73

JULY 1965
40c Wow!

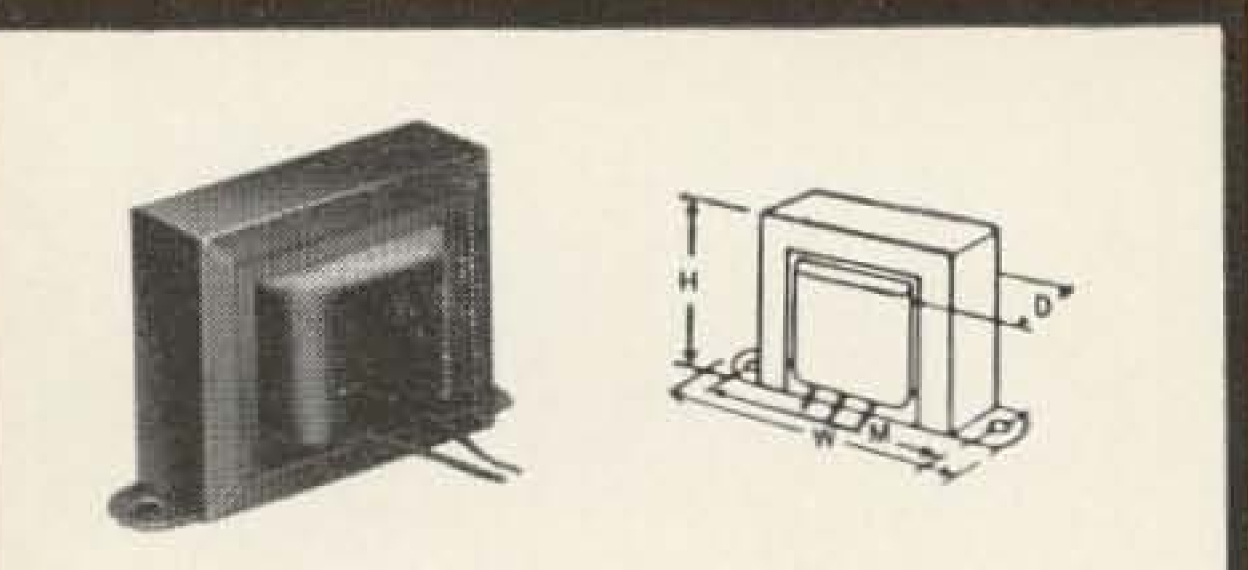
SPECIAL ISSUE VHF

REPLACEMENT TYPE TRANSFORMERS & REACTORS

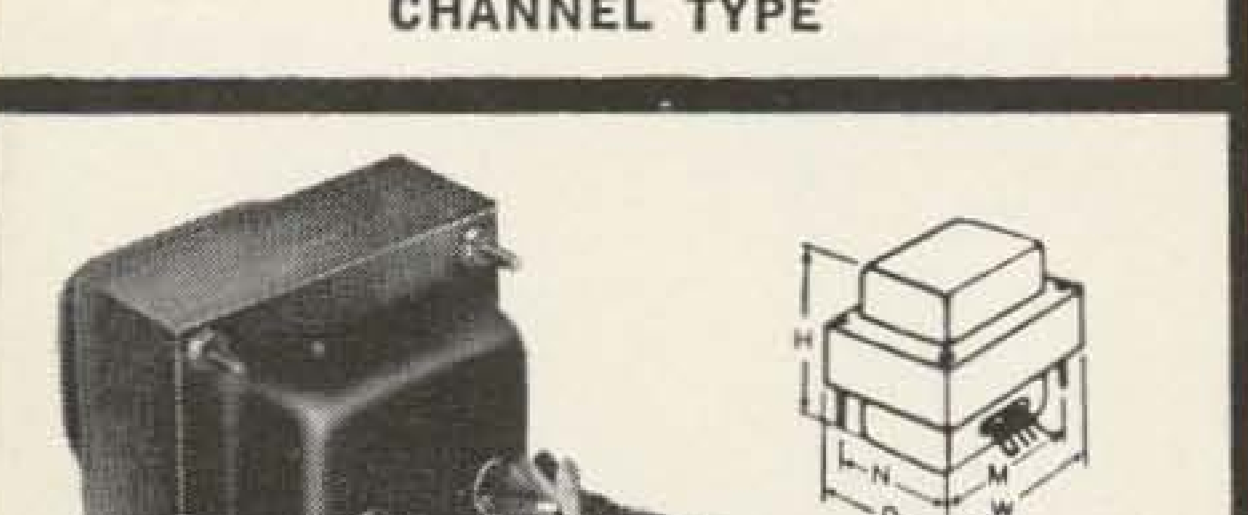
PIONEERS IN MINIATURIZATION

Thirty years of pioneering by UTC's research, design, and engineering staffs assures you quality and reliability unexcelled in the industry. UTC's line of stock and special custom built items covers virtually every transformer and filter requirement for both military and commercial use.

UTC replacement type transformers, here described, (Pri. 117 V. 50/60 cycles) provide the highest reliability in this field. All units are low temperature rise, vacuum sealed against humidity with special impregnating materials to prevent corrosion and electrolysis. Shells are finished in attractive high lustre black enamel.



CHANNEL TYPE



DOUBLE SHELL TYPE

VERTICAL SHELL TYPE

CHANNEL FRAME FILAMENT/TRANSISTOR TRANSFS.

Pri. 115 V 50/60 Cycles—Test Volts RMS: 1500

Type No.	Secondary	W	D	H	M	Lbs.
FT-1	2.5 VCT-3A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-2	6.3 VCT-1.2A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-3	2.5 VCT-6A	3 5/16	1 7/8	2	2 13/16	1
FT-4	6.3 VCT-3A	3 5/16	1 7/8	2	2 13/16	1
FT-5	2.5 VCT-10A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-6	5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-7	7.5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-8	6.3 VCT-8A	4	2 1/2	2 5/8	3 9/16	2 1/2
FT-10	24 VCT-2A or 12V-4A	4	2 5/8	2 5/8	3 9/16	2 1/2
FT-11	24 VCT-1A or 12V-2A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-12	36 VCT-1.3A or 18V-2.6A	4	2 5/8	2 5/8	3 9/16	2 1/2

Taps on pri. of FT-13 & FT-14 to modify sec. nominal V, −6% +6%, +12%

FT-13	26 VCT-.04A	2 1/8	1 3/8	1 1/4	1 3/4	1/4
FT-14	26 VCT-.25A	2 7/8	1 5/8	1 11/16	2 3/8	3/4

DOUBLE SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-101	275-0-275	50	2A	2.7A	3	2 1/2	3	2 1/2	2	2 1/2
R-102	350-0-350	70	3A	3A	3	2 1/2	3 5/8	2 1/2	2	3 1/2
R-103	350-0-350	90	3A	3.5A	3 3/8	2 7/8	3 15/16	2 13/16	2 1/4	4 1/2
R-104	350-0-350	120	3A	5A	3 3/4	3 1/8	3 7/8	3 1/8	2 1/2	5 1/2
R-105	385-0-385	160	3A	5A	3 3/4	3 1/8	4 5/16	3 1/8	2 1/2	7

VERTICAL SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-110	300-0-300	50	2A	2.7A	2 5/8	2 13/16	3 1/4	2	1 3/4	2 1/2
R-111	350-0-350	70	3A	3A	2 5/8	3 7/16	3 1/4	2	2 3/8	3 1/2
R-112	350-0-350	120	3A	5A	3 5/16	3 11/16	4	2 1/2	2 5/16	5 1/2
R-113	400-0-400	200	3A	6A	3 7/8	4 5/16	4 5/8	3	3 1/8	8

CHANNEL FRAME FILTER REACTORS

Inductance Shown is at Rated DC ma—Test Volts RMS: 1500

Type No.	Induct. Hys.	Current	Resistance Ohms	W	D	H	M	Wt. Lbs.
				Dimensions, in.				
R-55	6	40ma	300	2 3/8	1 3/8	1 3/8	2	1/2
R-14	8	40ma	250	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-15	12	30ma	450	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-16	15	30ma	630	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-17	20	40ma	850	3 5/16	1 5/8	2	2 13/16	1
R-18	8	80ma	250	3 5/16	1 5/8	2	2 13/16	1
R-19	14	100ma	450	3 3/4	1 7/8	2 5/16	3 1/8	1 1/2
R-20	5	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-21	15/3	200ma	90	4 1/8	2 1/4	2 5/8	3 9/16	2 1/2
R-220	100/8 Mhy 25/2 Mhy	2.5A 5A	.6 .16	3 3/4	2	2 5/16	3 1/8	1 1/2

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150 VARICK STREET, NEW YORK 13, N. Y.

73 Magazine

Wayne Green W2NSD/1
Editor & Publisher

Paul Franson WA1CCH
Assistant Editor

July, 1965

Vol. XXXIII, No. 1

73 Magazine is published monthly (thank heavens it's not weekly) by 73, Inc., Peterborough, N. H. Zip 03458 (terrible number). The phone is 603-924-3873. Subscription rates $4.00 per year, $7.00 two years, $10 three years world wide. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in New Hampshire, U.S.A. Entire contents copyright 1965 by 73, Inc. Postmasters, please send form 3579 to Good Old 73 Magazine, Peterborough, New Hampshire. You are coming up for our July 4th hamfest, aren't you?

de W2NSD/1

never say die

The Docket

The deadline for your comments on this one is July 15th, so don't put it off any longer. Original (signed) and 14 copies (carbons OK) to FCC, Washington 25, D. C.

My views, expressed rather at length last month, are still the same . . . perhaps more so. I've talked this over in the interim with several hundred hams and a lot of old timers and no one yet has come up with any reasons why this FCC proposal will benefit ham radio. Sure, it will change everything and change it radically and this may be enough for those in our ranks who feel that "something must be done, no matter what." I still feel that we cannot hope to solve our problems until they are isolated and defined.

It is hard for me to dismiss from my mind the ridiculous start of this whole mess. Briefly, for those of you who have not been following the saga in 73 or K6BX's newsletter, here is the story:

1962 was a depressing year for the League. The Brass got together in December over a beer to glum over this and figure out what to do to make everyone aware of the glory of ARRL. Let's do something controversial. What? How about Incentive Licensing? OK, let's go. Since January was in the mail they whammed out a fine controversial editorial for February. The directors met in May and figured that the Brass must know what they are doing, go ahead. In October they followed through with RM-499.

The FCC now had the problem along with a request from the ARRL for "leadership and guidance." Well, we needed it along about then, but I'm afraid that the League turned to the wrong place, as many other groups have discovered in the past when they turned to the government to provide guidance and leadership. The FCC, hot potato in hand looked for someone to work things out and I understand, finally turned the whole works over to a non-ham lawyer and we ended up with 15928, lucky us.

I am hoping that you will join me in an effort to stop this ARRL inspired government creation from throwing ham radio into further unnecessary turmoil.

Big DXer

Now that I've become a DX hunter I've taken to reading the DX newsletters. I still agree with my original thought that there really is no way to provide any valuable DX news service in the pages of a monthly magazine. By the time something is reported it is usually all over but the shouting.

One thing that puzzles me though . . . Hammarlund has been sponsoring the DXpedition of the Month for over two years now and for some reason they just don't seem to try to get any publicity out of it. According to the latest list at hand they have the logs for 43 stations so far . . . a lot more than one a month. I notice it too when I go to send out QSL cards for contacts with some of the more interesting DX stations that I have contacted . . . the cards go to Hammarlund and get answered quickly.

Good show Hammarlund, but why keep your light under a bushel?

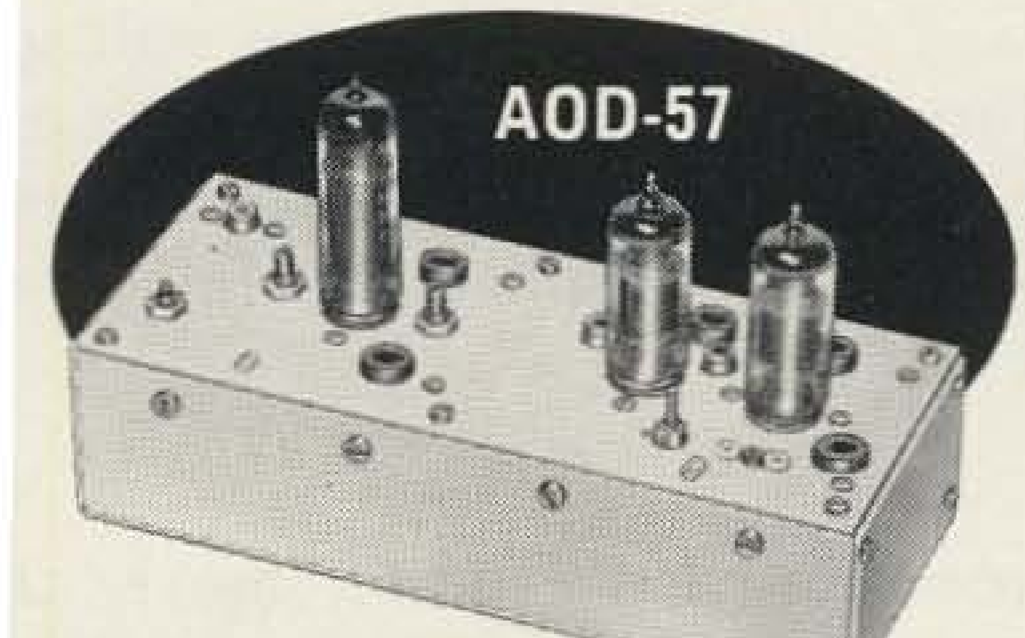
County Hunters

Though I personally think this business of trying to work gobs of counties is a bunch of horsefeathers . . . WAS is bad enough and look what DXCC has done to our DX bands . . . still, for those with little of importance to do in this world, hunting counties can be a big deal. I get a little perturbed when some

NEW FROM INTERNATIONAL

VHF/UHF UNITIZED TRANSMITTERS 50 mc – 420 mc

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

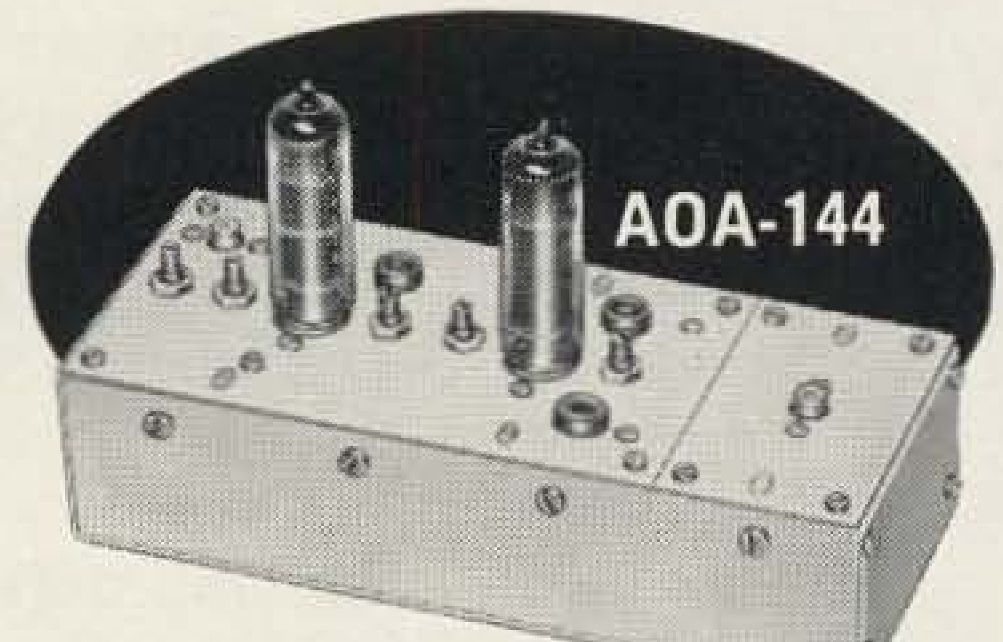


50 or 70 mc

DRIVER/TRANSMITTER

The AOD-57 completely wired with one 6360 tube, two 12BY7 tubes and crystal (specify frequency). Heater power: 6.3 volts @ 1.2 amps. Plate power: 250 vdc @ 50 ma.

AOD-57 complete........$69.50

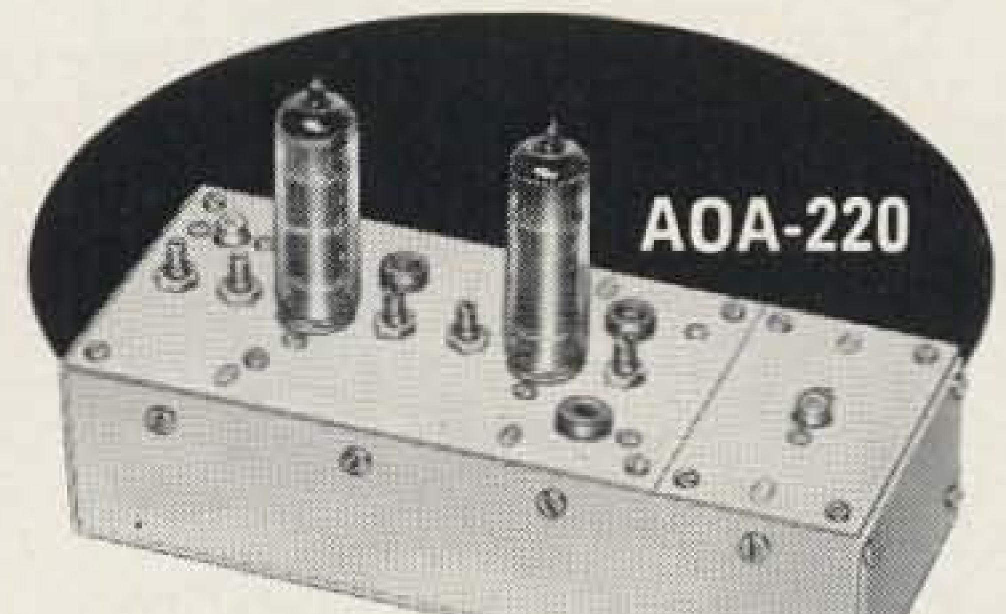


144 mc

MULTIPLIER/AMPLIFIER

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

AOA-144 complete........$39.50

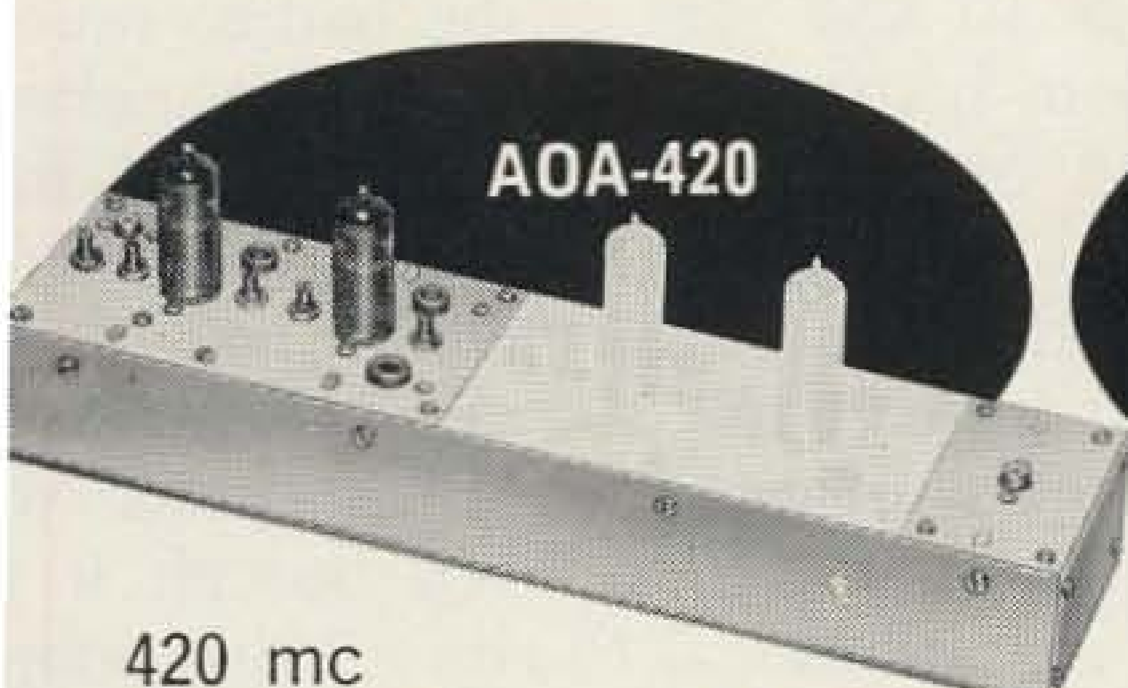


220 mc

MULTIPLIER/AMPLIFIER

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

AOA-220 complete........$39.50



420 mc

MULTIPLIER/AMPLIFIER

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

AOA-420 complete........$69.50

RELAY BOX

Four circuit double throw. Includes coil rectifier for 6.3 vac operation.

ARY-4 Relay Box complete $12.50

FILAMENT SUPPLY

The APD-610 provides 6.3 vac @ 10 amperes.

APD-610 complete........$9.50

MODULATOR

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

AMD-10 complete........$24.50

COMPLETE TRANSMITTER

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

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fellow comes along on the band and want to work me because I am in Greene County New Hampshire. I know right away exactl how much interest he has in me as a perso . . . zero.

Unfortunately for the county hunter crow they have had to send their QSL's into tha giant QSL trap down at CQ. One of the com plaints that I heard quite often in Europe wa the futility of trying to ever get QSL's returne from there. Clif Evans K6BX has an answe . . . a new award . . . one where you will ge your QSL's returned, the United States Count Hunters Award. Information is available fror Clif (Box 385, Bonita, California) for 26c o 3 IRC's.

High Power

In an unprecedented (almost) move the FCC recently announced that it had suspended the license of Dale Hoppe W6VSS for running a little over the legal limit. As I understand the circumstances, Dale was sitting there chatting away with someone when in walked the FCC inspector. Hmmm, ten kilowatts! Well it *does* put out a good signal. One of the chaps down here near Boston ran into problems with his 10 KW rig . . . he had so much rf pickup from his mobile whip that it melted the final coil of his transceiver . . . and the gutters on the house lit up with corona every time he talked . . . very spectacular.

Though the FCC has shown little interest in pursuing power violators, I do think we should keep in mind that, even though it is illegal, it is also unethical to run all that soup.

Many amateurs ask why we don't lower the power limits to around 200 watts. Read the W4LCY article in the May 1964 issue of 73 and you'll see why. Every time the QRM goes down on a ham band enough to make it usable for commercial services they dig right in, ITU or no ITU agreements. In areas where ham activity is low our bands are jammed with non-amateur signals. So, if we lower our power all we are doing is cutting our own throats. In this day of relatively inexpensive kilowatts we would do well to keep our QRM level as high as we can . . . we'll hold our bands a lot longer. I suspect that this reasoning may be behind the lack of FCC prosecution of amateurs for overpower . . . until it has gotten completely out of hand.

Europe Again

The purchase of a new Volkswagen 1500 squareback sedan in Germany just paid for a round trip to Europe. I like that sort of ar-

Cont. on p. 86.

TENTION: GOVERNMENT, AIRLINES, POLICE, FORESTERS, INDUSTRIES D OTHERS OPERATING IN THE 2 TO 30 MCS HIGH FREQUENCY BANDS

LEFT: CSB100TR.
RIGHT: CSB125C

INGLE SIDEBAND SETS BY HAMMARLUND ARE EIGHT TIMES MORE EFFECTIVE.

ays who? Says **Hammarlund** who makes these remarkable ong-range transmitter/receivers (see above). Each will deliver signal **eight times more effective** than an AM set drawing e same power. (In regular AM equipment the **carrier wave** bsorbs most of the power and carries no message. So ammarlund SSB sets transmit the message signal along **ne narrow sideband with no carrier wave.**)

IT WORKS

nd how it works. Hammarlund's SSB sets free themselves f conventional **AM interference** because they use only half he frequency space. They **cut distortion** because they depend ess on rigid relations between phase and amplitude. Talk is **nore private** because Hammarlund SSB sets can't usually be icked up by home-style shortwave receivers.

IDEAL FOR GOVERNMENT AND INDUSTRIAL OFFICES

When normal telephone lines aren't available or wanted, Hammarlund SSB takes over. The CSB100TR works on mountain-tops, in spots remote from its antenna, in installations where several dispatchers are working separately and can use the CU-10A Telephone Remote Control units providing up to 20 control points. The CSB125C, less expensive, works when dispatcher, antenna and set are in one location.

This means Hammarlund SSB sets **work beautifully in out-of-the-way locations** for government, maritime, forestry, airline, police and offshore oil installations.

FITS THE NEED

One antenna serves all six channels. Use handset, speaker or remote line. Phone or code. All simple controls on front panel. Just connect antenna, ground and **plug in.**

GO AHEAD AND WRITE

Mail this coupon for details on the **8-times more effective** Hammarlund SSB sets.

HAMMARLUND MANUFACTURING COMPANY
A GIANNINI SCIENTIFIC COMPANY,
73-88 Hammarlund Dr., Mars Hill, North Carolina, 28754
Cable Address: ARLAB, New York, N.Y.
YES—We want to know about Hammarlund SSB.

NAME____________________

WITH____________________

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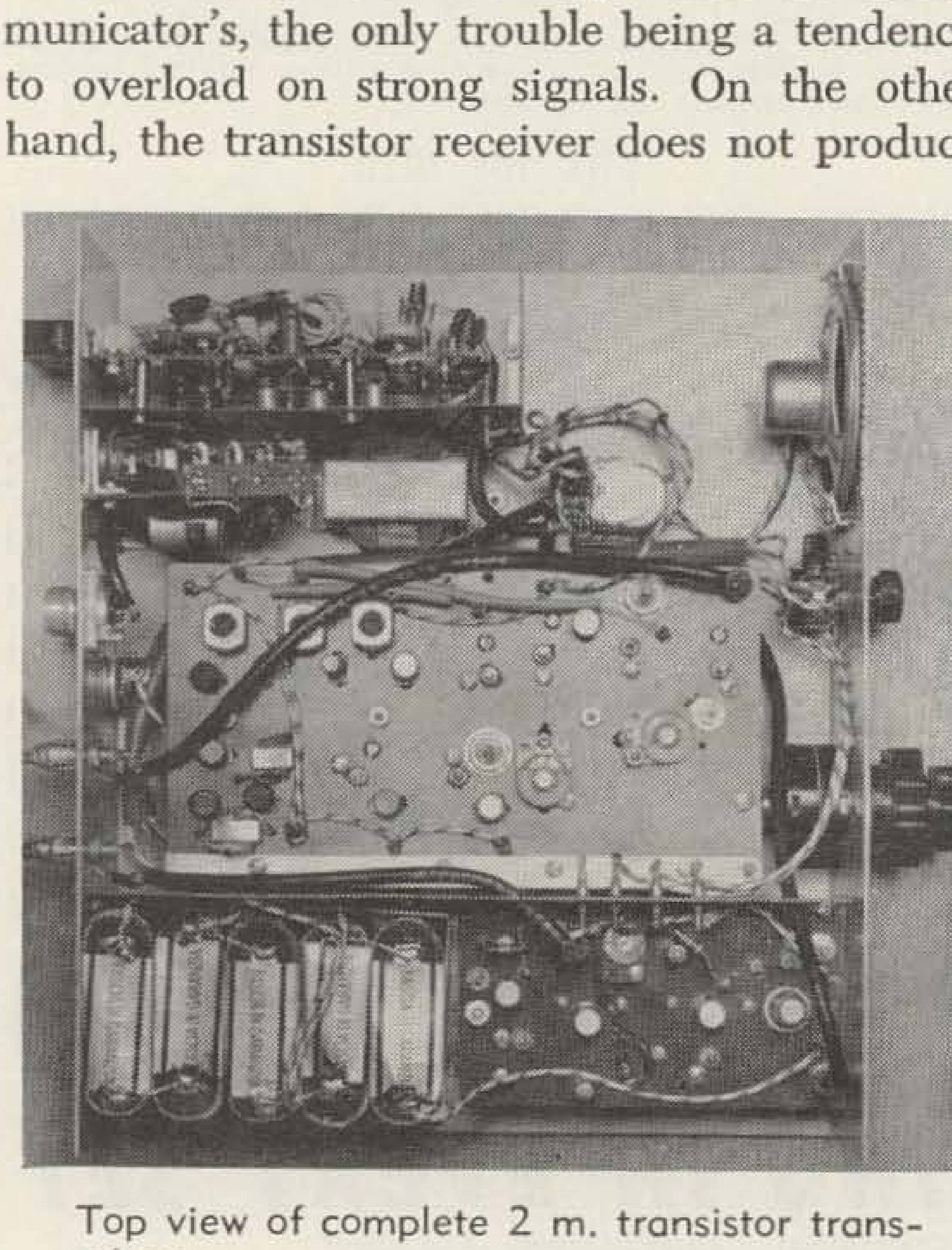
SUPERPRO ENGINEERING IN EVERY SET

From 1910 to Tomorrow: Hammarlund Builds Commercial Communications Equipment Variable Air Capacitors, Amateur Radio Equipment and the Outercom 2-Way Radio.

Gianfranco Lovisolo I1SI
Viale Caldara 24,
Milano, Italy

2 Meter Transistor Transceiver

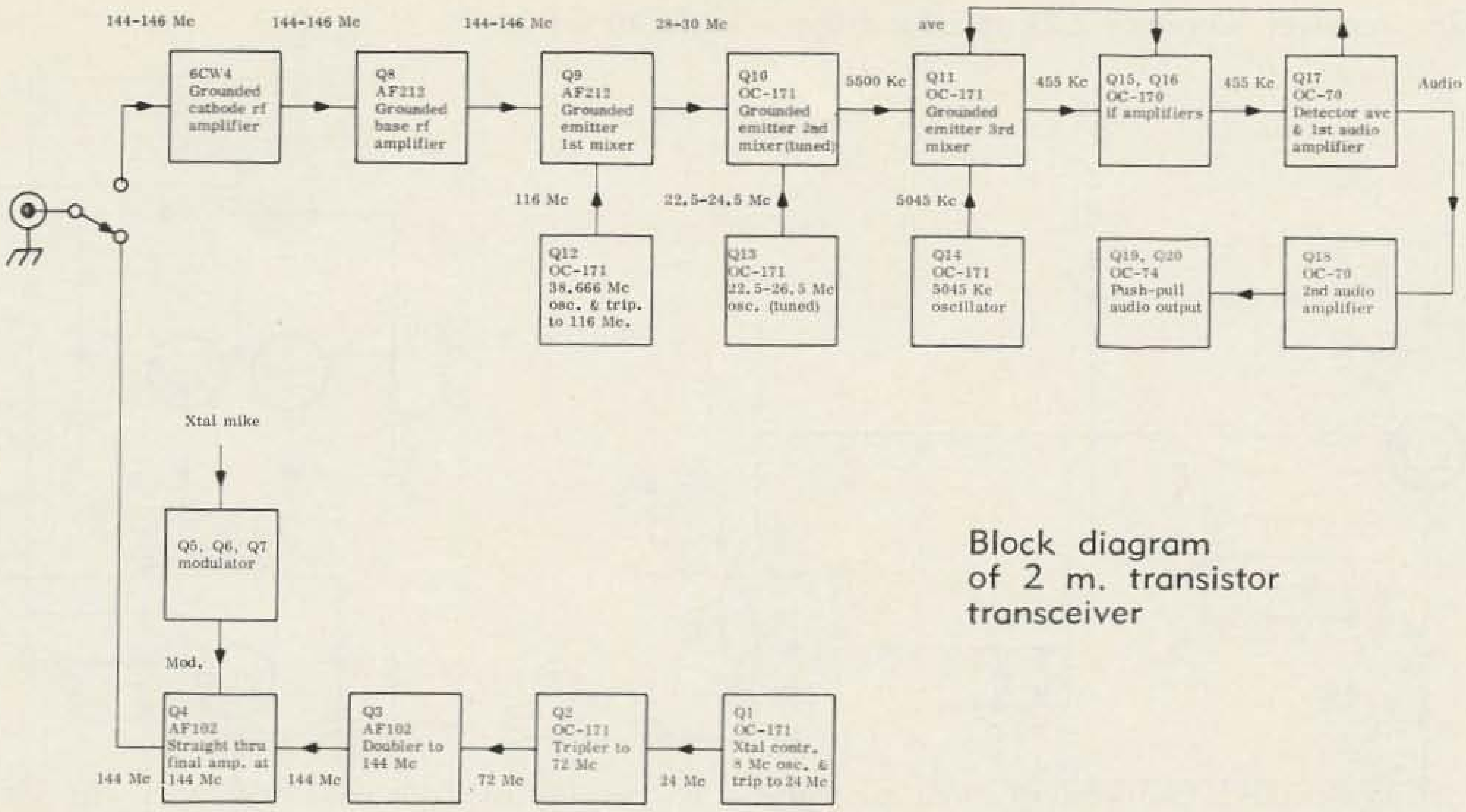
This transistorized transceiver was planned and built for portable and lightweight operation in the field. Receiver sensitivity and noise figure are excellent due to the use of a Nuvistor rf amplifier and triple conversion receiver. Transmitter final delivers a measured output of 30 milliwatts to the antenna. This power is of course in the QRP class, but, from favorable locations, it can give gratifying results. As a test, this transceiver was brought to the top of 4000 feet "Campo dei Fiori" mountain along with a Gonset "Communicator 4." The two sets were operated with the same ¼ wave whip antenna: the Nuvistor/transistor receiver compared favorably with the Communicator's, the only trouble being a tendency to overload on strong signals. On the other hand, the transistor receiver does not produce the annoying hiss common with the Communicator 4. As for the transmitters, every statio which could be worked with the Communicator, could be worked with the transisto transmitter. The signal strength reports wer of course favourable to the Communicator, bu if the Gonset set was given Q5, in most case Q5 was given to the transistor transceiver a well.



Top view of complete 2 m. transistor transceiver

Referring to the block diagram, the trans mitter starts with an 8 Mc xtal controlled os cillator and tripler to 24 Mc; 24 Mc rocks ca also be used with no modification to the cir cuit. This signal is fed to the base of Q2 whicl triples to 72 Mc; Q3 doubles to 144 Mc; Q4 is the final rf amplifier: collector voltage is 15 volts with no modulation and collector cur rent is 3.5 ma at full load and with a very noticeable dip. Input is around 50 milliwatts with an output (measured) of 30 milliwatts efficiency is little less than 60%. The modulator is a conventional resistance-coupled audio amplifier. Modulation is applied to the final only via modulation choke Z1 which is the only critical part in the modulator circuit. Modulation is clear and undistorted with this arrangement which proved to be superior to transformer modulation. Looking at the transmitter diagram, it can be seen that Z1 is fed from the 22.5 tap on the power pack: this is done to have at least 15 volts on the collector of Q4, since there is considerable voltage drop.

The receiver is made of two subassemblies: a xtal controlled converter with an *if* output between 28 and 30 Mc and a tuneable *if* receiver. The converter starts with a 6CW4 as rf amplifier which works with 22.5 volts on the plate and 9 volts on the filaments. This much filament voltage could be eliminated using a separate 6 volts battery and this I advise to do, although I have been operating it for



Block diagram of 2 m. transistor transceiver

ıny hours with no apparent damage to the be. The big disadvantage of this arrange- ent is the short life of B1 and B2 which must changed after about three hours of continu- ıs operation. By luck, these batteries are ıeap and can be easily replaced. Signal from 1 is fed to Q8 which acts as grounded base nplifier. Q9 is the mixer operated common nitter with harmonic signal coming from 12.

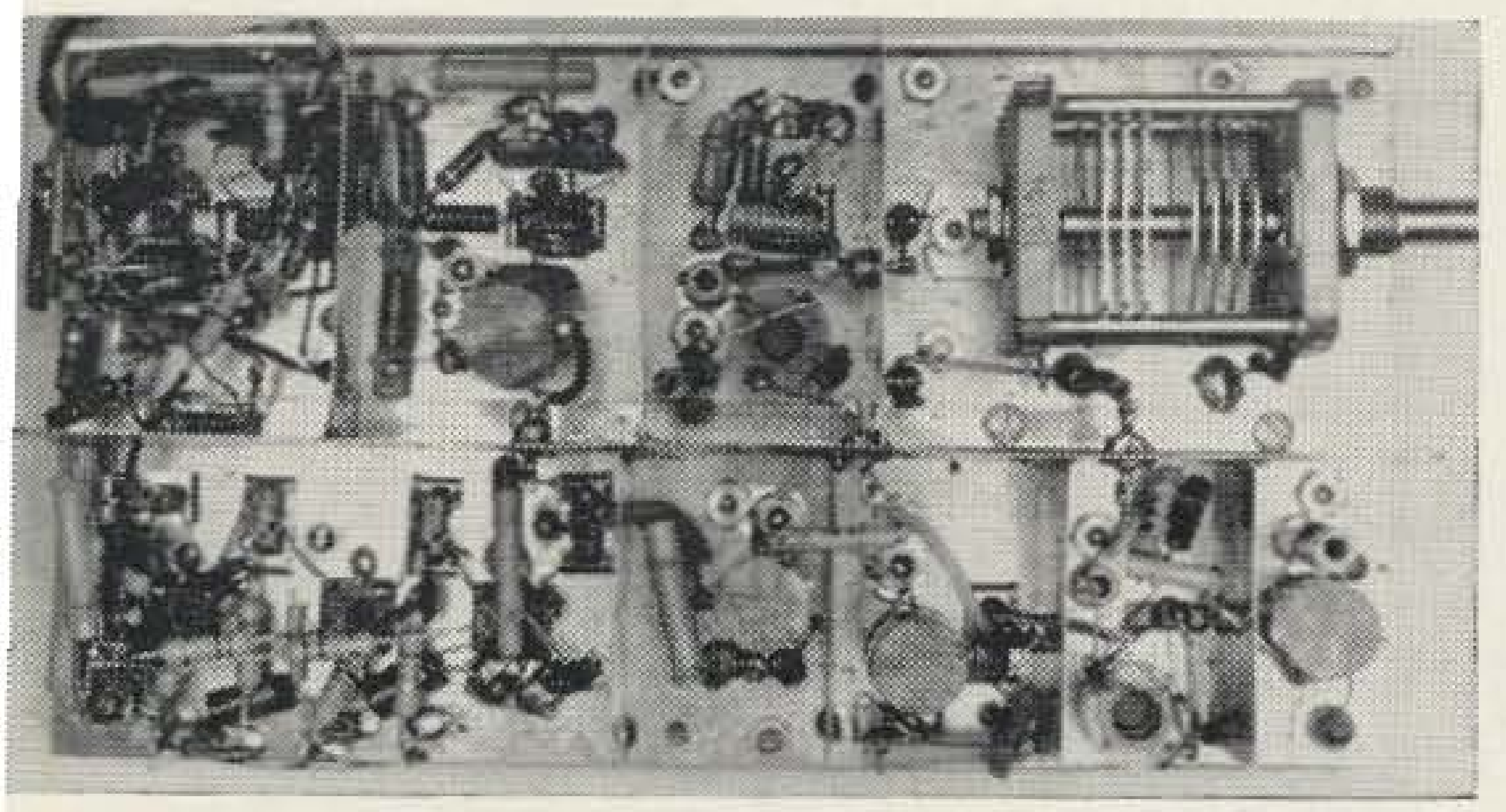
The tuneable *if* is made of two cascaded ixers Q10 and Q11 with separate oscillators, 455 kc *if* amplifier made of Q15 and Q16, Detector, avc and first audio made of Q17 ıd conventional audio stages following.

The converter and receiver were aligned to ›ver the two mc segment from 144 to 146 ıc which is the two meter European band. owever, the converter can be made to work om 144 to 148 mc with an output from 8 to 32 mc and the tuneable *if* can cover ıis 4 mc segment by the simple setting of ıe two trimmers C12 and C16 in series with ıain tuning capacitor C15. More on this ıter.

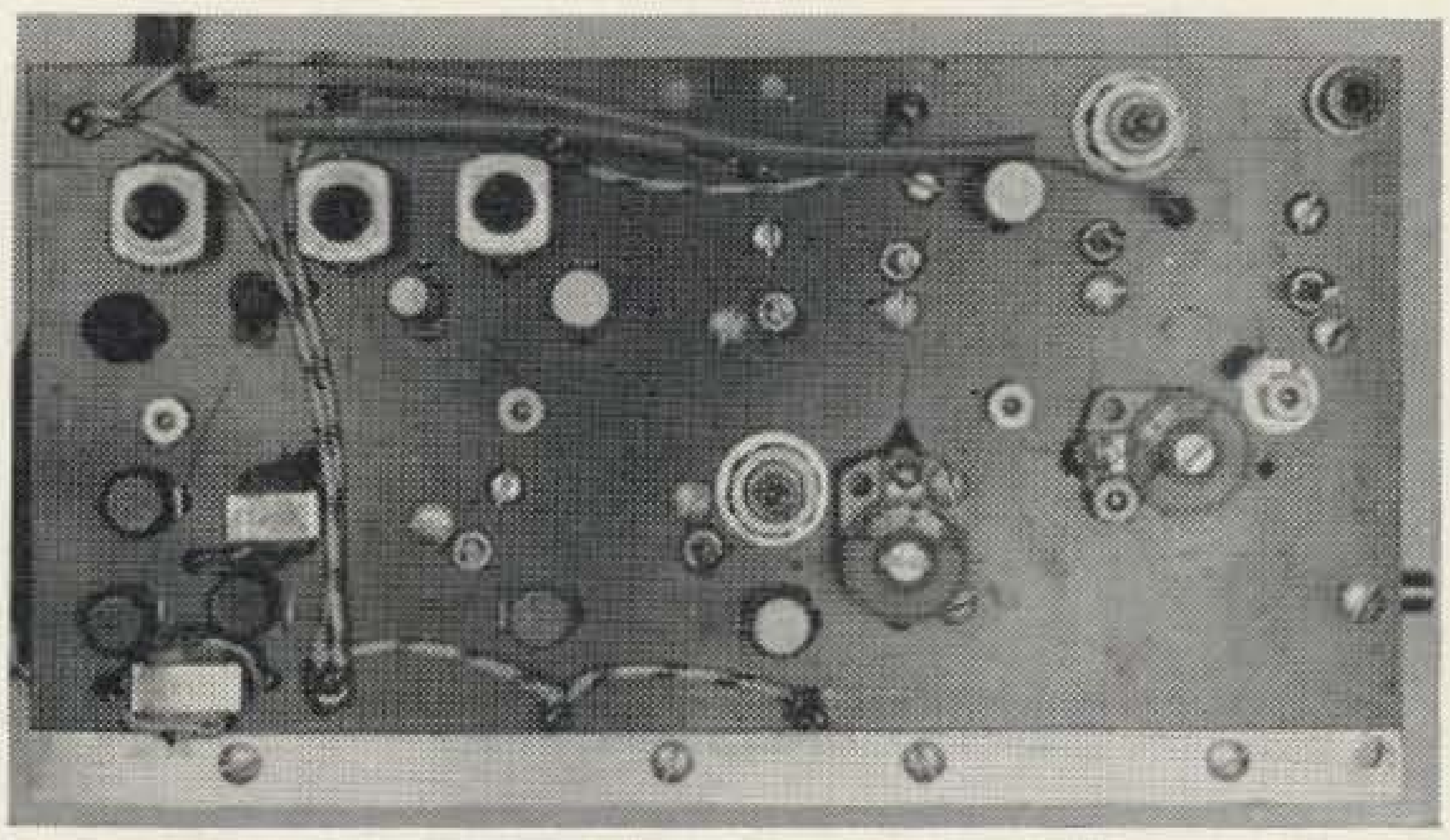
Construction and Alignment

The transmitter is shown in Fig. 2 with the modulator. It is built on a 4¾" x 2⅜" copper coated phenolic plate. It is suggested to follow the layout shown since it allows short connections and ease of wiring (see template A). The best procedure to save time and trouble is the following: drill all holes, mount all parts and then wire according to the diagram. Now check the resonate frequency of all coils with a grid-dip meter. With parallel condensers set at mid capacity and with transistors not inserted they should resonate a little higher than their proper frequency. Now put an 8 or 24 mc xtal in the holder and Q1 in its socket. Connect power to this stage through a 0-10 ma meter. Using the dipper as an absorption wavemeter couple it to L1, look for output and tune C1 for maximum without losing sight of collector current.

Oscillation is marked by a dip on the milliammeter. When you have tuned up the stage let it operate for at least ten minutes watching

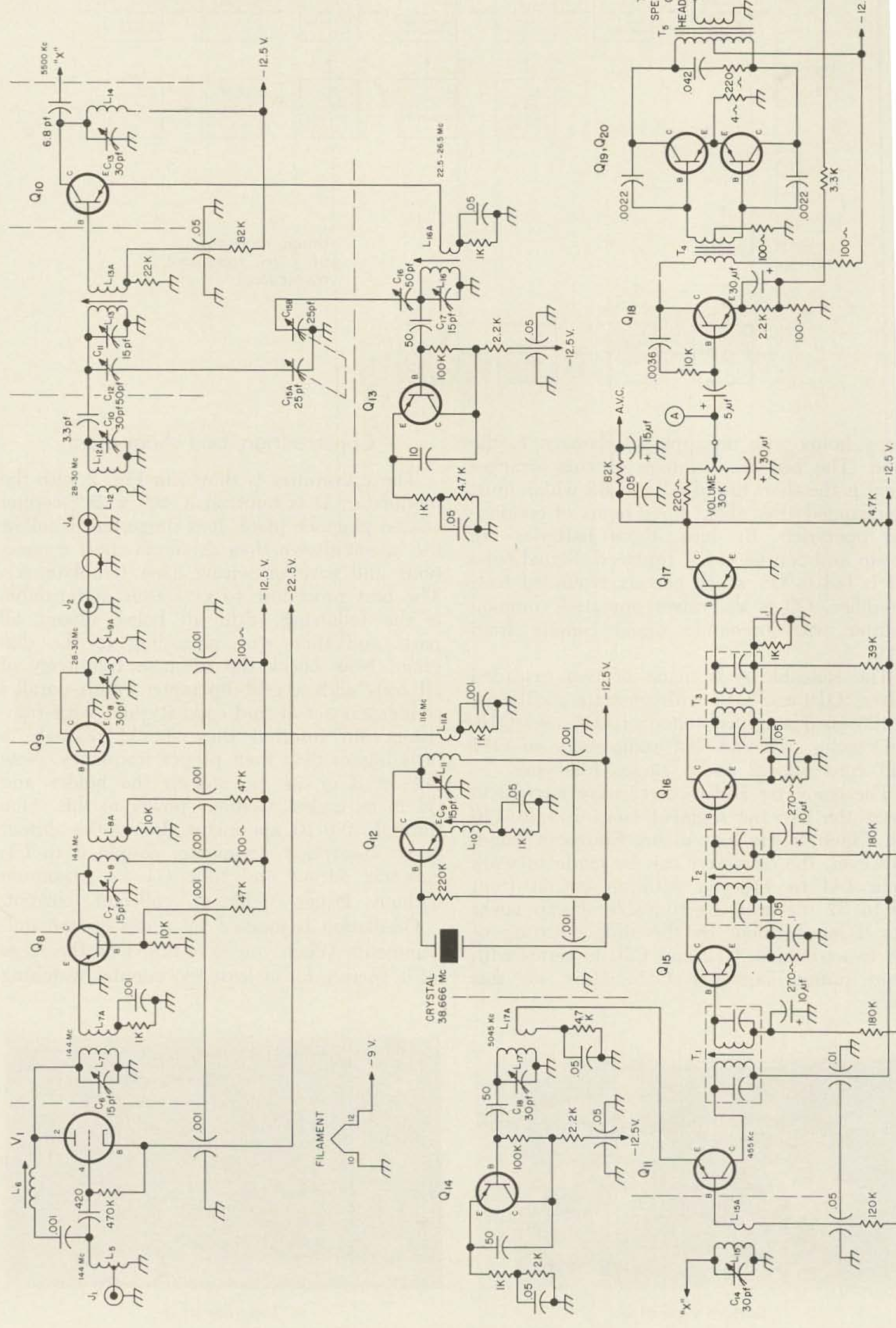


Bottom view of *if*



Top view of *if*

Fig. 1. 2m. receiver. Connect 2.2k resistor from $-12.5v$ to CT of T_4.



"I've got myself a $21.95 Kilowatt!!"

Waters CLIPREAMP™

"6 to 10db extra on the exciter add up to a KW gain any way you want to figure it. And using your Clipreamp with the S Line and 30L1 amplifier I've had consistent reports of 6 to 10db stronger signals QSO after QSO— short haul and DX.

On occasion I have alternated the Clipreamp with the 30L1 and the reports came back, 'No change — amplifier is working OK.' Again an approximate 6 to 10db gain.

I am delighted with the unit, of course, and actually feel that I've got myself a $21.95 kilowatt."

Charlie Burgoyne... W1LHZ

Your distributor has Charlie Burgoyne's "$21.95 kilowatt" now. WATERS doesn't guarantee it to take the place of your linear (after all Clipreamp weighs only 6½ ounces and fits in the palm of your hand) but it does guarantee your complete satisfaction. Buy it . . . try it! If your signals don't punch through QRM better the deal is off — your money refunded! Incidentally, Clipreamp is self-powered and installs in the mike line in a matter of minutes.

Model 372
(less battery)
$21.95

MODELS 3001 & 3002

WATERS UNIVERSAL HYBRID COUPLER & PHONE PATCH

MODEL 3002 (less battery)
$69.95

MODEL 3001
(without Compreamp)
$49.50

Perfection in a PHONE PATCH

Here's the only phone patch with its own speech processor! The built-in Compreamp (similar to Clipreamp) in Model 3002 maintains correct out-going patch levels, eliminating all manual switching and providing effortless VOX operation. The Compreamp may be used independently in the microphone line. Provision is also made to switch a tape recorder in for both recording and playback in the Hybrid Coupler and Phone Patch.

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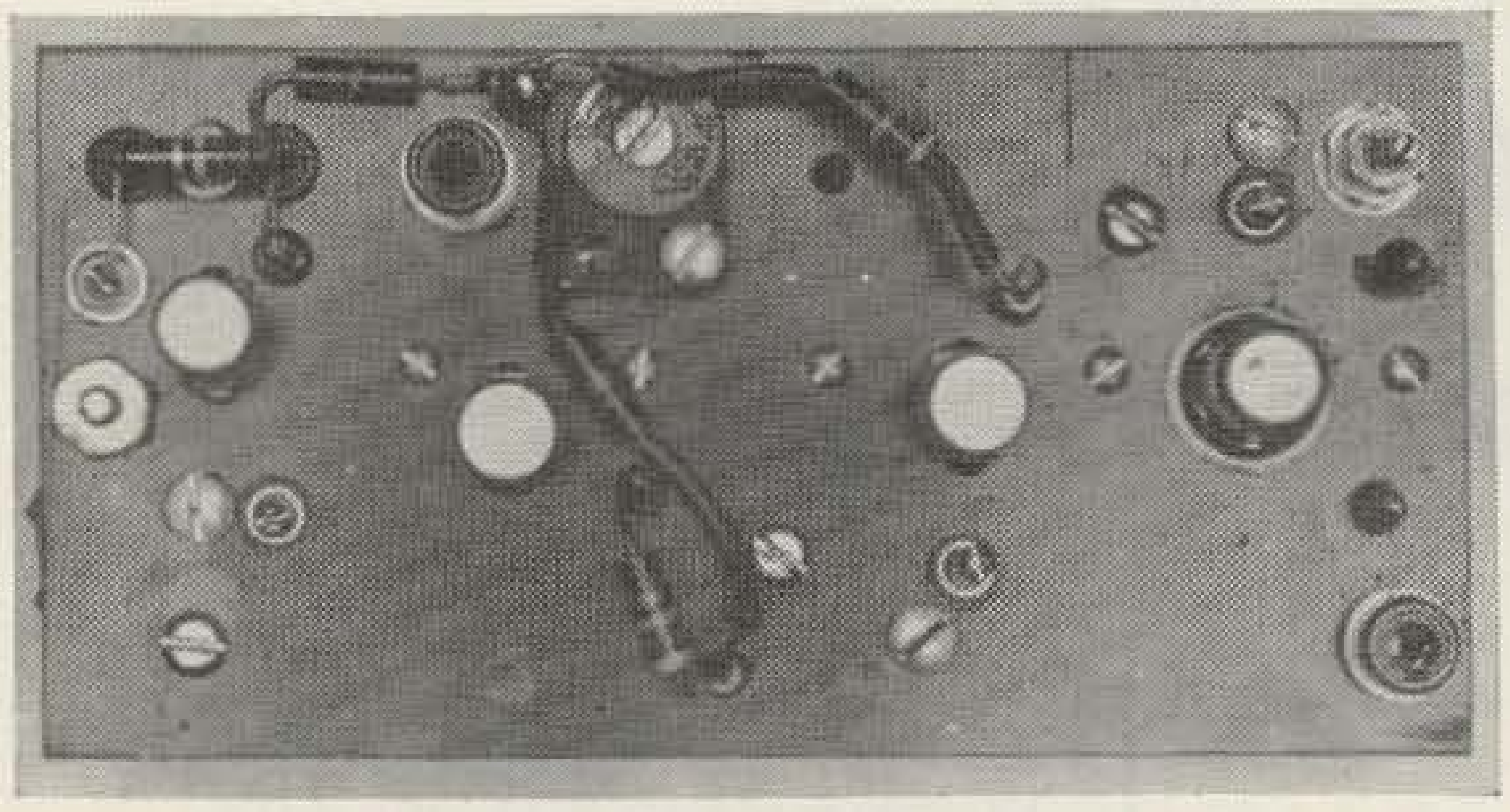
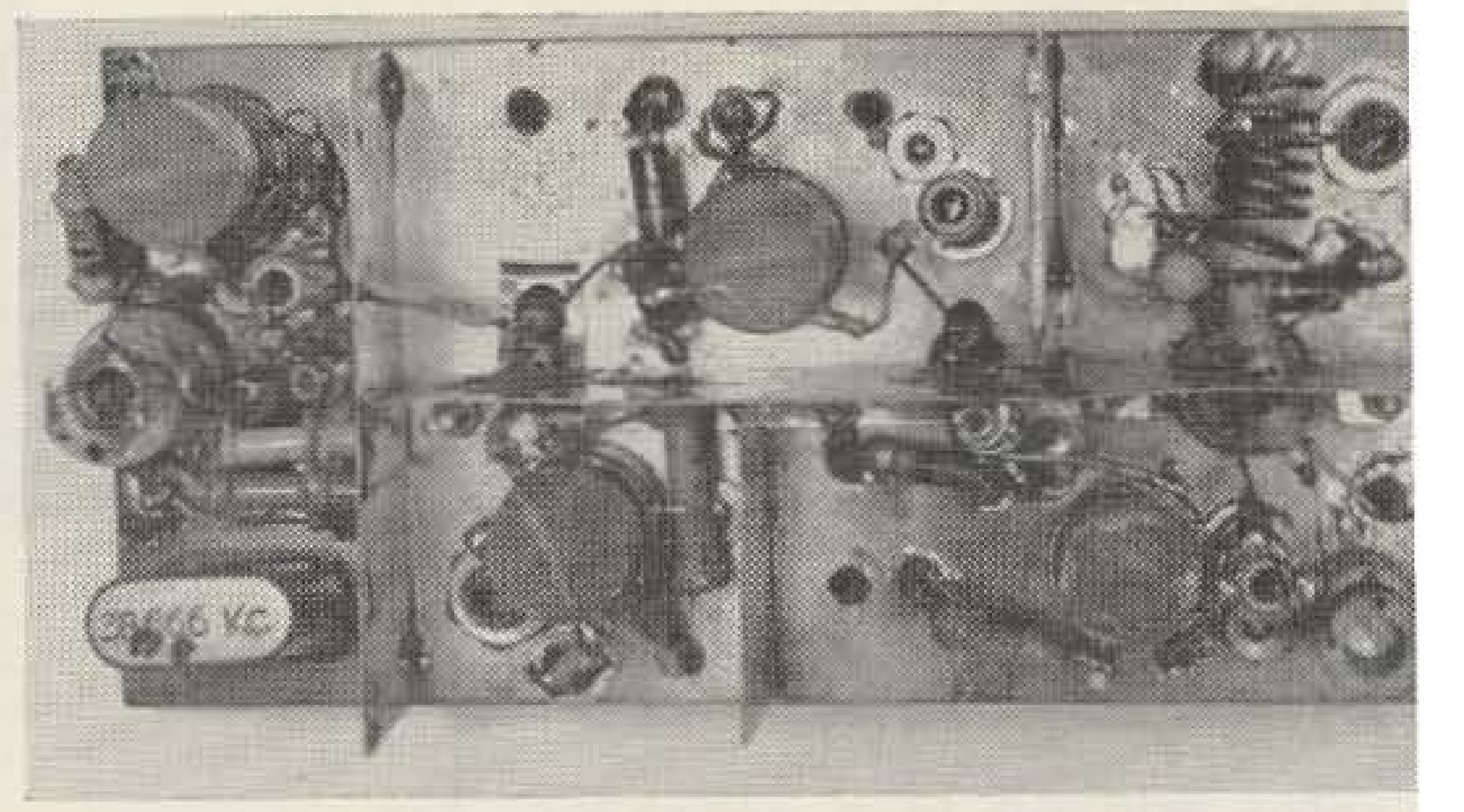




Left: Top of converter. Above: Bottom view of converter

Receiver Coil Table

L5—144 Mc input coil; 6 turns #18 wire-air wound. Tap 2nd turn from ground—1/4" diameter
L6—6CW4 neutralization coil; 24 turns #28 wire wound on 1/4" diameter form-brass slug
L7—144 Mc nuvistor plate coil; 2 turns #24 wire (*) see note
L7A—Q8 emiter link (144 Mc); 2 turns #24 wire wound on cold end of L7 (*)
L8—Q8 collector coil (144 Mc); 3 turns #24 wire (*)
L8A—Q9 base link (144 Mc); 1 1/2 turns #24 wire wound on cold end of L8
L9—Q9 collector coil (28 Mc); 13 turns #29 wire (*) close wound
L9A—Output link (28 Mc); 2 turns #29 wire wound on cold end of L9
L10—Q12 emitter coils (28-30 Mc); 23 turns #29 wire close wound on 3/16" diameter slug tuned coil form (**)
L11—Q12 collector coils (116 Mc); 4 turns #24 wire (*)
L11A—Q9 emitter link; 1 turn #24 wire wound on cold end of L11
L12—28 Mc input link; 5 turns #29 wire close wound (*) on ground end of L12A
L12A—28 Mc input coil; 12 turns #29 wire close wound (*)
L13—28 Mc tuned circuit; 13 turns #29 wire wound on 3/16 diameter slug tuned coil form
L13A—Q10 base link; 2 turns #29 wire wound on cold end of L13
L14—Q10 collector coil (5500 kc); 32 turns #29 wire close wound (*)
L15—5500 kc tuned circuit; 49 turns #31 wire close wound (*)
L15A—Q11 base link; 8 turns #31 wire wound on cold end of L15
L16—Q13 collector coil (22.5 Mc); 8 turns #29 wire wound on 3/16" diameter slug tuned coil form
L16A—Q10 emitter link; 2 turns #29 wire wound on cold end of L16
L17—Q14 collector coil (5045 kc); 49 turns #31 wire close wound (*)
L17A—Q11 emitter link; 4 turns #31 wire wound on cold end of L17

Notes:
(*) All coils so marked are wound on 15/32" diameter plexiglass rods. See detail D.
(**) For proper operation of oscillator L10 must be resonant between 20 and 30 Mc. Exact frequency is not critical.

T1—455 kc *if* transformer
T2—455 kc *if* transformer
T3—455 kc *if* transformer
T4—audio interstage transformer
T5—audio output transformer

the collector current to see if there is a tendency toward thermal runaway. If this ha pens increase R2 in small steps. Now p Q2 in its socket, apply power to this sta always through the milliammeter and tune (for maximum reading of the grid-dip met In the same way tune up the following stag Do not be afraid to lose drive to the m tiplier stages; if this happens the transisto cannot be damaged since they are at cut- with no drive. When you are confide every stage is working properly, you c check the modulation by listening to it your 2 meter receiver.

Receiver

The tuneable *if* receiver is by far the mo critical part of the entire rig. It is built on 9" × 3¾" copper clad phenolic plate. S template B. Form the complete intersta shield by following dimensions given in te plate B: all parts for this shield are cut o of 1½" high thin brass strip and then so dered together.

To facilitate wiring of the *if*, the shield soldered in place after wiring is completed. advise following the layout shown carefu since it prevents all troubles due to unwant coupling between stages.

When wiring is completed and the shie is in place, start checking the audio stage connect a loudspeaker across secondary of T and an audio signal generator (or any oth audio source such as the output from a reco player) to point A: audio output should clean and undistorted. Next tune the 455 *if* (Q 17, Q 16, Q 15), by connecting a mo ulated signal generator across primaries of T T2 and T1 and tuning these transformers f maximum output as seen on a ac voltmet connected across the loudspeaker. If how and whistles are heard when all the 455 transformers are tuned the *if* strip must neutralized. This is accomplished by reversi the secondary leads of T2. This should gi a marked inprovement: if however oscillati

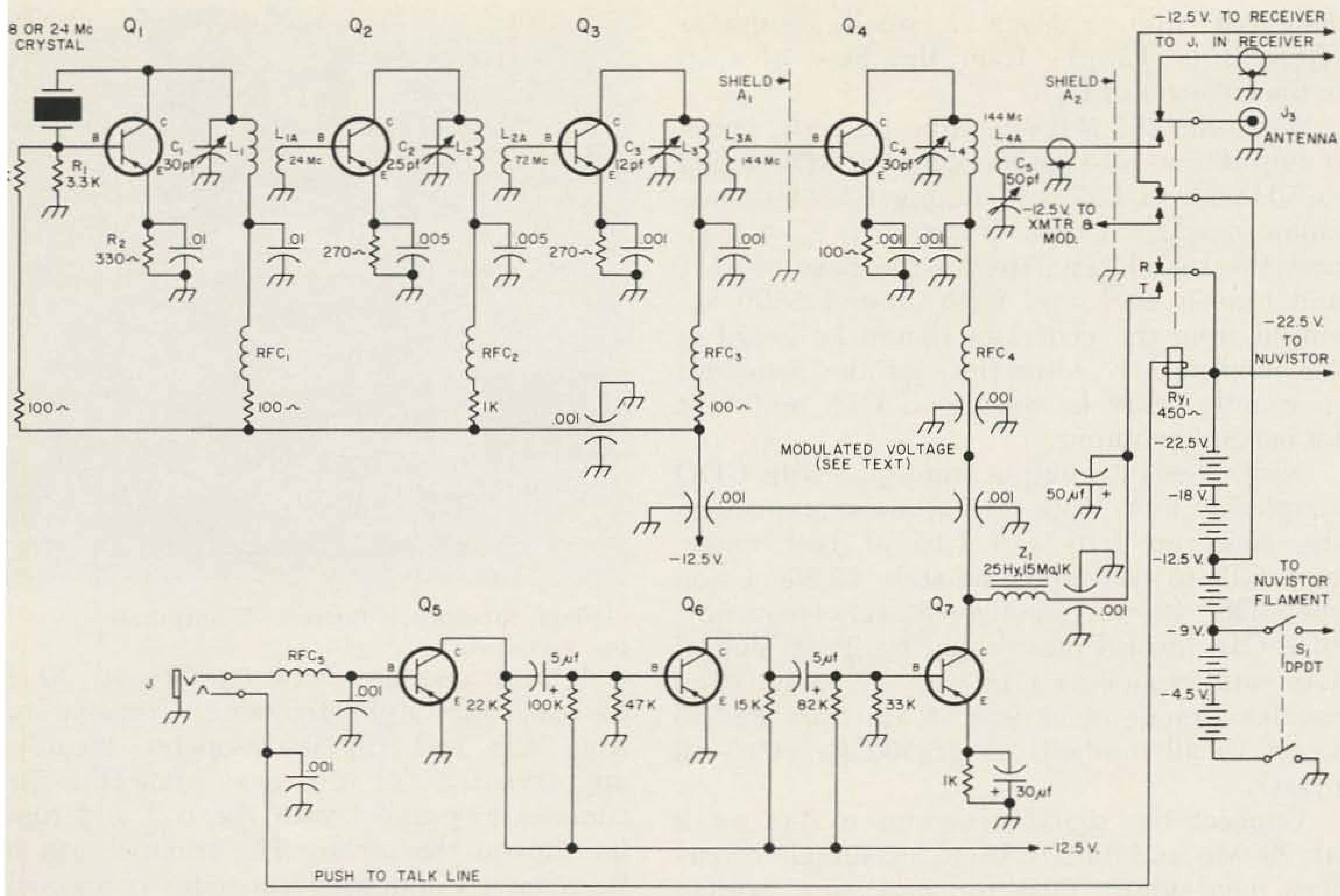


Fig. 2. 2m transmitter

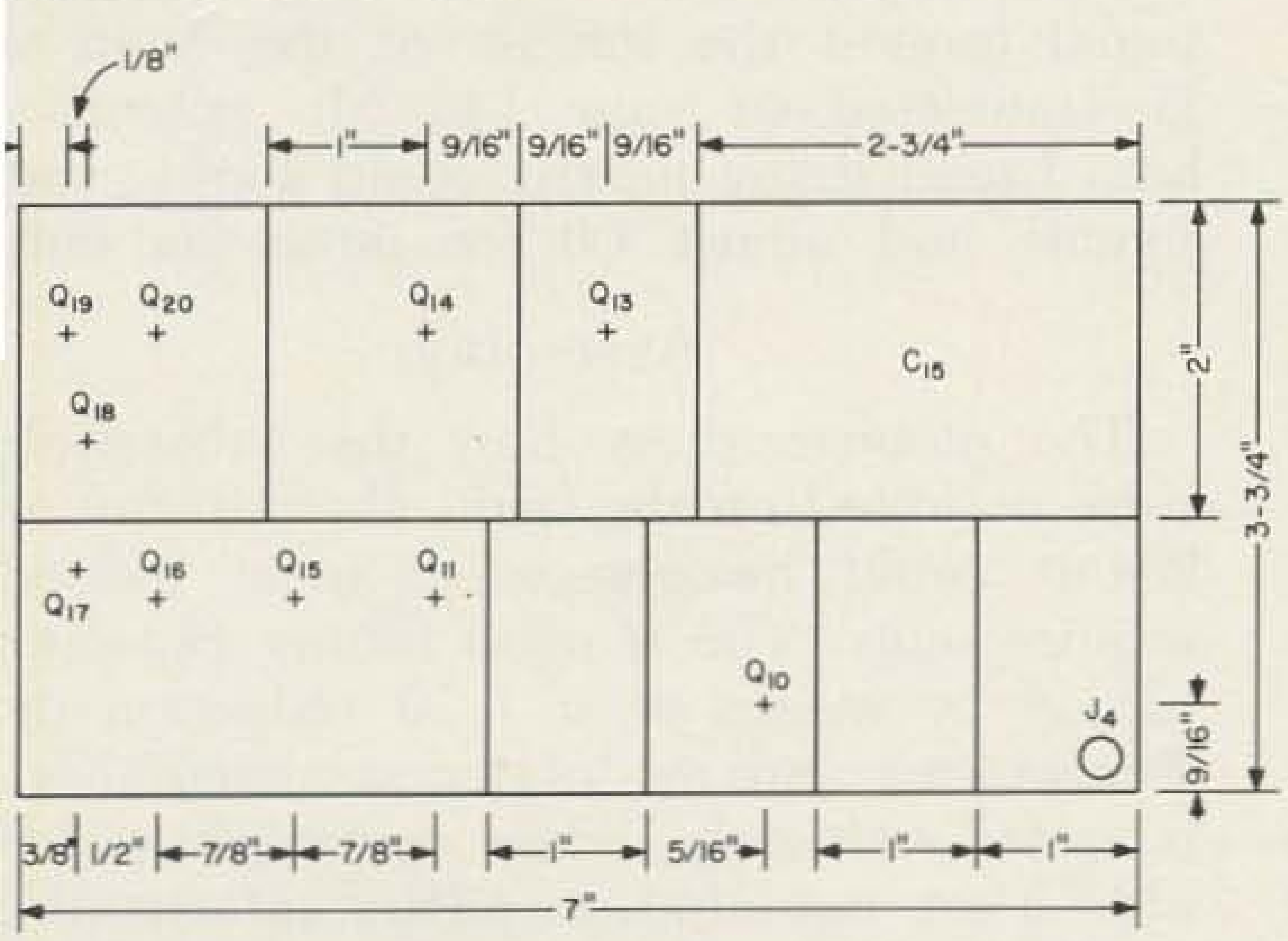
Transmitter Coil Table

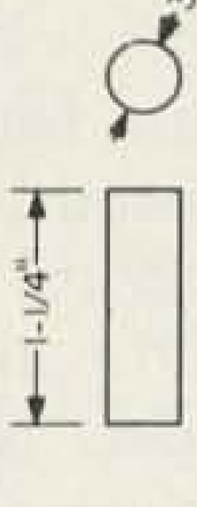
: 18 turns of #32 wire on 1/4" coil form: close wound
A: 4 turns of #32 wire wound on cold end of L1
: 7 turns of #28 wire on 1/4" coil form: close wound
A: 3 turns of #28 wire wound on cold end of L2
: 3 1/4 turns of #18 wire air wound: coil diameter 1/2", coil length 5/8"
A: 2 turns link of #18 wire (insulated)[1] inserted between turns of L3
: 3 1/4 turns of #18 wire air wound: same dimensions as L3
A: 1 3/4 turns of #18 wire (insulated)[1]: inserted between turns of L4
ote: Insulation is made with spaghetti to prevent accidental shorts with collector coils.

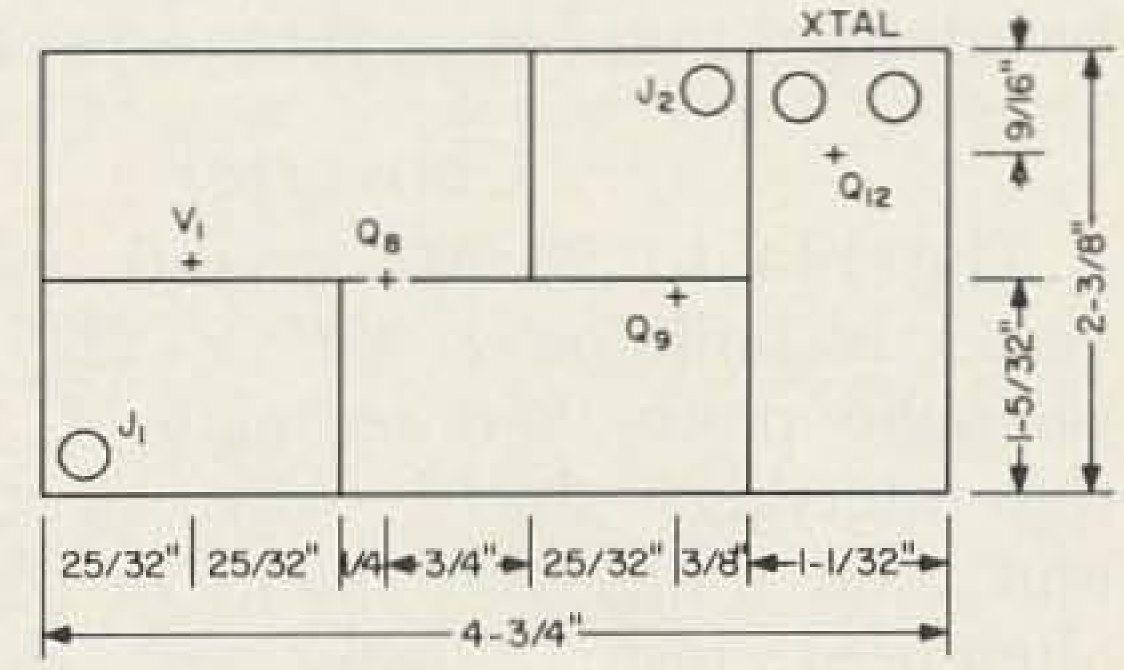
Transistors

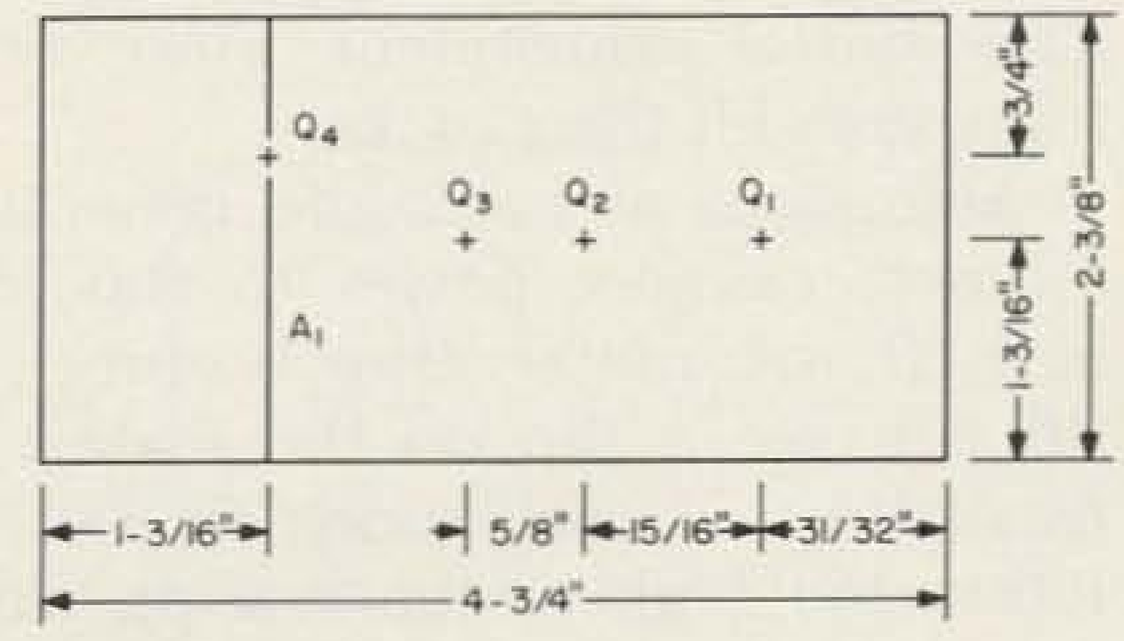
Q1, Q2: OC171, 2N1517, 2N2084
Q3, Q4: AF102, 2N2084, 2N2671
Q5: OC71, 2N2428, 2N1274
Q6, Q7: OC74, 2N109, etc.
Q8, Q9: AFZ12, 2N2495, 2N2360, 2N2084
Q10-Q14: OC171, 2N1517, 2N2084
Q15, Q16: OC170, 2N156, 2N267
Q17, Q18: OC70, 2N2428, etc.
Q19, Q20: OC74, 2N109, etc.

American types are editor's suggestions. Many other types will also work.









Above: Detail B, receiver *if* layout. Top right: C, converter. Bottom right: A, transmitter. Center: Detail D, coil forms.

does not stop, connect a small condenser (from 3 to 12 pf) from the base of Q16 to the collector of Q15.

When the 455 *if* is operating properly, check rf output from Q14 by coupling the GDO tuned to 5045 kc to L17 and tuning C18 for maximum output at this frequency. Now connect the signal generator to the base of Q11 and tune it back and forth around 5500 kc: output from the generator should be heard in the loudspeaker. After this, set the generator to exactly 5500 kc and tune C18 and C14 for maximum output.

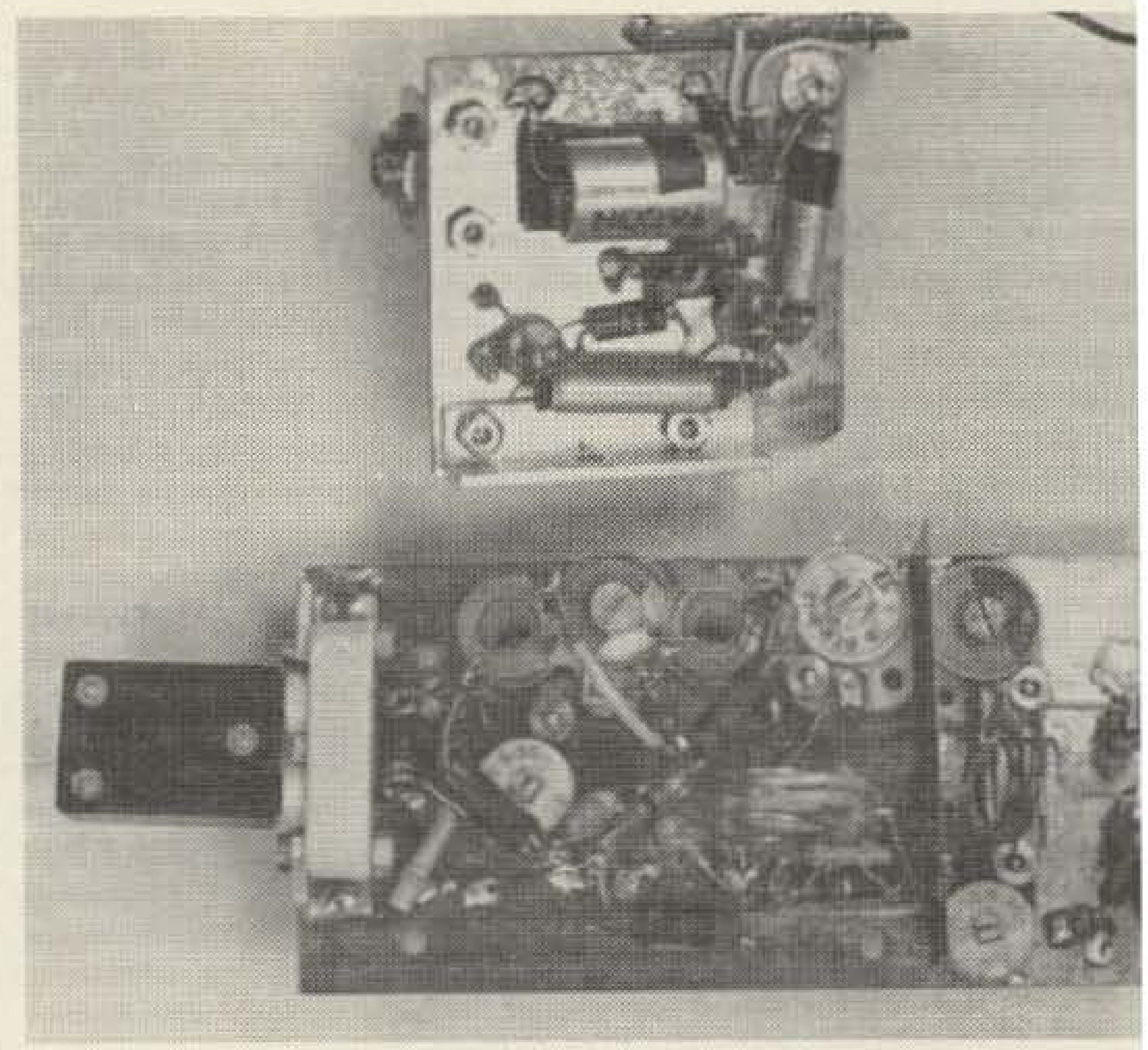
Next, check for output from Q13 with GDO coupled to L16. With C15 at maximum capacity, slugs on L16 and L15 at half range, tune C17 to read approximately 22,500 kc on the GDO. If you cannot reach this frequency, tune C16 toward more capacity. Tune slug of L16 and capacitors C16 and 17 to have an oscillator range of at least 4 Mc from 22,550 kc (C15 all meshed) to 26,500 kc (C15 all open).

Connect the signal generator to J4: set it at 28 Mc and turn C15 to maximum capacity: now adjust C12 for maximum output. Set generator to 30 Mc, tune C15 to receive this signal and adjust C10 for maximum output. Next set generator to 32 Mc, tune C15 to receive this signal and adjust C11 and L13 for maximum output. Repeat the above procedure several times, since these adjustments interact. When the 4 Mc coverage is accomplished and Q10 and Q13 are tracking properly, set again generator to 30 Mc and tune C13, C14 and C18 for maximum output. This alignment is easy if it is remembered that C12 and C16 are in series with the two sections of C15: to get more coverage from the main tuning condenser, C12 and C16 must be adjusted to increase their capacity.

Converter

The 144 to 28 Mc crystal controlled converter is built on a 4¾" × 2⅜" copper clad phenolic plate. See template C. Again form the interstage shield, wire all the assembly and then solder the shield in place. Prior to alignment, test all coils with the GDO and bring them to resonate on the proper frequencies by means of the parallel trimmers. This initial adjustment must be done with transistors off their sockets.

Alignment of harmonic generator Q12 is as follows: connect power to this stage through a 0-10 ma meter: slowly tune slug of L10 till you see a dip on the meter: Q12 is now oscillating. If oscillations do not start, L10 is either too high or too low on frequency: this



Top: Modulator. Bottom: Transmitter

coil must resonate between 20 and 30 M to reach the right frequency, remove tur from the coil till it resonates broadly approximately 32 Mc; now connect a 50 trimmer in parallel with the coil and tune for dip on the meter. The trimmer can n be removed and fixed capacitor connected its place. With Q12 oscillating, couple t GDO, tuned to 116 Mc, to L11 and tu C9 and L10 for maximum output.

Connect a short cable between J2 and communications receiver tuning from 28 32 Mc (The variable *if* can be used if y have already aligned the dial). Set receiver 28 Mc, signal generator to 144 Mc and co nected to J1: adjust C6 for maximum outp generator to 146 Mc, receiver to 30 Mc: adj C7 for maximum output; finally generator 148 Mc, receiver to 32 Mc and tune C8 maximum output.

V1 must be neutralized: to do this, disc nect −22.5 volts to this stage leaving filament power. Tune in on receiver a stro signal around the middle of the band w J1 connected to your 144 Mc antenna ham friend living nearby could supply such signal) and adjust L6 for *minimum* outp

Assembly

The pictures show how the subassembl were mounted on the main chassis: any ot layout could be chosen to meet individ requirements. The *if* main tuning capacitor turned by means of a 1:10 reduction dri Transmitter and modulator subassemblies mounted vertically, while converter and va able *if* are mounted on pillars cut out of t copper tubing. For frequency stability, least four pillars should be used for the va ble *if*. . . . I1SI

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A Simple 2m Collinear

A while back, a ham got tired of fighting poor signal reports on two meters. So, he built a series of yagi antennas. Some improvement, but not worth the blood, sweat, tears and *time* wasted in trying to resonate the things, broaden or narrow major lobes, drop SWR, etc., etc., etc. It was all of the etc.'s that tired that ham (me). The etc.'s were mostly raising and lowering antennas by hand; very tiring work . . . but, I came to a conclusion:

The extra-ordinary ham, of course, has the knowledge, skill, instruments, and *time* to properly design, build and tune those tricky yagis; but how about the rest of us, the "average" hams? Is there no two meter antenna that is broad-banded, that is not so sharp directionally that being 10 degrees off one way or the other misses a signal, that needs

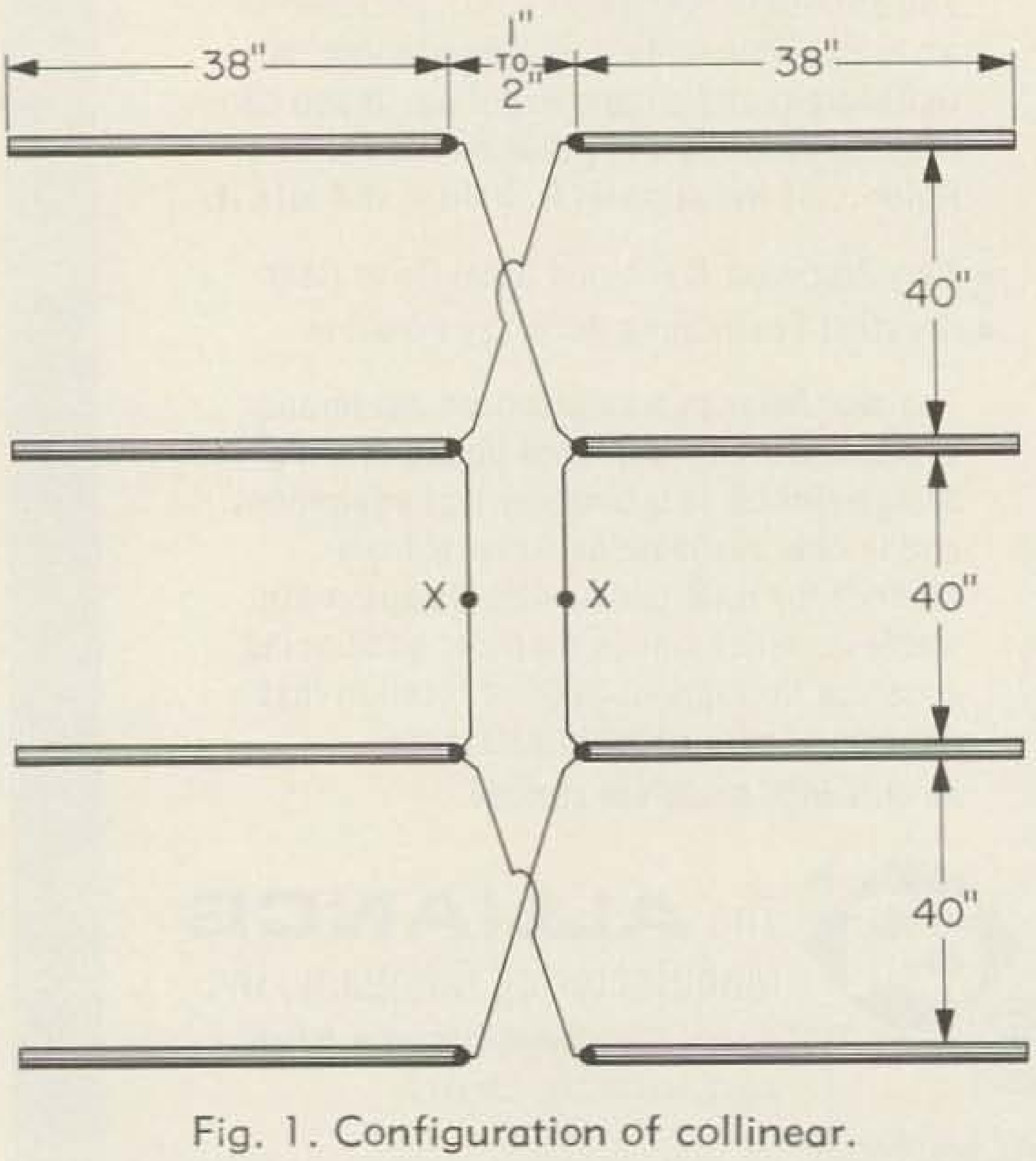

Fig. 1. Configuration of collinear.

little or no adjustment to get that SWR down? Yes, the collinear array.

This is the answer for the "average" two meter ham. This is the antenna that works like a charm the first time. The 16 element version described here is roughly the equivalent of eight 2-element beams, is easily fed and has a large "capture area" (this is good on two meters).

A collinear curtain consists of eight horizontal half-wave driven elements, arranged four high and two wide, and spaced 1 or 2" end to end, horizontally, and ½ wave apart vertically. See **Fig. 1.** Such an array radiates broadside, that is, into and out of the page. The feed point impedance of an end fed half-wave is quite high, but by feeding several it can be brought down to under 1000 ohms (a value that can be manipulated).

A set of 8 reflectors should back up our 8 driven elements to bring the impedence down further, and also to improve the directional qualities of the antenna. These reflectors should be 40" long (using ¼ to ½" tubing). Spacing them .2 wavelengths (16") behind the 38" long driven elements will bring the feedpoint impedence (X-X) down very close to 300 ohms. So much for theory.

In practice, the heart of the collinear array is the physical supporting structure. You can build the thing all-metal, as in **Fig. 2.** Since the driven elements and reflectors are supported at voltage nulls, no insulation is needed. This kind of construction works find. But—look at the size and at the relative complexity of construction that this all-metal array presents to the average ham-type builder, who is armed only with hacksaw, hand tools, and hand drill.

There is another way to support a collinear, and it's the method used by most of the antenna manufacturers. A look at **Fig. 3** will how you why. You can see that physically his is simpler; the only catch is that the nsulators must be both non-conductive at two neters and strong enough to support up to :0" of element on either side of it. You can ee that electrically this type of construction ; much "cleaner," having less metal floating round to adversely affect pattern, SWR, tc. It decreases the XYL-R, too, due to its eater (and lighter) appearance.

Well, having long been sold on collinears ver yagis, and, more recently, sold on insulaive over all-metal construction, it appeared hat the only thing standing between me and *good* antenna was the little matter of those special" insulators. But, when you are as dumb s I am, you have to be lucky . . . and sure nough, I lucked in. I found myself in Sears Roebuck one day, and I wandered into the plumbing department by mistake (dumb but ucky, remember). I had this antenna dilemna on my mind, so you can imagine my urprise and delight when I looked up and aw a whole pile of my "special" insulators for !9c a shot. Of course I corralled the nearest alesman and applied pressure at his elbow intil he agreed to break open a dusty catalog rder book to determine just what those little eauties were made of. After a little search, ie was able to supply me with flow-data, tc., *and* inform me that they were made of NYLON. They were nylon "T's" for plastic pipe used in do-it-yourself plumbing. I bought

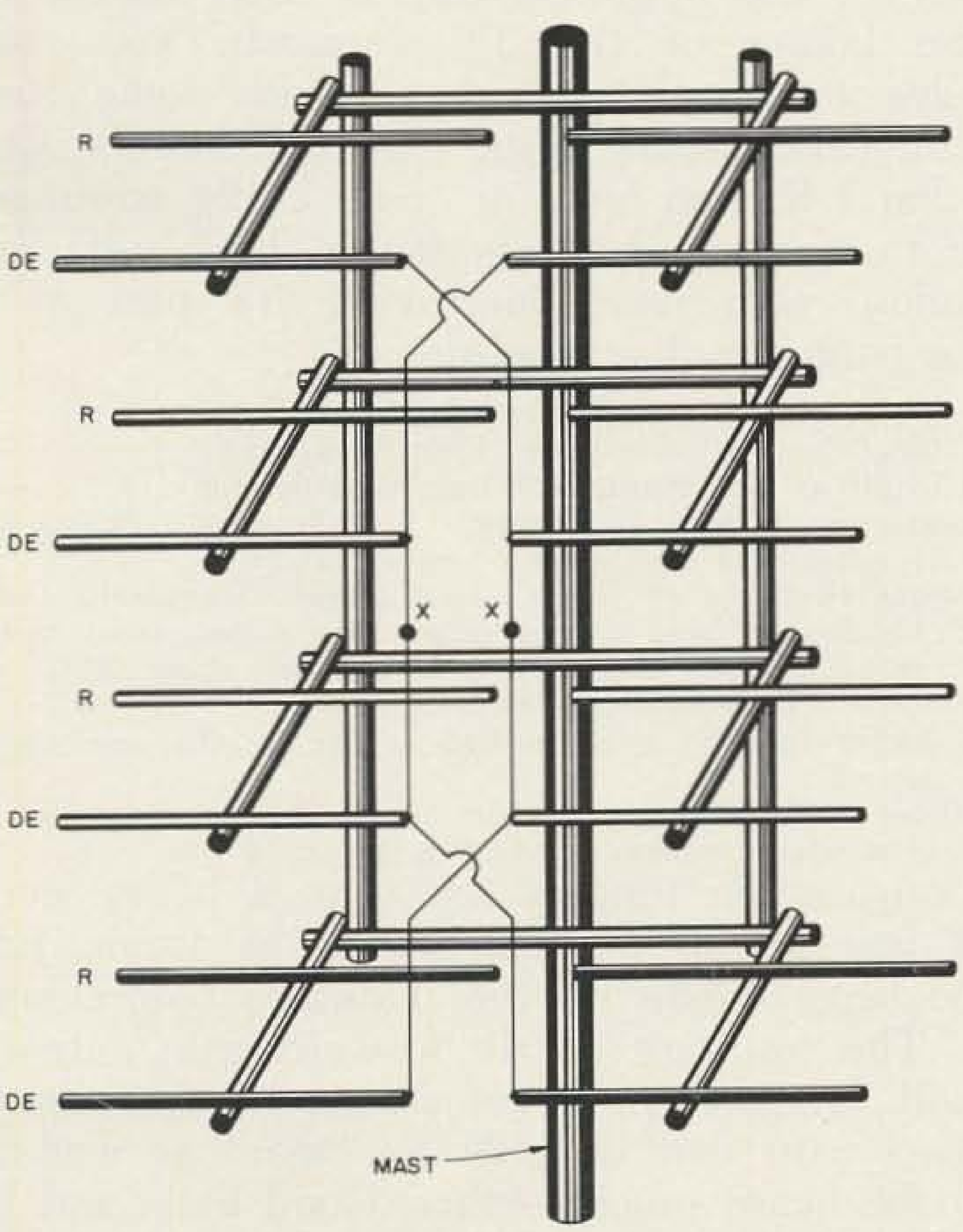

Fig. 2. All-metal construction.

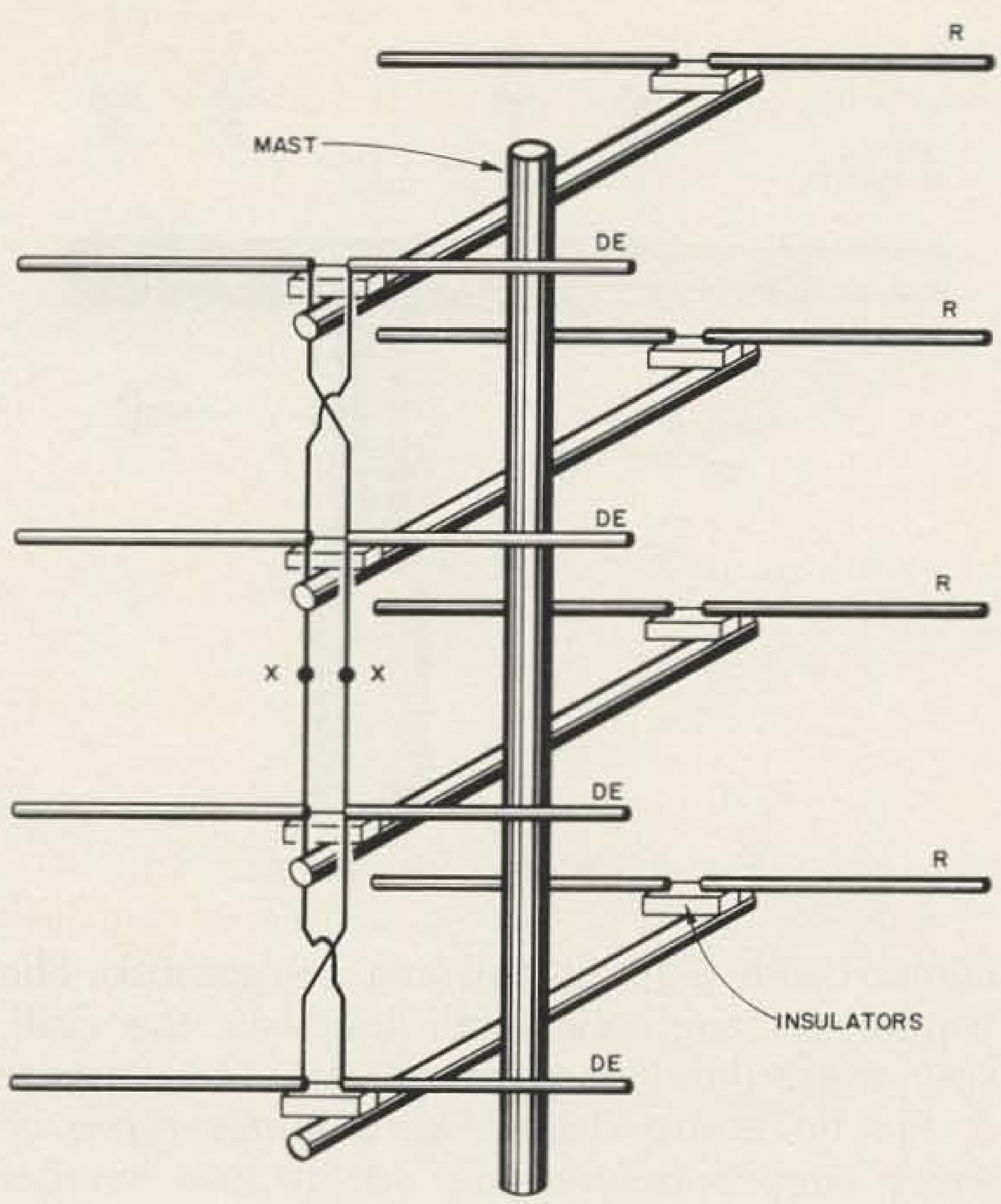

Fig. 3. Simplified construction.

8 and left the salesman wondering about my plumbing project and my sanity.

These "T's" come in at least two sizes. I got the smaller size—just a shade over ⅝" O.D. They are designed to be jammed into plastic pipe, so they have raised, sloping rings on the connecting portions that act like barbs to secure the joint. This also helps hold them when they are jammed into aluminum tubing that is ⅝" I.D.

The collinear elements are inserted into the "arms" of the "T" and secured there by means of 6 × ½" sheetmetal screws (**Fig. 4**). Drilling the small pilot holes for these screws was troublesome until I found that the smooth, curved Nylon surface could be "dimpled" by touching with a warm soldering gun. I also discovered drilling the pilot holes in both the element and the "T" for the "A" screws before assembly was the easiest method. After the "A" screws are in, one shot of the hand-drill will drill the hole for the "B" screws in the "T" and the element simultaneously. Naturally, it goes almost without saying: don't overtighten these screws. Remember, this is soft nylon and soft aluminum.

Since the driven elements have to be fed at the end (and inside the "T"), it is necessary to put an electrical connection at screw "A." I found that thin strips of copper drilled to pass the "A" screws worked fine. If you want to solder these copper tabs to screw "A," do it before screw "A" is set in the nylon. Another word of caution: drilling small strips of

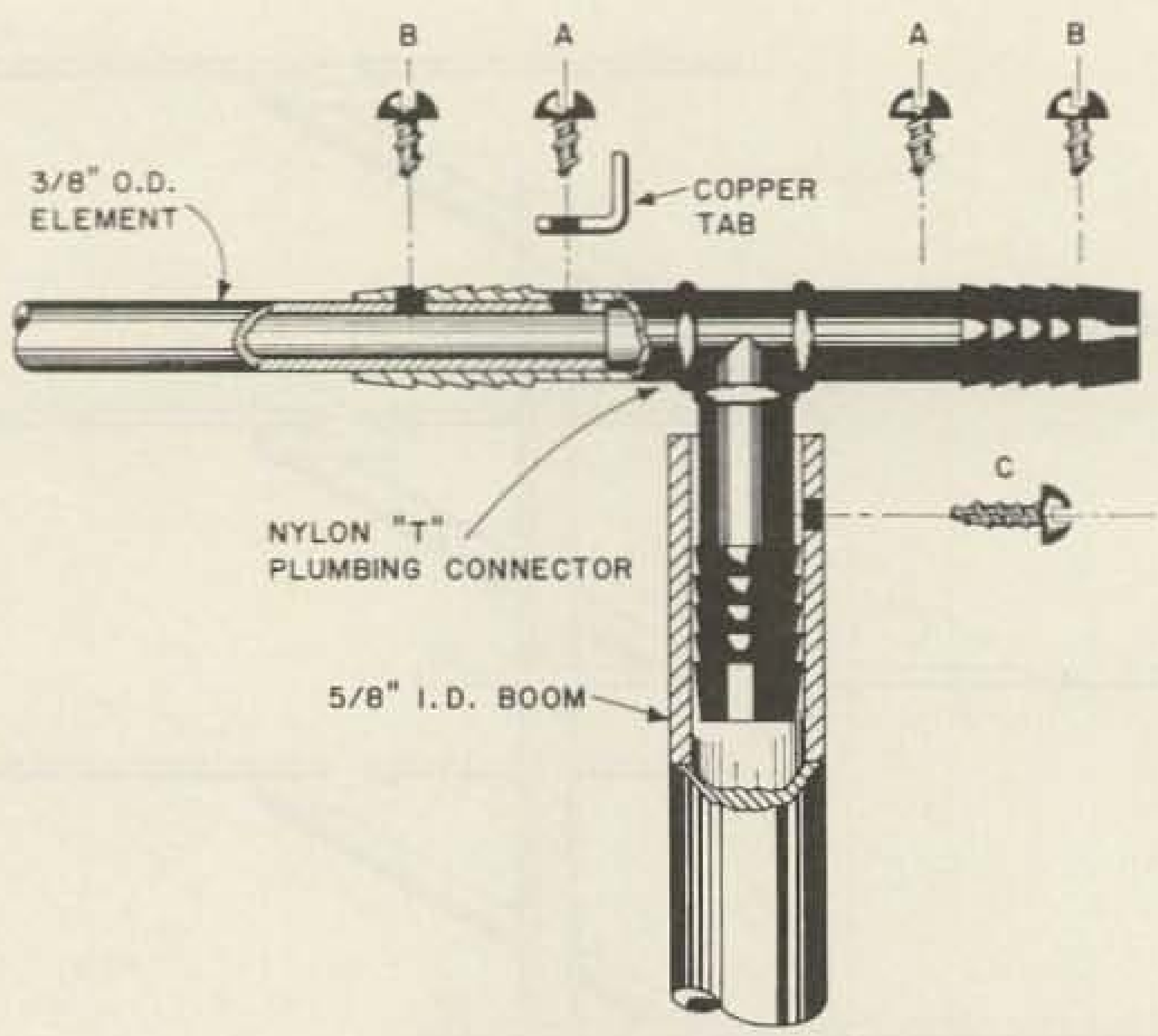

Fig. 4. Details of insulators.

copper with a hand-drill can be painful. The copper is tough and will bind on the drill, spinning around chopping fingers. It is easier if the holes are drilled in a larger piece of sheet copper before you cut it into smaller strips. The larger piece of copper is easier to hold on to.

After 2 driven elements are secured in one "T" and 2 reflectors in another, plug the 2 "T's" into the ends of the ⅝" I.D. boom. Lay this H-shaped bay on a flat surface, such as a porch or driveway. This lines up the driven elements and reflectors into the same plane. Be sure that your U-bolt holes are also in this plane by running a long, straight rod through them. When all the elements and U-bolt holes are flattened out, drill the pilot holes for the "C" screws, and insert them. See **Fig. 5** for the layout of a single bay.

When you have built 4 of these bays, you are ready for a rest. All that remains now is to stack these 4 bays on a mast and hook up the phasing and feedlines. When you have the bays stacked on the mast, 40" apart, and all facing the same direction, solder the phasing lines to the copper tabs on the driven elements' "A" screws as shown in Figure 1. The ARRL Antenna Handbook says to use #18 copper (or copperweld) spaced 1"; so copper I used. Where the phasing lines cross, between the central and outer bays, a couple of home-made phasing line separators are in order. Any good insulator that will separate the phasing lines by about an inch will do the job. I happened to have on hand, and used, thin strips of plexiglas slotted at the ends. After the lines have been slipped into the slots, a touch of the soldering gun will fuse the slots closed tightly over the wire, keeping the separators in place on the line.

Attach your 300 ohm twinlead, open-wire

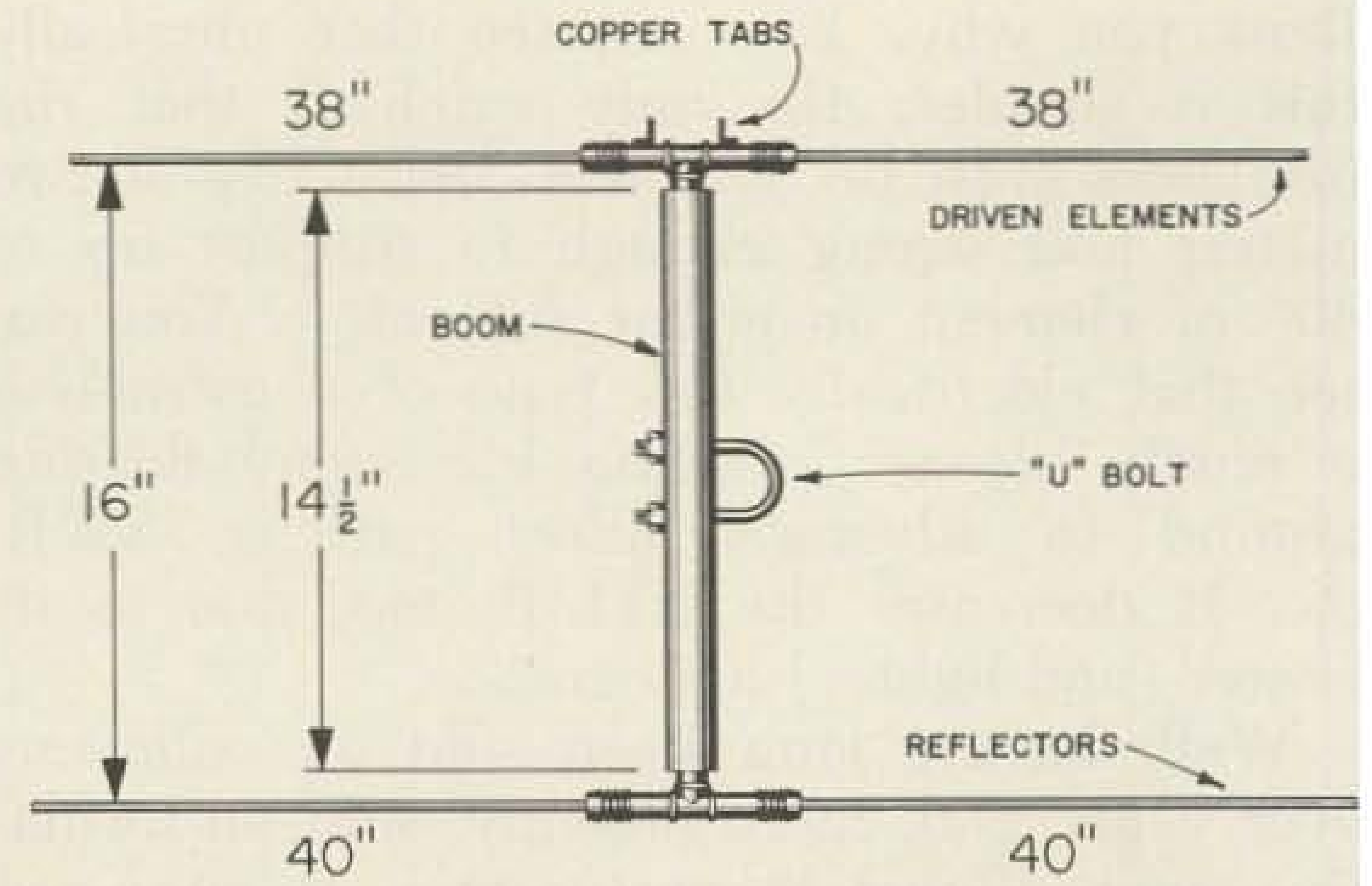

Fig. 5. Layout of single bay.

line, or 4 to 1 coax balun at the points marked X-X on **Fig. 1**. Lift the thing into the air and use your creation. Store bought arrays are dandy, but they never quite give the same feeling of accomplishment that a well-constructed home-brew antenna does. Besides store bought arrays are worth every cent you pay for them, but they do cost in the neighborhood of $20. I managed to build mine for less than $3, but I had a head start . . . I had the U-bolts on hand. Assuming that any ham worthy of the name can make sure he falls heir to a graveyard of busted TV antennas, the array here can be built for about 33c per db, *ie*, $4 for a 12 db antenna. TV antennas, especially those terrible conicals, are generally built of the approximately ⅜" O.D. aluminum tubing used here. If you can't find any of the approximately ⅝" I.D. tubing in the booms of the TV antennas, you may have to surrender and purchase some conduit (aluminum). Mine was built largely with what I had on hand or could easily scrounge. If these methods or materials don't suit you, follow your nose, improvise; it's part of a long-standing ham tradition.

Parts List

8 lengths of ⅜" tubing 38" long (aluminum)
8 length of ⅜" tubing 40" long (aluminum)
4 lengths of ⅝" I.D. tubing, 14½" long, and drilled for
4 U-bolts (size depending on your mast)
About 40 #6 x ½" sheet metal screw (Sears calls them #7137-Binder head gimlet point zinc plated sheet metal screws, and sells them 20 to a box for about 20c)
8 nylon "T's"—⅝" plus O.D.
8 copper tabs 1" x ¼" drilled at one end to pass above screws
About 21" of #18 copper wire
2 or 4 plastic separators 1¼" x ¼" x ¼"

Construction time is less than 4 hours, even if you are as non-mechanical as I am. Just be sure to line up the materials beforehand.

The resultant 12 db forward gain antenna will increase your enjoyment of two meter since you will be able to "hear" as well as to be heard much further. Good luck, and be seeing you via Oscar IV.

. . . W5GVE

Mosley

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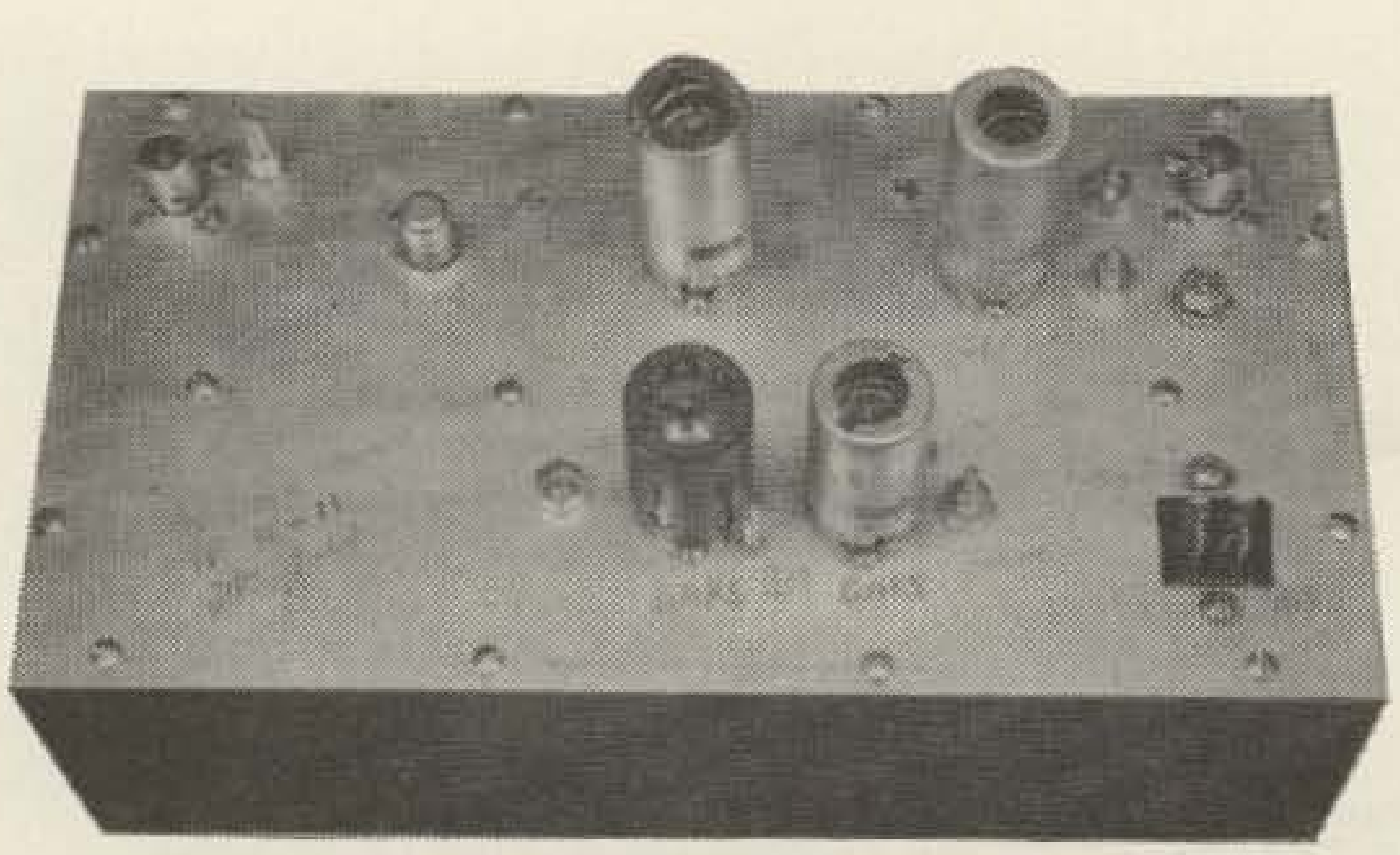

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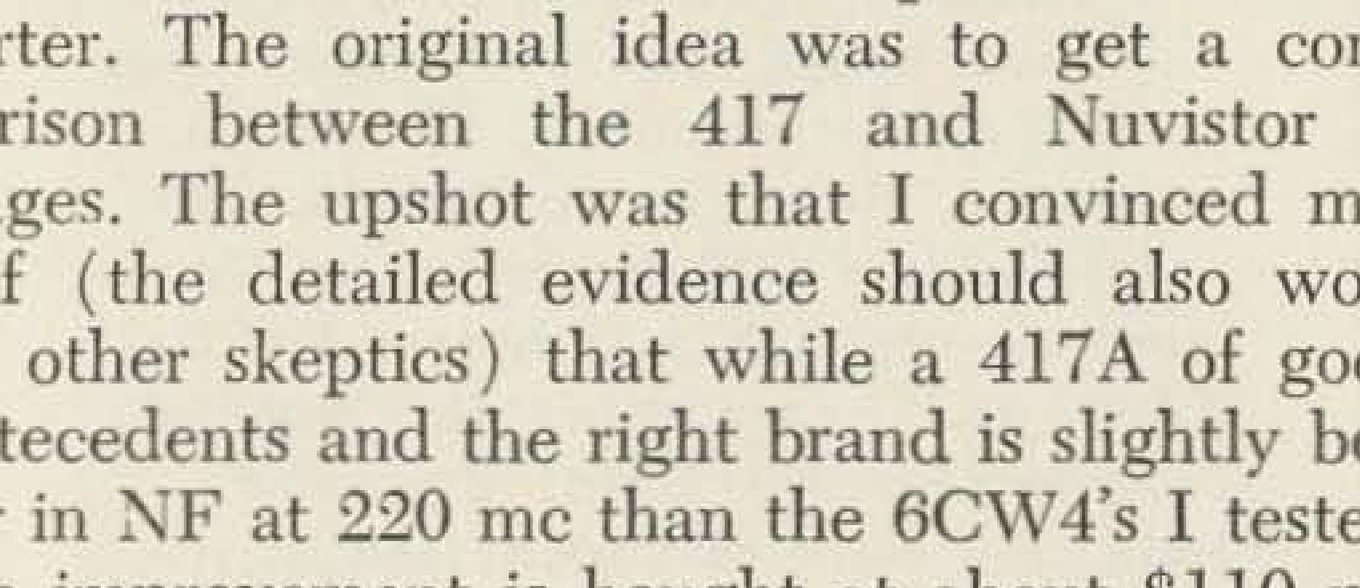
220 mc Converter No. 9

(Not a construction article)

I don't make them all alike, because ham radio is a hobby, and the fun in *making* them is to try something that is at least a little different from the conventional.

This converter started out as an argument. It was a test bed for several rf stages using the 6CW4, at the same time that I was fooling with a somewhat modified Tapetone 220 converter. The original idea was to get a comparison between the 417 and Nuvistor rf stages. The upshot was that I convinced myself (the detailed evidence should also work on other skeptics) that while a 417A of good antecedents and the right brand is slightly better in NF at 220 mc than the 6CW4's I tested, the improvement is bought at about $110 per decibel. (Not to say that you can't do better; just that I didn't.) The comparison was valid because the converters were the only differences between the two setups, and correction for the second stage contributions was made in each case. I tried the 6CW4's grounded-grid first; at 220 that grid lead is too long for stable operation. Neutralized, the noise figure was the same as I later found the grounded-cathode connection to be . . . a bit under 5 db. Neutralizing the g-g Nuvistor was trickier than for grounded cathode, hence, I do not recommend it. The 417, by comparison, is stable, and seems to need no neutralization, as the layout is of course ideal for grounded-grid. There is a new g-g Nuvistor that should be excellent if it can be obtained.

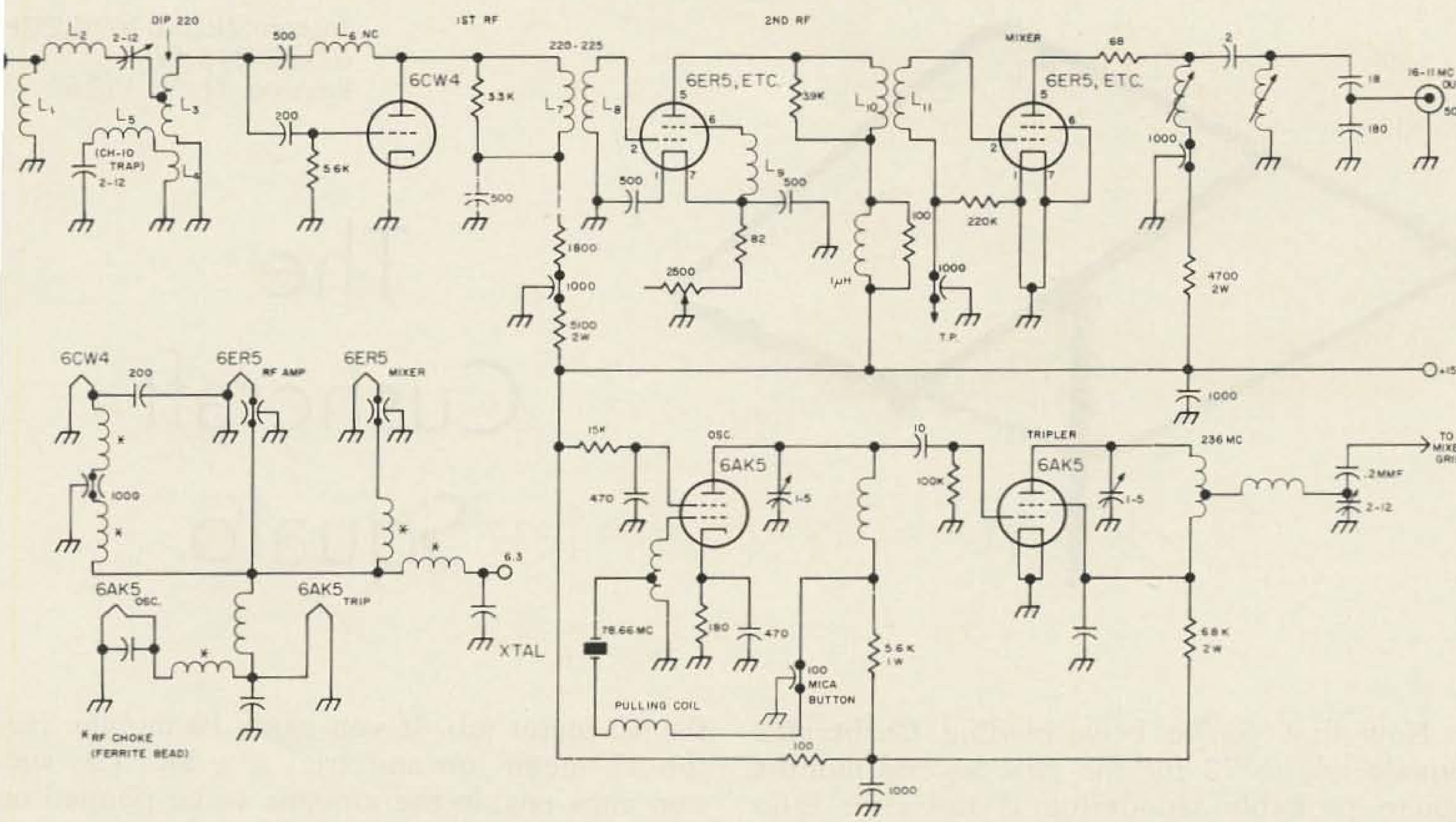


Bottom view. Input on left. Mixer to right. Crystal oscillator behind partition.

Aside from the first rf stage, which is conventional (other than the channel 10 trap which is built around the input network) there are a few novelties in the rest of the circuit:

1. The oscillator is on the high side so you'll get no images from TV. 236 mc means that you tune 16 to 15 for 220 to 221. The circuit is not original, but seems somewhat more stable than the more common Butler oscillator. The first 6AK5 acts as an overtone oscillator, with the crystal series resonance in the low-impedance feedback path. A coil or capacitor in series permits a small adjustment of the frequency to get calibration. The second 6AK5 is a tripler to 236 mc. A double-tuned network filters the drive which is coupled to the mixer grid by a capacity probe sticking through the partition.

2. The second rf stage uses a 6ER5 or 6FY5. These are somewhat overlooked by many hams; they are better and simpler than, for instance, a 6BQ7. For one-band use the neutralization is simple, similar to what's used in many pentodes on six meters. The shield is only that (no current flows) so the noise formulas for triodes apply. In this application, the excess gain is held down by a cathode bias pot. Probably the second stage is not needed, but calculations showed that it *might* make as much as a decibel difference in overall noise figure, so in it went. (I use a single 6FY5 on 144 ahead of a 6CB6 mixer, for instance).

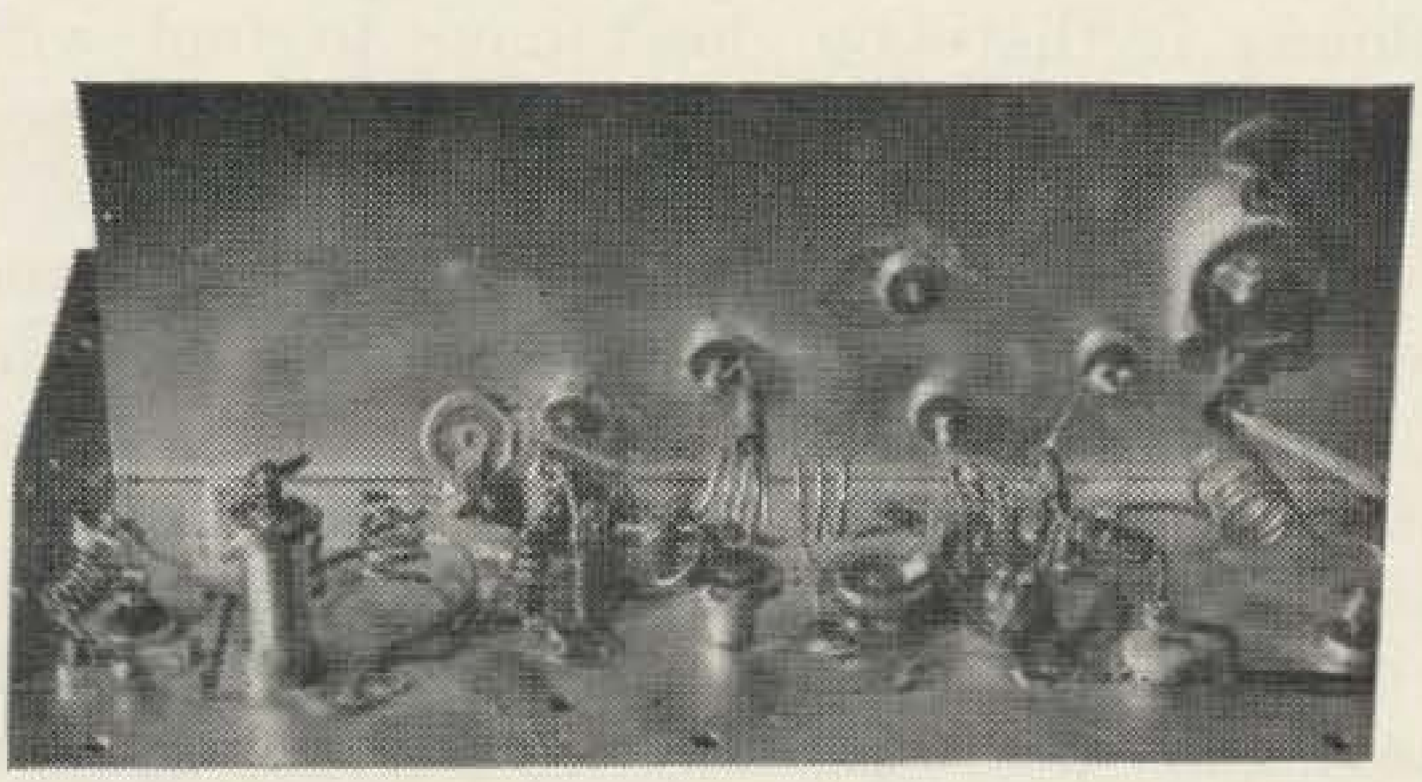


220 mc converter. Unmarked capacitors are 500 pf.

3. The mixer is a 6ER5. Very successful. The shielding is just what triode mixers always needed. Grid-leak bias makes for easy adjustment and provides a "detector" test point for sweeping the rf, or tuning up on a signal generator. There was sufficient injection available—2.5 volts at the test point was found best—to permit coupling quite loosely to the multiplier tank.

The *if* output circuit and general layout are similar to the Tapetone converters, as interchangeability made the aforementioned tests simpler. Apparently the oscillator-multiplier circuits are well shielded to avoid spurious beats, as there are two BC, three TV and four FM stations within a few miles of my QTH. (Channel 10, which gives me the most trouble on 220, is about 30 miles away).

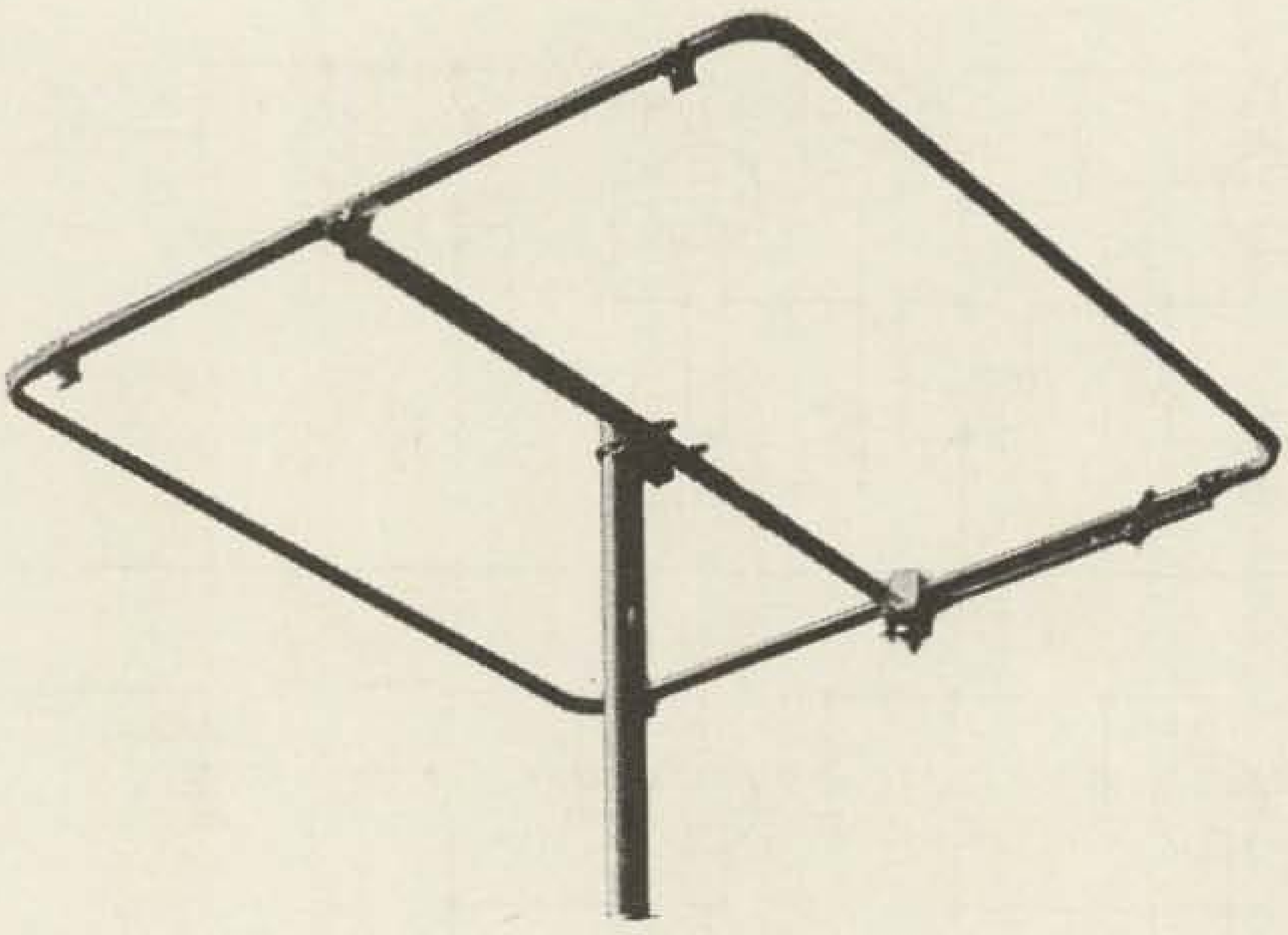
To make such a collection of conditionally stable tubes perform properly, tuneup proceeds from output to input. The oscillator is made to run with 22 ohms where the crystal should be; when it's on the right frequency,



RF stages. Input jack on left. 2-12 mmf oscillator trimmer at upper right.

substitute the crystal. The tripler primary is tuned for maximum soup as indicated on a grid dipper on the right frequency (in the diode position) and then the second 236 trimmer is adjusted to dip the primary rf. (Later trimming uses mixer grid bias, read at the test point.) The mixer grid coil is peaked to 222 with all power off, and the second rf plate coil loaded, detuned or shorted. Then the mixer has a detuning capacitor clipped across its grid coil and the second rf plate coil is initially tuned, also to 222. A signal is fed via coax to the second rf grid and the neut coil (between shield and cathode) is squeezed or stretched until the signal vanishes or at any rate is almost completely nulled out, the local oscillator and mixer being in action, but no heater power on the tube being neutralized. Once this is done, the 6ER5 grid and plate coils can be set to band center with the grid dipper, taking care to short the opposite windings of each pair. The Nuvistor grid plate neutralization coil is adjusted in a similar manner, but this coil will of course be much more sensitive to hand capacity. An orange-wood stick (get it from a manicurist or AT&T repairman) is handy for the coil adjustment.

The input adjustment will go fastest if you have an automatic noise-figure meter, but I use (at home) a target signal—a transistor oscillator or a long-winded ham—and a receiver with good avc action. It becomes easy to tune for best signal to noise ratio, which, of course, is what all this folderol was intended to accomplish. . . . W1OOP



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Bayside, N. Y. 11364

The Cushcraft Squalo

Now that you've been reading Cushcraft's Squalo ads in 73 for the past several months you're probably wondering if the cute little things really work. Yep, they do. The Squalo series consists of models from 2 meters on down through 40. They're a full half wave on all bands and horizontally polarized. They are nice and cheap ($8.45 up) but sturdily put together and have a radiation pattern which is essentially omnidirectional. Now the big plus . . . facility of mounting. This antenna can be put in more positions than Little Egypt. No kidding, you can mount it on anything (witness cover of 73 Jan. 65). They all mount beautifully on a tower. In fact the Cushcraft people would have you festoon a tower (or even rather light mast) with several Squalos for different bands. Not a bad idea, especially for you city-suburbanites where the real estate ads called the plots "estate sized" but you found it must have been a scale model, you bought. The largest model, for 40 is a comparatively small 16 feet square, the 20 meter version is only 100 inches square and the ten meter job is a tiny 50". The same rod that supports the Squalo on a mast can be swung around to one end and you can easily flip the thing out a window (making sure you hold on to the other end). This is a great antenna for portable operation because you can easily separate it into its four sides so even the largest can be tied onto the side of the car and transplored. When you put the thing back together it's a cinch. In fact you'll be finished before you could even untangle a dipole.

Here's the best part of all. The six meter model comes with suction cups which definitely makes it the best mobile antenna going. The CB version also comes this way, but not the 10 meter job. If you work 10 mobile, buy the 11 meter job and trim it a bit. The suction cups enable the antenna to be popped on the center of the car roof, like a luggage rack. This has a great effect on radiation pattern. The bumper mount halo or whip is not omnidirectional like the book says but in fact has a rather sharp lobe across the front of the car. The Squalo, by virtue of its center roof mounting position is much more omnidirectional. This all adds up to a great reduction in QSB on both transmit and receive. Also, it seems to me that ignition noise (especially from other cars) is reduced somewhat.

Helpful hints: When assembling the thing don't guesstimate the correct dimensions (which can be varied a few inches) or you will probably find the SWR heading west. Use a bridge and start with Cushcraft's suggested dimensions. Then a little poking around here and there will easily bring the SWR down to excellent levels. If you have problems getting the suction cups to stay stuck where you want them, a little vaseline or glycerine judiciously applied under the suction cups will turn the trick. Also take it from me, don't play with the Reddi match. It's right when it comes from the factory. One of the best things about this antenna is that you don't have to fool with baluns or matching networks to get a good SWR so take advantage of it.

You can use a standard bumper mount and mast on the higher frequency squalos but why lose the really great reduction in QSB when the roof top mounting is used. Of course you may have to use a bumper mount if you own a convertible, unless you typically ride with three bald men who don't mind sitting very still . . .

. . . WA2ZCH

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SPECIFICATIONS *

Frequency Range	143.975 to 148.025 MC
Modes of Operation	AM, SSB, CW
Carrier Suppression	50 db
Sensitivity	0.5μv for 10 db $\frac{S+N}{N}$
Selectivity	3.1 KC crystal bandpass filter
Output impedance	50 ohms
Audio Output	2.5 watts into 3.2 ohms
Antenna Input Impedance	50 ohms unbalanced

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Push Pull 5763's on 144

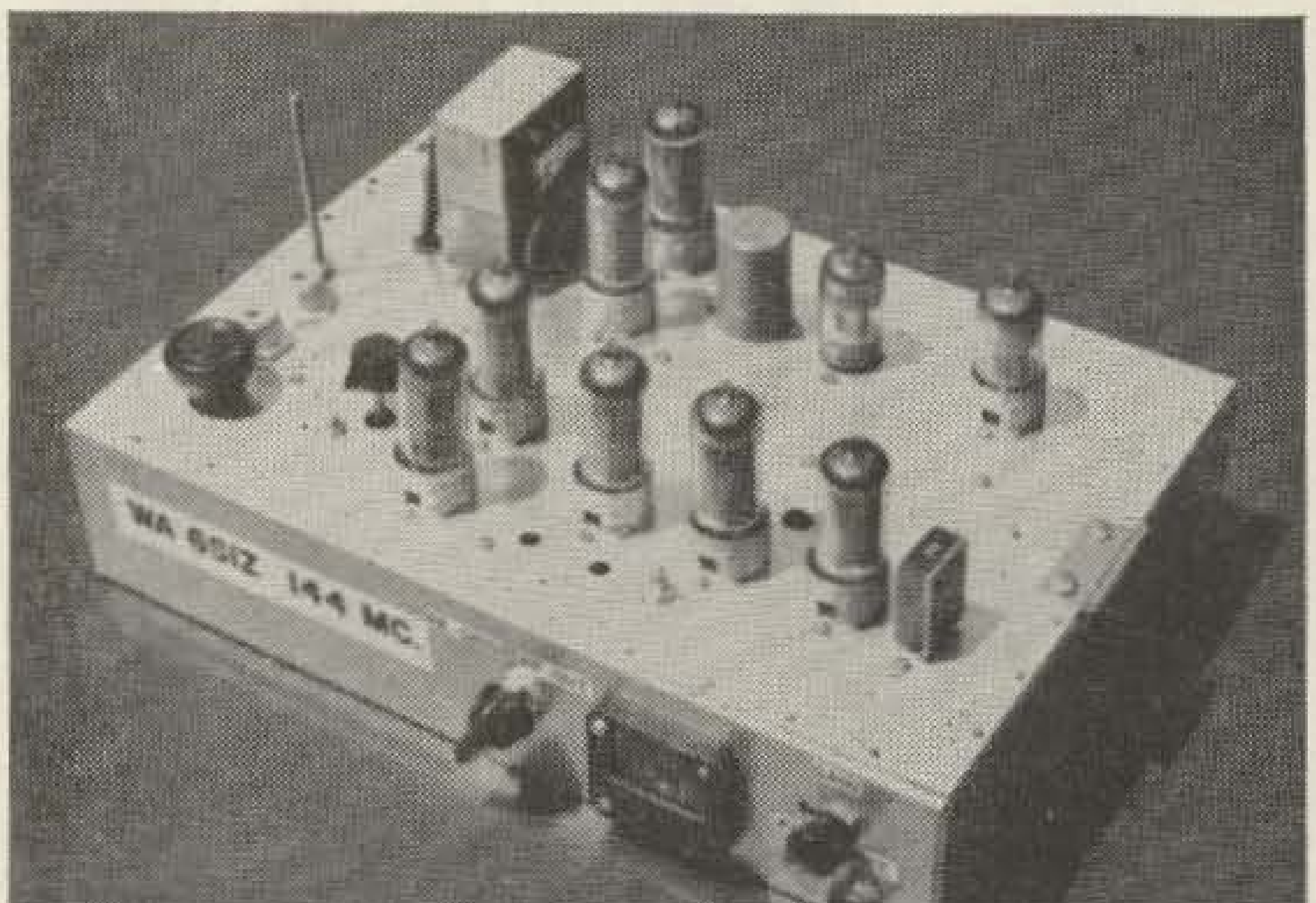


Photo Credit: WA6QDY

The club station for Aerojet-General Company's amateur employees owns Heath Sixers and Twoers which are circulated among members to give them a chance to try VHF bands. This got me on two meters—building and checking out a "Twoer" for W6IJK. Wanting something better than the "Twoer's" super-regen receiver, I built a nuvistor converter[1] to go with my NC-300, continuing to use the "Twoer" as the transmitter.

The Sacramento two meter gang kidded me unmercifully for having a ninety dollar receiving saddle on my twenty dollar transmitting mule. So I had to design and build a suitable transmitter complete with modulator to get out from under this barrage of kit-and-Gooneybird owner insults.

W6PIV suggested I consider using as a final, the 5763 which is often a driver but seldom a final. At two and a half dollars a copy, five dollars worth of 5763's is almost the rf equal of a six dollar 6360 (a dual tetrode very popular on two).

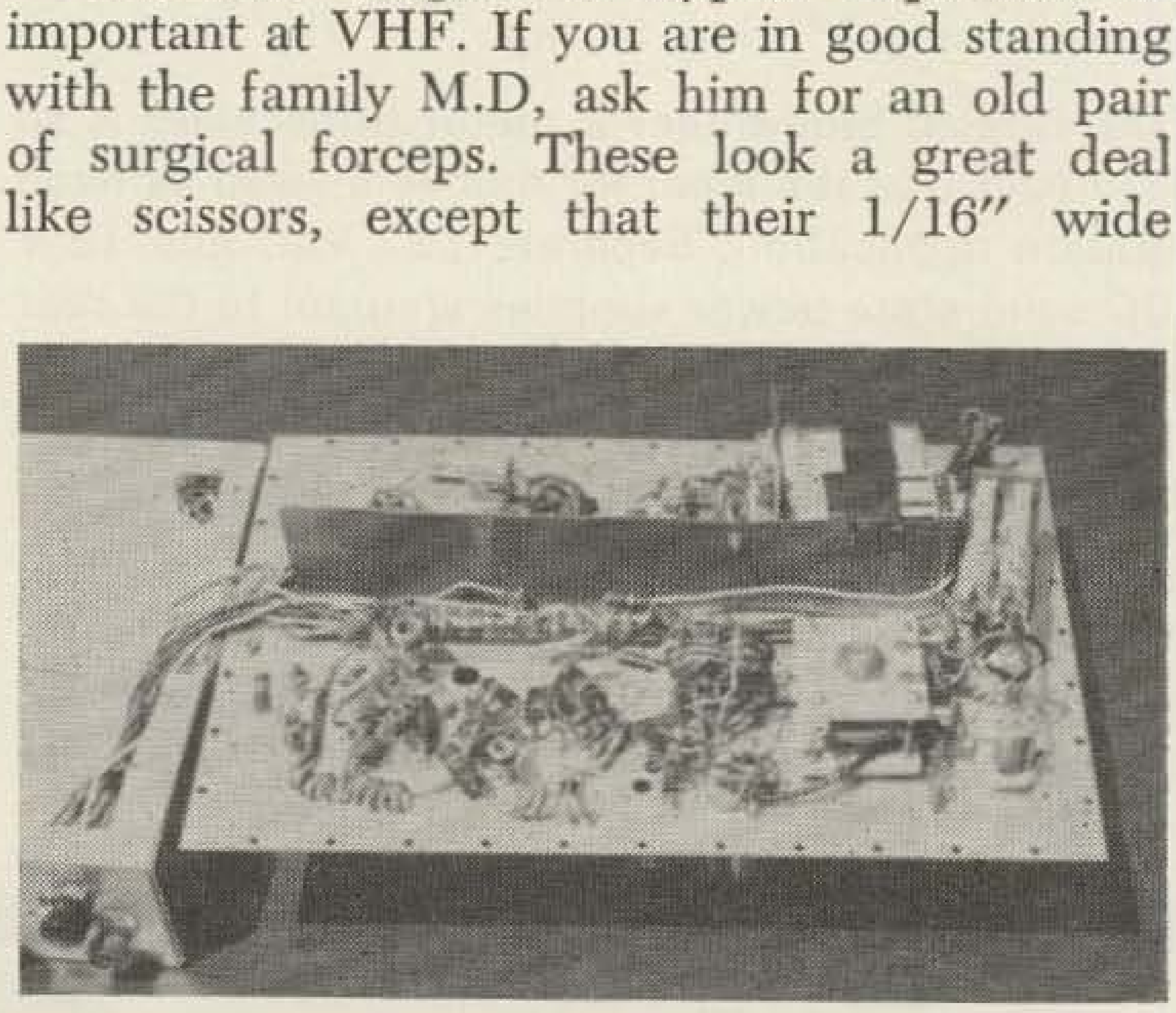
Tube manuals give the 5763 a maximum full rating frequency of 50 mc, and also give its characteristics as a multiplier up to 175 mc. With such capability as a multiplier at hard-to-reach VHF, I was led to the conclusion that the 5763 should perform well as a final amplifier on 144 mc.

I had a spare 10 watt modulation transformer with 1 to 1 primary to secondary windings, so another pair of identical tubes modulating the pair at rf seemed a logical choice, both as to power rating and impedance matching. No audio service ratings for the 5763 came to hand in my design research. I tried them and they worked.

The rf section of the transmitter is entirely 5763's, conventional in design and coupling. The first is a Colpitts "hot cathode" oscillator using 8 mc crystals with its plate tuned to 24 mc. The second is a tripler to 72 mc, the third a doubler (cathode keyed for CW) to 144 mc, with these stages using capacity coupling. I experimented with both link and capacity coupling of double tuned circuits (notice the unoccupied holes in the chassis just north of the 24 and 72 mc slug-tuned forms) but found capacitative coupling of single tuned circuits easier to set up and adjust, and almost as broad-banded for QSY.

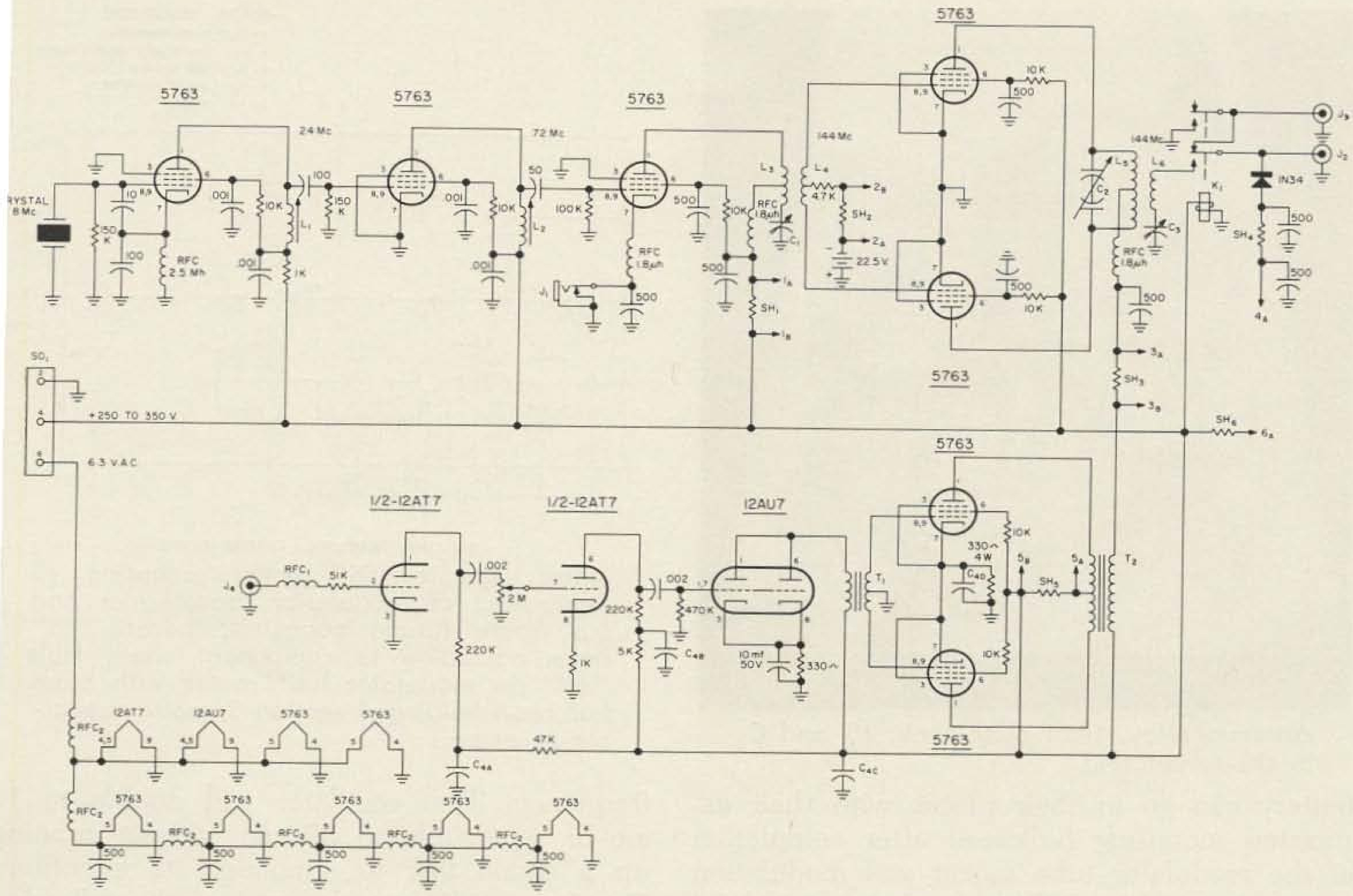
As the photographs show, I used a surplus 522 variable to resonate the final tank. Smaller components are available, such as Johnson's 3.2 to 11 mmfd butterfly dual or its equivalent. Their use would avoid using the length of the 522's capacitor stator plates as a tuned line section of the final tank, which is effectively what I have done.

Zero lead length for bypass capacitors is important at VHF. If you are in good standing with the family M.D, ask him for an old pair of surgical forceps. These look a great deal like scissors, except that their 1/16" wide



Bulkhead and shield of flashing copper; from roofing supply house or lumber yard.

[1] Progressive Two Meter Station, Tilton, E.P., QST, October 1961.



Parts List

C_1 2.5-7.0 mmfd piston trimmer. (ceramic trimmer may be substituted)
C_2 3.3-15.0 mmfd butterfly, from SCR 522. See text
C_3 5.0-50.0 mmfd miniature variable
C_{4A-4D} Four section, each 10/450, Sprague TVL 4760
L_1 18 T #30E, 3/8" Ceramic form, Iron slug tuned, Miller #4000
L_2 5T #26E, 1/4" Ceramic form, Iron slug tuned
L_3 4 T #14, 1/2" airwound, CT
L_4 3 T #14, 1/2" airwound, CT, spaghetti covered, in center of L_3
L_5 4 T #14, 1/2" airwound, CT, prune as required to resonate with C_2
L_6 1 T #14, 1/2" airwound, CT, spaghetti covered, in center of L_5
K_1 DPDT relay, 5000 Ohm coil. Guardian 200 series
RFC_1 10 T#30E, on 1/4 watt Hivalue Resistor
RFC_2 Filament chokes, 6 T, 1/4" diameter, hookup wire
T_1 Transformer, audio driver, single plate to push pull grids, 1:4 step up See text
T_2 Transformer, modulation, 10 watt, 1:1 primary to secondary, Merit #3008
SH_{1-6} Meter shunt resistors: value as required for meter used

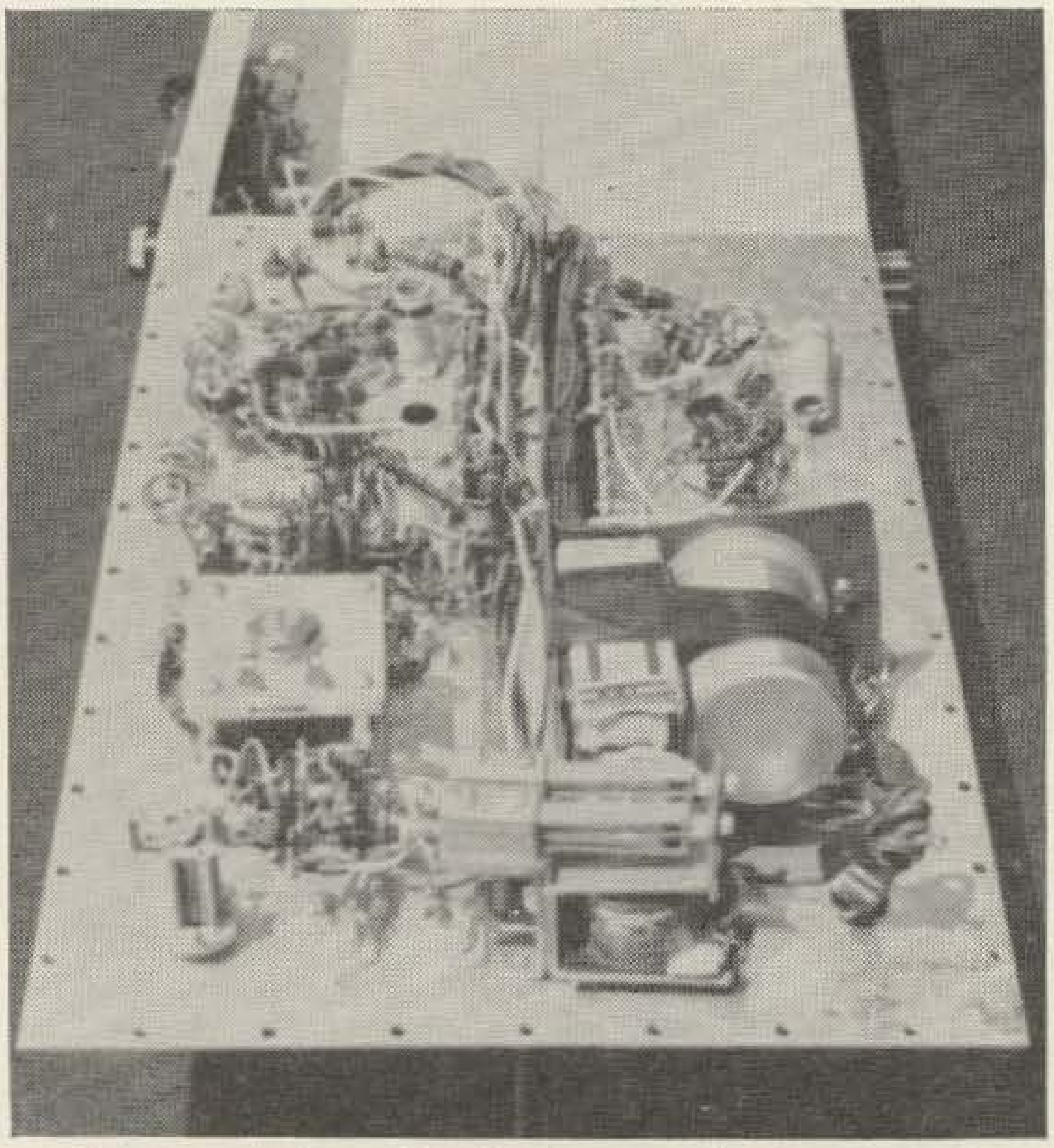
blades meet rather than cut, and they have a locking ratchet near the finger holes. With a little practice, zero length leads are easily obtained without burned fingers or the greater expense of button bypasses over disc ceramics. The locking device beats needle-nosed pliers by a wide margin.

Note in the photographs the long terminal strips on each side of the copper midline shield. Their use made it easy to check out both modulator and transmitter one stage at a time, and gave plenty of "hanging places" for meter shunts and similar components.

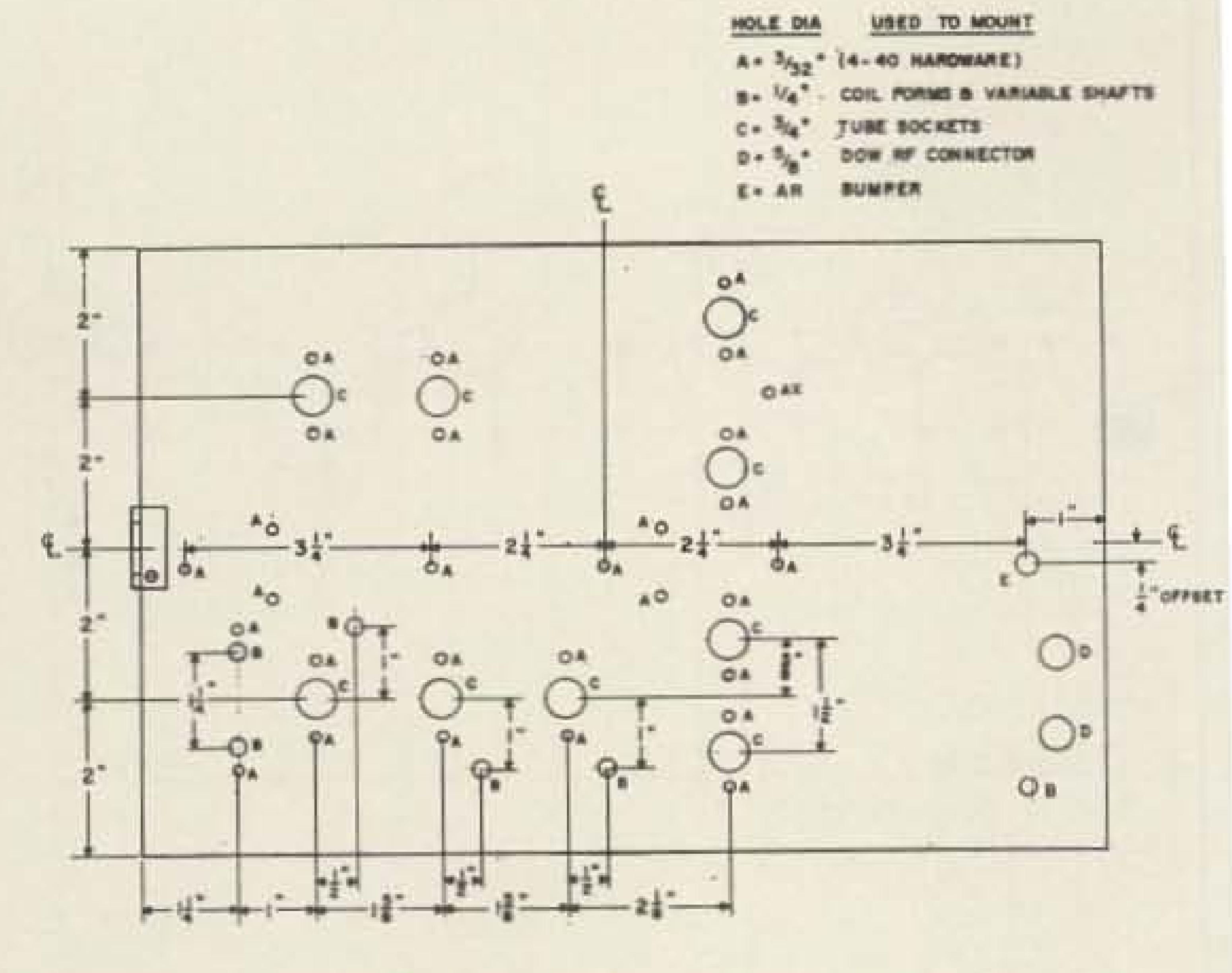
The complete modulator and transmitter rf sections are built on an 8" × 12" chassis plate, hinged at one end and secured by sheet metal screws at the other to seat in a 2½" deep 8" × 12" chassis. The copper mid-line shield separates modulator and rf sections mechanically and electrically. The space between shield and terminal strips is used as a wiring raceway.

I found it easy to lay out parts and make up a roughly accurate drilling template before boring any holes; this avoids mistakes requiring component relocation. Install tube sockets, center shield, terminal strips, modulation transformer, but leave the four section filter capacitor and its mounting bulkhead the bias battery and antenna relay until last. Wire up all components for each tube socket, running each B plus plate lead to a separate terminal on the terminal strips but not connecting them to the master B plus tie-points until each stage is ready for checkout. At *that* time, either jumpers or decoupling resistors can be soldered in place from B plus master tie-points on each terminal strip to each plate lead, but not before.

The four section filter capacitor and bias



Antenna relay, final plate tank, L_6 and C_3 in the foreground.



DRILLING TEMPLATE CHASSIS PLATE

Notes: Locate "X" holes according to dimensions of modulation transformer and p.a. plate tuning capacitor. Locate "D" holes according to component sizes. Hole "AX" in modulator half mates with cross bulkhead holding 4 section Sprague capacitor in place.

battery can go in their places with their associated mounting bulkhead after completion of the modulator tube socket and modulation transformer wiring. The bias battery is held in place both by the center shield and its frictional fit, and by a strip of insulation tape.

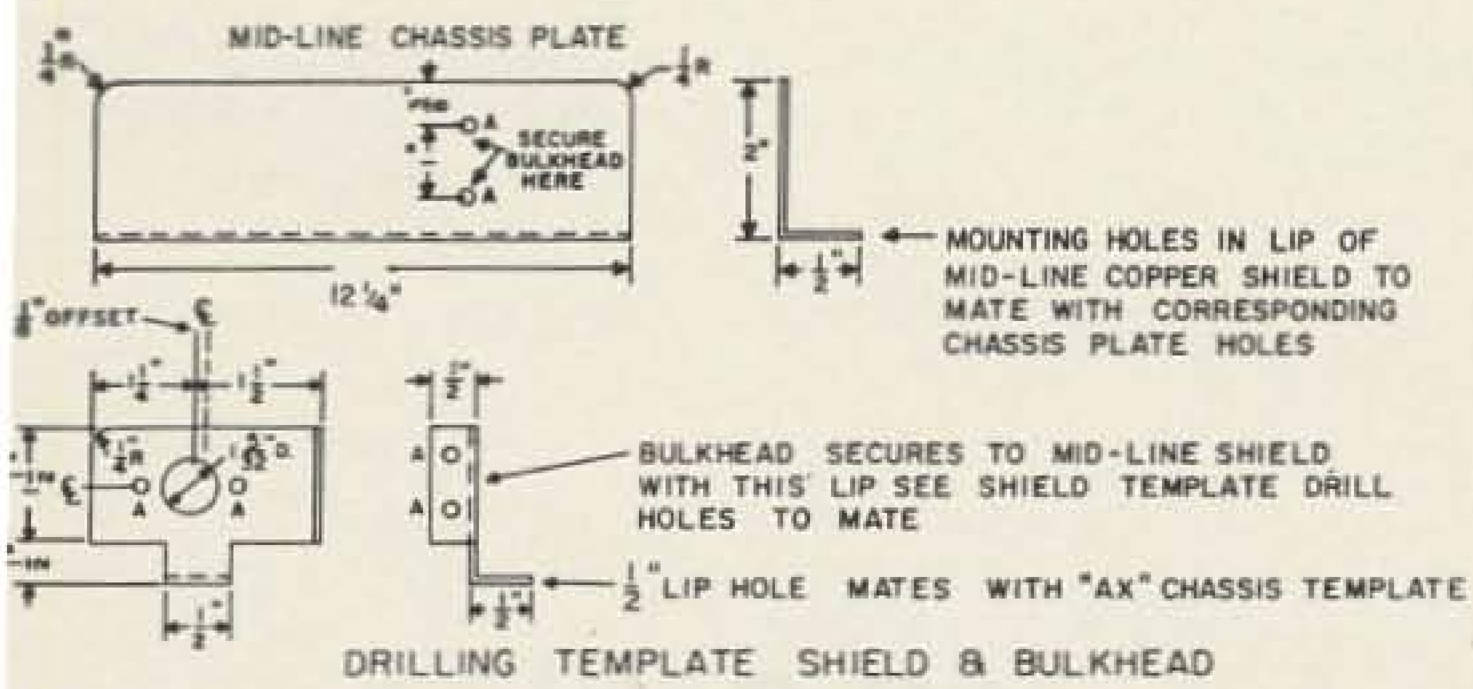
The completed unit at 20 w input requires 6.3 volts at 5 amps for filaments, and from 200 vdc at 320 ma to 350 vdc at 250 ma. Power is furnished in my installation from an outboard power supply which also contains necessary fuses, switches, pilots, and relays to give safety, and one switch control of both transmitter off-on and receiver mute-on-transmit functions. At voltages over 250, place a 5k 25w series resistor temporarily in the B plus lead to protect the tubes during tune-up.

Put all tubes in place. That threaded brass rod shown in the photographs on the output end of the unit acts as a bumper to protect tube tips from mechanical damage. Don't omit it. Check the wiring thoroughly for goofs and apply filament voltages. Dip all coils with a grid dipper to their approximate frequencies, and tie the first stage into a B plus master tiepoint with a 1k resistor. Check the coil with the grid dipper to make sure of its output frequency. That oscillator will double to 16 mc or quadruple to 32 mc without running up a signal flag to announce its intentions. Couple a VTVM to the grid of the following stage (top of resistor through an rfc) and tune the slug in the oscillator plate coil for maximum negative dcv to the tripler grid. Or lift the ground end of the following stage grid resistor and insert an 0-5 ma meter, if you prefer. Tuneup of the tripler is identical. Remember that its output frequency must be checked at 72 mc. It also will quadruple if you are not careful.

The final grid coil is tuned only by the tube input capacitances and should be soldered in place and dipped to 150 to 160 mc before the driver plate coil is put in place. Change the frequency of this coil by squeezing or spreading turns until it dips out as close to 150 mc as you can get it. With driver plate coil in place and voltage applied to the driver plate, tune the plate of the driver with C_1. After obtaining maximum p.a. grid readings, adjust the position of the final grid coil relative to the driver plate coil for optimum coupling and maximum energy transfer until all possible has been coaxed from the driver stage. As little

Stage	Grid MA	Plate MA	Grid Volts at 250 Plate Volts	Where Read
5763 Osc	—	17	— 15 VDC	Grid pin (Crystal current)
5763 Tripler	2.8	28	— 170 VDC	Grid pin
5763 Doubler	2.1	32	— 130 VDC	Grid pin
5763 PP PA	3.2	88	— 52 VDC	Top of 4.7K resistor
12AT7 Sp Amp	—	—	40 VAC	Pin 7
12AU7 Driver	—	—	120 VAC	Driver Xformer Secondary
5763 PP Mod	—	30/94	—	—

Typical voltage and current readings.



Drilling template, shield and bulkhead.

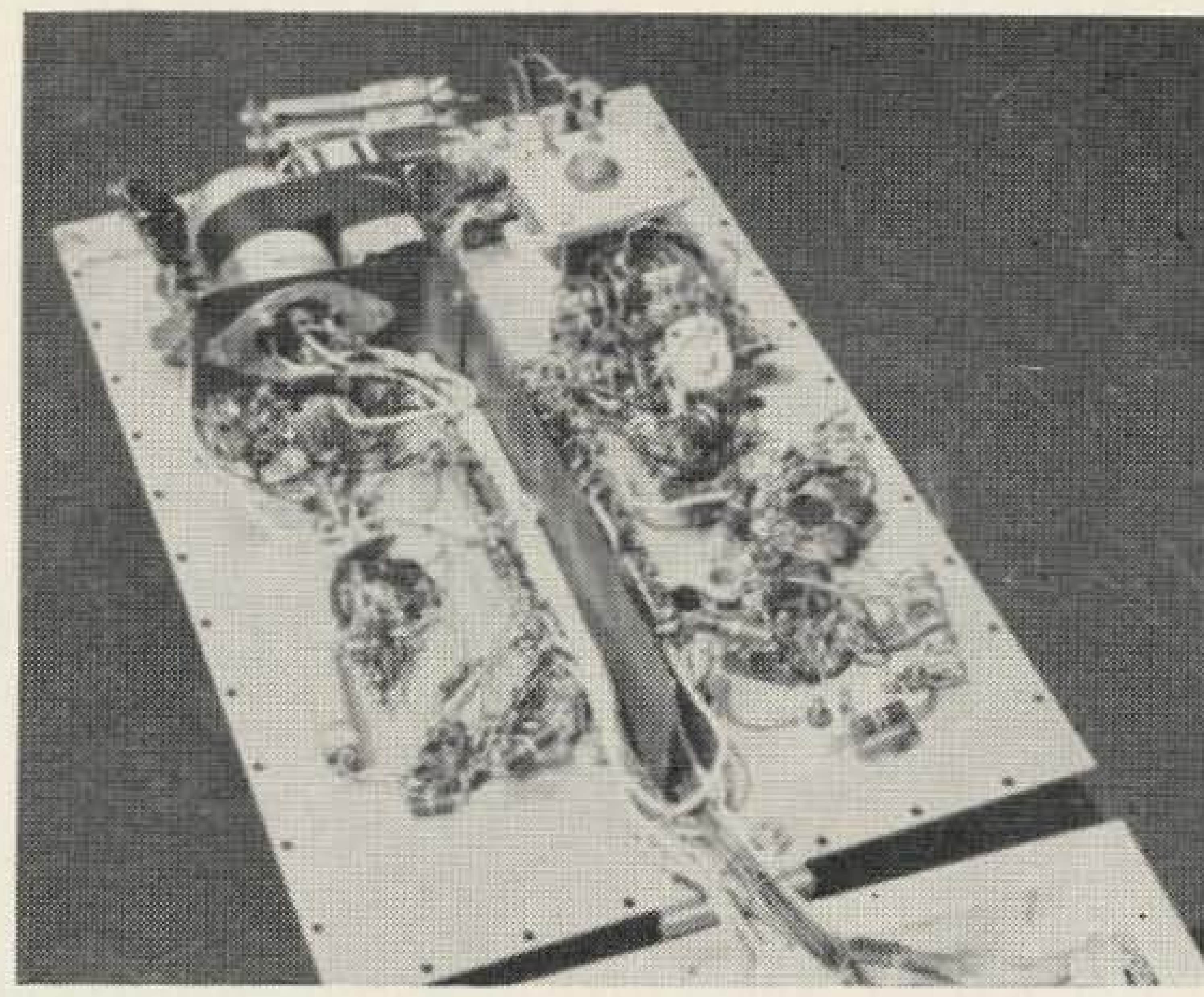
s 0.3 ma (or −28 vdc bias) can be used, ut 3.0 ma is required for full input and is ot hard to obtain.

To set up the final, use a dummy load onsisting of a #47 (blue bead) lamp and 1 turn coil loosely coupled to the final tank. Vhen resonance is established, increase the oupling if you desire, to obtain good bril- ance, and retune all stages beginning with he oscillator for maximum lamp brilliance nd proper plate current to the final. Remove he dummy load, switch the meter to read rf ut, connect the antenna, tune out the anten- a feedline reactance with C_3 (similar to load- ng a pi-net), maintaining resonance with C_2, nd your rf section is on the air. If you have hecked each stage with the grid-dipper in vavemeter position, you are on the right and, too.

The audio section is easy. Beginning with he input stage, connect the decoupling resis- ors between tie points and plate load resistors or transformer primaries) one stage at a ime. Either use the VTVM tied to .01 block- ng capacitors temporarily soldered to plate ins, reading af volts to ground with the /TVM, or use headphones and GOOD locking capacitors across each plate to round. Crank up the gain and watch for udible or visual indication as you talk into he mike. The headphone system also gives check on audio quality, but if you use it, be areful to keep B plus away from that low esistance ear-to-ear electrocution path.

The modulators are in Class AB_2 with the ndicated value of cathode bias. They could e run in Class B using fixed bias supplied rom the negative battery terminal to the entertap of the driver transformer secondary, f it suits you better. Either arrangement gives good performance and good audio. If you lack suitable driver transformer, see the audio ection of the ARRL handbook and rig up he 12AU7 as a phase inverter to drive the nodulator tubes in Class AB_1.

The −22.5 vdc bias applied to the final educes key up current for CW to a very ow value, well within the plate dissipation apability of the tubes, but does not cut the



Bottom View

final plate current to zero. The serious CW man will provide a system for shorting out the modulation transformer secondary. My listeners on two meter CW will simply have to put up with whatever inductive "tails" my characters have on infrequent 2 meter CW contacts.

No provision is made for neutralization, since the final amplifier as configured here was stable without provision for it. With other components, such might not be the case. If final instability appears in a modified con- figuration, standard screen neutralization of each 5763 ought to produce stability.

For those who might wish to try a copy but don't care to duplicate mine exactly, or who prefer to experiment with components, the following suggestions are made:

Try a 6CL6 oscillator. Use link coupling. Make it all 5763's, including both speech am- plifier and audio driver. They work, and this reduces the callout for spares in the tube lock- er. Use 6AQ5's for modulators—watch your matching impedances. Use airwound coils and variable capacitors in the rf circuits instead of slug tuned forms. Omit metering circuits ex- cept the relative rf output and final grid drive. Use closed circuit jacks and a plug-in type meter. Use a single 5763 final amplifier with appropriate changes in driver plate and final grid and plate tank components. Ten watts on two with a good antenna will let you work all you can hear except genuine two meter DX for which 100 watts or more is needed.

The 5763 seems to have gone relatively unnoticed as a two meter final, and it has merit in modulator service. A pair of them are capable of 20 watts input at 144 mc at reasonable efficiency, and are less expensive than tubes specially designed for the VHF bands. . . . WA6SIZ

Silas Smith WA8CHD
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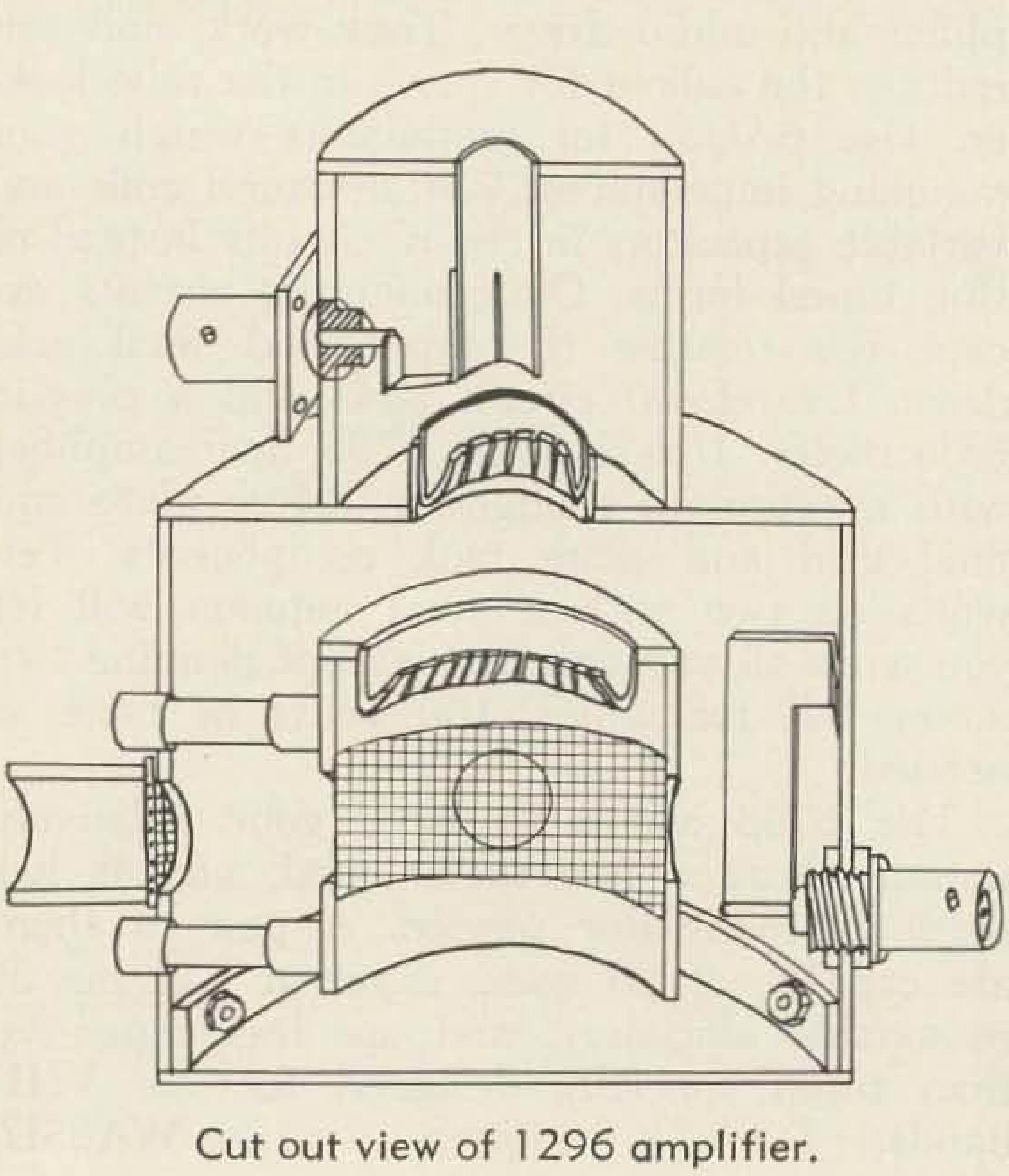
Flint, Michigan

2C39 Amplifier for 1296 mc

Bill K1CLL suggested in one of his recent articles that the 2C39 would make an ideal amplifier for 1296. Some time ago, I picked up some 2C39's for seventy-five cents apiece, so Bill's suggestion prompted me to design the amplifier described in this article. I designed the amplifier as I went along, with suggestions for construction coming from the APX-6 cavities.

I tested this amplifier with a 350 volt power supply. The first testing was done before final construction to determine the frequency without any tuning. The output was coupled to the input through a slotted coax line indicator to make the amplifier into an oscillator. The measured frequency was 1365 mc. This was considered close enough so I continued the construction to the end. Final testing was done with the drive from a APX6 and a 15 watt lamp as a load. I was able to get a 35 watt input to the amplifier. The output was not measured but must have been a fair percentage as the 15 watt lamp had a nice glow. At this frequency I would guess that the output may have been as much as 20 watts.



Cut out view of 1296 amplifier.

The 2C39 is an air cooled tube and building it into the cavity created a cooling problem. The cavity and plate line were drilled with one half inch holes that were covered with copper screen wire. This allows air flow from the input port to the other port. Both ports are made of one half inch copper tubing. The XYL better keep her eye on the vacuum cleaner.

It is necessary to use soldering flux and 60-40 solid solder wire. If regular core type of solder is used it would make it most difficult to clean. Lots of heat should be used and if you don't succeed the first time pick up the pieces and start over again.

You will notice as you put this amplifier together in sequence that seldom will the heat give you problems.

The finger stock was from some sort of a socket in a piece of surplus equipment but could be easily made from brass weather stripping. Plate stock can be obtained from copper pipe split and flattened out.

Construction Sequence

A. Plate line.

1. Cut a piece of 1½ inch copper water pipe 1½ inches long.

2. Drill four ½ inch holes 3/4 inches from either end spaced 90 degrees apart.

3. Tin inside of line.

4. Cut a piece of copper screen wire 3/4 inch by 4 3/4 inches.

5. Tin and solder inside of line over the ½ inch holes. (This will provide vents for the 2C39.)

6. Construct an end plate from 1/16 inch plate.

7. With a 1¼ inch hole punch out a 1¼ inch hole in end plate.

8. Center the line over the end plate and solder.

9. Pre-shape some finger stock and cut a iece to fit inside the end plate.

10. Solder the finger stock and dress up verything already done.

. Plate Cavity

1. Cut a circular piece of 1/16 inch stock inches in diameter.

2. Punch a 3/4 inch hole in middle of this inch plate.

3. Cut a ¼ inch ring from a brass miniature ube shield. (This ring is to keep the finger tock's shape.)

4. Cut a piece of finger stock to fit inside f the above ring.

5. Fit the above over a piece of ½ inch pipe, enter the works over the 3 inch plate and older. (Do not solder the ½ inch pipe.)

6. Cut a piece of 3 inch pipe 2½ inches ong.

7. Center and solder end plate over this 3 nch pipe.

8. Remove the ½ inch pipe and dress things ıp.

9. Drill holes per template.

10. Cut two pieces of ½ inch pipe 1¼ inches ong.

11. Cut two pieces of copper screen 5/8 nches in diameter.

12. Sandwich the 5/8 inch diameter screen etween the outside of the 3 inch cavity and he 1¼ inch length of ½ inch pipe. Center ver the ½ inch holes in the cavity. Hold in lace with a "C" clamp and solder. Do this n both sides of cavity.

13. Use an old 2C39, place plate line over ube and insert tube into cavity deep into the grid fingerstock.

14. Center plate line and solder in place 3 auto fuses that have been deliberately lown. (AGX type is just the right length.) Note: At this point it is very difficult to older the fuses to the rear of the plate line, out that will be FB even if you can't. You can remove tube after you get a few spacers n place. Using fuses in this fashion makes a eal sturdy device.

C. Output pickup loop. See **Fig. 1**

1. Cut a piece of brass shim stock per detail 1 and form.

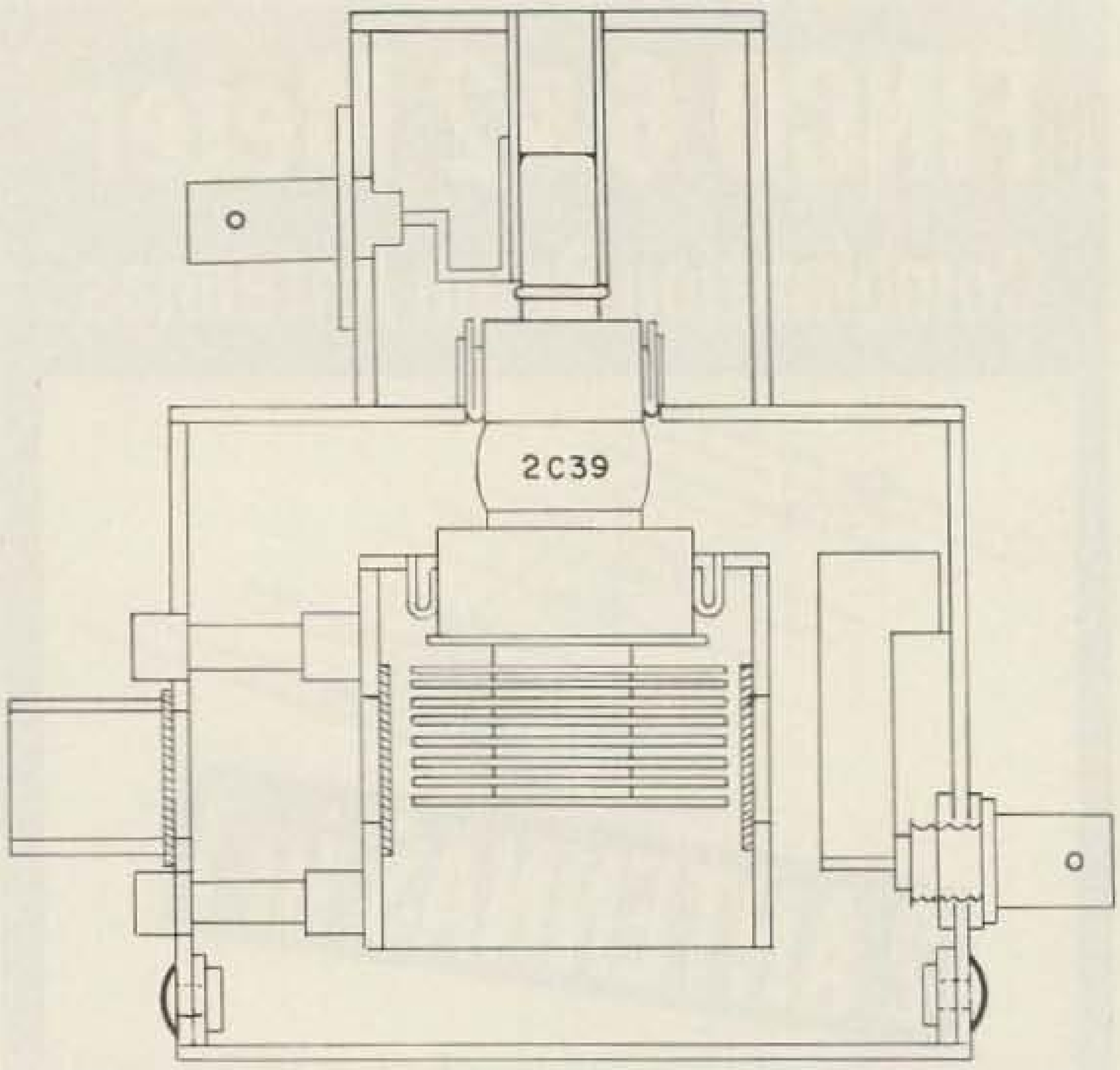
2. Add output BNC fitting UG-625A/U or use your choice of fitting.

3. Using a soldering iron solder the pick-up oop to the fitting.

4. Heat cavity with torch from the outside and solder the loop to the cavity.

D. Cathode Cavity

1. Cut a piece of 1½ inch pipe 1⅜ inches ong.



Amplifier with 2C39 in place.

2. Drill a ⅜ inch hole 11/16 inch from either end.

3. Put 2C39 (old one that is) in place.

4. Center and solder the 1½ inch pipe to top of plate separating the plate cavity and cathode cavity.

Note: This is the only place that I had trouble. I lost my grid finger stock and had to get it resoldered in place.

5. Solder a chassis type connector over the 3/8 inch hole in the cathode cavity. (The flange can be removed if you like.)

6. Cut a piece of 5/16 inch inside diameter tubing 1 inch long.

7. Cut 4 slots 90 degrees apart 7/16 inches deep in one end of the above tube.

8. Cut a piece of shim stock 3/16 inches wide and ⅞ inches long. Shape per detail #2.

9. Solder detail #2 to the above tube which we can call the cathode cap. (Be careful here not to fill any of the slots.)

10. The 2C39 was installed in item D-3. If it isn't, install it now.

11. Place cathode cap over cathode of tube and solder detail #2 to the connector.

12. Cut an end plate 1½ inch in diameter.

13. Drill a ⅜ inch hole in center of this end plate.

Note: It is very important at this point that the ⅜ inch hole is a sloppy fit over the cathode cap. If it isn't, rat-tail it until it is sloppy. This is to prevent heat traveling from the end plate to the cathode cap.

14. Solder end plate to cathode cavity.

15. While end plate is still hot solder cathode cap. (It would be wise to cool the end plate with a wet rag as soon as you can after soldering.)

E. Tuning (Fine). See **Fig. 2**

1. File the head of a round head 6-32 by 1 inch screw until very little is left.

2. Cut a ½ inch disc from brass shim stock

3. Center disc on the above 6-32 screw and solder.

4. Solder a 6-32 nut to the outside of the plate cavity at point C 1 on the template

5. Cut the screw length down to the longest length that will fit between the plate line and cavity.

6. Cut a screwdriver slot in end of screw

7. Install screw.

F. Tuning (Coarse). See **Fig. 2**

1. Solder a 6-32 nut to the outside of the plate cavity marked C2 on the template.

2. Choose a piece of spaghetti to fit over a 6-32 screw and cut a piece ⅝ inch long.

3. Choose a piece of brass tubing that will fit over the above spaghetti. Cut a piece ½ inch long.

4. Remove the 2C39.

5. Put spaghetti inside tubing.

6. Run a 6-32 screw down through the "C2" nut, through spaghetti almost to the plate line.

7. Solder tubing to plate line.

Note: Both condensers are locked in place after tuning by lock-nuts.

G. Plate cavity base cover.

1. Cut a piece of 3 inch pipe ⅜ inch long.

2. Cut out a piece ⅜ inch wide and reshape to fit inside a 3 inch pipe.

3. Cut a plate 3 inches in diameter.

4. Center and solder the two above items together. This will make a cup-like structure.

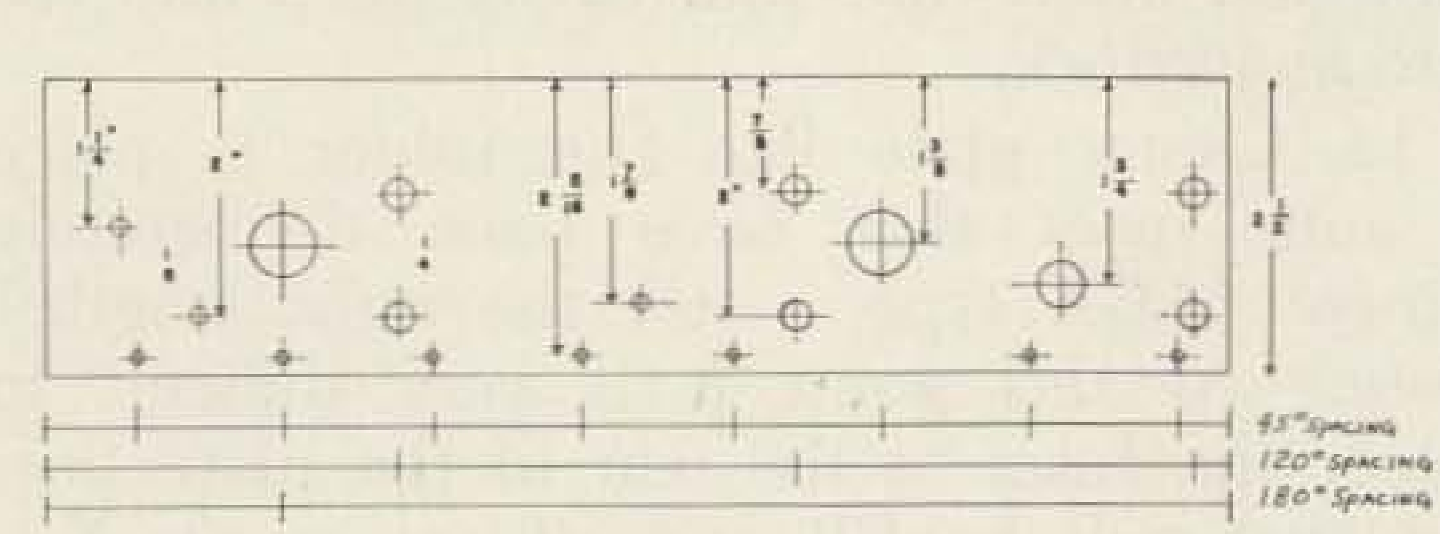
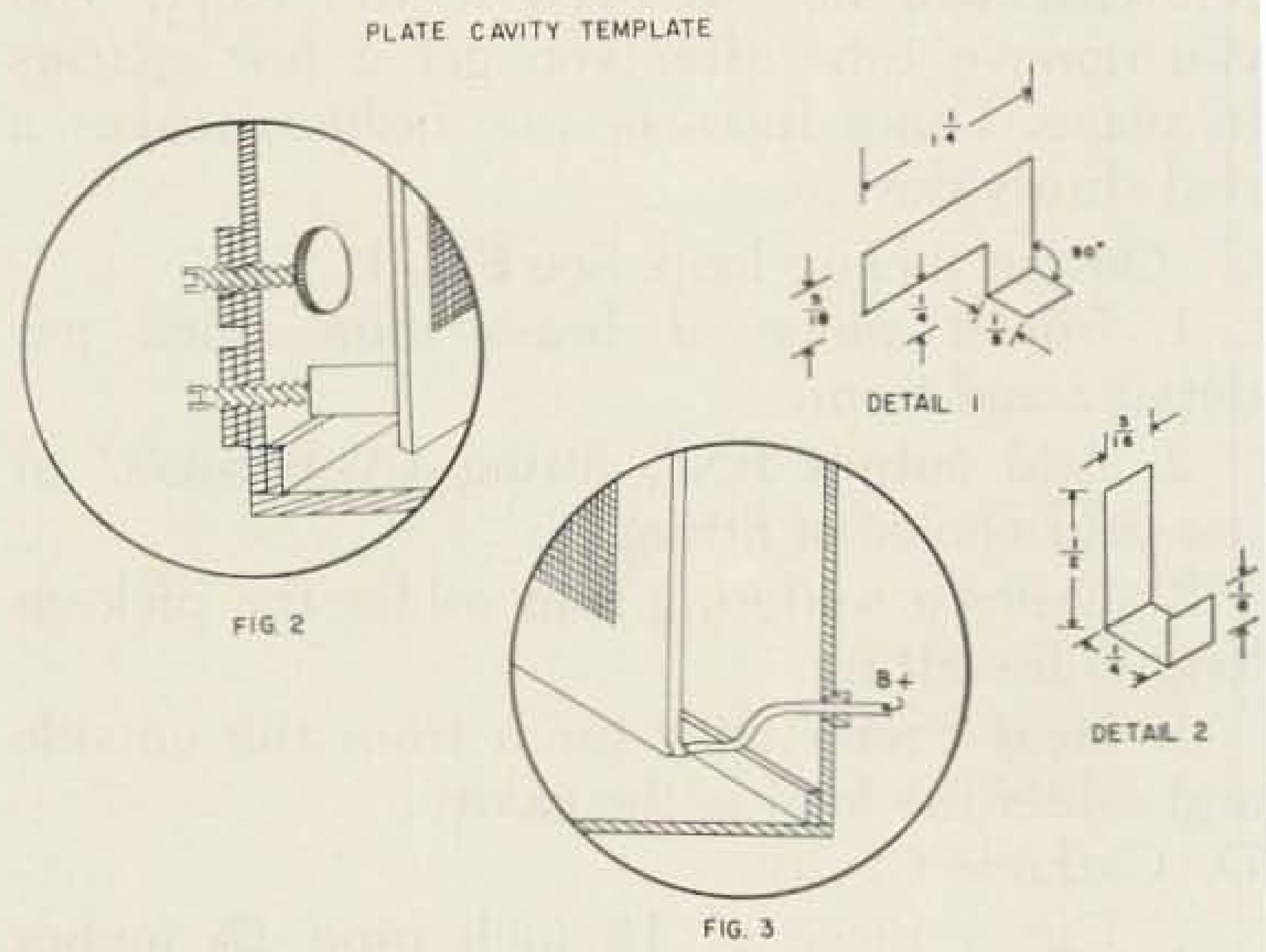


PLATE CAVITY TEMPLATE



Details of construction.

5. Drill holes to match base holes shown on template.

6. Solder 6-32 nuts inside of the ⅜ inch ring.

Note: To aid in soldering, a ¼ inch piece of 3 inch pipe may be slipped over the ring and removed after all soldering is completed.

H. Plate power. See **Fig. 3**

1. Install a teflon bushing and feed-through or something similar in the hole marked B plus on the template.

2. Connect a 4 turn #22 guage ⅛ inch diameter RFC from feed through to the base of the plate line.

I. Heater

1. Cut a piece of ¼ inch tubing 1½ inch long.

2. Slot tubing several times and reduce size to fit heater.

3. Add one layer of plastic tape to insulate heater from cathode.

This amplifier with a feed-back loop added to the plate cavity and coupled back to the cathode cavity would make a nice oscillator. Feed this oscillator into another amplifier of the same kind and add plate modulation. Then you would have a FB transmitter for 1296 mc. This would really give you a good start for a home brew 1296 mc station.

. . . WA8CHD

Tom O'Hara W6ORG
10253 E. Nadine
Temple City, California

Varactor Tripler to 1296 mc

With quite a few varactor triplers being used here in the Los Angeles area on 432 mc, an easy way to get on 1296 with a clean stable signal is to add another varactor tripler.[1] The tripler described here takes 5 watts

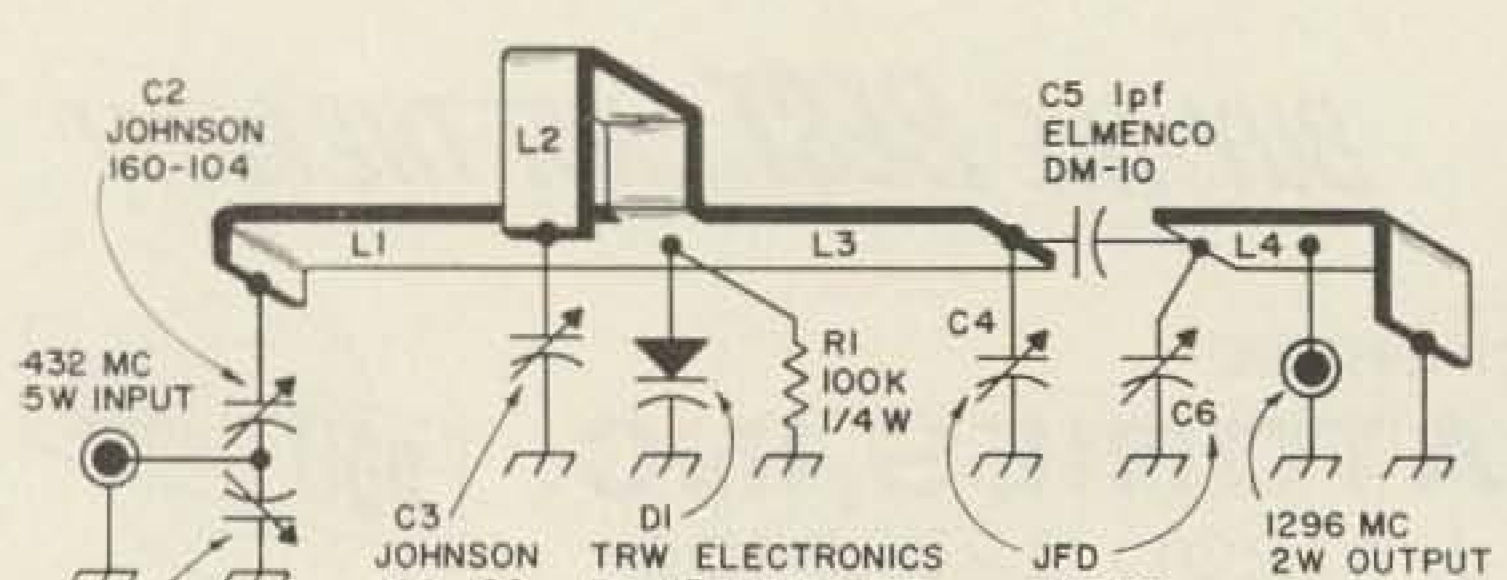
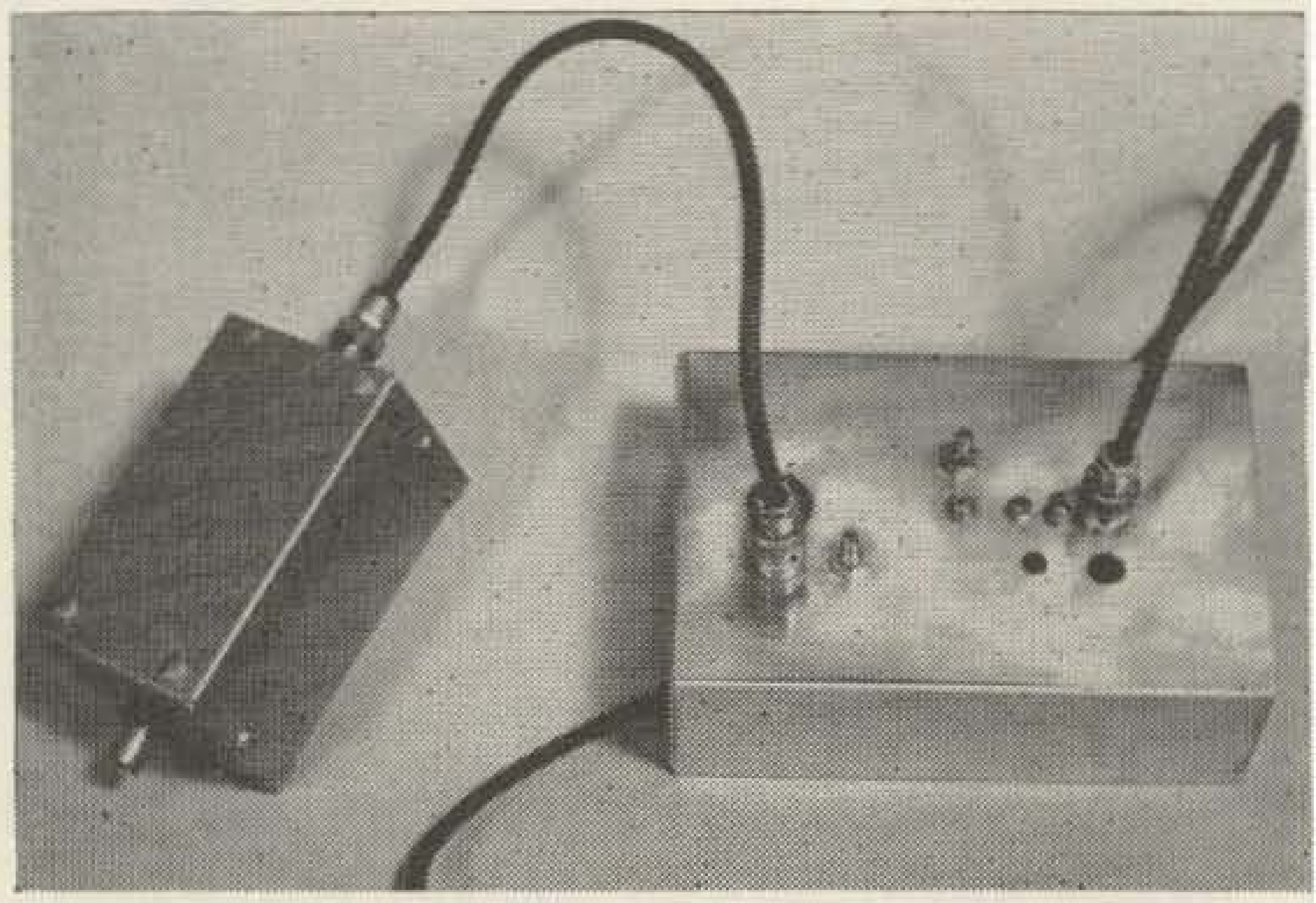


Fig. 1. Schematic of varactor tripler to 1296 mc.

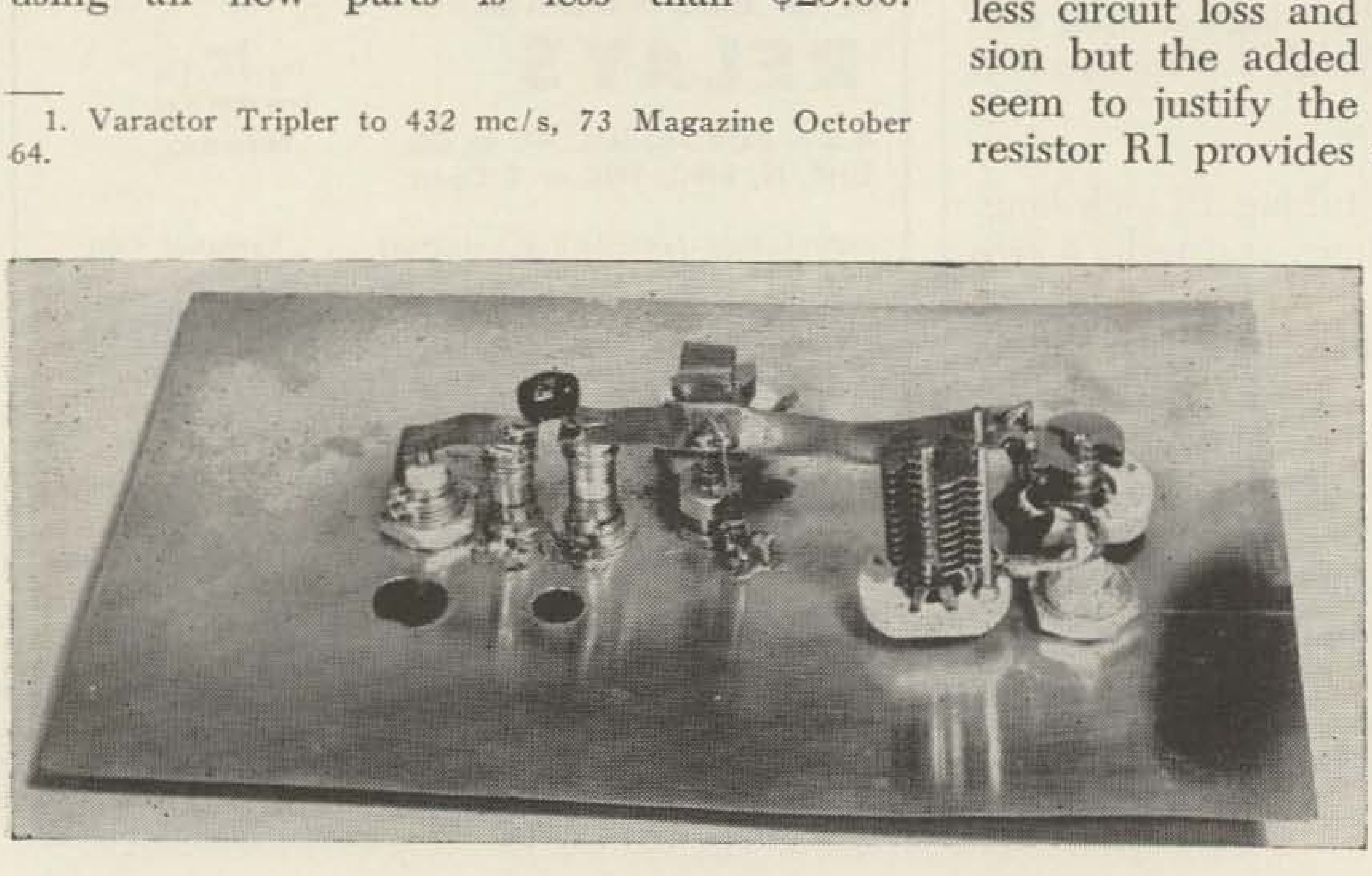
input at 432 mc of FM or CW and triples it to 1296 mc with an efficiency of 40% or 2 watts output. AM can be tripled but the maximum input power cannot exceed 3 watts. The output can be used to drive a 2C39 type amplifier for higher power. The total cost using all new parts is less than $25.00.

1. Varactor Tripler to 432 mc/s, 73 Magazine October 64.



Tripler to 1296 driven by tripler to 432 (left).

L1, C1, C2 are tuned to 432 mc and match the 50 ohm input to the varactor impedance. L2, C3 is series tuned to 864 mc as an idler so that the 2nd harmonic energy is circulated only through it and the diode to mix with the fundamental. L3, C4, and L4, C6 are two tuned circuits at 1296 mc to select only the 3rd harmonic energy, clean it up, and match to the load. Cavities can be used for less circuit loss and greater parasitic suppression but the added cost and effort does not seem to justify the slight improvement. The resistor R1 provides a DC return and self bias



Layout of varactor tripler. 432 mc input is on right with 1296 mc output on left. Varactor can be seen in center in front of idler components. Note two extra holes.

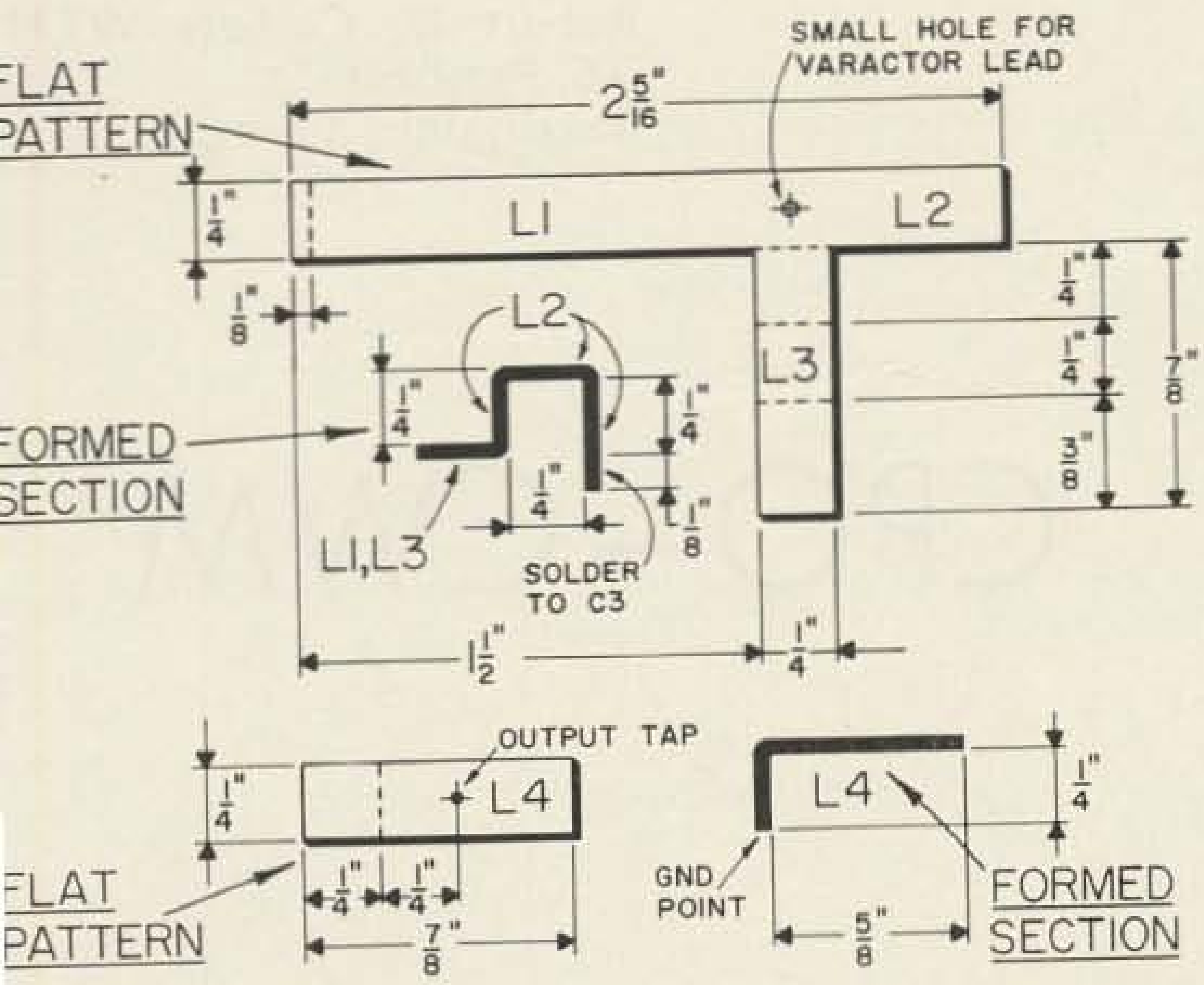


Fig. 2. Patterns of inductors.

or the varactor so no power supply is necessary.

The cost of varactors jumps up sharply for nput frequencies above 400 mc and powers ıbove 5 watts. The PC-115 is $12.00 and for powers up to 16 watts input a TRW Electronics (formerly PSI) PV-002 for $16.00 can be used. I recommend the PV-002 if you use the Hybrid 432 mc Exciter (March 65-73) which s a great rig. They are available through most mail order parts houses. Newark Electronics at 223 W. Madison St., Chicago, handles the varactor. *Care must be exercised* if other varactors are used since dissipation, efficient frequency range, and impedance are very discrete.

Cut out the inductors as indicated in **Fig. 2** from a piece of sheet copper.

Construction

Layout the brass board as shown. The board tself takes the place of the bottom plate on a 4 × 6 × 2 box chassis.

Refer to the pictures for parts placement and position. The varactor holder is made from a Cambion PLS6 coil form. If a PV-002 s used the form is not necessary since it is

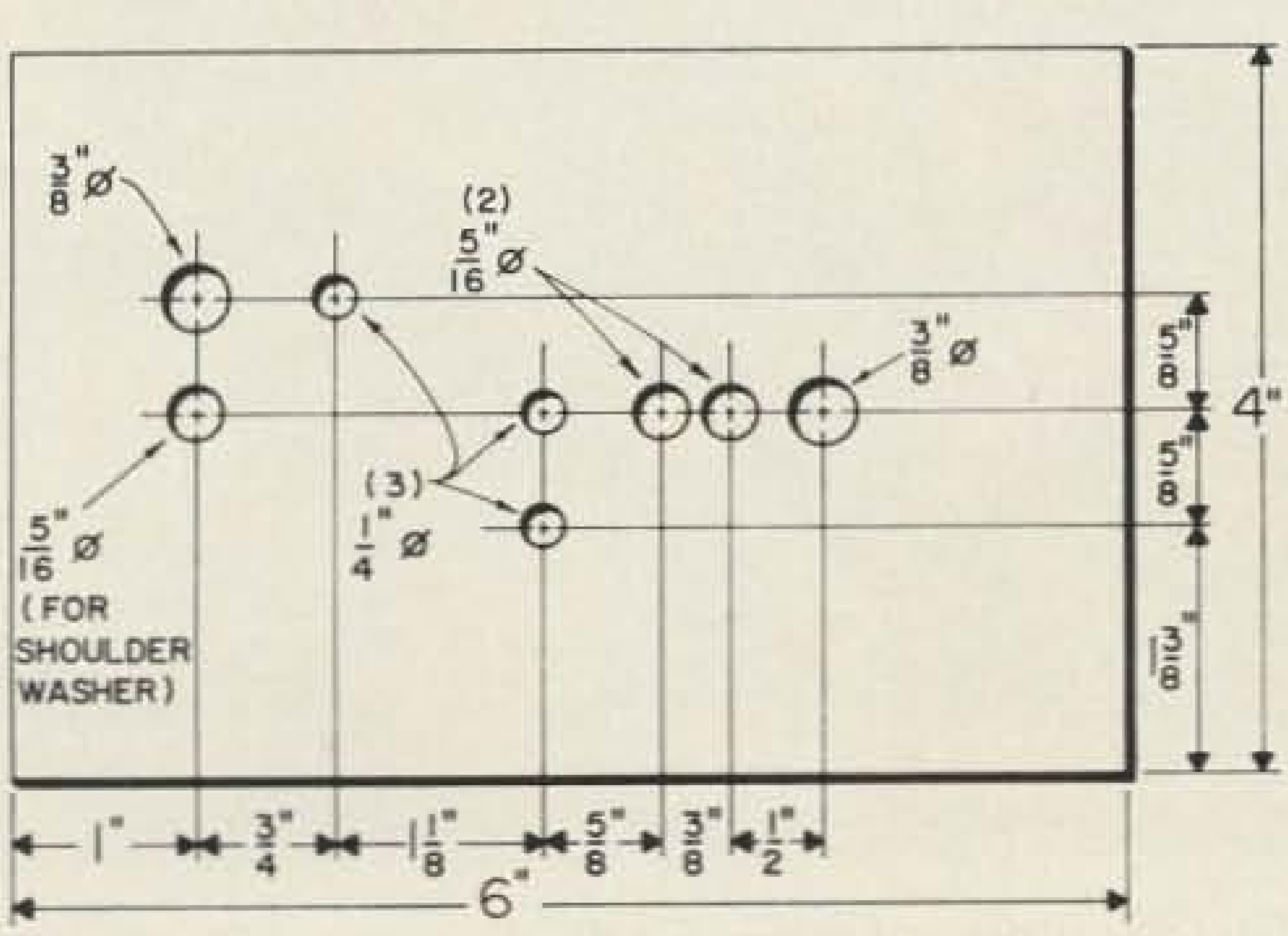


Fig. 3. Layout of tripler.

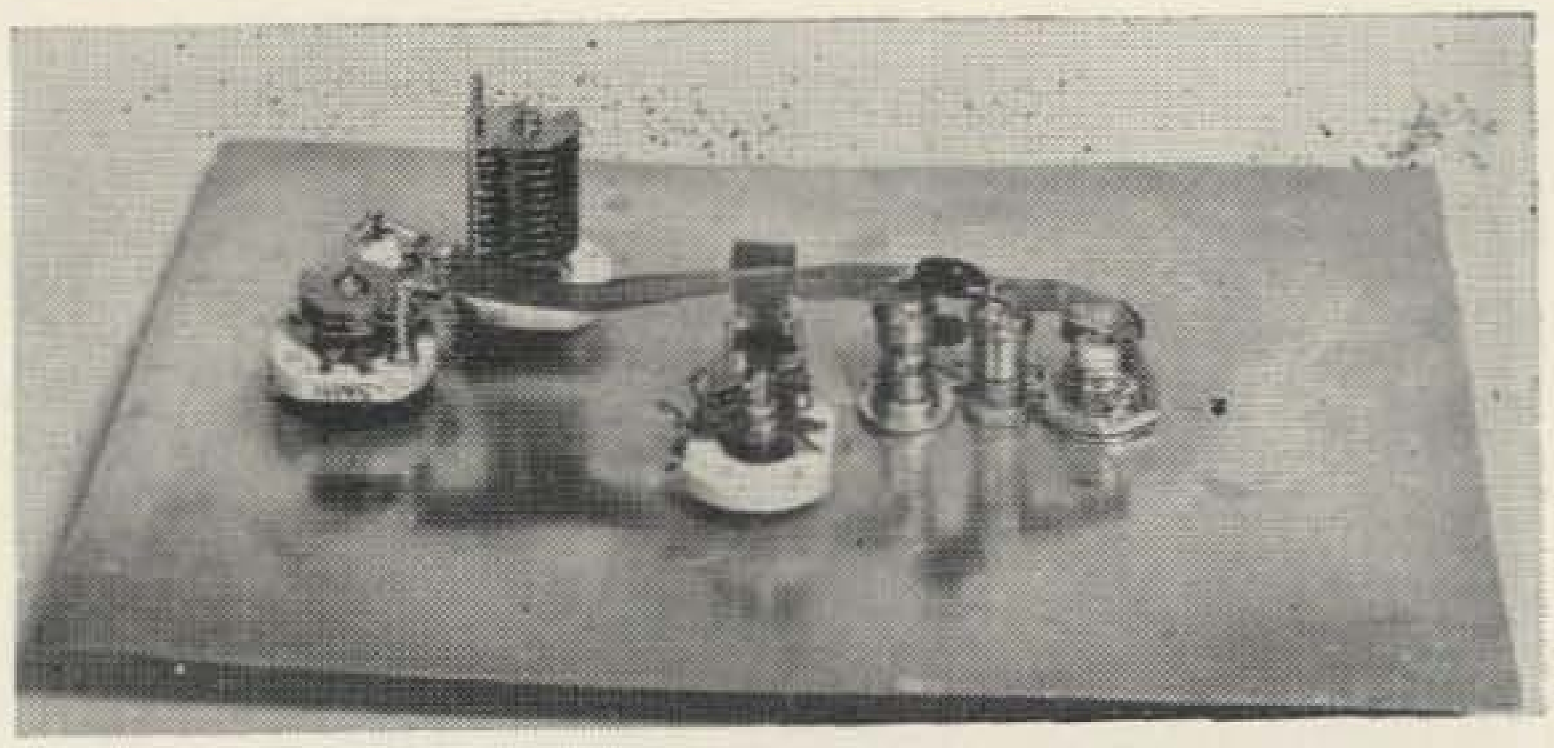


Photo of varactor tripler.

a stud mount. Break off the ceramic and take off the spring clip.

Mount the varactor holder on the board. Gently place the varactor in the holder with the brown band down. You may have to spread the holder fingers a little. Do not force the varactor in as the glass case is fragile. This holder provides a simple but effective ground and heat conductor for the varactor. Assembly from here on is straight forward. Make sure that the rotor of C2 is not grounded from improper seating of the fiber shoulder washer. The cold end of L4 is soldered to the BNC chassis connector body. Solder the hot lead of the varactor with no more than a 47 watt iron using care not to over heat as you would for any semiconductor. The JFD Variable Capacitors are fragile but they are the only ones that are good at this frequency. Take care when soldering around the top of the capacitor and L3 and L4.

Tune Up

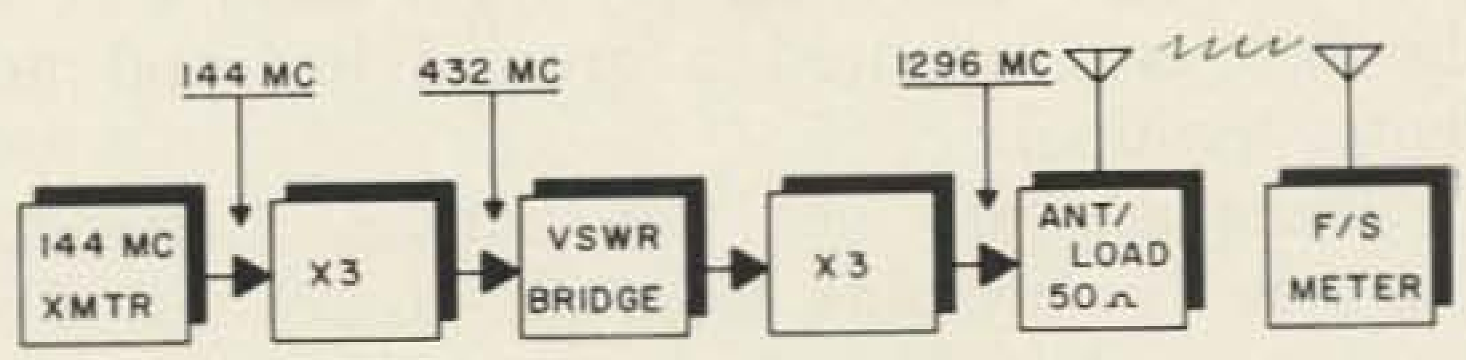


Fig. 4. Tune-up procedure.

The best way to tune up any varactor multiplier is to tune for the lowest VSWR between it and the generator. When properly tuned and matched, maximum power output and minimum VSWR coincide. It is assumed however, that most hams will not have a VSWR bridge capable of operating up to 432 mc so a field strength meter and the old method of "tune for maximum smoke" can be used. The L and C combinations have been chosen such that the wrong harmonic does not fall into any of their ranges. Each adjustment affects the other, so touch up each capacitor several times.

Now you're ready to get on the air on 1296 mc. Remember not to exceed the power rating of the varactor. Good DX'ing.

. . . W6ORG

Robert D. Corbett W1JJL
46 Prospect St.
Torrington, Conn.

CPO–CWM

The unit shown in the photographs and diagram (Fig. 1) is designed to be used as a code practice oscillator, and also as an off-the-air cw monitor. It utilizes two transistors, one PNP and one NPN. Also included are one diode and several small parts.

My particular unit is built into a small Minibox that is 3¼ x 2⅛ x 1⅝. It contains a built-in speaker and key jack as well as the oscillator. The battery, which is used only for code practice, is also inside the box.

As can be seen from the photos my unit is built on a printed circuit board. This simplifies construction and makes a neat and sturdy job.

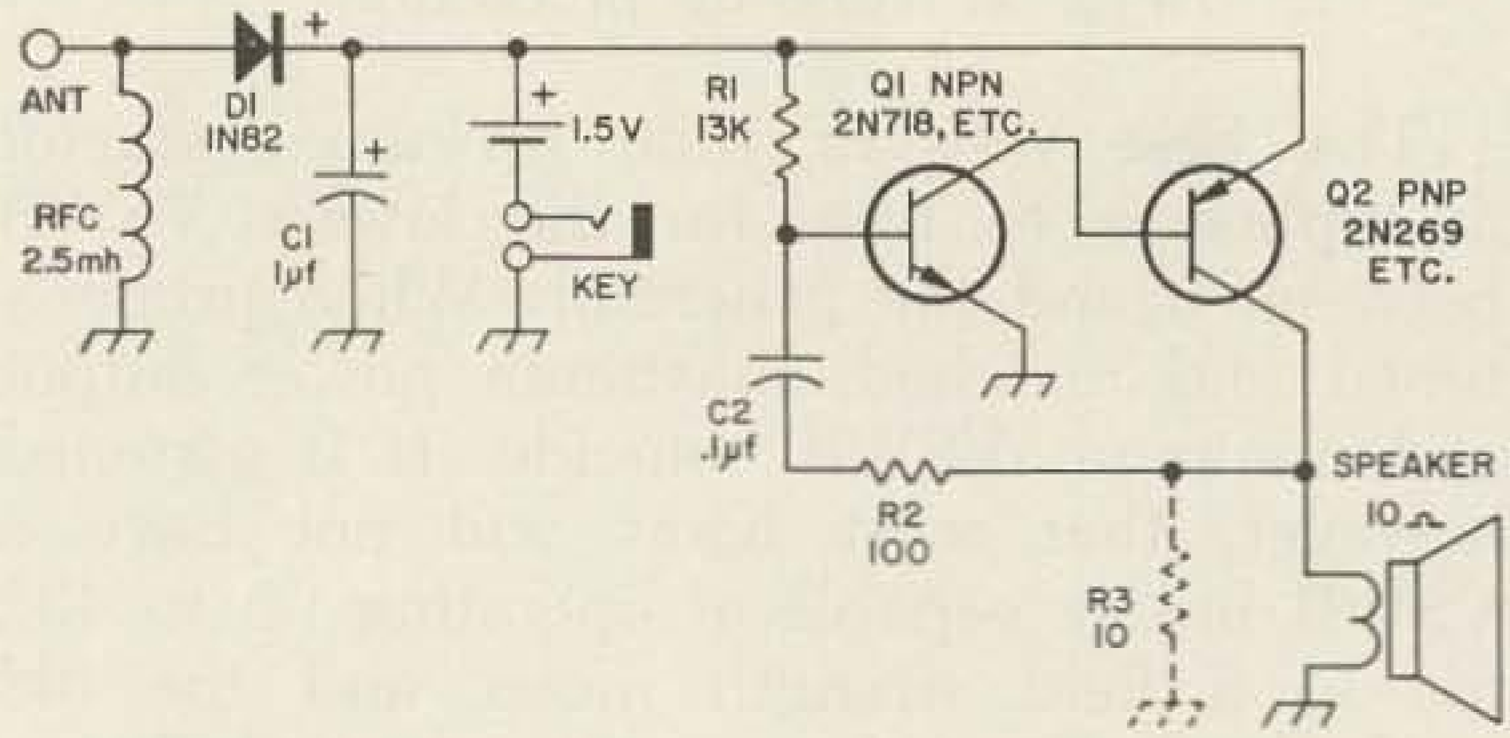
The speaker and key jack are mounted on the front panel and while no dimensions are shown (your speaker may have different mounting holes) the general layout of the panel can be seen. On the right-hand end of the box are mounted a ground lug and antenna terminal.

The parts are not too critical. Capacitor C2 may be anything from .01 to .25 μf. The larger the value, the lower the tone. C1 is shown as being 1 μf in value, but it may be anything up to 50 μf. The value of C1 will only effect the tone when the unit is being used as a cw monitor.

When used as a monitor it is only necessary to connect the case to the station ground, and a short wire to the antenna terminal. No adjustments or tuning are necessary.

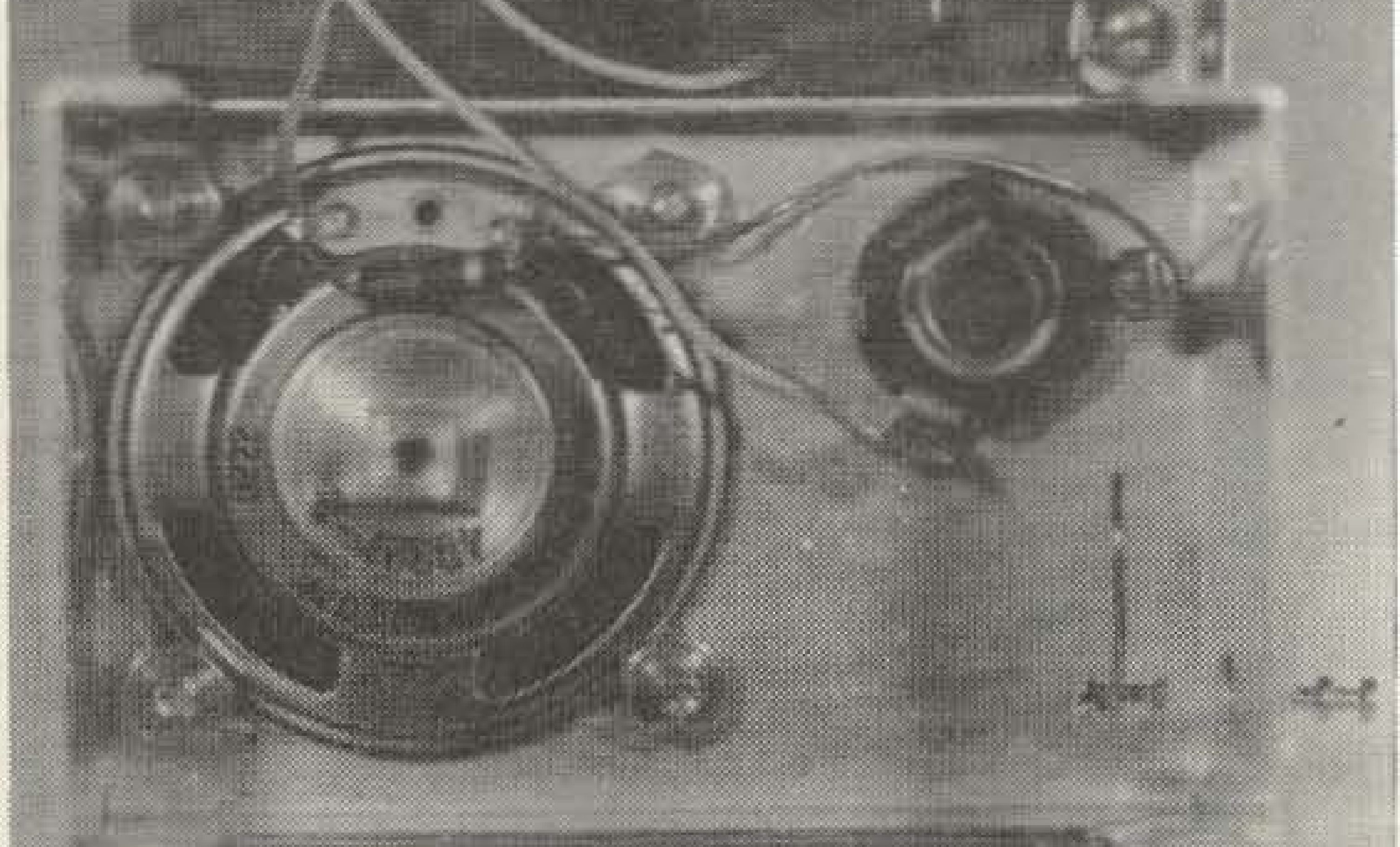
As for the transistors. A type 2N718 and type 2N269 were used in my unit but only because they were types that I had on hand. You may use almost any type as long as one is PNP and the other NPN.

A word of caution as far as the speaker is concerned. Aside from getting one that will fit into the case, try to get one with a voice coil that is 10 ohms or less in value. If your speaker happens to have a higher resistance than 10 ohms it will be necessary to connect

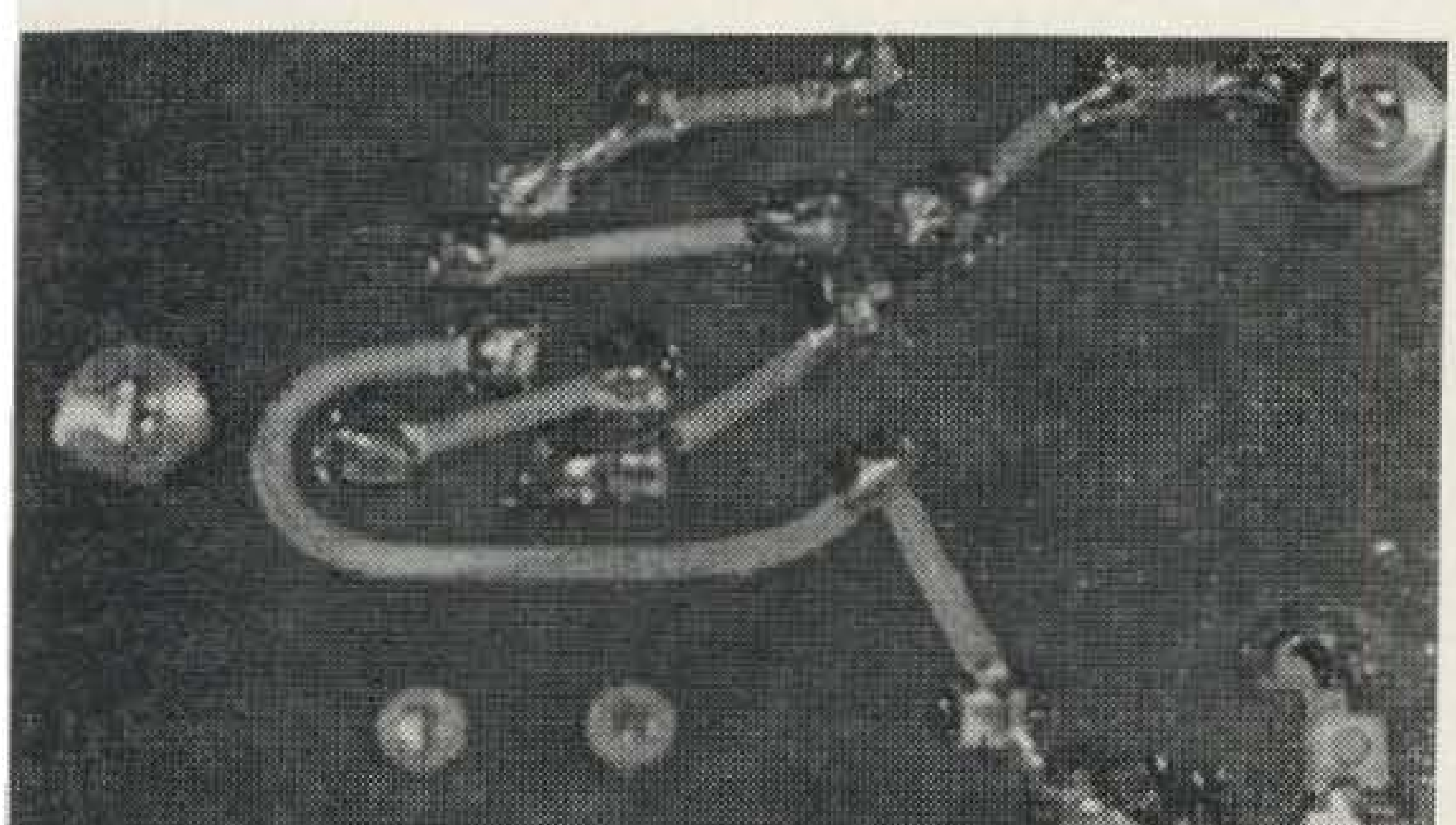


Parts List

RFC—2.2 mh RF Choke
C1—1 μf 10 volts
C2—.1 μf 10 volts
D—1N82 diode, etc.
R1—13 k ½ w
R2—100 ½ w
T1—2N718
T2—2N269
Speaker, key jack & misc. hardware
Cabinet is Premier AMC 1001
Battery is Eveready 912



Inside view of the Code Practice Oscillator and CW Monitor.



Copper side of the printed circuit board. It's available for 50c; see note below.

a 10 ohm resistor across the voice coil. If this is not done, the unit will not oscillate.

So . . . go ahead and spend an hour or so of your time. Build one of these gadgets and be able to tell what your keying really sounds like (you may be surprised). It's also useful as a group code oscillator and has plenty of volume.

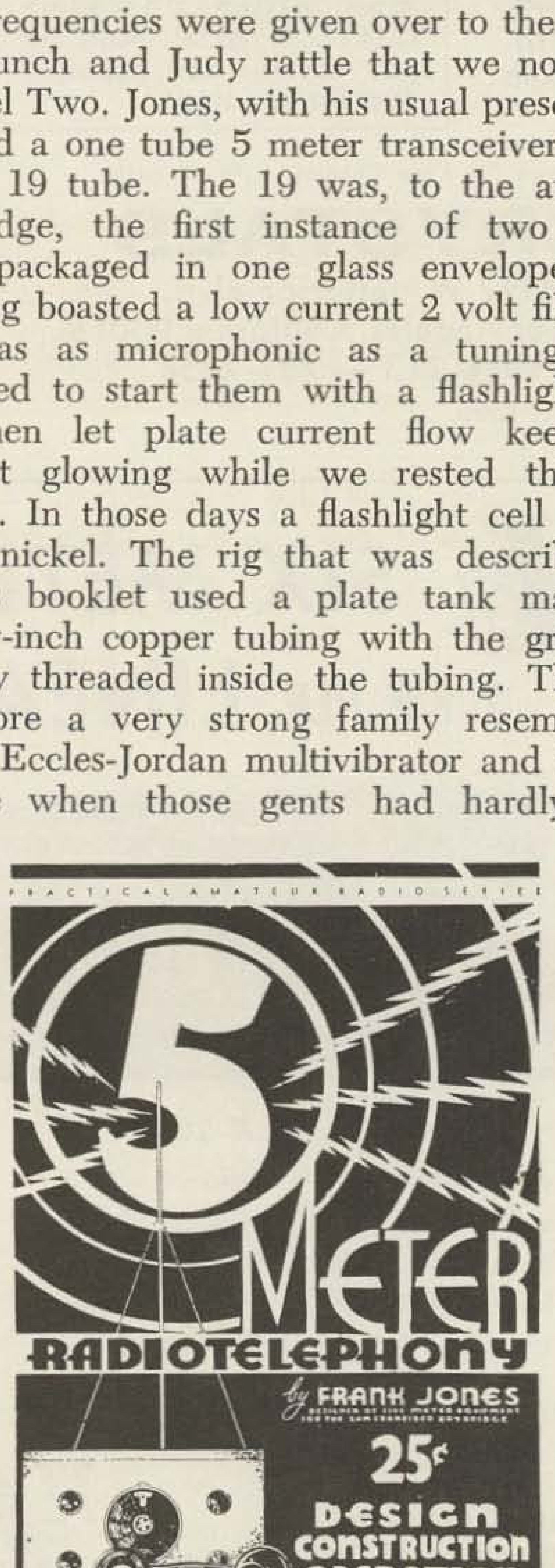
. . . W1JJL

A printed circuit board for this useful project is available for only 50c from the Harris Co., 56 E. Main, Torrington, Conn.

Joe Williams W6SFM

VHF Flashback

Is it possible that a single vacuum tube, a particular circuit or a certain ham could cause a big upswing in VHF activity? Probably not—but if we take the three and add them together just right the chances improve. Back in 1934 Frank C. Jones W6AJF, wrote a booklet called "5 Meter Radiotelephony"; that little 25c paperback was the most complete treatise on VHF of its day and it triggered an outburst of VHF interest that has not yet subsided. Five meters lay from 56 to 60 megacycles and was "the" VHF band before those frequencies were given over to the marathon Punch and Judy rattle that we now call Channel Two. Jones, with his usual prescience, featured a one tube 5 meter transceiver using a type 19 tube. The 19 was, to the author's knowledge, the first instance of two tubes being packaged in one glass envelope; this little jug boasted a low current 2 volt filament and was as microphonic as a tuning fork. We used to start them with a flashlight cell and then let plate current flow keep the filament glowing while we rested the "A" battery. In those days a flashlight cell cost a whole nickel. The rig that was described in Frank's booklet used a plate tank made of quarter-inch copper tubing with the grid coil cleverly threaded inside the tubing. The circuit bore a very strong family resemblance to the Eccles-Jordan multivibrator and this at a time when those gents had hardly met.



The whole thing was laid out on a real breadboard and used a king-sized porcelain based d.p.d.t. knife switch for the send/receive control. An evening's work on that switch was almost equal to a trip to the local gym. The super-regen receiver was surprisingly sensitive and was complete with a wavering radiated whistle that usually out-DXed the transmitter. The circuit in the transmitting state was grid modulated and would light a #47 pilot lamp on a loop while the modulation was checked by observing brilliance variations that accompanied whistling into the mike. The grid modulation worked better than it had a right to but somehow the carbon mikes got hot and turned out to be real lip burners.

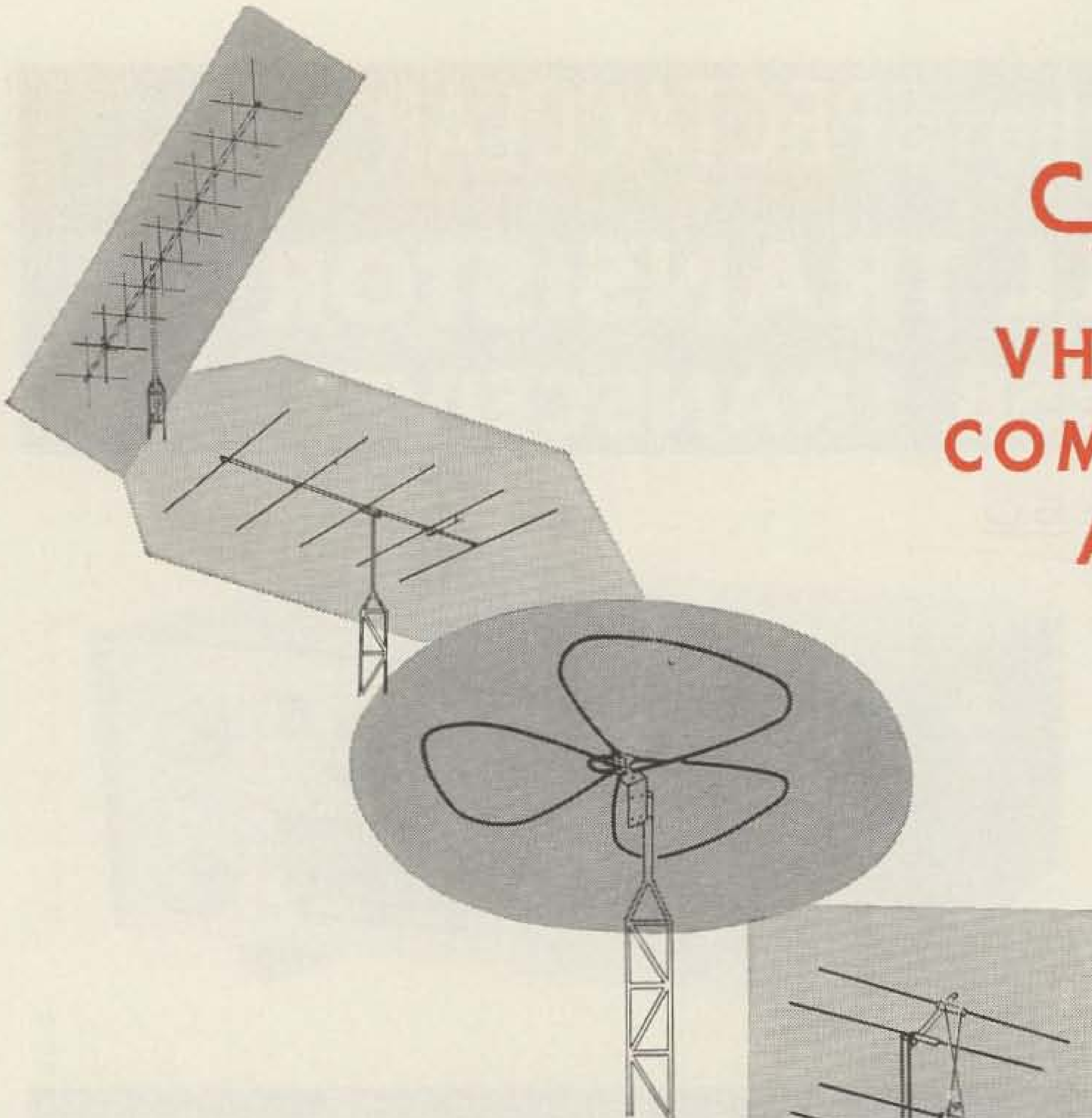
Those were exciting times and new "discoveries" were being made almost everyday by an eager VHF crowd. The most baffling ionospheric vagary of those days was the fact that 5 meters would go stone dead each evening at 7 pm. Not a peep. Then somebody tumbled to what should have been an obvious cause. The VHF stalwarts, along with most of the balance of the population, dropped everything to listen to Amos 'n Andy on the radio.

If you run across a copy of "5 Meter Radiotelephony," thumb through it and you will find information on Rhombic antenna design for VHF; A modern Link-Coupled Phone with a type 46 in the final; How to run a pair of 210's in a stabilized 5 meter transmitter; An explanation of Superregeneration; The Franklin antenna, a vertical colinear that could have some current pragmatic value on Six; Measuring the Wave at 5 Meters and a description of a rig using an Armstrong-Dow oscillator.

One of the most interesting things about looking at old publications is the advertising that appears in them. "5 Meter Radiotelephony" is no exception. It may come as a surprise to some to learn that even in those days transceivers bearing the name Knight were available from Allied Radio. Other transceiver producers were National and Harvey. The Collins Radio Company, which termed itself "Designers and Manufacturers of Transmitters, Transformers and Speech Equipment" offered quite a collection of audio transformers priced at an unbelievable Two Bucks each. Other names, still known today, pop up in ads and in the text. Some of them are: Stancor, Raytheon, Thordarson, Burgess, I.C.A., Newark, RCA, Walter Ashe and Amperite.

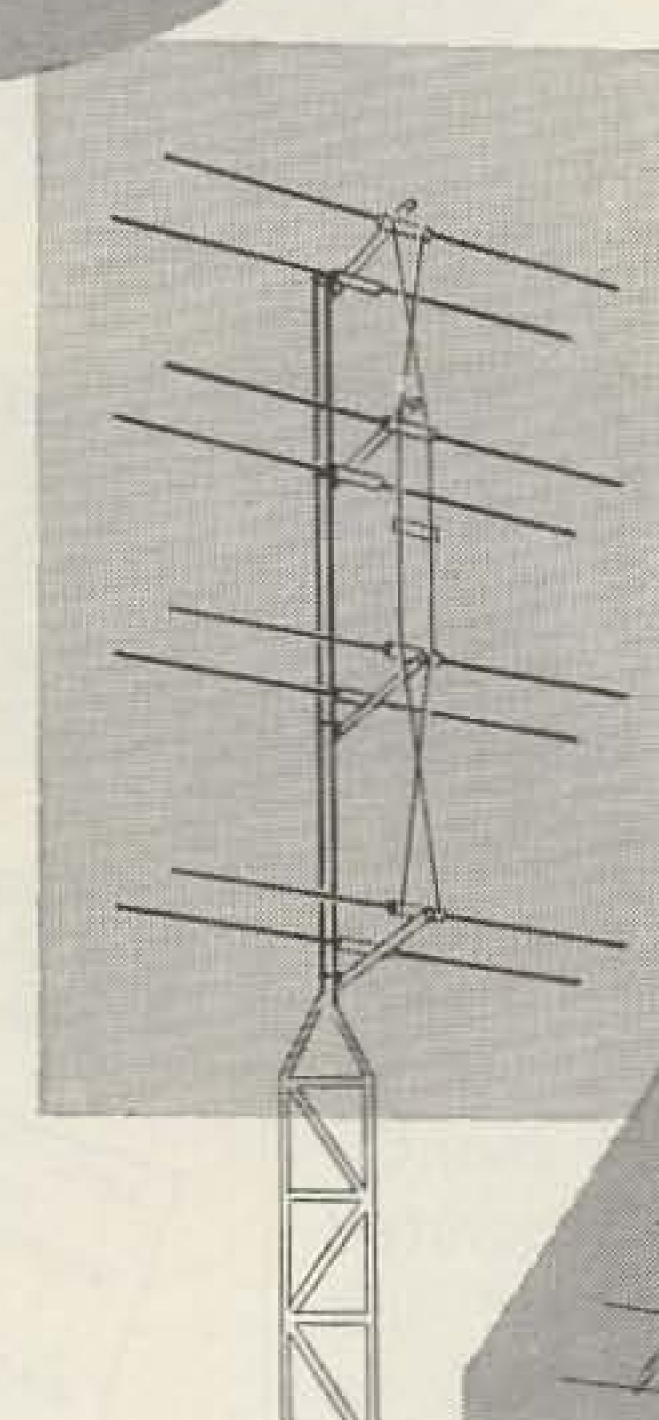
Just for the ducks of it, the type 19 transceiver was built here at W6SFM a few months ago. A few little changes were incorporated into the make-up but the design was left just the way Jones had described it back in 1934. For instance, instead of a 19—a pair of 7586 Nuvistors were used and a toggle switch replaced the old blunderbuss d.p.d.t. The copper tubing bit was duplicated exactly except that this time the grid winding was teflon insulated. A slightly larger tuning capacitor was used and it fell into six meters with ease. The receiver is a gas! Those Nuvistors really play loud. A sked was arranged up in the FM section of the band and WA6EOY reported that the rig, carbon mike and all, was crashing through at about umpty-ump db over Gangbusters. All this has given me the courage to make something that I've been wanting to try for quite a spell: the W6AJF rig condensed down to hand holding size. Figure to use a couple of lucky 2N711's and a toroidal tank. Ought to make a great little local FM net rig. I'll let you know if it works.

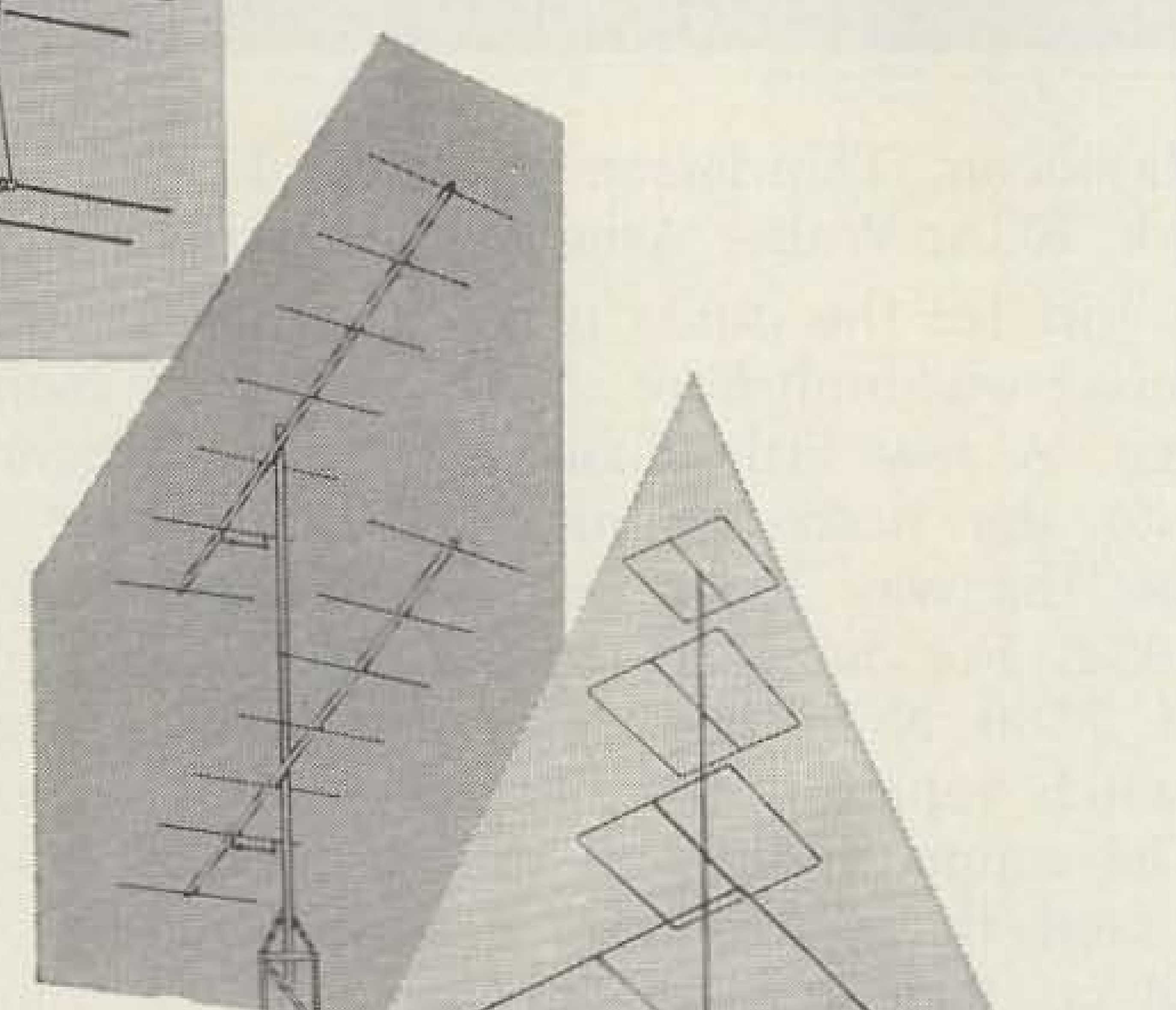
. . . W6SFM



Cush Craft

VHF AMATEUR COMMUNICATION ANTENNAS





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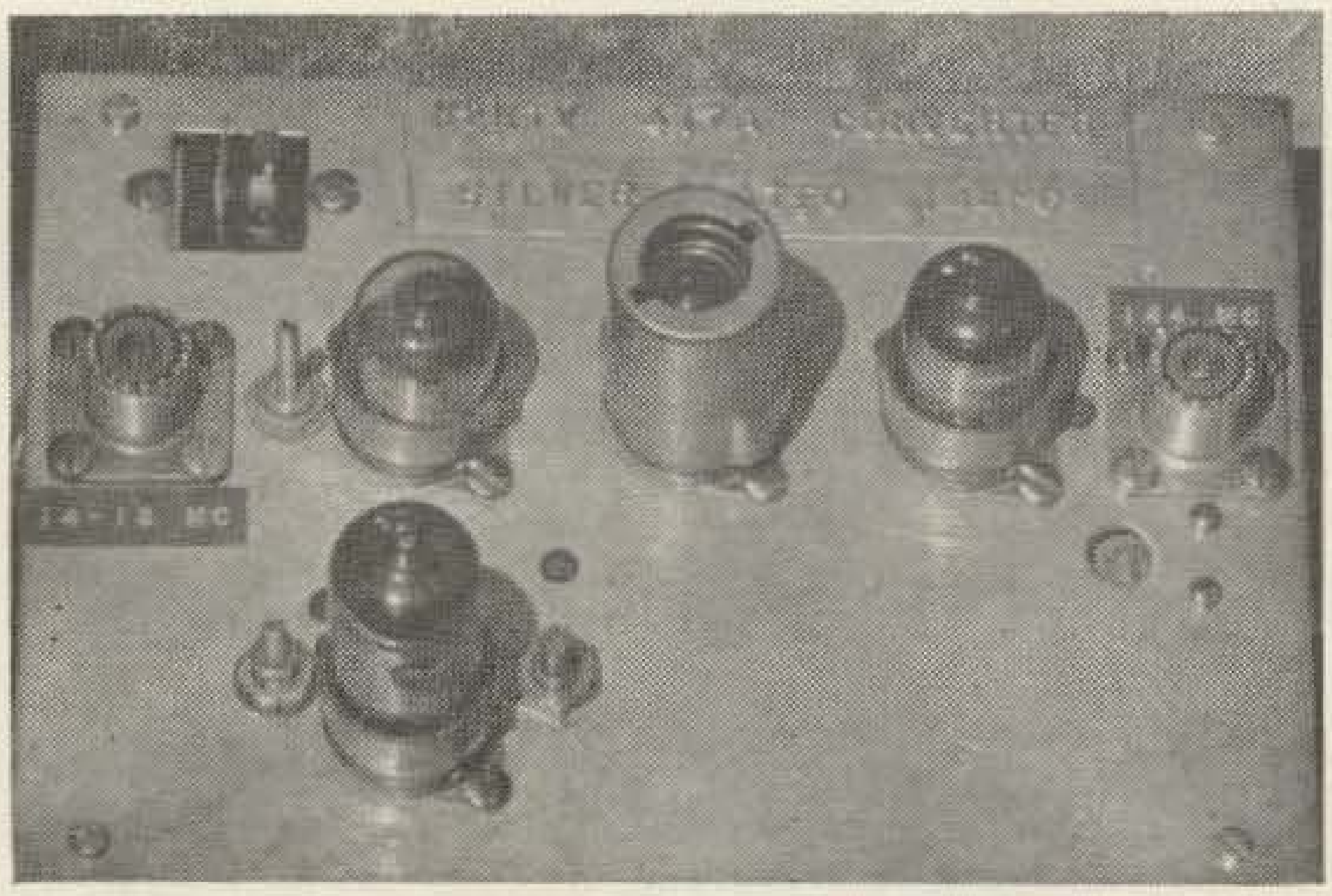


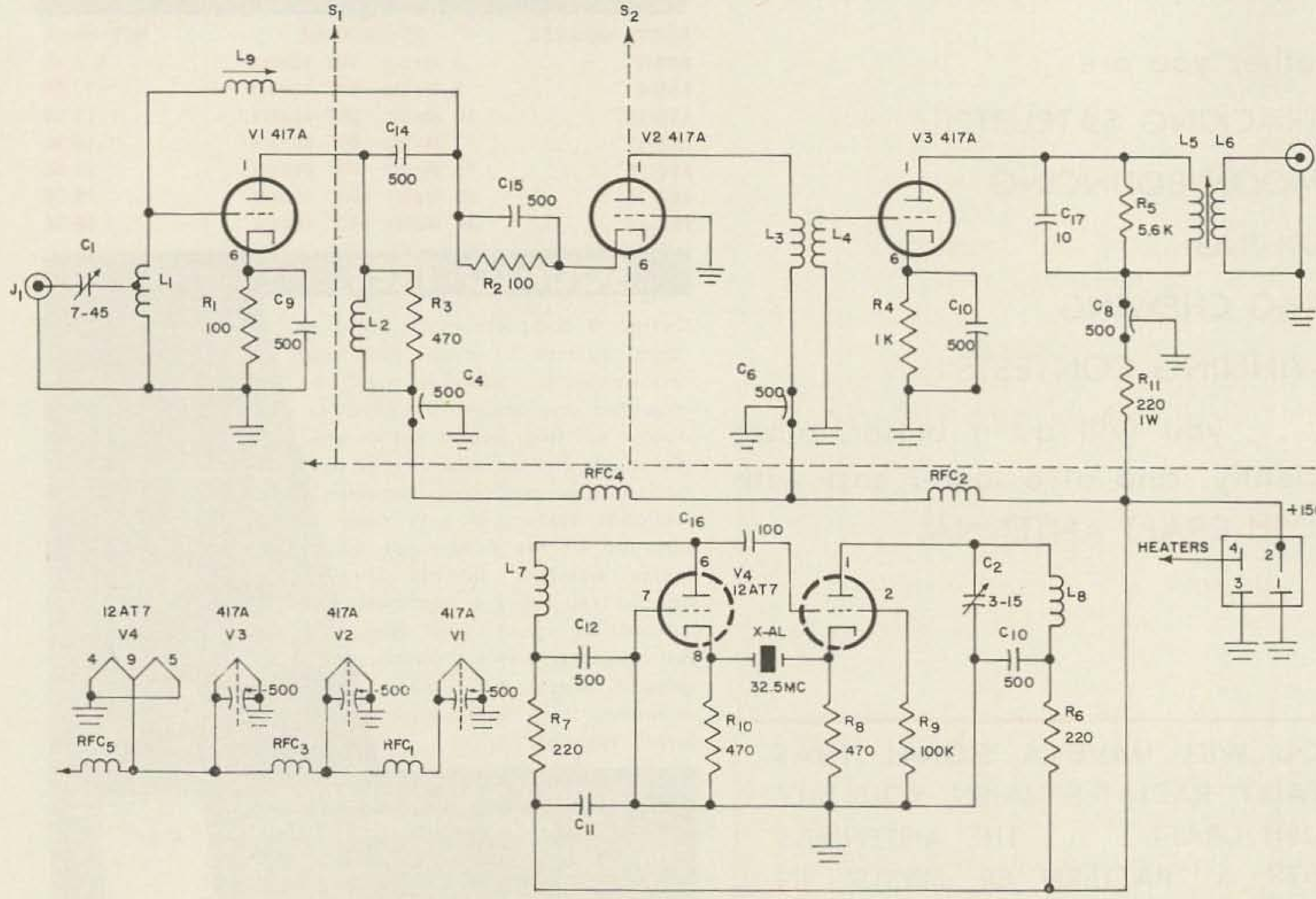
Stanley J. Plager K2KTV
55 Windsor Avenue
Rockville Centre, New York

Seeking the ultimate on two

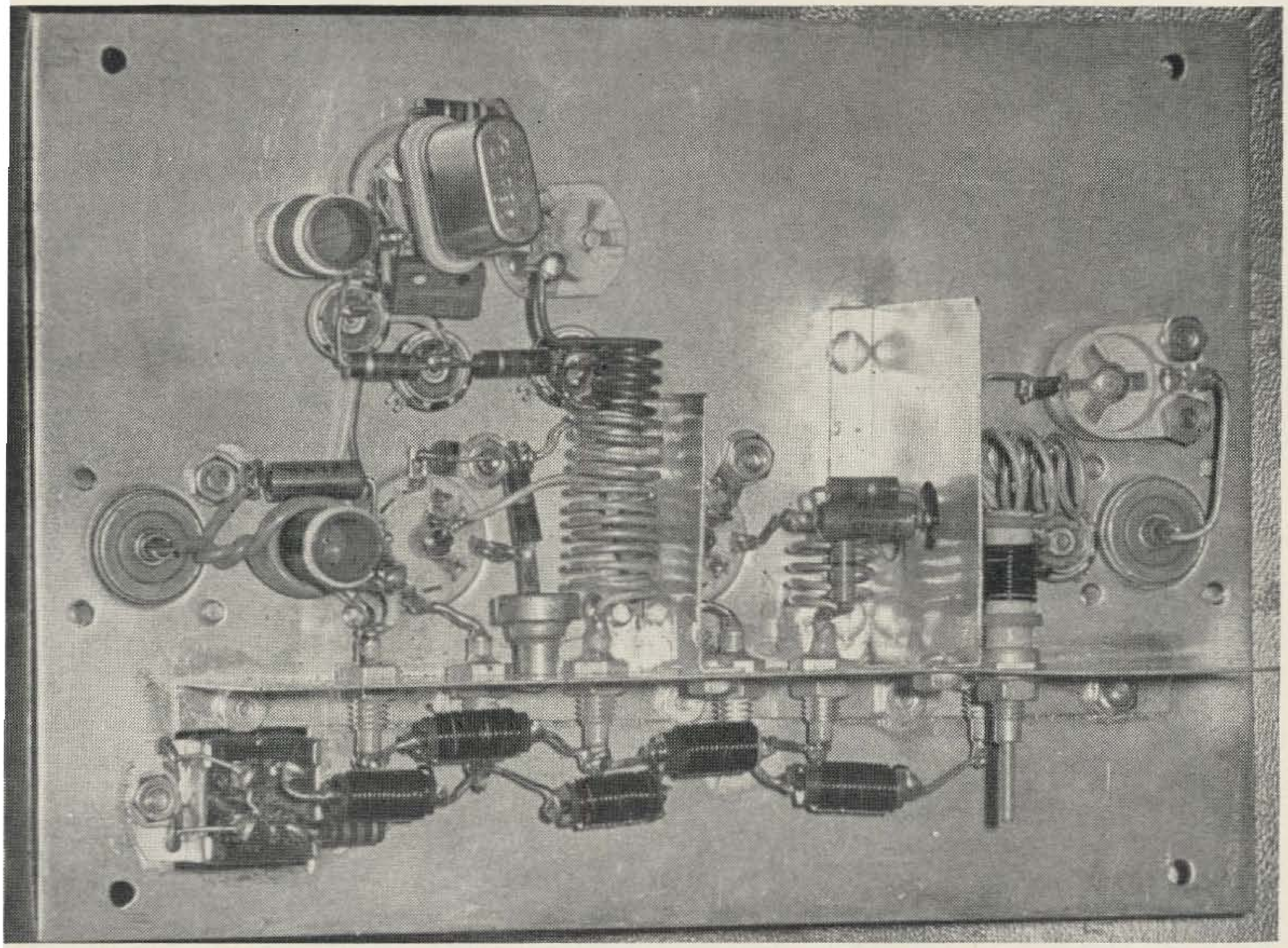
Silverplated 417A Converter

This is an attempt at an ultimate 144 mc converter using present day components and techniques. This attempt was sparked by availability on the surplus market of the Western Electric 417A triode. The 417A, with it's golden grid, is considered one of the finest VHF receiving tubes ever made. A noise figure of 2.5 db has been realized with this converter, but only after the utmost care was exercised in construction, alignment and trouble shooting.

It is recognized that several of the com-



Schematic of silverplated 417A two meter converter.



Bottom view of 417A converter. Antenna input is at right with neutralizing coil beneath airwound input coil. Oscillator is at top. *If* output is jack on left.

ponents specified herein could be replaced with less expensive items, but in attempting to achieve an extremely low noise figure, it was felt that cost was secondary within reason.

The converter plate when completed is screwed to the lip of a modified and inverted five by seven by two inch aluminum chassis. All wiring must be kept to a minimum. All 500 pf capacitors are mica feed-through or button. Feed-through capacitors should be soldered to the shield partition S3. The threaded type may not make good contact unless soldered. It may be found necessary to use 1000 or 1500 mmfd feed-through capacitors. To check for positive bypassing, touch the bypassed circuit at the capacitor with the converter in service. There should not be any noticeable change in noise or signal strength. L9 is the neutralizing medium for the triode first rf stage and is tuned in the following manner. Locate a strong signal and disconnect the filament of the first 417A. This is easily accomplished by cutting off half of pin 9 on the 417A tube. Loosening this tube in its socket will break the filament connection. Adjust L9 for minimum signal, lock setting in place and reconnect the heater or firmly seat V1. This circuit requires no further adjustment.

The 7-45 pf antenna trimmer is adjusted for maximum signal—not maximum noise. A small shield may be required between L-7 and the L-3 L-4 L-8 group to reduce interaction.

Coil Chart:
- L-1 3T #18 bare 3/8" I.D. tapped in center
- L-2 5T #18 bare 3/8" I.D.
- L-3 6T #18 bare 3/8" I.D.
- L-4 3T #18 bare 3/8" I.D.
- L-5 Slug tuned broad band I.F. coil tuned to 14 Mc. (38T #26 enamel on 3/8" Slug Tuned form)
- L-6 4T #22 bell wire over cold end of L-5
- L-7 15T #22 enamel on 3/8" Slug Tuned form (resonant at 32.5 MC)
- L-8 4½T #18 bare 1/4" I.D.
- L-9 11T #22 enamel on 1/4" Slug Tuned form.
- RFC 1-5 14T #22 enamel on 220K Ohm—1 Watt resistor
- L-3 L-4 L-8 are in line end to end with L-4 in center; loose coupled.

. . . K2KTV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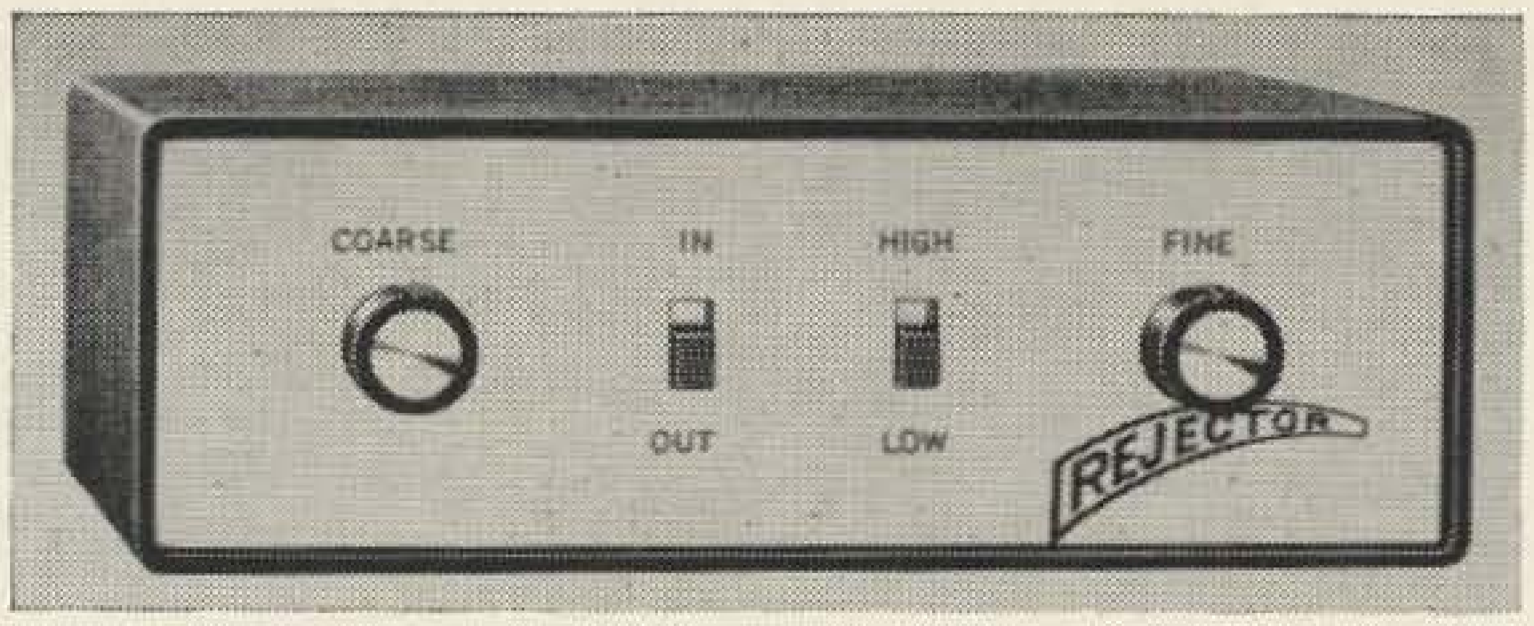


Charles Leedham WA2TDH
101 West 23rd St.
New York, N. Y., 10011

Testing the Galaxy Rejector

About the only thing that has ever made me unhappy about my nice new SSB equipment is that the receiver doesn't have a notch filter. This is by no means unusual—few receivers or transceivers do have notch filters built in. Install one? Even though this confession may reveal me to the world as a rotten appliance operator, I have never felt up to designing, building and installing one somewhere inside the guts of the little box. Tsk. But just recently, Galaxy came up with the gadget I'd been wishing all along somebody would make —a notch filter that goes into the speaker line.

The *Rejector* is an all-transistor audio filter which tunes across the audio spectrum from 300 to 5,000 cycles. Within that range, it will knock any ten-to-twenty cps segment down 40 db, effectively removing it from what you hear in your speaker. Thus when you are listening to a nice signal and the usual heterodyne starts blasting your ear, you no longer mutter and curse the schlunk who's throwing it on you. You flip the Rejector on—when off, the unit is completely out of the circuit—and tune the "Coarse" control until the notch is centered on the heterodyne. The heterodyne will disappear. If you don't hit it exactly with the "Coarse" knob, there's a "Fine" control knob for more precise adjustments, but I've hardly ever needed it.

In operation, the Rejector is a handy gadget to have on your operating table, as it can be made to do considerably more than just eliminate heterodynes. On CW, it will knock an interfering signal, if not completely out, at least far down enough to make the desired signal easy to read. And on SSB it can be a blessing for reducing interference. If, for example, you're listening to a contact, and someone else comes on a kilocycle or so away, you can edge the notch around to depress the high audio frequencies of monkey chatter, or the low audio of rumble. In one or two cases, I have even been able to get usable copy from one station with another on essentially the same frequency—if one guy's voice is enough higher or lower than the other's, it is possible to use the notch to depress either the higher or lower voice. Obviously, nothing can completely eliminate the unwanted voice in this kind of situation, but the Rejector can make the difference between copy and confusion.

Even on single signals it can be useful. Trying to copy weak DX signals, I've been able to swing the Rejector's notch down to cut out some of the lower voice frequencies (plus at least a small hunk on the QRN) and make relatively easy copy of it by getting only the higher and more penetrating parts of the voice.

The unit is small (7½ by 5½ by 2½), attractive, and has a reversible front plate so that you can use it horizontally, sitting on top of your receiver, or vertically, standing between units or alongside. It is simplicity itself to hook up. Two cables are supplied with pin-plugs (RCA phono type) on each end. One goes from your speaker socket on the back of the receiver to the back of the Rejector, and the second cable from the Rejector to the speaker.

Power required is 12 volts at half an ampere, AC or DC, which can be taken from the auxiliary power socket of many transceivers and receivers. If yours doesn't supply 12 volts, it is easy enough to whomp up a little AC supply with a filament transformer and a switch mounted on a minibox. Or, if you like, Galaxy sells a small 12-volt supply for $6.95.

If you've never used a notch filter, you'll be astounded at what a difference it can make in your reception. And even if you already have a notch in your receiver, by the way, the Rejector can add a second notch, to take out the interference above the signal while your internal notch is handling the stuff below. It's a good little unit, and, for $34.95, is well worth adding to your equipment. . . . WA2TDH

William Welsh WA6VTL

20 WPM—or Bust!

If FCC Docket 15928 becomes a way of life in amateur radio (and it probably will), thousands of Conditional, General, and Advanced hams will make every effort to upgrade to the Amateur Extra Class License so that they won't suffer any code or voice operating restrictions. It's quite possible that some parts of the published docket will be changed before the new regulations take effect but it does seem likely that Amateur Extra Class licensees will enjoy exclusive (or semi-exclusive) code and voice operating privileges. This article will help you upgrade yourself to the point where you'll be able to pass the code portion of the Amateur Extra Class license examination.

It is assumed that you hold a valid Conditional, General, or Advanced class ticket and that you've held it for the required two years, or more. If the Amateur First Class License becomes a reality, this article will help take you to the 16 WPM code requirement for that class of ticket. It is assumed that you will be striving for the top license, though, and this article will help you achieve that goal.

In case my current call sign (WA6VTL) bothers you, I'll take this opportunity to assure you that I know licensing programs. I've taught free general class licensing courses for 14 years. My time has been divided between the El Ray (W1OMI), Middlesex (W1HEB), Salem (K1HDZ), and Lockheed (W6LS) amateur radio clubs. In addition, I've taught ham courses for schools, scout groups, CD groups, industrial recreation groups, boys clubs, etc. Due to the fact that I've been able to make most students realize that there's no substitute for study and effort, I've been able to help thousands of students get their tickets. You'll find that you'll be helped, if you follow instructions.

As you probably know, the Amateur Extra Class License code test requirement is 20 wpm. If you are an amateur who has put in a normal amount of your on-the-air time working code QSO's, your code speed probably exceeds 20 wpm now and you'll only be interested in subsequent theory articles. On the other hand, if you're an ardent phone or RTTY operator (or if you've been off the air for a while), you may need a few hints on how you should get your code speed back up to where it was and then on up to 20 wpm.

The best way to increase code speed is still on-the-air QSO's with other code stations. Make room on your operating table for your handkey, bug, or electronic keyer and shove that mike aside.

If you are very rusty, move into the Novice code bands on 80, 40, and 15 meters. Please be very patient with these new hams and remember that a little consideration means a lot to a guy who's just learning the game. Be patient and make sure any criticism you make is of a constructive nature. Leave that final off when you're in the Novice bands to avoid unnecessary interference. As a general rule, you'll find that the slowest Novices seem to congregate on 80, faster ones on 40, and the fastest seem to get on 15; you'd do well to

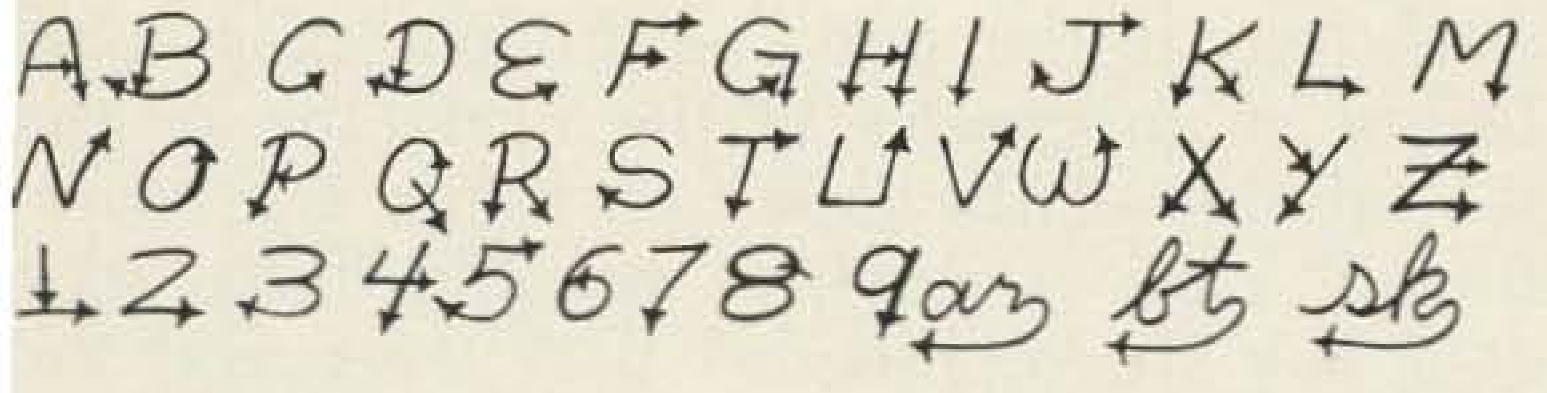
move up through their bands as your code speed picks up. In addition to being courteous, please remember that a QSL means more to a beginning ham than it does to you; make it a practice to ask for their address so you can send a card to each new station you contact.

Once you start to get your code ability back, move out into the 'general' bands and get in as much code operating time as possible. Make it a practice to answer guys who are sending at a rate which will make you 'sweat' a bit and tell them you are looking for a little code practice so there's no need to keep the QSO brief unless they are in a hurry. Whether you are practicing code with on-the-air contacts or by any other method, you've got to set aside a certain amount of time each week for code practice and stick to it without fail; four hours per week should be the minimum amount of time devoted to your code program. You can have a little fun working regular code schedules with other guys who are striving to reach the 20 wpm goal.

One of the best ways to increase your code proficiency on the air is to participate in as many local, national, and international contests as time permits. Field day, sweepstakes, C-D, QRP, DX, and other contests provide excellent operating opportunities. Read your radio publications carefully and mark a calendar (at your operating position) to remind yourself when each contest is on. Remember to submit logs when you participate in a contest to provide validation for the other contestants, whether or not you are interested in your own contest standing.

If you want to kill two birds with one stone, you should handle traffic as part of your code speed program. There are bound to be nets you can join which are on at times, frequencies, and speeds which are suitable. Message handling will develop high-speed transcription habits if you stick in there and handle a lot of traffic.

If you're in a club, get the group interested in conducting an "extra class" course, including a 'high-speed' code class. Your club would do well to plan a 16-week course with a single 3-hour class each week. Each class should consist of a 55-minute code session, a 10-minute coffee break, and a one hour and 55-minute theory class. Club instructors can't assume code ability on the part of their students; they'll have to rely on results noted during the code speed runs which are held as part of the code sessions. An initial code speed ability of 7 wpm should be required of all 'extra class' students and each student is expected to increase his code speed 1 wpm each week of the course to progress to a 22 wpm code proficiency by the end of the course. During the first code sessions, stress the fact that code transcription must be both rapid and legible. Teach a system of fast printing which will provide positive character identification. **Table I** shows a printing system I've taught for the past decade; I think you will find this variation of prescribed government printing is well-suited to code transcription. If you've ever tried to write a pair of E's in the middle of a high-speed run, I'm sure you realize the advantage of making this



Note:

1. Arrow heads indicate the end of pencil strokes.
2. The first and last numbers (one and zero) are distinguished from the letters I and O.
3. The last letter (Z) is distinguished from the number 2.

Table I. Speed Printing System

letter as I suggest rather than to print each one as many as four separate pencil strokes. Every character must be transcribed as quickly and easily as possible and it must be easily read to be useful; stress good copying habits and have students practice their printing from the start of the slow speed runs so that they'll have the system down pat by the time they get up into the high-speed code.

Next to on-the-air code contacts, pre-recorded magnetic tape recordings provide the best means of building code ability. Prerecorded code practice tapes permit students to copy error-free, perfectly-timed code runs which provide the maximum amount of useful code copying time because students don't have to wait idly while the code instructor makes a character-by-character count to determine what exact speeds were sent during each part of each run. There are several pre-recorded tapes available but I don't know of any which have the amount of high-speed code practice you'll need to progress past 20 wpm. A set of seven 1200-foot tapes, recorded at 3¾ ips, will do the job perfectly; they'll take students from 7 wpm to 22 wpm. If you use a set of tapes like mine, the student will be required to progress from 7 through 10 wpm before he leaves the first tape. Each side of each succeeding tape requires the student to increase his code speed 1 wpm before he progresses on to the next side/tape in the series. I've used this system very successfully with thousands of students and I know it does the job extremely well. In addition to the advantages already covered, pre-recorded tapes free the code instructor from the code oscillator and permit him to wander about among his students to see how they are progressing and to correct obvious faults. Another major advantage to having a complete set of code practice tapes at your club is that you'll be able to make as many duplicate copies as you want to let your students get as much code practice as they need (at home) between weekly classes. Any club instructor who wants to make up a set of code practice tapes would do well to consider a set

Letter	"Old" ICAO Phonetic	"New" ICAO Phonetic
A	Able	Alfa
B	Baker	Bravo
C	Charlie	Charlie
D	Dog	Delta
E	Easy	Echo
F	Fox	Foxtrot
G	George	Golf
H	How	Hotel
I	Item	India
J	Jig	Juliett
K	King	Kilo
L	Love	Lima
M	Mike	Mike
N	Nan	November
O	Oboe	Oscar
P	Peter	Papa
Q	Queen	Quebec
R	Roger	Romeo
S	Sugar	Sierra
T	Tare	Tango
U	Uncle	Uniform
V	Victor	Victor
W	William	Whiskey
X	X-ray	X-ray
Y	Yoke	Yankee
Z	Zebra	Zulu

Table II. International Civil Aviation Organization Phonetic Alphabets

like the one I've recorded and the following breakdown provides the major information needed to produce a set of 'high-speed' code practice tapes:

a. General—Use only one tone throughout a code run and try to have that tone be from 400 to 1000 cps to suit the majority of your students. Use plain-language and mixed-group (5-letter, alphabet-only) runs very sparingly because cipher groups (letters, numbers, punctuation marks, and work signs sent in 5-unit-count groups) provide the best code practice. Precede each code run with a statement of what will be sent; state the tone, type of key, length of run at each speed, type of text (mixed groups, cipher groups, or plain language), and any other pertinent data. Immediately after each run, provide a complete phonetic read-off of what was sent and identify the speeds used at each point where the rate changed. Use only punctuation marks and work signs (in addition to the alphabet and numerals) which are used in FCC code exams. End each side of each tape with an FCC-type 5-minute plain-language code test at the rate the student must pass before he progresses to the next tape or the second side of the tape he's using. Use 'over-the-hill' runs as much as possible; these start at a low speed, progress past the speed the then drop back down to the speed he should pass before he leaves the side of the tape he's using.

b. Tape Breakdown—The tapes should contain the following code instruction material:

Tape #1, Side #1. Reintroduction to the work signs and punctuation marks used in the FCC code exams (and in the code tapes). Two over-the-hill (O-T-H) cipher group runs @ 7-10-8 wpm. A 5-minute cipher group run @ 8 wpm. A 5-minute plain-language run @ 8 wpm.

Tape #1, Side #2. Cipher group O-T-H runs @ 8-11-10 and 8-12-10 wpm. A 5-minute cipher group run @ 10 wpm. A 5-minute plain-language run @ 10 wpm.

Tape #2, Side #1. Cipher group O-T-H runs @ 10-12-11, 10-13-11, and 10-15-11 wpm. A 5-minute plain-language run @ 11 wpm.

Tape #2, Side #2. Cipher group O-T-H runs @ 11-13-12, 11-14-12, and 11-16-12 wpm. A 5-minute plain-language run @ 12 wpm.

Tape #3, Side #1. Cipher group O-T-H runs @ 12-14-13, 12-15-13, and 12-15-13 wpm. A 5-minute plain-language run @ 13 wpm.

Tape #3, Side #2. 3 cipher group O-T-H runs @1 3-16-14 wpm, plus a 5-minute plain-language run @ 14 wpm.

Tape #4, Side #1. 3 cipher group O-T-H runs @ 14-17-15 wpm, plus a 5-minute plain-language run @ 15 wpm.

Tape #4, Side #2. 3 cipher group O-T-H runs @ 15-18-16 wpm, plus a 5-minute plain-language run @ 16 wpm.

Tape #5, Side #1. 2 cipher group O-T-H runs @ 16-20-17 wpm, a 5-minute cipher group run @ 17 wpm, and a 5-minute plain-language run @ 17 wpm.

Tape #5, Side #2. A cipher group O-T-H run @ 17-23-18 wpm, an 8-minute cipher group run @ 18 wpm, and a 5-minute plain-language run @ 18 wpm.

Tape #6, Side #1. 2 cipher group O-T-H runs @ 18-23-19 wpm and a 5-minute plain-language run @ 19 wpm.

P,TH	N6AV	2LDR	Q5XE	Jbt8	U4IK	Csk1
F/MB	O3?	ar7G	ØY.	SW9Z	2,E	CskOJ
G.LA	6T/	QMarP	4U8	WIRØ	HbtDS	Y91
3B?	V5ZN	X7KF	TØ?	LarVO	I1sk	D3XN
K.FY	GA/R	7MBS	U29	P,6	4Ebt	CQZ8
W5JH	1L,	Far?	ØA/	OWH3	MskJB	9.Z
CR5Q	S7bt	6EXT	D8PI	K4YV	UN2G	(etc.)

Table III. Typical Cipher Groups

Tape #6, Side #2. 2 cipher group O-T-H runs @ 19-24-20 wpm and a 5-minute plain-language run @ 20 wpm.

Tape #7, Side #1. 2 cipher group O-T-H runs @ 21-27-22 wpm and a 5-minute plain-language run @ 21 wpm.

Tape #7, Side #2. 2 cipher group O-T-H runs @ 21-27-22 wpm and a 5-minute plain-language run @ 22 wpm.

Use recognized phonetic codes in making your read-off of code practice runs. **Table II** shows the old and new ICAO phonetic alphabets which are the two most frequently used sets of phonetics.

Table III shows typical cipher groups such as I use in my own series of code practice tapes; you'll need to make up several hundred different 5-unit-count groups for use in each of your code tapes. Remember that each "word" has a 5-unit count, based on letters having a 1-unit count and each punctuation mark, work sign, and numeral having a 2-unit count. Use each symbol an equal number of times and use a 'chance sequence' selection system to avoid any pattern of combinations.

To summarize the preceding paragraphs, I'm simply reminding you to do something which I'm sure you've known all along; you've got to set your mike aside and start using code. Club members can add a little interest to their code proficiency program by having code competitions between all club members and posting the test results regularly. League-affiliated clubs can make use of ARRL club code proficiency awards, plus their own stickers, to provide some shack wallpaper to show how each member is progressing in his individual battle to get "over-the-hump."

It may be that you have forgotten some of the good sending habits you knew. You'd do well to have your sending checked out by someone who is an expert and listen to his constructive criticism, if he has any to offer. It is quite possible that you may have developed poor sending habits and, if this is so, you should make a determined effort to get rid of them at the start of your code improvement program.

TF1-4539 and TF1-4540 are a pair of Air Force training films which cover, "The Technique of Hand Sending," and, "Rhythm, Speed, and Accuracy in Hand Sending," respectively. These films are F-24 and F-25 in the ARRL film library and league-affiliated clubs should show them as part of their code program. Non-affiliated clubs can borrow these films through local military outlets.

As far as your code operating arrangement in your station is concerned, you would do well to make certain everything is set up for the best possible results. One of the most common goofs I find is that hams don't mount their handkeys to the surface of their operating table (or anything else, sometimes) or they are mounted incorrectly. Your key should be securely mounted in the position where it is in line with your forearm when you are seated normally at your operating position; you shouldn't have to reach for the key nor should the elbow of your sending arm be off the edge of the table. You must be comfortable and correctly positioned to send code at your best. A second common goof I find is that most stations don't have any code monitoring arrangement. It is best to have a code monitor and it is relatively simple to build and install a good one. The third most common goof I find is that stations are not set up for efficient operation. It is foolish to work with 'hay-wire' setups when you can make an efficient, easy-to-operate station by just expending a little time and intelligent effort. Take the time now to make your station a better code station and this will help you become a better operator much faster.

Many hams leave handkeys too soon. If one shifts to a bug or electronic keyer before he completely develops a good fist with a handkey, he may never finish developing the fine sense of rhythm needed for top code operation. If you've never developed good handkey ability, you should slow yourself down for a while and develop it now; you'll soon be back up to the speed you presently have but you'll be sending much easier and better than ever before.

Licensing class instructors in league-affiliated clubs should make sure they have a copy of the ARRL, "Licensing Classes," brochure which contains a lot of information vital to 'general' licensing classes; most of the material is equally useful in an 'extra' licensing class.

That wraps this one up, gang, and I hope you make it all the way to that extra class ticket as soon as possible; I know 73 is planning a detailed series of articles to help you with the material you must know to pass the written portion of the extra class exam.

. . . WA6VTL

73 Tests the Gonset Six Meter Sidewinder and Linear Amplifier

Everyone who operates VHF knows the Gonset Communicator. It was the rig that brought real life to the six and two meter bands. Not content with stealing the first honors, Gonset has been busy again and brought out another piece of equipment that will make all of the six meter boys drool. It's the Gonset model 910A six meter Sidewinder SSB transistorized transceiver. We reviewed the two meter model a few months back and had been waiting anxiously for the six meter one. It fulfills all of our expectations and then some.

Sideband is growing on six at a pace that the AM boys consider as merciless as the take-over of the HF bands. The SSB contingent is growing larger every day—and fine commercial gear such as the Sidewinder accounts for most of this growth.

The Sidewinder is a real pleasure to use. It covers four one-megacycle ranges from 50-54 mc. Tuning over the megacycle on each range is very easy. There's both slow and fast tuning with a very solid feel in the movement. In addition, there's a convenient receiver offset control that permits you to tune over a 3 kc range centered on your transmit frequency. The receiver provides very low-noise reception and plenty of gain and audio output for mobile use.

Transmitting with the Sidewinder is a real pleasure, too. It's very easy to tune up. One nice feature is four switch-selected crystals so that you can work DX down in the CW part of the band. They're also good for net operation. The Sidewinder has provisions for CW, AM or SSB. It even uses separate AM detector on receive. The receiver has a sensitivity of 0.5 microvolts for 10 db S/N ratio. Image rejection is 50 db. The unit is extremely stable. We couldn't find any noticeable drift. The crystal-lattice filter at 9 mc provides perfect selectivity for SSB.

The transmitter runs 20 watts PEP input to a 6360. On CW the input is 20 watts, on AM about 6. Spurious suppression is down 40 db, unwanted sideband down 40 db and carrier is down 50 db.

The Sidewinder is completely transistorized and solid state except for three tubes used in VHF portions of the transmitter. You can turn their filaments off for standby receive, so that the transceiver draws almost no current from your car battery.

The instruction manual provides complete information—even about alignment. It should be very helpful if you ever need to fix the gear, which is unlikely because of the transistorized design and modern high-reliability components.

We also tried out the Gonset Model 913A six meter rf power amplifier. It's an interesting departure from the extreme miniaturization craze of late. There's no reason to waste a lot of space with transistorized gear, but for an amplifier rated at 500 watts, we sometimes get suspicious of an ultra-tiny construction. The 913A is solid and husky. It uses full-sized underrated components for high reliability and lack of trouble. It runs 500 watts PEP on SSB and also works perfectly on CW, FM and AM. It only requires 5 watts of drive for linear service for full output. The amplifier tube is a 4X150A—though you can use other tubes in that family if you wish.

The complete power supply is included in the 913A. It's all solid-state except for the voltage regulated supply for the 4X150A screen. You aren't likely to have much trouble with it!

So much for a description. You're probably curious about the results. They're outstanding. We got the set going up on the mountain. Everyone we worked commented on the excellent signal. There was no distortion, spurious signals, instability, etc. All of the reports were first class. We've lost count of the stations and states worked, but it has been well-tested in all propagation methods commonly used on six: line-of-sight, extended ground wave, sporatic E skip, and aurora. It's a fine rig; our only complaint is that it has to go back to Gonset before the June contest.

. . . 73

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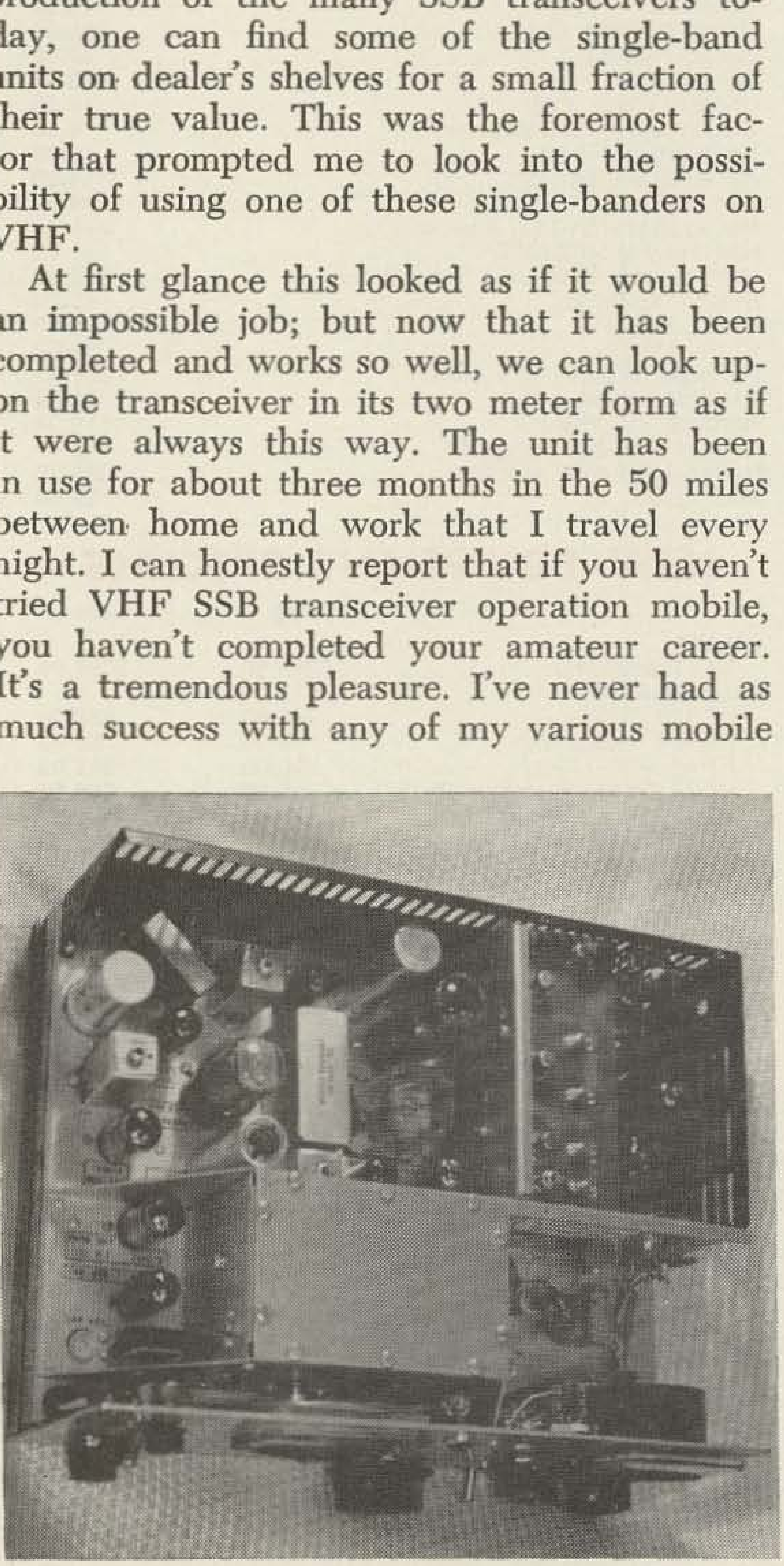
Converting the 20m Swan to 2

With the increase in the production of the production of the many SSB transceivers today, one can find some of the single-band units on dealer's shelves for a small fraction of their true value. This was the foremost factor that prompted me to look into the possibility of using one of these single-banders on VHF.

At first glance this looked as if it would be an impossible job; but now that it has been completed and works so well, we can look upon the transceiver in its two meter form as if it were always this way. The unit has been in use for about three months in the 50 miles between home and work that I travel every night. I can honestly report that if you haven't tried VHF SSB transceiver operation mobile, you haven't completed your amateur career. It's a tremendous pleasure. I've never had as much success with any of my various mobile rigs as I get with this 2 meter version of the Swan and the "J" beam mobile antenna.



Side angle view of the converted Swan SW-120 transceiver ready for action on 144 mc. Two meter section is at the upper left.

In this article you will find out exactly how to convert a 20 meter transceiver so that it will work on a 600 kc section of 2 meters in four steps. In the next issue the final amplifier that mounts in the trunk with the power supply will be described.

To start the project you must acquire a single or tri-band SSB transceiver. This conversion can be made with other transceivers changing just the physical mounting of the converters slightly. The unit I used was the 20 meter Swan SW-120.

If we analyze the operating necessary to convert a 20 meter transceiver to two meters, it will be noted that you have two converters —receiving and transmitting—to bring the original 14 mc frequency to 145 mc. This is the same situation encountered at the station with a separate receiver and transmitter. In the transceiver, however, we have the receiver and transmitter using many of the same components on each side. We must, then, separate the receiver front-end and the transmitter-driver (not the final) and feed them into the converters. This is all that's required.

Converter Construction

By using fiberglass epoxy boards (with clad copper on one side) this project becomes quite simple. These boards can be purchased with all holes punched, sockets mounted and ready for parts from the Melco Co., Marissa, Ill., for $15. A complete kit of parts is also available from this firm.

If you build these units from scratch, proper size has to be noted so that the two boards will fit perfectly in the space that was used originally to house the 6DQ5 14 mc amplifier, which has to be removed before anything can be mounted. Everything but the coax connector is removed from this final cage. The tube socket for the 6DQ5 is left on the vertical panel that runs through the middle of the Swan. This necessitates removing the wiring harness from this socket and taping the loose ends. Leave all connections as they were originally installed on the V^1 tube socket.

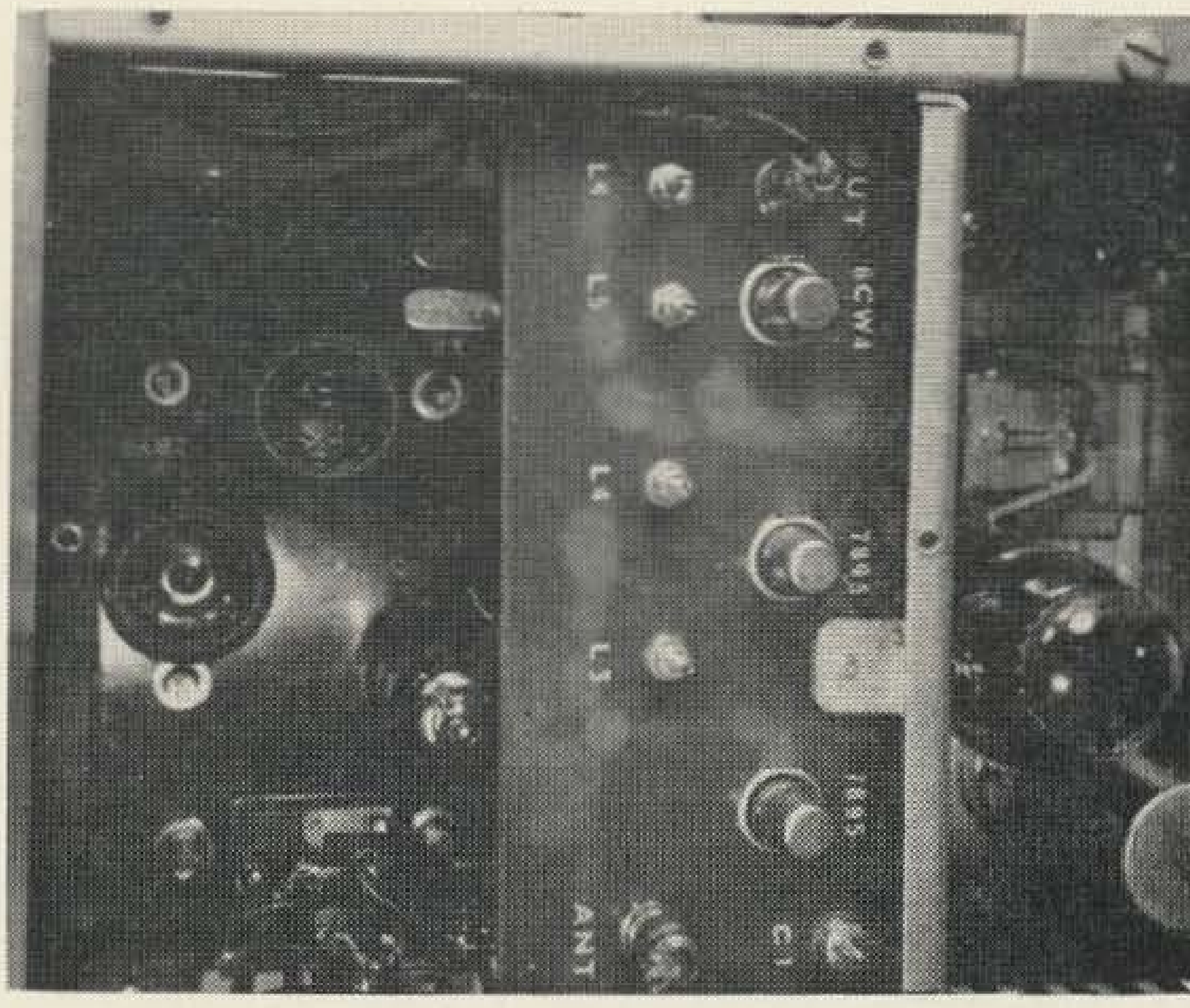
The oscillator-tripler is used for receive and transmit so that transceive facilities will be correct. It is capacitively coupled to the transmitting mixer and inductively coupled to the receiver. This is through L_2. The 6360 PLATE and LOAD controls are mounted on the rear apron of the original chassis, enabling you to tune the two meter final from outside the cabinet. The GRID TUNE is broadband enough so that it will operate over the entire 600 kc segment with no difficulty.

The receiving converter has two 7895 nuvistors in a neutralized cascode circuit which drives the 6CW4 mixer. 6CW4 tubes could be used in place of all three tubes without any modification, but the 7895 will give you a little better performance. (Tests from here show that the 7895 gives I db better signal-to-noise ratio.) Be very careful that shield be placed in between each of the stages. Self-oscillation will be apparent if the shields are not well made. They are constructed from the fiber epoxy boards with copper on *both* sides. Holes are drilled in respective locations for the L_{10} lead, L_8 lead, and all of the 2200 ohm plate resistors and filament leads to be passed through. No feed-thru capacitors are necessary here.

The original filament circuit has to be completely rewired so that it can be used with 12.6 volts. With the 6DQ5 out of service now and the other additions made, the circuit must be rewired. By following the schematic closely and paying attention to the tube numbers in the original Swan manual, this is not too difficult. But it has to be done and now is the best time in the conversion to do it.

Connecting Converters to Transceiver

After the converters are completed, be sure and check for proper resonance of all coils and a final check that wiring is correct. With this done and everything found to be in order, the ventilation holes that were originally under the 6DQ5 are cut out so as to accommodate the transmitting board. The receiver board is mounted on the side of the final stage (which had the feed-thru) to connect the original 14 mc rf amplifier to the tank circuit). Remove this small feed-thru and place the receiver board up as close to the top lip of this panel as possible, making sure that the nuvistors and the coil slugs do not extend above the top



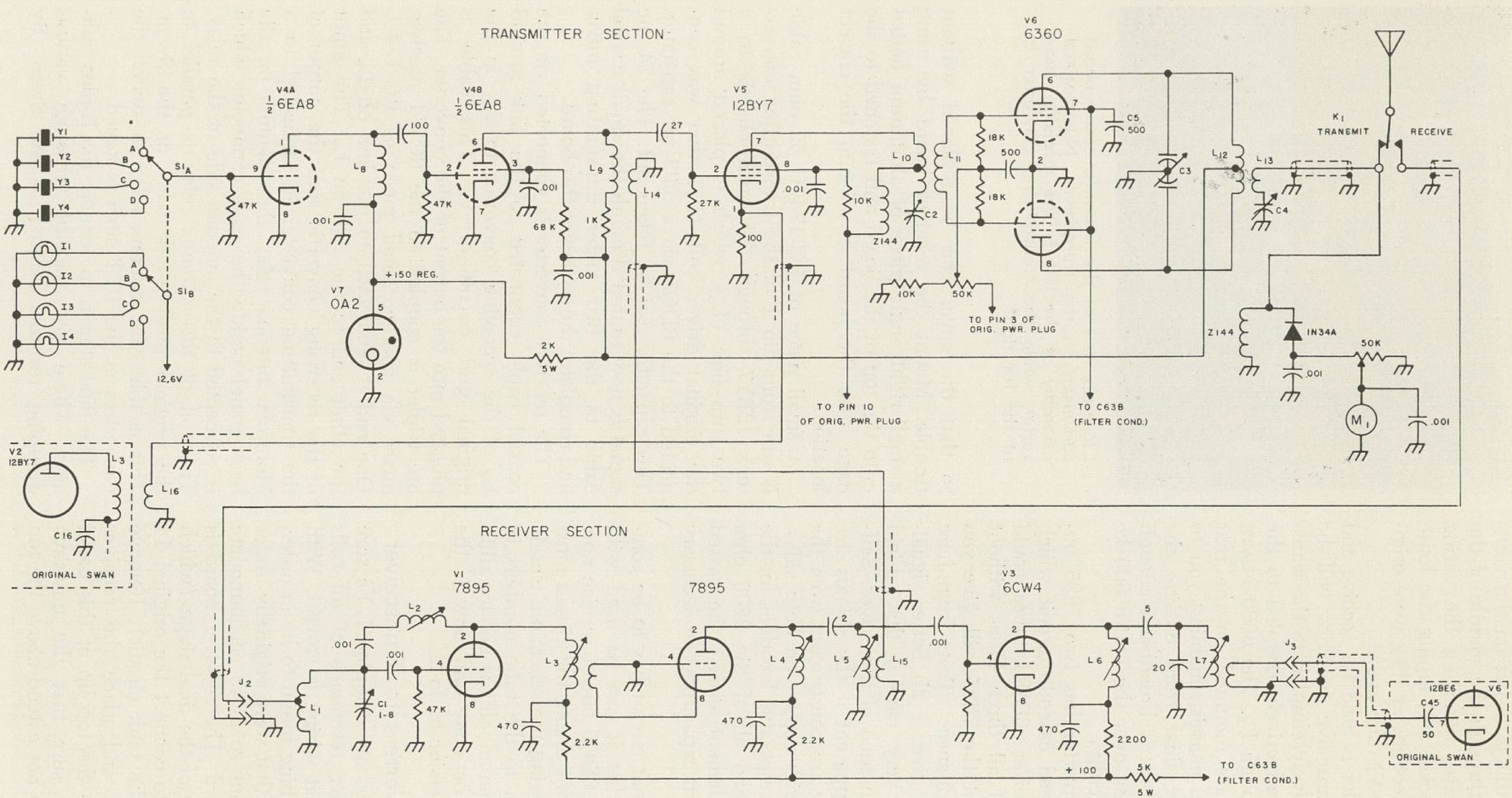
Close-up view of the installed epoxy board converters in the transceiver. Nuvistorized assembly at the left is the receiving converter, while the transmitting converter is at the far right.

so that the cover can be replaced without trouble. Mount the receiver board by using a small right angle piece of aluminum bolted onto the top of the board and fastened to the cage after the board is set into the correct location.

A small piece of RG-174/U 52 ohm cable is run from pin 1 of the transmitting converter's 12BY7 through the main chassis to a two turn link (L_3) which is placed around the original driver coil (L_2) that was connected to the 6DQ5 via a .002 mf capacitor. This capacitor can be taken out. The 14 mc signal is now routed through the small coaxial cable to the two meter transmitting mixer and completes the wiring of this board.

The receiver converter is connected via the coaxial cable connected to the link around L_6 of the receiving converter to C_{45} in the original grid circuit of V_6. This cable is plugged into the output of the converter. The osc.-tripler is coupled to the 6CW4 receiver mixer via another small piece of RG-174U. One end is connected to the link on L_8 and the other end to the link on L_2. The input of the receiving converter and the output of the transmitting converter is connected to a Motorola antenna relay that mounts on the back panel beside the coax connector which is connected to the antenna side of the relay. The coil of this antenna relay is parallel to the original push-to-talk relay of the Swan. This enables the antenna relay to switch the converters as the PTT sitch is keyed.

The final step is to connect the B-plus voltages. These are available through various dropping resistors located in the Swan. By



C₁ is not used; see list:

C_1—1-8 mmfd miniature tubular trimmer.
C_2—3-25 mmfd miniature single section variable.
C_3—3-15 mmfd miniature butterfly.
C_4—3-35 mmfd single section miniature variable.
K_1—Original Swan relay.
K_2—12 v. relay from Motorola VHF equip.
L_1—10t. #24 e. closewound on ½″ ceramic form.
L_2—4t. #20 tinned on ¼″ ceramic form, wound length of form with 2t. link of #22 plastic hook-up wire on hot end.
L_3—2t. link of #22 plastic covered hookup wire.
$L_{4,5}$—5t. #20 tinned ⅝″ dia. ¼″ spacing, 1¼″ long.
L_6—30t. #30 e. closewound on ¼″ dia. slug-tuned form.
L_7—Same as L_6 with 2t. link around center.
L_8—4t. #20 tinned on ¼″ slug-tune form, wound length of form wth 2t. #20 plastic hookup wire link.
L_9—Same as L_8, without link.
L_{10}—Same as L_8.
L_{11}—12t. #30 e. closewound on ¼″ dia. slug-tuned form.
L_{12}—5t. #16 tinned ¼″ dia. ¾″ long, tapped at 2t.
M_1—Triplett 220-M, 0-1 ma. meter.
X_1—43.60 mc type FA5 third overtone crystal.
X_2—43.65 mc type FA5 third overtone crystal.
X_3—43.70 mc type FA5 third overtone crystal.
X_4—43.75 mc type FA5 third overtone crystal.

using a VTVM with the sideband transceiver on, a check can be made at various points at the filter capacitors. The voltage for the 6360 plate is acquired through a bleeder resistor in the final so that the high voltage is not taken from the 300 volt side of the power supply to function properly. Note that the 6360 plate is connected to the pin that was used in the original plug, the 6DQ5.

Testing the Units

With all proper voltages found and applied to the units, the testing commences. The oscillators should be operating and feeding the tripler so that the 130 mc signal is fed to the receiver and transmitter converter. With this functioning, the receiver should be capable of receiving signals if the coils are on the proper frequency. By using a noise generator (one is available from Melco Co., Marissa, Ill.), proper alignment of the receiver can be achieved.

With the receiver operating, the transmitter should be tuned up. Insert some carrier or a 1 kc tone and note the output on the dummy load. Make sure that L_4 does *not* tune 130 mc, but rather 145!

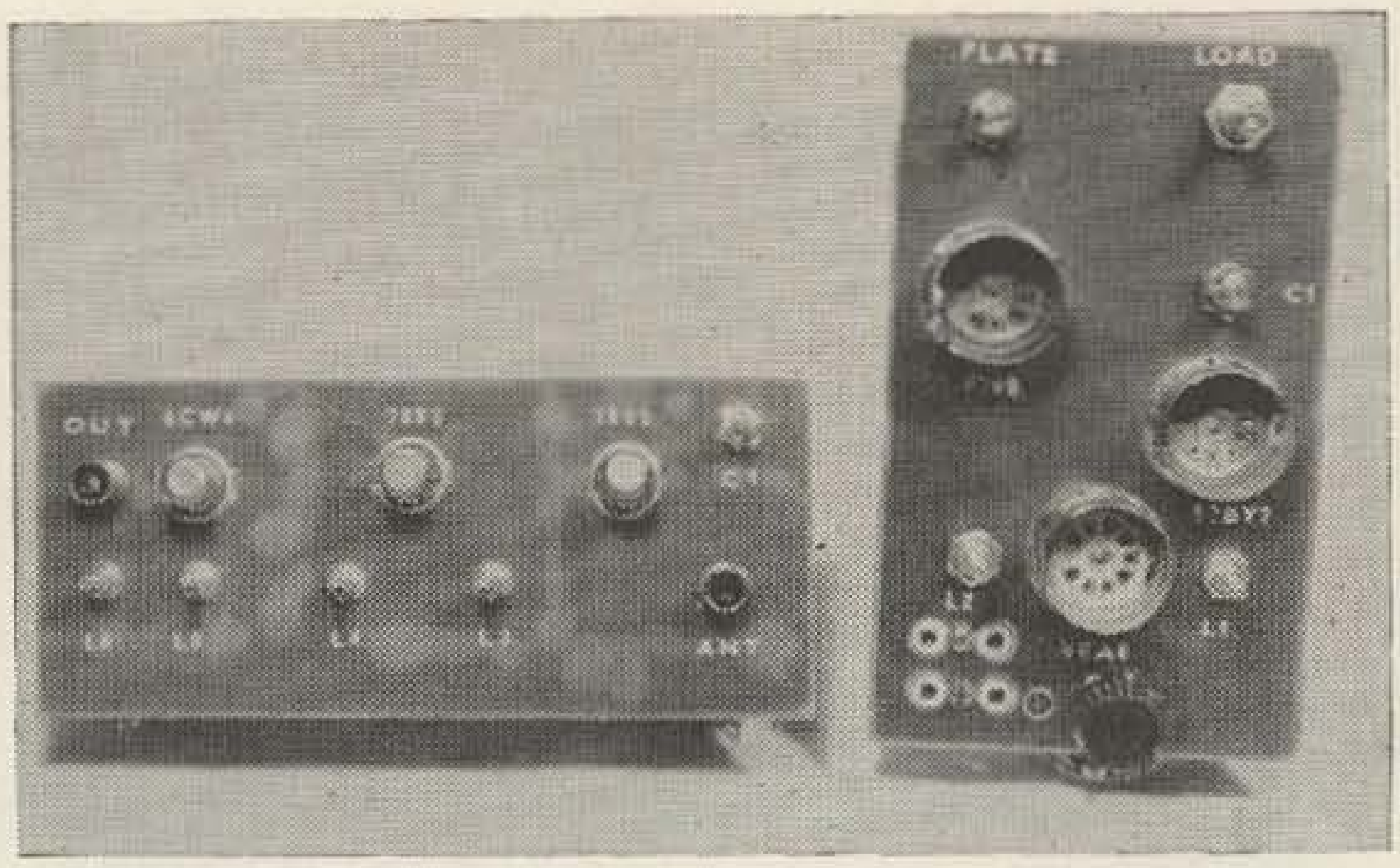
Output Meter

The original meter was used to measure the plate current of the 6DQ5 final amplifier. This is not necessary here so long as you can tell maximum output, so the meter was changed to a 0-1 ma. This is used as a relative rf meter and is hooked up with the 1N34A diode to read the output of the transmitter. The 50K pot. was mounted on the front panel where the PLATE TUNE was originally located. This gives you a METER ADJUST so it can be made very sensitive, enabling a carrier null condition. Make sure you don't talk into the microphone with the meter wide open, since the meter will be banged against the pin and meter movement will be damaged. By using care, this rf meter can become a very useful aid in tuning this transceiver on 2 meters.

Voltages

The BIAS-ADJUST pot for the 6360 is mounted on the rear apron near the power plug. The bias should be adjusted so that the 6360 receives 22 volts. This can be set once and forgotten.

The proper voltages for the transmitting converter section should read as follows (all measured in the RECEIVE position): 6EA8 triode plate–150 vdc reg.; 6EA8 pentode plate–280 vdc; 12BY7 plate–300 vdc, screen–160 vdc; 6360 grid–minus 22 vdc, screen–200 vdc, plate–300 vdc. The receiving converter should receive 60 vdc on the plates of all nuvistors.



Converter (left) and transmitter boards.

Bandswitch Lights

Four lights are mounted on the front panel below the meter making it very easy to connect them to S_1. These lights are the aluminum sleeve-type and can be purchased from Melco Co., Marissa, Ill., for $1.50 each. They are very small in size and are different colors which correspond to the different number colors printed on the new dial. This makes it very simple to see what frequency the transceiver is on at all times. As the BANDSWITCH (mounted in the original TUNE SWITCH position) is turned, the lights will change to the correct color of the proper band. The TUNE-OPERATE switch is moved to the spot directly under the meter and is still wired as was originally installed. The BANDSWITCH is then mounted at the bottom of the 6EA8 socket underneath the chassis and the shaft is extended through the original hole used to mount the TUNE switch.

The New Dial

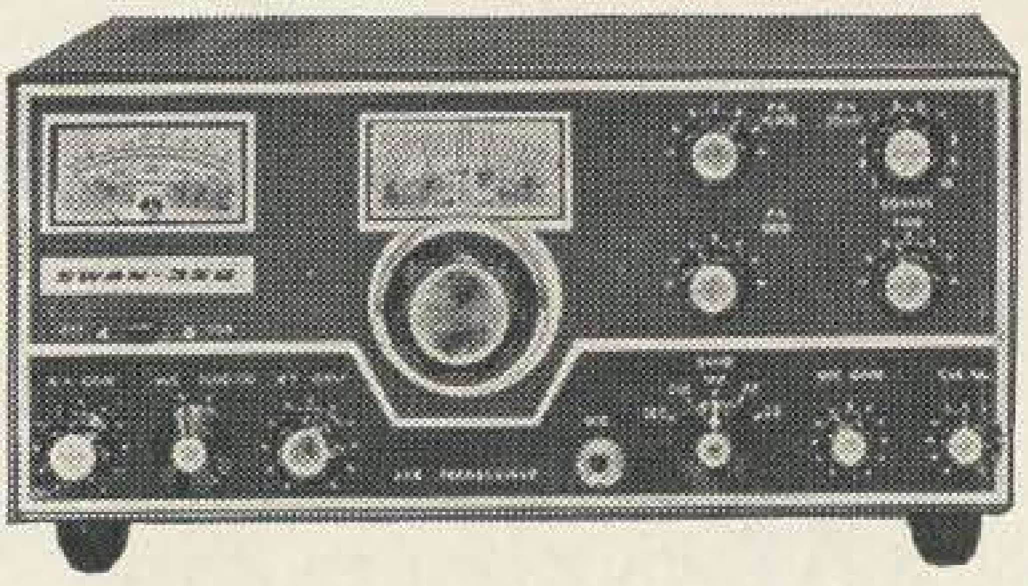
The new dial can be calibrated using the same markings as the original by painting over the 14 mc markings with white paint and replacing with four colors to match with the bandswitch lights. This allows the 2 kc markings on the original dial to be used.

With all this completed, the low frequency transceiver has been successfully converted to two meters. All operating facilities have remained the same including the push-to-talk, carrier balance, tune up and transceive. With the Swan you use practically every section. The main thing to remember is that when you tune the receiver, the transmitter goes right along with it. After you get accustomed to the idea, you'll never go back to ancient modulation.

I hope that this article is of some value to those who want to take on this project. Get to work and get those two meter SSB transceivers on the air!

. . . K9EID

TRANSCEIVER HIT PARADE



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GONSET GC-105 2 mtr Transceiver	149.00
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How's Your VHF Beam Working?

Have you ever wondered if the specifications that the manufacturer gives for your beam are correct? If your antenna is radiating as effectively as you hope that it would? If your radiation pattern is what it should be? If you have asked yourself these questions, and are looking for a good way of answering these questions, read on.

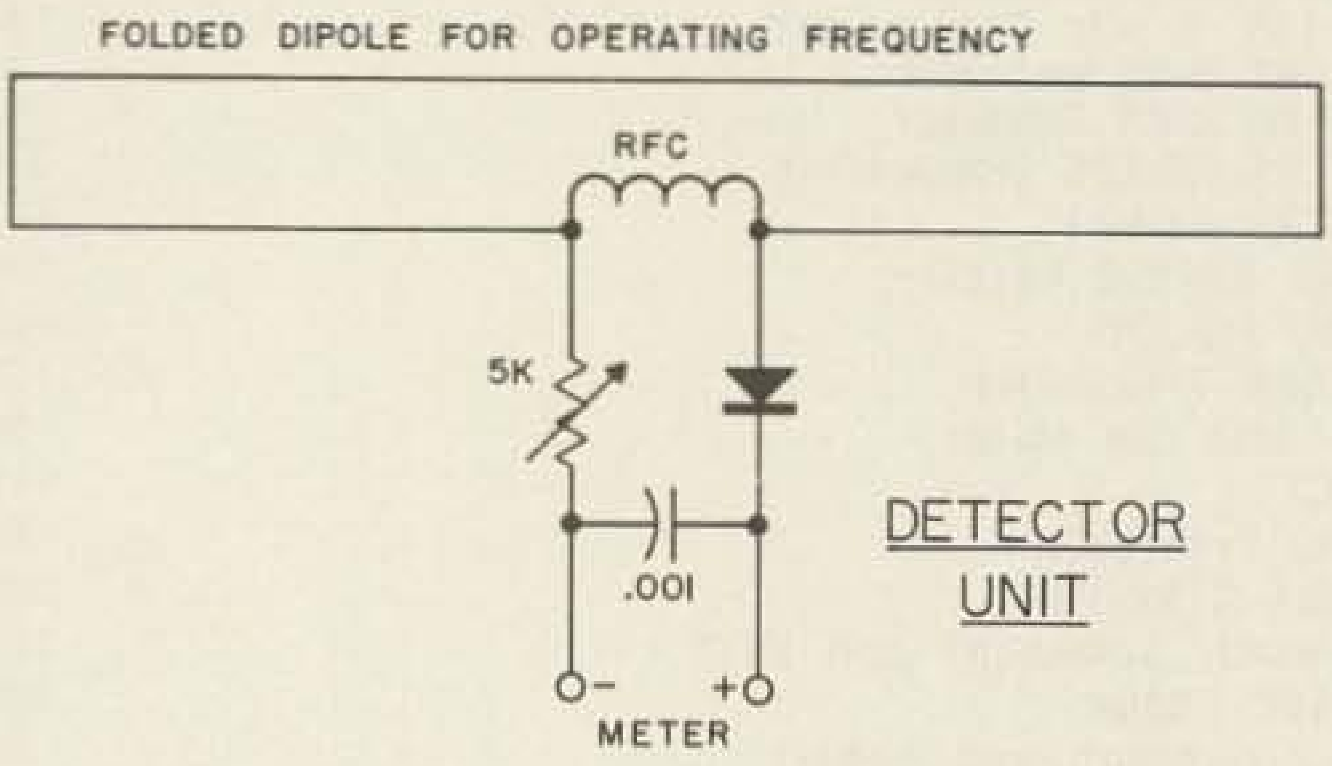

Fig. 1. Detector dipole.

Probably the best way of measuring the gain of a beam is by the comparison of the beam with a reference dipole. The gain figures for beams are usually given as the gain over a dipole, so why not measure it that way? To do so requires an antenna handbook, a coaxial relay, some coax, a VTVM or sensitive microammeter, a pot, a diode, some twinlead, a capacitor, and a little work.

The measurement dipole is placed a distance away from the main antenna. The dipole is terminated with a detector that will allow field strength readings to be made on a meter or VTVM. The details for the detector are shown in **Fig. 1**. The dipole is cut for the operating frequency as determined from the antenna handbook. Regular 300 ohm TV type twinlead will work fine. The ends are soldered together to form a closed loop and one conductor is broken in the center for the rf choke. The components can be left hanging or mounted in a small Minibox, according to your preference. The completed unit should be mounted in the clear, and at least 30 or 40 feet away from the main antenna, if possible.

The next thing to do is to make a reference dipole. A doublet cut to the proper frequency and mounted on a broomstick or other support will do. If a broomstick or wooden support is used, it should be covered with Q dope to prevent moisture from causing a loss. The coax relay is used to switch the transmission line from the reference dipole to the main beam. It should be mounted right next to the reference dipole. The coax from the transmitter is disconnected from the beam and connected to the relay. The length of coax from the relay to the beam should be an exact electrical wavelength, or multiple of an exact wavelength, long. This is to keep the phase of the two signals the same as much as possible.

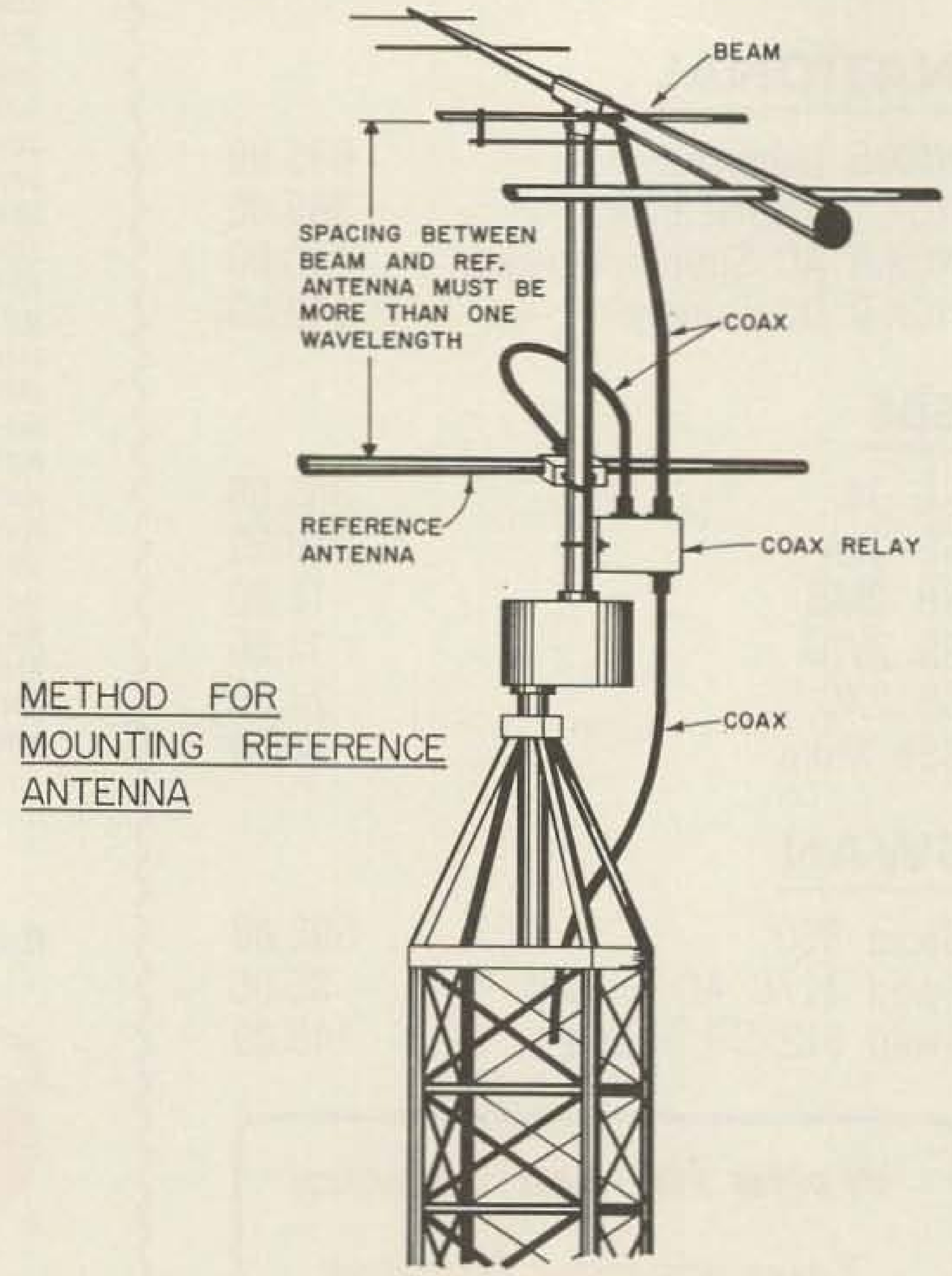

Fig. 2. Mounting reference antenna.

The reference antenna should be mounted on the same mast as the beam, and facing in the same direction. It should be mounted at least 2/3 of a wavelength away from the beam to prevent interaction. A wavelength or more would be desirable. The reference antenna can be left up permanently, if desired. Be sure to remember to allow for the difference between the physical and electrical lengths of a wavelength when cutting coax (velocity factor).

After everything is set up, the next step is the actual measurement. It is helpful to have a SWR bridge. The first thing to do is to load the transmitter to a low power input. Connect the SWR bridge and note the forward and reflected readings. Now go out and measure the level of the signal. Connect the beam, set the forward power to the same level that the reference dipole had, note the SWR and go out and measure the level of the signal. After this is all done, you can calculate the forward gain of the beam. Refer to **Fig. 3.** Assuming that the reference level of the dipole is one (this can be an arbitrary unit, as long as all other readings are relative) you can find the gain by looking up the relative signal level. If there is any difference in the SWR of the two antennas be sure to include this in your calculations. This is done by finding how much more power is being radiated by the antenna of the lowest SWR and changing power ratios to compensate. SWR to power tables should be in any antenna handbook. For finding the front to back ratio, set the level of the back of the beam to one and note the gain of the dipole. Now add the forward gain of the beam. This should be the f/b ratio. The radiation pattern can be plotted by noting the relative levels as the beam is rotated.

Level of Beam (Voltage)	Gain in db
1	0
1.41	3
2	6
2.51	8
2.82	9
3.16	10
3.54	11
3.96	12
4.44	13
4.97	14
5.62	15
6.29	16
7.05	17
10.0	20
17.8	25
100.0	30

$$db = 20 \times \log_{10} \frac{V_1}{V_2}$$

Fig. 3. Level of reference antenna = 1

The above measurements should give you a fairly good idea of what the beam is doing. By leaving the reference dipole up permanently, you can check your receiving gain on your S meter. You can also run comparison experiments to see if it is possible to work a given station with a dipole, or to see if he can be worked with less power.

I hope that this article has been of some assistance to those that really want to know what their antenna is doing. You may be dismayed or pleasantly surprised. I hope that it is the latter. . . . WA2INM/1

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	300-Q	144-148	14-18	$12.95 ppd.
6M	300-B	50-51	.6-1.6	$12.95 ppd.
	300-C	50-54	14-18	$12.95 ppd.
	300-J	50-52	28-30	$12.95 ppd.
20M	300-G	14.0-14.35	1.0-1.35	$11.95 ppd.
CB	300-A	26.965-27.255	1.0-1.29	$11.95 ppd.
WWV	300-H	5.0	1.0	$11.95 ppd
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CHU	300-L	3.35	1.0	$11.95 ppd
Marine	300-M	2-3	.6-1.6	$11.95 ppd
Aircraft	300-N4	121-122	.6-1.6	$13.95 ppd
	300-N5	122-123	.6-1.6	$13.95 ppd
Fire, Police etc.	300-P	155-156	.6-1.6	$13.95 ppd
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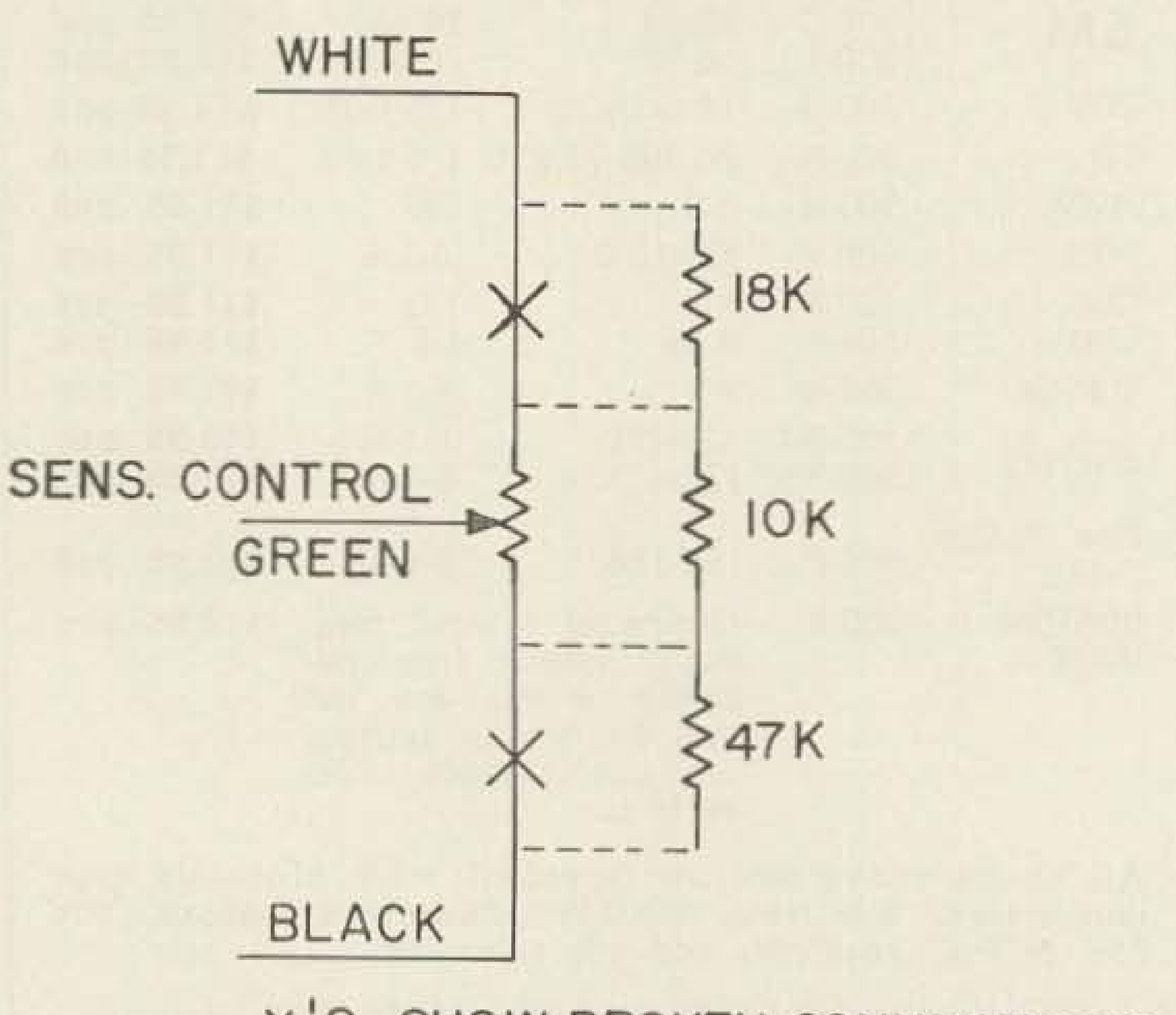
Transformer Noise

All of us at some time have experienced the familiar "transformer hum" which comes quite often from high power transformers. This transformer noise may even be the cause for undue alarm to the novice in radio. Although generally known as a normal occurrence, how many of us actually know what causes the noise?

We all know that the transformer consists basically of coils of wire through which alternating current flows when in use. The alternating current goes first in one direction and then in the other, following a sine or cosine function of time. Since the current in adjacent turns of the coil is in the same direction, an attractive force between the turns of wire is created. This force varies as the current goes through the function of time, reaching a maximum when the current is maximum, reaching a zero value when the current is zero. When the current is large, this periodic force may be enough to cause the wires of the coil to vibrate and produce an audible hum. This hum will vary in pitch depending upon the frequency of the alternating current passing through the transformer. . . . W2QCI

Improving the Tunnel Dipper

Some time ago a Heath tunnel dipper was added to the test gear in the shack. It performed quite well; outstandingly, in fact, in all respects but one. The proper adjustment of the sensitivity control required considerable practice and patience. It was extremely touchy and a nuisance at best.



X'S SHOW BROKEN CONNECTIONS, DOTTED LINES SHOW LEADS TO ADDED PARTS.

Fig. 1. Modifications to Tunnel Dipper

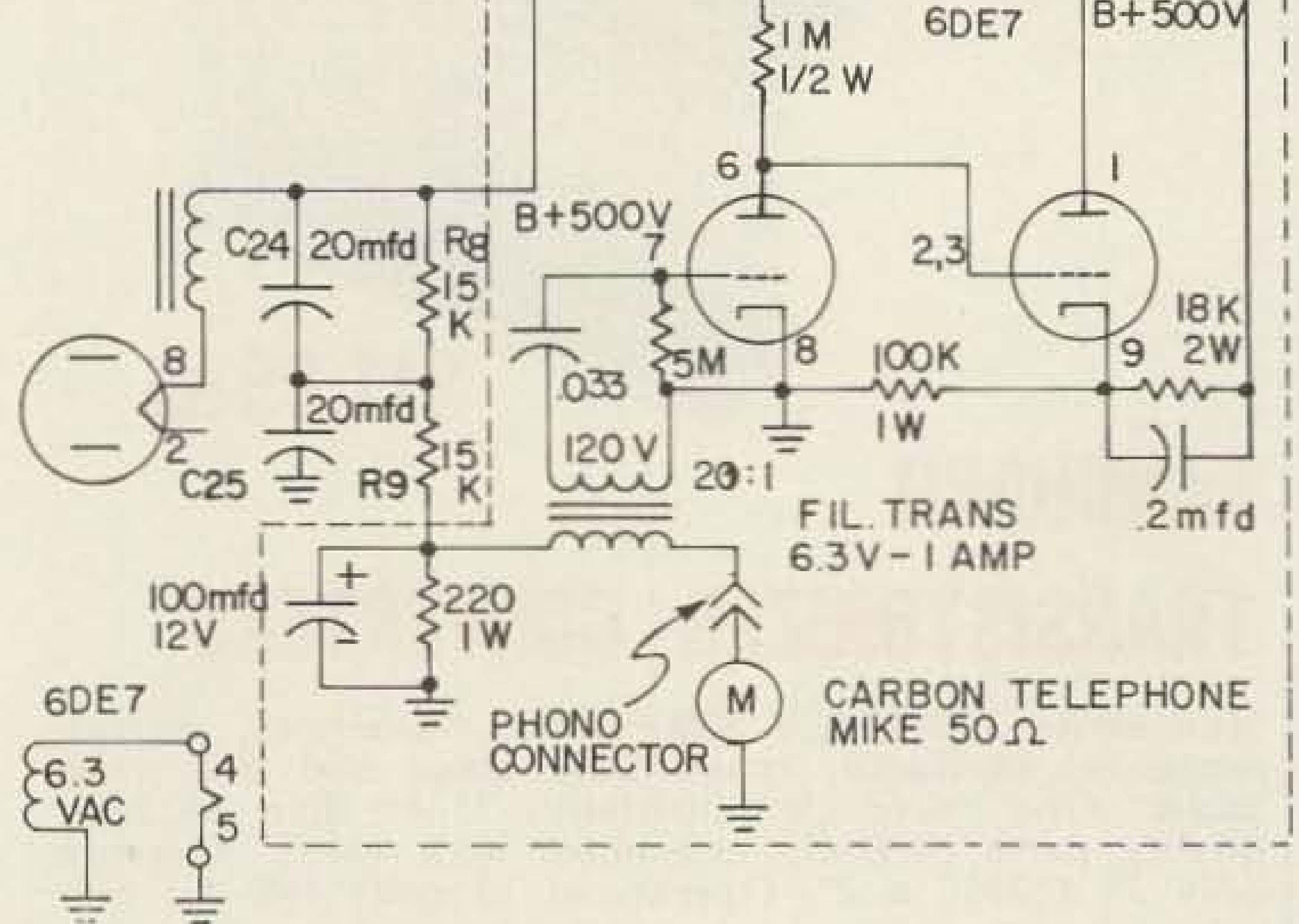
A cheap and dirty solution to the problem was devised by restricting the range of the pot by the addition of 3 series and shunting resistors. Fig. 1 shows the schematic in detail.

Heath engineers advised that the pot used in the dipper was necessary to insure operation over the wide temperature range specified for the unit. Possibly this was also to accommodate for variations in transistors used in the amplifier. In any event, the above modification seems to have incurred no ill effects, has increased the ease of adjustment considerably, and seems a likely solution for anyone who has encountered similar difficulties.

. . . K6MIO

A Modulator for the HX-II

Adding a low cost modulator to this CW transmitter is quite easy and will result in a more versatile piece of equipment. First, drill a hole between the filter choke and the front panel for a miniature 9 pin tube socket. Then add a spdt switch on the front panel above the OFF/ON switch in line with the oscillator tuning capacitor. Next, remove the grounded end of R9, the 15K bleeder resistor, from ground and tie to an insulated terminal board. From this point connect a 220 ohm 1 watt resistor to ground. In parallel with this resitor add a 100 mfd 12 v electrolytic. Wire the rest of the circuit as shown in the diagram.



An ordinary telephone mike button will work very well with this unit. Using this combination all reports on modulation have been very good. . . . WA6PHR

More on Coax Losses

Recent articles[1,2] set forth attenuation figures vs. VHF frequencies of some of the favorite coax cables currently in use. It also shows the maximum length of a coax run to stay inside of a fixed loss of between one and five decibels.

This new tabulation is presented to add the Polyfoam® Coax cables, and to represent the cable by RG and part number. Polyfoam cable was designed to fill a particular need; to lower the capacity of the cable (from center conductor to shield), and to provide a better velocity of propagation (V.P.) for rf energy down the cable. In the table it can be seen that in some polyfoam, a by-product is a lower attenuation at the VHF frequencies. However, the equivalent of RG59/U has been changed physically (the diameter is smaller) to maintain a 70 ohm impedance, and subsequently has not resulted in lower attenuation at VHF as in the RG8/U and RG11/U equivalents. At this time there isn't a polyfoam equivalent to RG58/U.

CABLE	AMPHENOL part number	IMPE-DANCE	FREQ MC.	LOSS db/100'	LOSS IN FEET 1 db	2 db	3 db	4 db	5 db
RG8A/U	21-290	52.5	50	1.33	75	150	225	300	375
			144	2.42	41.5	83	124.5	166	207.5
			220	3.13	32	64	96	128	160
			432	4.7	21	42	63	84	105
RG11A/U	21-296	75	50	1.51	63	126	189	252	315
			144	2.62	38	76	114	152	190
			220	3.35	30	60	90	120	150
			432	4.8	21	42	63	84	105
RG58/U	21-024	53.5	50	3.13	32	64	96	128	160
			144	5.8	17	34	51	68	85
			220	7.2	14	28	42	56	70
			432	10.08	9	18	27	36	45
RG58C/U	21-316	50	50	3.3	30	60	90	120	150
			144	6.0	16.5	33	49.5	66	82.5
			220	7.75	13	26	39	52	65
			432	13.0	7.5	15	22.5	30	37.5
RG59/U	21-025	73	50	2.4	41.5	83	124.5	166	207.5
			144	4.0	25	50	75	100	125
			220	4.95	20	40	60	80	100
			432	7.2	14	28	42	56	70
RG59B/U	21-794	75	50	2.4	42	84	126	168	210
			144	4.2	24	48	72	96	120
			220	5.3	19	38	57	76	95
			432	7.8	13	26	39	52	65
POLYFOAM RG8	621-111	50	50	1.25	80	160	240	320	400
			144	2.32	43	86	129	172	215
			220	2.95	33.5	67	100.5	134	167.5
			432	4.5	22	44	66	88	110
POLYFOAM RG11	621-100	75	50	.99	100	200	300	400	500
			144	1.78	56	112	168	224	280
			220	2.27	44	88	132	176	220
			432	3.25	31	62	93	124	155
POLYFOAM RG59	624-715	72	50	2.35	42.5	85	127.5	170	212.5
			144	4.3	23	46	69	92	115
			220	5.5	18	36	54	72	90
			432	8.1	12.5	25	37.5	50	62.5

Note that the attenuation in RG11/U is higher than in RG8/U. This happens since the center conductor of the cable is larger to change the impedance from 52 to 75 ohms, but the O.D. remains constant at .405 inches.

Thanks are given to Joe Buckley W6JPO of FXR, Div. of Amphenol-Borg Electronics for his help.

References

1 K5JKX, "Coax Cable Losses," 73, August 1963.
2 Roberts, "Economy?", 73, May 1961.
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. . . W6ORS

73 HAMFEST

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Be sure to have reservations if you expect to stay in the area; there'll be quite a crowd.

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The Design of VHF Tank Circuits

For years, VHF enthusiasts have been hampered by the lack of simple usable techniques for the design of VHF tank circuits. The purpose of this article is to provide simple methods for designing resonant VHF tank circuits of four commonly used types, (1) parallel lines, (2) coaxial lines, (3) trough lines, and (4) strip lines.

First of all, you do not have to be a mathematician; just use common sense and follow the steps indicated. The design information is based on circuits with distributed constants; that is, transmission lines and not lumped constant circuits such as coil and capacitor combinations.

The first difficulty to overcome is the preconceived notion that the entire process is so difficult that it is easier to do the job by the cut and try method—and hope for the best. This is just not so. How often have you had just so much space available for a VHF tank circuit and could not find some workable way to use the tank circuit you had in mind. It is much easier to decide what you want and design it to fit the space you have the first time, knowing beforehand it will tune and that any modifications required will be relatively minor.

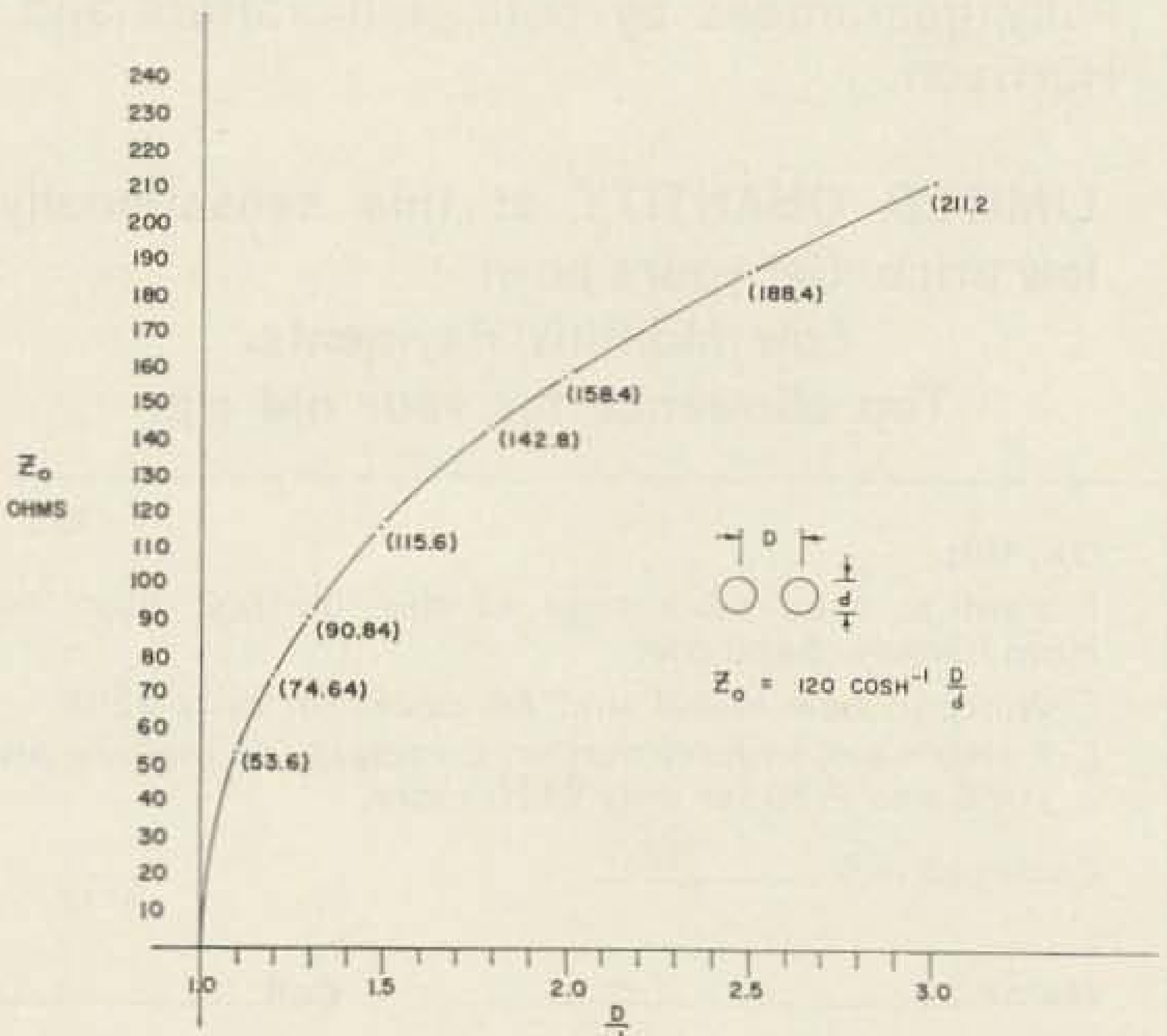


Fig. 1. Impedance of parallel lines.

Calculation of Line Impedance

Since the four types of lines we are dealing with are of the distributed type, the first thing you have to know is the characteristic impedance of the line. Next, you want to know what length of line will be resonant in the circuit you are going to use. Also you would like to know what is the best line length to use, and whether or not you are better off using a quarter wave, half wave, or some other multiple configuration. The data provided here will give you some guidelines on how to make these decisions and what tradeoffs can be made. Some of the formulations are a bit difficult but do not let that scare you. For the most part, they have been reduced to simple graphs and detailed examples are given explaining the design techniques. Most important of all, the graphs give you a visual picture of what happens electrically when the parameters are varied. This provides you with a very useful tool to help make the design decisions required.

Parallel Lines in Air

The characteristic impedance (Z_o) of this type of line is given by the formula

$$Z_o = 120 \cosh^{-1} \frac{D}{d} \qquad (1)$$

where capital D is the center-to-center spacing between the two lines and small d is the diameter of the line. This assumes that both of the lines are equal in diameter. If they are not, it will not work. Fig. 1 is a plot of Z_o versus the ratio of D/d. This formula applies to lines in air only, but reasonable results will be obtained if the box they are put in is at least larger in each dimension of width and height by a factor of two times the outside spacing dimension of the lines.

Coaxial Lines

The characteristic impedance, (Z_o), of this type of line is given by the formula

$$Z_o = \frac{138}{\sqrt{\epsilon}} \log_{10} \frac{D}{d} \qquad (2)$$

vhere D is the inside diameter of the outer oaxial member and d is the outside diameter of the inner coaxial member and ϵ is the lielectric constant of the medium between he members, air = 1.0. Fig. 2 is a plot of Z_0 versus the ratio D/d.

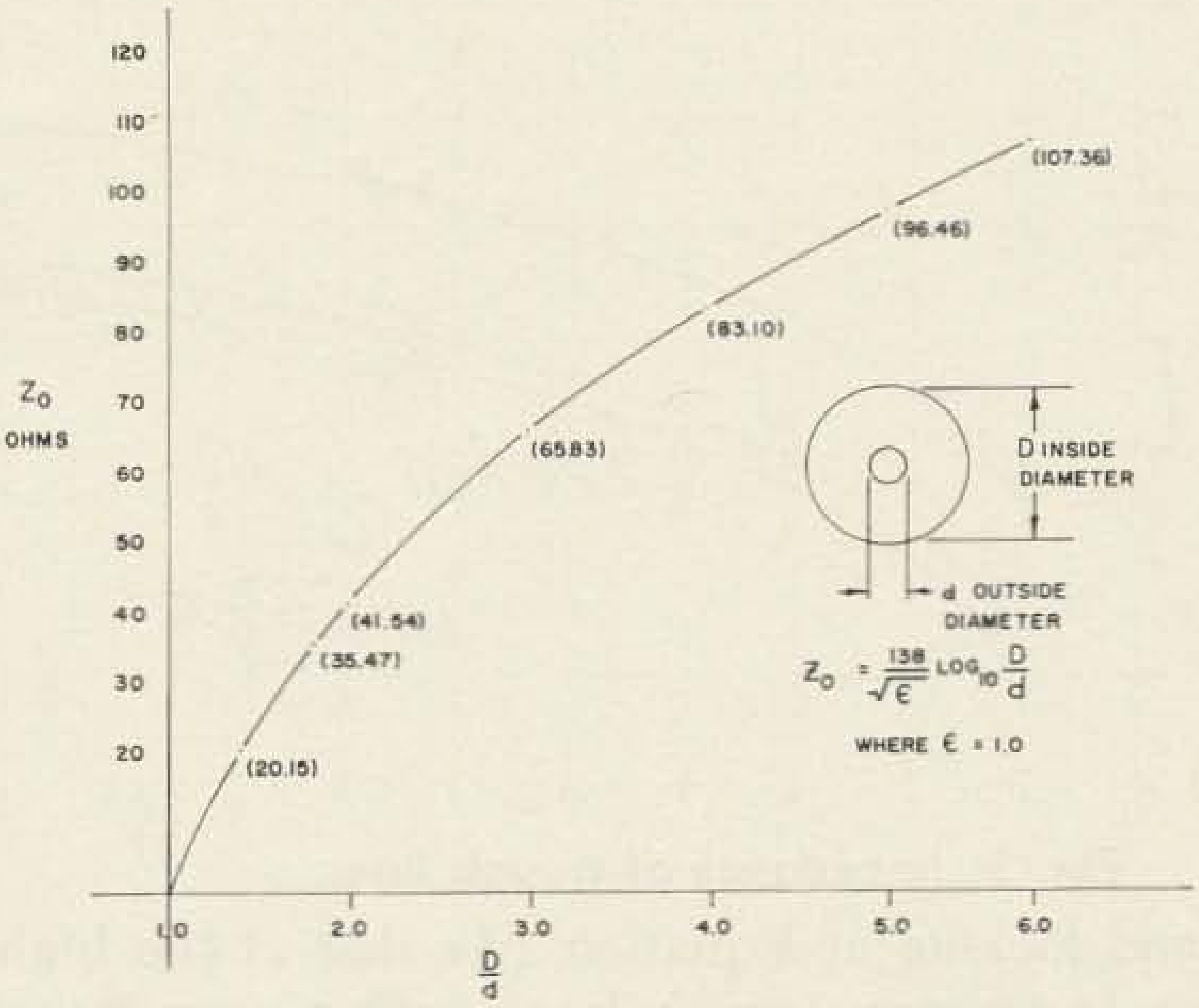


Fig. 2. Impedance of coaxial lines.

Trough Lines

This is a much more difficult configuration or impedance (Z_0) calculation since there is a limitation that the center conductor must be much smaller in dimension than either its centerline height from the base of the trough or the width of the trough. This does not make the formula unusable and the results are acceptable within the limits of accuracy that hams require. Remember that we are considering an open trough only; ends closed but one side missing.

$$Z_0 = \frac{138}{\sqrt{\epsilon}} \log_{10} \left[\frac{4\,\text{w} \tanh \frac{\pi \text{h}}{\text{w}}}{\pi \text{d}} \right] \qquad (3)$$

Where we is the width of the open trough, h is the centerline height of the center conductor from the bottom of the open trough, d is the diameter of the center conductor, and ϵ is the dielectric constant of the material filling the trough. Fig. 3 is a plot of Z_0 versus the ratio of $\frac{w}{d}$ This plot shows ratios of $\frac{h}{w}$ at 0.33, 0.5, and 0.66. Mechanical configurations that vary greatly from ratios shown will have to be calculated directly from formula (3) above.

Strip Lines

The formula for determining the impedance (Z_0) of a strip conductor between two ground planes is also difficult, primarily because of the inter-related geometry of the physical structure. Since this configuration is one of the easiest lines to build, from a mechanical point of view, Figs. 7, 8 and 9 were drawn to provide the essential design information. Data on the line Z_0 is given for 1/16 inch, ⅛ and ¼ inch thick line material from ½ inch to 4 inches wide between ground planes from 1 to 5 inches apart only. These dimensions represent those that are most likely to be used. Other desired values within this range can be interpolated directly with reasonable results. Note that the physical configuration shown in the figures assumes infinite ground planes spaced equally from the center conductor. In practical applications this will not be the case. However, the values given are reasonable, provided the ground plane width is greater than the width of the strip line center conductor by at least a factor of two. The only other constraint is that the dielectric medium in which the line is to be operated must be air. If other materials are to be used, the value of the line impedance must be corrected by multiplying the value obtained from the graph by the square root of the dielectric constant of the material used. This, of course, assumes that the entire volume between the ground planes surrounding the center conductor is filled with the dielectric material.

Calculation of Quarter Wave Lengths

The applicable formula for the determination of quarter wave lines is derived from a general equation from transmission line theory and is simply stated as

$$X_c = Z_0 \tan \beta l \qquad (4)$$

where X_c is the capacitive reactance shunted across the open end of the quarter wave line, Z_0 is the characteristic impedance of the line, β is the number of electrical degrees per unit length at the frequency considered (i.e., 360° divided by the free space wave length in the same units as (l)), and l is the length of the line. This may look somewhat formidable but when you look at it closely, you will see that you can easily determine all the elements necessary to find the one you are most interested in, l, the length of the line. To make things easier, Fig. 4 is a plot of X_c versus capacitance for 144 mc, 222 mc, 432 mc, and 1296 mc. It is obvious from this plot

TABLE 1

Freq.	λ in.	λ/2 in.	λ/4 in.	β°/in.
144	82.02	41.01	20.5	4.39
220	53.7	26.85	13.45	6.70
432	27.34	13.67	6.93	13.17
1296	9.11	4.56	2.28	39.52

where λ is the free space wave length.

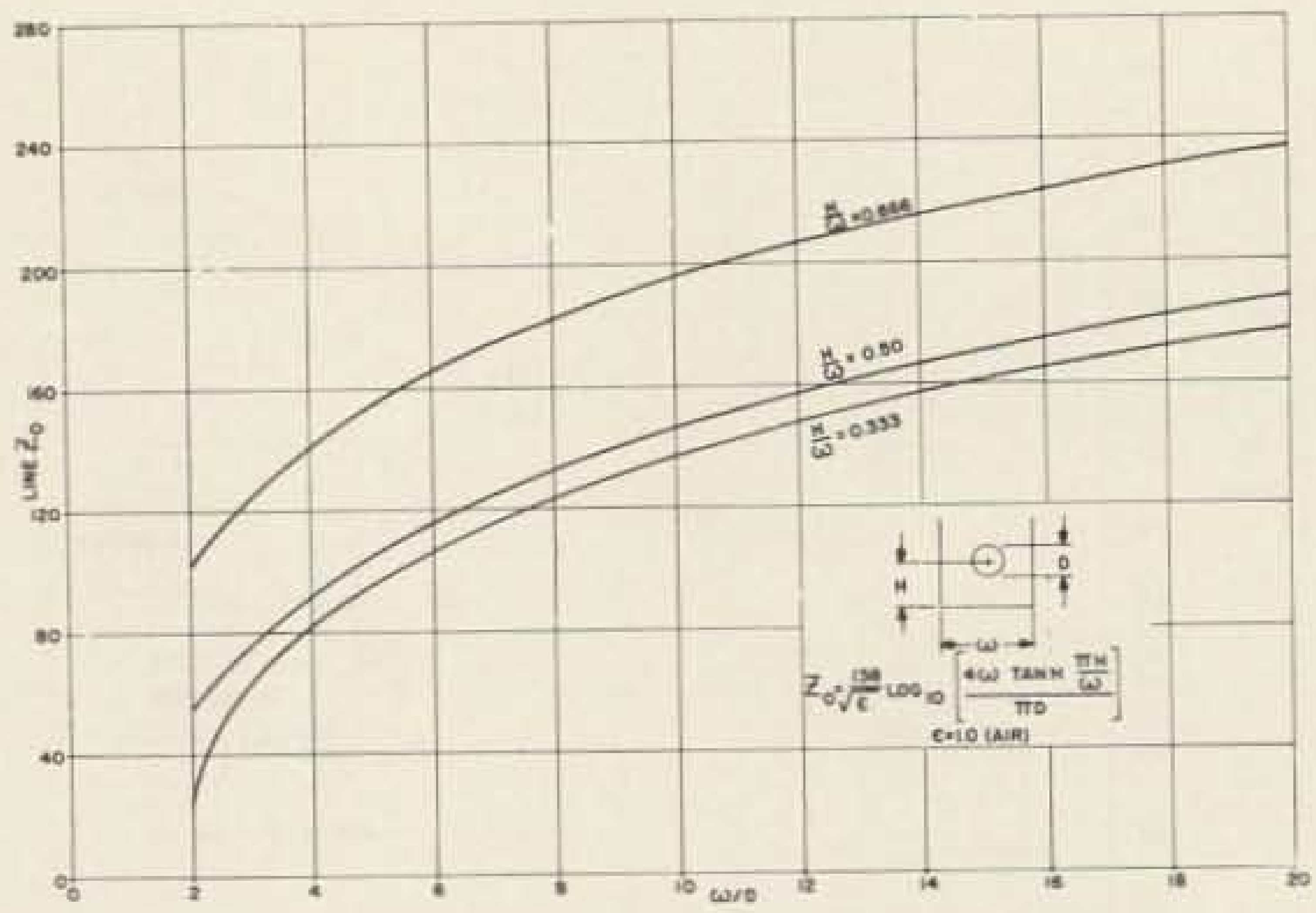


Fig. 3. Impedance of trough lines.

and looking at Equation (4) that at the higher frequencies much less loading capacitance can be tolerated than at the lower frequencies since, for a given capacity, X_c increases with frequency, and l decreases.

At this point the best method of demonstrating use of the design data is to do so by direct example.

Example 1—Parallel Lines

Parallel lines in air are relatively simple to calculate but one factor must be carefully accounted for to make sure that you wind up with the right result. In most cases, the lines are used in push-pull circuit; therefore, the tube capacity loading on the lines is effectively in series. See Fig. 3a.

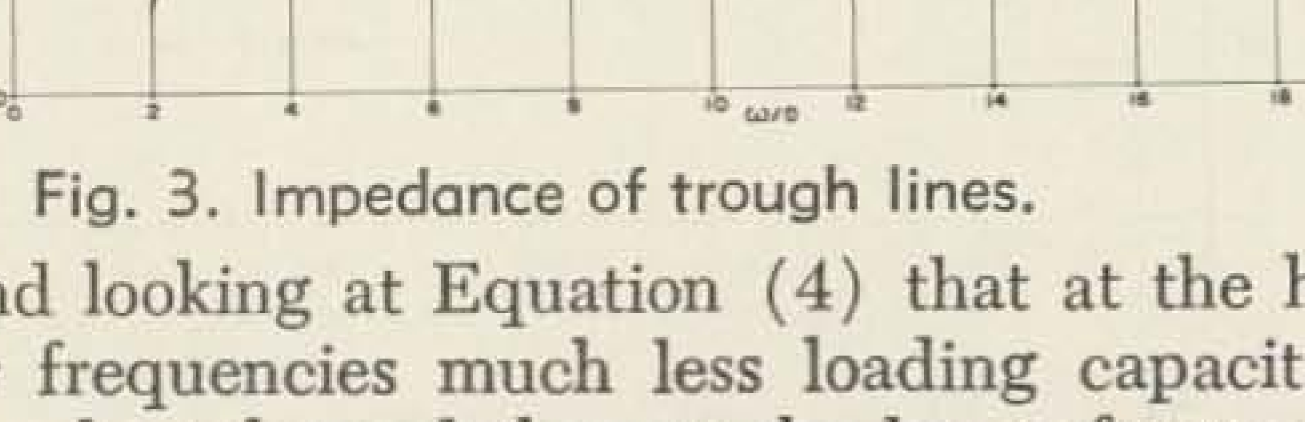


Fig. 3a

Consequently, the total capacity (C_T) equals

$$C_T = \frac{C_{T_1} \times C_{T_2}}{C_{T_1} + C_{T_2}} + C_{T_3} \qquad (5)$$

When $C_{T_1} = C_{T_2}$, the total capacity (C_T) equals the value of one of the capacities divided by two plus the tuning capacity.

$$C_T = \frac{C_{T_1} \text{ or } C_{T_2}}{2} + C_{T_3} \qquad (6)$$

If a tuning capacitor of the double stator type is used, both sections are effectively in series and the total capacity can be calculated using Formula (6).

Parallel lines may be used in single ended configurations provided you add an adjustable capacitor to the side of the line not connected to the tube and adjust this capacitor to equal the same value as the tube capacity. This is not as difficult as it may first appear. All you need is a simple rf probe attached to a sensitive amplifier, such as a VTVM. Apply grid drive to the stage, and adjust the compensating capacitor for identical readings at a spot the same distance from the short circuit end of each line. This will not give you an exact adjustment but it will be close enough.

As a practical case, let's assume the following:

(1) We have on hand lengths of 1 inch OD tubing.

(2) We want to design a λ/4 resonant tank for 222 mc.

(3) The maximum spacing available is 2½ inches center-to-center to provide good clearance to the sides and bottom of the shielded enclosure.

(4) The line length should be 6 inches or less to fit the space available.

(5) The configuration will be a single ended plate/line using a 4×150A tube.

(6) If these are practical limits, what tuning capacitance will be required for resonance?

Step 1—Determine the line impedance Z_o, by first finding D/d. In this case 2.5/1 = 2.5, refer to Fig. 1 and determine the Z_o for this ratio. In this case, it is 188 ohms.

Step 2—Determine the total X_c and then

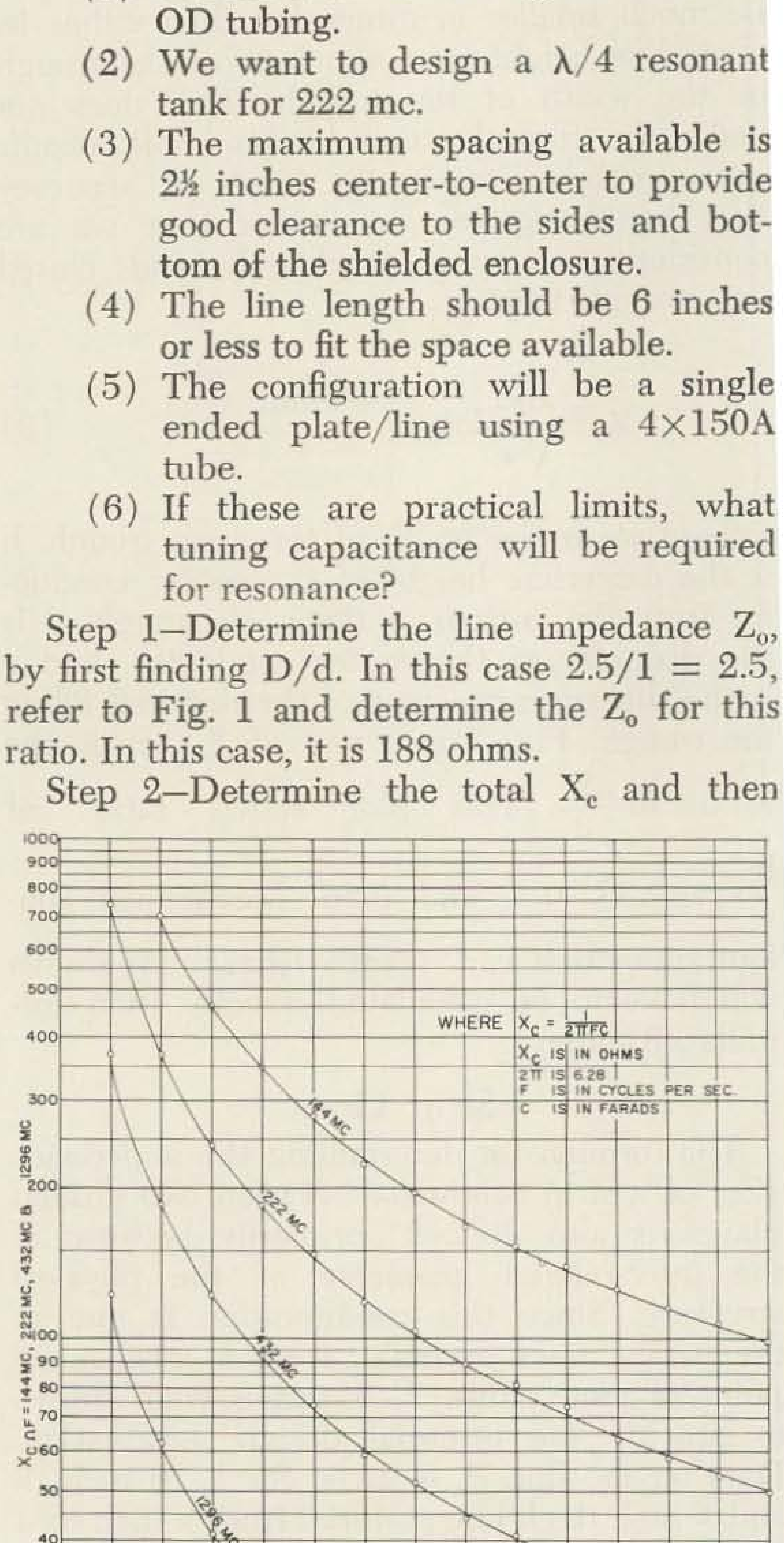


Fig. 4. Capacitive reactance vs capacitance on amateur VHF and UHF bands.

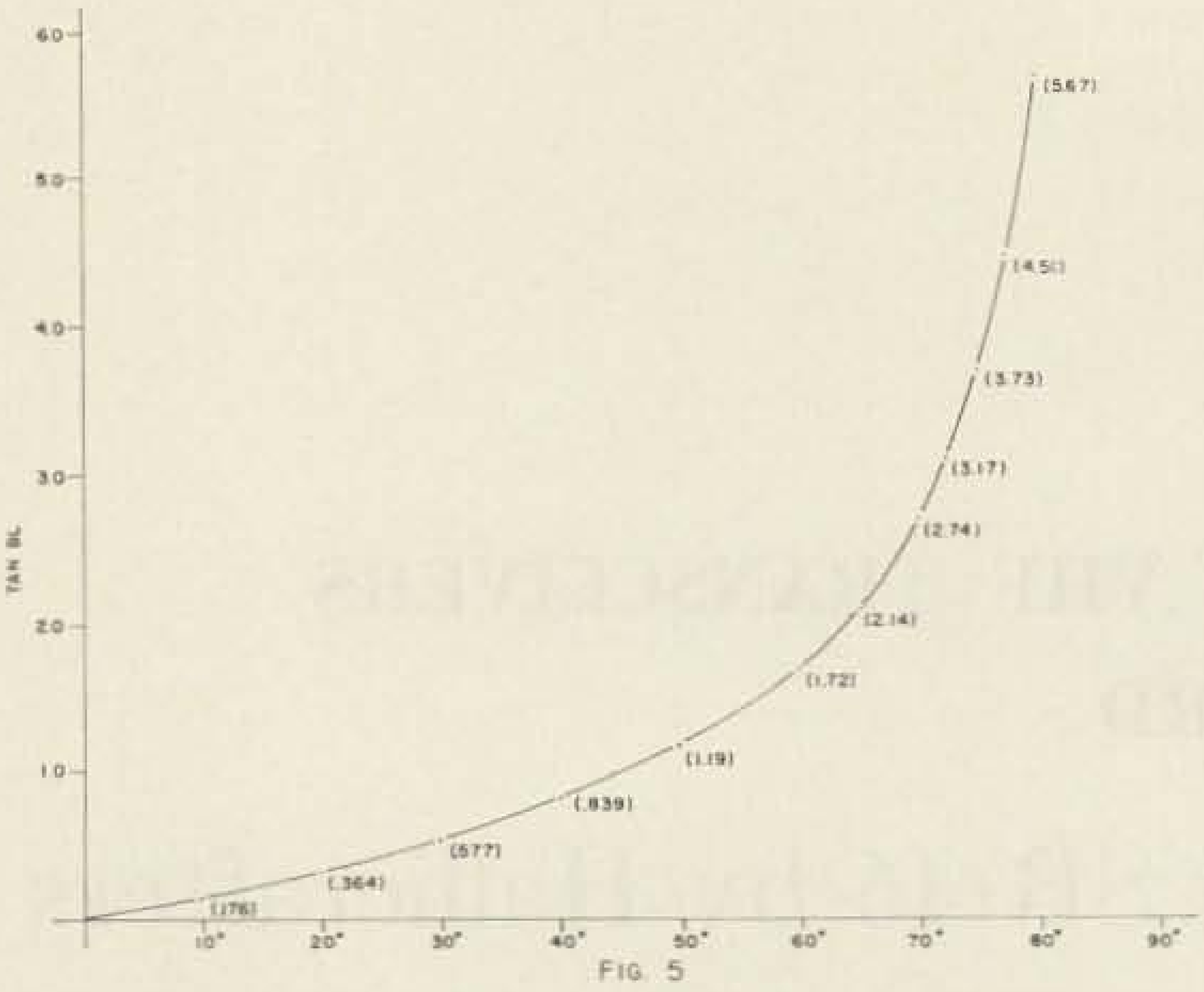


Fig. 5. Tan β1 vs angle (tangents of angles).

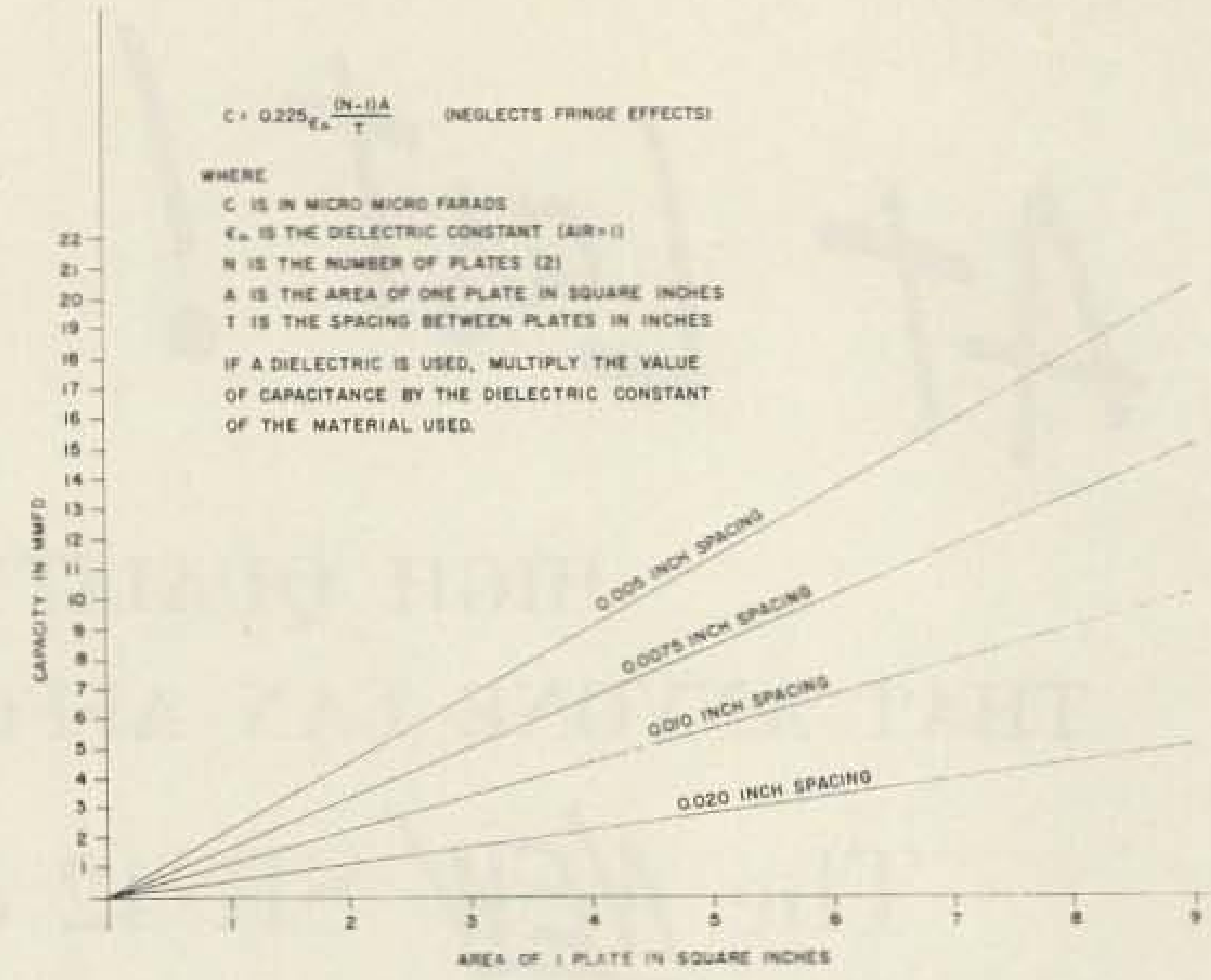


Fig. 6. Capacitance of parallel discs.

the actual capacity required for this length of line to be resonant at 222 mc. from Formula (4).

$X_c = 188 \tan \beta l$

$\beta = 6.70$ from Table 1

$l = 6$ inches (given maximum length from above)

Therefore,

$X_c = 188 \tan (6.7 \times 6)$

$X_c = 188 \tan 40.2°$

Refer to Fig. 5, the tan of 40.2° is 0.85

$X_c = 188 \times 0.85$

$X_c = 159.8$ ohms

The capacity required for this X_c is obtained by referring to Fig. 4 on the 222 mc curve and is 4.6 mmfd. Therefore, the total capacity required to resonate the line is 4.6 mmfd.

Step 3—The output capacity of a 4×150A is 4.5 mmfd and in this case, we will add a compensating capacitor to the other side of the line equivalent to the tube capacity to balance the line. With the compensating capacitor both capacitors are effectively in series; therefore, the tube loading capacity across the line is 4.5/2 or 2.25 mmfd.

Step 4—The additional capacity required to tune the line to resonance is the difference between the effective capacity of the tubes and the total required to tune the line to resonance. For this case, 4.6 mmfd minus 2.25 mmfd equals 2.35 mmfd.

Step 5—If you want to use a disc capacitor to tune the line, refer to Fig. 6 and determine the area of the capacitor plate that yields 2.35 mmfd. Assuming 0.020 spacing to be on the safe side, this yields an area of 4.2 square inches or a minimum diameter of about 1.1 inch. Therefore, the tuning capacitor should be made up of two discs 1.1 inch in diameter or preferably a little larger to give you a better safety factor.

Example 2—Coaxial Lines

We are going to design a coaxial quarter wave plate tank for a 4×150A to be used at two meters.

(A) What would be the length of the cavity be if we used a Z_0 of 77 ohms? What is the diameter of the coaxial members for this Z_0?

(B) We have 12 inches of space available for the cavity length; what should be the diameters of the coaxial members?

Condition A

Step 1—Going to the handbook, you find that the output capacity of a 4×150A is 4.5 mmfd. In all practical applications, an amount of capacitance is added at this point for tuning purposes, and effects due to discontinuities in the line, stray capacitance and variation in the tube parameters. Since most of these lines are tuned using circular or rectangular parallel plate capacitors, with one plate soldered on the line and the other movable, Fig. 6 was drawn showing a plot of capacity in micro-micro farads versus the area of one plate. If it is drawn assuming that maximum capacity is used, since it is easier to subtract capacity than add it once the size has been determined. Various spacing factors between the plates are plotted for use, depending on the voltage requirements. A good rule of thumb for determining spacing with an air dielectric is 22 volts per .001 inch. If teflon is used, 600 volts per .001 inch is a good figure. From this data and the information you will determine regarding the diameters of the line, you can readily determine how big a capacitor plate you can fit in the space available. For this example, we will add approximately 4 mmfd, bringing the total capacity to 8.5 mmfd. Referring to Fig. 4, we see that at 144 mc this represents an X_c of 147 ohms.

Step 2—For a $Z_o = 77$ ohms, determine the value of the tan βl.

$$X_c = Z_o \tan \beta l$$

$$\tan \beta l = \frac{X_c}{Z_o} = \frac{147}{77}$$

$$\tan \beta l = 1.91$$

Step 3—Refer to Fig. 5 and determine what angle the tan βl is equal to, for a value of 1.91. In this case, it is about 62.5°. Now we can determine the element we are really interested in—the required length, l.

Step 4—Go to Table 1 and obtain the value for β. In this case, it is 4.39 degrees/inch. We determined in Step (3) that the product of βl is equal to 62.5°, so by simple substitution we can find l.

$$\beta l = 62.5°$$

$$\text{therefore: } l = \frac{62.5°}{\beta}$$

$$l = \frac{62.5°}{4.39 \text{ degrees/inch}}$$

$$l = 14.24 \text{ inches}$$

Note that the units are consistent.

Step 5—Assuming a 0.005 inch spacing for the capacitor required. Refer to Fig. 6 and for 5 mmfd. A plate area of 1.85 square inches will be required.

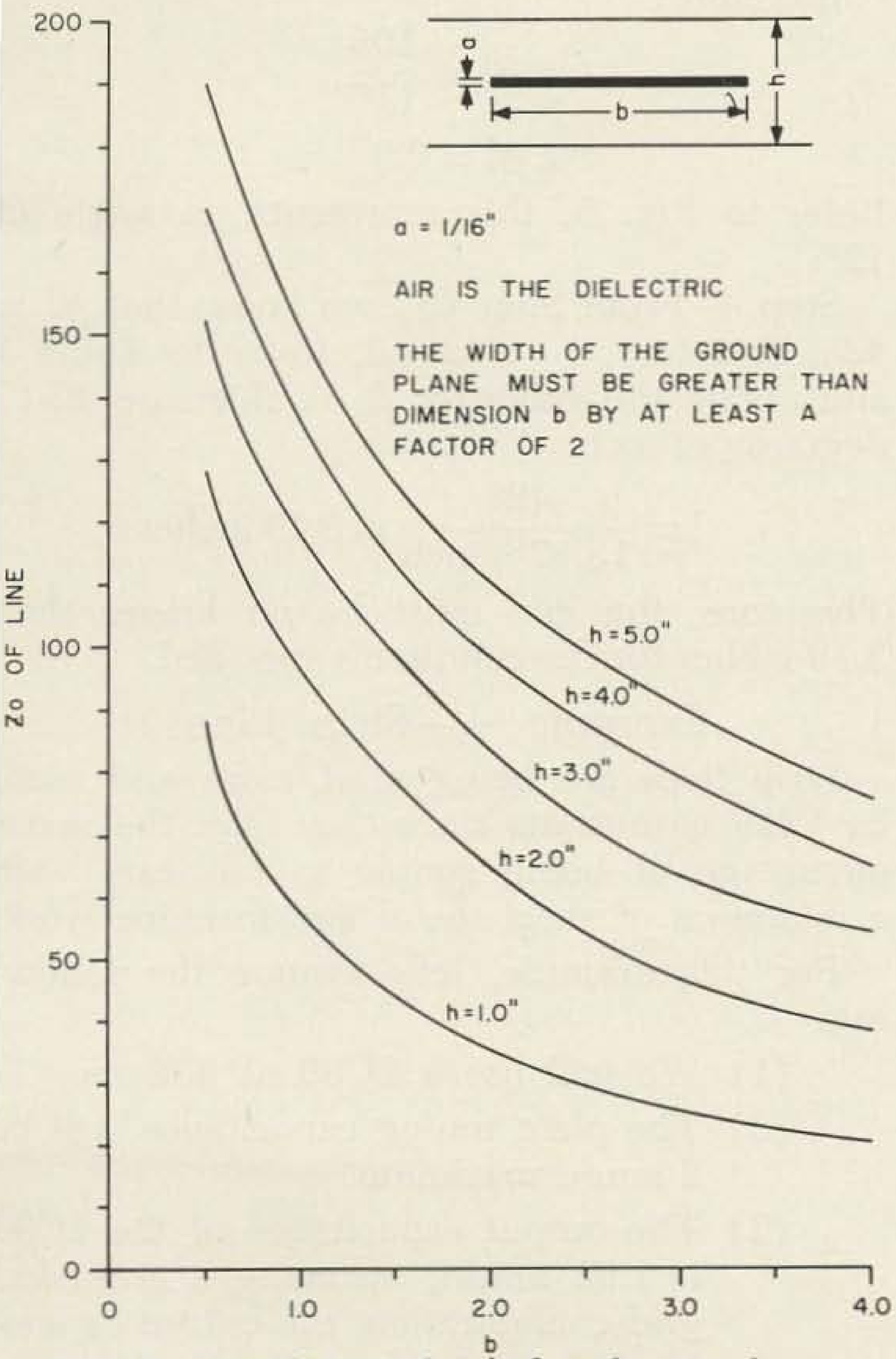


Fig. 7. Impedance of 1/16 inch strip lines.

Step 6—For a Z_o of 77 ohms the ratio of diameters can be determined from Fig. 2 and is 3.66. This means that if the inner conductor is one inch in diameter, the outer conductor must be 3.66 times one inch or 3.66 inches.

We have now satisfied Condition A.

Condition B

In this case, since the limitation is a given length (12 inches), work backwards and determine the Z_o of the line required. Then find the ratio of diameters that satisfy the required Z_o.

Step 1—

$$l = 12 \text{ inches (given)}$$

$$\beta = 4.39 \text{ (from Table 1)}$$

The angle required is

$$\beta l = 12 \times 4.39 = 52.7°$$

Step 2—Refer to Fig. 5. The tan for an angle of 52.7° is 1.33

Step 3—From the formula $X_c = Z_o \tan \beta l$, solving for Z_o yields:

$$Z_o = \frac{X_c}{\tan \beta l}$$

Assume that the same value of X_c obtained in Step (1) of Condition A will be used, since this is the same circuit. The value of the tan obtained in Step (2) is 1.33, therefore:

$$Z_o = \frac{147}{1.33} = 110.5 \text{ ohms}$$

Step 4—Refer to Fig. 2 and for a Z_o of 110.5 the ratio of $\frac{D}{d}$ is approximately 6.2. This is an awkward value since the outer conductor must be at least 6.2 times the diameter of the inner conductor, and a rather bulky cavity will result. The reason for this is the assumption made in Step (3). Obviously more capacity must be added for tuning to bring the cavity dimension to a more reasonable size.

Step 5—Since you are still limited by the 12 inch dimension, arbitrarily reduce the Z_o to a value of, say, 80 ohms. From this new figure, now calculate the total capacity required to tune the circuit. From Step (2) the tan βl is 1.33 and

$$X_c = Z_o \tan \beta l$$

therefore

$$X_c = 80\ (1.33) = 106.4 \text{ ohms}$$

Refer to Fig. 4, and on the 144 mc curve, 106.4 ohms is equivalent to 13 mmfd. Since we have already made an allowance of 4 mmfd for tuning capacity, bringing the total capacity to 8.5 mmfd, we must now add another 4.5 mmfd to resonate the tank.

Step 6—The total tuning capacity required is now 8.5 mmfd. Refer to Fig. 6 and, assum-

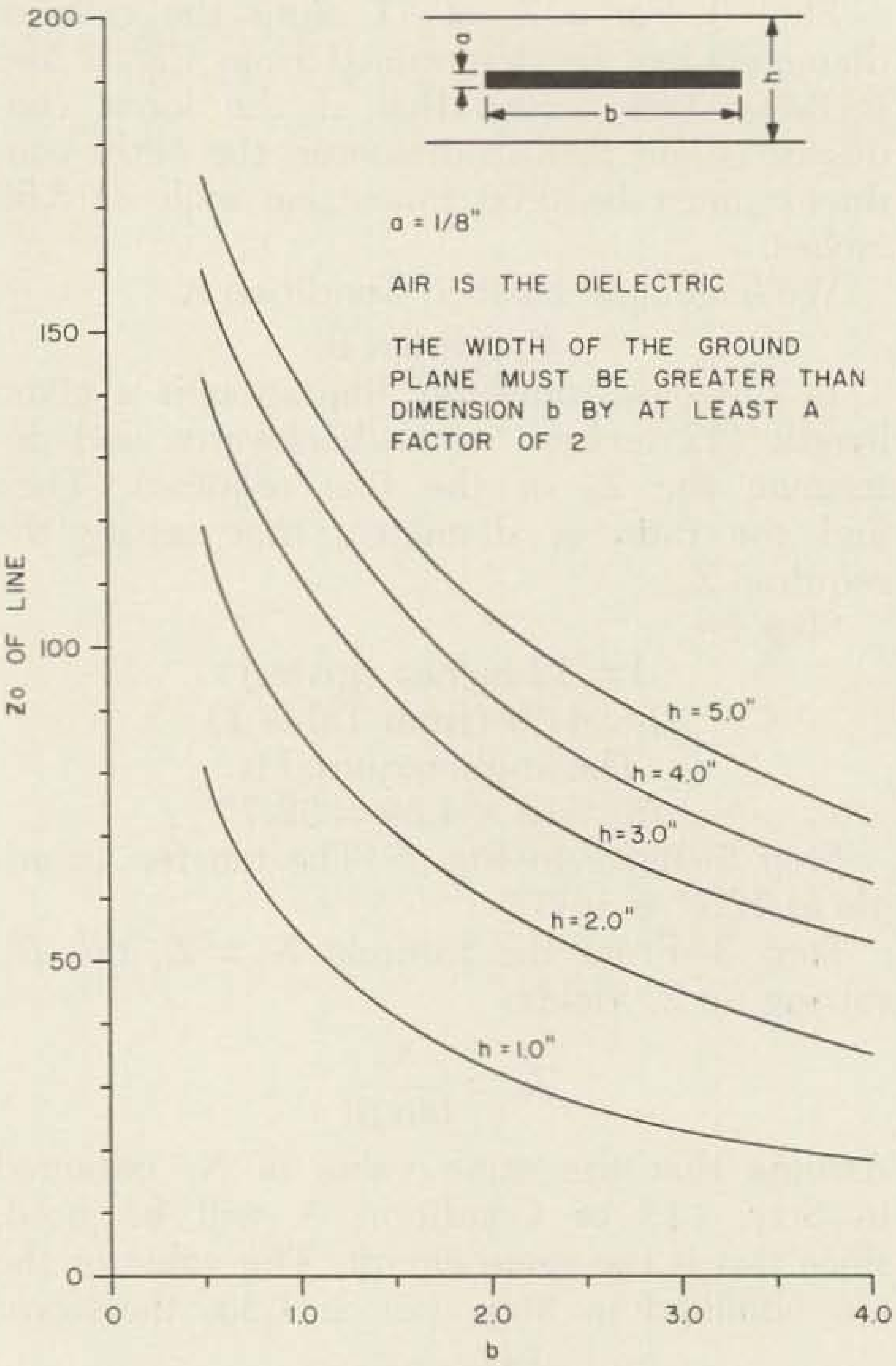


Fig. 8. Impedance of 1/8 inch strip lines.

ing .010 spacing, the plate area required is approximately 7.6 square inches, or 2 discs 1.6 inches in diameter. If you wanted more conservative spacing increase the size of the disc, but first make sure it will fit in the cavity.

Example 3—Trough Lines

Most trough lines are used as resonant line elements in receiver rf amplifier service. The sample calculation here will be representative of this type of design. However, trough lines are not limited to this design choice and can just as easily be used as a line tank for a 4X 150A tube.

For this case, assume the following:

(1) The frequency is 432 mc, and you are designing a plate tank.

(2) The tube is a 6CW4 nuvistor in a grounded cathode circuit with an output capacity of 1.5 mmfd.

(3) The line length should be as long as possible consistent with the above conditions, and a 2 mmfd maximum tuning capacitance will be used.

(4) The trough will be 1½ inches square, open on the top, with a ¼ inch center conductor spaced in the middle.

Step 1—Determine the impedance (Z_o) of the line from Fig. 3. For our case h = 0.75, w = 1.50, and d = 0.25. Therefore:

$$\frac{h}{w} = \frac{0.75}{1.50} = 0.5$$

To find the Z_o, the ratio of $\frac{w}{d}$ must be determined. In this case,

$$\frac{w}{d} = \frac{1.50}{0.25} = 6.0$$

From Fig. 3, the Z_o is 117 ohms.

Step 2—Now determine the value of X_c that will be effectively shunted across the line by the capacity. Total capacity = tube output capacity plus tuning capacity. $C_T = 1.52 + 2$, = 3.5 mmfd. Refer to Fig. 4 and for 432 mc the value of X_c for a capacity of 3.5 mmfd is 105 ohms.

Step 3—From the same formula used in previous examples,

$$X_c = Z_o \tan \beta l$$

we can now determine the length of line required. Substituting the values obtained, we have the following:

$$105 = 117 \tan \beta l$$

therefore:

$$\tan \beta l = \frac{105}{117}$$

$$\tan \beta l = 0.9$$

Refer to Fig. 5; this represents an angle of 42°.

Step 4—From Step (3) we know that βl = 42°, therefore, $l = 42°/\beta$. Refer to Table 1 and obtain the value for β, in this case 13.17 degrees per inch.

$$l = \frac{42°}{13.17°/\text{inch}} = 3.19 \text{ inches}$$

Therefore, the line must be no longer than 3.19 inches for the conditions specified.

Example 4—Strip Lines

Strip lines are being used more and more by VHF enthusiasts since they offer the major advantage of being simple to fabricate with a minimum of sheet metal and machine work.

For this example, let's assume the following:

(1) We will use a 2C39 at 432 mc.

(2) The plate tuning capacitance will be 2 mmfd maximum.

(3) The output capacitance of the 2C39 is 1.95 mmfd, assuming a grounded grid configuration, the output capacitance is the grid to plate capacity.

(4) We will use ⅛ inch thick line, 2 inches wide between ground planes, 2 inches apart. As stated previously, this means the minimum distance for the width of the enclosing section of the box is 4 inches.

Step 1—Determine the impedance (Z_o) of he line from Fig. 8. From (4) above, we find hat b = 2 inches, h = 2 inches and from 'ig. 8 the Z_o is 59 ohms.

Step 2—Now determine the value of X_c hat will be effectively shunted across the ne by the loading capacity. The total capac-y = tube capacity plus the tuning capacity.

$$C_T = 1.95 + 2 = 3.95 \text{ mmfd}$$

ℓefer to Fig. 4 and at 432 mc, the value of X_c for a capacity of 3.95 mmfd is 94 ohms.

Step 3—From the same formula used in revious examples,

$$X_c = Z_o \tan \beta l$$

ve can now determine the length of line equired. Substituting the values obtained, we ave the following:

$$94 = 59 \tan \beta l$$

$$\text{therefore: } \tan \beta l = \frac{94}{59} = 1.59$$

ℓefer to Fig. 5; this represents an angle of 8.5°.

Step 4—From Step (3) we know that βl = 8.5°, therefore $l = 58.5°/\beta$

ℓefer to Table 1 and obtain the value for β, ı this case 13.17° per inch.

$$L = \frac{58.8°}{13.17°/\text{inch}} = 4.44 \text{ inches}$$

'herefore, the line must be no longer than .44 inches for the conditions given.

Design Considerations

As a general rule for resonant line tank rcuits, you want to keep the line length, for given amount of loading capacity, as long as ossible. This can be done by making the haracteristic impedance (Z_o) of the line ɔwer. In most cases a good rule of thumb is ɔt to use a (Z_o) lower than 35 to 40 ohms. his does not apply to parallel lines in air. or these lines about 100 ohms is about as ɔw a figure for (Z_o) as you would normally se. Generally, for coaxial, trough and strip nes, (Z_o) values of from 50 to 77 ohms are esirable and for parallel lines a (Z_o) some-here between 250 to 300 ohms is desirable. you can keep your line designs close to the ınge of figures recommended, the tank circuit ill have close to optimum unloaded "Q".

The next consideration is what wave length f line should be used. This is determined by ıe following factors.

(1) space
(2) frequency
(3) loading capacity
(4) ease of mechanical layout

Bear in mind that a good ground rule is not to use any more multiples of a quarter wave length than you have to. The more you use, the greater the loss. For relatively few multiples, the losses are small. For example, if you are designing a coaxial grid tank for a 4CX250B to be used at 432 mc you will quite likely find that the first quarter wave is right in the middle of the glass header, due to the high input capacity of the tube and the associated mechanical construction of the grid. In this case it is clear that at least a half wave line will be required.

In Example 3 you determined that the quarter wave line length for the plate circuit using a 6CW4 should be no greater than 3.14 inches. This assumed a tuning capacity allowance of 2 mmfd that also includes any stray capacitance, etc. that you will encounter. This is a fairly marginal situation. It would be much better if we could have an allowance of say 4 mmfd. If the line were longer it would be a little easier to fabricate and work with.

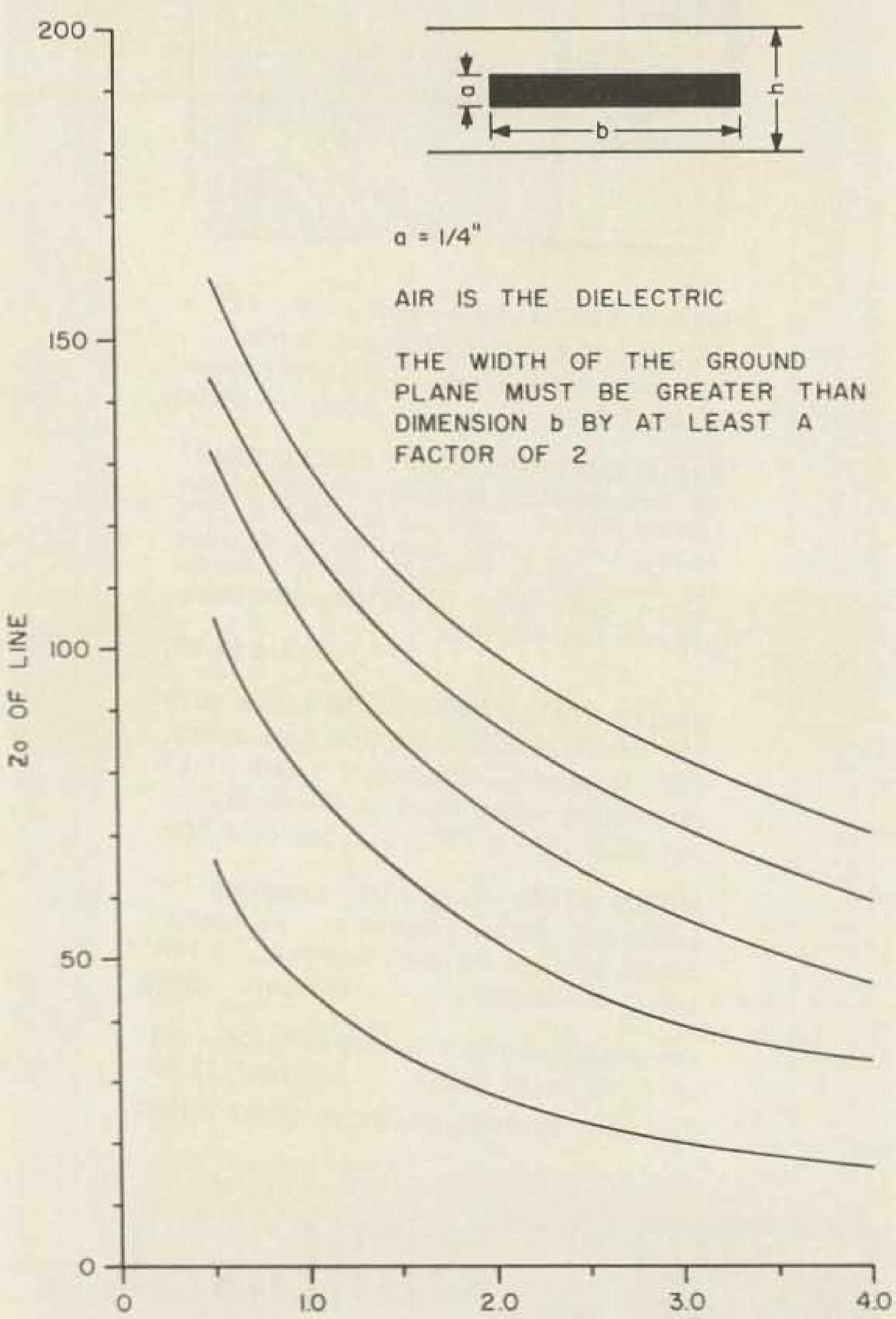


Fig. 9. Impedance of 1/4 inch strip lines.

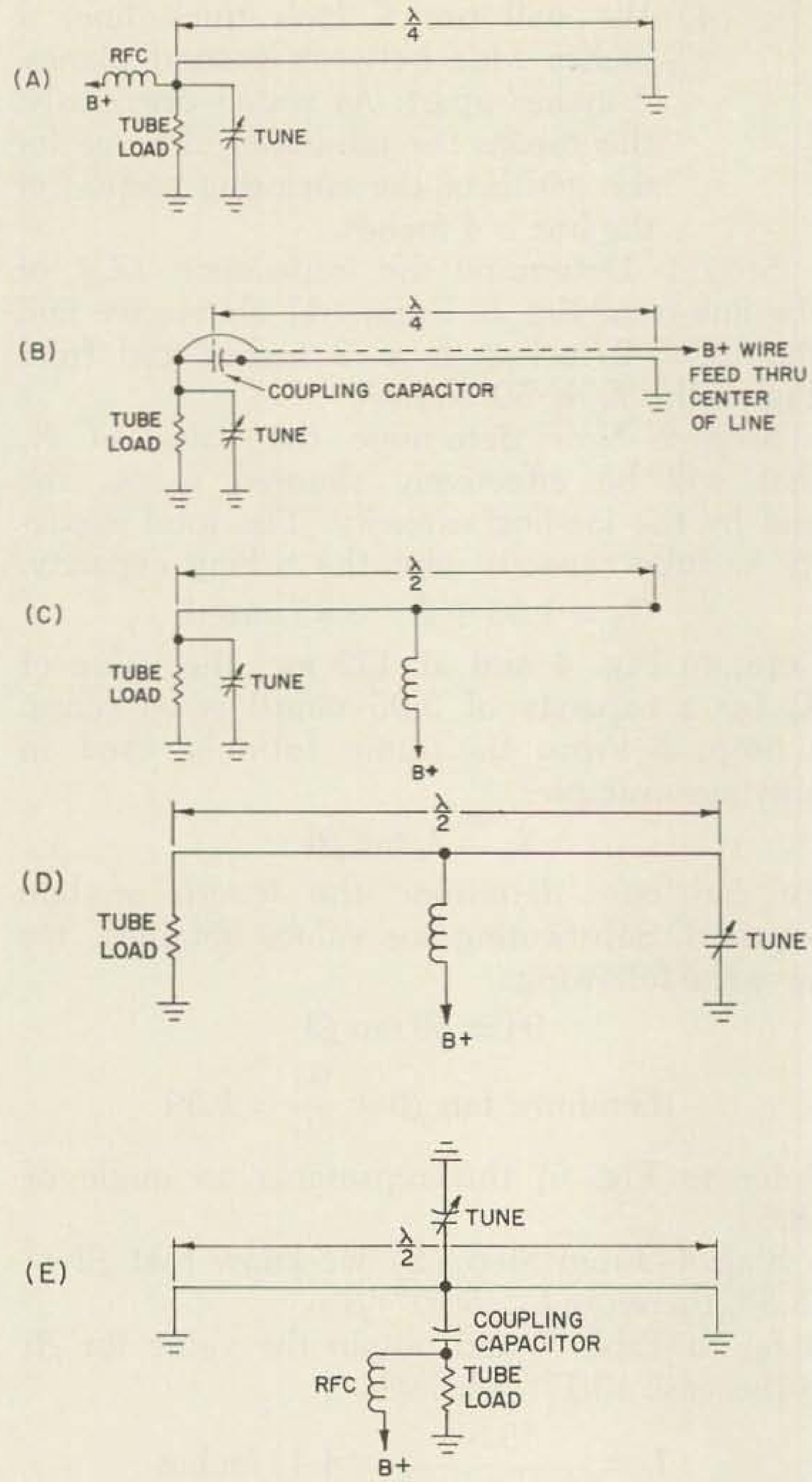


Fig. 11. Various tank configurations.

So instead of using a quarter wave line, use a half wave line. You have already calculated a quarter wave section of the line so now calculate the next quarter wave section. You are adding only 2 mmfd additional capacity so determine the additional length required for resonance.

Step 1–Refer to Fig. 4. For 2 mmfd at 432 mc

$$X_c = 185 \text{ ohms}$$

Step 2–The Z_o is the same 117 ohms therefore,

$$\tan \beta l = \frac{X_L}{Z_o} = \frac{185}{117} = 1.6$$

Step 3–Refer to Fig. 5. 1.6 represents an angle of 58°; therefore,

$$\beta l = 58°$$

$$l = \frac{58°}{\beta} = \frac{58°}{13.17°/\text{inch}} = 4.4 \text{ inches}$$

Step 4–From this, and the data determined in Example 3, a half wave length should b

3.19 inches plus 4.4 inches or 7.59 inches ong. The tube capacity will be 1.5 mmfd nd the maximum tuning capacity will be 4 nmfd. This is an advantage since all the ca- acity does not have to be at one end of the ine. The tuning capacitor can be at one end upporting the line and the tube capacity can e at the other end. The net effect is the ame as if it were all at one end and the ther end was left free. Fig. 11 provides addi- ional data on possible line arrangements.

For the most part, the examples given were resented from the conservative point of view oncerning the length of the line (1). This was one following the rule that it is easier to horten the line to bring it to resonance at the esired frequency than to add to it.

Fig. 11 shows various configurations of line vave lengths and some of the possible feed ystems that can be used.

If at this point you feel quite confused, run hrough a problem of your own and see for ourself that it is not as difficult as you might hink. Be independent and design that line or the new rig yourself.

. . . W6GGV

References

1) "Reference Data for Radio Engineers" Fourth Edi- on.

2) "Radio Engineers Handbook"—Terman, Fourth dition.

3) "Formulas for Characteristic Impedance" Electronic esign, September 13, 1961, Page 173.

There is no Fig. 10.

Because of space limitations, we had to make the graphs in this article small and inconvenient to read. For $1, we'll send you an 8½ x 11 booklet with 9 beautiful full page graphs and a reprint of the text. Ask for "The Design of VHF Tank Circuits." 73 Magazine, Peterborough, N. H.

Gus Browning W4BPD

Gus: Part III

This little episode is being written while I am in Calcutta, India. I am feeling a little low today because I have just this morning seen my sweet wife, Peggy, leave for the U. S. A. and I am really lonesome. I should be returning back to the AC lands next week where I have a transmitter and at least can get on the air. Right at this moment some fellow out on the street who sells gadgets to passers by is playing a very mournful oriental tune on a flute and he has been at it for the past 3 hours.

I am standing by here trying to get my good equipment out of Customs. It has been referred to the Central Government in New Delhi by mail! Boy, I sure hope that Ministry will open my letter when it arrives so I can get my stuff and head back to the high Himalayas and get away from this hot weather here. You would be surprised at all the sounds you hear coming up from the street. The constant honking of those horns on taxis (they use those very old type of horns where you press a rubber bulb and they actually say "honk-honk-honk") and these fellows just love the sound that they make. My little hotel room is not equipped with an air conditioner but it has one of these old slow turning ceiling fans like you see in the movies of scenes taken overseas. The sweat is pouring from me.

The hams here in Calcutta have promised my wife that they will not let me get lonesome and I think a few are coming around to take me out tonight. They are a FB lot. VU2AJ, VU2RF, VU2DK, and many others have met Peggy and me and one or two of them shows up almost every night for an eye-ball QSO.

A new sound just started down on the street—one of these snake charmers with his flute and cobra is now at it and going strong. Well, I better get along with my story now; I have wandered long enough away from it, daydreaming here in my solitary room.—I wonde if the band is open to W land now, it's 130 GMT—or 6:30 PM Indian Standard time! N rig here, no nothing. You all back home hav it made and don't know it! You lucky dogs you

Like I said in the last episode, I spent mos of my time during the War building rigs an putting up a lot of rhombics and eating dinne every day with the Draft Board man! Finall the war was over and the fellows everywher were getting back on the air—and I was i there with the boys working 'em right an left. You know, when you get up 13 rhombic —big ones too—that keeping them up starts t become quite a task all within itself. It's prac tically impossible to walk around to inspec them all each week. I used my Jeep eac Sunday after lunch riding and riding lookin over all those antennas, and usually at leas one was down, a guy wire broken, a rop broken. Then I would spend all day Monda getting that antenna back up and in operatin condition. At times during summertime whe thunderstorms were prevelant lightning woul completely remove all the wire from a whol rhombic or at times just half of it, but neve bothered any feed lines.

This sort of thing kept up quite a numbe of years. Occasionally I would have a QS with Buck Joyner W4TO over in Atlanta wh is a rep for a number of different radio manu facturers. One of them at that time was Telre Buck would all the time say "Come on Gu why don't you put up a good beam. You kno they are better than those rhombics you hav there." I would say to him, "Buck, I can wor anything you can and get just as good a re port as you get and you know I run just KW."

Well, one day I went out to inspect th antenna farm, and three of them were dow

That night here comes Buck again with his antenna argument and this time I said, "Buck, what kind of antenna do you have there that you want to *give* me?" He said, "Gus I got a brand new 5 element Telrex that's too long to put up on my place and it's yours for $100.00 if you will come to Atlanta and pick it up. It's still in the factory crate." I said, "OK, Buck I will try out one of those beams just to see if it's as good as my rhombics."

I got in my old beat-up pick-up truck, along with my man Pocket, and over to Atlanta we drove. When I left there I had a 5 element beam.

On my way home I was passing through a very small Georgia town and spotted a radio station where some fellows were taking down a nice little tower. I stopped in and ended up buying that 150 foot tower for $100.00. In the truck it went too. When I arrived back home I was all set: a good 5 element beam and a 150 ft. tower all for a total price of $200.

I had read lots of books on beams in the meantime and was ready to see how some of those writeups on tuning and adjusting beams worked out in practice. At first I just put it up and tuned it like the book sa'd to tune it, at the factory marks on the elements. The SWR was FB at the exact center of the band but, brother, by the time either band end was reached the SWR was way up—about 3.5 or maybe 4 to 1! I decided I couldn't make it any worse by tuning and adjusting by some other method. I had heard about this business of Gamma and Mega matching with small tuning condensers mounted in a weather proof box right up on the antenna, and this sounded fine to me. So they were installed along with a field telephone on top of the tower. Up the pole Pocket went and we started our tuning up. After many trials and errors you kind of begin to see the curious effects turning either condenser has. You plot a curve with the condensers at one setting, then you run another curve with another set of adjustments of the condensers. After a while you began to see which way things are going, and by some slight mis-adjustments (on purpose—that is) you find that the antenna can be used all over the whole 14 mc band with an SWR of not over 2:1. Of course it never gets at 1:1 on any frequency, but which is best: 3.5:1 on each end of the band with 1:1 at the center frequency, or 2:1 at each end and maybe 1.25:1 at the center? I liked the latter adjustment much better.

After that 5 element beam was up I began to compare it with my old rhombics and I found that the beam was just exactly as good at the rhombics at their very best direction, but with the beam I could fill in those weak spots between the rhombics! And the nicest part with the beam, I had only one antenna to keep up in the air! And the front to back ratio helped to eliminate a lots of QRM when working DX! So as one rhombic after another came down for one reason or another I just let them stay down! But I did lose my good 40 and 80 meter signal!

Since using vertical Hy-Gain antennas on DXpeditions I have a good idea on a fairly good way to overcome a low frequency antenna problem. I want to try this when I get back home again: Run a 40 meter co-ax feedline to the proper place up near the top of the tower; then tap it on the tower and put out the 40 meter ground plane radials (remembering the loading effects of the 5 element beam on top). Slide up and down until you have the lowest SWR at the middle of the band, then try a tuning coil in series with the co-ax feed line (to tune out the inductive of capacative reactance—whichever you have to tune out). Then you have a good ground plane that's up high so you drop down the tower and find the right spot for the 80 meter co-ax connection and it ground plane. (Remember the top loading effects of both the 20 meter beam and also the top loading effects of the 40 meter ground plane wires too.) When you get through with the 80 meter ground plane, I believe you could do the same even with a 160 meter ground plane. When all is finished you then would have up a good 40-80-160 meter vertical ground plane and also a good 20 meter beam. Then put on top (this should be done before you start the low frequency verticals) a good 10 and 15 meter beam, and then everything is on one tower! I have found that a good vertical with a low SWR like the Hy-Gain that I used on all my DXpeditions is hard to beat. I do know Old Buck W4TC proved his point to me more or less—that is to say, a good 4 or 5 element beam, up high is just as good as a fairly good rhombic, of course only on one band. With these 5 over 5 or over 6 beams, I suppose that they are better than a run-of-the-mill rhombic. These fellows using stacked jobs are very hard to beat.

All during most of the 1950's I kept thinking about my very slim chances of going on a DXpedition to any rare country. The chance of such a thing ever happening was, in my opinion, one in a million. But I did start making some plans just in case something did eventually turn up.

To start with I though how nice it would be if a fellow could write with one hand and use the other hand to operate his key. All m fe I had been using my right hand both to rite and send with. I was talking to a friend mine who had studied the human brain and ow it functioned and I asked him if it were ossible for me somehow to learn to use my left and to write while keeping my right hand to perate the key. He told me he had read in ne of his books how to do this and that he ould look this info up and give me a phone ll if he found it. A few weeks later he lephoned me to come and see him.

When I arrived there he told me how to go out trying to change my writing hand. Here what he told me to do. For two weeks I as to stand up in front of a mirror with one nd on top of my head and the other hand on y stomach, then to pat my head with the nd on it and at the same time to rub my omach with the hand that was on it, then to y "change" and to rub the hand on the head vhen rubbing, the hand should be going in circular motion) and to pat the stomach with e hand that was on it. This did take two eeks really to get so you could change in-antly from rub to pat and vice versa! About) minutes each morning I practiced this. All is time I was told to do all my writing with y left hand but to keep on using my right nd on the key while operating the rig.

Well, back to my doctor I went, and demon-rated to him that I had accomplished my as-gned task. Next he told me to change the sition of my hands, explaining that he meant r me to put the other hand on my head and e other on my stomach and to practice this r two weeks and to report to him then.

This task was perfected in two more weeks, d my writing with my left hand was getting etter (I could almost read it!—hi). Back I ent to him and he made me demonstrate ain—with him telling me when to change om rubbing to patting and vise versa. He id, "Gus you are doing fine, but you have ly begun to work; there is more to learn yet!" e said, "From here on I want your wife to ve you the commands when to change. I ant you to be able to use either hand on your ad or stomach. Let's start using numbers om now on. Number 1 will be right hand on ad patting while left hand is on stomach bbing. Number 2 will be right hand on head bbing while left hand is on stomach patting. umber 3 will be left hand on head patting hile right hand is on stomach rubbing. Num-r 4 will be left hand on head rubbing while ght hand is on stomach patting. Let your fe do the counting, 1 2 3 4, 1 2 3 4, then 3 2 1, 4 3 2 1, then 1 2 4 3, 4 3 2 1 etc. Do is for one month and come back to see me."

I was working like a slave on this darn assignment and my wife was laughing her head off at me or bawling me out for being so silly! But you know me, I am hard headed. I was going to learn to write with that left hand or else.

One month later it was back to the doctor's office again. This time he did the counting and boy, I jumped when he gave those 1 2 3 4, 4 3 2 1 etc. commands. But I satisfied him that I could do the exercises 100% perfect. (You know, I used to have plenty of hair on my head, and I wonder why it's so thin now? Maybe all that rubbing and patting had something to do with it!)

My writing with my left hand was beginning to get sort of almost legible too. My wife said to me one night when I was doing my exercises, "How crazy can you get?" I guess I could not blame her for this remark when you sit down and think about these things I was doing either! You know, about this time I got a letter from my bank wanting me to come down and give them a new signature card—I wonder why?

Well, back to the Doc and me—Next he said for me to keep doing these 1 2 3 4, 4 3 2 1 exercises but everytime I change from one number to another for me to be patting one foot with the other foot still and then to change feet! You know, this was getting to be a complicated thing, and was turning out to be lots of hard work! He said to do this for 6 months, to keep writing with my left hand while transmitting with my right hand, to put a Coke on the table, then while I was writing to stop and pick up the Coke and take a drink while I was still keying with the right hand, then to light up a cigarette while I was still using the key, and to get all this down to where it was a smooth operation and perfectly coordinated with both hands. (You see, I had told the Doc why I wanted to become left handed in my writing, explaining to him about DXpeditions, the necessity of speed in filling out logs while using the key—he understood the problem.)

Well, in 6 more months I had things down to perfection. I went back and demonstrated to him and he even came out to the house and let me show him how it work out while I was actually in QSO with someone. He said to me, "Gus boy, you have it all O.K. now; you don't need me anymore," and that was that! I must say this has helped me out in speeding up QSO's when those piles get real high and you have to work em, to get the pile down, where you can control em!

I used to listen to W4KFC and W3BES in those SS contests and their system of operation was an education all by itself. I als learned a lot listening to ole Nose KH6IJ ou in Hawaii too. I was getting ready for anythin in the line of operating that the future migh bring my way. Of course I was all the time o the air working what DX there was, and tryin to out-guess the other fellows who were m competition. During those times I was tryin to make as many good friends as possible over seas with the hope that some day I would ge the chance to visit them and at the same tim not have to be paying a hotel bill! Oh yes, will admit most of my motives had two view points but I think both of them were hones viewpoints.

All during these years those trees on m farm kept on growing and growing and diffe ent people in the lumber business kept o making me offers to buy the timber. Most c the offers were made by small timber buye and did not amount to much, but eventuall one of the larger companies came to see m and said they were making a serious offer c so-and-so many dollars for the timber I ha Well, I had no real idea as to what the timbe was really worth, but I just told them I woul not consider selling at the price they offered m but I would sell them if they would pay m that same day a figure about 35% higher the what they had offered me. I said for them t go back to their office and make their ow decision and if they wanted to make the pu chase just to bring me the money before 6 p that same day—or to forget the whole thin but not to come after that day because th timber would not be for sale at any pric They left at about 2:30 pm and back the were at 5 pm with a certified check for th amount I had asked. The papers were signe they had departed and the next day I we down to a bank and deposited their chec

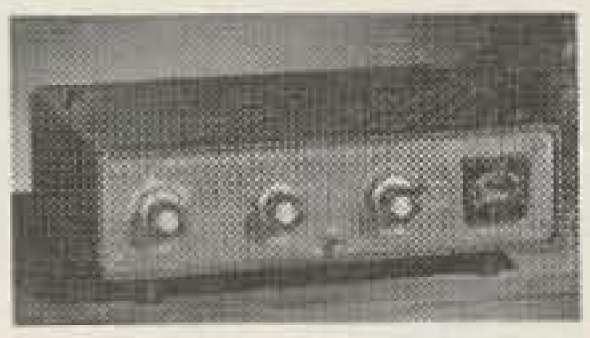
I said to myself, "There is my DXpeditio money." I never did mention this to the wif Then I kind of gradually started telling som of the DXers overseas that I might come an visit them the next year if they had a spa room for visiting hams. If they said they ha the room for me I said FB and if they did n answer my query I just forgot about them.

The plans for a DXpedition were slow i developing at first, but after a while the new got on the grape-vine that I was going on DXpedition and then the fellows started as ing me where was I going—and to be hones up to that time I did not have the faintest ide where I wanted to go or where I should g I asked different DXers what countries the needed and the answers at first were usual Tanna Tuva or Wrangle Island. Then I woul ell them to be reasonable and they would sually mention a few countries that it was ossible for me to visit. I wanted to go to as nany good spots as my little money would ake me, but I knew the money would have o be stretched very thin if I went to too many. But I had my mind made up how I would perate when and if I ever got going. I vould never have any Black List; I would ever work anyone on my frequency; I would ot start this business of having someone in he USA or elsewhere assist me with giving list of stations to work; none of this W1, W2, V3, etc. business. I wanted to be the one to un my DXpedition the way I wanted to run t: no favorites, come one, come all, no holds barred.

About this time I started wondering about getting licenses overseas, getting equipment to use (I had nothing small or portable at all), he various language barriers, Custom troubles vith radio equipment, the health problems, etc.

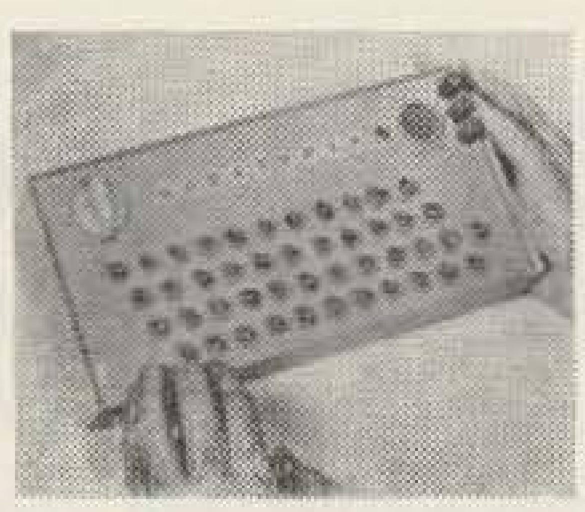
In the next episode these things begin to tart getting solved—things start moving—and problems start coming up that have no solu-ions—or at least I could see no solutions to them. I said to myself many times—Come on Gus, don't chicken out now!— . . . Gus

New Products



One KW — $99.95

Looks as though Heathkit is determined to take over the ham SSB market. Their new HA-14 "KW Kompact" linear is the smallest yet–and only costs $99.95. It's just 3-3/16 x 12-3/16 x 10 inches too. The HA-14 runs 1000 watts PEP to a pair of 572-B's on 80 through 10 meters. It even has a SWR bridge built in. The HP-14 mobile power supply is $89.95 and the HP-24 AC supply is $49.95. Find out more from Heath, Box 73, Benton Harbor, Michigan.



Codetyper

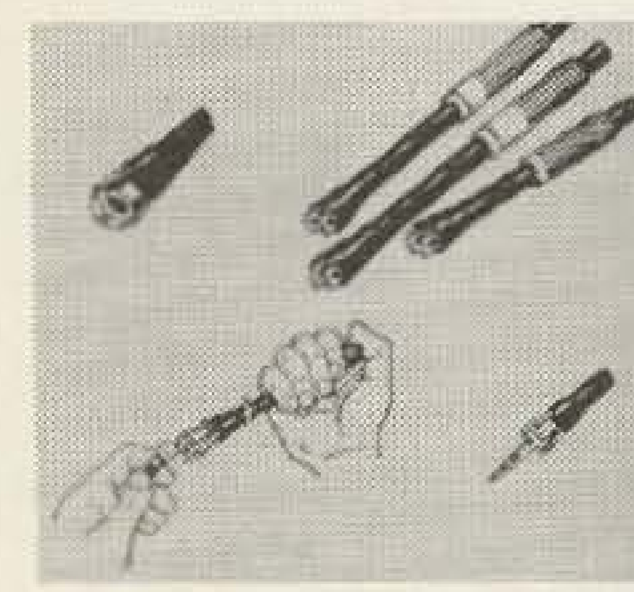
Here's something that we've all been looking for for quite a while. It's the Computronics Engineering Model 400 Codetyper, a subminiature keyboard code generator. It uses 21 transistors and an internal NiCad battery. Relay contact output is provided for transmitter keying and a built-in speaker provide 1000 cycle tones for monitoring and code practice. Speed is continuously adjustable from 5 to 55 wpm. Key action is momentary snap-action with electrical lockout during character plus space duration. Price: $299.50 from Computronics Engineering, Box 6606, Metropolitan Station, Los Angeles, California.

Speech Clipping Mike

American Microphone Division of Electro-Voice has brought out the new D-501K hand-help, transistorized, speech clipping communications microphone. It can easily be substituted for the original mike on most communications equipment, and can deliver up to twice the "talk power." The mike clips the loud, unimportant vowels to let the more important consonants get through better. Power for the D-501K is supplied by a small, internal long-life cell which can easily be replaced. An internal control is provided for clipping depth. Price: $49.50. Contact Lynea Dalrymple at E-V, Buchanan, Michigan 2N107.

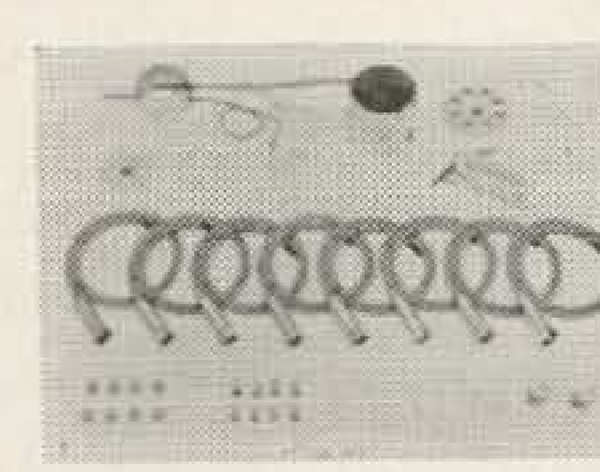
VHF Associates

VHF Associates is adding to their line c VHF equipment. Now in addition to thei varactor triplers, and converters for 432 mc they've announced a superregenerative de tector-modulated oscillator transceiver for 42 mc. It could provide a lot of fun for the UHI beginner or old timer. They also have an nounced a noise generator for the HF, VHI and low UHF range. Get the full informatio from them: VHF Associates, P. O. Box 22135 Denver, Colorado 80222.



Tip Wrench

G and G Tool Company has brought out a interesting new gadget. It's called the Ti Wrench and is used for tightening and loosin hex and square nuts and bolts, and deep slotte machine and pan screws. You press the plung er head with your thumb to pick up the nut then the wrench holds it firmly while you fas ten it. The tool comes in four sizes for use wit nuts and bolts from no. 2 to no. 12. G and G P. O. Box 1005, Thousand Oaks, Calif.
Ohio.

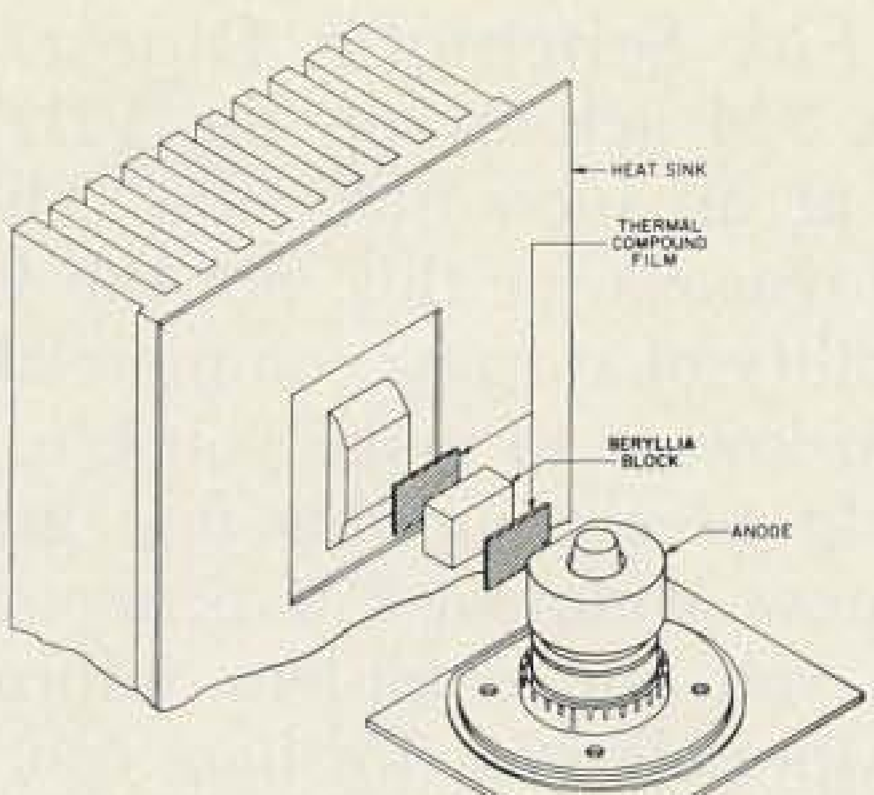


Electro-Shield Noise Suppression Kit

Estes Engineering is making the new Electr Shield noise suppression kit for mobile use It's in semi-assembled form to fit a wide variety of engines. The kit provides complete shielding and filtering for your car ignition system Installation of the kit is very quick and only requires trimming of spark plug cables, attaching fittings at trimmed ends and inserting or engine. More information from Estes Engineering, 1639 West 135th Street, Gardena, California.

Certificate Holder

Tepapco has brought out the ideal match for their popular plastic QSL card display packets. Now you can protect your certificates and display them on the wall. Price is $1 for 3 packets which hold 15 certificates. Tennessee Paper and Box Company, P. O. Box 198, Gallatin, Tennessee.



mperex Conduction Cooled 4CX250B

Well, you can throw away those blowers ou've been saving. Amperex has developed new type of tube that is good for 270 watts itput (CCS) at 432 mc with no blower, ater, or wide open space. It uses a new onduction cooling system that uses a heat sink dissipate power that doesn't go out the eedline. The number of the conduction cooled CX250B is the 8560. Amperex Power Tubes Hicksville, New York, can give you more formation on this interesting idea.

Vacuum Nozzle

The Radio Vacuum Nozzle is a semi-flexible lastic reducer to fit on the end of an ordinary acuum cleaner hose. It can be bent on the nd to get behind and between parts on a hassis for cleaning out noise making dust. is cast in one piece, so there are no parts get mislaid, and can be hung on a peg-oard. Cleaning out a rig can more than pay or it by boosting trade-in value. The price is nly $1 postpaid in the U. S. from Grace pitz, Box 4095, Arlington, Virginia 22204.

Ham Global Time Watch

Here's a useful product for the DX'er: a lobal wrist watch that will tell you the time nywhere in the world as well as giving the ocal time. The Swiss-made jewelled move-nent is anti-magnetic and has a luminous dial, sweep-second hand and an unbreakable main oring. Price is $16.46 including FET from Nordlung Radio Products, 7635 West Irving ark, Chicago, Illinois.

FM Schematic Digest

Amateur FM activity on the VHF bands is increasing at an incredible rate. There are a number of reasons for this, not the least being the availability of surplus commercial FM gear at prices so low as to make you blush. An important help in getting this fine gear on the air is the new *Motorola FM Schematic Digest* that gives you the complete information on adapting Motorola gear for ham use. It's available from Two Way Radio Engineers, 1100 Tremont Street, Boston 20, Mass. for only $3.95 postpaid.

Photocell Applications

Rufus Turner has been at it again. He's got out a new book that gives many simple and complex applications of the many photocells distributed by Lafayette Radio. The 84 page book is called *Photocell Applications* and is available from Lafayette for only $1.50. You'll find it very interesting.

Mobile and Marine Station License Manual

Leo G. Sands' new *Mobile and Marine Station License Manual* published by Sams will be of great interest to many hams. Though it is not directly concerned with amateur radio many hams work with or would like to work with commercial two-way radio. This book answers virtually all of your questions about station licenses, type-acceptance, equipment standards, allocations, etc. A copy plus a commercial license could provide significant spare time income for the knowing ham. $6.95 from your local distributor.

Getting Started

Rider's *Getting Started in Amateur Radio* by W2PIK and W2MDL will answer many of the questions that newcomers have about amateur radio and will help them get their licenses. It covers learning the code and theory and regulations for the novice and general exams. A few of the regulations may be changed by the FCC soon, but that will affect only a small part of the book. One of the appendices include FCC regulations. $2.95 from your local distributor.

Charts and Nomographs

Some hams seem to have a dread fear of math. Others don't mind it, but try to avoid lengthy calculations. Allan Lytel's *Handbook of Electronic Charts and Nomographs* solves both of these problems. It contains 58 electronic and mathematical charts and nomographs that will give you answers to your electronic questions with slide-rule accuracy in the time it takes to draw a line. Price is $4.95 and it's available from your distributor.

EICO Full Line Catalog

Many new products are featured in the new 1965 EICO Full-Line catalog. The 36 page catalog is completely new in style for better readability and convenience. It contains well over 200 pieces of ham gear, test equipment, Hi-Fi gear, etc. Every piece of equipment in the EICO line is included and described in depth. You can get a copy from EICO, 131-01 39th Avenue, Flushing, N. Y. Tell 'em 73 sent you.

Toroid Balun Kit

Ami-Tron's new Toroid Balun Kit will make a broad band (80-6 meters) 1:1 or 4:1 impedance ratio balun good for 500 watts or more. It will give you an improved match for beams, quads, vees, windoms, dipoles, etc. The kit includes a ferrite core balun, lots of #14 Formvar insulated wire, and complete instructions. Price is $5. You can get more information from Ami-Tron Associates, 12033 Otsego Street, North Hollywood, California.

W2NSD from p. 4.

rangement. The car was waiting for me in Frankfurt and I drove it from there down to Ctuttgart, Zurich, Luzern, Geneva, Turin, Venice, Trieste, Zagreb, Graz, Budapest, Vienna, Prague, Nuremberg, Warzburg, Hannover, and left it at Hamburg for shipment back to Boston. About 3000 miles.

Due to the hospitality of amateurs along the way and the inflated price of the not yet imported VW, my trip probably cost me less than $200. You know, Cowan is right, I am tight with a dollar . . . he says (I hear) that NSD stands for Never Spend a Dime. That's me.

Besides putting me even further back in answering my mail, the trip was a bit of a vacation and immensely valuable in moving the Institute of Amateur Radio ahead. Rather than go into a long hassle on the politics of amateur radio, I will start things moving and see if we can't get some valuable progress before ARRL can throw a wrench in the works.

One of the most encouraging things that happened during the trip was my visit to Geneva for the centenary celebration of the ITU wherein I had an opportunity to talk freely with amateur representatives of many foreign countries. I am very happy to report that the U. S. stands just about alone among the major amateur radio countries of the world in its lack of action toward the survival of our hobby. I don't think I can even express in words the concern that other countries feel over this unhappy situation. I found the influential amateurs in these countries to be most anxious to be cooperative . . . and this, amazingly enough, also includes some of the "iron curtain" countries.

The ARRL, by the way, was conspicuously absent in representation at the ITU affair, though I did work Dick Baldwin on 20 meters from 4U-ITU. ARRL's absence did not go unnoticed.

As time and space permit I'll try to cover some of my interesting visits. My return just before final presstime prevents me from carrying on at length this month. Count your blessings. I must tell you that my short visit to Yugoslavia, Hungary and Czechoslovakia have whetted my interest in a visit to the Soviet and a meeting with some of the hams there. Many of them called me during my two week spree on twenty before the trip and said that they read 73 and hoped that I would make plans to visit.

This travel stuff is heady . . . I start day dreaming. I could fill a lot of space here with my supposin trips. I should keep my feet on the ground and my butt in my office chair and work at 73 but I do like the idea of visiting UA-UQ-UR, or even more fastastic, teaming up with some similarly naive ham for a drive in a rugged car from Tangier down the west coast of Africa to Capetown, operating a ham rig in as many spots as possible. Those Land Rovers aren't very expensive in England and could probably be sold for a good part of the price in South Africa. I've talked with quite a few hams who live along the way and they say it can be done. I'd sure like to get a chance to talk personally with the government radio authorities in a lot of those countries and tell them how wonderful amateur radio is and what a great thing it would be for their country if they would encourage it there . . . and how we will help them to do this.

Aren't dreams fun?

WAZ et al

One thing that seems to be worrying the certificate hunting crowd is what will happen to the various commercial awards that CQ is selling such as WAZ, USACA, and all that if CQ should decide to stop selling them or perhaps go out of business. Since these awards are copyright by CQ there is no way that they can be perpetuated by any other magazine or organization.

Clubs

It would be more than prudent to have your club secretary write to 73 for our special Club Plan. This unusual offer combines a special low introductory subscription price to 73, cash for the club treasury and free books for the club library or to be given away as door prizes at meetings.

Channel A

Let's get those CB rigs up on ten meters and bring our ham band back to life. The national calling frequency is 28.6 mc. When that gets crowded we'll go up to 28.65 and 28.7 mc. The first response to this plan has been enthusiastic. How about it, will I see you there?

VHFer

The VHF contingent of amateur radio is in luck. Loren Parks K7AAD, of Parks Labs has put together 6up and the VHF'er (previously published by a VHF manufacturer in Michigan) and came up with a fine monthly VHF magazine. The subs are $2 a year for those of you who were not subscribed to either of the parent publications. Write VHFer, Route 2 Box 35, Beaverton, Oregon. I suspect that everyone but Loren will benefit from this new arrangement. Send him articles and subscriptions. . . . Wayne

VHF

Bill Smith KϕCER
1301 Churchi'l Ave.
Sioux Falls, S. D.

OSCAR III is still circling the earth opening the door of space-age amateur radio wider. After over one-thousand orbits the 144.850 beacon continues to send back HI's and telemetry indicating a battery voltage of approximately 4 volts.

A wealth of information has been, and is being, obtained. This is the topic of this month's column.

I attended a recent VHF dinner in the Twin Cities where WB6JZY, a Sylvania engineer and avid OSCAR Association member, spoke. In brief, this is what he said:

OSCAR III was one of nine satellites ejected from the single launch vehicle. The number was a new record from one vehicle. The other eight satellites were governmental. Their purposes were not disclosed and pictures of the launch were not allowed.

An apparent miscalculation placed the satellite in an orbit about twice as high as planned, and right in the middle of the Van Allen radiation belt. This, coupled with one of the largest solar flares in recent years shortly after the launch, probably explains the premature failure of the translator.

The extra height of the orbit accounted for the repeated signals being weaker than expected. The additional signal loss was about 12 db.

It is believed the 144.950 mc beacon never functioned because of a collision with one of the other satellites at ejection breaking off the steel tape-measure antenna.

The QSB is thought to have been caused by one, and/or, two things. The satellite should have been ejected in a stabilized orbit but apparently the tension of the ejection spring or the collision with another satellite caused OSCAR to pitch at one rpm.

The rapid build-up, and sharp cut-off, of the white noise has been blamed on insufficient isolation between the input and output of the translator. Needed was about 138 db of isolation. This amount was never obtained. Probably more efficient shielding or more than 800 kilocycle separation in the input and output channels would help. This lack of isolation caused the translator to feed white noise into the 144.1 input stag, the noise was then sent back into the output, building up in strength until it saturated, broke down, and then the process repeated itself.

OSCAR IV is ready to go up at anytime and is identical to III. It was III's back-up and was also taken to the launch site. The Association says they will probably launch it sometime in early fall. I am betting it will be re-worked some before they do, however.

Plans are already underway for OSCAR's V through X and the Association is looking for suggestions on what to do with them. Suggested so far have been 432 beacons, 1296 beacons, cross-band translators and the like. They want to know what YOU would like up there.

There is also a possibility that future satellites will have an OUTPUT power of 12 to 15 watts. Space has been offered on one of the new nuclear-powered satellites and the power is available for a nuclear power OSCAR, no less!

Most of the parts that went into OSCAR's III and IV were donated by various companies because of company interest. The rest of the expense—and it was terrific—was borne by the Association. The Association is NOT soliciting donations to help out on future projects, but I'm sure they wouldn't turn them down. It is the least WE can do.

Much has been said and discussed about the types of antennas that were used. Success was had with most any type, but circular polarization with an elevation ability paid off the best in the opinion of the Association and others who were set up to make checks through switchable polarization on given passes.

Circular polarization is not new, but it has not been used to any great extent in amateur circles until recently. There are several means of generating circular polarization and knowing little about this myself, I have asked for assistance from several of those who do.

WϕLER is one of these. John has made available information on this topic and some of his ideas, along with those of some others, should be in the August issue. WϕCUC and I are in the process of building and testing several systems. I had hoped to have it ready for this issue but do not feel that we have it to the point where we could present it in proper fashion. The August issue should allow time for those of you who are interested in constructing a circular system in time for OSCAR IV. Also being tested is Gain, Inc.'s commercial antenna with selectable horizontal, vertical, right and left hand circular polarization. (Ed. note: Cush-Craft makes one, too.) The results of these tests will also appear next month.

Several letters have been received from those of you who are just starting on VHF. From the questions that have been asked it would appear that those of us who take pen in hand have been badly overlooking the newcomer.

This is a problem I hope to lessen with information primarily directed at the newcomer in the form of an article.

Also, I am wide open for suggestions and am looking for additional column material in the form of short construction articles, handy gadgets, measuring noise figure, pre-amps, improving converter, receiver and transmitter operation and so forth. Some of these seemingly minor things to us may be just the thing someone else is looking for. How about it?

. . . KϕCER

SEMICONDUCTORS

Paul Franson WA1CCH
Peterborough, N. H.

The first item this month is a slight goof last month. The 2N3478's are NPN, not PNP as shown in the schematic. The polarity of the supply voltage is shown correctly.

Because of delays in getting the transistors and being sidetracked on other matters, I am not ready to report my results on the 2N3478 converter I built. However, W1OOP, who is accepted as *the* converter man in these parts, has been working extensively with 2N3478's and reports that he is down to a 5 db noise figure with a 3-cavity filter followed by 2 rf stages and a mixer. The cavities are for selectivity but do degrade the noise figure slightly. Hank has a single input cavity preamp in front that brings the works down to 3.6 db. We hope to have the details on this in 73.

The 2N3478's aren't just good for amplifiers, of course. It may be sacrilegious to some to use low noise amplifiers as oscillators, but they are inexpensive and perfect for oscillators, crystal oscillators and multipliers—though an Amperex 1N3182 variable-capacitance diode (i.e., varactor) at 88c makes a fine multiplier and is a little simpler. I built a little emitter-dip-oscillator using a 2N3478 to simplify construction of some 432 mc equipment. My old GDO is rather bulky. You take the coils to it, not it to the coils. Most transistorized dip meters use a small diode detector for sampling the rf to give an indication of resonance. I find it easier to measure the emitter current. A class C oscillator draws less current when it's not oscillating—or at least not oscillating as vigorously when it's coupled to a resonant circuit of the same frequency which absorbs part of the energy.

We've had a number of questions about varactors. A number of companies make them: Motorola, TRW, Microwave Associates and Amperex seem to be the most popular with hams. High power varactors are expensive compared to the surplus material most of us are familiar with, but they are very economical compared to the new tubes, sockets, power supplies and modulators that can be used to get on 432 mc. For instance, the 432 mc rig in the '64 *ARRL Handbook* uses two 6939's at $11.90 apiece for about 5 watts on 432. By comparison, I've been using the Amperex H4A (1N4885) which sells for only $15 retail. It's good for 13 watts of CW output at 432 and is the cheapest high power varactor I know of. I'm using a circuit similar to the one by W9SEK in the March *73*. There were other articles about varactors in the October '64 *73*, by W6ORG, October '62 *QST* by W1OOP and January *CQ*.

One of the handicaps to high power transistor rf stages (other than the price) is the problem of getting decent gain at the 13.5 volts available in most mobile applications. You either have to use a number of transistors in parallel with extra drivers or use an inverter to furnish a higher voltage. Motorola has been interested in this problem because of their prominent position in the mobile communications field. They've developed some new rf power transistors (2N3717 and 2N3718) made for operation from car batteries. They're expensive and work better at 25 volts than 13.5, though. Maybe cars will double their voltage again.

Another aspect of the same problem is the high DC current required for high power inputs at 13.5 volts. 50 watts at this voltage requires almost 4 amps. That takes a bulky tank. Compare that to the 1/10th of an amp at 500 volts a typical tube would use. But tubes do require filaments. A satisfactory solution is instant-heating tubes, such as the extensive line that Amperex makes. They use 1.5 volts for the filament rather than 13.5 volts since the lower voltage makes a more reliable filament. A one or two turn loop around the toroidal power supply core as in HV rectifiers in TV sets takes care of the filament. The new Transcom transistorized SSB transceiver uses a pair of 8042's—the instant heating equivalent of 6146's.

Here's a rather dramatic example of the advantages of the new cheap consumer transistors that I've been discussing the last few months. The 2N918 is a good old reliable NPN UHF transistor that has been around for quite a while. It appears in many applications bulletins because it works well as an amplifier and oscillator, as in UHF TV. It ought to. It sells for $14.20 (Motorola). The new Motorola MPS918 is similar except for higher dissipation and lower temperature rating and is made for the same uses. But it's in a glob of plastic instead of a hermetically sealed case. Price is $1.35 for one. The newer MPS3563 at $1.20 is made for the same purpose. Either would be excellent for dip-meters, mixers, VHF amplifiers, etc. Other transistors in this Motorola line are the NPN MPS2923-5 at 65c to 75c for low-level *if* and audio uses.

I said last month that I'd try to explain the common transistor parameters this month, but it looks as if I'm running out of space. I'll try again.

Someone wrote in to ask where you buy the transistors I've been mentioning. You don't buy them from the manufacturer. You buy them from industrial wholesalers. Newark Electronics in Chicago will send you their fat catalog with both ham and industrial listings including many of these transistors if you mention 73. Be sure to get it. Other mail order distributors such as Lafayette and Allied and large local ones carry them, too. In some cases, they don't list the transistors in the consumer catalog you get when you send in the coupon in *Popular Electronics*, but they still have them hidden in their industrial catalogs. They love to give away the consumer catalogs—that's why they don't advertise in 73; you've already got the catalogs and don't need to write for another—but they are a little more stingy with the industrial ones. You normally need letterhead to get the industrial catalog. Also, Poly Paks, Alco and Transistors Unlimited and other mail order companies often have the older transistors at good prices.

Don't forget to write.

. . . WA1CCH

Corrections

On page 52 in the June issue, the B+ is grounded in the schematic. Don't do that.

On page 82 in June, remember that the plate circuit isn't really grounded. There is a blocking capacitor at the cold end of the line.

On page 88 in June in the schematic, the transistors should be indicated as NPN. The supply polarity is shown correctly.

In the May 73, there is an article entitled the "Constant Gain Audio System." A better title would be the "Constant Output Audio System."

Also in May, in the article on Log Periodics: Page 62, second column. σ' (the mean spacing factor) equals $\sqrt{\tau}$ (tau) not $\sqrt{T}$. On page 63, second column, h/a is 300 at 52.5 mc, not 600. This will change a few dimensions in the example. Also on page 63, first column, Za = 120 (Loge h/a — 2.25) ohms, not h/a = 2.25.

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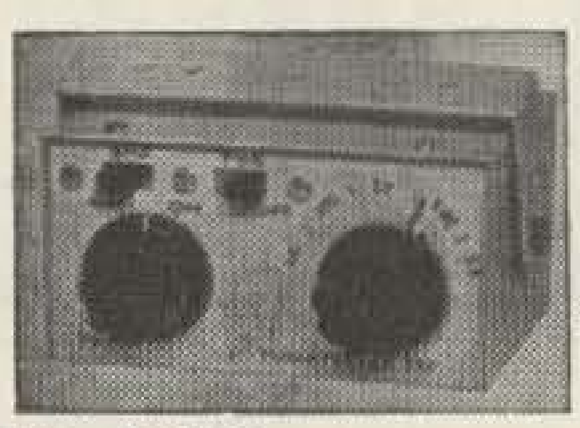

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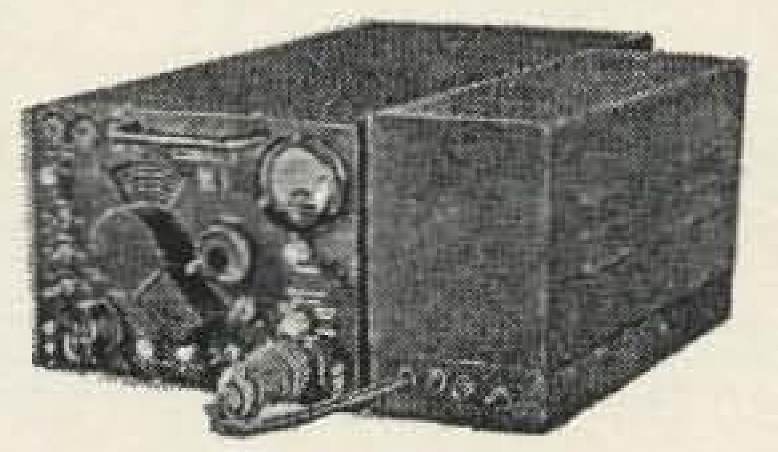
(Add $3 for extra-clean selected unit.)



ALL-BAND SSB RCVR BARGAIN: Hallicrafters R-45/ARR-7. 550 kc to 43 mc continuous: Voice, CW. MCW: 2 RF's. 2 IF's: S-meter: 455 kc Xtl. 6 select. choices. Ready to use. w/60 cy pwr sply & book. aligned. fob Los Angeles **199.50**

Deduct $30 if you make your own pwr sply from schematic we furnish. Deduct $20 if SSB not required, or deduct $15 if you will wire in your own SSB with kit & diagram we furnish.

TIME PAY PLAN: Any purchase totaling $160.00 or more, down payment only **10%**

ARC-5 Q-5'er Rcvr 190-550 kc w/85 kc IF's. Use as 2nd converter for above or other rcvrs. Checked electrically. w/lots of tech. data. w/spline knob. 9 lbs. fob Los Angeles **14.95**
(Add $3 for extra-clean selected unit.)

AC PWR for SCR-522: RA-62-B made by Signal Corps for the specific job! 115/230v, 40 60 cy in. Regul. & filt outputs 300v, .26A; 13v, 4A; -150v. 10 ma. OK grtd, w/data, 90 lbs. fob Sacramento **17.95**

AN/APR-4 RECEIVING UNIT w/tuning units to tune 38-1000 mc plug & handbook. all checked & grtd 100% OK, ready to use on 60 cy fob Los Angeles .. **179.50**

Add $30 for am/fm version modified for 60 cy pwr input: add $60 for TN-19, 975-2200 mc; add $125 for TN-54, 2175-4000 mc. All uncond. grtd. OK.

LM FREQ METER 125 kc to 20 mc is combin. heter. freq. meter & signal source. CW or AM, accuracy .01%. xtl calib. Clean, checked 100% grtd. w/plug, data. 16 lbs fob Los Angeles **57.50**

Add $10 for EAO, converts for LM Power Supply w/parts, data, included 47 lbs fob San Diego

TS-323/UR, 20-480 mc. Crystal. 001%. W/handbook supplement giving supplementary xtl check points & instruc. to closely approach crystal accuracy. W/schematic, instruct., pwr sply data, clean, checked. 100% grtd. fob Los Angeles **199.50**

TELETYPE BARGAINS

U: Unchecked, as is, fair condition, some minor parts may be missing. C: Checked & repaired as needed, ready to use, grtd OK.

#14 Trans-Dist, sync., C $49.50, U	35.00
Handbook TM 11-2222 for above	8.50
#14 Typ. Reperf, no keybd, C $74.50, U	49.50
Same with keyboard, C $89.50, U	69.50
Handbook TM 11-2223 for above two	9.00
TG-26B, like #19 but tape, C $139.50, U	99.50
40 rolls oiled tape 11/16" wide	11.95
#15 w/keybd, sync. C $149.50, U	95.00
Handbook TM 11-352 for Mod. 15	7.50
#19 w/keybd, syn. C 249.50, U	149.50

BEST OSCILLOSCOPE AT MODEST COST: Tektronix 514AD: DC-10 mc. Calib. defl. 30 mv-100 v/cm. Calib. sweep 0.1 usec—10 msec/cm. Sq. wave w/variable duty cycle, .05-50 v, available to test amplifiers. Other outputs: Sweep sawtooth, pos. & neg. gate pulses. Signal delay network, ¼ usec, permits viewing the signal which triggers the sweep. Locked-in triggering provides stable-as-a-rock picture. Completely overhauled, 100% grtd OK, with Book, clean and pretty, only **395.00**

R. E. GOODHEART CO., INC.

Box 1220-GC BEVERLY HILLS, CALIF. 90213
Phones: Area 213, office 272-5707, messages 275-5342.

QUESTIONNAIRE?

1. Without looking back through the magazine try listing here the advertisements that you remember as being of interest to you in this issue of 73.________________________

2. Is there a good chance that you may purchase something advertised in one of these ads?

3. Which article did you find most interesting in this issue?________________________

4. Now please glance through this issue and list here the ads which you feel are not satisfactory. ________________________

5. Is there any particular piece of equipment that you would like to see us test?____________

(If you don't like to shred your magazine put the answers on a separate card or paper.) Send answers to 73, Peterborough, N. H.

INDEX TO ADVERTISERS

Propagation Chart

July 1965

J. H. Nelson

EASTERN UNITED STATES TO:

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

CENTRAL UNITED STATES TO:

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

WESTERN UNITED STATES TO:

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

Very difficult circuit this hour.

* Next higher frequency may be useful this hou

Good: 1, 2, 5, 6, 10-13, 18-21, 25-31

Fair: 14-17, 22

Poor: 3, 4, 7-9, 23, 24

VHF DX: 3-8, 12, 17-19, 27

WVG
MARK
II

$15.95

New

POSTPAID!

ALL BAND VERTICAL

WRL

WVG MARK II

New low cost vertical antenna which can be tuned to any amateur band 10–80 meters by simple adjustment of feed point on matching base inductor. Efficient radiator on 10, 15, 20, 40, 75 and 80 meters. Designed to be fed with 52 ohm coaxial cable.

Conveniently used when installed on a short 1-5/8″ mast driven into the ground. Simple additional grounding wire completes the installation. Roof top or tower installation. Single band operation ideal for installations of this type. Amazing efficiency for DX or local contacts. Installed in minutes and can be used as a portable antenna.

Mechanical Specifications: Overall height — 18′ Assembled (5′ Knocked down) Tubing diameter — 1¼″ to 7/16″. Maximum Wind Unguyed Survival — 50 MPH. Matching Inductor — Air Wound Coil 3½″ dia. Mounting bracket designed for 1-5/8″ mast. Steel parts irridite treated to Mils Specs. Base Insulator material — Fiberglas impregnated styrene.

Electrical Specifications: Multi-band operation — 10-80 meters. Manual tap on matching inductor. Feed point impedance — 52 ohms (unbalanced). Maximum power — 1000 watts AM or CW-2KW PEP. Omni-directional. Vertically Polarized.

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☐ Check enclosed. ☐ Ship one WVG MK. II @ $15.95 Postpaid.

Name__________
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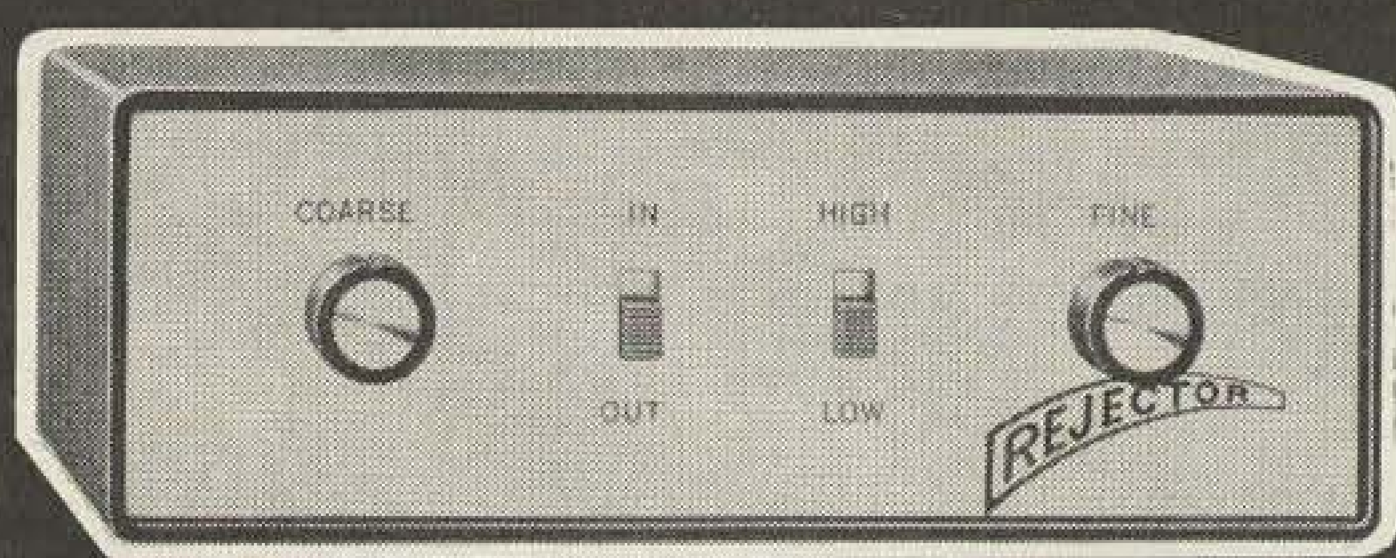
City__________
State__________

NOW! IMPROVE YOUR RECEIVER— TRANSCEIVER RECEPTION



"REJECTOR" *TUNABLE* NOTCH FILTER *

ONLY $34.95

*Patent applied for

THE REJECTOR TUNABLE NOTCH FILTER WILL GREATLY IMPROVE RECEPTION ON ANY RECEIVER OR TRANSCEIVER—HAM/CB/SW

■ No insertion loss. ■ Audio filter with tunable range 300 to 4000 cycles. ■ Fully transistorized. ■ Ideal for CW-RTTY-SSB AM-SWL. ■ Simply connects between receiver or transceiver audio output and P.M. speaker. Apply 12V. ac/dc (½A) Size—7½″ x5⅜″x 2½″. Opt'l AC Supply—**$6.95.**

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Please rush me
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☐ Opt'l AC Power Supply—$6.95.
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City__________ State__________ Zip__________

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CAN BEAT OUR
ANNIVERSARY
SPECTACULAR TRANSCEIVER SPECIAL

MOBILE GALAXY V

POSITIVELY THE BEST TRANSCEIVER BUY EVER OFFERED THE AMATEUR....

REGULARLY PRICED AT **$469.95**

***NOW JUST* $399.95** SAVE **$70.00**

USE WRL'S CHARG-A-PLAN — JUST $20 MONTHLY

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

Don't Forget . . . We're still offering you a **2 WEEK FREE TRIAL*** plus you can use our *NO DOWN PAYMENT CHARG-A-PLAN.*

We'll also allow you *WRL'S TOP TRADE-INS* on your present gear.

YOU JUST CAN'T GO WRONG! TAKE ADVANTAGE OF THIS SPECIAL OFFER TODAY!

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REGULAR **$119.95**
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SAVE $30.00

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SPECIAL PURPOSE VFO covers MARS, CAP etc. . . . $89.95 write for details

GALAXY V & DC P.S.
MOBILE STATION **$489.90**
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3415 West Broadway
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WØGFQ
PRESIDENT

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- ☐ Send quote on gear on attached sheet.
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- ☐ Send catalog and Reconditioned Listing.
- ☐ Ship "Mobile Pkg. V" — $489.90.

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Address____________________________

City____________ State______ Zip______

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 ± 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.

37 Washington Street, Melrose, Massachusetts, 02176 World Wide Export Sales: Auriema International Group, 85 Broad Street, New York City, N. Y.; Canada Tri-Tel Associates, 81 Sheppard Ave. W., Willowdale, Ontario