to reduce Q a bit. This is pure cut-and-try, but start with high-valued resistors and work down until things smooth out. You really shouldn't run into this problem unless your slide rule slips a cog (as ours does now and then), in working the arithmetic.

Peaks too low and the band too wide indicate Q lower than design value. Increase circuit capacitance at C_a and C_2 and retune L to resonance. This will require reworking the design equations if the changes are very large.

While our entire approach in this article has been toward use of bandpass couplers in transmitters, they are equally applicable to receivers, especially in the signal-frequency stages and *if* output stages of vhf converters. The same principles apply except that the value of R_1 must usually be fixed by a composition resistor across the tank on each side. This resistor appears in parallel with the output impedance of the tube on the plate side and with the input impedance of the following tube—and at vhf input impedance of some more popular tubes can get below 1000 ohms. Best bet here is to shoot for a practically realizable impedance level; this is usually found with a top-ripple factor of 0.8 db. Though out-of-band rejection won't be quite as good as with higher top-ripple factors, it will still be better than with single-tuned circuits. For instance, a 50-54 mc bandpass coupler with 0.8 db top ripple is only 15 mc wide (total) at the −20 db points, and if three of these couplers are cascaded as they would be if used between antenna and first rf, first rf and second rf, and second rf and mixer, then by the time signals reach the mixer the bandpass will be 60 db down 7½ mc either side of 52 mc. This is more than adequate for good image rejection if the output *if* is at least 4 mc or more.

For more information on double-tuned circuits, see references below. . . . K5JKX

References

F. Langford-Smith, Radiotron Designers Handbook, RCA, pages 412 through 422.
IT&T, Reference Data for Radio Engineers, 4th edition, pages 236 through 246.
F. E. Terman, Electronic and Radio Engineering, McGraw-Hill, 4th Edition, pages 63 through 74.

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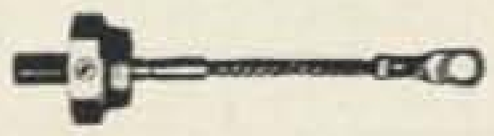

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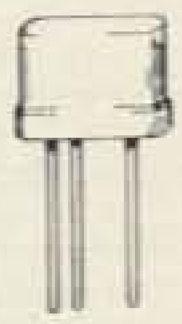

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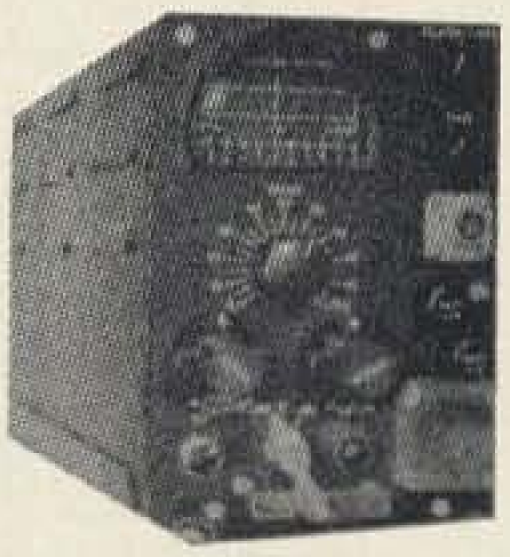

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HAWAII	14	7#	7	7	7	7	7	7	14	14*	14	14
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MEXICO	7	7	7	7	7	7	7	14	14	14*	14*	14
PHILIPPINES	14	7#	7#	7#	7#	7	7	7	7	7#	7#	7*
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SOUTH AFRICA	7	7	7	7	7#	7#	14	21	14*	14	14	7#
U. S. S. R.	7	7	3.5*	3.5	3.5	3.5#*	7#	14	14	7#	7#	7
WEST COAST	14	7	7	7	7	7	7	14	14	14*	14	14

CENTRAL UNITED STATES TO:

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AUSTRALIA	21*	14	7#	7#	7#	7#	7#	7	14	14	14	21
CANAL ZONE	14	7	7	7	7	7	7	14	14*	21	21	14*
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SOUTH AFRICA	14	7	7	7#	7#	7#	7#	14	14	14*	14	14
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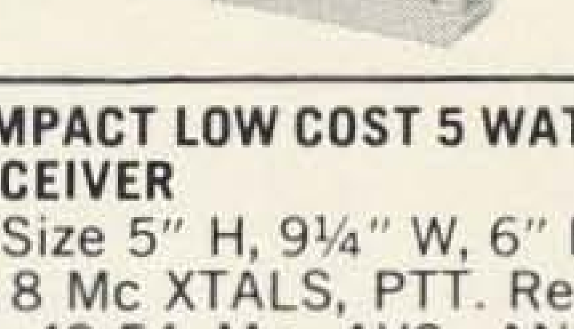

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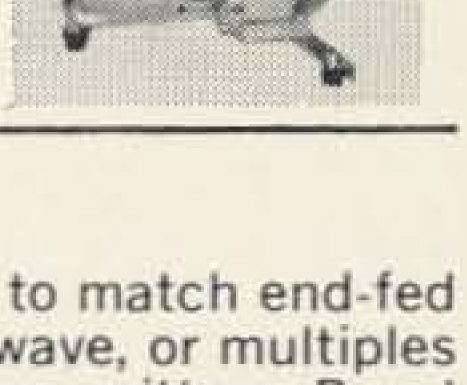

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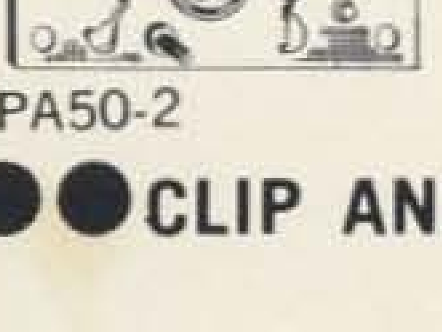

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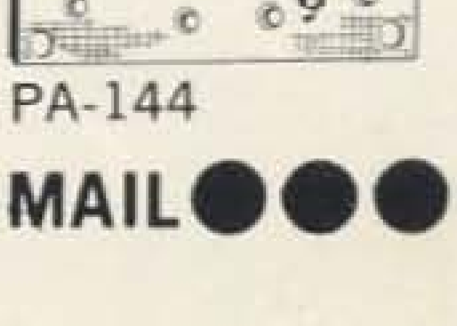

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