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September 1965
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For over 30 years UTC has been the leader in advancing the art and technology of iron core inductance devices . . . The Linear Standard (LS type) units are the highest quality, non-hermetic, high fidelity transformers of their type. This series includes transformers designed for tube, transistor, hybrid, modulation and matching applications.

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IMMEDIATE DELIVERY
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LINEAR STANDARD
HIGH SHIELDING
DIE CAST CASES
TOP & BOTTOM MTG.

LS-1 CASE

Length	3⅛"
Width	2⅝"
Height	3¼"
Mounting	1$\frac{13}{16}$ x 2$\frac{7}{16}$"
Screws	6-32
Cutout	1⅞" dia.
Unit Weight	3 lbs.

LS SERIES

TRANSFORMER TYPES	Pri. Range Ω	Sec. Range Ω	Freq. Range ±1 db	Max. Level Range
Low Imped. to Grid and Mixing and Matching	2.5 to 5,000	50 to 120,000	7 ∿ to 50 KC	+ 15 dbm to + 23 dbm
Interstage and Driver	5,000 to 30,000	50,000 to 135,000	10 ∿ to 20 KC	100 mw to 40 W
Hybrid and Repeat Coils	150 to 600	150 to 600	20 ∿ to 40 KC	+ 15 dbm to + 18 dbm
Plate, Crystal, Photocell, and Bridging to Line	4,000 to 30,000	50 to 600	7 ∿ to 50 KC	200 mw to 400 mw
High Level Matching	50 to 600	1.2 to 600	10 ∿ to 40 KC	20 W to 40 W
Output to Line and Voice Coil	8 to 10K	500 to 1.2	7 ∿ to 50 KC	20 W to 60 W
Modulation	3K to 10.4K	6000 to 1.2	10 ∿ to 50 KC	20 W to 2500 W

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73 Magazine

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ditor & Publisher

aul Franson WA1CCH
ssistant Editor

eptember, 1965

'ol. XXXV, 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 Bristol, Conn., U.S.A. Entire contents copyright 1965 by 73, Inc. Postmasters, please send form 3579 to Good Old 73 Magazine, Peterborough, New Hampshire. Use your Zip Zone and save our shirt.

de W2NSD/1

never say die

Brand X Raises Price

The July issue of CQ came out so late I didn't have it before our August issue went to press so I could good naturedly rib them about their last-ditch-desperate-when-all-else-fails move of increasing the price of the magazine. Actually August would have been a difficult time to make any sarcastic remarks because we raised the cover price of 73 to 50¢ that month ourselves. We raised the newsstand price to 50¢ a couple years back, but had kept the price at radio distributors at 40¢ since that worked out fine for us. Then our printer sent a truckload of 40¢ copies up to our Canadian newsstand distributor by mistake and that made an awful mess. I figured it was about time to stop the nonsense and make all the copies 50¢ and be done with it.

CQ might do better if they invested in a smart publisher who kept costs down instead of pleading helplessness over the rising costs of paper, printing, postage, labor, taxes, engravings and general overhead. Baloney. If there is any rise in the costs of paper I haven't seen it. We're using a lot better stock than either of the other magazines and we have managed to cut our paper costs almost yearly by shrewd shopping around. By working with printers that are set up to handle our magazine we have been able to cut our printing costs considerably and we are now planning on running 128 pages per month most of the time in the future as a result of our recent change to a printer better able to handle the larger run our increased circulation has made necessary.

Postage has been going up, I'll grant, but the increase has been miniscule. Taxes? Only when you are making a profit, fellows. No profit, no taxes, so where is the problem? We are paying the same for our engravings that we paid five years ago and there is no hint of any increase . . . and if an increase does come along I believe that we can find a half dozen engravers to work at our present price. Labor? Sure, if I had a bunch of high priced dunderheads sitting around here on permanent vacation or out on a 56 foot yacht on Long Island Sound paid for by the magazine I would cry about labor costs too.

Perhaps I should increase our cover price to 75¢ and out-yacht CQ . . . hi. Shucks, at the rate things are going around here I could add a small plane to that.

HQ Instructions

Here I go, picking on ARRL again. This time I just want to pass along some information sent in by an SCM who has been rather frustrated in trying to report the reactions to "incentive licensing" in his area to his Division Director and ARRL HQ. The answer he received from his Director was that he wasn't supposed to get advice from the members, just bring them into line. Get into line fellows, and do as you are told.

IARC Convention in Geneva

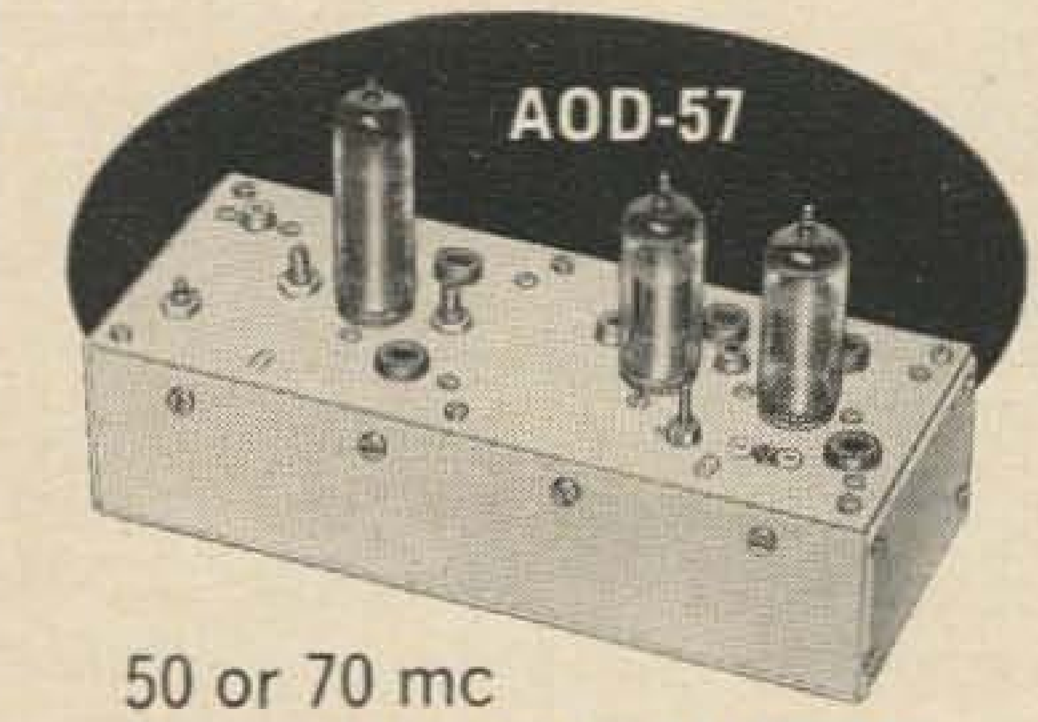
The International Amateur Radio Club, an organization formed primarily to demonstrate amateur radio to delegates attending ITU meetings, has announced that it will have a convention on September 18th and 19th at Geneva. This is an excellent time of the year and a good excuse to get over to Europe . . . particularly to Switzerland. In addition to the usual technical papers, meetings with well known DX amateurs, and general confab, you will have an opportunity to operate the six ham stations which will be on the air around the clock for the two days on all bands as 4U1ITU through 4U6ITU. If you haven't tried DX operating here is a chance with the tops in gear and a great location.

Drop a line to IARC, Box 6, 1112 Geneva 20, Switzerland for more info.

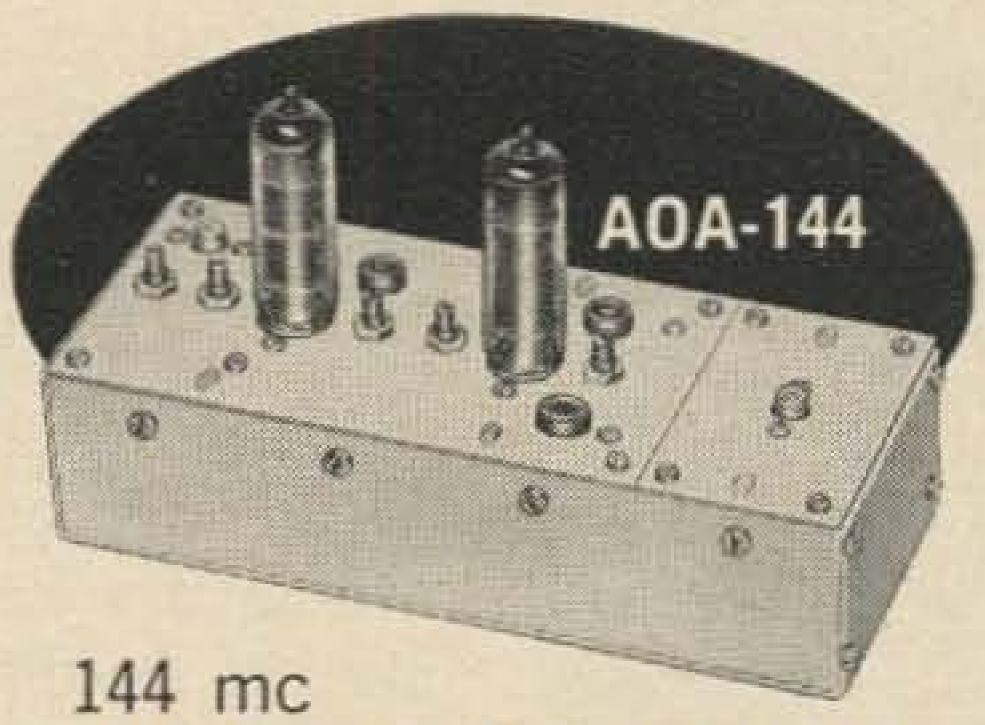
NEW FROM INTERNATIONAL

VHF/UHF UNITIZED TRANSMITTERS 50 mc – 420 mc

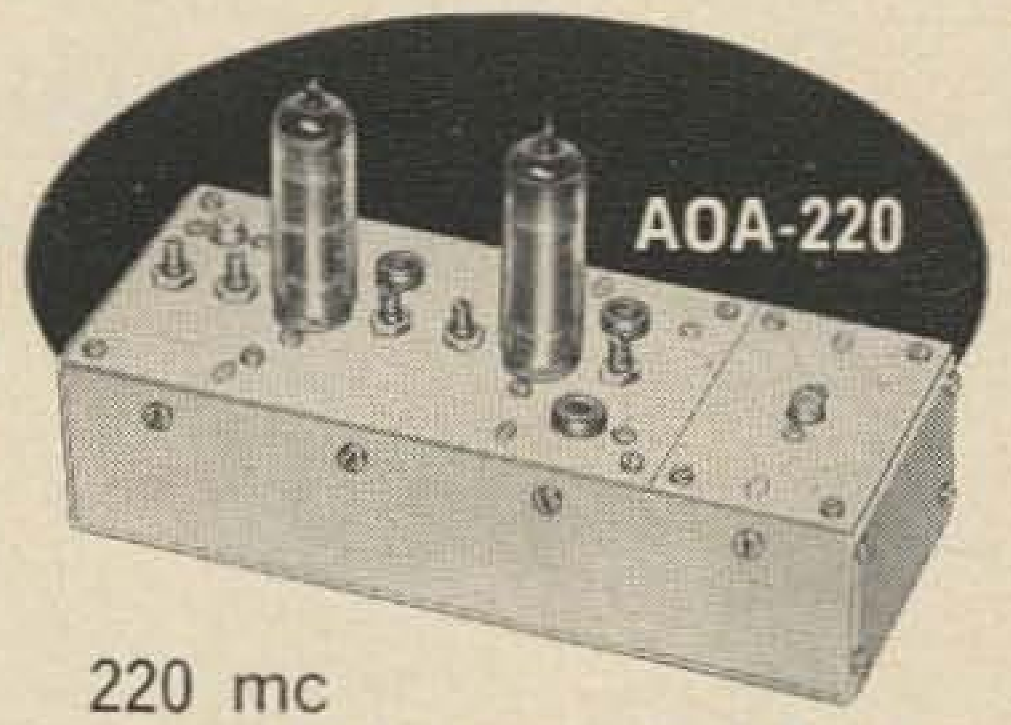
International's new unitized VHF/UHF transmitters make it extremely easy to get on the air in the 50-420 mc range with a solid signal. Start with the basic 50 or 70 mc driver. For higher frequencies add a multiplier-amplifier. All units are completely wired. Plug-in cables are used to interconnect the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



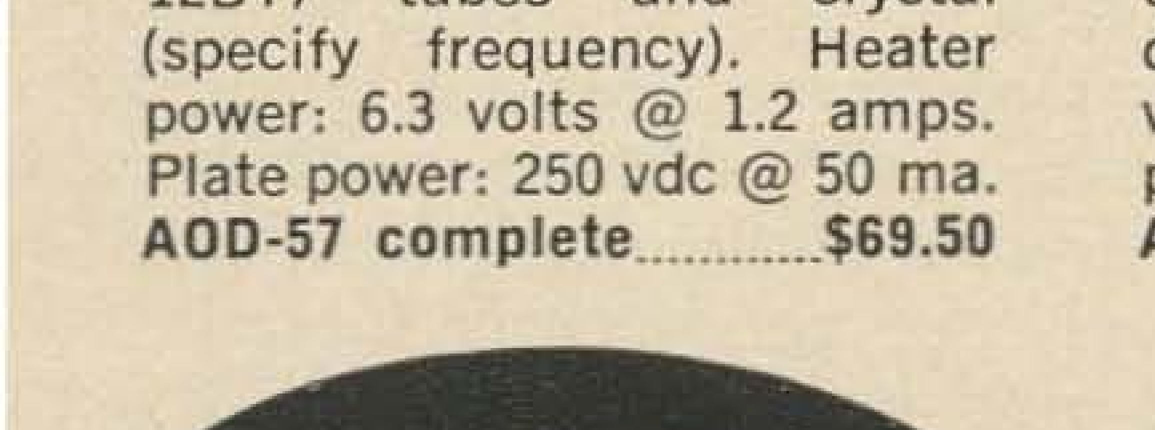
50 or 70 mc
DRIVER/TRANSMITTER
The AOD-57 completely wired with one 6360 tube, two 12BY7 tubes and crystal (specify frequency). Heater power: 6.3 volts @ 1.2 amps. Plate power: 250 vdc @ 50 ma.
AOD-57 complete $69.50



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

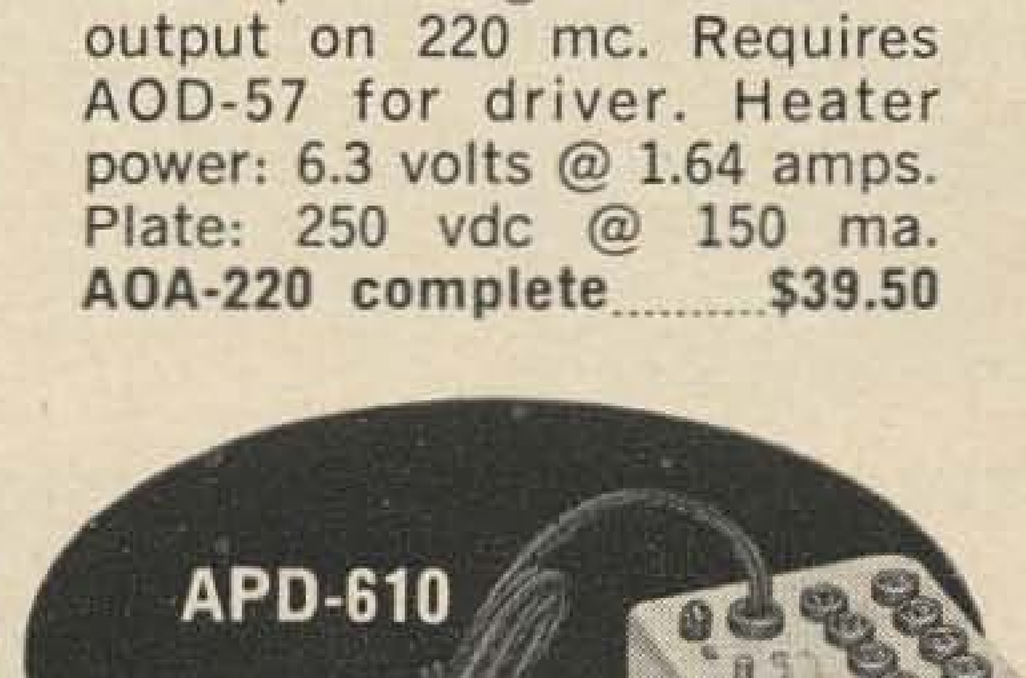


220 mc
MULTIPLIER/AMPLIFIER
The AOA-220 uses two 6360 tubes providing 6 to 8 watts output on 220 mc. Requires AOD-57 for driver. Heater power: 6.3 volts @ 1.64 amps. Plate: 250 vdc @ 150 ma.
AOA-220 complete $39.50



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

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

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

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Say You Saw It

A good friend of 73 who works for a major ham manufacturer points out that all too many of you who send for information on new products don't give credit to 73 in your letter or card. While I do hope that you'll always mention 73 when you write for literature, it seems to me that it might just be fun to credit 73 no matter where you saw the ad . . . I can just see them trying to find their ad in an issue of 73 after a dozen or so amateurs write in saying they are answering their ad in 73. Heh.

Station Operator Jazz

The recent FCC decision that the operator of an amateur station must use his own call unless the licensee is in actual control of the station as discussed in my February editorial will have an interesting effect on some of our DX hunters. From now on they will have to be on hand to work their own DX and not be able to depend upon a friend to come in and hook a rare one when he is away. Even worse, fellows on DXpeditions won't be able to work their own station and they'll end up being the only one not working the rare one. This could put quite a crimp in DXpeditions.

Many of us are watching QST with interest to see how long the ARRL general manager is going to wait before telling the members about the new interpretation of the rules.

IQ Test

Here's a little IQ test which takes less than a minute. First, read the following sentence,

FINISHED FILES ARE THE RESULTS OF YEARS OF SCIENTIFIC STUDY COMBINED WITH THE EXPERIENCE OF YEARS.

Now count the number of "F" 's in the sentence. Count them out loud. Count them only once, then check your answer at the bottom of this page.

New Trophy

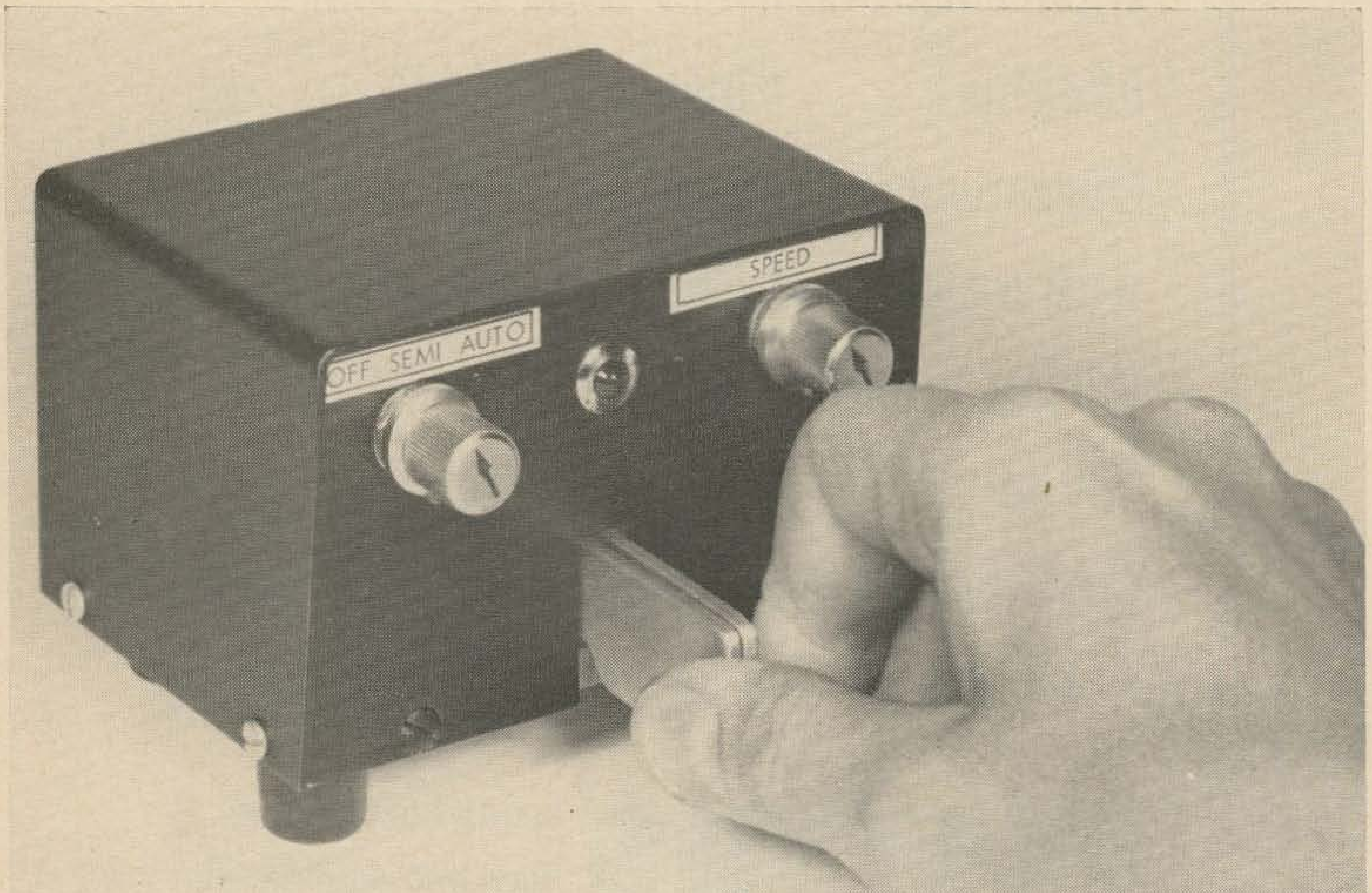
Nominations are now in order for a brand new amateur radio award, the Benedict Arnold Trophy. This handsome trophy will be awarded whenever needed to those amateurs who have placed self-interest sufficiently far enough ahead of the common good to attract national interest in their shame.

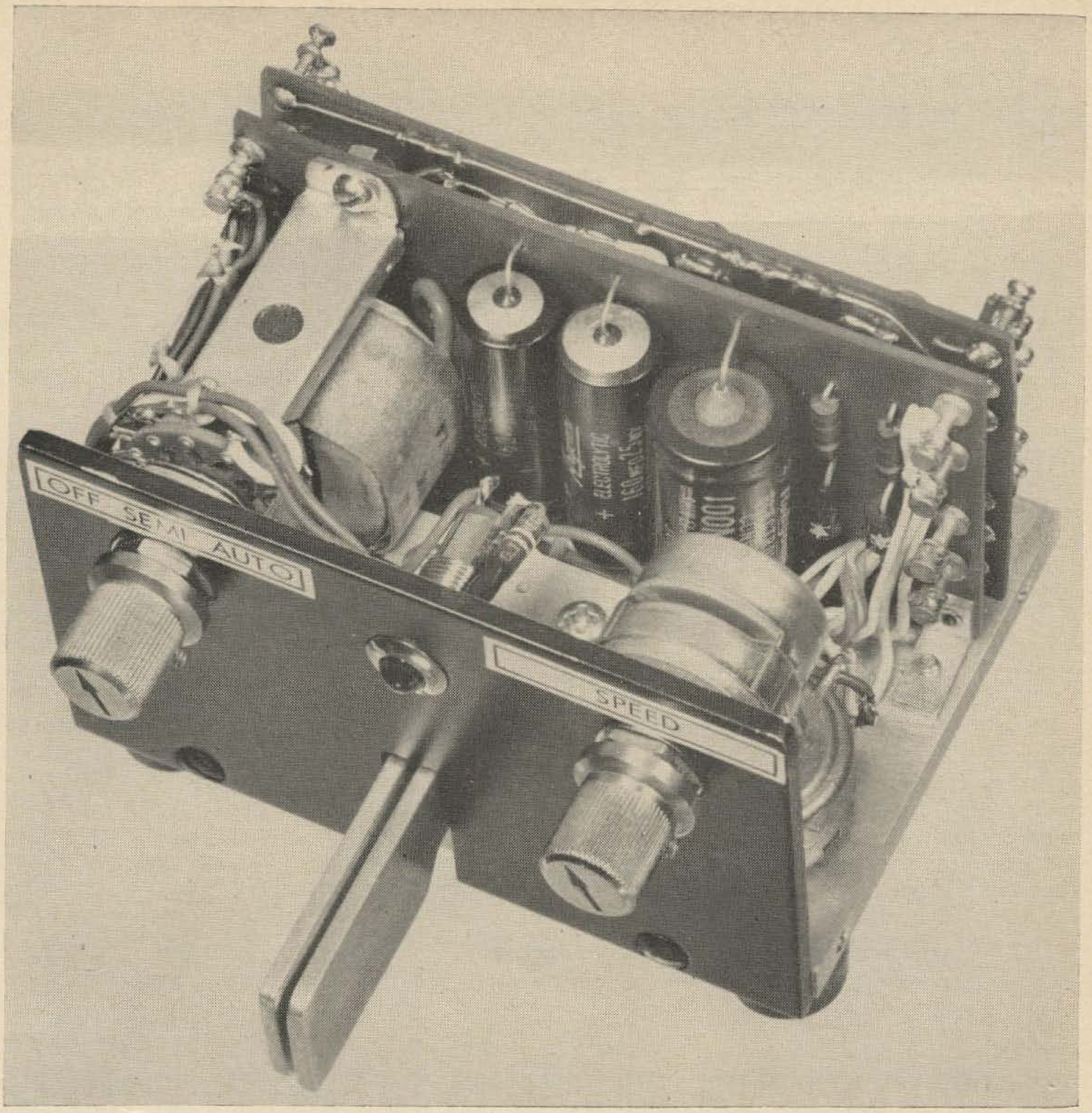
IQ test answer. There are six F's in the sentence. The average reader finds three; above average four. Welcome to the dunce club?

. . . Wayne

E. L. Klein W4UHN/WB2PKE
2501 Chestnut Lane
Riverton, New Jersey

Der Kleiner Keyer





Have you ever wished you had a CW keyer that would automatically make perfect dots and dashes? Here is your opportunity to make just such a keyer, using modern digital computer transistor circuits. Capable of speeds from 10 to 50 words per minute, Der Kleiner Keyer automatically generates dots and spaces which are of identical duration; and dashes which are exactly as long as three dots. And how is all this magic performed?

An explanation of the switching logic

To achieve an undertsanding of just how our transistors function to produce this precise spacing and timing, let us refer to the Logic Diagram of the Keyer, **Fig. 1** and the pulse diagram in **Fig. 2.**

Basic circuits in the Keyer are the *multivibrator, flip flop* and *nor gate*. Added to these are three additional switching or amplifying stages whose only purpose is to obtain isolation and current gain and may therefore be temporarily disregarded for the sake of our explanation.

When the keyer mechanism is moved to the dot position, negative six volts on the base of transistor Q3 causes the multivibrator to turn on, producing a series of positive-going pulses as long as the key is closed. This negative voltage also inhibits the flip flop preventing its operation, so that only dots are present at the driver transistor Q6 and output switching transistor, Q7. Further, once a dot pulse has been initiated and is present at the output of Q6, it is fed back to the base of Q3 and en-

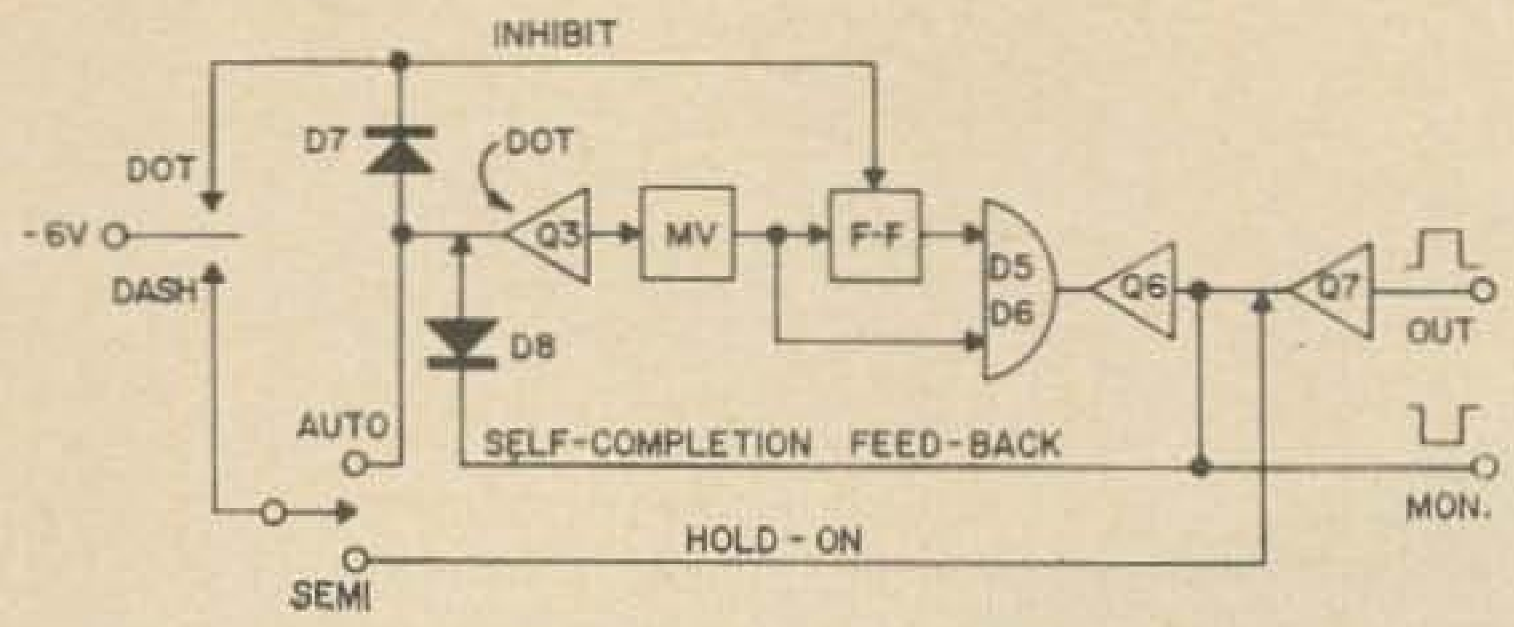


Fig. 1. Logic diagram of Der Kleiner Keyer.

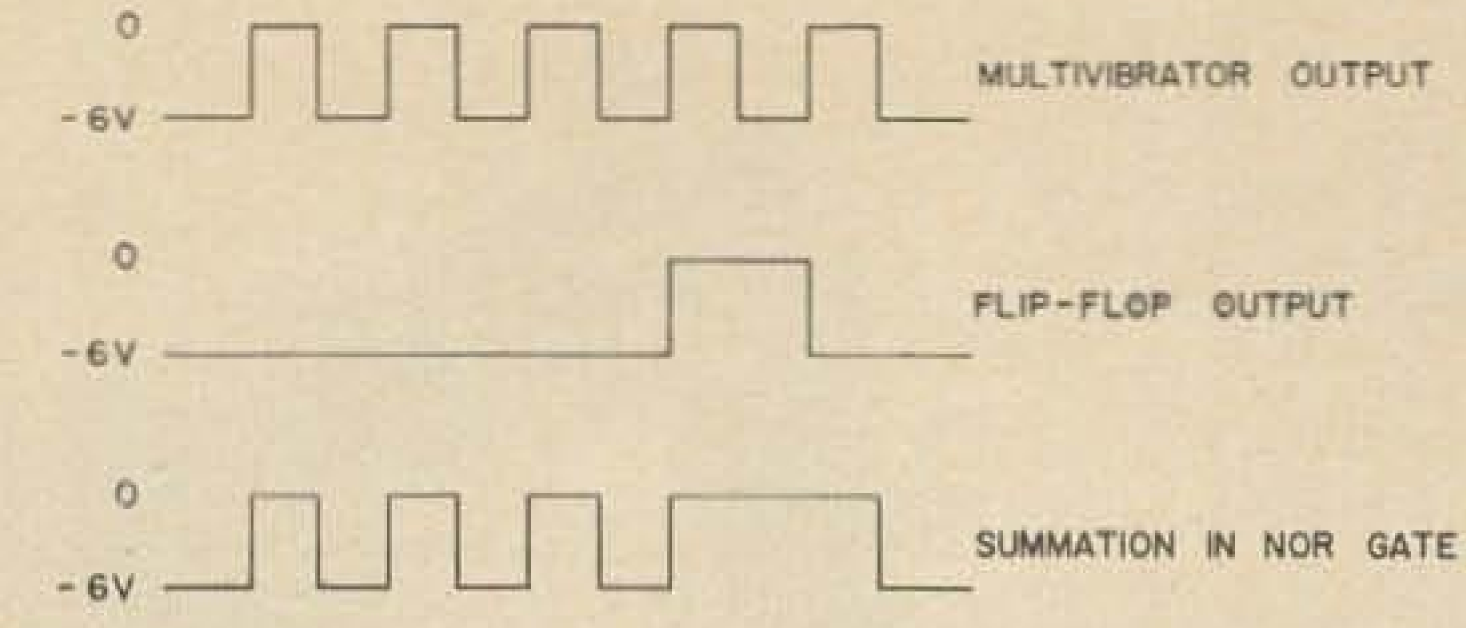


Fig. 2. Digital logic in producing the letter "V".

sures completion of the individual pulse. Operator error is thereby corrected to some extent.

Now, if the keyer mechanism is moved to the dash side, and we are operating in the semi-automatic mode, we find the negative six volts impressed directly on the base of Q7, causing it to be held on so long as the key is down. In this mode, our keyer is like a bug" which is in fact a semi-automatic keyer.

In the automatic mode, the negative six volts is again present at the base of Q3 causing it to turn on the multivibrator. Now, however, the negative inhibit voltage is not present at the flip flop due to its being blocked by the dot diode, D7.

Being thus uninhibited and having the characteristic of being triggered alternately on and off by succeeding positive going pulses only, we find that our flip flop will actually count. In other words, the flip flop produces one positive pulse for every two positive dot pulses. The digital logic diagram, **Fig. 2** illustrates this relationship. Going one step further, we may add these positive pulses from the multivibrator and flip flop by the use of the nor gate, diodes D5 and D6.

Thus we find that the output of the nor gate provides a dash exactly three times as long in duration as a dot. What could be more convenient in the design of our keyer?

A quick look at the circuit

Fig. 3 is the complete circuit for the keyer including power supply. The principal components described in the foregoing switching logic discussion may be readily identified. The 150k bias resistors connected to the base of each transistor provide an adequate positive voltage which effectively cuts-off the PNP type transistors. Due to the much higher resistance of this bias resistor than that of the respective coupling resistor or diode, any negative pulses will take precedence at the base of the tran-

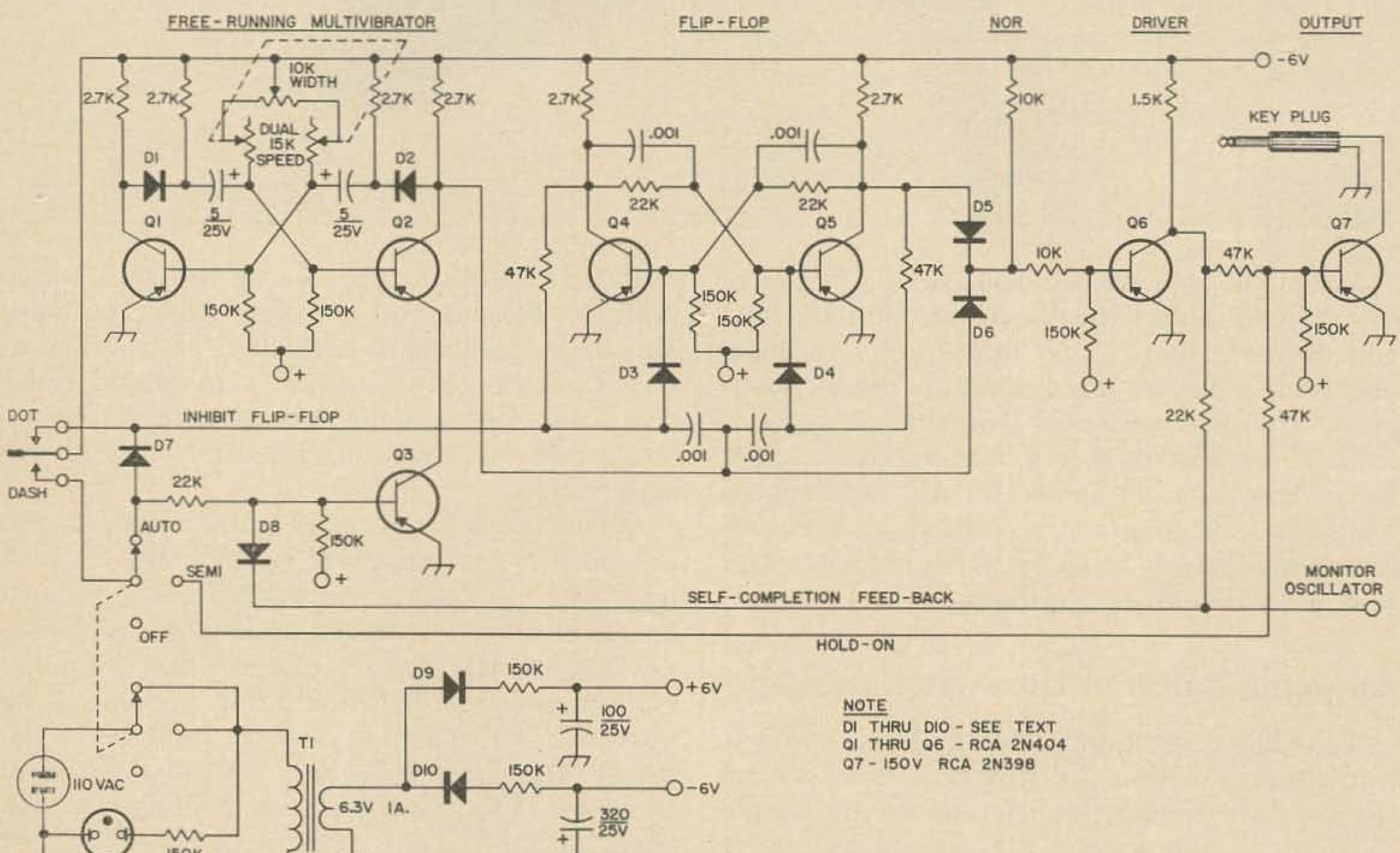


Fig. 3. Schematic diagram of Der Keyer.

sistor and cause the transistor to conduct.

The ratio of dot spacing to duration is set by the 10k potentiometer in the negative supply to the multivibrator. This control is adjusted only once, preferably by aid of an oscilloscope and need not again be adjusted.

Keying speed is determined by the dual 15k potentiometers and the two 5 μf miniature electrolytic capacitors in the multivibrator. As has been shown earlier, only the dots need be controlled, because the dashes automatically are timed by the dots through the counting action of the flip flop and adding action of the nor gate. The value of timing potentiometers and capacitors may be changed within reason remembering the relationship, T = RC. A nonlinear dual potentiometer such as one having an audio taper should not be used because it will tend to crowd the faster speeds making difficult adjustment.

Inexpensive components throughout

All transistors used in the keyer except the output transistor, are inexpensive general purpose audio transistors or surplus computer switching units. The RCA 2N404 is excellent for this purpose, and currently sells for only 35¢. The output transistor is an RCA 2N398B. Although the A" suffix or no suffix at all may be used, we find that for only an additional 20¢, our emitter to collector voltage can be increased by 50% to 150 volts. This safety margin is completely worthwhile when using a nominal minus 100 volt transmitter bias supply. If transistors of dubious genesis are used in the keyer, a little care in matching up their forward and reverse resistance will prove valuable. Of course, a beta checker is desirable, but a simple check on an ohmeter will go far in keeping you from wishing you had used sockets for your questionable transistors.

It is essential that good quality silicon diodes be used. These are quite readily available in bargain packages of 10 for 88¢. Be sure you do not install the diodes with mechanical

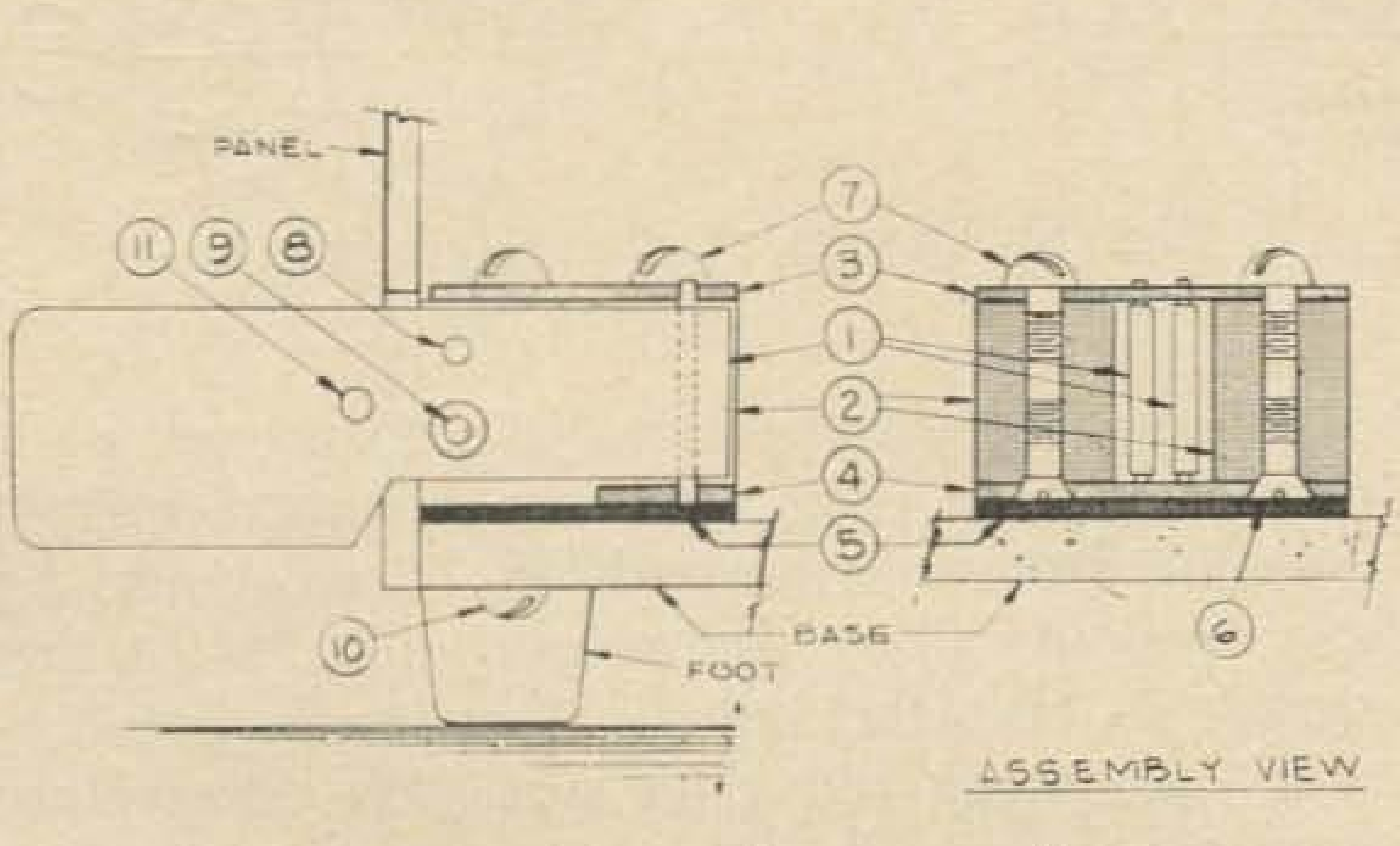
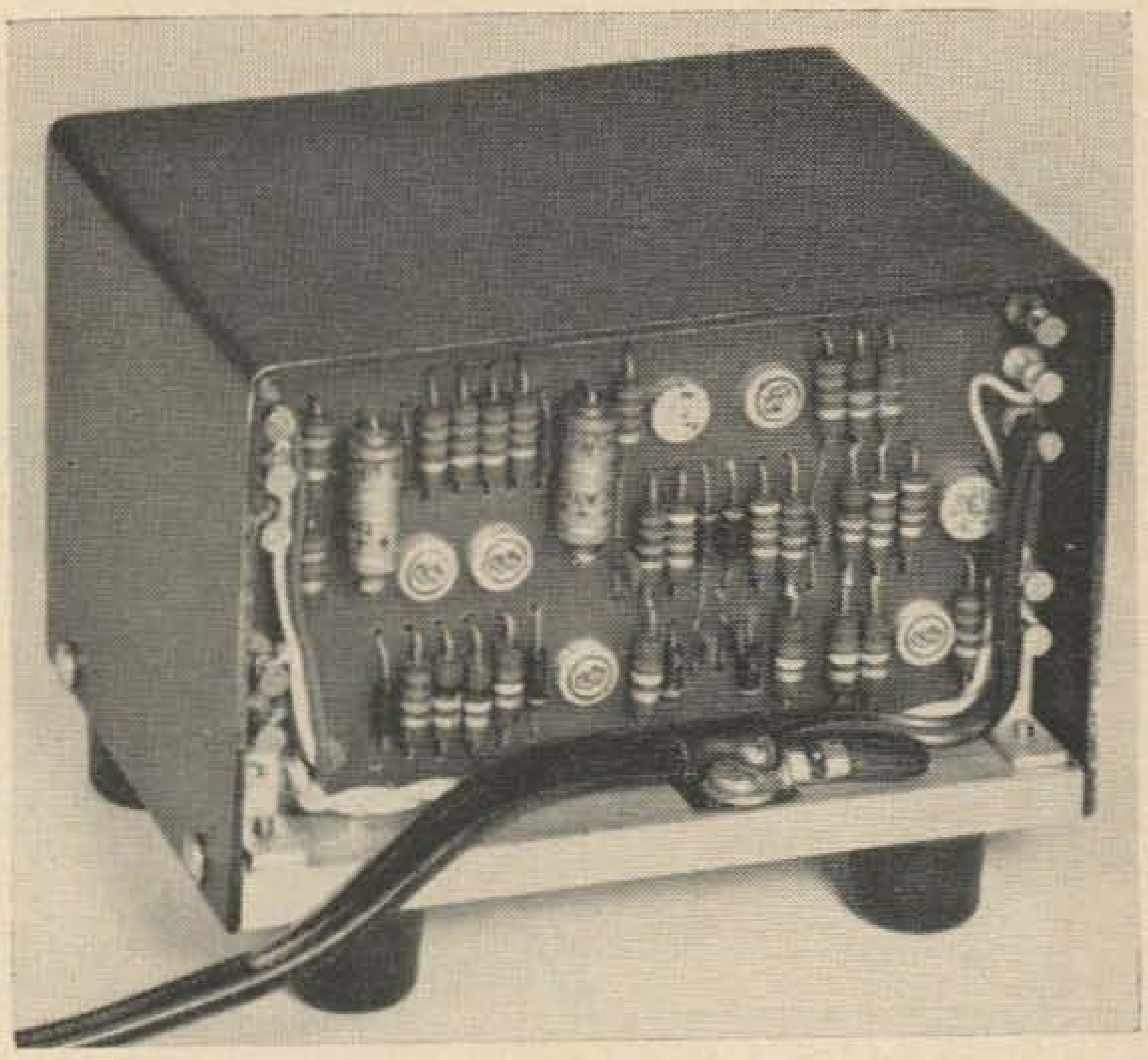


Fig. 4. Assembly of keyer mechanism.



stresses in their leads, and do heat sink them when soldering, in keeping with good semiconductor practice.

Transformer T1 is an inexpensive (75¢) miniature 6.3 volt filament transformer. Taking the plus and minus six volts from the same transformer winding results in a somewhat higher plus voltage (6.3V. × 1.4 = 8.8V.) because of its very low load. This, however, has not been found to be objectionable at all due to the relatively high value of bias resistance.

The rectifier diodes, D9 and D10 may be just about any type power diode. Those used in the author's keyer were the two for 49¢ variety, even though they carried a rating of 750 ma. at 600 PIV. Filtering of the keyer power supply is not at all critical so long as the hum amplitude is less than 20% that of the signal amplitude. Even with such a low impedance source, 100 to 500 μf is entirely adequate.

Easy-to-make keyer mechanism

Fig. 4 shows a side and front cross section of the keyer mechanism. The accompanying parts list and detail drawings in **Fig. 5a** through **5e** should be quite easy to follow. A number of different automatic keyer mechanisms are on the market today, but perhaps none is quite so easy for non-professional construction as the mechanism illustrated here. Accurate hole placement and squareness of corners are to be desired, but may be compensated for in final assembly, to some extent. It is important, however, that the paddle hinge pins fit quite snugly to provide a good electrical contact not only with the paddle but also with the top and bottom pieces, items 3 and 4.

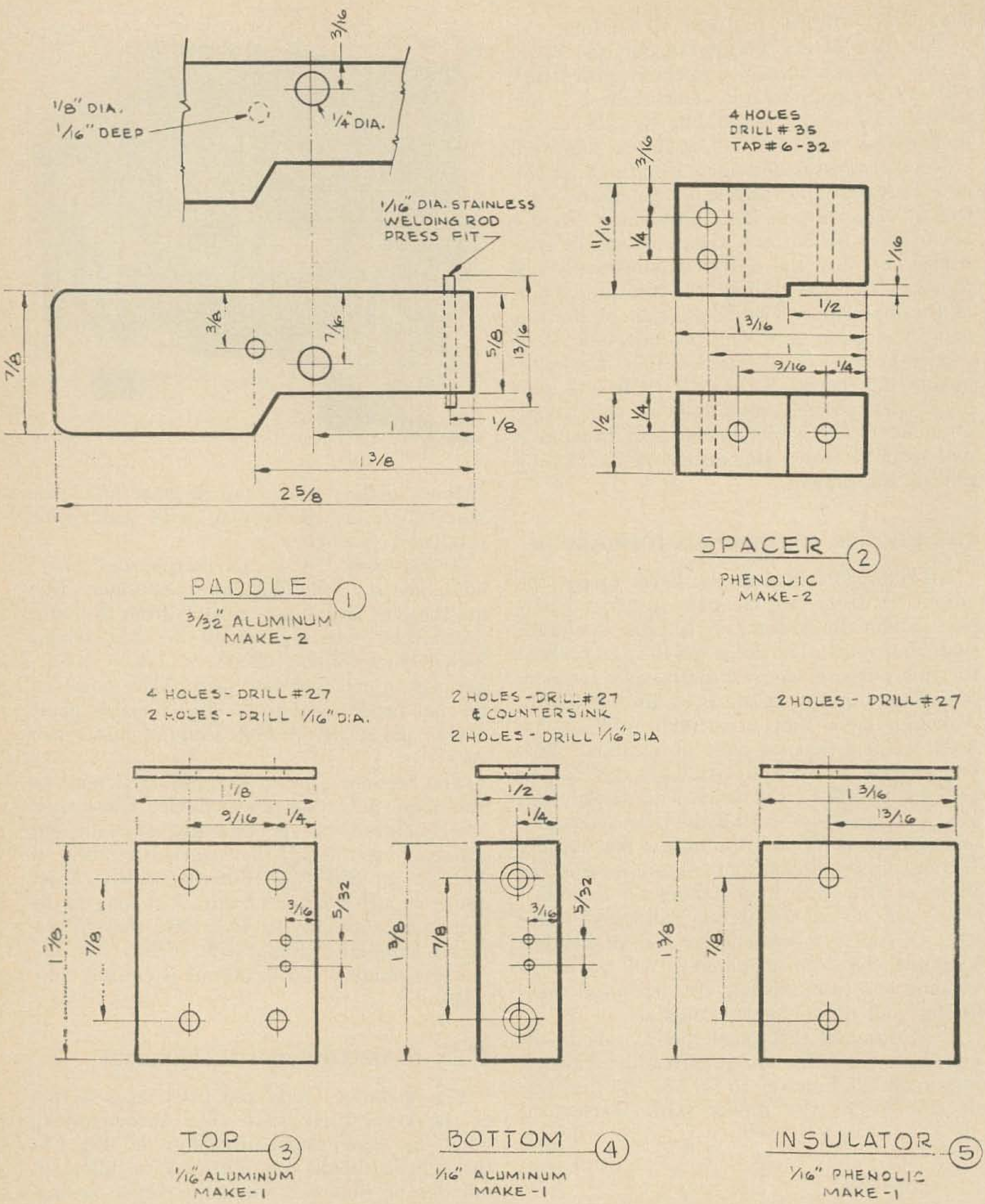


Fig. 5. Details of the keyer mechanism.

One unique feature of this keyer mechanism is the alternate placement of the back-stop adjusting screws, item 8, and the contact screws, item 9. The latter pass through a one-quarter inch clearance hole in one paddle in order to contact the other paddle. Once set, the four screws wil not need further adjustment to suit individual taste as is frequently practiced with a "bug."

The spring which serves to return each paddle after being depressed is a common spring, item 11, between the paddles. Care should be exercised in drilling the retention holes for this spring so that the hole is deep enough to retain the spring but does not pass completely through the paddle.

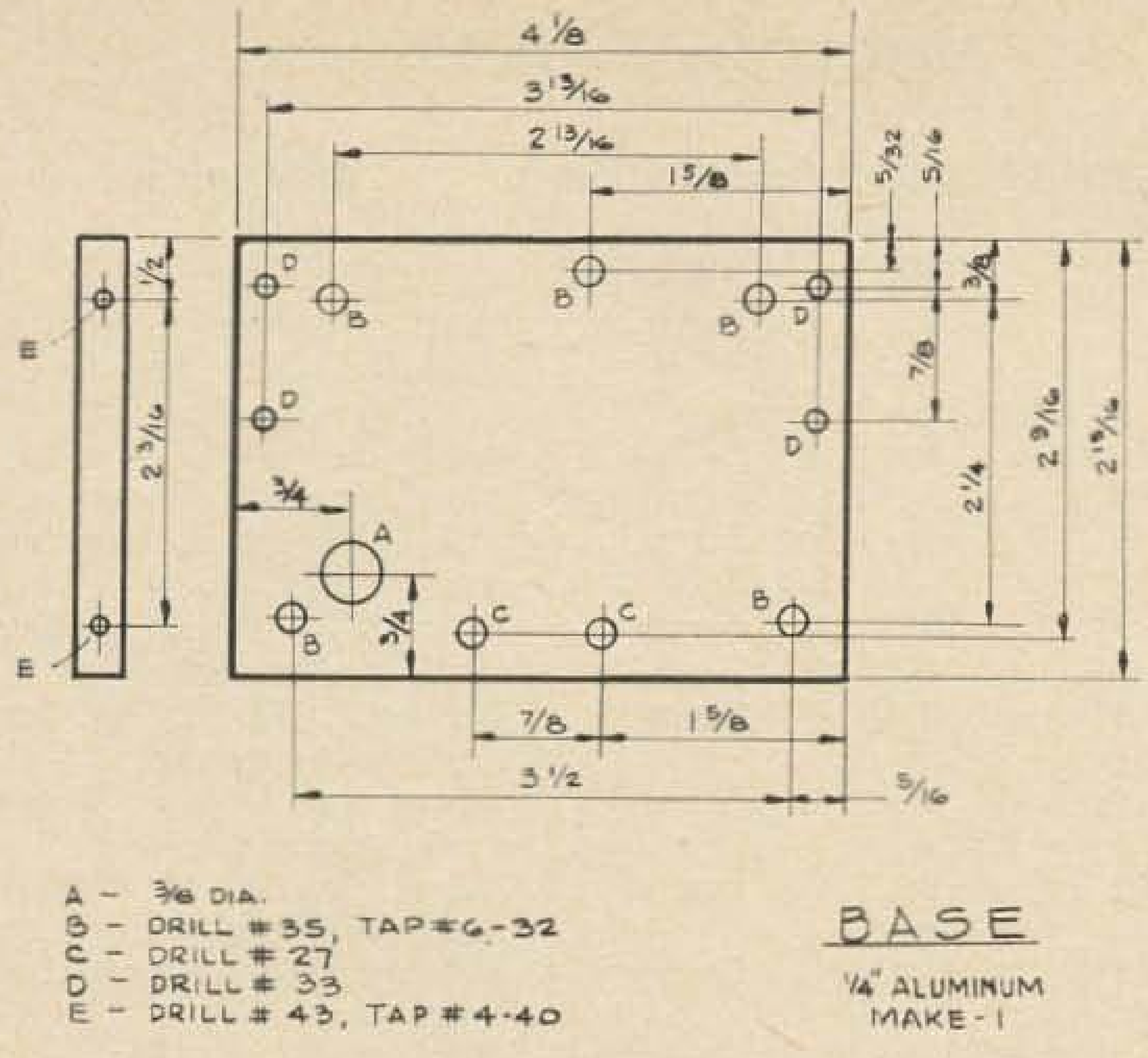
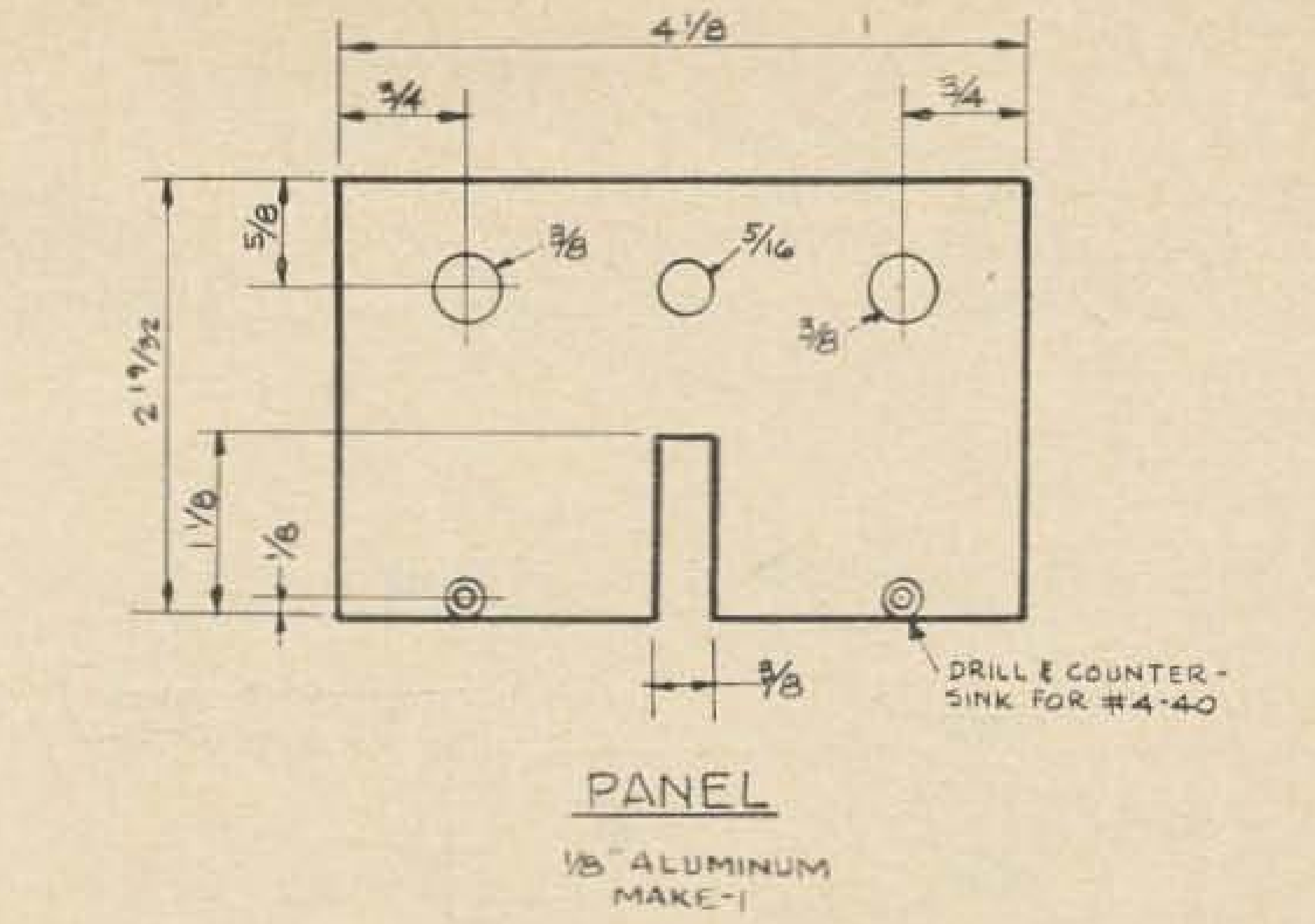
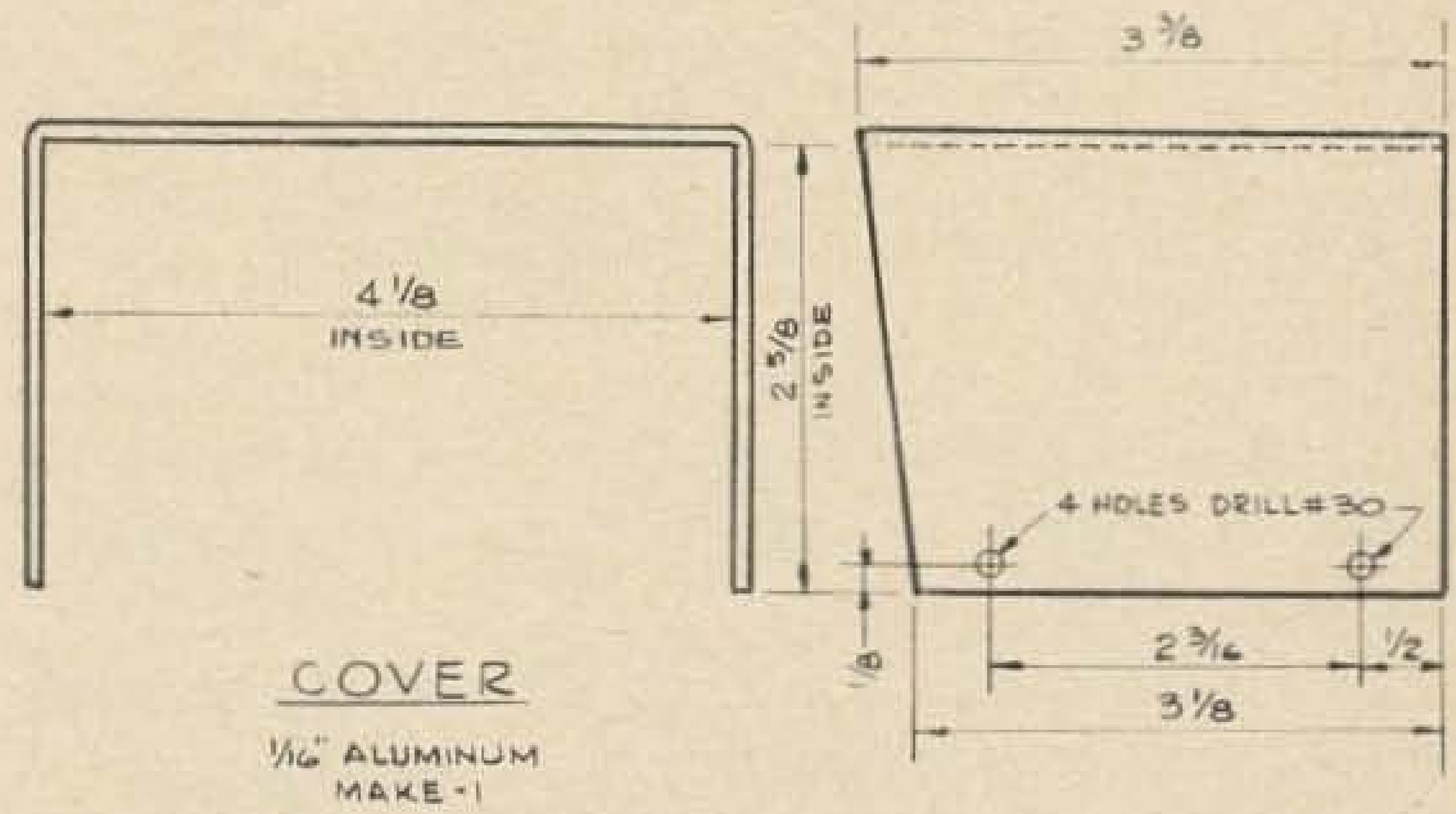


Fig. 6. Base; Fig. 7. Panel; Fig. 8. Cover.





Construction of the case

These parts are fabricated in accordance with **Figs. 6, 7** and **8.** A relatively soft aluminum is used for the cover allowing it to be readily bent between two pieces of wood in an ordinary vise. The base need not be ¼ inch thick although the weight and low center of gravity is helpful in preventing a "creeping-key." Indeed, the base may be made of brass or steel to further weight it down.

After all drilling, taping and deburring is completed, all aluminum parts should be thoroughly sanded with 000 sand paper to produce a uniform unidirectional scratch pattern. Some constructors may prefer to remove the scratches and impart a homogeneous satin finish to the aluminum. This can be done by bathing the parts in a glass bowl containing warm water and "Drano." Do not breathe the fumes and handle the parts only with rubber gloves or wooden sticks.

The front panel and cover are given two or three coats of flat black enamel from an aerosol can. A more durable finish can be achieved by baking the paint in the kitchen oven for about 20 minutes at 200 degrees.

Simple circuit boards

While it is desirable and quite gratifying to construct the circuit boards using printed circuit techniques, it is not at all essential. The method used by the author and illustrated in the photographs is quite satisfactory. The component leads are inserted through pre-drilled holes and bent over on the reverse side. In most instances, the leads are of sufficient length to reach their destination and be soldered in place. Twisting of the leads prior to soldering is not desired. Some rather long runs as well as the occasional cross-over leads should be insulated with spaghetti.

Figs. 9 and **10** show the power supply and digital boards respectively. One-sixteenth inch phenolic is used, either of the plain or perforated variety. The boards each measure 2¼ inches by 4 inches and are fitted with ½ inch angle aluminum feet cut from a strip of storm door stop. These feet should be tapped to re-

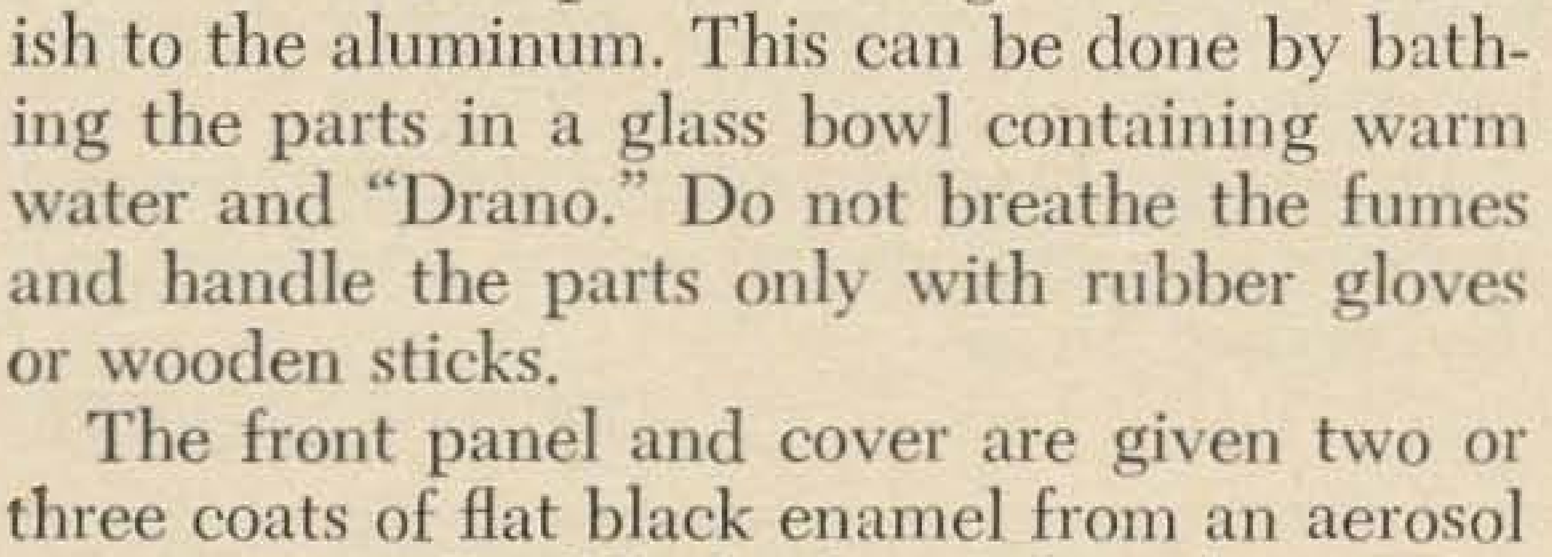


Fig. 9. Power supply board.

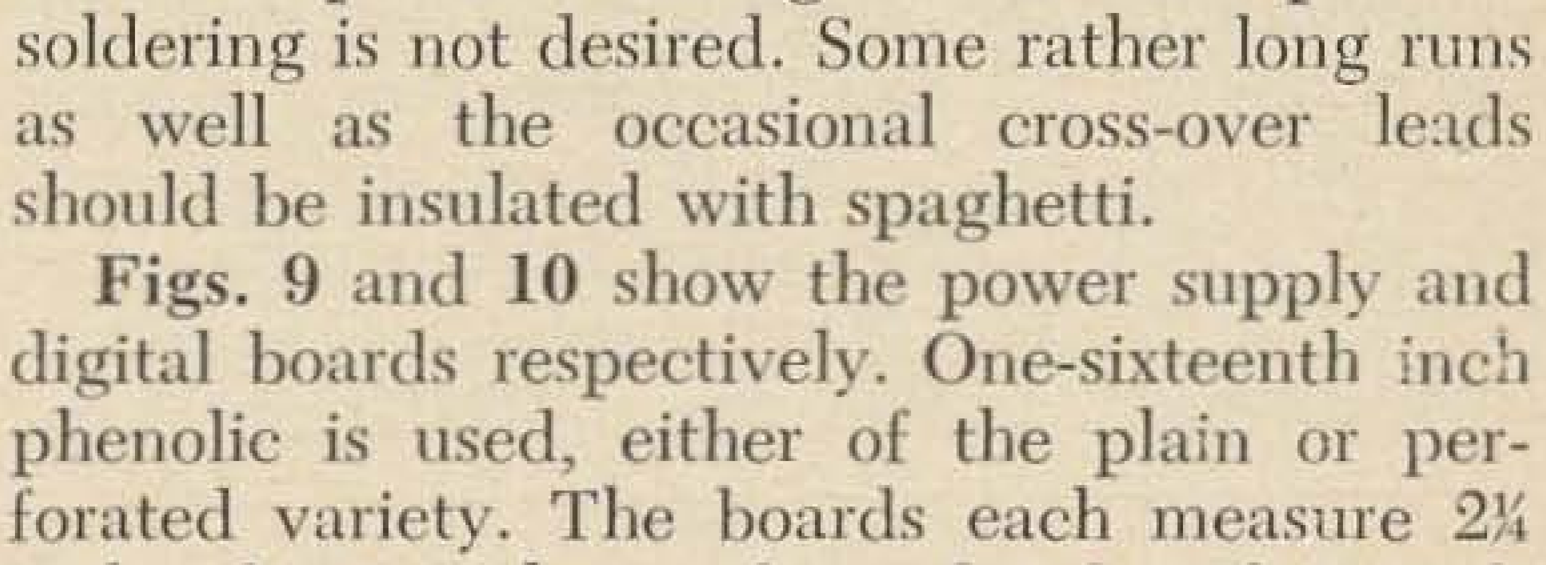


Fig. 10. Component board.

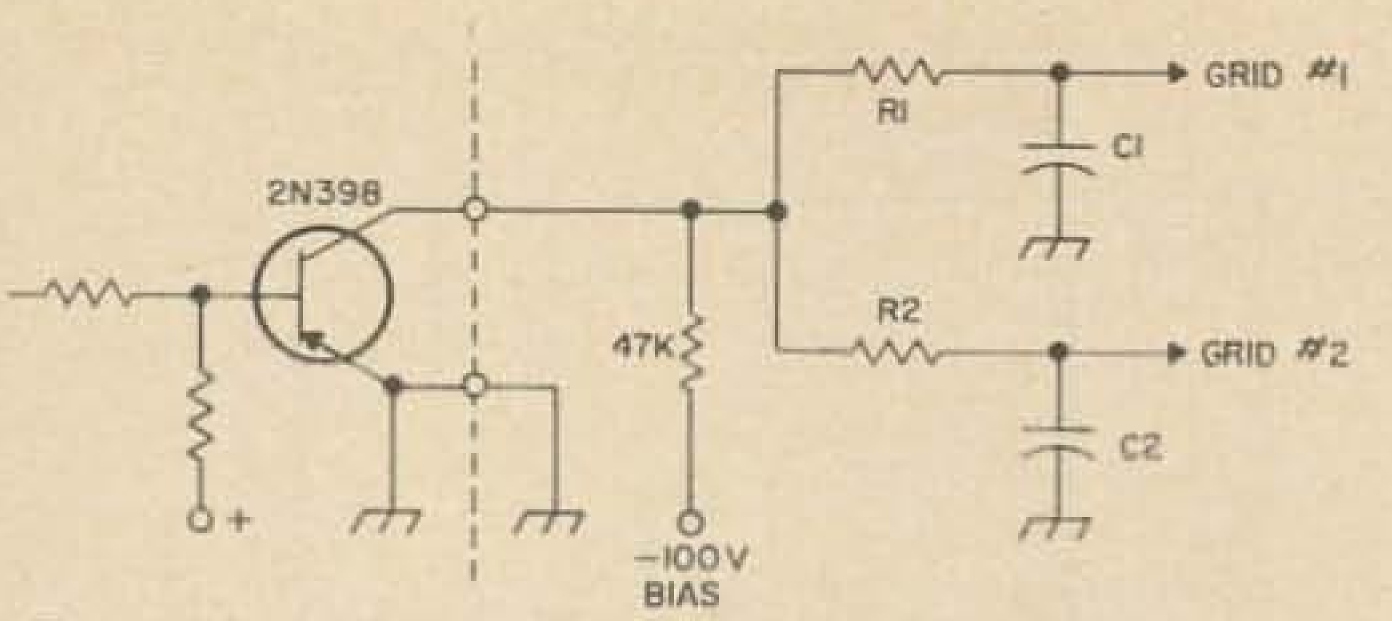


Fig. 11a. Application to grid-block keying.

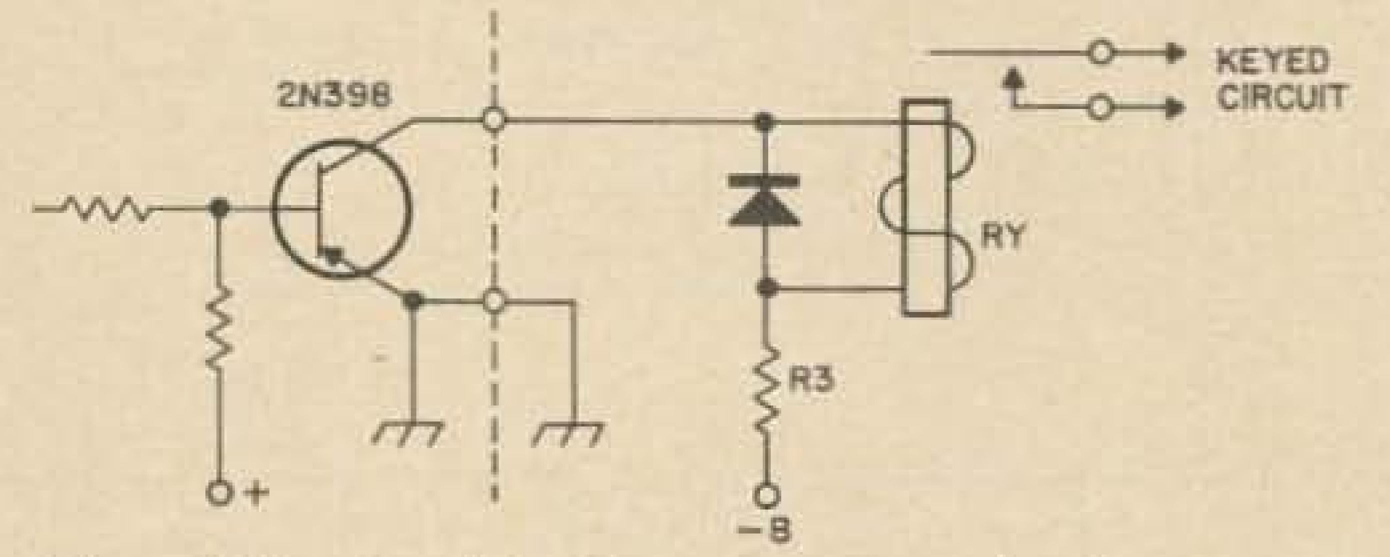


Fig. 11b. Application to relay keying.

Material for Keyer Mechanism

Item	Quantity	Description	Material
1	2	Paddle	3/32" aluminum
2	2	Spacer	Phenolic, cloth base
3	1	Top	1/16" aluminum
4	1	Bottom	1/16" aluminum
5	1	Insulator	1/16" phenolic, paper base
6	2	Screw	Flat head, #6-32, 1/4" lng. steel, nickle plated
7	4	Screw	Round head, #6-32, 1/4" lng. steel, nickle plated
8	2	Screw	No head, #6-32, 3/4" lng. steel, nickle plated
9	2	Screw	Round head, #6-32, 1" lng. steel, nickle plated
10	2	Screw	Round head, #6-32, 3/4" lng. steel, nickle plated
11	1	Spring	1/4" long section from ball point pen

NOTE: Brass may be substituted for aluminum in the above parts.

ceive #4-40 screws from the base and may be either screwed or riveted to the phenolic boards.

Part placement is not at all critical because of the very low frequency and impedance encountered in the keyer. A little lacing cord will go a long way in dressing up the wiring harness and enhancing reliability.

Keying the transmitter

Der Keyer may be employed in a wide number of ways in keying the transmitter. Two of the more popular methods; grid block keying and relay keying are shown in **Fig. 11a & b.** The 47k resistor is provided to limit current thru the 2N398 to a safe valve as well as to prevent overloading the bias supply. R1 and C1 determine the time constant for grid #1 and similarly, R2 and C2 control grid #2 for differential keying. The B minus supply and R3 are selected to suit the keying relay. Actually, the built-in 6 volt supply in the keyer could be used. In this case, a 2N404 could replace the 2N398. In any event, a back connected diode across the relay is desirable to prevent the collapsing relay magnetic field from damaging the output switching transistor.

One improvement which should prove invaluable, is a built-in monitor. This has been done since the pictures were made. A 3-transistor imported amplifier, phase-shift network and 2-inch speaker are all that are needed.

The proof of the paddling

Once an operator becomes accustomed to an automatic electronic keyer, he will be satisfied with none other. Fatigue is reduced and accuracy increased. Speed of sending is significantly increased; sometimes to the point where we can't receive so fast. In all, Der Kleiner Keyer is a very worthwhile project and a real honey to use.

Thanks to Dave Lyndon, WA2JGJ for his asssitance on the circuit and in checking out the finished keyer

... W4UHN/WB2KPE

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

LEFT: CSB100TR.
RIGHT: CSB125C

YES

SINGLE SIDEBAND SETS BY HAMMARLUND ARE EIGHT TIMES MORE EFFECTIVE.

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

IT WORKS

And how it works. Hammarlund's SSB sets free themselves of conventional **AM interference** because they use only half the frequency space. They **cut distortion** because they depend less on rigid relations between phase and amplitude. Talk is **more private** because Hammarlund SSB sets can't usually be picked up by home-style shortwave receivers.

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

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QRM on 432

It was like 20 meters on a busy afternoon. The moon lumbered into place, right on schedule, and Gordon casually picked up the mike, watched the clock, and at 1111 GMT he pushed the button and called a short CQ on 432.00 SSB. When he finished we turned on the receiver and were met with bedlam . . . CW, SSB, AM, all mixed together up and down the band. We tuned in amazement, listening to the dozens of signals, largely crowded around the low end of the band.

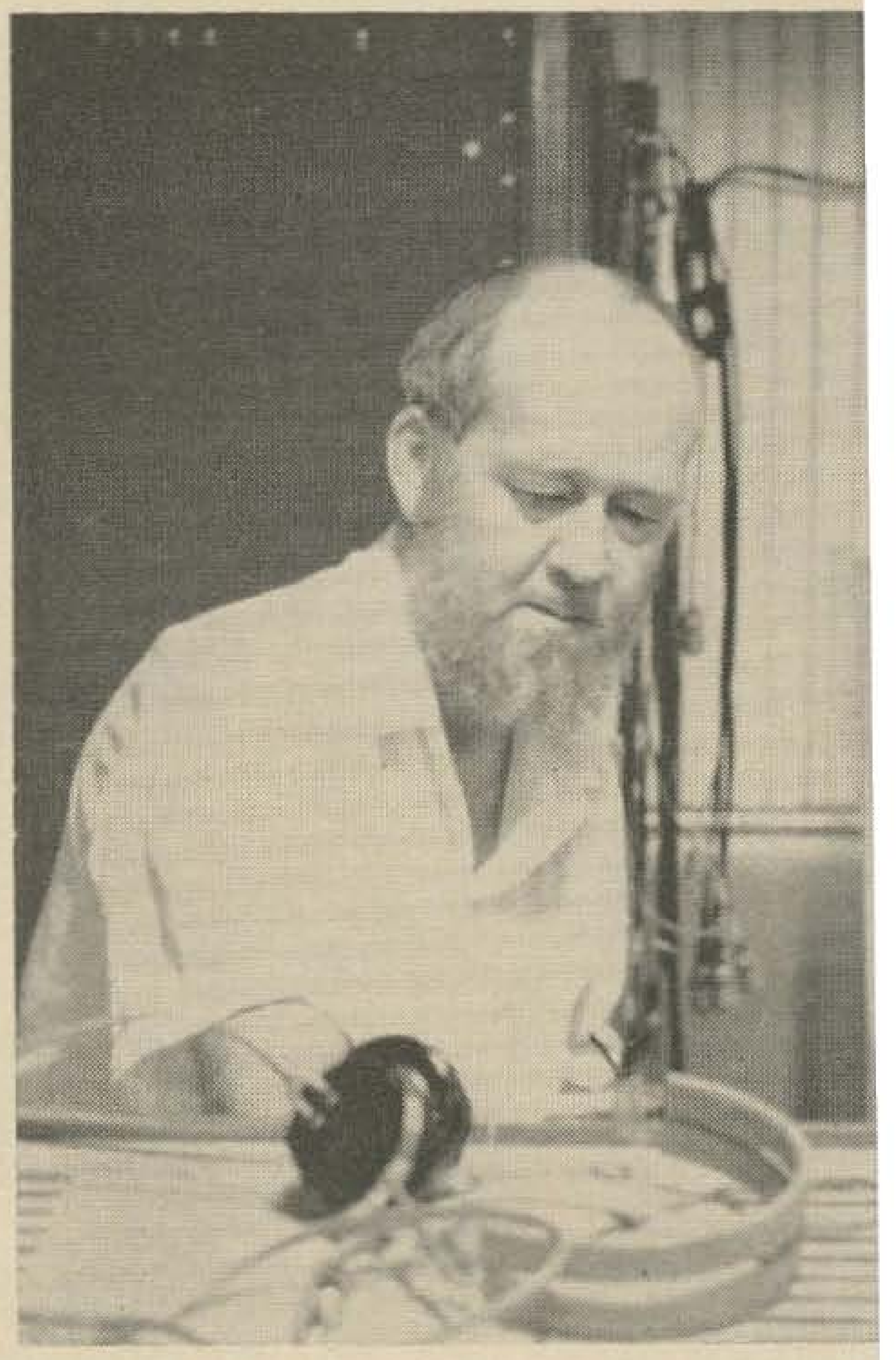
The loudest of all was WA6LET calling us on sideband. Three hours later we had made 39 contacts via the moon, eight on sideband, and including all call areas, Canada, Germany, England, Sweden, Netherlands and Denmark.

)f course there were dozens of frustrated peo-
le all around the world who had tried to
nake the hop and failed. In order to minimize
he frustration from this aspect we taped the
25 kc band complete on an eight channel
ecorder along with the audio outputs from
wo receivers, the sounds in the transmitting
oom, WWV, and a flutter removing synchron-
izing channel. This means that Sam (W1FZJ/KP4) will be able to play back the tape several times and retune the band, copying signals that were missed the first time through. Eventually he should be able to copy every signal that actually made it down to Arecibo via the moon.

I've been fascinated by the moonbounce

Left. The historice moment: Gordor KP4BPZ calls CQ 432 moonbounce

Below. Sam W1FZJ/KP4 tunes the R390 receiver, trying to sort out signals through the QRM.



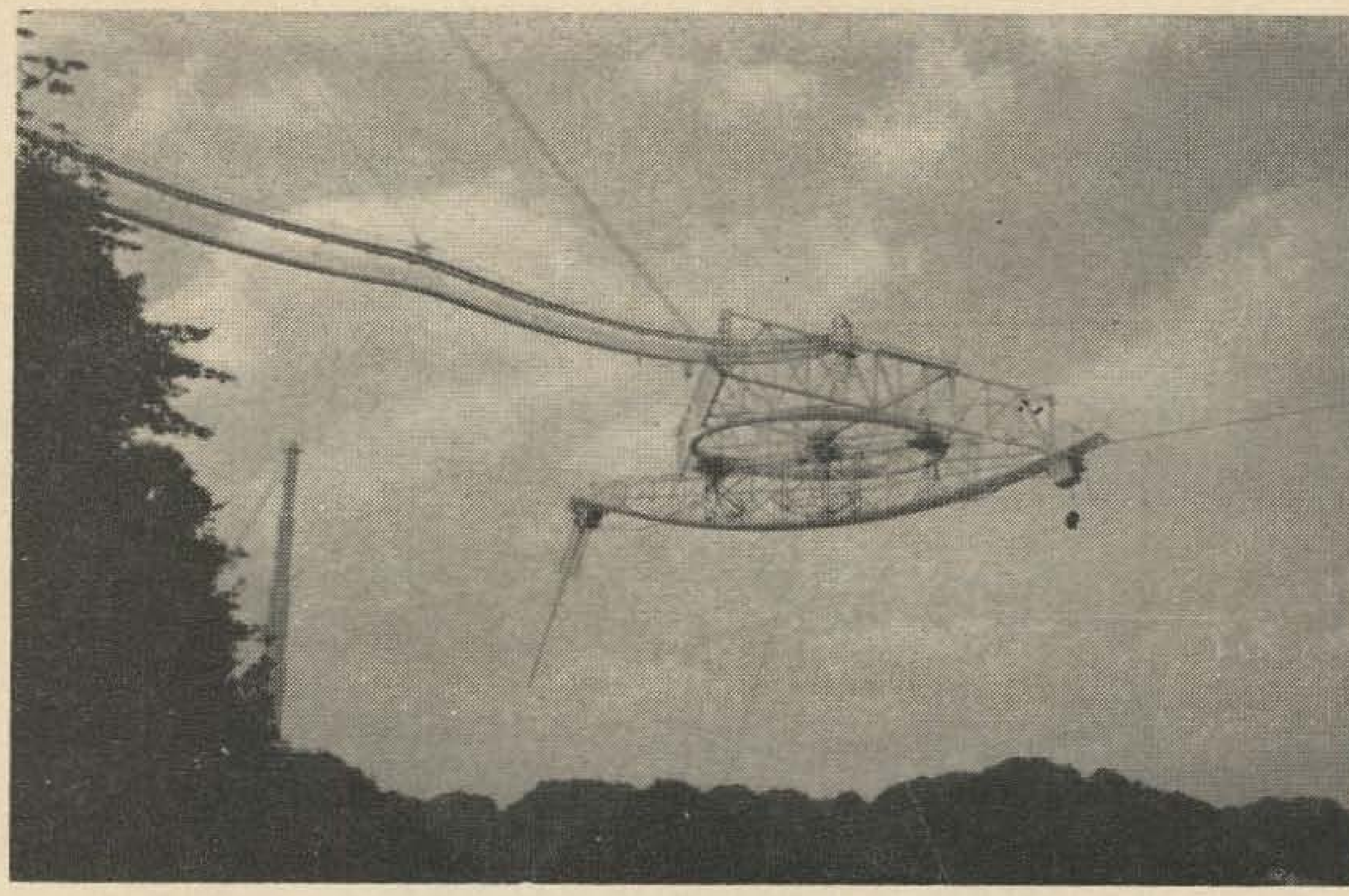
Left. Walt K2KWL/KP4 tunes the other receiver. We worked the best signals they could find.

contacts that have been made from this 1000 foot dish and all it took to get me to come down was the slightest hint of an invitation from Sam. They had two skeds, one on July 3rd, the other July 24th. My hamfest was the 4th, so I had to wait until the 24th to come down. I zipped down on the 23rd, rented a little VW in San Juan and drove the 50 miles along the nort coast of the island to Arecibo.

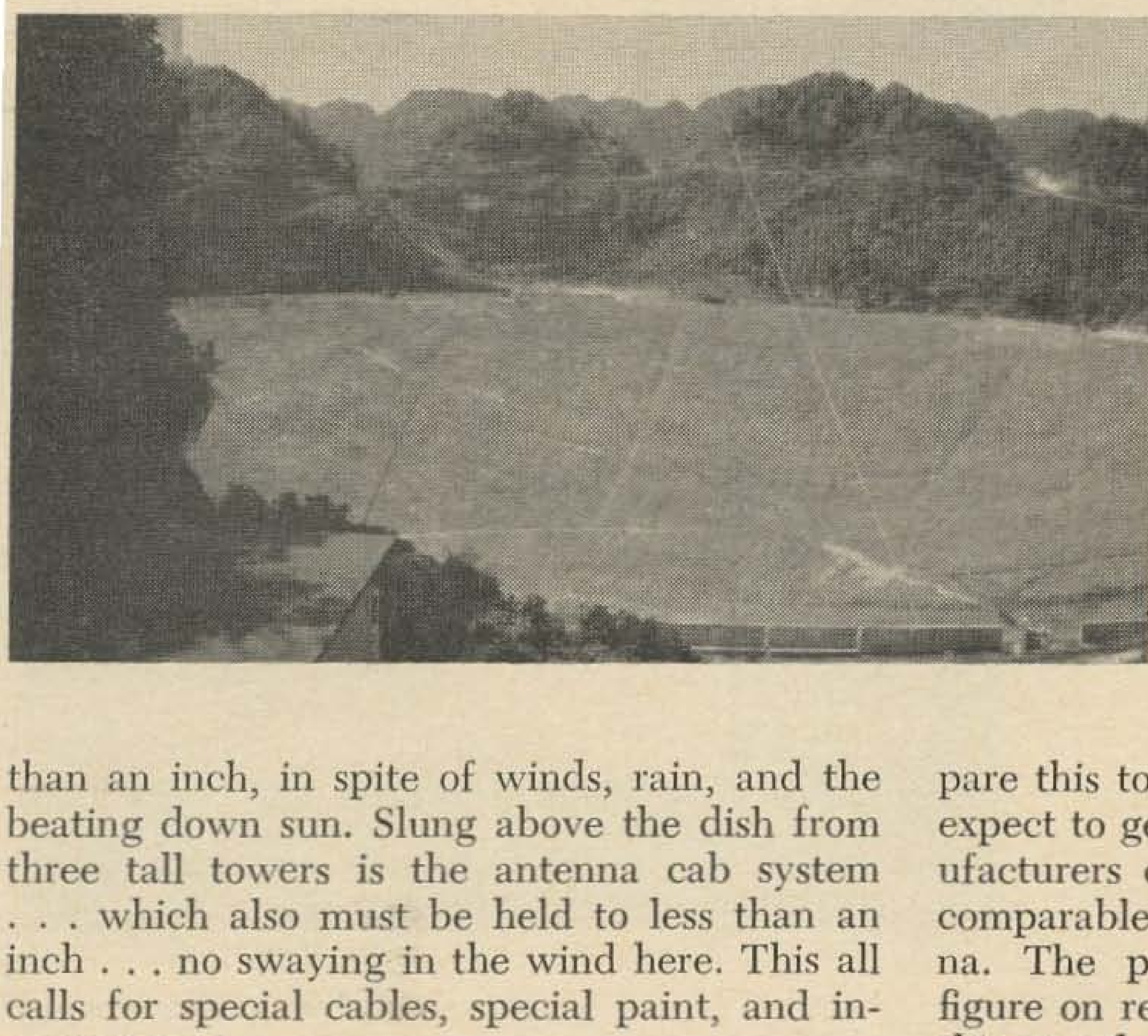
Sam and Gordon Pettengill KP4BPZ worked pretty late that night getting everything ready for the morning test. Then we got together and talked even further into the night, finally getting to bed around 1 AM. At 4:30 the alarm clocks started banging away, adding their dim to the insistent crowing of the damned roosters which seem to be everywhere down here.

After a quick breakfast we careened out the winding narrow road through the mountains for twelve hairy miles. The road is one car wide and the usual driving pattern here is to drive as fast as possible, blowing the horn steadily because the roads are made up of blind turns . . . I think Sam said there are 176 dangerous turns on the road to the dish. Perhaps this is why it is hard to find undamaged cars here. The fellows that work out there drive that road every day . . . I guess you can get used to almost anything.

We arrived at the lab in the grey light of pre-dawn. What a spectacle! A 1000 foot dish covers 18 acres and is over three football fields long. Immense . . . huge. The dish is hung in the air about twenty feet above the ground and is kept at an accuracy of much better



Right. The antenna hangs down from the feed structure, moving on the track to follow the moon. It is automatically run by a computor.



The 1000 foot disc is concave, a part of a sphere, not a parabola. The idea is to swing the antenna feed to follow the moon rather than having the disc itself pointed, as it would be with a parabola.

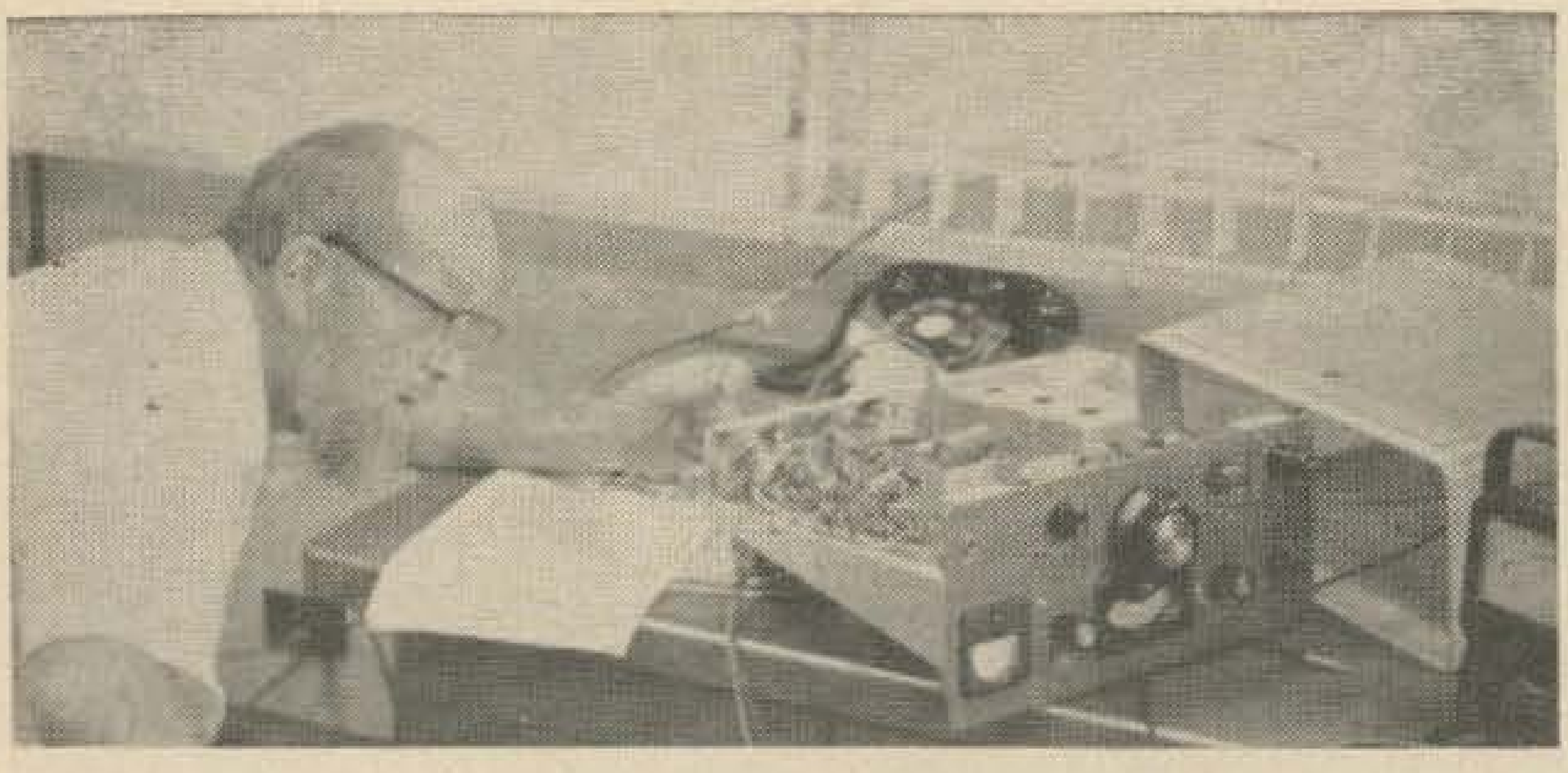
than an inch, in spite of winds, rain, and the beating down sun. Slung above the dish from three tall towers is the antenna cab system . . . which also must be held to less than an inch . . . no swaying in the wind here. This all calls for special cables, special paint, and incessant care.

In addition to Gordon KP4BPZ (W1OUN) I found KP4BEU Andres Sanchez who was going to run the audio tape recorder for the test, Bill Black KP4COO (ex K4BSN) who would mind the antenna (the antenna was actually run by a computer which had been fed the predicted locations for the moon for the duration of the test), Dr. Rolf Dyce K6DSJ-KP4CMO who would run the i-f plus audio tape recorder, and Walt Zandi K2KWL who would tune one receiver, Gordon would do the operating of the transmitter and Sam would tune the second receiver. I found that I was the head log keeper.

The dish was a gain of about 58 db. Compare this to the 6 db that you would normally expect to get from a three element beam, manufacturers claims notwithstanding. It is about comparable to a 25,000 element beam antenna. The parametric amplifier gave a noise figure on receiving of about ½ db. With a dish this size the beam is so narrow (which is what all that gain means) that it is one sixth the width of the moon, and the moon is about ½ of a degree wide.

There was a last minute flurry when we discovered that we had forgotten to bring the power cord for a third receiver that we hoped to use. Those of you who have tried to figure out a 75S1 without the schematic know how futile our efforts were.

The transmitter, which usually puts out 2½ megawatts of pulses for interplanetary radar tests and runs about 150,000 watts dc, was tamed down to our legal maximum. Scoffers should know that in order to run the rig at any higher power they have to use a slow motor



Left. Sam tries to figure out line cord connections for the third receiver.

Left. Helen W1HOY/KP4 on the left, Swiss computer engineer with glasses waiting for us hams to get out of the way so he can get back to work. Tape recorder is taping entire passband of the receiver for later tuning of the band. Dr. Dyce K6DSJ/KP4CMO checks recorder.

Right. The big rig is tuned remotely from the control room. 150 kilowatt final was idled with kilowatt driver working straight through it for the ham test.

driven Variac which takes about two minutes to operate. We had little enough time for the tests without sitting around for two minutes every time we turned on the transmitter.

The moon was scheduled to be within range at 0711 local time and at the appointed hour, with the sun beginning to shine down into the dish, all systems were go and Gordon made his last transmitter test and announced that KP4BPZ was standing by on 432.

We'll know better how many stations were on when Sam gets through reading the tape, but our guess is that about a hundred stations made it over the path. This is quite something when you think about it. This is not easy to do at all. In order to get a signal that we could copy, even without big antenna, you had to run a fair amount of power and a sizable antenna. The fellows that made it were running a minimum of 100 watts, with most of them up around a kilowatt. The antennas were mostly dishes of various sizes, ranging from the 150 footer at WA6LET to the 60 footer at K2MWA, the 30 footer at W1BU (W1HIV), down to an 8 footer used by one of the Europeans. We worked quite a few fellows using collinear antennas, the smallest being about 64 elements and the largest we know about being 96 elements used by VE2LI. For the most part yagi antennas just didn't make it. WA4BYR did get through on SSB with a 32 element yagi and 500 watts.

Some of the KP4 hams and their families who turned up for the hamfest the day after the 432 test.

SM7OSC had four 15 element yagis.

I talked with Sam quite a bit to try to find out what you have to know to get a signal through to him. Assuming that you've picked a reasonable antenna, built a good converter, and have some power available, how can you tell if your stuff is working. Simple, says Sam, just point your antenna at the sun, the best noise generator (and least expensive) we've found yet. If you don't hear the sun then you aren't in. Now if you want not only to work Arecibo, but hope to work some of the other fellows, you've got to have a system that will hear its own signals coming back from the moon. This takes a kilowatt plus at least an 18′ dish or equivalent.

So far probably only four or five fellows have systems that are capable of receiving echos back from the moon. I know of W1BU, K2MWA, WA6LET and KP4BPZ.

One interesting problem when tuning for moonbounce contacts is the 2½ second time delay for the signals to reach the moon plus 2½ more for the signals to come back. You sure don't work any fast break-in over this path. And when you tune in someone just standing by there is no use breaking back and asking for a repeat on his call.

We wasted a lot of time listening to fellows calling our call over and over. This seemed like a strange way to waste everyone's time. We knew that everyone was calling us and what we wanted to know was their call, not ours. I suspect that the procedure for the next test will be a bit different, with the Arecibo end standing by for each station known to be calling in order for an exchange of signal reports. It would seem prudent to have your station call and frequency on file with Sam (Box 1738, Arecibo) so you'll get called. Once they've worked everyone on the list they will look around for unlisted stations. This will help to keep two stations from trying to use the same frequency too.

There is no way to know when any further tests will be made. Gordon will soon be going on to another big dish project and we may be hearing ham signals from a new source. We don't know how receptive the new director of the Arecibo Observatory will be to our amateur radio, but we can all hope.

Though Sam has only been down here about a month he has already been looking around for a good ham location and seems to have found a corker. He's thinking seriously of making a smaller version of the $8,000,000 dish, something about 330 feet in diameter. He wants to poke good moonbounce signals on 144 and 432 mc. I'll bet he does it too.

KP4 Hamfest

I mentioned to KP4AXM (Sandy) that I was planning on visiting Arecibo and he suggested that I arrange some sort of hamfest. I checked with Sam and got the go ahead. KP4JM, the SCM, got a letter out to just about everyone telling them that I would be here and that all were invited to come visit the observatory. About fifty hams plus their families turned up on Sunday morning and we all had a wonderful time going through the lab, getting a close look at the dish, and riding up the cable car to the antenna carriage. Quite a few of the fellows drove all the way across the island from Ponce, a rugged slow trip. I was particularly glad to see Bill Thomas KP4CF (ex KV4BB), whom I had visited on my last trip to the Virgin Islands back in 1957.

. . . W2NSD/KP4

Bill Smith KØCER
1301 Churchill Ave.
Sioux Falls, S. D.

Practical Meteor Scatter

Meteor scatter propagation, if it can rightfully be called "propagation", was discovered some years ago but has received attention only from the military and a relative small number of two meter men looking for ways to work DX on 144 megacycles. While the number of two meter men using meteor scatter has increased in the past four years, it has been nearly 2½ years since I have seen anything in an amateur publication on the subject. It has been eight years since W4LTU's article which has become the bible of meteor scatter enthuiasts was published in QST.

While I do not claim to be any kind of an expert in the field, I think it is time to review meteor scatter techniques and possibly interest some other operators in the field.

SHOWER AND DATES	OPTIMUM PATHS AND TIMES N-S	NW-SE	E-W	SW-NE	PERIOD-NEXT MAXIMUM	
January 1-4 QUADRANTIDS		0300-0800	0800-0900	0900-1400	7	1967
April 19-23 LYRIDS	0230-0530	2330-0100		0700-0830	400	2261
May 1-6 AQUARIDS		0830-1000	0630-0830	0300-0630	76	1986
May 19-21 CETIDS		1100-1230	0900-1100	0730-0900	37	-*
June 4-6 PERSEIDS	0800-1000; 1300-1500				29	-
June 8 (2-14)	0600-0800; 1100-1300				38	-
June 30-July 2 TAURIDS	0700-0900; 1300-1500	1130-1300	1030-1130	0900-1030	31	-
July 26-31 AQUARIDS		0300-0500	0100-0300	0000 0100	3.6	-
August 10-14 PERSEIDS		2330-0300	0300-0800-	0800-1130	108	-
October 9 GIACOBINIDS		1100-1600	1600 1700	1700 2200	6.6	1965
October 18-23 ORIONIDS	0000-0200; 0600-0800	0430-0600	0330-0430	0200-0330	76	1986
November 14-18 LEONIDS	0300-0500; 0800-1000				33.2	1965
December 10-14 GEMINIDS	0030-0330	2130-2300		0500-0630	1.6	-

* Blank means showers are about the same each year.

Table I. Most important meteor showers.

Meteor scatter, or MS, is not a method of communication for the ham equipped with a five watt transceiver, but is an interesting challenge for the operator equipped with at least 100 watts of CW into a honest 10 db antenna, a stable and selective receiver and a reasonbly good converter.

Before discussing station requirements let us first explore just exactly what MS is.

Basically MS is an attempt to reflect signals off ionized trails left by meteorites as they enter and burn up in the earth's atmosphere.

The earth is bombarded daily by a fantastic number of these minute particles. If it were not for our atmosphere which burns them up, the earth's surface would resemble that of the moon.

During certain periods of the year the earth passes through concentrated streams of meteorites. These streams, or showers, are dense enough at times to cause sufficient ionization allowing reflection of two meter signals.

Thirteen major showers occur each year, and in peak years, can provide amazing signals in terms of strength and duration.

Table I is a table of showers that are of most interest to two meter hams.

This table is an "educated guess" as to the dates, best times and directions but will be found to be fairly accurate.

The number of meteorites in a given shower can, and does, vary considerably from year to year in intensity. However it is wise to arrange schedules for each of them.

In past years the Quadrantids in January have produced some QSO's but the shower this year was extremely good and signals rivaled the best shower of them all, the Perseids in August.

Using the table is not complicated and a close examination will show it to be fairly self-explanatory.

Suppose W4VHH wants to schedule KØCER during the Quadrantids between January 1st and 4th. The path between the two stations is northwest to southeast and the table shows the optimum time is between 0300 and 0800 local standard time. The shower peak is centered on 0530 LST so the two stations should schedule at about this time taking into consideration the time zone changes. An hour or so either way probably won't make too much difference.

Equipment

Earlier, mention was made of equipment requirements. Now for a closer look.

Power? The higher the better! Here is where you MS professionals may begin to disagree with me.

Success can be achieved with 100 watts of CW *in the antenna*. However, most of the fellows are running from 500 to 1,000 watts input with such bottles as 4X150's and 250's. I have worked MS with 125 watts input and a 10 db antenna but it was spotty and every extra db helps. MS is a CW game, and SSB has been used but the wide bandwidths and power losses associated with AM and FM phone make results from those modes highly unlikely.

After you have those precious watts of RF don't throw them away in the feedline. All serious 2 meter DX'ers use either open wire feeders or a *good* quality of coax.

This leaves out RG-58/U and the like and you had better think twice about using RG-8/U. This rule applies to any VHF work. RG-17/U is commonly used because of its low loss and ease of installation. Open wire feeders are the best in terms of low loss but they present more installation problems. The money you spend for feedline is the best you will ever spend on a VHF station. It does no good to pump a fine signal into a feedline that is no better than a wet piece of string!

Antennas are a complete subject in themselves and there are many types in use. Probably the most common is a pair of stacked yagi's followed by quad configurations, colinears, skeleton slots and single long yagi's. The largest antenna you can put up will be the best if it is properly installed and adjusted.

Capture area of the array is important because we are dealing with relative small amounts of received signals. Remember, the gain of the antenna system applies to both transmitting and receiving.

HEIGHT Wave Lengths	- Feet at 144 Mc.	DISTANCE Miles
1	6.8	430
2	13.7	720
3	20.5	900
4	27.5	1020
5	34.0	1090
6	41.0	1130
8	55.0	1230
10	68.0	1280
12	82.0	1310

ANTENNA HEIGHT CHART

Table II. Optimum antenna heights.

Before selecting an array, check on what the successful MS operators are using, and don't be mislead by some of the fantastic gains some antenna manufacturers claim for their products. You will find the serious two meter man willing to give you advice and steer you in the right direction.

Charts have been worked out for the best height to mount antennas for MS work. Table III is excellent, but if you can not achieve the optimum height at least make sure the array is not buried among trees or power lines.

Receivers and converters are equally important in a successful MS station. The most important factors are a low noise figure, stability, selectivity and good calibration.

The majority of MS operators use receivers in the Collins bracket although some of the other better receivers are in use.

You will need a receiver that is calibrated at least every 5 kilocycles and 1 kilocycle calibration is to be desired. An MS signal is here and gone in seconds and you have to be on the other station's frequency. There isn't signal or time enough to be hunting all over the dial. Most MS operators know their frequency within 500 cycles.

This is why stability is important. Many premature grey hairs have appeared when a receiver drifted at the wrong time!

A 2.5 kilocycle bandpass is probably the best overall choice, giving a better signal to noise ratio than a wider bandpass but still being broad enough to find a signal and hold it in the bandpass. Even crystal controlled signals will shift slightly when the crystal heats up. VFO's, except a few highly stable multiplier chains, are out for MS work. Stability can't be stressed too highly!

There are several fine commercial converters available or one such as the W2AZL can be built.

Everyone talks about noise figure and how to measure it. One quick way to make sure your converter is operating well is to disconnect the antenna input. If the background noise in the receiver drops noticeably the converter is usually working well. If the noise remains the same, or rises, you had better do

Nothing or incomplete calls	Calls only	S1	Up to 5 sec
Complete calls	Calls and signal rept.	S2	6 to 10 sec
Calls and signal rept.	Signal rept. and ROGER	S3	11 to 15 sec
Signal rept. and ROGER	R's continuously	S4	16 to 20 sec
2 or more R's	Nothing	S5	over 20 sec

QSO EXCHANGE CHART

some work because you may not be hearing the weak ones.

When selecting an *if* input frequency for the converter, consult the Handbook or similar publications. The rule of thumb here is to select the highest frequency at which your receiver functions well in the manner previously discussed.

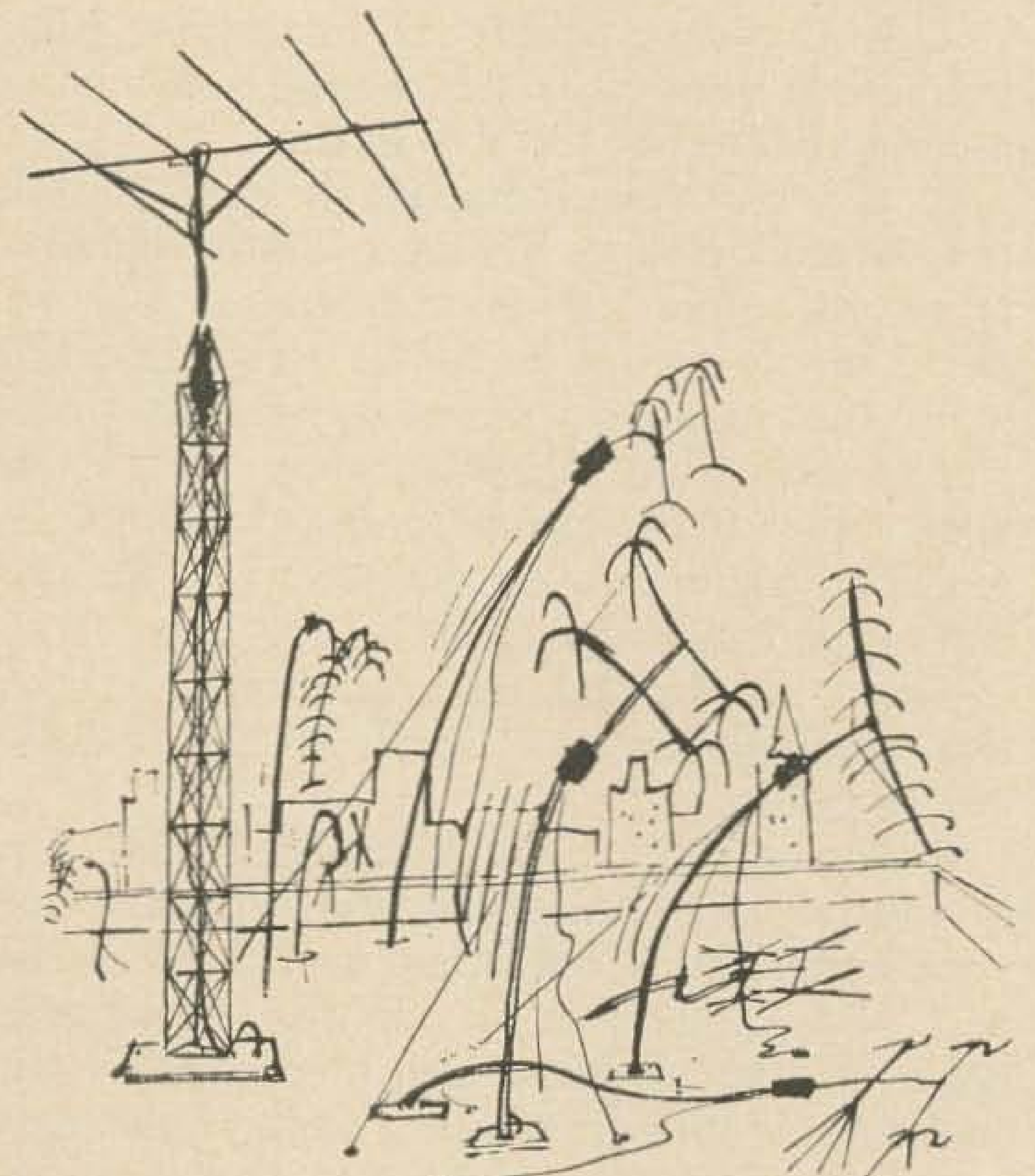
That is a brief run-down on basic station requirements. As you progress in the MS field you will find such items as tape recorders and automatic keyers helpful but not absolutely necessary.

Now that the equipment is ready, how do we make the actual meteor scatter QSO?

First, you arrange a precise schedule with a station depending on the information in Table I.

There has been much discussion on what actually constitutes a QSO. MS operators have arrived at a system that leaves no question whether or not a valid QSO has been made.

This is the system that is used by most operators. As the schedule begins, both stations are sending calls only, i.e., W4VHH de KØCER W4VHH de KØCER, etc. This continues until both stations receive a *complete* set of calls. Then calls and signal reports are sent, i.e., W4VHH de KØCER S2 S2 W4VHH de KØCER S2 S2, etc. (The signal report is based on Table III.) This procedure continues until both stations receive their signal reports, then reports and a roger are sent, i.e., S2R S2R S2R, etc. When this is exchanged, only rogers are sent, i.e., RRRRRRRRR. When two or more R's are received you stop sending... you have made it! A look at the chart will help clarify the procedure.



These transmissions are made with precise timing by following a clock with a sweep second hand exactly calibrated with WWV. Usually the station on the western end of the circuit sends first. Schedules are usually arranged so each station makes either one 30 second transmission each minute, or two 15 second transmissions each minute with the western station taking the first 30 seconds or the first and third 15 seconds. I don't know why it is customary for the western station to transmit first, it probably all just started that way. Most schedules run for one hour each day during the shower.

It is useless to send an S-1 report because by definition an S-1 signal lasts only a maximum of five seconds and even at keying speeds of 25 to 30 words per minute it takes about that long to send a set of calls. The minimum report usually is an S-2 which indicates a received transmission of up to 10 seconds, or long enough for calls and signal report. We just mentioned keying speeds of 25 to 30 words per minute. This is the speed used by most MS operators and even though you may not be able to copy 25 wpm solid on paper, I bet you will recognize calls, signal reports and the letter "R".

This article was intended only as a brief look at MS operation with the hope that it will encourage others to try this fascinating method of DX on 144 megacycles.

Part of the information for this article was taken from articles written by W4LTU in QST for April of 1957 on page 20 entitled "VHF Meteor Scatter Propagation," and W3TDF's article "Meteor Scatter" in the October 1962 issue on VHF Horizons, page 30.

Both articles are excellent and I highly recommend that they both be read.

Yes, a meteor scatter QSO takes time, patience and some work, but the rewards are there for those who wish to try and "advance the state of the art."

. . . KØCER

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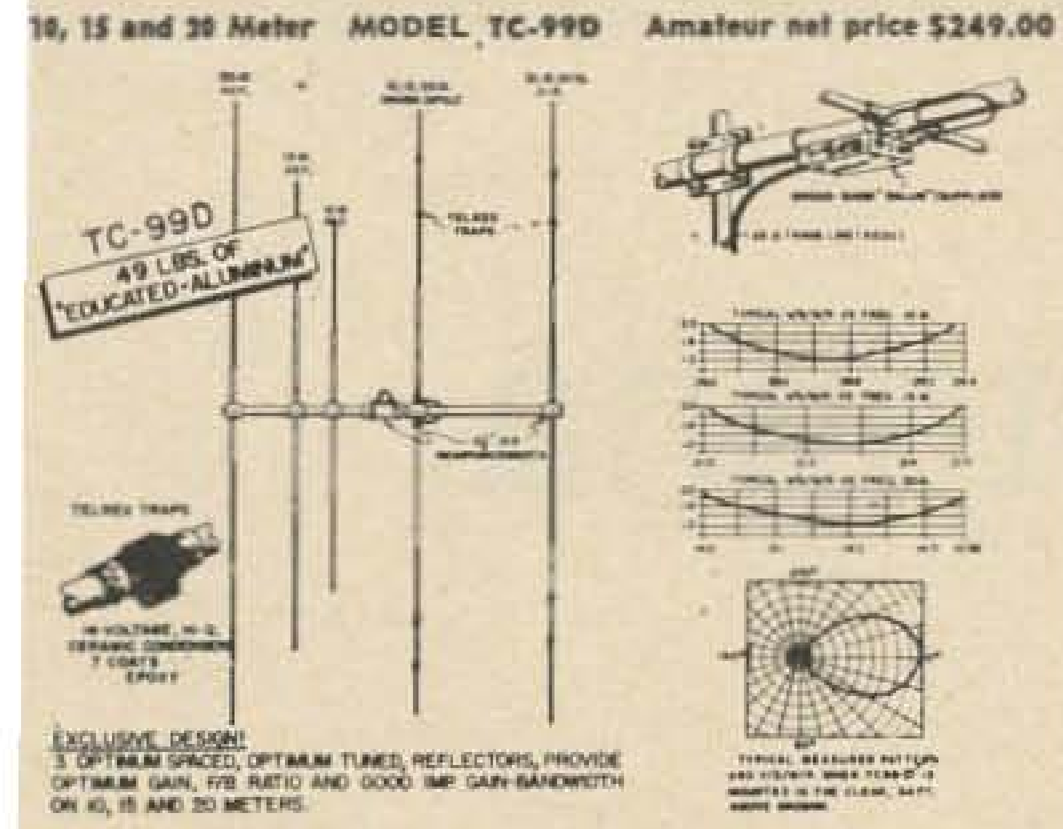

TC-99D SPECIFICATIONS

- FREQ. RANGE: 10, 15 and 20 METERS
- POLARIZATION: LINEAR, HORIZONTAL
- GAIN-MEASURED: 8.5 DB. AVERAGE
- SIDE NULLS: 35 DB
- F/B RATIO: 25 DB+
- V.S.W.R.: 1.5/1 AT RESONANCE, 3 BANDS
- WEIGHT: 49 LBS
- ENVIRONMENTAL: 95 MPH
- BEAMWIDTH TO 1/2 PWR PT.: 60° - 3 BANDS
- SHIPPING WT.: 60 LBS
- WIND SURFACE AREA: 4.6 SQ FT
- WIND LOAD AT 100 MPH: 210 LBS
- LONGEST EL. LGTH.: 34 FT
- TURNING RADIUS: 21 FT
- RECOMMENDED SUPPORT MAST: 2" O.D.
- POWER RATING: 2 KW P.E.P.
- CONSTRUCTION: ALUMINUM DURAL, MICARTA INSULATION, STAINLESS STEEL ELEC. HDWR, HEAVY DUTY CAD. PLT. STEEL GUSSET PLT. MOUNTING
- RECOMMENDED ROTATOR: 75 MPH AREAS — GOOD TV ROTATOR; 120 MPH AREAS — TELREX MODEL TS-250-RIS
- BOOM: ALUM. 2" O.D. x 12' LONG

TM-30C SPECIFICATIONS

- FREQ. RANGE: 10, 15 AND 20 METERS
- POLARIZATION: LINEAR, HORIZONTAL
- GAIN-MEASURED: 10 DB. AVERAGE
- SIDE NULLS: 35 DB
- F/B RATIO: 30 DB
- V.S.W.R.: 1.5/1 AT RESONANCE, 3 BANDS
- WEIGHT: 85 LBS
- ENVIRONMENTAL: 95 MPH
- BEAMWIDTH TO 1/2 PWR PT.: 55° 3 BANDS
- SHIPPING WT.: 114 LBS
- WIND SURFACE AREA: 9.5 SQ FT
- RECOMMENDED SUPPORT MAST: 3" O.D.
- LONGEST EL. LGTH.: 36 FT
- TURNING RADIUS: 28 FT
- WIND LOAD AT 100 MPH: 300 LBS
- POWER RATING: 3 KW PEP
- CONSTRUCTION: ALUMINUM DURAL, MICARTA INSULATION, STAINLESS STEEL ELEC. HDWR, HEAVY-DUTY CAD. PL. STEEL GUSSET PLATE MOUNTING
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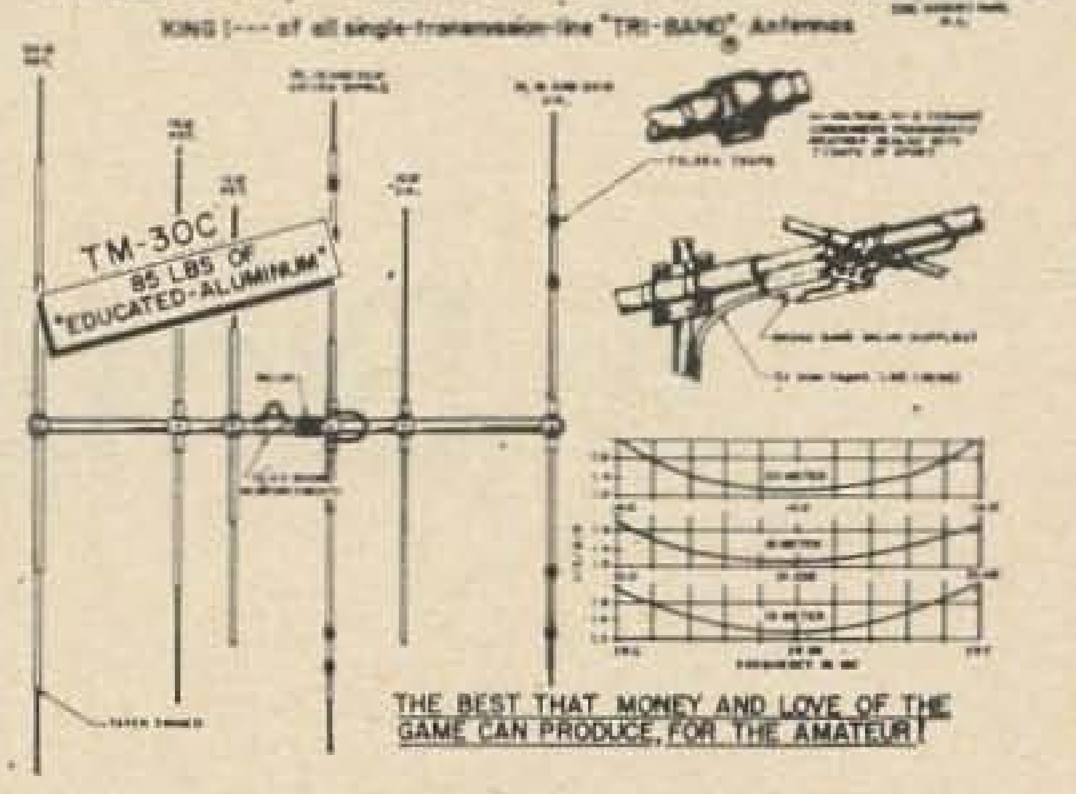

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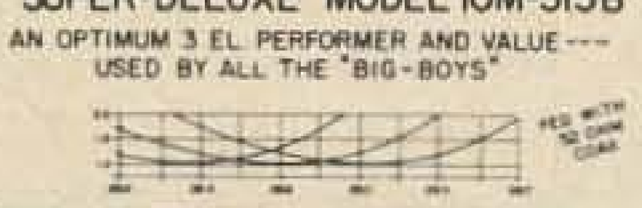
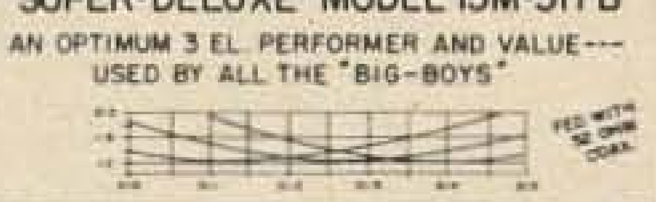


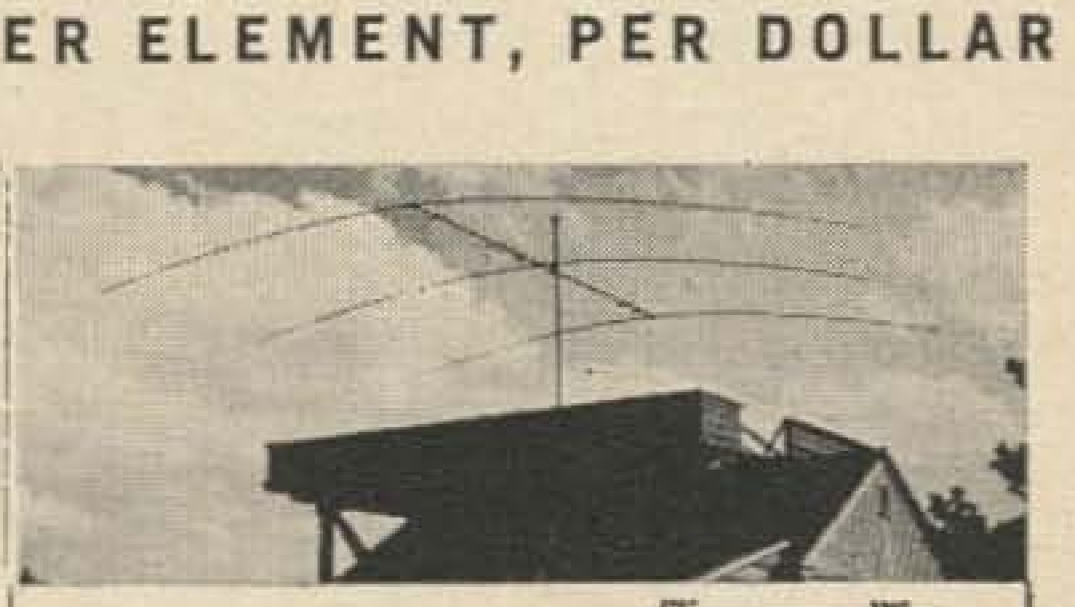
GAIN IN DB	10.0	BOOM LGTH & DIA.	14'x2"
F/B RATIO IN DB	24	LONGEST ELEM LGTH	18'0"
1/2 POWER BEAMWIDTH	57°	TURNING RADIUS	12'0"
WIND AREA SQ FT	2.75	NET WEIGHT LBS	21
WIND LOAD, 100 MPH LBS	82	SHIPPING WEIGHT LBS	28

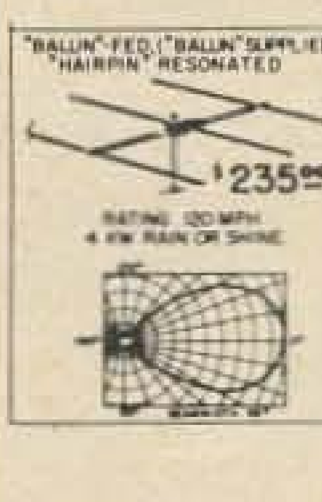
15 METER 3 EL. OPTIMUM-SPACED "SUPER-DELUXE" MODEL 15M-317B

AN OPTIMUM 3 EL. PERFORMER AND VALUE --- USED BY ALL THE "BIG-BOYS"



GAIN IN DB	10.0	BOOM LGTH & DIA.	17'x2.5"
F/B RATIO IN DB	24	LONGEST ELEM LGTH	24'0"
1/2 POWER BEAMWIDTH	58°	TURNING RADIUS	14'6"
WIND AREA SQ FT	3.55	NET WEIGHT LBS	37
WIND LOAD, 100 MPH LBS	107	SHIPPING WEIGHT LBS	48





20 METER 3 EL. OPTIMUM-SPACED "MONARCH" MODEL 20M-326B

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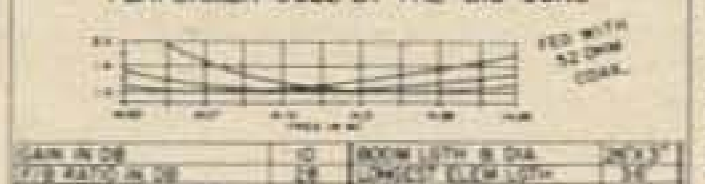

GAIN IN DB	10	BOOM LGTH & DIA.	26'x3"
F/B RATIO IN DB	28	LONGEST ELEM LGTH	36'
1/2 POWER BEAMWIDTH	58°	TURNING RADIUS	24'
WIND AREA SQ FT	8.53	NET WEIGHT LBS	71
WIND LOAD, 100 MPH LBS	268	SHIPPING WEIGHT LBS	85

ALSO AVAILABLE

10	METER	5	ELEMENT	MODEL	10M-518B	$185.00
10	"	5	"	"	10M-523	285.00
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15	"	5	"	"	15M-532	365.00
20	"	5	"	"	20M-536	395.00
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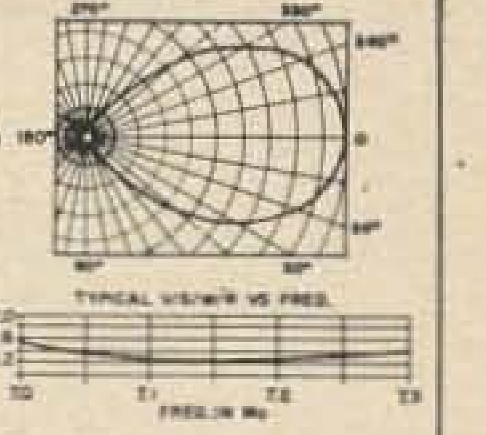
SPECIFICATIONS	
GAIN IN DB OVER 1/2 WAVE DIPOLE	9.0
F/B RATIO IN DB	30
BEAMWIDTH TO 1/2 PWR POINT	59°
WIND AREA IN SQ FT	13.80
WIND LOAD AT 100 M.P.H. IN LBS.	427
BOOM LGTH & DIA. approx.	46'x3½"
LONGEST ELEM. LGTH. approx.	64'
TURNING RADIUS approx.	40'
NET WEIGHT LBS. approx.	177
SHIPPING WT. LBS. approx.	222



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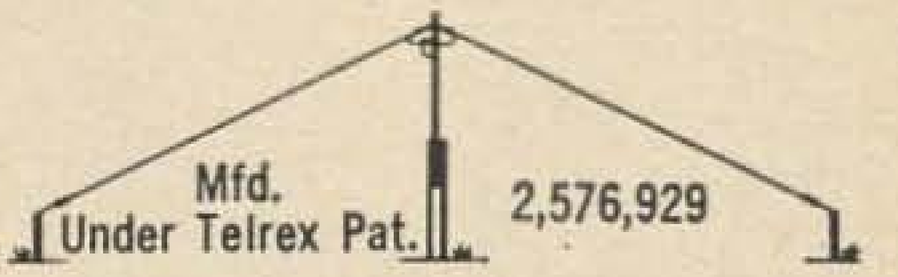

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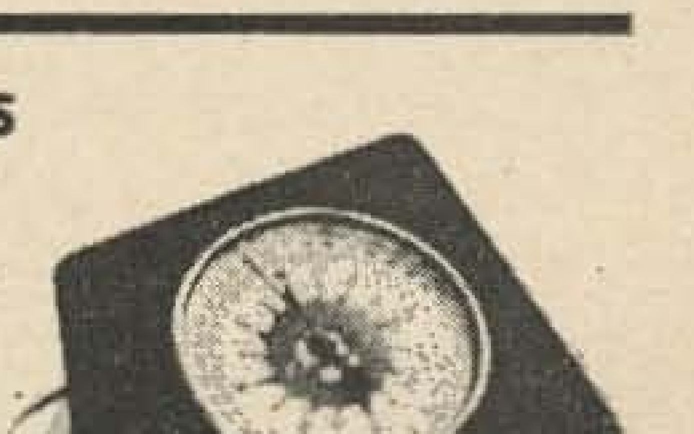


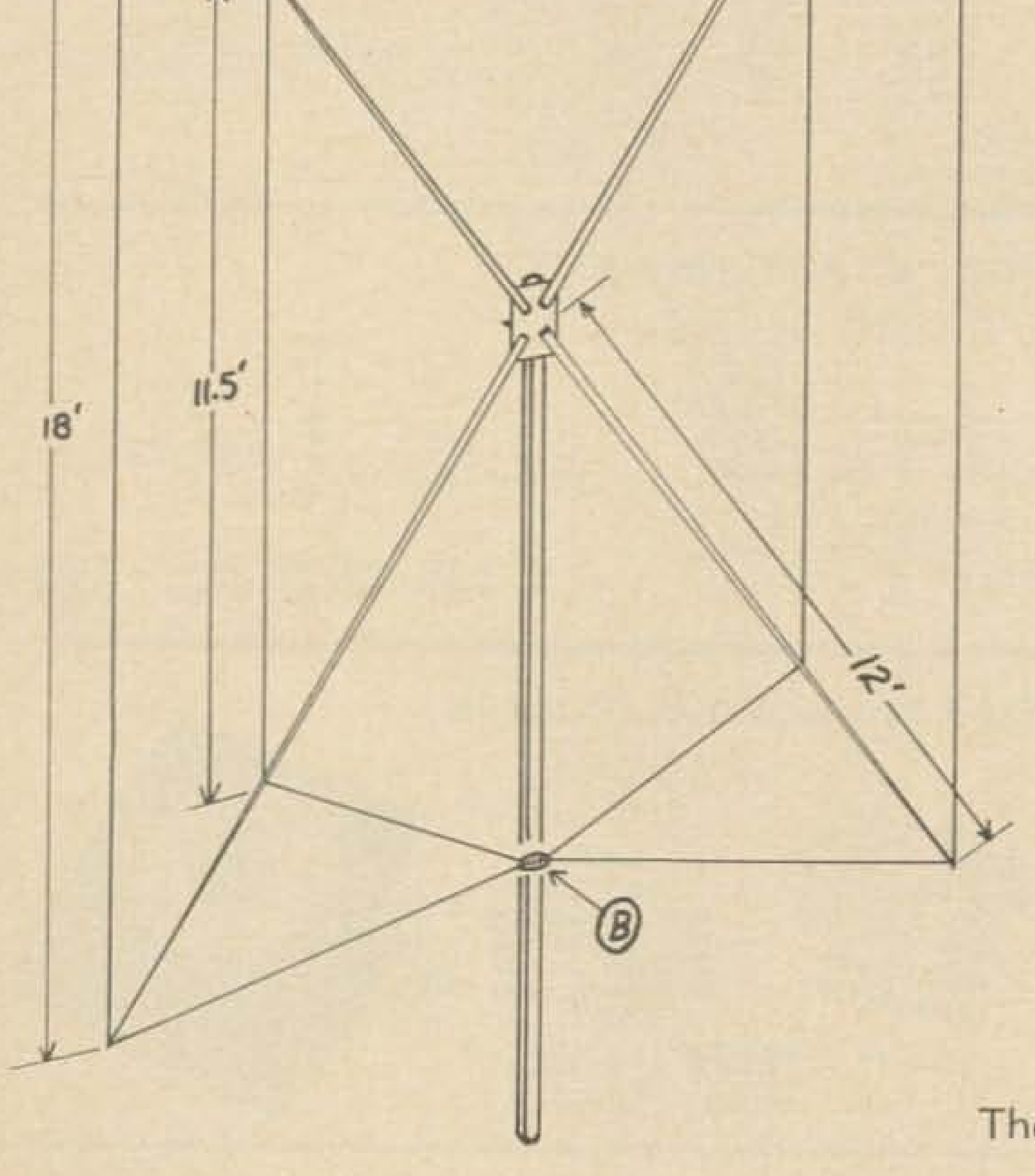
TELREX LABS.
ASBURY PARK, N.J.

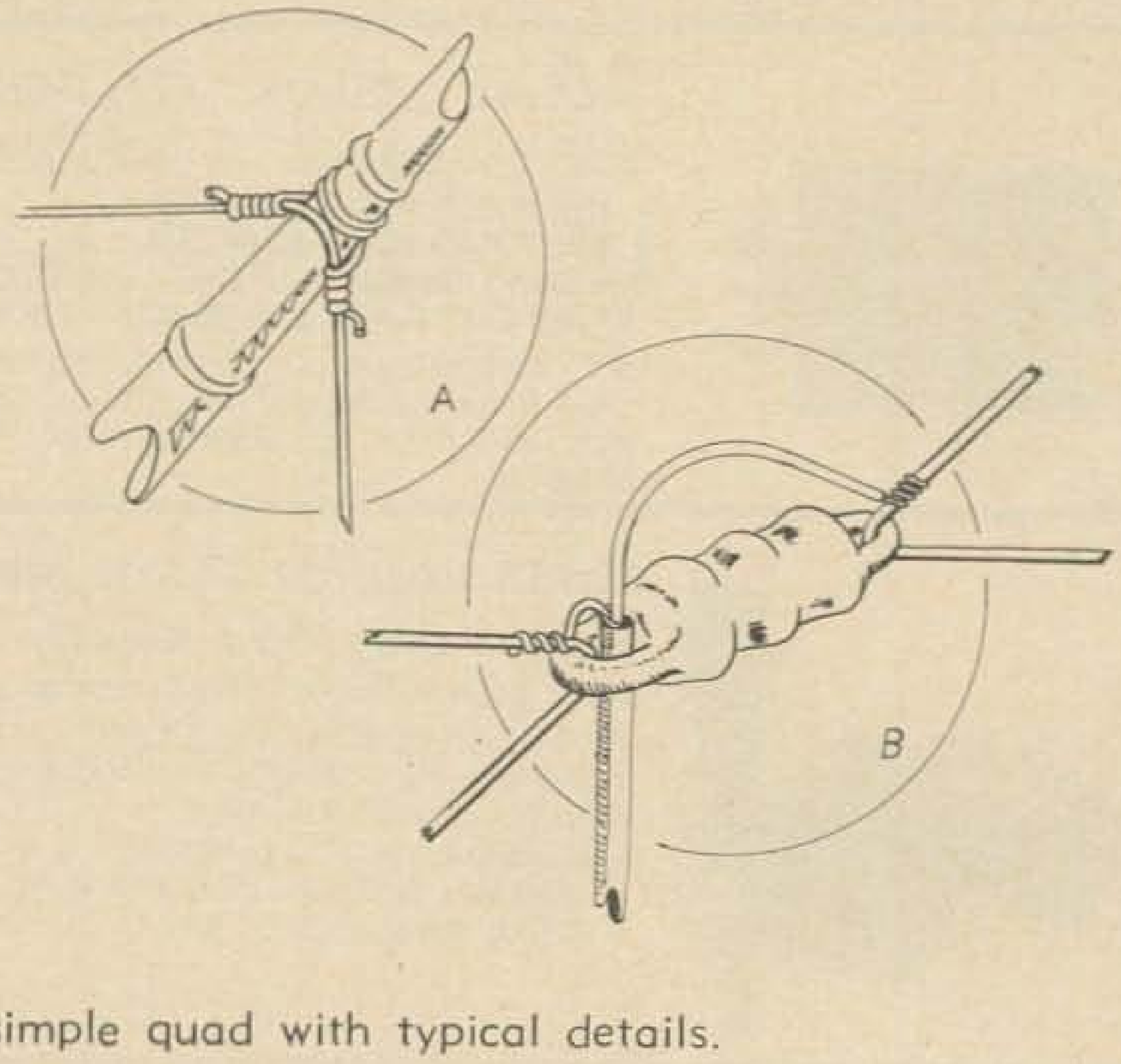
James Young W6WAW
1412 N. Fairfax Avenue
Hollywood, California

A Simple DX Antenna

A simple quad element forms a simple and effective DX antenna for the amateur faced with a limited space problem. This antenna will provide considerably better results than a simple dipole, due to the lower vertical angle of radiation achieved at heights below a half-wavelength. Similarly, the quad will afford less noise pickup in the receiver than a vertical or ground plane. Addition of a reflector element at a future date can easily be accomplished if the additional gain is desired.

A recent change in location at W6WAW resulted in a drop to zero in European contacts. Although the actual move was less than a mile, several discouraging factors soon became apparent. Primary among these was the fact that the base of the Hollywood Hills was now only two blocks away, directly in the polar path, while a very tall palm tree in close proximity to the only available spot to mount the all-band ground plane was absorbing all the rf in that direction. The ground plane produced excellent reports in all directions except towards Europe however, so it was decided to put up a fixed beam aimed roughly 30 degrees East of North. The "old standby" 8JK or a fixed parasitic array were considered, but again the palm tree would be in the way.





The simple quad with typical details.

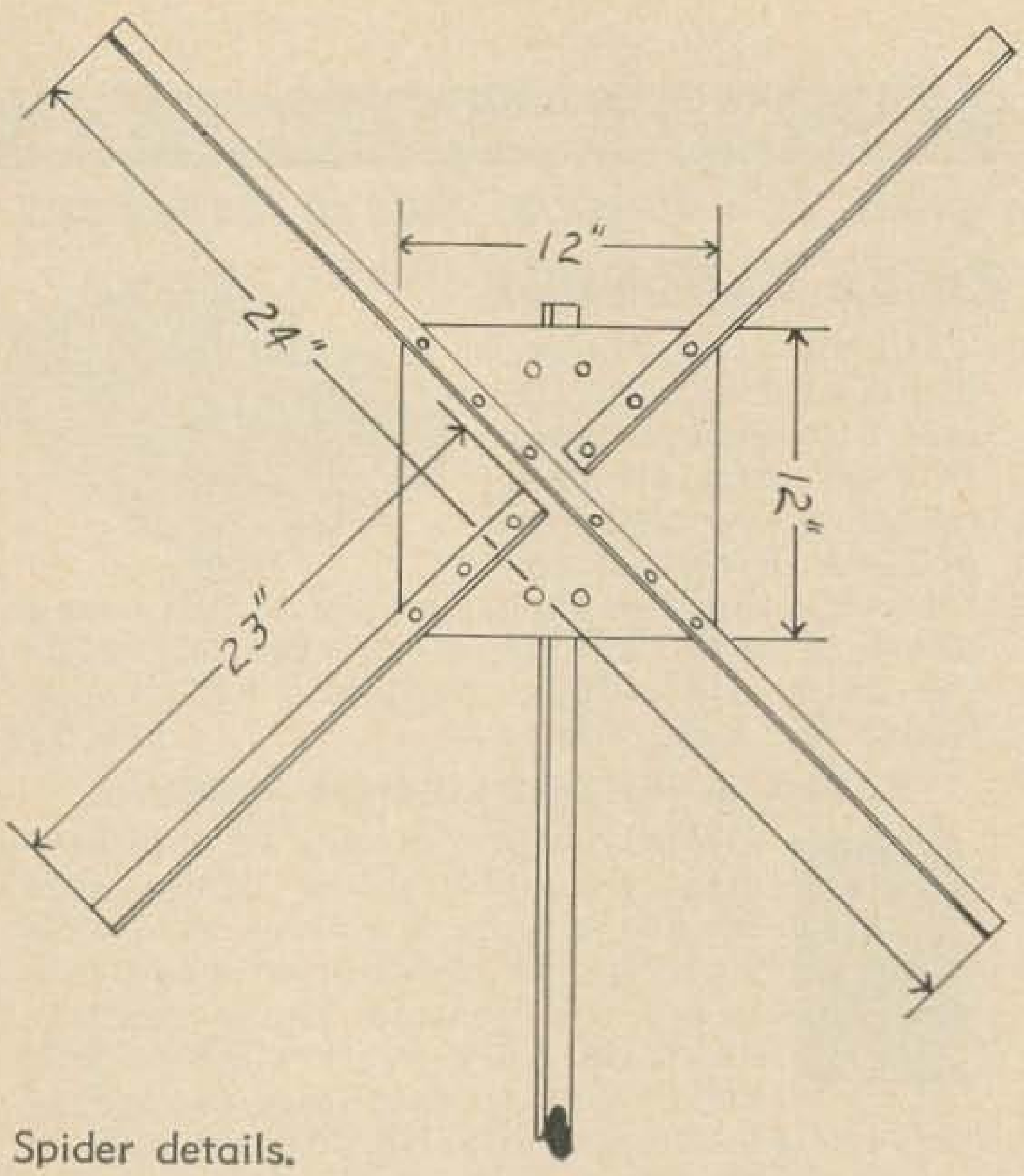
After researching the possibilities of various antenna configurations, a quad was selected as the best solution, and a two element 14 mc array drawn up. However, as the first weekend of the DX contest was only 24 hours away at this point, it was decided to put up a single quad element for use during the contest and hope for the best. The results obtained with this antenna were much better than had been anticipated, including reports from Europe that equalled those from the old QTH. The decided decrease in receiver noise was also a boon, especially as Fairfax Avenue is one of the major North-South streets in the Hollywood area.

The antenna was built and put up in less than two hours, with the further advantage that no outside help was required. The basic "spider" assembly was fabricated from a 12 x 12 inch piece of ¼ inch thick aluminum, and 8 feet of 1 inch "do-it-yourself" aluminum angle stock. A suitable piece of plywood would probably have served just as well, but the aluminum was available, so it was used. The bamboo arms are a few inches over 12 feet long, wired securely to the aluminum angle to provide maximum support.

The wire element was made up by soldering a glass strain insulator to one end of a 100 foot roll of #14 stranded antenna wire, tying it to the garage door, and then applying "VW pressure" to pre-stretch the wire. The wire was then measured off and cut to length at 72 feet. A piece of tape was placed 9 feet from the insulator, and three more at the subsequent 18 foot points to facilitate assembly by marking the points of contact between the wire and bamboo.

The spider assembly was attached to a 15 foot mast, made of 1¼ inch TV mast sections by means of two U-clamps. A vent pipe clamp was attached to the other end of the mast and three guys of nylon clothes line were pre-cut and lashed to the lower U-clamp. The wire element was stretched around the bamboo frame and secured to the end of each pole by small lengths of #14 wire, twisted tightly around the pole and well soldered. The free end of the element was then attached to the insulator and soldered after the slack was taken up. Two of the guys were secured and the antenna raised into position, slipping the vent-pipe clamp over the sink vent on the roof. The array was roughly oriented on Central Euorpe/Australia, and the third guy line tied off.

The antenna reference books indicated that the feed point impedance of a single quad element would be around 125 ohms. The only available transmission line of sufficient length was a piece of RG-59/U, which would produce



Spider details.

a theoretical SWR of 1.75:1, but as this was under the nominal 2:1 limit it was connected across the insulator, soldered in place, and the transmitter fired up as the contest was now 16 hours old.

The first contact on the quad was with FO8AA, with the report approximately the same as that normally obtained on the ground plane. Several UAØ and JA stations were worked off the end with QSA 8/9 reports, while an HK off the other end produced an S6. This seemed to indicate a "skewed" pattern, probably caused by direct connection of the unbalanced transmission line as the shield was connected to the side "pointed" at South America. Further checks performed with a Stoddart NM-22A Field Intensity meter showed this to be true, but, as many European stations were worked without difficulty, it was decided to leave well enough alone; the antenna was serving its purpose admirably, while the one case of TVI at the new location was reduced considerably. A check on the SWR at the feed point of the antenna and also at the output of the Matchbox showed approximately 1.8:1 from 14000 to 14050 kc, and 1.95:1 at 14100 kc, which was considered low enough to be tolerated.

A 21 mc section was later added to the array and paralleled across the insulator. This element was made up in the same manner as the 14 mc element, however, the total length was 46 feet, being 11.5 feet on each side. The SWR on 21 mc was lower, ranging from 1.31:1 at 21000 to 1.71:1 at 21200 kc, while the overall effects on 14 mc operation were nil for all apparent purposes. As a bonus: 7 mc operation can be had in addition, by connecting a 28 foot 9 inch length of 300 ohm twin lead across point "X" and shorting the far end. Operation on 14 and 21 mc will not be affected.

By employing the vent pipe as a pivot point the antenna can be rotated through approximately 135 degrees of arc if the guys are properly spaced. This, together with the fairly broad lobe and bi-directional radiation pattern has provided good world-wide coverage and resulted in all six continents plus Antarctica being consistently worked on 14 mc in the midst of the sunspot slump, without resorting to opening negotiations for a kw final.

The purist may cringe at some of the engineering practices employed in this antenna, and the array at W6WAW is certainly not the optimum to be expected from the configuration. However, the antenna does provide exceptional results on G, LA, DL, UA1, VP8 etc., while the same purists are explaining their 1.01:1 match to a guy within ground wave range and bemoaning the fact that no DX is coming through!

The total height to the center of the array is 26 feet in this case; however, even at this height the low angle of radiation of the quad is apparent from the results. Mechanically the array seems quite secure, having survived one of the local 'Santa Anas' a week after it was put up.

The mismatch in feeding the antenna has not been corrected to date; however, the "skewed" pattern could easily be corrected by use of a gamma match. It was decided to let this change wait until the reflector element is added and a TV rotator installed.

In conclusion: the single element quad has the following characteristics. If any of them meet your requirements, start building; you will be pleasantly surprised at the results obtained.

1. Requires half the space of a Yagi, 8JK, or dipole
2. Requires only a single support
3. Provides lower angle radiation than other horizontal arrays at heights below a half wavelength
4. Requires no radials
5. Costs about $5.00 for a 14 and 21 mc version (excluding coax)
6. Produces less noise in the receiver than a vertical or ground plane
7. Can easily be converted to a two element configuration with approximately 6 db forward gain.

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TYPICAL OPERATING CONDITION

Tube Type	Freq. (Mc.)	Approx. Drive Power (Watts)	Approx. Load Power Output (Watts)
5894	250	6	96
	470	3	33
6252	200	2	67
6360	175	1.0	16
6907	470	3.0	24
6939	470	1.2	6.0
7377	470	1.4	12.5
	960	1.5	5.0
7854	175	3.5	163
8458	175	1.2	30

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The Ultimate Transmitter Control

If your rig suffers from chronic "Haywire Strangulation," or you have to dance a jig to change over from operating one rig to another, read on and see what fortitude and wire cutters can do to cure those common ailments. Of course a little time, effort and some parts

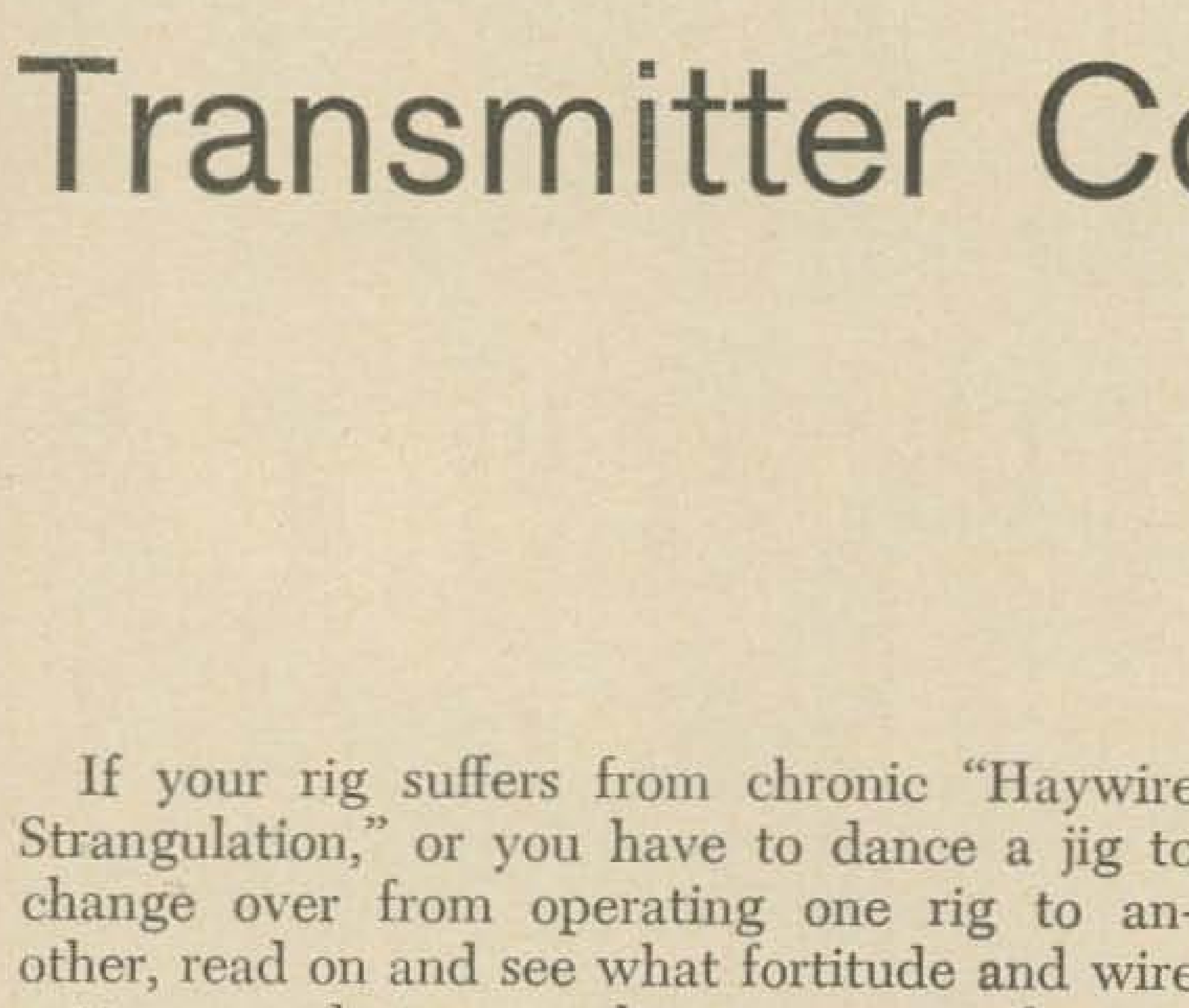


Fig. 1—Control panel

(many of which are probably just waiting in the junkbox) are involved, but the long range dividends of a carefully thought out control and distribution system are too numerous to ignore. Not the least of these is safety, both for yourself and for your rig(s), and certainly there is much to be said for operating convenience and enough flexibility to cover even future rigs.

However, before starting any drastic surgery, let's explore some control circuit ideas and see just how they can be applied. The panel shown in Fig. 1 is a compact solution to centralizing the control functions for several rigs. The controls (l-r) consist of a master line switch (push buttons), control interlock disabling switch, plate supply high-low switch, rig selector (rotary) switch to take care of all power supply, filament and rf switching required to operate the selected rig, and a tune/manual transmit switch.

The indicators (l-r) are red, for a power supply failure or overload, amber in a delay circuit which prevents applying plate voltage prematurely to certain unsympathetic tubes and green to indicate that the filaments are on.

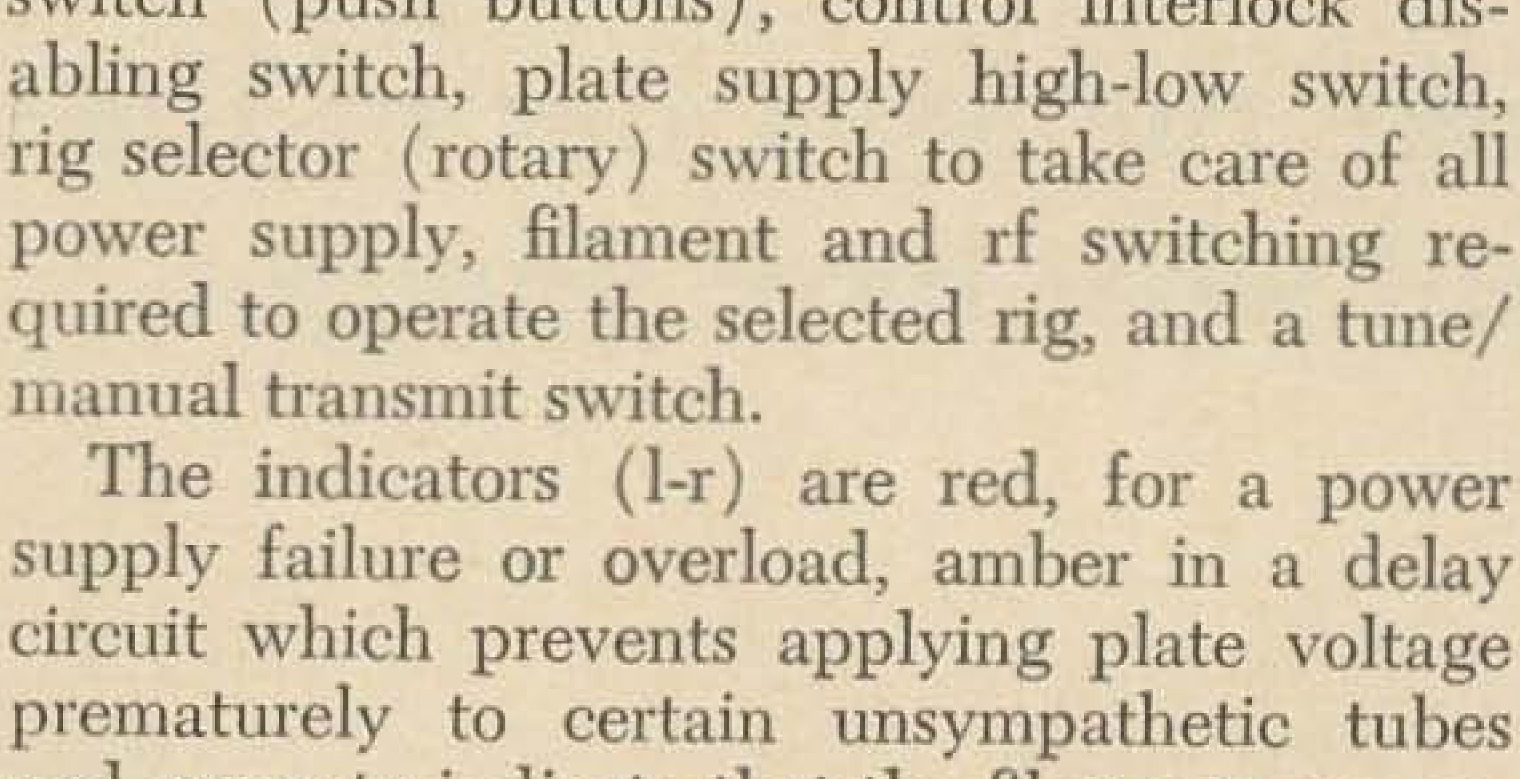


Fig. 2—RY_1 & RY_2, 250 ohm coils, rated 12-24 vdc
$CR_{1, 2, 3, 4}$, 750 mil 100 piv
CR_5 & CR_6 1N34 type
control voltage; 24 vac (rms)

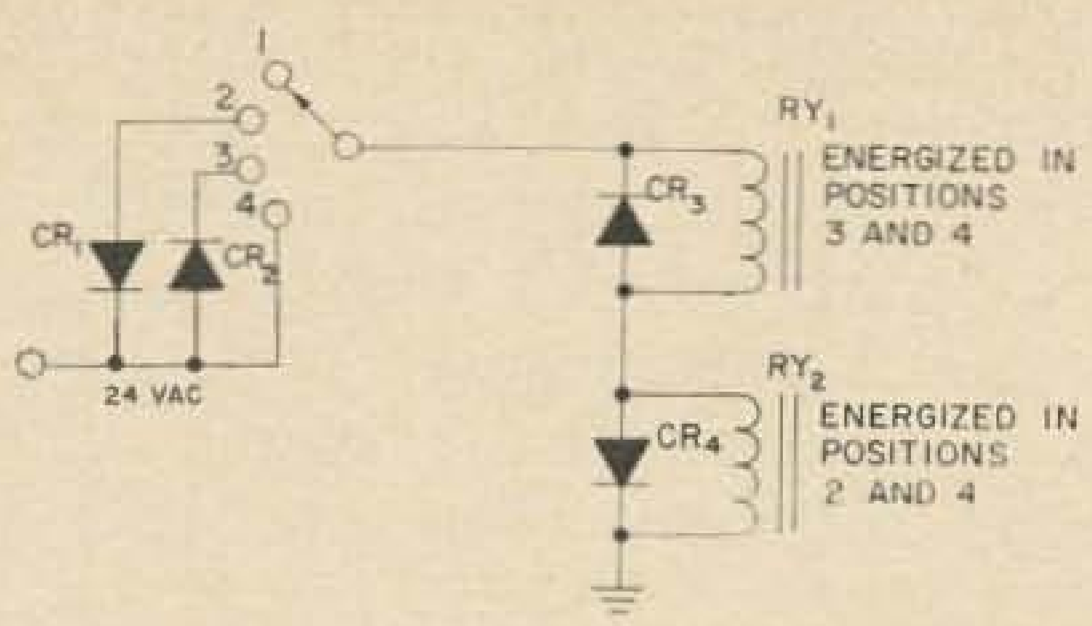


Fig. 3—CR_1 & $_2$, 2-10 amps,* 100 piv
CR_3 & $_4$, 750 mil, 100 piv
Ry_1 & $_2$, 250 ohm coils rated 12-24 volts dc
* Depends on number of control circuits which must be served simultaneously by CR_1 & $_2$.

The white serves unmistakable notice that the selected rig is on the air.

The real heart of the unit lies in the portion that sorts the power supplies, etc., which are required for each rig and performs all of the necessary switching operations. To keep the number of control circuits required down to a respectable minimum required digging into the bag of tricks and coming out with some dc relays, a handful of inexpensive low voltage silicon diodes and a 24 volt transformer. There are a number of advantages in the use of dc relays with quieter operation and longer life expectancy being the most important.

Referring to Fig. 2 you will see how one lead (plus a common ground) can be used with ac for the control voltage to handle either or both of two circuits. Of course dc relays will chatter plenty when operated on raw half wave ac unless something is done to prevent it. The chatter is caused by induction in the relay coils, so by adding CR_5 and CR_6 across the coils we provide a short circuit for this induced voltage but not for the supply voltage. For proper operation the ac voltage should be about 2½ times the normal dc operating voltage for the coils. CR_3 and CR_4 may be rated at about 60% of the normal coil current and CR_5 and CR_6 at about 40%.[1]

In many cases 1N34 type diodes will perform perfectly for CR_5 and CR_6. Occasionally, however, you may find a relay that will not quite operate properly using back-wave diodes at the voltage you have available and in these cases you can substitute a small capacitor (usually 50 mfd is adequate) for the back-wave diode. As a matter of fact you can use relays of mixed voltage ratings in this way, selecting your ac voltage to allow for all-diode operation with the relays requiring less voltage.

If relays for two different functions but operated by the same control lead are located close together on the same chassis, such as in the power supply application described below, the derivation of the circuit shown in Fig. 3 may be used. It provides the same control option as Fig. 2 but with a saving of two diodes. Putting the two relay circuits in series makes each of the diodes perform a double duty; as a polarity selecting rectifier for the relay above or below it and at the same time a back-wave diode for the relay that it is in parallel with. All of the operating conditions including the required voltage are exactly the same as in Fig. 2 as during any half-cycle of the applied control voltage one of the diodes provides a virtual dead short bypassing the relay coil that it parallels and passing the full rectified half cycle to the other coil.

Just a word in passing about the parts values indicated in the accompanying diagrams. Many of the diodes indicated are far in excess of the required ratings with their selection dictated by virtue of their being the cheapest size available locally at the time. However, as the current requirements of various relays may vary considerably and the availability and price of diodes varies even more, it is suggested that you check the bargain ads.

Using the configurations of Fig. 2 and Fig. 3 has proved highly successful for performing the various switching jobs for several rigs. There are a variety of power supplies in the rack at the home station, each of which is set up with two relays such as in Fig. 3; one relay to turn on the primary and the other to switch the output voltage to whichever rig is in use during transmission periods. The filaments for each exciter, amplifier, modulator or what have you are controlled using the Fig. 2 scheme, as are coaxial relays for rf switching. Of course, not all of the power supplies are necessarily in use for any particular rig as the requirements of particular rigs vary from some

[1] International Rectifier Corp. Engineering Handbook.

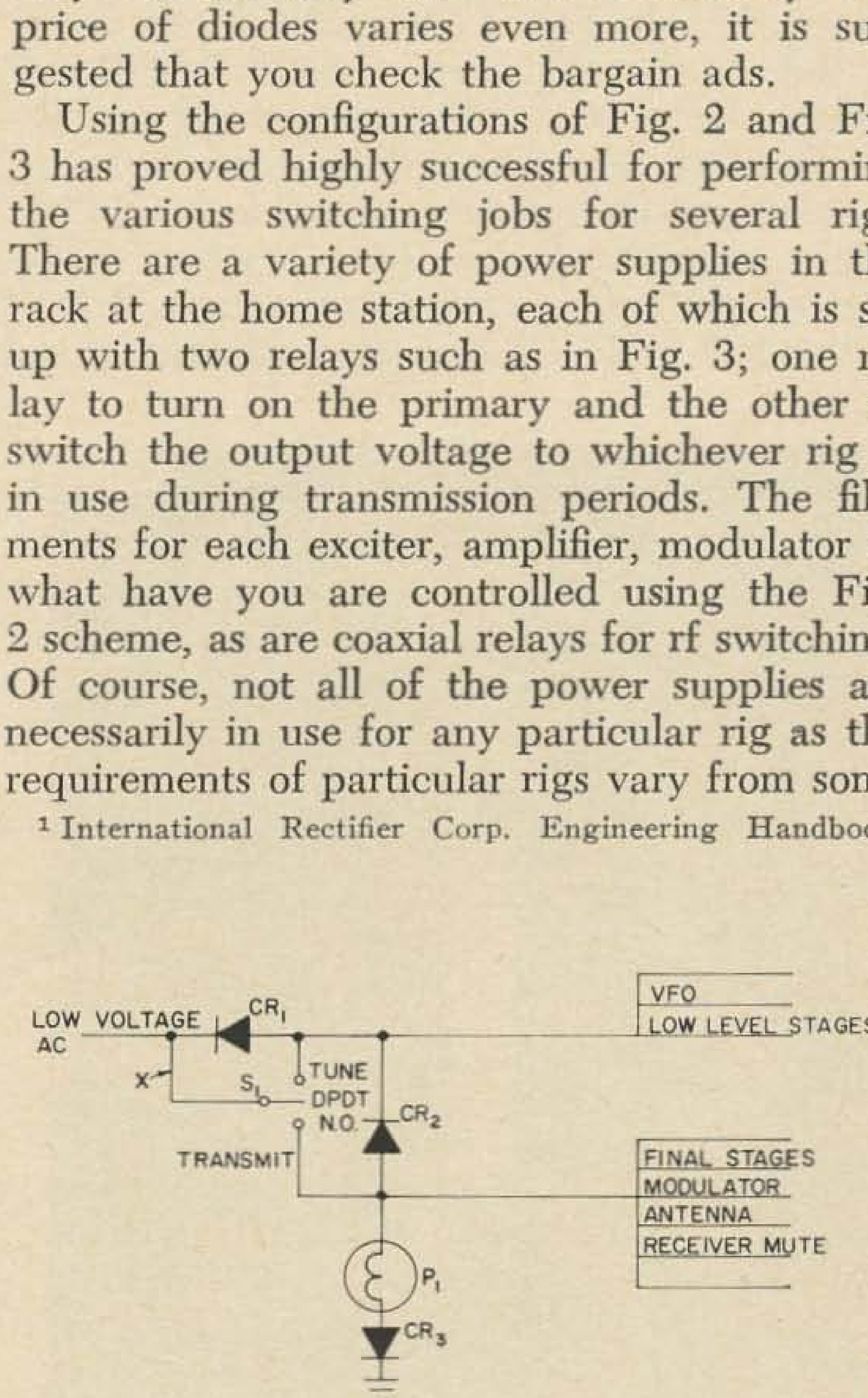


FIG. 4

Fig. 4—CR_1 & CR_2, 10 amp 100 piv
CR_3, 750 mil 100 piv
P_1 GE #313, 28 v
Lof voltage ac supplied by 24 vac, 8 amp transformer (surplus)

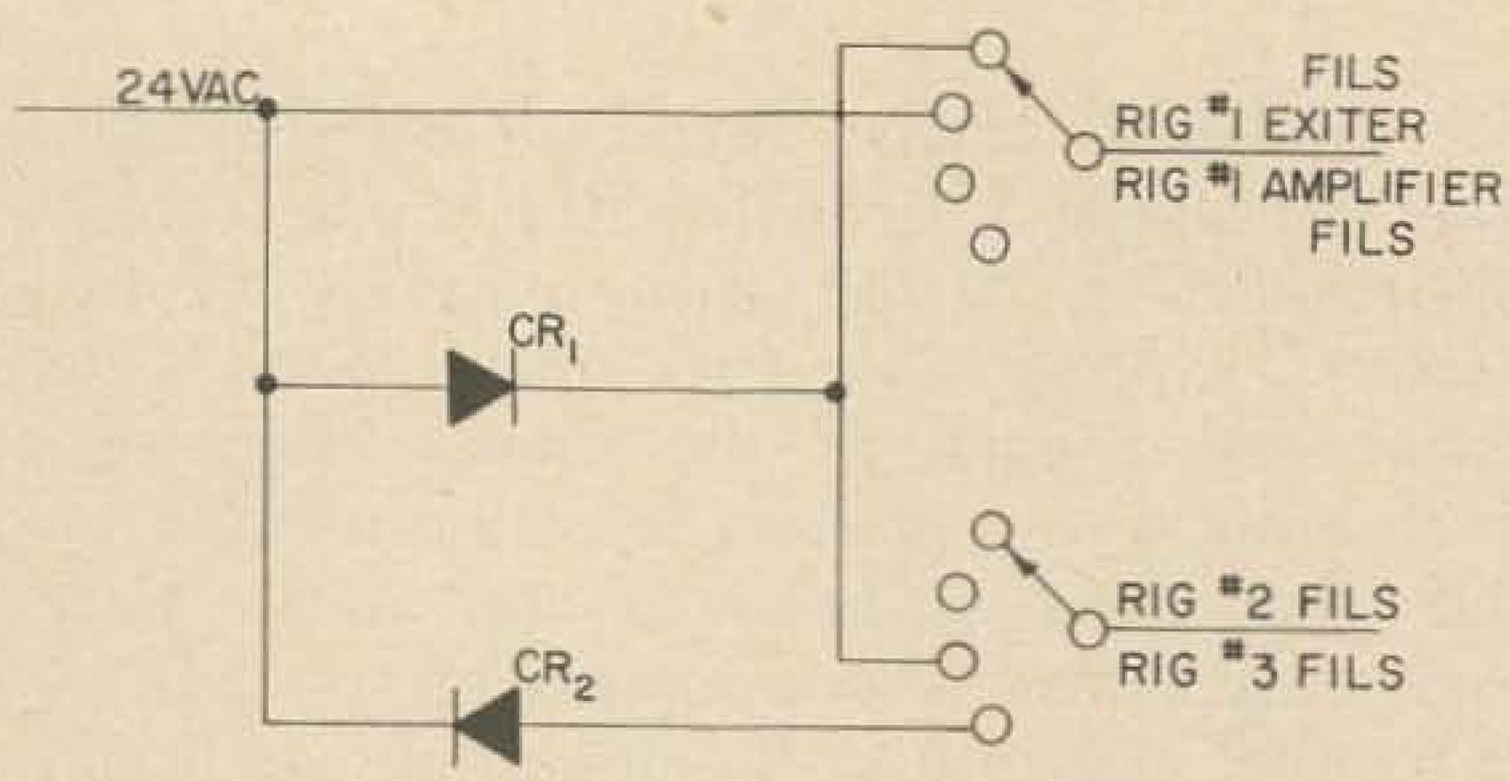


Fig. 5—CR_1 & $_2$, 2-10 amps, 100 piv amps rating determined by total number of control circuits to be served by this part of control system

low powered rigs requiring only one supply to more complex rigs which may require that particular supply plus two or three others.

Now the trick is to wrap all of these control functions together into a simple package that will allow one rotary switch to select the proper power supplies and filaments and do the necessary rf switching to put any of several rigs on the air Fig. 4 shows in block form just how easily this can be accomplished. To simplify the project, all of the power supply control relays have matched polarities; that is, the relays which turn on the primaries of the various supplies all require a negative half-cycle and the output switching is done with the positive half-cycle. CR_1 in Fig. 4 eliminates the positive half-cycle from the power supply control leads during the stand-by period. CR_2 is inserted between the functions which are to be turned on during tuning up and those which are to be turned on only during transmissions and provides a sneaky way of allowing S_1 to function as a tune-transmit switch. The pilot light shown indicates when any rig is on the air.

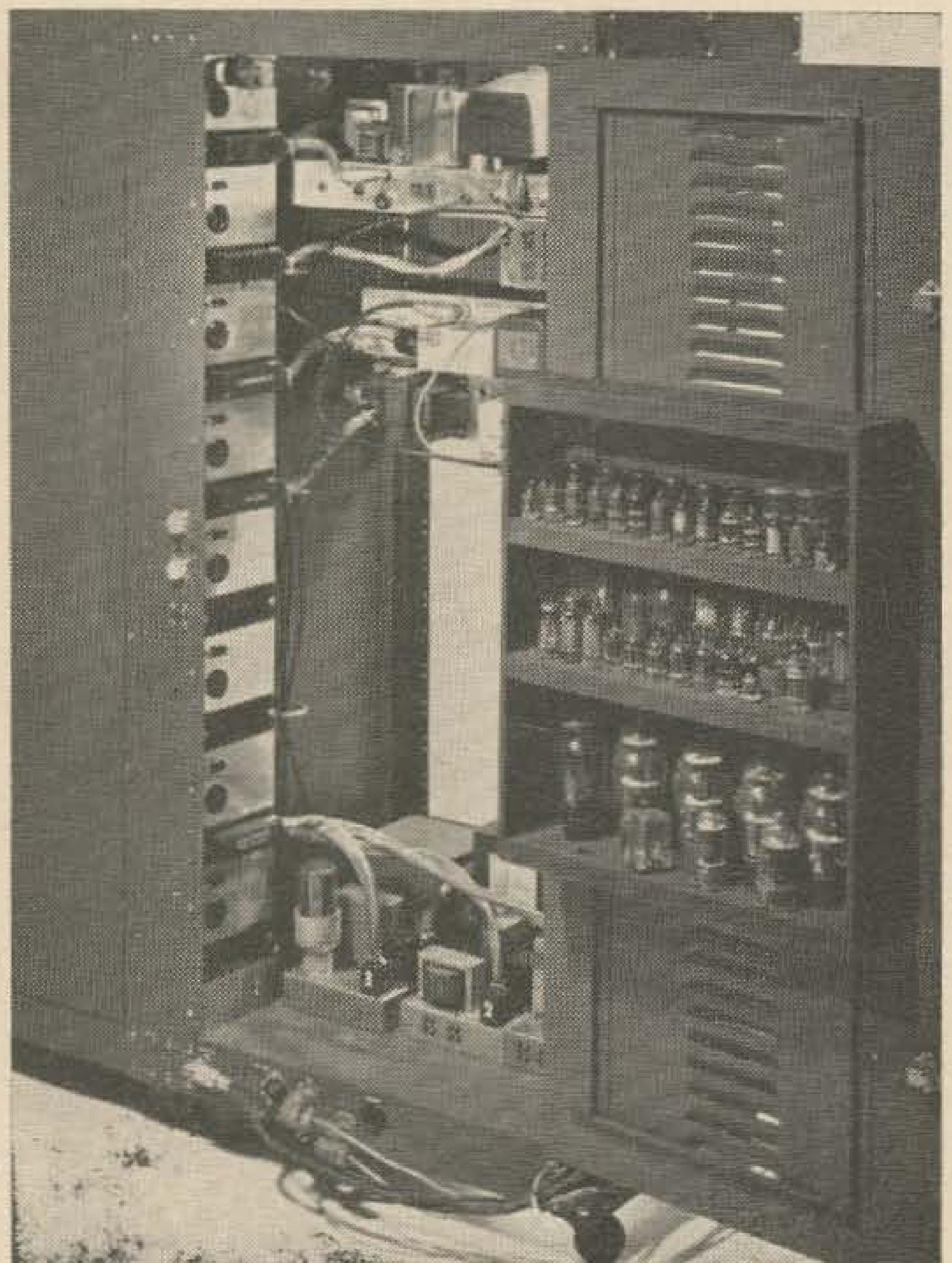


Fig. 6

The control leads shown at the right hand side of Fig. 4 go to a rotary switch which has a number of sections, several sections of which switch these leads on or off as required for the particular rig which that position of the switch selects. This takes care of power supplies, antenna relay switching and receiver muting.

The filament circuit control, and other functions such as switching the output of an exciter from the antenna circuit to an amplifier input, requires a little different system and it is best for these circuits to use a separate section on the master rotary switch for each control lead connected as shown in Fig. 5 which shows a typical setup for one such filament control section.

Proper choice of the rotary switch used for controlling all these functions is very important. The number of sections required will, of course, depend upon how many functions must be performed. The switches that come in knocked-down form are ideal for this purpose as additional sections may be added later if required (if the index assembly is long enough in the first place). Since comparatively low voltages are all that will be handled by this control switch, the sections can be spaced quite close together.

Before going on to some of the little refinements, it's about time to tackle the haywire jungle. As a station grows, so, all too often does the amount of haywire wadded, stuffed and crammed in behind its otherwise well constructed units. An excellent way to dispose of great wads of wire is to make up a distribution strip such as shown in Fig. 6 (photo). Such a strip need be made up only of a number of multi-contact female connectors of any appropriate type, spaced at convenient intervals and connected together in parallel. Each power supply, exciter, amplifier or what have you is then fitted with an appropriate cable terminated with a matching male connector.

In the installation shown, the female connectors on the strip are 33 pin Cinch-Jones spaced on 5 inch centers. These connectors carry all of the control circuits required for several rigs and in additon the dc outputs of all of the power supplies (up to an including

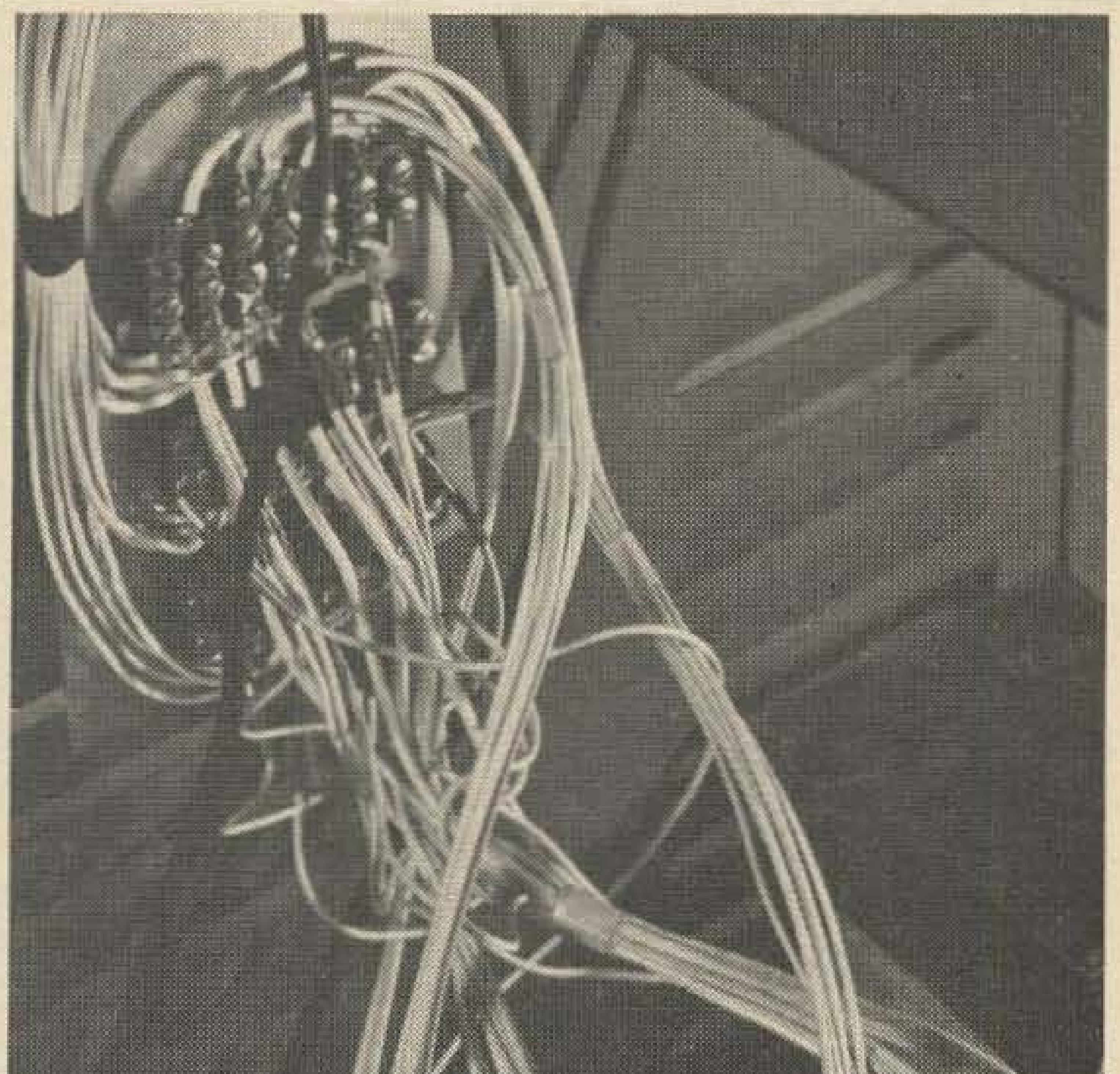


Fig. 7

500 vdc) as well as 110 ac for the primaries of the filament and other transformers. Bypassing can be done as required behind the strip, and the cables connecting the various units to the strip should be made up with shielded cable and well bypassed. The connecting cables shown are made up of individually shielded conductors, inserted in neoprene tubing. In between the 33 contact receptacles, ordinary 110 ac receptacles are included to accomodate any rack sections that do ot require connection to the control system and common power supplies and also to provide a handy place to plug in a soldering iron and/or test equipment during servicing.

Ordinary U-bolts, such as can be seen at the lower right corner of the outside of the cabinet and also just to the right of the distribution strip on the inside, are a very easy way to keep loose wires behind the cabinet from getting caught under the castors, and on the inside are a good way to keep the high voltage leads for the amplifiers, audio and rf cables back out of the way. The section shown open on the photo contains low level stages and power supplies, etc., with the adjacent section set aside for high voltage power supplies and amplifiers but with the control distribution for the two sections interconnected. So, before you start feeling smug, confident that you don't have need of any such at your station, just take a look at Fig. 7 (photo) showing part of the same section as shown in Fig. 6 before installing the

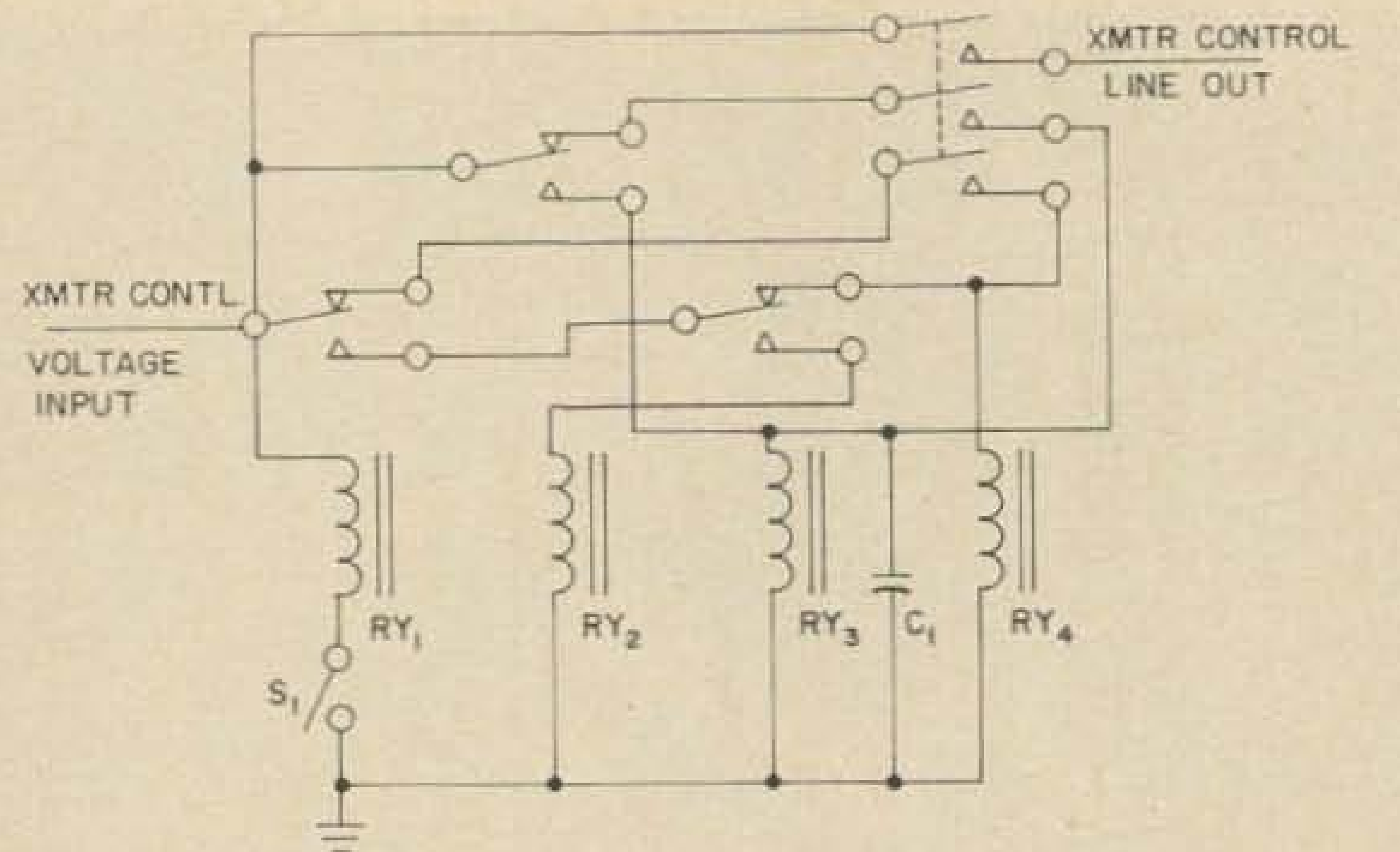


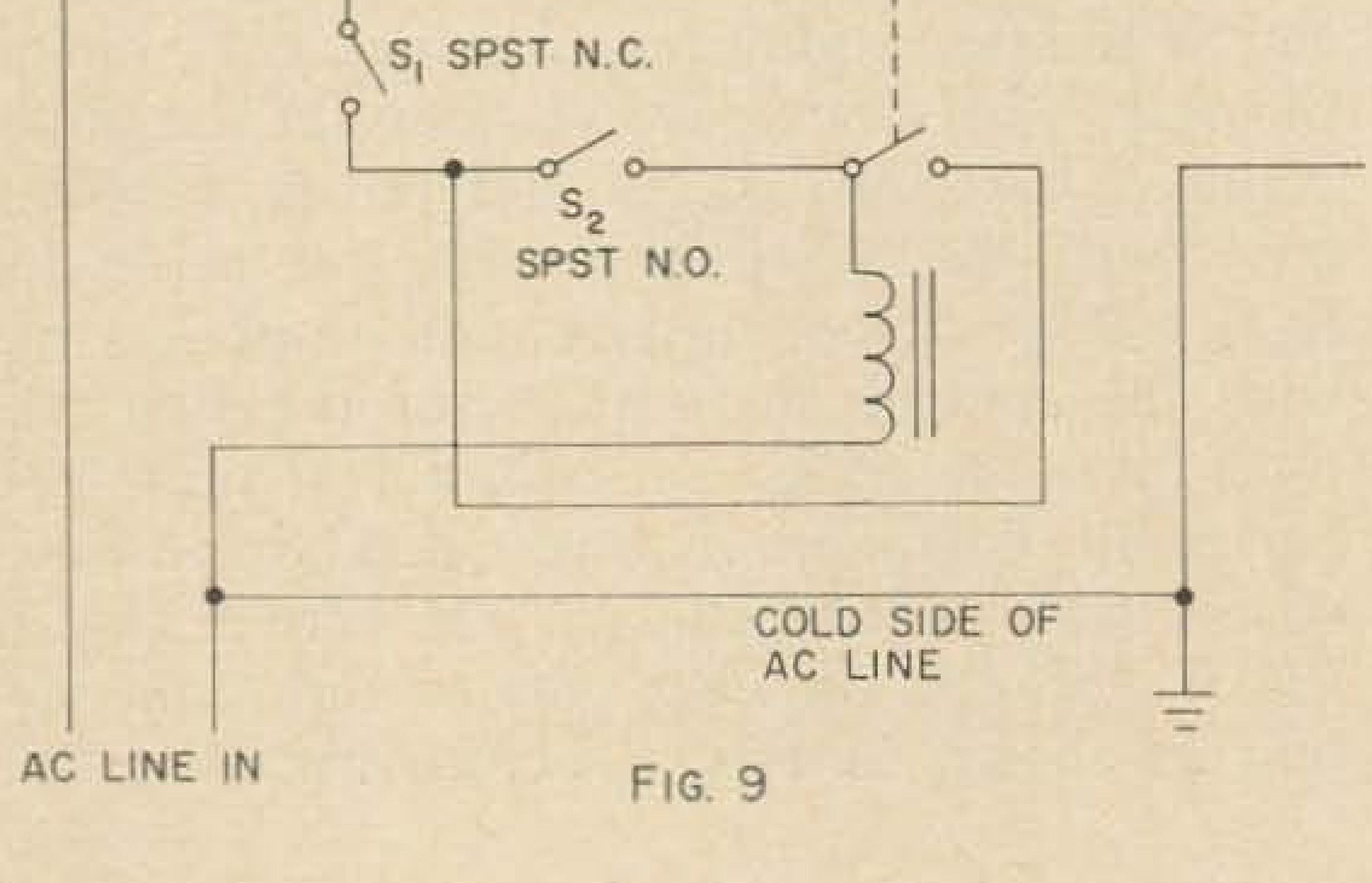
Fig. 8 Ry 1,2,3, spdt (NO)
Ry 4, 3 pst
C_1, see text
S_1, spst (NO) mike switch

distribution strip . . . remind you of anything lurking in your vicinity?

Don't panic at the idea of having male connectors on the output of power supplies; the ac input has to come in through the same connector with this system so assuming you have proper bleeders those pins are cold whenever they are not plugged in. Speaking of connectors, be sure when you select the type to use that you plan ahead and try to anticipate how many contacts will be required even when you finish that super band blaster you've been thinking about building.

Now that we are back in operation we can add some of those little extra conveniences back at the control panel. One of the handiest of them is a lazy mans push-to-talk that comes on with the first push and stays on till the second. Latching relays are the easiest approach, but leave much to be desired.

The circuit in Fig. 8 does the job very nicely, and if there is any interuption in the power during a transmission (such as a power failure or the tripping of an overload relay anywhere along the line) the relays are de-energized until the condition is corrected and the cycle restarted by pushing the button. It is more convenient to use all dc relays since



AC LINE IN

FIG. 9

RY_3 must be of the dc variety with a capacitor across the coil to hold it on during the switching time of the other relays. The value of C_1 will depend upon the relay used and will have to be determined experimentally.

Referring back again to the panel shown in Fig. 1, the failure indicator circuit is a nice little luxury utilizing some bargain relays. Two-bits each bought a bunch of dpdt hermetically sealed surplus relays that operate on 4 ma. One of these was incorporated (with a series resistor to drop the voltage) in the bleeder net of each power supply. The control voltage which turns on the primary of that power supply is also applied to the normally closed contacts. As long as this relay in the bleeder net is not energized the control voltage for that power supply is switched to a failure circuit which in turn energizes a relay back at the control panel. This latter relay interrupts the control circuit at point "X" in Fig. 4 so that the transmiter can not be turned on until all of the power supplies required reach operating voltage, or cuts off all of the high voltages in case of a failure or overload in the middle of a transmission. The resistor in series with the bleeder relay should be adjusted so that the relay will just hold under normal operating load on that particular supply. A failure bypass switch has been provided on the panel in case it should ever be useful.

The master power switching is done by the two push buttons shown at the left side of the panel. These in turn operate a *heavy duty* relay with contacts more than adequate to handle any size rig. The exact specifications for the relay(s) used for this purpose will depend entirely upon the individual station and whether it is fed by 110 or 220 vac, etc. However, the general wiring scheme is shown in Fig. 9. Separate contacts should be used for the main line and the circuit to hold the relay(s) closed to prevent putting the whole starting surge across the push button.

The stop button should be well marked and placed where the XYL can find it in a hurry . . . just in case.

It probably looks like a lot of work to go to, and it is. But the next time your rig sends up smoke signals and you start fighting that copper jungle to get at it, or you go through a long ritual when changing over from one rig to another, stop and think about what you can do about solving the problems in your station. Better yet don't wait for your next crisis; do it now and then settle back for some real relaxed hamming.

. . . WB2CCM

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DSB Circuits

There are several ways of providing audio to modulate double-sideband transmitters. All of them have been mentioned in amateur publications, but not all have been widely used.

Fig. 1 shows the most common DSB arrangement. The transformer, T1, can be a Triad A31X or a Thordarson 20D76. A power transformer can also be used. By using the plate winding of the transformer to drive the screen grids of the DSB tubes, an approximately 3:1 or 4:1 (or higher, depending upon the characteristics of the power transformer) step-up is accomplished. The writer has used this system, and the audio quality is quite good.

Another method uses a cathode follower arrangement, as shown in Fig. 2. Depending upon the tubes employed, about 150 volts can be realized at the screen grids of the DSB tubes, which is adequate when using the smaller receiving-type tubes in a low-level DSB balanced modulator.

A system the writer has used for some time with considerable success and excellent audio quality is shown in Fig. 3. This system assumes the existence of an AM transmitter, and uses both its rf and audio outputs. The big problem, of course, which prevents use of conventional modulation transformers in most DSB applications is the lack of a secondary winding center tap. That lack can be overcome by using rectifiers—either tube or silicon—connected across the secondary as shown in Fig. 3. These rectifiers, with the balanced modulator tubes, form in essence, a bridge circuit so that both the positive and negative peaks cause audio voltage to be applied to the balanced modulator screens. We have used both tube (6X4) and silicon rectifiers with equally good results. The modulator in the author's AM rig is rated at approximately 60 watts output, which is, obviously, many times more audio than is required for the screens of the DSB tubes, so resistor R1 is placed across the secondary not only to absorb the excess audio power, but to provide an adequate load for the transformer. In the case of the illustrated transmitter, a 10-watt, 4000-ohm wire-wound resistor is used, and the audio gain on the AM transmitter kept very low. Because of the limited amount of audio allowed to reach the modulation transformer, and because the power output of the transformer is intermittent, the 10-watt resistor shows no signs of overheating except on the application of a continuous tone over a period of about one minute. The audio circuit of the transmitter was designed to minimize lows through use of small coupling capacitors, and

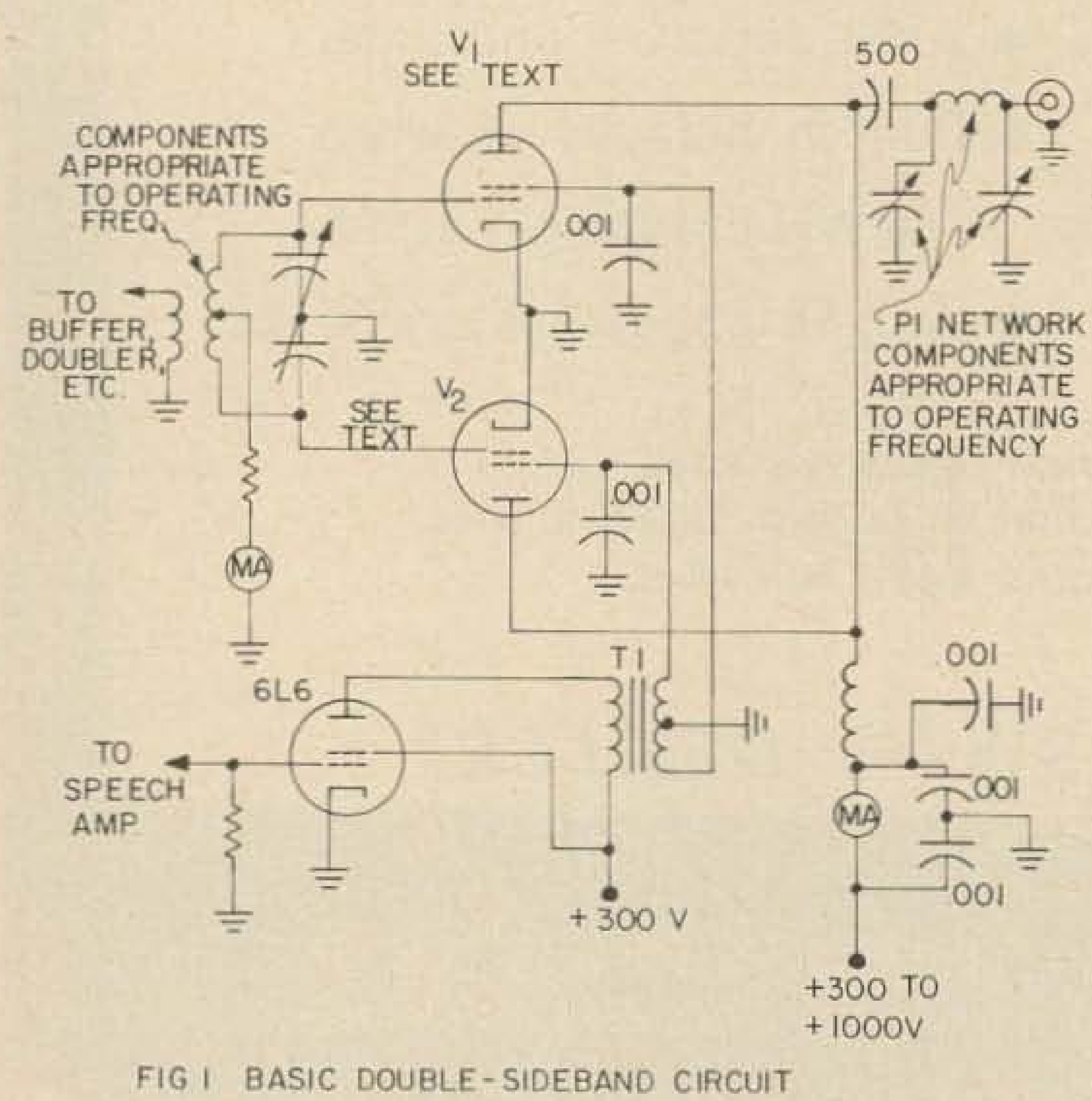


FIG 1 BASIC DOUBLE-SIDEBAND CIRCUIT

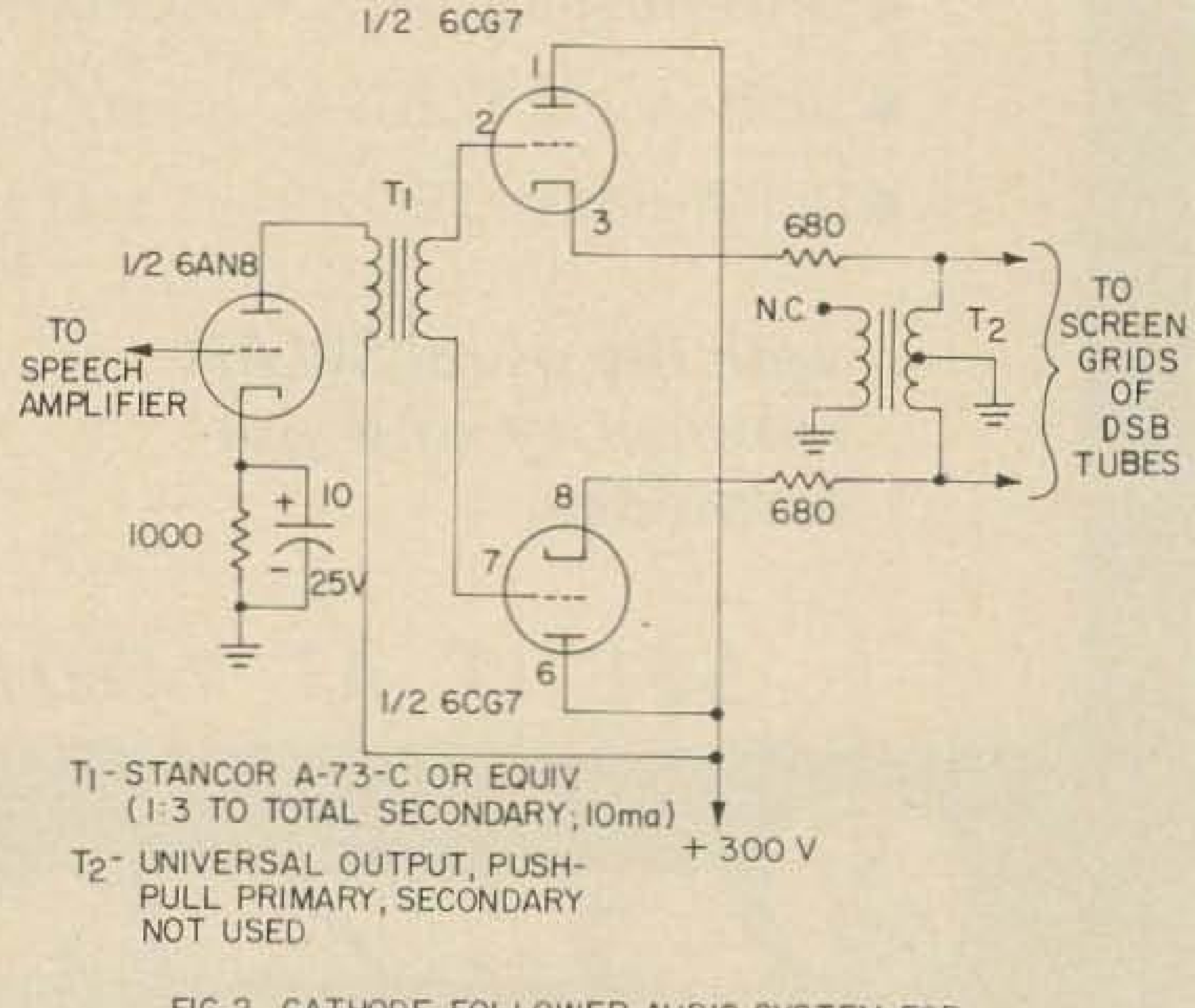


FIG 2 CATHODE FOLLOWER AUDIO SYSTEM FOR DSB TRANSMITTERS

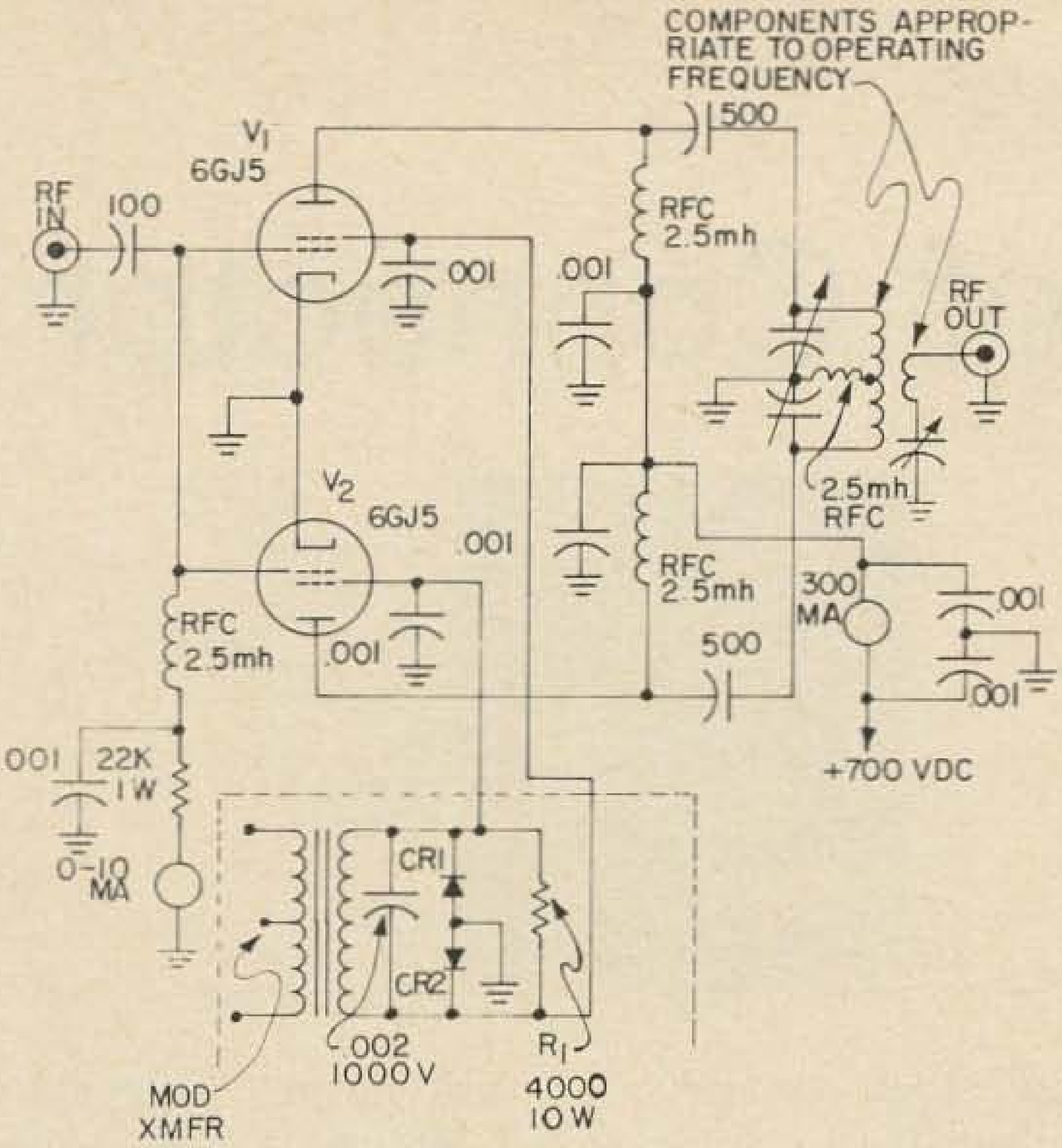


FIG. 3

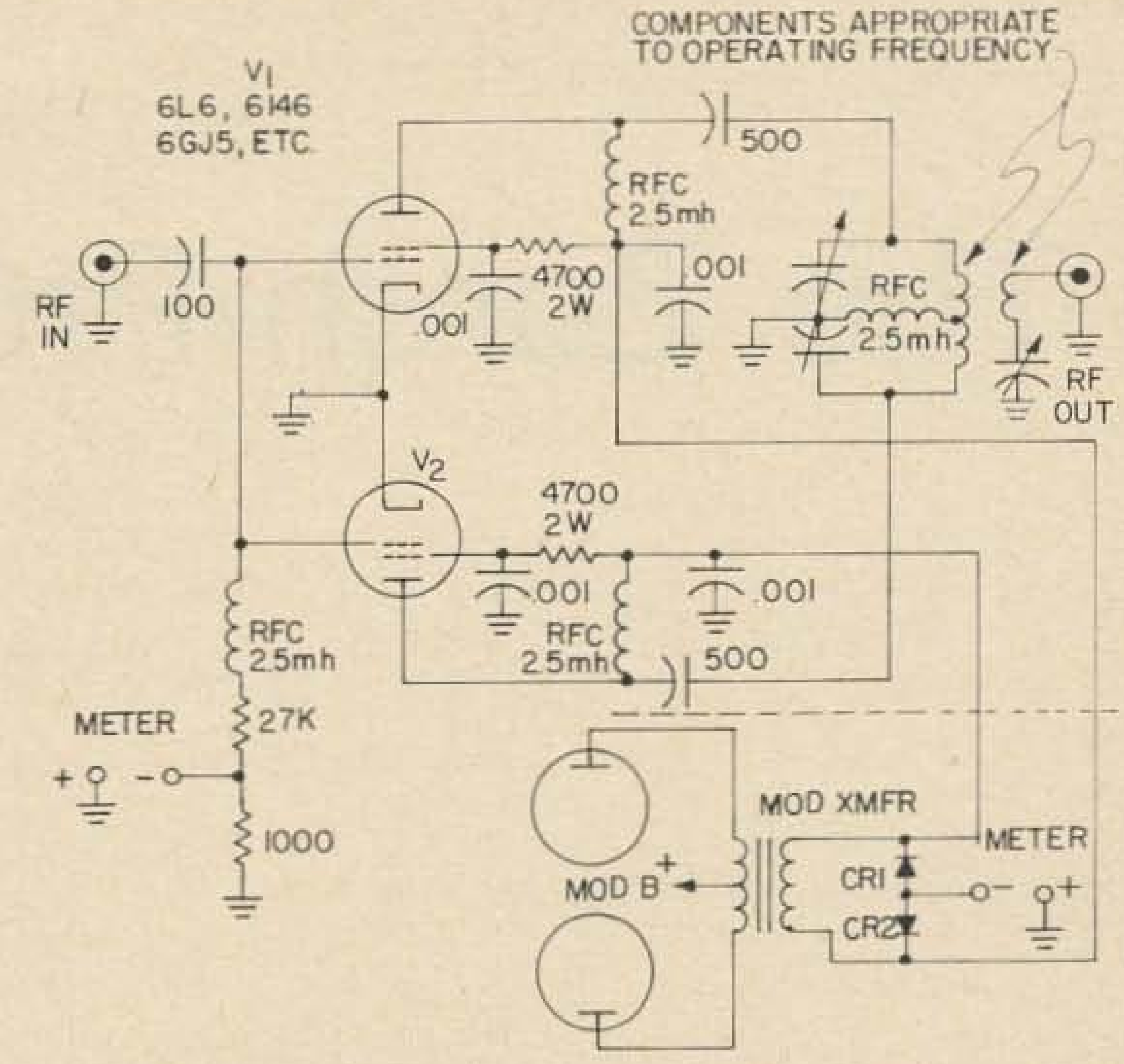


FIG. 4 HIGH-LEVEL DSB BALANCED MODULATOR

the capacitor across the secondary of the modulation transformer reduces highs.

The use of auxilliary rectifiers was described by Rockafellow *, as was the next system to be described. Fig. 4 illustrates a high-level double-sideband balanced modulator which obtains both plate and screen voltage from the modulator contained in an existing AM transmitter. The rf drive is also obtained from the same transmitter. The only problem encountered by the writer in using this system was that the voltages measured from one end of the secondary to ground (at the rectifiers) and from the other end of the secondary to ground were not equal upon application of a single tone to the modulator. The result was unequal voltages to the screens and plates of the DSB balanced modulator tubes. Consultation with an engineer more learned than the writer resulted in the conclusion that this effect was caused by one end of the secondary winding having a larger capacitance than the other end to the primary winding. Various values of capacitance were tried between the individual ends of the secondary and primary windings and the situation was noticeably improved with the use of 160 mmfd between one secondary terminal and a primary terminal.

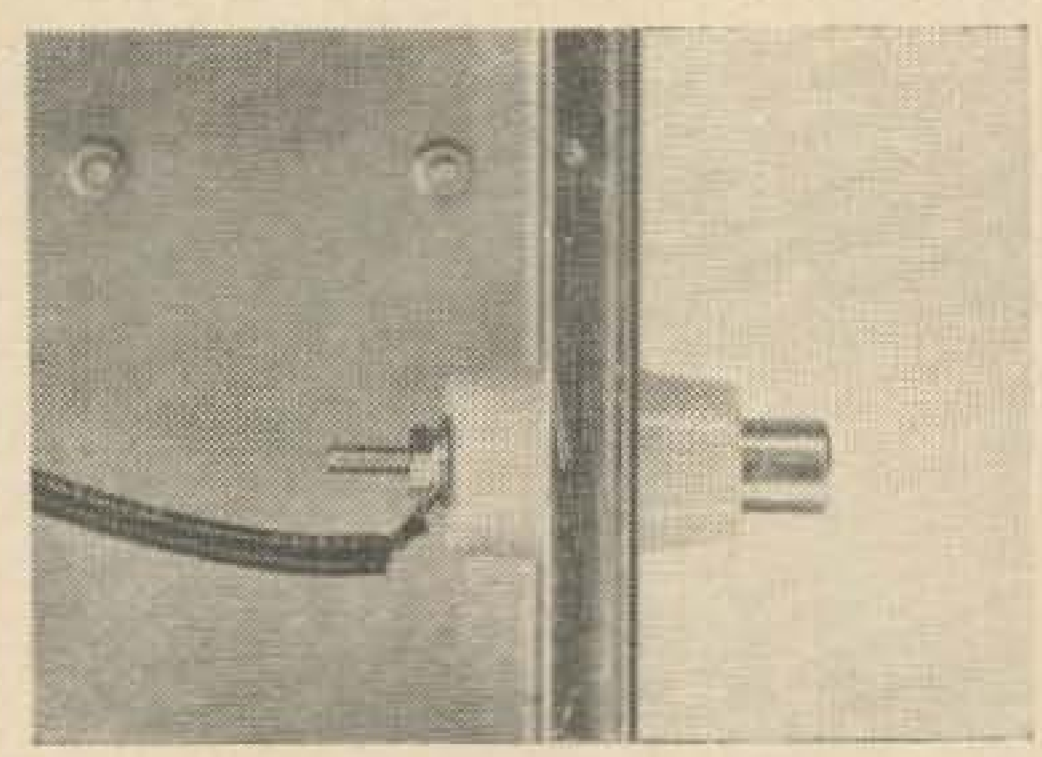
An important word of caution. Although DSB is an easy way to "get on sideband," it still requires care in the construction and operation of the equipment. Before you put any piece of DSB equipment on the air, *look at the output with an oscilloscope.* Beg, borrow, or steal one, but use a 'scope. With a single tone from an audio oscillator as the audio input, load the transmitter as heavily as possible and observe the pattern on the scope. It should be the familiar "two-tone" (if it isn't familiar, then refer to any recent A.R.R.L. Radio Amateur's Handbook!) pattern. Increase the audio gain and note the point at which the peaks flatten. (Remember that a single-tone DSB signal will produce the same pattern on an oscilloscope as will a single-sideband two-tone signal.) Then connect a microphone and talk. You will find that the same peak on the oscilloscope achieved under single-tone modulation will be reached with your voice at a plate current meter indication of between one-third and one-half the single-tone plate current reading. It is at this point where some DSB operators run into trouble. Many try to "talk up" the plate current meter to the point at which they would operate under CW or AM conditions. It simply cannot be done without flat-topping, which results in distortion and splatter.

Remember, too, that to a linear amplifier, a DSB signal is the same as a two-tone SSB signal, and flattening of the peaks, and consequent distortion and splatter, will occur at a lower plate current meter reading than would occur with a single-tone SSB signal. The efficiency of a linear amplifier is lower in the case of a two-tone SSB or single-tone DSB signal (around 50% is all that can be expected) which may be a good argument for using high-power, high-level DSB modulators, with their excellent Class C efficiency, if you plan to run much over 200 watts PEP input.

. . . W6TKA

* Rockafellow, "High-Level Balanced Modulator for D.S.B." QST, April, 1960.

The Zorch-Proof Connector



Roy Pafenberg W4WKM

Interconnection of high voltage points in high power transmitters poses several problems. Factors to be considered include adequacy of insulation, appearance, availability of materials and—most important of all—safety. The photograph shows an excellent method of making such connections between chassis units.

A ceramic feed-through insulator of adequate voltage rating is mounted at the high voltage terminal point. The feed-through stud nut on the external connection end of the insulator is replaced with a ⅜″ diameter, internally threaded ⅜″ to ½″ long round metal post. A standard, ceramic insulated tube plate clip is then used to complete the connection. Suitable plate clips are manufactured by several firms. Of these, the National Radio type SPP-3 is perhaps the most widely available.

The round metal posts may be made from rod stock or may be purchased. Internally threaded, round metal posts in ⅜″ diameter were not found listed in the parts catalogs. Various firms stock round, ⅜″ diameter, cadmium plated brass posts with unthreaded clearance holes. It is a simple matter to tap the screw clearance hole to accept the stud used in the feed-through insulator. The following listing gives Herman H. Smith part numbers for ⅜″ and ½″ round posts:

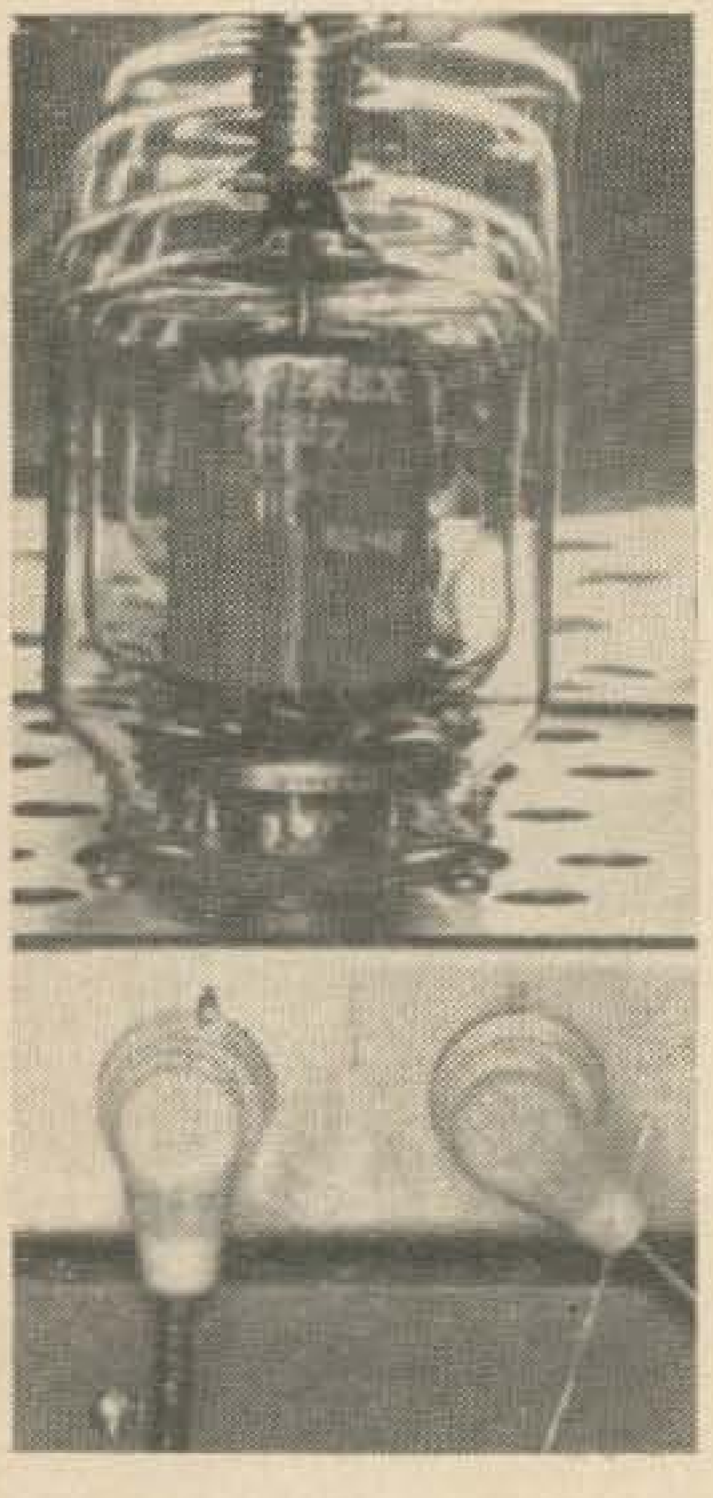
	Clearance Hole		
Length	#4	#6	#8
⅜″	2346	2111	2116
½″	2347	2112	2117

Cable used to interconnect the plate clips must be suitably insulated. Automotive spark plug cable is one possibility; TV high voltage lead another. Probably the best cable for this use is neon sign cable. Known as UL type GTO-15, this cable is rated at 15 kilovolts. Because of its high voltage rating, easy availability and low cost, this cable is widely used in commercial transmitters.

The technique described above is not limited to chassis interconnections. Many high voltage components use threaded stud terminals which lend themselves to this treatment. Simply thread on the round posts and complete the wiring with tube clip terminated high voltage patch cables.

The wiring method presented here is not intended for use in exposed locations. *Always* house high voltage circuitry in interlock protected cabinets. However, it is sometimes essential that equipment be tested with power applied. In such cases, exercise the greatest caution and stay clear of the high voltage circuits. This improved insulation system will then serve to minimize the danger of inadvertent contact with exposed high voltage points.

. . . W4WKM



The Zorch-Proof Connector at work.

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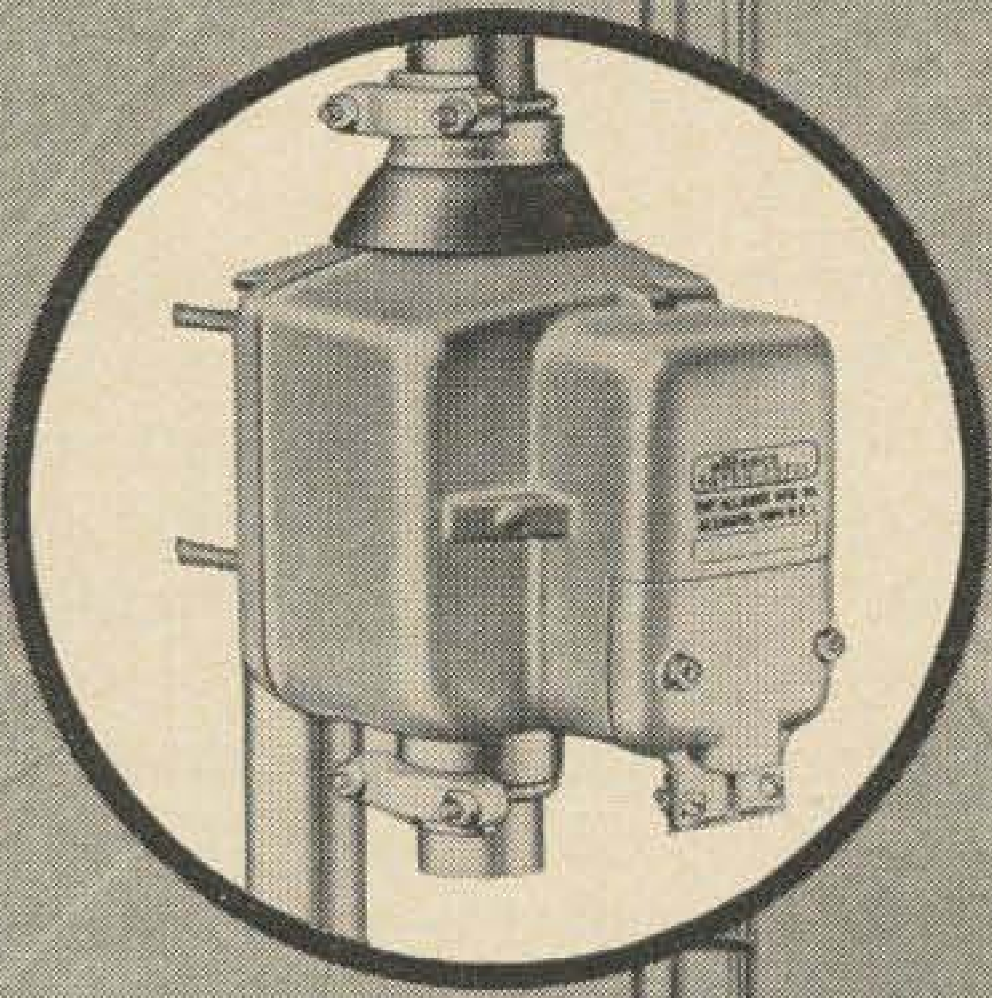

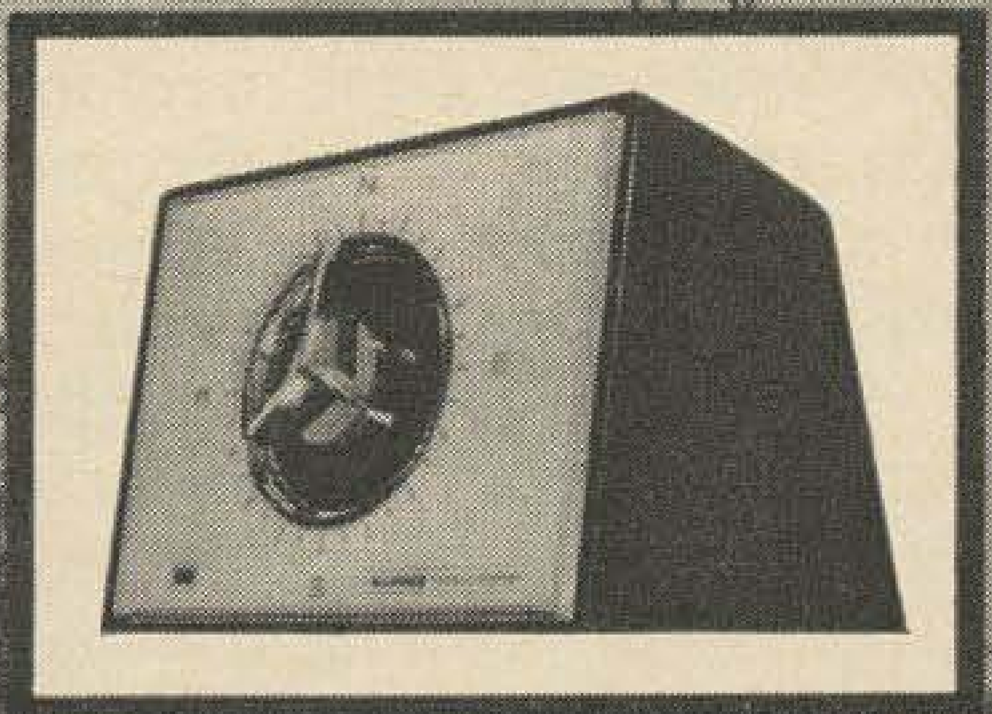

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A Full-Wave Bridge With One Filament Transformer

Recently, while searching around for components to be used in a medium high voltage power supply, 1200 to 1500 volt class, this bridge rectifier circuit was dreamed up to use with the components on hand. A 750 volt, each side of center tap, plate transformer, and TV damper tubes, for rectifiers, in a bridge rectifier circuit, to give the desired higher voltage, for more efficient operation of our linear amplifier in SSB service. This bridge is very unique in that it uses only one filament transformer.

Silicon type rectifiers were first considered, but they have their own particular drawbacks, and are expensive, when it is considered how many it would take in a series arrangement in each leg of a bridge circuit, operating at these voltages. Tube type rectifiers still seem to be the best bet in this circuit, but using 816 or 866 tubes requires the use of three filament transformers, so cathode type tubes were considered. The ideal tube should have its cathode separate from, and be independent of, the filament. The half wave rectifier tubes developed for TV damper service fill this requirement, and have been used in high voltage power supply circuits many times by amateurs. Several articles have appeared in the ham publications in recent years using these rectifiers in bridge circuits. Practically all of these circuits use a 5U4 tube for one half of the bridge and TV damper tubes for the other half of the circuit. This arrangement is commonly known as the "economy power supply," and uses a TV set power transformer with a bridge rectifier circuit to get twice the output voltage, as you would with a full wave arrangement. Around 700 volts can be obtained from the economy supply, using a power transformer from an old TV set, and its schematic is shown in Fig. 1. One objection to this circuit is that it takes two filament transformers, one of 5 volts or the 5U4, and another of 6.3 volts for the cathode type recti-

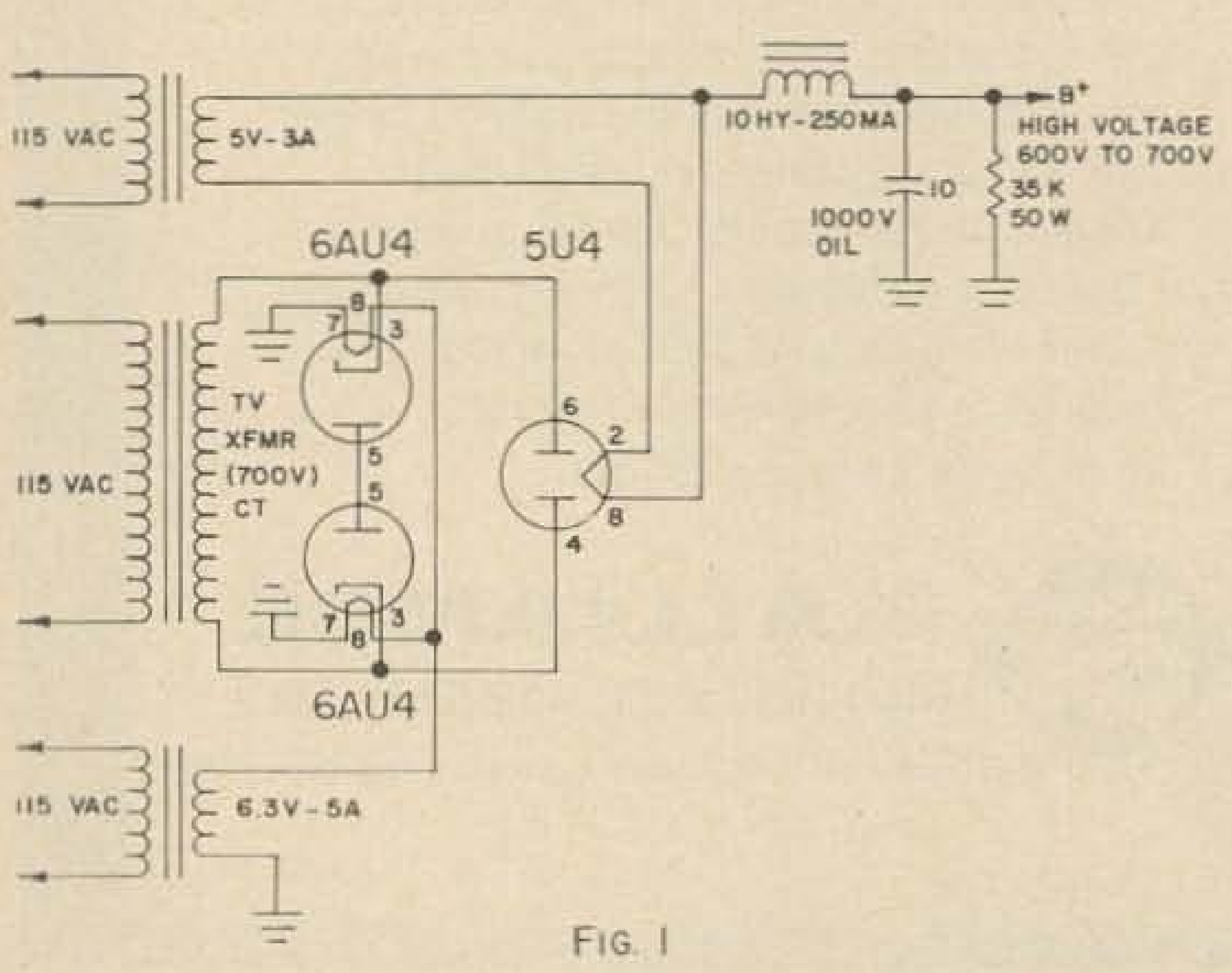

FIG. 1

fiers. This is definitely an improvement, in our way of thinking, for a bridge circuit, but we are faced with the problem of needing two filament transformers.

Since the TV damper tubes work so well in the arrangement in Fig. 1, and this set-up has been in use many years, so is pretty well proven, there is no reason why the TV damper tubes can't be used for the other half of the bridge circuit, provided they have sufficiently high enough voltage ratings. Since the TV damper tubes have a cathode in them, separated from the filament, our problem of the multi filament transformer is solved, as shown in Fig. 2.

Searching through the receiving tube manual, our choice of rectifier tubes is the 6AU4GTA. The main rating we have to look for here is the breakdown voltage, from heater to cathode. The tube manual gives it as 4500 volts, and that is about three times the voltage we plan to use in our power supply, so this tube should suffice. Now, another rating to consider: Maximum operating plate current, and it is 210 ma, which is a little under the maximum peaks, pulled from the supply, but well above the average value. So, from the tube manual, this tube fills our bill for a good rectifier, with a separate cathode. Another damper tube that would be OK for a rectifier in this circuit is the 6DE4. It actually has a higher heater to cathode breakdown voltage rating, but the average dc plate current rating is only 180 ma, therefore the 6AU4GTA is still the best tube, with all factors considered. Actual voltages are as follows: The transformer secondary ac voltage is 1530. With the bleeder current and static plate current being drawn on the linear amplifier, output voltage is 1430 volts dc. On voice peaks the meter on my linear amplifier indicates 350 ma and the voltage drops to 1350 volts dc, which is fairly good voltage regulation, with only 8 mfd of capacity on the output of the power supply. More capacity could be added and even better voltage regulation could be achieved; however this holds true for any power supply, regardless of the type of rectification used. Another hint is to use a good, stiff bleeder resistor. If a power supply has a good, constant load on it, the regulation will be much improved, when higher current is drawn, plus the safety factor of discharging the filter capacitors when the power supply is turned off.

The only other thing that is a little different about this power supply is the placement of the filter choke in the negative lead. It is not anything new, but is a little uncommon. This

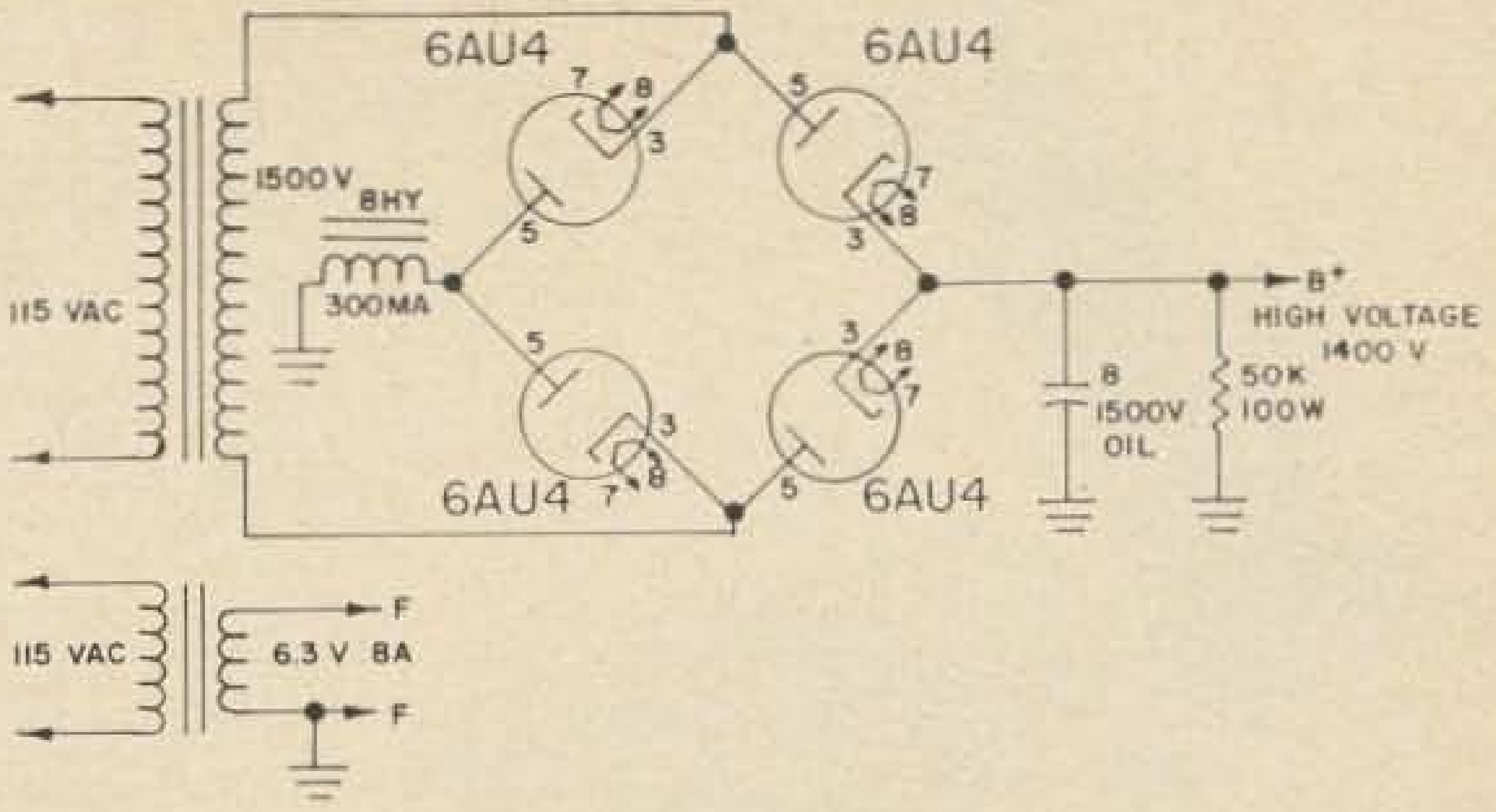

FIG. 2

was done so a choke of a lower voltage breakdown rating could be used. This particular one used here has a rating of 8 hy at 300 ma. A choke manufactured for use in a TV set could be used in this way, because the actual high voltage is not on it, as it is when the choke is placed in the positive lead. It is still considered to be a choke input filter however.

Money-wise, this type of supply beats all other types, we think. A transformer with a rating of 750 volts each side of center tap, costs about one third the price of one rated at 1500 volts each side of center tap. Rectifier tubes: The 6AU4GTA cost $1.80 ham net, on the current tube price list. And of course the big savings is in the filament transformers: Only one against three in a conventional bridge circuit, or two, in the economy type supply, shown in Fig. 1.

I fully expect some rebuttal from readers of this article, telling the many reasons why it won't work, but I would welcome any constructive criticism. This power supply has been in use here for several months now, and I have never had one bit of trouble with it. My linear amplifier uses three 837's in a grounded grid circuit, and I drive them to 350 ma on peaks, with a Central Electronics 20-A exciter. I have never once been given a report of flat topping, hum or distortion being noticed, or any of the other things that could be caused by power supply troubles.

In closing, I would like to say that this is an excellent power supply; as good as any that I have ever had in my shack. Also, I would like to mention my two good friends, W5SHL and K5FMJ, who have built up similar type power supplies, and their units have worked equally well with voltages up to 1900 volts.

This power supply was designed for Single Side Band operation, with high peak currents drawn from it, with a relatively low average value. For constant current service, with current requirement higher than the capabilities of the tubes, it is definitely not recommended.

. . . W5NGX

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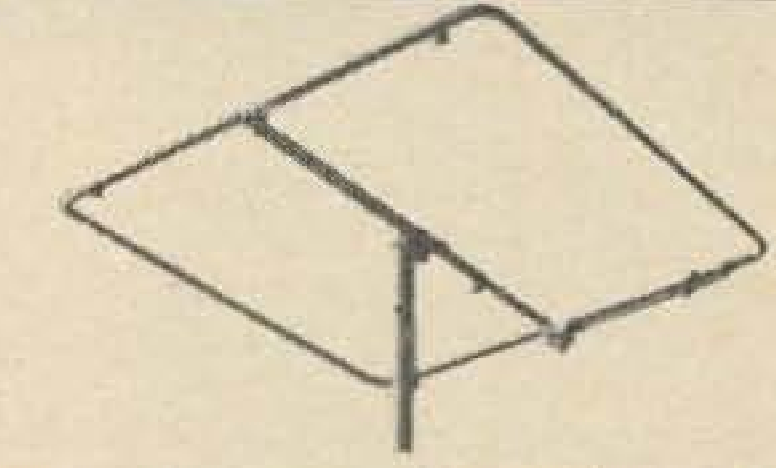

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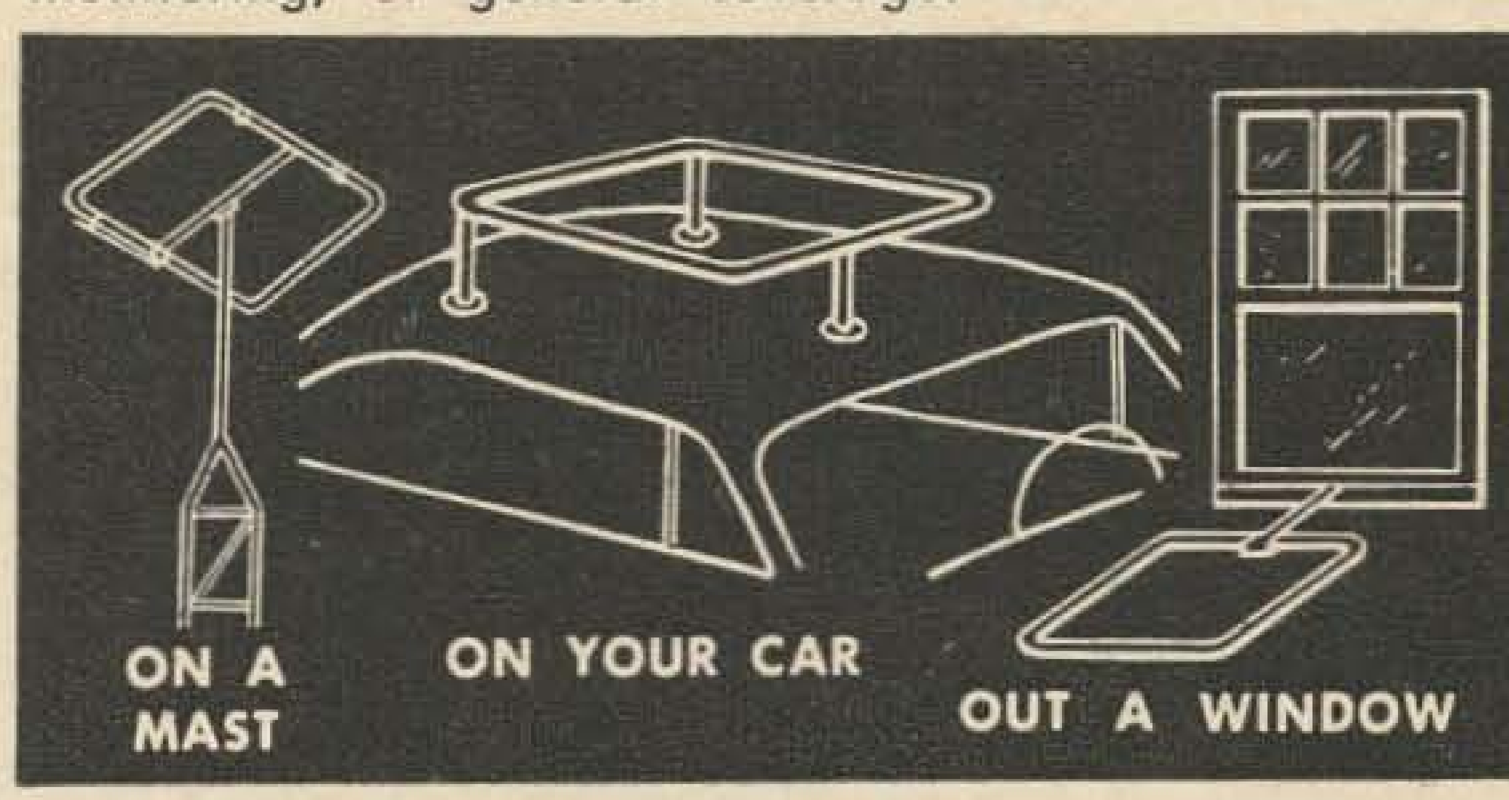

MODEL NUMBER	DESCRIPTION	NET PRICE
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ASQ-10	10 Meter 50" square	19.50
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ASQ-15	15 Meter 65" square	23.50
ASQ-20	20 Meter 100" square	29.50
ASQ-40	40 Meter 192" square	66.50

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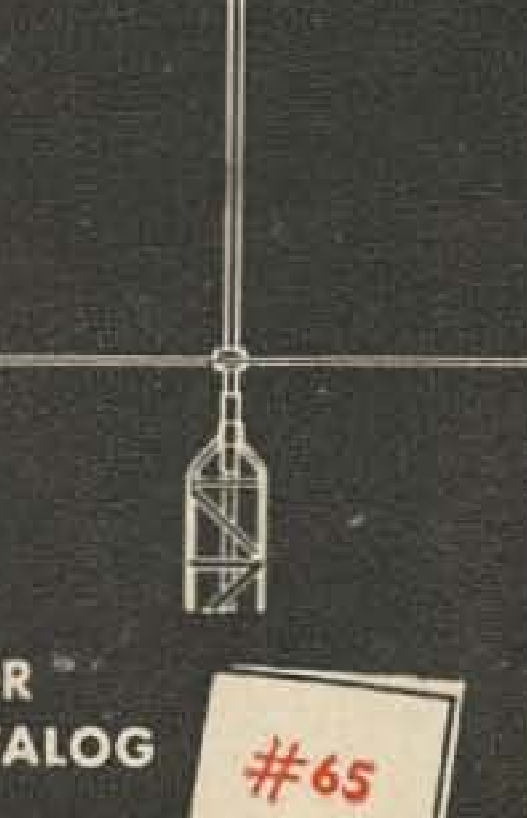

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A Cheap SWR Bridge

The unit to be described in the following paragraphs is not "just another SWR Meter" but is designed to be easily duplicated, and it makes use of a printed circuit board for the critical part of the unit.

As can be seen in the photo of the interior, the section of line that is used for indication of SWR is made up of a section of double sided printed circuit board at the suggestion of WA1CCH. On one side can be seen the portion of line that is connected between the input and output coax connectors. Also on this side may be seen the diodes, bypass capacitors, and the load resistors. On the reverse side of the board are the two pick-up loops that provide the indication of forward and reflected power.

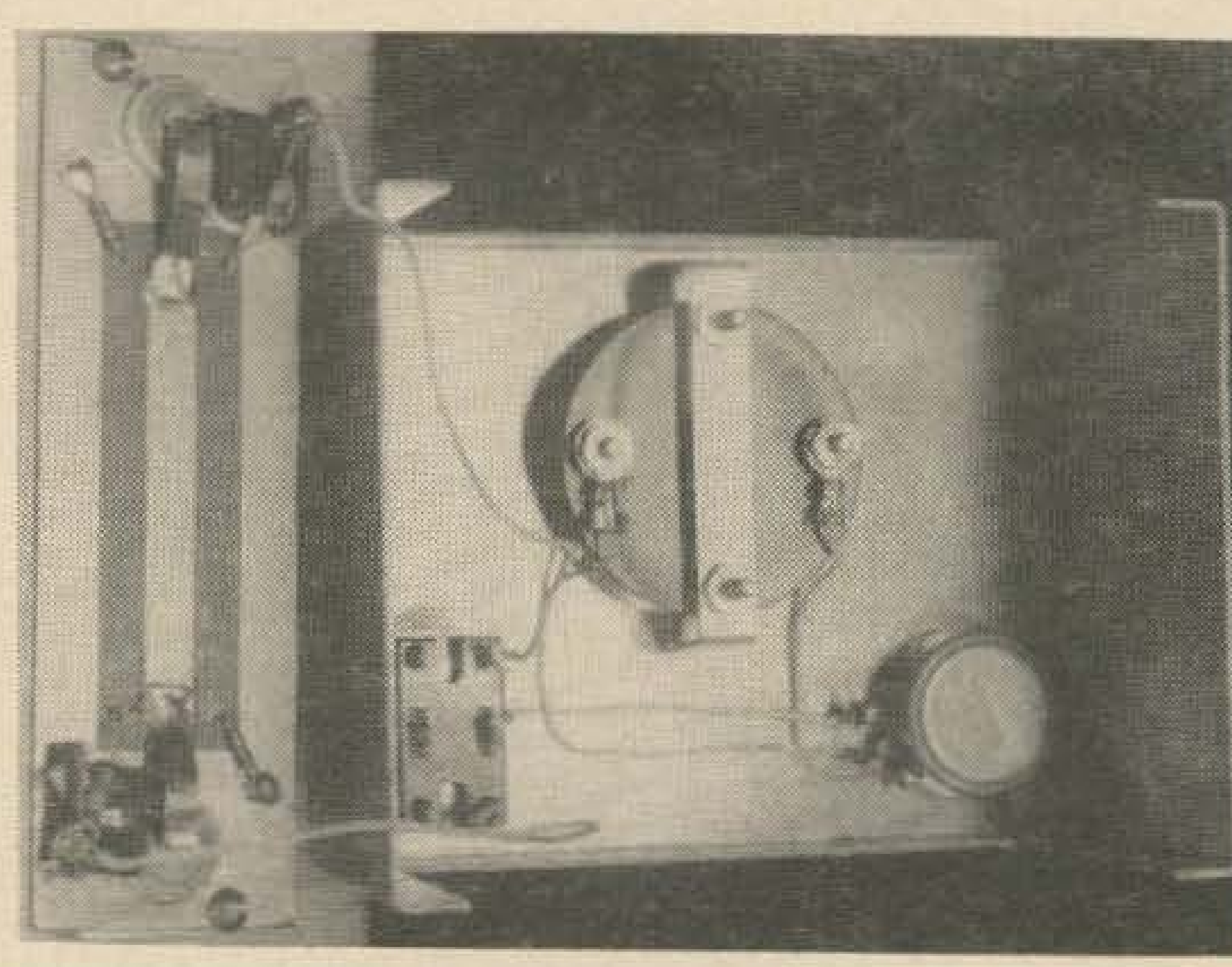
On the front panel of the unit are mounted the meter, calibrating resistor, and the selector switch. It may be noted that the switch I used is a DPDT. This is because it is what I had available at the time. All that is necessary is a SPDT type. The calibrating resistor is a 10 k to 50 k pot. The meter I used in my version has a special scale that is calibrated in SWR ratio, but you may use a 0-1 ma meter and use the chart below.

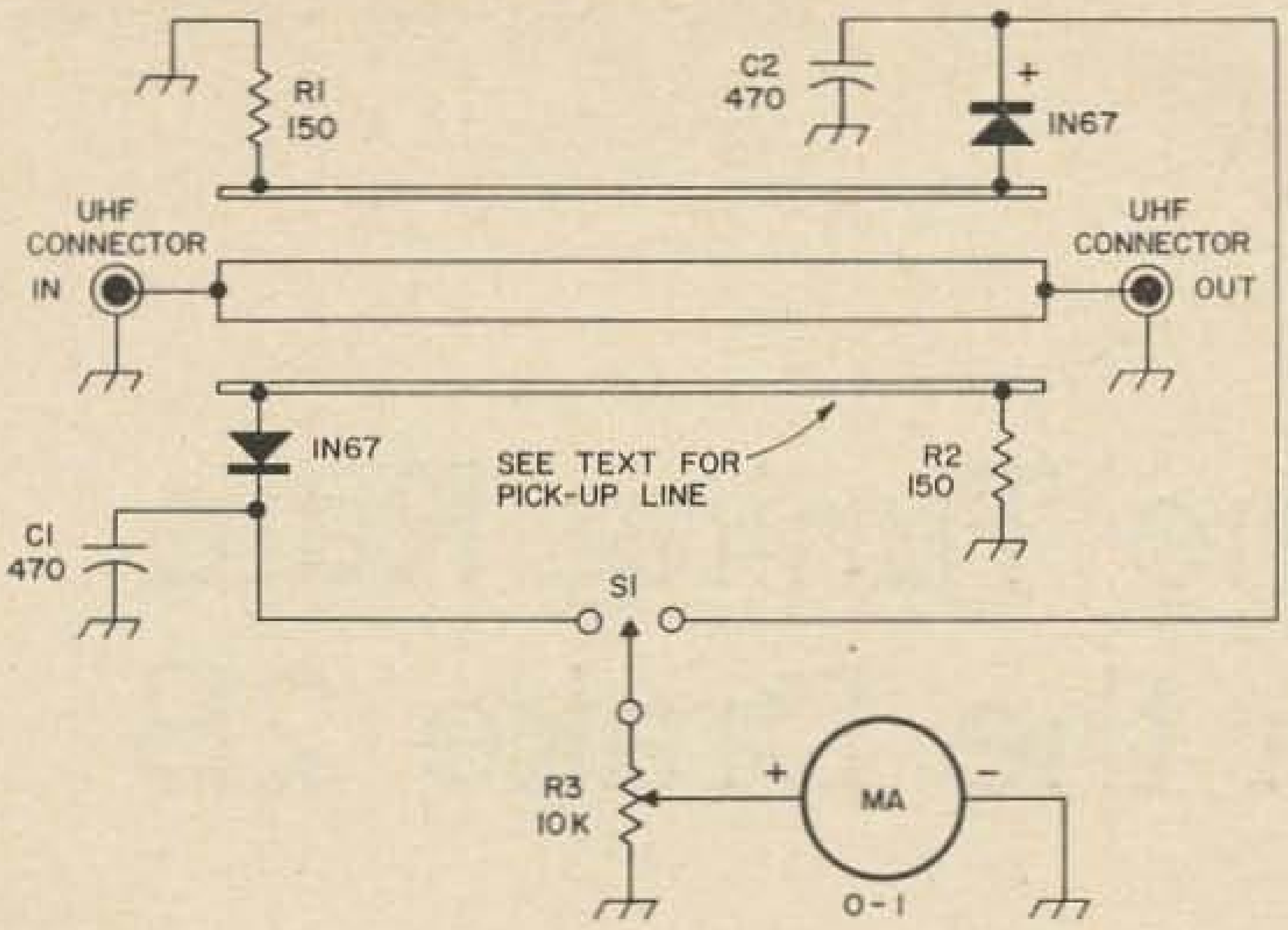
Inside view of the SWR Meter. The special pick-up line at left is available inexpensively. See end of article for details.

Following is the calibration for the meter specified in the parts list.

Meter	SWR
0	0
10	1.25
20	1.5
33	2.0
50	3.0
60	4.0
66	5.0
72	6.0

The above will only hold true if the meter is adjusted to exactly full scale in the forward position.





Schematic diagram of SWR bridge. Pick-up line is available from Harris Co.

Parts List

Cabinet	Premier AMC 1005 (5x4x3)
Meter	Similar to Shurite 850 (0-1 ma)
Diodes	1N67
R1, R2	150 ohm
C1, C2	470 pf
R3	10 k to 50 k
S1	SPDT
Coax fittings	Regular UHF type
Misc Hardware	

Once connected into the antenna system of your station, operation of the unit is simplicity itself. All that is necessary is to flip the switch to the forward position and then adjust the calibrating control for full scale deflection of the meter. The switch is then placed in the reflected position and the SWR is read directly from the meter scale.

If you find that your SWR is much higher than 1.5:1 I suggest that you inspect and adjust your antenna. Remember that the SWR can be reduced only by adjustment or trimming of the antenna. It can never be reduced by adjusting the transmitter. . . . W1JJL

David Middelton W7ZC/W5CA
Box 303
Springdale, Utah

Slowing Down the Tuning Rate on the Drake 2B

Users of the excellent Drake 2B may now slow down the tuning rate by a factor of 6 to 1 without modification of the receiver. The method described here permits the use of a planetary gear drive to reduce the normally fast tuning rate to a point where, for example, the 7200-7300 section requires 14 turns of the tuning knob. This figures out to be about 7 kc per tuning knob rotation! Yet there is NO backlash, the tuning is smooth and even, the calibration is not disturbed, and the band spread is something wonderful!

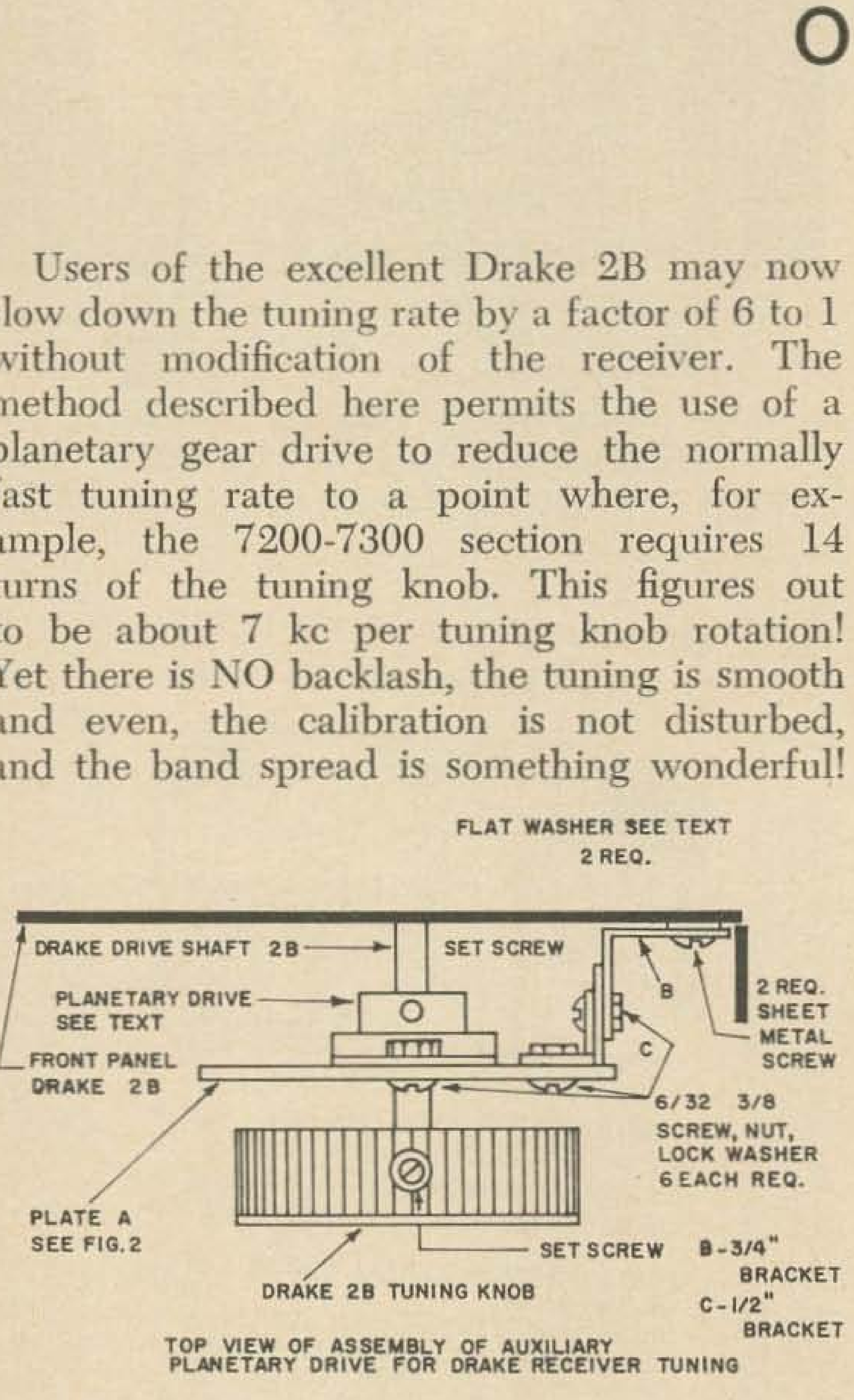


FIG. 1

The introduction of the Jackson Bros. (England) planetary drive made this possible. This device, a ball-bearinged precision drive, is available from Arrow Electronics Inc. (900 Broad Hollow Rd., Farmingdale, N.Y. and other of their stores) for $1.50 each.

A plate, see Fig. 2, is made to hold the Jackson drive out from the panel. See Fig. 1. Four brackets, six screws and two longer sheet metal screws are required (the latter to replace the two screws normally in the right hand side of the Drake 2B). Remove the normal Drake 2B tuning knob.

Remove the two sheet metal screws at the lower right hand corner of the front panel. Mount the plate, with the Jackson drive fastened in place, using two small flat washers to protect the panel from possible scratching by the bracket—or smooth down the bracket edges, and carefully align the drive mechanism to permit smooth operation of the drive shaft on the existing bearings, when the Jackson drive is in place. Fasten the screws holding the plate; drive and panel tightly. Replace the Drake knob. Tape the removed Drake screws in a safe place for replacement, if desired.

This modification is worth while and simple. It does not violate the "Guarantee", and the original state of the receiver may be obtained in a minute by removing the plate and restoring the knob. If you desire to do so, a simple inspection of the inside mechanism of the Drake 2B will reveal how the Jackson drive may be installed permanently.

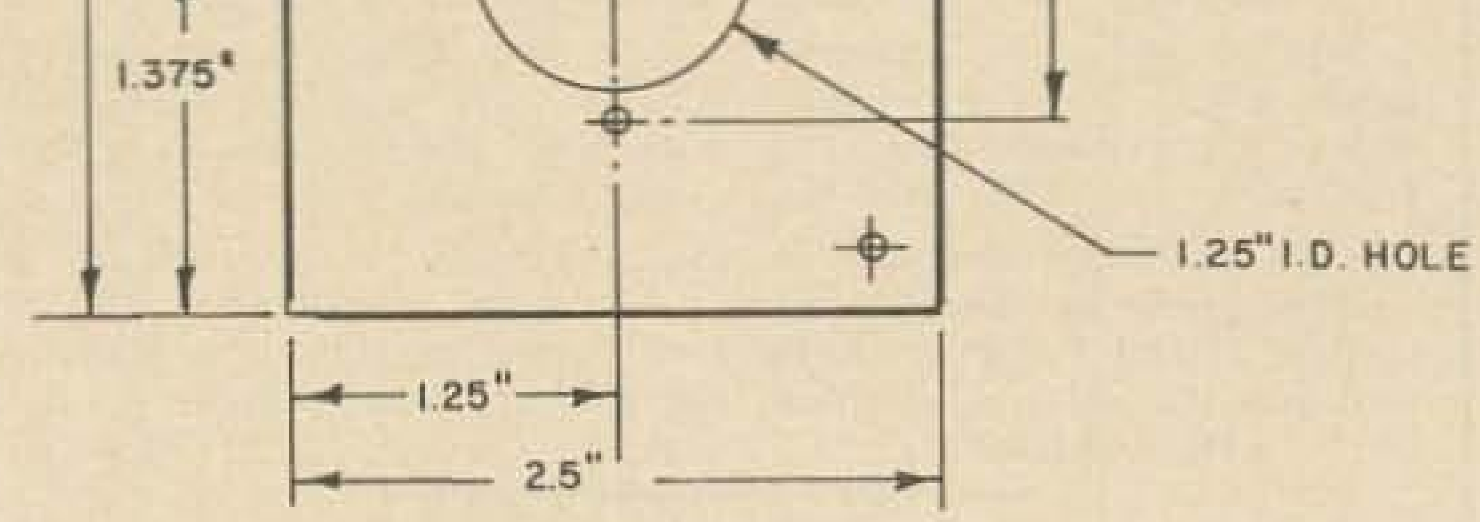


FIG. 2 PLATE - MATERIAL 1/16" METAL OR 1/8" BAKELITE STOCK

Try this. You will be amazed at the ease with which you can now tune in signals, effortlessly and without the "flywheel" effect. The planetary drive adds firmness, yet does not add any backlash, and it spreads them out!

. . . W7ZC/W5CA

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Wayne Green W2NSD/1

W2NSD in Europe

A little while ago I shoved the accumulated work on my desk aside and turned on the receiver to see what was around on twenty. I'd just gotten a DX bulletin from Puerto Rico which mentioned several exotic stations that should be active . . . perhaps one of them would be around. Nope, not much doing . . . fairly quiet this afternoon. Oh, oh . . . UA3KBD in Moscow signing with someone in Africa. I gave him a short call . . . I'm 5-9 in Moscow. We talked for about fifteen minutes and then signed . . . and there was Janos HA5AM in Budapest calling me.

Back in May I visited Budapest and had a wonderful time talking with Janos and the other members of the Central Radio Club. They even invited me to use the club station for a few QSO's! I remember my state of mind as I crossed the border into Hungary from Austria, driving my VW. I was pretty worried . . . I didn't know what was expected of me, or what would happen. At the border no one spoke any English, which didn't help matters. Further, I didn't even have a visa to get in the country. And in my pocket was Hungarian currency that I had been sold cutrate by the Austrian border guards . . . illegal currency.

The soldiers with guns, heavy gates across the road, and other unfriendliness contributed to my state of mind. Several times as I neared the border I thought seriously of turning back. I didn't know if other people worry themselves over things the way I do . . . I wonder if I have enough money along . . . enough of the local currency . . . will I have car trouble . . . run out of gas . . . do something wrong . . . have an accident . . . not be able to find the people I'm going to visit . . . etc.

I waited at the door of the customs building for some word from the official that had disappeared with my passport twenty minutes before. It seemed impossible that here I was on a major border crossing point between Austria and Hungary and I was the only person crossing that morning. Suddenly a cuckoo clock started sounding somewhere in the distance . . . followed by another. I startled the guards by laughing when I suddenly realized that those were cuckoo birds I was hearing . . . the real thing.

Soon my visa was ready and, passport in hand, I started off toward Budapest. Hungary could just as well be parts of New York or Pennsylvania with rolling mountains and flat plains. It was beautiful and I soon gathered courage. The big difference is in the houses and lack of cars. There are bus stops every mile or so along the road, but hardly a car. Now and then I would pass a bus or government truck . . . an ox cart or horse-drawn cart. As I approached towns I had to be careful of groups of people walking.

About twenty miles inside the border some soldiers guarding the road flagged me down for just a moment . . . the same thing happened on my way back out of the country so I suppose that they have all roads guarded to keep people from getting close to the border unless they have business there.

The road was fine . . . about the same as one of our small county roads in New Hampshire, so I perked along at 60-70 most of the way. In the European tradition all of the houses were in village groups. You rarely see a house out in the country in much of Europe. Almost all of the houses in the villages faced small dirt (mud) roads of either side of the main highway. No stores much, no restaurants, and nothing even remotely approaching a road-side stand selling anything.

As I drove I ruminated over the self-destructive urge that had brought me to Hungary in search of HA5AM. Why not stay in Peterborough where everything is completely familiar? Why ulcerate myself venturing into something as unknown as this? And what will happen? These people are friendly enough, I guess, but they speak virtually no English and not even any French. If I have any problems it is going to be rough. And I'm sure to have problems for I have managed to lose all but a very old address of HA5AM's. Janos is one of our subscribers in Hungary, so I dropped him a letter a few weeks back explaining that I would be visiting. Just a few days before my departure Janos called me on twenty meters and said he was looking for me. Naturally I left without his address. Great, eh? In Stuttgart I got an old address from a DXer. In Zurich I talked with my home station from HB9RG and got his new address . . . and I lost it almost immediately. In Geneva I forgot to look in a Callbook. Hmmm.

Along about five o'clock I arrived in Budapest (Budapesht, they pronounce it) and stopped at a newsstand to try to buy a map of the city. My sign language was successful and the woman pointed at a nearby stationery store. A few minutes later I found the old address. I asked a woman at the house for Janos . . . no. She called to a fellow that was just leaving and fortunately he knew enough English so I was able to explain my problem. He asked around . . . no. Then we tried the phone book . . . aha, two Emmer Janos's. I drove him to his apartment and he phoned for me . . . and found Janos, who gave him instructions. After a glass of wine, a look through his family album at pictures of his wife and children, and a tour of his apartment we left and he directed me to the Central Radio Club a few blocks away. Janos was there waiting for me and the chap, obviously very pleased to be of help, excused himself and quickly walked off.

Janos took me in and introduced me to the half dozen or so hams gathered for the regular Friday night club meeting. Fortunately most of them spoke English quite well and we had a wonderful rag chew. Also visiting that evening was Fred DM3RM from Eastern Germany and George WØUXQ. George offered to put me up in his hotel room for the night . . . apparently hotel rooms are hard to come by here . . . and I readily agreed, realizing that I would probably learn more about Hungary from this veteran than any other way.

The Central Radio Club has its own club building, complete with an old army transmitter which looked like it could put out several kilowatts (shades of California). It seems that Radio Club members are able to get cast off equipment from the airlines, busses, PTT, taxis, police, etc. This is one advantage of having all the communications owned by the State. Just think what our ham stations would be like if we could get all the replaced gear from all the various users in our country! Say, what does happen to old broadcast transmitters?

George and I went to the hotel and had dinner about 9 p.m. George, being an expert at these matters, had no problem in waving off the girls who wanted to share our meal (and evening) with us. Lucky for me I was with him or else I might have had to endure the company of a beautiful blond (English speaking) girl for the night.

Dinner was good, but expensive, costing about $8 for the two of us, wine included. The hotel caters to foreign visitors so their prices are quite high by Hungarian standards.

Our country, in an attempt not to help the Russians any more than possible, has a pretty tight embargo on electronic equipment to Russia and the satellite countries. George is a salesman for Wilcox and has managed to break this barrier and sell some of their airbourne equipment to several of the iron curtain countries. He was in Budapest for a few days to exhibit his equipment at the Budapest Fair.

We talked until after midnight and I gathered that he has great hopes for increased understanding between the east and west and a healthy growth of trade. It seems to me that the U.S. would be very clever to subsidize the manufacture of small inexpensive automobiles for sale at a low price to Hungarians. This could change their whole economy and, I believe, perk it up tremendously. The auto industry is one of the foundations of the U.S. economy . . . it could be elsewhere. Judging from how hard the Hungarians work for their extremely expensive tv sets, I think they would work around the clock for cars . . . gas to run them . . . and it could change everything. Typical American reaction, I suppose.

We got up early the next morning, the usual coffee, rolls and jam European breakfast and then out to the Fairgrounds. The day was rainy and dark . . . bah. I wandered around the fair for a while, looking for things to snap with my camera, but the dark and rain didn't encourage the expenditure of much color film. Suddenly I came on the U.S. exhibit. Naturally I went in to see what kind of stuff we were doing to sell the United States to the Hungarians. The exhibit was a gigantic garish affair mostly taken over with big ads for how rich we are . . . hundreds of pictures of our big tv sets, cars, lavish homes, kitchens, appliances, furniture. I suppose that we do have a few people that can live like that, but darned few that I've met. They had a $1000 hi-fi and one of those $250 easy chairs in the "typical" living room . . . the hi-fi was blasting out a demo tape. One each of the popular brand cars were lined up outside the exhibit. They even had a ham station set up . . . well, piled up, for it was all just thrown in a small booth with nothing hooked up. The poor Hungarian in charge of the ham exhibit knew absolutely nothing about the equipment and was pathetically eager to know what it was all for, how much it cost, who used it, etc., so he could answer the fair goers questions. I understand that a license had been applied for and almost came through, then the Viet Nam difficulty upset things. From what I could gather from the people at the fair the U.S. exhibit is one that travels from fair to fair with two Americans running the whole thing . . . one a fat arrogant loud mouthed cigar chewer and the other an insignificant mouse who was unable to make any decisions. Feelings ran quite high against them. Makes you proud to be an American.

Not knowing the language at all I was afraid to plunge into one of the chow lines in front of the food stalls. Perhaps George would help me through this hurdle. Fair-ly well pooped I went back and grabbed George at about 2 PM and we headed out for lunch. He went right by the food booths, in spite of my plucking at his sleeve. He knew a better place nearby. We passed people working on big plates of shish kabob, goulash, and other unknown but interesting dishes. We walked and walked and walked. Hmmm, here it is, but it is too full. We went on for another half mile to a restaurant set up for the exhibitors where they had particularly poor but expensive food for the foreigners.

It was late in the afternoon when we got back to George's exhibit. We found that OK1MB had been there while we were gone and would be back in a half hour. I was distraught at missing Beda, the best known OK ham in the world, but I was going to be late for an appointment with another Hungarian ham in a small town about 80 miles away.

I bid George goodbye and thanked him for making my visit to Budapest so educational and entertaining. I drove back to the hotel, checked out and asked for my passport. Oh, sorry, come back at 3 PM. I said it is now 4:15 and I am late, what do you mean come back at 3? Oh, you are leaving? Yes, may I have my passport. Wait a moment please. Finally, after a couple phone calls, they sent a bellhop with me to the police station several blocks away and I got my passport. Some society.

Since I was a little low on gas I drove a few blocks to where I had seen a state owned gas station. Sorry, all the gas has been sold out for today. Oi. I drove on to another that I remembered passing . . . long line waiting there . . . I'm going to be late, I can see that now. I parked at the end of the line and walked up to the front to see how much it was and if I could buy enough with the money I had left. They looked at me and back at my car and somehow got through to me that I needed super and all they sold at this station was regular grade. I remembered that the VW people had explained that I must use super at all costs in the communist countries. They explained that I would have to get super down by the railroad station. OK. I drove back to the station, across the street from my hotel, and located the super pump by the long line waiting for it. It was 5 PM by now and I could see that I definitely was going to be late meeting Harry in Gyor.

About a half hour later I finally made it to the pump and was ready to go . . . about 50¢ a gallon. I drove through the center of Budapest, over a bridge, and found myself out in the country. I put my foot down, hoping to make the two hour trip in 1½ hours and arrive about on time. There was little traffic . . . with the least expensive cars costing about $5000 and salaries running about one fifth of ours it is easy to see why there are not many privately owned cars yet.

By not slowing down too much going through towns I managed to arrive at Gyor three minutes early. Harry was waiting for me in the appointed spot.

We parked my car and walked around with him showing me the town. He told me how he had been with the freedom fighters back in 1956 and as a result would never be able to get a ham license again. He felt bad about the loss of his beloved amateur radio and the fact that he would never be able to leave the communist countries or rise to any important position, but philosophically shrugged it off with the observation that at least he was alive, something not many of those involved could say.

He and his wife treated me to a wonderful dinner, then we went out for coffee, back home for cakes and talked until 1 AM. They fixed up the couch for me. Fortunately I was not far enough to the north to worry about having to entertain the wife after lights out, a delicate problem which one can stew over if he has a vivid enough imagination and his host has a lovely enough wife.

Up at 7:30 . . . a quick hot chocolate . . . a warm goodbye and off I go through the continuing rain. A few minutes later I arrived at the border and, after about 15 minutes of paperwork and a careful inspection of the car I was breathing sighs of relief as I entered Austria.

Now that I've been there I wouldn't hesitate to go back. The people were universally friendly . . . those girls in the hotel might have been friendly too. But next time I want to get there when the sun is out and bring back color slides of lovely Budapest to show you at clubs and hamfests. If you run into any of the HA5 gang please say hello for me.

. . . W2NSD/1

Bill Hoisington K1CLL
Peterborough, N.H.

The Compactron Two Meter Transmitting Converter

The success of the six meter crystal-VFO transmitter described in the April 1965 73 suggested that the same type of system might be very useful of two. So I built one using Compactron tubes to go with the six meter exciter. It has worked very well. The block diagram, **Fig. 1**, shows how it works. The left section is the exciter from the six meter rig. The next part is the heterodyne mixer to two meters. Then comes a 5763 buffer amplifier and a final 7984 Compactron with the modulator from the six meter rig.

A description of the converter circuit

Fig. 2 is the schematic diagram of the exciter. The first triode section of the 6AF11 is used as a 47 mc crystal oscillator. Regeneration is used to increase the output, the ease of starting, flatten the power-output curve on the capacitor and make the circuit less critical.

The output of the oscillator is fed to a doubler which is the other triode section of the 6AF11. The 94 mc output of the doubler is fed to the control grid of the pentode section of the 6AF11.

The 50 mc output from the six meter exciter is fed to the screen grid of the pentode mixer. This is screen grid modulation. Note the 50 mc link-coupled tuned circuit L5-C3 which couples the six meter rf to the tube.

The pentode mixer plate is tuned to 144 mc. Output from this mixer will burn out a number 48 pilot lamp (120 mw) if the plate voltages are pushed a little. However, I wanted a stable signal so used only 80 volts on the oscillators and added an extra stage of amplification to increase the drive to the final.

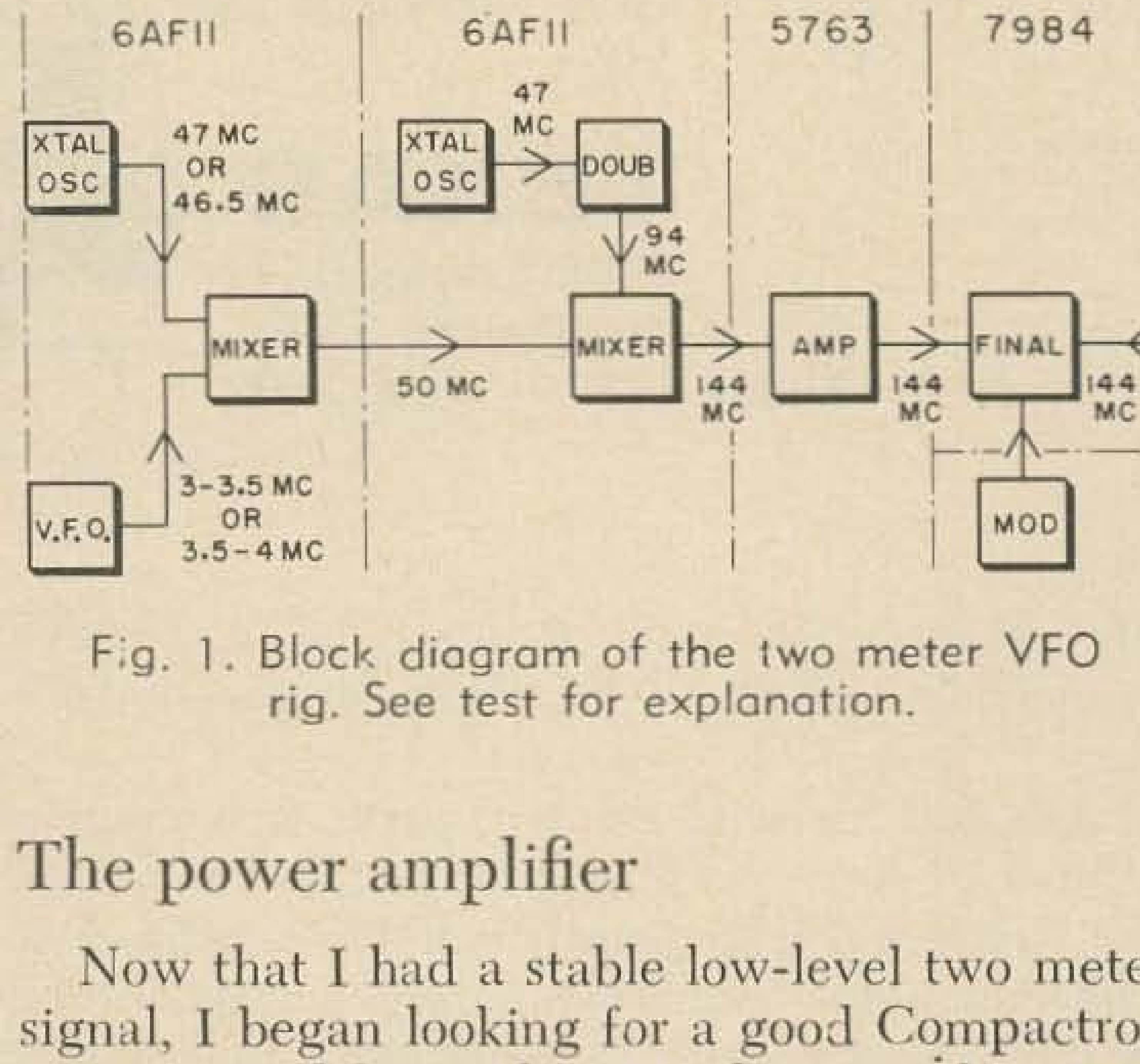


Fig. 1. Block diagram of the two meter VFO rig. See test for explanation.

The power amplifier

Now that I had a stable low-level two meter signal, I began looking for a good Compactron power amplifier. The TV horizontal output tubes were tried first, but handled very poorly at VHF. That came as no surprise since they're designed for 15.75 kc, not 144 mc.

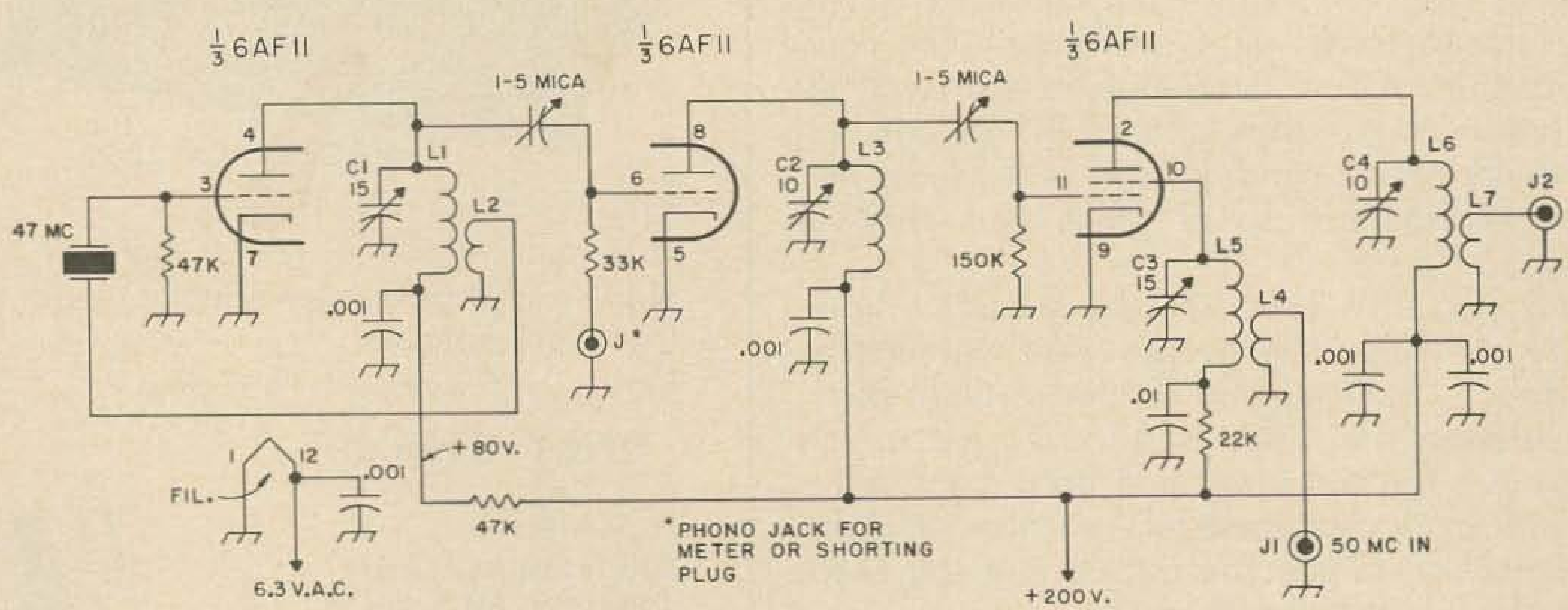


Fig. 2. Mixer portion of the two meter converter.

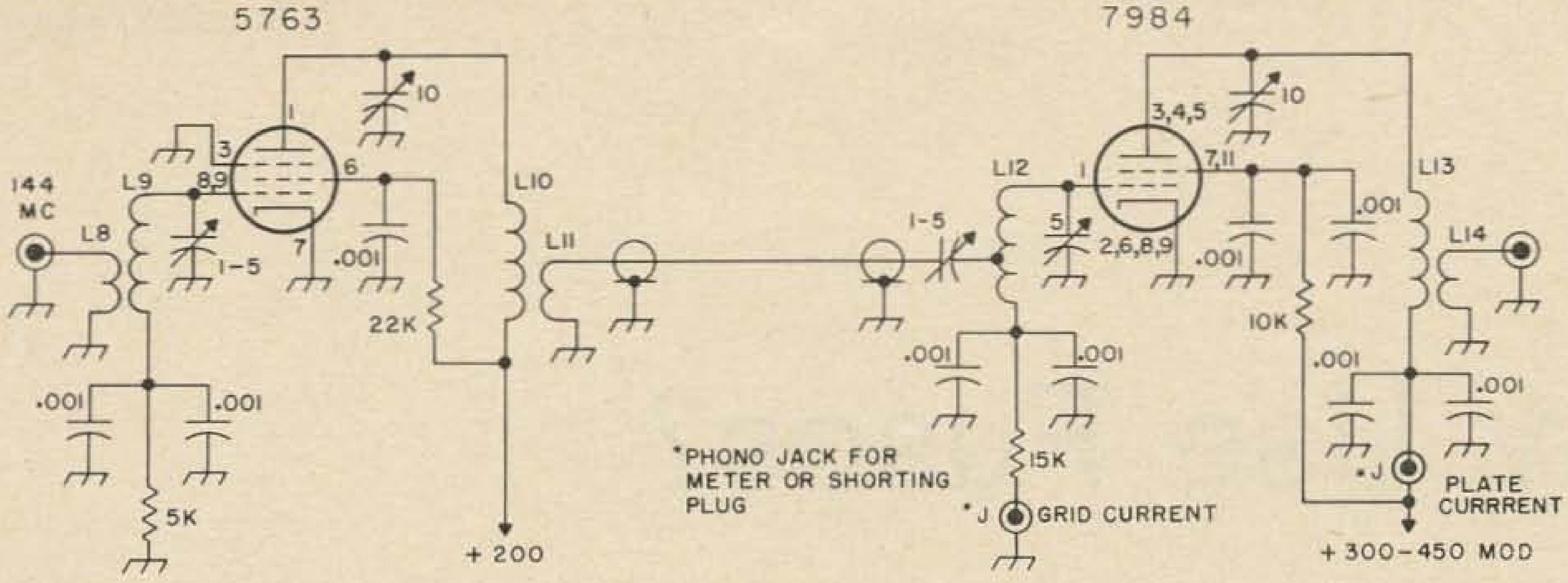


Fig. 3. Amplifier for two meters. Don't forget shielding and other good VHF layout.

But a little bit of looking turned up the General Electric 7984 Compactron designed for mobile and fixed communications transmitters. It is capable of delivering a power output of 46 watts at 175 mc! There is a slight hitch, though. It can remain slight depending on your attitude toward $5 tubes and how long you expect them to last. The rating is for *IMS*. That means Intermittant Mobile Service. That is an application where the design factors of light weight, minimum size and "exceedingly high power output" are the primary requirements even though the average life expectancy of the tube may be reduced.

Please note that I am not recommending 46 watts out all the time—unless you want to buy a new tube every so often. I *have* lit a 60 watt bulb to full brilliance on two, but normally run it on the air at a modest 60 or 70 watts input. It really lights a 25 watt bulb, giving about 30 to 35 watts out.

The manufacturer also published ICAS ratings. They suggest a 56 watt maximum input. So take your choice. The whole idea of a variable tube life based on power input is very interesting.

So much for input. The 7984 has the 12 pin Compactron base. Comparing it to the 6146, the lack of a phenolic base on the 7984 allows half inch shorter leads. The larger diameter also means greater spacing when needed and more connections per element. In **Fig. 3** you can see the many connections to each one. It makes a big difference on two. The spacing between grid and plate pins is enough to permit high power without any need for neutralization at all. Incidentally, the tube has a 12 to 14 volt filament.

The amplifier circuit

Fig. 3 shows the amplifier circuitry. Note that the first stage is a 5763 buffer. The reason for this was explained before. This stage runs very cool, but makes it possible to have a real stable signal. The extra tuned circuits help keep down the TVI, too.

The final stage is the 7984 power amplifier. Even though this tube, like more high gain beam power tubes, has a very high input capacitance, I was able to use a parallel tuned tank and still get excellent efficiency. Drive is about two or three mils through the 15 k grid resistor. Input to the 7984 is about 150 to 175 ma at 450 volts. I'd advise you to use a lower voltage for tuning up.

The modulator uses two 6L6GC's and was described with the six meter rig.

On the air tests

With a dummy load, tuned diode detector, transistor audio amplifier and well padded earphones, I listened to the modulation. It sounded good, so I put it on the air. This was my first experience with a two meter variable frequency transmitter. It's quite different from being crystal controlled. Even though two meters isn't a "listen only on or near your own frequency" band, it was fun to move around. I will also admit to more and more thoughts of six and two meter SSB and to the fact that this mixer can easily be adapted to sideband. Who knows what the future will bring?

. . . K1CLL

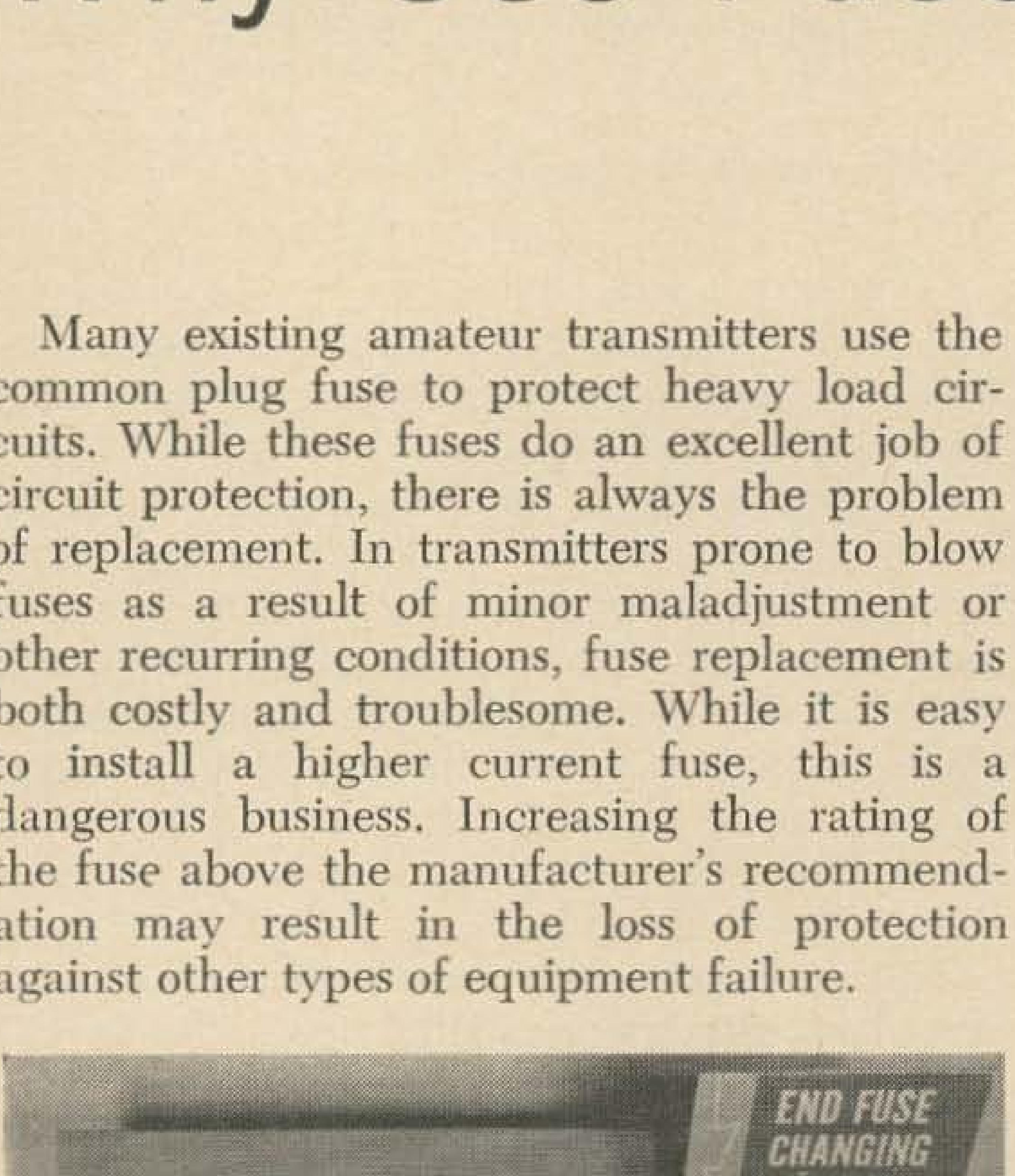
COIL TABLE

L1: 7 turns, 16 tpi, ½ in. dia.
L2: 5 turns #22, ins. inside L1
L3: 4 turns, 8 tpi, ½ in. dia.
L4: 2 turn link in L5
L5: 7 turns, 16 tpi, ½ in. dia.
L6: 2 turns #12, ¾ in. OD, ½ in. long
L7: 2 turn link near cold end L6
L8: 2 turn link over L9
L9: 2 turns ¼ in. copper strap, 7/16 wide, 1 in. long
L10: 3 turns copper strap similar to L9
L11: 2 turn link over L10
L12: 2½ turns copper strap
L13: 2½ turns copper strap
L14: 2 turnli nk

Roy Pafenberg W4WKM

Why Use Fuses?

Many existing amateur transmitters use the common plug fuse to protect heavy load circuits. While these fuses do an excellent job of circuit protection, there is always the problem of replacement. In transmitters prone to blow fuses as a result of minor maladjustment or other recurring conditions, fuse replacement is both costly and troublesome. While it is easy to install a higher current fuse, this is a dangerous business. Increasing the rating of the fuse above the manufacturer's recommendation may result in the loss of protection against other types of equipment failure.



One answer to the fuse replacement problem is a circuit breaker that screws directly into an existing fuse socket. The photograph shows one of these widely available thermal-trip units. The circuit breaker shown is a Sears, Roebuck and Company "Circuit Saver." These convenient little gadgets are available in 15, 20 and 30 ampere ratings and sell for a bit less than a dollar. These compact circuit breakers have a thermal element which opens the circuit in the event of overload. When tripped, the reset button located on the top of the assembly pops out, exposing the red shank of the button. To reset, you simply depress the button.

For new construction, consider the use of panel mounted circuit breakers instead of fuses. A wide variety of magnetic and thermal-magnetic circuit is available for power distribution applications. The other photographs show one of the available types mounted on a panel. This particular unit is a Bulldog "Pushmatic" circuit breaker. You simply push the exposed button to close the breaker and push it again to open the circuit or to reset after an overload.

These distribution panel circuit breakers are made by several manufacturers and are widely available in various ratings with 15 and 20 ampere units being the most popular. Cost varies with manufacture but averages a little over two dollars for the single pole units. When you select one of these circuit breakers, consider the mounting facilities which vary with manufacture. Many of these units have specialized mounting arrangements to suit available power distribution circuit breaker panels. Select a type that is readily adaptable to panel mounting. The "Pushmatic" unit shown required drilling and tapping of four mounting holes in the breaker front plate.

Go modern. Circuit protection provided by circuit breakers is, for many applications, superior to that provided by fuses, and from a standpoint of operating convenience and safety, the circuit breaker is far superior.

. . . W4WKM

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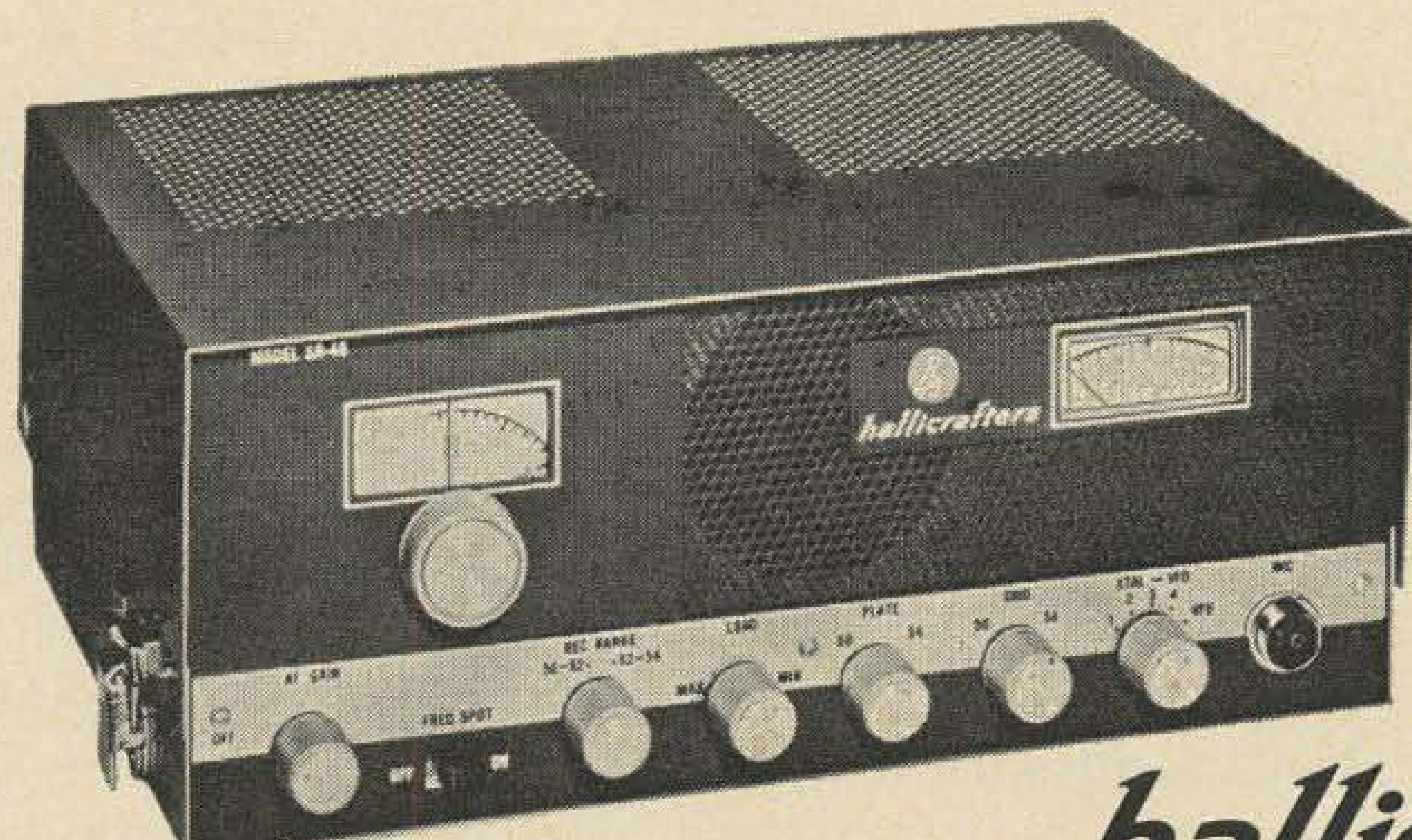

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Writing for 73

Perhaps you've noticed that for some obscure reason all of the top writers in the ham radio field seem to be writing for 73. This isn't just chance, by a long shot. These fellows know what they are doing. Let me unobscure the situation for you.

You've just built up something that you're proud of and the local hams are bugging you to write it up. Well, this turns out to be a lot of work you find, as you try to get one of the chaps who pushed you into helping with the pictures that seem to come out an indistinguishable blur with your Instamatic or old Polaroid. You thumb through the magazines to find out how to write such common items as rf, ac, CW, etc. Funny you never noticed that different magazines have different ways of printing these abbreviations.

Perhaps you've taken the time to write to me for instructions on preparing articles for 73. In this case you will already know that I prefer to have articles typed double spaced (which leaves me room for corrections) on 8½ x 11 paper with generous margins. Four of these pages is about equal to one in 73, in case you want to make a rough estimate of the length of your article. Articles should be two or three pages long for best readership, including the pictures and diagrams. The better the pictures the better the article. We have all diagrams drafted so all we need is a good pencil drawing . . . but *please* check and recheck it for accuracy. Put all parts values on the schematic rather than a long parts list. The R2 stuff is OK for discussing the operation of the circuit, but it raises the devil when you are trying to build.

Now, you've got the article written, the photos taken and the diagram checked. You maybe even have a parts layout. Where do you send the article? How about QST? Well you're up against some problems with them. First of all they do not pay one cent for articles . . . you are doing it for the good of amateur radio (and helping them earn over a million dollars a year). Secondly, quite a few fellows get a bit upset over their articles being rewritten and severely edited. Then there is the prestige of being published in QST to consider. More fellows will see it than in the other magazines, no question about that. Since they only publish one half to one third the number of articles that 73 does each month and a goodly portion of those are written by the QST staff, only a very few outside articles are ever published. Thus, if you are one of the chosen few you can well be proud. This pride tends to wear off after one or two articles when the $50 to $100 lost on the deal begins to come to mind more and more frequently.

Well, how about CQ . . . they pay for articles? One of the big bones of contention that I had with CQ when I worked there was the raw deal that authors got. They frequently had to wait from one to three years after submitting articles before being paid. I found that this dried up all of the worthwhile authors and left me with first-timers only. I note from an article in the January issue of CQ that they seem to be in the same predicament still. Also, some of our 73 contributors have written complaining about not being paid by CQ.

Is 73 any better? When I started 73 I made it a firm policy that all articles would be paid for on acceptance. I wanted to be sure and get the best articles submitted to 73 and, recalling the furious authors I had to contend with at CQ, despite my every strategem to get them paid, I felt that the best way to do this was to pay off with the highest price the fastest. The system worked. Few articles take more than a month to be read and either returned or paid for. Now and then I get further behind or I am on tenterhooks about some article and I let it come to the top a few times before making a final decision. I pay from $15 to $25 per 73 page, depending upon the importance of the article, the weather, how good the pictures are, and other vague factors. With but one or two small exceptions where I goofed all articles that have appeared in 73 have been paid for considerably before publication.

It is only fair to explain that I am up to here in articles right now, having almost a full years worth on hand in various stages of preparation for publication. This means that I am being particularly selective these days. Before you plunge into the preparation of an article you should consider the yard stick I use in making my decisions. The first test is whether the article will be of interest to the great bulk of our readers. A modification of the Superbandbanger III for a product detector is not a thriller. Modifications of only the most popular equipments are of interest. Almost any construction article will be of interest if it is ham gear. Simplified technical articles, DXpeditions, transistorized equipment, are all looked on with great favor. Humor is usually not too funny, unfortunately, and should be submitted to QST, which seems to have the current corner on the market for unfunny humor. Modifications of equipment will do best with CQ. They will probably accept your humorous article if QST rejects it. Poems? not unless they are exceptionally good. I know poetry pretty well and will not accept anything but the best. Crosswords? Only if they are professional in construction. Cartoons? Yes, if they are really funny. We've done pretty well by you cartoonwise and I intend to keep it up.

Once you've been paid for your article you can expect to get some galley proofs of it in a few weeks or months. Next you'll get page proofs for final checking. These are for correcting typographical errors, not for last minute thoughts or changes, unless you want to send along a check to cover the unbelievably high costs of such nonsense. Get the article right the first time . . . then we'll both work to keep it right.

And if your article does get rejected take heart, about 50% of our rejects seem to turn up in the other magazines, so you still may get published. . . . W2NSD

F. D. Whitmore, W2AAA
223 W. Holly Ave
Pitman, N. J.

Catching Up With The Past—No. 2

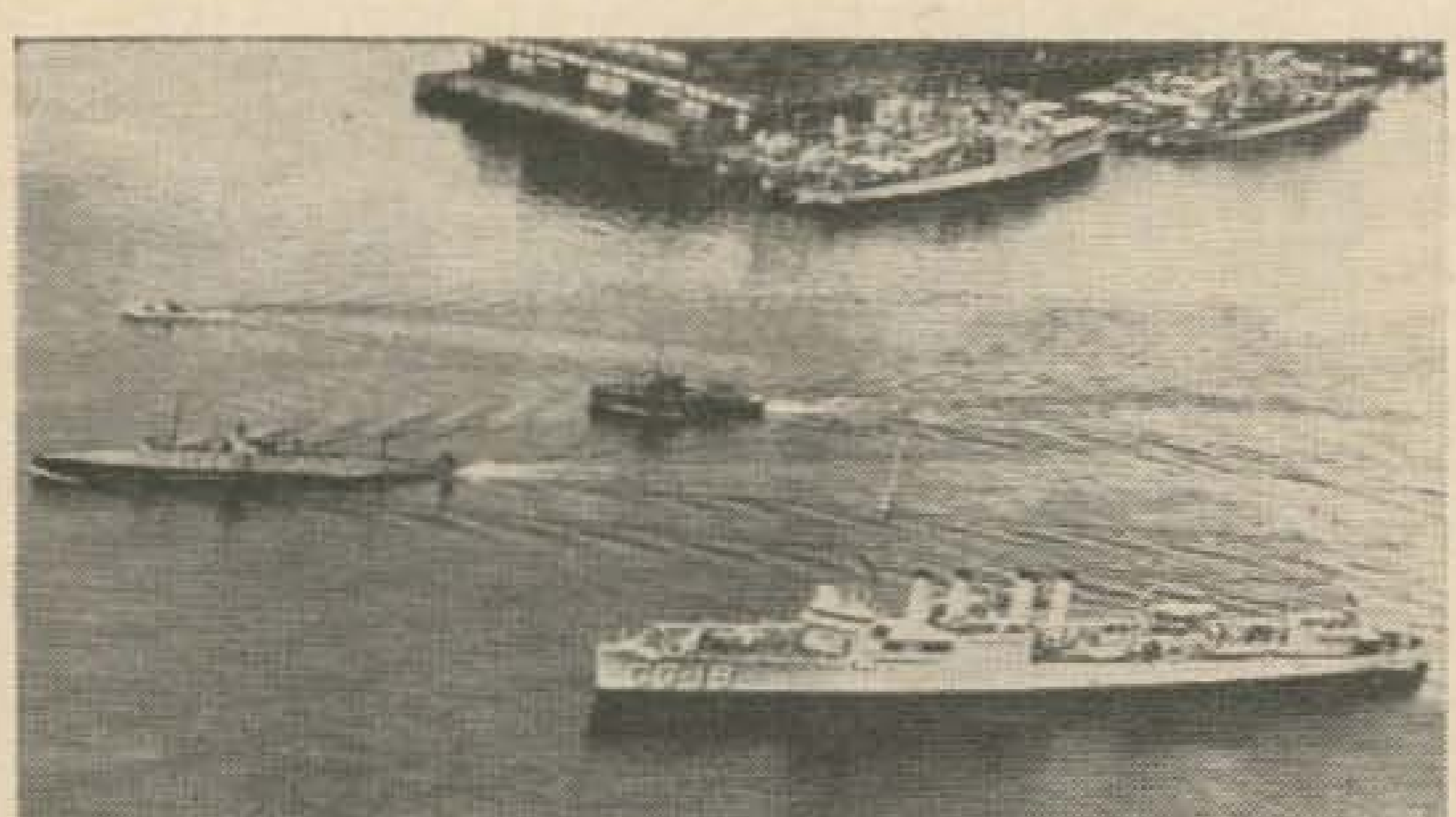
A Gold Award SOS

Today, DXpeditions sail, fly, and drive to remote areas of the Earth. All seek to open new countries or zones to the "gang". Great experiences surround these adventures: some thrilling; others, hazardous. None, however, brought more thrills to an Amateur than the expedition that left the United States thirty-two years ago for a voyage beneath the Arctic ice and under the North Pole.

Conqueror of the Arctic both afoot and by air, Sir Hubert Wilkins, the Australian explorer, headed a scientific expedition in 1931 especially equipped to study the polar sea from a submarine. The route picked extended from Spitzbergen, Norway, passing under the North Pole to the Bering Straits. By leaving Spitzbergen about July 1st, the Scientists hoped to reach a point near Alaska around mid-August before freezing started again. Their itinerary allowed 42 days for the 2100 mile trip.

The Expedition

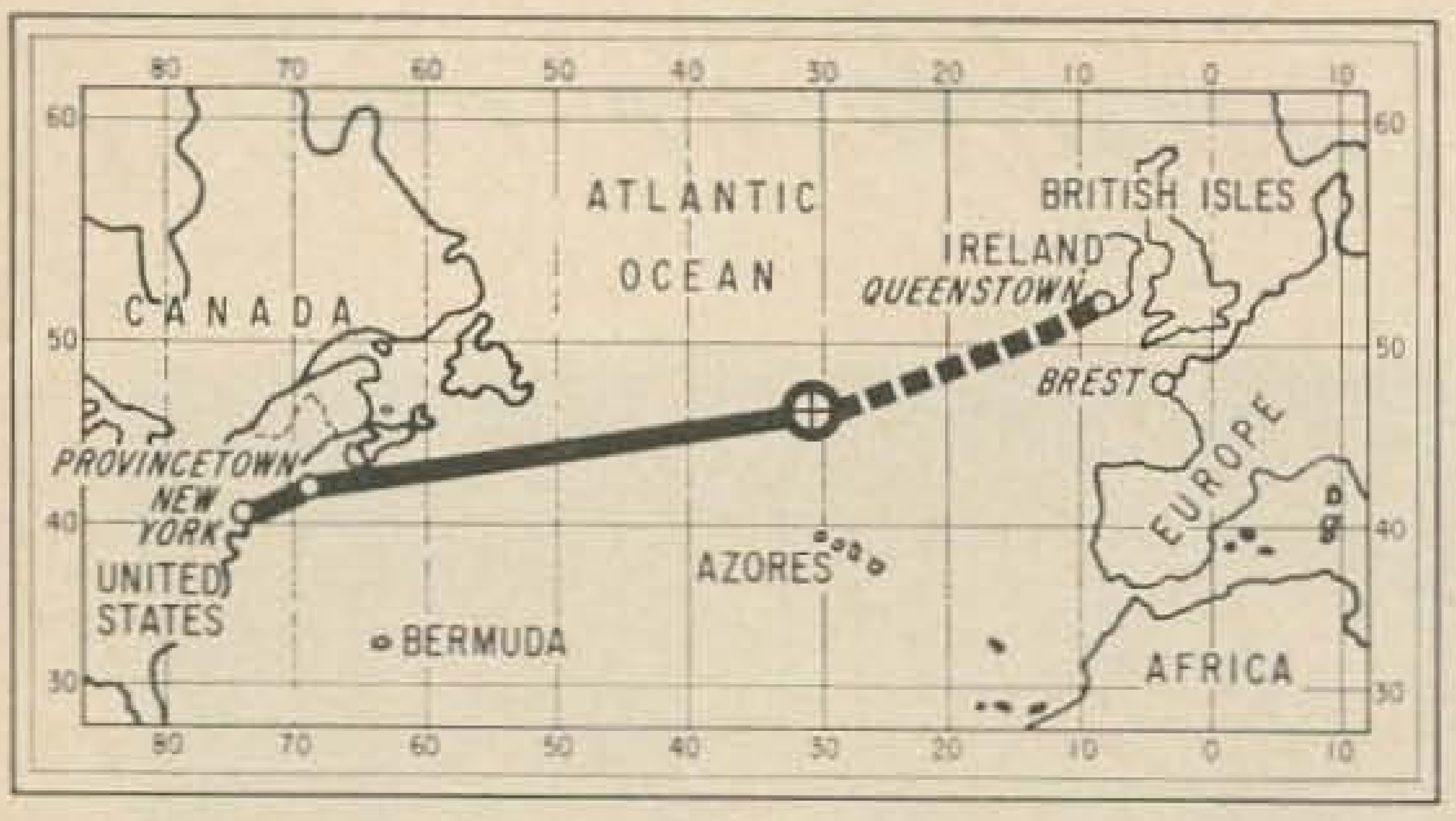
The Arctic had been crossed only twice before—by airplane and airship. Captain Sir Hubert Wilkins made one of these daring flights just three years before. In 1928, he and Ben Eielson flew an airplane across the unexplored Arctic from Point Barrow, Alaska, to Spitzbergen, Norway, covering the 2100-mile distance in 20½ hours. For that famous feat, Sir Hubert received a knighthood from King George the V. The flight still remained unequalled at the time of the Nautilus expedition.



The Nautilus sailing out of New York harbor under Naval escort for Provincetown, Massachusetts, and the start of the Polar journey.

Sir Hubert, a graduate electrical engineer, served as a Captain with the Australian forces in World War I. He included in his adventurous career: war correspondent, moving picture photographer, aviator, and polar explorer. The master of the Nautilus, Lt. Comdr. Sloan Danenhower, served many years in the United States submarine service, and inherited the lure of the polar regions from his father. (John W. Danenhower, also a submarine officer by profession, survived the tragic Jeannette expedition to the Arctic fifty years earlier.) Dr. H. U. Sverdrup of Norway sailed with the Expedition as Chief Scientist. He previously spent seven years in polar work, and accompanied Roald Amundsen as chief of scientific staff on the famous Maud expedition to the Arctic. Backing the Wilkins expedition were: American Geographical Society, Carnegie Institution of Washington, Cleveland Museum of Natural History, Det Geofysicke Institute of Norway, and the Woods Hole Oceanographic Institution.

The Scientists planned to conduct wireless telegraphy experiments in the Earth's flattened surface at the Pole, and experiment with voice transmission from the point on the flattened surface closest to the center of the Earth. While at the North Pole, they intended also to weigh the Earth and determine the geological content of the Earth's crust. And



The route followed by the Nautilus from Provincetown, Massachusetts. The cross marks the spot where W3AJZ sent the SOS. The dotted line charts the 1000 mile tow by the United States battleship, Wyoming, to a point near Queenstown, Ireland.

throughout the whole trip, they expected to study the animal and plant life, water currents, magnetic variation and intensity, and to note the formation and disintegration of the ice masses above and below the surface of the polar waters.

One of the major aims of the expedition sought to prove that submersibles could open up and bring development to the Hudson Bay district, and transport North American products to Europe cheaper by way of the Arctic. To prove the feasibility of such a scheme, they arranged to keep an accurate record of the influence of low temperature on the operation of the submarine, the batteries, and the engines. During the last half of the voyage, Sir Hubert intended to explore his pet project—long-range weather prediction—and determine the possibilities for setting up a weather station on the drifting ice somewhere between Alaska and the North Pole.

The Nautilus carried enough fuel to travel over 7000 miles on the surface. Plans, however, called for the "floating laboratory" to spend most of the time moving at 3 knots under the sea. At this speed the submarine could operate 40 hours and travel 125 miles on one charge of the batteries. Nevertheless, the explorers planned to limit travel to only 50 miles a day. By staying submerged 16 hours and surfacing in the leads of open water for eight to charge the batteries, the Scientists allowed themselves plenty of time for scientific investigation as they criss-crossed about the Arctic under the ice. Based on Sir Hubert's knowledge of the Arctic, they expected to find the ribbons of open water spaced about twenty-five miles apart. If in doubt at any time about the location of the next lead, they could push a helium-filled balloon out the conning tower to explore. The balloon carried a camera and a compass. Each picture taken included a view of the compass too. With every photograph referencing the direction, the explorers could easily determine the best way to proceed.

A six-months supply of ordinary ship's rations and a year's supply of emergency rations stocked the submarine's larder. If necessary, hunting in local waters with the rifles and shotguns carried along could augment those provisions considerably. Such extra foresight reflected the planning behind the whole expedition.

The Submarine

Renamed Nautilus in honor of the submersible in Jules Verne's novel, "Twenty Leagues Under the Sea", the converted U.S. World War I submarine left Provincetown, Mass., June 4th manned by an American crew. All possessed years of submarine duty. However, little about the converted Nautilus reflected the fighting submersibles on which they trained. She looked different both inside and out. Surfaced, she resembled a fat cigar floating in the water half submerged.

Ray Meyers, the radio operator, stood watch at the radio gear installed in the converted torpedo room behind plugged torpedo tubes. Ray's radio activities dated from 1910. Formerly 2MI and at the time of the Nautilus voyage, W3AJZ, Ray worked as a commercial operator from 1910 until 1912; served in the Navy as Electrician, Electrician-radio, and Radioman from 1914 'til 1930; and held the Chief Engineer post at broadcast station WDEL in Wilmington, Delaware, from 1930 until 1931. Recommended very highly to the recruiters for the Trans-Arctic Submarine Expedition, he signed on the Nautilus for the polar trip.

The Navy's 0-12 submarine—built in 1918 by the Lake Torpedo Boat Company in Bridgeport, Connecticut, and costing over $1,000,-000—lay rusting in the back channel at the Philadelphia Navy Yard slated for scrapping under the London Naval Treaty. When approached about the Arctic expedition, the Secretary of the Navy turned the sub over to the U.S. Shipping Board who chartered her for five years at a dollar a year to Lake and Danenhower, Inc., of Bridgeport, Connecticut. This firm redesigned the undersea craft for the Arctic expedition.

The charter restricted the submarine for use in scientific research and required eventual scrapping in accordance with the disarmament pact. Lake and Danenhower, Inc., signed the charter then subcharted the 0-12 to the Trans-Arctic Submarine Expedition, Inc., headed by Captain Sir Hubert Wilkins. With his desire for a submarine now fulfilled, Sir Hubert gathered together a group of scientists for the voyage across the top of the World.

The radio shack shared the converted torpedo room with a diving compartment, an airlock for holding sea water out while divers left or reentered the submarine, and the scientific laboratory. Underneath lay the Diesel fuel-oil tanks, and the lead-lined tanks containing distilled water for the Exide batteries. Beyond midship and just aft of the galley, two 500 BHP Busch-Sulzer-Diesel engines powered the twin-screw Nautilus and turned two 200 HP Diehl electric motors in the next compartment. When the sub operated on the surface, the electric motors became generators and charged two 60 cell banks of batteries. Each cell weighed 1000 pounds. Under submerged conditions, battery-power turned the motors and propelled the submarine. Half the batteries lay below the living quarters in the compartment behind the converted torpedo room. The other 60 cell group filled the compartment under the galley. Between the living quarters and the galley nestled the central control compartment filled with a maze of valves, gauges, wheels and recording instruments.

Besides driving the submarine during underwater maneuvers, the 5000-ampere/hour storage batteries energized a 440-volt motor generator set to supply ac filament and dc plate power to the transmitting equipment, and supplied the submarine's electric-equipped galley and other services. The Nautilus carried two radio transmitters. For the main work, an RCA 500 watt band-changing set with 849's in the final operated either CW or AM from 450 kc to 18 mc. The other, a 50-watt Radiomarine life-boat rig, served as an auxillary on 600 meters. Messages to the Nautilus came in over a Navy 1420C receiver. Except during the periods set aside for hamming, the submarine communicated under the commercial call WSEA.

Special Safety Devices

Thirty-eight new devices equipped the Nautilus for the journey under the polar ice cap. A number of them appeared topside. However, an outrigged superstructure enclosing the main deck, hid them from view until they performed their functions. When used, they emerged into view through the long narrow opening left in the top. Only WSEA's long-wire antenna showed regularly above the superstructure, and even that disappeared whenever the submarine dived.

A standard periscope couldn't survive among the ice floes so the Nautilus carried an especially designed one. Instead of sliding up and down in the normal manner, this one worked like a jackknife. When struck by ice or other objects, it bent over and voided damage. Collapsed, the periscope disappeared from sight between the sled runners.

The special superstructure enabled the Nautilus to go "sledding under the ice". It looked like a huge sled mounted up-side-down with the sides enclosed. Two broad runners extended the length of the 175-foot hull. Sloping upward a short distance from the bow and stern, they leveled off at a height that cleared the conning towers. By operating the submarine beneath the ice floes with a slight positive buoyancy, the sled runners pressed against the jagged underside raising and lowering the submarine on even keel, as they followed the rough bottom surface. This technique enabled the Nautilus to slide along under the ice like a fly walking on a ceiling.

Several of the devices mounted on the deck concerned the safety of the crew should the Nautilus get stuck under the ice. The unique conning tower combined a telescopic feature with an escape hatch. Containing an ice drill in the top and pushed aloft by two hydraulic pistons, this 28-inch-diameter conning tower could extend through thirteen feet of ice at the rate of one foot per minute. An electric motor revolved the head at 6 rpm and the ice cutter at 600. Set eccentric to the center of the tower, the cutter bored a hole through the ice slightly larger than the diameter of the conning tower. The 13-foot limitation satisfied the experts' opinion that the Arctic ice wouldn't measure over ten feet thick during the summer months.

No one of course knew the exact thickness of the Arctic ice. The Scientists, therefore, intended to measure it constantly as the submarine bumped along underneath the ice pack. A pneumatically controlled trolley arm fastened to a hinge in the top of the superstructure, moved up and down as it followed the ice pattern overhead. By comparing the reading of the indicator with the submarine's depth gauges, the Scientists could determine the thickness of the ice overhead. As a precaution in case the submarine encountered thicker ice than expected and became stuck under it with run-down batteries, two tubes with drills protruded from the deck above the motor compartment and the control room. By adding extensions, those drills could bore through 120 feet of ice to let Diesel-engine exhaust escape and fresh air for the engines and crew enter. This feature enabled the Diesel engines to run even though the submarine lay under water,

Five hundred miles from the North Pole, the silhouetted Nautilus prepares to dive under the ice floes in the Arctic Ocean.

and recharge the batteries for another lap of the voyage.

Another safety feature built into the Nautilus protected the submarine from head-on collisions with solid ice when running below the surface. It consisted of a collapsible bossprit. Sticking out ahead of the submarine twelve feet, this ram acted like a bumper and absorbed all shocks within its penumatic piston. The bowsprit also doubled as a lamp post for a special 5000-watt Westinghouse underwater lamp.

But these special safety devices only operated during specific situations. Over most of the voyage, the ultimate safety of the Nautilus and her crew depended upon the communication equipment and the radio operator. Two antennas connected the Nautilus with the outside world. One, a fixed loop, lay hidden below the superstructure. It rose through the deck above the radio shack, ran forward to the bow, aft under the superstructure, then back along the hull to the radio room. The second antenna, a long-wire, extended above the superstructure supported between two "V" shaped masts. This antenna worked only when the submarine sailed on the surface. During underwater operation, the "V" masts lowered to the deck inside the shelter of the enclosure. Over these two antennas W3AJZ handled the Nautilus' communications and worked hams in his spare time.

The Voyage

Pushed by her twin screws encased in ice guards, the Nautilus plowed steadily into the Atlantic at 10 knots an hour. In the distance, at the end of her ake, the coastline of Cape Cod gradually melted into the sea. Apparently the complete overhaul at the Brooklyn Navy Yard did the job. The engines beat evenly now. No hint existed of the trouble experienced on March 14th after taking on fuel at Marcus Hook, Pennsylvania. Engine failure at that time resulted in the ignominious tow by the nose through the Delaware Bay and along New Jersey's shore line to the Brooklyn Navy Yard.

Besides doing an unexpected overhaul of the engines, the Brooklyn Navy Yard also installed some special equipment. This gear supplemented the diving compartment and airlock built by the Philadelphia Navy Yard into the former torpedo room, and the "inverted-sled" superstructure and ice drills installed at the Mathis shipyard in Camden, New Jersey. Failure of the Philadelphia Navy Yard to finish the original reconditioning and modification work by December, upset the Nautilus' sailing date badly. Now, instead of the shore line of Norway fading in the distance, the coast of the United States still showed vaguely on the horizon.

Underway at last, the crew pondered what lay ahead. Success, or disaster. The chiding remarks of scoffers continued to ring in their ears. "The men will freeze to death." "You'll run into an iceberg and knock a hole in the vessel." "It will be dark under the ice and you'll lose your way." "The ice is hundreds of feet thick and too deep for the submarine to go down."

For slightly over a week the Nautilus knifed the mild seas splashing occasional sprays of salt mist into the superstructure. Captain Danenhower's course held the Nautilus in the Atlantic shipping lanes pointed for Land's End, England. Once in European waters, a new course would veer the submarine around the British Isles to Norwegian ports and ultimately into the Arctic Sea.

During this Elysian period, W3AJZ cleared traffic with coast stations KUP and WRH until 9 PM EST then opened up on the ham bands. Under the calls K7XI and W3AJZ/mm, Ray kept regular schedules with W3QV and worked many of the other hams. He picked the frequency most suitable for prevailing conditions and designated the Amateur band for the replies. The 3.5 mc Hams listened on either 5555 or 6620 kc; the 40 meter "gang" tuned to 8450 or 11110; and, on the nights the 20-meter band stayed alive, 14 mc Amateurs found his signals on 16660.

W3AJZ enjoyed a "ball" until the Nautilus reached mid-Atlantic. There all fun suddenly ceased. The starboard Diesel cracked a cylinder knocking that engine out and taking half the submarine's battery-charging facilities with it. As the remaining motor couldn't overcome the discharge rate, the batteries grew steadily weaker.

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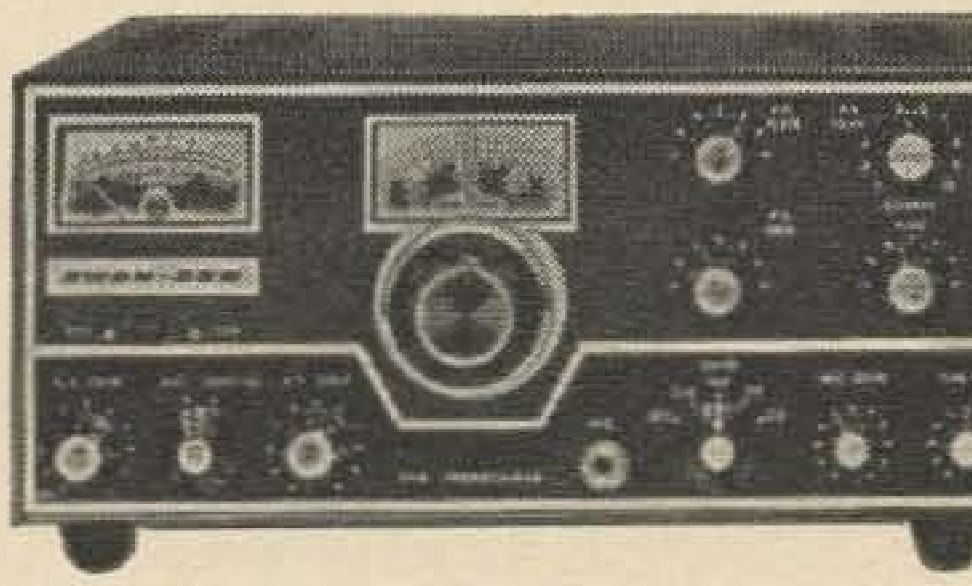
TR-4



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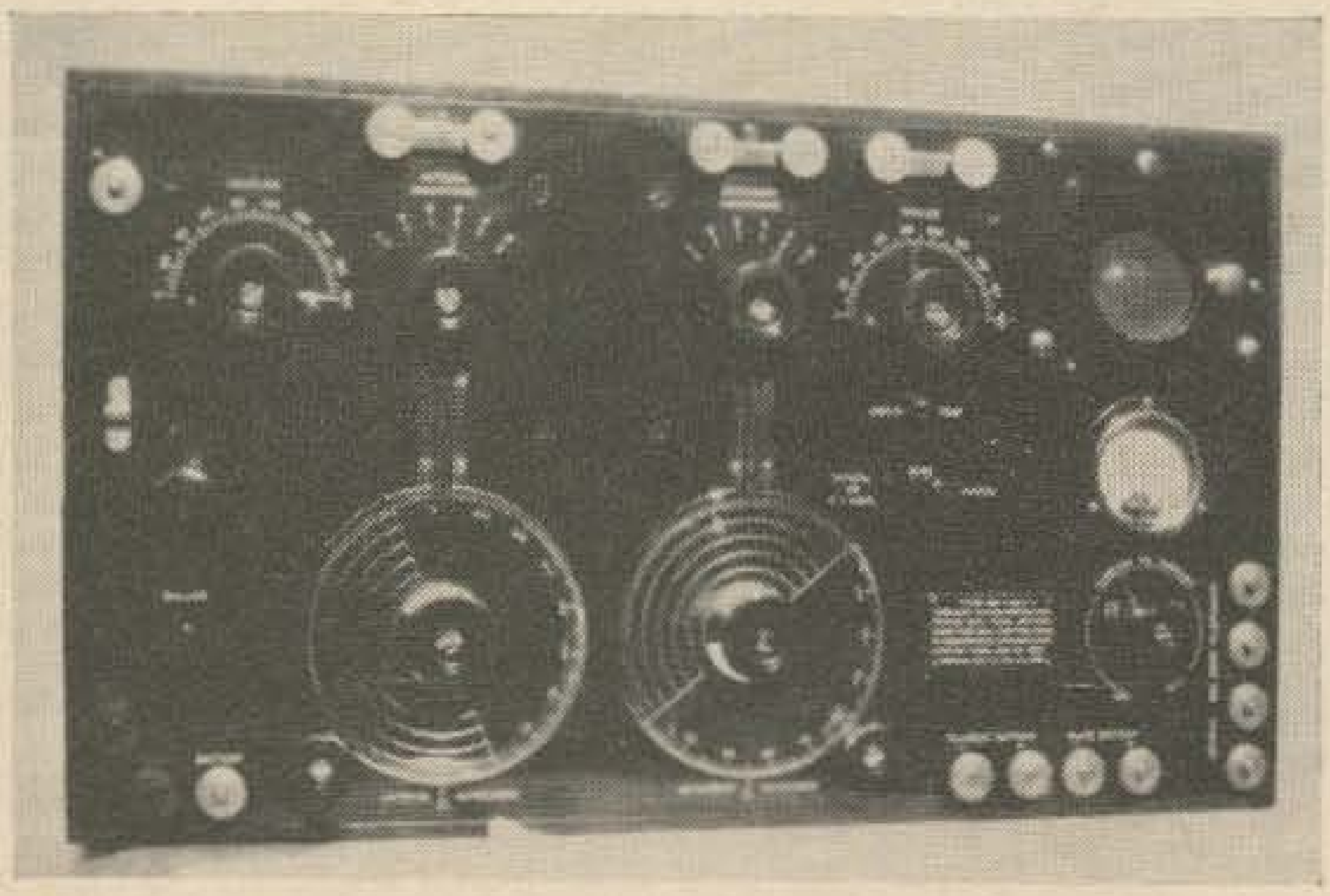
Loss of one engine only slowed the Nautilus two knots. With the port Diesel and a half wake, she still parted the sea at 8 knots. But the generator loss really hurt. Captain Danenhower and his officers sized up the situation. If the weather held good, they believed they could reach their destination without any help. They decided to try. Meanwhile, Captain Danenhower wirelessed home ordering the necessary repair parts sent on ahead.

But the weather didn't hold good. The wind began to blow. It grew from moderate, to fresh, to *strong*. Soon the choppy sea tipped with whitecaps spread into long, deep swells. And the growing billows, urged on by the relentless wind, rose higher and higher. As the waves increased, the submarine's battery power decreased. In a short while, radio communication with the Nautilus became mostly a one-way affair.

When one fuel tank ran dry, they switched to another. Soon the lone engine started to knock. While the engineers searched for the trouble, someone made a terrifying discovery: As the fuel level went down, so did the submarine. The Nautilus was slowly sinking!!

Investigation showed sea water mixing with the fuel. But how did it get in? An engineer with a hacksaw shortened the standpipe in the tank so it didn't penetrate beyond the pure oil near the top. The engine responded immediately. Then a member of the "black-gang" discovered waste clogging the vent pipe and removed it. Meanwhile, a study of the submarine's construction revealed the Kingston valve used for diving purposes located in this fuel tank. When they tried to close it, the control wheel spun. Broken! Now they understood the trouble: As the engine sucked fuel, the heavier sea water seeped in to replace it.



A Navy model 1420C receiver. The radio operator threw one of these into oscillation and keyed the antenna circuit to send the SOS. Courtesy of the W2ZI Historical Wireless Museum, Trenton, N. J.

The more fuel used, the heavier the submarine got. Responding to the constant increase in weight, the submarine gradually settled towards zero buoyancy—the point of sinking.

By now the storm raged fiercely. Forced to reduce speed, the single-hulled Nautilus—true to her "pig-boat" type—wallowed in the waves with superstructure often awash. Indicators on the inclinometers rolled from 47 degrees to port to 47 degrees starboard. Oil seeking its level sloshed annoyingly from side to side. Suddenly, a huge gray shadow bearing down straight ahead became the White Star liner, Homeric. She missed the Nautilus by just a few feet. And as the severe rolling sapped the sea legs of many in the crew, the motor behind the good Diesel burned up in a series of sparks sealing the doom of the already weak batteries. Captain Danenhower ordered an SOS.

Fortunately the Captain's course from Cape Cod held the Nautilus in the Atlantic shipping lanes. Aid would arrive quickly once the call for help went out. With the Nautilus' position on a slip of paper before him, W3AJZ reached for the power switch. Maybe the submarine's batteries would turn the motor generator long enough for one call. He threw the switch and listened for the high-pitched whine. *It didn't come through.* Only the scream of the sea reached his ears as the Nautilus tossed and rolled 1700 miles east of Cape Cod, surrounded by help but without the means to summon it.

But the receiver still worked. In desperation W3AJZ turned to his Navy 1420C. If you're an Old-timer, you'll remember the old trick taught to students by wireless schools as late as the early "thirties": Set the regenerative receiver for CW and key the antenna lead-in. Ray tuned the set to 600 meters and sent it into oscillation. A feeble signal radiated back to the antenna. Bracing himself agains the heavy roll of the sub, he tapped out WSEA's first SOS.

In a few moments he stopped and listened, heard nothing, and called again . . . then again . . . and again. An hour passed—two hours—three! *Nothing.* Less than a watt on 600 meters going into an antenna scraping the wave-tops, offered scant competition to the strong signals usually heard on the combination calling and distress wave. Twelve hours later: still no change—only a crew sore from bumping about in the close quarters of the wallowing submarine, and a wireless operator weary and cramped. An endless supply of hot coffee kept W3AJZ alert as he doggedly continued tapping and listening in the restricted confines of the radio room. *Eighteen hours* after the first SOS left the "receiver", call letters W-S-E-A blasted from the earphones. An answer at last! Somehow the radio operator aboard the SS Independence Hall snared the whisper-of-a-signal from the loud QRN and now asked the Nautilus' trouble and position. "Mechanical. Latitude 46.40, longitude 30.30," flashed the overjoyed reply.

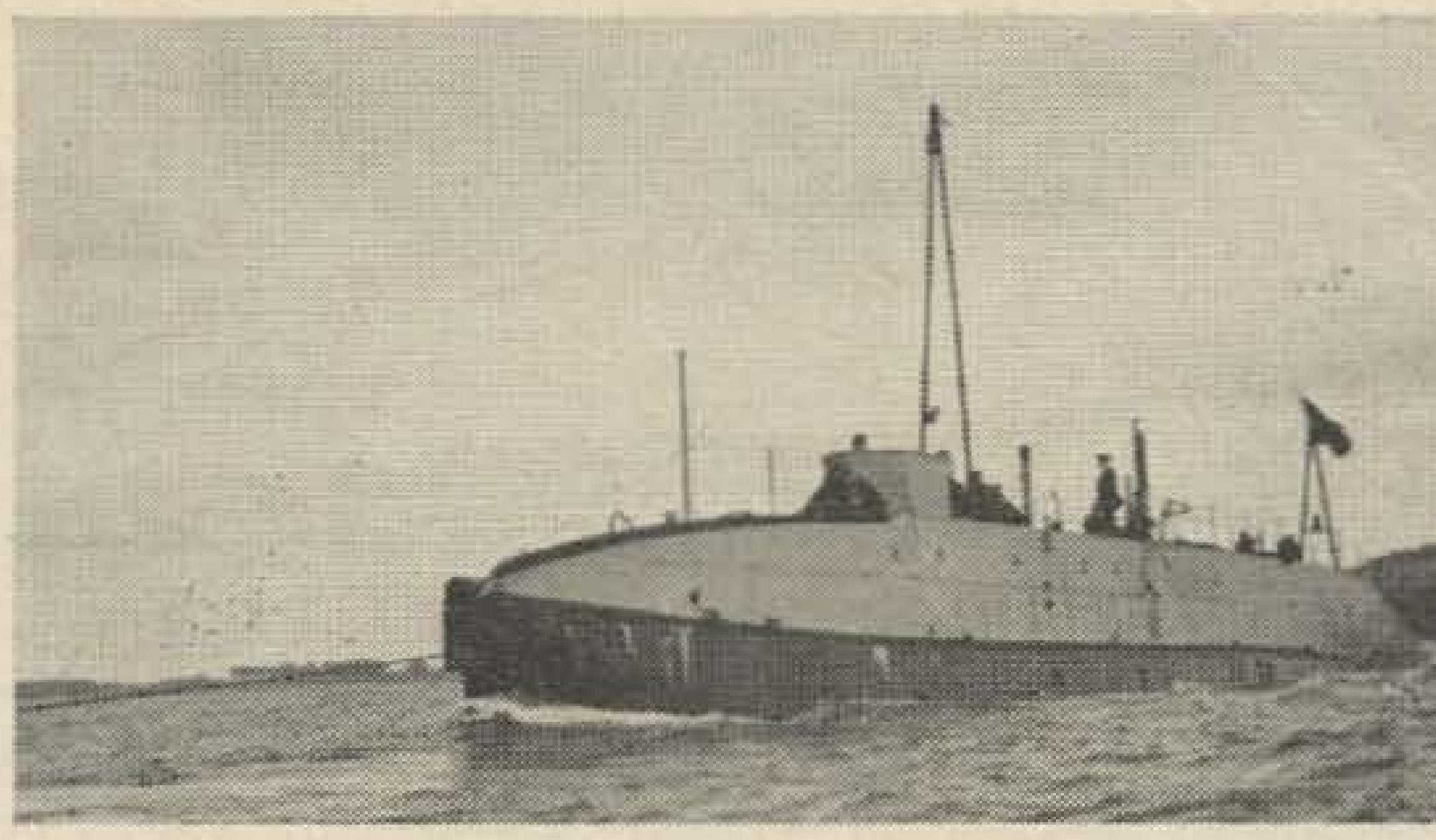
Before long, the SS Independence Hall's superstructure appeared above the waves as the freighter moved in close and stood by. Shortly after, the United States battleships Arkansas and Wyoming hove into view. Following a few wirelesses to naval authorities in Washington, the USS Arkansas continued on the Midshipmen's Cruise to Europe while the USS Wyoming interrupted hers to tow the Nautilus to Ireland.

Getting a line aboard the Nautilus proved difficult. The USS Wyoming maneuvered several hours in the high seas before the line drifted along side the stricken submarine. Even then, rough seas and lack of winch-power prevented the submarine's crew from pulling the water-soaked hawser aboard. In the process of trying, a giant wave swept Frank Crilley, the main diver, overboard then washed him right back again. Hours later, when the sea moderated, the crew succeeded in fastening the rope to the Nautilus' bow and she started the 1000-mile tow. Near Ireland, the USS Wyoming cut loose and an Irish tug continued the tow into Queenstown. As the Nautilus neared the wharf, a welcome rang out from shore: The bells in St. Coleman's Cathedral pealed the Star Spangled Banner.

Conclusion

Completely repaired at Devonport—the British navy station near Plymouth, England—the Nautilus continued on her way to Norwegian ports and W3AJZ resumed hamming activities. The Nautilus left Spitzbergen, Norway, August 19th and entered the pearly gates of the Arctic. Lumps of rough ice the size of summer cottages loomed out of the fog to greet her. Picking a big floe, Captain Danenhower prepared to send the submarine under. Then came Sir Hubert's most crushing disappointment: Somewhere among the ice floes the Nautilus lost both diving rudders; without the "elephant ears", she couldn't dive.

Nevertheless, during the ten days spent in the Arctic Sea, the explorers demonstrated the soundness of the "sled-runner" idea many times by tilting the bow down with ballast and pushing under the floes. Each time they marveled at the sight visible fifty feet around them. Varying light, caused by the passing



The Nautilus under tow by an Irish tug as she nears Queenstown, Ireland. A World Wide Photo.

clouds overhead, "painted" the scene continually with changing colors creating an effect like the "painted desert" in north-central Arizona. One of the floes they sledded under measured 17 feet thick. But, as expected, the explorers found no icebergs; icebergs mostly come from glaciers on the Greenland coast.

During the short stay in Arctic waters, fresh water pipes froze solid; the periscope fogged and got stuck; the ice drills jammed; a battery cell, unable to stand the rapid temperature rise from almost freezing to considerable heat during rapid recharging, cracked and spread acidy gas fumes throughout the submarine; heavy precipitation forming on the inside of the single-hull Nautilus, froze on the floor of the living quarters; and a rivet started to give in the diving compartment letting icy water seep slowly through.

Recognizing the lateness of the season and the fact that to do their work thoroughly and in safety, they required a newly-equipped double-hull ship, Sir Hubert regretfully turned the Nautilus back to Norway and discharged the crew. On March 20th, complying with the terms of the London Naval Treaty, United States authorities sank the Nautilus in the 200-fathom water of the Bergen fiord. Sir Hubert never realized his dream of sailing under the North Pole, but he lived to see his dream come true. The Navy's atomic-powered Nautilus II sailed across the North Pole under the Arctic ice on August 3, 1958. Sir Hubert died the the following December.

Ray Meyers, the wireless operator on the Wilkins polar expedition, received a gold medal from the Veteran Wireless Operators of America for his outstanding work in radio that year. Today, Ray is ARRL Director for the Southwestern Division. If you would like to swap adventures, work him when you get a chance. You'll find him on the air under his 6-land call, W6MLZ.

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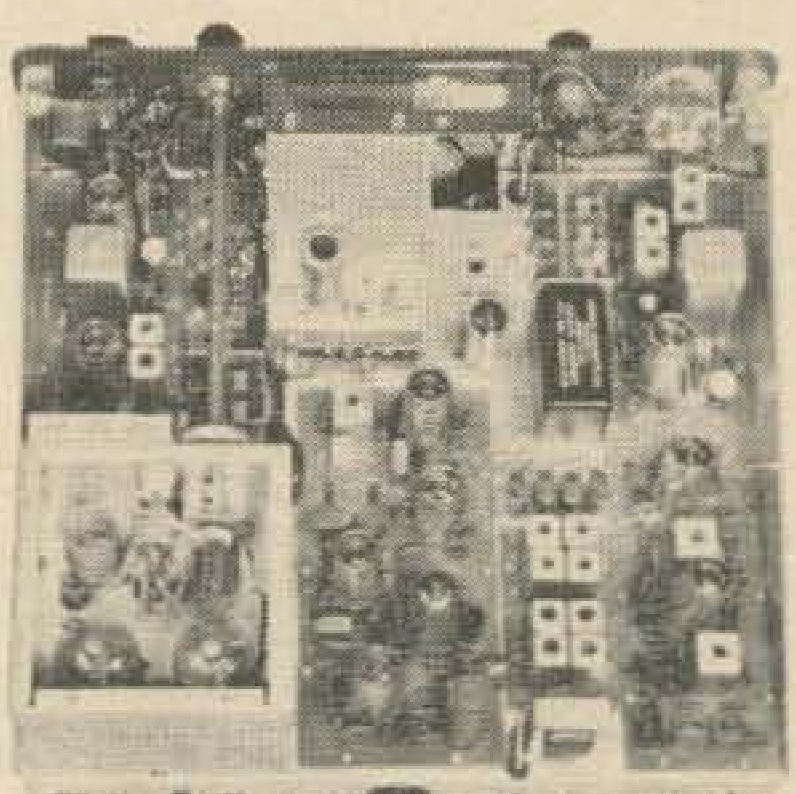
Write for complete SB-110 specifications and schematic.



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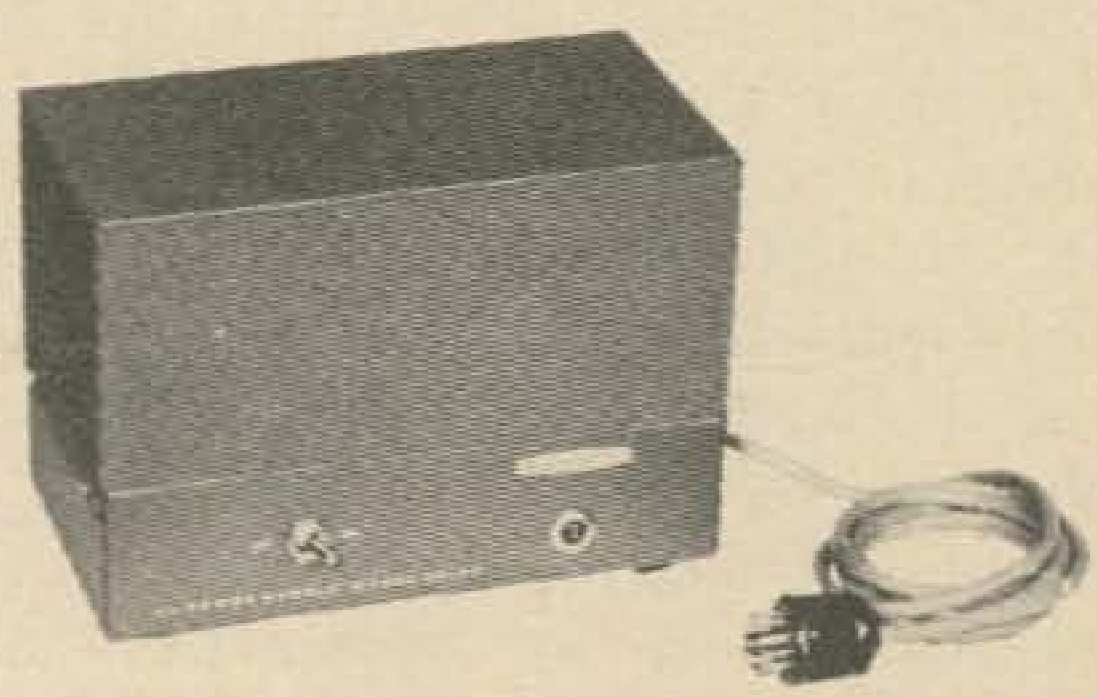

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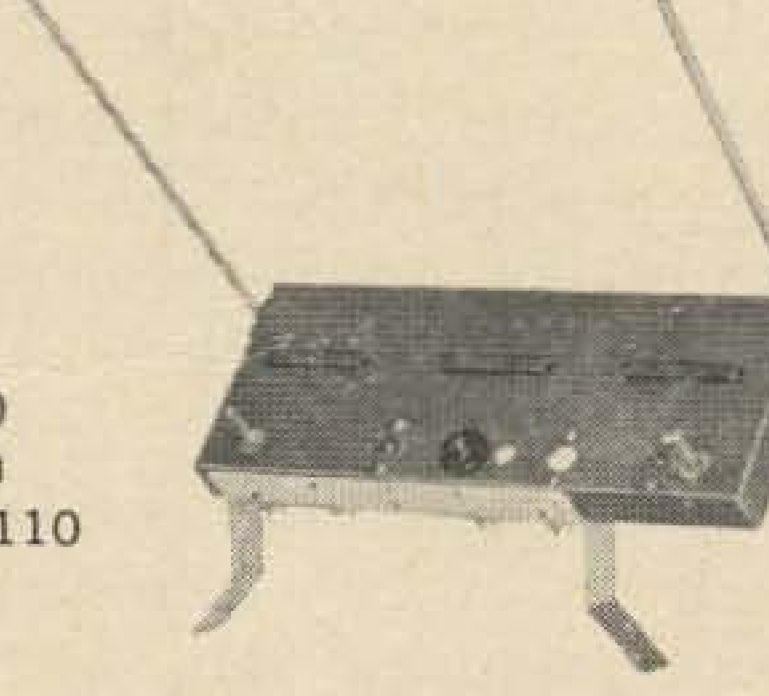

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Gus Browning W4BPD

Gus. Part V

Last month at the end of that chapter of "Gus Rides Again," I was on the train right in the middle of East Germany on my way to Berlin with "Polizei" all over the train, and of course at every stop along the way. I kept wondering if they were out because there was an American on their train. They all seemed to be looking at me. It does make a fellow have a funny feeling, but after a while I got used to all the police and security officers everywhere and I just did not pay them any more attention. I began looking around the railway carriage I was in and noticing how everyone was very quiet, no smiles. It was rather a gloomy lot.

At lunchtime, I noticed that almost everyone had their own food with them. A fairly well-dressed man sitting beside me saw that I had nothing to eat and offered me some of his sandwiches of black bread and sausage. I found that this man could speak fairly good English. He asked me where I was from and I told him. He was amazed to find that Americans could come and go from the US anytime that they wanted to. He was even more interested in the fact that we could take as much money out of the US as we wanted to. He asked me if I had checked into the US Consulate in Hamburg and told them where I was going. I told him I had not even thought about that. He was more flabbergasted. His picture of life in the US was pretty distorted. At this time, the train was passing through a big wheat field and I noticed that there were many workers in the field gathering wheat, and that they were using old-fashioned sickles to cut the wheat. They all were women, in groups of ten, equally spaced across the field. I asked him why they were spaced like that. He said that was to be sure each one did her task and did not loaf. I asked him how long he thought it would take them to gather all the wheat in that big field. He said he would guess about 7 to 10 days. Then he asked me how they would gather wheat like that in the US. I replied that they would use a reap-and-binder. He asked how many people would work in such a field with this reap-and-binder. I told him probably two or three. Then he asked how long it would take to gather that much wheat . . . I answered probably one day. That really stopped him for a while. He just sat there thinking. Eventually he asked me about all that unemployment we have in the US, mentioning that they had none in the German Democratic Republic. He then went further and said that he could see why there was so much unemployment when we had such things as those reap-and-binders that took the place of about 50 people. He said everyone worked there, even the women, like those we saw in the wheatfield. That's when I said, "You use your system and let us use ours. We like for our ladies to be rested when we come home to them, not tired and sweaty from gathering wheat all day." Well, that really quieted him.

The train continued on, and let me tell you, it was a very rough trip. The train was jammed . . . even the aisles were full. The ride was so rough that suitcases fell on people from the overhead racks. The train made its last stop just before entering West Berlin, and most of the passengers got off. Everyone had to show their passports or identification passes again. Then all the German Democratic Republic officials got off the train and the West Berlin officials and train crew got on. Our passports were glanced at again and the train was off. In a few minutes we stopped. We were in West Berlin . . . and I was glad that the trip was over!

I had a QSO with Wolfe DM2XLO while I was at DL6ZZ and he knew when my train was to arrive in West Berlin. We had arranged a get-together at the Zoo station of the subway. Our identification was a QSL card he was to have on his hat band. He was there waiting. Wolfe was a very nice chap and spoke very good English. We boarded the subway and away we were to East Berlin.

In those days there was no Berlin Wall and people in East Berlin could come and go without much trouble. Wolfe lived in the section of East Berlin called Koepenick, in a nice clean house. Wolfe is manager of an electronic factory there. I found that he had done lots of traveling all over the world, even in Red China.

I also spent a few nights with DM2FSO and his beautiful platinum blonde wife. He had a car and drove me all around East Berlin where we met lots of the radio amateurs there. They all treated me very nice.

In East Berlin I saw many buildings still standing just like they were on VE Day; no attempt was made to rebuild them at all. The opposite was true in West Berlin. There is a difference between East and West Berlin! The average East Berliner is a dull, drab looking fellow, dressed in a plain suit, no smile, and a beat look on his face, walking slowly as if he just did not care any more.

The day for me to depart from East Berlin arrived and DM2FSO and his wife took me down to the railway station. When we entered the station, DM2FSO asked me to wait a few minutes in the waiting room. In a few minutes he came back and he handed me my ticket to Prague, Czechoslovakia. This was a real surprise to me, because I certainly did not expect him to buy my ticket. I tried to pay him for the ticket and he would not think of letting me pay. I stood on the platform waiting for the train to depart, talking to him and his wife. They were not happy to see me leaving. His wife had tears in her eyes and they both expressed wishes for me to return and visit them again soon. It seemed as though I had known them for a long time. They were so sincere and friendly. Just as the train blew its little high pitched whistle to depart, he asked me if I had any East German Marks for my food. I answered no, and he handed me a bill, and the train departed for Prague. When it was time to eat, I gave the bill to the steward in the lunch car to pay for my food. He gave me back a whole handful of bills in change. Later on I found out that the bill I had been given was worth something like $20. Now what do you think of that? You just can't find that kind of friend very often.

The trip to Prague

This train was very similar and the tracks about the same as the ride through East Germany to Berlin. There were just as many police as before, and they all seemed to be looking at me most of the time. I was more or less getting used to being gazed at by then, so I just didn't pay any attention to them. Food on the train was OK, and it was cheap. As usual, the train was jammed full of people, many standing. I can certainly say that people over there really use the trains for their transportation. The cost of rail fares is very cheap too. I strongly suggest that anyone wanting to tour Europe use the railroads . . . you can save lots of money and you get to see the countries and meet people.

While in East Berlin, I had a number of QSO's with the fellows in Prague and they promised to meet me when I arrived there. At the border between East Germany and Czechoslovakia there was the usual customs check, money changed to Czech money, change of police on trains, etc., and you were in Czechoslovakia. You could see that the people were a bit better dressed and they seemed much happier than they were in DM land. I remember some of the QSL cards from OK stations saying that it was the country of "the happy people." I suppose someone like me must have taken a similar trip like I did, and same in OK land and then noticed the difference between DM land and OK land . . . so they had decided that OK land was the land of "happy people." Well, comparing it to DM land I suppose it is at that!

The train pulled in the station at Prague and I was really surprised at the number of OK hams that met me at the train. Many pictures were taken, a lot of hand shaking, and I could see that my stay in OK land was going to be very pleasant. While in Prague, I stayed with Myrek OK1FF, and every moment was most enjoyable. I have yet to find anyone more friendly than Myrek.

My stay in Prague was one continuous round of visiting hams. Every night it was at one of the fellow's homes or some very fancy restaurant. Those OK boys can drink more vodka than I can drink Coke! I drew a big laugh when these fellows gave me a tall glass full of Vodka, when I poured some of it in a saucer and struck a match to it and the flame was a beautiful blue . . . and I said, "None of that flamethrower stuff for me!" There were no Cokes in any of the "curtain" countries . . . and the coffee was so strong that I had to chew it.

While in Prague I asked about the whereabouts of Beda OK1MD. The answers were always the same: no one seemed to know his whereabouts. In fact, they just did not want even to talk about him at all. One day one of the local fellows and I were walking down the street together, no one was with us, so I asked him what the story was about OK1MD. He said something like this, "Beda did too much talking. He tried to run the activities of the DX boys around Prague." He said that the caravan that OK7HZ was with had very bad radio operators and that they should have been DX operators so that they would know how to work the world from their various stops. He then explained to me that this OK7HZ caravan that was going to many rare countries was basically non-ham radio minded, but ham radio was included in their caravan only for the purpose of communication back home. It was not a DXpedition at all as many people seemed to think. It appears that Beda just talked too much, and I guess when you are in OK land you should not do that

One night I met one of the publicity men of the big radio station there in Prague. He asked me to come down to the radio station the next morning to make a talk about my trip. I asked if they were going to tape my speech and re-edit it before airing it? He said that it was going to be a live broadcast. I asked what I should not mention over the mike. He told me to talk about anything I wanted to, but suggested that it would be a good idea not to mention anything about politics or religion. When we departed he said, "I'll see you at the radio studios tomorrow morning, comrade."

Watch out, Gus. You're going in the Lion's Den!

Charles Leedham WA2TDH

The Heath Ham Scan

There you are, sitting up late at night, idly eavesdropping on a local QSO on a very dead 20 meters, interested in a good local contact but not particularly wanting to break in on the one you're hearing. Suddenly you see a station come on the air 30kc higher on the band. You tune up to the spot and catch his call, give him a blast, and there you are. You *see* a station come on the air? Yep. You do with the new Heath HO-13 'Ham-Scan' Panoramic Adapter. Using this nifty little box of Benton Harbor tricks is like turning on the light in a dark room. It adds a whole new dimension to ham operating—you can now *see* what's happening on the band instead of fumbling around with the dial hoping to find something.

What the HO-13 does it take up to 100kc of the band and show it to you on the face of an oscilloscope tube. It gives a visible report of everything that's happening within that 100kc reading from the high segment on the left of the scope to the low on the right. The frequency you're turned to is always at the center of the scope, with the signal you're hearing popping up and down as a pip in the middle. Other signals on the band—50kc up and 50kc down—show themselves as little jumping pips above or below the center, or rather to the left or right. You can even tell whether they're CW, SSB, AM or RTTY.

Basically, the HO-13 is a second *if* system branching off from the mixer of your receiver. The signals from the mixer plate (which are amplified and eventually converted into sound by the *if* inside the receivor) are taken by the HO-13 and amplified, and than scanned by the frequency sweep of an internal oscillator. Starting 50kc down from the point the receiver is tuned to, the sweep goes along looking at everything in the *if* up to a point 50kc above center, and does this from 10 to 50 times per second, depending on where you set the Sweep Frequency control. About the best analogy at hand is a comparison to ordinary receiver tuning: you could do pretty much the same job as the HO-13 if you swung your receiver back and forth across a range of 100kc, and listened and remembered everything you heard. But you'd have to do it at least ten times a second—and the HO-13 takes the remembering out of it by displaying the information on the face of the cathode ray tube, with the signal pips showing you exactly how far away—higher or lower—all the signals are from the center point.

The kit is a simple one to build, representing 12 to 15 hours of work, all very straightforward and made easy by Heath's usual careful instructions and clear pictorials. In only one spot is there some small opportunity for confusion, and this is on pages 16 and 17 of the manual, where you are told to attach wires to control terminals and then route them through clamps for later connection. Heath supplies only one color of hook-up wire, and it would be worthwhile for you to use some of your own wire of different colors for these two or three connections. Either that or make your own code of knots, or stick on pieces of tape. Otherwise you may end up like me, with the horizontal and vertical controls reversed at first, because it isn't easy to follow those same-colored wires through when the time comes later for hooking up the far ends to the proper terminals on the back of the CRT.

Heath has very wisely designed the HO-13 to operate with a wide range of receiver *if*'s. Parts and alternate instructions are supplied for using the Scan with ten different *if*'s ranging from 455 to 3395kc. Again, the instructions are clear, but there is a small possibility of confusion here if you try to keep everything in your head. The instructions will say, for example, to install Resistor R203, but R203 can be any one of several different values depending on the *if* of your receiver. You have to go to a separate table to find out which, and it is a good idea to write down right in the instruction steps what value R203 (and the others) should be.

Once the kit is done, you have to get some signal for it from your receiver but, as a 73 reader, you are certainly not one of those who screams with fear at the thought of going inside the box with a soldering iron. The signal you want is taken from the mixer plate of your receiver. This requires fastening a capacitor (supplied) to the plate and running a small coax (supplied) from there to the back of the Ham-Scan. If you have a "Spare" jack or terminal on the back apron, you run the coax to that, and then make up a cable to go from there to the HO-13. If you have no such connection, then you'll have to make a tiny hole in the back apron of the receiver and run the cable straight from the mixer pin to the Scan. However, the RG-62U supplied is so small that the hole can be very, very tiny, and shouldn't harm the value of the receiver as a trade-in, particularly if you pull out the connection and coax before you take the machine down to your friendly ham dealer. Also, just in case you're not sure which pin of which tube is the mixer plate, Heath even goes so far as to supply a full-page table listing the proper tube and pin for 7 makes and 19 models of receivers, thus covering most of the receivers around.

If you're one of the many in the fraternity who have found the Ham-Scan's predecessor, the HO-10 Monitorscope, a valuable operat-
available from Heath, part number 206-238
ing aid, you will be interested to know that the Scan provides a special mu-metal shield for the cone of the 3RP1 tube which completely eliminates any possibility of AC ripple in the CRT trace. This special shield, incidentally, is for $2.35, if you want to get another one to put on your HO-10. As soon as I built the HO-13 I wrote to Heath for another and was happy to find that it cut out 99% of the tiny HO-10 ripple that had been bugging me.

Turn on the receiver and the Ham-Scan, and as soon as the audio hits the speaker, there is the whole spectrum of the band in front of you. The sweep range of the HO-13 can be varied from about 30kc to 100kc. Thus you can monitor a wide part of the band, or you can cut down the range to widen the pip of a particular signal and take a closer look at it. It gives you an instant picture of the quality of whatever you're hearing, because it shows you exactly what's happening at every point in the spectrum—overmodulation, splatter and such. Also, if enough of your transmitter signal gets through to your receiver *if*, you can take a critical and continued look at your own signal.

You will at first be stunned by the amount of stuff that's going on in the *if* of your receiver—all the noises, pulses, garbage, and a few signals. Pretty soon you won't be able to believe that you ever operated without it. Looking for a signal on a quiet band? Just park your receiver at the middle of it—say at 14.3 on 20—and everything that moves will show up on the scope. Got a good contact who's being clobbered by QRM? No longer do you have to tune away—and with a transceiver, maybe forget where you were and never get back—to find a clear spot. Just let your eye wander along the trace and you'll immediately see by the lack of pips where you should QSY. And what with the calibration marks along the base line plus a little experience, you will be able to impress the bejabbers out of your contact by telling him instanter that you see a clear spot exactly 23 kc down.

The HO-13 costs $79 from Heath, which takes panoramic fun right out of the rich man's class and brings it down to all of us. It's well worth every cent of it.

. . . WA2TDH

Martin Smith W8ADV
27389 Cook Road
Olmsted Falls 38, Ohio

The Sub-Antenna

Guaranteed to bring in loud, clear DX right through summer static, regardless of weather. I doubt the winds will blow this one down!

It was a known fact that radio waves travel through the ground just as they do the air. Listen in to Mother Earth's clear "Constant Potential" ground waves. Even the primitive Indian knew the greater carrying power and absence of interference in sound waves transmitted through the ground. The same is true of radio. These are some of the ads back in "Radio News" September, 1928, that started the whole thing here.

I had a receiver, and a nice long ground that I've been using for over four years now. So as I began to think about it . . . Well let's see now. Take the antenna off the receiver, now take that ground off the transmitter, put it on the receiver that's pretty dead right now. "WOW", signals, sure hard to believe but here it is!

The ground described is a fifteen foot piece of heavy rubber coated wire, I would guess about #4. The ham shack is a 9 × 12 block building 100 feet back of the house. This heavy wire goes out through the side to a ground rod 5 feet long. To this is also tied a heavy aluminum clothesline which runs along the ground to a second 5 foot stake about 6 feet north of the ham shack. From here it goes to a 60 foot drilled well about 90 feet to the north of the shack. The wire is buried just under the grass and upon reaching the well it is connected to the well casing, ergo: water contact. Thus you have an underground antenna.

The following are various reports:

W8GNP—Loud and clear—about fifteen miles away

W8LHW—Jack said: "This is the loudest signal I've ever heard in Avon, Ohio." -40 DB over S9 he has never heard a station as close as Lorain, Ohio, which is much closer to him, come close to that S-meter reading.

W3ØX—Tony near Pittsburgh said he heard it very well.

W8QMB—Ravenna, Ohio

W8KJU—Jeromesville, Ohio

W8BIQ—Toledo, Ohio

WA8ADB—Cincinnati, Ohio

K8BBI—Cincinnati, Ohio

W4SBM—Ft. Thomas, Ky.

and many more in Michigan. his was on 1805 kc to 1820 kc.

I tried it on Ohio Mars 2258 kc and was heard over the state of Ohio. The next experiment was on 3830 kc on which two more stations were worked: K8SEY in Genoa, Ohio and K8PER in Newcomberstown, Ohio. The last frequency tried was another Mars frequency, 4030 kc, and again good coverage.

I'm sorry I can't say what the resonant frequency is; however, it does seem to be vertically polarized. Again I'm not sure of the feed point impedance; however, the Ranger II doesn't seem to change very much when switched to a full wave Diamond (520 ft. for 1.8 mc.). The top of the diamond is at 75 feet and the bottom feed point is 7 feet from the ground.

It should be noted that the diamond antenna was installed after the underground tests were run. There is a difference between the diamond and underground antenna in performance, the diamond being better; however, if a strong wind should come along and blow down the diamond, I still have the reliable underground antenna to support my activities.

I still haven't figured out what I've done, but I'm having a lot of fun with the gang around here. Needless to say, do I have the company looking for a larger coffffee pot.

. . . W8ADV

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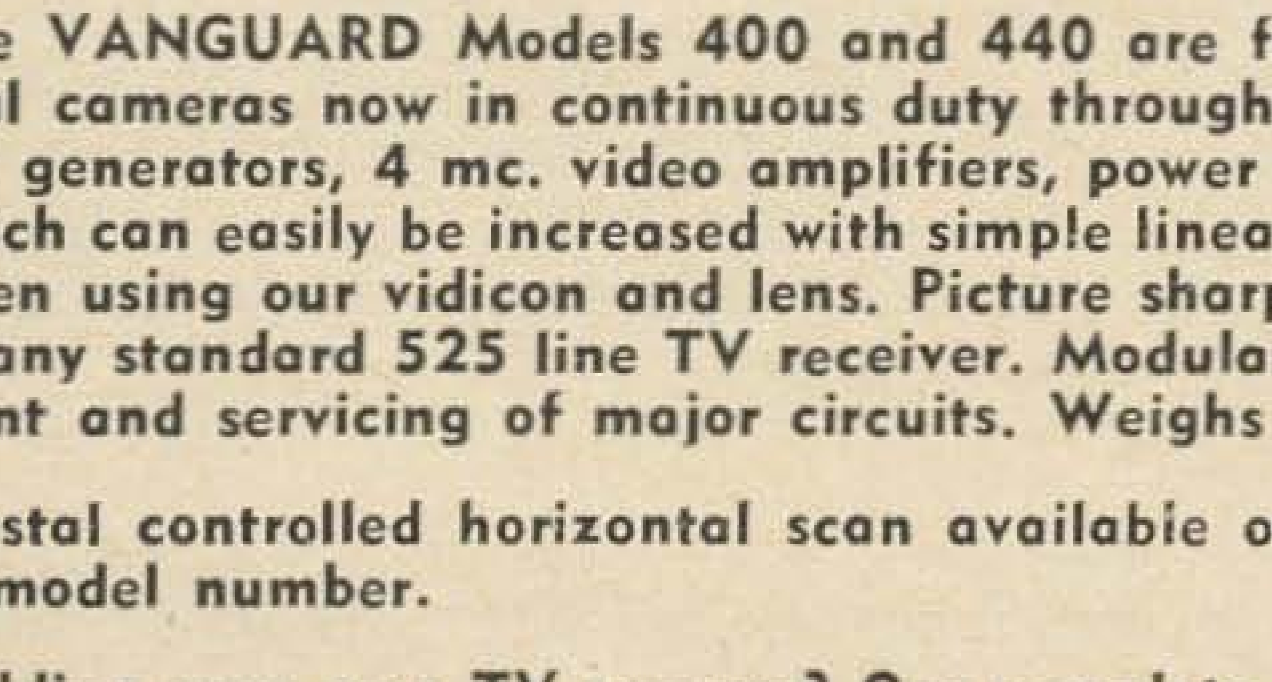

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	300-F	144-146	28-30	$12.95 ppd.
	300-Q	144-148	14-18	$12.95 ppd.
6M	300-B	50-51	.6-1.6	$12.95 ppd.
	300-C	50-54	14-18	$12.95 ppd.
	300-J	50-52	28-30	$12.95 ppd.
20M	300-G	14.0-14.35	1.0-1.35	$11.95 ppd.
CB	300-A	26.965-27.255	1.0-1.29	$11.95 ppd.
WWV	300-H	5.0	1.0	$11.95 ppd.
Int'l.	300-I	9.0-10.0	.6-1.6	$11.95 ppd.
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Marine	300-M	2-3	.6-1.6	$11.95 ppd.
Aircraft	300-N4	121-122	.6-1.6	$13.95 ppd.
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Fire, Police etc.	300-P	155-156	.6-1.6	$13.95 ppd.

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Robert A. Kidder
20 Prescott Street
Nashua, New Hampshire

Passivating Aluminum Alloys

It may come as a surprise to many people that much of the aluminum in use for a great variety of purposes requires surface passivation. This is a fancy way of saying that such items as aluminum chassis and front panels need some kind of protection against corrosion. The reason for this is that virtually all aluminum in common use is alloyed with other metals, mainly magnesium, and to lesser extents with copper, manganese, and silicon. It's true that chemically pure aluminum passivates itself by forming a film of aluminum oxide on its surface, and that the oxide film is impervious in general to further atmospheric attack. From a chemical standpoint, however, aluminum alloyed with other elements is highly impure, and its tendency to corrode is greatly multiplied. Apparently the other metals in the alloy have a catalytic effect on the aluminum, and in electronic equipment corrosion may be further aided by electrolysis.

Granted that surface protection of some sort is required for aluminum alloys, what alternatives are available? The easiest way out is paint. This is also the least satisfactory, when primer and paint by themselves are used. There are two more answers to the question, both of which are eminently satisfactory: alodizing, and anodizing. Both processes result in the formation of impervious films which are molecularly bonded to the surface of the alloy.

Alodizing is a purely chemical treatment which produces a very thin (about 3 microns deep), electrically conductive coating that's proof against normal atmospheric conditions, including industrial smog and sea air. The process described herein imparts a mustard color to the alloy, but the surface can be buffed with a clean, soft cloth to yield a finish that resembles polished bronze, or fogged gold plate. Unbuffed, it's an excellent base for primer and paint.

Anodizing is an electro-chemical treatment which produces on the surface of the alloy a heavy film of aluminum oxide that's electrically non-conductive. For those who may be interested, emery and ruby are also forms of aluminum oxide. It's second only to diamond in hardness, physically tough, and practically bomb-proof to corrosion. As formed by anodizing, it's satiny silver in appearance, but it's porous and can be colored by dyeing. Dyes are available in a bewildering array of colors and metal tones. Being non-conductive, anodizing is a dandy finish for transistor and diode heat sinks, because the devices can be bolted directly to the heat sink without using fiber washers or mica gaskets. This results in much more effective cooling of the semiconductors.

Both of these processes can be carried out at home if suitable equipment can be scrounged, jury-rigged, or (perish the thought!) purchased. Before diving into the details of either treatment, however, the author is conscience-bound to emphasize certain

Fig. 1
First Aid

Cardinal rule: Call the nearest hospital or doctor immediately.

Acid or caustic burns:
Rinse immediately with running water. Do not scrub, wipe, blot, or even touch the affected area. After rinsing for at least 10 minutes, cover the burn with a loosely fitting, clean, soft cloth. Do not apply salves, ointments, or other medication of any kind.

Acid or caustic in the eyes:
Rinse continuously with running water, keeping the eyelids open. Flush the surrounding areas also. Do not apply medication of any sort.

Swallowed acid:
Drink immediately one quart of milk (one pint for a child 5 years or younger) or one tablespoon of milk of magnesia in a cup of water. Do not try to induce vomiting.

Swallowed caustic soda:
Drink immediately one quart of milk, vinegar, or any fruit juice (one pint for a child 5 years or younger). Do not try to induce vomiting.

Swallowed solvents:
Drink immediately one quart of milk and induce vomiting by prodding the back of the tongue and the throat with the fingers or a spoon.

In all cases:
Once again, call the nearest hospital or doctor immediately.

essential safety measures. Both processes entail the use of dangerously corrosive chemicals, and specific precautions must be observed to insure both personal safety and the protection of various household appurtenances, notably the plumbing. It may seem that the writer is going to ridiculous extremes in making the following recommendations, but he has seen the results of caustic and acid burns. They are excruciatingly agonizing to experience, and they leave permanent, ugly scars. Even a tiny spatter of acid or caustic in the eyes can cause blindness. Needless to say, these chemicals are violently poisonous if swallowed. In spite of all that, they are not dangerous to work with *if they are treated with respect and handled with due regard for the potential havoc they can wreak.* The importance of strictly following the safety measures outlined below is impossible to overstate.

Familiarize yourself and several friends or family members with the First Aid information given in Figure 1. Have one of these people in the area at all times while you are working so that emergency treatment can be rendered instantly in the event of an accident. The one factor that literally will save somebody's hide is the speed in which First Aid can be initiated.

Ventilate your work area. A regular kitchen exhaust fan is adequate if you set up your equipment under it. An electric fan blowing out through a window will also do nicely. At the very least, open all the windows and outside doors of the room in which you are working.

Wear protective coverings. The minimum is a pair of *watertight* rubber gloves and goggles, or a swimmers' face mask. If you can turn up a rubber apron and a pair of rubber boots or galoshes, so much the better, because raw sulphuric acid will burn through a leather shoe or a trouser leg in very short order.

Leave a nearby water faucet running at all times while you are working with or around these chemicals. This spigot should have enough free space beneath it to allow getting the face under it in an emergency. Also, keep a pail of water in a handy location where it's not likely to get contaminated by any of the chemicals. This is for use in case acid or caustic is spilled on the torso or the legs.

Flush or wipe up spills immediately. Also rinse promptly anything that comes in contact with these chemicals, including gloves, stirring rods, and measuring containers. Upon completion of the work, rinse the gloves and other protective coverings before taking them off.

Fig. 2

List of Materials

Pickling (Cleaning) Process

Equipment:
- Steel, stainless steel, or plastic container
- Glass or plastic container
- Beam balance, or spring scale accurate to one gram
- Steel rod
- Glass rod
- Stove, or hot plate ...... optional
- Thermometer, reading to 212°F. optional

Chemicals:
- Nitric acid (HNO_3) 42% concentration
- Caustic soda (Sodium hydroxide, $NaOH$)
- Organic solvent

Alodizing Process

Equipment:
- Glass or plastic container
- Glass rod
- Beam balance, or spring scale accurate to one gram

Chemical:
- "Alodine 1200"
  available from:
  American Chemical Paint Co.
  Ambler, Pennsylvania
  $3.80 per pound

Anodizing Process

Equipment:
- Glass, plastic, or lead-lined container
- Glass rod
- DC power source, heavy current, 10 to 18 volt output (see text)
- 2 automotive battery cables
- Sheet of chemically pure lead (not required with a lead-lined tank)
- Insulated support rod (piece of broom handle, etc.)
- Aluminum strap stock, ½" to 1" wide, 1/16" to ⅛" thick (See Figure 5)
- Metal container for boiling water

Chemical:
- Sulfuric acid (H_2SO_4) 66° Baumé scale (undiluted)

Dyeing Process

Equipment:
- Metal container, preferably disposable
- Beam balance, or spring scale accurate to one gram
- Stove, or hot plate
- Thermometer, reading to 212°F.

Chemicals:
- Dye
  available from:
  Sandoz, Inc.
  61-63 Van Dam Street
  New York 13, New York
- Nickel acetate, of anti-leaching agent recommended by the dye manufacturer. The use of anti-leaching agents is optional, in general.

NOTES

1. The various containers called for should be large enough to allow the complete immersion of the article to be treated.
2. Use separate containers for each process.
3. It's permissible to use acids of different concentrations than those specified here, provided they aren't diluted down below the strengths of the solutions described in the text.

Exercise caution at all times. Keep in mind that these chemicals are in the same league as the B-plus in your final. Members of that league are well-behaved as long as you respect them, but they'll burn you good 'n' proper if you disregard their potency and act carelessly.

Don't begin to work until all safety measures have been complied with.

Don't pour water into an acid. This will cause the acid to spatter violently. Do it the other way around. Put the required amount of water in the tank first, then slowly add the acid while stirring the water with a glass rod.

Don't put your fingers or hands into the solutions, even with rubber gloves on. Use slings made from rubber or teflon insulated wire or hooks bent from tinned solid copper buss, 16 gauge or heavier, to hold and support the work while it's immersed in the various baths.

Don't handle the work by its edges or corners. This will preclude the possibility of slicing or piercing the gloves.

Don't leave the solutions unattended. As an added precaution, lock all the kids up in a closet or send them to Grandma's house for the day.

Don't let any unnecessary people mill around

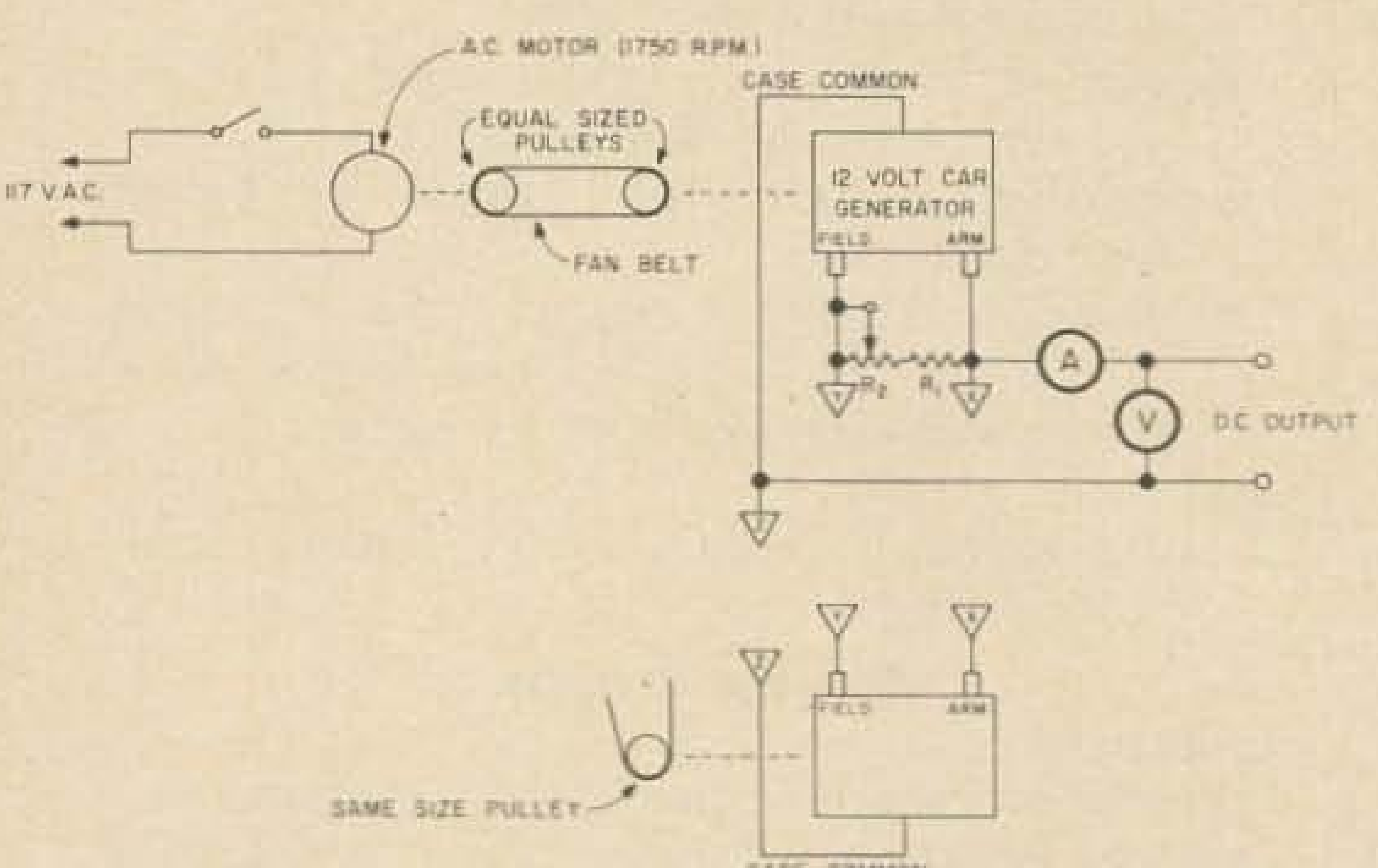

Fig. 3

For one generator:
R1 2 ohms, 10 watts
R2 25 ohms, 50 watts
Motor ¾ HP Wire size 8GA
Ammeter 0-50 amps dc
For two generators:
R1 1 ohm, 25 watts
R2 12 ohms, 100 watts
Motor 1 HP minimum, 1½ preferred
Ammeter 0-100 amps dc Wire 4GA
The values given above are typical for an average hook-up. They may vary as much as 50% among different makes of generators.
Maximum overload for one generator is 40 amps for not more than 20 minutes.
Maximum overload for two generators is 75 amps for not more than 20 minutes.
Maximum continuous load per generator is 30 amps.
R2 is the output voltage control.

the work area. These processes are fascinating to watch, but all it takes for a catastrophe is one extraneous individual under-foot at a critical moment.

Don't salvage the solutions when the work is finished. Dispose of them. The cost of the chemicals used in these processes is very reasonable, but the accidental damage they might cause can be very unreasonable.

That covers the subject of personal safety measures rather thoroughly. They are based on the standard operating procedures of labs and shops where corrosive chemicals are used, so the author really isn't an old worry-wart.

Now let's consider the plumbing. If your house has a cesspool or a septic tank, don't dispose of the solutions by pouring them down the drain. They will kill off all the bacteria that normally break down the sewage, and you may get stuck with backed-up drains and an incredible stink. The best way to get rid of them in this case is to bury them. Dig a hole somewhere that's clear of the cesspool or septic tank, the leaching bed, and the wll, dump the solutions in, and fill the hole up again.

If your house is served by a city or town sewer system, the solutions can be safely disposed of by pouring them slowly down the drain while the faucet is running. Let the water continue to run for at least fifteen minutes after the last of the baths goes down. This will flush out all the traps and low spots in the plumbing and give you the cleanest drains for miles around.

There's nothing wrong with rinsing the work off into the drain though, whether or not you have a cesspool or a septic tank. The tiny amounts of chemicals that might wind up down there by doing this will be so diluted that they wouldn't bother even a small amoeba.

The general procedure for passivating an item of aluminum alloy is first to pickle it and then either to alodize it or to anodize it. An alodized article can then be primed with zinc chromate and painted or it can simply be buffed with a soft cloth. An anodized piece can be left clear or dyed almost any imaginable color or metal tone. Anodized surfaces also hold primer and paint very well.

The first thing to do is to consult the list of materials and to round up all the paraphernalia for the processes that you intend to use. Suitable containers are the various plastic pails, dishpans, and waste-paper buckets available cheap at your friendly neighborhood 5 & 10. A few alternatives are plastic bleach jugs with the neck and handle cut off, photo developing trays, and borrowing the real McCoys from a

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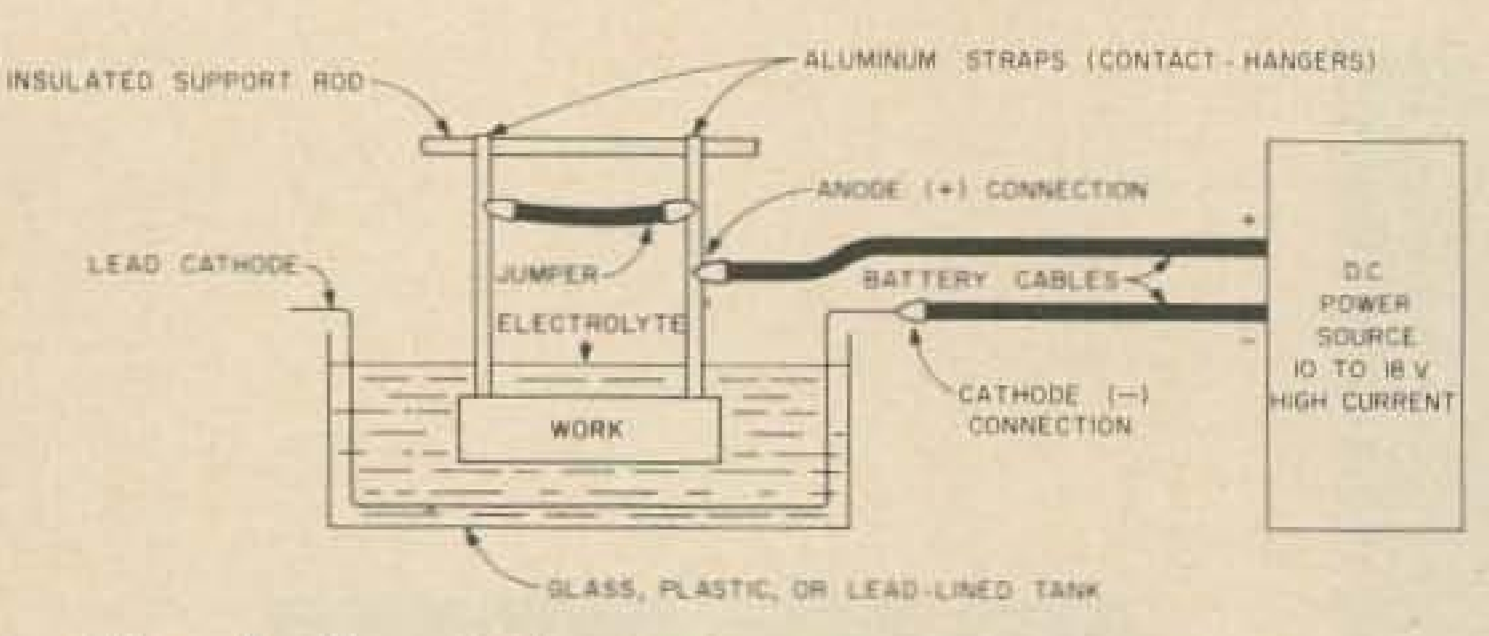

Fig. 4. Anodizing set-up

high school or college chemistry lab or a plating shop.

It's best to use commercial sodium hydroxide for the caustic etch, in preference to a household lye such as Drano. Perusal of a Drano label reveals that the product contains only 54% caustic soda and a total of 46% additives and "inert" ingredients. These extra goodies are included to prevent turning animal fat in the drain into hard soap. This is lovely for the drain, but these same additives will cause the formation of blemishes and little black things on aluminum alloys. Besides, the author's 12 ounce can of Drano cost 33 cents and commercial sodium hydroxide can be had for as little as 16 cents a pound.

The organic solvent can be almost any common cleaning solvent such as methyl ethyl ketone (M. E. K.), acetone, toluol, or methanol. Stay away from carbon tetrachloride or carbon disulfide. They're both sneaky killers.

The chemicals and some of the equipment can be obtained from a chemical or scientific supply house. Other possible sources are a plating shop, a high school or college science department, large hardware or paint stores (expecially those catering to industry), rental agencies, surplus outlets, auto boneyards, and the Yellow Pages.

After you've rounded up all the gear, set up all the processes that you're going to use. This is necessary because once the aluminum alloy has been cleaned, it's really clean. If it's left lying about while subsequent steps are being prepared, it may build up enough of a film of corrosion to affect the remaining procedures. Then you'd have to start all over again, and thin aluminum alloy parts won't stand being pickled too many times before they develop great gaping holes all over.

The first pickling or cleaning bath is the caustic etch. This is prepared by dissolving from 2 to 8 ounces of sodium hydroxide per gallon of water. Mix it up in a steel pot if you intend to heat the solution, or in a plastic container if you're going to use it at room temperature. You ought to heat it if you have lots of pieces to clean, or if they're really cruddy or scarred up. Heating the caustic etch makes it more effective and its action faster. You can get away with using it at room temperature if you have only a few pieces to do and they are fairly clean to start with. Use 8 ounces of sodium hydroxide per gallon if you plan to work the etch cold. Use 4 ounces per gallon if you heat it. Use only 2 ounces per gallon if you heat the solution and the parts are quite clean and without scratches. Stir the mixture with a steel rod until all the caustic soda has dissolved. If you intend to heat it, bring it up to a temperature of between 150° and 160°F.

The second pickling bath is the nitric dip. If you have obtained the 42% concentration of nitric acid, mix it even-Steven by volume with water. For example, if you need two gallons of the dip, put one gallon of water into a glass or plastic container, then slowly add a gallon of 42% nitric acid while the solution is being stirred with a glass rod. The resulting mixture will be 21% nitric acid. If you are using a different concentration of acid, you'll have to alter the amount of water you start with. The bath should be between 20% and 25% nitric acid.

The alodizing solution is prepared by dissolving 2 ounces of "Alodine 1200" per gallon of water. Mix it up in a glass or plastic container and stir it well with a glass rod. A card to the American Chemical Paint Company, Ambler, Pennsylvania will reveal the whereabouts of the nearest distributor of "Alodine 1200". If you happen to get hold of some other alodizing agent, prepare it according to the manufacturer's instructions.

Let's consider the dc power source necessary for anodizing before we discuss the actual set-up. Ideally it should have an output variable between 10 and 18 vdc and be able to supply between 10 and 25 amps per square foot of anodized surface. The exact current drain will depend on the composition of the alloy, the concentration of the electrolyte, the purity of the lead cathode, the voltage used, and other imponderables such as whether or not Brezhnev had borscht for breakfast. For clear anodizing, 15 volts is required, but if you intend to dye the article, the anodizing voltage will be determined by the dye that you use.

Before somebody gets all shaken up over the improbability of turning up such an exotic supply, the writer hastens to point out that any dc potential between 10 and 18 volts will produce an anodized film on aluminum alloy, and that the film so formed will effectively protect the metal beneath it. Working with a different voltage than the one needed for best results with the dye will affect the vividness of the color, but the dye will take to a greater or lesser degree. You can always run a piece of scrap alloy through the whole process to find out how the end result will look.

The chances are that you already have a power source that can be used for anodizing. It's the family bomber, if it has a 12 volt ignition system. It will supply up to 25 to 30 amps, more if you've installed a heavy duty generator or alternator for that California gallon reposing in the trunk. If you use the car's electrical system, prop up the throttle linkage so that the engine is turning over fast enough to keep charging the battery continuously while the anodizing is in progress. Be sure to work upwind of the exhaust, and don't work inside the garage, even with the doors wide open.

Another scheme is to make up a dynamotor set using an ac motor to turn over an automotive 12 volt generator or alternator (or a pair of them, even). The hook-up shown in Fig. 3 will put out over 700 watts (at 18 vdc) for short periods with one generator, and in excess of 1.3 kilowatts intermittently with two generators. In addition, its output voltage is variable over the desired range. The generaltors can be the common, garden variety 12 volters available at the local auto junkyard, but if you use two gennies, try to get two of the same make and model.

Other power source possibilities include borrowing a heavy duty battery charger from the corner gas station, and paying a visit to the science department of the local high school or college. Undoubtedly there are other ways to obtain the necessary schmaltz for anodizing, but the author has attempted only to point out a couple of methods that can be jury-rigged from goodies around the house and neighborhood.

Prepare the anodizing electrolyte by adding one volume of 66° (Baumé scale) undiluted sulfuric acid to nine volumes of water. It is especially important with undiluted sulfuric acid to add the acid to the water, not vice-versa, in order to avoid spattering. Add the acid slowly while stirring the water with a glass rod. The resulting solution should be 15% to 18% sulfuric acid by weight, or 10% by volume. If you started with diluted acid, you will have to reduce the amount of water to make it come out right. (A gallon of water weighs 8 pounds; a gallon of sulfuric acid weighs 13 pounds.)

Using an automotive battery cable, connect the negative side of the power source to the lead electrode. If you were able to get a lead-lined tank, a separate lead cathode won't be needed, and you can connect the negative cable directly to the lead lining of the tank. Fig. 4 shows the whole set-up.

If you're going to color the anodized surface, mix up the dye according to the directions on the label. You will only need something like ¼ to 1/3 of an ounce of dye per gallon of water, so it's quite probable that a sample of the dye will be sufficient for most small jobs. Send a card off to Sandoz, Inc. for specific information on colors (they make dyes in about 100 colors, all different), samples, and the location of the nearest dealer. The mixing instructions will probably indicate a proportion like 2 grams per liter of water, so use these conversions: 28 1/3 grams = 1 ounce (avoirdupois); 1 liter = 1.06 quarts (fluid).

After the dye is mixed, put it on the stove or hot plate and bring it up to a temperature of between 150°F and 160°F. Also, fill another metal container with water and bring it to a boil. Add the anti-leaching agent to this water, if one is called for. This completes all the setting-up procedures.

Now let's look into the pickling process. Incidentally, all forming, bending, cutting, drilling, and other machining of the piece to be treated should be finished before any of these processes is undertaken. Start by wiping the work with the organic solvent and a clean cloth or a paper towel. This removes any skin oils, grease, and other residues from the surface of the piece. Now dip it into the caustic etch, using a hook or a sling to support it. The work may fizz like an Alka-Seltzer when you first put it in. Tip the article back and forth a couple of times to free any trapped air.

This bath will actually reduce the surface of the alloy. It will remove shallow scratches, and it'll feather the edges of the deeper ones

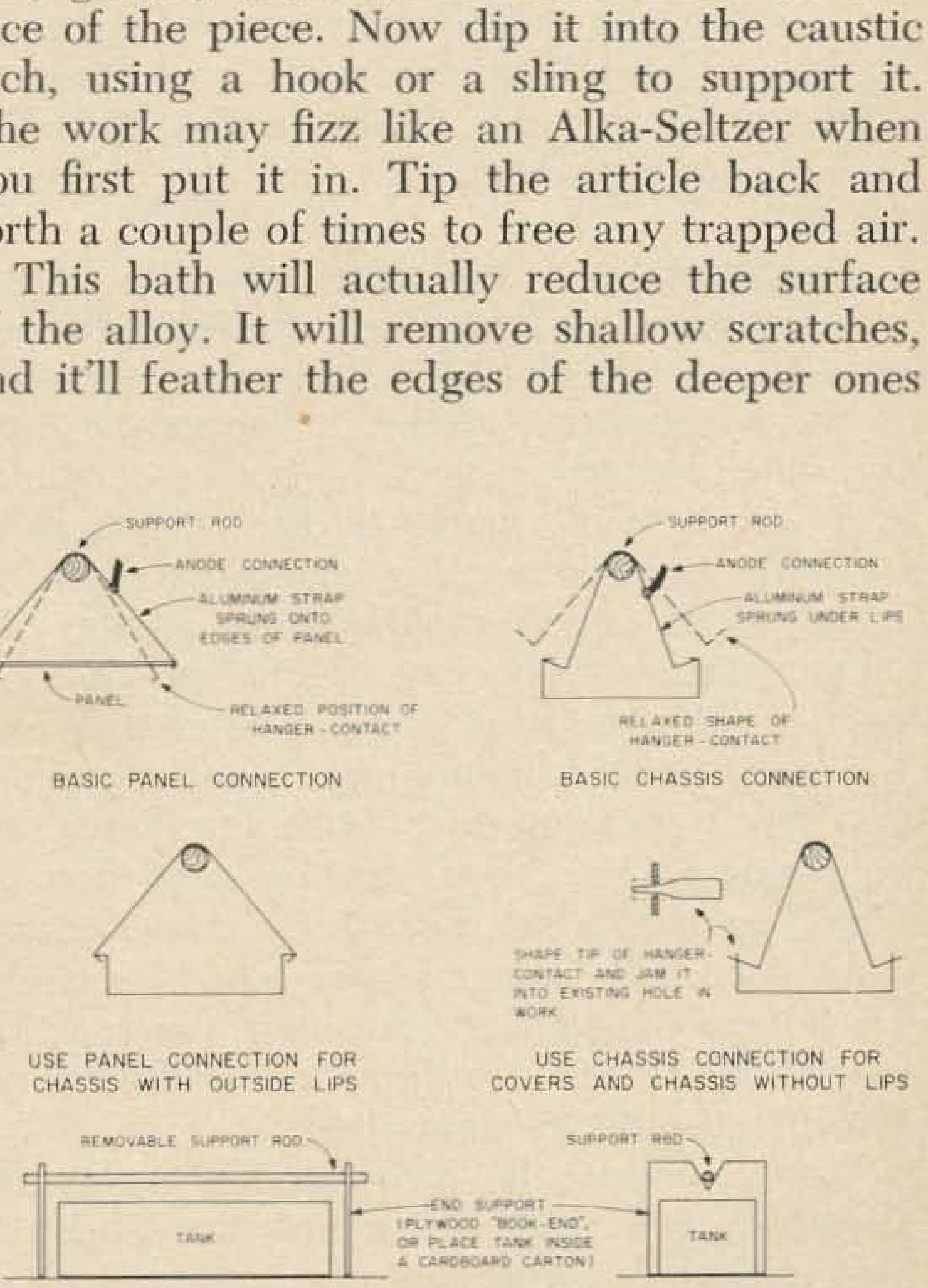

Fig. 5. Work support and connections

Fig. 6
ANODIZING VOLTAGES AND TIMES

VOLTAGE	MINUTES CLEAR	MINUTES DYED
16 to 18	15 to 15	10 to 20
13 to 16	15 to 20	20 to 25
10 to 13	20 to 30	25 to 40

so they'll be less noticeable. Leave the work immersed in the caustic etch for 2 or 3 minutes, then take it out. At this point the surface will have a smoky, faintly grainy appearance, somewhat like a cold solder joint. Rinse the piece thoroughly with running water.

Now dunk the work into the nitric dip and shift it around a bit to eliminate trapped air. This bath removes the smut formed on the surface of the alloy by the caustic etch. There may be some fizzing in this solution, too. Let the piece soak for 2 or 3 minutes, until it's bright and shiny. Then take it out and rinse it thoroughly with running water. This completes the pickling, or cleaning, process, and the work should now go immediately to the alodizing bath or to the anodizing tank.

The alodizing is accomplished by immersing the pickled part in the "Alodine 1200" solution. Tilt the work once or twice to release trapped air. Let the piece stay in the bath for 30 seconds to one minute if the solution is fresh, longer if you've done lots of parts in it. When you take the article out of the bath, it will look as though it had been sprayed with mustard. Rinse the part thoroughly with running water and hang it up to dry for an hour or so. When it is dry it's ready to be buffed or primed and painted. It can also be used "as is."

Anodizing is a bit more complex. If you aren't using a leadlined tank, immerse the lead cathode in the electrolyte. Connect the work to the positive side of the power source, using the other battery cable. The points of contact may leave visible marks on the object, so try to make the connection somewhere on the piece where possible marks won't matter. The only metal that you can use for making connections that will be in physical contact with the electrolyte is aluminum or aluminum alloy. Don't use copper or brass for these "wet" connections, but they can be used for any "dry" contacts. See Fig. 5 for some connection hints. The power source can be switched on before the work is put into the tank, because no current can flow unless the item is in contact with the electrolyte.

Now immerse the piece in the tank, being careful not to short it against the lead cathode (it might wipe out the power source). Rock the work a bit to free any trapped air. For clear, uncolored anodizing, give the item 15 volts for 15 to 20 minutes. For dyed work in general, 15 volts for 20 to 25 minutes should do the trick, but if it's possible for you to do so, follow the dye manufacturer's recommendations for voltage and time. For those of you who are using a fixed voltage other than 15 volts, Fig. 6 will serve as a guide to the proper time for the voltage you have available.

While the piece is in the tank stir the electrolyte with a glass rod. This is necessary to insure an even film. When the time is up, take the work out of the tank, disconnect it from the power source, and rinse it thoroughly with running water. The surface of the article will have a satiny appearance. This is the anodized film.

If you are going to color the item, it goes vat next. Keep the temperature of the dye as constant as you can at about 150°F. and follow the manufacturer's recommendations for dyeing time.

From the dye bath the work goes into the pot of boiling water for 15 minutes. The water may leach out some of the color, and this may lighten the shade a bit. An anti-leaching agent, added to the water beforehand, will minimize this occurrence. A dash of nickel acetate is the usual additive, but the dye people may suggest, or require, something else. When the work comes out of the boiling water, the process is finished, and the part is ready to use.

If you are not dyeing the article, it goes directly into the boiling water after you've taken it out of the anodizing tank and rinsed it thoroughly. The purpose of the boiling water is to seal the pores in the film. Let it cook for 15 minutes, then take it out. This completes the anodizing process, and the piece is ready to use.

You should promptly break down the setup and dispose of the solutions when the last item is finished. If it really goes against your grain to get rid of the acid solutions, they can be stored in glass or plastic jugs. Don't fill them up to the top, though. Leave some space in each jug for gas formation, otherwise enough pressure may build up inside the bottle to burst it. The other solutions are so inexpensive that they aren't worth the bother of storing them. Store the acid solutions, if you trouble to save them, and any unused chemicals under lock and key.

The author wishes to acknowledge the essential assistance rendered by Gus Fletcher of Sanders Associates, Nashua, New Hampshire. Without his help this article could not have been written.

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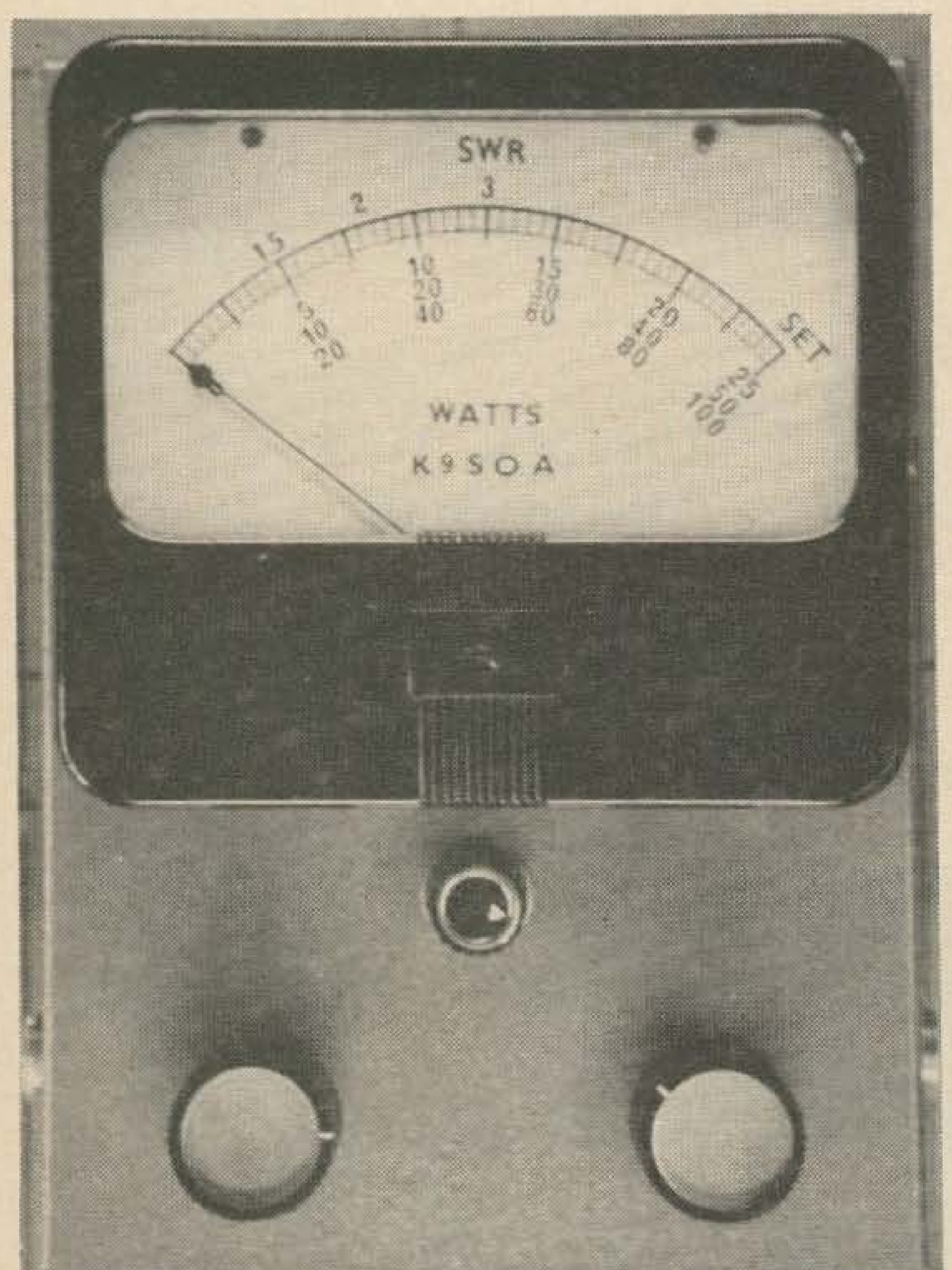
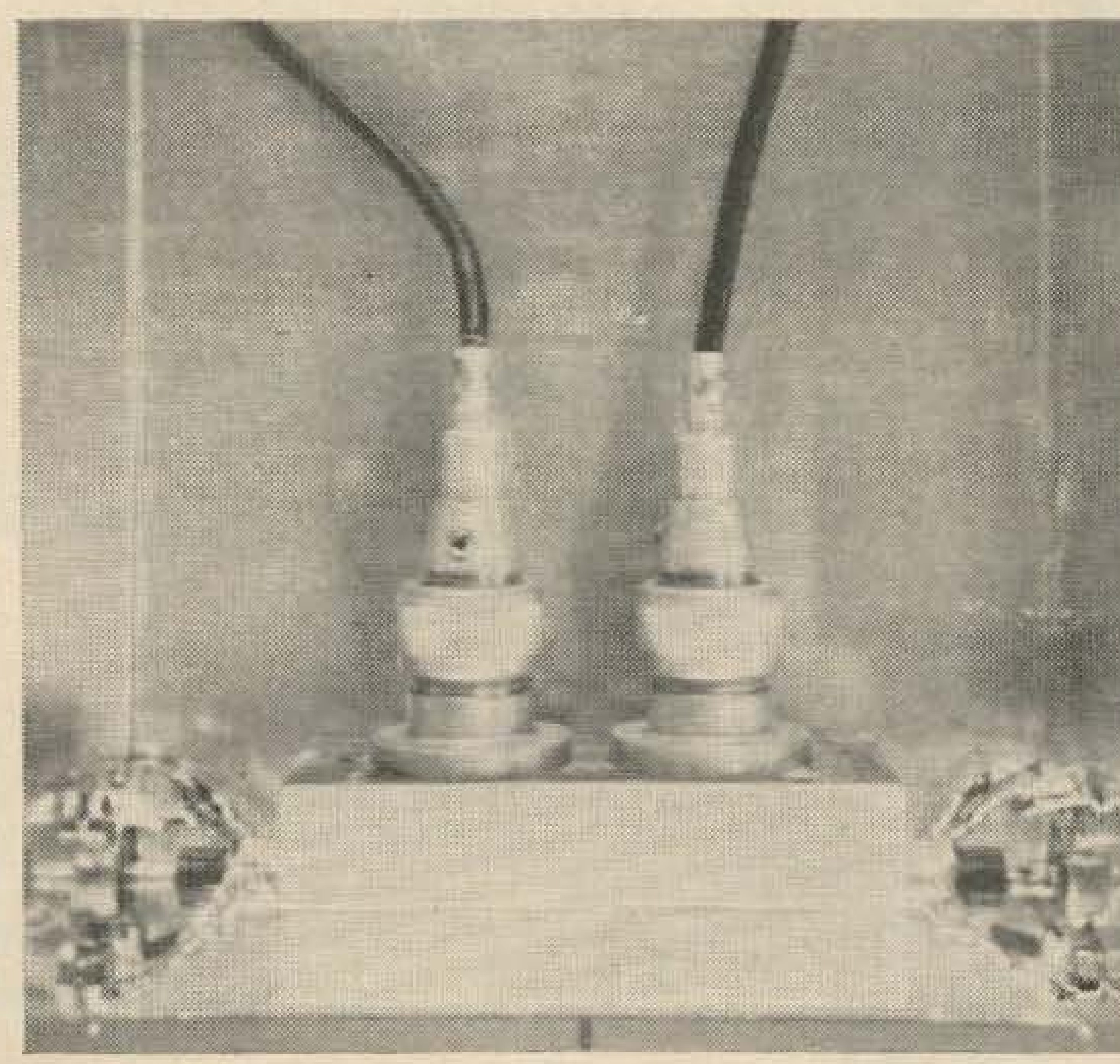
A Surplus SWR-Power Meter

The SWR of a transmission line is more important in the VHF and UHF range than it is in the HF ham bands. Unfortunately, most inexpensive SWR meters made for the amateur market aren't very useful above 30 mc. I was trying to figure out a simple solution to this problem when I noticed an ad in 73. E. C. Hayden in Bay Saint Louis, Mississippi sells a surplus reflectometer with 200 microamp

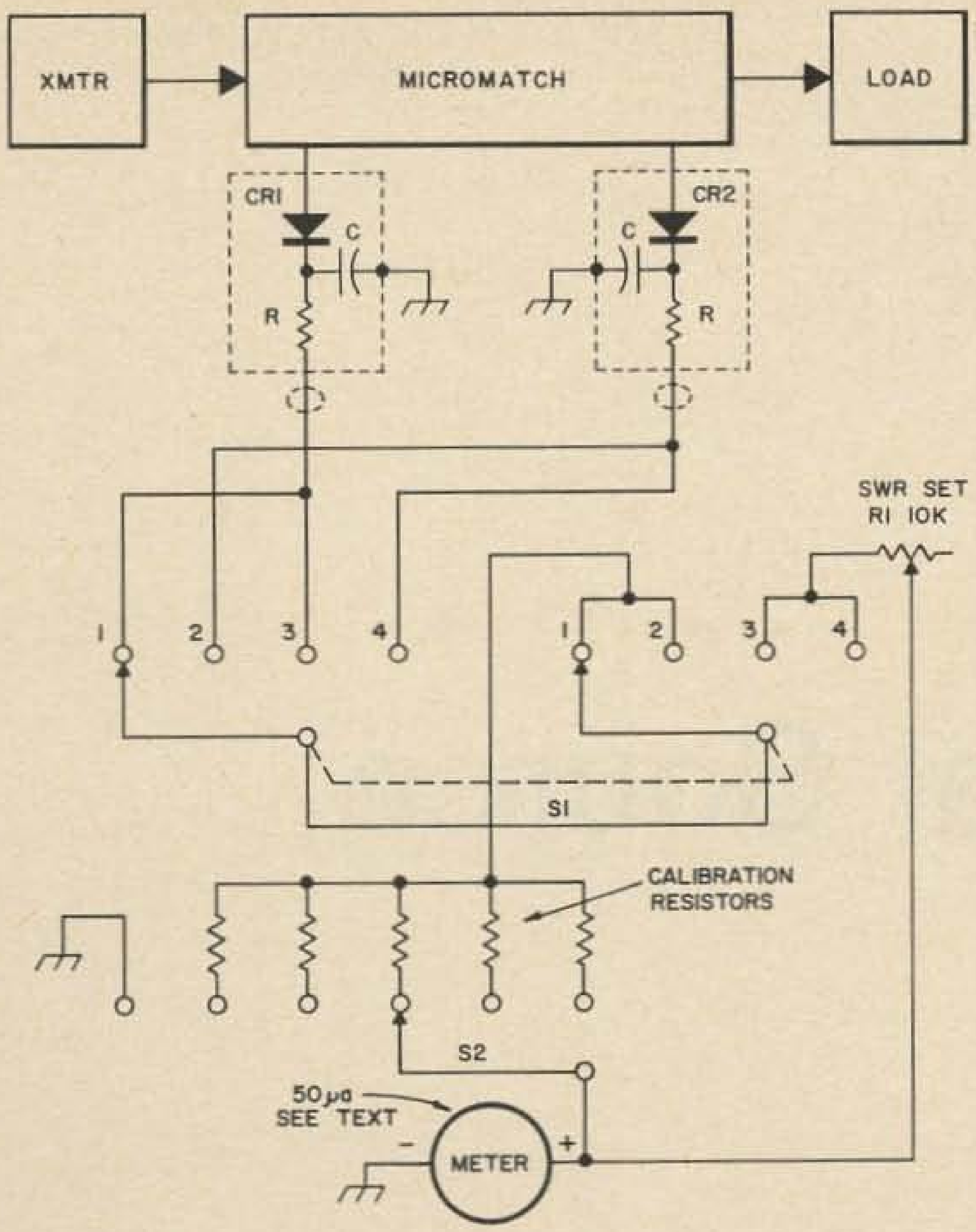




meter, diodes and even the calibrating rheostat for only $8.25. I ordered one and found that it was the Saratoga Industries Model HC 999 R which is identical to the Jones Model 574.23 Micromatch. It comes attached to a piece of RG 9 50 ohm coax and has a huge connector on one end. The other end is cut. The assembly comes from a Hallicrafters T-465/ALT-7 radar jamming transmitter covering the range of 168 to 352 mc.

I decided to use another meter and save the small 200 microamp one for another use. You can use any size meter from 50 μa to 500 μa. The more sensitive meter is necessary for low power at lower frequencies.

I mounted the reflectometer and metering circuitry in a gray hammertone Minibox, 5 x 7 x 3 inches. I used a nine position range switch

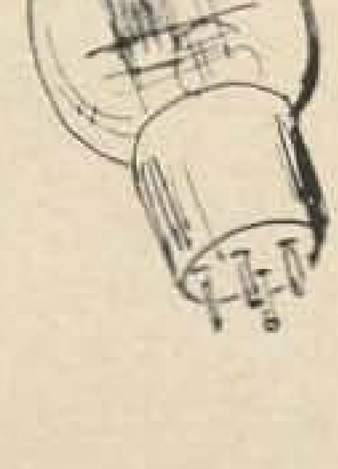


because it was available, but you can use other ranges. Since I used a 50 μa meter, I made one position of the switch a direct short to protect the meter. Switch two has four positions. The first reads forward power to the antenna in watts. Position two reads reflected power in watts. Position three is used to set the meter to full scale with R1. The fourth position reads the SWR.

You can calibrate the meter using a good bridge or with a dummy load such as the Cantenna. Remember that power readings are only good at the frequency of calibration in this type of unit. Also, the meter won't read linearly at low powers. Pick the calibration resistors with a decade box or by trial and error. It's rated as good for 200 watts, but that seems to be very conservative.

This SWR bridge will take only a little time to build and will cost less than any comparable commercial instrument. When you're finished, you'll have an excellent piece of test equipment that you will use often.

. . .K9SOA



Bill Hoisington K1CLL
Peterborough, N.H.

UHF Signal Source

The UHF experimenter learns early that the UHF ham bands don't always furnish a signal when you need them. When I build receivers and converters for 432 and 1296, I find that I need a small signal generator for alignment and band spotting. Not much power is needed for this work, so transistors are the ideal choice for generating the signal. This signal source is in three parts, a 432 source, a tripler to 1296 and a modulator.

The 432 Driver

I started with a low-cost 27 mc crystal that I found in my junk box. (Never mind how it got there!) I used my usual phase-reversing crystal circuit followed by a bunch of doublers. Lower-priced transistors were used in the early stages and the UHF ones saved for later. You really need good ones on 1296! Each doubler is biased from rectification of rf from

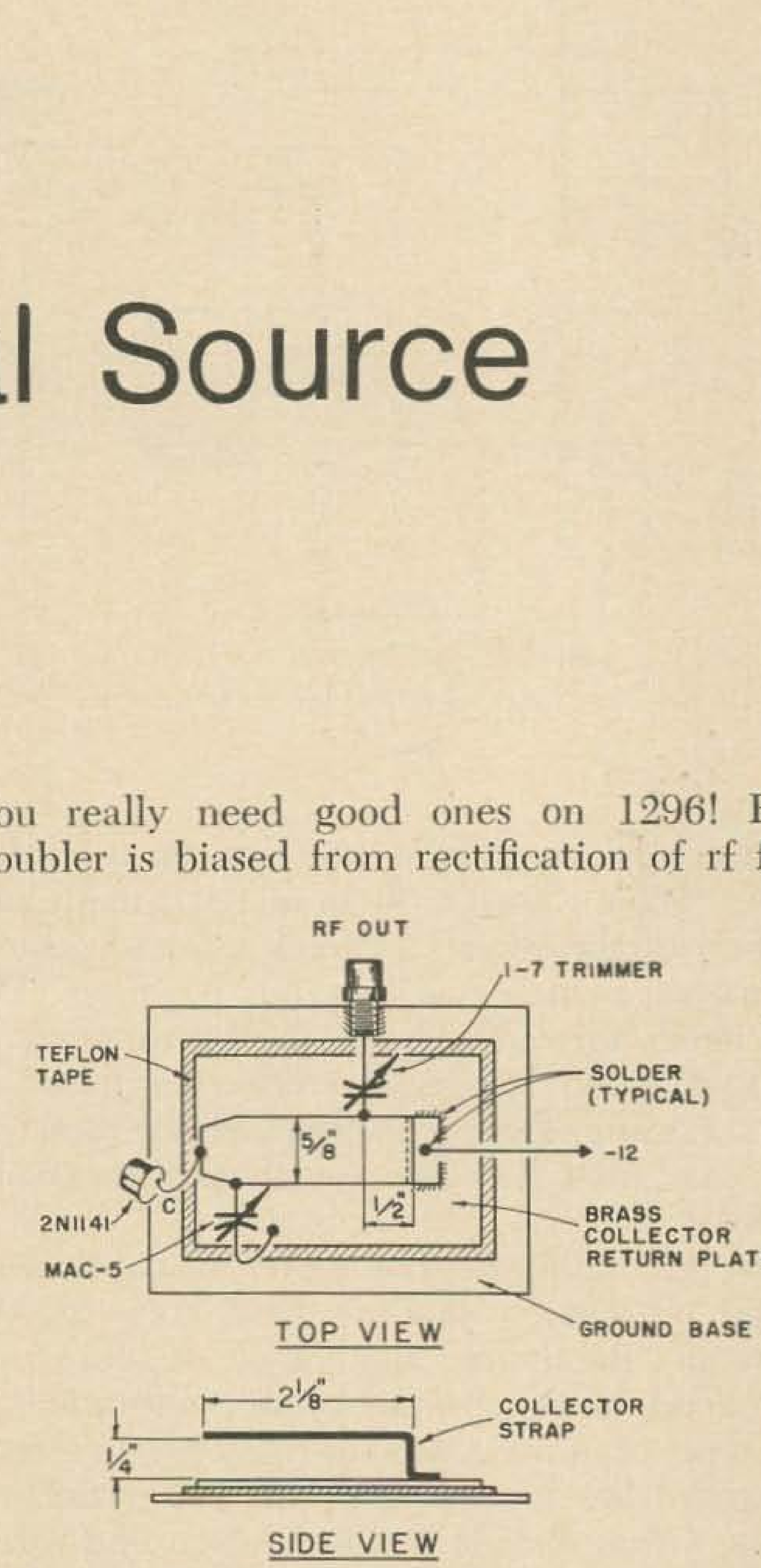


Fig. 2. Details of the 432 mc collector circuit.

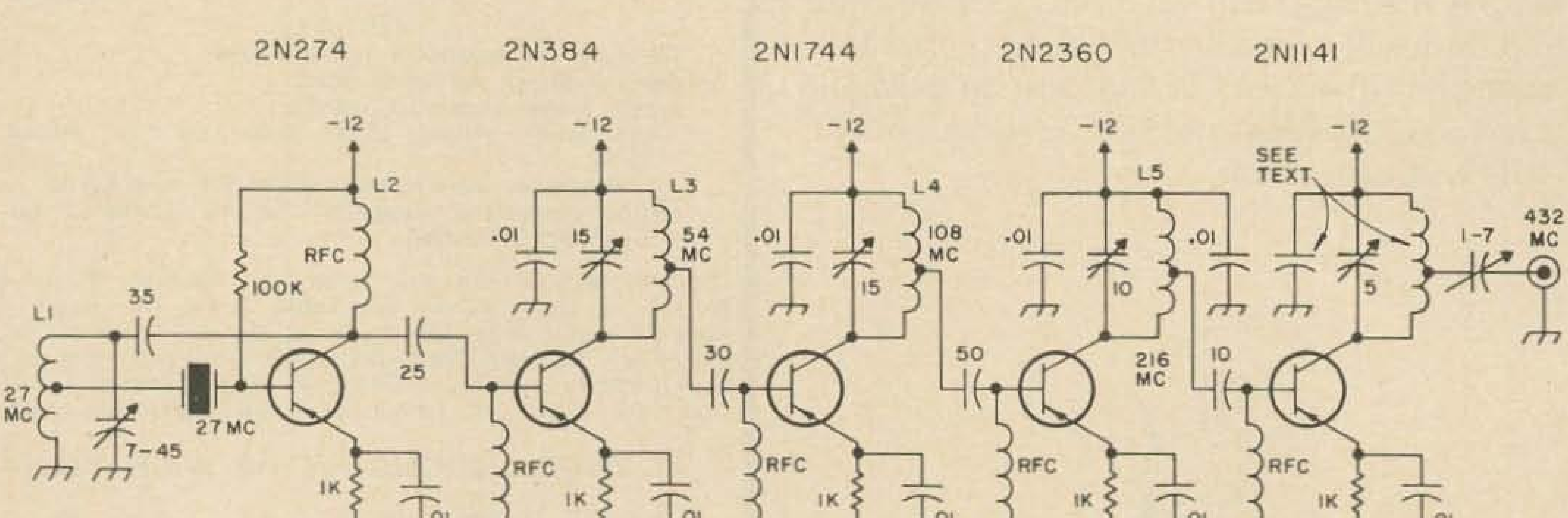


Fig. 1. Schematic diagram of the 432 mc signal source. The transistors aren't critical in most cases and other UHF and VHF ones will work fine.

the previous stage. If you need more output than this circuit gives you, use less than a 1 k resistor in the emitter, but watch out for high collector current. **Fig. 1** shows the schematic of the 432 mc generator and **Fig. 2** gives details of the 432 mc collector circuit.

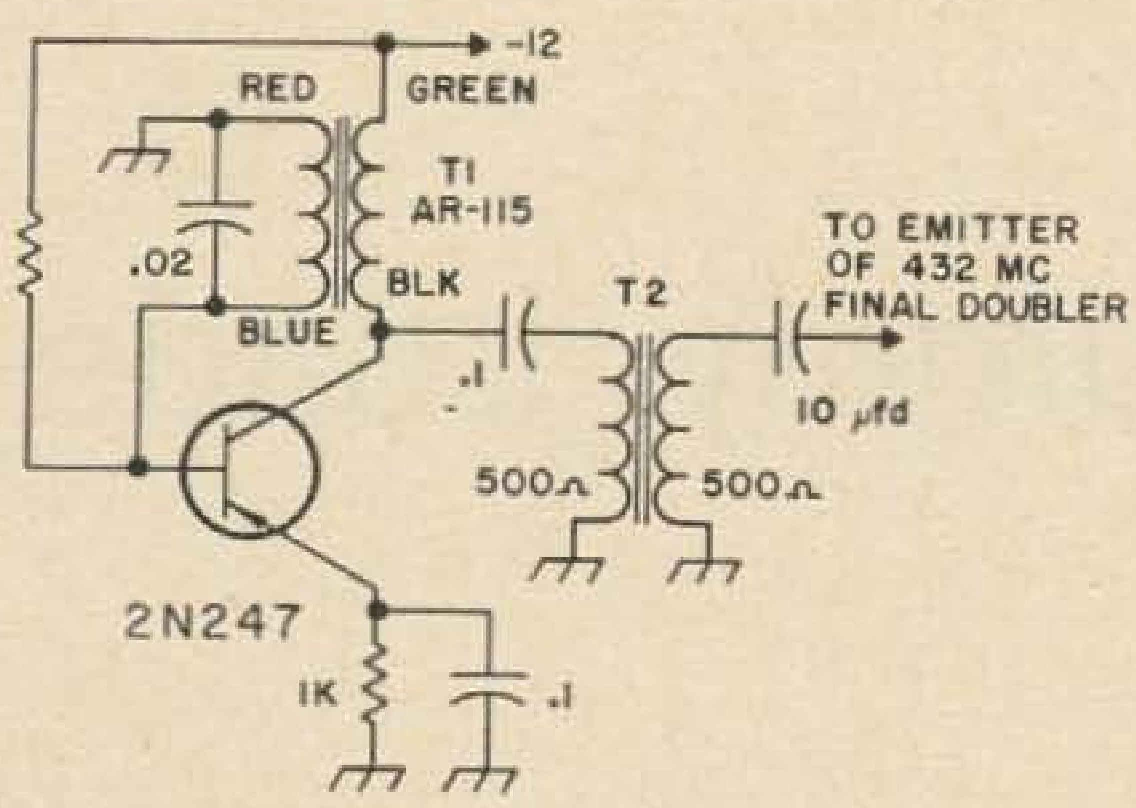


Fig. 3. The tone oscillator for the 432 mc signal source.

The tone modulator

This is a crude modulator (**Fig. 3**), but it works. The modulation transformer is not absolutely necessary, but seems to improve results. You can apply the modulation almost anywhere for this application, but modulating across the 1 k emitter resistor gave the cleanest sound with the doubler used.

Now to 1296

I built this tripler to 1296 just for the fun of it. But it worked quite well. I normally don't hold with triplers at this frequency, but it's an easy way to get 1296 mc energy from the 432 mc driver. The transistor I used was a Motorola 2N1141. It's several years old and there are better ones that are far cheaper now. But it does work on 1296. I couldn't get it to work with grounded emitter, but grounded

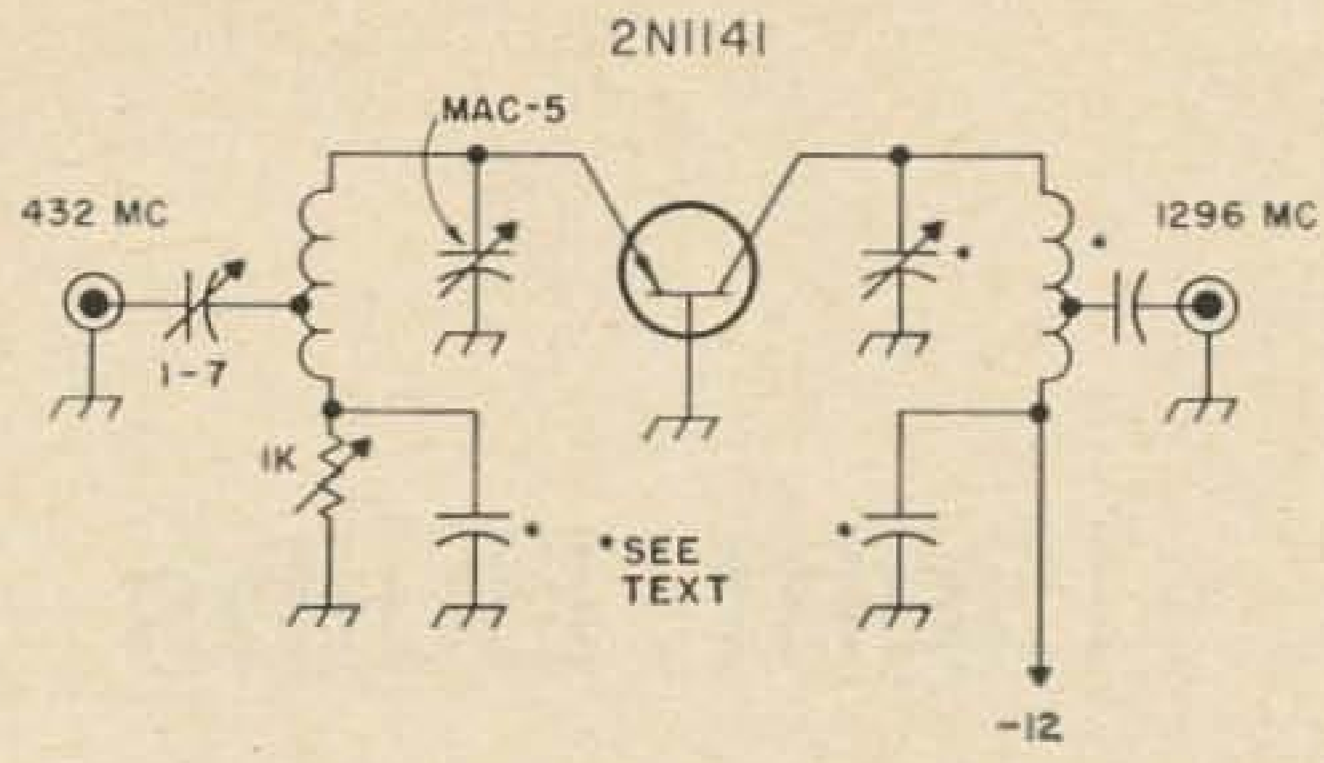


Fig. 4. Schematic of the 1296 mc tripler.

base is fine. **Fig. 4** gives the schematic but **Fig. 5** gives the details, which are vital. The input on 432 tunes very nicely. But I had to reduce the emitter resistor in the doubler to 432 to get enough drive. It ended up at 200 ohms. The collector circuit is short, but tunes smoothly. The 1296 mc output registers 100 a in the 1296 cavity in the May 73.

You might try a small amount of modulation on the 1296 mc tripler. Also a waveguide attenuator. Be seeing you on 23 cm.

. . . K1CLL

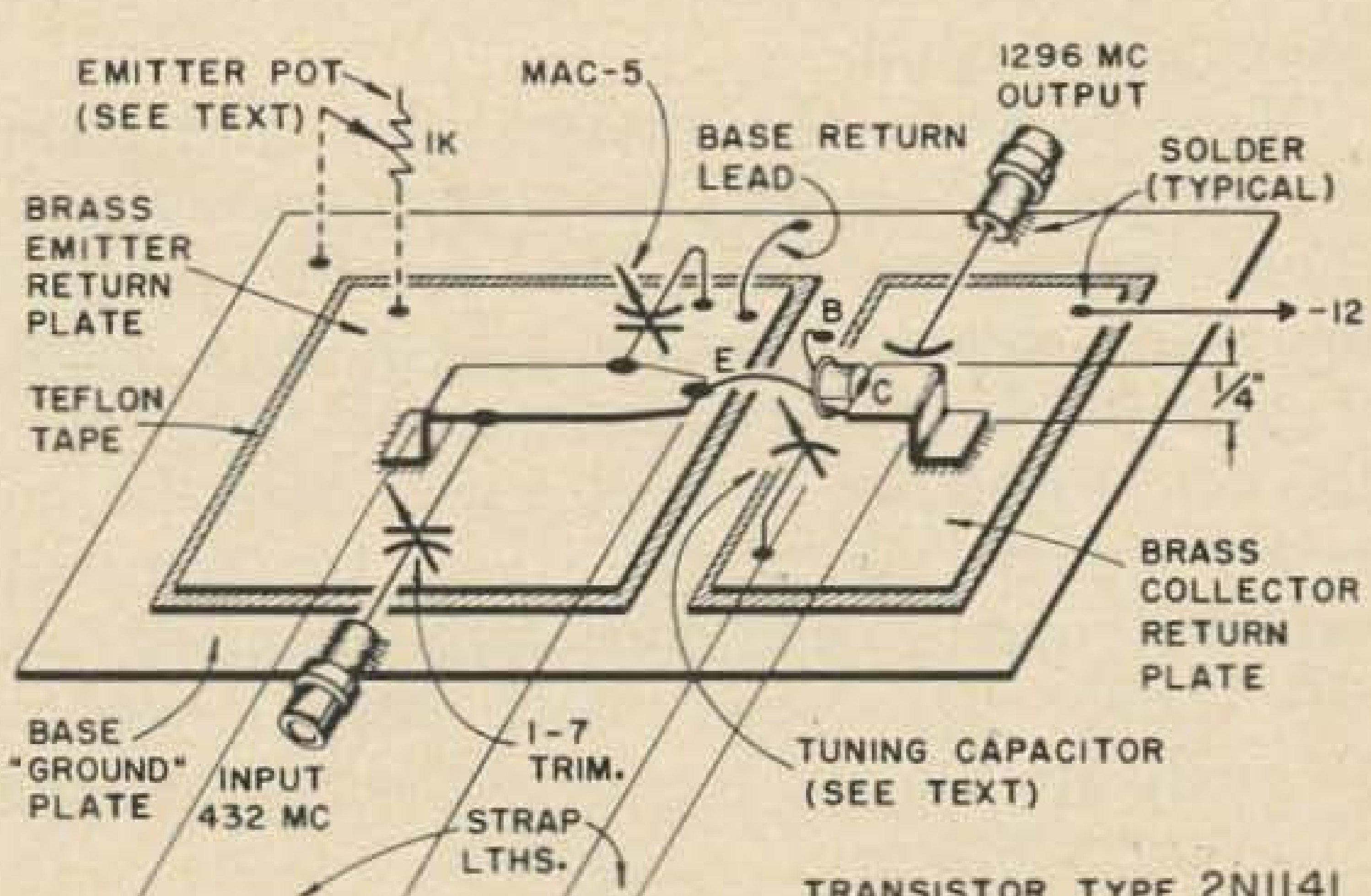


Fig. 5. Pictorial layout of the 1296 mc tripler.

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Light Bulbs for Dummy Loads

Light bulbs have intrigued me for many years. This goes back to the old bulbs with the tip on the top. The younger generation missed the fun of putting these old bulbs in a bucket of water, breaking the tip and having the bulb fill with water. This was a real dandy device; it could be used to gently sprinkle the girls with water or used as a combination hand grenade and bomb.

Now back to the present day and some comments on dummy loads for transmitters. Light bulbs have been used for this purpose for many years; however, as dummy loads, they leave lots to be desired. As you know, the cold resistance is much lower than the hot resistance. As you start to load the transmitter, the impedance is constantly changing and you cannot get a good match. Now if you try to modulate the rig, the impedance is jumping all over the place.

I do not mean to sell light bulbs short as a cheap dummy antenna. In fact, I was going to write a big, dandy article on a means of checking transmitter output by comparing the brilliance of a bulb tied to a transmitter and one connected to the line with a method of controlling its brilliance, then measuring the power to the controlled bulb and thus finding the power output. The research on this project revealed several things. First, the impedance, as mentioned before, is all over the place; and second, the Heath Cantenna is a better way. Third, it's more fun to watch a light bulb light up than to watch a meter swing up scale.

If you still like to see your transmitter light a light bulb, here are a few facts to keep in mind. Just because a bulb has a wattage rating close to the rating of the transmitter does not mean that it will be a good match. A 50 watt, 120 volt bulb is 280 ohms; very fine if you use 300 ohms feed line to the antenna and the transmitter is running at 100 watts input. If you use 50 ohm coax then you should get a 30 volt, 50 watt bulb because this has 45 ohms and they are available—still some used with the old Delco plants and lots on boats. You can figure out for yourself what bulb will be best. Just remember that most transmitters only run about 50% efficient, especially with PI output.

The following table shows what can be expected of bulbs running with less voltage than rated. From this you may be able to guess what output you have and can calculate the resistance for a given condition.

% Rated Voltage	% Hot Resistance	% Total Light
10	40	-0-
20	52	0.6
30	60	2.1
40	67	5.8
50	74	10.9
60	80	19.5
70	85	32.1
80	90	49.0
90	95	70.6
100	100	100.0

For the very low power rig there is not too much available that will give a good impedance match. Heath Company sends a No. 47 pilot bulb to use as a dummy load on the "Twoer", "Sixer," and "Tener." This bulb is rated at 6.3 volts and .15 amps. Resistance then is 42 ohms, which is a fair match for 50 ohms output but the power is *only* 0.95 watts and I never heard anyone complain that the 5 watts input burned out the dummy load.

Christmas tree bulbs rated at 7½ watts are no good because the resistance is 2000 ohms. I could not find a good automotive bulb, resistance all too low. The old series string Christmas bulbs are still available and are good for 4.8 watts at 47 ohms.

. . . W8QUR

William Goldsworthy W6BUV

VFO Stability

Do you want to get a little more stability out of your existing VFO or do you just want to build a decent one from scratch? Let's examine in some detail just what it is that separates us from that one cycle stability that we all dream about and then let's see what can be done to approach our goal. Of course, in the hobby of ham radio, we don't need quite the stability of a broadcast station, but with the wide use of single sideband we do need a pretty high degree of oscillator stability.

Instability Sources

The gremlins that prevent us from obtaining that no drift oscillator can be separated into three broad classes: effects from temperature variations, effects from mechanical variations, and effects from phase variations.

Temperature Stabilization

Of these variations, probably the one most often encountered is the drift associated with temperature variations. Since the primary parameters determining the frequency of oscillation are the inductance and capacitance of the oscillator tank, it is necessary to prevent or compensate their variations in order to eliminate most of the drift that occurs from temperature changes.

Isolation of the oscillator tank circuit from heat sources and the use of temperature compensation must be employed to reduce the effects of temperature on the operating frequency. It is possible to place the oscillator tank external to the rig for excellent heat isolation, but for the sake of convenience and compactness, it should be included as an integral part of the rig. Tank circuit placement should, however, be made so that heating is kept to a minimum.

It is the inductance of the oscillator tank circuit that is responsible for the majority of the temperature drift problem. The inductance, almost invariably, has a positive temperature coefficient, while capacitors can be selected with almost any temperature coefficient, including zero. Since capacitors are available in a number of negative temperature coefficients, the greater part of the oscillator frequency drift with temperature can be removed by using a capacitor having the correct value of compensation to balance out the positive coefficient drift of the tank inductance.

Schemes to accomplish temperature compensation of an oscillator tank circuit are shown in Figs. 1 and 2. The circuits shown are that of a Clapp oscillator. Temperature compensation is provided in the circuit of Fig. 1 by paralleling the usual tuning capacitor with a series combination consisting of small negative temperature coefficient capacitor and a zero temperature coefficient padder. Increasing the capacitance of the padder will increase the amount of negative temperature compensation provided by this series combination. The shift in frequency associated with this adjustment must, however, be corrected by resetting the bandset capacitor CB. To eliminate this necessity, it is possible to use a specially designed split stator padder with the dual capacitor arrangement shown in Fig. 2. This will allow compensation to be accomplished with little or no shift in the frequency of oscillation. Excellent temperature compensation can be obtained with either of these arrangements only if pains are taken to keep all of the frequency determining parameters in close physical proximity so as to insure their uniform temperature variation. In other words, you don't want the inductor to heat up faster or differently than the capacitors or vice versa.

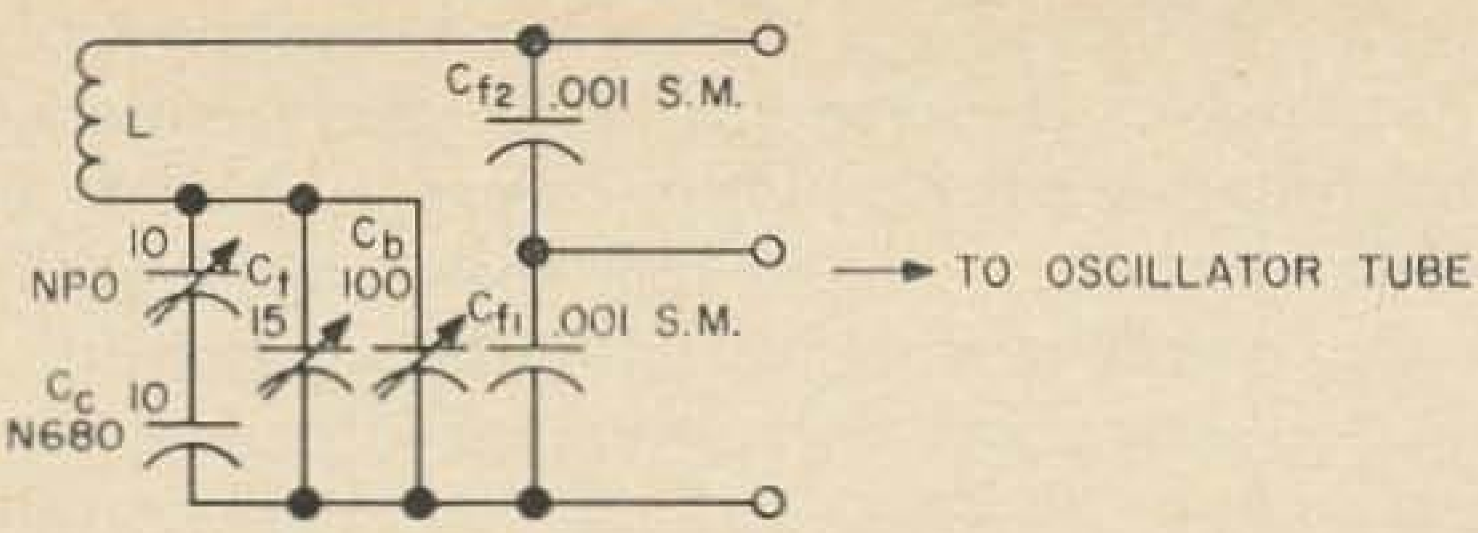

FIGURE 1

RF Heating

There is also another little temperature problem associated with the oscillator inductor that may give considerable trouble. This is the tendency for the inductor to heat rapidly when RF current flows in it. Although temperature equilibrium will be reached in several minutes, this effect may be bothersome where oscillator coils are switched for changing bands.

Several precautions, if taken, will avoid this pitfall. These are the use of large wire sizes in winding the inductors, the use of coil form materials providing good RF insulation and good thermal conductivity such as ceramic, and the operation of the oscillator at a low enough level to minimize RF current heating.

The use of plastic materials and air-wound coils, which provide good RF insulation but poor thermal conductivity, should be avoided in an oscillator tank circuit, especially where oscillator coils are band switched. It is preferable to use coils tightly wound on ceramic forms where the ceramic is in good thermal contact with the surrounding chassis, to provide for a maximum equalizing of temperature in the vicinity of the oscillator tank circuit.

Mechanical Stability

Even if we have done the greatest job in the world to temperature stabilize the oscillator frequency, we still may not have arrived at our desired degree of stability. We still must consider mechanical and phase stability. In order to avoid mechanical instability, it is important that frequency determining components and wiring be mounted so as not to be subject to motion from shock or vibration; that hardware such as shafting, gears, or bushings in the vicinity of the oscillator coil be placed and operated so as not to produce variable or intermittent contact or coupling; and that the oscillator tuning arrangement be stable enough to provide smooth tuning with good reset ability over the desired tuning range. This means that all frequency determining circuits should be wired with fairly rigid wire, that the frequency determining inductances and capacitors should be rigidly mounted, and that a sufficiently rigid chassis should be used to insure adequate rigidity for component mounting. Control shafting used in close proximity to the oscillator coil should preferably be non-metallic or at least insulated in such a fashion from the chassis so as not to form shorted coupling loops that may couple to the oscillator tank or form ground returns that may parallel the chassis ground in the vicinity of the oscillator coil. A ground formed by a metal shaft passing through a bushing or hole in a panel may be quite intermittent, resulting in considerably frequency instability when the impedance of this ground palallels grounds in the vicinity of the oscillator coil, or when it provides inductive coupling to the oscillator coil.

Even the bearings and wipers used on the oscillator tank tuning capacitor should be carefully scrutinized to make sure that the impedance of the rotor return circuit does not fluctuate with rotation. Many capacitors have very poor return circuits and the ones using ball bearings to form part of the ground return circuit from the rotor should be avoided, since these bearings do not always make uniform contact. Variable capacitors that use wipers can give exceptionally good stability if care is taken to see that the wipers are making good contact. It is however, preferable to use tuning capacitors that do not use wipers, such as insulated rotor, split stator types. Even when a good quality tuning capacitor is used, care must be exercised in coupling it to a dial mechanism.

A number of difficulties can arise if the dial mechanism forms part of the ground return circuit from the tuning capacitor's rotor. Variations in the ground impedance of the dial mechanism may cause undesirable variations in frequency with rotation.

Some means should be provided so that the dial mechanism does not palallel the tuning capacitor's ground return. This can be accomplished by providing a solid insulated coupling between the capacitor's rotor and the dial mechanism. Poor alignment between dial and capacitor can also cause considerable frequency instability when springing and back lash result. Single bearing capacitors which are quite subject to springing should never be used as variable tuning capacitors in oscillators, but instead, the use of double bearing units or ones in which the capacitor is constructed as an integral part of the dial mechanism should be employed.

Another precaution often neglected is to make sure that grounding to the chassis be made at the place of intended contact only from any of the components in the frequency determining circuits. Often times, a lead from a fixed tuning capacitor may accidentally make brushing contact with the chassis at a short distance from the point of intended contact. Any flexing motion or temperature change may cause this contact to vary, resulting in a variation of the inductance of this lead and therefore the frequency.

Phase Stability

So far, we have considered problems only with the frequency determining tank circuit. It is equally important that the oscillator tube be connected to and operated in such a fashion with this tank circuit, so as to minimize frequency variations associated with tube parameter changes, output loading, and output tuning. Since the oscillator tube must supply the losses suffered in the oscillator's tank circuit to sustain oscillation, the phase and amount of feedback applied to the oscillator tank, as well as changes in tube parameters, will have an appreciable effect on the operating frequency. By careful design, these effects on frequency can be greatly minimized. This can usually be achieved by reducing the coupling between the oscillator's frequency determining tank cricuit and the oscillator tube. Reduction can be accomplished by using an oscillator tube having great power gain, by using an oscillator tank circuit having low losses (Hi-Q), and by using only enough coupling between oscillator tank and tube to sustain stable oscillation.

The small degree of desired coupling between oscillator tank and tube is usually obtained by connecting the tube elements across a small part of the total capacitance of the tank circuit. Although a reduction in coupling would also exist by tapping across part of the inductance for the tube connections, parasitic difficulties are quite likely to be encountered, especially when the grid is tapped across only part of the inductance. The arrangement used in the Clapp oscillator, Fig. 3, will provide control over the coupling by varying the ratio between the total series value of Cf1 and Cf2 and the total parallel value of Ct, Cc, and Cb. Less coupling will result when the ratio of these two capacitive reactances is high and more will result when the ratio is low. It is desirable to keep the ratio as high as possible while still maintaining oscillation.

Q of Tank Circuit

In order to provide a tank circuit with the extremely Hi-Q needed for stable oscillator operation, it is necessary to use capacitors and inductors having Hi-Q characteristics. Most good quality capacitors are of sufficiently Hi-Q to give no worry, but providing an inductor having Hi-Q characteristics is a little more difficult. An inductor having Hi-Q characteristics can be made by winding with reasonably heavy copper or silver wire on a low loss coil form, having reasonable diameter, with as much spacing from shield can or chassis as possible. In addition, all metals, especially magnetic ones, should be kept away from the immediate vicinity of the inductor if at all possible.

Frequency variations resulting from tube parameter changes occur due to mechanical changes in the element spacing with temperature, to the change in applied anode and filament voltages and to component variation. Even when the coupling between oscillator tank and tube are optimized, there will still be some oscillator frequency shift associated with loading, tuning, and voltage variations. To minimize these effects, it is necessary to provide sufficient isolation between frequency determining circuits and output circuits to prevent feedback coupling of these circuits. A convenient method of attaining some of this desired isolation is by the use of a screen grid tube, where the screen acts as the oscillator's anode and coupling to the output circuit is through electron flow to the plate circuit. Output can be obtained either at the fundamental or at the harmonics of the oscillator frequency.

Another way of attaining isolation is by the use o fa buffering tube following the oscillator tube. The additional tube can be either a cathode follower or an amplifier. The isolation desired may be hard to attain if the output circuit is tuned to the oscillator's fundamental since feedback may still exist from this output circuit to the frequency determining tank, through the tube's inter-electrode capacity or through other means of coupling that may exist. By operating the output at a multiple of the oscillator frequency, isolation is automatically provided, since the output circuit now operates at a frequency where feedback that does occur will have little or no effect on the frequency stability.

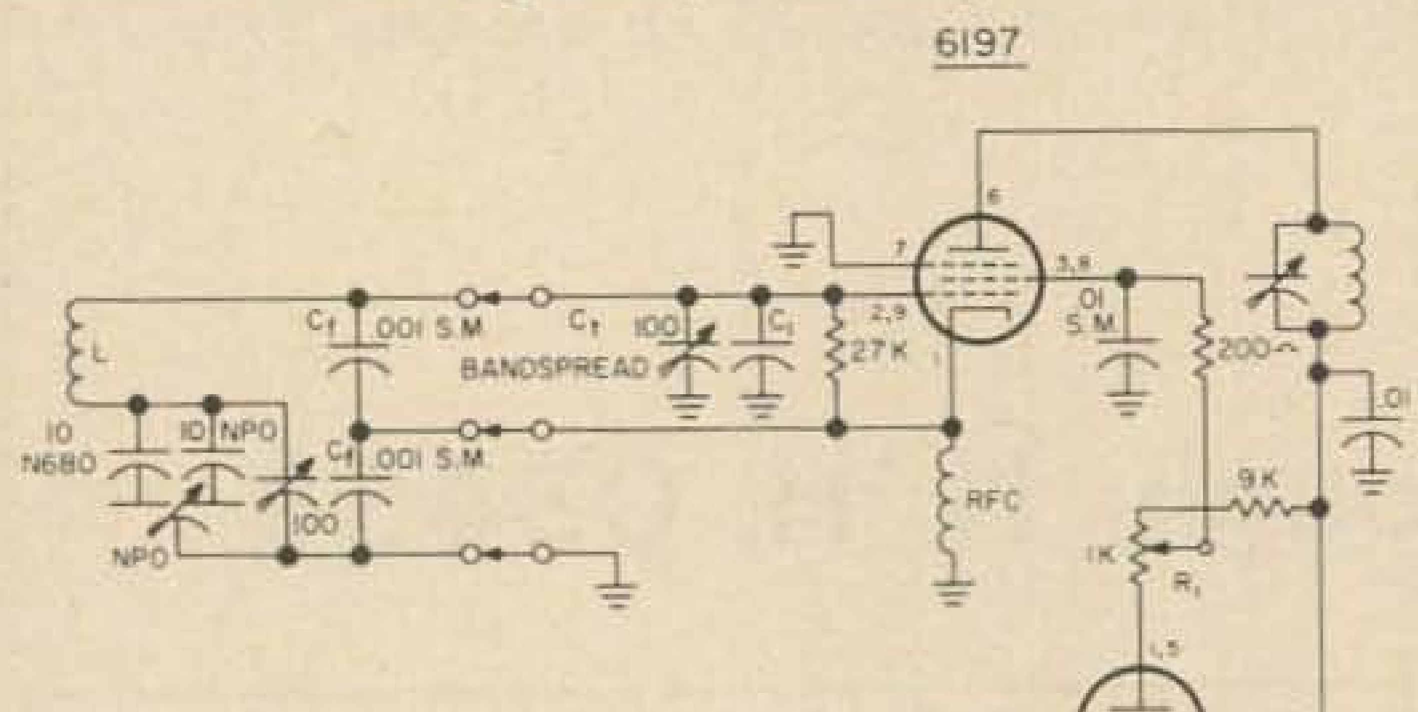

FIGURE 2

Compensation

Screen grid tubes have another advantage which makes their use attractive in an oscillator circuit. This is the property that voltage variations occurring in the anode circuit provide frequency shifts in the opposite direction, as do variations in the screen circuit. This property can be used to provide correction where the screen voltage, but not the anode voltage, is regulated. A Clapp oscillator circuit using this means of compensation is shown in Fig. 2.

Potentiometer R1, the zero frequency shift balance control, which comprises about 10% of the bleeder resistance from A+ to the VR tube, applies a varying percentage of unregulated voltage to the oscillator screen as the potentiometer's swinger is rotated towards the B+ and when R1 is correctly adjusted, there will be just enough screen voltage shift accompanying anode voltage shift to result in zero frequency shift. Where anode voltage can also be regulated, this form of compensation would not be needed.

Oscillator Filament Voltage Regulation

Usually, shifts in the oscillator tube's filament voltage have much larger effects on frequency than do shifts in the anode voltage Variations in this voltage not only cause large changes in the power gain of the oscillator, but also result in changes of the physical spacing of the tube elements. Variations in the spacing from cathode to grid, resulting from thermo-mechanical expansion, cause the most bothersome change. Since there is no easy way to compensate out this variation, it is imperative to provide some means of filament voltage regulation for the oscillator tube where large voltage variations are encountered. The extremely poor regulation of an auto's electrical system will require the use of oscillator filament voltage regulation. A simple regulator can be made by using a zener diode, and if more elaborate means are needed, a transistor voltage regulator can be provided.

Parasitics

Even after all of the aforementioned precautions have been taken in building a stable oscillator, it still may operate poorly and erraticly. This can be very often due to parasitic oscillations occurring at some other frequency than the desired one. The usual methods of parasitic suppression should never be applied to an oscillator, such as placing resistors or L-R networks in series with the tubes electrodes, as these additions can greatly reduce the Q of the frequency determining tank circuit to which the tube is connected. This reduction of the oscillator tank circuit Q will occur because the capacity existing between tube electrodes forms part of the tuning capacitance of the oscillator tank circuit, and any series resistance will provide loss when the high circulating currents of the Hi-Q oscillator tank circuit pass through these series resistive-capacitive circuit formed by the parasitic suppressors.

The proper approach to eliminating parasitics in an oscillator is by proper circuit layout, that is, the avoidance of long leads from the frequency determining tank circuit to the tube and by proper placement of the components comprising the tank circuit. Sometimes, where lead lengths are long from the tuned circuits to the tube, where band switching is applied to a Clapp oscillator circuit as in Fig. 2, parasitics can be avoided by placing a small portion of the grid cathode feedback capacitance directly at the base of the oscillator tube. This will prevent the oscillator from oscillating at a frequency determined solely by the lead inductance appearing between the tube and oscillator tank and the oscillator tubes inter-electrode capacities.

Capacitors

By-pass capacitors used in an oscillator circuit should be of good quality, and hi-C ceramic ones should be avoided, since these units exhibit large capacity variations with applied voltage. Be safe, and use silver micas.

Bandswitching

A word of caution about bandswitching of oscillator tank circuits. If this is to be done successfully, that is, with good resettable stability, it is preferable to do all of the switching in the low impedance parts of these tank circuits. Fig. 2 shows such an arrangement used with a Clapp oscillator. C1 is placed from grid to ground for parasitic suppression, and Ct is a band spread capacitor which is placed across the feedback capacitors to simplify the band switching arrangement.

The Clapp oscillator is not the only type of circuit providing excellent frequency stability, but it is used as an example; since it derives its operating stability by loose tube-tank circuit coupling in the same general manner as do other stable oscillator circuits of the Franklin and other varieties.

Hi-C or Lo-C

There is another problem often raised about whether to use a high C or low C tank circuit. There are some advantages to either type of operation. As the C of the tuned circuit is increased, circulating currents increase for a given circuit Q, causing greater RF inductor heating, but on the other hand, the increase of tank circuit C greatly reduces the effect of tube input capacity variation on the frequency of oscillation. Since it is this input capacity variation that produces one of the largest single instabilities, the advantages of high C operation greatly outweighs the disadvantages.

Although this discussion has been confined to vacuum tubes, most of it applies also to transistors. Transistors are generally bad choices where extreme frequency stability is desired, since they will provide an order of magnitude poorer stability than that obtainable from vacuum tubes.

Conclusion

I certainly hope that by writing this article I have touched on enough of the basic problems involved with oscillator stability, that it may result in applying some of this information to correct some of your existing stability difficulties or to help you in the design of some of your future rigs. I am sure that I have not covered everything possible, but I do feel that this subject has not been extensively enough covered in past articles describing oscillators.

. . . W6BUV

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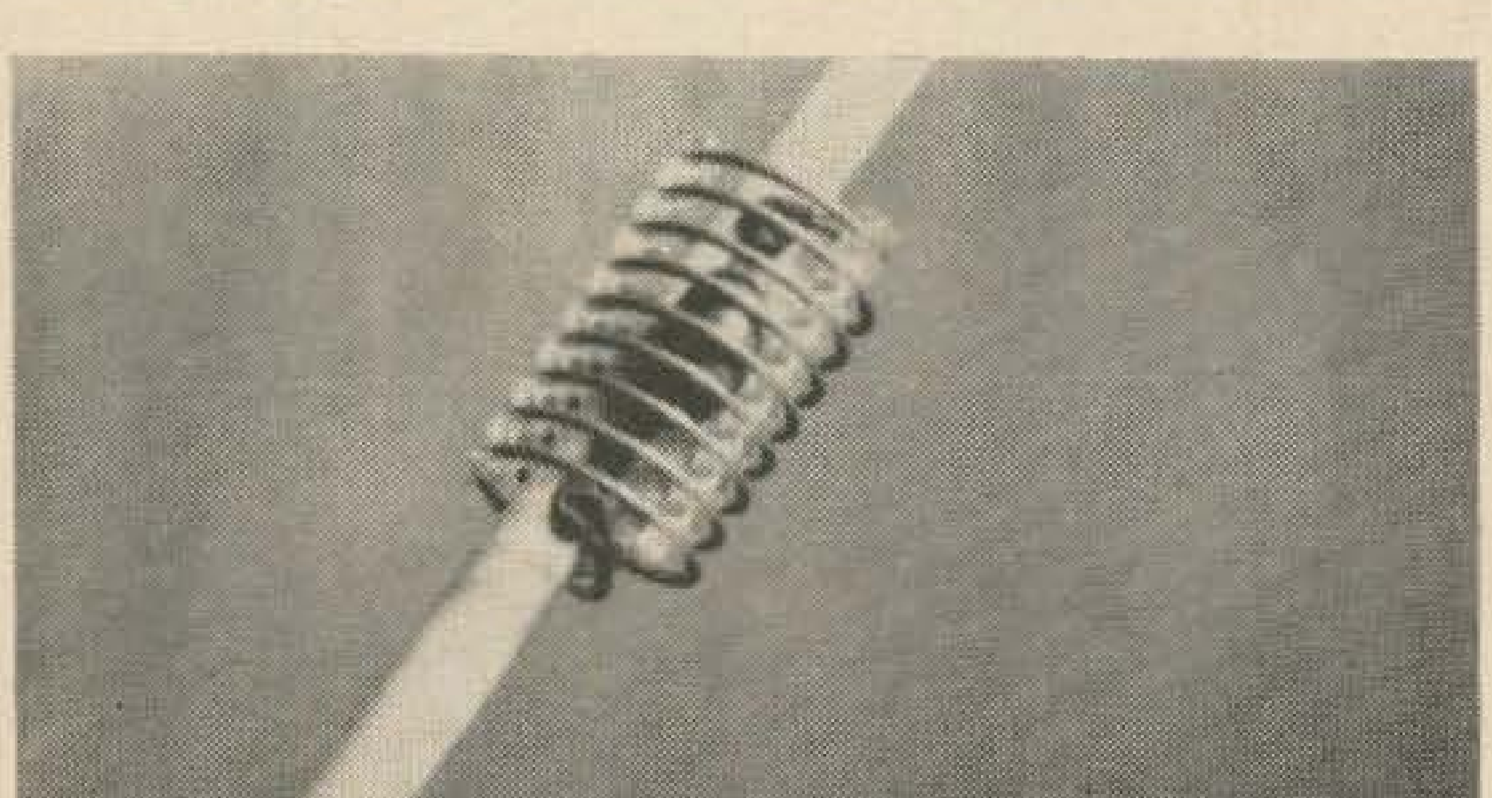
A 6-10 Combo Mobile Whip

I had for a long while wanted to operate on ten and six meters mobile, but the idea of having to use two different antennas on the car, and being too conservative to want to exhibit an eye catching or traffic stopping car, I kept postponing the act. Finally I undertook the rig construction, figuring to use the brute force of fifty watts on six with the ten meter whip to try to get through.

The modifications, or re-construction of my "Hanky Box" (see 73, Jan. '62) was near completed when the idea struck! Traps! Trap antennas are not a new subject, but I can't recall ever having seen one used with a mobile whip. The idea was to insert a high impedance trap at the 59″ spot of a ten meter whip, to isolate the upper part of the antenna for six meter rf and have insignificant impedance to 10 meter rf. This should effectively make the whip appear to end at the 59″ length for six meters, and still be good for ten. On paper it looked promising so the only answer was to try it and see what results could be had.

The first thought was to use a steel whip; cut it and insert the trap, and reassemble with plexiglass or the like as re-inforcement.

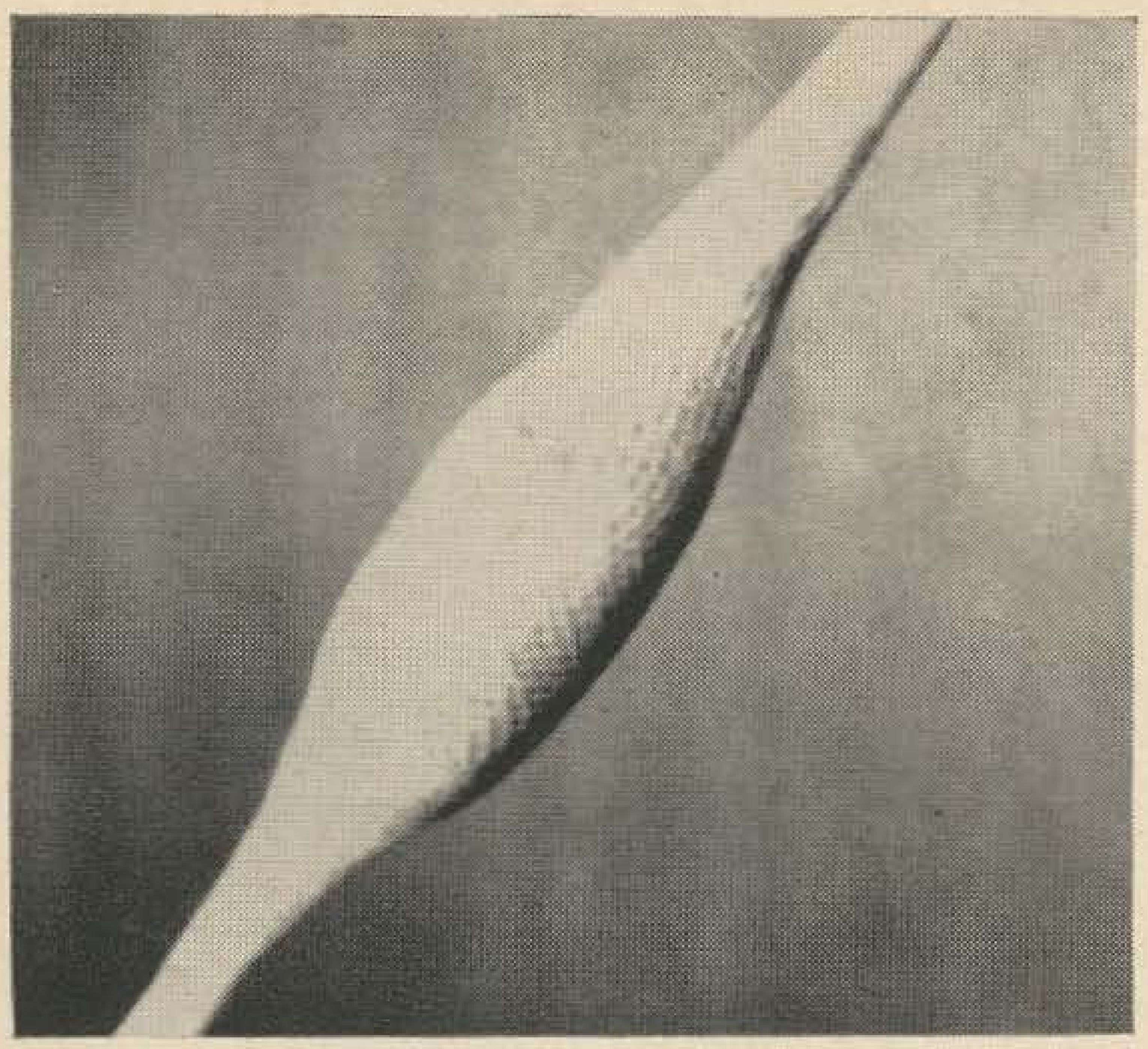


The weight of the steel made it soon apparent that a mechanically strong junction would be hard to come by. Next, I decided to try it with my 8′ Wonderod (Shakespeare-Columbia) whip, which is made of fiberglass.

I measured up the 59″, which would constitute the normal length of a six meter whip, and began cutting a slot into the fiberglass approximately one inch long, and one-eighth inch wide. I used alternately a small file, razor blade, and the hole making blade of a scout knife to finally expose a one inch length of the wire running up the center of the whip. Looking for any easier ways to do the job, I could only suggest that if a slow speed drill press is available it is possible to set the penetration to slightly less than half the diameter of the whip, and cut away the bulk of the slot with the drill. Once the wire was bared, I broke it in the center, bending each ½″ out at right angles, and applied solder to re-inforce it and prevent breaking of any of the strands.

Next came the trap. I wanted it to resonate at 50.5 mc, the approximate center of the portion of six meters I would be using. I used a 15 mmfd 3000V disc ceramic capacitor and 8 turns of a miniductor ¾″ diameter, 8 t.p.i. (B&W3010). When the dip was exact, I separated the coil and capacitor, and inserted the capacitor into the slot of the whip and wedged it in as securely as possible. The coil was slid down over the whip and both were connected to the original whip wires. The theory and procedure for trap antennas may be found in the more recent editions of the ARRL handbook.

Next came the trials, and happily the combo whip performed identically on both bands as



did unmodified whips cut for each band. One thing I forgot to consider on this prototype, but which can easily be handled in future antennas, was that I was going to use a spring with the 8′ whip to facilitate garaging the car at night and the 6″ height of the spring causes the whip to be electrically long. The effect of this lengthening was more apparent on six than ten, creating almost ½ an "s" unit difference on the home rig compared with no spring. This led to more tests to prove its occurrence, and when I was satisfied the whip was not the cause of the loss, filed the results away for future antennas. To minimize the spring effect I substituted one of the newer "Mini-Springs", 4″ high and noticed some improvement.

I finished off the job by buying a fiberglass boat repair kit, and molded the trap inside and out with white fiberglass; this both sealing the trap from weather and regaining any strength lost by cutting the slot. In lieu of the boat repair kit, fiberglass auto body repair kits are more readily available, and some of these are much easier to handle and apply with neater results. One always seems to think of easier ways to do something after having done the job, never before. The result now is an unobtrusive combination whip for ten and six which gives full quality performance on each band. The idea could be expanded for six and two meters, or even ten, six, and two, I guess, and may well be applied to CD purposes.

Acknowledgement is tendered to K3ADH, Bob Patterson for the photos, and K3LDL (my XYL) for the help in making the performance tests, and enduring my workshop hibernations during the design and construction days.

. . . W3GSC

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How to Screen Modulate

Arguments about screen modulation versus plate modulation have been going on among the AM gang for many years, and many operators have formed definite and closed opinions on the subject.

However, the apparent economy of a screen-modulated rig as opposed to one with a high-level modulator is still attractive to quite a few fellows, so a roundup of circuits with which to accomplish this aim appears to be in order.

Before we begin to examine the circuits, though, we ought to set the records straight on a few points which may have gotten lost in all the arguments back through the years. Many people consider "screen modulation" and "lousy audio" to be synonymous. Frequently, they are. But not always. Employed properly, screen modulation can produce results indistinguishable from any other type of AM. Best proof of this is that not a few commercial AM broadcast stations use screen modulation; one, for instance, is KFI in Los Angeles. These people must prove their performance to the FCC, and "lousy audio" is unacceptable.

However, accomplishing this goal of perfect audio with screen modulation is *not* so easy as getting good audio with the high-level types. In general ham practice, screen-modulated rigs tend to distinguish themselves by a lack of audio quality. Part of the problem lies in modulator design, and we'll look into that in detail in these pages. The rest of it lies at the operator's door. We'll tell you how to overcome this too; *doing* it is up to you.

A good starting point for examining screen-modulation circuits would be to determine the basic principles on which they work. In doing this, we're going to take a step "backward" and talk about AM as if it were a single carrier wave of varying amplitude, rather than using the more correct approach of considering the carrier and its two sidebands. We have a reason—this makes it much easier to see how the screen-modulation process works.

We know that in a high-level modulated AM rig, which is completely linear and is being modulated 100 per cent both positive and negative by a sine-wave signal, the *instantaneous* rf power out at the positive modulation peak is four times as great as at

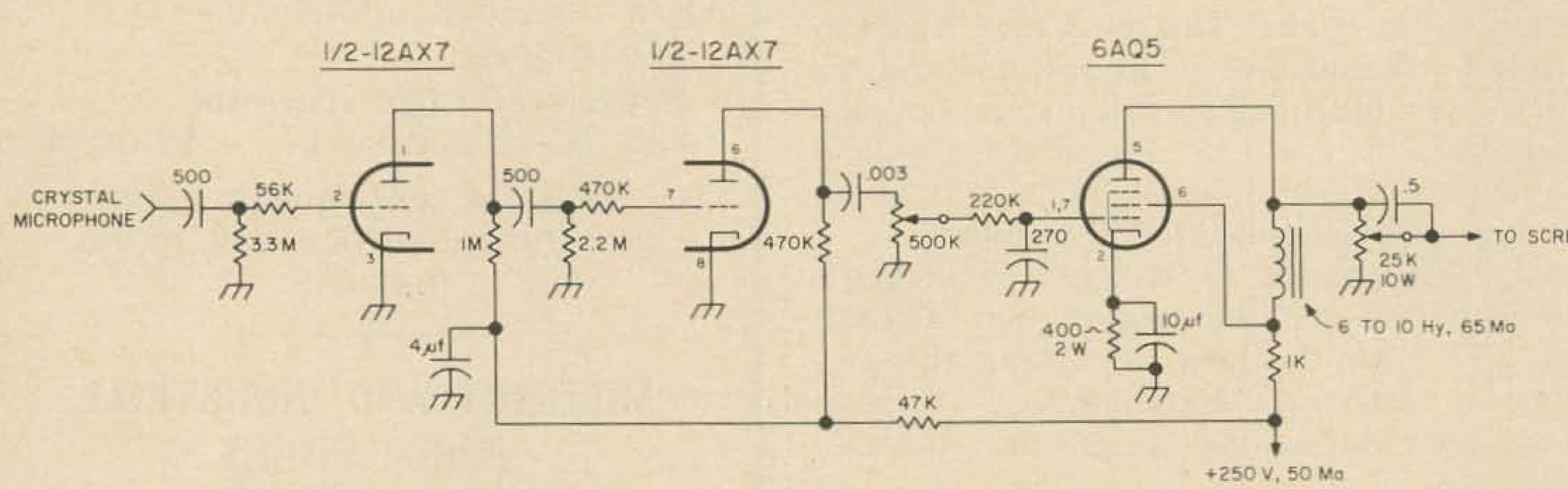


Fig. 1. W6AJF constant-carrier modulator.

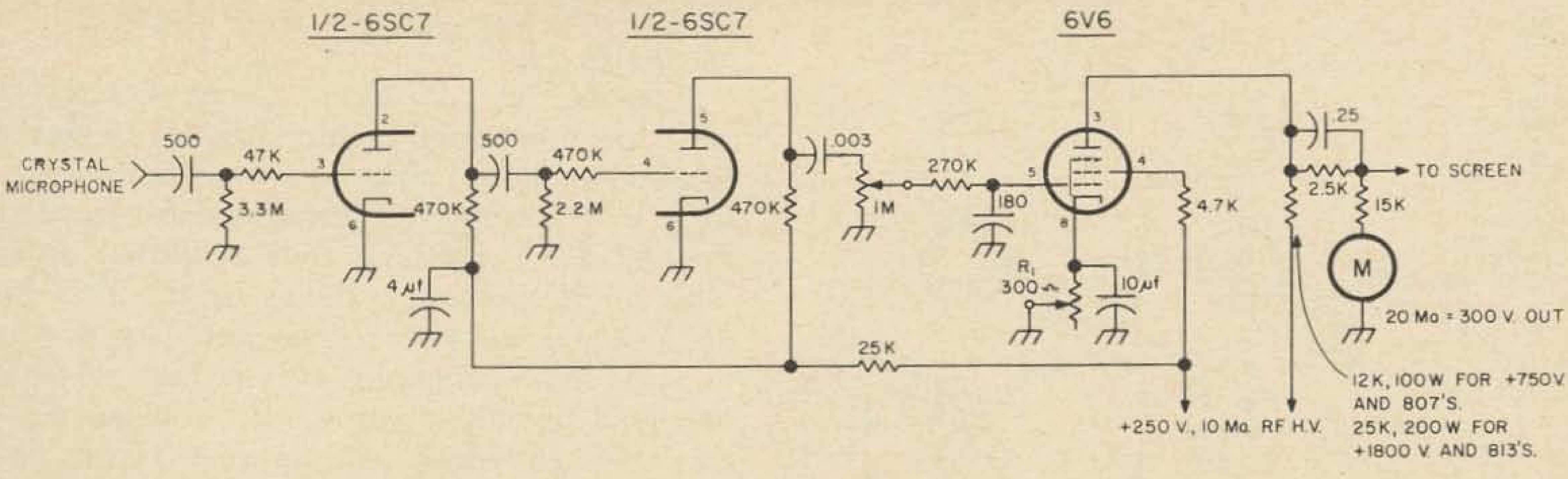


Fig. 2. Controlled-carrier modulator if R1 = 0; constant if R1 = 300. W6AJF.

the carrier level, and at the negative modulation peak drops to zero.

In the plate-modulated rig, this is accomplished by adding the audio voltage to the dc supply of the rf final amplifier, so that at positive audio peaks the final gets twice as much voltage as it does in the absence of audio, and at negative peaks the final supply voltage drops to zero. To the power supply, a Class C final looks exactly like a resistor, so when the voltage is doubled the instantaneous current will double also, giving four times the power in.

Dc-to-rf efficiency of the final remains the same (approximately 70%) throughout the process, so if our carrier-only power input to the final is 100 watts we will have about 70 watts of rf out. At positive modulation peaks, power in rises to 400 watts and we have 280 watts out. On negative peaks, power in and power out both drop to zero.

In the high-level modulator, we vary the rf power output by changing the dc supply voltage to the final. However, anything which will vary the rf power output in the same manner from the same af input signal will produce exactly the same results at the far end of the contact. Once we have a 70-watt signal going out which rises to 280 watts on positive modulation peaks and drops to zero on negative peaks, the other fellow's receiver couldn't care less how we got it!

So let's see what happens if we vary the screen voltage in an rf final. With normal screen voltage, we get normal rf output. If we reduce screen voltage, rf output drops also. This means that our screen-voltage level can be used to control, or modulate, the outgoing rf.

However, if we try it on for size we find that it does *not* control the output just the way we want it to. The audio signal going into the modulator varies from zero up to a positive peak and back down to a negative peak. This means that, if added to the screen voltage through a modulator, it can at best make the screen voltage swing from the resting value up to twice that resting value, and back down to zero.

But doubling the screen voltage of the tube in the final will *not* increase its power output by four times. Just how much it will increase the power output depends on the tube, and on the screen voltage at which we started. The average change appears to be about 2½ times.

And this amount of power change, in comparison with the four-time change we need, means that (at this point anyhow) the modulation is going to be extremely distorted.

At this point it should be clear that if we had a tube available which could be made to draw four times the current when the screen voltage doubles, then it could give the same output and efficiency with screen modulation that it would with plate modulation. The procedure would be to operate it at double normal plate voltage (the level reached by the plate during positive modulation peaks) and with an average current of half that used in plate modulation. The combination of double voltage and half current would give the

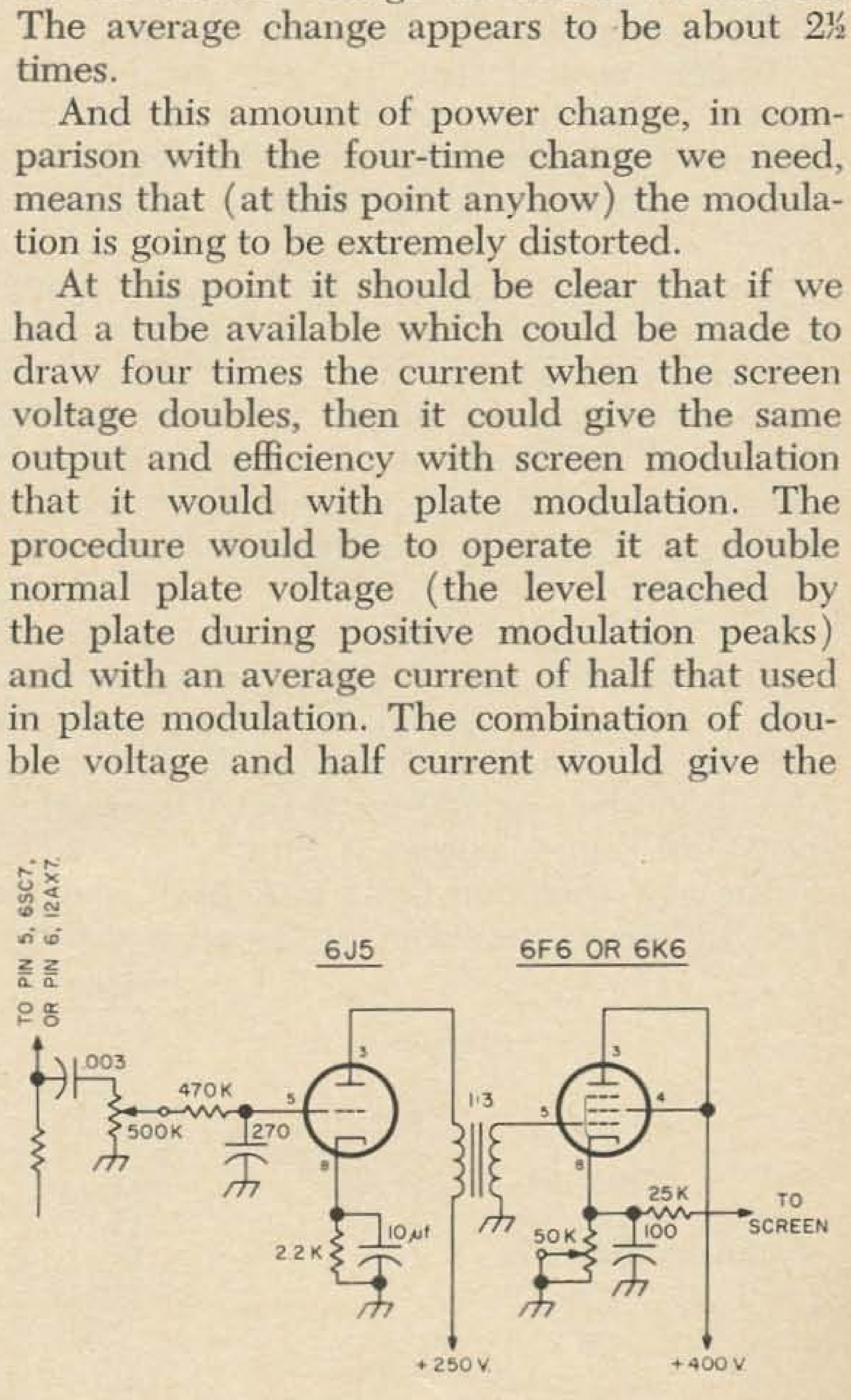


Fig. 3. W6AJF controlled-carrier gating modulator.

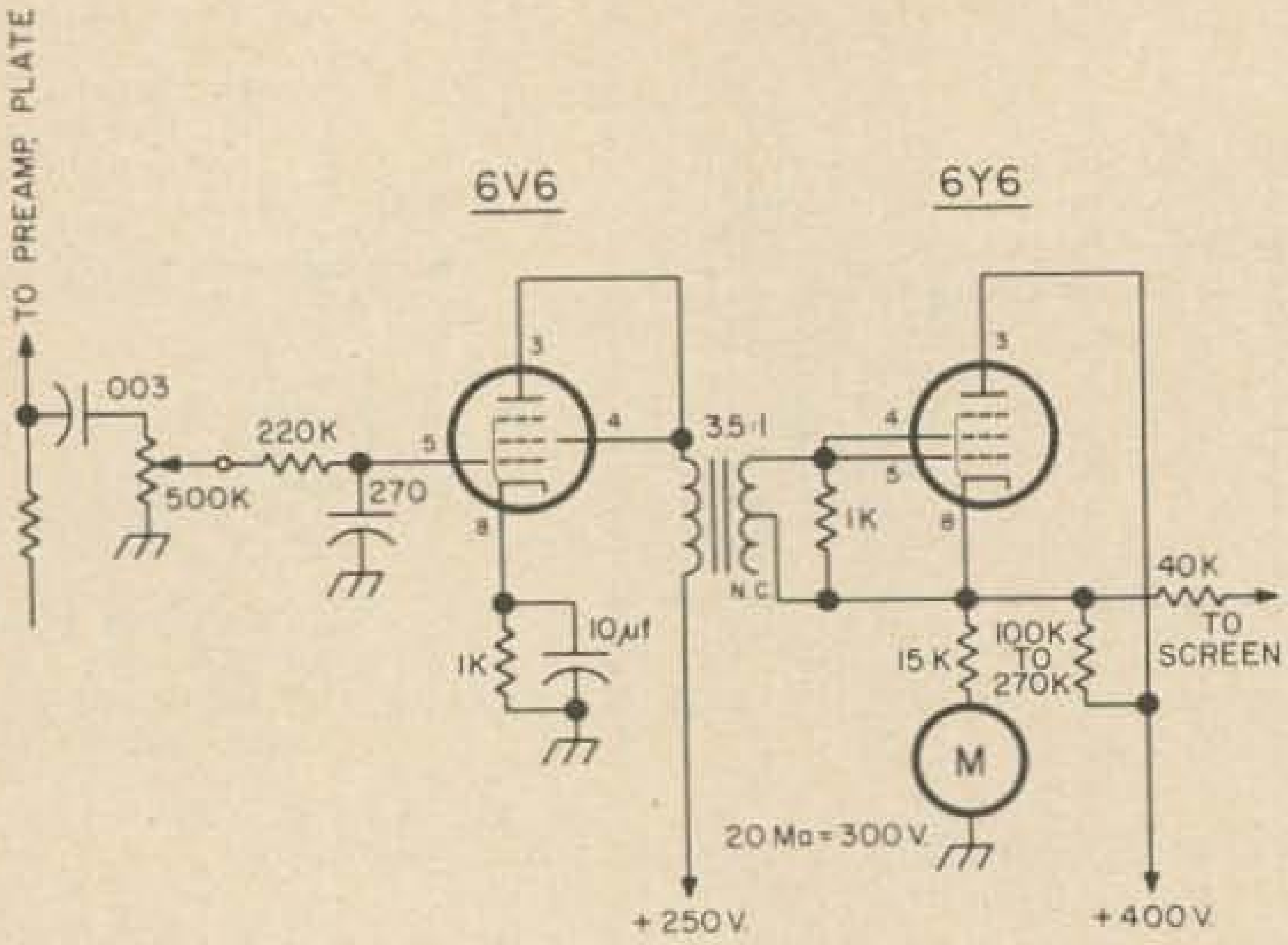


Fig. 4. Improved controlled-carrier gating modulator by W6AJF.

same power output as the plate-modulated version, in the absence of audio. Audio peaks would drive the tube up to four times the current level, reproducing the conditions which exist at high-level modulation peaks, while negative peaks would drop current to zero and reduce power output to zero. However, it doesn't appear likely that any such tube will be available in the foreseeable future.

Which means that to get good-quality screen modulation, we must vary something *besides* the power input to the final. One thing we can vary is the efficiency of the final stage.

Let's assume that our final-amplifier tube is one which draws just double normal plate current when screen voltage doubles. If we can set the stage up so that it has normal 70-per cent efficiency under peak-modulation conditions, but the efficiency drops to half or 35 per cent at the carrier level, let's see what happens:

Our 100 watts input now gives only 35 watts out at the carrier level. Positive modulation peaks double the plate current, giving us 200 watts in, and out 70-per cent efficiency at this level gives us 140 watts out. On negative peaks, of course, output is zero.

We now have our 4-to-1 ratio back, and the only difference the fellow at the other end can find is that our signal is 3 db down from its original level.

Actually, we don't do it just exactly this way. As mentioned before, the plate-current-to-screen-voltage ratio varies with many factors, so the actual adjustments are done on-the-air and everything gets twiddled around a bit until the scope shows us the best linearity of modulation we can get. But it works on just this principle of varying efficiency. We load heavily to produce low efficiency at carrier level which will rise as power level rises, and drive to allow enough rf input to saturate the stage even at maximum power level. And all the adjustments are critical.

Let's go back a bit though and see what side effects we have brought on. Our original 100-watt 70-per cent-efficient rig had only 30 watts dissipation in the final tubes. A pair of 6146's could handle that with room to spare, and a single one might do it if you didn't mind overloading it a trifle. But when we went to screen-modulation, we found 65 watts being dissipated in the tubes. This means more than twice as much power lost in the tubes, and also shows that we can't hope for much more carrier power out than half the dissipation rating of the final tubes. One 6146, screen modulated, will give only about 12 watts out and shouldn't get more than 36 watts in. An 813 will give 75 watts out. Efforts to get more power output will result in poor audio, short tube life, or both. And this is one of the big disadvantages of screen modulation.

It's well known that tubes can stand short overloads without harm. If we held the input power down on standby, yet brought it up only while talking, we could run higher power levels. This is the reason for what is known as "controlled-carrier" screen modulation. It holds carrier level down, yet automatically raises the carrier with speech so that efficiency remains more or less constant. You might say it applies the 2½-to-1 screen-voltage-to-plate-current factor twice, so that we can get the 4-to-1 ratio needed.

With controlled carrier, we can run out 100-

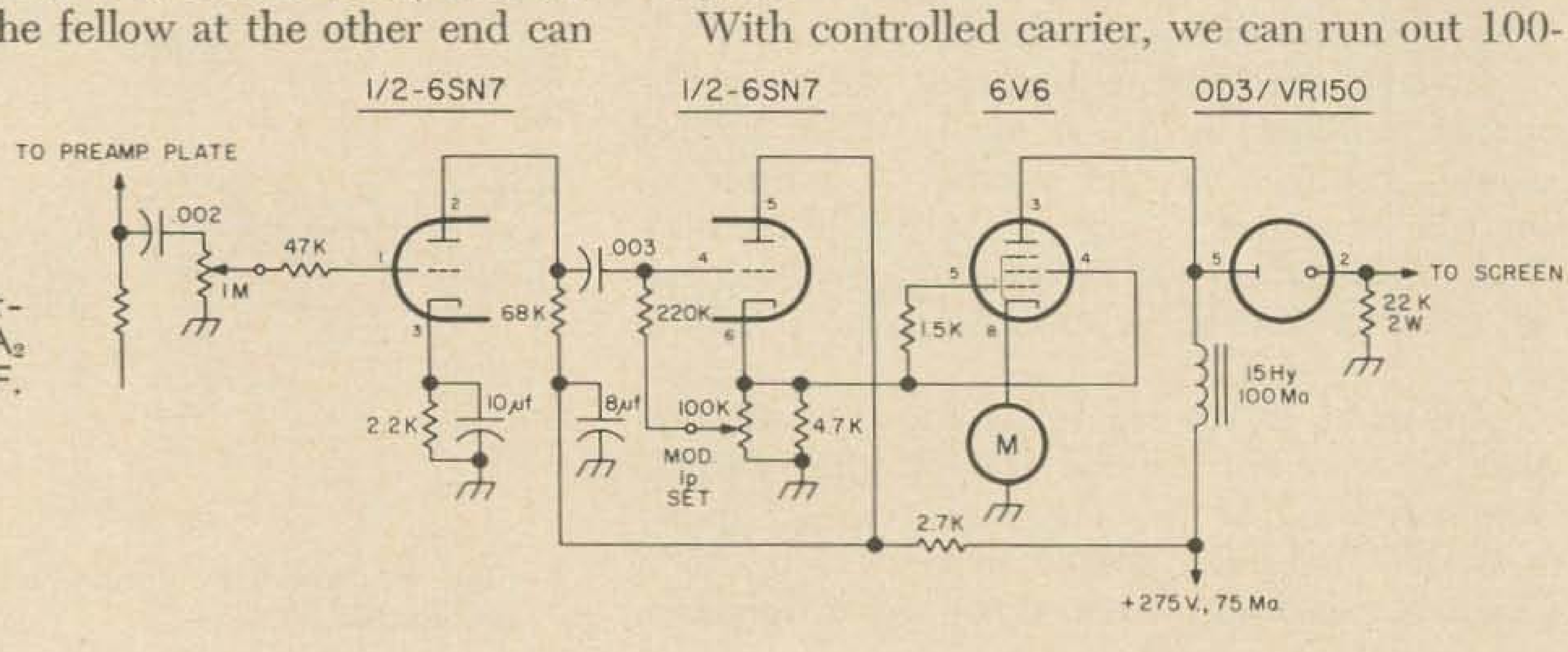


Fig. 5. Constant-carrier class A_2 modulator. W6AJF.

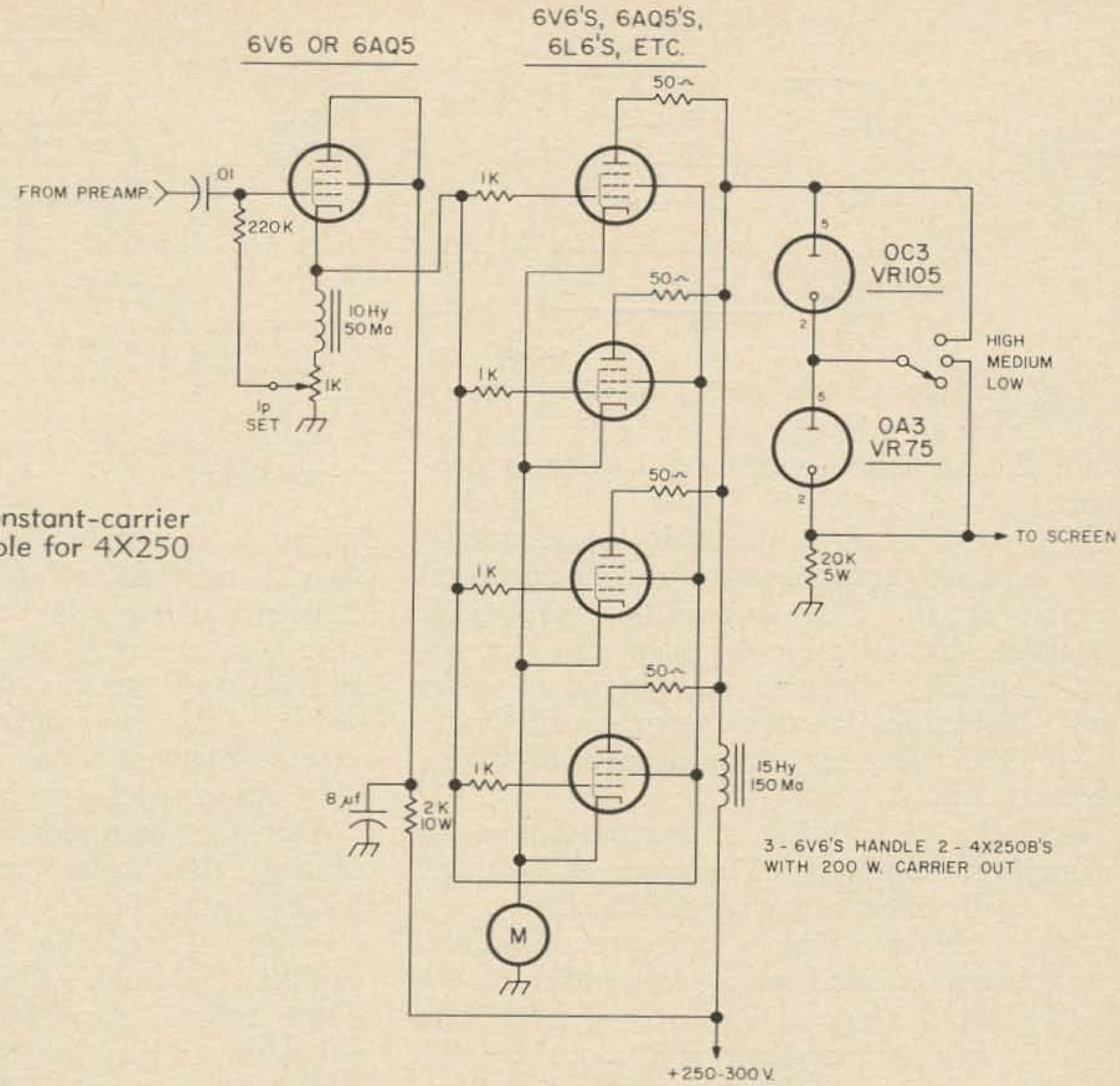


Fig. 6. High power constant-carrier class A_2 modulator suitable for 4X250 series RF tubes.

watt rig with an input on standby of only about 36 watts, giving us 12 watts out and dissipating 24 in the tube. When we talk, input rises to 100 watts and audio-peak output power can be up to 140 watts. The 65-watt dissipation taking place in the tubes between syllables won't hurt, because the average input goes back down toward 36 watts as fast as we stop talking. We're still 3 db down from high-level modulation, but we don't have to change from a 6146 to a 4-65 just because of plate dissipation.

Controlled carrier does have some disadvantages. The S-meter at the other end will flicker with speech, and so will the plate meter. You can determine power input only by loading up for CW and making an educated guess from that (the SSB technique would also be applicable). On marginal contacts, the carrier may drop out entirely between words, which is disturbing to the listener. But it doesn't have to sound bad!

Practical system modulation circuits

Having taken a brief journey through the why and how of screen modulation, let's look at a dozen selected screen-modulation circuits. Of them, six are the work of W6AJF, who has probably done more than anyone else with screen modulation. All will work.

The circuit in Fig. 1, using a 12AX7 and a 6AQ5, is a constant-carrier clamping-type modulator which will handle an 829, one or two 807's, a 4-125A, or an 813. The resistors in the 12AX7 grids make this stage act as limiter on large signals and a straight amplifier on low-level inputs, while the RC network in the 6AQ5 grid is a low-pass filter to remove the audio harmonics created by any clipping. Audio voltage to swing the screen is developed across the choke, and the 25K potentiometer or adjustable resistor is used to set the screen voltage to the proper value. The .5 μf capacitor across the upper half of the pot allows the audio modulating voltage to pass without attenuation.

The circuit of Fig. 2 is similar to that of Fig. 1, except that the choke is replaced with a high-wattage resistor which should be mounted away from all other components. The value of this resistor must be chosen for proper screen voltage on the modulated stage; R1 in the 6V6 cathode gives a fine adjustment of screen voltage, but is intended as a controlled-carrier device. With R1 shorted out, carrier level is low in absence of audio.

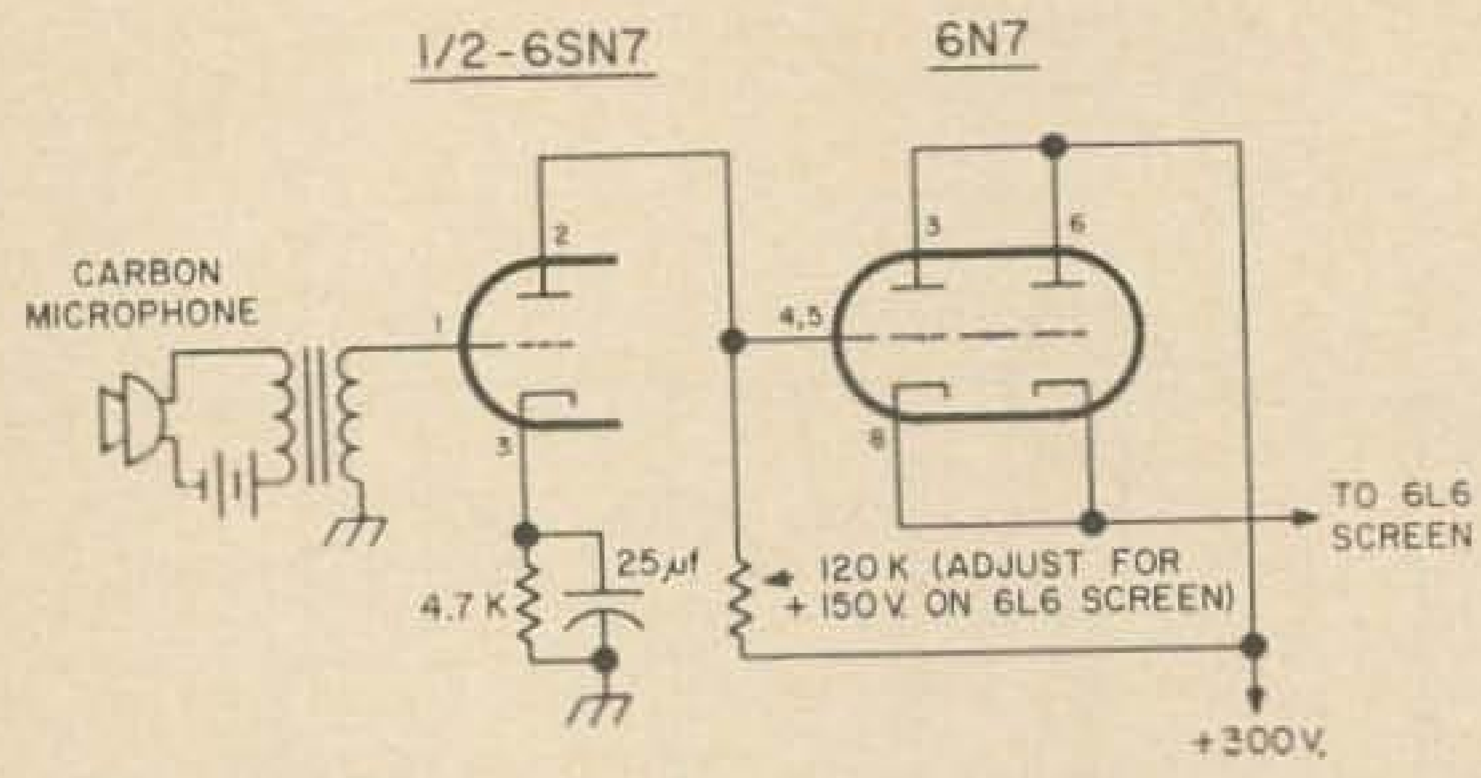


Fig. 7. Super simple gating modulator by W6MTY.

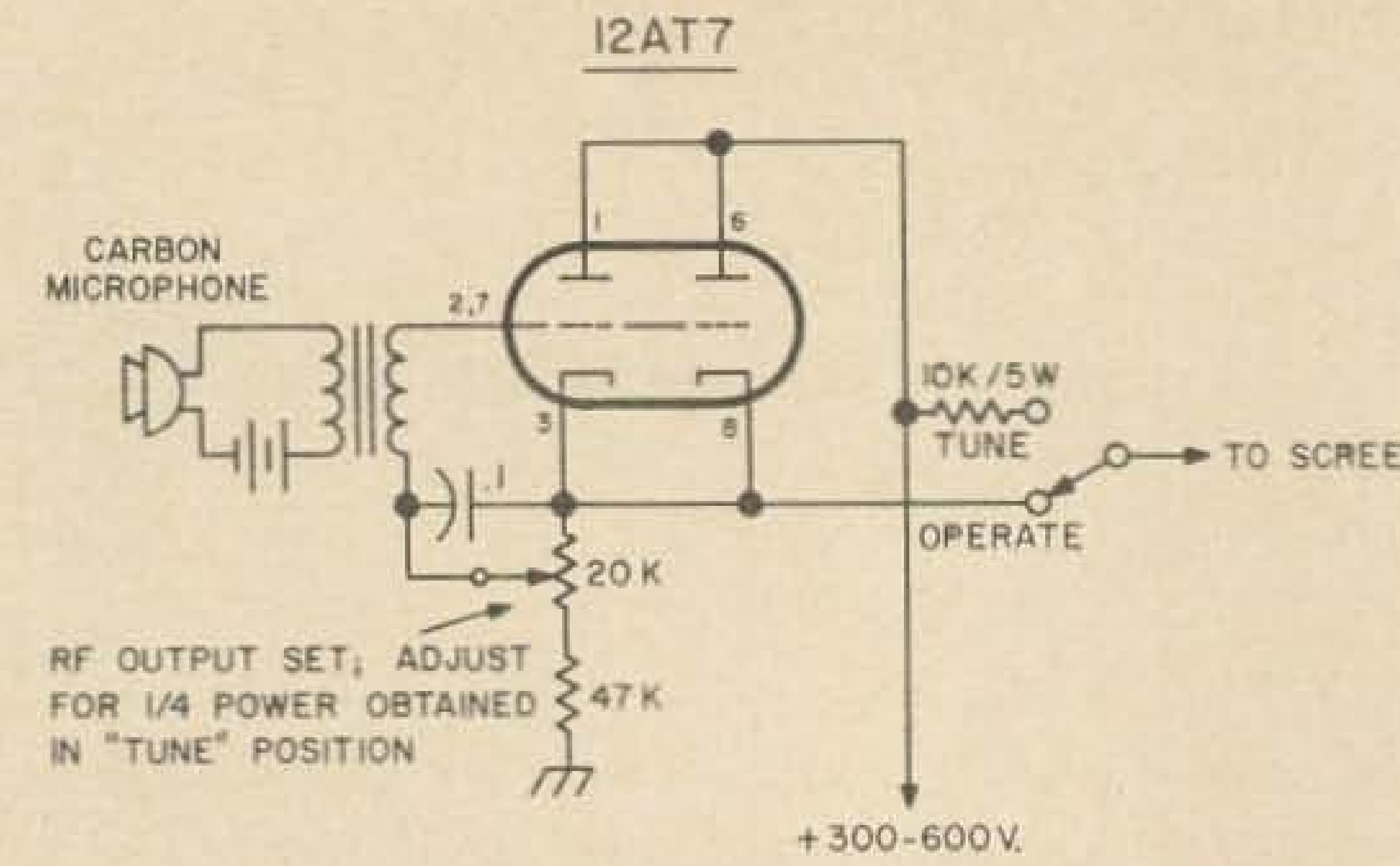


Fig. 8. Constant-carrier, one tube gating modulator.

With R1 near full resistance, carrier is constant.

When examined on a scope, the circuit of Fig. 2 shows little negative-peak modulation present at all. This represents considerable distortion, but in some types of rigs the circuit simplicity warrants acceptance of some audio distortion. Positive peaks remain linear up to 130 volts output, and tend to flatten above that point.

Both Fig. 1 and Fig. 2 are shunt-type, or "clamping" modulators. The series, or "gating," type usually offers better overall linearity.

Fig. 3 shows a simple gating-type modulator. Its input comes from a preamplifier similar to the 12AX7 stage in Fig. 1 or the 6SC7 in Fig. 2, and is amplified still more by the 6J5. The gating modulator is a cathode follower, which means that its grid voltage must swing a little wider than the swing desired on the screen, so a 1-to-3 step-up transformer couples the 6J5 to the 6F6 or 6K6 gate tube.

The 50k pot in the cathode circuit is set for cut-off bias on the gate tube, typically around 30 volts. This also sets the modulated screen voltage at this low level. Audio applied to the grid lowers the internal resistance of the gate tube, so that the cathode voltage rises, giving us carrier control. Like the circuit of Fig. 1, this works nicely with an 829 or two 807's. It is not usable with tubes having negative screen currents over any part of their operating range, such as the 813 or the 4X150 series.

A somewhat improved gating modulator is that shown in Fig. 4. It differs from the Fig. 3 circuit mainly in using a Class B gate tube rather than a Class AB_1 hookup. This, in turn, requires a power driver to supply grid current. The 1k resistor in the grid circuit stabilizes the load on the 6V6. This circuit is good for an 829 or a pair of 4-125A's, and can give linear modulation of the 4-125A's up to 250 ma indicated peaks. Like Fig. 3, it produces controlled carrier.

A clamping modulator which doesn't display the bad characteristics of many such designs is shown in Fig. 5. This one uses a Class A_2 modulator hookup, where the grids of the modulator tube are always positive and draw grid current. This in turn lowers output impedance of the modulator and reduces distortion. (The low output impedance of the cathode follower is the reason why the gating arrangement usually works better.)

With the exception of the unusual grid circuitry, this hookup isn't too different from that of Fig. 1. It is fed by the preamp of Fig. 1 or Fig. 2, and the first half of the 6SN7 amplifies the audio still more. The second half of this tube is a cathode-follower driving the modulator, to give low-impedance drive to the current-drawing grids. The modulator grid arrangement makes the 6V6 in effect into a high-mu triode. Resting current of the modulator is controlled by the 100k pot in the 6SN7 cathode; the less bias this introduces for the 6SN7 grid, the more positive its cathode will be. The 6V6 grids are tied to the 6SN7 cathode, so their bias follows automatically.

The VR tube is used to drop the 6V6 plate voltage to the value needed at the modulated screen. With no audio, the 6V6 plate will be fairly close to the supply level; the VR150 then drops 150 volts from this so that about 125 volts appear across the 22k output resistor. With audio, the 6V6 plate voltage fluctuates with signal. This change is transmitted through the VR tube so that voltage across the 22k resistor ranges from about 5 to about 145 volts. The VR tube must not be allowed to go out during modulation as this would cause extreme distortion.

Fig. 6 shows a high-power version of this circuit, which is capable of handling a pair of 4X250B's at maximum ratings. This gives 200 watts output on 2 meters, rising to 800 or so at modulation peaks. The only essential difference is that the 6SN7 cathode follower is replaced by a 6V6 or 6AQ5, to give more driving power.

If tubes are chosen for either Fig. 5 or Fig.

6 which have non-linear transfer characteristics, and these characteristics are picked to cancel out any non-linearities present in the screen characteristic of the modulated stage, a worthwhile decrease in distortion can be obtained. For instance, 6Y6's can be used in Fig. 6, and results will be considerably cleaner with 4X 250's than if the 6V6 or 6L6 types are employed. Determining just what is best is, in most cases, a trial-and-error proposition since no suitable curves are available.

If simplicity appeals more to you than does near-perfection of audio, the circuit of Fig. 7 should be interesting. It's hard to get much simpler than this.

Input from the mike is amplified by the 6SN7 half, which is direct-coupled to the 6N7 grids. The cathode of the 6N7 goes to the screen of the modulated 6L6, and that's all there is to it. Designer W6MTY used the other half of the 6SN7 as an oscillator to drive the 6L6, getting a complete transmitter with just three tubes. Screen voltage should be set to ½ normal by adjustment of either of the two resistors, though adjustment of the plate resistor is recommended.

Almost equally simple is the "Golden Gate" circuit in Fig. 8. This one also uses a carbon mike, but drives the modulator tube directly with it. Bias on the 12AT7 is set by the 20k pot, which indirectly sets screen voltage and RF power output. The tune-up switch allows CW conditions for tuning. In practice, the rig should be tuned for maximum output in TUNE position, then loading increased until output drops about 15%. Switch to OP and adjust R1 until power output drops to ¼ of the *maximum* read at TUNE. You're on.

For top-quality audio, the circuit of Fig. 9 is recommended by W6SAI. It's a gating circuit, and offers independent adjustment of both carrier-level power output from the modulated stage and of negative-peak level. It's applicable, without change, for the modulation

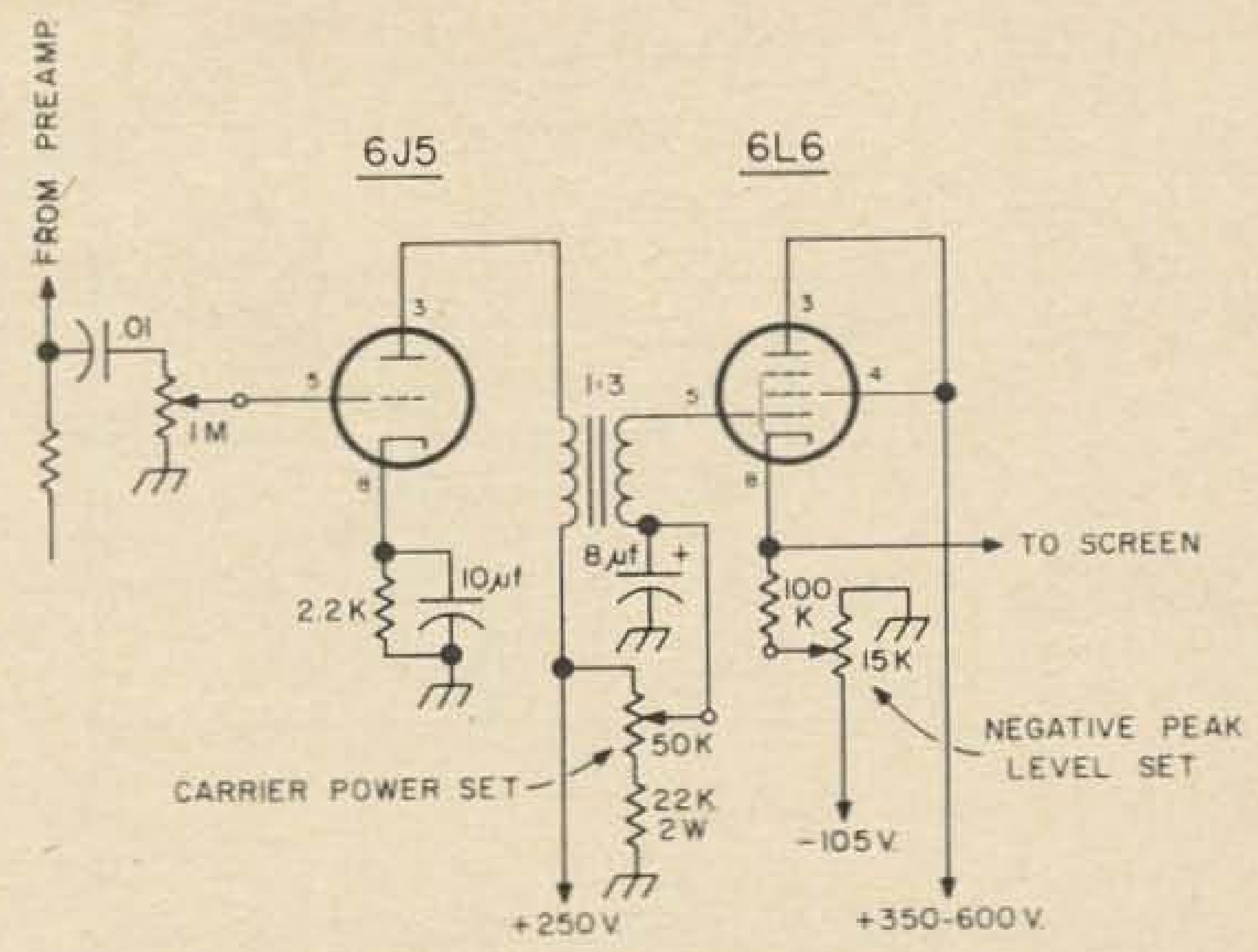


Fig. 9. High quality gating modulator. W6SAI.

of anything from a single 2E26 up to an 813 or a 4-250.

Plate supply of the 6L6 should be about 100 volts greater than normal screen voltage for the modulated tube. Then the 50k pot is set for ½ normal screen voltage and the 15k pot is set at its grounded end. The modulated stage should be connected to a dummy load and a scope hooked up for modulation checking.

Initially, the scope display (if a trapezoid pattern is used) will probably show little negative-peak modulation, as well as extreme flattening of the positive peaks. Loading of the modulated stage should be increased (together with drive, if necessary) until the positive peaks are satisfactory. Then the 15k pot should be moved toward the negative-voltage end until the negative-peak modulation just reaches 95 percent. Apply excessive audio input to see if negative-peak overmodulation is possible; if it is, reduce the setting of the 15k pot.

To hook up a screen-mod transmitter for trapezoid display is something of an art in itself. The connection usually made to the secondary of the modulation transformer can be made to the modulated screen instead; it

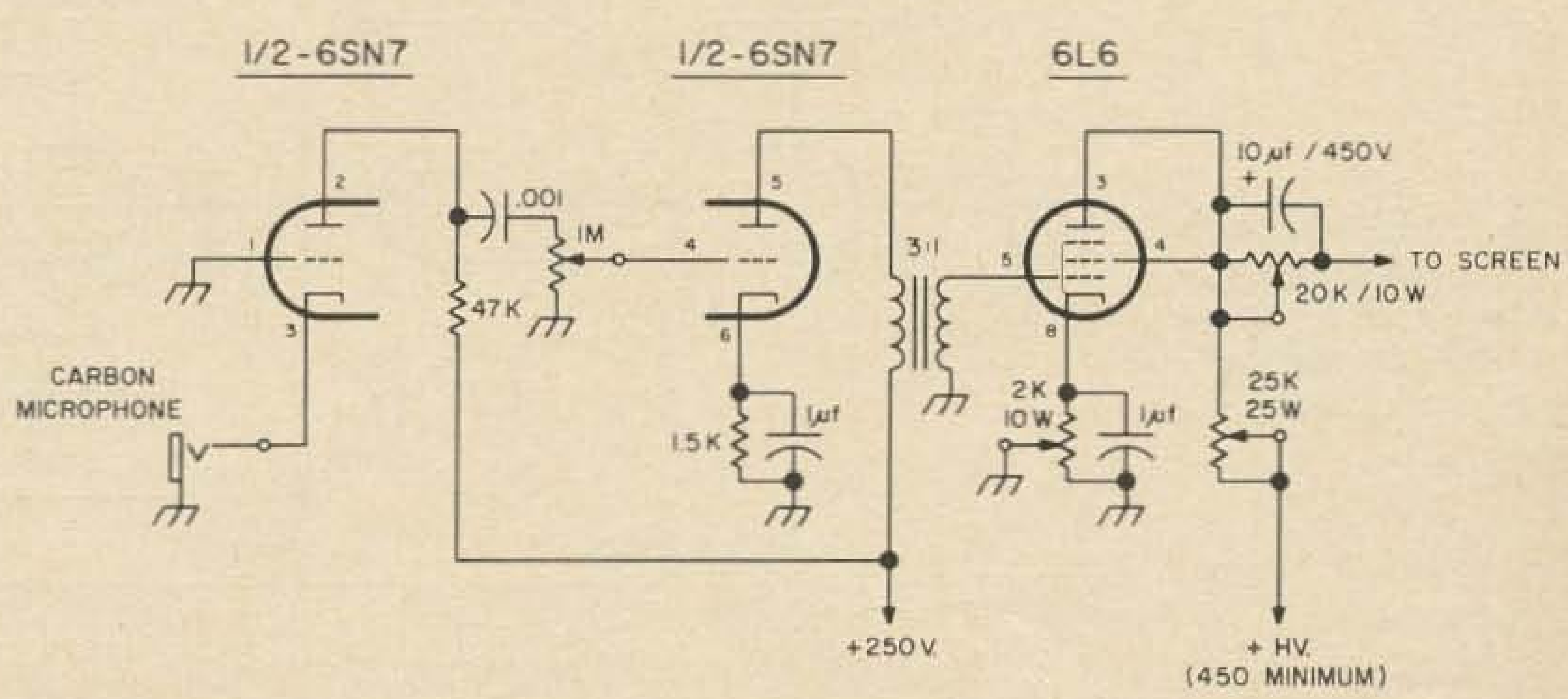


Fig. 10. Clamp tube modulator for 807. W6SAI.

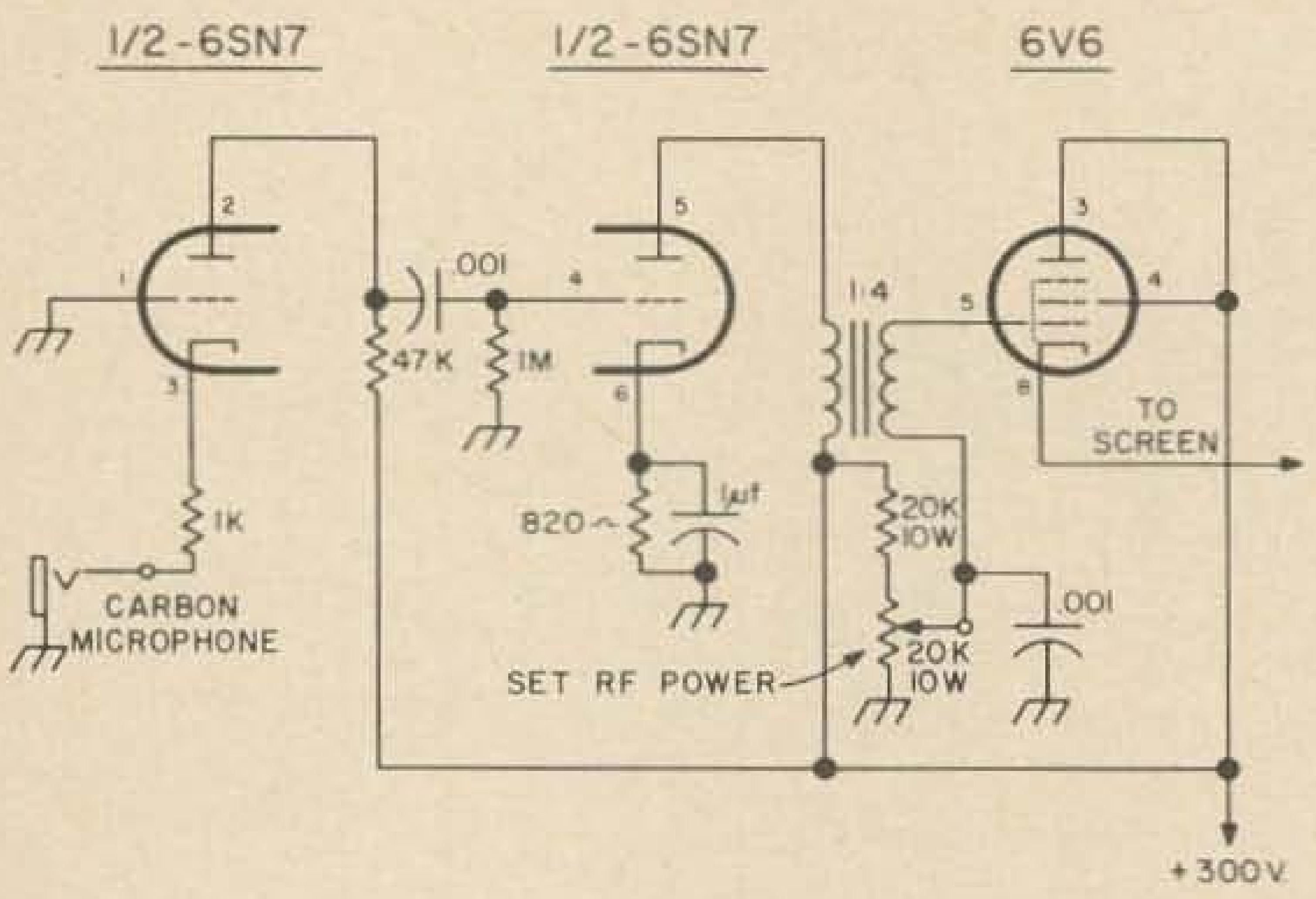


Fig. 11. W6SAI gating modulator for 807.

may require a bit more scope gain to get a good display, but the results will be every bit as good.

If both positive and negative peaks appear satisfactory, but the sides of the trapezoid are kinked, then the resting value of screen voltage is incorrect for the particular tube. Change it in either direction until you get the straightest possible sides, then re-load for best peaks.

Once adjustment is correct, you can lock both potentiometers in place. Note the grid-current reading and the carrier-level plate-current readings of the final stage. Henceforth, adjust drive for exactly the same amount of grid current, and load for the same plate current, and you should have screen-modulation which can't be told from the high-level variety.

Note that the 6L6 cathods is very hot to ground; this means that the filament of this tube should be supplied from an isolated source. This requirement makes this circuit difficult to use in mobile work unless final-stage tubes are chosen which don't require very large screen voltages.

Fig. 10 shows W6SAI's version of the basic circuit also illustrated in Fig. 2. This circuit works nicely with either one or two 807's but isn't so good with 6146's or other low-screen-voltage tubes, and is definitely poor for TV horizontal-output type tubes. Even with 807's, final high voltage must be at least 450 for good results, and 700 to 1000 volts is preferable.

The 25k adjustable resistor should be set to give 250 volts on the 6L6 plate with the final stage tuned to resonance, and the 20K resistor for 130 volts on the final screens. The 2k cathode resistor should be adjusted for 20 volts at the 6L6 cathode. All three adjustments interact and should be checked.

The gating modulator of Fig. 11, using much the same set of components, gives superior results and works with more types of tubes. It is a simplified version of the circuit of Fig. 9, with the negative-voltage supply omitted. Though intended as a constant-carrier circuit, it will produce controlled carrier if the 20k pot is set too close to its ground end.

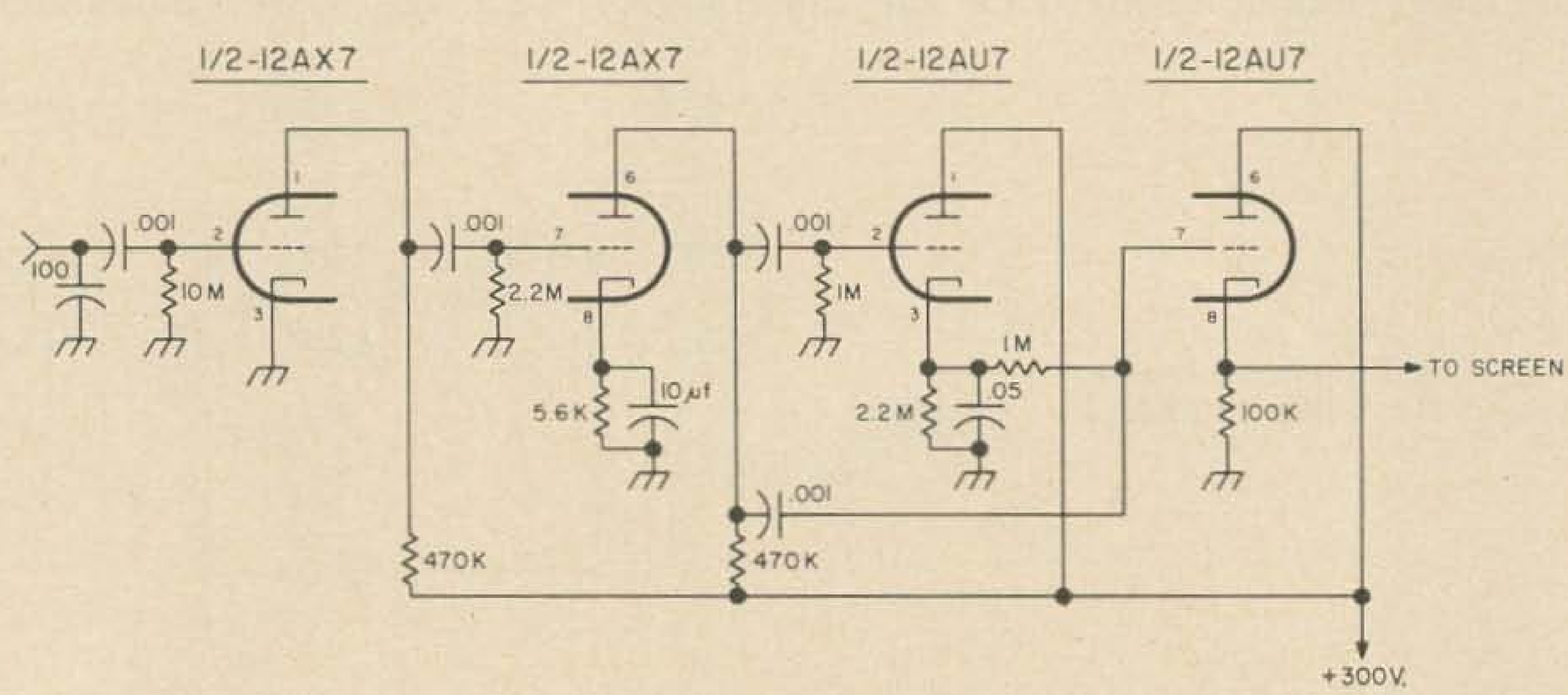
So far, all the gating modulators we've discussed have had to use transformers to get up enough audio swing at the gate tube grids, and the clamping types which give good performance have all used inductors. But in compact equipment, we frequently want to do away with as much iron as possible.

The circuit of Fig. 12 does just that. It's a controlled carrier gating modulator which is highly suitable for a single 6146 and has been used to drive a pair of them, which has no iron at all in it.

This one comes from the Heath people, and was used in the DX-35. Later models used about the same circuit but substituted a 6DE7 for the 12AU7, and on-the-air performance appeared to suffer from the substitution.

The 12AX7 is a preamplifier, and gives us about 150 volts peak-to-peak at its output when driven by a crystal mike and a moderately loud voice. The left-hand half of the 12AU7 is hooked up as an infinite-impedance

Fig. 12· Heath Company transformerless controlled-carrier gating modulator.



detector, because of the high-value resistor in its cathode circuit. The .05 μf capacitor bypasses the individual cycles of audio frequency, but maintains a charge equal to the instantaneous peak voltage of each cycle. The right-hand half of this tube is a straight cathode follower, with its grid returned to the top of the .05 capacitor. Thus the voltage across the 100k cathode output resistor will consist of the 150 volt-peak-to-peak audio signal from the preamp, superimposed on a 0 to 150-volt varying dc level from the detector. This goes to the screen of the 6146; the varying dc level controls the carrier, and the af cycles do the modulation.

Modulation level is between 80 and 90 percent on both positive and negative peaks, and with a 6146 is exceptionally linear if the tube is properly loaded. Unlike the other controlled-carrier circuits described here, this one uses both the positive and the negative half of the audio input cycle, and has a definitely cleaner sound. The only thing about it which identifies it as screen-modulation is the controlled-carrier effect.

When used with a pair of 6146's, or with a 6DE7, however, linearity suffers. It appears that the circuit can only handle enough current for a single tube, and that the 6DE7 requires changes in circuit constants.

Now, after looking over a dozen different designs, you are in a position to pick the ones which fill your own needs best, and if quality is your goal you can get a circuit which will give it to you.

But getting that quality is up to the operator, since as mentioned previously almost every adjustment in a screen-modulated rig is critical. If you're used to tuning up a linear, just think of the screen-mod rig as a different kind of linear and you won't go far wrong. Heavy loading is a must. So is plenty of drive, but excessive drive can also cause troubles. Best procedure here is to start with all the drive your final tube can stand, then reduce it a bit after everything else is set and see if you can improve the scope picture.

In general, the positive-peak modulation will be determined by the loading and drive while the negative-peak conditions will depend on the modulator circuit. Linearity between these peaks will depend on the exact screen voltage of the tube (and may vary from tube to tube in a given type) as well as on the match or lack of one between plate characteristics of the modulating tube and screen characteristics of the final. The adjustment to correct for all of this is the resting-screen-voltage control, sometimes called the carrier-power level-set control. Since so many variables are involved, the only recommendation is to make a change and see if it helps or hurts. If it helps, keep on the same direction. If it hurts, go the other way.

A scope is a necessity for getting top quality out of a screen modulated rig; for that matter, it's just as important with high-level modulation. But with a screen-mod rig, only the scope can tell you which adjustment should be moved. With high-level modulation, you can tell by an educated guess.

The most meaningful scope display is the trapezoid. For this, the vertical plates of the scope should be connected to the transmitter rf output. A handy way of doing this is to take a length of "zip cord," form a two-turn link at one end by splitting the wires and wrapping each back one turn, then twisting them together and taping everything to hold it in place, and connect the other end of the zipcord to the vertical plates of the scope. The link can then be coupled to the final tank and will usually pick up plenty of signal.

The horizontal input to the scope should be taken from the screen of the modulated tube, with the other input lead grounded. Switch the scope to "external sweep" and control the width of the trapezoid with the horizontal gain control.

A perfect display shows up as a triangle. The base of the triangle is the positive modulation peak, while the point is the negative peak. If modulation is less than 100%, the point will be flat. If overmodulating, the point will have a line extending from it. Curved sides on the triangle indicate distortion.

Fortunately, once you have the rig tuned up properly on dummy load it will work the same on any load of the same impedance. This means you can lock all modulation adjustments, note final current readings, and if drive and loading are always adjusted for the same readings, modulation will also remain the same.

If you want to do more reading up on the subject, here are a few references:

Orr, William W6SAI, The Radio Handbook, 16th edition, page 286.

Jones, Frank W6AJF, "Some Experiments with Screen Grid Modulation," CQ, January, 1952 (reprinted in CQ Anthology No. 1, page 127).

Jones, Frank W6AJF, "A New Class A2 Screen Modulator," CQ, April, 1956, page 21.

Orr, William W6SAI, New Mobile Handbook, Cowan Publishing Corp., pages 98 through 103.

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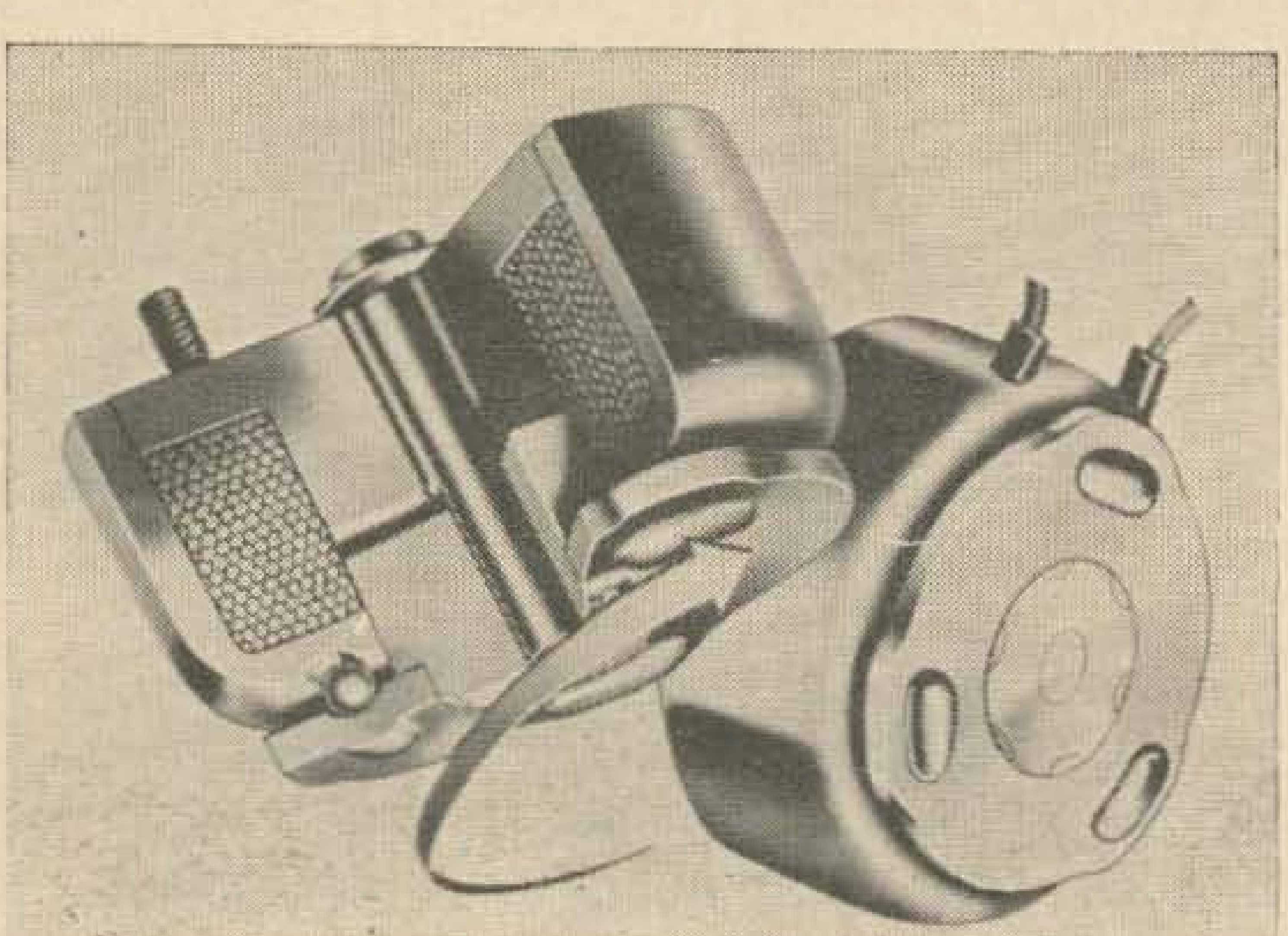
Surplus Remote Switching

In an earlier article,[1] I referred to the use of LEDEX stepping relays as remote switching elements in a complex transmitter switching application. A second article[2] described a surplus, motor driven coaxial switch. Mail received in response to these articles showed widespread interest in such remote switching and positioning devices. Questions were about evenly divided between "How do they work?" and "Where do you buy them on the surplus market?". This article will attempt to answer both questions as related to the rotary solenoid type of remote switches and positioners. The writer is indebted to Ledex Inc. of Dayton, Ohio for much of the information presented herein.

As shown in the exploded view, a rotary solenoid consists of a very short stroke solenoid with the armature supported from the frame by ball bearings which travel in inclined ball races or grooves. When the coil is energized, the armature is drawn into the coil. At the same time, the inclined ball races cause the armature to rotate. By connecting a ratchet mechanism to the armature so that the ratchet is engaged on the forward stroke and disengaged on the return stroke, it is possible to cause the solenoid to rotate a shaft a fixed number of degrees each time the solenoid is energized. Addition of switch sections to the rotary mechanism results in a highly useful stepping switch.

This basic switch still leaves something to be desired from a practical point of view.



Exploded view of a Ledex rotary solenoid.

First, the power source must be manually applied and removed for the switch to advance each position. This handicap may be overcome by adding a separate set of normally closed interrupter or commutating switch contacts to the solenoid. These contacts are connected in series with the solenoid coil and arranged to open as the solenoid approaches the limit of its rotation and remain open until the armature returns to its resting position. When the interrupter contacts close, the cycle repeats and will continue to advance the rotary switch through its detented positions as long as power is applied.

A second addition to the basic stepping mechanism makes it a practical remote switching device. One of the driven rotary switch sections is wired into the control circuit to cause the switch to stop at the desired, remotely selected position. **Fig. 1** shows the circuit of a remote selector switch with all the elements we have discussed. This circuit uses open circuit or "notch" homing to remotely position the switch. If the position of the control switch is changed from that shown, power will be supplied to the stepper switch. The switch will then step through the detented positions until the switch contact through which power is applied rests in the notch of the rotor and power is removed.

The circuit shown in **Fig. 1** is simplified. Rotary solenoid type stepper switches are normally available with 8, 10, 12, 18 or 24 detented positions. If less switch positions than these are required, a mechanism is selected with an even multiple of detented positions and the desired switching pattern repeated for the full revolution of the switch.

Arc suppression circuitry is not shown in the schematic but is essential for good contact life and reliable operation. When the circuit to the solenoid is opened, the magnetic field collapses, generating reverse voltages. While of short duration, these voltages are sufficiently high to damage the contacts in the control

[1] "Surplus Frequency Synthesizer," W4WKM, 73 Magazine, February, 1962.

[2] "A Surplus Motor Driven Coaxial Switch," W4WKM, 73 Magazine, August, 1962.

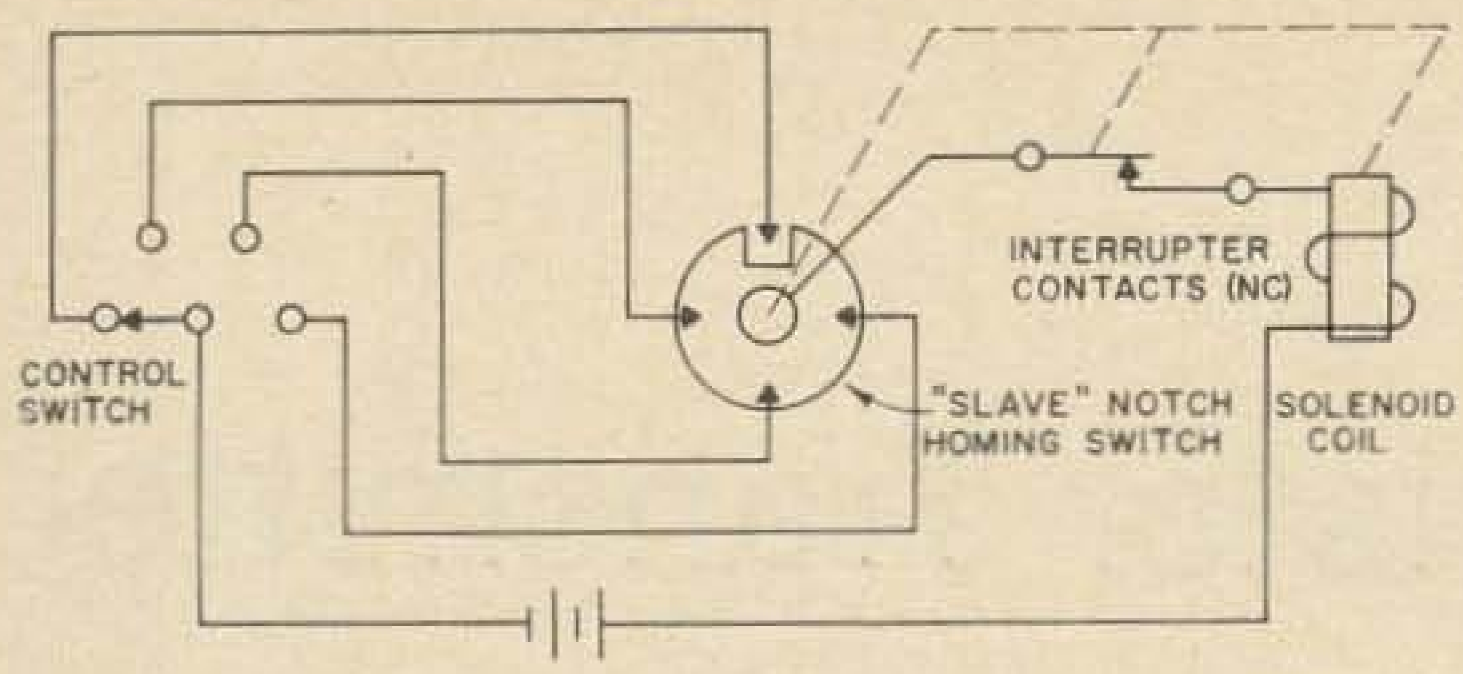


Fig. 1. Basic "open seeking" remote switching.

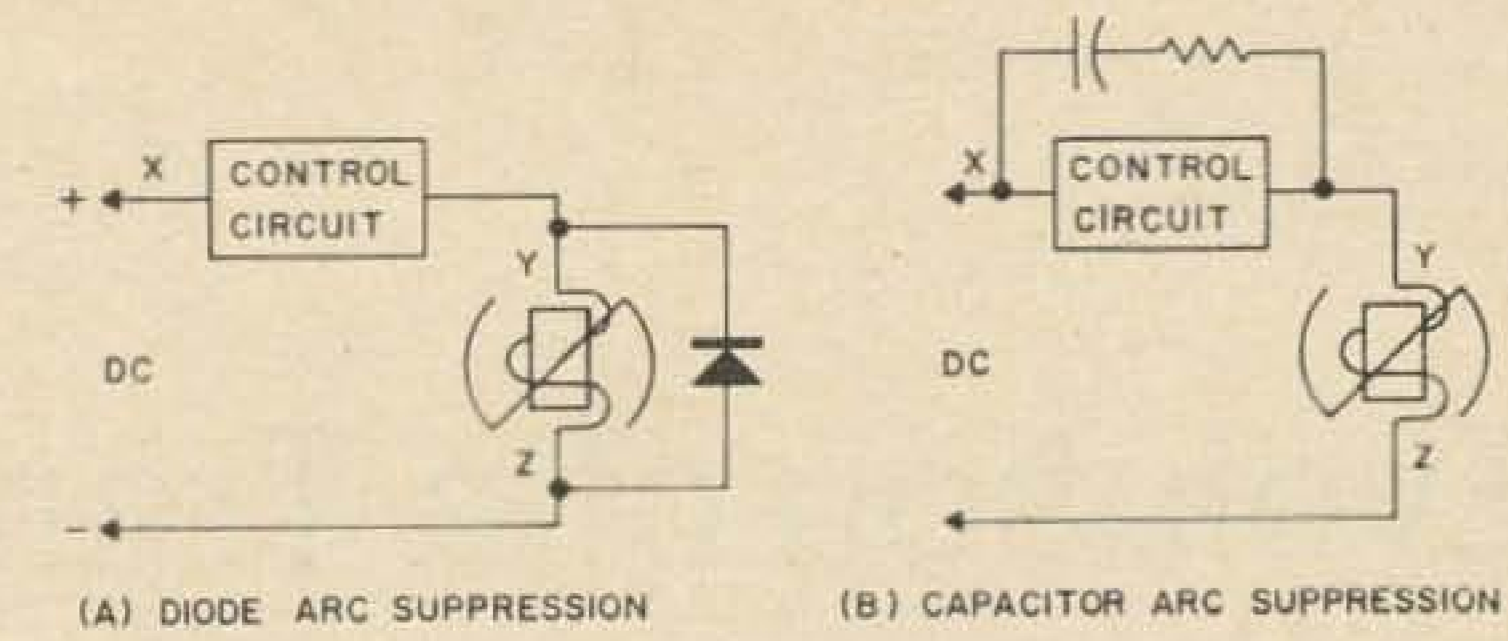


Fig. 2. Arc suppression circuits for use with rotary solenoid stepping switches.

circuit, cause insulation failure and generate radio interference.

Commonly used protection methods are the use of a diode connected across the solenoid winding as shown in **Fig. 2A** or a capacitor connected across the control circuit contacts as shown in **Fig. 2B**. Quite often both techniques are used and this is possibly the safest method. Diode polarity is important and must be as shown in **Fig. 2A**. Suitable diodes are 1N538 or equivalent. When the diode method is used, connect a .05 μf capacitor across the control circuit contacts. Use of the diode reduces the stepping speed of the solenoid approximately 50%. However, this is not too important for amateur applications since the stepping speed will still exceed ten steps per second. The capacitor method of arc suppression, shown in **Fig. 2B**, requires the use of a larger capacitor. Typical value is 0.5 μf at 600 working volt rating. The resistor shown in the drawing is not required with lower voltage units. For units designed for use at between 85 and 100 volts, use the resistor. Five ohms at five watts is a typical value.

Power supply requirements for rotary solenoids are rather critical. These units draw substantial current and a fairly stiff supply is required. Most stepping relays on the surplus market are designed for use with a 28 volt dc power source so this poses power supply problems. A heavy transformer and a full-wave bridge rectifier is almost essential if a conventional supply is used. However, if a slower stepping speed is tolerable, a one ampere transformer feeding a single diode half-wave rectifier may be used with a filter capacitor of 4,000 μf. This circuit will work only if diode arc suppression is used.

Where do you buy these rotary solenoid stepping relays? Well, if you are loaded, you figure out exactly what you need, go to the manufacturer and have him make it up. Of course, this will be a custom design and you will pay a minimum billing charge of $50.00 or so. The next best thing is to pick a stock model (with more contacts than you need) and pay the asking price. Net prices on these units start at around $25.00. Now that we have eliminated 99% of the reading public, we come with the right answer—we buy them on the surplus market. Ray Marver of Ledex says, in response to my query, "Of course, the best deal for a radio amateur is when he is able to locate and design around surplus units offered through distributors."

So here we are, back to surplus. All surplus dealers, at one time or another, have rotary solenoid switches on hand. The unit shown in the photograph was found at Ritco Electronics in Annandale, Virginia and it is typical of the current crop of surplus. However, reference to the current surplus advertisements discloses few offerings. The best bet is to shop around and when you find, buy. If you don't have any luck, there are surplus dealers who specialize in relays. Since they buy stock by manufacturers type, even build up units on order, their prices are a bit higher than what you would pay from the usual surplus dealer. However, it is worth it if you can't find what you need on the open market. Universal Relay Corporation of 42 White Street, New York 13, New York publishes a relay catalog. They carry numerous listings of Ledex, Oak and Price rotary solenoid type stepper relays, solenoids, wafers and power supplies. Prices are very much lower than for manufacturers stock and if you can't find what you need on the open market, give them a try.

This article only skims the surface. However, sufficient information has been given to apply surplus stepper units in your next project. Stick to the simple circuits presented here and try to find surplus units to do the job. There is such a variety of control circuits in general use, each with their own special control and slave switch requirements, that it is impossible in the available space to discuss them all. If you hit a snag, try to find the equipment the surplus unit was used in and then attempt to locate a circuit of the relay control system. While sometimes complex, they all follow a common pattern and you should be able to figure it out. After all, that's half the fun in surplus.

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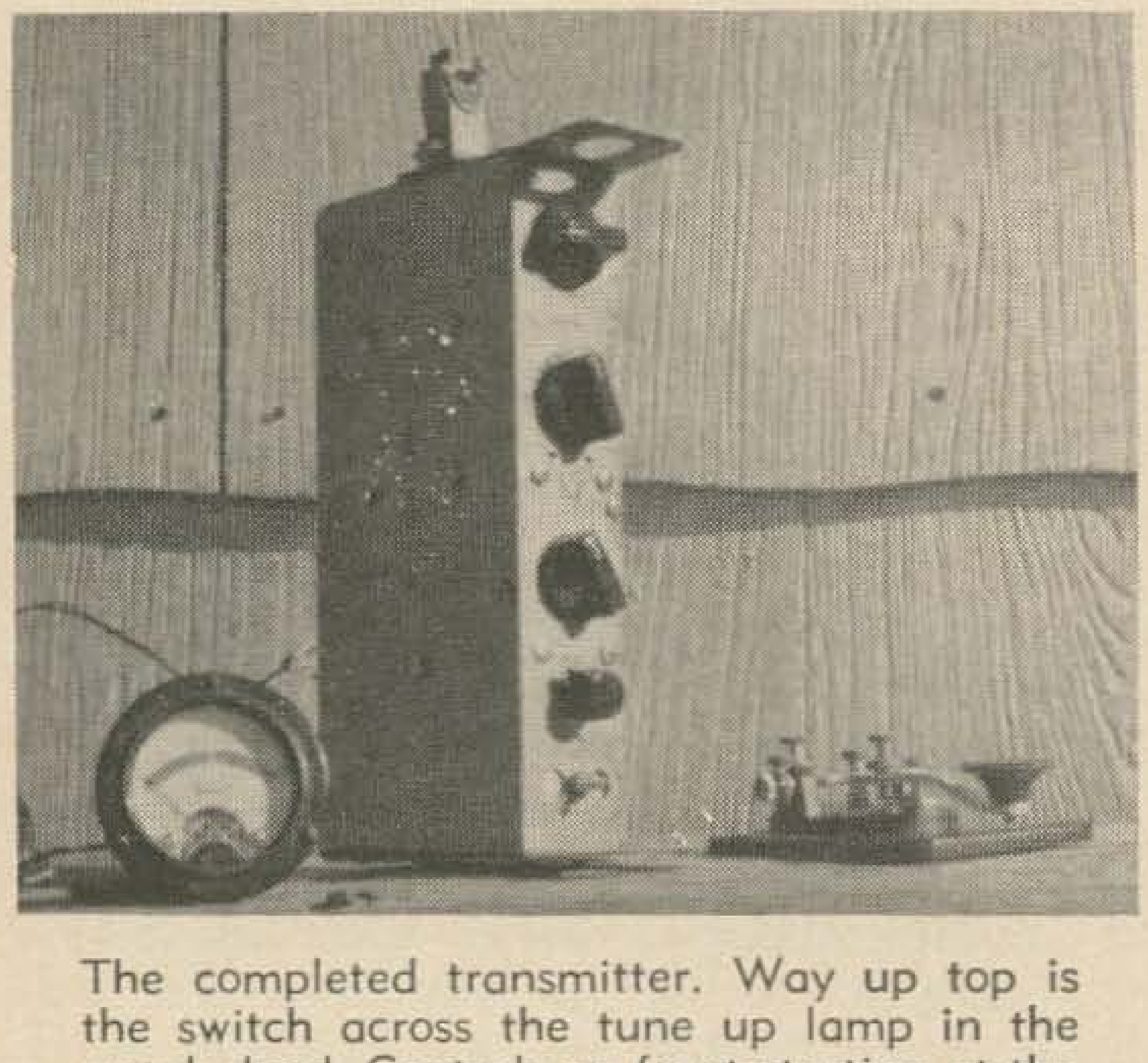
Evolution of a Transistor Transmitter

The everyday use of completely transistorized transmitters seemed to be only an idle dream—a riddle for future engineers and scientists to solve. A transistor transmitter is usually regarded as a very interesting toy and little more. However, the thought sometimes occurs that if the power were a bit higher and a vfo used, such a transmitter would be just the thing for hunting and fishing trips.

A move to an isolated location several miles from town and a mile from a power line yielded excellent receiving conditions. The urge to get on the air grew stronger by the day. Since a transistor receiver was already in use, a small quarter watt transmitter with three transistors was constructed. The hope was that it would work out a few miles under ideal conditions. The isolated location proved to have far better propagation conditions than expected. Six weeks of operation on the 160 and 80 meter bands yielded several states and four QRZ's in a row from a KH6. The conclusion was reached that a vfo was needed.

For the new project, it was decided to try for one watt of power on the 160 and 80 meter bands. With this amount of power the use of inexpensive germanium transistors and flashlight or lantern batteries is practical.



The completed transmitter. Way up top is the switch across the tune up lamp in the supply lead. Controls on front starting at the top: oscillator, drive-doubler and final tuning. The small pointer knob is the band change switch. The meter is from an old tube tester. On 80 meters it reads "doubtful," which may explain the poor report from KL7-land.

Photographs show the arrangement that finally evolved. The BC610 tuning unit at first seemed a sturdy and ideal foundation to build upon. It actually proved to be far from a short cut to a finished product. The "Q" of the coils is lowered by a large amount with the cover in place. The joints in the box are not rf tight. The edges of the box had to be bent out and filed bright to prevent frequency jumping with handling. A more conventional style of construction, with the oscillator in its own shielded box, will save much work. The crude construction is a result of very limited workshop facilities. Most of the work was done outdoors with a kerosene lamp for light and a camp fire to heat the soldering copper. The resulting product, although large and heavy, has proved satisfactory in performance and is still in use with no major changes.

With three transistors in the final amplifier the desired power was obtained on the band of most interest. The vfo problem was much harder to solve. The first attempt at transistorising a Colpitts oscillator was a nerve shattering experience, to say the least. The drift was high and supply voltage critical. When the drift finally stopped, a one volt increase changed the frequency about 2 kc at 2 Mc. The drift started all over again—apparently as bad as the first warm up.

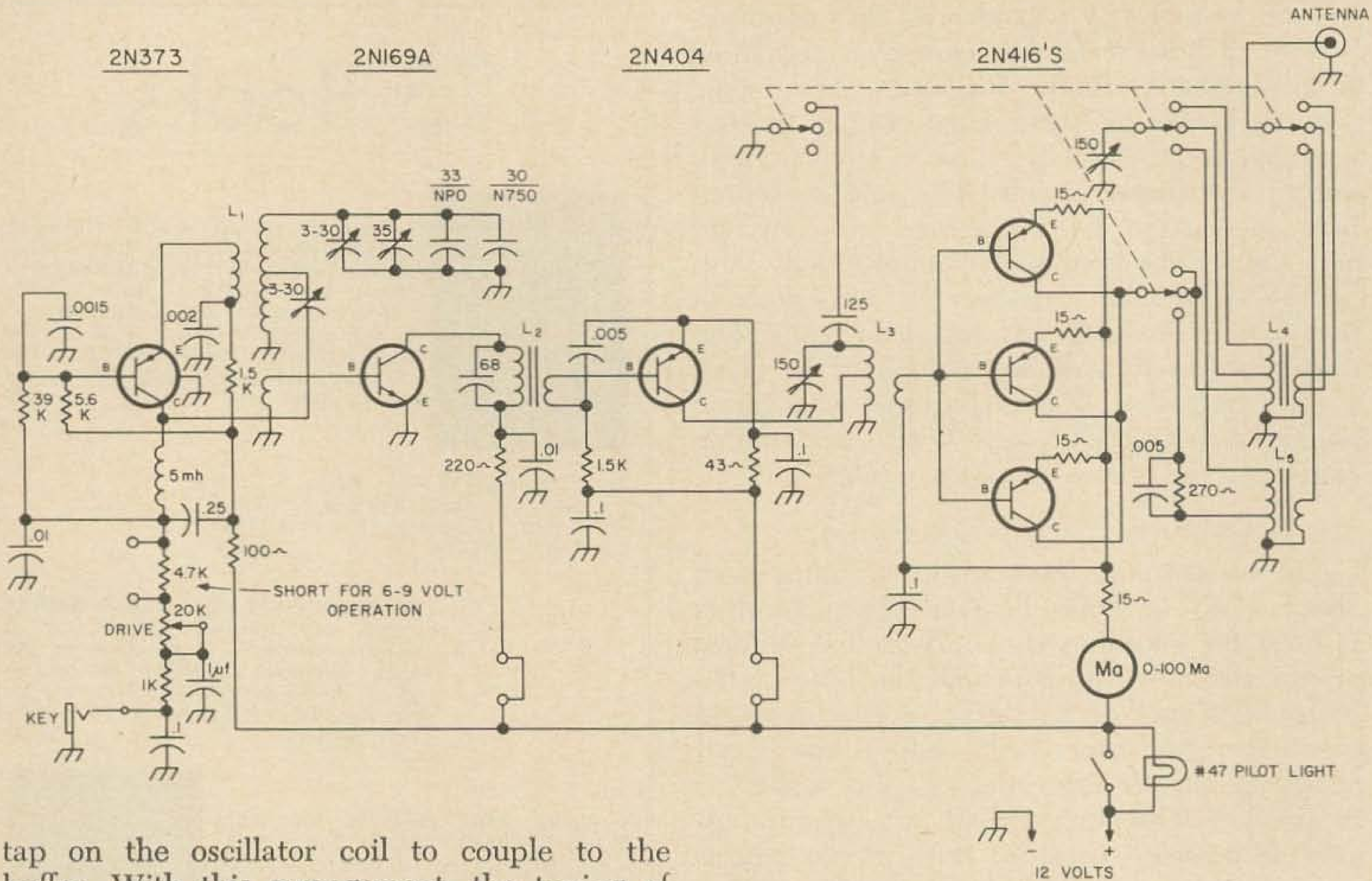
After several months of crystal control, the need for moving about the band seemed important enough to justify another session with the "beast." Since every possibility of taming the Colpitts seemed exhausted, the Hartley was the next confidence breaker. About the same results were obtained. Total shift, drift and creep amounted to about 18 kc. While plotting the frequency and voltage curves of the two oscillators, the discovery was made that the change in frequency was nearly the same amount with either oscillator, but in opposite directions. Clearly, here was the first clue to the cause of our difficulties. The instability was mainly due to changes in the loading of the tuned circuit by the transistor, not by changes in capacity as first assumed.

After a quick refresher course in oscillators from Terman's Radio Engineers Handbook, several oscillators were tried which used a combination of capacitive and inductive coupling to the tuned circuit. The one presented here seemed to be the easiest to construct and adjust. The coupling trimmer allows compensation for wide variations in coil construction, circuit loading and transistor gain. The drift problem was all but eliminated by using a drift transistor. The final result is a stable oscillator that can be keyed with no audible chirp, and the drift is just a few cycles.

General Circuit Description

The oscillator of the transmitter tunes from about 1745 to 2005 kc. Inductive coupling is used for coupling the tank to the emitter of the oscillator transistor and the base of the buffer. Changes of temperature or current to these two transistors will change the input resistance to a large degree. Rf power is supplied to the tank circuit through an adjustable trimmer capacity. With proper adjustment, the change in frequency of the oscillator tank caused by the variation of the load on the inductive coupling loops, is cancelled by the current lead through the capacitative reactance of the trimmer between the collector and tank coil. This system compensates for a multitude of effects that plague a solid state oscillator. Without it, voltage regulation of the collector, bias stabilization by means of a thermistor or similar device, and rather complete isolation of the oscillator from the following stage would be necessary. This would complicate the system greatly and still leave the keying problem for later in the chain between the oscillator and antenna. Even then, the inherent low frequency rumble in current of most transistors would cause a random quiver in the note that resembles a slight case of aurora propagation on the VHF frequencies. The dc operating point of the oscillator transistor is set by means of voltage divider base bias and emittor resistor.

The buffer is loosely coupled to the oscillator tank and is operated without forward bias. Operated in this manner, nearly one tenth of a volt of drive is needed to start current flow in the collector circuit. By using this effect, differential keying is accomplished without complications of relays or extra parts. The output of the buffer is heavily loaded by the following stage, and is fixed tuned. It was during the testing of these first two stages that the old stability problem loomed large and threateningly again. The first design used a



tap on the oscillator coil to couple to the buffer. With this arrangement, the tuning of later stages of the transmitter pulled the frequency a matter of a kilocycle or two. Improper tuning produced a beautiful chirp. Careful inspection of the diagram at this point showed that proper decoupling would be difficult to obtain. A change to inductive coupling with the return of the secondary to a common point for each stage was completely effective in regaining stability. The lesson here is: transistors are low impedance devices, and ground loops are to be avoided. Stray capacitances are not as objectional as in tube type circuits. Both the oscillator and buffer were crowded into one small compartment with no bad effect as long as the returns were handled in the proper manner.

The driver stage operates either on the oscillator frequency or doubles to cover the 80 meter band. When used as a doubler this stage delivers somewhat less than optimum drive to the final amplifier. The band switch available did not allow separate coils for each band, so compromises were necessary. Drive is such that the desired one watt to the final is available on 160 meters and about .6 on 80. Resistors in the emitter and base circuits supply several times cut off bias in a manner similar to conventional tube type circuits. Drive to this stage is held down to a point that limits the out of tune current to a little over ten ma. This is done in order to use only one metered circuit and not have a minor disaster during tune up procedure.

COIL DATA

L1. 85 turns 5-44 litz. D ⅝, L ⅝. Tap 27 turns. Emitter coil, 2 turns over ground end wound same direction. Coupling coil, 2 turns near ground end. Exact position determined by tests.

L2. 100 microhenry rfc or video peaking coil. Secondary is about 30 turns of 30 wire wound over main winding.

L3. 55 turns #32 tap 15 turns from ground. Secondary is 5 turns small plastic hook up wire, over ground end.

L4. 120 turns #30, tap 80 turns up. Collector tap is 8 turns from ground. Output link is 8 turns tapped at 6. See Text for alternate output coils for 50 ohms. Form is surplus ⅜ diameter with ⅞ winding space. All the turns won't fit in one layer so it was semi-scramble wound.

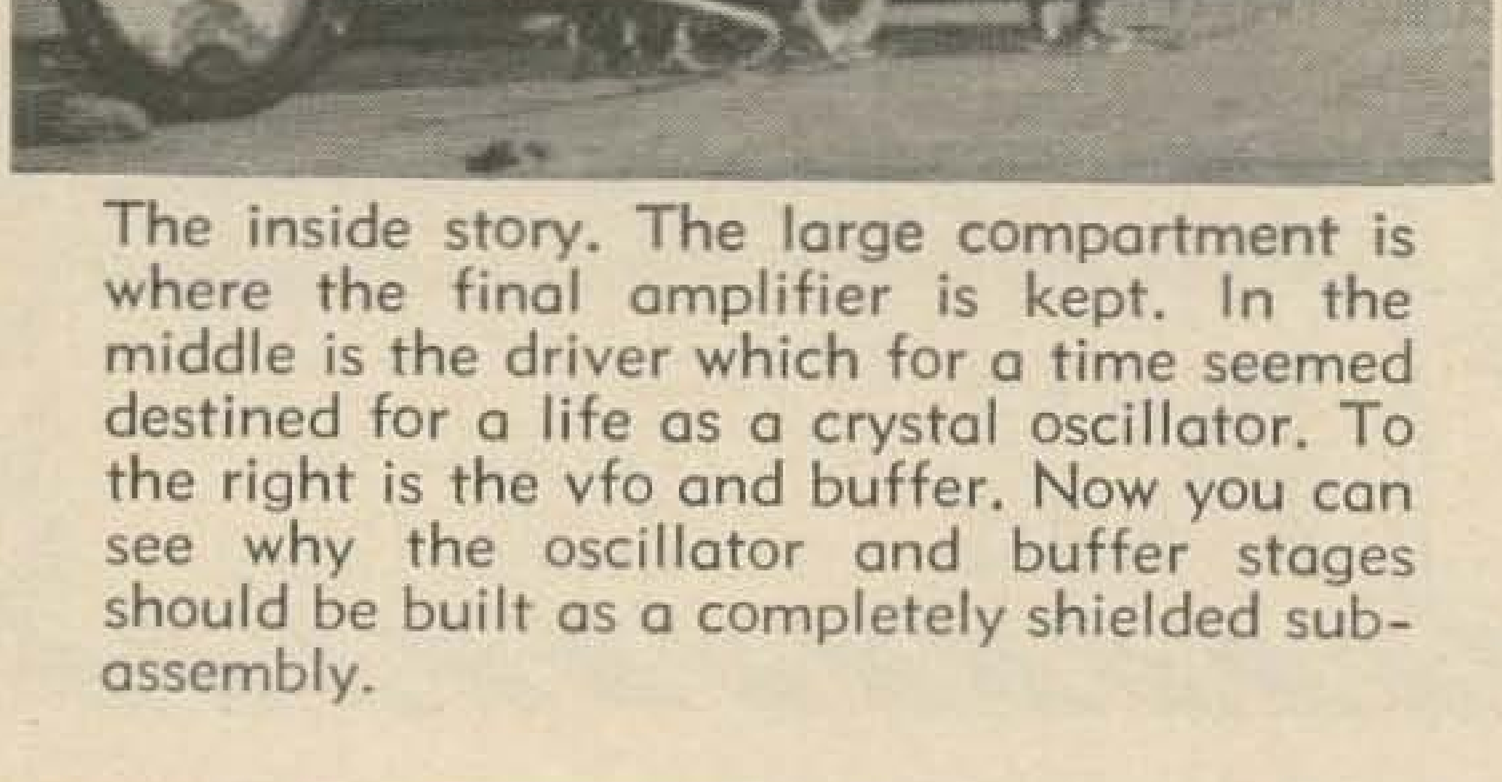
L5. is on a Miller 4400 form ⅜ d. 18 turns #26 tapped 5 turns from ground. Output coil is 2 turns.

In the final amplifier, considerable work was done to establish the number of transistors and class of operation for the power desired. During these tests, up to four transistors operated in class C were pushed to two and a half watts input. Under these conditions, neutralization is very desirable. Both reactive and resistive components of the transistors must be balanced out under full load and drive. As an added precaution, the final must not be operated under full drive and no load. Tank circuit considerations are very stringent in regards to loaded "Q" and leakage reactance. Since the main limitation of these transistors is the peak current rating of 200 ma each—a never evceed sort of a thing—not even for a microsecond, the three that I have left are operated substantially class "B."

The efficiency is somewhat lower with the peak current rating rather than transistor dissipation still being the limiting factor. Overall efficiency of the transmitter doesn't suffer much due to the smaller drive requirements. A reasonable input seems to be about 300 milliwatts per transistor. At this power level the collector current shows no tendency to creep during key down conditions. When several transistors are used in one stage there is a problem of getting the power divided evenly between transistors. The use of unbypassed emittor resistors of ten to fifteen ohms each did much to stabilize this stage and divide power evenly without careful selection of transistors. Collector current can be loaded to about 90 ma at 12 volts.

The low impedance made conventional tank provided one interesting effect not encoun- circuits almost unusable. The pi network provided one interesting effect not encountered before. Every strong signal from 3 Mc and lower was fed back into the collector circuit where they mixed with a radio range station signal from about 15 miles away. This mess radiated to the receiver and filled the dial with a strange mixture of voice, music, RTTY, code and other sounds that defy description. For this reason inductive coupling was used between the tank and antenna. In order to obtain a reasonable ratio of loaded to unloaded "Q" a practice resorted to in receiver coils was used. The collectors were coupled to a low "C" tank by means of a tap on the coil in order to provide a large step-up in voltage. This provides proper flywheel effect with components of reasonable size.

At this point it was discovered that an iron or ferrite core was a necessary part of the scheme. Contrary to the usual practice with slug tuned coils, the slug should be well into the windings on the cold end of the coil. The



The inside story. The large compartment is where the final amplifier is kept. In the middle is the driver which for a time seemed destined for a life as a crystal oscillator. To the right is the vfo and buffer. Now you can see why the oscillator and buffer stages should be built as a completely shielded subassembly.

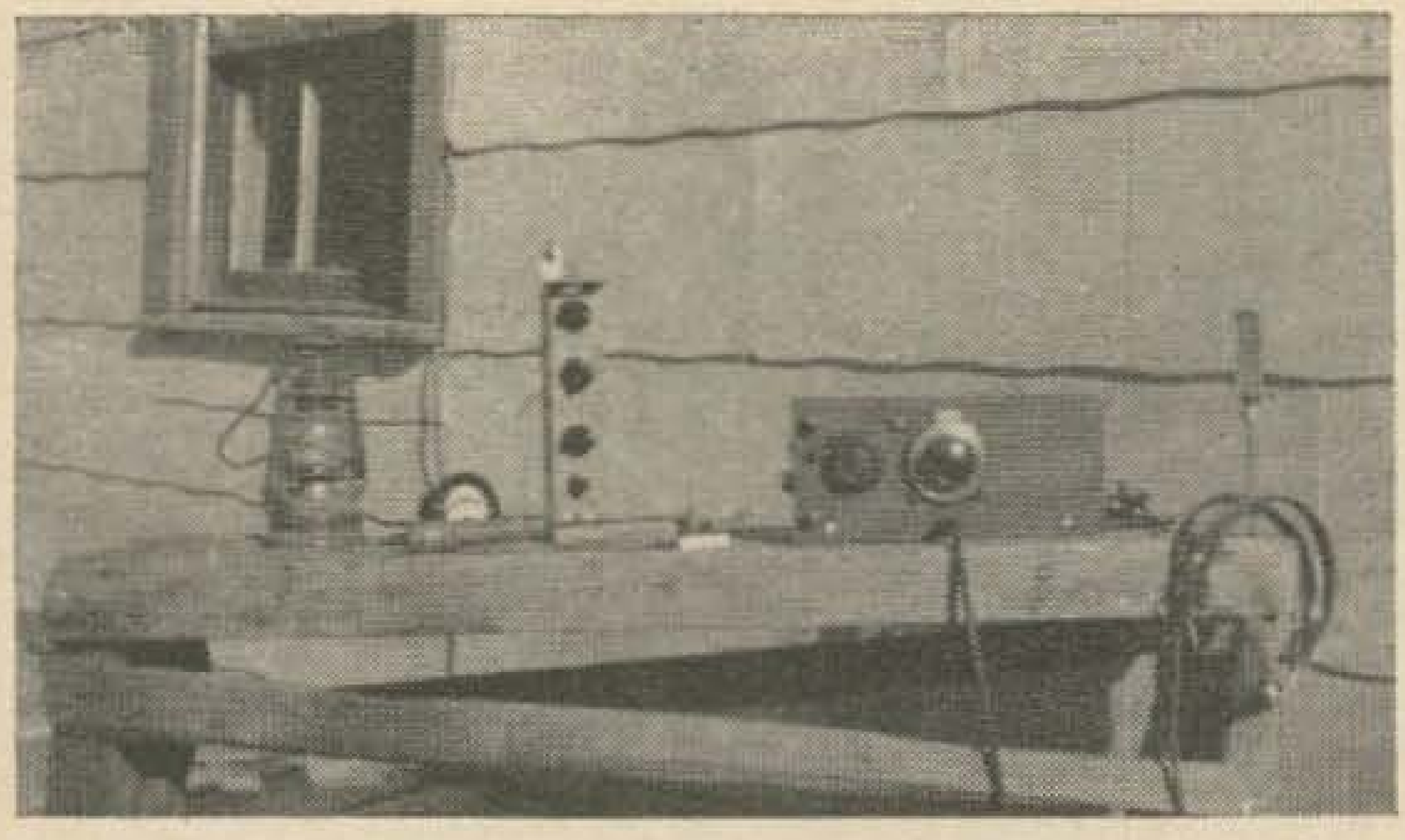
low impedance windings of the tank should be right over the bottom of the tuned winding centering over the slug. The slug is used as a means of increasing coupling and decreasing leakage reactance, not as an adjustment aid. The turns on the coils should be adjusted to obtain the required inductance with the slug in its correct position. With this method of construction the tuning is conventional in every way with the point of maximum output and minimum collector current occurring at very nearly the same spot on the dial. Since a three position band switch was used, a 40 meter coil was added as an afterthought. The bias on the final is too low for effective doubling so the efficiency is very low. The power input to the final is held within the dissipation rating of the final transistors by means of a bypassed dropping resistor in the lead to the collector tap on the 40 meter coil. About 80 milliwatts output was obtained. This will heat the filament of a two volt 60 ma bulb to a visable temperature on a dark day. When used by itself this puts the transmitter in the toy class again. This power will excite an amplifier of some size though. It has been used to drive a bank of six type 2N404 transistors to one watt input. As a test it drove a TV sweep tube, 6CD6G, to 75 watts.

After construction comes adjustment. For this use a six volt supply and in the preliminary checking always use the tuneup bulb in series with this supply. Temporarily short out the 4700 ohm oscillator dropping resistor. Set the drive control to deliver about four volts to the oscillator. Use a meter of about ten ma full scale to read buffer current. Use no voltage on the driver or final at this point. Find the signal and adjust the trimmer to be sure the oscillator will cover the range of 1750 to 2000 kc. Adjust the position of the two turn buffer coupling coil for about one ma of collector current. Now lower the voltage with the drive control and notice which way the frequency changes. If the frequency goes lower as the voltage decreases, the coupling trimmer is too small in capacity. Try again with a slightly higher capacity setting. If the adjustment is made at a frequency of about 1850 kc, the adjustment will probably hold over the entire frequency range. It should be possible to vary the voltage from two and a half volts to almost six volts and stay within zero beat with the receiver. As the signal starts to shift at low voltages, the drive to the buffer should be low enough to cause very low collector current. The adjustments of the coupling trimmer and buffer coupling coil interact to some extent so it will be necessary to go back over them a few times to get best stability and the differential keying effect simultaneously.

The compensation tends to be nearly perfect at two points on the dial. If the compensation is done near 2000 kc, the stability gets progressively worse as the frequency is lowered. When the compensation is done at one of the cross-over points, the compensation will be excellent over most of the dial. At the point of best compensation, the stability in regards to voltage changes is somewhat better than a crystal oscillator.

At this point the driver should be supplied with power through a meter. With increasing drive, the collector current should reach a maximum of seven or eight ma. With no voltage on the final, the loading will be very heavy, so the resonance dip may be very slight. At this point in the adjustment procedure, the final touch up of the two oscillator adjustments can be done. The differential keying should be very evident and maximum drive should not cause over about eight ma collector current regardless of frequency. Now apply voltage to the final. Still using the tune-up bulb, the off resonance current to the final should be about thirty ma on the 160 meter band, with twenty-five ma or so on the 80 meter band. At this point, the coupling coil on the driver tank can be adjusted for most drive on 80 meters. With the final tank output coils specified, the transmitter will load into a 170 foot antenna by using a series tuned circuit in the antenna lead for reactance cancelation and harmonic suppression. If a 50 ohm output is needed, some change in turns will be required.

By using a six volt supply and a 60 ma 2 volt bulb for a dummy antenna, the turns can be adjusted for heavy loading and full brilliance of the bulb. When the transmitter is used on 12 volts it will approximately match a 50 ohm load. With the adjustment procedure given here, the transmitter can be used with any supply voltage from 6 through 12 by shorting the 4700 ohm resistor for 6 through 9 volt operation. During operation of the transmitter, use just enough drive to secure peak output for the loading used. Excess drive tends to spoil the differential keying effect and causes unnecessary demands on the driver and final transistors. During procedures involving band changes and large frequency changes in a given band, the use of the tune up bulb in the supply lead will give some measure of protection. Due to the low thermal inertia of the small transistors, out of resonance operation should be avoided.



Here are some of the essentials of the station. From left to right; kerosene lamp, meter, transmitter, receiver and key. The device with the wood handle is not commonly available from the usual radio supply store. It was obtained on special order from the local hardware store. By asking the white-haired gentleman first, considerable explanation and some time can be saved.

Out of resonance current is probably in excess of 125 ma.

During normal operation the currents to the various stages are approximately as follows: Oscillator: one ma or less. Buffer: two ma or less. The driver current will be about six ma on 160 with nearly ten ma when doubling. The final can be loaded safely to 90 ma on 160 with about 60 to be expected on 80 meters. These values are for normal 12 volt operation. For six volts the oscillator current will still be near one ma with the other currents a bit less than half the 12 volt values.

During the breadboard stage of development, many different types of transistors were tried in all stages. For oscillator use, all the drift types tried seemed to perform about the same. The use of ordinary high frequency alloy junction transistors in applications such as this did not prove to be acceptable due to the changes in capacitance between collector and base during changes of voltage, current and temperature. With normal collector voltage this capacitance will be in the neighborhood of 10 to 30 pf. However, with very low voltage, this capacitance will be very much higher, perhaps as much as 100 pf. The drift type has very low capacitance to begin with, apparently 2 pf or less. In the drift transistor, the base to emittor capacitance is less than 300 pf as compared to nearly 2000 pf that some alloy junction types will have. With the smaller and perhaps more stable capacitances of the drift transistor, the capacitance effects can almost be ignored, leaving only the resistive effects to be reckoned with. In the buffer the same considerations apply to a lesser extent. Here either the drift or grown junction types were satisfactory. The alloy junction types used here caused some drift and loss of isolation from effects of later stages.

In the driver and final stages, the alloy junction types come into their own. With their rather large internal structure, the peak current capabilities exceed the drift and grown junction types by a factor of ten or twenty.

The low load impedances that can reach values under one hundred ohms make their large capacitances insignificant during normal operation. With no collector voltage the capacitances will be high enough to be misleading if a grid dip meter is used to check the coils. If such a method is to be used, the transistors should be disconnected temporarily.

Results with this transmitter were far better than might be expected from its modest power. During winter months it was common to hold hour long rag chews with stations several states away with only an occasional repeat needed. During the summer months, just after dark, operation was generally successful, but later in the evening towards midnight, the static caused trouble about half the time. Just before dawn, when static levels drop sharply, contacts at a distance of 1500 miles were not unusual. Best DX on 160 meters was a KH6, while on 80 a KL7 was agitated until he finally got my call letters straight. On 40 meters the results 'barefoot' were generally poor, due to the very limited power output. One contact at a distance of 800 miles was solid for an hour. Several reports were received at greater distances, but a solid contact was a rarity.

Two types of antennas were used with this transmitter. The old faithful half wave worked out to about a hundred miles with a good signal. The most interesting antenna was an inverted L marconi with a hundred foot flat top and a sixty foot down lead. This is the antenna that did the best by far. At 500 miles it was about four S units louder and much less plagued by deep fades. In the late afternoon this antenna was usable a full hour before the half wave and stayed in for almost two hours later in the morning. During daylight hours this antenna was usable for over 60 miles while the half wave was of no use whatever. The inverted L uses a three wire counterpoise with each wire about a hundred feet long. Several different arrangements of the counterpoise were tested with no big difference as long as they were under the flat top. Comparison of the counterpoise with a ground rod driven six feet into the ground could not be made, because with just the ground, no one answered my calls.

. . . W6WFH

Richard Factor WA2IKL
115 Central Park West
New York 23, New York

Standard Frequencies

Most hams are familiar with the process of deriving 10kc marker signals from their 100kc standard by means of locking a multivibrator on 10kc using the 100kc signal for synchronization. From time to time, other standard frequencies are required in the shack, either for the alignment of filters or for calibration points on test oscillators. This same principal can be used to obtain even divisions of 10kc (10kc, 5kc, 3.3kc, 2.5kc, etc.). Instead of building another multivibrator to accomplish this, simply connect the output of the 10kc multivibrator to the vertical plates of your oscilloscope, adjust the sweep oscillator until the number of complete cycles on the screen corresponds to the number of times you want to divide the original signal, turn up the sync until the pattern locks, and your sweep oscillator is oscillating on a very accurate submultiple of 10kc. A binding post on the front panel of your scope should take care of your output requirements. If you are a member of a two-scope-family, you can get literally hundreds of calibration points throughout the audio range. If you have good scopes, you can use the sweeps to divide your 100kc and even 1 mc standards.

Because of the (hopefully) high harmonic content of both the multivibrator and sweep oscillator, it might be advantageous to include a simple filter in the output. It need be nothing more than a resistor in series with the output and a capacitor with fairly high reactance at the operating frequency but low reactance at its higher harmonics connected to ground after the resistor. This will be unnecessary in most cases.

Other audio frequencies available around the shack are 60 cycles from the ac line, 120 cycles from the output of any full wave supply, 440 and 600 cycles from WWV, 1000 cycles from the telephone company (dial local exchange and 9945), and if you have a good tape recorder, you can double or half any of the above without resort to the scope.

. . . WA2IKL

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Build— or Buy?

I suppose that as long as we have hams, this will be a controversial subject; it has been for as long as I can remember. Pioneer hams back in the dear, dark ages did more building than buying. In most cases they had to . . . available factory-built equipment was spread pretty thin. Sure, you could purchase a spark coil, a slide tuner and later even a loose-coupler . . . telegraph keys were relatively plentiful but aside from a few items like this, the choice was either to build it yourself or give up the hobby.

Now? There is such a myriad of transmitters, receivers, antennas and various accessory equipment offered on the open market that it leaves one completely bewildered! Ninety per cent or more of these offerings are darned good pieces of merchandise; like anything else, the greater the strain that your wallet will bear, the more elaboate gear you can come up with. But . . . where's the fun? Creativity is a most important asset to the American way of life. The great sense of satisfaction in building a boat . . . restoring an ancient automobile . . . using your skill to design and construct a new set of bookshelves for your living room or den all provide a thrill

An example of home constructoin on a kitchen table. This item is shown ninety percent complete needing only soldering the loose wires shown to their final terminals.

that you'll never get from simply plugging in a few wires and cables, tossing a random length of wire over a conveniently located tree limb and calling yourself a ham. You're *not*; really!

Juvenile, youthful and adult Americans, both male and female, welcome a challenge to their skills, initiative and ingenuity. Ham radio construction from scratch is a perfect provider. To design a circuit or perhaps use someone else's published design either with or without modifications to suit your taste, puts you right on your own, construction-wise. And, while you are improving your craftsmanship through the actual physical building of a piece of ham gear, you are also increasing your knowledge of basic circuitry, radio theory and construction techniques. There is no thrill to equal that of having actually built a piece of equipment which goes right to work when you put it on the air. Maybe a few bugs to work out first, but each one of these teaches you something which will prove of increasing value to you throughout your entire ham career.

Frequently the question is asked, particularly by the young "Eager Beaver" group, anxious to get on the air at the first possible moment, "Why do I have to drill all those holes, cut and bend sheet metal and all that slow and tiresome work when I can buy a kit with all of the hard work done?". It's a fair question and can be fairly answered. The apartment dweller, for example, with no shop facilities available, is probably confined to a few evenings and week-ends when he is, perhaps, privileged to use the kitchen table for a work bench (if he cleans up afterward!). By reason of noise-conscious neighbors on the opposite sides of the "cardboard walls", a hammer, electric drill and similar noise-makers are taboo. For such aspiring hams, the factory offered kits are a boom. Placing screws in pre-drilled holes, tightening nuts with a socket wrench and soldering wires to terminal points are all silent operations; no neighborhood complaints. And the time element in kit assembly is ordinarily much less than in building from scratch.

Maybe you're a busy executive who, of necessity, brings home a briefcase full of papers to work on in the evening. Little time for physical construction activity, yet you want to pursue ham radio as a hobby and relaxation. Either a kit or, at some increase in cost, a complete factory-wired set of equipment, will give you many pleasure filled hours on the air. You are, nevertheless, sacrificing the indescribable joy of creation. Should you be fortunate enough to occupy a home with perhaps a basement, or a shop at one end of your garage, the opportunity to enjoy the full measure of ham radio construction and operation can be yours. A modest collection of simple tools, embracing a hand or electric drill, a bench vise, light hammer, diagonal and long nose pliers and a few screwdrivers together with a soldering gun or iron will just about cover the essentials for the less elaborate items of ham construction. Expand your shop facilities and add to your tool collection from time to time as you can. Many labor saving devices such as socket punches, a "nibbling" tool, an electric rather than a hand drill, are all readily available and at moderate cost. The catalogs of all of the major electronic mail-order supply houses list many tools as well as electronic parts . . . your choice is wide.

Your local supply house, if you happen to live in an area which supports such, also carries most of these items in stock for over-the-counter delivery.

Ham radio construction isn't hard. You're not a plumber crawling on the damp ground under buildings and fitting heavy pipe. You are not an electrician groping through dark and musty attics, drilling holes and dragging wires. You can ordinarily work in warm, pleasant and comfortable surroundings and do most of your electronic work from an ordinary chair or a kitchen stool. A large part of the work represented in the accompanying photographs was accomplished in just that way. The tremendous sense of satisfaction and accomplishment to the builder after satisfactory completion of such projects, was a many-fold return. Next time you want a piece of electronic gear, try *building* it . . . it's really fun!

. . . W7OF

VHF

Project OSCAR

The reduction of OSCAR III flight data is now underway. Temperature data during the first thousand orbits is especially desired. With the satellite now well into its second thousand orbits, the 145.850 mc beacon continues to operate intermittently. Project OSCAR believes the operation of the beacon will become more consistent when the earth shades the satellite from the sun and the internal temperature drops. (OSCAR has been traveling in full sunlight.)

Reliable reports indicate the 145.950 mc beacon IS operating, but some 20 db down in signal strength from the expected level. Reports on this beacon are solicited.

OSCAR IV??? It is hoped the data and information received from the OSCAR III flight will assist in the launch of an improved 2 meter OSCAR IV repeater satellite during the latter months of this year.

If you have not already done so, please send your report on OSCAR III to: Project OSCAR, Foothill College, Los Altos Hills, California.

Project OSCAR appreciates the reports received and if you have not received a reply to a specific question regarding the program, it is because they do not have the staff to handle all the mail and are busy processing data.

West Coast Antenna Contest

W6AJF's 432 megacycle expanded-extended colinear has again won the annual west coast antenna measuring contest.

Loren Parks tells me this year's contest turned up two commercial 432 yagis that showed an actual LOSS in "gain" over a reference dipole.

This yearly contest is becoming more and more popular and is surely disproving gain claims made by some manufacturers on their 432 mc antennas.

Loren will have the full results of the contest in "VHF'er Magazine" which he publishes. If you haven't seen a copy of the "VHF'er", drop Loren a card at VHF'er Magazine; Route 2; Box 35; Beaverton, Oregon. Subscriptions are $2 per year and worth more.

Circular Polarization

A couple of months ago I said I was running some tests on circular polarized yagis and that the results would soon appear in this column.

Well, I've learned not to plan too far ahead. The Gain "Moonbouncer" is in operation and living up to the claims made for it. There have been no meteor showers at the time of this writing to test it on and I want to before going any farther.

Some of the experts say there is a 3 db loss between circular and linear polarization. I have not noticed this and doubt that I will. If there is such a loss I do not believe the average "S" meter or ear will detect it.

On tropo and groundwave paths and "Moonbouncer" is delivering the "goods" with a suggestion of QSB reduction with the circular polarization.

Coax Losses

Joe Burnett, K2SBV/7, has sent me a list of 81 different coaxial cables and their characteristics. Some of these cables are uncommon and information on them is difficult to obtain. If you want a copy, send me a stamped, self-addressed envelope and I'll get one to you.

SK

This past month has brought a large increase in the mail regarding this column. A healthy sign the column is starting to take hold. My thanks to those who have written the compliments, suggestions and criticisms. The criticisms have been well taken and I appreciate having the mistakes pointed out. Keep the letters, etc. coming and the column will continue to grow.

. . . KØCER

Letters

Dear Wayne:

Please print a thoroughgoing resumé of the ARRL Convention at San Jose, including a lucid, simple explanation why it was held in San Jose in the first place; after all, San Francisco has topless waitresses and San Jose has nothin'! What I really would like is to know what happened, because I tried to make it, honest-to-gosh I did—even bought a ticket, but couldn't hack it.

This is what happened:

I received a flyer explaining the conveniton was to be held in San Jose this year, that there would be a helluva program, and furthermore I could Advance Register for the trifling sum of $9.50 US. This didn't seem like too hard a bite, so I sent the $9.50 along—my XYL likes to go to the more interesting soirees with me, such as Union Socials, Teachers Meetings and the like, but when I asked if she would like to take this one in she just gave me a pitying look. I wondered why at the time, but since have come to the conclusion that she must have been born with a caul.

Inasmuch as the convention was slated for the Fourth-of-July weekend, I knocked the crew off for Sunday and Monday, and after work Saturday fought the traffic down to San Jose.

Not only did I have bright hopes of the good-fellowship and companionship of a bunch of dedicated hams, but there was the added impetus that *CQ Magazine* might have a booth there, which would give me the opportunity to inquire, in a loud and demanding tone of voice, why the hell I haven't been paid for an article of mine they published some three or four years back.

Anyhoo, I gets down to San Jose and tracks the convention to the Municipal Auditorium. At least I think I did, because at about 5 PM I couldn't find anything of the registration committee except a sign telling where the line formed for registration. Not a bloody soul in sight, s'help me!

I corralled a couple people who were wearing badges, though, and asked them how I would go about getting registered and getting my blue badge too, and also if *CQ Magazine* had an exhibit.

The first party I asked told me that I would have to go around to the other side of the Municipal Auditorium and come through the parking lot and then I could register, and the second ham-type in all seriousness (*could* he have been putting me on?) told me *CQ Magazine* was running the show.

I strongly suspected the latter piece of information at first sight, and I began to question the validity of my directions for registering when I hiked around the building and found that the untrusting souls had locked the doors on the other side, too.

Some good heart then informed me very kindly that I should go over to the hotel kitty-corner across the way, because that was where the action is.

I have seen more action at the Pioneers Home in Sitka, Alaska on a week-day evening after supper.

I wandered around holding my nine-and-a-half postcard and asking all the sundry what to do to get registered, including various people wearing ribbons indicating they were officially connected with the clambake. Nobody knew nothin'.

One ham from Sacramento, though, did agree that it was generally run at about the same level as a Field Day, and regaled me with a sad tale of the ham who poured the five-gallon can of lube oil in the gas tank of the putt-putt. . . .

Up on the second floor was a ladies hospitality room where a tired broad could get the weight off her corns and have a cuppa coffee, but inasmuch as I was disqualified by the possession of the wrong kind of plumbing, I was not allowed even this kindness.

Another ham did let me look through his program—keeping a firm, tight grip on it all the time—and there were several features that looked promising.

After about an hour's waste of time I was fortunate in meeting a YL from KL7 who told me how to reach a dinner meeting that was about to start. This looked like a fine deal but somehow it didn't look so good when I found that it was necessary to register well in advance or no grub.

All was not lost. I had the good fortune to be able to say "Hi" to two very fine KL7's, Jack and Marge Reich, KL7AUF and KL7BLL.

Since I didn't have the ghost of a chance of getting anything to eat at this particular spread and remembering that San Francisco is famous for its good restaurants, and San Jose is famous for being the home of the Roscrucians (sic), I did the obvious thing and hied myself up 101.

But first, or rather, last, I politely handed my nine-dollar card to a young man with a "Host Committee" ribbon.

He looked at it blankly and asked, "What do I do with this?"

"Now you got me, Brother," I replied. "I haven't found anything to do with it either, and any suggestions I would make would probably lead to fisticuffs."

When I got to San Francisco I called the crew while the scallopini was working and told them the boss had recovered from his temporary aberation and that all hands would come to work mañana por la mañana.

The XYL is still giving me the "I-knew-better-but-I-didn't-want-to-say-anything" look, and I think she is right.

Funny, but she had a heck of a fine time at the Photographic Society of America Convention.

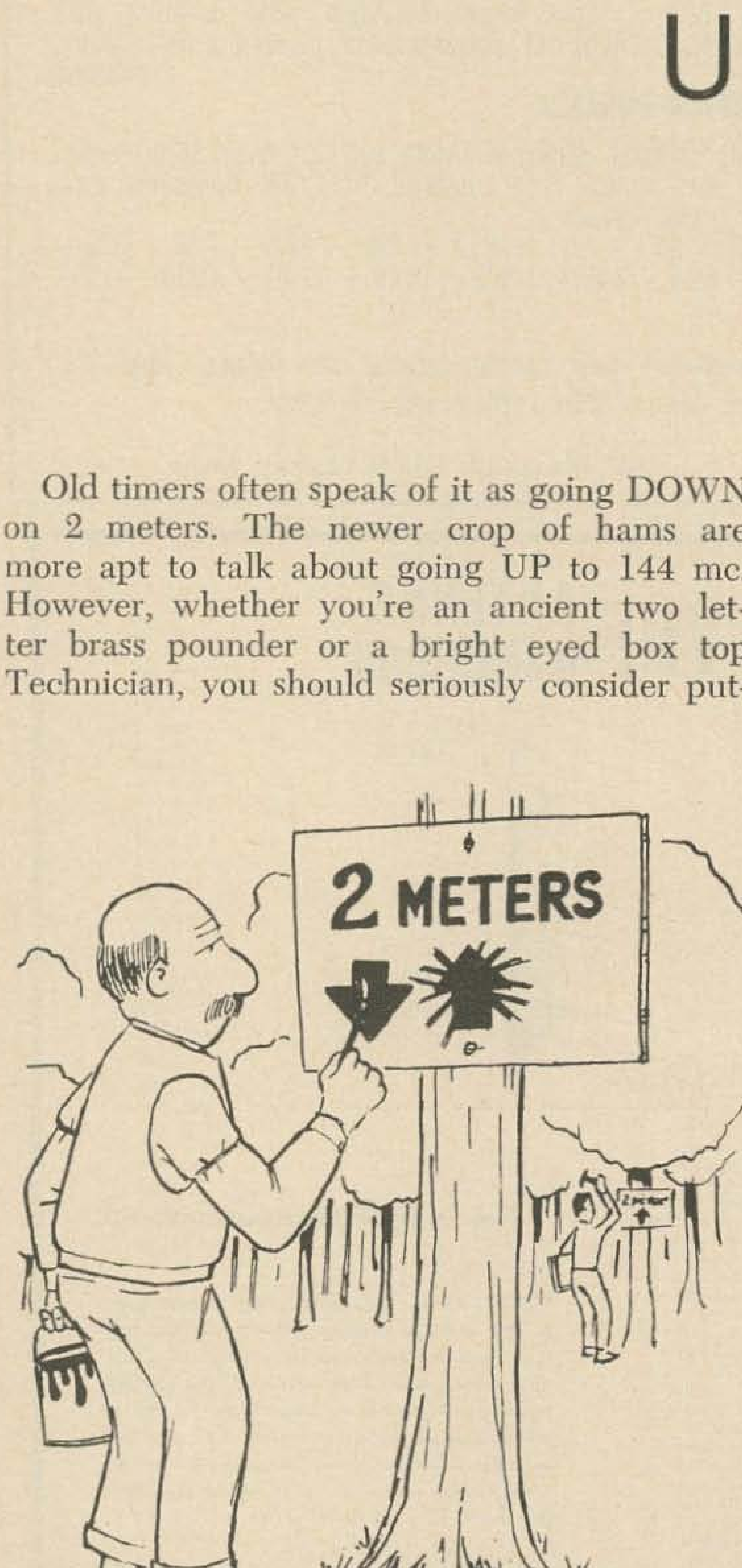
But of course it was held in a town chock-fulla good restaurants (San Francisco. where else?) and was not operated like a cross between a PTA meeting and a Box Social.

Terry Murray, WB6AKO, ex KH6DXG, etc.

Hartland Smith W8VVD
467 Park Avenue
Birmingham, Michigan

Let's Go—Up or Down

Old timers often speak of it as going DOWN on 2 meters. The newer crop of hams are more apt to talk about going UP to 144 mc. However, whether you're an ancient two letter brass pounder or a bright eyed box top Technician, you should seriously consider putting some sort of rig on the 2 meter band.



Until a short while ago, my high frequency experience consisted merely of a short stint on 2½ meters with a long lines oscillator and a superregen receiver back in 1945, plus a few 420 mc QSO's provided by a surplus BC-645. Then, last winter, Oscar took off. K8EGD loaned me his 144 mc converter just long enough to give me a chance to tape record the pioneer ham satellite on a couple of its early passes. While waiting for Oscar's high speed "HI's" to come squeaking through the speaker, I did a bit of tuning from 144 to 148 mc and was pleasantly surprised to discover how many stations were making use of this band. I decided then and there to get my feet wet on 2 meters.

In the belief that habitués of the dc bands may be interested to learn what's really transpiring in "never-never-land", I'm setting forth a few of my experiences in the paragraphs which follow.

Being a dyed-in-the-wool home constructor, I hurriedly put together a Nuvistor converter, one consisting of a pair of 6CW4's in cascode and a 6CW4 mixer. Crystal oscillation and multiplication is accomplished with a 6U8A. The output of this gadget is then fed into the special 30-35 mc tunable *if* range of my NC-300.

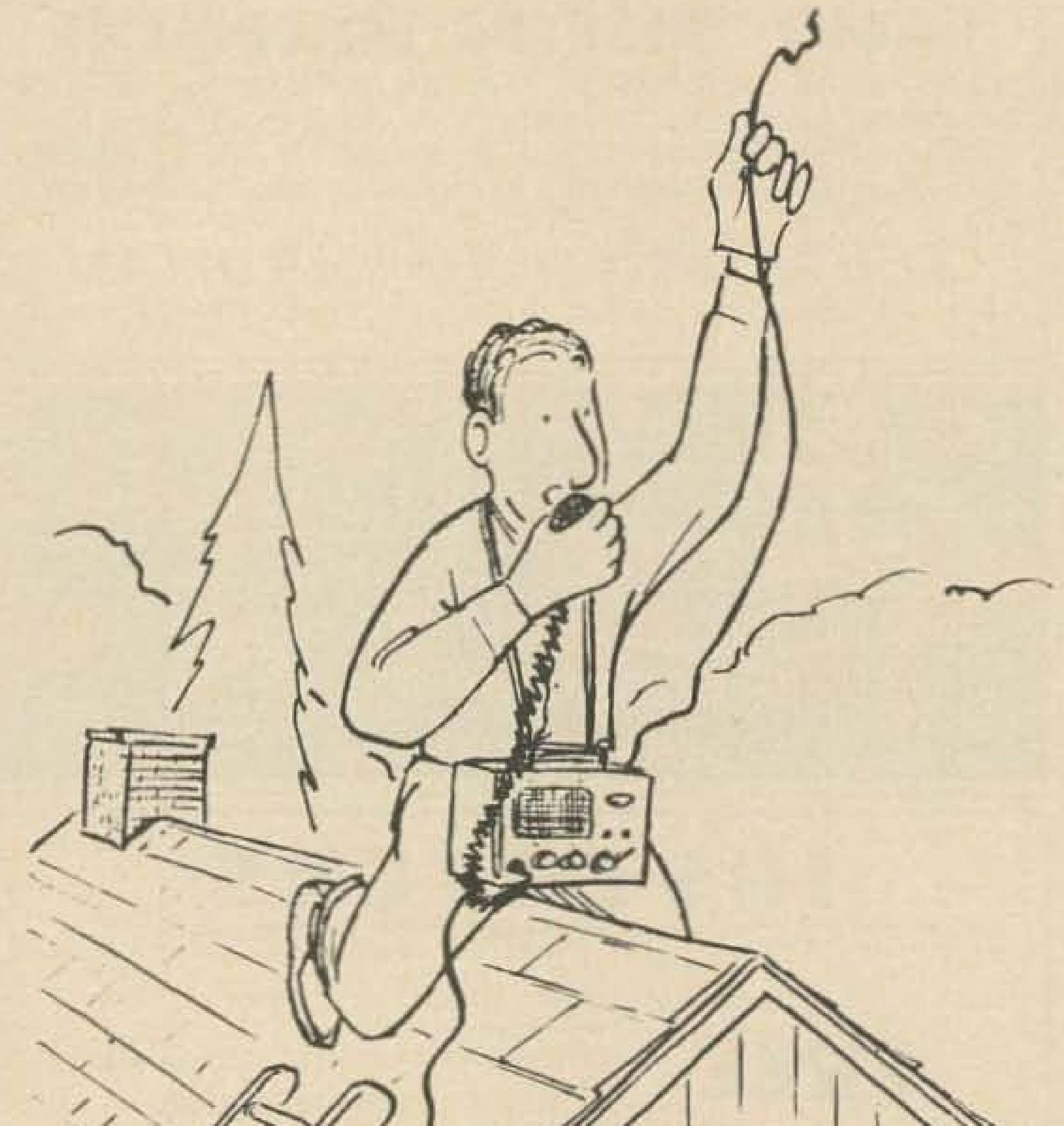
For a transmitter I threw together a 20 watt :E26 rig. And when I say "threw together" mean it quite literally. Parts were scrounged rom the deepest corners of the junk box in n effort to keep the cost at a bare mininum. The result may not be a work of art, the fficiency may only be 20 or 25%, but by golly 'm having loads of fun working the local boys, s well as stations in Ohio, New York and Canada, on the 2 meter band.

Most hams seem to hold the widespread nisconception that kilowatt transmitters, hunlred foot towers and 64 element arrays are equired to produce 144 mc QSO's beyond he horizon. Nothing could be further from he truth. As a matter of fact, almost no power t all is required for consistently good QSO's ut to 30 miles or so. Take the Heath Twoer, or example. The transmitter section of this omplete 2 meter station struggles valiantly to ut out enough rf to light a single pilot bulb. And yet, there is a fellow whose QTH is at east 15 miles from mine who consistently puts n a 10 over 9 signal with his Twoer driving small beam. I recently contacted a VE3 at nore than 20 miles who was using an indoor ntenna hooked to his Twoer. His signal vas around S-7. He told me that when the and was open, he easily worked New York tate, a distance of more than two hundred niles!

What kind of antennas to the boys have? Well, almost everyone utilizes a factory built adiator of some sort. Five to ten element Yagis predominate. Consequently, when I first got on the air and employed a folded dipole ed with ordinary TV twinlead, I felt somevhat out of step. The dipole was perched top my 10-15-20 meter beam at a height of bout 42 feet and could be rotated for optinum directivity. Even this simple antenna lid quite well for me. With it, I had no lifficulty working into Goderich, Ontario, well over a hundred miles away. Right now I have home-brew eight element Yagi with a half nch aluminum boom and hard drawn aluminum clothesline wire for elements. Its weight s practically nil and it causes almost no added train on my low band beam installation.

While it is true that every foot of antenna height means that much better ground wave coverage on the VHF bands, you'd be surprised at the results achieved with chimney nounted beams. 30 to 50 mile contacts are commonplace. And when the band is open, he height above terra efirma seems relatively nimportant.

Take my QTH, for instance. I'm situated on he north side of a small hill. Unfortunately,



most 2 meters activity is to the south. Consequently, even though my beam is 42 feet above the back yard, I am forced to shoot through, rather than over, the houses and buildings which tower above my radiator. Despite this handicap I manage to snag plenty of fellows with S-9 plus signals at or beyond the 30 mile mark. When the band is open for extended ground wave or skip I'm able to work most of the distant stations I can hear.

What about receivers? Well, the majority of fellows tack a commercially built converter ahead of their low frequency ham-band sets. Now that Nuvistors are commonplace and inexpensive it is no longer necessary to spend hours and hours building and adjusting an exotic and costly converter in order to hear weak 2 meter signals. A few of the real pros are still struggling for that last db with a 417A, but most of the general run of 2 meter boys are content to sit back and let the tiny 6CW4 do the work of dragging 'em in.

Except when utilizing the receiving portion of a Twoer, very few 144 mc men still rely on the "broad as a barn door" super-regen circuit. Twoer operators, by the way, are the only ones who ever seem to complain about QRM. 2 meters is so tremendously large (it has more space than all ham bands from 160 through 10 meters, combined) that just about any type of superhet will give more than adequate selectivity. During my nine months on the band only a very few QSO's have been even mildly QRM'ed!

This lack of interference can hardly b blamed on inactivity. True, the band is usuall deader'n a smelt during the daylight hour on weekdays, except at lunch time and whe the commuters are mobiling. However, b 2300 GMT, at least here in the Detroit area a person is almost certain to get a contact i he's willing to try one, or possibly two, CQ's As a matter of fact, it is much easier to ob tain an evening QSO on 2 than it is on 10 me ters.

Are you a fugitive from those miserabl low band roundtables where you never get chance to talk, and it really doesn't matte anyway, because you have little in commo with the rest of the people in the group? I that's the case, 2 meters is definitely the ban for you. Thanks to the relative scarcity of meter vfo's, once you hook a particular sta tion, there is little chance that you'll b bothered by breakers. At least, not unles you invite them in and then tune around th band looking for them.

How would you like a wireless inter-con to keep in touch with ham friends or mem bers of your local club? Many groups ar picking up surplus 150 mc commercial mobil FN rigs for conversion to 146.94 mc, th unofficial national calling frequency. Thank to a built-in squelch, these units remain silen as a mouse until some member of the gan gives out with a blast. Then, before you know it, the frequency comes alive, thanks to th numerous eavesdroppers on this ethereal par ty line. FM rigs have also proved useful to those who enjoy AFSK RTTY.

And there's even a place for TV on 2 me ters—at least the audio portion of TV QSO's Listening in on a TV QSO's a rather weird experience, since you can't see what the boys are talking about.

Any mention of TV immediately brings to a ham's mind the business of TVI. Thank goodness, up to now, I've had no reports of in terference from my 2 meter rig. In spite o its unshielded construction, my junk box trans mitter causes absolutely no trouble with th family TV set. This is in a strong signal area with channels 2, 4, 7 and 9. The rig start out at 24 mc with an overtone crystal. The oscillator's 2nd harmonic falls below channe 2 and its 3rd harmonic comes out above chan nel 4. The low input power probably helps also. Nevertheless, from what other 2 mete ops tell me, TVI on this band is much less than one encounters on the dc bands and is truly miniscule compared to 6 meters.

Tired of listening to the quack-quack of low frequency sidewinders? Then hop down

2 meters where you'll encounter practically
) Donald Duck talk at all. A few pioneers ive tried the stuff out and say that it's terfic for long hauls. Successful daily skeds at stances of 150 to 200 miles are relatively isy with a couple of hundred watts PEP id decent beams at both ends of the line. Un. very recently, the lack of suitable comercial gear has held back the development any significant amount of 2 meter SSB tivity. There's little doubt that it will be a ng time before carrierless QSO's are the rule 1 2.

Believe it or not, there is a surprising nount of CW activity on this interesting ind. The real DX'er's, of course, resort to W for long distance work whenever skip is poor that voice signals just can't penetrate 'en the quietest receiver front end. Moduted CW is also popular, especially among echnicians boning up for their General class ams.

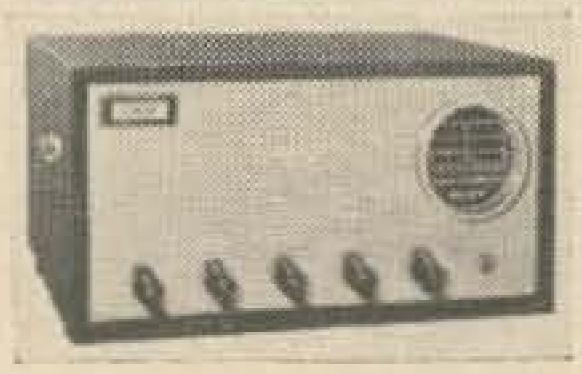
Have you heard that 2 meters is red hot iring the summer months and then dies for e rest of the year? Well, it just ain't so! ome of the best band openings I've ever enuntered took place in mid-winter. While the eater when the weather is warm, lots of X comes pouring through the speaker when ie thermometer is well below the freezing ark.

How about giving 2 a try? Drop down and in with the rest of us who are having so uch fun. If you live within 30 miles of a ig city, you'll be able to get an evening QSO ist about any time you want to shout a CQ, ven with the most inexpensive gear. By inxpensive, I mean something that costs no iore than $50 and includes a transmitter, reeiver and sky hook. 50 miles from a metroplis, you'll want at least a Communicator, oly-Comm or a Pawnee with a 10 element agi up about 50 feet. A hundred miles away, ou'll be wise to feed a stacked antenna with Seneca or Zeus if you want consistently good round wave performance. Beyond a hunred miles, results will be spotty unless you go 1 for high power and the best possible anenna mounted 70 or more feet above ground. ven this far away, though, if you're a paent fellow willing to wait for a band openig, modest equipment will, at times, furnish iany fine QSO's.

Once a venerable ham wilderness, the 144 1c band is now well populated. You're missig an exciting facet of the hobby if you fail) make use of this interesting VHF band.

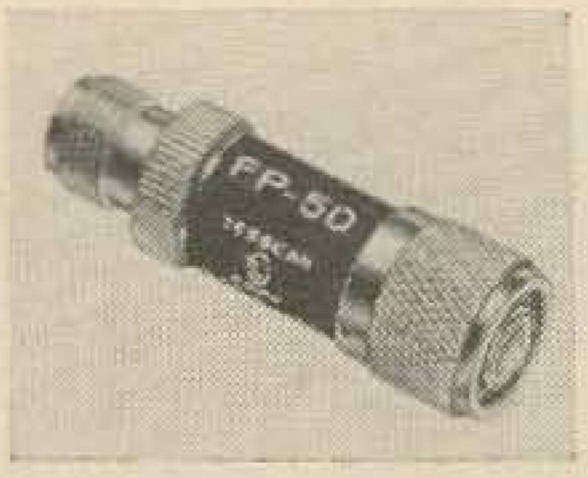
. . . W8VVD

New Products



Singer Panadapter

Singer is a well-known manufacturer of laboratory equipment, such as spectrum analyzers. They've recently announced their PR-1 Panadapter for amateur use. Everyone knows the convenience of a panadapter by now, so we won't go into that much. But anyone who's ever used one says they can't get along without a panadapter. The PR-1 has a number of interesting features and costs only $144.50 FOB the factory or from your distributor. Write for more information from the Singer Company, Metrics Division, 915 Pembroke Street, Bridgeport, Conn.

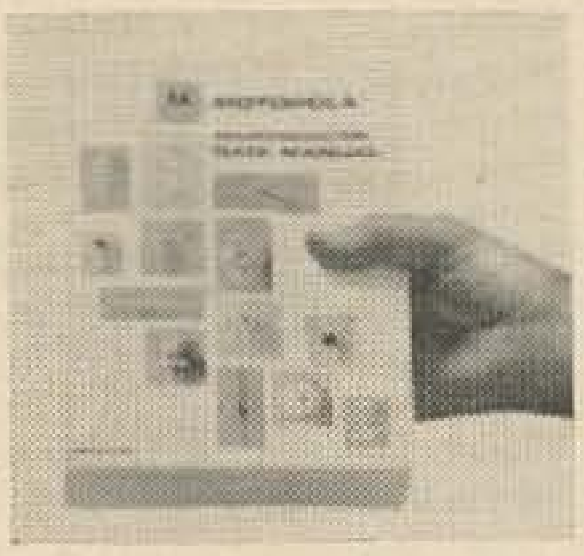


Texscan Attenuators and RF Detector

Hams doing serious experimenting need good instruments. Up until recently, they had to make their own, buy them surplus, or steal them. Now a new company, Texscan, is making coaxial attenuators and RF detectors for precision work at reasonable prices. Pads are available from one to 20 db at 50 ohms. They have excellent VSWR up through the 23 cm band. The RF detector, has excellent frequency response. Together, the pads and detectors are ideal for noise figure and antenna measurements, etc. Write for more information from Dept. 73, Texscan Corp., 51 Koweba Lane, Indianapolis, Ind.

LogDex

Tired of keeping your log in a hard-to-use old book? W6TKA has brought out an inexpensive logging system using 4 x 6 inch index cards. It can easily be filed by date or by geographical location. A number of accessories are also available. For a free sample LogDex card and price information, write to LogDex, P.O. Box 4051S, Milpas Station, Santa Barbara, Cal. 93103.

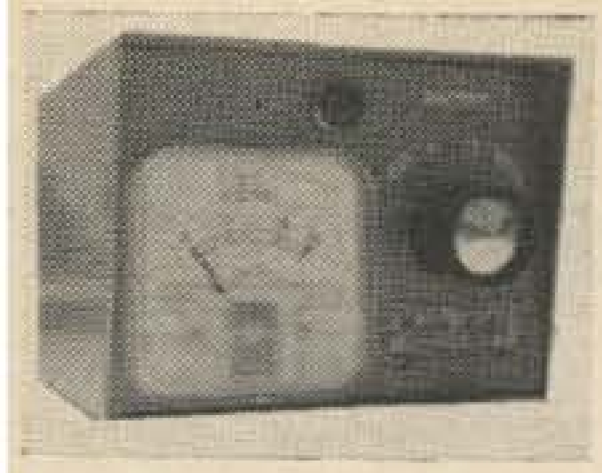


Motorola Semiconductor Manual

Hams keep asking where they can get more information about transistors. Motorola, with one of the largest lines of useful semiconductors, has just published a book that will tell them. It's a huge 908 page bound volume with complete specs on more than 2600 transistors, application guides, general semiconductor information, etc. It's a tremendous bargain at $3.50 from the Technical Information Center, Motorola Semiconductors, Box 955, Phoenix, Arizona 85001.

Sprague Suppressikits

The new car alternator electrical systems have eliminated a number of headaches of mobile operation, but have introduced a few new problems. Sprague has brought out new Suppressikits to eliminate RFI in alternator equipped vehicles. They are very easy to install and provide effective protection through 400 mc. Get more information from your local distributor.



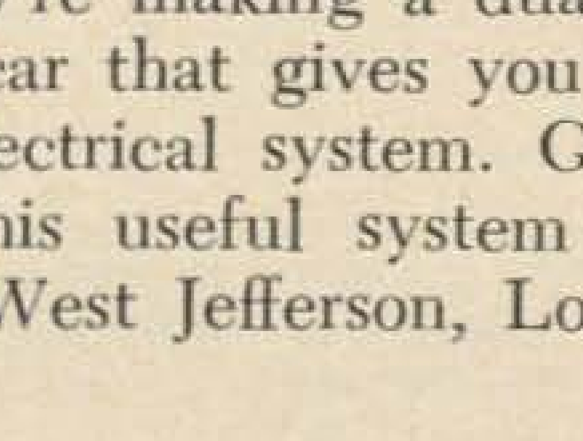
Two Battery System

Ever suffered the embarrassment of a dead ›attery in your car from too much mobile op- rating? Master Mobile can help prevent it ›appening again. They're making a dual bat- ery system for your car that gives you com- ›lete control of its electrical system. Get all he information on this useful system from ⁄Iaster Mobile, 4125 West Jefferson, Los An- eles, Cal.

Free IRC Electronics Dictionary

The International Resistance Company has evised their very popular glossary of elec- ronics and is now offering it free to interested ›eople. It contains over 800 terms in its 28 ›ages. Many illustrations are included to help larify definitions. The *IRC Expanded Glossary f Electronics Terminology* is available from)ept. ST, International Resistance Company, 01 North Broad Street, Philadelphia 19108.

IDC 10 meter Converter



Instrument Devices is making a little tran- istorized converter for use with your car adio. It's called the SS-Ten and features easy, o-soldering installation. It draws less than 20 nilliwatts from the internal nine volt battery. ize is 5 x 2¼ x 2¼ inches and it weighs only ix ounces. Send your order with $22.95 to In- trument Devices, P.O. Box 284, Huntington, N.Y. Tell them you saw the notice in Playboy nd shake them up.

Noise Cancelling Mike

The new Roanwell lightweight, carbon, oise-canceling mobile microphone (Model RM-515) is described in an eight page, 2- olor, illustrated brochure now available. It ncludes an explanation of the principles used o cancel random ambient noise which re- ults in increased intelligibility. Write Roadn- vell Corporation, Roanwell Building, 180 Va- ick Street, New York, N. Y. 10014.

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

TOOOOOBES, TRANSMITTING-SPECIAL PURPOSE, New, Boxed, Guaranteed. . . . 6CW4—$140, 6146B—$4.75, 417A—$3.95, 826—$6.90. . . . Free Catalog. . . . Vanbar Dist. Box 444, Stirling, N. J. 07980.

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

COLLINS 75-A-4 OWNERS: Don't trade up! Investigate our conversion that makes the 75-A-4 a real dream. W2VCZ—30 Pitcairn Ave., Ho-Ho-Kus, N. J. 201-652-8494.

BIGGEST, Nope. BEST? Heck yes! Warren ARA Hamfest, Aug. 29. Newton Falls. Arrows from Rt. 534, Turnpike Warren Exit 14, Details: WARA Hamfest, Box 809, Warren, Ohio.

PEORIA HAMFEST September 19, Exposition Gardens, Peoria Area Amateur Radio Club, advance registration $1.00 until Sept. 11. Ferrel Lytle, W9DHE, 419 Stonegate Rd., Peoria, Illinois.

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

VW MOBILE 1963 sunroof sedan, green with radio, shoulder harness, 43,000 miles, HW-12, Hustler, transistor power supply. All excellent condition. D. Crosby K2VVN, 147 Charter Circle, Ossining, N.Y.

PROTECT LOW NOISE RECEIVERS—Solid state and tube front ends can be damaged or destroyed by transmitter leakage. Prevent this with broadband receiver protectors. Two models: RP-1 for 80 through 6 meters, and RP-2 for 6 through ¾ meters. Details in brochures RP-1 and RP-2. Radiation Devices Company, P.O. Box 8450, Baltimore, Md. 21234.

HRO-50T with 5 coils and SSB crystal oscillator plug-in adapter, Heath HX10 exciter-transmitter, Heath HA10 linear, Heath HO10 scope. All wired and tested by an engineer. Any reasonable offer considered. Wells Chapin, 2775 Seminole Road, Ann Arbor 48104, Michigan. Telephone 313-663-1337.

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100 QSL Cards, 50 full letterheads and 50 envelopes with your name, address, etc. High quality. Fast service. $2.95 postpaid. Merchants Press, Taylor, Texas 76574.

LM-21 FREQUENCY METER, late type with power plug and schematics, $60. J. H. Gordon W5GXH, 60 Mill St., Woburn, Mass. 01801. Phone 617-933-5520 or office 617-271-3250.

HOT DX-100 250 CW 200 AM watts. NC-155. Both ex cellent condition. Will sell individually. Best reason able offer. David Wood WAØIIJ, 301 East Oakhue Olivia, Minn. 56277.

FILAMENT TRANSFORMER for that 4-1000 or 3 1000Z gg linear. 120 v 60 cy. primary. Two second aries: 7.6 v at 21 amp and 5.1 v at 13 amp. Hermeti cally sealed. Mounting studs. Standoff terminals. Un used new. Weight 14 lbs. $4.50 plus postage. AR(Sales, P. O. Box 12, Worthington, Ohio.

ERIE VHF HAMFEST. Brookside Fire Hall. Sunday September 19. Write WA3ANA, 4300 Cooper Road Erie, Pa. for more information.

HEATH HR10 RECEIVER $65. WØIZV, 7927 Durang St., Denver, Colo. 80221.

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

UHF: 2C39's and 3CX100A5's. Pullouts but tested goo at 432 mc. $1.50 each or 5 for $600 postpaid. Le Malone WA5DAJ, 4305 Windsor Dr., Garland, Texa

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572B's: Matched set of 4. Factory fresh and boxe never opened. $39.50 per set or $9.95 each postpaid WA5DAJ, 4305 Windsor Drive, Garland, Texas.

HIGH POWER class B modulator. Pair 805's, 2A drivers. Complete with schematic, $40. Power suppl 1500/1250/1000 v at 500 ma. Paid 866's complete, $3 Stancor plate transformer 2500 v at 300 ma/2000 v a 500 ma, $20. WA1BLY, 9 Lownds Ave., Easthampton Mass.

NEW HEATHKIT SB-400 transmitter and SB-300 re ceiver. Both excellent condition. SB-400, $300. SB-30($225. Both $500. Jim Chancey K8ZPP, 125 Morningsid Circle, Parkersburg, West Virginia.

L.I. HAMFEST. The Federation of Long Island Radi Clubs will hold its annual Hamfest and picnic at th Hempstead Town Park, Point Lookout, Long Island o Saturday August 28 from 9:00 AM to dark. Plan a outing for the entire family. The park features ocea swimming, boardwalk, playground area for the chil dren, golf and food service.

GONSET SIX METER SIDEWINDER and power sup ply. Perfect condition. $300 or best offer. HQ140X PSA63A, Tecraft 6 meter converter. Craig Reinhard WAØAUB, 8600 Crystal, Kansas City, Mo. Tel 816-356 2458.

ZERO-BEATERS ARC HAMFEST. City Park, Wash ington, Mo. August 1, 1965. Pre-registration $1. Con tact WAØFYA Lester Maune, 1010 Esther Stree Washington, Mo.

FOUNDATION FOR AMATEUR RADIO HAMFES' September 19th at Ft. Belvoir, Virginia about 17 mile south of Washington. Contact W. R. Russell W3BOS 1022 17th Street, N.W., Washington, D.C.

SOUTH JERSEY RADIO ASSOCIATION HAMFES' September 12 at Molia Farms, Malaga, N.J. Rain dat September 26. Joe Duffin W2ORA, 247 King's Highwa West, Haddonfield, N.J.

MODEL 15 TELETYPE, sync motor, holding magnets. Recently cleaned, overhauled, cabinet refinished. Table included. Write for details. WAØDNB, 606 N. 8th. Missouri Valley, Iowa.

HALLICRAFTERS HA-2 SSB 2m transverter, matching P-26 P/S $150; TAPETONE SB-50 SSB 6m transmitting converter, Model 201 receiving converter both brand new $75; HARVEY WELLS TBS-50D, matching P/S $45; will consider swapping all or part for mobile SSB transceiver. BENJAMIN, K1SLZ, 11 Douglas Rd., Lexington, Mass. 617/862-1541

TRADE Galaxy III w/AC and console, brand new, for 75A4 or sell. Trade Propane carburetion equipment for Car or Truck for Ham Gear. WØBNF, Box 105, Kearney, Nebr.

HP-23 BRAND NEW HEATHKIT AC supply for Heathkit and other transceivers. Assembled, unused. $36 or best offer. Ken Ginsburg, K8VKC, 790 E. 254, Euclid, Ohio.

CANADIANS: BC375 transmitters 75 watts cw 50 am new $17.50. BC459A 40 meter transmitters new $13.95. TA12C $24.95. Shipped cod. Longmire's Surplus Waterville Nova Scotia.

SYRACUSE VHF ROUNDUP in its 11th year will be held Saturday, October 2nd at Three Rivers Inn, Liverpool, N.Y. Speakers! Mfgrs Displays! Prizes! and Dinner for only $6.00 pre-registration; $6.50 at door. Tickets-Reine Maavere, 2217 E. Colvin St., Syracuse, 13210

BLUE BOOK used list free! Check our low prices. Over 1,000 items. Includes: KWM2, Eico 720, AF68, PMR8, Galaxy 300, 755A VFO, Communicator 3/6, SX42, SX101A, SX117, SR150, SB400, Invader 2000, Viking 500, CM1, 32V1, 22'er, 2A, Champ 350, Globe 6-2. Free 1965 Catalog, World Radio Laboratories, Box 919, Council Bluffs, Iowa.

SSB STATION, 160-10. SX-100 w/speaker $150, Phasemaster II, matching VFO 90w PEP $150. Excellent condition. John P. Skubick K8ANG, 1033 Meadowbrook, Warren, Ohio 44484.

HEATH HX-30 6 meter SSB + AM transmitter, $120. HW-32 20 meter ssb transceiver, $95. Both like new. 16810 Weddington, Encino, Calif. Phone 213-784-2588.

HEATH SB-400 exciter, Hy-Gain TH-4, CDR TR-44, Brush BA-200-2, misc ham station parts. Money back guarantee. Make offer or send for price list. W9FMW, 1567 Southfield Road, Evansville, Indiana 47715.

BANDIT 2000A Linear Serial 439 complete with Hunter Bias modification excellent condition $375.00. Also Newtronics 80-40 meter Cliff Dweller Serial 503 good condition $50.00. Both units F.O.B. K4ZJF Milt de Reyna 4030 Hallmark Dr. Pensacola, Fla. Phone 433-6552.

SELLING RCVR, Heath GC-1A with AC and battery pwr supplies and Heath QF-1 Q multiplier. Excellent condition. Only $89. Richard Crow, Indian Hill Rd., Groton, Mass. 01450.

ANYONE KNOW where I can obtain a CV-253/ALR Converter at a reasonable cost? Also in the market for an unusual QSL card. K7VOY, 6831 East Moreland, Scottsdale, Ariz.

LARGE LIST GOVERNMENT SURPLUS ELECTRONICS MANUALS—35¢ for complete list, postpaid. Other manuals available, all subjects, send needs. MIP, POB 9867 (73-1) Dallas, Texas 75214.

MISSOURI-ILLINOIS—The Egyptian Radio Club will hold its annual Hamboree on Sunday Sept. 26, 1965 at the Club House. One half mile south of the Chain of Rocks Canal Bridge (Hy. 66 by pass) near Granite City, Ill. Games and contests for the entire family. Ample parking space. Soft drinks, coffee and sandwiches. For details write Cletus Woodard, W9IHE, P.O. Box 402, Granite City, Ill.

INDEX TO ADVERTISERS

Propagation Chart

September 1965

J. H. Nelson

EASTERN UNITED STATES TO:

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

CENTRAL UNITED STATES TO:

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

WESTERN UNITED STATES TO:

ALASKA	14	14	14	14	7	7	7	7	7*	14	14	14
ARGENTINA	14	14	14	7	7	7	7#	14	14	14	21	21
AUSTRALIA	14*	14*	14*	14	14	7	7	7	7	7#	14	14*
CANAL ZONE	21	14	14	14	7*	7	7*	14	14	14	14	14*
ENGLAND	14#	7#	7	7	7	7	7	14	14	14	14	14
HAWAII	14	14*	21	14	14	14	7	7	14	14	14	14
INDIA	14	14	14	14#	7#	7#	7#	14	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	14	14#	14#	14
MEXICO	14	14	14	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14	14#	7	7	7	7	14	14	14#	14
PUERTO RICO	14	14	14	14	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.	14#	7#	7	7	7	7	7#	14#	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 hour.

Good: 1, 2, 13-16, 19-21, 28-30

Fair: 8, 10, 17, 18, 22, 24, 26

Poor: 3-7, 9, 11, 12, 23, 27

VHF DX: 1, 2, 11, 12, 22, 23

"TAB" • TRANSISTORS • DIODES!!

GTD! FACTORY TESTED — FULL LEADS.

PNP 100Watt/15 Amp HIPower TO36 Case! 2N441, 442, 277, 278, DS501 up to 50 Volts/VCBO $1.25 @, 5 for $5. 2N278, 443, 174 up to 80V $3 @, 2 for $5.

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

PNP 25W/TO 2N538, 539, 540, 2 for $1
2N1038 6/$1, 1039 4/$1, 1040 $1
PNP/TO5 SIGNAL 350Mw 25c @, 5/$1
NPN/TO5 SIGNAL IF, RF, OSC 25c @, 6 for $1

Silicon PNP/TO5 & TO18 25c @, 5 for $1
2N1046/$1.40 @, 3/$4. 2N1907/$2@, 4/$6
Power Heat Sink Finned Equal to 100 Sq" Surface $1 @, 6 for $5
TO36, TO3, TO10 Mica Mtg 30c @, 4/$1
Diode Power Stud Mica Mtg 30c @, 4/$1

ZENERS 1Watt 6 to 200v 70c @, 3/$2
ZENERS 10Watt 6 to 150v $1.45 @, 4/$5
ZENER Kit Asstd up to 10w 3 for $1
STABISTORS up to 1watt 5 for $1

TRANSISTORS—TOO MANY! U-TEST

Untested Pwr Diamonds/TO3 10 for $1
Untested TO36 up to 100Watts 3 for $1
Untested TO5/SIGNAL/sistors, 20 for $1
Untested Power Diodes 35 Amp 4 for $1
Untested Pwr Studs up to 12Amp 12 for $1

D.C. Power Supply 115v/60 to 800 Cys. Output 330 : Tap 165V up to 150Ma, Cased $5@, 2 for $9

SILICON POWER DIODES • STUDS

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

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

*P.F. PRESS-FIT AUTOMOTIVE TYPE!

18 Amp Press Fit up to 200Piv 4/$1
2 to 3 Amp Studs up to 600Piv 6/$1
35 Amp Studs 150 to 200Piv 5 for $5

"TAB" • SILICON 750MA DIODES

NEWEST TYPE! LOW LEAKAGE

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

GTD ALL TESTS AC/DC & LOAD!

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

SCR—SILICON CONTROL RECTIFIERS!

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

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

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

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

We Swap Tubes! What Do/U Have?

OA3	.80	5R4	1.00	6F7	.99
OC3	.70	5T4	.90	6F8	1.39
OD3	.59	5V4	.89	6H6	.59
OZ4	.79	5Z3	.89	6J5	.59
1L4	.82	6A7	1.00	6J6	.59
1R4	5/$1	6A8	.99	6K6	.59
1S4	.78	6AB4	.59	6L6	1.19
1S5	.68	6AC7	.72	6SN7	.72

Send 25c for Catalog!

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

We Buy!		We Sell!		We Trade!	
2D21	.65	6BA6	.59	250TL	19.45
2K25	9.75	6BE6	.59	VR92	5/$1
2K28	30.00	6BK7	.99	388A	3/$1
2V3	2/$1	6BQ6	1.19	416B	16.00
2X2	.48	6BY5	1.19	450TL	43.00
4X250B	30.00	6BZ6	.91	813	9.95
5BP4	7.95	6C4	.45	815	1.75

Top $$$ Paid for All Tubes!

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

866A Xfmr 2.5V/10A/10Kv/Insl $3 @
Ballentine #300 AC/Lab Mtr. $54
(Sd) Choke 4Hy/0.5A/27Ω $40 @, 2/$60
"VARIACS" L/N 0-135v/7.5A $15
"VARIACS" L/N 0-135v/3A $10
TWO 866A's & Fil. Xfmr. $6

SILICON TUBE REPLACEMENTS

OZ4 UNIVERSAL $1.75 @, 2/$3
5U4 1120Rms/1600Inv $2 @, 3/$5
5R4 1900Rms/2800Inv $9 @, 2/$15
866 5Kv/Rms - 10.4Kv Inv $11 @, 2/$20

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

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

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

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

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

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Kit 5 lbs. Surprise Package
Kit 10 Transmit Mica Cond's.
Kit 3 Phone/Patch Xfmrs
Kit 10 Insltd Tuning Tools
Kit 6 "SunCells" Battys
Kit 10 Sub-Min Tubes
Kit 12 Alligator Clips Asstd
Kit (6) Tube Clamps Asstd
Kit (32) Transistors PNP & NPN
Kit (12) 2Amp Stud Rectifiers
Kit 75 Mica Condensers
Kit 10 Crystal Diodes
Kit 200ft Hook Up Wire
Kit 4 Rolls, 500ft/ea. Assorted Color
Kit 5 FT243 Xtal Holders
Kit 10 Xtal Osc. Blanks
Kit 4 Asstd Rectifiers
Kit 100 Self/Tap Screws
Kit Adj Wire Striper & Cut
Kit Hi Gain Xtal Mike
Kit 2 pair S0239 & PL59
Kit 12 Binding Posts Asstd
Kit (3) TO36/50Watt Untested
Kit (50) TOPHAT 3/4A/Diodes Untested
Kit (12) TO3/3A Transistors Untested
Kit (4) PF/PressFit 18Amp Studs

Order Ten (10) Kits—We Ship Eleven

One Each Above Kit Only. Each Kit 99c

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

WANTED TEST SETS & EQUIPMENT

Bandswitch Ceramic 500W 2P/6Pos $3 @, 2 for $5
6Hy-305Ma Choke Cased $3 @, 2/$5
7-½Hy-400Ma Choke Cased $7 @, 2/$12
250Mfd @ 450 Wv Lectlytic 4/SSB $3 @, 4/$10
Cndsr Oil 10Mfd x 600-2x2.5 & 5Mfd $1 @, 15/$10
Cndsr Oil 6Mfd @ 1500V $4 @, 4/$10
880Vct @ 735Ma for SSB $9 @, 2/$16
480Vct @ 40Ma & 6.3 @ 1.5A CSD $1.50 @, 4/$5
10Vct @ 5A & 7.5Vct @ 3A CSD $6 @, 2 for $10

WANTED LAB METERS! BRIDGES! K-POTS!

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

WANTED YOUR - ORDER - TODAY!

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

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XMTTG Mica Condsr .006 @ 2.5Kv 39c @, 5/$1
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Micro-Switch Rated 40Amp AC & DC 4 for $1
BandPass Filters 60 or 90 or 150Cys 3 for $5
T30 Throat Mikes $1 @, 4 for $3
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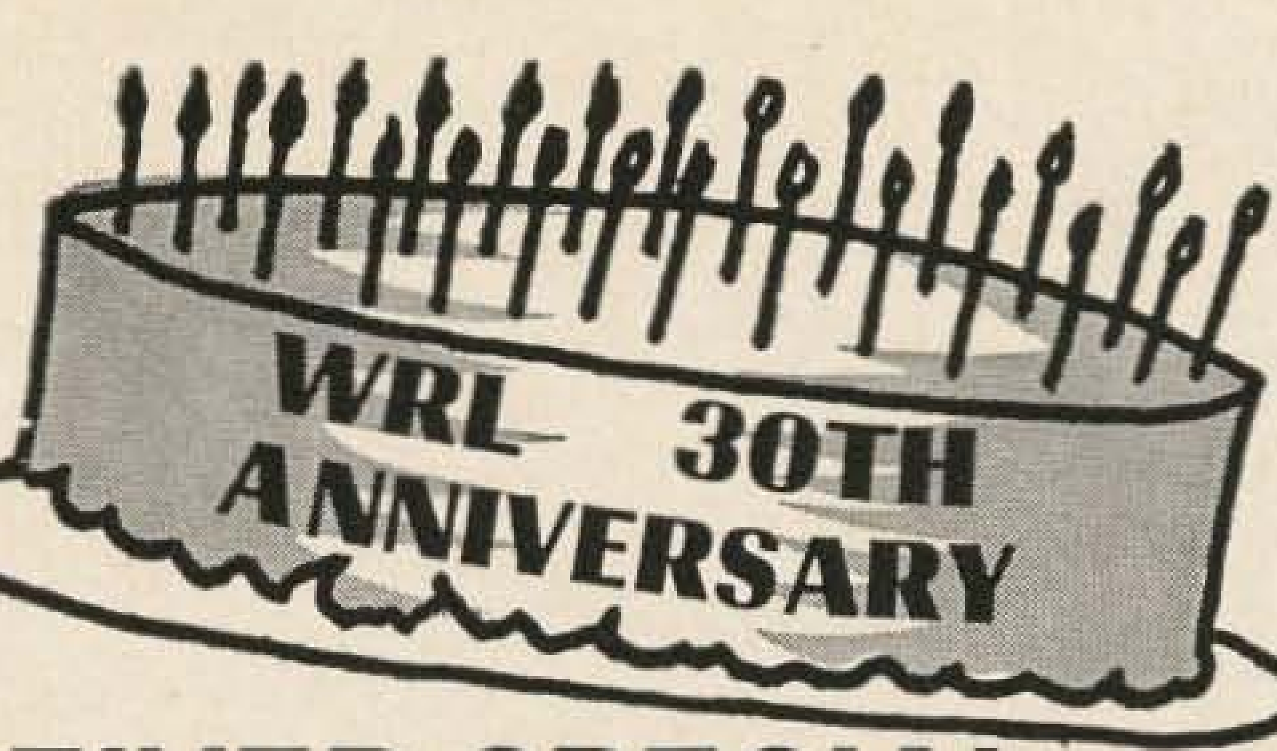

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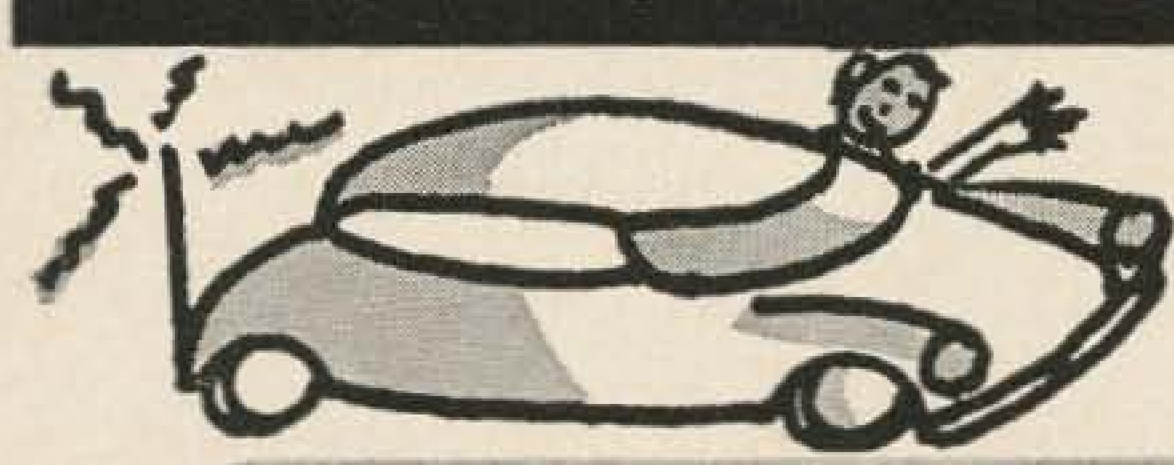

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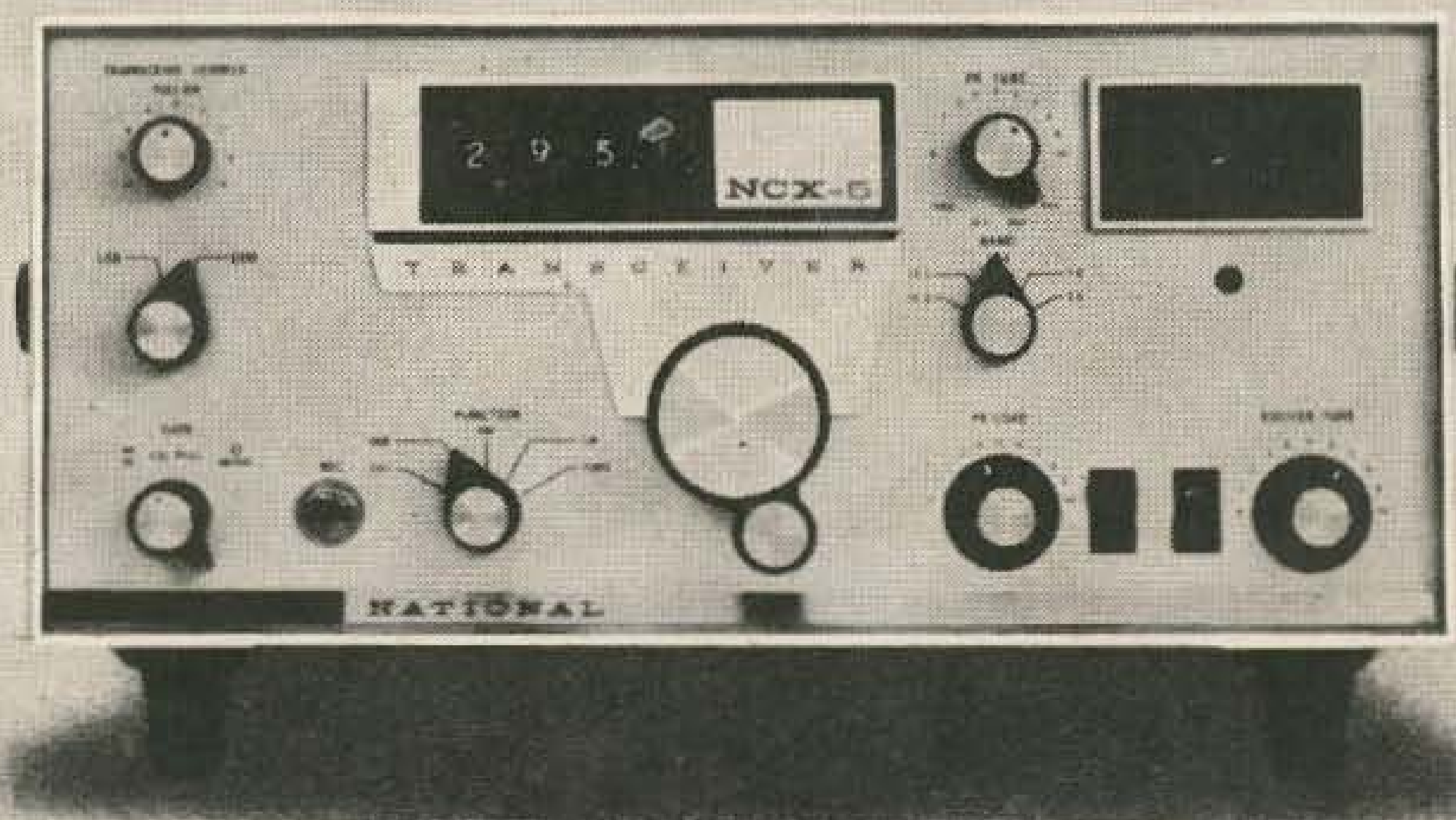

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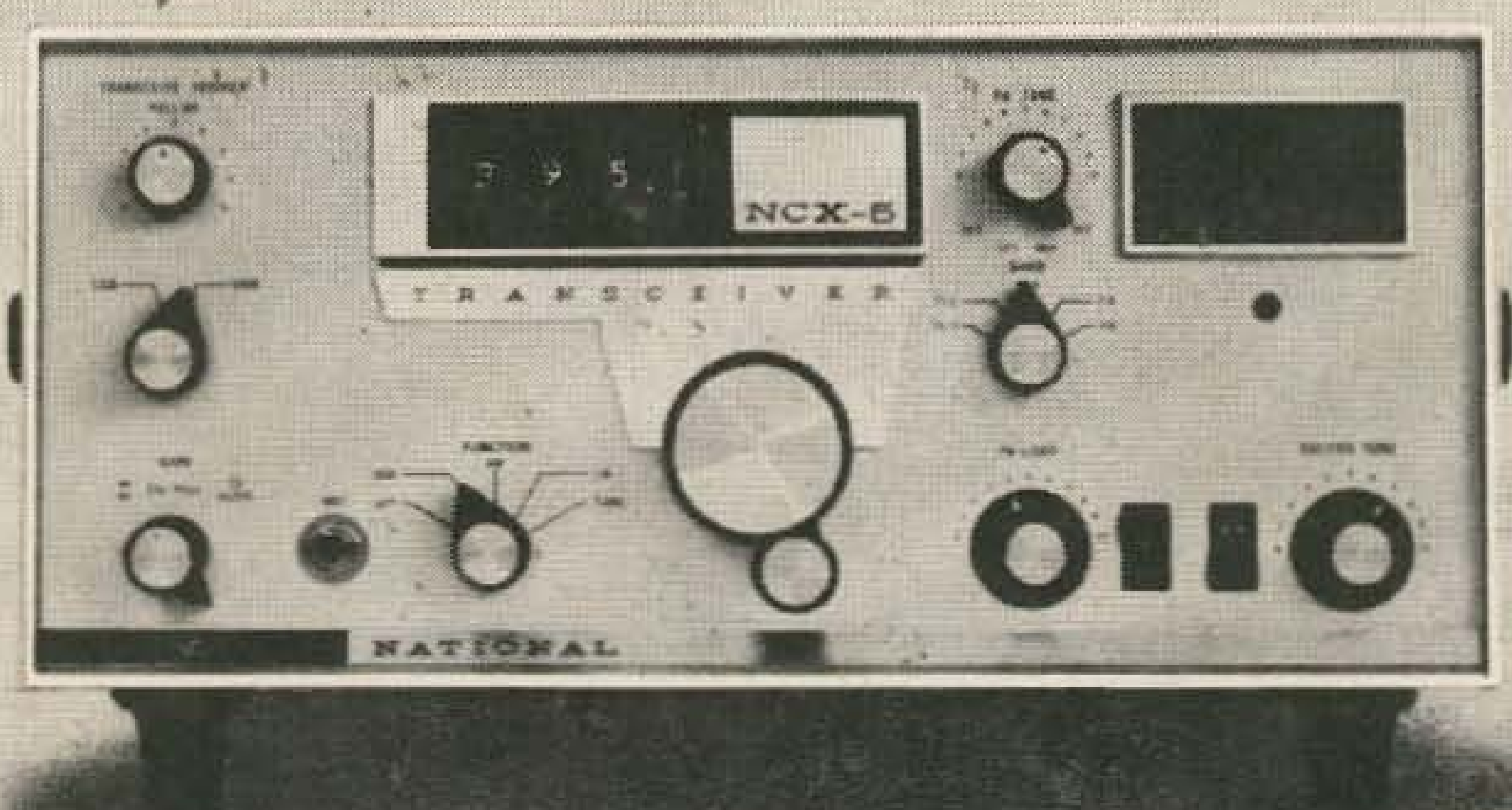

One thinks long and hard before making a change in a rig like the NCX-5 — after all, it has proven itself as the finest transceiver ever offered the amateur at any price. But we have designed a new balanced modulator circuit which offers such high performance that we felt it should be incorporated in new NCX-5 production. The new balanced modulator is a solid state ring-type device which is totally unaffected by external or magnetic influences, on-off cycling, aging, or warm-up time. Minimum carrier suppression is 50 db through all of these variables, and typically can be adjusted to provide even 65 or 70 db! In fact, the circuit cannot be unbalanced far enough, using the carrier balance control, to provide sufficient carrier for AM or CW operation of the NCX-5. We therefore replaced the carrier balance control with a new Carrier Insertion control to provide a gradual increase in carrier as the control is turned clockwise. Carrier is also now inserted automatically in the AM or CW positions of the NCX-5 mode switch. "Carrier balance" has become an internal factory adjustment which need never be touched.

The new NCX-5 is designated Mark II, and is identical in appearance to previous units. The superb dial calibration, stability, selectivity, and all other maximum performance features of the NCX-5 are, of course, unchanged (including the remarkable price of only $685).

When we make performance improvements during production we try to make certain that owners of earlier units can similarly improve their equipment, if they wish. So our Customer Service Department has a Mark II kit available for satisfied NCX-5 owners so that they can become satisfied NCX-5 Mark II owners. The NCX-5 is the finest transceiver on the amateur market, proven in operation by amateurs the world over. The Mark II NCX-5 is even better.

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