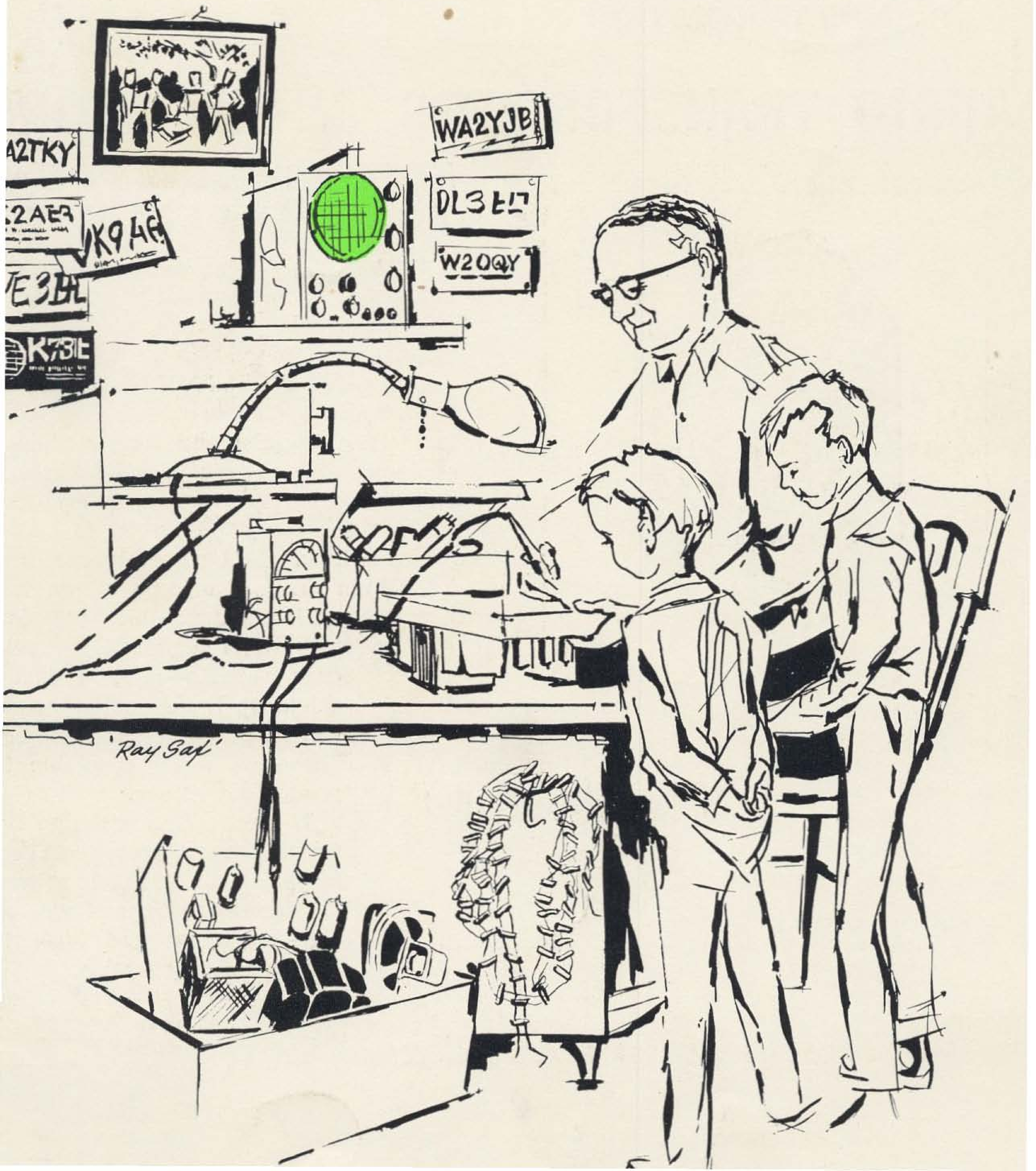
73 Amateur Radio

March 1965

40c



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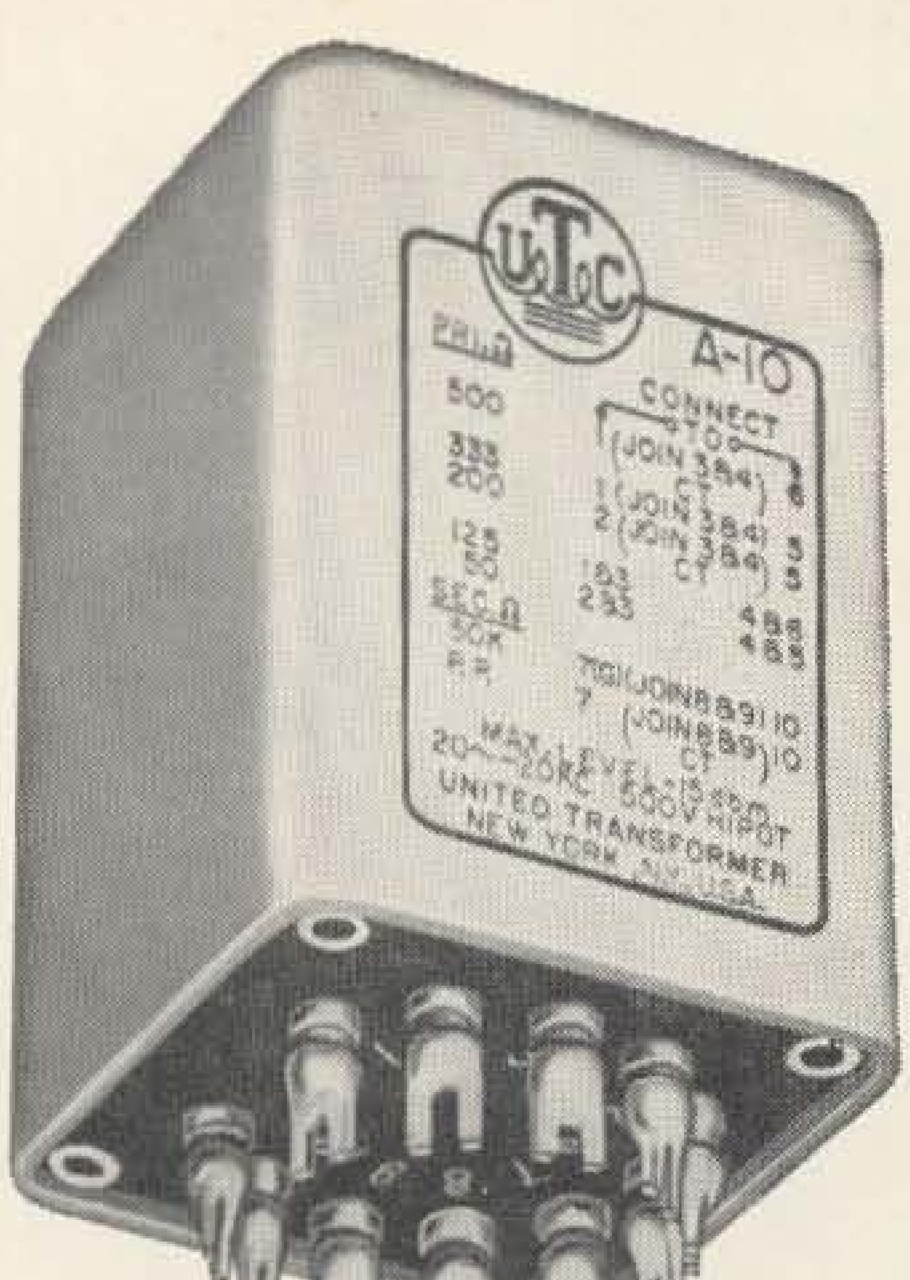
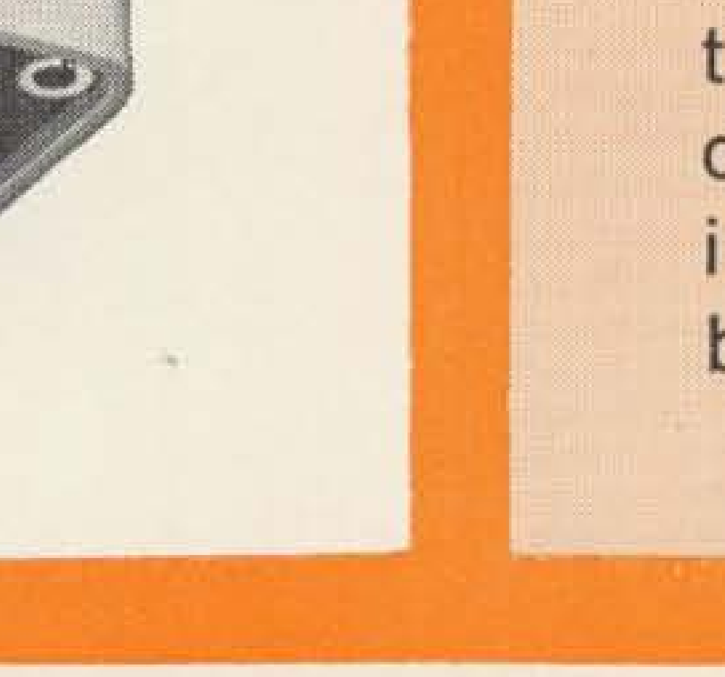


TYPE A CASE

Length	1½"
Width	1½"
Height	2"
Mounting	1$\frac{5}{32}$" sq.
Screws	4-40
Cutout	1⅜" dia.
Unit Weight	½ lb.



Hipermalloy Shield (A-33) shown slipping over "A"-line unit

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'73

..agazine

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..ostmaster: please send form 3579 to ..3 Magazine, Peterborough, New ..ampshire. All those interesting ..ds and here you are wasting your ..ime with the small print!

Docket 15640 (Conditional Class Modifications has been adopted by the FCC. More on thi next month.

de W2NSD/1

never say die

Flying Sorcerers

All us lunatic fringe types have been sort of keeping track of the flying saucer disturbances. While never an avid saucerite, I have read a few of the books and listened to radio interviews with some of the "experts" and crackpots who have been taking the subject seriously. By bringing up saucers whenever I am in intelligent company I have gathered some interesting facts and surmises.

Thus it was not entirely out of character for me to bring them up during a slight lull while lunching with the Institute Interim Directors in Washington in late December. All of us seemed to feel about the same . . . open minds on saucer existence and wondering why, if they do exist, wo don't hear more about them.

One director was coming down with a cold that day and was away from work sick for the next few days. The first day he was back at work he was called to the office window by a friend and there were six saucers flying at about 10,000 feet right over Washington. All six people in the office crowded to the window and watched them proceed at a good clip across the sky and out of sight. Then six more came zipping across as they were frantically phoning friends to take a look. Quite a few people saw them quite clearly.

When they started trying to tell about it they found out why we hear so little about saucers. The Washington papers didn't want to touch the story. One TV station put on an interview with one of the six and high government pressure was immediately put on him and the other observers to keep quiet about everything. It is so ridiculous that I hesitate to report it, but they were told that the sight they had seen was classified since they had been in a government office building looking through government windows.

The motive behind all this hush-hush seems to be one of keeping the populace from a panic, not military secrecy. The government is haunted by the reaction to the Orson Welles radio program back on Halloween eve, 1938 when he dramatized the H. G. Wells fantas "The War of the Worlds." Thousands we hysterical . . . a woman in Pittsburgh w stopped as she prepared to take poison, sa ing, "I'd rather die this way than that."

Balderdash. A nation that has been able calmly accept the news that their almost un versal and virtually unshakable habit of smol ing cigarettes is inexorably leading them an early and extremely painful death certainl has the stamina to accept the no doubt hic eous monsters that are peering over ou shoulders.

Perhaps by next month we'll be able t struggle through the Pentagon red tape enoug to bring you a story from a very convince saucer fan, one of our Washington Institut Directors.

News Flashes

Just as I predicted, ARRL membership ha dropped off again in 1964 . . . even wors than it did in 1963. The membership seem to have dropped from some 84K down t under 79K, about 5000! One might suspec that something is wrong when they see th League fading away while the number o hams is ever increasing. One would be right

Of course the report from CQ is about th same. Perhaps this is an indication that thei coat-tail position to ARRL has not been a successful as they hoped. At any rate thei year end report for 1964 showed a drop o about 6000 copies average over a six month period! That, for your information, is one heck of a drop.

While CQ and QST were dropping in popularity I am happy to report that 73 has been steadily increasing, with an overall 10% growth for the year.

Monitor Expires

The Monitor has, alas, demised. The Monitor went along smoothly and calmly for many years providing operating news for hams in the Southwest and was gradually growing to serve most of the country. Then along came ARRL's submission of RM-499. The explosion of ham opinion against this high handed affair

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FM-5000 with batteries, accessories and complete instruction manual, less oscillators, and crystals. Shipping weight: 18 lbs. Cat. No. 620-103 . . . . . $375.00
Plug-in oscillators with crystal $16.00 to $50.00

FO-2410

C-12B FREQUENCY METER For Citizens Band Servicing

This extremely portable secondary frequency standard is a self contained unit for servicing radio transmitters and receivers used in the 27 mc Citizens Band. The meter is capable of holding 24 crystals and comes with 23 crystals installed. The 23 crystals cover Channel 1 through 23. The frequency stability of the C-12B is ± .0025% 32° to 125°F, .0015% 50° to 100°F. Other features include a transistorized frequency counter circuit, AM percentage modulation checker and power output meter.

C-12B complete with PK (pick-off) box, dummy load and connecting cable, crystals and batteries. Shipping weight: 9 lbs. Cat. No. 620-101 . . . . $300.00

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C-12 complete, but less crystals. Shipping weight: 9 lbs. Cat. No. 620-100 . . $69.50

C-12M FREQUENCY METER For Marine Band Servicing

The International C-12M is a portable secondary standard for servicing radio transmitters and receivers used in the 2 mc to 15 mc range. The meter has sockets for 24 crystals. The frequency stability is ± .0025% 32° to 125°F, ± .0015% 50° to 100°F. The C-12M has a built-in transistorized frequency counter circuit, AM percentage modulation checker and modulation carrier and relative percentage field strength.

C-12M complete with PK (pick-off) box and connecting cable, batteries, but less crystals. Shipping weight: 9 lbs. Cat. No. 620-104 . . . . $235.00
Crystals for C-12M (specify frequency) $5.00 ea.

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erupted into the pages of The Monitor, gra ually easing out the operating news. On three amateur publications dared print pr and cons of 499: 73, The Moniter and K6BX Newsletter. The war was on. Tremendous pre sure was brought to bear by the League an soon all three of us began to find that a fe of the major advertisers were avoiding u The Monitor was forced under, K6BX w forced out of CQ and a few of the maj advertisers are conspicuous be their absen from 73. Fortunately we do not have to rel on ARRL's unofficial Board of Directors f our survival . . . the advertising results 7 provides bring us the smaller companies i a goodly number. For instance, one maj distributor wrote a few days ago to tell u that his ad in 73 outpulled his ad in QST b four to one . . . and I can't tell you wh another said about CQ. There I go gettin lousy again. But I'm angry . . . The Monit was doing our hobby a lot of good and hate to see them stamped out by Big Brothe

True or False?

One reader has written in to tell me that m long time friend and confidant Harry Dannal W2TUK, in the heat of the political race fo ARRL Director of the Hudson Division, ha intimated at ham club meetings that his op ponent Howard Wolfe W2AGW is a Com munist and, even worse, that he is someho connected with me.

We would all like to hear more about th million dollar libel suit that Huntoon is ru mored to be fighting . . . and to know who i footing the bill for the very expensive la firm supposedly representing him? Does thi come out of that hundred thou?

I am given to understand that W1AW i still in full operation even though such opera tion is now obviously illegal with paid opera tors and absentee licensee. Tsk, tsk.

And what will happen to the QST ad rate now that the Internal Revenue Service ha decided that the advertising revenues of mag azines such as that are taxable? Another rat increase in the works? It would be a sham for QST to have to compete with us taxpayer on an equal footing and not reap their fan tastic tax advantages because they spend abou 10% of their income on public service.

Many of us are wondering who the Leagu will hire for public relations to help improv their image after the jolt it received ove RM-499 . . . we hear they are looking. Per haps this would help stop the reported alarm ing drop in membership.

Continued on p. 86.

from 2 to 160 meters

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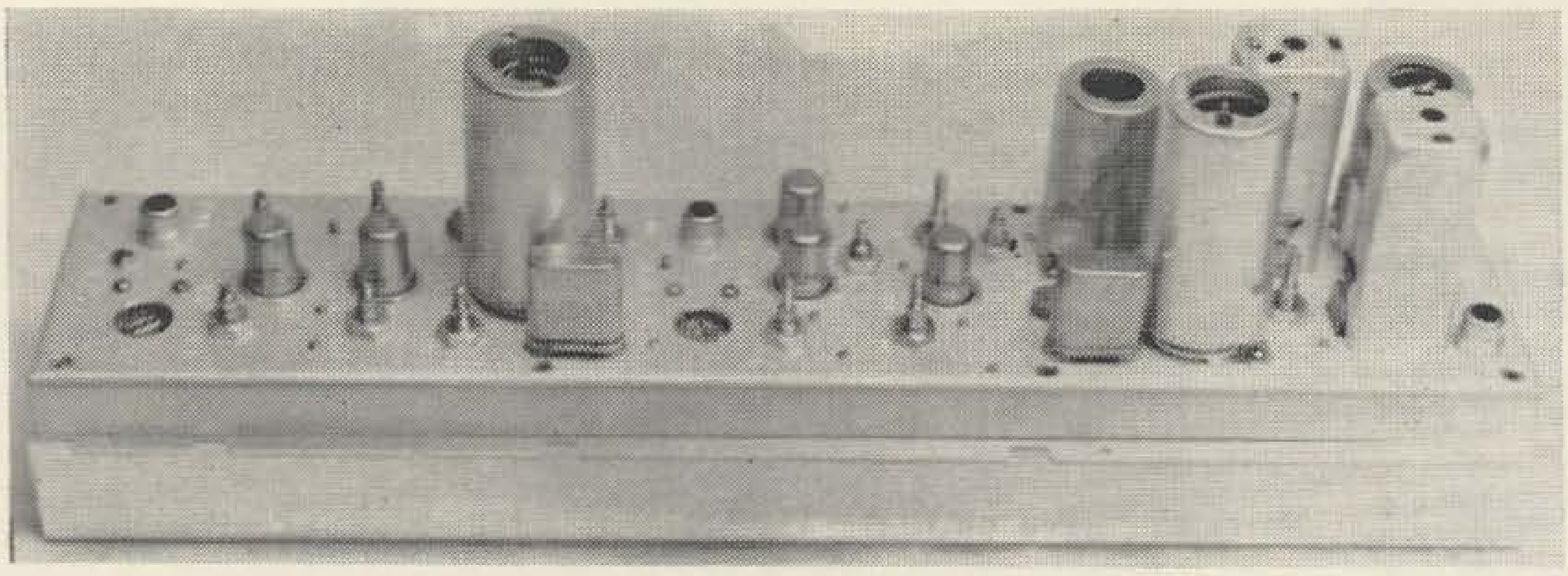


John Wonsowicz W9DUT
4227 N. Oriole Ave.
Norridge, Illinois

Photo work by W9JFW John R. Wonsowicz

Dual VHF Converter

The Nuvistor converter about to be described was designed for a critical vhf man. This converter has a good noise figure, ample gain and bandwidth, and is also economical to build. The dual converters reduce costs and space appreciably over two single converters.

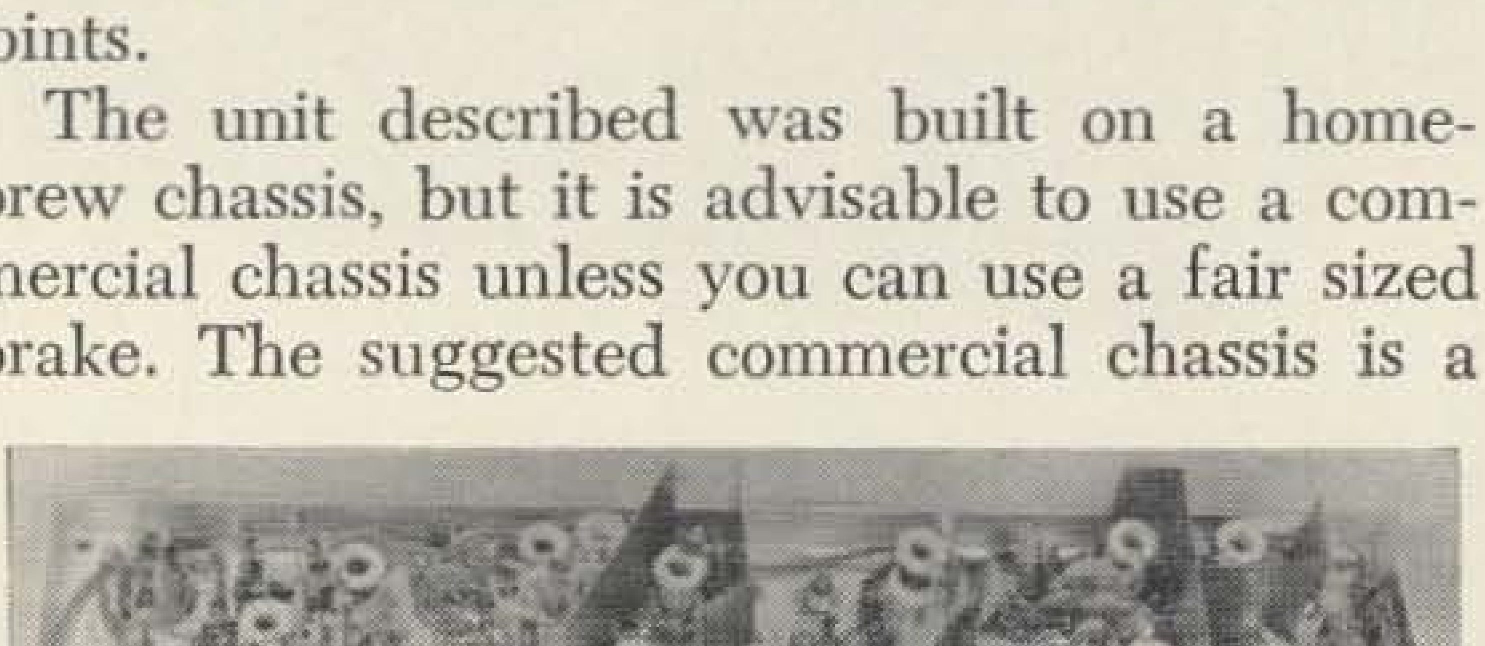
On 220 mc the noise figure is between 3 and 4 db; over-all gain is 60 db; and the bandwidth is within 2 db of being flat from 220 to 225 mc.

On 144 mc the noise figure is between 2 and 3 db; over-all gain is 50 db and the bandwidth is ±1 db over the tuning range of 144 to 148 mc. Sensitivity in both units is .1 microvolts.

Construction

Follow the schematic and parts layout closely and you should encounter no trouble. If difficulty is found in either of the converters, a close recheck of components and wiring in each stage should uncover the fault. Usually a mere oversight by an impatient builder causes disappointment, so double check all components and examine all connections for cold joints.

The unit described was built on a homebrew chassis, but it is advisable to use a commercial chassis unless you can use a fair sized brake. The suggested commercial chassis is a Bud CU-3014-A Minibox that measures 12″ × 2½″ × 2¼″ and is made of natural aluminum. Use the "narrow sides" section as the chassis and the "wide sides" part as the cover or bottom shield.



Bottom view of converter.

The drilling template was made for this module showing the Bud chassis. The photos show the placement of components.

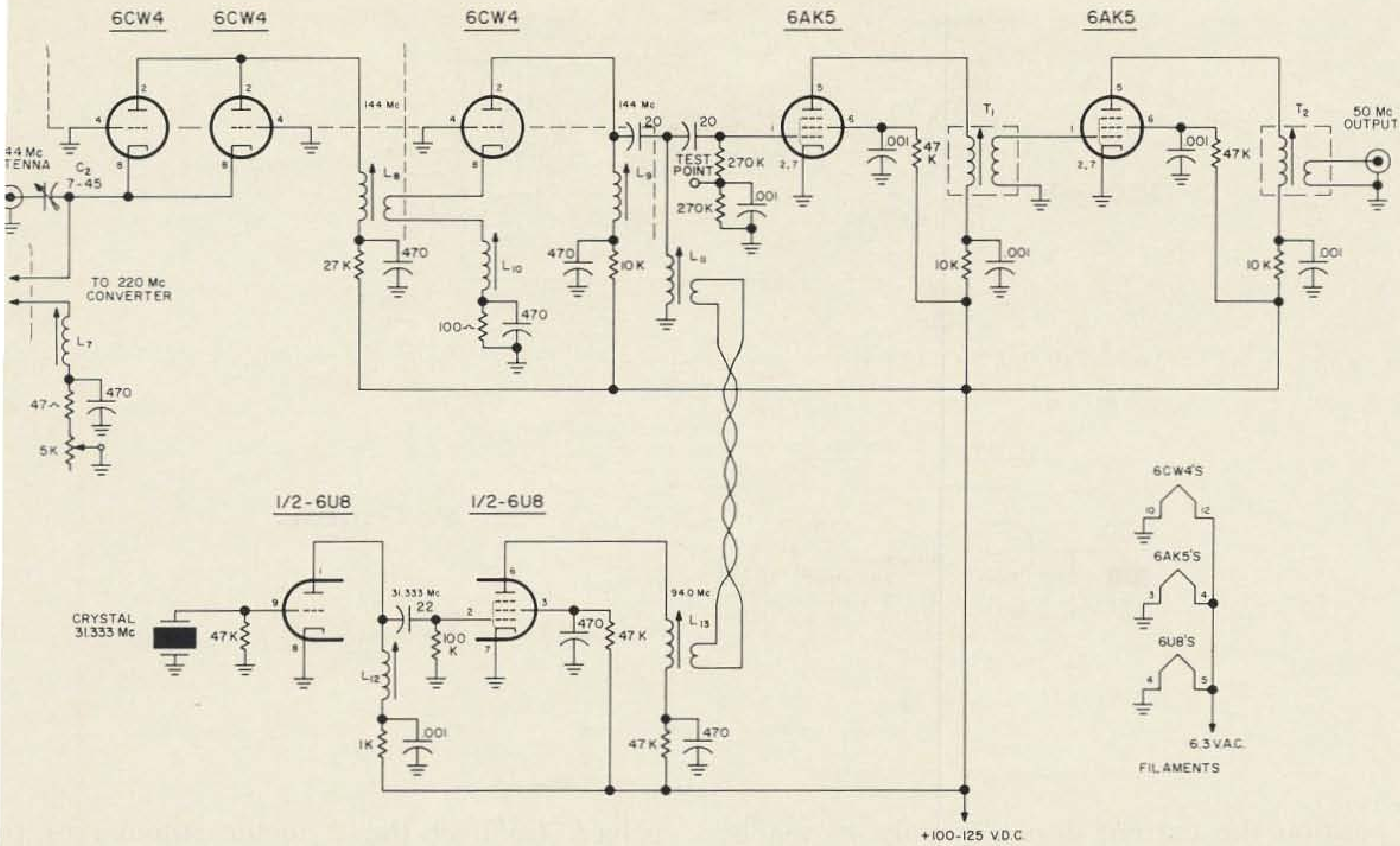
Circuit

The 220 mc converter has a 144 mc output that feeds into the cathode of the tandem 6CW4 Nuvistors of the 2 meter converter. The first Nuvistor in the 220 mc section operates as a grounded grid amplifier and the signal is fed to the cathode through a ceramic trimmer. Signal output is taken at the plate through a link and fed to L3 which is the grid coil of the second 6CW4 used as a triode mixer. You will notice that shields are provided between all 220 mc tuned circuits to prevent regeneration.

Needless to say, the gain of one grounded grid stage and a triode mixer is not very high. However, the signal is amplified sufficiently by the following 2 meter converter.

The local oscillator tube is a 6U8. The triode section is a crystal oscillator with its plate tuned to 25.333 mc. The pentode section of this tube is the tripler to 76 mc. The output of this section is coupled to the grid of the mixer by a 3 pf ceramic capacitor.

In the 144 mc section, we start with a link in series with the cathode coil of the tandem rf stage Nuvistors. The antenna is fed through a ceramic trimmer to the high side of



144 Mc CONVERTER

Coil Data
All coil forms—J. W. Miller No. 41A000CBI

No.	Freq.	No. Turns	Wire	Winding	Remarks
1	220 MC.	2½ T	#22	Spaced 1w dia.	
2	"	2½ T	#22	" "	3T. Link
3	"	3 T	#22	" "	3T. "
4	144 MC.	4½ T	#24	" "	
5	76 MC.	6 T	#24	Close wound	
6	25.3 MC.	20 T	#28	" "	
7	144 MC.	3 T	#24	Spaced 1w dia.	
8	"	4½ T	#24	" "	3T. Link
9	"	6 T	#24	" "	
10	"	4 T	#24	" "	
11	"	4½ T	#24	Spaced 1w dia.	3T. Link
12	31.3 MC.	16 T	#26	Close wound	
13	94. MC.	6 T	#24	" "	3T. Link

TI = J. W. Miller I.F. Trans. No. 6233 Modified 45.5 MC TV Trans. (remove 3 turns from coils).
T2 = J. W. Miller Trans. No. 6231 Modified 44 MC TV Trans. (remove 3 turns from coils).

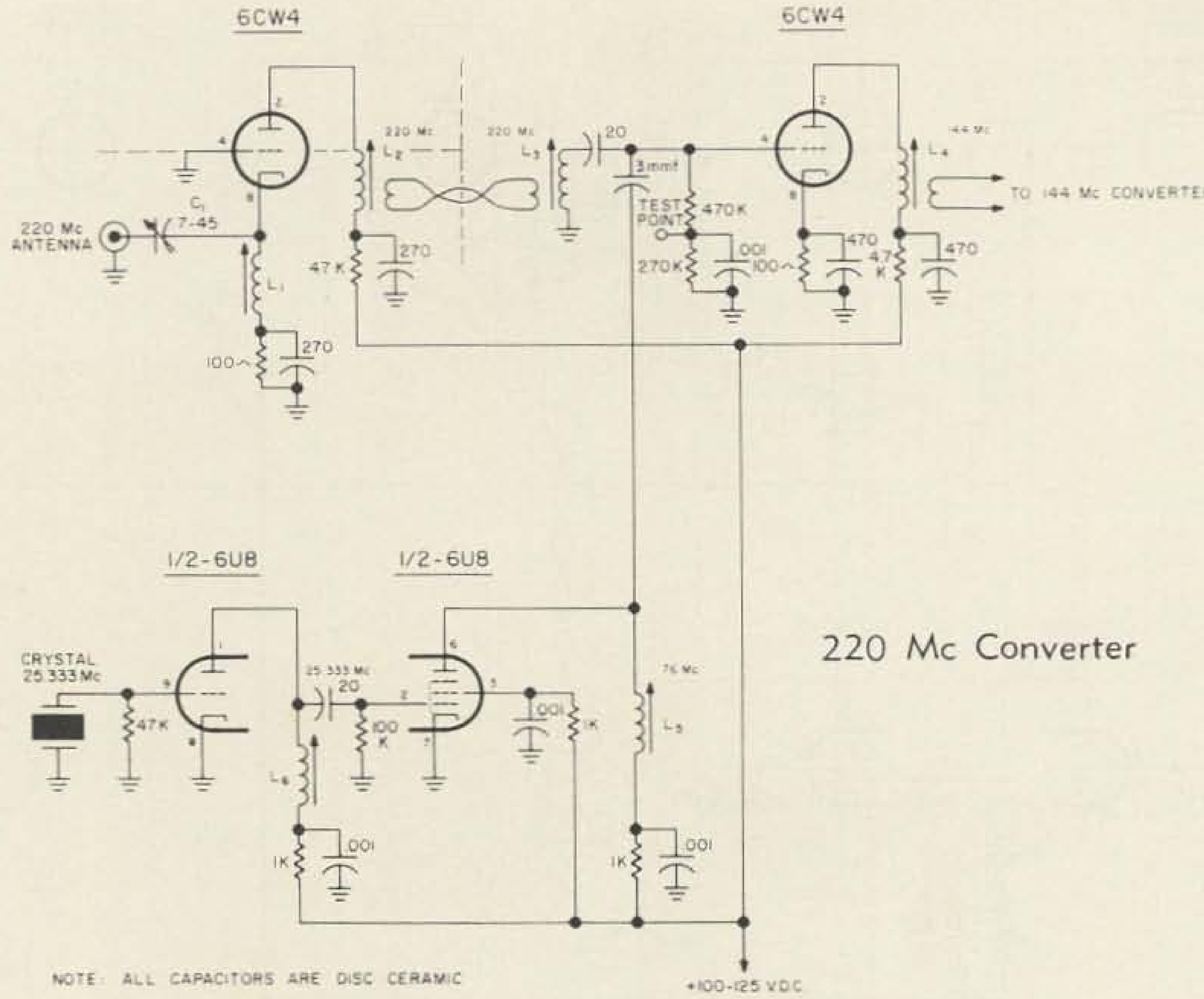
he link as shown on the schematic. The cold ide of the cathode coil is by-passed with a 70 pf ceramic capacitor and is connected to 47 ohm resistor. This resistor is connected o the 5000 ohm rf gain control. This control s not essential, but it helps prevent overloadng on strong signals. Similarly, the plate cir-uit of this grounded grid amplifier is link oupled to the cathode of the second stage. Output of the second grounded grid amplifier s coupled to the mixer grid through a 20 pf eramic capacitor. The mixer is a 6AK5. Its utput is fed to a stage of *if* amplification at 50 mc.

The oscillator circuit is similar to the 220 nc one. Differences are the frequencies of the uned circuits and crystal.

The *if* amplifier is also a 6AK5 and operates at relatively low plate and screen voltage. The output of this amplifier is taken off the link in T2 and connects to the output connector shown on the photo. Transformer T2 is a J. W. Miller No. 6231.

Notice that the B+ supply voltage is between 100 and 125 volts. This low supply voltage is essential in reducing over-all noise of the converters without sacrificing sensitivity. A good way to secure such voltages is a 108 volt regulator tube such as an OB2. This regulator tube can be mounted on the back of this converter chassis or on the power supply chassis.

The complete unit draws a maximum current of 20 ma at 108 volts. In the 2 meter



220 Mc Converter

position the current drawn is only 15 ma because the 220 mc section is made inoperative.

One way to cut off the 220 mc unit is to use a rotary switch and simultaneously switch the antennas and the B+ to the converters.

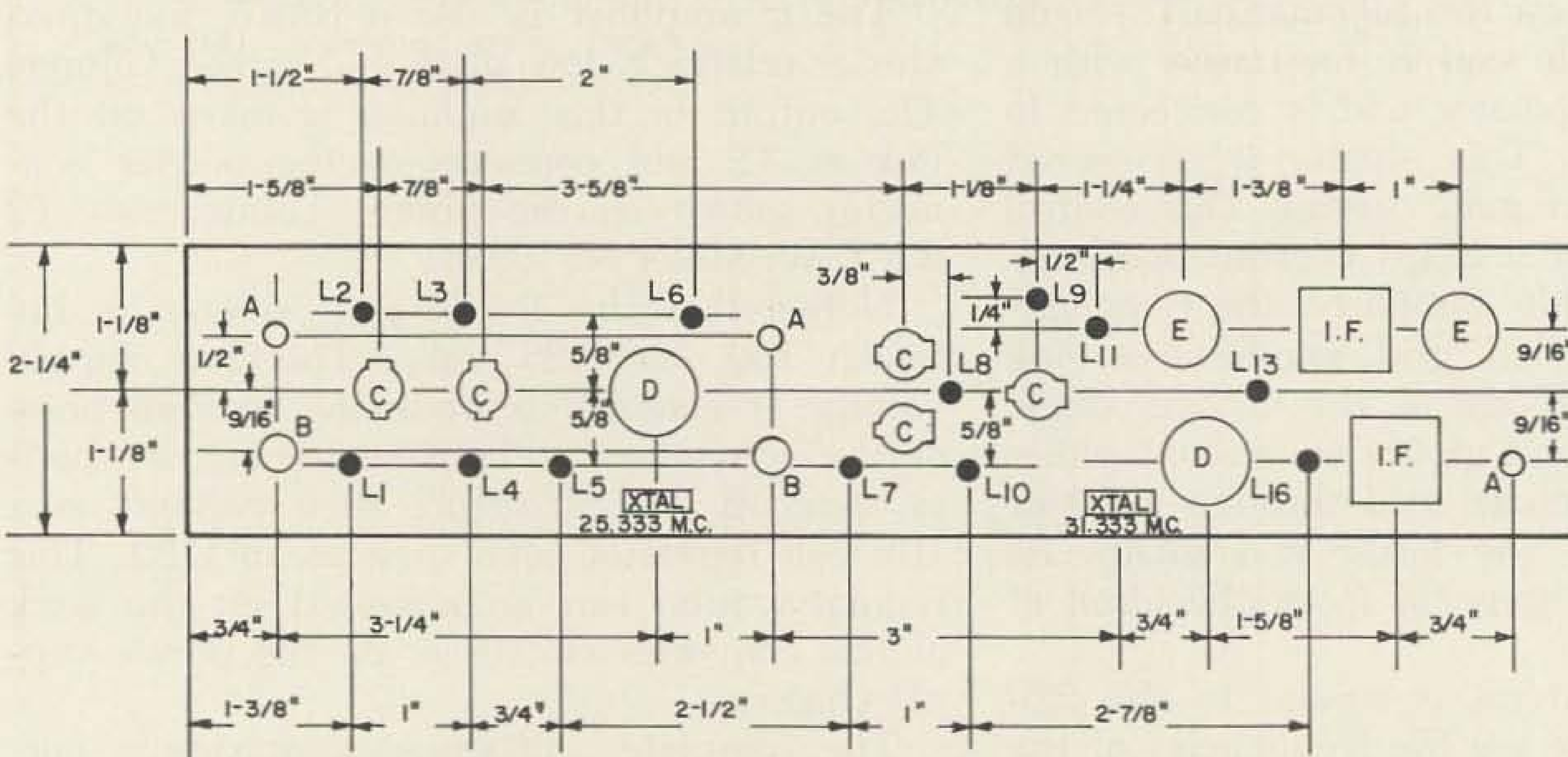
Tuning

Tuning of the converters is quite standard and follows a definite pattern. Use a dip meter to get all coils on frequency. If necessary, alter the coils by adding or eliminating a few turns or by adding a little capacitance across the coils that are too high. This won't be necessary if you follow the layout.

Be sure to short all coils near the one being dipped. Otherwise you may dip the wrong coil.

After all coils are on frequency, re-check all wiring and all component values. Connect the *if* output of the converter to a 6 meter receiver. Connect the 2 meter antenna to the 144 mc converter section and apply voltage to this section. Check the oscillator by using the grid dipper in the detector position. If the oscillator is working, the meter on the grid dipper will swing upward. Now tune in a strong signal (or use a signal from the dipper in modulated position) and peak all 2 meter coils and the *if* transformers. After this is done tune in a weak signal and re-peak all coils for maximum gain except L7 and C2. These two are adjusted for the lowest noise and best signal quality.

After adjusting the 2 meter converter, remove the antenna from the input jack and connect an antenna to the 220 mc section. Apply power and check the activity of the oscillator. Then proceed to make adjustments as in the 144 mc section.



Drilling Template

. . . W9DUT

R. E. Baird W7CSD
3740 Summers Lane
Klamath Falls, Oregon

A Two Band Collinear

for the ham with a little real estate

The advantages of assorted long wire antennas are well known. And we would be the first to acknowledge that their chief disadvantage is that they are just a wee bit difficult to rotate. However, many of us live where bi-directional properties will just about do the job that we want to do. From the location of W7CSD a good north-south pattern on 40 meters is highly desirable and a four leaf clover pattern on 15 isn't bad either.

A 300 foot East West long wire had been in use for some years with varied amounts of success; however, changing bands was cumbersome from the standpoint of retuning. With the rise of interest in 40 meter beams we decided to cut the long wire into four half wave sections phased *in phase* with quarter wave stubs between the sections. See Fig. 1. It will be noted that a one quarter wave on 7 mc becomes a three quarter wave on 21 mc. This will also give in phase operation. On 21 mc, instead of four half waves in phase, we have four one and one half waves in phase. This gives the familiar four leaf clover of the one and one half wave long wire re-inforced four times which makes the ears a little sharper. This covers parts of the Pacific Northwest and Southwest. New Zealand and Japan are hit about dead center.

Quarter wave stubs: A quarter wave in free space on 40 meters is on the order of 33 feet. To have three 33 foot sections hanging in the breeze presents some problems both mechanical and aesthetic. The XYL will probably take a dim view of such procedure. If you use 300 ohm twin lead, the length will be shortened to something like 25 or 26 feet but is still unsightly. However, it is possible to coil the twin lead up so that it hangs in a 5 or 6 inch diameter coil directly below the flat top. It is impossible in either case to measure with a ruler. Measurements must be made with a grid dipper. If the shorted end is shaped so that it will fit over the

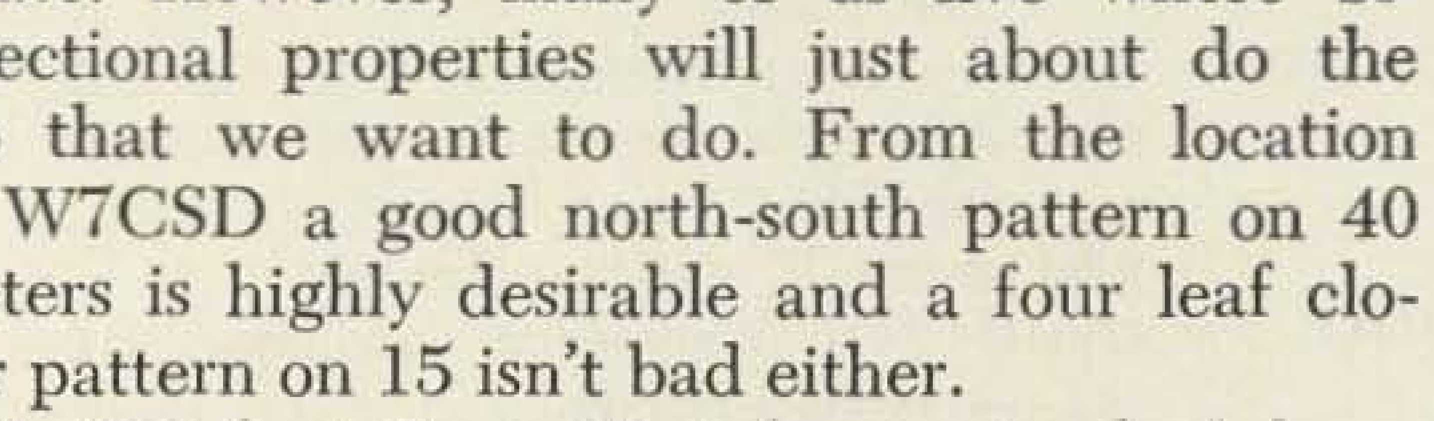


FIG. 1

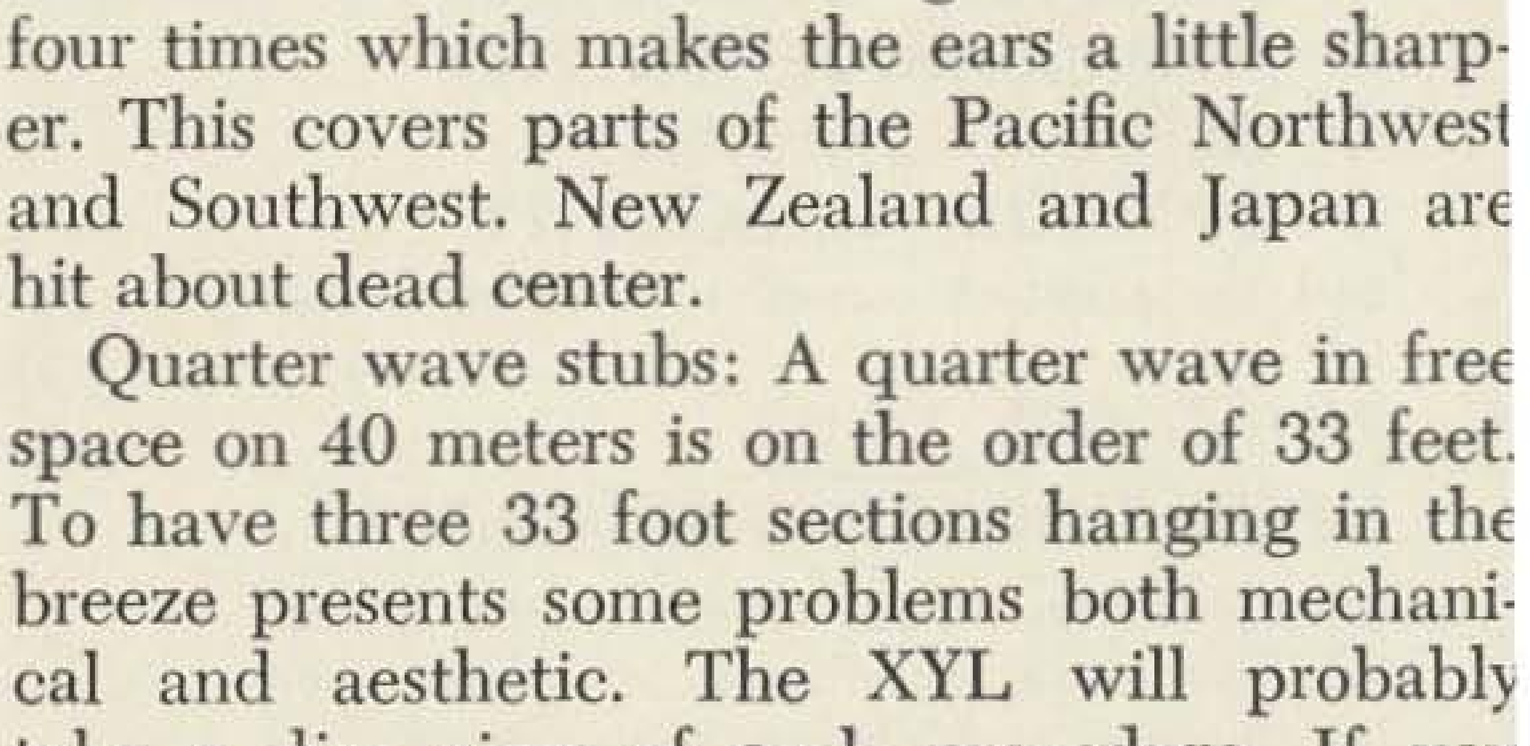


FIG.2

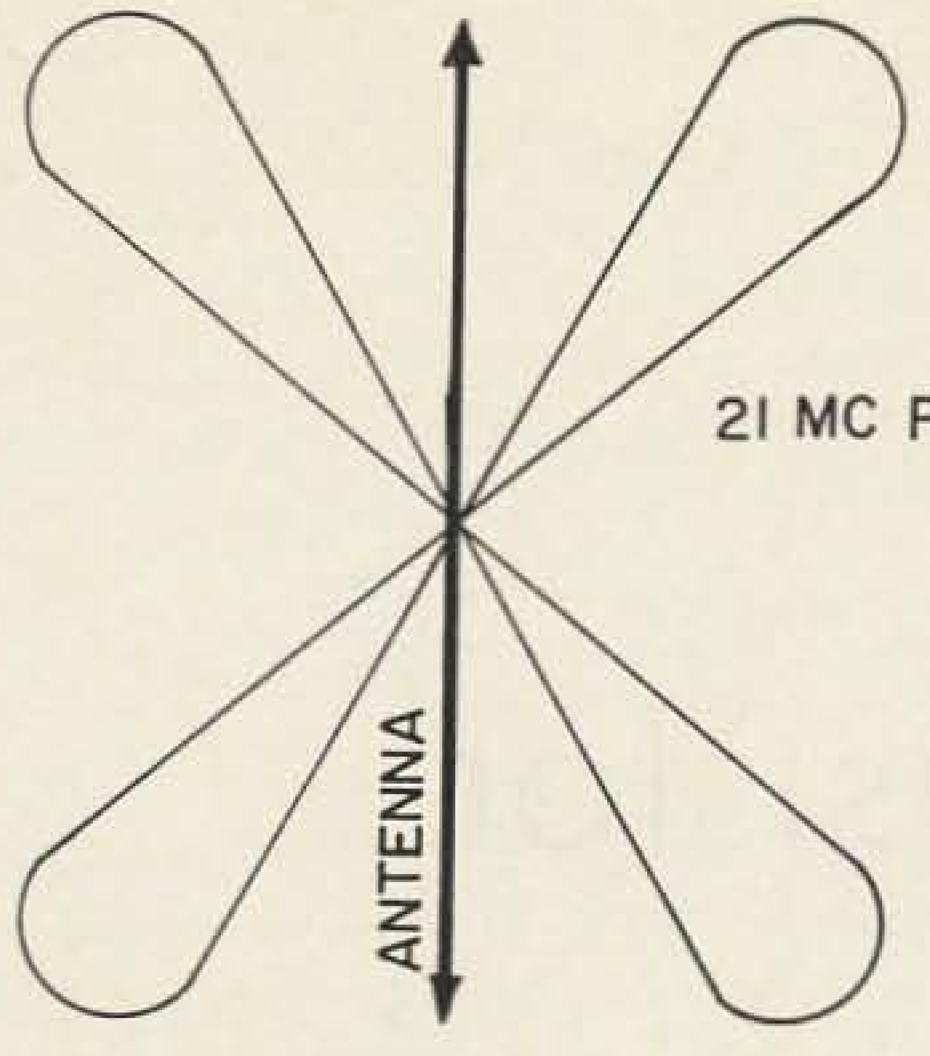


FIG. 3

oil on the grid dipper, a very sharp dip will occur at the frequency corresponding to that for a quarter wave length (or three quarter wave length) stub. All that is necessary is to set the griddipper on the proper frequency and start cutting with the diagonals. It was found that on approximately 6 inch diameter coil, with a foot and a half hanging out to trim, 23 feet was pretty close. A little trial on the first stub will determine the necessary length to wind up.

Feed point resistance: It would probably be highly desirable to feed the antenna somewhere near the center, but in our case, the feed point nearest the ham shack was the center of the first half wave section. We were in doubt about the impedance that would exist. A Heath antenna impedance meter was placed at this point and the antenna raised to a little less than its normal height (to be able to manipulate the meter). Strangely enough the impedance turned out to be a little under 100 ohms on both the 7 mc and 21 mc bands. So we decided to use 72 ohm transmission line.

Field pattern and operation: Figs. 2 and 3 indicate the expected field pattern. No accurate field strength measuring equipment was available to prove the exact patterns. Upon the completion of the antenna, we put a forty meter 20 watts input phone rig on the air. Number one contact was Vancouver, B.C. and number 3 contact was San Diego, Calif. Both were 100% QSO's in the middle of the afternoon. 15 meters has not been consistent enough to make any broad sweeping statements, but running about 250 watts NBFM reports have been good down Texas way and even as far north as Tennessee. Michigan looks pretty good on the other ear. We haven't heard anything in the Pacific but when things open up again it should be real good.

. . . W7CSD

Frank Firth W6QUD
Hank Olson W6GXN

The Parametric - Transistor Multiplier

In the past several years much interest has been displayed on the part of hams in the apparently magical device—the varactor—which has made BOTH parametric amplifiers and parametric multipliers possible. In this article the authors hope to show how rather ordinary transistors can apparently be made to operate as parametric multipliers, thereby opening the field to hams who might otherwise have left the "parametric" field alone.

Fig. 1A

Fig. 1B

The class "C" multiplier has been the accepted amateur method of radio frequency multiplication for many years. The technique was developed around vacuum tubes and has been extrapolated into the transistor-multiplier technology, with similar results.

However, in recent years, the technique of parametric frequency multiplication using voltage-variable-capacitors has rapidly come into its own. In this technique, the power input is rf at the fundamental (instead of dc, primarily) and the parametric multiplier simply converts some percentage of that fundamenta frequency power to the desired harmonic fre quency. The efficiency of such devices, usin modern silicon diode varactors, can be as hig as 80 per cent. The chief use of parametri multipliers has been in all-solid state powe sources at higher power levels and frequencie than available transistors will produce.

In addition, there are other types of fre quency multipliers utilizing the non-linea characteristics of various devices to generat harmonics. A familiar example of this sort o harmonic generator is the inexpensive germani um point contact diode used at the output o some 100 kc crystal calibrators to generate har monics of 100 kc throughout the hf bands, fo receiver calibration. Also, magnetic-materials with their non-linear hysteresis loops, are oc casionally used to produce harmonics. As class, these harmonic generators are low effi ciency devices and are usually used only i cases where efficient multiplication is not th primary aim.

In this article we hope to show that ham can marry their old friend the class "C" amplifier to the newly-developed parametric multiplier to produce an improved and economically feasible multiplier.

According to Terman, the efficiency of th class "C" multiplier, relative to a class "C" am-

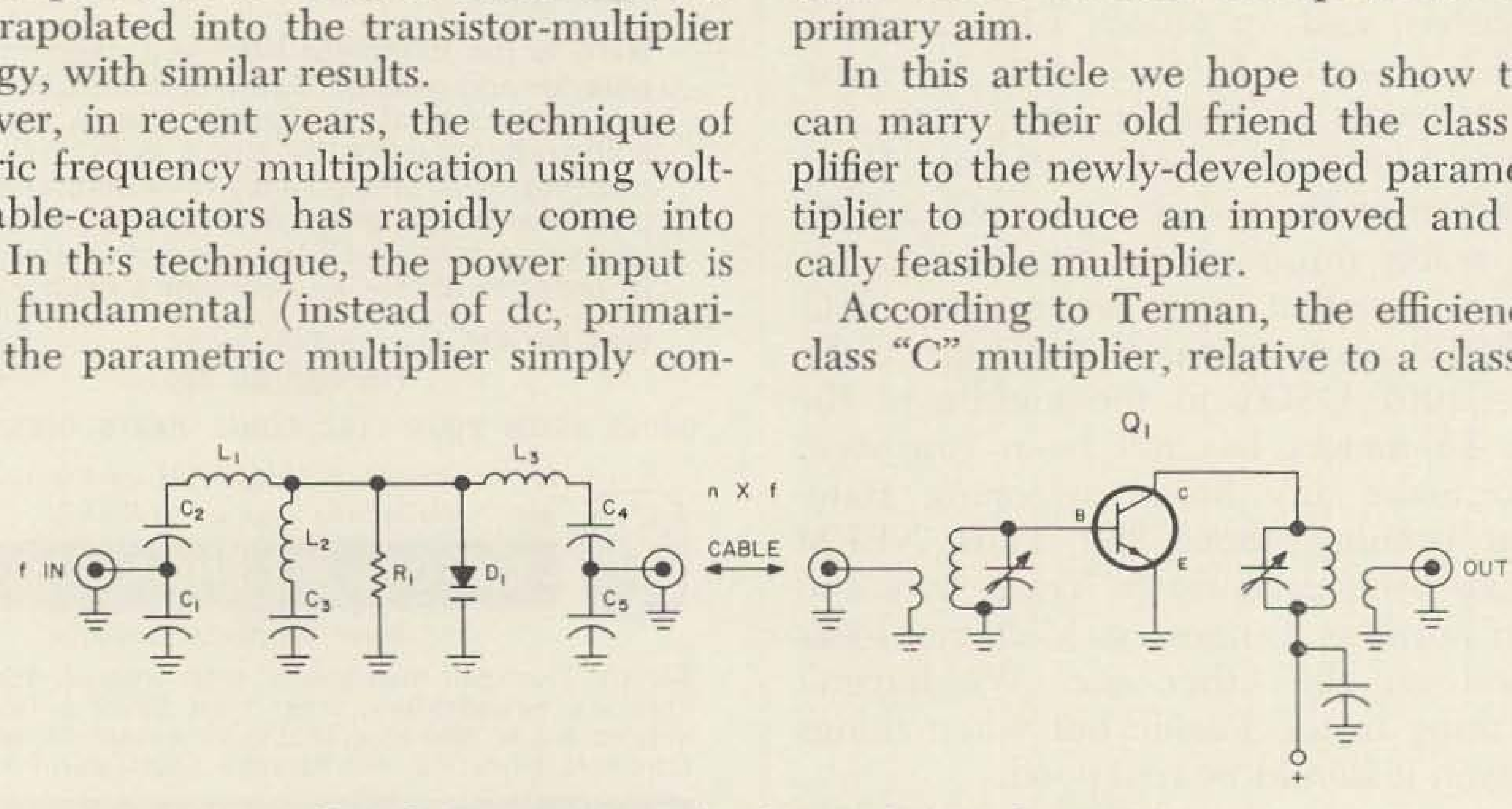


Fig. 2 Parametric multiplier and class C amplifier

TABLE 1

HARMONIC	OPTIMUM LENGTH OF SPACE CURRENT PULSE	APPROX. POWER OUTPUT RELATIVE TO CLASS "C"
2nd	90° to 120°	50% to 65%
3rd	80° to 120°	30% to 40%
4th	70° to 90°	25% to 30%
5th	60° to 72°	20% to 25%

lifier (a × 1 multiplier), falls off as shown ı Table 1.[1] These numbers assume that the onduction angle has been optimized as shown. 'hese efficiencies are relative and must be ıultiplied by the efficiency of a real class "C" mplifier. Taking 70 per cent as a figure for ıe collector efficiency of a good class "C" ·ansistor multiplier stage we get typical real fficiencies of some transistor multipliers as ıown in Table 2.

It might seem that, since the efficiency of a 1 class "C" stage is so much better than that f (say) a x4 class "C" stage, we could imrove overall performance by *parametrically* ıultiplying the drive x4, and then using an x1 lass "C" stage. If the x4 parametric multipliation can be made more efficient than the umbers in Table 1, we would gain some. 'his is shown in Figures 1a and 1b.

A typical parametric multiplier and a class C" amplifier could be connected as in Fig. by a low impedance line. However, by liminating the high to low and the low to igh impedance transformations between units, ıe transformation losses are eliminated, as ı Fig. 3.

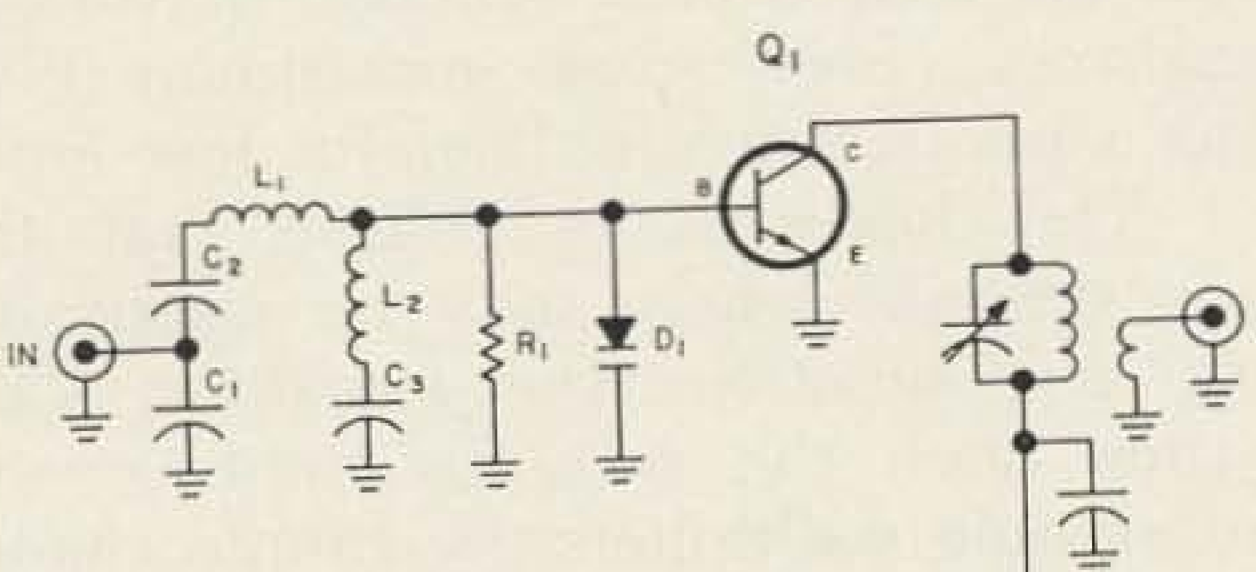


Fig. 3 Simplified multiplier-amplifier

Substituting the selectivity of the class "C" ollector tuned circuit for that of the deleted esonant transformations, we have the circuit ı Fig. 3 with the varactor and the emitterase diode of Q1 in parallel. So let's eliminate ıe varactor and use the emitter-base diode s our parametric element, and also use the est of Q1 as the class "C" amplifier. The ddition of L4-C6 is necessary to cause the irculation of x n currents in the base emitter ınction of Q1, previously caused by L3-C4-:5. (Both L4-C6 and L3-C4-C5 are seriesesonant circuits at the x n output frequency.)

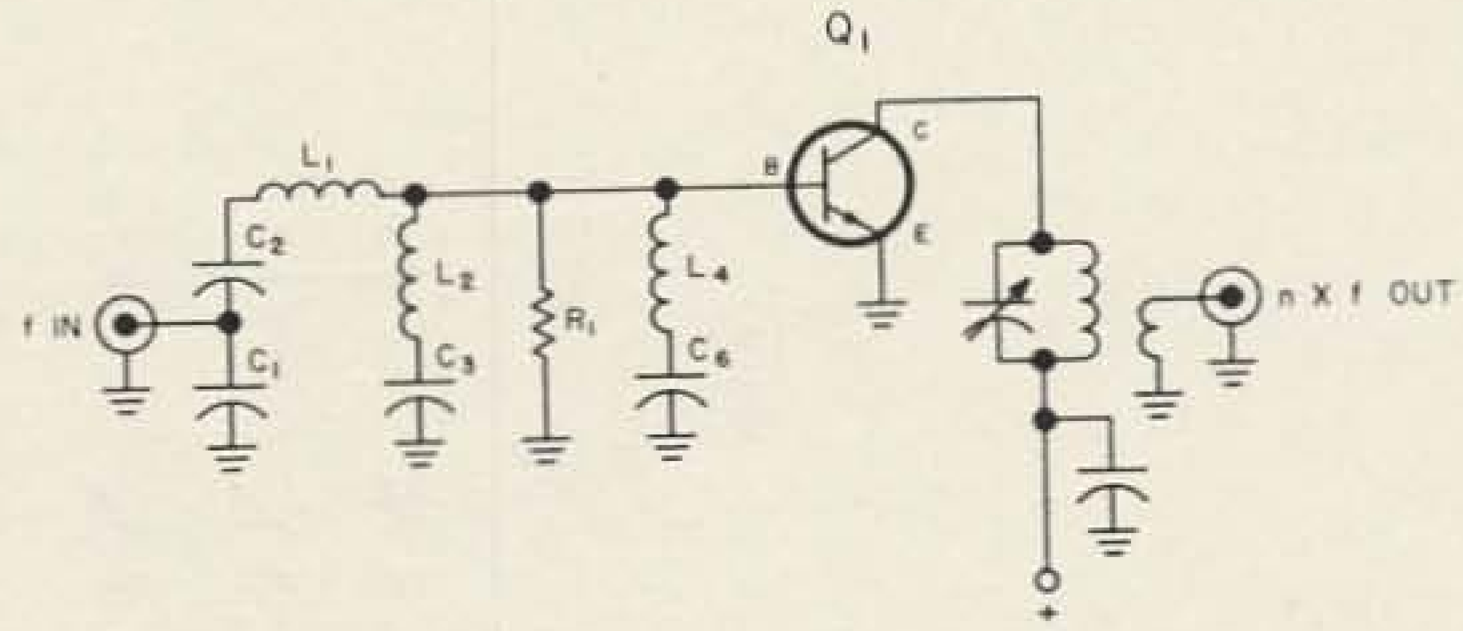


Fig. 4 Multiplier-class C amplifier using emitter-base of transistor as varactor

Such a system has several advantages over the other systems: no special varactors must be purchased, existing class "C" multipliers can be easily modified to this technique, improvements in load isolation over the simple parametric multiplier are achieved, and improvement in efficiency over the ordinary class "C" multiplier is obtained.

Several different circuits were tried in the hf range, using different multiplications and different frequencies. A 3.5 Mc to 14 Mc circuit was first constructed so that waveforms could be more easily observed with a 30 Mc bandwidth oscilloscope. As might be expected, our first choice for a parametric transistor multiplier was a silicon planar type transistor, since the silicon planar construction is also the way many varactors are made. A type 2N2951 was used to quadruple from 3.5 Mc to 14 Mc in the circuits of Figs. 5a and 5b. The circuit of Fig. 5a is the "control" circuit using the ordinary x4 class "C" technique, and Fig. 5b is the "experimental" circuit using the parametric transistor method. The collector efficiency of the circuit of Fig. 5a is 5 per cent and that of Fig. 5b is 24 per cent. Similar results with a type 2N1613 tripling from 7 Mc to 21 Mc confirm our relative efficiency measurements.

Both the circuit in Fig. 5a and that in Fig. 5b, were arranged so that both bias and collector impedance network could be adjusted

TABLE 2

HARMONIC	APPROX. EFFICIENCY
2nd	35% to 66%
3rd	21% to 28%
4th	17% to 21%
5th	14% to 17%

Fig. 5A

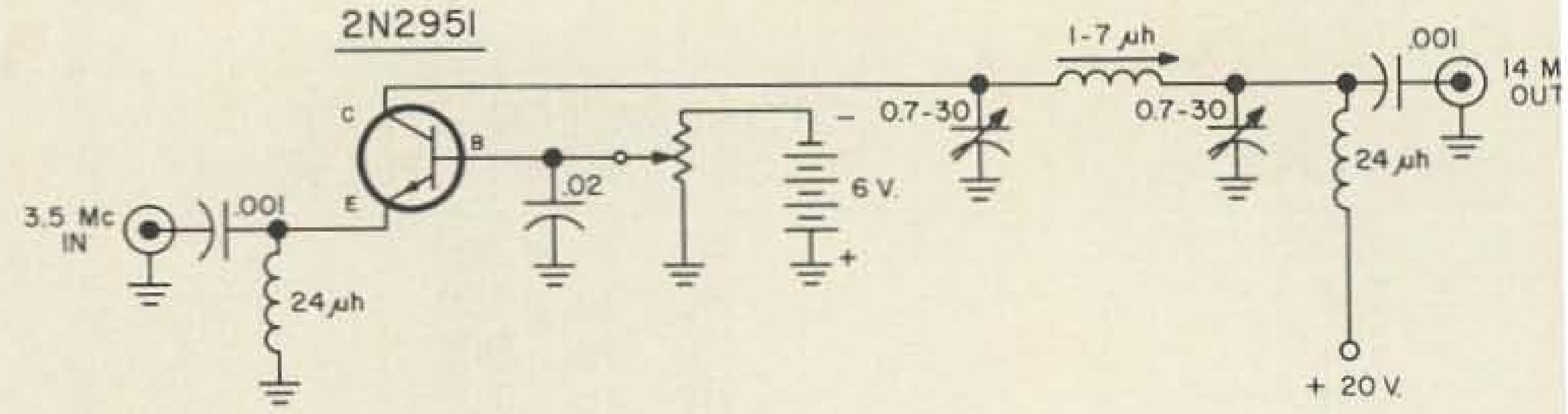
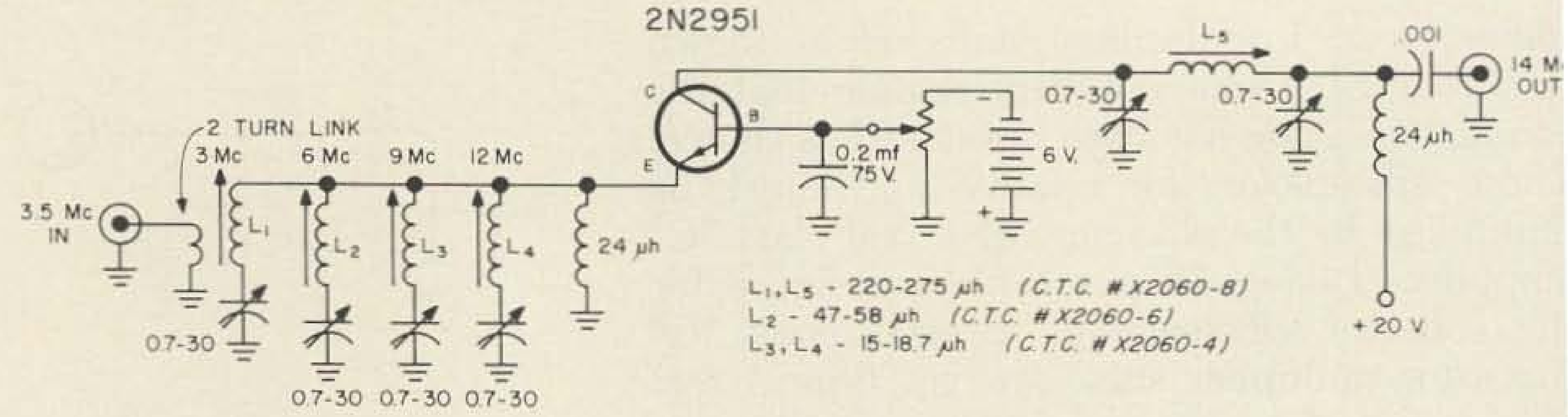
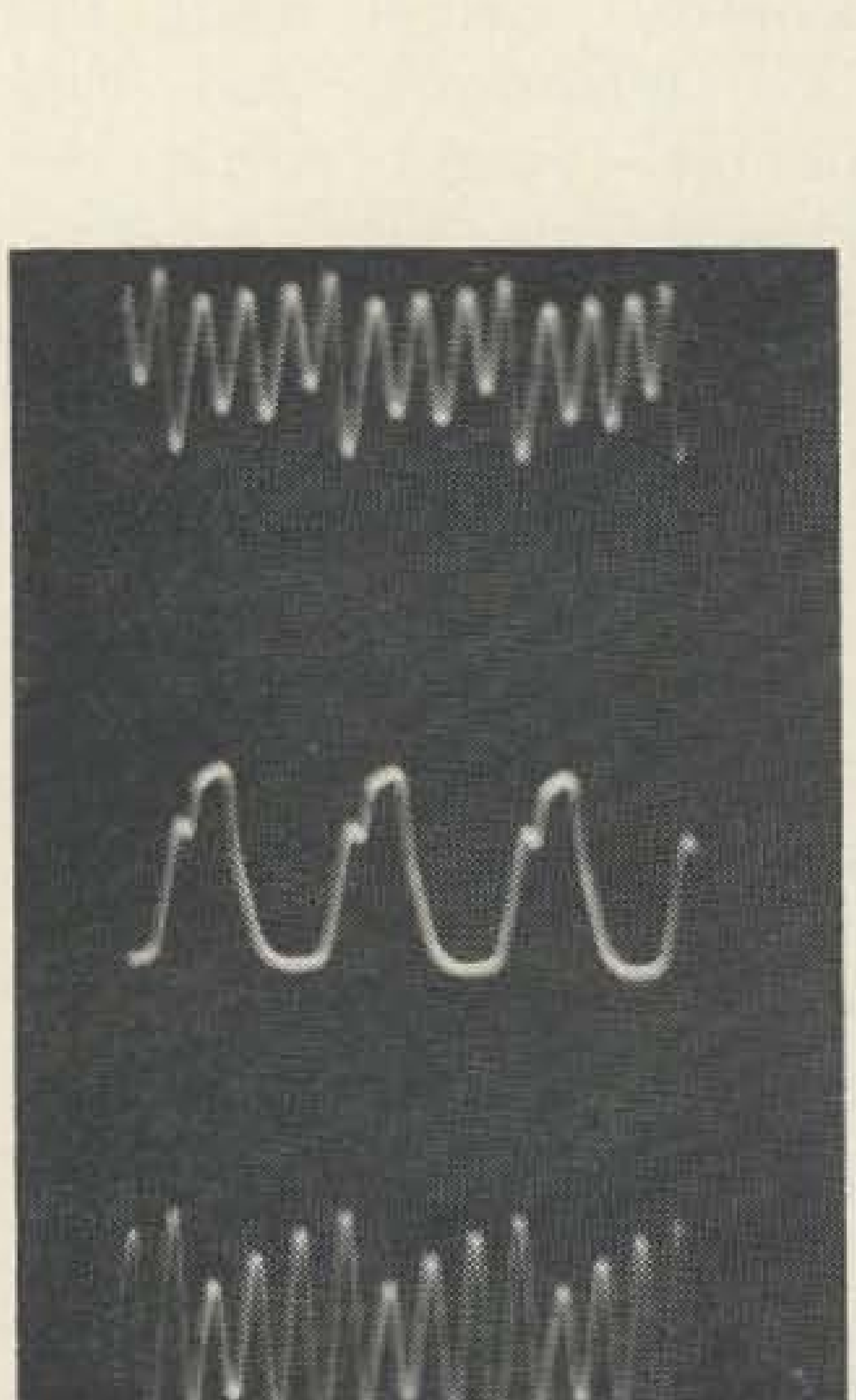


Fig. 5B



over wide ranges. This was done so as to be sure that the multiplication efficiency was optimized for each circuit. The input of the circuit of Fig. 5a was untuned, but provides a reasonably good match to a 50Ω generator. The input to the circuit of Fig. 5b was through a network, not to improve matching between the generator and the base of the transistor, but because it was the most convenient method-link coupling into one of the series-tuned idlers. The idlers themselves are of non-critical design, and in this case were made of comparatively low Q inductors (intrinsic Q's of 50 or less). The standard line of C.T.C. X2060- variable inductors were used in the frequency range specified by C.T.C. So long as any reasonable L to C ratio is held in each trap, it will work effectively at least to demonstrate the principle involved. The 24 µh R.F.C. in the emitter to ground position is simply for bias.



14 Mc output, parametric amplifier.

3.5 Mc drive.

14 Mc output, class C multiplier.

Fig. 6

One might think that the improvement in multiplication efficiency in the circuit of Fig 5b is due simply to improved input coupling efficiency and the effect that the 14 Mc series idler has in bypassing the emitter. However this is not felt to be the principal reason for multiplication efficiency improvement, because of the marked effect of the other idlers have on 14 Mc output, as they are tuned.

The observed waveforms are shown in Fig 6. The significant feature is the noticeable increase of "droop" between every fourth peak in the "C" output relative to the "parametric" output.

The use of one of the junctions of a transistor as a voltage-variable capacitor is not a new technique. Several workers have successfully used the base-emitter junction of various vhf transistors (even some germanium PNP types) as a parametric amplifier for low input noise.[3, 4] This leads us to believe that the technique described here may be applicable to nearly any junction type transistor. This would then open the way for improvement of many existing multipliers, by simple changes in biasing and addition of idlers.

The authors wish to thank Mauro Di-Dominico Sr. for his help, without which the working details presented here would not have been available.

. . . W6QUD, W6GXN

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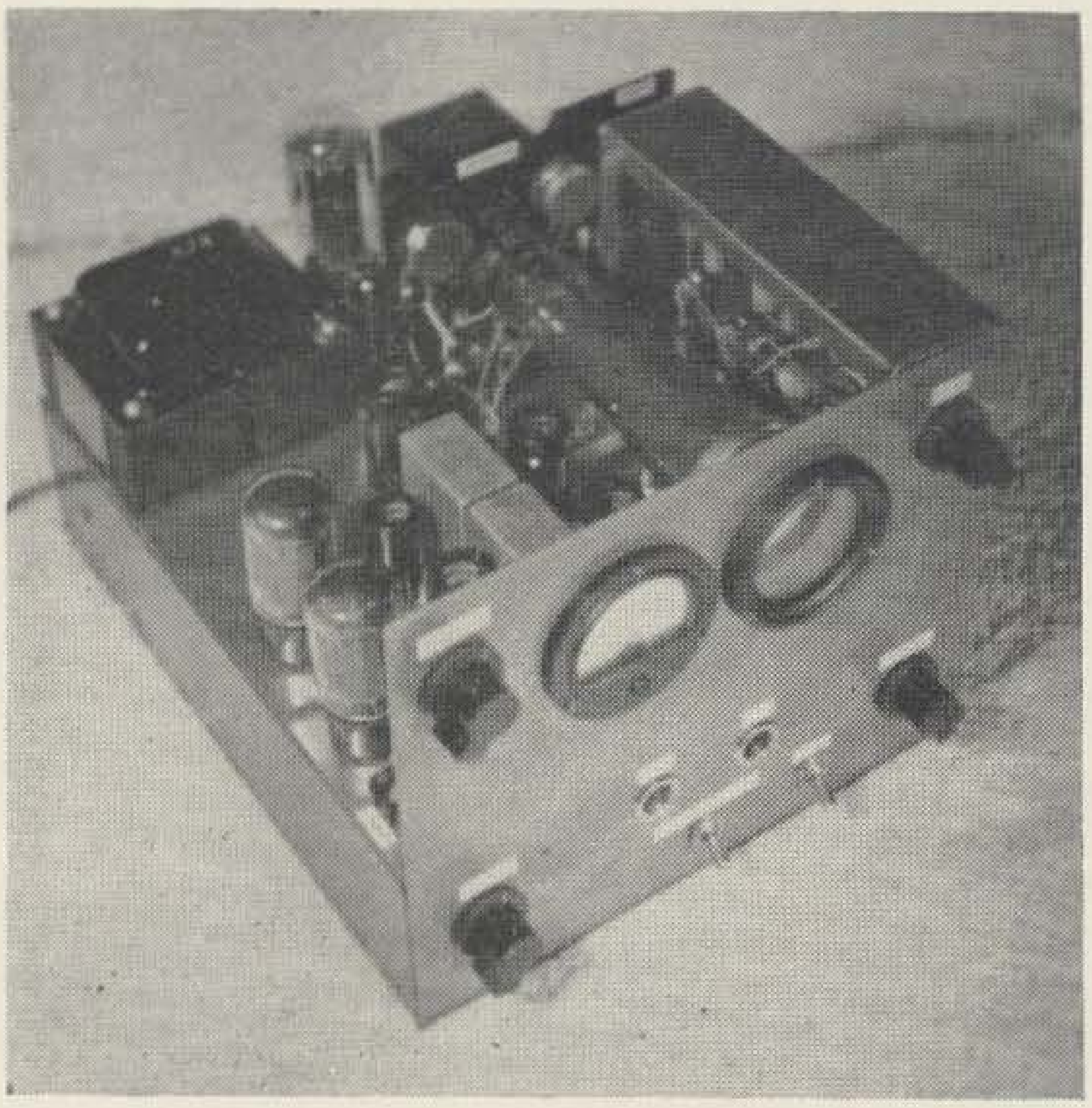
Improving the Garden City Terminal Unit



Improved TU.

Several improvements to the Garden City TU originally described in 73 Magazine (April '62) are described here. These include an adjustable mark-space filter, a wider range balance control, redesign of the limiter to favor the frequency response for normal tone frequencies, and a change of keyer tubes to increase the current capabilities, with provision for direct magnet keying, if desired. A 2″ scope has been built into the unit, and a db meter provided to monitor the level of the teletype signals.

The Mark-Space filter was designed from information published in 73 Magazine (Nov. 1962, page 22). The mark filter which is tuned to 2950 cps, is a 3 section fixed filter. It has a bandwidth of approximately 120 cps. The space filter is a two section filter, variable for shifts of 170, 230, 550, 650, 750 and 850 cycles. The average bandwidth is approximately 85 cycles. Also incorporated with this filter is a "Broad-Sharp" switch to widen the bandwidth to approximately 200 cycles. The later feature was found desirable for signals which have a normal shift in excess of 850 cycles. I have also found an improvement in reception of certain signals which were in a bad state of selective fading, by switching to the broad position. Perhaps someone can shed some light on this phenomenon.

The balance control has been removed from the cathodes of the 12AT7 amplifier and placed at the input of the Mark-Space filter. A wider range of balance is obtained without lowering the cathode bias of the 12AT7.

Frequency response curves were run on the original limiter and low and behold I found that the gain was higher at 400 and 1000 cycles than it was at 2000-3000 cycles. I also determined that the second harmonic of 1000 cycles was down only 7 db below normal tones when the limiter was driven to 20 db of limiting.

Changing the plate coupling condensers reduced the response of the limiter at 1000 cycles by 5 db and at 1500 by 3 db. Final response curves of the limiter showed the second harmonic of the 1000 cycle tone—the worst offender—to be down 12 db in the output of the 6AL5 diode. Harmonics from 550 cycles were down 20 db. This all means that

FIGURE 1

Construction of mark filter.

ou have increased interference rejection of ny signal which produces audio beats of approximately 550, 750, 1050 or 1500 cycles. The Sharp filter will reject these latter tones by 40 db or more, but we still have to contend with their harmonics developed within our own limiter.

6L6 tubes were used in the keyer circuits so that the selector magnet could be operated directly. To convert to 60 ma operation it was only necessary to reduce the 1000 ohm common cathode resistor to 500 ohms and increase the screen voltage until the desired 60 ma was obtained in the selector magnet.

The 2″ scope is built around a 902P-1 tube. A separate 12AX7 amplifier is used for the scope. One reason for this amplifier is to avoid overdriving the 12AT7 signal amplifier, which n turn would cause more harmonic voltage at the 6AL5 output. The scope circuits are simple and should not discourage anyone from building it. With a sharp filter the scope is a necessity.

Notice in the power supply that 3 rectifiers re used: a 5U4 with choke input to provide 210 v with good regulation for the audio and keyer circuits; a 6X4 with condenser input to provide 350 volts for the plate of the 902P-1; and a 1N70 bias supply on the scope for controlling brilliance. Since little or no current is drawn, any small diode is suitable for this. Notice the 330 k and 100 k resistor network from the power transformer to ground. This is a voltage divider and limits the ac voltage on the 1N70 to 75 volts. Due to the extremely low current this bias voltage s easily filtered with two .047 mfd condensers and a 2.2 megohm resistor. The bias voltage is continuously adjustable from 0-25 volts by means of the 4 megohm potentiometer.

Construction of the Mark Filter

Before starting to build this filter I suggest you read the very fine article in 73 Magazine for Nov. 1962, by W3TUZ. For this filter I unwound discarded 210a telephone repeat coils. However regular 88mh coils could be used and less time consumed in the construction. You must first determine the size and elect the coupling condensers to be used, as these are part of the frequency determining components. In this filter I used a .0025 mfd and a .001 mfd coupling condenser. The toroids were shunted with .033 mfd condensers. Since this is an exacting procedure, each condenser to be used in the filter must be used n the exact position while tuning procedures re being carried on. I suggest that all the

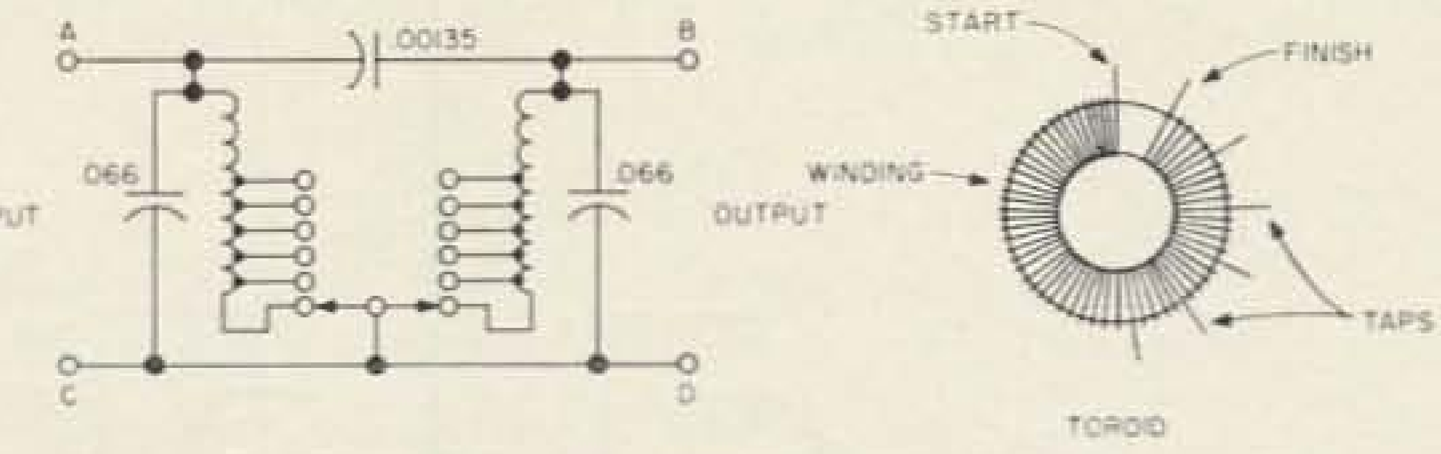


FIGURE 2

Variable space filter.

coils and condensers be mounted on a terminal board before tuning is started.

Tune these toroids to 2950 cycles for the Mark frequency. First short B to D. This places the .0025 coupling condenser across the "A" section coil in parallel with .033 mfd. Now check the frequency and start removing turns until Coil "A" tunes to exactly 2950. After the first coil is tuned, remove the previous short and place a short from A to D and from C to E. This places both the .0025 mfd and the .001 mfd condensers across the "B" coil. Tune the "B" coil to 2950 as above by removing turns. Now remove both previous shorts and place a short from B to E. This places the .001 mfd condenser across the "C" coil. Again tune by removing turns. Now if you are interested you can feed the audio oscillator in at A and D in series with a 47k resistor and place a 100k load and VTVM across the output. The resonance curve will be very sharp. You can check the bandwidth at the 3 db point by varying either side of center frequency to a point where you obtain .707 of the maximum developed voltage. The difference in the two audio frequencies is the bandwidth. It should be around 120 cycles. If this filter is reversed end for end it will be broader: around 200 cycles.

Construction of the Variable Space Filter

The space filter toroids were hand wound from discarded 210a telephone repeat coils. Other toroids could have been used but the ¾″ inside diameter of these cores make them ideal to rewind, using a TV horizontal Osc coil as the source of wire. It is only necessary to clamp the core between a couple of boards and start passing the TV coil through the hole in the center. Always pass from top to bottom. This may sound tedious but really it is not as bad as it sounds. It goes quite fast. Count up to 100 turns and put a mark on a piece of paper and count again up to 100. With very little practice you can put on 30 turns or more a minute. Try to keep the winding fairly smooth; however, this is not an absolute necessity. I have unwound several different commercial toroids and they are not wound very smoothly either. Start by winding a single layer to the right—along the core—until you

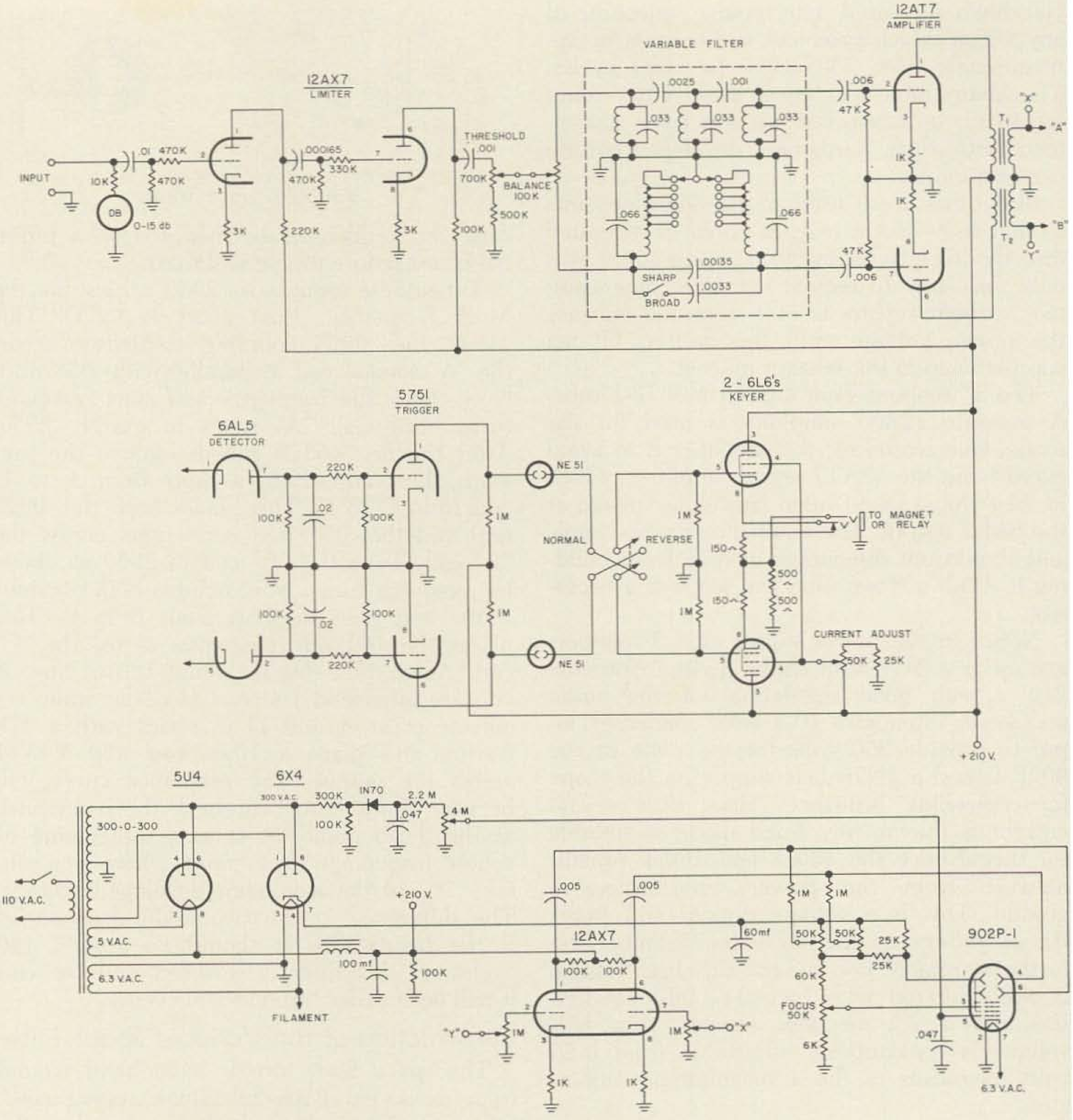


FIGURE 3

have gone half way around the core. Then wind back over your original winding to the left. The wire is always dropped through from the top so that the winding around the core is always in the same direction. Add layers winding back and forth until you have wound on about 800 turns. You should now have slightly in excess of 80mh. All of this winding will be on half of the core. You are going to use the other half for making taps. Since the taps require some tape for binding, more space will be used up. Select good quality .066 mfd condensers with which to tune these toroids. You must first determine the bandwidth you desire. This is determined by the size of the coupling condenser. I used a .00135 coupling condenser (actually two .0027 in series). Refer to Fig. 2. Mount the first coil to be tuned and the .066 mfd condenser which will tune it, on the terminal board which will comprise the space filter. Shunt the .00135 condenser across the coil and condenser combination. Connect the audio oscillator and VTVM as with the mark filter and check the frequency. For 170 cps shift this will have to tune to 2780 cps. If necessary remove turns until this coil is tuned to 2780 cps. Make a tap by joining on to the TV coil again and add about an 8" length of colored wire which will later connect to the switch 'ape the splice and fasten to the core of the ›roid with either plastic or masking tape.

Wind about 30 turns of wire on the un-'ound portion of the toroid core. Check the 'equency again, and remove turns if neces-ary until the coil tunes to 2720 cps (230 cps hift). Again make a splice and bring out a ifferent colored wire for the switch. The next 'equency gap is greater so you must wind on bout 125 turns or better, 150 to be sure, and heck the frequency again. This time tune ›r 2400 cps (550 cps shift). Again add turns nd taps and tune for 2300, 2200, and 2100 ps. Use different colored wires for each tap › readily identify them when permanent wir-ıg is made to the switch. This coil will now e tunable for shifts of 170, 230, 550, 650, 50 and 850 cycles.

Wind the second coil in the same manner. e sure to use the same .00135 coupling con-enser in shunt with the second coil and .066 ıfd condenser. Make sure you use the .066 ıfd which will be permanently used in the ircuit. Using the same color wires for taps ; you did with the first coil will make it asier to wire up the switch. The switch is a x position, two pole Mallory 3226J. Mount ıe two filters in a 5 × 7 aluminum chassis long with the switch and complete the wir-ıg to the switch.

The variable space filter could have been ıade from fixed coils using the switch to ıunt in different size condensers to tune the ›ils. I believe this would take a large supply : condensers in order to match condensers › exactly the same capacity, as the most com-ıonly used condensers on the market appear › be 10% or more tolerance.This is why I referred to make taps.

Miscellaneous Construction Notes

The face of the 902P-1 is mounted in an d 2" meter case. Mount back about an inch › help keep the room lights off of the face : the scope tube. In order to keep the system alanced all the way through, the grid re-stors on the 12AT7 amplifier should be ıatched. Also the following: the 100k load ›sistors on the 6AL5; the 220k filter resist-rs; the 100k grid and the 1 meg plate re-stors on the 5751 trigger tube. These can be asily matched within 2% with an ordinary ımeter.

No doubt someone will wonder how we ın space 85 cycle filters with their centers 00 cycles apart. Notice that the mark filter 120 cycles wide. Shifting the receiver tun-ıg slightly across the mark filter will allow 00% coverage.

. . . W7CJB

Robert N. Tellefsen W7SMC/6
Harley C. Gabrielson W6HEK
277B Tyrella
Mountain View, California

An Orbit Computer for Oscar III

To paraphrase a famous recipe for rabbit stew, to communicate through OSCAR III, first find it. The orbit computer described here will help you do just that.

The materials required for this computer are easily obtained—a 10- or 12-inch globe of the world, a piece of stiff wire, some tape, and a grease pencil.

To make the computer, proceed as follows. Draw a great circle around the globe, passing through 0- and 180-degrees longitude at the equator. The angle formed between the plane of the great circle and the plane of the equator should equal the inclination of the OSCAR III orbit. Divide this great circle into nine equal segments representing 10-minute intervals in a 90-minute orbit period.

Draw in the subsatellite track, the imaginary line on the earth's surface directly below the satellite. Starting at 0-degrees longitude on the equator, move north to the first 10-minute interval marker on the great circle and place a small mark on the globe 2.5 degrees west of the marker on the great circle. At the 20-minute marker, move west 5 degrees and place a small mark on the globe. Continue placing small marks on the globe due west of the 10-minute markers on the great circle, with each small mark being 2.5 degrees farther west than the preceding one. Be careful to place these small marks DUE WEST of the great circle marks and not on a line at right angles to the great circle.

Connect these marks with a line. For a 90-minute period, the subsatellite track should return to the equator after one orbit at a point 22.5 degrees west of the 0-degrees longitude line. If the OSCAR III period should be closer to 100 minutes, ten 10-minute intervals would be marked off on the great circle, and the subsatellite track would return to the equator 25 degrees west of the 0-degrees longitude line.

Bend the piece of stiff wire into a circle slightly larger in diameter than your globe. Separate the wire ends so that they lie on the ends of the subsatellite track, and bend the wire where necessary to make it agree with the subsatellite track all the way around the globe. Fasten the wire to the globe support ring, but leave the globe free to turn under the wire. When the wire is in place, transfer the 10-minute interval markers to the wire and add 5-minute markers between them.

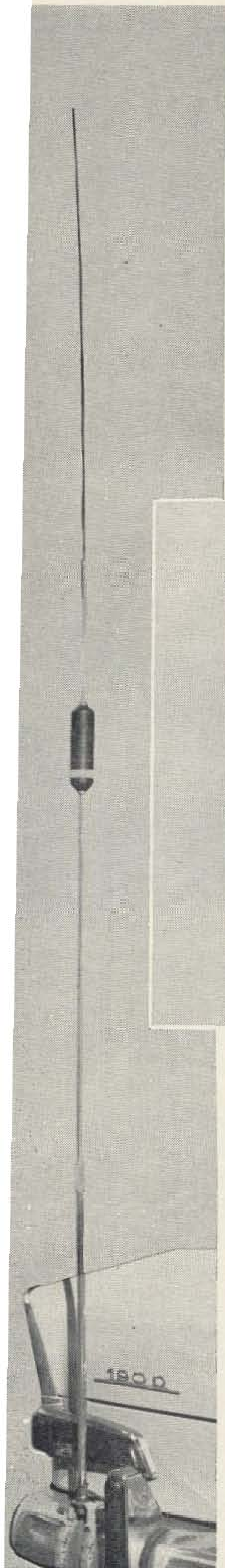
This orbit predictor is not absolutely accurate, since few satellites have exact 90-minute periods. However, it is close enough to give a tracking station operator a good feel for the location of a satellite during a given orbit. In order to obtain the best results, the inclination error should be less than 2 degrees; the error in longitude advance should be less than 1 degree; and the error in period should be less than 2 minutes. If care is taken in constructing the computer, these tolerances can be met easily.

Orbital predictions containing the data needed to make the computer work will be given in regular Project OSCAR bulletin transmissions from W1AW and W6EE. W6EE is the Project OSCAR headquarters station; it will operate on 3507.5 kc, 7015 kc, and 14030 kc using CW and RTTY. Bulletins will also be broadcast on SSB; the frequencies will be announced during the CW and RTTY bulletin transmissions.

To locate OSCAR III at any time during an orbit, set the beginning of the wire over the point on the equator where the predictions say the orbit crossed most recently. Then measure along the time marks on the wire to locate the satellite at the moment in which you are interested.

This is a crude device, but it is also quick and efficient. With it you should have no trouble locating OSCAR III.

. . . W7MC/6, W6HEK



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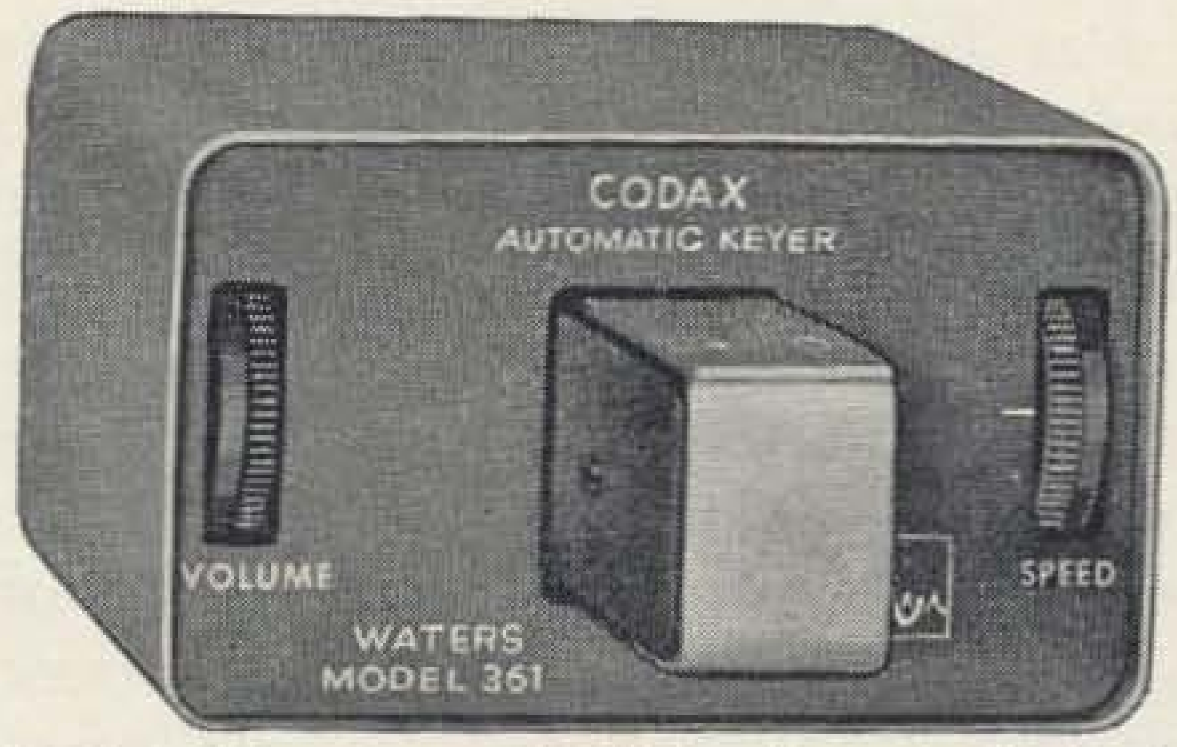

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The Ham

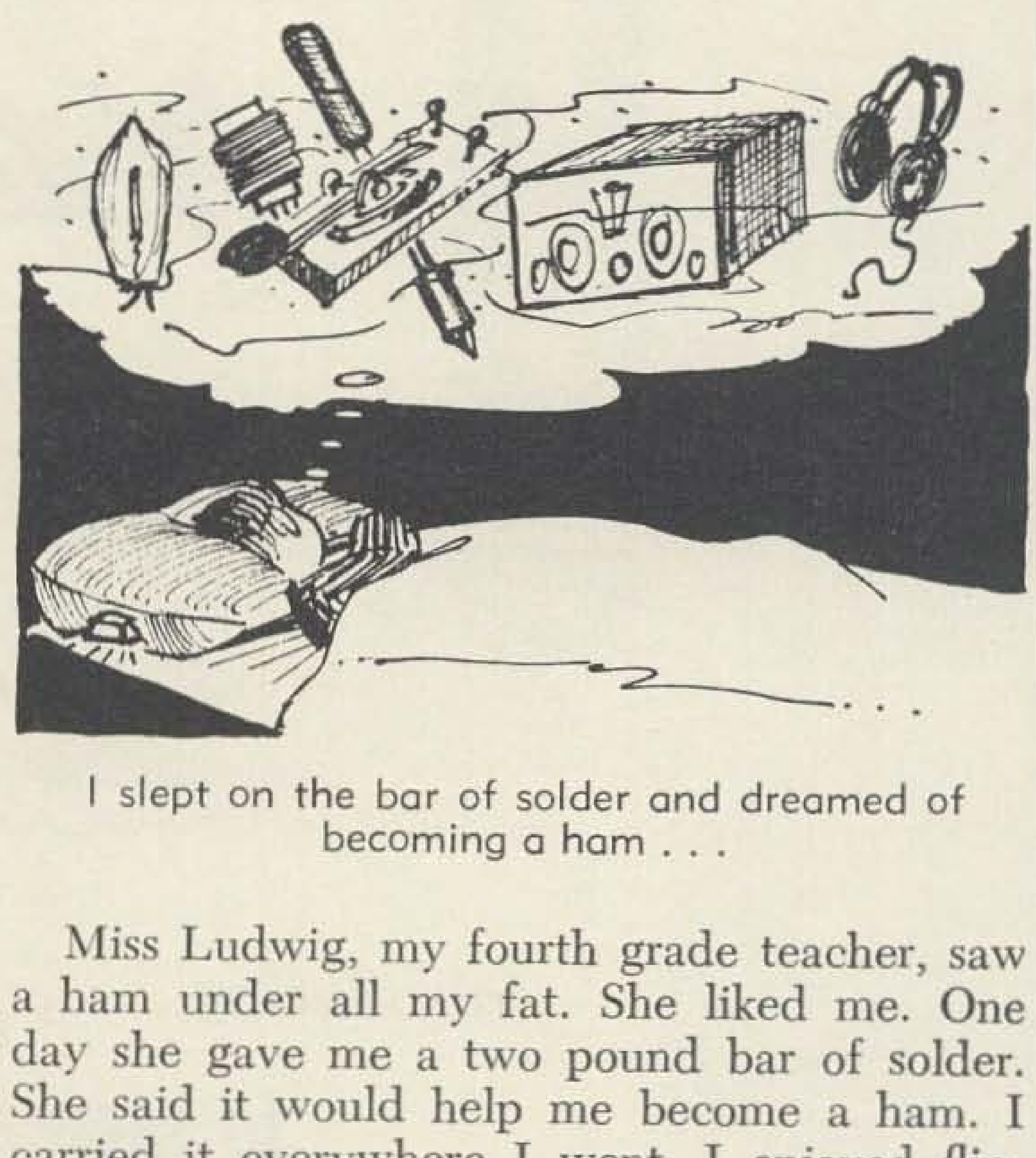
The road to becoming a Ham is as exciting as the road to stardom

It is hard for me to remember when I first wanted to be a ham. I never wanted to be anything else but a ham.

I was born June 1, 1928, in Minneapolis, Minnesota. I have a younger brother, Delbert, who lives a conventional life in California teaching exceptional children. My older sister, Dolores, is happily married and has thirteen children. My mother was a beautiful woman who loved to cook Sauerkraut mit Schweinekotletten, a German dish of sauerkraut and pork hocks. My father never understood me and left home when I was sixteen. I never saw him again.

My life was a complete waste until I was in the fourth grade. I was a small, fat kid whom nobody loved and everybody teased. I never played with the other kids at recess. To fill my lonely hours I read Boy Electrician and dreamed of becoming a ham.

I spent my lonely hours reading the Boy Electrician . . .



I slept on the bar of solder and dreamed of becoming a ham . . .

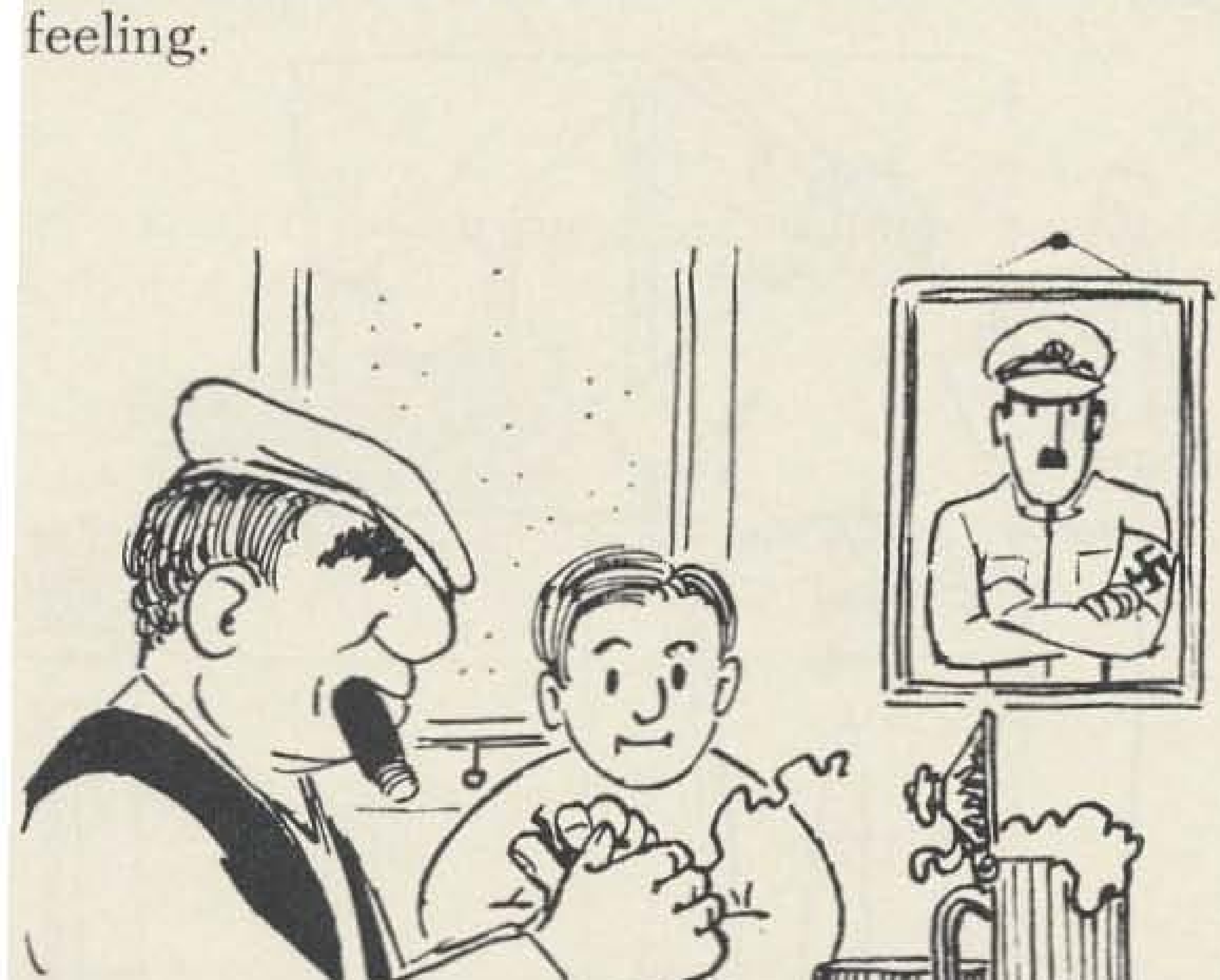
Miss Ludwig, my fourth grade teacher, saw a ham under all my fat. She liked me. One day she gave me a two pound bar of solder. She said it would help me become a ham. I carried it everywhere I went. I enjoyed flipping and spinning it in my hand. I loved its smell and smooth texture. It was then I discovered I commanded everybody's respect when I carried it clutched in my fist. At night I would sleep with it under my pillow, and dream of becoming a ham. I never lost that dream.

When I was eleven we moved to a large apartment building in Cincinnati. This was to be another turning point in my life. It was in this apartment building I met Joe Schultz. He gave me my first real start. I remember Joe. He slept late every morning because he would CQ late into the night. I ran errands for him to the delicatessen. He loved dark sour rye bread, hard salami and beer. In return, he gave me the privilege of watching him work. It was a great time for a boy to be alive.

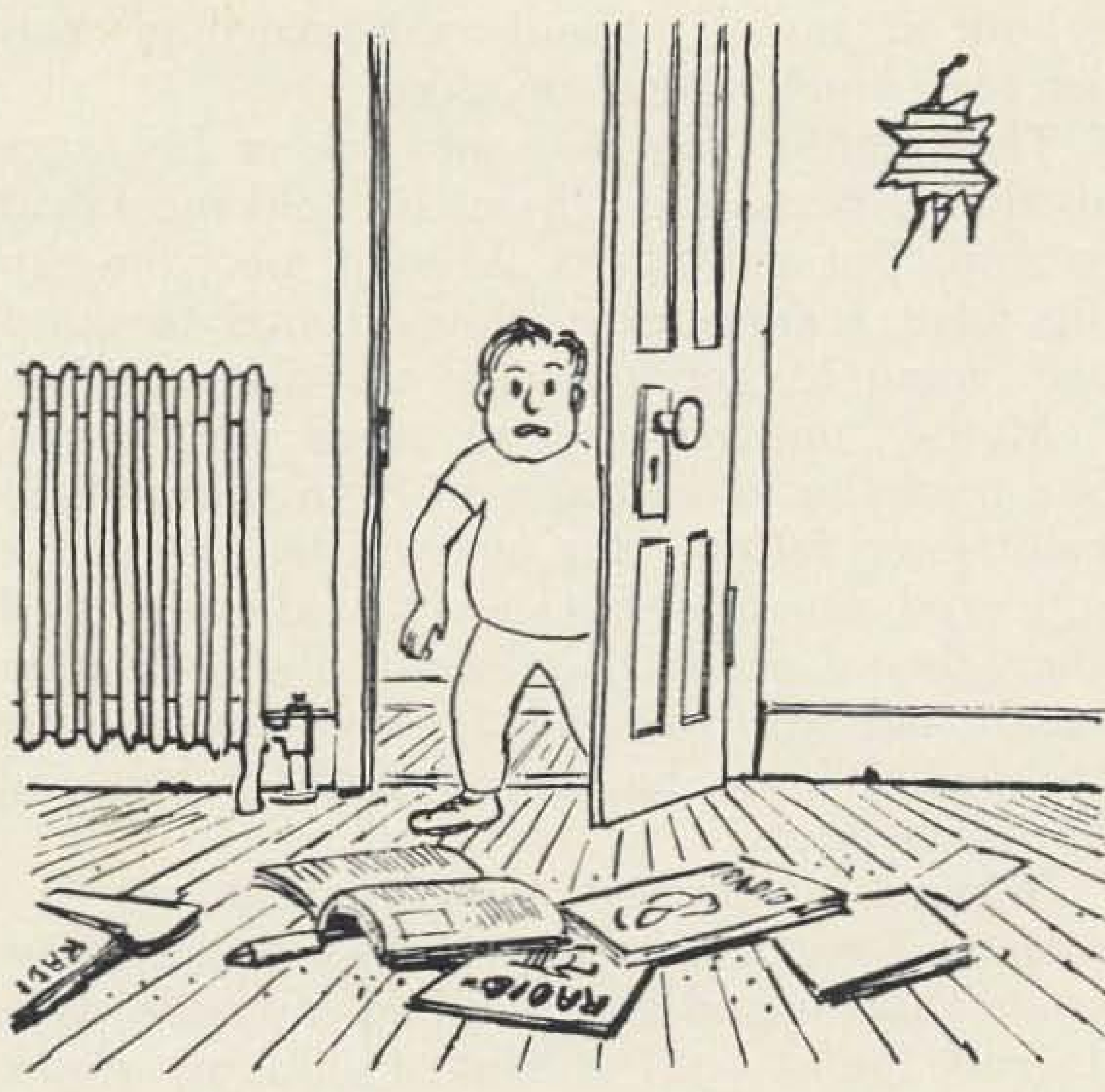
I fell under the spell of Joe Schultz. I can still see him wrapping a transmitting coil, his cap pulled down to his heavy eyebrows and a huge black cigar hanging in the corner of his mouth. He was the kind of ham that few younger men have the privilege of seeing today. He built his own rig up from nothing. This is the sort of thing you don't find among today's hams. They've gone commercial.

Joe worked hard. His entire apartment was his shack. Joe never kept a junk box—there was a place and purpose for every goody. No fancy soldering gun or rosin core solder for Joe. Just a good old three pound soldering iron heated on the gas stove. Joe loved to work in the dark and he always kept the shades drawn. On the wall was large photograph of a thin man with a little mustache and piercing black eyes. His arms were folded; he wore a kind of band on his left arm with a crooked indian cross on it. Joe would look up at the picture and would tenderly put his hand on my head. "Ja, you would do vell in der Jungvolk."

The hours I spent with Joe were the only really happy hours of my life. I watched and listened—a small, fat kid among a giant. I soaked up the smell, the sight, and the sounds. It was here I learned the basic essentials of being a ham. Hams aren't born. It isn't something you can inherit. You can't learn it from a book. Being a ham is an instinct, something that blossoms from within. Then came that crazy day when Joe told me I had a ham's instinct. My head swirled and I felt in my heart I was destined by fate to become a ham. Never for a moment have I lost that feeling.



While neighbor Joe Schultz wound a transmitter coil, I watched enraptured . . .



Father reported Joe to the FBI . . .

My life has been filled with tragedy. I remember the day I told my father I was going to be a ham like Joe Schultz. He flew into a rage. Hams like Joe were looked down upon in those days. People, especially my father, had no use for them. Father shouted that this whole thing had gone far enough. he was going to stop me. But he couldn't destroy the dream.

Yes, there was tragedy. Father reported Joe to the FBI. I remember the day when I came home from school and found Joe's apartment door open. His transmitter, power supply, and key were gone. I cried. Joe was gone! The apartment was a mess with *Radio* magazines scattered over the floor. They were something nobody wanted. I remember the strange chill when I found Joe's soldering iron under an old *Radio*. I have never used it. I carry it with me even today. Each time I look at it, I recall those happy days—the dahdit didit didahdidit's, the anticipation, the warm glow of the parallel TZ-40's, the smell of the sal ammoniac block—those were the days!

I suppose becoming a ham is largely a matter of getting the breaks, and I've had my share of them. I remember my first big break came when I was in the eighth grade. I was chosen to construct a transmitter for our science demonstration. I had just two days to solder my spark coil, capacitors, and key. It was either sink or swim.

I remember the night of the science demonstration. All the parents were there. Mother was so proud. They were fascinated with the way my rig arced. Even the government sent two men just to inspect my work. I told them

I built it myself. Hand craftsmanship! You don't see much of that anymore.

That night father flew into one of his rages about my becoming a ham. He told me I had to stop. But nothing could stop me from doing what I knew deep down I had to do. I was going to get a license no matter what.

Mother understood and stood beside me. She read the letter the men from the government gave father. Her eyes misted over. She squeezed my arm but never said a word. I knew then it would be all right. She and father fought late into the night. When the shouting stopped, I knew he had packed his bag and left home again.

When I was in high school, I build my first sustained arc transmitter. It was during those years I developed and polished my code style. I read *Radio* until it soaked into my pores. Those were the heady years when I learned didah to dahdahdidit. Becoming a ham is not so much in the knowing, but in the feeling. When I was eighteen, I almost got my first license. My feet never touched the ground.

I was studying for my first license when I married my first wife, Susan Maycomb. We had a daughter, Betsy, who could tell a resistor from a capacitor by the age of three. Susan was a pretty girl with flashing dark-brown eyes. In-law problems ended our marriage. Her father was strictly SSB.

My second wife, Mabel, talked me into taking a regular job with a large company. The pay was great, but I knew something was wrong. The parts I soldered had the dreary sameness about them. I was just repeating myself. I could tell from the cold solder joints I had gone stale. The company said if it was the air I wanted, they would give it to me. I was free again and my second wife left me several weeks later. I learned you can't be a ham and have a job and a wife at the same time. This is the mistake so many younger men make. They divide their interests.

I went back to live with mother. She was the only one who understood what it means to be a ham. She understood when I turned the living room into my shack. Some people were critical because my mother supported me during my early years. But I never flinched once; I knew she could do it. Good old mother—she gave me quite a start the day she grabbed my open transmission lines. She understood when I explained enclosed lines don't radiate freely.

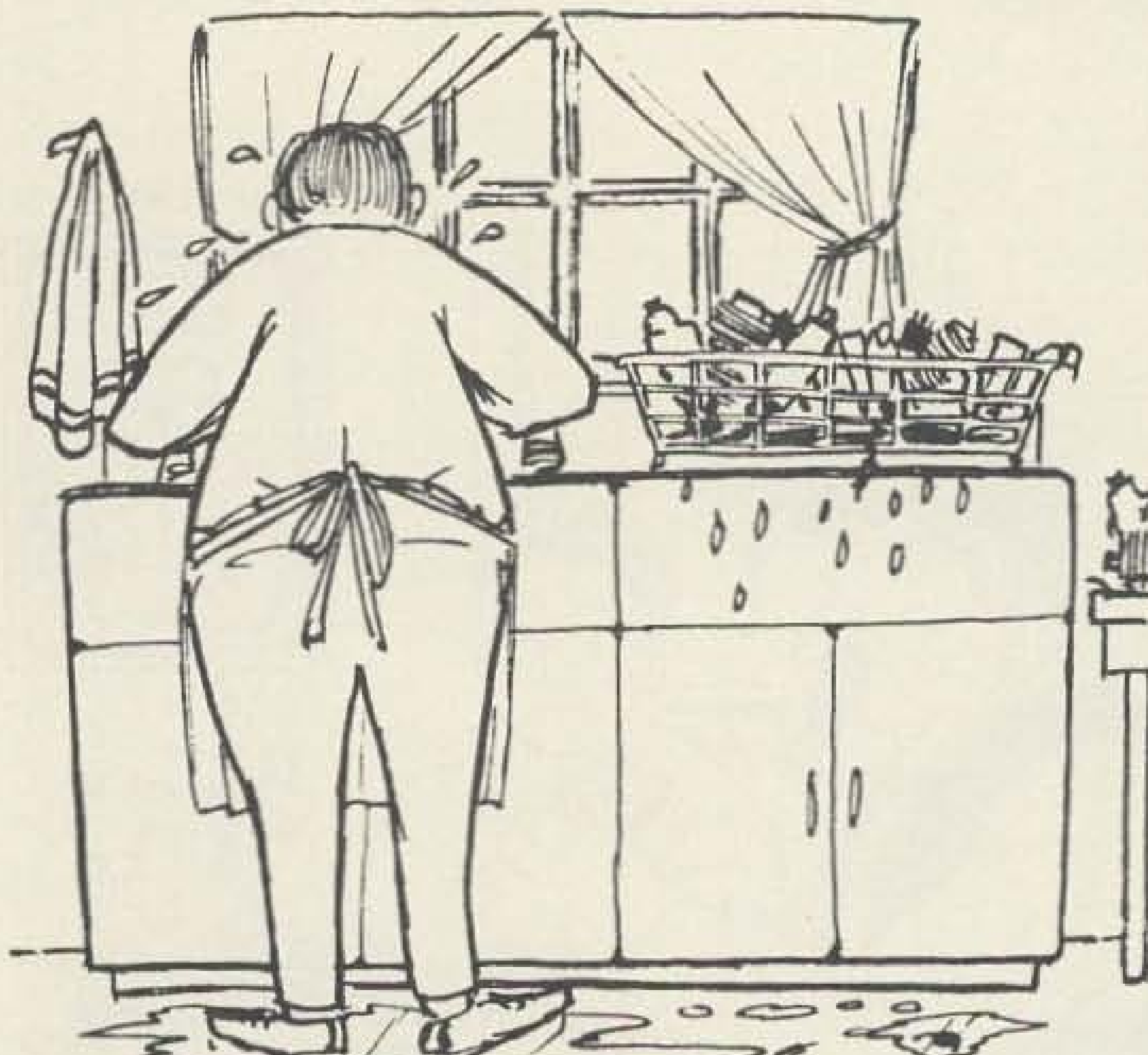
My first rig went west, but I didn't mind. I was a full time ham again. But something was wrong. I blew too many jugs. I was searching to find myself. Nothing seemed to click. I felt I was finished.

Then it happened. I was almost asleep one night when the words thundered into my sleepy brain. "Build what you know." That was it! I dragged myself out of bed and started to build my first modulated high frequency arc transmitter. It was wonderful.

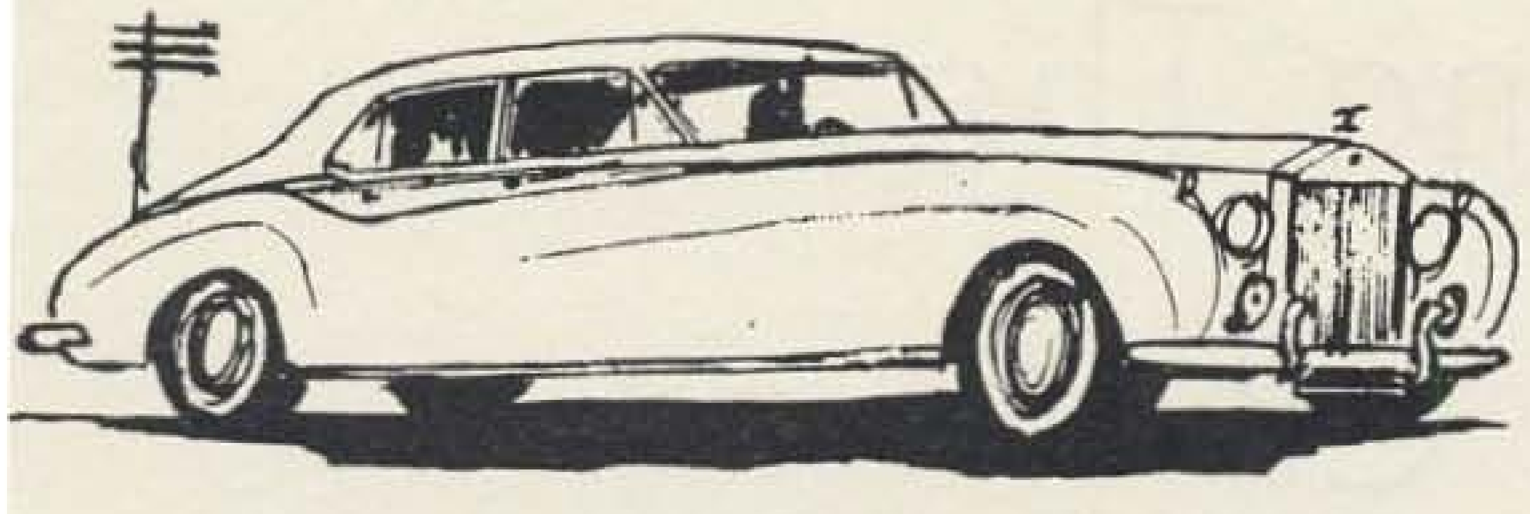
The morning began to break for me. Instead of fumbling with narrow band transmitters, I built broad-band rigs. I saw transmitters as a whole, not just parts. Little by little I learned *System* hamming. If something wouldn't click I would relax and let it simmer. Slowly the answers would come from the depths of my being. A warm glow inside would give me a sense of satisfaction and everything seemed to build itself.

This was the way it was with my first rig and this was the way it was with every rig since. To this day I can never start a rig without a sense of tremendous pressure. I become keyed, tensed, modulated, nervous, suppressed, impatient. I swear, smash a vase or break a window. Every nerve is raw, open and waiting for inspiration. This is the time a rig arranges and rearranges itself in my mind. Then it clicks, and I sit down and build. I become relaxed when I work, but the sense of responsibility remains.

When I became older, I realized there were other hams—young, struggling—less fortunate than I. I dedicated myself to helping them. I borrowed a thousand dollars from my mother and invested in surplus equipment. I carefully washed the jugs and bottles and beautifully relabeled them to make them easier to read. I reconditioned thousands of parts. I introduced them into the hungry ham market. Success was immediate and I was able to retire after two years. I retired with a deep satis-



I carefully washed the tubes to make them easier to read . . .



Success brought a Rolls Royce . . .

action that I had helped many young hams get their start.

We hams are a strange breed. On the surface we appear to be ordinary people. We laugh, drink, and dabble in the banal pleasures of the world. But underneath this false exterior there is a deep sense of humility.

Striving to become a ham has given me some of the material pleasures of life—a fishing retreat in Wisconsin, a hunting lodge in Canada, (mother likes to hunt and fish), a Rolls-Royce and so forth. But these are not important. Building a rig is all that matters to me. It's the soaring ecstasy, the flying to dizzy heights, the tingling of every nerve. To this day I can never go anywhere without Joe's three pound soldering iron. It reminds me of what I was and from what depths I climbed.

. . . Pirolo

Pres Graham W4FDA
Fleet Sonar School
Key West, Fla.

Improving SSB Performance of the SX101

SSB reception can be improved immeasurably by the addition of a product detector in any of the SX101 series receivers which have only a diode detector.

Referring to Fig. 1 and the receiver schematic, this is a step by step way to do it. No holes must be drilled and the receiver may be returned to its original condition in about a half hour.

First, build the circuit in Fig. 1 on a 7 pin miniature Vector socket, mounting all components on the socket extension. Mount the Vector socket on a small L-shaped piece of aluminum and secure to the side of the chassis with one of the bolts holding the side brace. Remove S5 and replace with a spdt toggle switch. Solder together the two wires removed from old S5, and tape. Make connections to filament and B plus. (B plus connects to C87B). Remove bfo lead from pin 1 of V7 and connect through a shielded lead to pin 1 of the product detector. Connect a shielded lead from pins 2 and 9 of V7 to pin 7 of the product detector through the 5pf capacitor. Do not disconnect any leads from pins 2 and 9 of V7; the output from the last *if* is fed to both the diode detector and the product detector at the same time. Connect the center of new S5 through a shielded wire to the side of C89 that goes to S2A. Disconnect at S2A the shielded lead coming from pin 6 of V7 and reconnect to the upper end of new S5. Connect a shielded lead from the bottom pin of new S5 to pin 5 of the product detector. This completes the construction. The only thing left is to recalibrate the bfo. This is done by removing the knob and adjusting the shaft (L16) to a point where the carrier of an AM signal will remain at Zero Beat when switching from uppr to lower sideband. The knob is then reinstalled with zero at the marker.

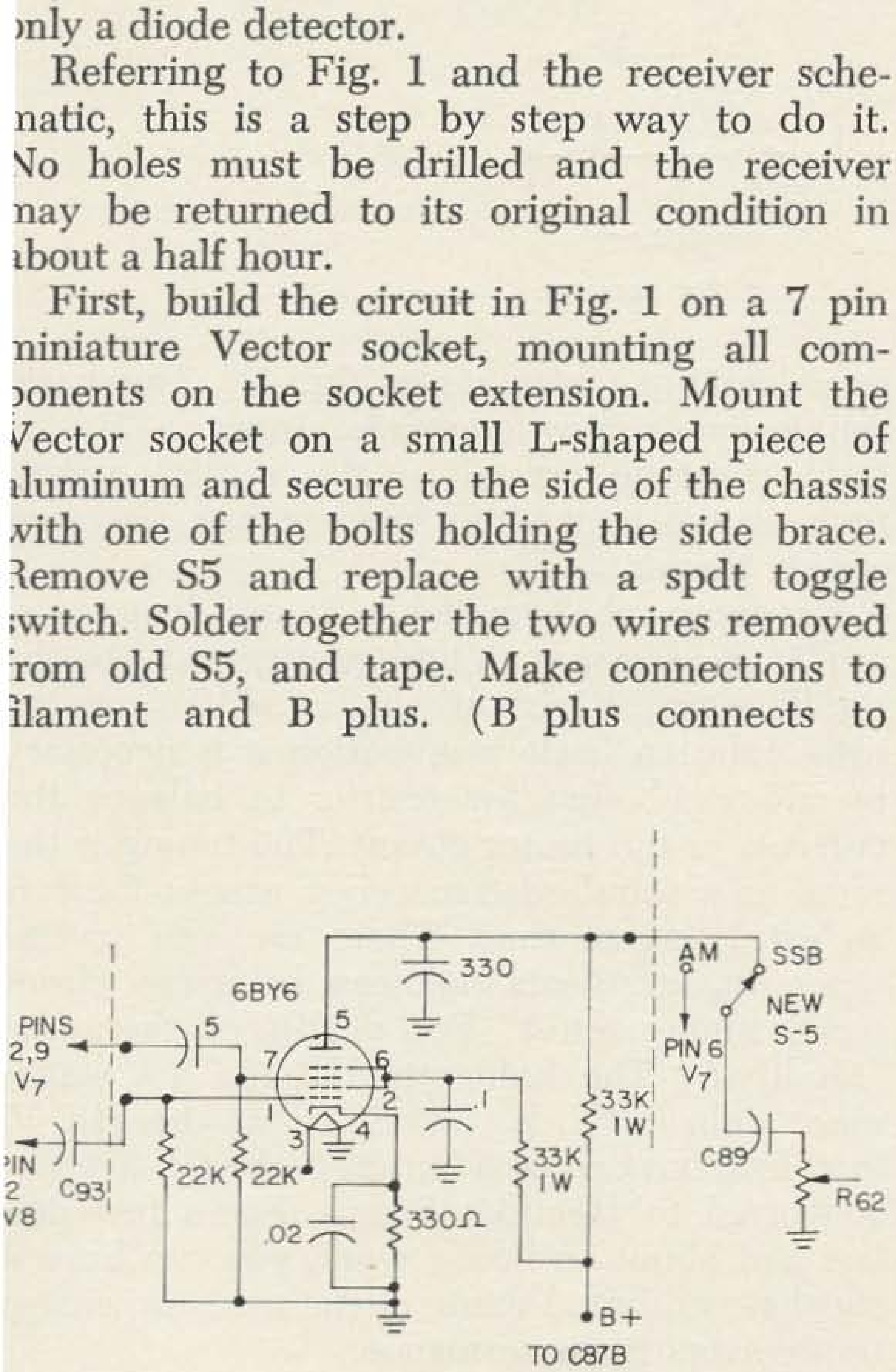


FIG. 1

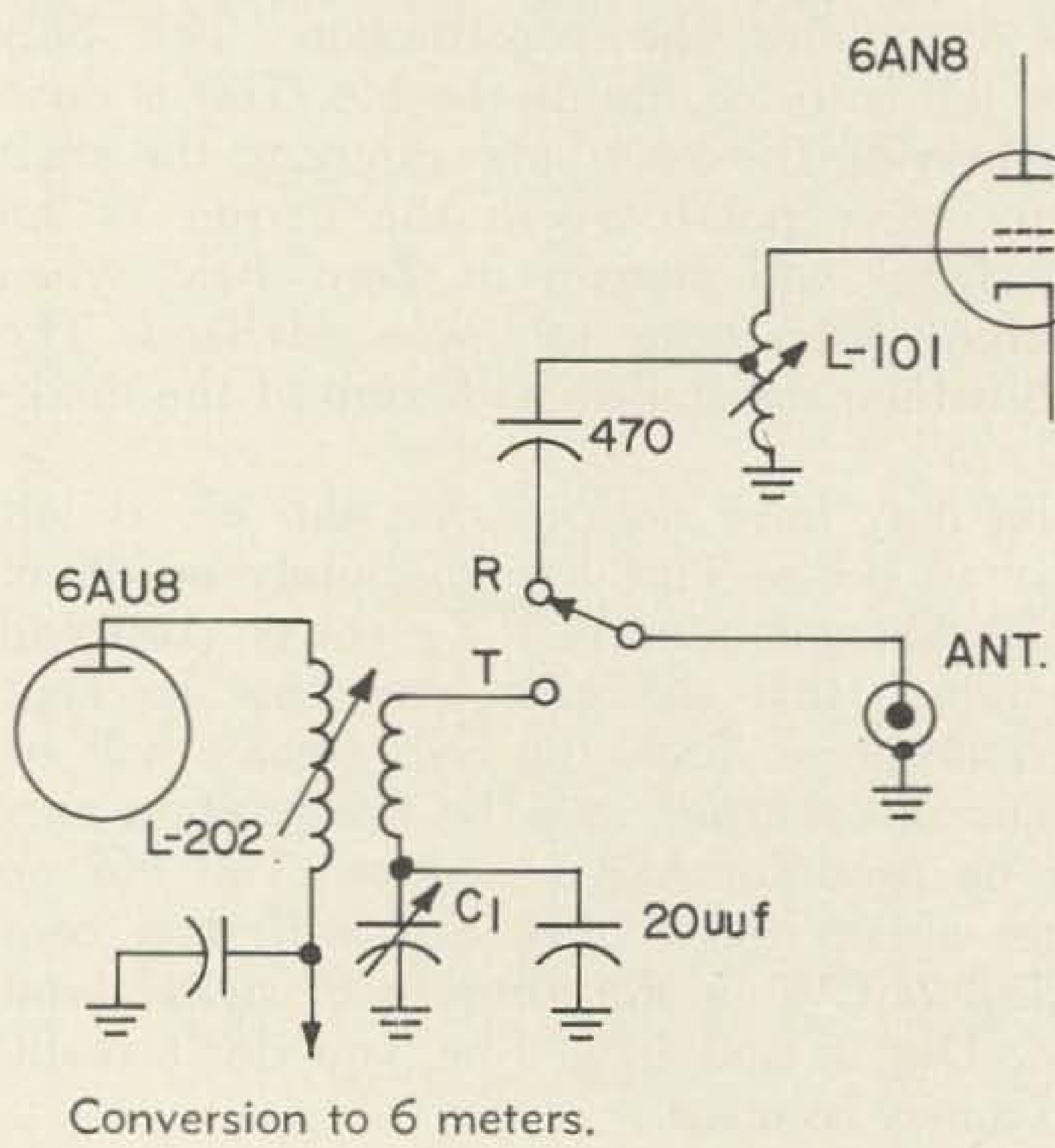
You may have noticed that the bfo is left on at all times. This has absolutely no effect on the AM operation of the receiver. You will also notice that the gain may now be kept much lower on SSB, the SSB signals will be cleaner and sharper, and the 1kc position may now be used for SSB reception. The bfo no longer affects the S meter; it will read zero on SSB & CW in the absence of signals and noise. Dig in and have fun; you don't really need a new receiver.

Converting The Heath CB-1 To Six Meters

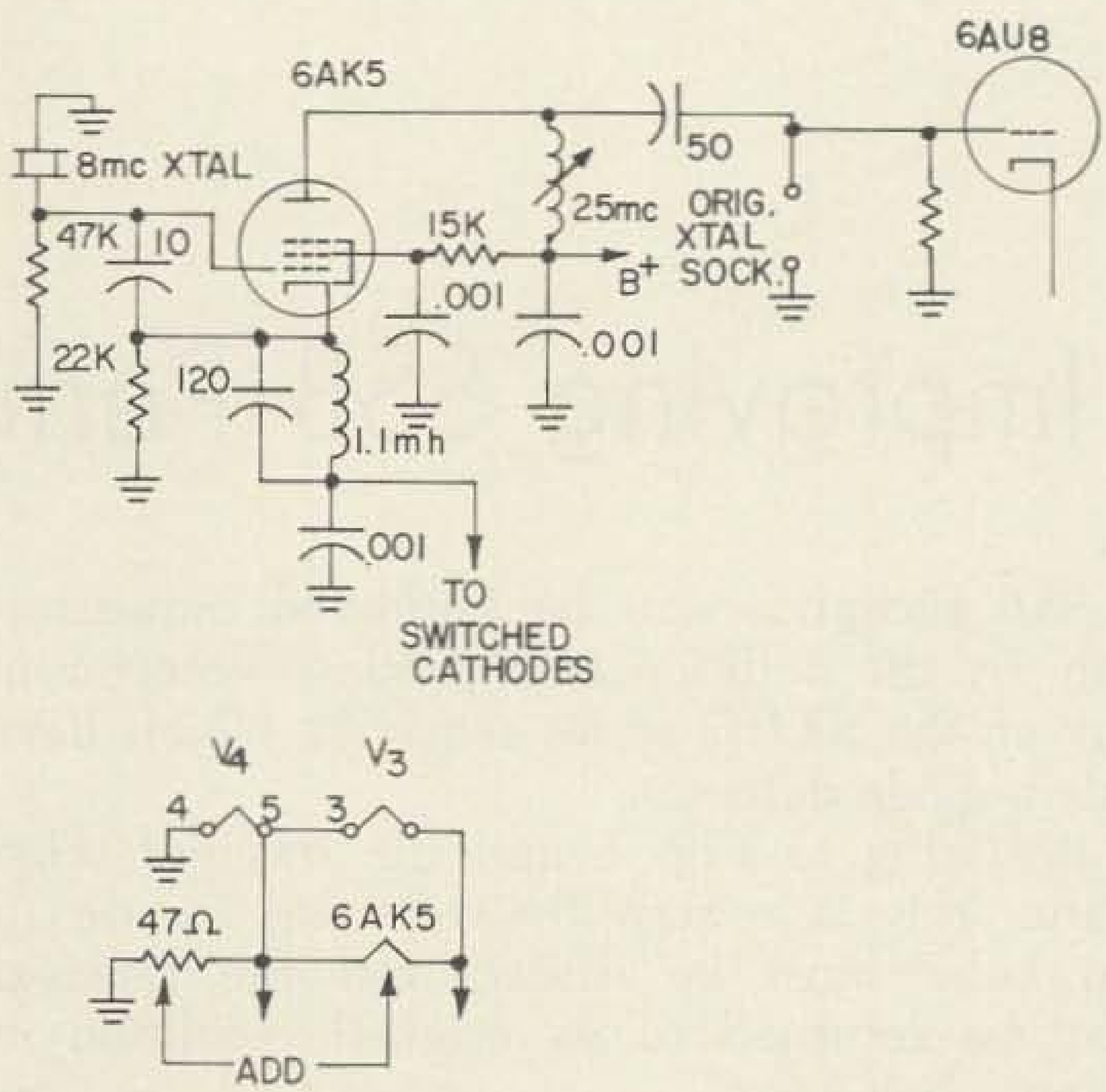
Larry Levy WA2INM

Because of the crowded conditions on the 11 meter band, it is almost impossible in this area to use a receiver that has a regenerative detector. For this reason Heathkit CB-1 transceivers are becoming available quite reasonably. These units have a lot more life left in them since, with a little conversion, they make wonderful mobile and low power fixed six meter stations. The receivers are extremely sensitive, are insensitive to ignition or similar noises, and selectivity is fine for most mobile operation.

The conversion is simple. Remove the 12 mmfd condensers that are across each of the four coils. Remove four turns from each of the coils. Remove the 2.2 mmfd condenser between the t-r switch and the antenna coil. Tap the coil 1½ turns from the cold end and connect a 470 mmfd condenser between the tap and the t-r switch. Remove the coil from the trap and connect the antenna lead directly from the jack to the switch. Break the lead from the grounded side of the link and connect to one side of trap trimmer. Connect the other side of the trap trimmer to ground. The trimmer will work as a loading control (see Fig. 1). The basic conversion is now complete. Insert a 50 mc third overtone crystal in the crystal socket, tune up the transmitter and receiver, and you are on the air.



Conversion to 6 meters.



8 mc conversion.

For those who would like to use 8 mc crystals, it is necessary to add another tube to the rig. The circuit is shown in Fig. 2. To use the extra tube on battery operation it is necessary to add a 47 ohm 5w resistor to balance the currents in the heater circuit. The tuning is the same as a standard transceiver except there is an extra coil to tune. There are also several other improvements that can be made (front panel tuning, etc.). For details of these see "Modifying The Lafayette HE-35," 73 Magazine, Feb. 1962, p. 54. Some of the HE-35 modifications can be adapted to the CB-1 (now converted to Heathkit Sixer). For a few dollars and about an hour's work, you can have a rig that will equal many of the more expensive transceivers in performance.

. . . WA2INM

G. Lambertson W4BV
512 Hatchet Drive
Fayetteville, Tenn.

An inexpensive GG 813 Linear.

The Big Bang

In the era "BGS"*, the art of ham radio was rather simple. Perhaps it was even crude compared to modern modes of communications. If you wanted to transmitt, you had to hunt for materials you hoped you could make the parts that would give you the results you were looking for. In other words, if you could not make the parts, you were not on the air. When a project was completed, it looked like something that should not happen to wire, tin cans, tin foil, copper tubing; but it worked!

For my money, one of the big thrills of ham radio is just about to fade away—to sit down and figure out a circuit, design the rig, give it the old smoke test, kill all the bugs, keep your neighbors on speaking terms, call CQ, and have someone come back with a big fat 5X9!

Then came the era "AGS"*. With a bit of time on my hands and drifting back to the dark ages, I thought I would like to see what would happen if I tried to figure out a simple linear using as few parts as possible.

So I sat down and came up with the circuit shown—keeping in mind we have to live under FCC regulations, a few simple electronics rules, and the fact these rigs can kill you quicker than you can give a break-break.

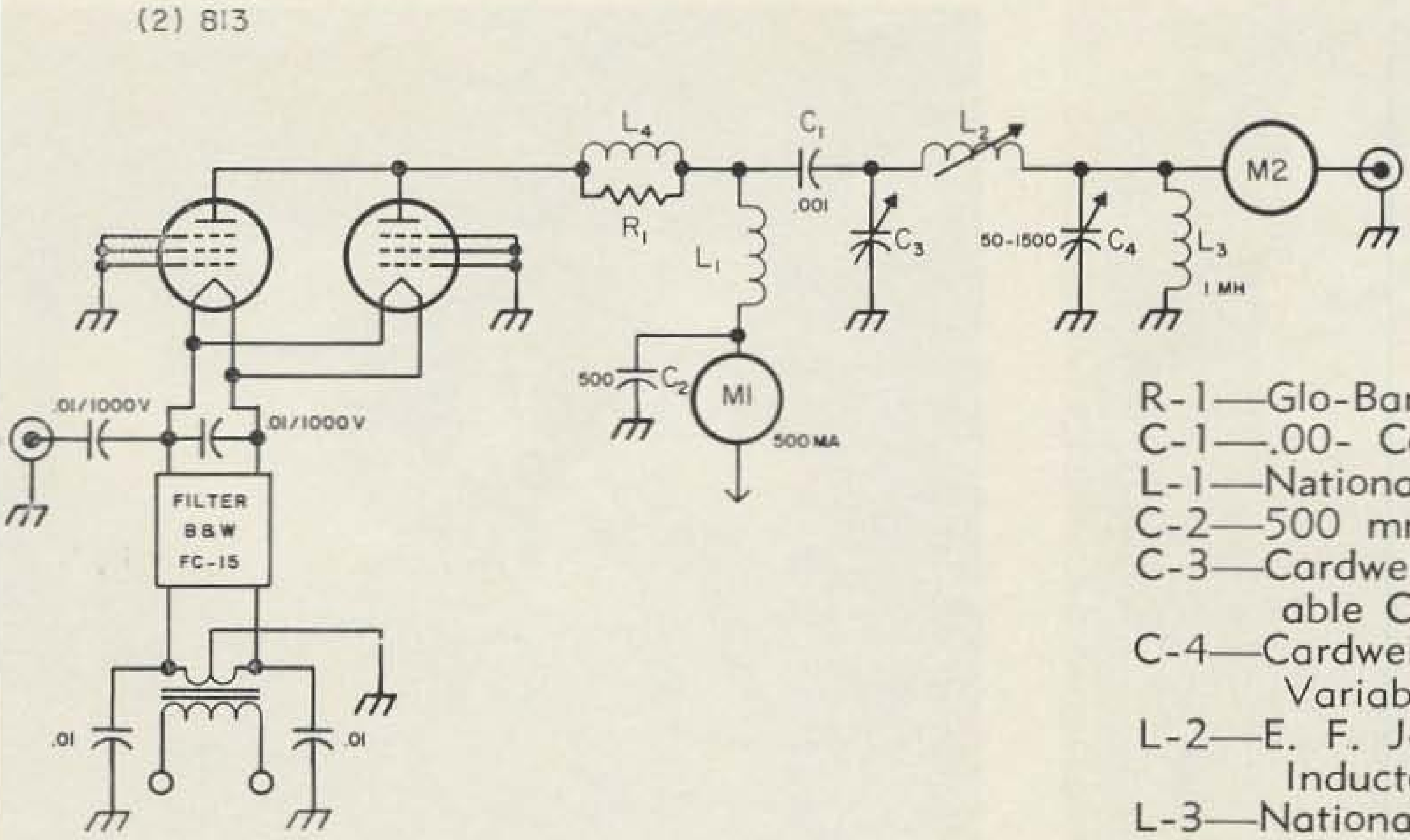
After a few smoke runs, I decided that all I had in mind could be put in a cabinet 12″ × 12″ × 12″. A pair of 813's was the choice; they are rugged, tough, and still on the surplus market at reasonable prices. They do not require forced air.

I took the sketch in hand and went to the local welding shop. In no time at all the frame was constructed from ½″ angle iron. Corners were spot welded, and a flat piece of the same material was welded 3½″ from the bottom of the frame to the top of the cross piece. This was necessary to allow the flat deck aluminum plate to be held in place. The flat deck plate was cut to allow the piece to fit snug inside the frame, even with the outside of the frame, making a good rf shield to the parts placed below the deck.

The front panel was cut 12½″ × 12½″, which allows a ¼″ edge around the cabinet. When placed on rubber feet this gives some protection to the side walls.

One of the photographs shows the underside of the flat deck plate, the trimmed corners, the two 813 sockets, the filament transformer, the B&W FC-15 choke (I might add, this is a must to avoid headaches), the high voltage feed-through insulator, the four .01 by-pass

* "BGS"—Before Goodie Stores.
** "AGS"—After Goodie Stores.



R-1—Glo-Bar-Fr-051 6 Turn #14 wire
C-1—.00- Centralab-858-5 H1-K
L-1—National R. 175-A platechoke
C-2—500 mmfd. door knob capacitor
C-3—Cardwell pl-8048 20/220 mmf Variable Condenser
C-4—Cardwell pl-8013 50/1500 mmf Variable Condenser
L-2—E. F. Johnson #229-202-2 Variable Inductor
L-3—National-R-300-1 mh. chore R.F.

capacitors—two at the hot end of the 10-volt filament, one from the BNC connector, and one across the filaments. The 813 sockets were wired as shown. The pins, except filaments, were grounded under the 8/32″ pan head screw.

The back wall was made from aluminum held in place with aluminum 90° angle. A five pin socket was used to the common ground and the incoming 115 volts ac. The Johnson feed-through insulator is shown to the right side with shielded high tension wire.

The top of the flat deck shows the placement of parts: the two 813's, the NAT R-175A plate choke with the 500 mmfd door knob by-pass, the top of the high voltage feed-through insulator, the globar parasitic choke, the blocking condenser with copper straps in place, and the two wires for the 500 ma meter.

There are a few comments regarding the back side of the front panel. The Johnson 229-202 is mounted on a small sub-bracket secured to the front panel by a piece of ¾″ × ¾″ aluminum held in place by 6/32″ flat-head screw in a counter sunk hole.

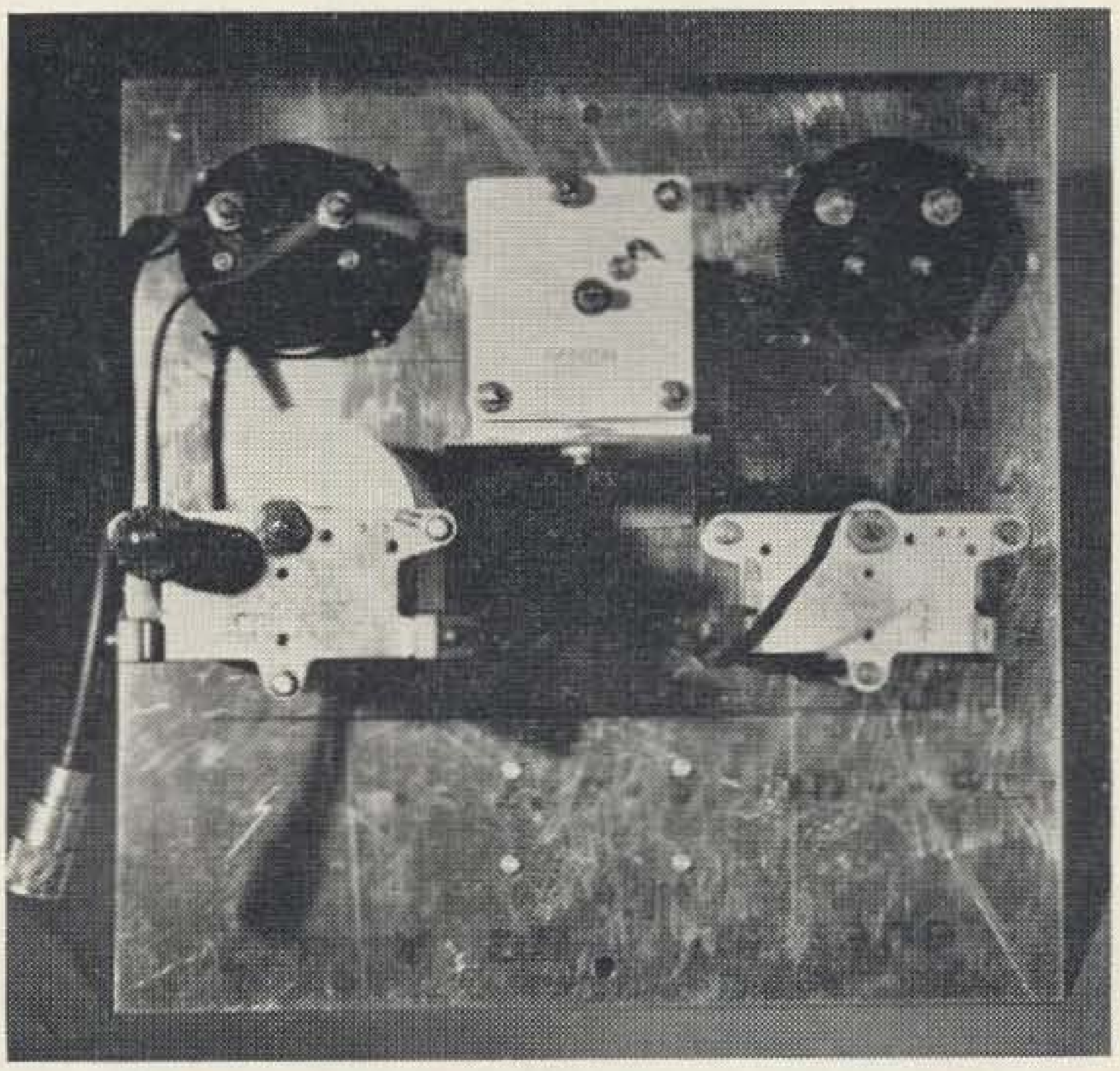
The variable inductor is placed on its bracket to allow ½″ clear of the front panel and ¼″ bearing connector. The rotor must be insulated from the ground. The copper strap shown on the plate tuning condenser and the strap on the right side of the variable inductor, go to the top of the blocking condenser secured by a pan head 6/32″ screw. A short piece of copper strap is soldered to the other end of the inductor and then to the roller of the inductor.

The antenna tuning condenser on the left is wired as follows: The roller of the inductor and the stator are connected to one side of the 0-5 rf meter. A word of warning: Do NOT tune this rig with high voltage applied unless it is connected to the antenna or a good dummy load. A light bulb is not a good dummy load. Should you try to load up without a proper load you will blow this meter out.

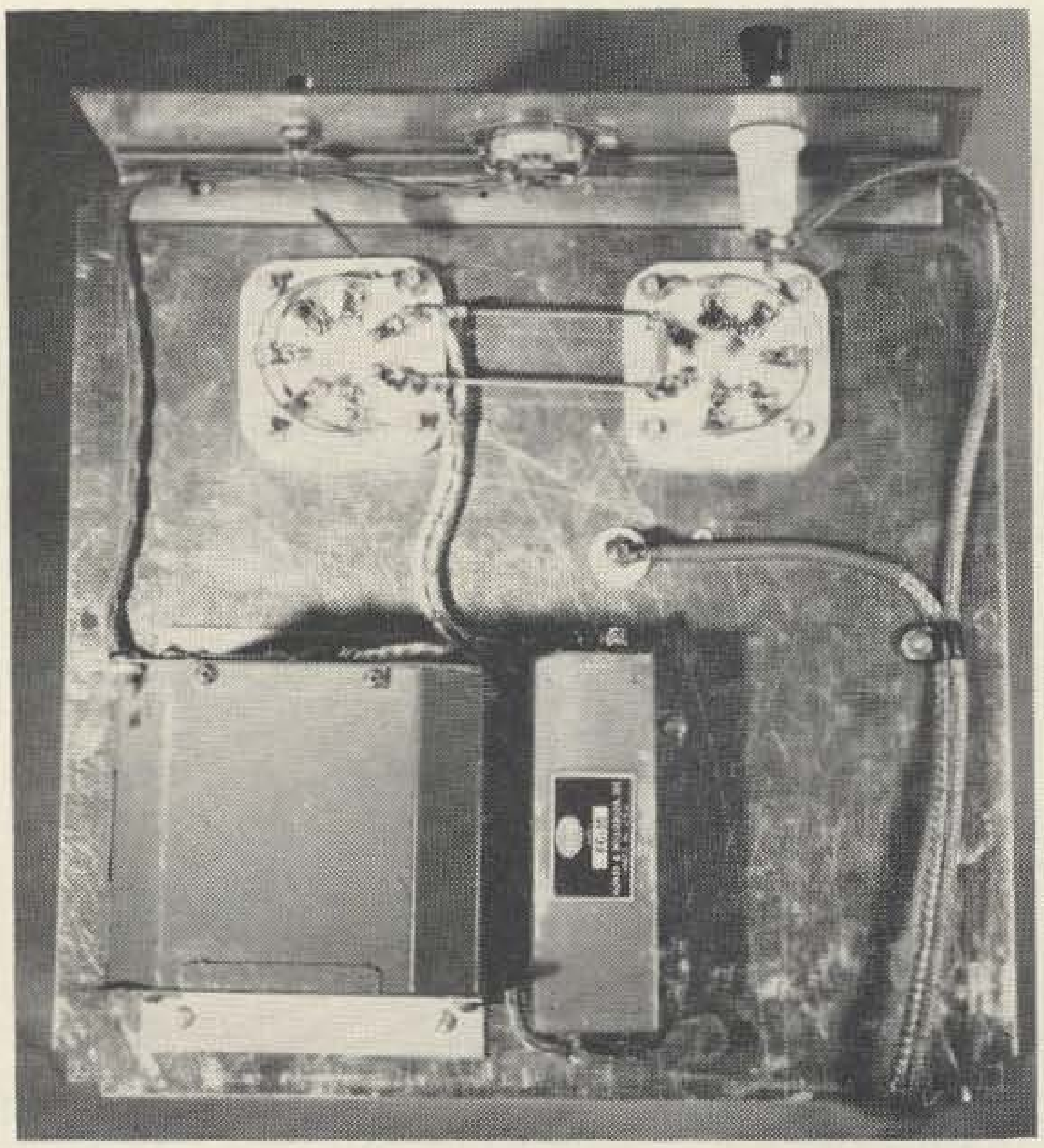
The output of the rig is carried to the Amphenol bulk head feed-through by the short piece of RG8/U secured to the rf meter. The braid is grounded under one of the meter screws.

The 1-mh rf choke shown on the left side of the antenna tuning condenser is connected to the stator side of the condenser to a ground on the condenser. Don't forget this one, or you might be sorry.

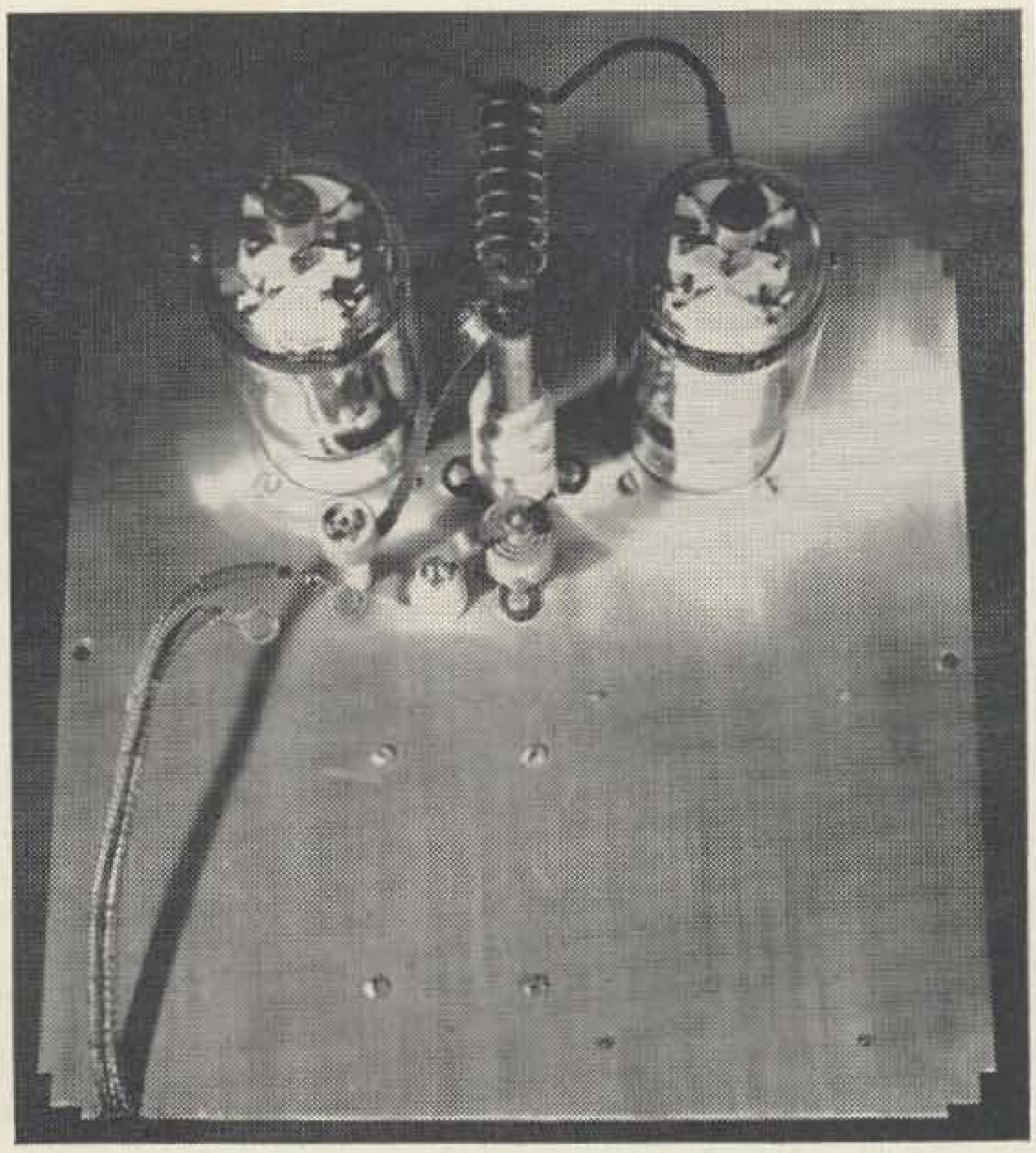
The back of the rig should not need many



Back of front panel.



Bottom view.



Top view without panel.

words. To the left top is the Amphenol antenna connector; on the lower right bottom is the grounding lug. Left to right: The BNC input from exciter, 5 pin socket, ground between power supply and rig, the 115 volts ac, bottom pin NC, two top pin ac coltage, and pins below are ground.

The frame is enclosed by perforated aluminum secured by tapped 6/32″ pan headed ¼″ screws.

Operating the rig is very simple. If you wish to raise freuency, you turn the spinner knob to the right. To lower the frequency, turn spinner knob to the left.

The front view shows a white dot on the plate and antenna condensers. When the two dots are at 12 o'clock, the two condensers are at low C, or the stators are in full mesh.

An incoming signal from the exciter will produce a reading on the plate meter. Say the signal from the exciter is at 3900 kc. You don't know where the variable inductor is positioned. Suppose it is in the middle of the coil. Turn spinner knob to the left until the plate meter starts to fall. By the use of the plate tuning condenser and the variable inductor you should find a point of resonance of approximately 10 to 15 mils on the 0-500 plate meter. At this point, leave the inductor as is. By the use of the plate tuning condenser and the antenna tuning condenser, you should be able to load the rig to 450 mills, or above.

Remember every time you change the setting of the antenna tuning condenser, you upset resonance, so re-dip the plate tuning condenser.

Static current for the two 813's, with the following voltages, should be (approximately):

1500 volts	30 ma
2000 volts	35 ma
2500 volts	40 ma
3000 volts	60 ma

The "watts per dollar dc carrier" of this little rig as shown, using parts listed and voltage and current as indicated, should be approximately one-third the cost of the standard linear amplifiers—2000 watt PEP ratings—being sold at current amateur net prices. Of course, this does not include the power supply which is not shown.

Any supply rated at 2000 to 3000 volts dc, with a current rating of 500 ma should keep you home free at all times.

The supply used here is a two section brute force filter, having a three tapped primary, giving a secondary output voltage of 2000-2500-2850 volts ac. The rectifiers are 3B28's. Any handbook will show this supply and components.

Summary

My QTH is far from ideal. Channels 4, 5 and 8 are approximately 75 miles air line; channel 3 is approximately 125 miles. So TVI is important. Thus far the neighbors speak, even pet my bull dog. Phone doesn't ring, and that's nice. Small town. I like it, and I don't want to move. I might mention that the local TV cable tower is within 500 yards air line on a high hill. Turning my beam on same, running legal limits on twenty, fifteen and ten—no reports from anyone.

. . . W4BV

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Input: 12-15 V. DC
Output at 13 V. DC In.
800 at 450 MA
275 or 325 at 200 MA
0-125 V Bias
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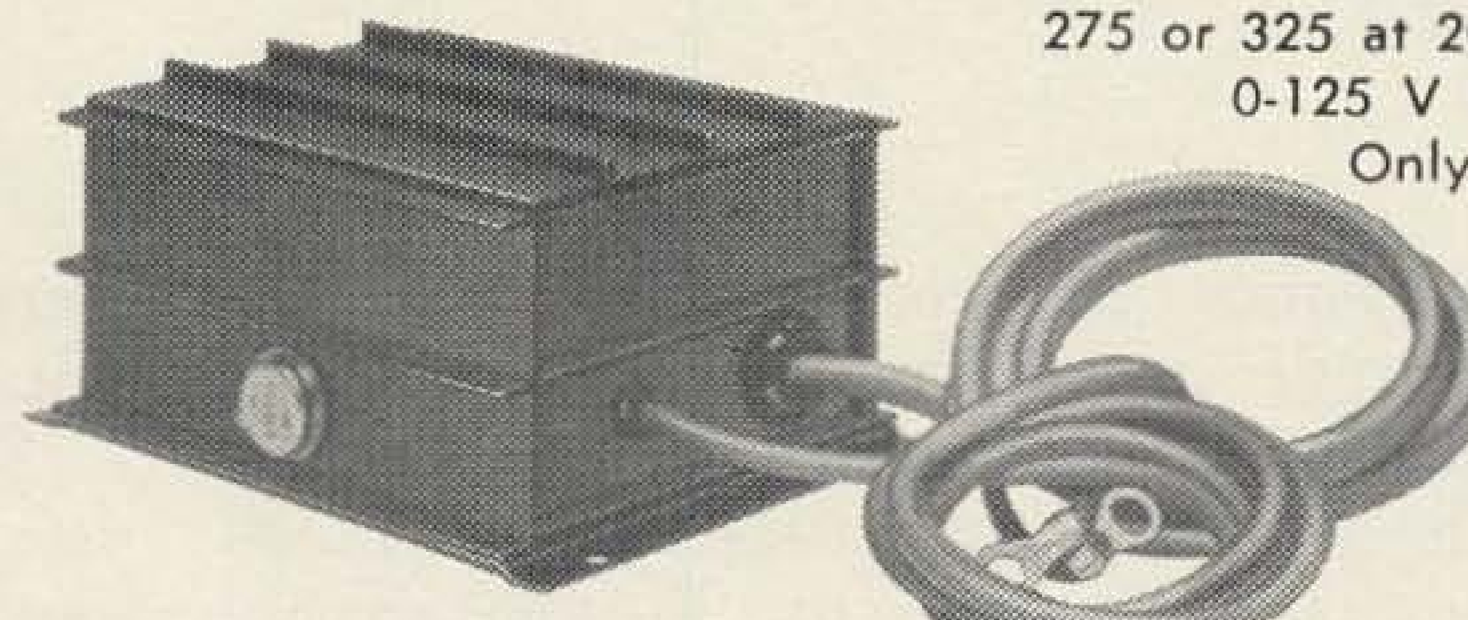

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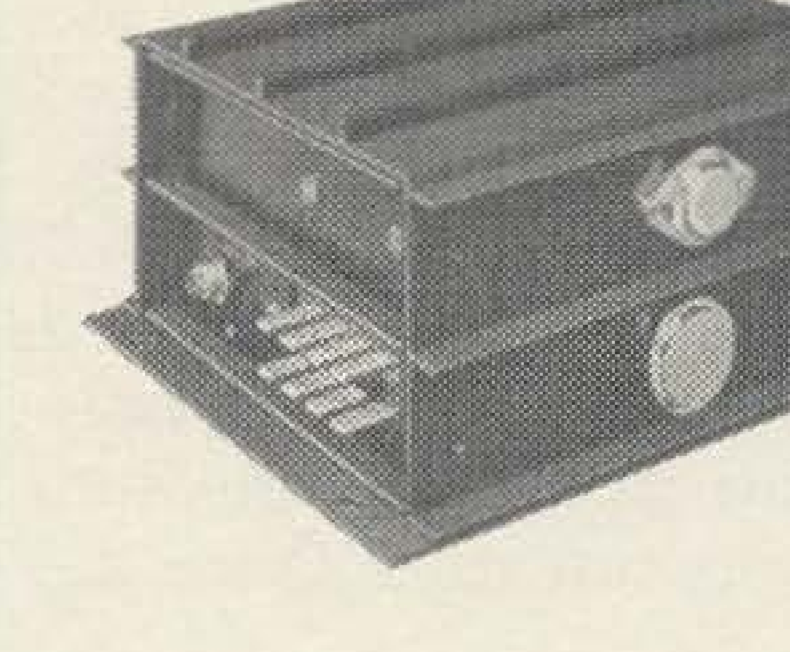
The first of the CENTURY converters to be introduced, the 400 was designed to power all transceivers, with features that marked it as a major breakthrough in the mobile supply field. Today it is proving its claim across the country as "the best supply money can buy."

Input: 12-15 V. DC
Output at 13 V. DC In.
850 at 500 MA
750 at 600 MA
650 at 700 MA
250/285/325 at 200 MA
0-125 V Bias
$145.



3 The POWERHOUSE CENTURY - 500

Recently added to the CENTURY line, the 500 delivers the extra power that is needed for high power mobile operation. A pace setter for future mobile communications with its ever-increasing power ratings, the 500 is a quality powerhouse in a compact package.

Input: 12-15 V. DC
Output at 13 V. DC In.
1150 V at 450 MA
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0-125 V Bias
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Note the Features of the Patented* CENTURY Design:

* Finned extruded case for maximum heat dissipation.
* Black annodize for rapid conduction of internal heat to the fin surfaces.
* Patented circuitry requiring no high dissipation starting resistors.
* High degree of regulation for top SSB operation, producing clean signals.
* Regulation better than 10% no load to full load.
* Low ripple due to wave shape in circuit, producing no damaging spikes.
* Less critical of over-voltage on input.
* Automatic circuit breaker protected.
* Reverse polarity proof.
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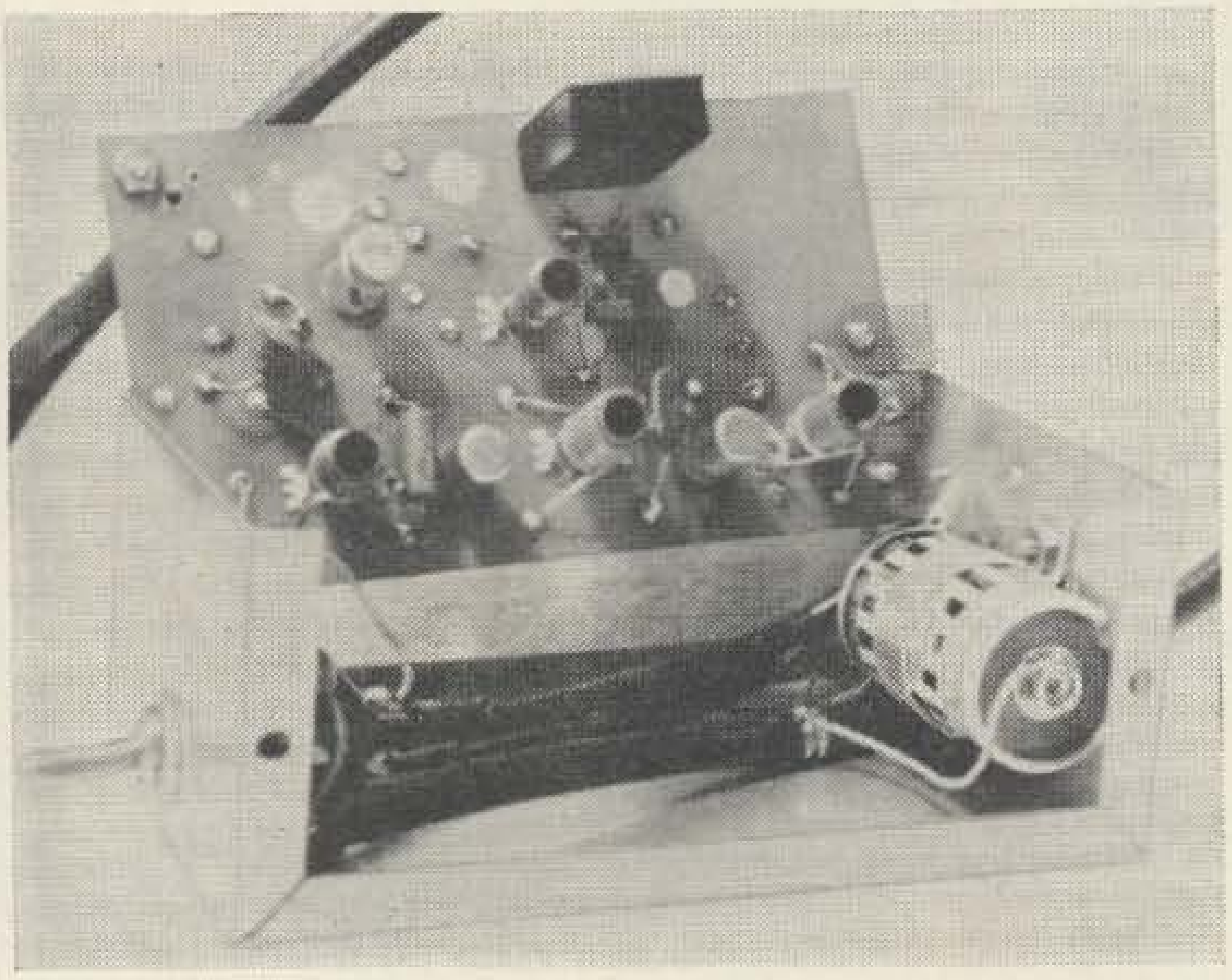


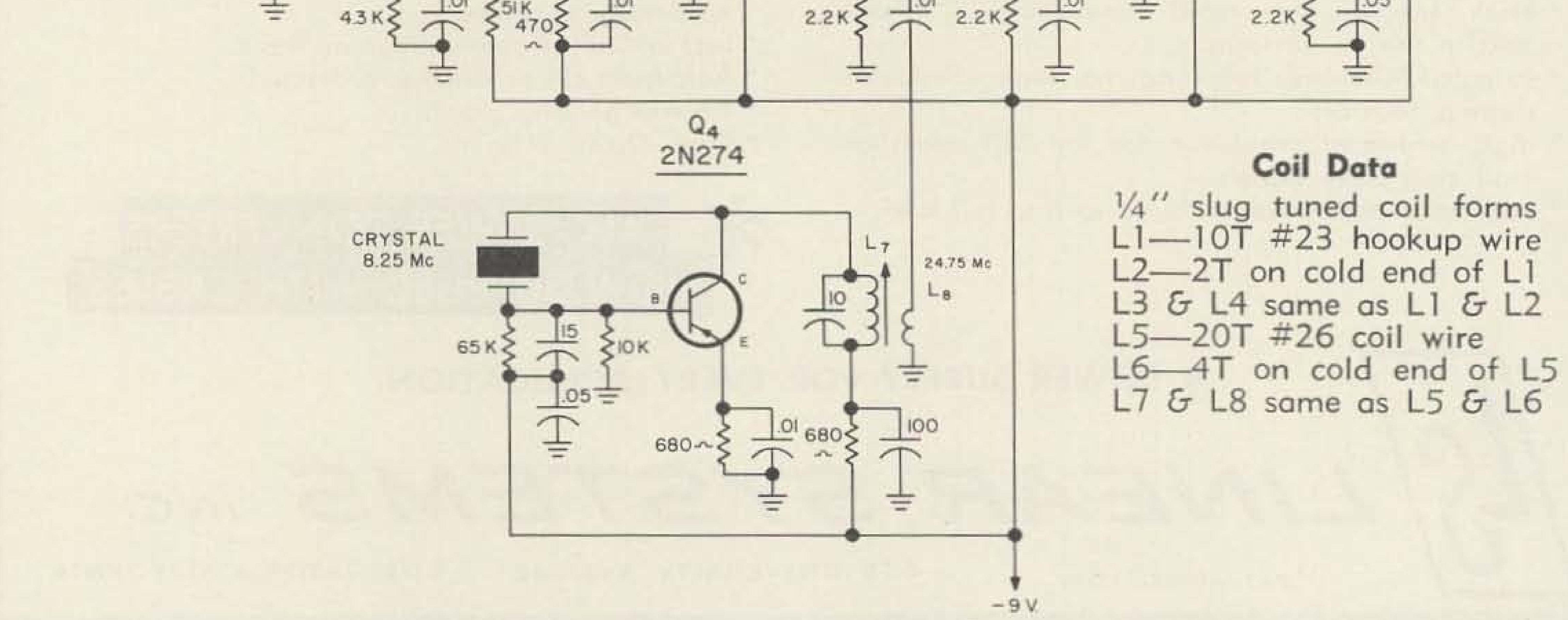
A Better Converter

At first glance, this converter looks like an ordinary single conversion converter. But the final stage is not an amplifier but a second mixer. The input coil to the last stage is tuned to a nominal frequency of 25 megacycles. There are two frequencies present in this coil: the first *if*, 25.75 mc, (50.5 mc minus the oscillator frequency of 24.75 mc) and the oscillator frequency, 24.75 mc, itself which is used twice. Q3, the second mixer, has an output circuit tuned to 1 mc (25.75 minus 24.75 equals 1 mc). The net result is a double conversion converter using only one oscillator stage, and since both the sum and difference frequencies are used there are no superfluous hetrodynes left over to cause whistles and squeals as you tune across the band.

While it was primarily designed for mobile use, it will make a real fine base station or portable receiver when used in conjunction with a small transistor radio. All should be inclosed in a metal box to prevent BC pickup. A few turns of wire around the antenna coil hooked between the converter output and case ground should provide adequate coupling.

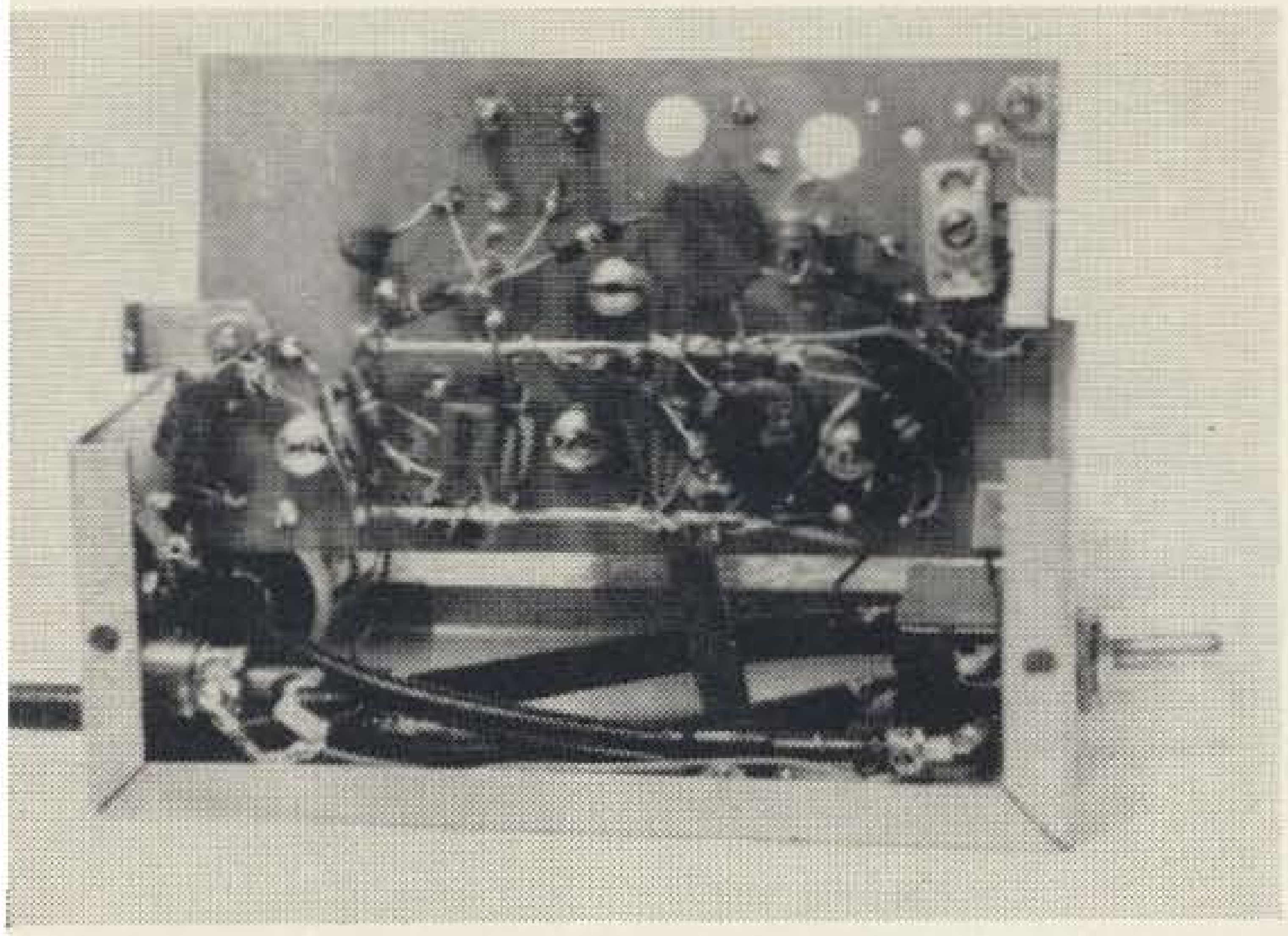
Construction

The converter was built on a phenolic board cut to fit inside a 5¼ × 3 × 2⅛" Minibox. The output cable, input jack and battery are mounted on one end and the switch on the



Coil Data

¼" slug tuned coil forms
L1—10T #23 hookup wire
L2—2T on cold end of L1
L3 & L4 same as L1 & L2
L5—20T #26 coil wire
L6—4T on cold end of L5
L7 & L8 same as L5 & L6



Inside view of converter.

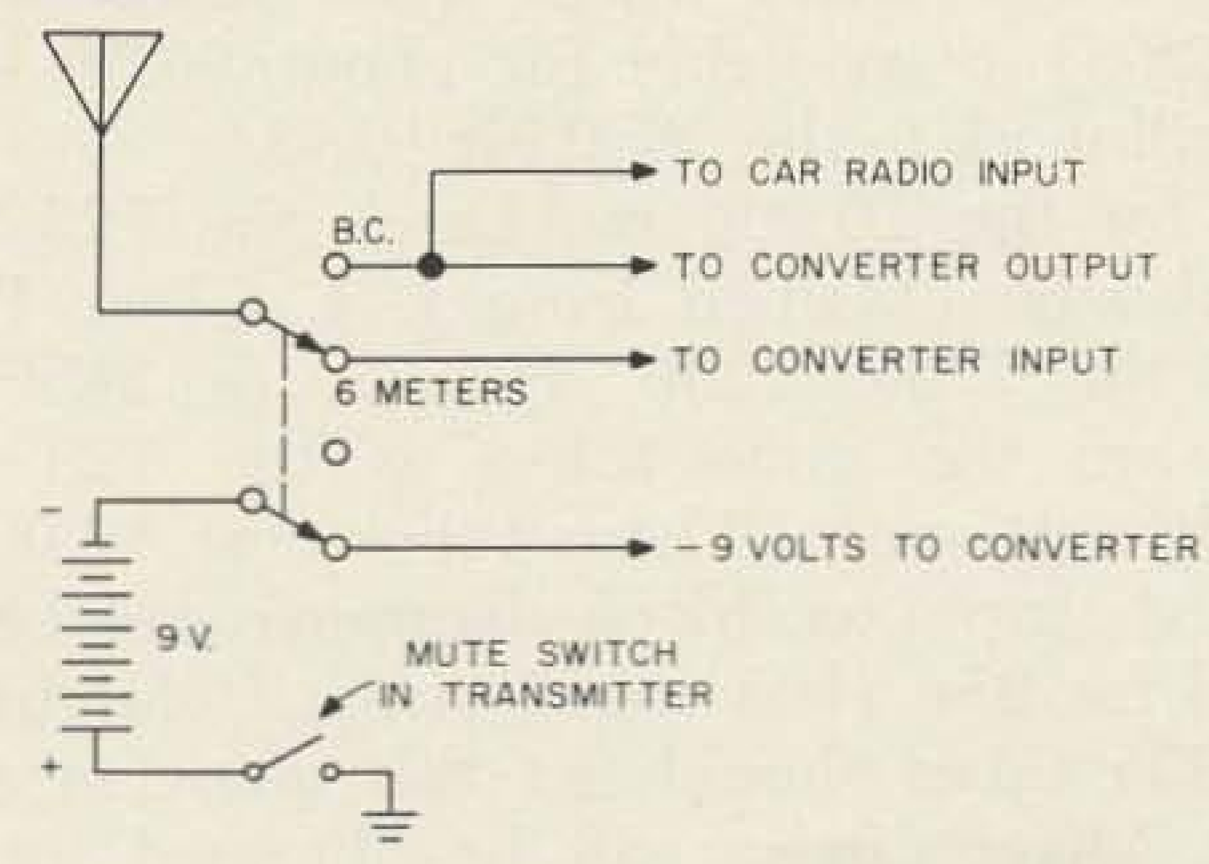
other. Major components are mounted on the board in the same relative positions as shown on the schematic. The input and output stages are at opposite ends and sheilded cable is run right up to the circuit terminals to prevent stray pickup. Keep all leads short.

I used an internal battery to simplify installation, and to avoid BC pickup and ignition noise from auto wiring. Current drain is only 4.5 ma.

Tuneup

Get the oscillator going first, then adjust the other coils for best response. After installing the converter in your car adjust the output trimmer for best reception on 6 meters. Switch to BC and adjust the antenna trimmer on the car radio for best broadcast reception. Repeat until no further improvement is noticed.

As may be expected, a super-sensitive receiver will pick up considerable ignition and other electrical noise when used mobile. It is assumed that suppression components will be installed on your own vehicle. However this does nothing for noise from other less concerned motorists. It is highly recommended that a tube type series gate noise limiter be installed on your auto radio. Circuits designed for citizens band mobiles work quite well.



. . . WAØHQA

Jim Foster K7ZFG
730 Riverdale
Gladstone, Oregon

Hints for Microwave

Many interesting articles on microwave have been written. This article merely condenses these into practical ways to start.

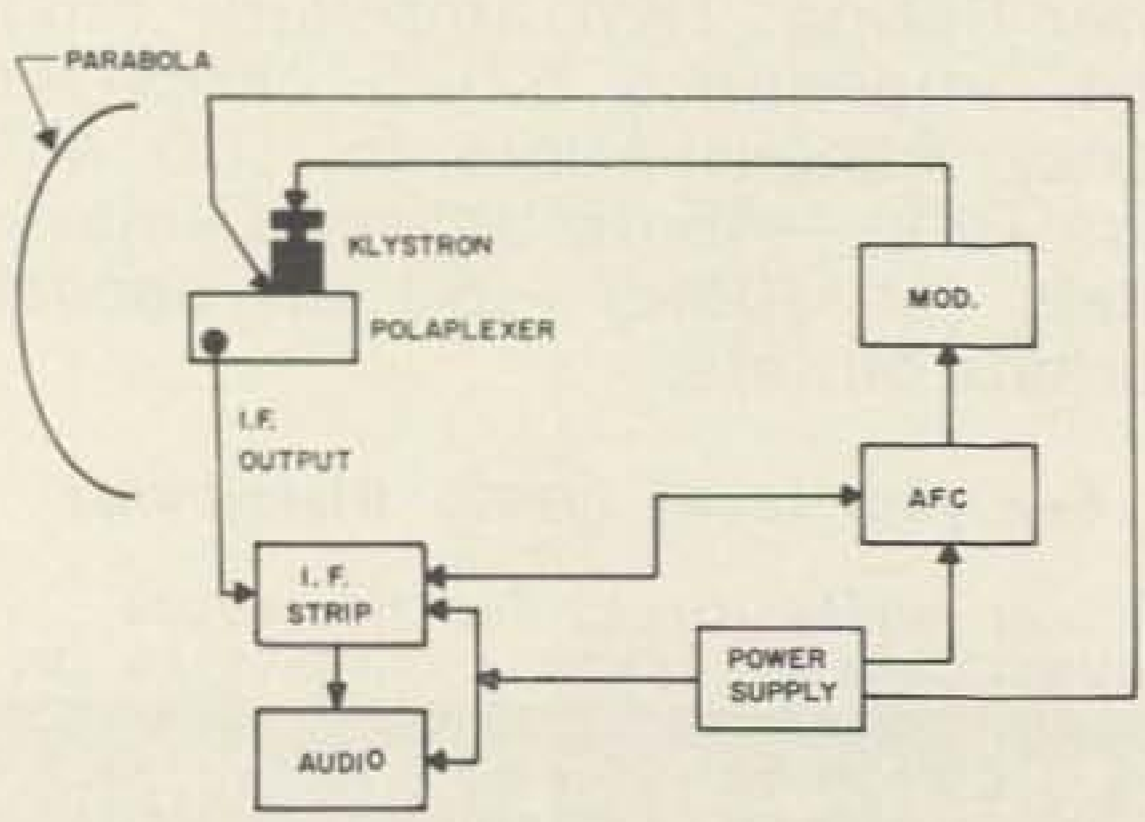
The three main objections to the use of microwave frequencies are: 1) too complicated, 2) hard to find parts, 3) nobody to talk to on these bands. Let's take these one by one:

To counter the first argument one must first look at some of these articles on the subject. For instance, my first construction project was the Beer Can Polaplexer[1] for 3300 mc.

This project involved obtaining a klystron (a tube for microwave frequencies), a mixer diode, an octal socket, an old coax fitting, a piece of copper tubing and a beer can. The total cost was \$3.05 (and they say microwave is expensive)! As for a power supply, I used an old stand-by, two vr tubes in series. This is a lot simpler than the electronic regulation specified in the article. Just be careful; the klystron shell is hot with B+.

One power supply providing regulated B+ of 300 volts and a regulated variable power supply of negative 0-150 volts should power all of your different units. The negative voltage on these tubes need not be elaborate as the current drain isn't more than 7 microamps.

The next band I tried was 10 kmc, using an old radar receiver module. I stripped this down to the waveguide, mixer crystal mount and then mounted an octal socket above the injection hole for the tube output probe.



Block diagram of system.

Tubes for this band must undergo a slight modification. File off the weld on the strut bolts and then turn the bolts until they become tight (usually about two turns).

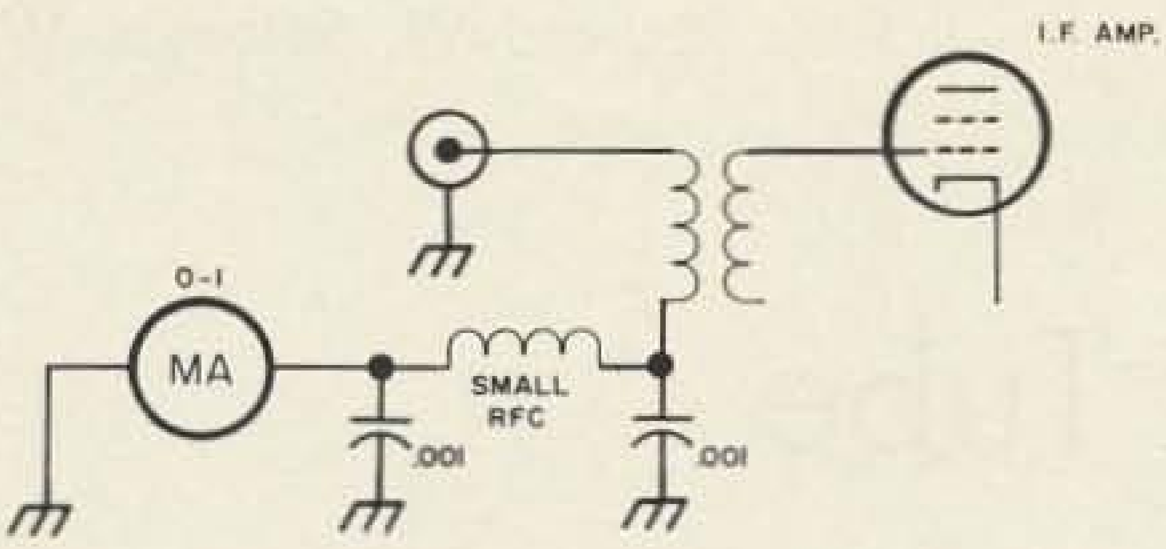
The next band encountered was 2.3 kmc. Some interesting articles on this band were "CQ 2400"[2] and "Pulse—a Practical Technique".[3] In the first article a super-regen transceiver was described. It could be put on 1296 mc by changing the cavity. The cavity used for this transceiver is somewhat difficult to construct, so I'd use the one described in the 1955 ARRL Handbook. The pulse article described a wide-band transmitter, and receiver for better efficiency on this band.

5650 mc seems the hardest nut to crack. There is a shortage of parts around, but it was found that it was because of a lack of tube listings. A couple of good articles on this band were: "Amateur Duplexing on 5650 mc,"[4] and "Experimental Transceivers on 5650."[5] The first article describes how klystrons work and how to operate them. The second article describes an operational setup. The afc is worthy of notice since it allows the tubes to "track" each other.

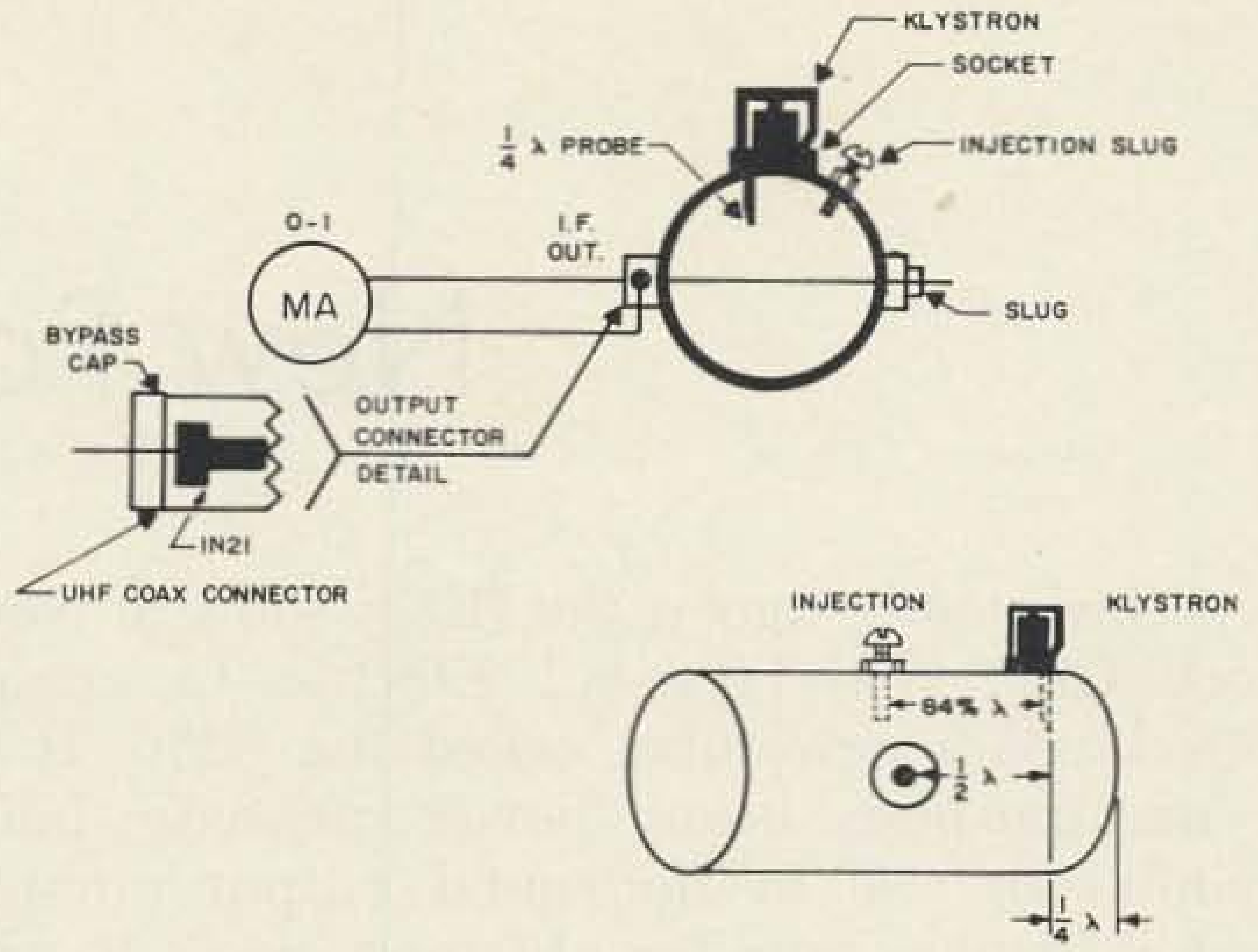
To counter the objection as to the availability, parts can be obtained from various wholesale houses and surplus stores. For 3300 mcs, the 726A klystrons are available from J. J. Glass for \$2.50 each. The 428A (order WL428-a) is available for about \$6.50 each, and will work in the 5650 mc band.

As for the 10,000 mc band, the 723 tube can also be obtained from J. J. Glass. Don't order the 723a, 723b, 723a/b, or 2K25, as these are the same tubes as the 723, and usually cost more. These tubes cost \$2.00 ea.

An *if* strip (see block diagram) can be obtained for 95c (less tubes) from Columbia. A few 33c tubes should get this going in short order. Mixer diodes can be obtained for 4-5 for \$1.00.



Connections to *if* amplifier



POLAPLEXER

Sockets for klystrons must be modified. Drill out pin 4 of an octal socket to accept the coax probe from the tube. Waveguide can be obtained, but it is usually high priced, so use old pipe, beer cans, fruit juice cans, etc.

A polplexer is a device that allows you to operate duplex using the same tube as local oscillator and transmitter. The mixer probe is 90° out of phase with the tube's output probe. It would be best to mound the diode antenna at the same place as the output probe. Since this is physically impossible, it's mounted ½ wavelength from the tube's probe. All of this is mounted in a waveguide.

Waveguide is a form of a high pass filter that will not pass any frequency lower than a half wavelength of its inside diameter. The tube should be placed a quarter wavelength from the sealed end of the guide. An injection probe should be placed at about 84% of the half wavelength (see illustration). The mixer probe's length, and the injection screw should be adjusted for maximum xtal current. The probe is adjusted by a slug. See illustration.

A few rules concerning these units are:

1) Make sure that the waveguide is basically free of dents.

Klystron: Picture on left, connections at right.

2) If you use a big dish, check frequency before installing into antenna. This can be done by an outgrowth of Lecher wires. Hook up a 0-1 milliameter to the *if* output. Next place a piece of metal plate about half wavelength from the end of the waveguide. Move the plate, and look for a dip in crystal current.

Mark this spot, and move the metal until another dip is observed. Measure this distance (in centimeters), and then use this formula:

$$\text{frequency in kmc} = \frac{150}{\tfrac{1}{2}\ \text{wavelength}}$$

3) Use the same *if* at each end so that both stations will track each other.

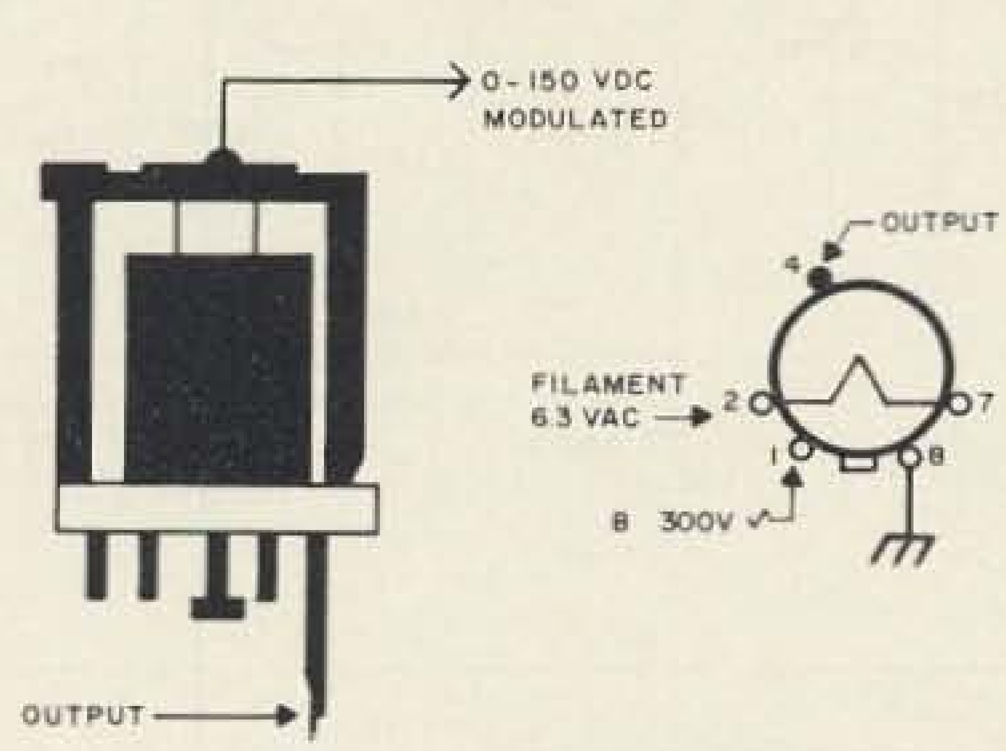
As for the third excuse (nobody to talk to), build two and loan one to a friend.

Dishes

The hardest part of getting on microwave is to find an antenna. A few surplus houses have them for sale. Fair Radio Sales has a nice one for less than $25.

Remember to mount the polplexer at dead center, and out from the dish about ½ the diameter of the dish.

KLYSTRON



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2. "CQ 2400 mc." **QST** July 1946.
3. "Pulse, a Practical Technique." **QST**, Feb.-May 1963.
4. "Amateur Duplexing on 5.6 Cm." **QST**, Jan. 1946.
5. "Experimental Transceivers for 5660 mc." **QST**, Aug. 1960.

. . . K7ZFG

Richard W. Solomon W1KSZ

New Power Tube

A few months ago at the IEEE show in New York City, the Tung-Sol Electric Company introduced a new tube, called the 8236. It is a multipurpose beam power pentode built mainly for use in horizontal output circuits and rf power amplifier. In most cases it will directly replace the 6DQ6, resulting in cooler operation.

The tube itself has a carbon anode, and this type takes plenty of abuse, and a borosilicate, or hard glass bulb. This lets the tube operate at 250°c continuously. In ICAS amateur operation, the tube can take a maximum of 1200 volts on the plate with a maximum plate current of 230 milliamperes. Efficiency runs about 70% up to 30 megacycles, with some drop-off above that. Typical operation, as amplifier up to 30 megacycles is as follows:

plate voltage	700	900	volts
screen voltage	140	145	volts
grid bias	− 75	− 77	volts
plate current	200	225	ma.
screen current	14	11	ma.
grid current	3	3.5	ma.
drive	0.25	0.25	watts
power input	140	200	watts
power output	105	140	watts

The major use of this tube as I see it will be as SSB linear amplifiers, but my use was as a modulator. With a pair of these tubes, and 1000 volts on the plates, I got 165 watts output. This was sufficient to modulate a 330 watt transmitter on 50 and 144 megacycles. The schematic is straight forward, and the only special item is a modulation transformer obtained from the surplus market. But any transformer in the 100 to 150 watt region will work all right.

The modulator I built occupies a 5 × 10 × 3 chassis and presently runs 125 watts output with 750 volts on the plates.

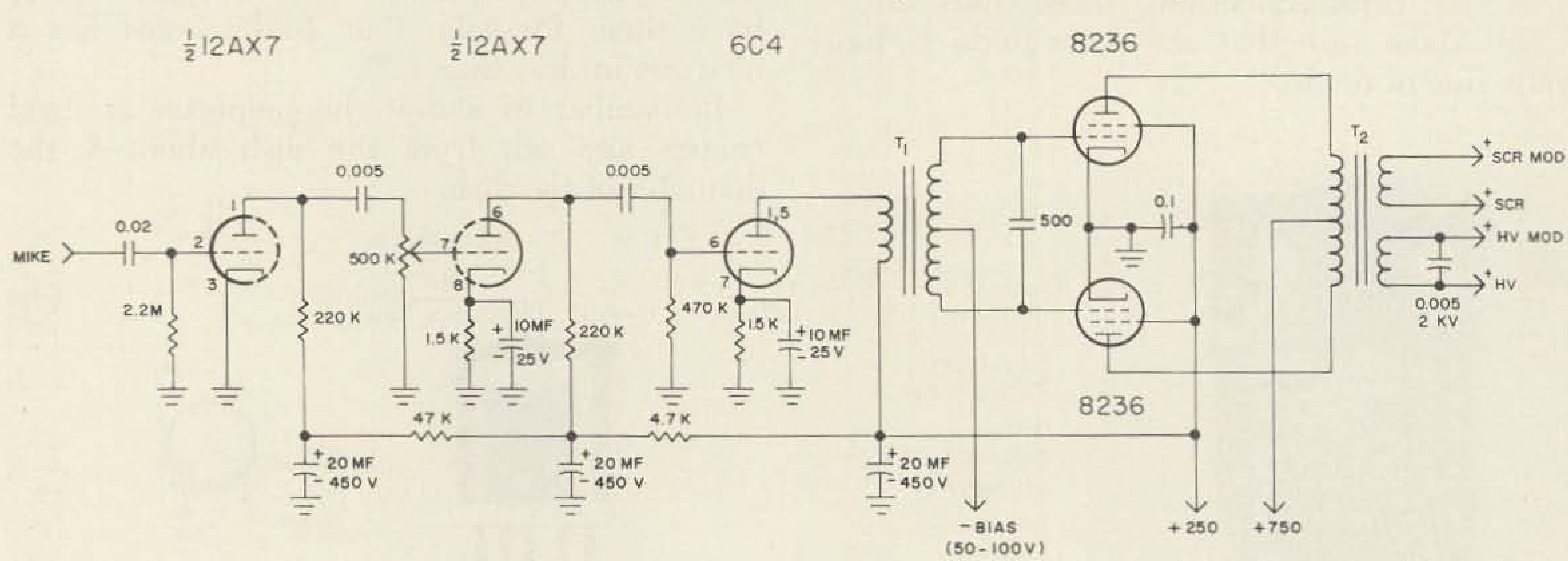
Further experimenting with this tube is planned on 6 meters and as a SSB linear amplifier.

The best news has been saved 'til last: the price is lower than the good old 6146.

. . . W1KSZ

Notes

All capacitors in mfd
T_1—Stancor A-63-C
T_2—Barry 125 w modulation transformer
adjust bias for resting current of 40 ma



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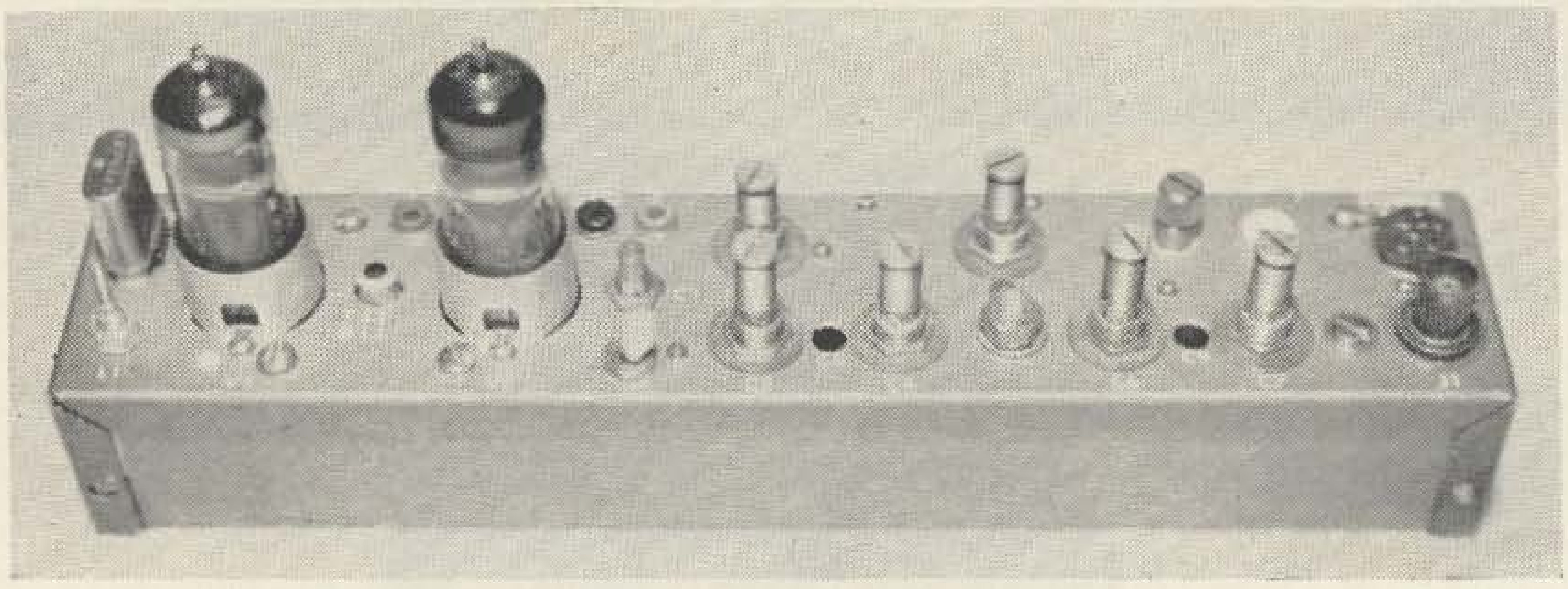


Two tubes and one varactor get you on 432.

A Hybrid 432 mc Exciter

Ronald Vaceluke W9SEK
Buckhorn Ranch Trailer Park
Lot B-39
Des Plaines, Illinois

When the ATV bug bit me a short while back, I had to take action. The first step, the TV camera, was not too difficult. However, getting the video on the air was another matter entirely. Since I live in a mobile home, space was the prime consideration. After looking at photos and actual ATV stations, I was set back somewhat. The space required was tremendous (or so it seemed to me.) I then set down all the things needed for ATV besides the camera and TV receiver. The result was four tubes and a great deal of semiconductors to fit in a small cabinet on the desk top. Two of the tubes and one of the 'fore mentioned semiconductors are the subjects of this article.

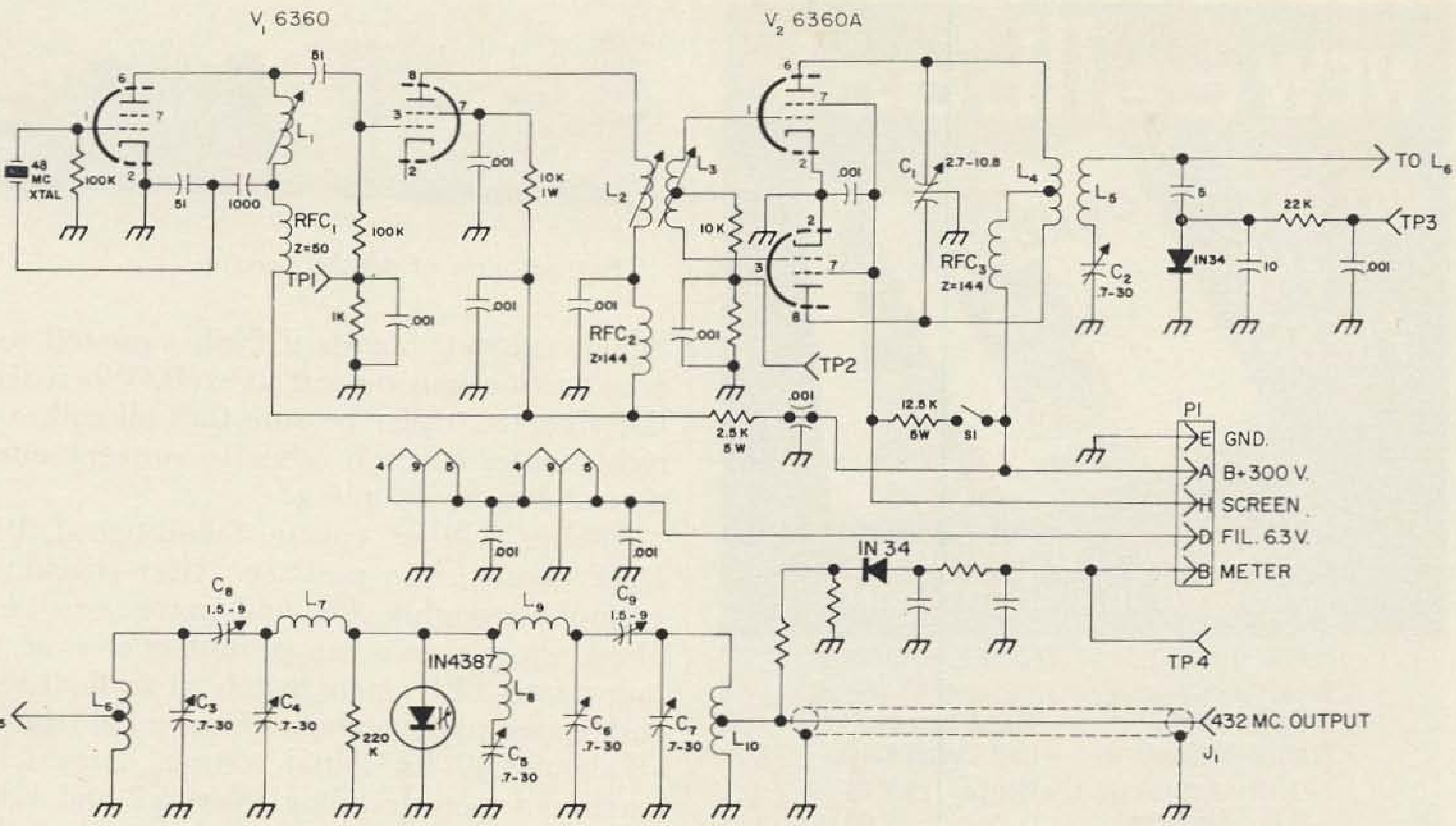
The exciter for my rig had to be small and not very hungry for power. Semiconductors could have been used throughout, however, on a cost basis this had to be ruled out. Therefore, a compromise was made and the hybrid circuit was chosen.

The line-up starts with a circuit previously published[1] but with minor changes. The heart of the unit is a varactor diode. Although these diodes are not in the "cheap" class, they have many things in their favor which overcomes some of the monetary objections. One of the prime considerations is that they consume no power other than their excitation. Another is that the little devils are quite efficient when tuned properly. My particular diode gives 75% efficiency which is nothing to sneeze at when thinking in terms of a 2C39 tripler for an example. Another minor factor in their favor is the fact that when used properly they have practically an unlimited life span.

The particular diode I have chosen is a 1N4387 made by Motorola. This diode can handle a maximum input power of 40 watts rf. When being driven with a 6360, the 1N4387 can loaf along. No pains were made in heat sinking this unit other than bolting it to the mini-box chassis.

The line-up starts with ½ of a 6360 as an overtone oscillator. This circuit drives the crystal quite hard so care must be taken or you may ruin your rock. The values of the capacitive voltage divider shown worked with my particular crystal but may have to be juggled somewhat to give adequate output to the following stage. The 51 pf capacitor should be a

1. Amperex—Application Bulletin, 6360. P. 17.



Coil Table

L1 15 turns #24 enamel 1/4" dia. slug tuned form—close wound.
L2 5 turns #16 enamel—close wound.
L3 5 1/2 turns #14 enamel—center tapped —9/16 long above coils wound on 9/32" dia. paper form double slug tuned 3/16 spacing between L2 and L3.
L4 6 1/2" turns #16 enamel—center tapped —3/8" dia. each half of coil 5/16" long. 1/4" spacing between coil halves.
L5 2 turns #16 enamel. 3/8" dia. placed at center of L4.
L6 7 turns #20 1/4" dia.—5/8" long—tapped 2 turns from cold end.
L7 same as L6—no tap.
L8 3 1/2 turns #16 1/4" dia. 1/2" long.
L9 2 turns #14 1/4" dia. 3/8" long.
L10 3 turns 3/16" wide, 20 gauge brass strap 3/8" dia. 1 1/8" long—tapped at 1 turn from cold end.
C1 2.7-10.8 E.F. Johnson 160-211.
C8, C9 1.5-9.1 E.F. Johnson 189-4-1.
C2-C7 .7-30 Johanson JMC 1902.

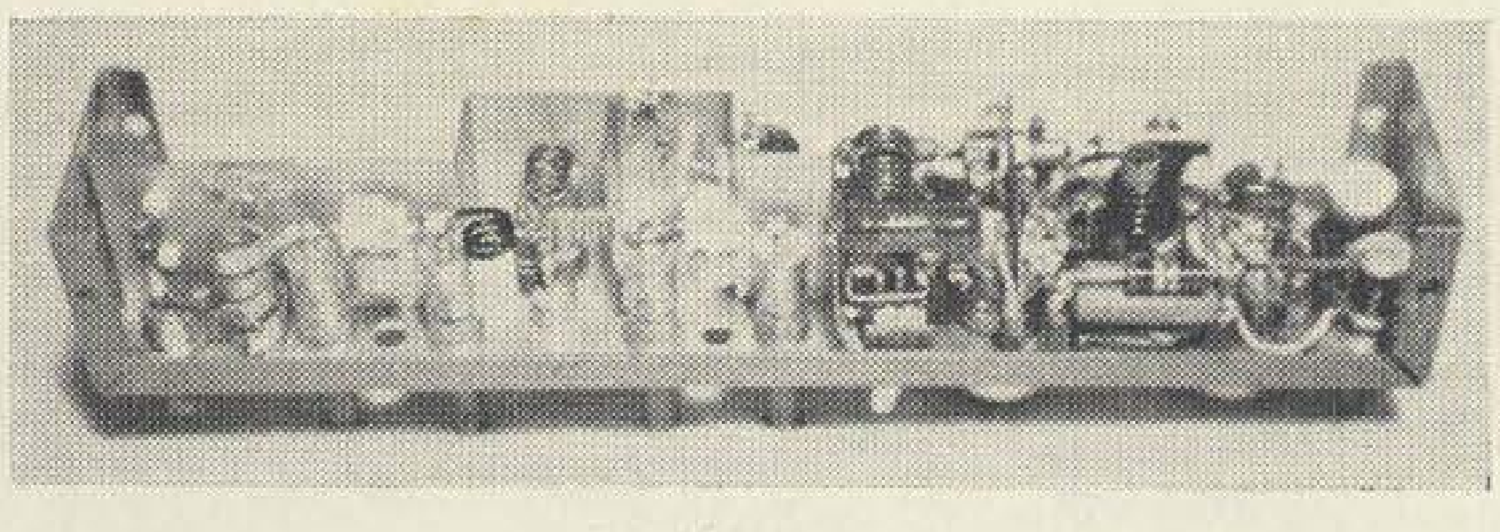
bit larger in value when firing up the oscillator for the first time. When the oscillator is functioning properly, then decrease the value, making sure that the crystal can does not get excessively hot to the touch. The original article I borrowed this circuit from used a 27 pf capacitor in this location; however, I found out the hard way that this drove the crystal too hard.

The second half of V1 is a conventional tripler stage. Once again I had to deviate from the original circuit which used capacity coupling from the tripler to the final. This arrangement did not provide sufficient grid drive in the final stage. This was then changed to a double tuned, inductively coupled configuration, the result of which now produces a surplus of drive!

V2 is a standard circuit for the 6360 as a straight-through amplifier at 144 mc. A shield is used across the center of the tube socket which precludes the necessity of neutralization. When this stage was first fired up, I measured 20 watts output. After dropping the grid drive and screen voltage down to proper values, the output was 17 watts.

This power is then coupled to the final varactor tripler stage to give a total power output at 432 mc of approximately 12 watts which is sufficient to drive my 7457 final grid modulated stage. A tripler with fewer components can be used; however, the efficiency will suffer. You will note that there are no traps used here since this stage is to be used in conjunction with a final that will have a tuned input and output. Any 144 mc and/or 288 mc signals will be tuned out at the final stage. If a tripler of this type is to be used as an output stage into an antenna, then it may be wise to add a few traps.

The entire exciter is built in a standard 10 × 2 × 1⅝ inch mini-box. Detailed layout is not included because you may wish to make changes to suit yourself. The general layout can be seen from the photos. Sharp eyed readers will notice that the tube sockets in my model are submounted but this was done only because of a height-space problem in my par-



Bottom view of 432Mc exciter.

ticular cabinet. Standard flush mounted socket construction will do just as well. When wiring the varactor tripler be sure that all coils are at right angles to each other to prevent interaction and stray coupling.

Wiring will of course follow good VHF/UHF construction practice. After checking all wiring thoroughly, filament power can be applied. Plug a low range milliameter or voltmeter into TP1, open switch S1 in final screen and apply plate voltage. This should be kept at about 200 for initial testing. Tune L1 for maximum meter reading. Next L2 and L3 can be tuned for maximum with the meter in TP2. After this preliminary tuning, 300 V can be applied and the crystal capacitive divider adjusted as explained previously. Now we can proceed to adjust the coils in the final tripler stage with a GDO. Then set C5 at minimum capacity, put a meter in TP3 and put a dummy load on the output. Be sure that your load looks like a fairly resistive termination at these frequencies. Close S1 and apply power. Quickly adjust C1 and C2 for maximum reading at TP3. With your GDO set to read output, adjust C3 for maximum at L6 and C4 for maximum at L7 (144 mc). Then set C6 for maximum at L9 and C7 maximum at L10 (432 mc). Put meter at TP4 and tune C5 for maximum output on meter. Now go back and adjust C1 thru C7 for maximum. The most critical adjustment is the idler circuit C5 and L8. If everything is working properly you'll have the following readings: .75 ma at TP1 and 3 ma at TP2. Power output will be approximately 10 to 12 watts.

For those who wish to decrease the output to drive a final, a 15 to 20 K rheostat can be connected from V2 screen to ground enabling the screen voltage to be lowered, thus decreasing the plate current.

I would be interested in hearing from those who construct a similar unit and their results. I'm sure you will be well satisfied with the operation of this Hybrid.

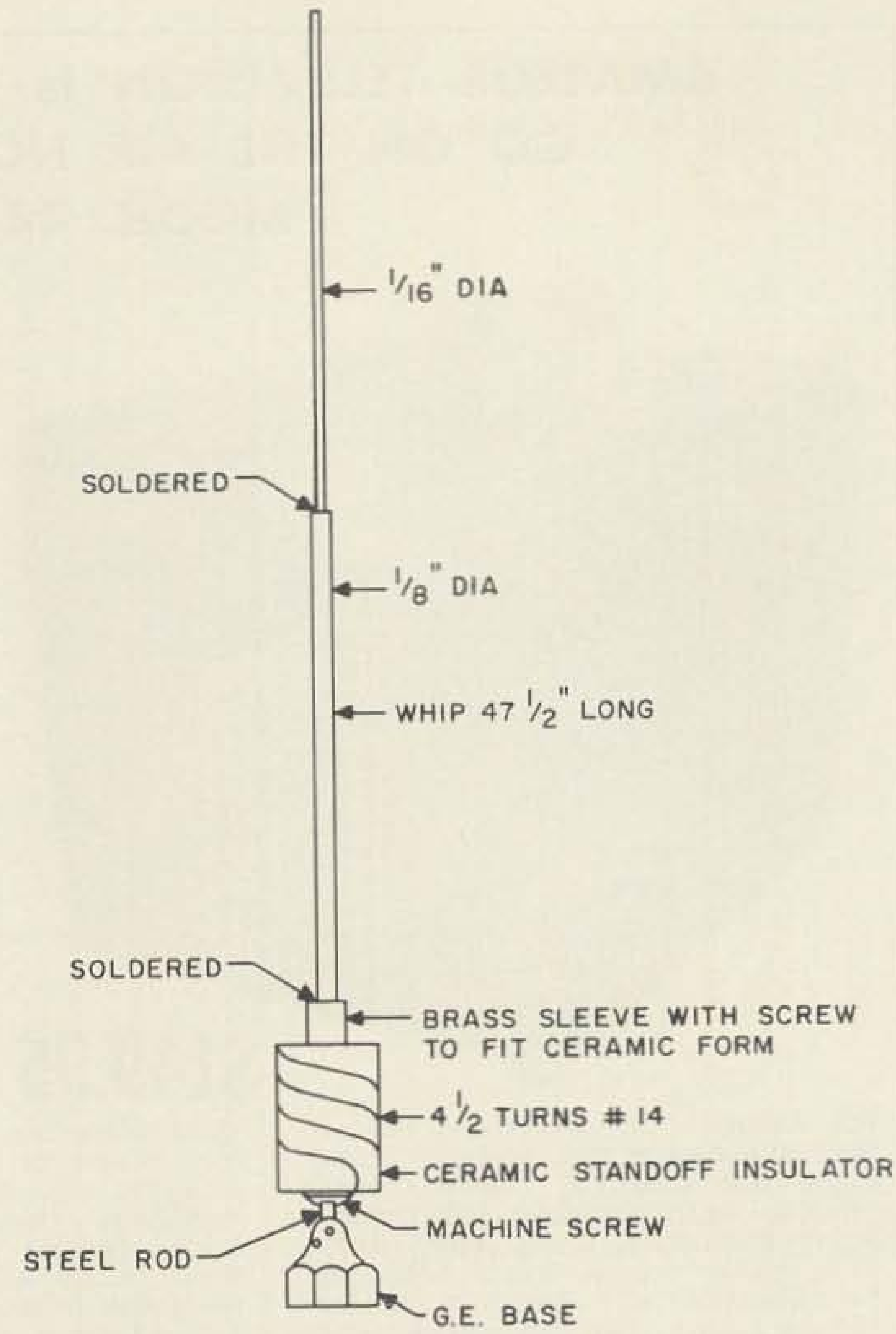
My many thanks to Jerry W9QXP for his introducing me to varactors and their possibilities.

Be seeing you on TV, I hope.

. . . W9SEK

A 5\8 – Wave Vertical Antenna

R. P. VanFossen K4DJG
509 8th St. N.E.
Charlottesville, Va.



Having a desire to improve coverage from my mobile station operating on 146.94 mc, I have scoured every ham magazine and publication that I could find, looking for information on the ⅝ wavelength vertical antenna. Finding none, I decided to try and design one myself. The following is the result of about two days' experimenting, and about four hours work on the final assembly and adjustment.

The antenna has a ⅝ wavelength radiator, based loaded to resonance as a ¾ wavelength antenna.

The coil form is a ⅝" dia. × 2" long ceramic standoff. The whip is made of a 30" length of ⅛" diam. steel rod, with a length of 1/16" rod soldered to it to make a total length of 47½". The whip was made in this manner because I could not find any material of suitable length. The rod is a stock item at most hobby shops and model stores.

A machine screw which would fit the ends of the ceramic form was drilled through the center with a 1/16" drill. A short length of 1/16" steel rod (the harder the better) was soldered in the resulting hole so that the rod is even with the end of the screw. The rod was then cut to a suitable length to fit in the base section of a G.E. rooftop antenna (the screw-on whip base). The base of the whip is inserted in a brass coupler made from a ½" length of brass tubing that has been tapped for a machine screw that will fit the ceramic coil form. A machine screw is screwed into the coupler for a length of ¼", the base of the whip is inserted from the opposite end and the three are then soldered together to make a rigid unit. Care should be taken to keep the solder off the threads of the machine screw.

The whip and the screw with the steel rod are screwed tightly into the ceramic form (not so tight as to break the ceramic).

A length of #14 copper wire is then attached around the head of the machine screw. A coil of 4½ turns, spaced about ⅛", is then wound on the ceramic form, and the end of the wire wrapped around the base of the whip. Both ends of the coil should then be soldered in place. The whip is then mounted on the antenna base by inserting the steel rod in the base and tightening the two set screws.

The antenna is adjusted by spreading the turns or squeezing them together while watching the reflected power on an accurate reflected power meter. A liberal coat of coil dope will hold the coil in place very well.

With this antenna, I have realized a gain of about 2.5 db. The antenna has been duplicated here with the same success by another local ham. It is easy to build, and I am sure that many other methods of construction will be brought to mind with just a quick look into the junk box. Try this one; it works.

. . . K4DJG

Clean-looking construction with minimum trouble.

Fred Muccino W3ITO
The Johns Hopkins University
Applied Physics Laboratory
Silver Spring, Maryland

Printed Circuits—Almost

How many times have you read an article about a piece of equipment which was just what you were looking for, but required a printed circuit board? Printed circuits are a wonderful method for building modern, compact gear with exact duplication of the original unit. But what average ham has the necessary material in his junk box and knowledge to duplicate a printed circuit?

The articles dealing with modern electronic techniques certainly should be presented to the amateur fraternity to keep him abreast of the latest developments. However, the chances of the individual amateur's ability to obtain the equipment to produce an etched circuit are practically nil. Having had the problem of producing printed circuits in the shortest possible time and with a minimum material has led to a technique that is most certainly in the realm of many hams. This technique will not produce a printed circuit, but will enable one to make a very reasonable duplicate with very little material and will not require any special tools or exotic equipment.

If you have a favorite printed circuit that you wish to duplicate, don't give up yet. Take the print of the circuit and trace it out. Obtain a piece of bakelite or epoxy insulating material 1/16" thick without copper coating and cut to the required size. It might be advisable to add ⅜" on one or two edges if mounting provisions have not been made. Place the print or tracing over the blank board and tape firmly in place. Using a scribe or center punch, lightly mark or punch the centers of all solder pads and terminals. Don't try to punch a large hole in the bakelite material; it will probably break. Using an appropriate drill (this will depend on the eyelet or terminals you select. A 1/16" drill or #52 is about the approximate size). Drill all holes. The terminal holes are usually larger, and these can be re-drilled to the correct size (#48 drill). Remove the paper copy and insert an eyelet in each hole, with the large diameter of the eyelet on top of the board corresponding to the solder pads. Using an ordinary center punch, set the eyelets in place by lightly taping the small end of the eyelet. You don't have to set the eyelet firmly against the board; you need only to keep it from falling out. The broad end of the eyelet should be placed against a wooden surface to prevent excessive deformation. After all of the eyelets have been set, insert any terminals, if used, in the remaining holes. Terminals will be required for all external connections even though the original may have used a solder pad. Use a punch to set these firmly in place. Check to determine if the terminals extend from the printed side or the back side (component side) of the original board.

Insert all components from the back side (unprinted side) and lightly solder each lead to the eyelets or terminals. Merely fill in the eyelet, don't solder the components as you normally do. The final soldering will come

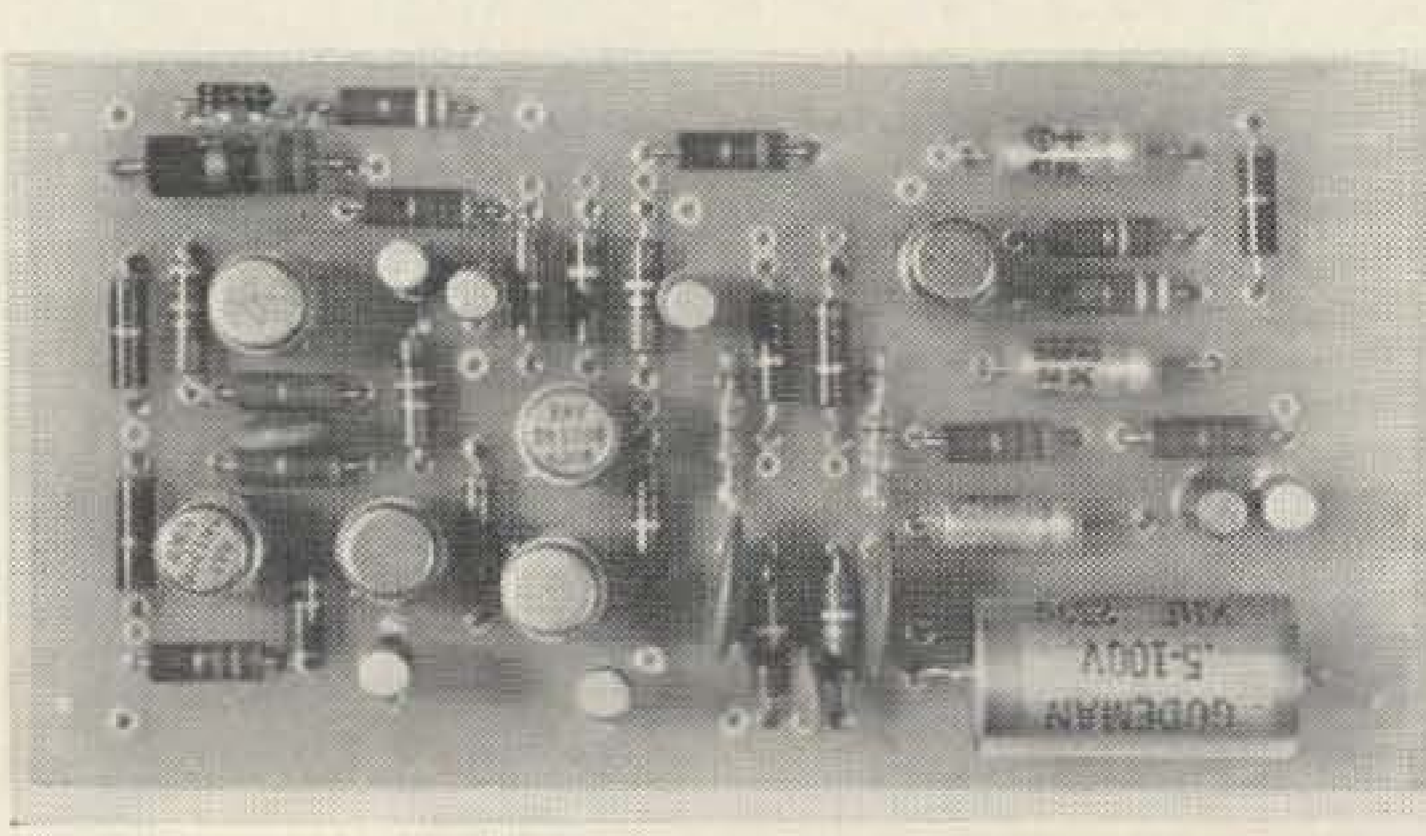


Fig. 1. Top of board.

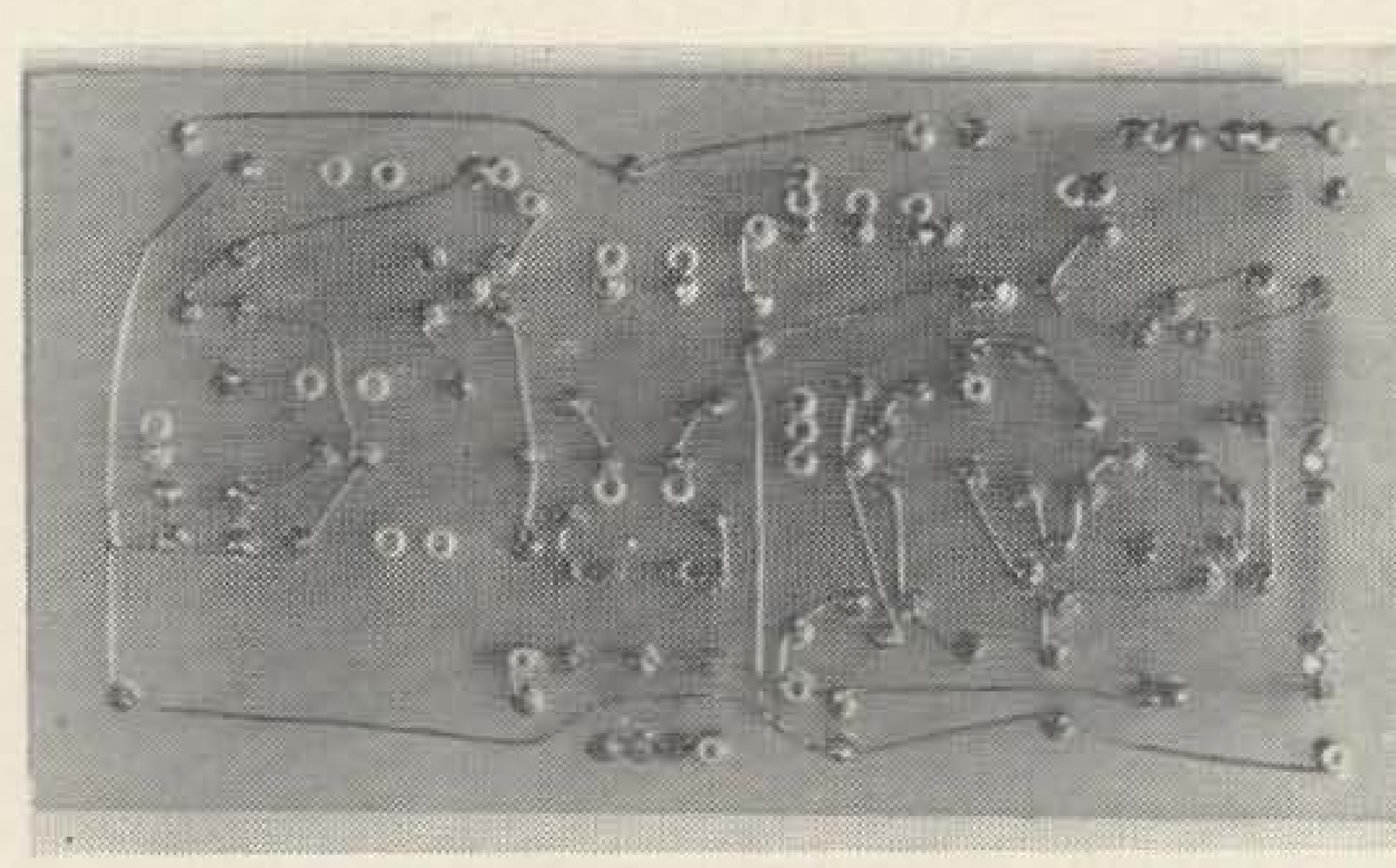


Fig. 2. Bottom of board.

later. A word of caution: DON'T USE A SOLDERING GUN. There is no way of knowing the tip temperature, and excessive heat can damage components or the board itself. Use a light iron, 40 watts or less.

After all of the components have been lightly soldered in place, return the board to its original position, components down and the leads upward.

Clip all leads to about a ¼″ length, (refer to the original printed circuit), using #24 or #26 tinned copper wire bend, and solder the wires in place, duplicating the original printed circuit. Solder each junction (wire, eyelet, and component lead) using the normal amount of solder. It is not necessary to wrap the wire around each lead except at the start and end of each length of track. Cut off excess wire leads so that circuit wiring now looks like Fig. 2. Upon completion, the wired version should look like the original printed version and should work just as well.

. . . W3ITO

1. : Lafayette Radio Corp. part 19G6811, Type PEY-12, 125 eyelets .062 dia. X .093 long @ 60c per package.
2. Terminals: Allied Radio, Cambion part #2027B @ $1.46 per 100.

Photographs by Fred Harvey W3AME

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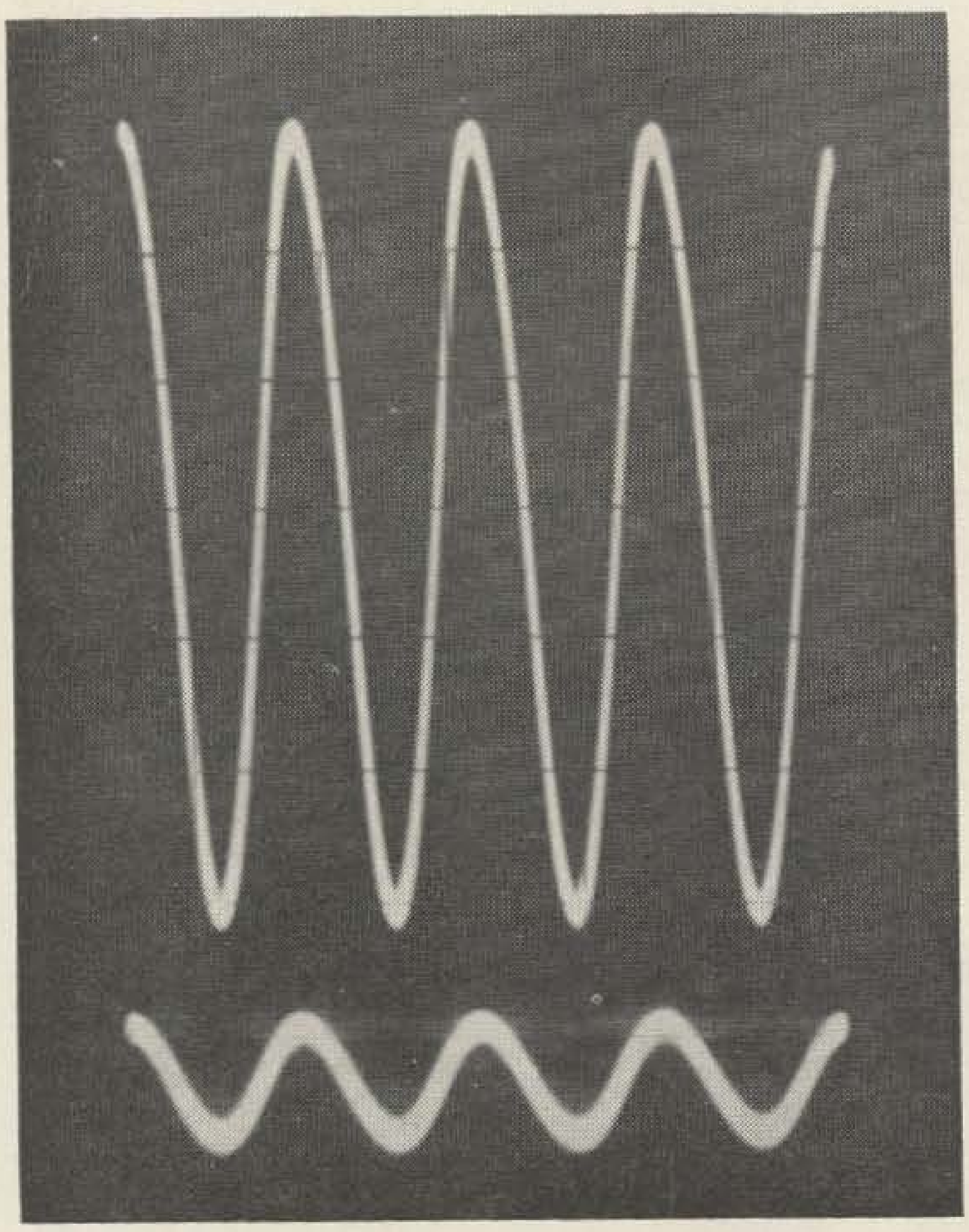


Using an electronic switch, you can display two traces simultaneously on a scope, such as input and output of an amplifier. Film speed 125, f/22, 20 second exposure.

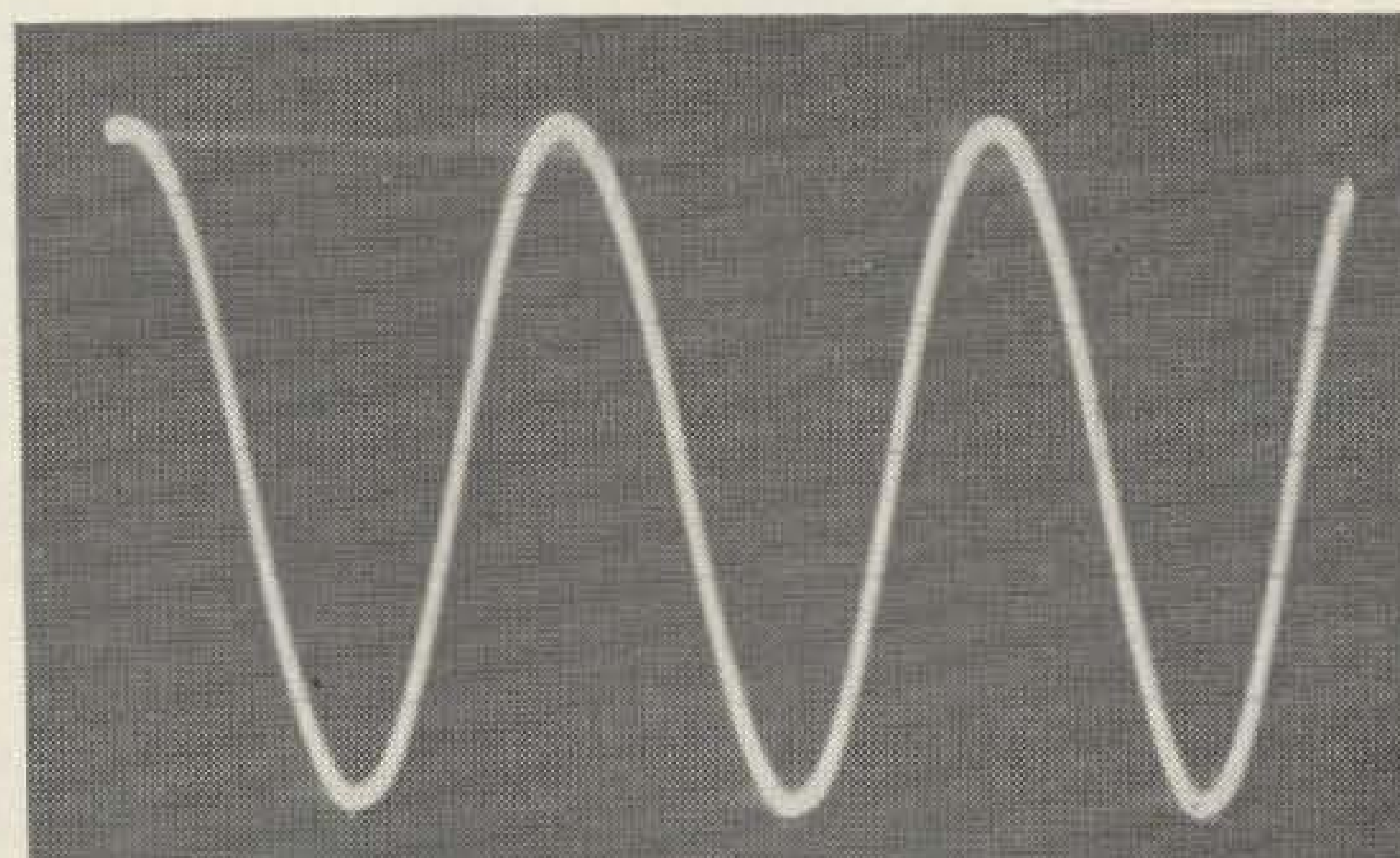
Scope Pix Trix

While the home experimenter or TV technician normally doesn't need "proof" of proper performance, there are many times when waveform analysis of a photograph is more convenient than trying to measure the pattern on the scope screen. To illustrate articles for technical papers, or for magazine articles, or for club meetings, one scope picture is worth the proverbial thousand words. By using a few things you probably have, together with some of the following hints, you should be able to get good scope photos every time.

To begin with, you must have a camera. This does not have to be an exotic camera at all, and, most 35 mm cameras have all the requirements.

The closeup lens? Just about any old lens from a broken child's telescope or binocular will do. The lens should be large enough in diameter to cover the camera lens. Mount the closeup lens the best way you can over the camera lens. Set the exposure to "time" or "bulb", and the focus to infinity. Put a piece of ground glass or waxed paper over the area where the film goes, and hold the shutter open. Using a well-lighted object, move the

A sine-wave display is one of the most common seen on scope screens. With the scope brightness up to full, this exposure was taken for 10 seconds, using ASA 125 film at f/16.



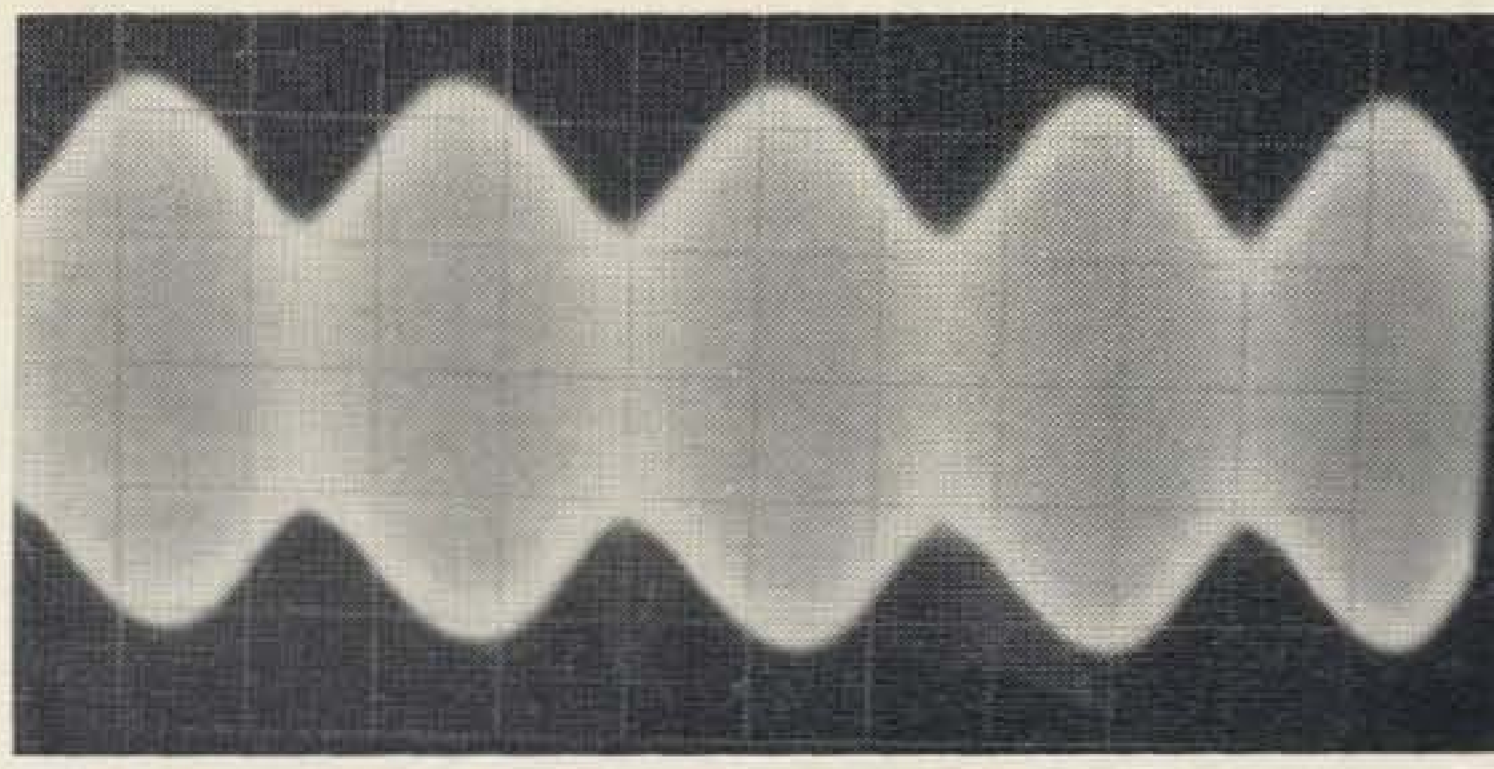
camera in close until the image is clear. Use an object with some kind of printing and place it upside down, so the image is right-side-up. Find the point of perfect focus.

Use the *smallest* lens opening (f/16 or f/22), which is desirable in closeup photography to keep the whole picture in focus. Now try using the scope screen as the object to see if you get enough of the screen in the photo at the focussing distance. This whole procedure is really very simple and straightforward, and you can try several different lenses in less time than it takes to describe.

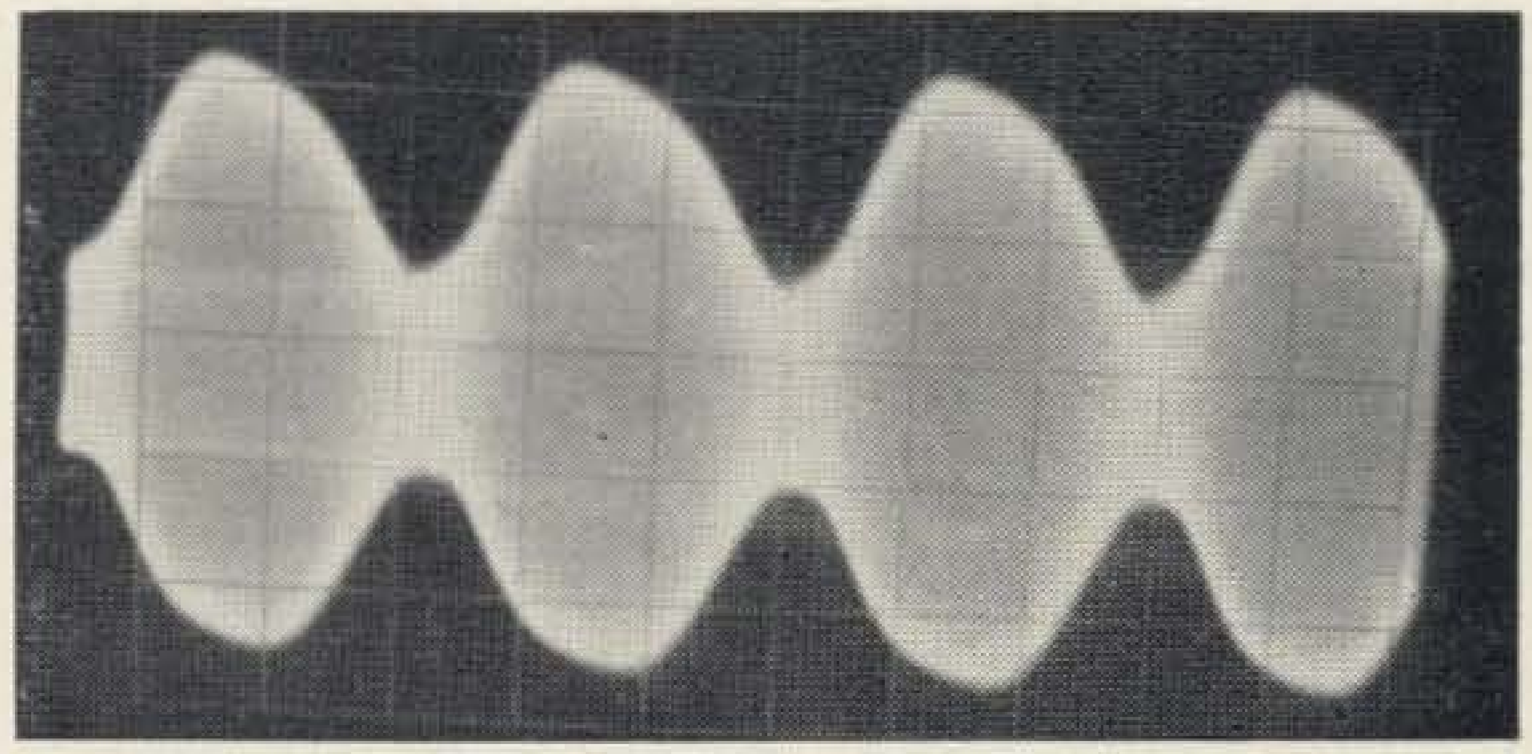
Once you've selected the closeup lens, load your camera with Plus-X (ASA speed of 125) or your favorite black & white film. Set up the camera so the lens is aimed at the center of the scope screen and at the proper focussing distance. Don't try to use the camera viewfinder since parallax at this close range will be severe; "eyeball" the aiming. Install a cable release. Set the lens to infinity, the shutter to "time" and the lens opening to f/11, f/16 or f/22. Now put the display you wish to photograph on the scope screen and adjust the scope sweep and sync controls for a stable trace—any drift or shift during the exposure will ruin the shot. Turn the scope brightness up to full, and readjust the scope for best focus. Check the camera aiming and distance, and look at Figure 1 for the exposure time. For a particular film speed and f-stop, Figure 1 gives recommended exposure times which take into consideration the light attenuation of the uncoated closeup lens you are using. Of course, great variations can be expected in the brightness of different oscilloscopes. So plan on using one roll of film just for experimentation, and use exposures of ¼, ½, nominal, 2-times and 4-times nominal on different types of displays, keeping a careful record for comparison with the negatives when they are developed. No special film processing is required. You may get only a few good shots on the first roll, but from then on you'll know the proper exposure to use in your case.

One other caution: room lighting should be held to a minimum during the exposure, since reflections from the scope tube can ruin the photo.

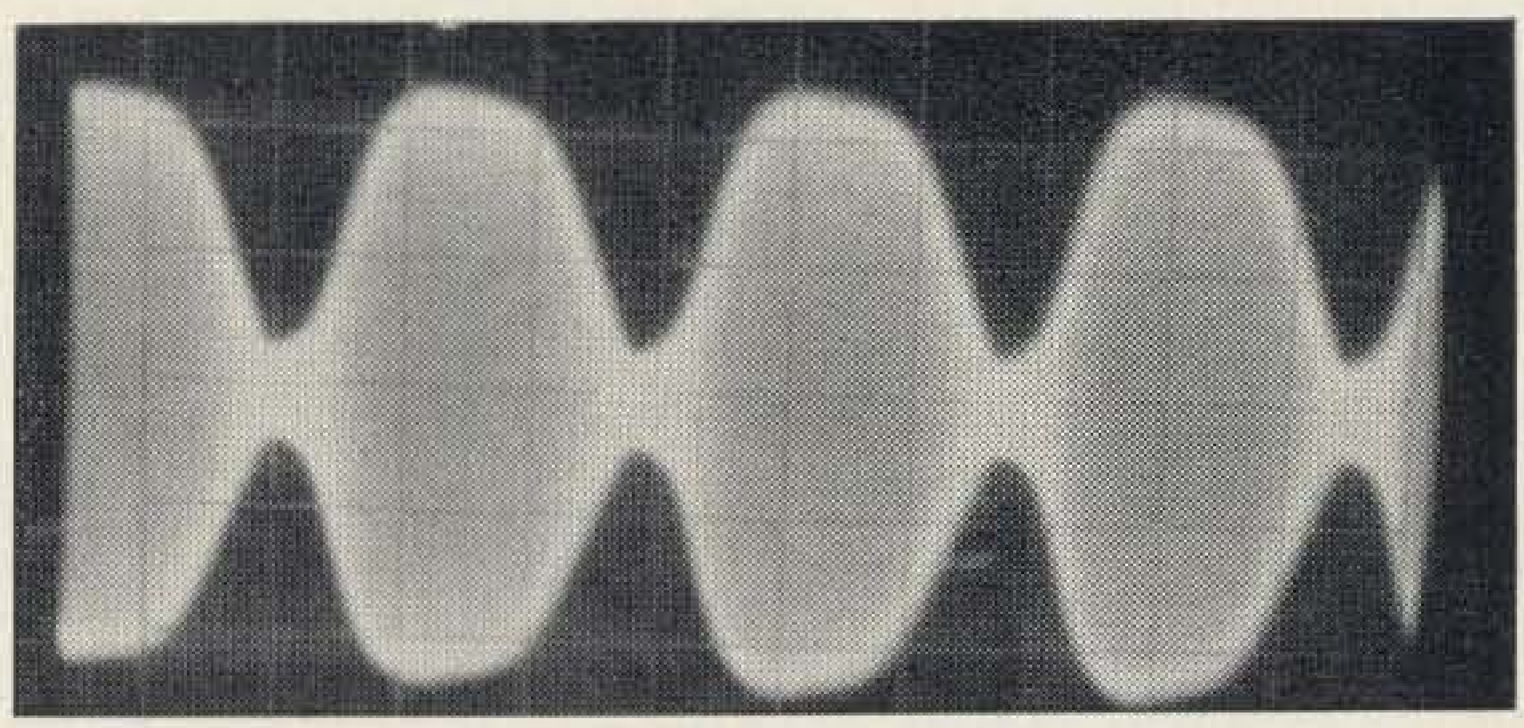
If you have a Polaroid camera, you can use the same techniques, but the extremely fast film speed will allow you to take snapshots, and you can assess the results right away and correct the exposure if necessary. Using the 3000 film speed, set the shutter at LVS 11 for the first try. A time exposure is *not* necessary. . . . K6UGT



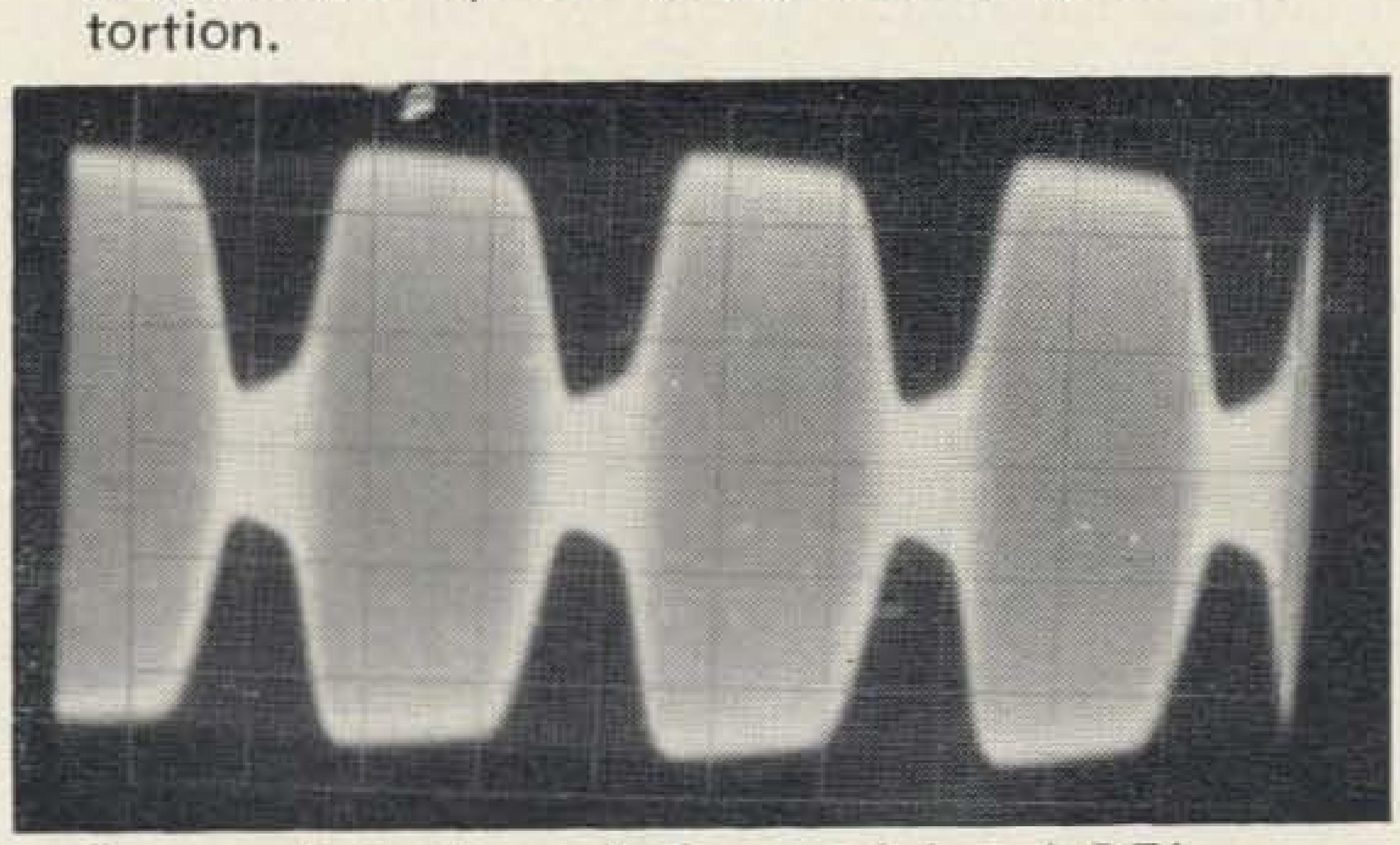
Here's a wave-envelope display of a modulated transmitter. The modulation percentage was only 30%. The following photos show attempts to improve the modulation. ASA-125, f/22, 30 seconds.



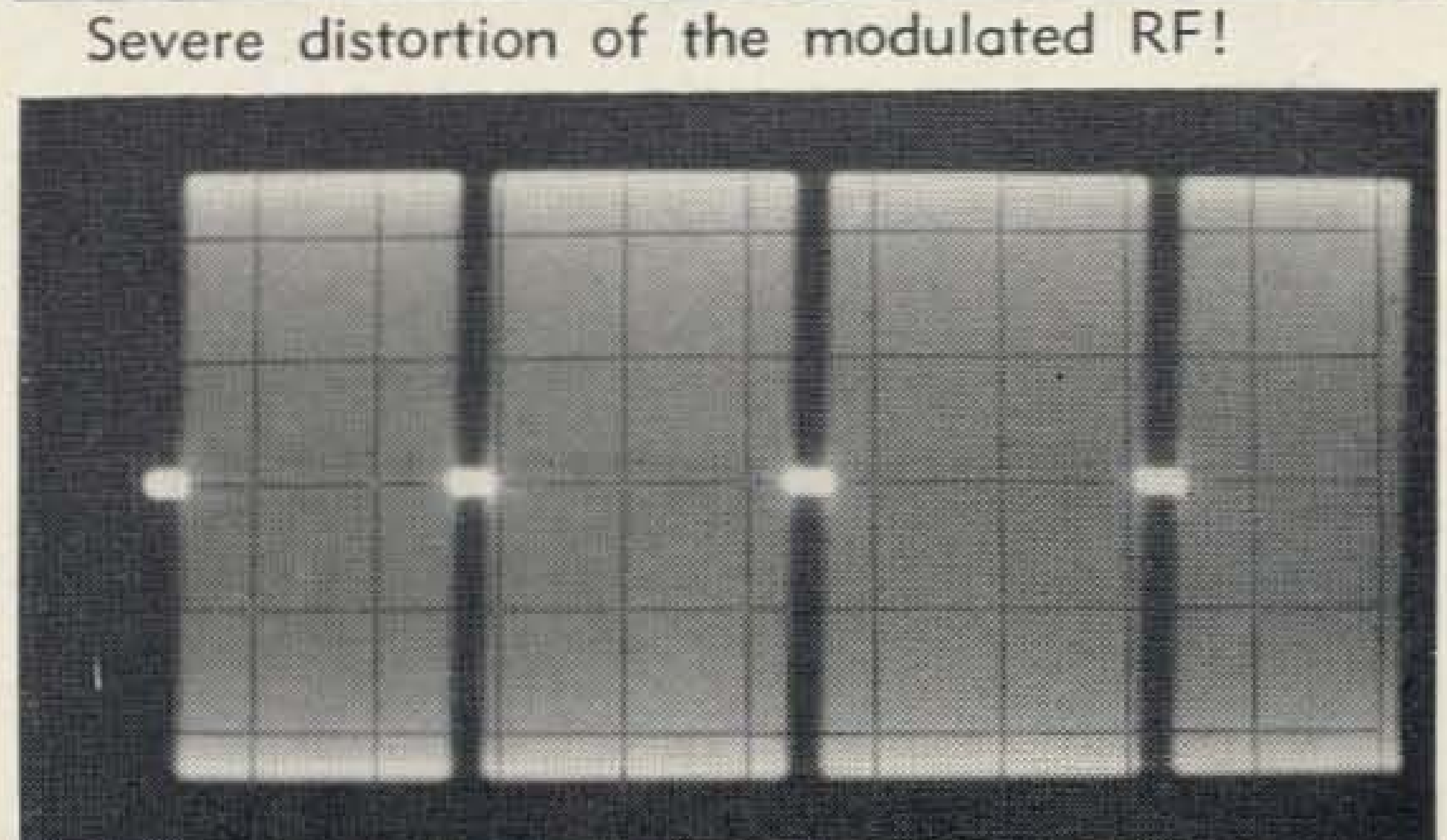
Modulation percentage is now up to 50%, but with some distortion.



Modulation up to 73%, but a little distortion.



Severe distortion of the modulated RF!



Pulse width modulation.

Clive Frazier K9FWF
5507 N. Lydell Ave.
Milwaukee, Wisc.

Easy Higher Power

How would you like to increase the power of your transmitter by 1/3 with less than one minute's work? It is almost as simple as turning the rig on; that is, you simply change the final tube to a 6146 B. There are only two little requirements which must be met for the fast change. One is essential, the other is desirable, but few hams pay any attention to this detail until it is too late. The tube in the final must be a 6146 or one in its family. This is not in any way to discourage you from rewiring a tube socket to take advantage of this improved tube, but that takes more than a minute. Next, pay attention to your power supply, or you will be paying for a new one. Make sure it can handle a 1/3 increase in power requirements. If the tube is used in AM phone, there is not much that can be done because of the constant current requirements. However, in CW, SSB, or af amplifiers, where there is a continually changing drain on the power supply, an extra capacitor, 40 to 80 mfd in parallel with the output capacitor will do a lot to insure that peak current requirements are met. It will also lighten the strain on the power supply in general. Most equipment should be able to handle this extra increase, provided you do not place extra overloads on the supply and watch its temperature.

I recently wrote RCA requesting their latest transmitting tube manual for some homebrew work. They enclosed the spec sheet for this new improved tube, the 6146-B.

I bring this message to 73 subscribers, as a public service, because you will not read about this tube in any ad in 73. Would you like to find one day soon, Joe Ham down the street, who reads brands X and Y full page back cover color ads, suddenly has 1/3 more power than you? Certainly not!

All right, before you go spend some money, you want to know what it can do. This increase in power is accomplished by greater plate current with increased plate dissipation. An article in 73, Power Booster, July 1962, extolls the virtues of the 6DQ5 over the 6146. This was due to higher plate current at low plate voltage. With the 6146-B you can have your high plate current with high plate voltage. Bet those extra watts taste good.

There are other interesting items on the data sheet. At these ratings, the plates show no color. In other words, you will run it even harder. Being a 6146, maximum ratings extend through 60 mc with reduced ratings, 50 watts output CW, up to 175 mc. Good news for mobiles. The tube features the Dark Heater. It is nominally rated at 6.3 volts but can be run anywhere between 5 and 8 volts on the old car battery.

I'll be listening for your BIG signal on the air soon.

. . . K9FWF

Operation	Maximum			Typical			
	Voltage	Current	Input	Voltage	Current	Input	Output
AM plate modulation	600	180	85	600	140	85	65
CW	750	220	120	750	160	120	85
SSB Two tone Test	750	220	35 watts plate dissipation	750	125		65

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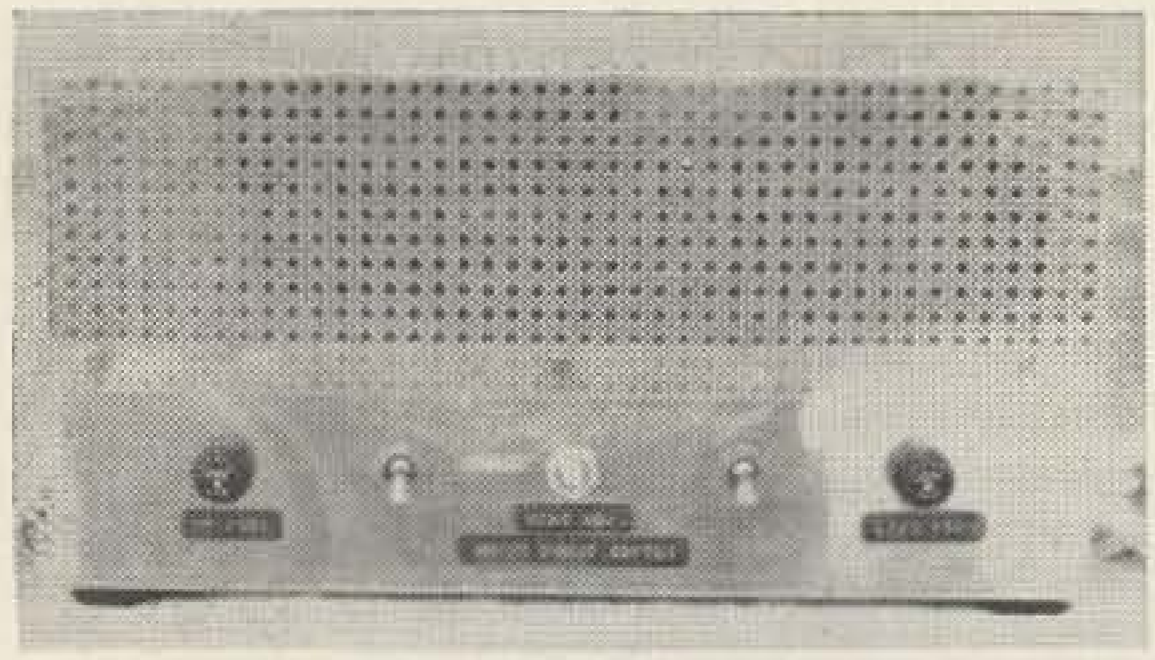
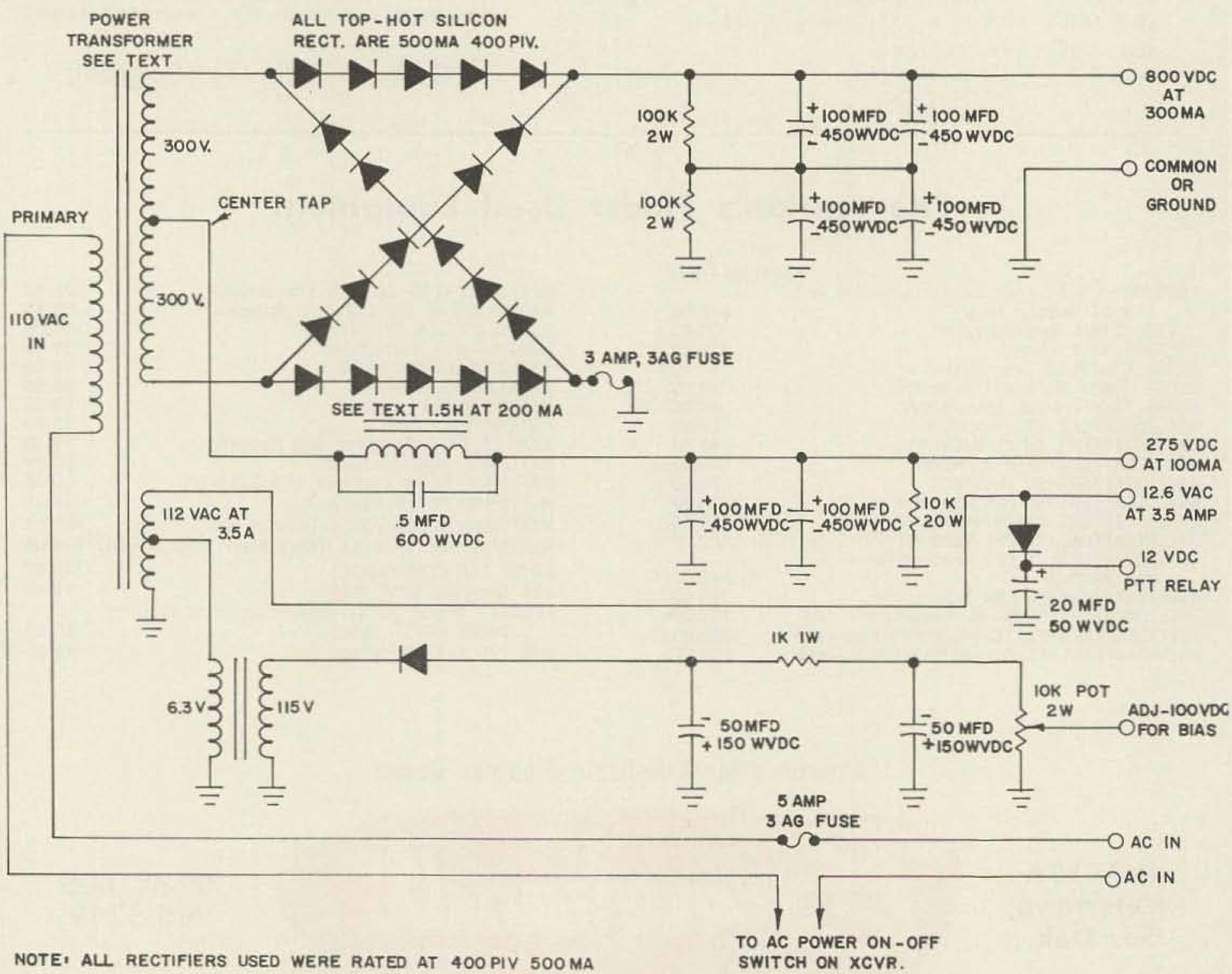


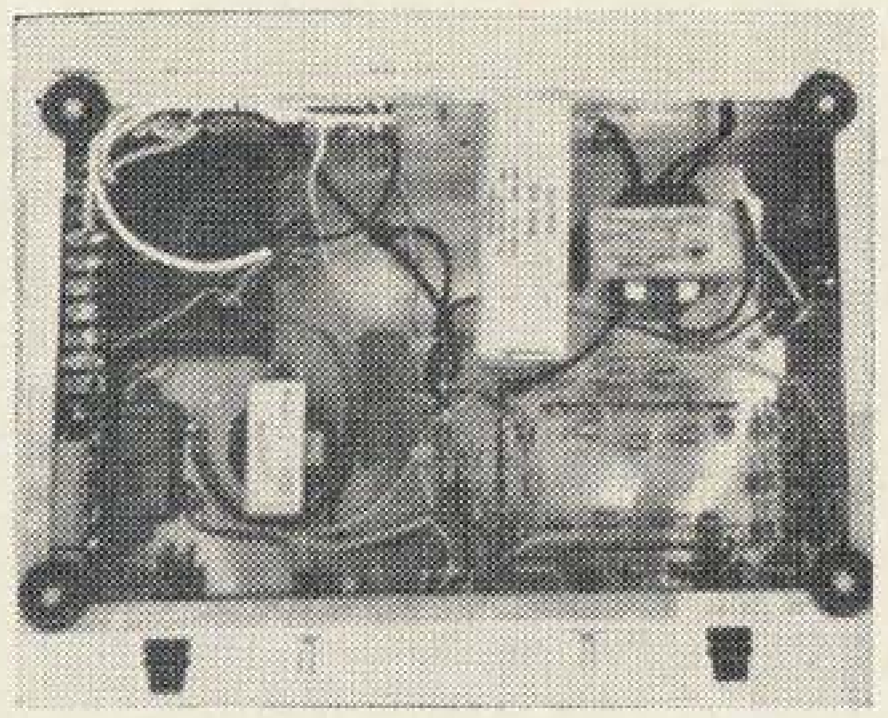
An AC Transceiver Supply

With the advent of many new supply-less transceivers, the cost of an ac supply must be considered if the transceiver is to be used at home. If you want to save a few extra dollars by rolling your own B+ supply, read on and see if this one won't fill that need.

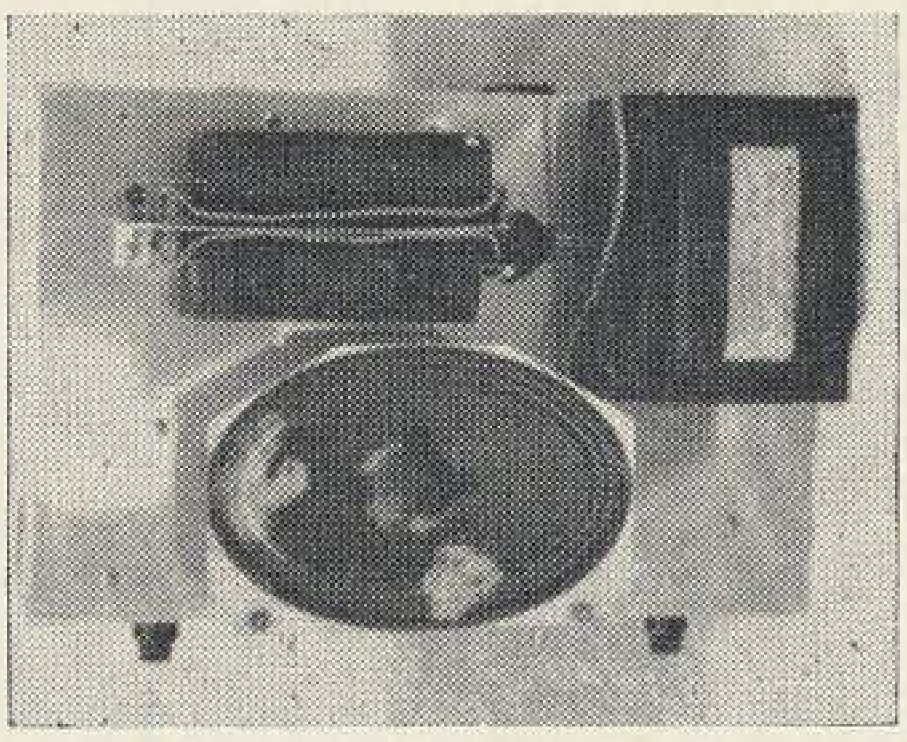
When I wanted to go on the air with my Swan Transceiver, I experimented with several types of transformer and rectifier circuits. The power supply herein described has proven to be a service-free high voltage supply with plenty of guts.



Omit .5 mfd capacitor across choke. Note that the winding labeled 112 vac should be 12.6 vac.



Bottom view.



Top view.

This circuit provides the following voltages:

800 vdc @ 300 ma	transmitter
275 vdc @ 100 ma	receiver
−100 vdc @ 50 ma (adj.)	bias
12.6 vac @ 3.5 amps	filaments
12.6 vdc @ 100 ma	PTT relay

The transformer used in this circuit was from an old Majestic TV. If you have an abundance of goodies, perhaps you will have one of these jewels. If not, Merit will gladly sell you one. The Majestic transformer number is D-9.252A or a Merit number P-3055 can be used. It is important for long life and service that a transformer rated at at least 300 ma be used, but 400 ma is preferable. The one in my supply is rated at 400 ma.

Top-hat silicon rectifiers are used and I bought them on special at a parts house. Their ratings are 500 ma 400 PIV. I paid $6 for two dozen of these little gems. Five are used in each leg of the rectifier circuit. They are *carefully* mounted on four 8 pin terminal strips. Use a heat sink when soldering these top-hats together. A fuse in the ground return leg of the rectifier circuit will help protect your top-hat rectifiers.

The receiver B+ was drafted from the center tap of the transformer secondary. It develops around 275 vdc through the filter network. Use a Merit C-2994 or equivalent filter choke.

For the negative bias circuit a 6.3 vac filament transformer was reversed. With it reversed, I connected the center tap of the 12.6 volt filament winding of the power transformer secondary to the 6.3 winding of the filament transformer. A negative bias of 125 volts was developed through the capacitor input filter circuit. Note the polarity of the electrolytic condensers in this circuit. The exact bias needed can be adjusted with the 10K 2 watt potentiometer and a VTVM.

The last 16 months I have used this supply and tested it extensively. The voltage regulation is very good. The 800 volts B+ varies only plus or minus 20 volts while on the air. At this voltage I load my Swan Transceiver to 300 ma with no difficulty. Incidentally, the supply runs extremely cool under this load.

All of the components are mounted on an 8″ x 12″ x 3″ chassis. The transformer is mounted in the right hand corner of the chassis and to the left of it I vertically mounted the four 100 mfd filter condensers on a 2½″ x 5¼″ piece of aluminum. In front of the filter condensers I mounted a 4″ x 6″ speaker. This eliminates the need of having an outboard speaker.

The component mounting under the chassis is not critical. The sides were used to mount the 12 vdc circuit as well as the bias circuit. Sufficient space was found to mount the top-hat rectifiers and the receiver filter network. The chassis cover was made from perforated aluminum and was very easy to cut out and fit. It certainly adds beauty to the finished product.

If the diagram is followed, no complications should occur. Good luck—in the fine art of Home Brewing.

. . . K4PNJ

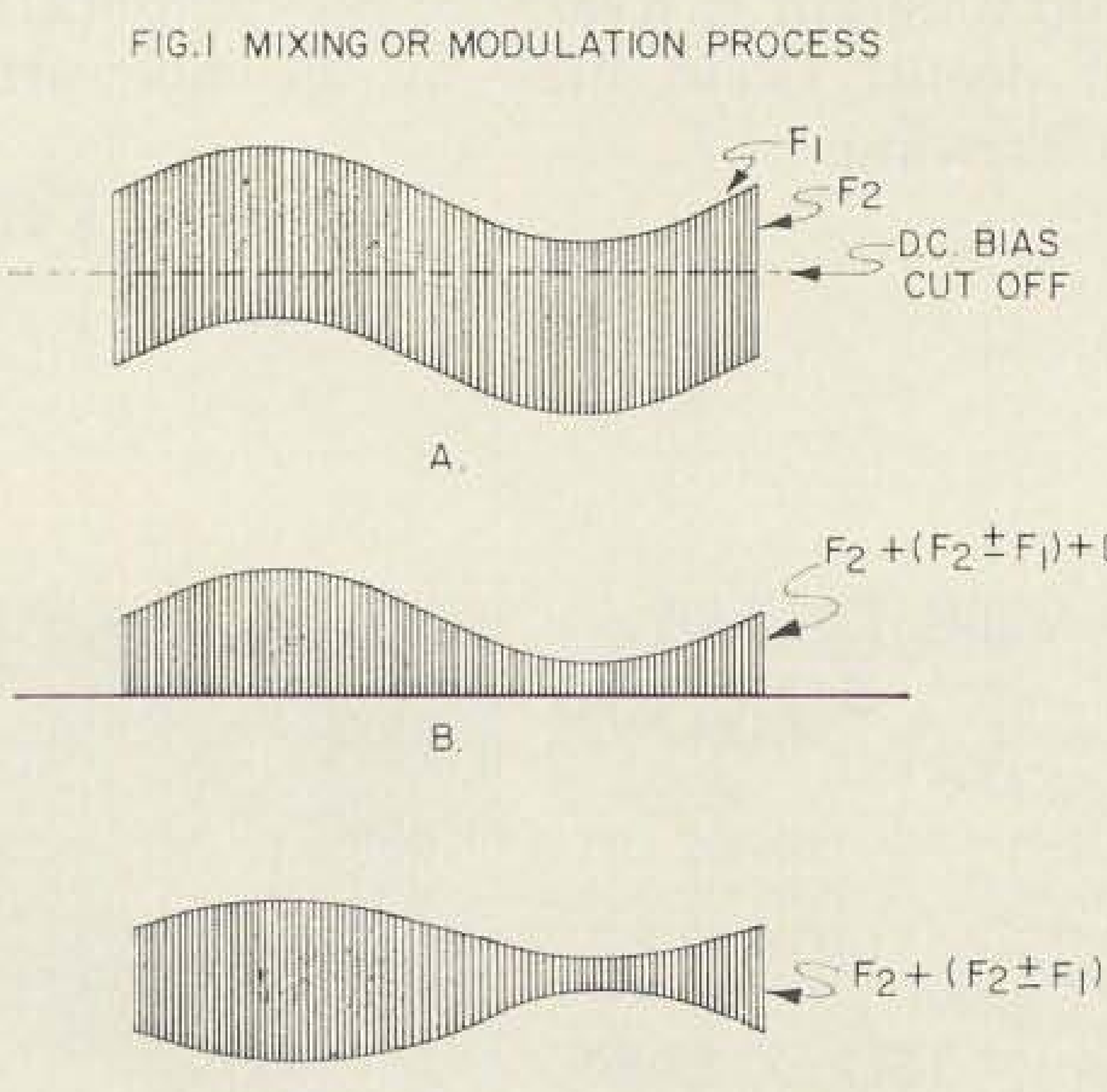
William Goldsworthy W6BUV
41 La Encina
Orinda, Calif.

Let's Understand Mixers

I certainly believe that of all the circuits that appear in communications equipment, especially in single side band gear, the least clearly understood is the mixer.

In modern communication equipment the mixer is commonly used for frequency conversion, for modulation, and for demodulation. A mixer can be defined as an electronic device which takes two signals and by its mixing action produces additional signals equal to the sum and/or difference of these original signals. Such devices are commonly referred to as diode detectors, product detectors, mixers, modulators, balanced modulators, converters, etc. All of these devices have one thing in common: at least two frequencies are mixed to produce additional sum and/or difference frequencies.

FIG. I MIXING OR MODULATION PROCESS



In the case of the common AM diode detector, the sidebands of the AM signal mix with the carrier frequency to produce a difference and sum frequency (both identical) which are equal to the original modulating frequency. With a product detector the action is similar, except that the carrier is supplied locally. The sideband signals mix with the inserted carrier to produce the difference frequencies which are equal to the original modulating frequencies. Frequency converters accomplish the same sort of mixing action, except that the resultant sum or difference frequency is usually in the rf range. Modulators, whether balanced or not, are again another form of mixer except that this time one of the input signals is audio, and the resultant mixer products are equal to the carrier frequency plus or minus the audio frequency signals applied. To say it differently, the resultant frequencies are equal to the sum and difference of the two mixed signals.

Now that we understand what mixers are supposed to do, let's look a little further and see how mixing action is accomplished without going into a lot of complicated mathematics. Fig. 1 shows graphically the modulation process. Fig. 1A shows where f^1 and f^2 are added with a proposed biasing level. Fig. 1B shows the wave shape produced when the portion of the wave form below cutoff bias is removed.

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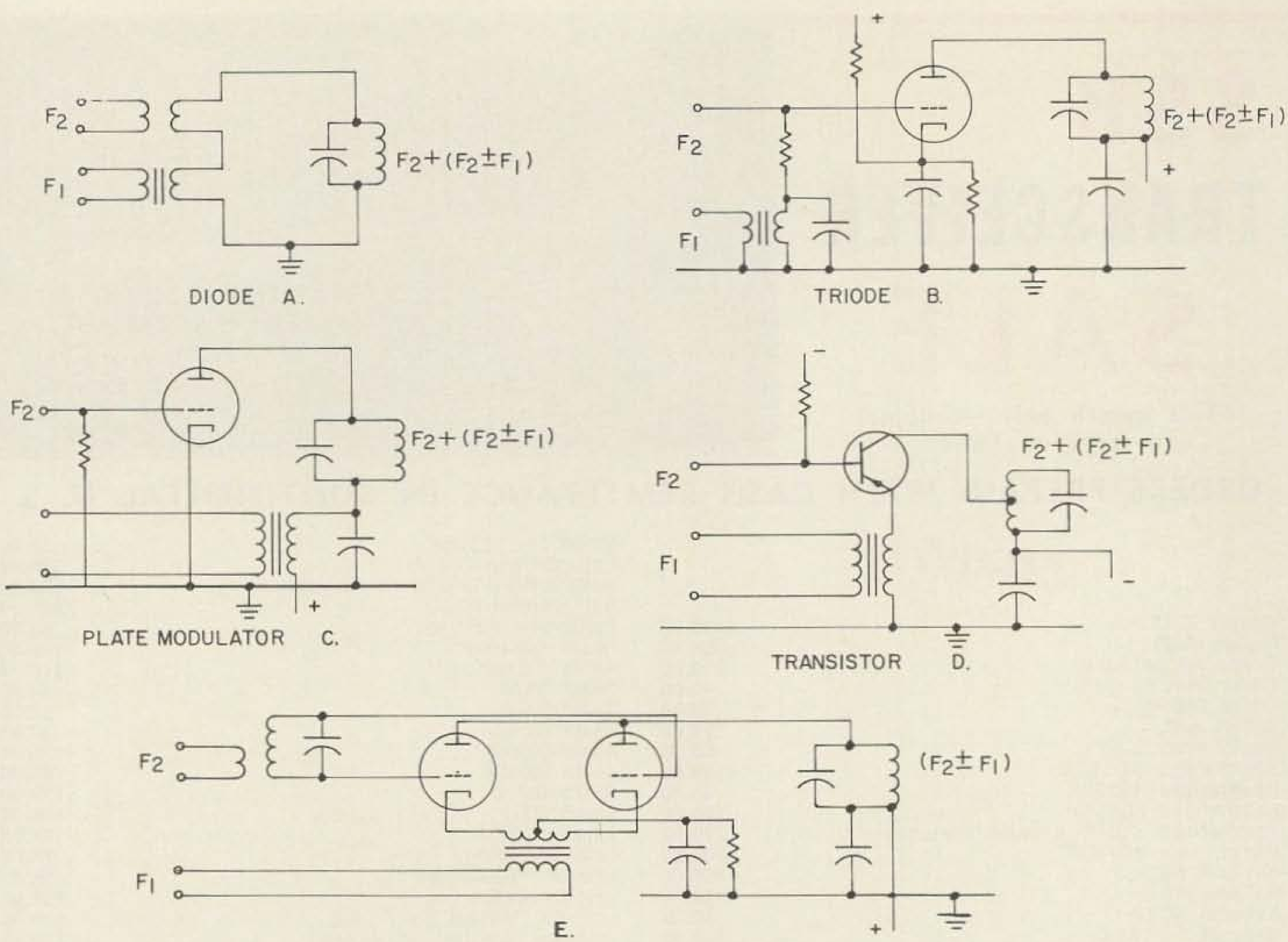

Fig. 2. Mixers or modulators. Put a diode in series with transformers in A.

Fig. 1C shows the wave form of 1B with the dc component removed.

In the wave form of 1A, only the fundamental frequencies f^1 and f^2 are present, but in the wave form of 1B, additional frequencies have been produced which are called mixed, modulated or heterodyned frequencies.

The difference between the modulated envelopes of Fig. 1B and Fig. 1C is only the existence of a dc component in Fig. 1B, but otherwise the envelopes are similar, and the envelope of Fig. 1C will appear after the dc component has been stripped by an rf tuned circuit.

When we now compare Figs. 1A and 1C we note that the upper parts of these two waves look quite similar but that the bottoms look different; the main difference being the absolute symmetry of the modulated wave against the partial symmetry of the added waves. All that has been done to create the wave form of Fig. 1B was the removal of the lower part of the wave form of Fig. 1A, thereby altering only the symmetry of the added wave. This change in symmetry or mixing can be easily accomplished in either tubes, transistors or diodes by biasing these devices so that conduction only occurs during the upper part of the wave form of Fig. 1A, above the dotted line.

In Fig. 2, examples of these modulator devices are shown.

Fig. 2A shows the common diode mixer. Figs. 2B and 2C show common tube mixers, and Fig. 2D shows a transistor mixer.

In all of these circuits several things are similar; two signals are mixed to produce a sum or difference frequency or both, and all of these devices are designed to be operative only over the upper half of the additive wave shown in Fig. 1A. Fig. 2A shows a diode mixer where the larger of the two input signals supplies biasing of sufficient amplitude to insure linear mixing with the smaller of the inputs. Fig. 2B shows a triode mixer in which biasing can be partially from the larger of the two input signals and partially from the dc cathode bias. Fig. 2C is the familiar plate modulator or mixer where one of the signals is fed directly to the plate and the other to the grid. Fig. 2D shows a transistor in a analogous circuit to the triode mixer of Fig. 2B.

Since the basic action of a mixer has been shown, let's go a little further and discuss some of the important facts about proper biasing, operating level etc.

Fig. 3A shows the operating voltages and currents of the diode mixer shown in the circuit of Fig. 2A, and Fig. 3B shows similar operation for the tube mixer shown in Fig. 2B.

In both of these figures the presence of both f^1 and f^2 in additive form are present at the input terminals. While both signals are shown series additive into the grid of the triode, either one of these signals may be similarly added by introduction into its cathode or plate circuit.

The output signals of both the tube mixer or the diode mixer are immediately recognized as the wave form shown in Fig. 1B which is the modulated or mixed envelope with dc component. By using a tuned circuit to remove the dc, we arrive at the recognizable common modulated envelope shown in Fig. 1C.

What has been discussed so far is just the basics of mixer operation, and it is now necessary to show how a mixer should be operated to produce the desired mixing frequency with as low a degree of distortion as possible.

In using the diode, the transistor, or the tube, there is a linear relationship between the applied control voltages or currents and

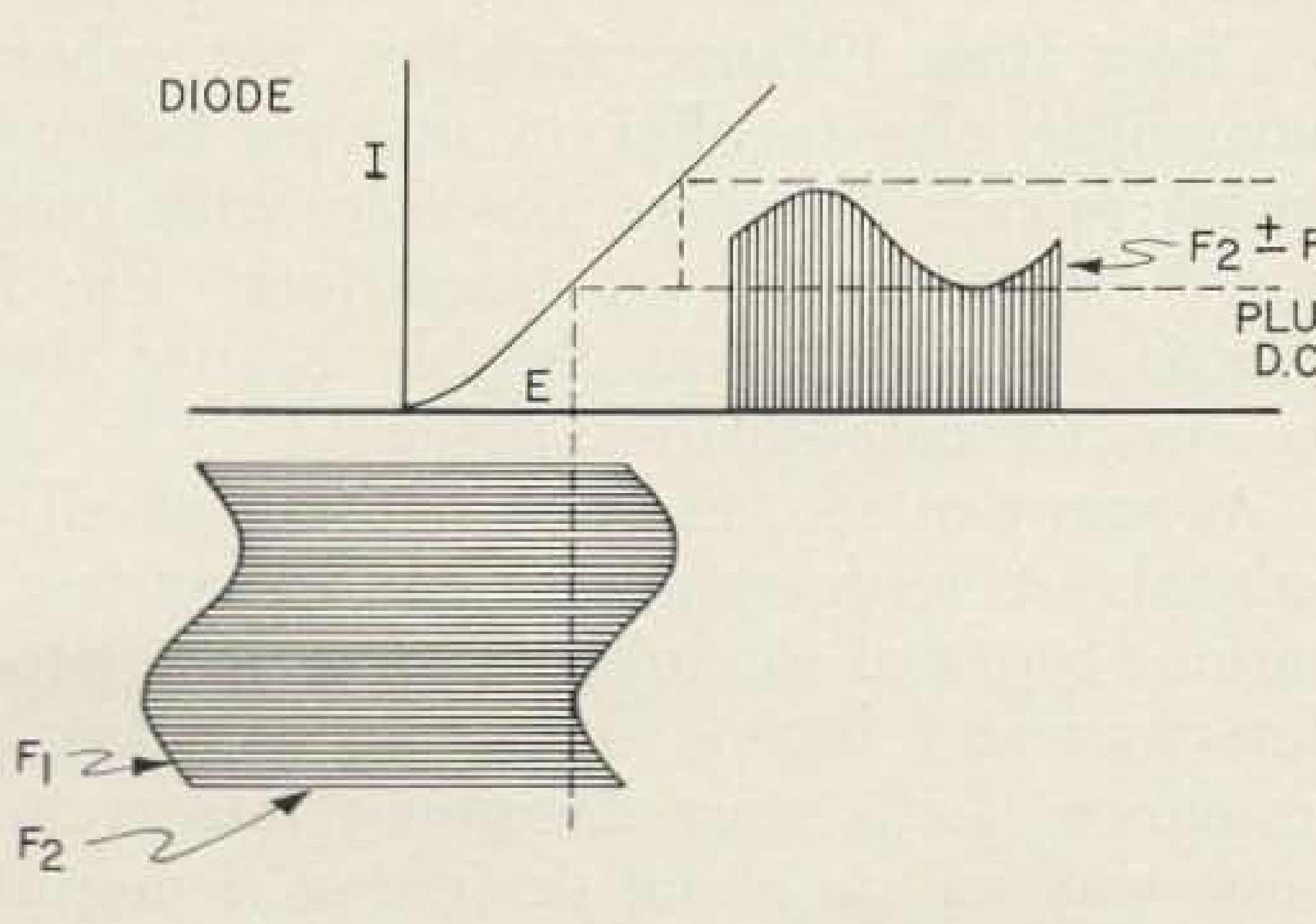

FIG. 3A

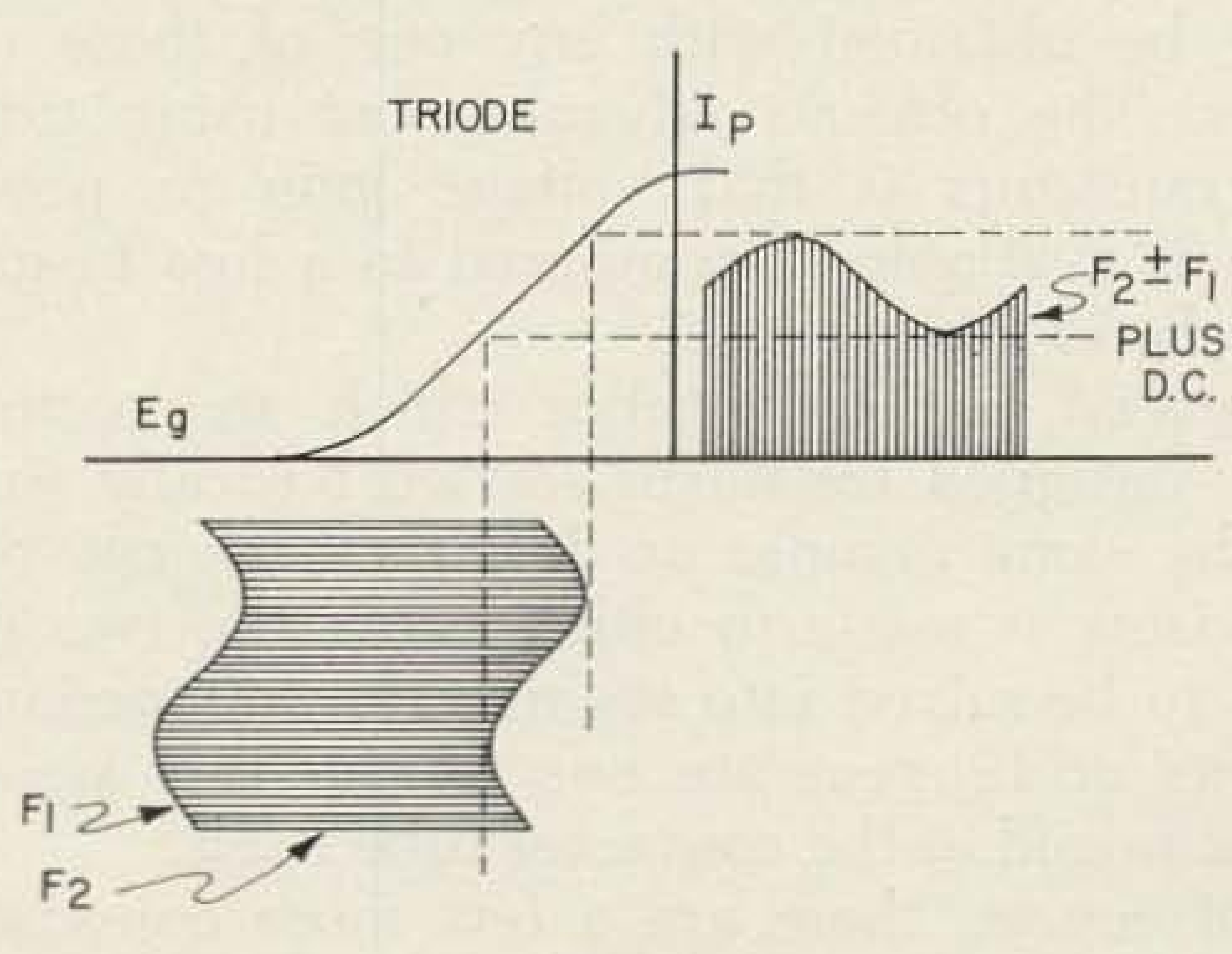

FIG. 3B

the output currents of these devices only over a limited operating range. It is over this limited range that mixing action should take place if undesirable distortion is to be minimized. With tubes or transistors, there are non-linear relationships between grid voltage and plate current, and base current and collector current in the cutoff and saturation regions of these devices. In diodes, there is a non-linear relation between applied voltage and anode current at low applied voltages. These regions should be avoided by proper choice of operating conditions.

Up to this point, you may be a little confused, since it has already been stated that the mixer must operate around the cutoff region in order to accomplish the desired symmetry change necessary to produce the modulated envelope. A little further discussion is necessary to eliminate this confusion.

In the output of a mixer, there will be present not only the sum and difference signals, but also the fundamental signals as well. We do not usually care if these fundamental signals suffer severe distortion, but we do care, however, if the sum and/or difference signals do.

Upon examination of the Eg-Ip and E-I relationships shown in Fig. 3A and 3B, this is seen to be easily attained by operating one of the signals over a range from below cutoff to the center of the linear operating range of the tube, transistor or diode and superimposing the other signal to be mixed at a sufficiently low level, so as to insure that the entire swing of this modulating signal (upper part) excurt only over the linear operating range of the device being used. As far as the bottom part of the additive wave form is concerned, it is only important that all of its modulating signal excursion occur below the cutoff of the device.

It matters very little whether mixing is done with a diode, transistor or tube. The basic action is the same, and equally good results may be obtained with any one of these devices. The obvious advantage of using tubes or transistors is that voltage gain or power gain is available as compared to a loss in gain in a diode mixer circuit.

Special converter tubes which are particularly designed for mixer service basically work in the same manner as described, except that provision is made to either bring the two signals to be mixed into separate high impedance inputs or to generate one of the two signals to be mixed in the converter tube itself.

Of course, there are a few more considerations with mixers that may be just as important in many cases as linearity. These are its ability to eliminate the fundamental signals from its output, the problem of undesirable mixing of two or more signals appearing on a common input, and the problem of harmonic and image suppression.

In the output current from any mixer, there will be a number of signals present. These will be the originating frequencies, the sum frequency, the difference frequency, and a number of other frequencies caused by harmonic distortion. The basic frequency that we are interested in, however, is either the sum or the difference frequency. These frequencies are present in the output of the mixer at a considerably lower level than the originating frequencies, and some means such as tuned circuits or filters are usually employed to discriminate against the unwanted signals. Often times, however, it may be impractical to supply enough suppression in this manner, where fundamental and mixed frequencies are too close for adequate rejection of the fundamental signals, or where, for economy reasons, it may be desirable to use fewer tuned circuits following the mixer stage and still obtain adequate suppression of the originating frequencies. In this case, it is possible to use any one of a number of balanced arrangements in which the fundamental and certain harmonics of the fundamental signals cancel in its output.

Fig. 2E shows a tube type mixer of the balanced variety.

This is only one of a variety of arrangements which may be employed with tubes, transistors, or diodes. The balanced mixer lends itself usefully also, where the carrier must be balanced out as in the case of a balanced modulator, or where mixing between multiple signals appearing at a common input should be attentuated, as in the case of a product detector.

There have been special tubes such as the 7360, built particularly for balanced modulator service. These tubes offer somewhat better long time balance stability, but otherwise have little else to offer in making better balanced mixers than are possible with conventional tubes, diodes, or transistors. The 7360 also is somewhat less flexible in use due to its common cathode arrangement.

As you can see, there is nothing at all difficult about understanding and designing the various types of modulators, detectors, product detectors and mixers to obtain excellent performance. Let's start designing mixers in the same way we go about designing rf amplifiers, that is, in a logical manner. . . . W6BUV

BRYAN EDWARDS, JR.

W5KFT

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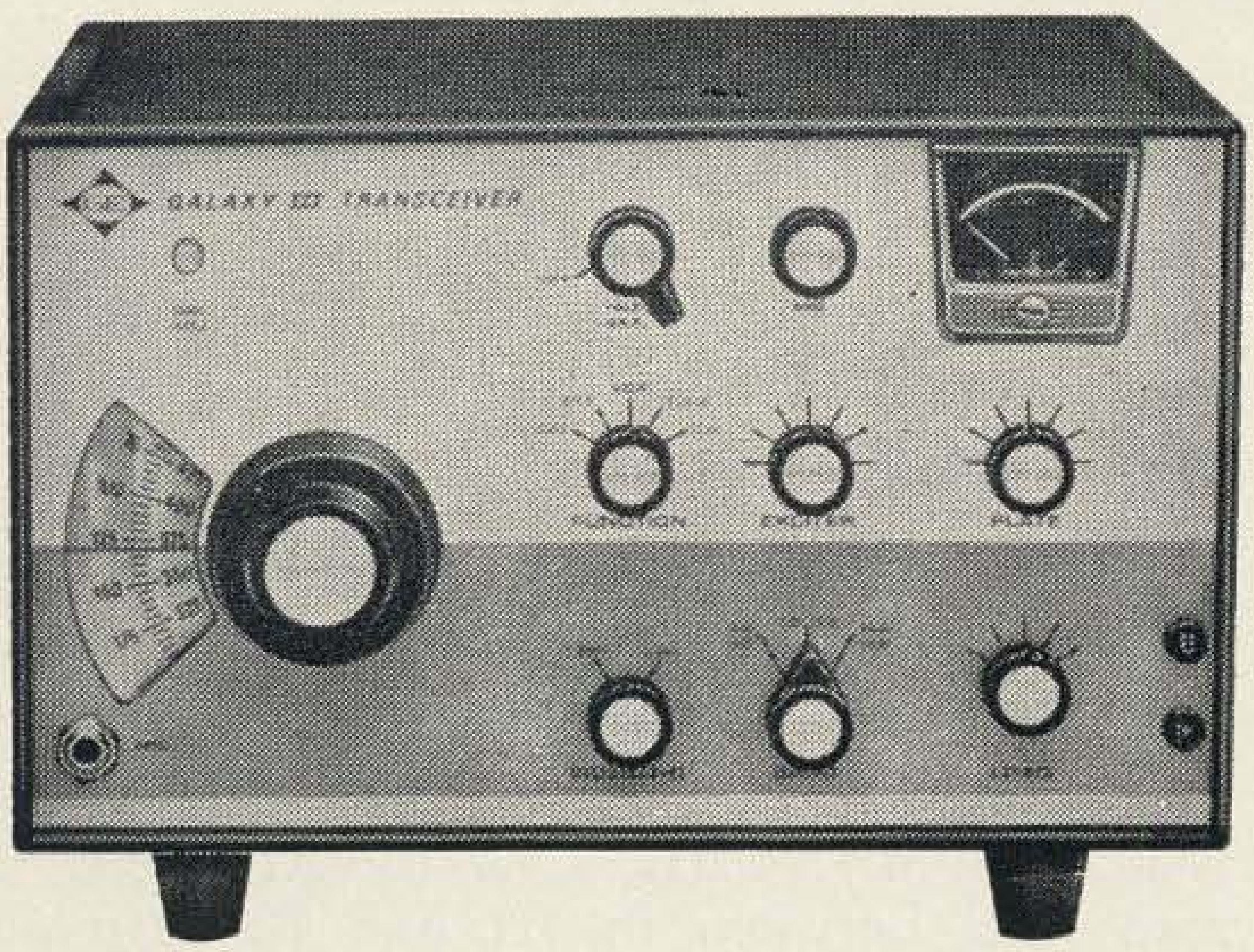

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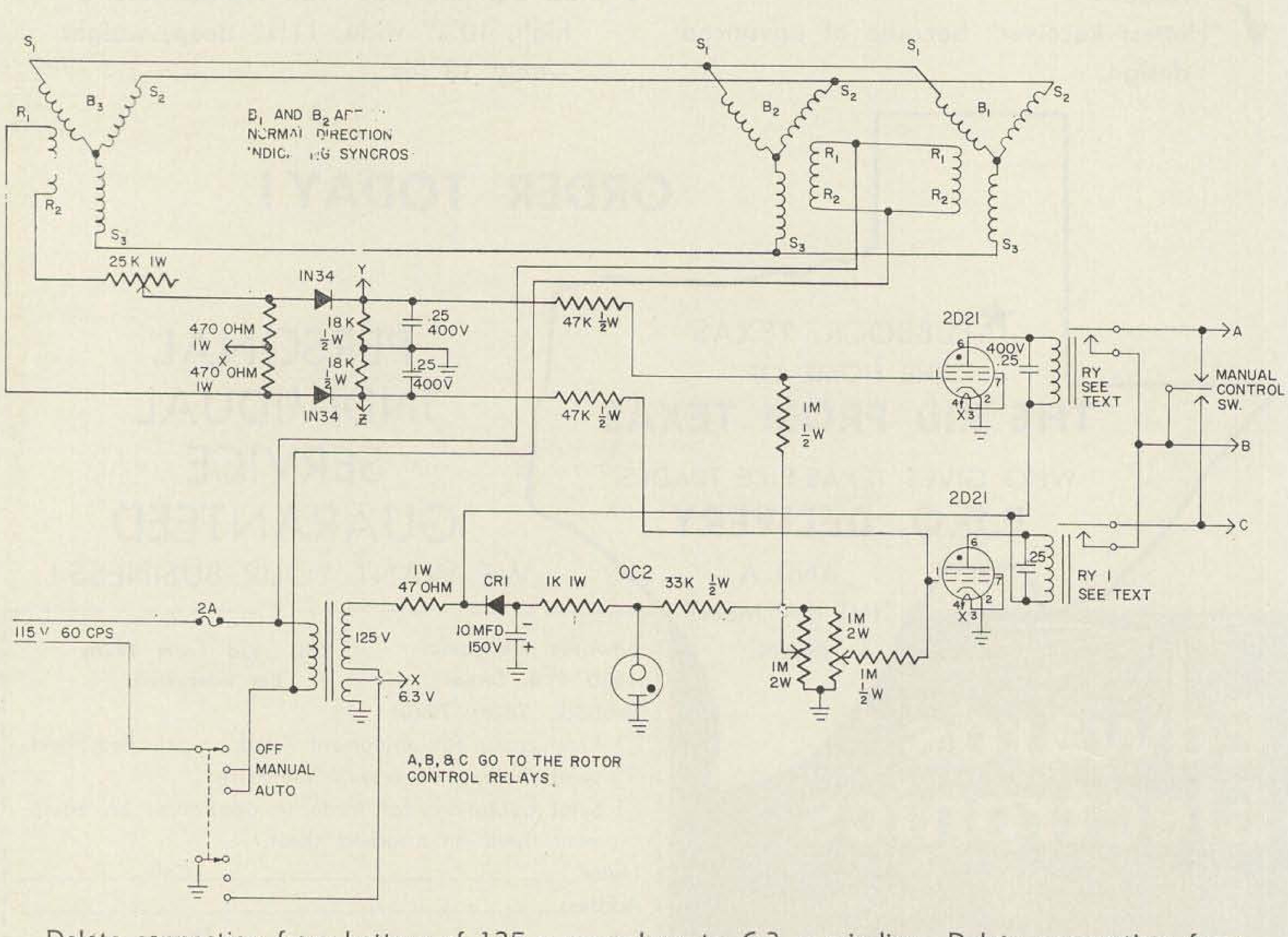
Most of the parts should be in the junk box except for the CT (control transformer) and a regular syncro can be used in place of it. There is nothing critical about the wiring. None of the adjustments need be placed on the front panel as they will hold until major part replacement is necessary. It is a good idea to place each bias adjustment pot next to the tube it controls. If you can rig a concentric system for the pointers, it takes up less panel space and is more convenient. I have this, the coax switches, SWR bridge and antenna relay all behind one 10½ inch panel.

Adjustments are easy. With the power switch in MANUAL, turn the CT rotor for zero volts between its R1 and R2 terminals. The pointer on the CT should be aligned with the pointer on the beam direction indicator now. Then turn the pots for maximum bias on the 2D21's. With the switch in AUTO, turn



Delete connection from bottom of 125 v secondary to 6.3 v winding. Delete connection from center of left 1 M/2 W potentiometer to top of this pot. The top relay is RY 2.

the rotor of the CT about 10 degrees to one side and reduce the bias on the 2D21 that goes to the positive point (Y or Z) on the phase sensitive detector until its relay closes. If the antenna goes away from instead of toward the CT pointer, reverse the R1 and R2 leads on the CT. The final setting for the bias pot is where the beam coasts to a stop when the pointers align up with each other. The bias on the other 2D21 is set the same way but on the other side. The sensitivity control is set to the point that gives the most reliable operation.

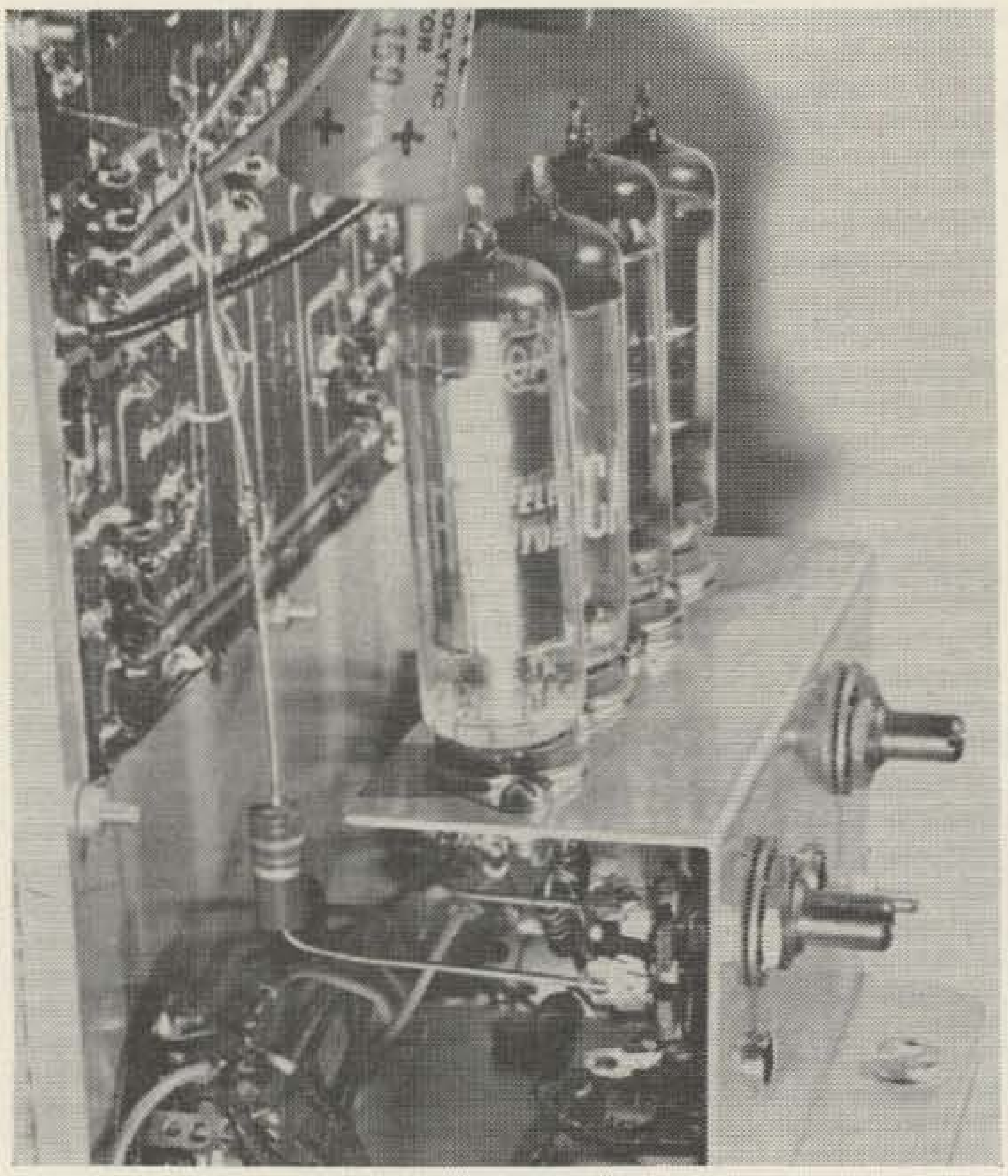
None of the parts are critical but circuit balance must be maintained for proper operation. RY1 and RY2 are 5,000 to 10,000 ohm plate relays. Any relay will work as long as it has enough sensitivity to be operated by the thyratrons and has enough resistance to limit the current through the 2D21's to a safe value. I used a pair of 10,000 ohm telephone type relays that were in the junk box. The CT was also in the junk box but most people won't have one. They are available at most surplus emporiums but if one cannot be had, all is not lost.

A regular syncro can be used by placing resistors in series with the S leads to reduce hum and motor action due to stray magnetic fields. These resistors will be about 1,000 ohm 10 watt wire wounds.

I hope your version works as well for you as mine does for me. It is a real pleasure to turn the knob to the direction that I want the beam and forget the antenna with no worries about twisted feed lines. Of course you should have limit switches for safety.

For more information about phase sensitive detectors, check Principles of Radar by MIT or the various books on syncros and servo systems.

. . . WA4GTA



Jim Kyle K5JKX
1236 N. S. 44th Street
Oklahoma City, Okla.

DC-izing an Oscilloscope

Though it's no longer in current production, the Heath Model OL-1 scope is still around in vast numbers. Thousands of these handy little 3-inch units were turned out during the years it was in the Heath line, and many of them are still providing excellent service.

Several months ago, I acquired one for general-purpose use. Cost was only $15; it had a burned-out 12AU7. Replacing the 12AU7 brought things back to life, and as I used the OL-1 I found myself preferring it to larger, more complex instruments. Only one thing was wrong; it was an ac scope, like most other inexpensive models.

While working on another project, I had occasion to examine the circuitry of the OL-1 to determine the maximum input voltage it could handle, and discovered that it could be converted to a dc instrument with a minimum investment in both time and money. Here's how to do it; the result is a lab-type scope at a total cost of less than $25. Even if you don't have an OL-1 around, you may be able to find one as inexpensively as I did.

Before we go into the details, let's take a brief look at the original circuit to see how the conversion from ac to dc amplification comes about so easily. The original circuit of the deflection amplifiers appears in Fig. 1; both the vertical and the horizontal amplifier are identical in the OL-1, so only one is shown.

Input from either the vertical-input jack or the sweep-selector switch is fed to a cathode-follower, with the gain control located at the cathode-follower output. The amplifier V1B drives V2 which operates as a longtailed-pair phase inverter, and is direct-coupled to the deflection plates. Spot deflection controls are in the grid circuit of V2.

V1 could be converted to a dc-amplifying stage easily were the cathode, grid-return, and ground for V1A all at the same voltage. Then both ends of the 50K gain control would be at ground for dc, and grid voltage of V1B would not change as the gain control setting was varied.

This target of ground potential at the top of the gain control exists only when no signal is present at the amplifier input, obviously. The "artificial ground" must have high enough impedance that both ac and dc signals can appear across it, and ideally should not change operating conditions for the cathode follower.

While we can't quite reach the ideal of having cathode, grid return, and ground all the same, we can make the grid return come

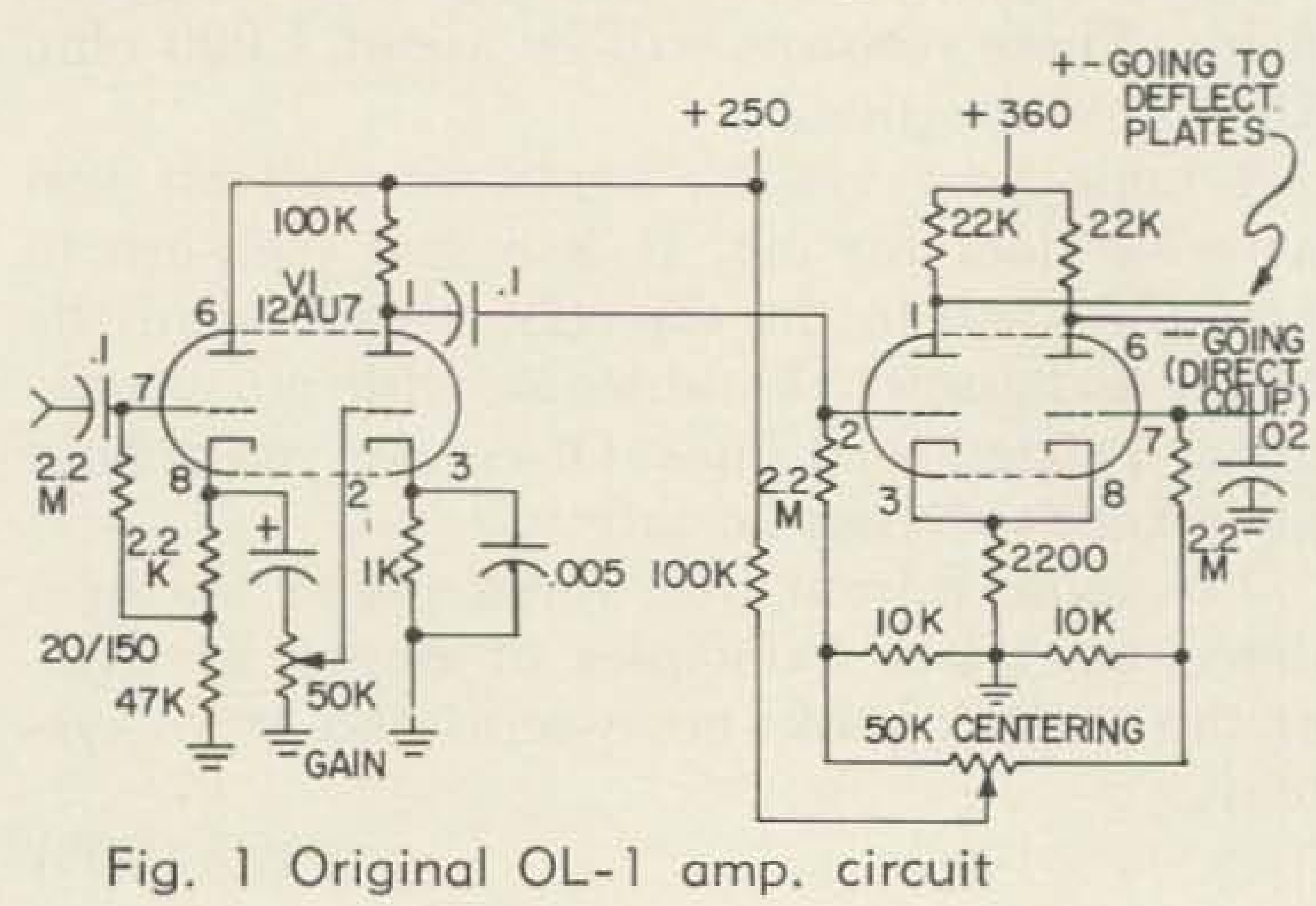


Fig. 1 Original OL-1 amp. circuit

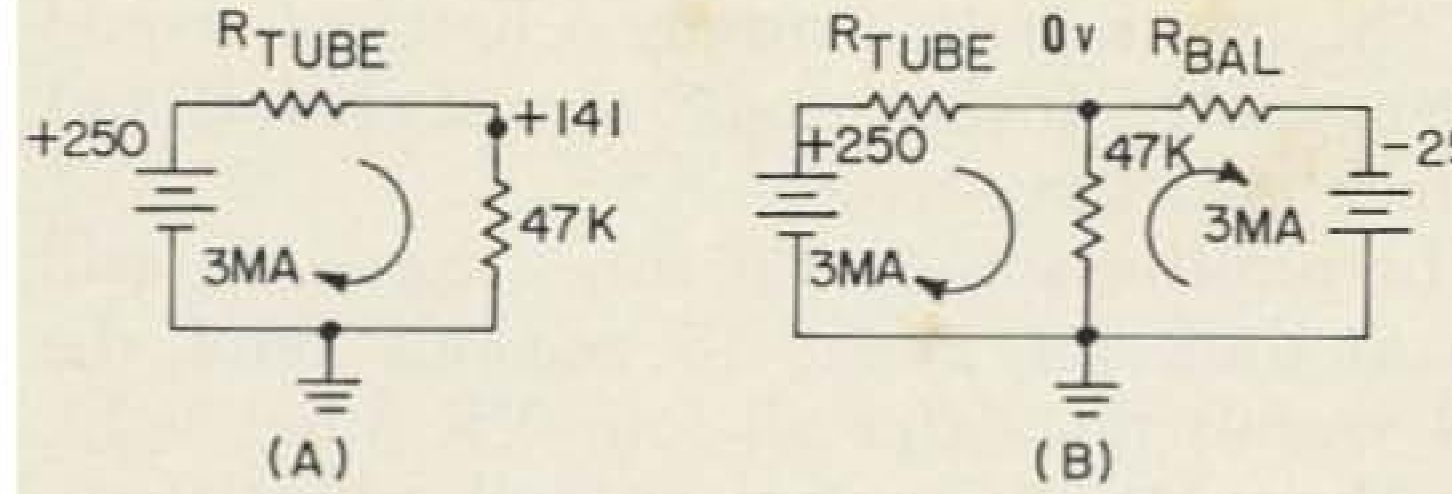


Fig. 2 Balancing input stage

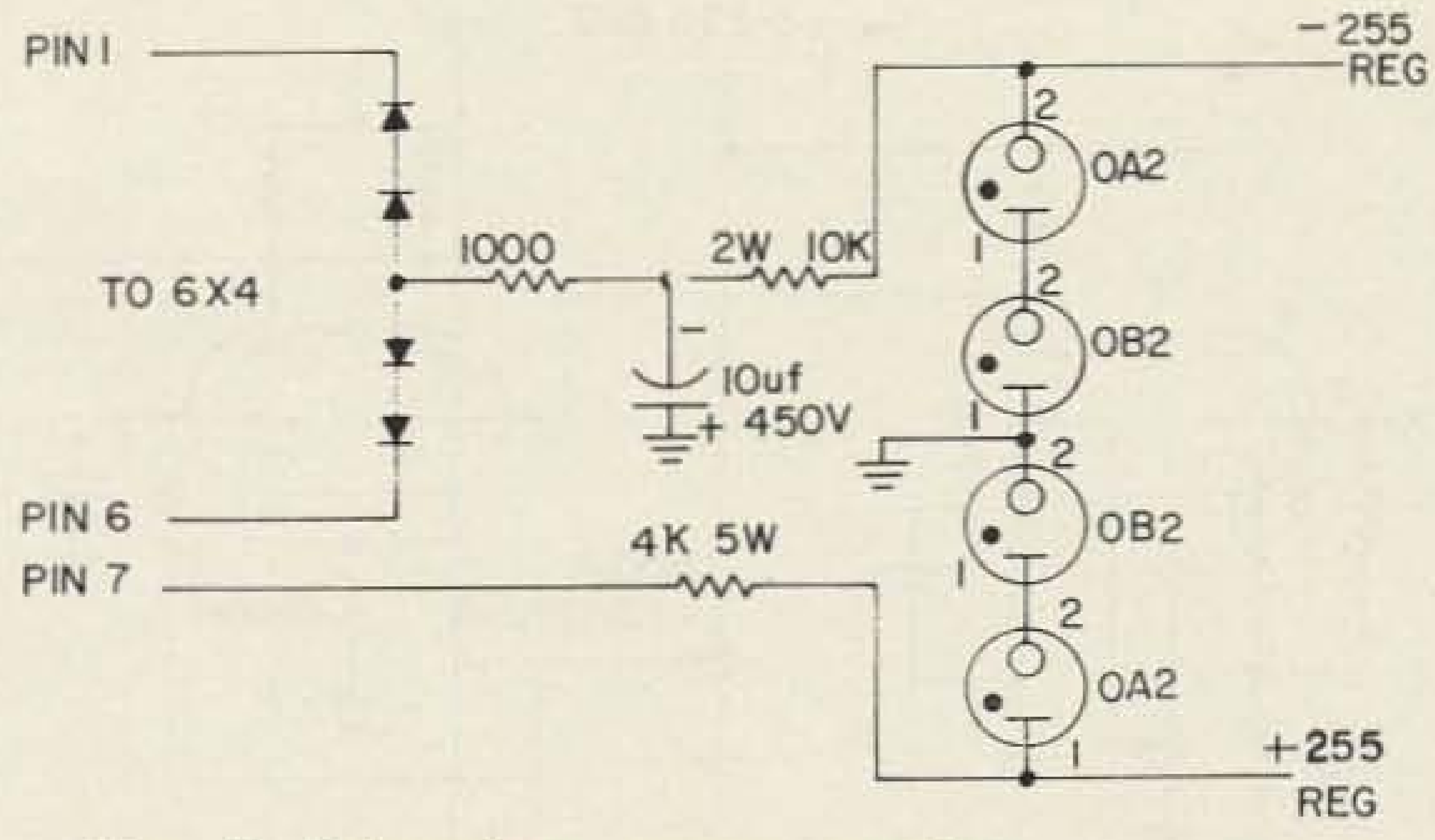


Fig. 3 Balancing power supply

to an "artificial ground" and bypass the 2200-ohm cathode resistor, while retaining unchanged the operating conditions of the cathode follower. Fig. 2 shows in much-simplified form how it's done.

Fig. 2-A shows a representation of the original conditions. The battery represents the +250-volt power supply, and R_{tube} includes the static resistance of the tube and any other resistors in the circuit except the 47K load resistor.

Under the operating conditions designed into the OL-1, approximately 3 ma flows in this circuit, and so the top of the 47K resistor (grid return point) is 141 volts positive to ground. The grid, also, is at this same voltage.

By adding a 250-volt negative supply together with a balancing resistor, R_{bal}, also in series with the 47K resistor as shown in Fig. 2B, current flow in the part of the loop operating from the negative supply can be adjusted to be exactly equal to that in the tube. The equal and opposite currents through the 47K resistor then cancel out, leaving no current at all flowing through it, so the voltage drop across it becomes zero. The top of the resistor is now at the same voltage as the bottom, or ground level.

However, when a signal comes into the tube the current flow undergoes change depending on signal; this upsets the balance and allows a voltage to develop across the 47K resistor. This voltage is the desired signal.

The original dynamic load on the cathode follower consisted of a 47K resistor shunted by a 50K gain control, or approximately 23K ohms. In the modified circuit, the load is 50K (gain control only) shunted by Rbal, which again comes out to about 23K ohms. Thus operating conditions are not changed—but the stage is now capable of passing dc signals.

Lest visions of an additional negative power supply frighten you, let me hasten to add that semiconductor diodes make it simple. Fig. 3 shows the schematic of the circuit I used; connections to the 6×4 rectifier already in the scope give both high-voltage ac and a dc source for the regulators. The VR tubes provide ample filtering at the low current drain encountered here.

Modification of the phase-inverter deflection driver stage requires a bit more physical work but is equally simple. In the original circuit, the grids are approximately 10 volts positive to ground; the centering control varies the relative positive voltage on each grid to move the trace.

The plate potential of V1B is about 50 volts, which means that the difference between V1B plate voltage and V2A grid voltage is about 40 volts. Raising the cathode and grid voltages of V2 by 40 volts each will bring V2A's grid to the same level as V1B's plate, allowing the coupling capacitor to be eliminated.

This is easily done by changing the 2200-ohm common cathode resistor to 8600-ohms and rewiring the centering circuit. Fig. 4 shows the details. The grid of V2A is now clamped to about 50 volts by the direct connection to V1B plate, and centering is accomplished by varying the positive voltage on the grid of V2B a few volts either side of the 50-volt level. The centering control was changed to 500K to allow a wider range; leaving the original 50K control in caused some distortion (due to limited available swing in V2) and a bit of warmup drift as the low-resistance control heated.

The completely modified deflection amplifier circuit is shown in Fig. 4; you can see that only four parts are changed, five removed, and one wire added. Now let's get down to the practical details of how to do it, step by step.

First, put together the power supply on a subchassis. Note that the 27K ½-watt resistor shown in the photos was later replaced with a 1-watt unit; the small one drifted badly during warmup.

Second step is to remove the scope from its cabinet. Then unsolder and remove from the printed circuit board the 47K cathode resistor for V1, the .1 mfd/200-volt coupling capacitor between V1 and V2, the 10K resistor in the grid circuit of V2B, and the 2200-ohm cathode resistor of V2. Disconnect all leads from the board to the vertical centering

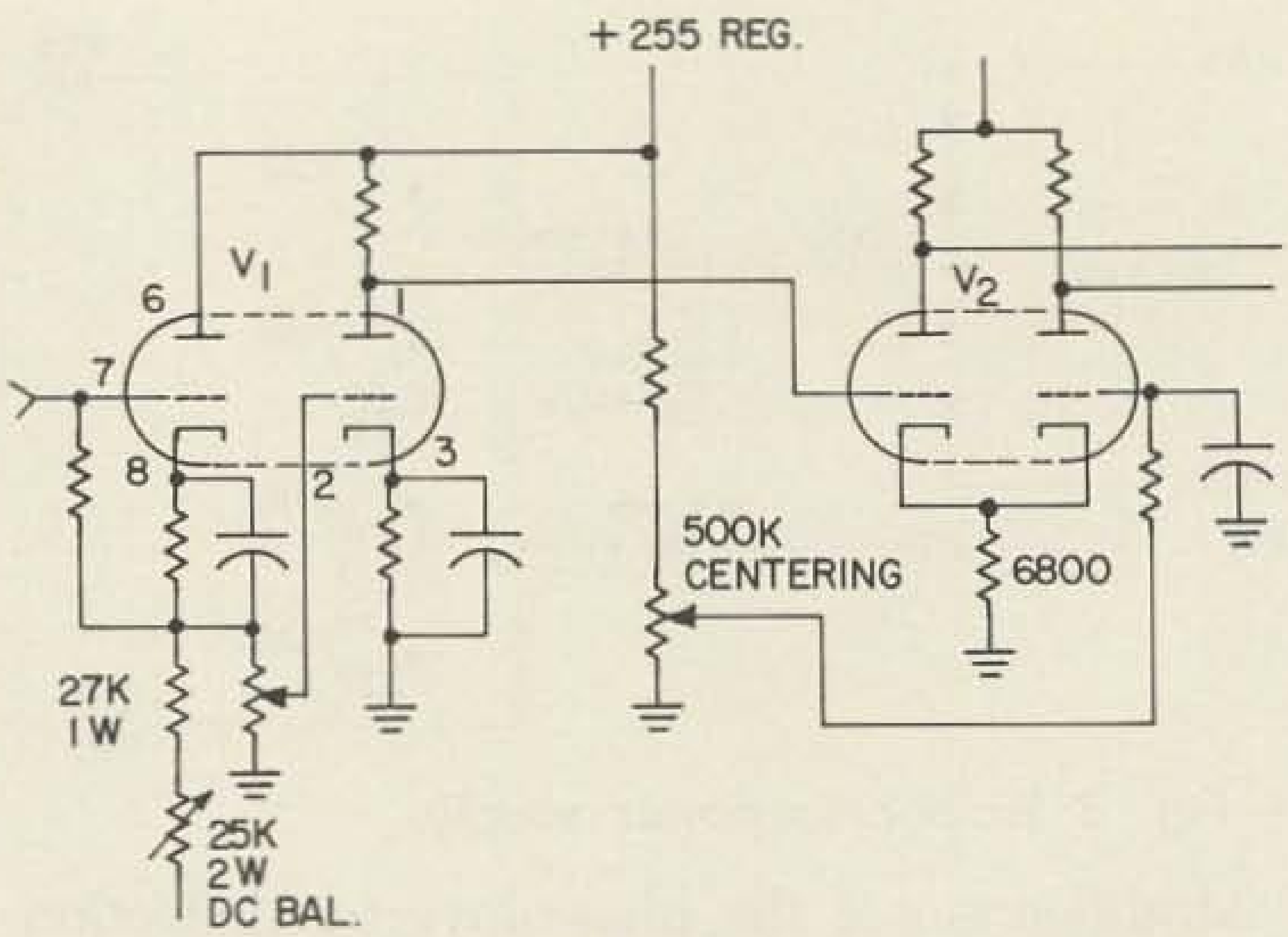


Fig. 4 OL-1 changed to dc amp. Parts not marked are unchanged

control, at the board, and locate the wire from V1's plate circuit back to the power supply. Cut this wire at the power supply.

Rather than remove the two resistors in the grid circuit of V2A from the board, I chose to cut the foil strip between pin 2 of V2 and the 2.2-megohm resistor. The break is shown in the photos; a sharp test prod is suitable for scraping the foil away from the board.

Now we start putting things back. Replace the cathode resistor of V2 with a 6800-ohm 1-watt unit, using existing board holes. The resistor will stand above the board surface but this doesn't matter. Replace the .1 mfd coupling capacitor with a piece of hookup wire soldered between the existing holes. Replace the vertical centering control with a 500K potentiometer, and ground the counterclockwise terminal of the new control. Run a wire from the other outside terminal to hole EE on the board, and from the arm to the hole nearest the 2.2-megohm resistor, left vacant by removal of the 10K resistor.

Replace the .1 mfd/400-volt input capacitor with a length of wire, and connect another length of wire from the junction between the negative terminal of the 20-mfd/150-volt capacitor and the gain control to the junction of the 2200-ohm and 2.2-megohm resistors in V1A's cathode circuit.

Install the power subchassis by removing two of the four transformer mounting bolts, placing them through the subchassis holes, and retightening them. Connect the subchassis leads to appropriate pins of the 6×4. Connect the 27K 1-watt balance padding resistor from the arm of the dc balance control on the subchassis to the junction of the 2.2-megohm and 2200-ohm resistors in V1A's cathode, and connect the cut lead from V1's power-supply circuit to pin 1 of the OA2 marked "+255 reg."

Set vertical gain of the scope to zero, recheck all wiring, cross fingers, and turn scope on. The two negative-supply VR tubes should light instantly. If they don't, turn it off fast and recheck for wiring errors.

The positive-supply VR tubes, however, will remain dark for about 15 seconds until the 6×4 warms up. After all four VR tubes light, turn the intensity control up and adjust vertical centering until the spot appears on the screen.

Switch horizontal sweep to any convenient frequency and adjust horizontal gain for a trace of about 2 inches. This is mainly to avoid any chances of burning the CRT face with a concentrated beam. Then center the trace vertically and mark a reference line on the screen to indicate trace position.

Advance vertical gain slightly; the trace will probably move either up or down the screen face. DO NOT RECENTER. Instead, adjust the dc balance control until the spot returns to the reference line. Then advance vertical gain all the way, keeping vertical input leads shorted to avoid hum pickup. Again, bring the trace to the reference line with the dc balance control. Now sweeping vertical gain quickly from full off to full on should result in no noticeable movement of the trace.

For best results, allow the scope to warm up thoroughly and repeat the balancing procedure described above. Balance should hold its adjustment then, providing only that the scope is allowed to warm up each time it is used.

If you prefer, the dc-balance control could be brought out as a front-panel adjustment either by drilling an additional hole or by using a concentric dual potentiometer for the new vertical centering control. However, I found that readjustment was not needed that frequently; a hole through the bottom of the cabinet, allowing screwdriver touchup occasionally, works nicely for me.

In using the modified OL-1, all controls operate exactly as before. Only one thing is different; since the scope now responds to dc, and panel space didn't permit easy installation of an ac/dc switch, the trace may shoot off the screen when you attempt to measure a waveform at a tube's plate. The remedy is to construct an ac probe, consisting of a .1-mfd/600-volt capacitor in series with the normal probe lead, to block the dc component of the signal when it's not wanted.

While at it, I installed a BNC connector for vertical input, but that's a simple matter having no connection with the main modification. I hope it works as well for you as it has for me.

. . . K5JKX

Carole Hoover Allen K9AMD/W5NQQ
171 Vermilion Drive
Lafayette, La.

The Missing Link

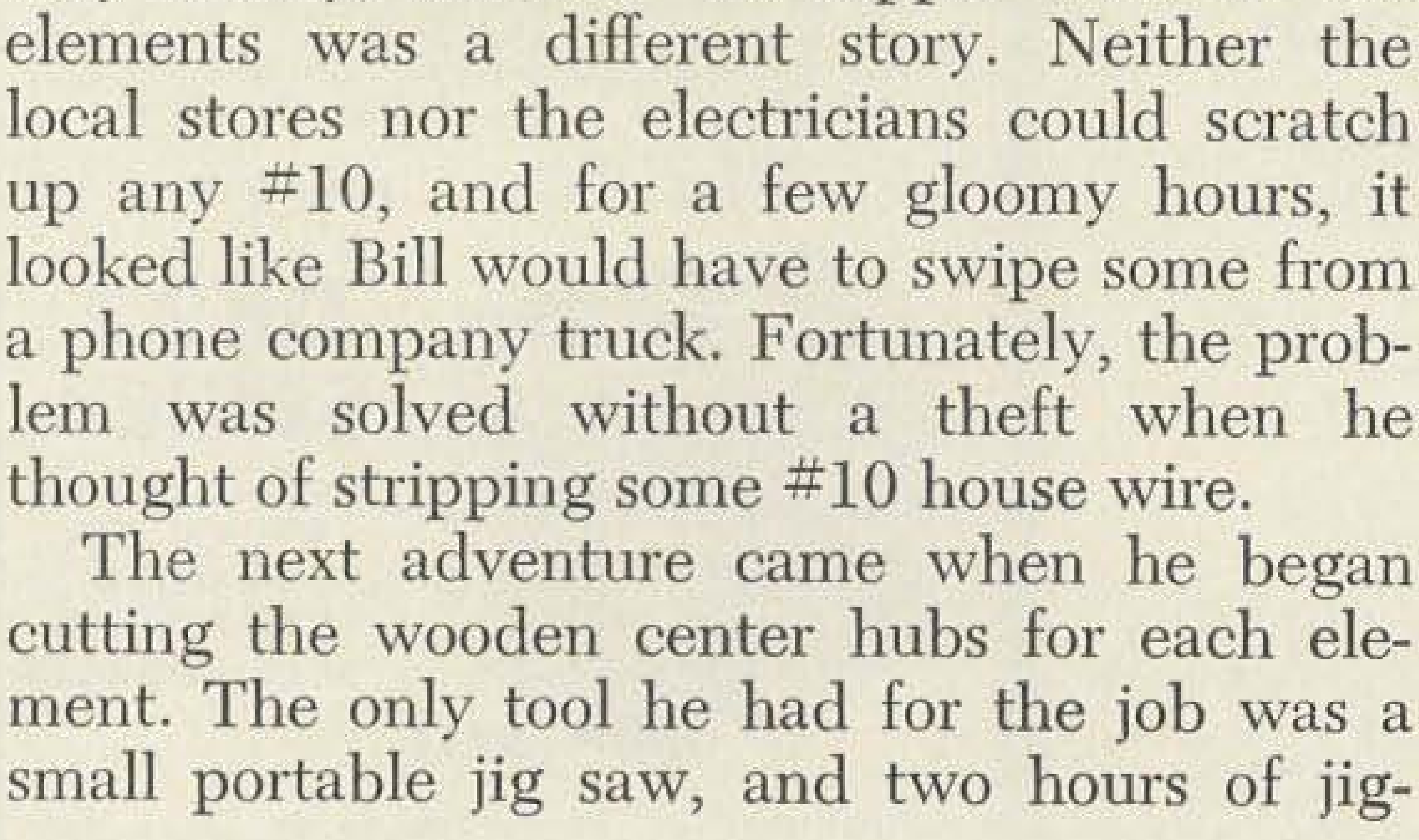
When my OM, Bill K9AKF, announced he was going to build the 2 meter Quad-Quad shown on Page 20 of the May '64 issue of 73, I was shocked! I had always thought that most hams read such spectacular schematics and diagrams like an XYL reading a recipe book—those baked Alaskas, bisques and Bavarians look fabulous, but who'd dream of trying one?

For those readers who may have missed the article, W8HHS built a fantastic 2 meter antenna consisting of four small cubical quads stacked broadside.

Well, when Bill read that the front to back ratio of the Quad-Quad exceeded 28 decibels, he forgot about lunch and a dental appointment and started gathering the needed materials.

The quad framework calls for thin-wall electrical conduit and the element supports are made from dowel rods. Acquiring these took only money, but the #10 copper wire for the elements was a different story. Neither the local stores nor the electricians could scratch up any #10, and for a few gloomy hours, it looked like Bill would have to swipe some from a phone company truck. Fortunately, the problem was solved without a theft when he thought of stripping some #10 house wire.

The next adventure came when he began cutting the wooden center hubs for each element. The only tool he had for the job was a small portable jig saw, and two hours of jigging produced what I guessed was a miniature egg-shape hexagon. Since my guess was wrong and there are twelve hubs needed, this job went to a wood-working friend-in-need.



Bill, K9AKF, assembles the bays of the Quad-Quad in the back yard.

When all the material was on hand, work began. Before long the basement was a jungle of dowels and hubs neatly spaced by wire. As each quad bay was tested successfully, excitement grew, and so did the size of the Quad-Quad. Completely assembled in the basement, it would have been another boat-in-a-bottle deal, twice as big as the door. But, Bill had thought of that and wisely decided to re-locate in the back yard.

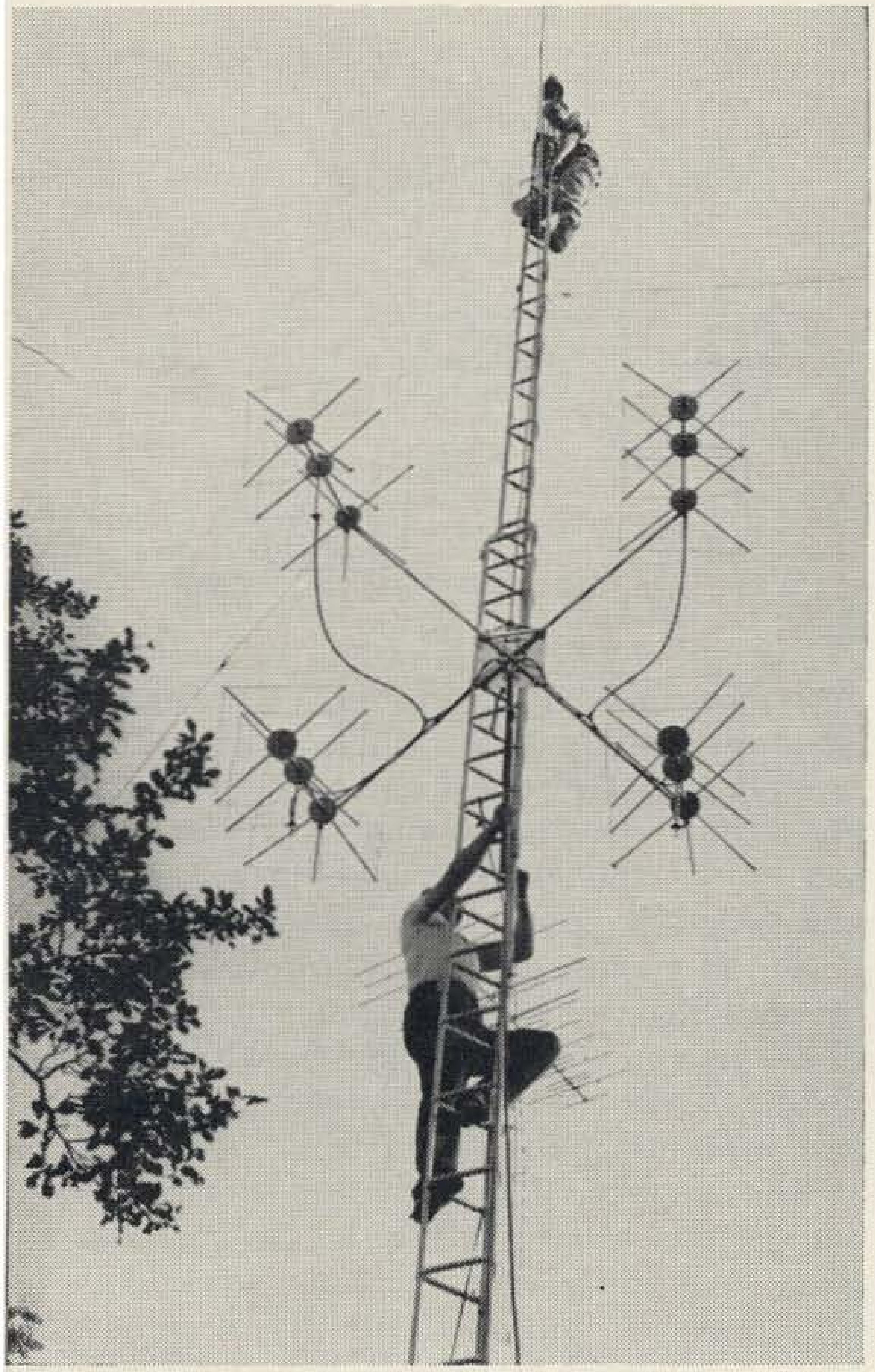
Next came the assembly of the bays on the framework and the wiring of the harness. Even in the hot June sun, work went well, and the wires were wonderful for drying nylons when his back was turned.

Now, I mean no criticism of W8HHS's fine article, but it does skip hurriedly from *The Tune-Up* to *The Performance* completely omitting an interesting phase known as *The Installation*. It is upon this missing link we will now dwell.

When the Quad-Quad is assembled, it reminds one of a wind-mill, and this is good since all hams seem to feel that the bigger an antenna is the better it is. The only time he wishes it was the size of a toothpick is when he is climbing to the top of his 70 foot tower swaying in a stiff wind with three or four nervous relatives milling helplessly below, and the beam hanging on a rope somewhere in between.

Bill chose a quiet evening for the raising of the Quad-Quad and climbed the tower trustingly placing its welfare in the hands of his XYL (me), and his in-laws, K9AXS Golde, and W9VEY Dan. The gals would guide the elements while Dan pulled on the hoisting rope.

All went well for about the first 10 seconds. At that time, a dowel tip hit the bird bath and bent a bit. This was quickly fixed, but as the quad was pulled toward the eaves, one bay seemed magnetized by the branches of our plum tree and became entangled. Panic struck. I climbed up the tower a few rungs to



Frank, K9HYZ, guides the Quad-Quad up to K9AKF after the disastrous plum tree episode.

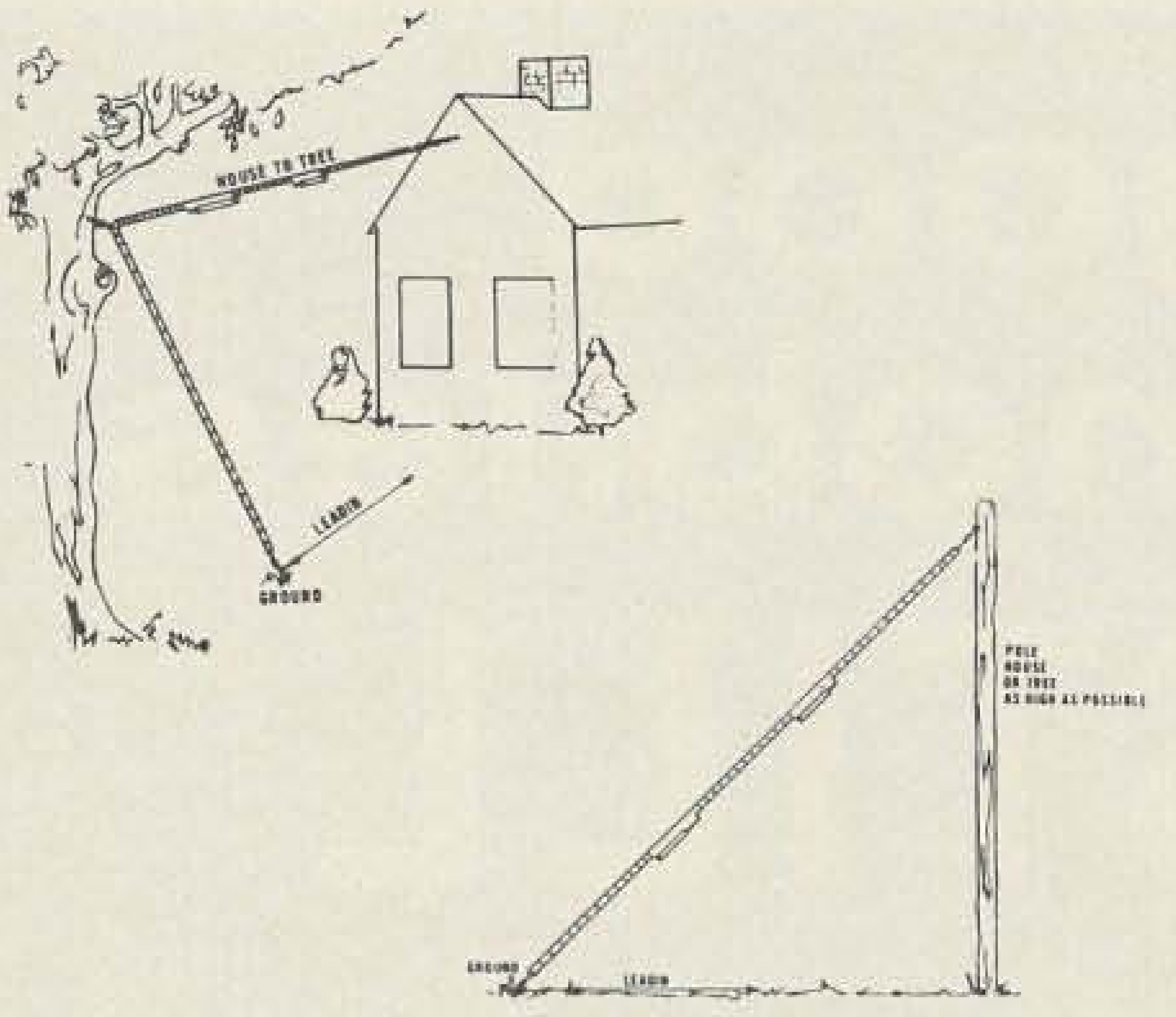
steady the quad and managed to catch the opposite bay on the corner of the house. K9AXS ran for the rake to push the elements free, and W9VEY dropped the rope to help his women leaving Bill at the top of the tower with the weight of the Quad-Quad on the rope.

The sickening sound of cracking dowels followed; the quad broke free; Bill came down, and we talked him out of starting a dowel rod bonfire on the spot. Later in the evening, an inventory revealed only minor damage, and it was decided to try, try again.

Two nights later, W9VEY pruned his prize plum tree 'til it looks like a poplar; Frank K9HYZ, climbed on the roof to guide the Quad-Quad, and up it went like Santa through the chimney.

We have found the performance of the Quad-Quad as terrific as Doug De Maw's claims. DX contacts have been made; reception remarkably improved; and, yes, the front to back ratio must be 28 decibels at least!

. . . K9AMD



Mosley's "El Toro"

Howard S. Pyle W7OE
3434-74th Ave., S.E.
Mercer Island, Wash.

They say "there is nothing new under the sun." Well, I found something which really opened my eyes; a three-band, trap-type, grounded quarter wave antenna using an unusual tuning method which, in effect, makes it an "automatic band-switching antenna."

Designed for the 20, 40 and 80 meter bands as well as a type for the novice 15, 40 and 80 meter domain, the whole assembly is only 58 feet long over-all and weighs but two pounds! Furthermore, it can be erected as a vertical, or as a combination vertical and horizontal and can be bent or "drooped" as necessary as much as 45 degrees to reach the ground termination! Or, it can be installed in a sloping position for it's entire length; truly a versatile antenna adaptable to almost any space or location!

Initial tuning is accomplished by a series of shorting bars and two capacity tuners. These can be adjusted to resonate in the middle of all three bands or right on your generally used frequency in each of the bands without further adjustment after erection. Tuning is sufficiently broad to provide high efficiency as well as extremely low SWR ratio at all other points in each band.

Such an antenna, known as "El Toro", is manufactured by Mosley Electronics, well and favorably known to most hams by reason of their excellent beam antennas, thousands of which are serving amateurs all over the world. This novel antenna is offered in three types; the NS-3 Novice Special, pre-tuned to the novice portion of the 15, 40 and 80 meter bands with a power handling capacity of 300 watts; the TW-3X Jr., for 20, 40 and 75/80 meter operation at 300 watts CW-SSB, 1000 watts to final amplifier and the TW-3X rated to handle the maximum legal limit of 1000 watts input to the amplifier, SSB-2000 watts PEP.

Any of these antennas can be either roof or ground mounted; slightly superior performance is realized with ground mounting; merely a good connection within a few inches of ground level is required and, in most cases, no radials are necessary. A driven ground rod or a convenient water pipe or conduit will generally prove to be an adequate ground. Roof top mounting will require a few radials except where mounted on a metal roof.

All antennas are supplied in kit form, with detailed assembly and erection instructions and with all of the "hard work" accomplished at the factory. The radiating portion comes completely assembled with all spreaders in place and all of the machine work done on the tuners. In spite of this, the complete antenna is shipped in a small, light weight carton only twenty inches long and about six inches square! Everything is supplied including end insulators; you need only assemble the kit which takes but a few minutes, solder the small shorting bars in place, connect the two tuners as shown in the instructions and hoist the complete antenna into the air. You need furnish nothing but a sufficient length of 52 ohm co-axial cable to reach the transmitter from the ground end of the antenna (actual length is not important although the shorter the co-ax feed-line, the less loss and better SWR), a short piece of nylon rope or clothesline . . . plastic clothesline will serve as well . . . with which to tie the end insulators to the antenna supports, and a good ground connection.

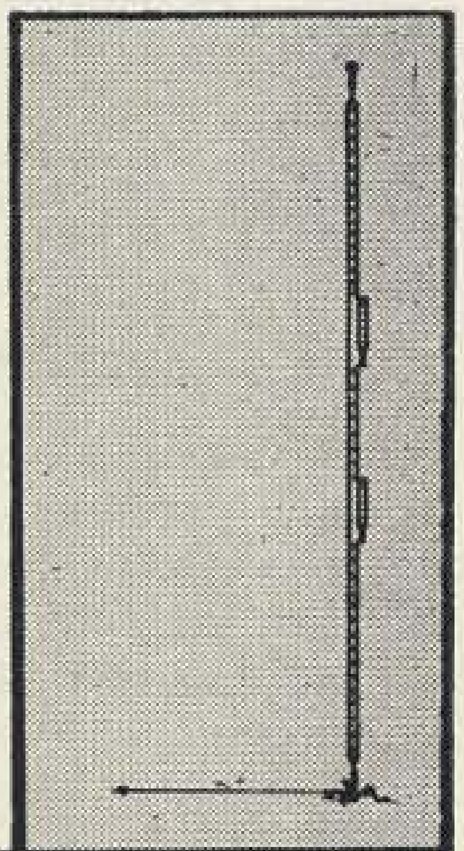
In effect, the antenna is a 450 ohm, open-wire feed line which comprises the entire *radiating* portion. The writer has experimented with scores of antennas over a period of many years and has found the Mosley "El Toro" to be the equal of any of those which he has used. And, at the cost, unless your 'piggy-bank' is awfully low, it will pay you to buy the Mosley kit rather than try to duplicate it by 'home-brewing'.

. . . W7OE

EL TORO

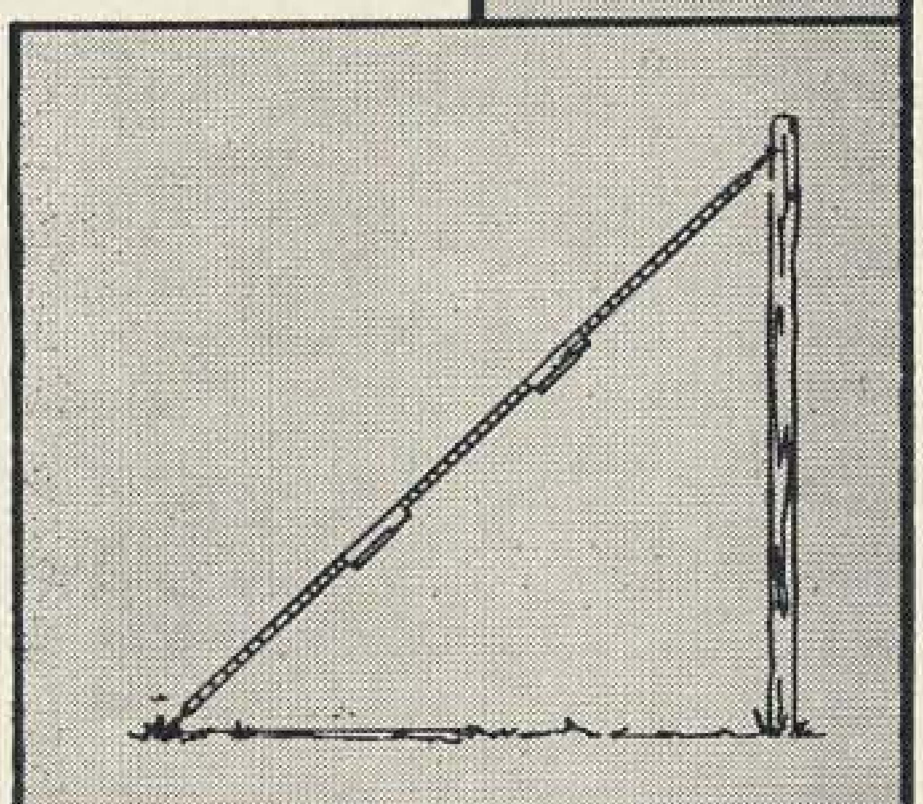
BY MOSLEY ... can be mounted almost any-where!

Mosley "El Toro" antennas are trap type grounded quarter wave antennas using a unique method of tuning and a single 52 ohm coax line. The antenna is only 58' long and can be mounted to fit almost any location. No radials are needed if mounted at ground level. "El Toro" comes pretuned, in kit form and can be easily adjusted to resonate at any portion of the antennas rated bands.



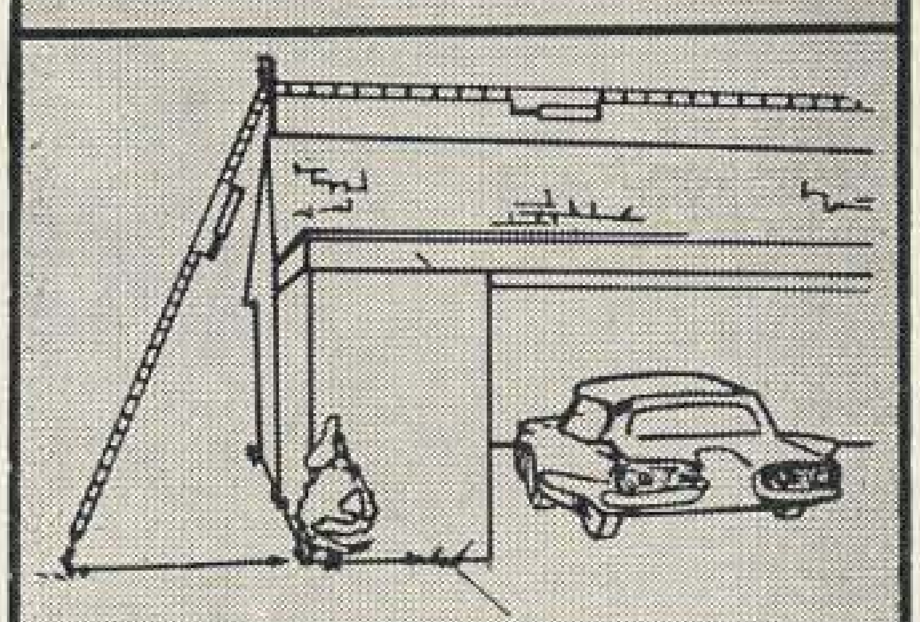
3 models

Mosley "El Toro" antennas are available in three models, TW-3X – TW-3X Jr. – NS-3, each is designed to give outstanding performance. These versatile antennas were developed for the Ham with a limited budget, limited space and the traveler who works portable.



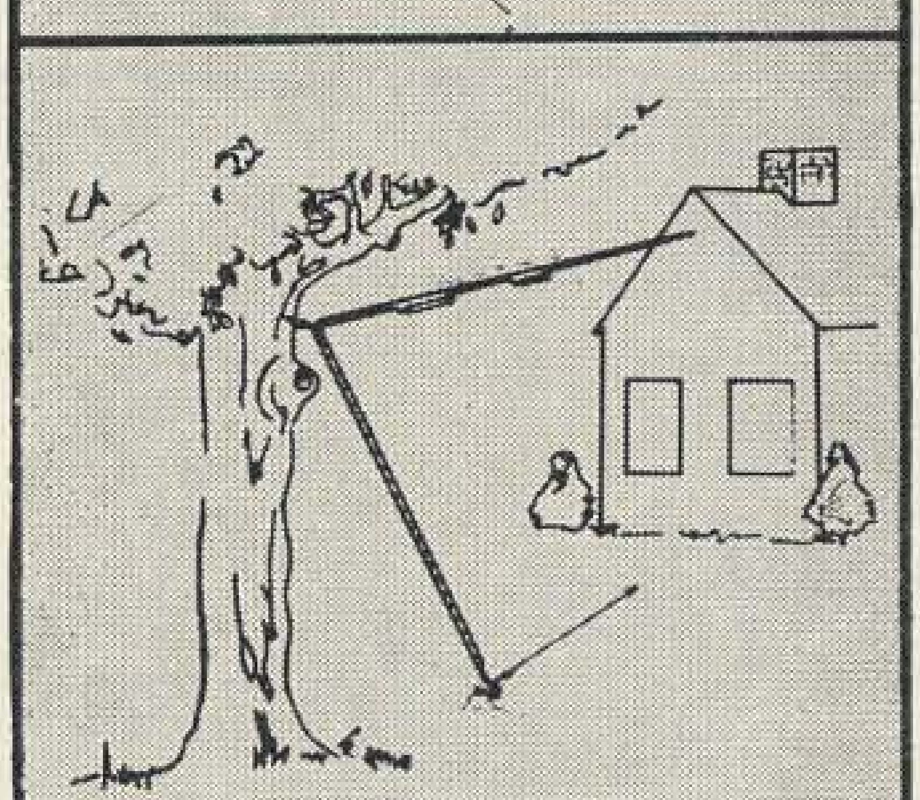
3 band operation

Mosley TW-3X and TW-3X Jr. operate on 20, 40 and 75/80 meters. Mosley NS-3 (Novice Special) is designed for operation on 15, 40 and 80 meters. The "El Toro" antennas feature pretuned, compact design and excellent broadband characteristics.



2 power ratings

Mosley TW-3X has an AM rating of 1000 watts input to the final amplifier and a CW/SSB rating of 2000 watts P.E.P. Mosley TW-3X Jr. and NS-3 (Novice Special) have ratings of 300 watts on AM, 500 watts on CW and 1000 watts P.E.P. input to the final amplifier on SSB.



MODEL TW-3X – – – – – – – – – – $ 19.95
MODELS TW-3X Jr. & NS-3 – – – $ 14.95

MOSLEY *Electronics Inc.*

4610 North Lindbergh Blvd.   Bridgeton, Missouri, 63044

advised by my lawyers that
don't you ever proofread y

Letters

have no other recourse but
should be tarred and feath

The Monitor Magazine (cc to 73)

Dear Joe,

In a recent form letter from John Huntoon requesting my reconsideration to re-join ARRL I see ARRL now lays claim to the success of the Goldwater Reciprocal Bill. Frank Mortensen W7HNT and I can tell you of the *many* negative replies from ARRL officials and legal representatives during the period prior to 1962. The mess that is resulting from their proposals for incentive licensing will not immediately stop. With all the opposition shown to date one would think that ARRL would reconsider their initial moves and review the matter for the good of all amateurs in full membership. Since it is apparent that they do not intend to do so, nor do they intend to adapt a democratic policy in the representation of the amateurs, the only solution appears to be the development of providing the ARRL with stiff competition in the form of another organized amateur body, one that will truly represent their members. The IoAR has already proven what another amateur radio group, although small in membership, can accomplish during its short life. If you and other editors would get with the officials of the IoAR in strengthening that new group I believe that it could be done.

John F. Barrows DL4HU

ARRL, Newington, Conn:

You will find from your records that I am no longer a member of the ARRL, nor will I be as long as the present policy of said group continues. I have a slogan of my own: Amateur Radio is going to Hell because we trusted our fate to the ARRL.

George Walker W7GCO ex-E.C.
Pocatello, Idaho

Dear Wayne,

I have received several letters concerning my article on alternators. The main question is how to eliminate alternator whine—particularly in two meter rigs. I've checked around and the best results are obtained by placing a pi filter in the filament lead or in the line from the battery. Evidently the AC from the alternator gets past the rectifiers and the battery to the filaments, and into the rig.

I would like to add to the long list of true ham experiences one of my own. On Friday the 13th, last November, a large portion of my home burned. What the fire and smoke didn't get the firemen did. However, enough remained, providing we didn't mind sleeping on the floor and not changing clothes. The next day—Saturday—I decided to rent a house across the street that had been vacant several years, and in West Texas, that means full of dirt.

The word got out that I was going to move that afternoon, and in large masses the hams began arriving at my once proud QTH. They cleaned the new house from top to bottom, the gas, water, and electricity were turned on (Saturday afternoon, no less), washed up the terribly smoked furniture, and moved it across the street to the new house! The amazing part of this fact is that it was accomplished in about an hour and twenty minutes. I estimate that 45 hams participated in my move.

The results of the fire are still quite evident, the furniture *still* smells of smoke, the XYL is *still* in the hospital recovering from burns received in the fire, but this will soon pass and be forgotten. However, I will never forget the friendliness of the hams that appeared that Saturday afternoon.

O'Kelly W5VOH
Midland, Texas

Dear Wayne:

Hmmm—that's strange: Seems I recall reading in one of CQ's editorials that one of the reasons for their dropping of Clif was that he wanted to print two to three pages of call letters. That's it! I knew there was something missing from their November issue. Sure enough—*their* four pages of call letters for *their* awards were saved for the next month (and, of course, a more unrelated editorial,) instead of the usual November issue. Nothing like following your own creed.

Jim WϕDSU

Dear Wayne:

Congratulations on the "ALC for SSB" article in the 1-'65 73. As Kyle points out, there has been very little written on such an important SSB subject, mine (CQ April '61) and two other references. I was about to write an article myself to bring things up to date and out in the open. One thing that I have never understood is that my material was written and submitted to the two amateur radio publications of the day five years before I finally got it published in the SSB column! There is a recent excellent reference that covers all phases of SSB, "Single Sideband Principles and Circuits" by Pappenfus, Bruene and Schoenike (Collins engineers) McGraw-Hill, and especially their chapter on "Signal Processing for SSB Transmission." Besides all of the dope on ALC they point out that AF clipping can be used with SSB, an argument to the contrary often used by the die-hard AM/DSB boys to "prove" some advantage for that ancient mode.

In adding ALC to the HT-32, recent experiments show that the ALC voltage should be applied to the grid of V2 (pin #1) and not the grid of V5 as shown in my article and mentioned by Kyle. There is a fixed negative bias on the grid of V5 and the ALC voltage would be in parallel with it, causing a delayed action. Kyle made a little slip when he referred to testing the ALC action with an audio oscillator. He should have said to use a two-tone audio oscillator as a single tone or carrier will not actuate the ALC.

Regarding the letter on 6DQ5's by W6ZGZ and the article to which it refers. I never could see why all the concern with brands of 6DQ5 tubes when there are a number of TV tubes that are better for RF Class AB1 amplifiers. The best tube that I have found is the Tung-Sol 8236. My check shows that it gave some 18% more output than the equivalent TV tube types at the same input. I am running a cool pair at 500W PEP input in my HT-32X and have been wondering why I never saw any mention of these fine little bottles.

Wayne W. Cooper K4ZZV/W6EWC

Dear Wayne:

Just want you to know I am making constant use of the gratis copy of 73 magazine you are sending me.

I am constantly reading appropriate articles on the 2 hour "RADIO DIGEST" tape distributed by Science For The Blind.

The last report I received some months ago our circulation was nearing the 100 mark. This means that these blind hams and would-be hams are receiving material they otherwise would miss!

With the co-operation of 73 and other ham magazines my expense is reduced. I furnish and maintain my own equipment and some supplies but am spared the expense of the magazine subscriptions.

Thanks again, Wayne, for myself and for all my sightless listeners.

Henry G. Kuhn W2IRU

Howdy Wayne,

The Ham Radio Commemorative Stamp is hideous. It shows a *modulated* wave form, a few bolts of lightning and is a sickly purple. A modulated wave form doesn't represent CW. I'm a CW man. QST is a CW magazine. Did somebody drop the ball *again?* It would be interesting to know just what came off here.

Thomas Turner K8VBL/6
Oakland, California

Four Armed

Editor CQ Magazine:

In August of 1964 I sent 104 QSL cards to Mr. Urban Le Jeune Jr., W2DEC, Box 35, Hazlet, New Jersey 07730 by registered mail. In October I received Certificate #404 for contact with 100 countries on SSB. On November 10, 1964 I requested the return of my cards in an air mail note to Mr. Le Jeune. Since I have not received the cards nor any reply to my letter, I can only assume that I have been cheated out of my cards and the $1.00 that I sent in to cover the return postage by the irresponsibility of Mr. Le Jeune and CQ Magazine.

W. E. Hughes Jr. XE2WH
Monterrey, Mexico

The New Heath GR-64 SWL Receiver

Donald Smith W3UZN
Kent Mitchell W3WTO

If you are like the usual ham you enjoy listening to your favorite amateur band as much as possible. However, monitoring the local gang or keeping a lookout for band openings is not always convenient. When you're working in the basement shop or in the garage you're often not within audible range of the shack. The obvious solution to this problem is to get a second receiver. Duplicating the expensive receiving gear you have in your shack would be economically unwise, so a search for something less costly is in order. Consider then, the Heath GR-64 receiver kit.

This receiver certainly fulfills our desire to keep cost down. It offers many desirable features besides. (Over 100,000 other people have thought so too, as indicated by Heath's sales records.) The GR-64 has a standard broadcast band which other members of the family may listen to when you are not receiving on the ham bands. Frequency coverage is 500 kc to 30 mc.

The receiver uses a 12BE6 in the converter to produce a 455 kc *if*. A 12BA6 *if* amplifier stage not only amplifies the 455 kc signal, but functions as a beat frequency oscillator as well. Detection is performed by a 12AV6 and a 12AQ5 amplifies the audio to drive the built-in 5" round speaker or ear phones. Power is provided by a transformer operated power supply using silicon diodes in a full-wave doubler-rectifier circuit.

Although the receiver has no rf amplifier stage, direct comparison tests with a well-known $450 receiver were surprisingly good. Alternately using the same antenna on both receivers, almost all signals heard on the higher priced model were heard on the GR-64. Selectivity seemed to be the main difference. An outdoor long-wire antenna is recommended for best results.

A large etched circuit board and uncrowded chassis lay-out make construction easy. Assembly time is approximately 14 hours.

Features of the GR-64 receiver include an "S" meter, a large slide-rule main tuning dial, a bfo, and provisions for an external Q multiplier. The all steel cabinet is finished in a gray wrinkle with an attractive silver trim. The front plastic feet on the bottom of the cabinet are slightly longer than the rear feet, so the receiver sits at a jaunty angle that makes tuning easier.

All things considered the Heath GR-64 is a good buy.

GR-64 Specifications

Frequency Coverage	550kc to 30mc (in four bands)
Circuit	Superhetrodyne
Controls	On-Off/Volume, Band Switch, Main Tuning, Fine Tuning, bfo, ANL (Noise Limiter) Mode Selector (AM-STBY-CW)
Tube Complement	12BE6 Oscillator and mixer 12BA6 if amplifier and bfo 12AV6 Detector and audio amplifier 12AQ5 Audio output
Antenna Impedance	High Z
Power Supply	Transformer operated, silicondiode in a full-wave-doubler circuit
Power Requirements	117vac @ 30 watts
Dimensions	13½" wide x 6" high x 9" deep
Weight	11½ lbs.
Price	$39.95

. . . W3UZN
. . . W3WTO

73 Books

Peterborough, N.H.

Marty Feeney, Jr. K1OYB

IQ Test

Are you kept off the air because of TVI? Is your puny 25 watts drowned in the vast wasteland of 20 meter QRM? Does your rig suffer from tired blood? In short, are you somewhat dissatisfied with amateur radio? Relax, then. This article won't solve all (or any) of your problems, but it will give you an enjoyable few hours.

There are five ham shacks, each of a different color. Each of the operators runs a different rig, each belongs to a different organization, and each reads a different magazine. Below are certain facts about each of these hams. By proceeding in a logical manner, you should be able to determine the answers to these questions:

1) Who reads "Playboy"?

2) Who belongs to the "Munjoy Hill Society for the Preservation of Spark on the Eleven Meter Band"?

Note. The relationships described need not necessarily be reasonable. For example, the DX'er may or may not belong to dxcc, the lid doesn't necessarily read CQ, etc. The houses are in a straight line, numbered from left to right.

1) There are five ham shacks.

2) The lid operates from the red ham shack.

3) The DX'er reads CQ.

4) The operator in the green ham shack belongs to DXCC.

5) The VHF'er belongs to ARRL.

6) The green ham shack is immediately to the right of the ivory one.

7) The owner of the DX-20 reads QST.

8) The ham in the yellow shack operates a Communicator II.

9) The operator in the middle house belongs to the IoAR.

10) The ham in the first house is a RTTY'er.

11) The ham who operates the home-brew rig has his ham shack next to the ham who reads 73.

12) The "Proceedings of the IRE" are read in the ham shack next to the ham shack where the Communicator II is operated.

13) The operator of the KWM 2 belongs to the Certificate Haters Club.

14) The Rag-Chewer runs an ARC 5.

15) The RTTY'er built his ham shack next to the blue one. . . . K1OYB

Answers on p. 78

Understanding the Schmitt Trigger Circuit-

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

Recent publication of RTTY converters built around "Schmitt Trigger" circuitry has revealed, through reader response, that many of us hams don't know very much about this exceptionally useful circuit, and consequently can't follow our usual practice of cut-and-try modification.

Which is distinctly not a good state of affairs, because the Schmitt Trigger is one of the most versatile and useful circuits ever devised outside the basic amplifier stage! It can act as a peak clipper to provide virtually infinite clipping; it can convert sine waves into square waves should you need them; and it is especially useful for RTTY converters because it combines several functions into a single stage.

Essentially, the Schmitt is a regenerative switch which flips on or off in a matter of microseconds (or even fractions of a microsecond when so designed) yet will remain on so long as the input signal tells it to.

It's a variant of the general family of multivibrators; the characteristic which makes it unique in the family is that it doesn't "vibrate" like all the rest. The routine multivibrator of the free-running variety oscillates continually, the "mono-stable" or "one-shot" delivers a single timed output pulse for each input signal applied, regardless of length of the input signal, and the "bistable" or flip-flop alternately turns on or off. Only the Schmitt exhibits the relay type of operation by remaining on so long as input is present.

Unlike the mechanical relay, though, the Schmitt can operate nicely up in the megacycle range. It has negligible time delay between input signal and output action, and similarly small delay between removal of input and "drop-out." To boot, it's a high-impedance device which can be connected almost anywhere without loading down the driving source, and it automatically provides an "inverted" or "reverse" output as well as its normal output.

The output is a voltage at one of two levels; the upper level is equal to the supply voltage (when the Schmitt is not loaded down by the following stage) while the lower is determined by the trigger design but is usually much much lower. A low-voltage level of about 50 volts is typical for vacuum-tube Schmitts; something well below 1 volt is typical for the transistor version of the circuit.

These output levels hold true regardless of the input level. If input signal is large enough to trigger the circuit, output rises to the upper level and stays there. If the input signal is not large enough to trigger, the output remains low.

At the "inverted" output terminals, conditions are reversed. Voltage is at the lower level when the circuit is triggered, and goes high when the input signal is absent.

These characteristices make the Schmitt a perfect clipper, since any signal above the trigger point will produce an output of known level. Signals below the trigger point don't get through. It also is a wave-squarer, since the trigger point can be set at virtually zero volts. For half of a sine-wave input, the trigger is on, and for the other half it's off. The output, consequently, is a square wave.

And since a 2-volt change in input level can cause a 150-volt change in output level (in the vacuum-tube version) the Schmitt turns out to be a pretty good amplifier as well. Thus in RTTY it can combine the functions of limiting, inverting for "bilateral" copy, and amplifying the teletype signal all in one stage. The transistor version is even more sensitive, producing a change in output of some 10 volts with an input variation of only 0.01 volt. This equals a gain of 1,000 times through the stage, with limiting action thrown in.

To see how it works, take a look at Fig. 1. This shows a typical vacuum-tube Schmitt Trigger circuit, with all circuit components identified. A bit farther on we'll find out how to determine proper values for all these things.

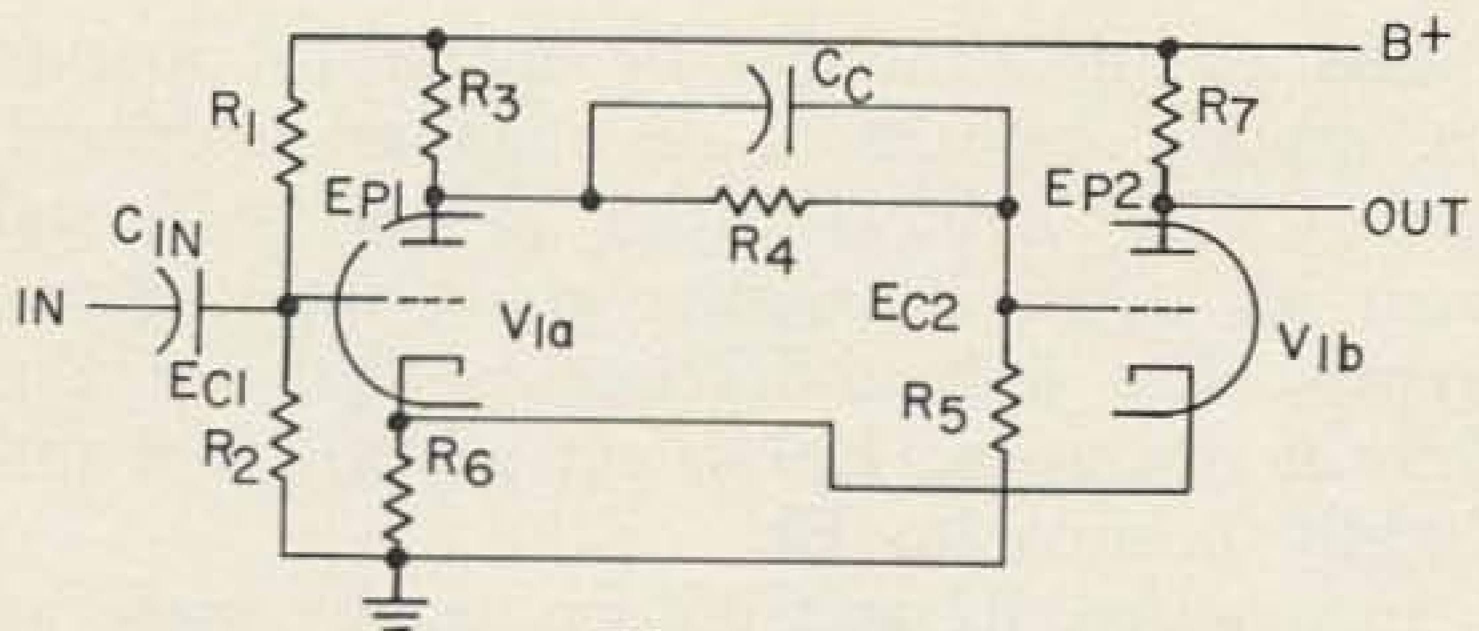


FIG. I VT SCHMITT

First let's assume that one of the two triode sections is at zero bias, and conducting as much current as the tube and its plate resistor will allow. Don't worry about the effect of R6, the cathode resistor, because it really doesn't have much to do with the amount of current which flows.

However, the voltage across R6, or Ek, will be equal to the current times the value of R6 in ohms. Let's make sure this amounts to enough volts to completely cut off either triode section; how much this will have to be can be determined from a glance at the tube handbooks.

Now let's adjust the relative value of R1 and R2 to fix the voltage at V1a's grid, Ec1, right at cutoff. Remember that cutoff voltage is measured between grid and cathode, and the cathode is positive to ground by Ek volts. Therefore, Ec1 should be equal to Ek minus the cutoff voltage (all voltages expressed as positive numbers).

This ensures that V1a is cut off, and no current passes through the tube. With no current flowing, the plate voltage Ep1 should rise to the same level as the supply B +. If it were not for the shunt path to ground made up of R4 and R5, this would indeed be so, and if R4 and R5 are both large compared to R3 the difference between B + and Ep1 will be small indeed.

The grid of V1b, though, is connected to the junction of R4 and R5, and so is receiving a fraction of the plate voltage of V1a. The exact value of Ec2 under these conditions is determined by the ratio of R5 to the total of R3, R4, and R5, and can be made almost anything desired. For most positive and sensitive action, Ec2 under these conditions should be set about ½ volt positive with regard to Ek. That is, if Ek is 10 volts, Ec2 should be 10½ to 11 volts.

Remembering that the effective bias is measured between grid and cathode, with the grid at Ec2 and the cathode at Ek, the effective bias on V1b will be about ½ volt positive. This locks V1b into conduction, which establishes our original assumption and assures us that Ek does really exist.

Since V1b is conducting as heavily as it is able, its plate voltage Ep2 will be comparatively low. The exact value of Ep2 under these at-rest conditions will be equal to Ek plus the plate-to-cathode voltage of V1b as determined by a load-line plot on tube curves. The calculations aren't really necessary, though; the value is normally less than 50 volts and with a bit of luck you can find as little as 15 volts at the plates.

So far, we've established only the "resting" condition of the circuit, and shown how Ep1 is maintained near the supply level while Ep2 is near ground in the absence of input signal. Now let's look at what happens when a signal comes in through Cin.

If the signal happens to be going in the negative direction, it will only bias V1a deeper into the cut-off region and nothing at all will happen.

However, if the signal is going positive, it will reduce the bias on V1a. As bias is reduced (by reducing the difference between grid and cathode voltages) the plate current will increase from zero. This will in turn reduce Ep1 by increasing the drop through R3, and the drop in Ep1 will in its turn reduce the value of Ec2. At the same time, Ek is increasing very slightly due to the current flowing through V1a, and the drop in Ec2 together with the rise in Ek moves the bias on V1b from its slightly-positive point back to zero and then on into the negative direction.

As the grid-to-cathode voltage of V1b becomes more negative, its plate current decreases and this in turn tends to make Ek slightly smaller, cancelling out the earlier increase. The reduction of Ek reduces bias on V1a still more, which allows more current through R3 and in its turn increases the bias on V1b. If the input signal remains at this level or continues to go positive, the cumulative effect of the changes in bias will be a "flip" of conditions to the opposite of those existing at rest. V1a will be conducting because of the input signal, and V1b will be cut off because its cathode is more positive than its grid. The output, Ep2, will rise to the supply value, while the "inverted output," Ep1, drops to the same low value which existed at Ep2 previously.

The whole operation described above takes place in a matter of microseconds; capacitor Cc steepens the voltage change at Ep1 as seen by V1b's grid, to speed up operation even more. And once triggered, the circuit remains in this state so long as the input signal remains above trigger point. Additional increase in input signal has no effect.

The circuit can also be made to operate just exactly opposite to the manner described, so that V1a conducts in the "at rest" state and turns off when a negative-going input signal arrives. The only difference is that for this type of operation, Ec1 is set so that it is just slightly positive to Ek.

In practice, R1 and R2 are usually made up of a potentiometer (frequently with limiting resistors at each end) so that Ec1 can be varied over a range wide enough to allow either type of operation. When this is done, a 1-megohm resistor is connected between the potentiometer arm and the grid of V1a to maintain isolation of the signal and the biasing voltages, and Cin connects directly to the grid.

Note that the absolute sensitivity of the VT Schmitt is determined primarily by tube choice and next by the value chosen for R6, the common cathode resistor. Tubes requiring little voltage to cut off make the most sensitive Schmitts. The amount of voltage necessary to trigger the circuit will always be at least as much as the swing from zero to cutoff on the tube. The value of R6 will in turn determine the ratio of R2 to R1 + R2, to set Ec1, and the ratio of R5 to R3 + R4 + R5, to set Ec2. R3 and R7 should be equal, and should be chosen to obtain maximum voltage swing between "on" and "off" states while not requiring excessively high values for R4 and R5. The sum of R4 + R5 should be at least 10 times the value of R3.

Inability to make a Schmitt do its triggering may be due to a wrong ratio between R4 and R5, or to too high a value for R6. However, R6 must be large enough to ensure cutoff of the "off" tube with the current available.

Occasionally, if the values of R1 and R2 are far out of line, you can find a situation where the thing won't trigger but it *will* turn V1b on and off. In this case, V1a is acting only as a class A amplifier to drive V1b as a switch, and the intended regenerative switching action is lost. The remedy is to adjust the values of R1 and R2.

So much for the vacuum-tube version. Now let's look at its transistorized equivalent.

This circuit is shown in Fig. 2, and the similarity is apparent. The major difference is that our switching factor now is base injection current.

With no base injection current, a transistor remains cut off and collector voltage is equal to supply voltage. If enough base current is supplied to "saturate" the transistor, collector to emitter resistance drops to less than one ohm and collector voltage becomes effectively the same as that at the emitter.

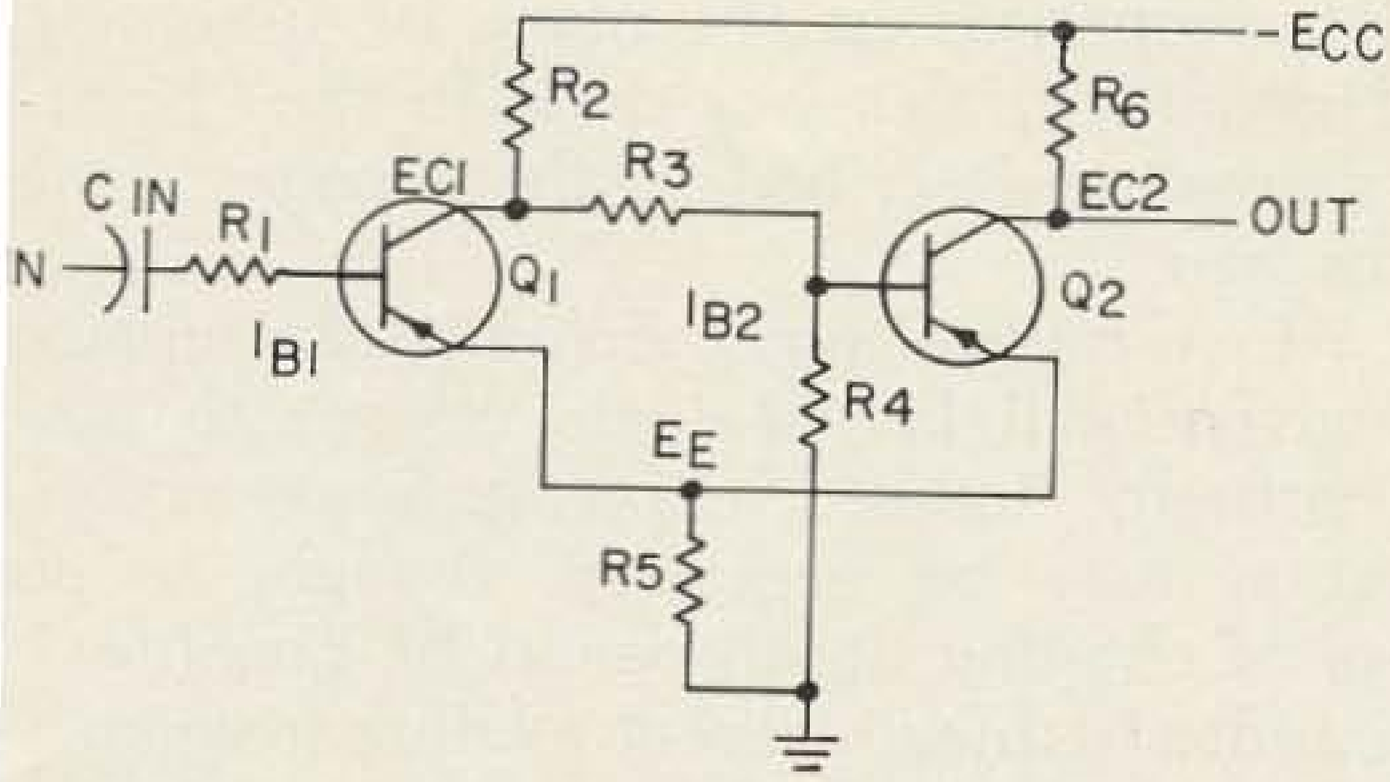


FIG. 2 TRANSISTOR SCHMITT

In the circuit of Fig. 2, with no input signal, Q1 receives no base current and so is cut off. Q2, on the other hand, receives base current through the series combination of R2 and R3. R4 bleeds off excessive current to ground, to prevent oversaturation of Q2. With Q2 saturated, the current through it is limited only by R6 and R5, and a definite emitter voltage (Ee) is developed by this current through R5.

This emitter voltage reverse-biases the emitter-base junction of Q1, which helps hold Q1 even more firmly cut off and maintains the input impedance of the circuit at a high value.

When a negative-going input signal greater than Ee comes in through Cin, the emitter-base junction of Q1 becomes forward biased and Q1 is no longer cut off. With Q1 conducting to even a small degree, the current through R2 has two paths to follow instead of merely one and thus the current through the R3-R4 path is reduced. This reduces the base current available for Q2, thus reducing the current flow through Q2 from collector to emitter. When the current flow drops, the current through R5 falls accordingly and Ee's value becomes less. Reduction of Ee by this action increases the amount of forward bias on Q1, which allows more current to flow through Q1 and in turn reduces the base current of Q2 still more.

Since this action is regenerative, the base current of Q2 rapidly drops to zero. Q1, by this time, is in saturation and Ec1 is only slightly greater than Ee. With no base current in Q2, this transistor is cut off and Ec2 rises to be equal to the supply voltage.

The situation persists as long as the input signal is present. Upon removal of the input signal, Q1 ceases to conduct and the base cur-current available for Q2 drives the second transistor from cutoff back into conduction, restoring the "at rest" conditions.

Since the voltage difference between base and emitter required for cut-off is on the order of only millivolts, rather than being in volts as with tubes, the transistor Schmitt is much more sensitive than its tube equivalent. In addition, since no grid-bias network on the input section is necessary, fewer parts are required.

These two dfferences make the transistor type more attractive for many applications. The only real disadvantage is the requirement for a negative power supply; a secondary item which might be considered a disadvantage is the inability to switch from negative-going to positive-going trigger input.

However, should triggering from positive-going signals be a requirement, it can easily be achieved by simply switching from the PNP transistors shown in Fig. 2 and using NPN types instead. Then the power supply would be positive in polarity also.

Adjustment of trigger voltage level is accomplished by varying R5, which typically is a 500-ohm potentiometer connected as a rheostat.

To design a transistor Schmitt, R2 and R6 are chosen to limit transistor current in the "on" or saturated condition. They should be equal in value. R5 is chosen for the desired trigger-voltage point, so that about ½ volt less than desired triggering is developed with the design current flowing through it.

Next, R3 is picked to deliver enough current to the base of Q2 (with Q1 disconnected) to ensure saturation of Q2, and R4 is then chosen to bleed off just enough of this current to prevent over-saturation. An empirical design technique is to make R3 10 times as large as R2, then use a pot for R4 and set it so that the voltage measured at Ec2 (with Q1 disconnected) is just barely higher than that at Ee. If R4 is too small, Ec2 will be too high; if R4 is too large, a small time delay may be introduced in the trigger action.

This procedure fixes all the resistor values except R1. This is a current-limiting resistor to protect Q1, and should be about 1,000 ohms for every volt of peak input signal expected.

A transistor Schmitt circuit published by General Electric uses the following values with type 2N396 transistors (PNP) supplied from a 12-volt Ecc: R1, 4700 ohms; R2 and R6, 1800 ohms; R3, 18K ohms; R4, 15K ohms, and R5, 560 ohms. This set of values switches at −5 volts signal input, and holds in until the signal rises to −2 volts. Output levels are −4 and −12 volts.

Another circuit developed at General Precision, Inc., uses type 2N1302 NPN transistors and a + 20-volt Ecc. Values for this one are R1, 4700 ohms; R2 and R6, 1500 ohms; R3, 18K; R4, 15K; and R5, 0-500 ohm adjustable. Input voltage ranges from 1 to 6 v rms, and the circuit can trigger on a 0.01-volt change in input level. Output levels are not specified.

Still another circuit, from G-E and using type 2N78 NPN units with a + 12-volt Ecc, uses these values: R1, 1K; R2, 3300 ohms; R3, 1800 ohms; R4, 6800 ohms; R5, 5600 ohms, and R6 2200 ohms. Turn-on point is at 6.8 volts input, and drop-out occurs when the input signal falls to 5.2 volts. Output swing is only from 12 to 10 volts as a result of the high resistance value at R5 and the lower value of R6 (as compared to R2). However, this circuit was designed to operate at 1 mc, a rather high frequency for transistor Schmitts. The other circuits described operate well up to 500 kc but begin to fail above this point.

Now that we've seen how the Schmitt works, let's see how it can be used in practice. Let's assume that we want to limit the audio output of a receiver to a definite value, say for CW reception.

A transistor Schmitt, using the circuit of Fig. 2 and the parts values given for type 2N1302 transistors, but using 2N107's or better yet 2N404's instead (with consequent − 12 volt Ecc instead of + 12) will do the trick. Simply connect Cin to a phone plug and plug it in in place of your phones. Connect the phones, then, across R6, either with or without a blocking capacitor in series.

Any input signal will be squared off top and bottom by the Schmitt, giving the same level of output. Because of the amplification provided by the Schmitt in addition to its limiting duties, you can run the receiver gain controls far enough down to have little trouble from QRM or QRN. However, the gain controls won't affect the loudness of the signal in the phones. To reduce the signal somewhat, reduce Ecc (with a potentiometer across the battery if you like).

The fact that you're listening to a square wave instead of a sine wave won't be particularly bothersome; the note will sound "richer" but will otherwise be unaffected. The difference will be that now the kw down the block won't be any louder than the weak YC4 you're digging for!

For RTTY, the Schmitt can be used the same way as a limiter ahead of any conventional TU. Even better use for the Schmitt's peculiar properties can be made by designing a TU around it; this was done in the "Errorless" converter described in these pages some months ago.

In a fone transmitter, a Schmitt can replace the conventional biased-diode clipper to produce virtually "infinite" clipping. Some experimentation may be necessary, though, as no control of clipping depth would be possible.

An audio-frequency direct-reading frequency meter can easily be built around the Schmitt, since it converts incoming sine waves to square waves. The frequency can be determined by differentiating these square waves through a short-time-constant RC network, then using the narrow spikes to actuate a microammeter. Deflection of the microammeter needle will be directly determined by the frequency at which the spikes appear, which in turn is determined by the frequency of the sine wave input.

And if you like to test audio equipment with square-wave input, a Schmitt between your sine-wave oscillator and the audio gear will give you the square waves at any frequency you like.

These are only a few uses of the Schmitt. Some others depend on the fact that the output load resistor, R7 in Fig 1 and R6 in Fig. 2, need not necessarily be a resistor.

If a relay coil is substituted, the relay will operate every time the output half of the stage conducts, and will release the rest of the time. Thus a 10-millivolt input level change can be made, through the Schmitt of Fig. 2, to operate a relay which in turn operates a heavy-duty contactor to turn on or off a multi-kilowatt power supply. How about this for overload protection of your final, in conjunction with a cathode resistor across which a control voltage for the Schmitt would be developed?

Similarly, a loudspeaker coil may be used in place of the output resistor; with normal tubes or transistors, you'll get plenty of volume. Using phones here will probably give far too much sound for even the deafest of us.

At any rate, the usefulness of the Schmitt circuit is limited only by your imagination and by your understanding of how the circuit works. We've tried to help in the latter department. The former is up to you!

. . . K5JKX

Answers to IQ Test on p. 73

Shack 1	Shack 2	Shack 3	Shack 4	Shack 5
RTTY	VHF	LID	DX'er	RCC
YELLOW	BLUE	RED	IVORY	GREEN
COMMUNICATOR II	PROCEEDING OF THE IRE	IoAR	CHC	DXCC
73	ARRL	DX-20	KWM-2	ARC-5
M.H.S.F.T.P.O.S.O.T.E.M.B.	HOMEBREW	QST	CQ	PLAYBOY

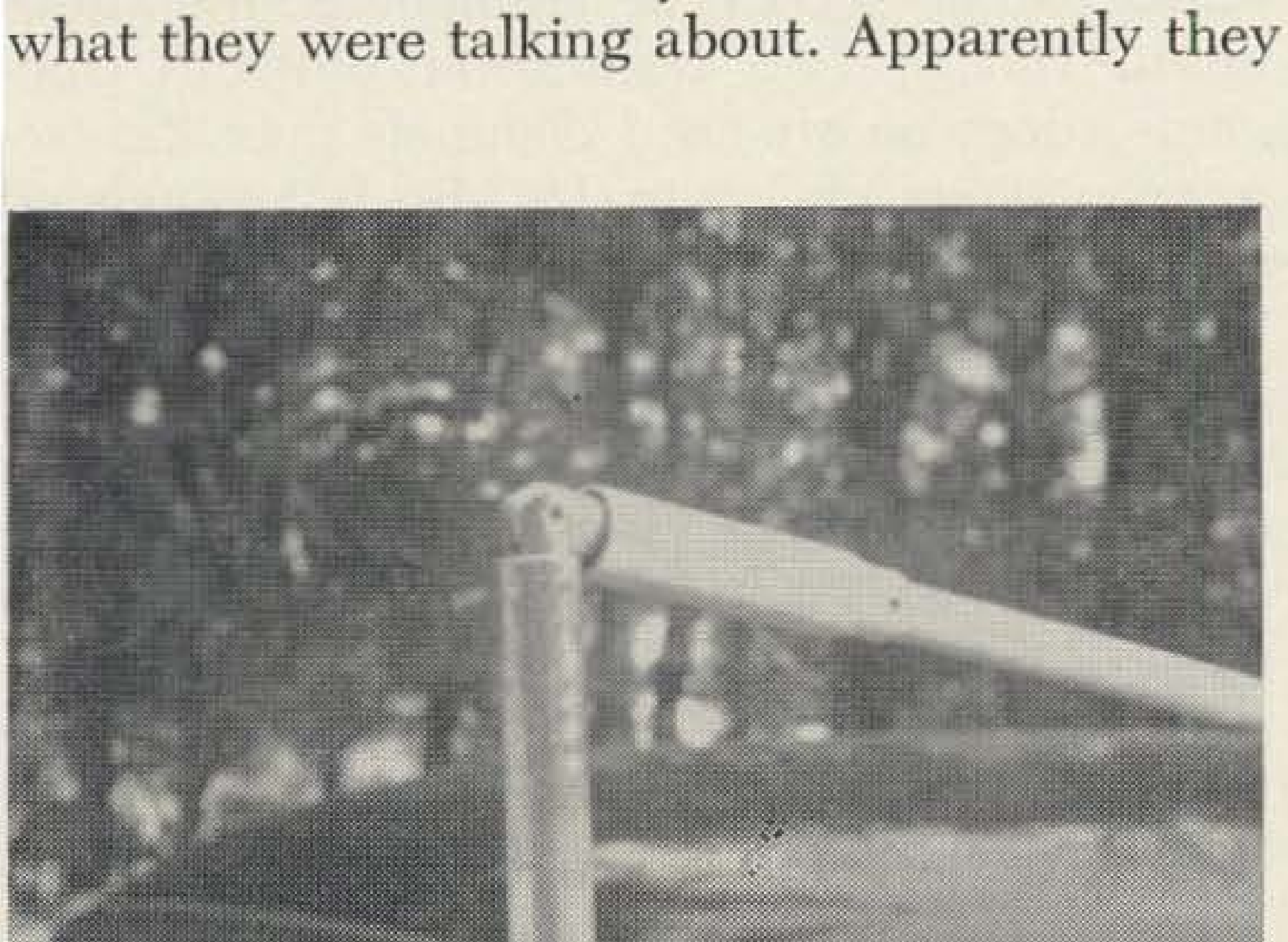
73 Tests The Waters Mobile Whip and a Mercedes 300

Wayne Green W2NSD/mobile 1

Those of you who have been following my mishaps down through the years know that along in 1957 I discovered the Porsche. Well, I've still got my original Porsche and it is a lot of fun, despite a bookful of difficulties with the factory and their dealers. But somehow, up here in New Hampshire where the distances are far and the weather is cold half of the year, it seemed prudent to go for something sedanish, with perhaps some room for a rig.

A Mercedes 300 seemed to best fit my retiring personality, so I inveigled the bank into buying me one. One of our advertisers had a special on SB-33's. After some wheeling and dealing I ended up owning a 33 and still had a little of 73 left in my name.

Waters Manufacturing had just recently announced their new mobile antennas so it seemed reasonable to try one of them and see what they were talking about. Apparently they are in very great demand for it wasn't easy to locate one. I finally rounded up an 80 meter top section and the fold-over bottom unit.



Close-up of joint.

The lower mast looks and feels like it will withstand just about anything. It is made out of aircraft aluminum tubing and has a very clever fold-over arrangement. To fold it over all you have to do is lift the upper section which fits snugly over the bottom. The two are fastened together so they can't come completely apart, but just far enough to expose the joint for folding.

The coil unit is encased in black epoxy and is striking to see with its particularly identifying white stripe near the bottom. I don't think that rain, sleet, or anything short of a rather hefty steam-roller will affect the coil.

The top whip is made out of tapered stainless steel and can be adjusted according to a chart that comes with the antenna to tune over any portion of the band you choose. I set mine for the high end and the SB-33 tuned up into it with no problems.

Frankly I've worked out with this setup a lot better than I ever expected, considering the relatively low power of the rig. While putting around up here in New Hampshire I've talked with fellows all over the midwest and down to Florida. It is really great to be mobile again and to be back in contact with the hundreds of old friends on 75.

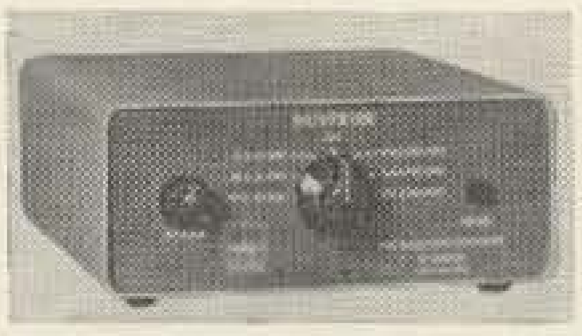
New Products

Clegg 22'er

Clegg's new 22'er 2 meter transceiver has many interesting features. The receiver uses a Nuvistor g. g. rf stage for high sensitivity and low noise figure, tunable 1st and 2nd *if*'s and bandpass circuits for excellent rejection of spurious signals. The 3rd *if* is crystal controlled at 455 kc for good VHF selectivity. Other features of the receiver are squelch, ANL, 2 watts of audio and excellent AGC. The transmitter runs 20 watts input to a 2E26. Plenty of drive is furnished with broadband exciter stages for easy QSY'ing. The final tank is tapped down to improve efficiency. A built-in tvi-itv filter is included for both transmitting and receiving. High level plate and screen modulation, a spotting switch and PTT with switching for an external VFO or linear are other features. The meter serves for signal strength on receive and relative output on transmitt. 115 vac and 12 vdc power supplies are provided. Price is $239.50. Squires-Sanders, Martinsville Road, Liberty Corner, Millington, N. J.

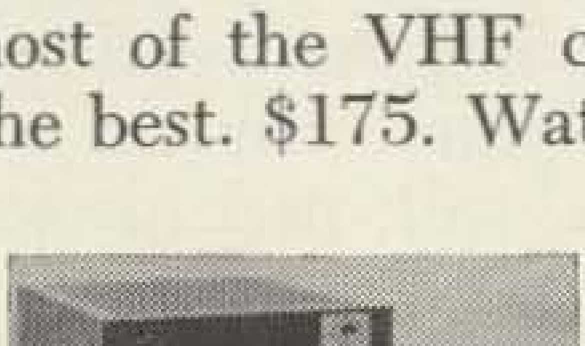
Amitron RF Toroid Kit

Amitron is known among hams chiefly for their ingenious EZ Etch printed circuit kit. It makes printed circuits as easy to make as possible. Now they've come out with another very clever kit. It's the Signal RF Toroid Kit. You've been wondering where to find toroids with known characteristics for some of your projects. Here's where. The kit contains two small toroids designed for use between 1 Mc and 60 Mc, plenty of wire and instructions and application notes. The notes make it easy to find the proper number of turns for the inductance (and frequency) you want. Among the many uses for the toroids are: tanks, pi networks, baluns, rf transformers, bandpass filters, multiband tuners, loading coils, traps, VFO's, etc. Amitron Associates, 12033 Otsego St., North Hollywood, Cal.



Waters Nuverter

Waters sent us one of their Nuverters to check. It's a very fine piece of gear—just what you'd expect from them. It covers 50.0-51.8 Mc and 144.0-145.8 Mc with 28.5-29.1 Mc output. The power supply is built in, but provision is made for an external supply if you want to use the Nuverter mobile. The all Nuvistor circuit produces a sensitivity of less than .1 μv and the noise figure is less than 3.5 db on 6 or 4 db on 2. The most outstanding feature of the Nuverter is its freedom from images and other spurious signals that plague many other high gain, low noise units. Waters uses very careful shielding and filtering and numerous bandpass circuits to accomplish this. There is even a connection for external AGC if you want to use it. That plus the built in gain control provide excellent protection from overloading and attendant cross-modulation. The unit is very small (2¾ × 6½ × 7½), well built and attractive. The front panel is reversible for vertical or horizontal mounting. We've tried most of the VHF converters and this is one of the best. $175. Waters, Wayland, Mass.

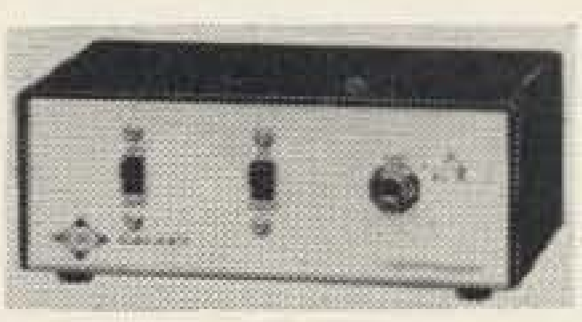


RF Communications SSB Transceiver

R F Communications has announced a new single sideband transceiver for teletype, facsimile and CW applications as well as voice transmission. The power rating of the Model SB-6FA is 125 watts PEP and average in continuous duty service at ambient temperatures up to 150°F. This transceiver provides communications on six fixed channels over the frequency range of 1.6 to 16 Mc. It is intended for commercial and government applications, and makes possible reliable communications over distances of 25 to 1000 miles. Stability is better than one part per million, which is ideal for FSK applications and makes possible extended use in phone service without the need for tuning and adjustment by an unskilled operator. R F Communications expects to find widespread interest in this new SSB transceiver among its government customers in the United States, as well as its many government, military and industrial overseas customers. List price on the SB-6FA is $1600. RF Communications, 1680 University Ave., Rochester, N. Y.

Ameco 6 and 2 Transmitter

Ameco's new TX-62 6 and 2 meter transmitter looks mighty nice. It's complete with modulator and solid state power supply in an attractive, well ventilated 11½ × 9 × 6 in. cabinet. It covers all of 6 and 2 and uses either 8 Mc crystals or an external VFO. The final tube is a 7984 Compactron designed for VHF use with 35w place dissipation. The modulator is a 6GK6. The transmitter is TVI supressed. The final grid and cathode, and output are metered. Controls: power, AM-CW, meter, band, crystal/VFO, audio gain, drive pot, and final tuning and loading. Mike/key jack is on the front panel. The price is only $149.95 wired and tested. Ameco Equipment Co., 178 Herricks Rd., Mineola, L.I., N. Y.



Galaxy Compression Amplifier

Galaxy's new Compression Amplifier will compress and amplify your voice up to 30 db to give you much more talk power. Adding the compressor will increase communications distance considerably on transmitters without ALC. It's completely transistorized, compact and complete. Power is supplied by a 9 volt battery. The compression amplifier is wired for PTT and no additional plugs are required. Size: 2¾ x 6¼ x 3¾. Amateur net price, $24.95. An optional AC supply is available for $6.95. Galaxy Electronics, 10 South 34th Street, Council Bluffs, Iowa.

Panco HV Supply

Need 1500 volts dc for a scope, piv tester, photoflash unit, etc.? Panco has a new high voltage power supply that is only 4¾ × 5¾ × 3½ and fits in a standard chassis. It puts out 1500 vdc, 6.3 vac and 3 adjustable voltages for a scope. It has a relay discharge to prevent it from shocking you, too. $29.80. Panco Electronics, P. O. Box 66139, Los Angeles, Cal.

Poly Paks Flyer

Poly Paks new 1965 eight page flyer lists many interesting bargains in semiconductors and other electronic components. Be sure to get your copy. Poly Paks, P. O. Box 942. South Lynnfield, Mass.

Newtronics Antennas

Newtronics has released a new bulletin NT-106 listing of their new base station and mobile antennas. It gives complete information on the Coveya 6, the 2 band mobile antennas for 6 and 2 and the Hustler hf mobile antennas. Get your copy from Newtronics, 3455 Vega Avenue, Cleveland. Ohio.

Coaxial Switches

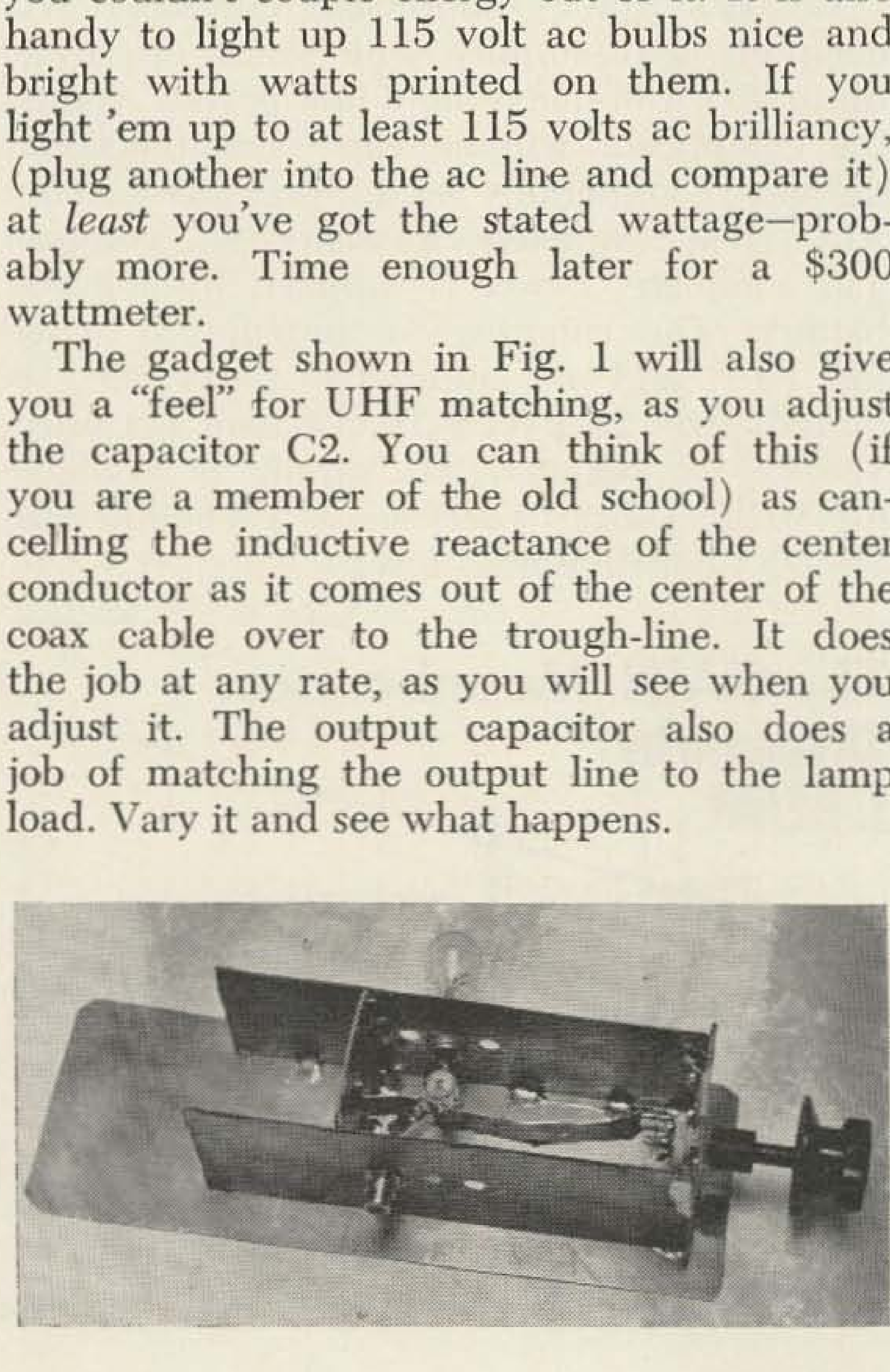
Dow Key, who most of us know through their coaxial relays, now have four different manual coax switches available. The switches are 3" in diameter and 1⅛" deep. The 1P2T and 1P3T switches sell for $12.75 and the 1P6T and transfer switch sell for $15.75. All switches come normally with UHF connectors, though N, BNC, TNC and C connectors can be had at a slightly higher price. The switches are rated at 1 kw to 500 mc and are 50 ohms. For more info write to Dow Key or see your local distributor and ask about the DK78 series switches. Dow Key, Thief River Falls, Minn.

Bill Hoisington K1CLL
Peterborough, N. H.

Low Cost UHF Power Load

An oscillator would not be much good if you couldn't couple energy out of it. It is also handy to light up 115 volt ac bulbs nice and bright with watts printed on them. If you light 'em up to at least 115 volts ac brilliancy, (plug another into the ac line and compare it) at *least* you've got the stated wattage—probably more. Time enough later for a $300 wattmeter.

The gadget shown in Fig. 1 will also give you a "feel" for UHF matching, as you adjust the capacitor C2. You can think of this (if you are a member of the old school) as cancelling the inductive reactance of the center conductor as it comes out of the center of the coax cable over to the trough-line. It does the job at any rate, as you will see when you adjust it. The output capacitor also does a job of matching the output line to the lamp load. Vary it and see what happens.



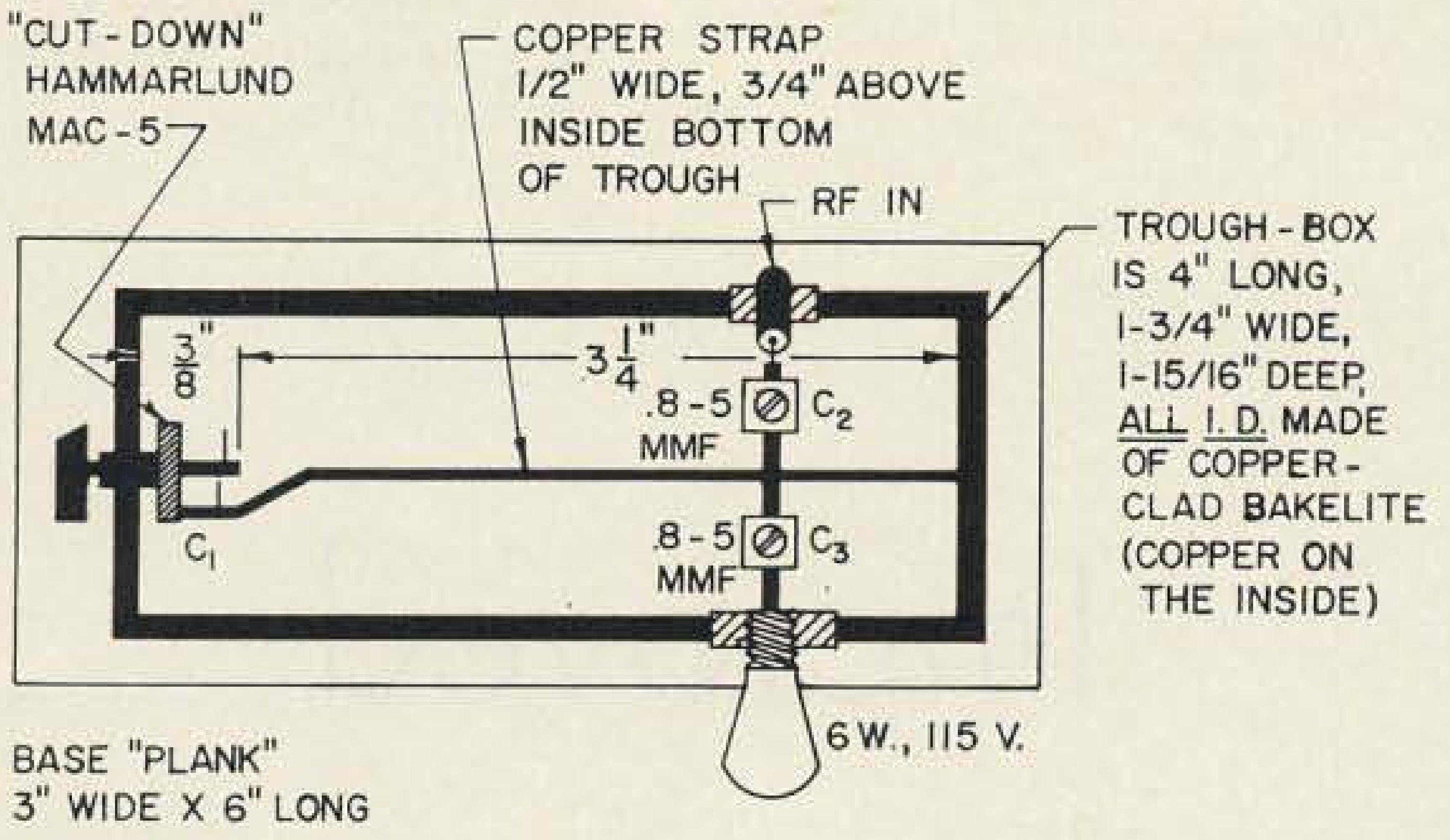


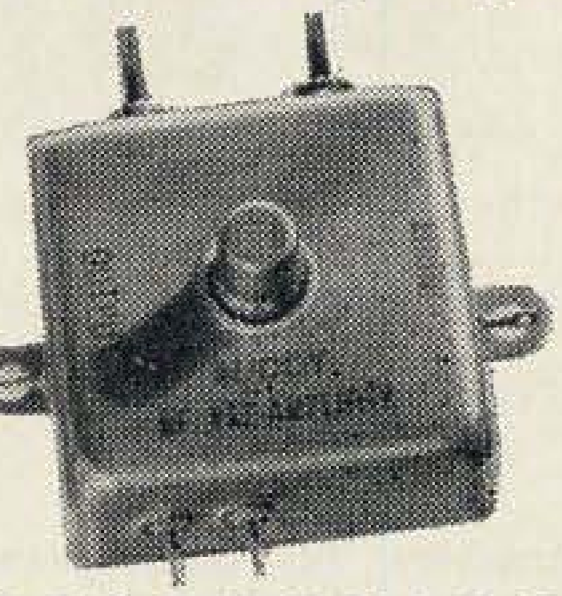
Fig. 1—Visible UHF power load, 6 watts. (At least!)

The trough line itself can be made of my old favorite material, copper-clad bakelite. If you make it exactly as shown, it will tune from near 400 to 500 megacycles. Of course, you can shorten it a little and use a larger capacitor for greater tuning *range*.

The bulb shown is a 6 watt one, and works OK—at least up to 650 megacycles. You will find quite a variation if you have leads on it. Not every type of bulb works at these frequencies. Reminds me of my two meter kilowatt, (1950) (the one that fell down 64 feet, along with my tower-shack, in the Kitty-Demise Mountains) using a pair of surplus VT-127A's. Bought a nice shiny new 500 watt bulb and looped it into the main plate lines. Did it light up? Sure, with a big fat purple arc inside! I finally had to use five 100 watters, *each* with it's own loop. I used porcelain sockets, loose on a plank under the plate line. By moving them around with a long stick, I could get them all to light up at once, full brilliance. 500 watts! At least!

Another interesting point of experimentation that can be done with the oscillator and this load concerns (A), the interlocking effects of the variation of the amount of coupling obtained between two tuned circuits produced by the Q (figure of merit) of the circuits, and (B), the Q variation brought on by varying the coupling when the loads are matched. Try unloading the lamp from the tuned circuit by decreasing C3, returning C1, and you will find the best match. L2 must be adjusted while doing this of course. Another thing of interest, but don't say *I* suggested it: Try putting some steel wool (extra-fine) in the trough-line near the high voltage end. See what happens and guess why. Or even look it up in the books, if you can find it. Have fun.

. . . K1CLL



Jack Ayres K3JZH
325 Washington Ave.
Jermyn, Pa.

Improved Halo Mount

If you've ever had a halo on your car you're aware of the snickers generated by its unsightly appearance as well as the project of removing it whenever the car is run through an automatic car wash. Determined to minimize both of these complications, I evolved the installation shown below. It not only represents a drastic improvement in the looks department but can be removed in less than a minute (with a pocket screwdriver), costs much less than the usual bumper mount and is not subject to destruction in minor rear end collisions.

The heart of the installation is a flag mount of the type used on the stern of fancy boats.

Any marine shop has them at an average of $1.75 and they conveniently accept a ¾" OD mast with a nice press fit. The only modification recommended prior to bolting it on your car is to drill and tap the "snoot" to accept one or two set screws of the type used in radio knobs. They will keep the mast from turning no matter how enthusiastic your driving may be yet are small enough to prevent accidental crushing of the mast due to overtightening.

The bottom of the fixture is open so if a hole is drilled in the car to line up with it the co-ax can be fed from inside the car through the mount, up through the mast to the top where it is brought out and connected to the antenna. The top of the mast should be sealed off around the co-ax with epoxy to prevent water from getting in and a rubber gasket placed between the base fixture and the car for the same purpose. A little Amphenol Silicon Compound smeared on the part of the mast that fits down in the fixture completes the waterproofing. The fixture serves as a template when cutting the gasket as well as in marking the car body for the three holes required to anchor it. Inner tube scrap is ideal material for the gasket.

To permit removing the mast and antenna as a unit a coupling is installed in the co-ax. There are probably a number of suitable possibilities but be sure the fitting on the antenna side of the line is small enough to fit through the base fixture. I used a pair of phono plugs joined with a double female Switchcraft fitting and although they are not intended for rf no difficulty has been encountered.

A word of caution: When selecting a location for the base make certain it will provide vertical positioning of the mast before drilling the car. Inasmuch as the fixture's "snoot" is angled a variety of locations will be possible. (By simply rotating it vertical alignment as viewed from the front and rear will be obtainable almost anywhere). If the spot you select yields a slight mast angle when viewed from the side just bend the top of the mast to restore the halo to horizontal. Inclination toward the front or rear is quite acceptable aesthetically.

This installation has been in use about three months for both the Cushcraft FM Halo shown in the photo and, alternately, a separate 2 meter halo with its own mast. Although a Saturn 6 could conceivably be burdensome to a ¾" mast, the mount should cope with any of the single-hoop 6 meter halos quite easily.

. . . K3JZH

W2NSD from p. 4

Harry Dannals was elected ARRL Director of the Hudson Division and I'm absolutely disgusted with every one of you for letting such a ghastly thing happen. He won by twelve lousy (exceedingly lousy) votes. Lotsa luck, Hudson Division. If the ARRL survives Harry you will have a chance to bail yourselves out of this terrible mess in 1966.

FCC Regulations

The new FCC view on call letters following station operators rather than the licensee of the equipment being used as disclosed in my January editorial has caused considerable comment. I knew it would.

A letter from Perry Williams W1UED, Assistant Secretary of the ARRL, is entertaining in its avoidance of the obvious. "The Commission now says that if you visit my station while I'm there, we have a choice as to whether you use my calls or yours as portable; if you visit when I'm not there (unless I'm listening in my mobile rig) you *must* sign your call as a portable." I suggest that Perry read the direct quotes of the FCC pronouncement that I published in January for what he says is *not* true. You must be in control of station if it is used with your call letters. This means that you must be able to turn it on and off yourself. Obviously this is impossible from your mobile rig.

Perry goes on to say, "The current FCC interpretation is a new and arbitrary one we think, as it flies in the face of previous FCC decisions and policies, copies of which we have on hand. Therefore we have not accepted it as actual FCC policy; it creates far too many problems for amateurs." How about that? ARRL has decided not to accept FCC policy because they don't agree with it. Perry goes on to say that the ARRL counsel is going to try to fight this out with the FCC because it will bring great problems to ARRL on such items as DXCC, where, according to the new FCC pronouncement, a DX operator could visit a nearby friend with a better station and rack up more countries than he could at home. I do hope that the FCC is able to eventually convince the ARRL who is currently making our rules for us.

RM-499

Though it is being kept under close wraps, the word from several sources is that the FCC is finally getting ready to act on this catastrophy. As I understand it, the Amateur Division has hashed over all of the material in the files and come up with a proposal which is in the hands of the Commissioners. The probability is high that they will go along with whatever has been suggested. The contents of this proposal are rumored to be quite shocking and to affect *all* grades of licenses. There may be a change of plans again as there seems to have been last year, but all indications are for a release in early March . . . probably immediately after our April issue goes to press.

Midwest VHF Meeting

There will be a two day VHF meeting at the Holiday Inn, Sioux Falls, S. Dakota on April 10-11 complete with speakers, banquet, etc. Write Box 400, Sioux Falls, S. D. for details and tickets ($5 each).

Reciprocal Licensing

The passing of the Reciprocal Licensing Bill was the first step toward our being able to operate in other countries. Now we still have to make the agreements with the foreign countries and this has to be done through our State Department. You can do something concrete to help this little program along if you will volunteer yourself to make the effort required. Pick a country and start writing letters.

In every U. S. embassy there is a Counselor of Embassy for Economic Affairs. Under this person is the Commercial Officer and any matter under the head of "communications" falls to him. This is the man to contact. You should provide him with the following:

1. A copy of P.L. 88-313 (obtainable from the Government Printing Office).

2. A copy of the suggested language of the agreement. (The Government Printing Office will eventually have a copy of the Costa Rican agreement which will give you the formal language.)

3. The dates and numbers of all unclassified messages sent by the State Department to foreign posts regarding the matter (write the Treaty Branch of the State Department for this).

4. A written statement detailing:
   a) Explaining in detail what the agreement proposes to do.
   b) Show how the agreement will work to the advantage of the U. S. ham . . . large numbers of U. S. hams who travel compared to much fewer foreign hams who might come to the U. S. A.
   c) Cite the good will that will result from the U. S. letting down its barriers to foreign hams operating in our country, including increased travel by ham-tourists to the U. S.
   d) Explain that all U. S. government agencies have approved the language of the bill.

Do not try to deal directly with the telecommunications section of the foreign government. Get the national radio club of that country to work on their own government. Between your efforts with our government and theirs with their government we may see reciprocal licensing become a fact instead of a promise.

If just a few fellows would take on the responsibility of seeing this through we would have quite a number of countries signed up within the next year or so . . . and we might find that this would help us considerably when we sit down with them at Geneva.

All those who don't volunteer please stay seated.

DXpedition

Brandy Ward WB6DL is looking for an amateur (or two) to accompany a group of twelve that will cover some 5000 miles of Canadian wilderness this summer, including over 2000 miles down the Mackenzie River to the Arctic Ocean in canoes. The cost of the whole trip will run about $700 which will include all meals, transportation and hotels. The trip starts at Edmonton and ends at Seattle, lasting about six weeks, including a reindeer roundup on the Arctic coast, travels with Eskimos out on the ice fields, Dawson in Yukon Territory, Fairbanks, Alaska, Mount McKinley National Park, Juneau, etc. Ham gear they've got, operators they need. Write to Ward, San Clemente High School, San Clemente, California, where he teaches. This is a trip that one will never forget, that's for sure. I'd like to make the scene myself, but how do I get away for six weeks?

African Troubles

The RSGB reported last month that it had been planned that observers from Region 1, IARU would be present at the African LF/MF Broadcasting Conference which opened in Geneva in October 1964. They had planned to discuss amateur radio problems on a long term basis with the government delegates present from the new and developing African countries. After checking around with responsible parties they gave up the idea. Sure enough, the conference was abandoned after only four days, the first ITU conference ever abandoned, as a result of political issues raised by the delegates.

Swampscott

The Dayton Hamvention and the Swampscott affair are the two biggest conventions in ham radio. Since the Swampscott convention is within easy driving distance of the 73 HQ

See page 92.

all of our staff will be there as usual. I've been trying to think up something unusual to do this time which might make it interesting for those of you that will be there.

So far we've had almost twice as many subscriptions this January as last January. Now I'd like to have that delightful situation keep up so I'm planning to have a real special deal for those of you who subscribe at the convention. I'm planning on having a big table full of back issues so that every one who subscribes at the convention can pick up as many of the back issues that he is missing as he wants at no charge. Talk about something for nothing. . . . I shudder to think of the armloads of back issues we'll see leaving. Why do I think up ridiculous things like this that I will kick myself for later?

See you at Swampscott April 24-25th?

Chef Green

One of my hobbies is cooking, as anyone who has seen my collection of avoirdupois can testify. I won't bug you with my special wine receipts, but you might give a try to a simple little concoction I modestly call Green's Ambrosia. A glass of this on the operating table will steady the nerves when that scoundrel on the other side of town gets the DX station you've been calling. Mix (a blender, if you have it) one small can of frozen orange juice concentate, five cans of water, 1/3 cup of sugar and a generous scoop of vanilla ice cream. Chill.

Jamming

A paper being circulated clandestinely in Europe calls for amateurs to jam the broadcasts of short wave stations operating inside the amateur 40 and 80 meter bands. It cites in particular the transmission of ARK, Pakistan on 7008 kc, Peking on 7019 kc, Cairo on 7050 kc, China on 7080 kc and the USSR on 7100 kc.

All of these stations are transgressors and are operating in defiance of the UIT agreements. With the exception of China we should be able to put considerable pressure on these stations through regular political channels. If U. S. amateurs would send official complaints to the FCC and European amateurs would originate official complaints through their governments it is quite likely that these transmitters would be moved.

I do believe that our taking of the law into our own hands will lead more to our demise at Geneva than the removal of broadcasting stations illegally in our bands.

. . . Wayne

QUESTIONNAIRE

Answers may be written on a postcard or letter if you don't want to destroy the resale value of your magazine. Equipment in use at my station (make and model):

A. Transmitter(s) (exciters, linears, etc.):
B. Receiver(s) (and converters):
C. Transceiver(s):
D. Accessories:
E. Antennas:
F. Mobile:
G. Tower:
H. Rotator:
I. Major test equipment:
J. Other:
K. How many people normally read your copy of 73?

CAVEAT EMPTOR?

We've had so many requests from 73 readers for a want ad section that we're starting one—against our better judgment. After all, we're dreadfully overworked now and are bound to have even more of a headache handling all those tiny ads. But you say you want it, so please follow these instructions when you submit ads:

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

PRINTED CIRCUIT BOARDS. For many different projects. Hams, Experimenters. Send for catalog 10c. Dealer inquiries invited. P/M ELECTRONICS. Box 6288, Seattle, Washington 98188.

FOR SALE: Ranger 1, $140, Hallicrafters S-40B, $50, Globe Scout 65B, $40, National NCX-3 and NCX-A, $350. All in excellent condition. K1APA, 3 Sunny Acres, Brattleboro, Vermont.

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

WANTED: All types, military, commercial, airborne, ground, electronics items-testsets, GRC, PRC, Collins, Bendix, others—We pay freight. RITCO. P.O. Box 156, Annandale, Va.

SPECIAL in new and used amateur gear. We have it at an exceptional savings. Write or call Bob Grimes, 89 Aspen Road, Swampscott, Massachusetts, 617-598-2530.

CLEGG 22'er never used $195.00. Also new 44 element Cush Craft quad for 2 m. $65.00. Send check to Jerry Hirsch, 215 California Dr., Williamsville, N. Y.

NATIONAL NCX-3 and NCX-D power supply, both units in very clean condition, and operate perfectly. Late serial numbers. Priced for fast sale. $300.00. WA2OHN.

UNIT 6, 10 kc step generator of SRT14 synthesizer, new, less tubes, w/schematic, $8.00 Postpaid Check w/order. RITCO P.O. Box 156, Annandale, Va.

LICENSE PLATES wanted, old amateur radio types, for collection. Postage refunded. Tnx, Mike, WA4QED, Box 14, Milan, Tennessee.

COMPLETE SHACK—National NC-98 rcvr, Vmtr Viking II, Heath Kit VF-1, VFO, Pre-Selector RME, DB-23, Speech Clipper RME, Q-Multi, like new, in operation $325.00 W2JGQ Isaacs 231 East 11th St. N. Y. 3.

COLLINS Mechanical filters—455kcif, sixteen kcbw $12.00, eight kcbw $14.00—Pair eight and sixteen $23.00—Postpaid send check, Steve Ritter, 1422 Valleycrest Blvd., Annandale, Va.

JOYSTICK ANTENNA—All bands eighty thru ten to one KW. No traps or coils. Complete with tuner $24.90. Garland Electronics Associates, P. O. Box 1222, Garland, Texas.

HEATH APACHE—HE45B (see Feb. 73) with HE61A VFO—Saturn 6 halo and bumper mount—Gonset G33 all-band receiver. All Excellent with manuals. Best reasonable offers, no trades. K1TAX, Turtleback Road, Wilton, Conn.

RME 126, 152; Seneca; 2 & 6 Beams, 22' Booms; B & W 5100/51SB Best offers. Cliff Junkins W1UWX, 36 Carlton St., Holyoke, Mass.

SRT-14 Synthesizer units 8, 9, 10, 11A, 11B—new, less tubes—no schematic—$8.00 each or three for $20.00. . . RITCO P.O. Box 156, Annandale, Va.

WANTED: AN/TCC-3 units AM/682 and TA-219. AN/GRC sets and parts; AN/GRC-3-3, 4, 5, 6, 7, 8, 9, 10, 19, 26, 27, and any others. All PRC, PRR, VRC, VRQ, etc. All ARC sets, including AN/ARC-27, 33, 34, 38, 44, 52, 55, 57, 58, 66, and 73. AN/ARA, ARN, Collins, Bendix Aircraft Sets, R-220, R-388, R-390, R-391, SP-600. Military Test Sets AN/UPM, URM, USM, SG, ARM, etc. Metascope night viewing type equipment. AN/APR-9, 13, 14, 17, etc. Military equipment catalogs showing pictures and description of radio, radar sets, etc. We pay top prices. Technical Systems Corp., 42W. 15th St., NYC 10011. Call Ed Charol Collect.

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PNP 30 Watt, 2N155, 156, 235, 242, 254, 255, 256, 257, 301, 392, @ 35c, 4 for $1
PNP 2N670/300Mw 35c @, 4 for $1
PNP 2N671/1Watt 50c @, 3 for $1

PNP 25W/TO 2N538, 539, 540, 2 for $1
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PNP/TO5 SIGNAL 350Mw 25c @, 5/$1
NPN/TO5 SIGNAL IF, RF, OSC 25c @, 6 for $1

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DC AMP	50Piv 35Rms	100Piv 70Rms	150Piv 105Rms	200Piv 140Rms
3	.08	.14	.17	.24
12	.30	.55	.70	.85
18*	.20	.30	.50	.75
35	.70	1.00	1.50	2.00
100	1.65	2.05	2.50	3.15
240	3.75	4.75	5.75	8.75

DC AMP	300Piv 210Rms	400Piv 280Rms	500Piv 350Rms	600Piv 420Rms
3	.29	.30	.40	.48
12	1.00	1.35	1.45	1.70
18*	1.00	1.50	Query	Query
35	2.15	2.45	2.75	3.33
100	3.75	4.60	5.50	8.00
240	11.70	17.10	23.94	29.70

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2 to 3 Amp Studs up to 600Piv 6/$1
35 Amp Studs 150 to 200Piv 5 for $5

"TAB" * SILICON 750MA DIODES

NEWEST TYPE! LOW LEAKAGE

Piv/Rms	Piv/Rms	Piv/Rms	Piv/Rms
50/35	100/70	200/140	300/210
.05	.09	.12	.14
400/280	500/350	600/420	700/490
.15	.19	.23	.27
800/560	900/630	1000/700	1100/770
.35	.45	.65	.75

GTD ALL TESTS AC/DC & LOAD!

1700 Piv/1200 Rms/750 Ma/$1.20 @, 10/$10
Same 1100 Piv/770 Rms 75c @, 16/$11
3 Kv/2100 Rms/200 Ma/$1.80 @, 6/$10
6 Kv/4200 Rms/200 Ma/$4 @, 3/$9
12 KV/8400 Rms/200 Ma $8 @, 2/$14

SCR—SILICON CONTROL RECTIFIERS!

PRV	7A	16A	PRV	7A	16A
25	.60	1.00	260	2.70	3.00
50	1.00	1.35	300	3.00	3.45
100	1.60	2.15	400	3.75	3.90
150	1.95	2.45	500	4.75	4.80
200	2.20	2.80	600	5.45	5.65

UNTESTED "SCR" Up to 25 Amps, 6/$2
Glass Diodes IN34, 48, 60, 64, 20 for $1

Two RCA 2N408 & Two Regulators RCA IN2326 on prtd ckt. 30c @, 4/$1

"TAB" THAT'S A BUY

"TAB" Tubes Factory Tested, Inspctd. Six Months Guaranteed! No Rejects! Boxed! GOVT & MFGRS Surplus! new & Used

Low Prices! New XMTTG Tubes!

4-65A	$7.00	4X150A	$6.75	OB2	.55
4-125A	15.00	826	Query	5R4WGA	3.50
4-400A	25.00	829B	7.20	24G	Query
4-1000A	75.00	872A	3.50		
		OA2	.65		

We Swap Tubes! What Do/U Have?

0A3	.80	5R4	1.00	6F7	.99
0C3	.70	5T4	.90	6F8	1.39
0D3	.59	5V4	.89	6H6	.59
0Z4	.79	5Z3	.89	6J5	.59
1L4	.82	6A7	1.00	6J6	.59
1R4	5/$1	6A8	.99	6K6	.59
1S4	.78	6AB4	.59	6L6	1.19
1S5	.68	6AC7	.72	6SN7	.72

Send 25c for Catalog!

1T4	.85	6AG5	.65	6V6GT	.90
1T5	.95	6AG7	.75	12AU7	.69
1U4	6/$1	6AK5	.69	12A6	.45
1U5	.75	6AL5	.55	25L6	.72
2C39A	Q	6AQ5	.66	25T	4.00
2C40	5.50	6AR6	1.95	28D7	.89
2C43	6.50	6AS7	3.49	50L6	.59
2C51	2.00	6AT6	2/$1	83V	.95

We Buy!		We Sell!		We Trade!	
2D21	.65	6BA6	.59	250TL	19.45
2K25	9.75	6BE6	.59	VR92	5/$1
2K28	30.00	6BK7	.99	388A	3/$1
2V3	2/$1	6BQ6	1.19	4'6B	16.00
2X2	.48	6BY5	1.19	450TL	43.00
4X250B	30.00	6BZ6	.91	8'3	9.95
5BP4	7.95	6C4	.45	815	1.75

Top $$$ Paid for All Tubes!

"VOLT-TAB" 600Watt Speed Control 115VAC $4.50 @, 2 for $8

866A Xfmr 2.5V/10A/10Kv/Insl $3 @
Ballentine #300 AC/Lab Mtr. $54
(Sd) Choke 4Hy/0.5A/27Ω $40 @, 2/$6
"VARIACS" L/N 0-135v/7.5A $15
"VARIACS" L/N 0-135v/3A $10
TWO 866A's & Fil. Xfmr. $6

SILICON TUBE REPLACEMENTS
0Z4 UNIVERSAL $1.75 @, 2/$3
5U4 1120Rms/1600Inv $2 @, 3/$5
5R4 1900Rms/2800Inv $9 @, 2/$15
866 5Kv/Rms - 10.4Kv Inv $11 @, 2/$20

Mica Condsr .006 @ 2500V 4/$1
Snooperscope Tube 2" $5 @, 2/$9
Mini-Fan 6 or 12Vac/60Cys $2 @, 3/$5
4X150 Ceramic Loktal $1.25 @, 2/$2
Line Filter
Line Filter 50Amp/250VAC $10 @, 2/$16

DC 3½"/Meter/RD/800Ma $4 @, 2/$7
DC 2½" Meter/RD/100Ma $3 @
DC 2½" Meter/RD/30VDC $3 @, 2/$5
AC 3½" Meter/RD/130VOC $5 @, 2/$9
DC 4" Meter/RD/1Ma/$5 @, 2/$9

Battery Charger 6&12V Charges up to 5Amp "Approved" Heavy Duty Design with Klixon Circuit Breaker. Operates 220 or 110VAC @ 50 or 60 Cys $8, 2 for $15, 7/$49

Transformers—All Input 115v/60Cys VCT @ 250Ma, 6V/8A/5A/3A $6, 2/$10
400VDC Supply @ 200MA & Silicon Rect & Filters $10
20VAC & TAPS/,8,12,16, 20V @ 4A, $3
32VCT/1A or 2X16V @ 1A, $8 @, $2/$5

Line Filter 4.5A @ 115VAC 4 for $1
Line Filter 5A @ 125VAC 2 for $1
Converter Filter 400 Ma @ 28VDC 4 for $1
Converter Filter Input/3A @ 30VDC 4/$1
2.5MH PiWound Choke/National 5 for $1

We Buy, Sell & Trade

SEND 25c FOR CATALOG

"TAB" Terms Min Order $3 FOB New York. 10 Day Gtd. Our 20th Year.

111NM Liberty St., N.Y. 6, N.Y. Re 2-6245

"TAB" FOR THE BEST KITS!

Each "TAB" Kit Contains The Finest Selection!!!

Kit 35 Precision Resistors	Kit 75 Mica Condensers
Kit 75 Resistors 1/2/1&2W	Kit 10 Crystal Diodes
Kit 12 Electrolytic Cond's.	Kit 200ft Hook Up Wire
Kit 65 Tubular Condensers	Kit 4 Rolls, 500ft/ea. Assorted Color
Kit 500 Lugs & Eyelets	Kit 5 FT243 Xtal Holders
Kit 10 Bathtub Oil Cond's.	Kit 10 Xtal Osc. Blanks
Kit 5 lbs. Surprise Package	Kit 4 Asstd Rectifiers
Kit 10 Transmit Mica Cond's.	Kit 100 Self/Tap Screws
Kit 3 Phone/Patch Xfmrs	Kit Adj Wire Striper & Cut
Kit 10 Insltd Tuning Tools	Kit Hi Gain Xtal Mike
Kit 6 "SunCells" Battys	Kit 2 pair SO239 & PL59
Kit 10 Sub-Min Tubes	Kit 12 Binding Posts Asstd
Kit 12 Alligator Clips Asstd	Kit (3) TO36/50Watt Untested
Kit (6) Tube Clamps Asstd	Kit (50) TOPHAT 3/4A/Diodes Untested
Kit (32) Transistors PNP & NPN	Kit (12) TO3/3A Transistors Untested
Kit (12) 2Amp Stud Rectifiers	Kit (4) PF/PressFit 18Amp Studs

Order Ten (10) Kits—We Ship Eleven

One Each Above Kit Only. Each Kit 99c

W.E. Polar Relay #255A/$5 @, 2 for $9
W.E. Socket for #255A Relay, $2.50
Toroids 88Mhy New Pckg $1 @, 6/$5
6.3VCT @ 15.5A & 6.3VCT @ 2A $4 @, 2/$6
200KC Freq Std Xtals $2 @, 2/$3
Printed Ckt Bd New Blank 9x12" $1 @, 6/$5
Klixon 5A Reset Ckt Breaker $1 @, 8/$5
2K to 8K Headsets Good Used $3 @, 2/$5
Xtal Blanks Asst Types 12 for $1

WANTED TEST SETS & EQUIPMENT

Bandswitch Ceramic 500W 2P/6Pos $3 @, 2 for $5
6Hy-305Ma Choke Cased $3 @, 2/$5
7-½Hy-400Ma Choke Cased $7 @, 2/$'2
250Mfd @ 450 Wv Lectlytic 4/SSB $3 @, 4/$10
Cndsr Oil 10Mfd x 600-2x2.5 & 5Mfd $1 @, 15/$10
Cndsr Oil 6Mfd @ 1500V $4 @, 4/$10
880Vct @ 735Ma for SSB $9 @, 2/$16
480Vct @ 40Ma & 6.3 @ 1.5A CSD $1.50 @, 4/$5
10Vct @ 5A & 7.5Vct @ 3A CSD $6 @, 2 for $10

WANTED LAB METERS! BRIDGES! K-POTS!

Pwr Sup Kit 900VDC @ 500Ma & 4/ Silicon Diodes 1700Piv FWB $12
Pwr Sup Kit 1200VDC @ 200Ma/Xfmr & FWB Silicon Rect $10 @, 2 for $18
Modulation Xfmr 60W/15K to 5.7K $5
Headset Rubber Bunyon Pads pair $1
Socket Ceramic 1625 Tube 4/$1
Socket Ceramic 866 Tube 4/$1
Socket Ceramic 4X150/Loktal 4/$2

WANTED YOUR - ORDER - TODAY!

6MTR Ground-Plane Ant (R Exp) $4
Knob Spin-Crank BC348 Type $1
MiniFan 6 or 12 VAC $1.50 @, 4 for $5
Beam Indicator Selsyns 24VAC 2 for $10
Precision TL147 Feeler Relay Gage $1
8 foot Elec. Cord #16ga & Plug 39c @, 3/$1
Fuse 250Ma/3AG 5 for 30c, 100 for $3

DON'T C-WRITE & SEND ORDER!

XMTTG Mica Condsr .006 @ 2.5Kv 39c @, 5/$1
XMTTG Mica Cndsr .00025 @ 8Kv 75c @, 4/$2
Mini-Rectifier FWB 25Ma @ 115VDC 3 for $1
Micro-Switch Rated 40Amp AC & DC 4 for $1
BandPass Filters 60 or 90 or 150Cys 3 for $5
T30 Throat Mikes $1 @, 4 for $3
"Bruning" 6" Parallel Rule #1 @ 3 for $2
Linear SawTooth Pot KS15138/W. E. 3 for $1

RUSH YOUR ORDER TODAY. QTYS LIMITED!

Propagation Chart

March 1965

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	7	7	7*	14	14	14
ARGENTINA	14	7#	7#	7	7	7	14	14	14*	21	21*	14
AUSTRALIA	14	7#	7#	7#	7#	7#	7	14	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	14
ENGLAND	7	7	3	3	3	3*	14	14	14	14	14	7#
HAWAII	14	7#	7	7	7	7	7	7#	14	14	14*	14*
INDIA	7	7	3#	3#	3#	3#	14	14	14	7#	7#	7
JAPAN	14	7#	7#	7#	3*	3*	7	7	7#	7#	7#	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7#	7#	7#	3#	3#	7	7	7	7#	7#	7*
PUERTO RICO	7	7	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	14	21	14*	14*	14
U. S. S. R.	7	3	3	3	3#	3#	14	14	14	7#	7#	7
WEST COAST	14	7	7	7	7	7	7	14	14	14	21	14*

CENTRAL UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3	3	3	7	7	7*	14	14	14
ARGENTINA	14	7#	7#	7	7	7	14	14	14	21	21*	21
AUSTRALIA	14	14	7#	7#	7#	7#	7	7	14	14	14	14
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	21
ENGLAND	7	7	7	3	3	3*	7	14	14	14	7#	7#
HAWAII	14	14	7#	7	7	7	7	7	14	14	14*	14*
INDIA	7	7	7#	7#	3#	3#	7#	14	7*	7#	7#	7
JAPAN	14	7#	7#	7#	3*	3*	7	7	7	7#	7#	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7*	7#	7#	3#	3#	7	7	7	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14*	14	14
SOUTH AFRICA	7	7	7	7#	7#	7#	14	14	14*	14*	14*	14
U. S. S. R.	7	3	3	3	3#	3#	7#	14	14	7#	7#	7

WESTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	3	3	3	3	7	14	14	14
ARGENTINA	14	14	7#	7	7	7	7#	14	14	21	21*	21*
AUSTRALIA	21*	21*	14	7#	7#	7	7	7	14	14	14	14
CANAL ZONE	14	14	7	7	7	7	7	14	14	21	21*	21
ENGLAND	7	7	3	3	3	3#	7#	7#	14	14	7#	7#
HAWAII	21	14	14	7	7	7	7	7	14	14	21	21
INDIA	7#	14	7#	3#	3#	3#	7#	7*	7*	7	7#	7#
JAPAN	14	14	14	7#	7	7	7	7	7	7#	7#	14
MEXICO	14	7	7	7	7	7	7	7	14	14	14	14
PHILIPPINES	14*	14	14	7#	7#	7#	7	7	7	7#	7#	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	21	21	14
SOUTH AFRICA	14	7	7	7#	7#	7#	7#	14	14	14*	14*	14
U. S. S. R.	7#	3#	3	3	3#	3#	7	7*	7*	7#	7#	7#
EAST COAST	14	7	7	7	7	7	7	14	14	14	21	14*

Very difficult circuit this hour.

* Next higher frequency may be useful this hour.

Good: 2-4, 6, 7, 22-26, 28, 29
Fair: 1, 5, 8, 11, 12, 14-18, 20, 21, 27, 30, 31
Poor: 9, 10, 13, 19
VHF DX: 9, 10, 22, 23

J. H. Nelson

a steal

Feel like a little larceny? Go ahead. Take advantage of us. At only $685.00, National's NCX-5 transceiver is a steal. Here's a total station transceiver for the 80 through 10 meter bands which gives you more features and performance than any other transceiver at any price. Judge the NCX-5 by any criterion: **Dial Calibration** using a digital counter with accuracy to one Kc and read-out to 100 cps — ten times better than any other amateur equipment available. **Stability** from a cold start with a linear solid-state VFO which eliminates tube-type warm-up drift due to electrode structure change with temperature. Each VFO individually temperature compensated and double-regulated against input voltage variation. Long-term stability from a cold start superior to most tube-type VFO's after warm-up. **Selectivity** with an 8-pole crystal lattice filter substantially superior to any filter of any type ever used in commercial amateur gear. 6-60 db shape factor of 1.7:1 and 2.7 Kc bandwidth assures superb sideband suppression and adjacent-channel receive selectivity with pleasing, natural voice quality. **Sensitivity** of 0.5 μv for 10 db S/N, using **two** RF stages on all bands. **Split-frequency operation** with built-in **Transceive Vernier** for $\pm$5 Kc independent receiver tuning. Also accessory VX-501 VFO console to provide completely independent control of receiver and transmitter frequencies as well as transceive operation controlled by either NCX-5 or VX-501. Console also provides choice of five crystal-controlled frequencies for net or novice use. **Complete AM and CW facilities** including separate high-quality AM detector and break-in CW with adjustable release time. **Quality and workmanship** you expect from National — one-year guarantee against component failure and the neatest wiring you've seen since the last sun-spot cycle . . . right-angle component dress, with even the resistor color-codes all lined up in the same direction. **And everything else** you want in a transceiver . . . precision styling that complements the NCX-5's performance . . . 200 watts PEP punch on SSB or CW . . . 10 db of ALC for maximum talk-power without flat-topping or splatter . . . front panel choice of VOX, push-to-talk, or manual operation . . . SSB/CW/AM AGC and D'Arsonval S-meter/PA meter . . . mobile mount included . . . even optional deluxe oiled walnut cabinets separately available for the NCX-5, NCX-A AC supply/speaker console, and VX-501 VFO console for custom home installations.

NATIONAL RADIO COMPANY, INC.

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