# 73

Amateur Radio

April 1961

37¢

# "220"... band for big gain...

# GONSET COMMUNICATOR IV-220

220 megacycles ... long regarded as a band of promise ... where big antenna gain comes easy. A quarter-wave antenna is only a foot long and good ground planes—including the top of a car—are easy to come by. Simple beams and even complex arrays of high gain are conveniently small in size—easy to put together and get up into the air. Here's a band where antenna experimentation can run rampant. Multi-element yagi's ... stacked colinears ... sleeve types ... bedsprings ... log-periodic types .. helicals. The band has DX possibilities too. Remember KH6UK to W6NLZ?

In Gonset Communicator IV-220 you have ready-to-operate "packaged" equipment that offers power to really go places on this fine band. On the intake side—an excellent triple conversion receiver having sensitivity of 1 microvolt for 10 db S+N/N ratio. And a noise figure of 3 to 5—exceptional for equipment of this general type. Receiver is continuously tunable but also includes provisions for spot frequency reception on one crystal controlled frequency. (A C-D requirement.)

Power input to 6360 final amplifier is 20 watts, amplitude modulated by P-P 6BQ5's. Transmitter is crystal controlled, has 6 crystal positions. Dual power supply is built-in, operated from 12V DC/117V AC, is equally well suited to fixed station or mobile operation.

**C-D Models:** Model 3351 is certified to OCDM as meeting applicable specifications, qualifies for matching funds when furnished with Model 3361 C-D Kit.

**Communicator IV-220.... #3351 ..... $394.50**
(Less microphone, crystals.)

**GONSET** *Division of Young Spring & Wire Corporation*
801 SOUTH MAIN ST., BURBANK, CALIFORNIA

EXPORT SALES: WESTREX CORP., 111 EIGHTH AVE., NEW YORK 11, N.Y.

*Central Electronics*

Famous for

# DYNAMIC PUNCH

ANNOUNCES

THE NEW

# 200V

## BROAD-BAND

### Exciter—Transmitter

Amateur net. . . . $795

**NEW FEATURES IN THE 200V**

NEW! Silicon rectifier power supply. Better regulation. Less heat. Higher voltage. 200 watts PEP input on SSB.

NEW! Frame grid (6EH7-6EJ7) mixers. Extremely high gain Less heat. Unwanted mixer products down in excess of 50 DB.

NEW! Temperature compensated crystal oscillator circuits for extreme, long term stability.

NEW! Increased mike pre-amplifier gain. Compensates for weak voices or low output microphones.

NEW! Smooth as silk two speed tuning knob with 5 KC per turn vernier tuning ratio.

PLUS THESE ORIGINAL FEATURES

COMPLETELY BROAD-BANDED. You tune only the VFO . Inherently matches output impedances of 50-72 ohms.

COMPLETE BAND COVERAGE. ALL of the 80-40-20-15-10 meter bands, plus generous overlap and position for extra band.

INPUT 175 watts on CW, FSK and PM. 100 watts on AM.

"TAILORED" audio filter-Audio limiter.

ADJUSTABLE POWER OUTPUT control. 2" MONITORING SCOPE.

CALIBRATION ACCURACY better than 1 KC.

UNWANTED SIDEBAND SUPPRESSION 50 DB.

CARRIER SUPPRESSION at least 50 DB.

HARMONICS down in excess of 50 DB.

Third order DISTORTION PRODUCTS down in excess of 40 DB.

THERE IS NOTHING FINER THAN THE 200V

EASIER TO OPERATE THAN EVER! Choice of USB-LSB-AM-PM CW-FSK at the flip of a switch. Perfected VOX, PTT, CW breakin 4 ways to key.

Available soon - write for literature.

*Central Electronics, Inc.*

1247 W. Belmont Ave. Chicago 13, Illinois

A subsidiary of Zenith Radio Corp.

73 Magazine
1379 East 15th Street
Brooklyn 30, N. Y.

April 1961
Vol. 1, No. 7

# Table of Contents



**Staff:**

editor-publisher ..... Wayne Green W2NSD
publications manager ..... David Fish
associate editor ..... Don Smith W3UZN
associate editor ..... Jim Kyle K5JKX/6
associate editor ..... Marvin Lipton VE3DQX
associate editor ..... Charles Spitz W4API
sales representative ..... Jim Morrissett WA6EXU
sales representative ..... Jack Gutzeit W2LZX
photographer ..... Joe Schimmel W2QDM
subscriptions ..... Mrs. Virginia Green
transportation ..... Porsche
printing ..... Ye Olde O'briene Presse

**COVER:** W2MUM's tower as photographed by Joe Schimmel W2QDM.

73 Magazine is published monthly by Amateur Radio Publishing, Inc., 116 Main Street, Norwalk, Connecticut. Business Office, 1379 East 15th Street, Brooklyn 30, New York. Telephone: NA 9-0360. Subscription rates: U.S.A. and possessions, APO, FPO, Canada and Mexico; one year $3.00; two years $5.00; three years $7.00. Foreign: one year $4.00; two years $7.00. Second-class postage paid at Norwalk, Connecticut. Printed in the U.S.A. Entire contents copyright 1961 by Amateur Radio Publishing, Inc. Postmaster: Please send form 3579 to 73 Magazine, 1379 East 15th Street, Brooklyn 30, New York.

# . . . de W2NSD

## (never say die)

The more observant readers will discover that we have thrown budgetary caution to the winds this month and have bound in a postcard. The reasons behind this are manyfold and would possibly be too numerous to mention were it not that I have little else to comment on.

Besides goading more of you to vote on the articles you find most interesting, the card also will enable the more industrious to request literature from our advertisers just by writing in their name and addresses. Having already experienced the drawbacks of merely including a reader's service coupon in a magazine and being aware that the advertisers know how easy it is to circle a few extra numbers on incoming coupons to make the response look good, we plunged ahead with a more foolproof system.

Let me put in just a short congratulatory statement. You fellows have been doing a fine job and are holding up your end quite well as readers. The advertisers, who are paying for this magazine, are enthusiastic about your response and I note that many of them, after trying you out for a month or so, have decided to sign for a full year of advertising. Don't let down.

### Building

We are getting more and more letters from readers who claim that 73 has pushed them over the brink and started them to home brewing. Operating is fun, but it is only *half* of the hobby. We have a long way to go yet. We'll keep at it with everything we can muster to develope this atrophied activity. Those of you who have been around the hobby for a few years can remember when the local distributor had a big parts department with tables of specials. You may even remember when parts manufacturers advertised in ham magazines. How many of you have seen a Bud catalog? I used to practically wear that one out looking over their coils, racks & panels, and small parts. Maybe, if we keep at it, we can see a return to the old days. Maybe we'll again be able to pour over catalogs of parts by National, Hammarlund, Johnson, Par-Metal, and Millen.

### Propaganda

.. There are still a lot of fellows who don't know that 73 exists. We cannot, as you should be able to figure out, advertise in the other ham journals. This means that we're depending quite a lot on your to tell others about 73. If every reader mentioned 73 to every contact on the air for a few weeks, every ham in the country would at least *hear* about the magazine.

### Grumbles

Someone wrote in complaining because he found some small errors in the magazine. He wanted to know why we didn't hire a better proof reader. The three examples he used to prove that 73 is a "mass" of errors consisted of two words with transposed letters and our "Subscription Department" ad which he thought was mispelled.

We will have to hire our first proof reader before we can attempt to hire a better one. Virginia and the authors do the best they can to correct the sometimes incredible mish-mash that comes back from the printer. I look 'em over too. What in the devil is it that bothers some folks so much about an occasional word getting bolixed up . . . it isn't as though this gave them even a slight difficulty in figuring out what is being written. The next thing you know we'll be getting requests for correct grammar usage. Good grief!

While these odd chaps are going over the magazine with a fine tooth comb looking for errors we are trying desperately just to make sure that we get all of each article in each issue. It is awfully easy to leave out a parts list, a coil table, or a photograph during the last hectic hours of hassle when we are trying to get everything set for the presses. Just how easy I found out last month when we managed to leave out the whole schematic diagram for the 432 mc converter. How many of you frustrated proof-readers noticed that one? Ha! Well, it's in this issue anyway, marked "part II."

How come no proof readers? Because we are trying to bring you a new type of ham magazine and we started from scratch without much scratch. Proof-reading volunteers will be accepted at our editorial offices at any time, the only thing is that they will have to work for the same salary as the rest of the staff.

### Caveat Emptor

In spite of our acknowledged poverty we are, I believe, the most particular when it comes to our advertisers. Again, we have to depend on

# INTERNATIONAL 1961 CATALOG

# FREE


*Your*

BUYING GUIDE FOR
PRECISION RADIO CRYSTALS
AND QUALITY ELECTRONIC EQUIPMENT.

• COMMERCIAL CRYSTALS • AMATEUR AND CITIZENS BAND CRYSTALS • AUTO RADIO CONVERTERS • OSCILLATORS • FREQUENCY ALIGNMENT EQUIPMENT • TRANSMITTERS • MODULATORS • POWER SUPPLIES • TRANSISTOR SUBASSEMBLIES • CITIZENS BAND TRANSCEIVERS • CITIZENS BAND ANTENNAS/ACCESSORIES

Specialists in precision radio crystals, Citizens 2-Way radio equipment, and quality electronic products.

**INTERNATIONAL**
**CRYSTAL MANUFACTURING CO., INC.**

18 NORTH LEE • OKLAHOMA CITY, OKLA.

**AMATEURS —**
Complete data on International's all transistor subassemblies; 6 and 2 meter transmitting and receiving gear; crystal controlled converters for 75, 40, 20, 15 and 10 meters.

**CITIZEN LICENSEES —**
International transceivers, accessories and antennas for dependable 2-Way radio communication. See International's kit for constructing your own Citizens transceiver.

**EXPERIMENTERS —**
Printed circuit oscillators, RF converters, IF units, audio units, transistor subassemblies, crystals and crystal ovens.

*Mail today for your FREE Catalog!*

International Crystal Mfg. Co., Inc.
18 North Lee, Oklahoma City, Okla.
**Send Free 1961 International Catalog**

Name____________________

Address____________________

City__________ Zone_____ State________

you. Please let us know if you have any problems, but don't ask us to mediate or straighten them out. If we get several complaints we will just have to look elsewhere for an advertiser.

### Feedback

We've enough votes on the January lineup of articles to conclusively determine the winner. Way out in front with 229 votes we find Tom Lamb's Nuvistor Converters. Our monthly technical article placed second with 147 votes. In third place with 115 votes is Down With Drift by Jim Kyle. 1296 mc by Bill Ashby was fourth with 96 votes. Four other articles received over 50 votes. I'm learning a lot from the votes. Some articles that I figure are of lesser interest turn out to get a lot of votes. For instance take the "8 mc Crystal Modification Kit" article by W3UZN in January. I figured that Heath and a handful of readers would be interested. Believe it or not we got 43 votes for this article! How many people could be interested in 1296 mc? 96 votes is quite a landslide.

The February issue vote puts Kyle right back up on top again. His "Rolling Your Own" really rolled up a score! All of which would seem to prove that interest *is* high in building. The VHF's get a lot of votes, so perhaps it isn't too surprising to have this 50 mc rig pull down the first prize: an all expenses paid trip to Santa Susana, California . . . plus 50% extra on the article payment. Second place goes to another VHF rig, the Two Meter Pip-Squeak by Ray Fulton K6BP. Ray is just recovering from an accident which stove in a few ribs and he may be behind on answering mail. Our big technical article on BFO's came in third! There just isn't any question, we've got to run more good technical articles. Kyle's Worlds Simplest Phone Patch was fourth, with Squawk by Ken Cole, W7IDF fifth. Both of our commercial gear evaluations got many votes from other than the manufacturers so we'll continue that sort of thing.

### Conventions

We'll be seeing those of you who attend the Swampscott, Dayton, Rochester and Phoenix Conventions. Don't forget that Phoenix date on May 26-29th. It isn't much of a drive from Southern California, so I hope all you fellows come on over for the fun.

Virginia will be there with me and would like to meet you all.

### California Style

U. S. #1 Electronics will officially open their store in Linden New Jersey on April First. I'll be over there picking things over as soon as they open up for they tell me that they have a veritable mountain of surplus stuff there.

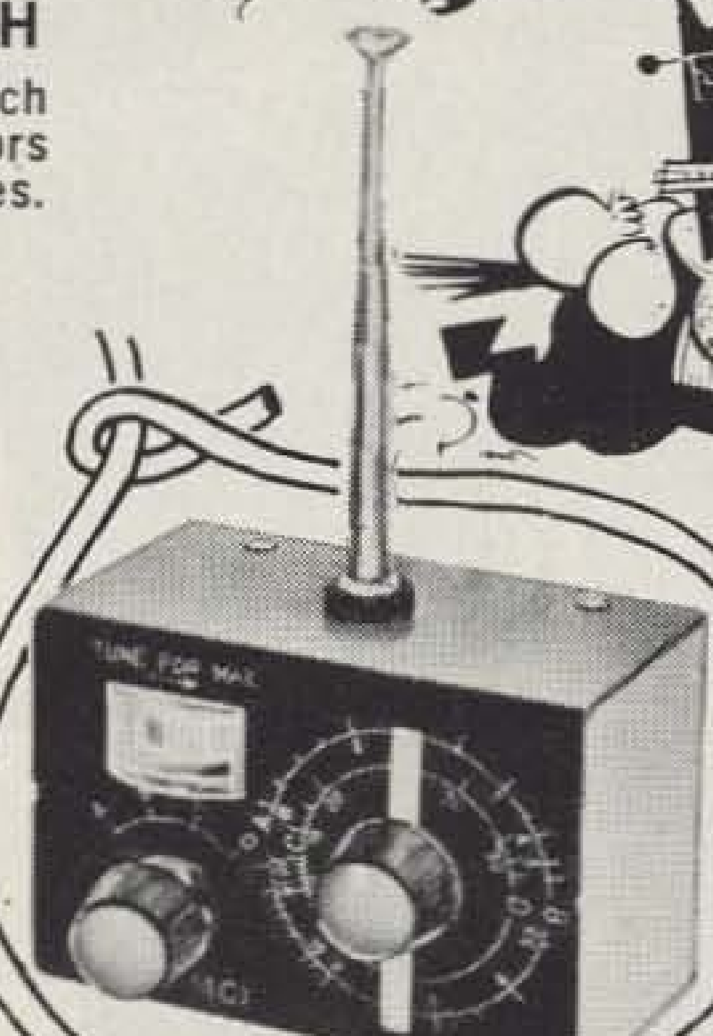
. . . W2NSD

# THE LAFAYETTE ROUNDUP OF HAMSHACK VALUES

**MODEL HE-26**
**HYBRID PHONE PATCH**

Perfect for AM-SSB Phone Patch operation. VU Meter monitors line level for Q5 phone patches. An unmatched low—

**24.50**



**MODEL TM-15**
**WAVE METER**

Checks transmitter output for harmonics, parisitics, and out-of-band operation. Provided with magnetic feet. Perfect for the novice.

**8.95**

**37.50**

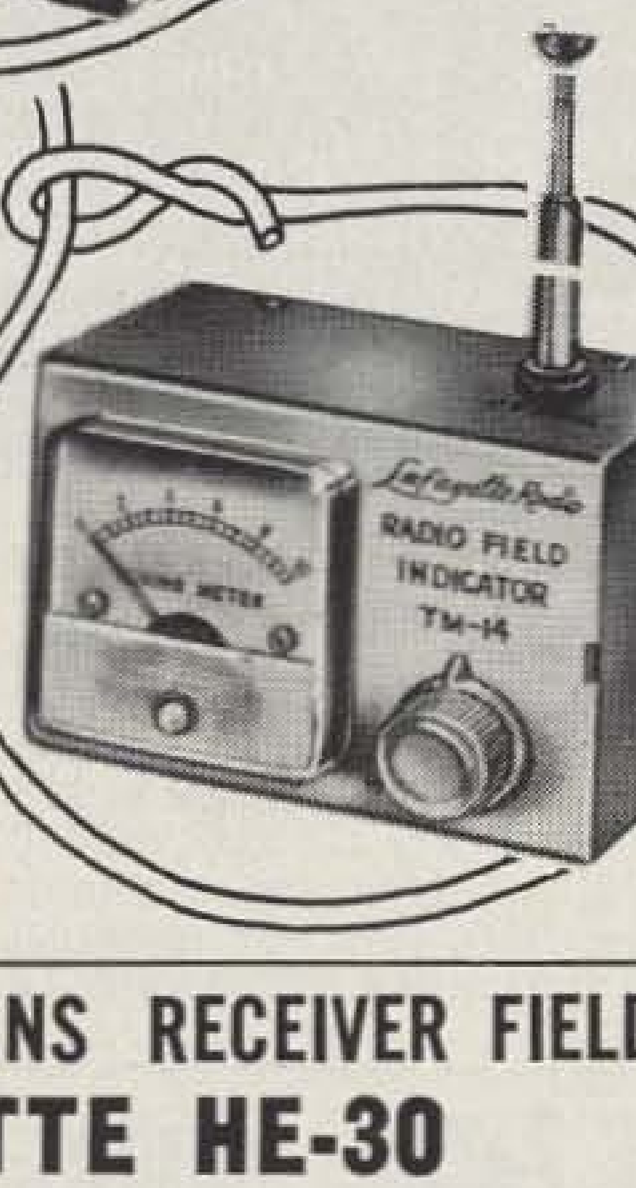
**HE-28 RF WATTMETER AND SWR BRIDGE**

150 watts full scale—Built-in dummy load—Wattmeter ±5% to 54 mcs. SWR ±5% for in line use.

**MODEL TM-14**
**FIELD STRENGTH METER**

Complete, no wires to connect. Monitor transmitter output, check antennas, etc. Perfect for mobile, provided with magnetic feet.

**7.95**




## AN UNHEARD OF BREAKTHROUGH IN THE COMMUNICATIONS RECEIVER FIELD

## THE LAFAYETTE HE-30

- TUNES 550 KCS TO 30 MCS IN FOUR BANDS
- BUILT-IN Q-MULTIPLIER FOR CROWDED PHONE OPERATION
- CALIBRATED ELECTRICAL BANDSPREAD ON AMATEUR BANDS 80 THRU 10 METERS • STABLE OSCILLATOR AND BFO FOR CLEAR CW AND SSB RECEPTION • BUILT-IN EDGEWISE S-METER

**99.50** THE DREAM RECEIVER FOR TODAY'S CROWDED BANDS AND AT AN IDEAL PRICE

**LAFAYETTE RADIO**

165-08 LIBERTY AVENUE, JAMAICA 33, N. Y.

OTHER LOCATIONS

| NEW YORK, N. Y. | NEWARK, N. J. | BRONX, N. Y. | PARAMUS, N. J. | BOSTON, MASS. | PLAINFIELD, N. J. |
|---|---|---|---|---|---|
| 100 6th Avenue | 24 Central Avenue | 542 E. Fordham Rd. | 182 Route 17 | 110 Federal Street | 139 W. 2nd Street |

**FREE 324-Page 1961 Catalog No. 610**

Cut Out & Paste on Post Card

Lafayette Radio Dept. 73-1 P.O. Box 190 Jamaica 31, N.Y.

☐ $..........Enclosed. Send Stock #.................... ☐ Rush FREE 324 Page Catalog 610

☐ $..........Down Payment Enclosed for Stock #....................

Lafayette Easy Pay Application Will Be Forwarded Upon Receipt of Down Payment

Name ..........

Address ..........

City .......... Zone .......... State ..........

Russell M. Summerville K8BYN
Box 354
Niles, Michigan

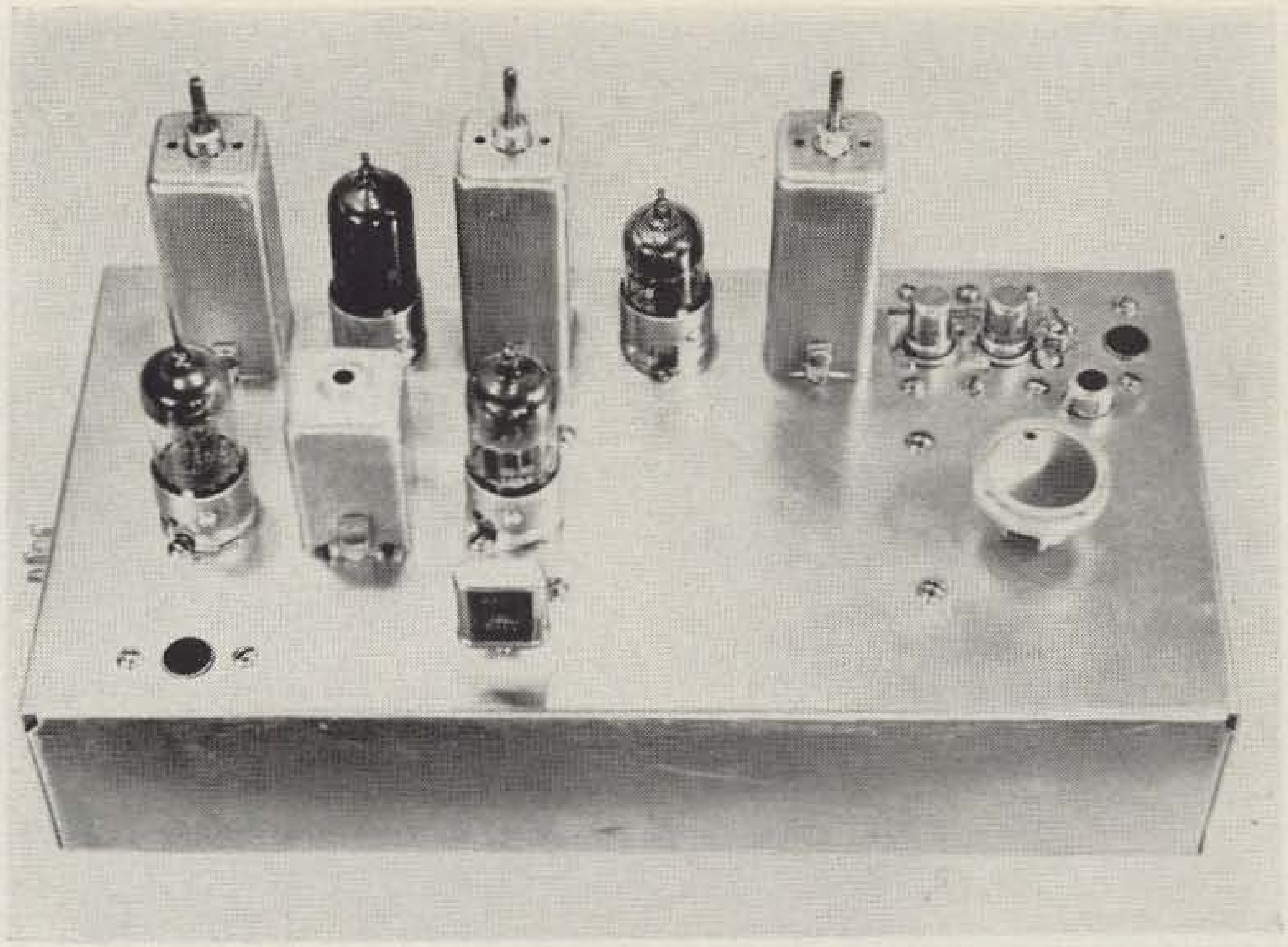


Fig. 2

# Six Meter Nuvistor Cascode Converter

FOR many years it has been the secret desire of almost every amateur interested in the VHF bands to own one of those gold plated 417A converters, but for most of us scraping up the gold dollars to buy the tubes has been out of the question.

Now a miracle has happened! RCA has developed a tiny ceramic tube which they call a Nuvistor for use in their TV tuners. These little gems at a cost of only $2.49 each are the answer to your dreams. For all practical "ham" purposes they perform about the equal of the 417A!

After listening to a commercial on TV all about how noise free RCA's Nuvistor tuner was I decided just for kicks to build up a 6 meter converter using Nuvistors in cascode. The resulting converter outperformed most conventional converters and equaled a couple 417A converters in comparative noise tests.

## Construction

To mount the Nuvistors cut out a piece of tin (tin solders real nice) 1½ inch by 1¾ inches and drill 2 holes just the size of the Nuvistor sockets. Also drill 6 holes around the edge of the tin plate. These are for mounting screws to fasten the tin plate solidly to the aluminum chassis. (See Fig. 2.) Mount the tin plate to the chassis. Bend back the 2 tabs on the Nuvistor sockets and slip them into the top of the holes cut for them. Solder the tabs to the tin plate. Be careful not to bend the lugs on the socket that are for the purpose of grounding the Nuvistor shield when it is inserted into the socket.

Two 8 terminal tie lug strips are mounted 2¼ inches apart and resistors "A" thru "H" are connected across the points. All of the resitors on the strip near the outside of chassis are connected together and this is the B plus bus line. (Fig. 3.)

Although it is not necessary to use them, for convenience and to save space dual capacitors were used on each tube socket and at the terminals of the *if* transformers. *Keep all leads short*—mount the capacitors as close to the socket pins as possible. If you use duals, just ground the center lead and connect the outer leads to the points to be bypassed.

It is customary to use rf chokes in series with filaments and to bypass them with small capacitors. By using shielded wire (the type with heavy wire and high internal capacity) for filament wiring the use of rf chokes and bypass capacitors is not necessary. Be sure to ground the shield close to each socket.

A neutralizing coil is usually employed where we use resistor "L". This coil to be useful must be resonated at 50 mc and unless

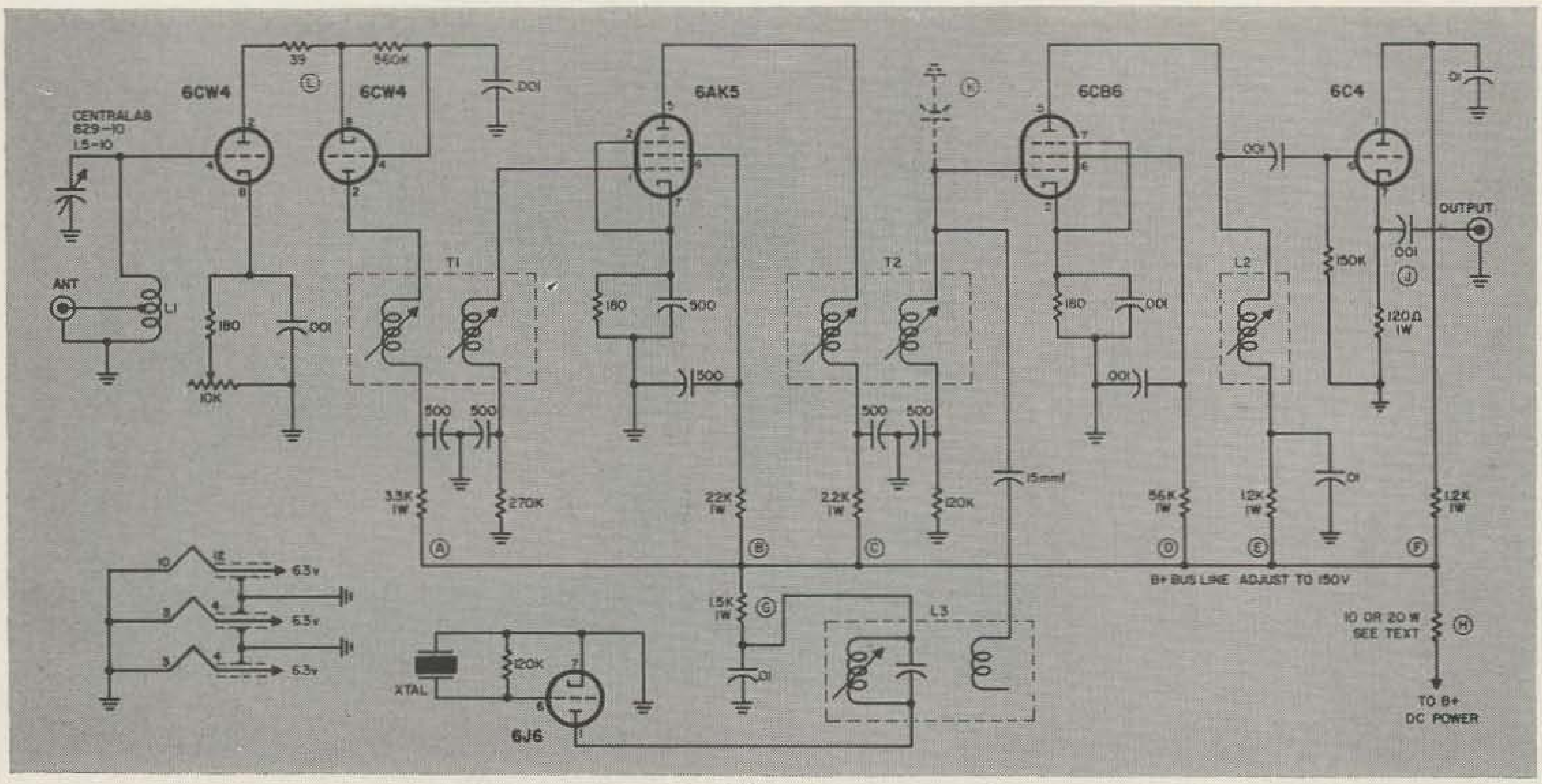


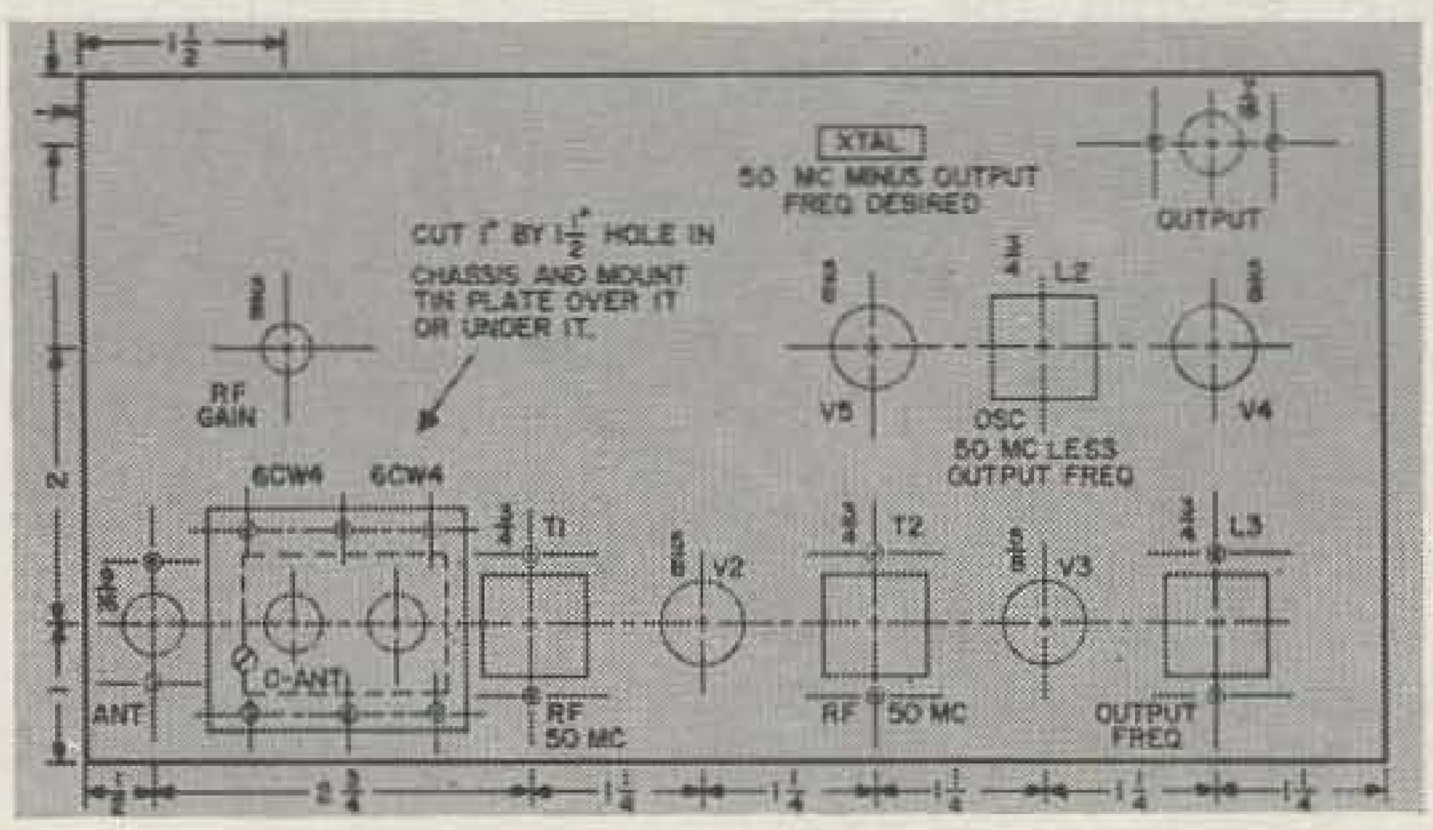
Fig. 1

it is correct it does little good. The increase in noise because of the use of the resistor in place of the usual coil is negligible.

## I-F Transformers

The *if* transformers can be made from 40 mc video *if's* removed from an old TV set, or if you want to use new parts use Miller #6218-TV video *if* transformers. Remove all of the existing windings and wind 17 turns of #18 enamel wire to form the lower part of the transformer and connect to lugs. Then wind 10½ turns of the same wire to form the top half of the transformer and bring leads down to the lugs and solder.

In all tuned circuits in which a wide band pass is necessary it is possible to broaden out the response either by putting a "swamping" resistor across the tuned circuit or to make use of a circuit having a large L/C ratio. The latter method is used in this converter in both the *if* transformers and the input and output coils. The idea is to have the coils "self resonant" so that they resonate at the signal frequency with little or no capacity other than distributed capacity, stray circuit capacity, and tube capacity. Sometimes a small amount of capacity is necessary because it is impossible



to make all units exactly alike. If you find in final alignment that with the slugs all the way in the coils will not reach a peak then add a small capacitor from ground to plate or grid depending on which coil needs lowering—or both if necessary. (See "K" in Fig. 1.)

Several makes of slug coils were wound as described and all were found to resonate fairly close to 50 mc when connected into the circuit. If extra capacity is needed use as little as possible usually between 5 and 20 mmfd.

## Coils

The input coil L1 is made of 10½ turns of #22 bare wire wound around a ⅜ inch coil form tapped at 2 turns for the antenna input. An *Airdux* type of coil could be used. The important thing is to be sure that with the antenna plugged into the jack, the tube in the socket and the circuit wired, the circuit will resonate at 50 mc when the tuning capacitor across the coil is tuned. If the frequency is too high add another turn or two to the coil if necessary and, if too low, take off a turn or two.

The frequency of the crystal and the oscillator tank circuit (L3) must be 50 mc less the output frequency desired from the converter. For example the SX101A has a 6 meter dial and requires an input of 30.5 mc. The oscillator frequency then must be 50 minus 30.5 or 19.5 mc. You can use a fundamental or overtone 19.5 mc crystal or a cheap surplus lower frequency crystal and multiply in the second half of the 6J6 to the desired frequency. The fundamental or overtone crystals are much to be preferred and will prevent any possibility of images, birdies, etc. You may prefer some other type of oscillator circuit. By much experimenting we found this simple circuit would work wth more crystals than other more complicated circuits.

The output coil (L2) must be broad and so it is tuned to resonance by it's own distributed capacity. With the bottom slug of the coil all the way in and the top slug part way in, put enough turns of wire around the form so that it will resonate at the desired output frequency. This will have to be done experimentally and checked with a grid dipper while the coil is wired into the circuit. The converter shown here had an output frequency of 30.5 megacycles and it was found that with 25 turns of #22 enameled wire that frequency was obtained. If you want to use a low output frequency, such as 5 megacycles, it would be desirable to use a finer wire.

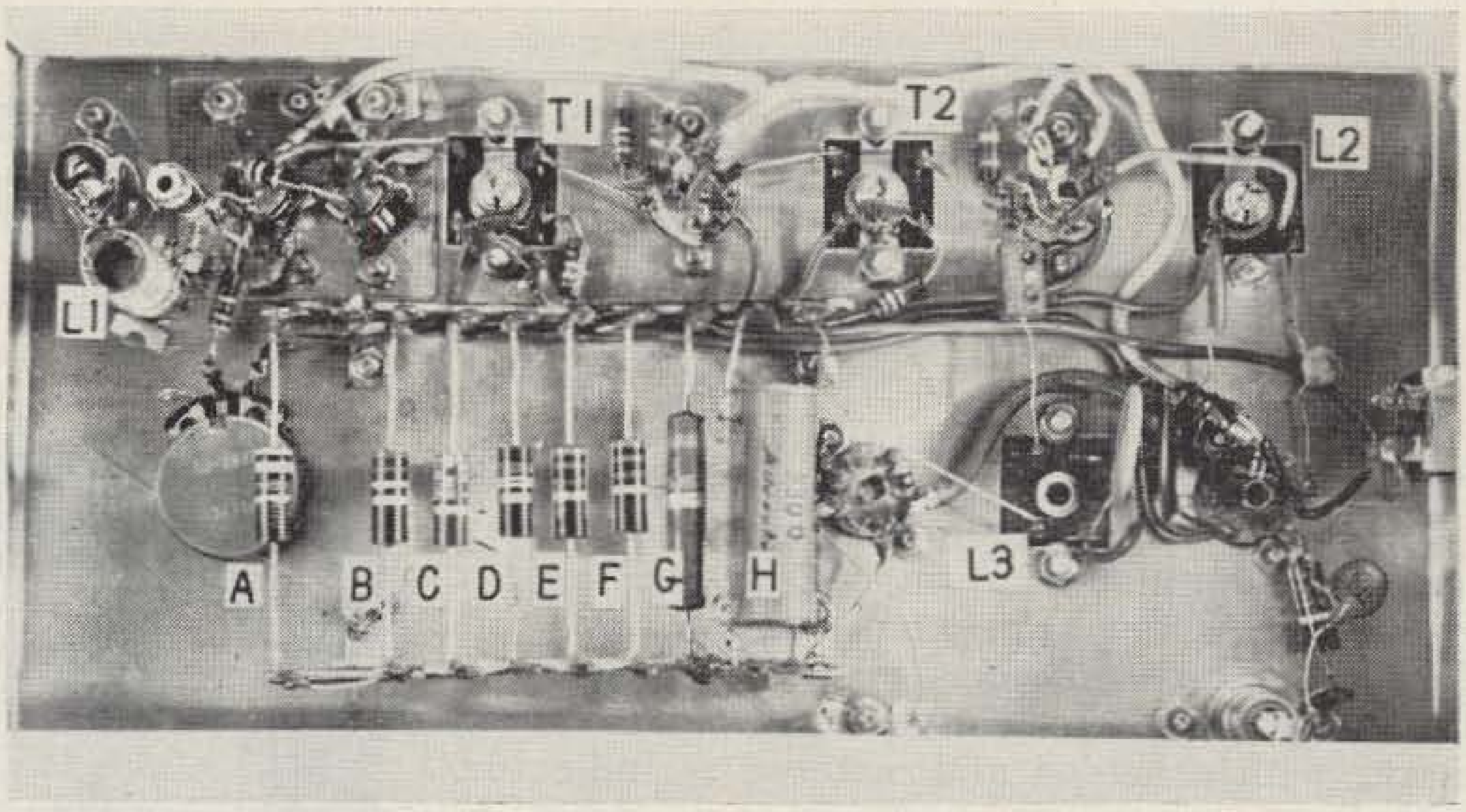


Fig. 3

The oscillator coil (L3) is a tank circuit and should be a fairly high Q so some capacity should be across the coil. It was found that with a 25 mmfd capacitor across the coil it would tune to 19.5 mc when wound with 15 turns of #18 wire. To pick up a signal for injection into the mixer a couple turns of insulated wire is wrapped loosely around the coil and soldered to the lug which connects to the mixer grid through the 15 mmfd capacitor. The coil form (slug tuned) was removed from an old TV tuner, but a Miller 6218TV video *if* transformer would work here also, as would many other types of coils.

## Power Requirements

The converter will draw about 35 ma when the voltage on the B plus bus has 150 volts on it. Resistor "H" is a voltage dropping resistor in series with all of the decoupling and dropping resistors feeding the tubes. If your power source is 250 volts you will need a drop across "H" of 100 volts. Since $R = \frac{E}{I}$ we find we need $\frac{100}{.035}$ or approx. 2860 ohms. A 3000 ohm resistor would work fine. The power dissipation needed would be 100 X .035 or 3.5 watts. A 10 watt resistor would be OK but a 20 watt one still better since by using a much larger one there would be less heat dissipated. If your supply is 150 Volts connect directly to B plus bus line.

## Alignment

From a WEAK signal source such as a weak station or signal generator or crystal oscillator adjust the rf gain control on your receiver so that the S meter will read about S 5. Set signal source to around 50.3 mc and adjust C across antenna input coil for peak. Set Signal source to 50.8 and tune the top of T1 and T2 for maximum reading on S meter. If meter goes above S 9 reduce rf gain control. Then set signal source to 50.1 and adjust the bottom of T1 and T2 for peak reading. Now set to 50.5 and adjust output coil L2 for Maximum. If you cannot get a peak with slugs all the way into the coil add some capacity as described earlier. You should get very broad peaks—don't expect a sharp one. The sharpness of the peaks in no way indicates the noise figure of the converter. In fact we found with the input coil way off frequency we could still get a good noise figure with much reduced sensitivity.

## Conclusion

This converter is hot—it puts out more than an S9 "hiss" into most receivers. If your receiver does not have an rf gain control it would probably be well to reduce the output of the converter feeding the receiver by putting a very small capacitor "J" in place of the .001 shown in the diagram. The front of the converter is quite subject to overload from strong stations and because of it's great sensi-

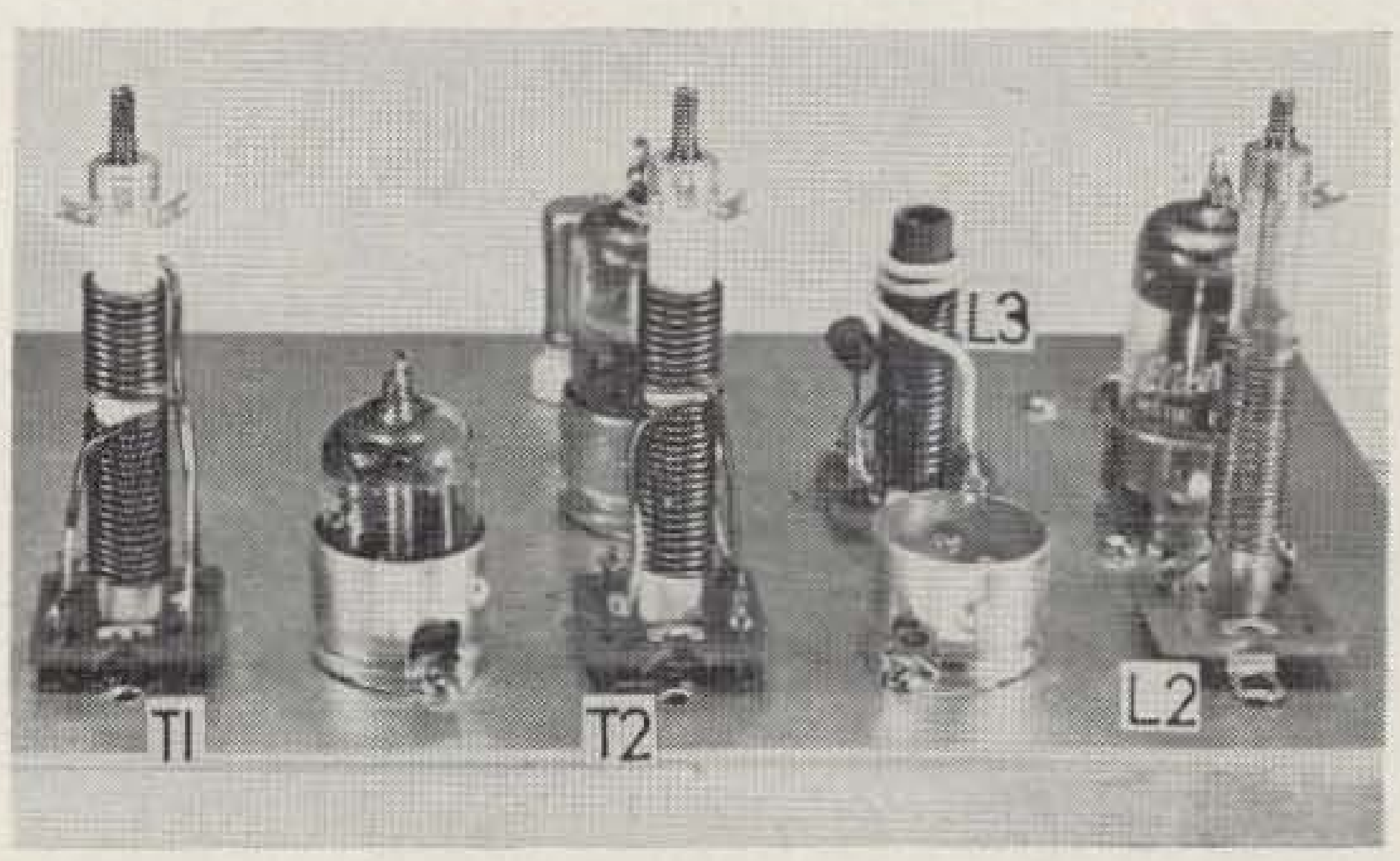


Fig. 4

(Continued on page 61)

# The Power Meter

Tom Lamb K8ERV
1066 Larchwood Road
Mansfield, Ohio

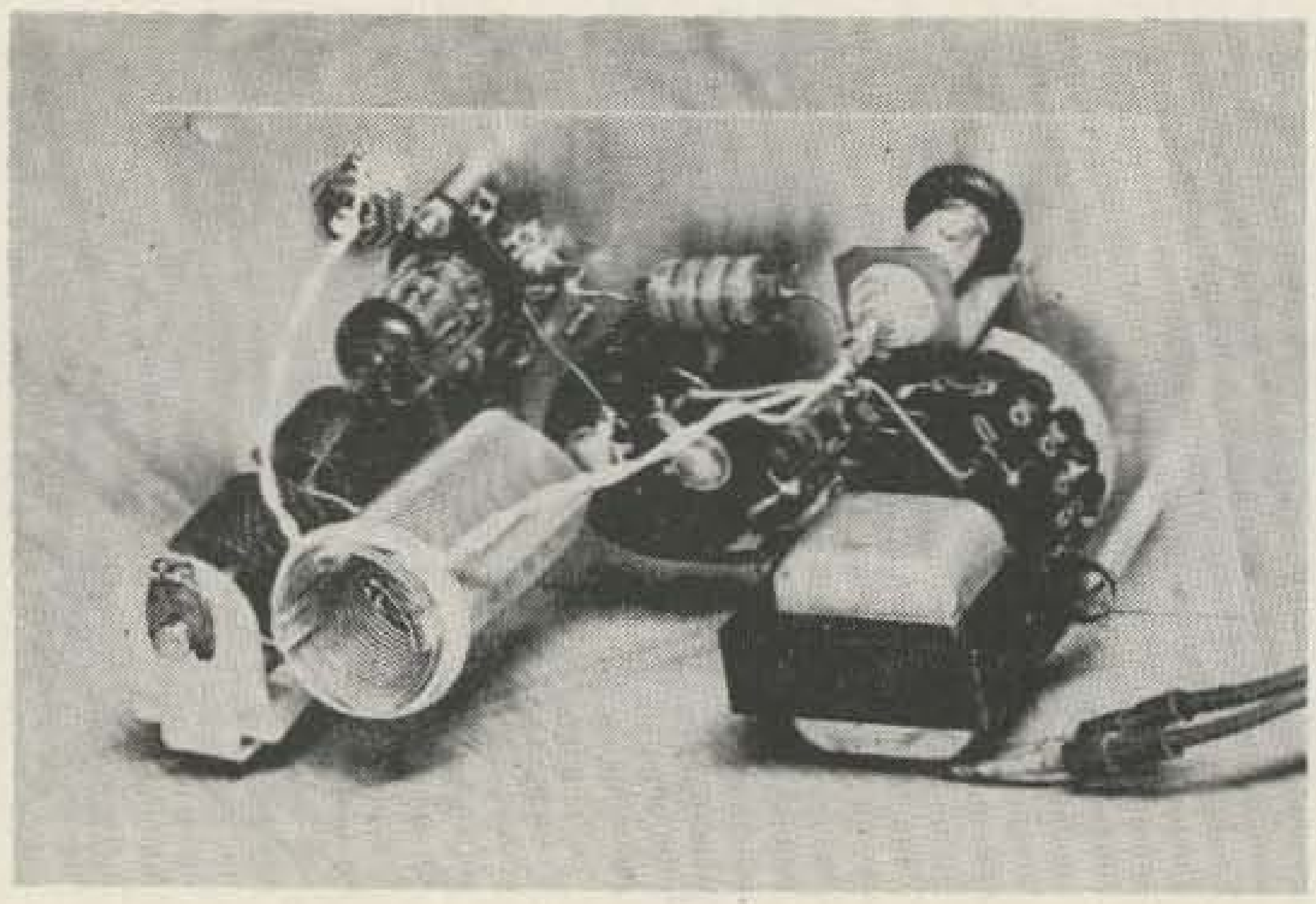
THE Power Meter was designed to be a "dummy next stage." When coupled to an oscillator, amplifier or multiplier tank coil it will indicate the approximate drive available for the following stage. It is basically a comtinuous tuning, link coupled absorbtion wavemeter with a loaded and metered *rf* indicator.

## The Circuit

The first departure from standard wavemeter design is the use of a multiband resonant circuit, tuning 4 to 35 mc. The very simple MBT described by Johnson[1] solves the problem of winding and finding numerous plug in coils. The reader should refer to Johnson's article for changes in the tuning range or L and C values. As with any multiband tank, two frequencies are tuned simultaneously. However, these two frequencies are far enough apart that the correct one will usually be obvious from the circuit under test.

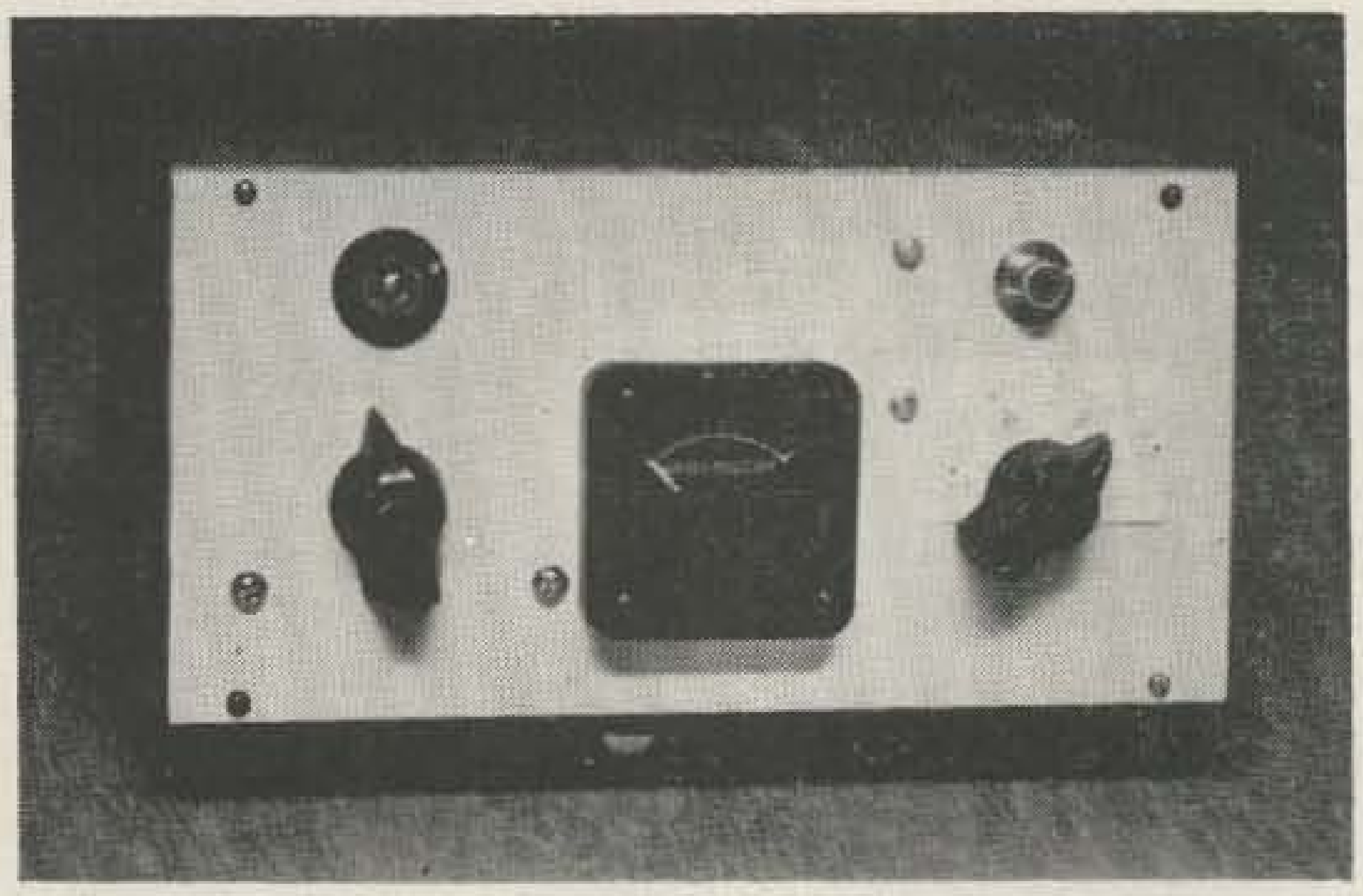
The MBT is coupled into the simulated "next stage" consisting of various values of grid resistance, a grid current meter, and a 6AL5 diode. Don't try to use a semiconductor diode in this circuit.

A #49 pilot lamp is coupled to the MBT for those who are used to its power indication. The lamp should be removed from its socket during calibration, accurate frequency reading and



metered power reading.

The construction is not at all critical. This meter was thrown together in a hurry to meet an immediate need. Mount L1 to C1 with short leads, don't place metal panels too near to L1, and you have it made.



Remove the lamp and set S1 to 10K-1 ma. Loosely couple the link to a grid dip oscillator. Set each desired calibration frequency on the GDO, peak C1 and mark the dial. When the high end of C1 is reached, pick up the same frequency at the low end and keep on going up.

The Power Meter will do anything a conventional wavemeter will do, within its frequency range. Some of its uses are:

Frequency Indication-Method 1. Couple the Power Meter link to an operating circuit, peak the meter with C1, and read the frequency. S1 serves as a sensitivity control. Note that the dial will indicate two possible frequencies. normally the correct one will be obvious, but there is no way of being sure without additional equipment. This is the disadvantage of the mulitband tank.

Frequency Indication-Method 2. If the tuned circuit to be measured has its own indicator, such as a grid or plate current meter, simply use the Power Meter as an *absorbtion* wavemeter. Couple the link to the operating tuned circuit and adjust C1 for a sharp dip in the circuit's indicator. The advantage of Method 2. is that no line power is required for the 6AL5, making the Power Meter useful for portable and mobile work.

Harmonic Indicator. Couple the link to the circuit being tested and run C1 throughout its range. Use S1 for a sensitivity control. All frequencies present will be read and their relative voltages indicated.*

It is interesting to note the amount of undesired output in high-order frequency multi-

[1]Johnson, "Multiband Tuning Circuits," QST, July, 1954.

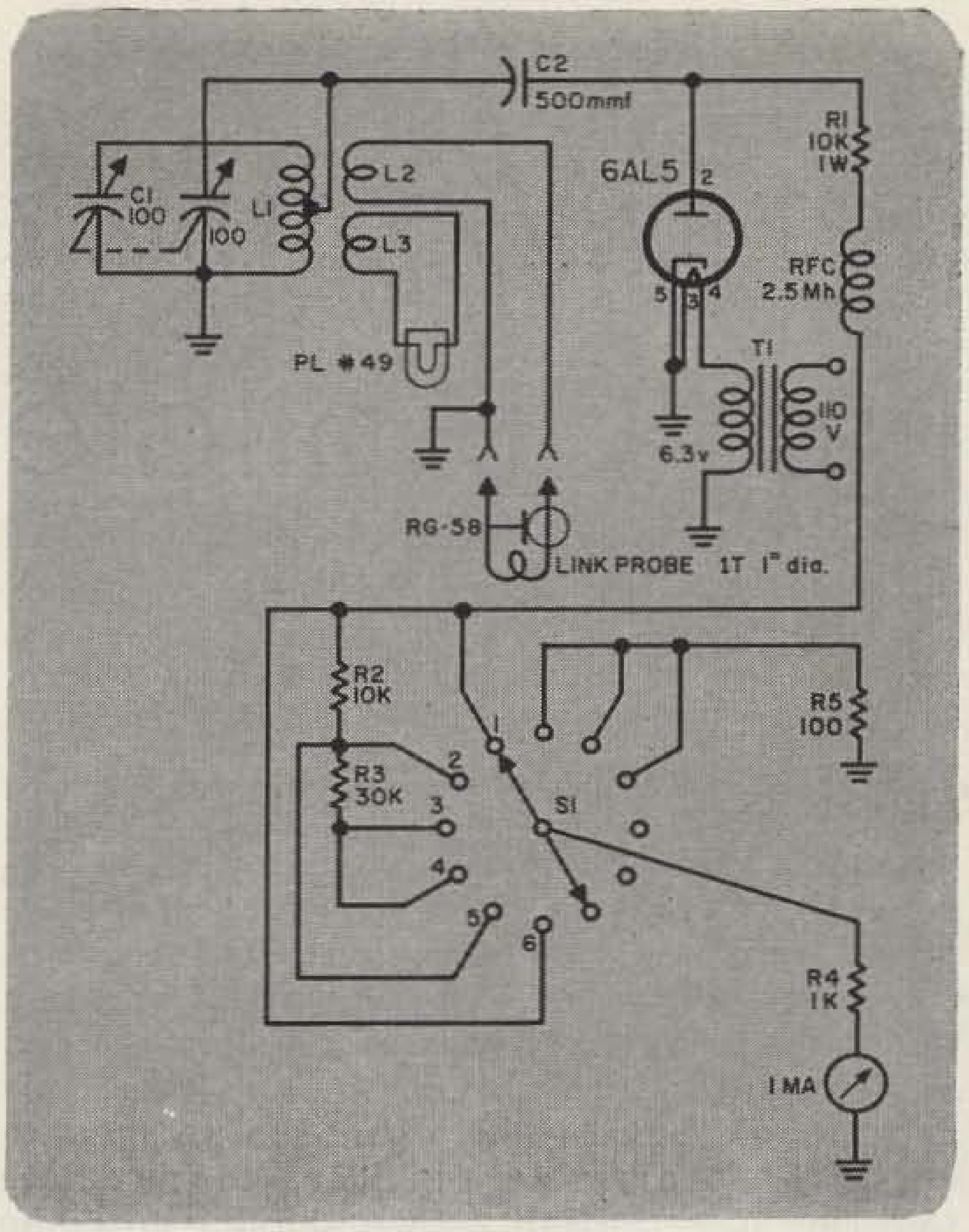
*Note that the meter indication may not be exactly the same at various frequencies even with the same input power. This is because the various couplings and the L/C ratios change with frequency.*

pliers. The low Q tank circuit usually used in multipliers may pass considerable energy at one multiplication above and below the desired one. Thus in a quadrupler the Power Meter will show additional outputs at three and five times the fundamental. If strong enough, these outputs can contribute to the grid current of the next stage and give a falsely high reading.

In the hetrodyne type of exciter, the output strength of the undesired products of mixing is strongly affected by the amplitude of the input signal. Indicating the relative voltages of the desired and undesired outputs is a main feature of the Power Meter.

Output Power Indicator. When breadboarding an oscillator or multiplier, the Power Meter becomes a metered load, or dummy next stage. Set Sl for the planned resistance and current of the next stage, couple the Power Meter to the output coil, and read the approximate drive that will be obtained.

With a little experience, the Power Meter can be one of the most useful accessories in the shack. It is in almost daily use in mine, and I would like to hear from anyone finding other useful applications. 73




# Surge Protection in Reverse

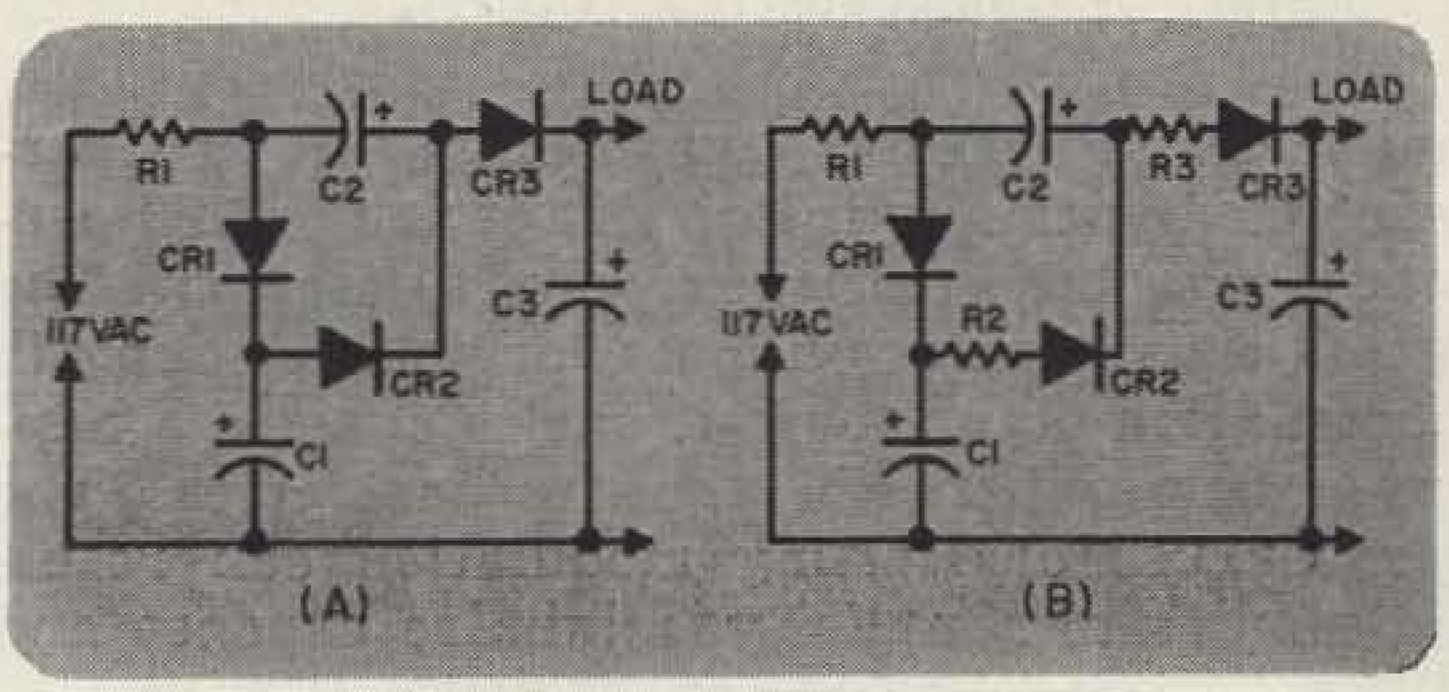
Roy E. Pafenberg

A VOLTAGE multiplier power supplies have increased in popularity since the introduction of silicon diodes. The classic voltage tripler circuit is familiar to most and the function of the input surge resistor needs little explanation. The value of this resistor, R1 in Fig. 1A, is such as to limit the charging current of the capacitors to a value below the maximum surge current rating of the rectifiers. For example, the Sarkes Tarzian M-500 silicon diode is rated at 30 amperes surge current. The limiting resistor is calculated on the basis of peak applied voltage and for a line operated supply would be $\frac{117 \times 1.414}{30}$ or at least 5.5 ohms.

Not so obvious is the function of resistors R2 and R3 in Figure 1B. Assume the power supply shown in Fig. 1A is delivering power to a light load and that the input line is opened, leaving C1 charged to the peak line voltage. Accidental or safety shorting of the supply output will discharge C1 through diodes CR2 and CR3, invariably leading to the catastrophic failure of both rectifier units. Resistors R2 and R3 will limit this current to a safe value in the event the power supply output is accidentally shorted. Values the same as R1 should provide adequate protection with commonly used filter capacitor values.

The entire question of safety shorting of capacitors is open to debate. Capacitors, even of the electrolytic type, can hold lethal charges for a substantial period of time and common sense dictates that they should be discharged before working on the circuit. On the other hand, short circuiting the terminals of a charged capacitor can result in current that will fuse the internal leads of the unit. Also, rigging of haywire limiting resistors to safely discharge the capacitors could possibly result in more accidents that the procedure was designed to avoid.

The best answer appears to be the inclusion of limiting resistors such as R2 and R3 in Fig. 1 B to provide protection to the components in the event of accidental shorting of the supply and a fail safe bleeder circuit for personnel protection. This arrangement will provide the maximum protection to components and the amateur. . . . Pafenberg



# Let's Modulate, Not Crepitate

Richard A. Genaill K4ZGM
719 Quarterstaff Road
Winston-Salem, N. C.

Every year, about this time, a rash of articles begin to appear in almost all of the popular "ham" publications dealing with low-power transmitters designed for mobile or other portable type operations. This rash is more than likely caused by visions of vacation trips, Field Day activities or possibly the end of the winter hibernation. At any rate, this article is designed to help *you*, the prospective low-power transmitter builder, to modulate that flea powered job without having to make any excuses for low modulation percentage or severe distortion.

You may have noticed that many of the portable transmitters described in various articles make use of "choke-coupled" or, more commonly, Heising modulation. In many cases, the author fails to indicate that in his transmitter design he may have only 70 to 80 percent modulation with low distortion or 100 percent modulation with severe distortion. The usual circuit arrangements for "choke-coupled" modulation do not permit one to achieve a happy medium between the two extremes. The proper use of Heising modulation can result in maximum simplicity, minimize expense and give one a fully modulated-low distortion portable transmitter that will get results. Here's how it's done, the easy way.

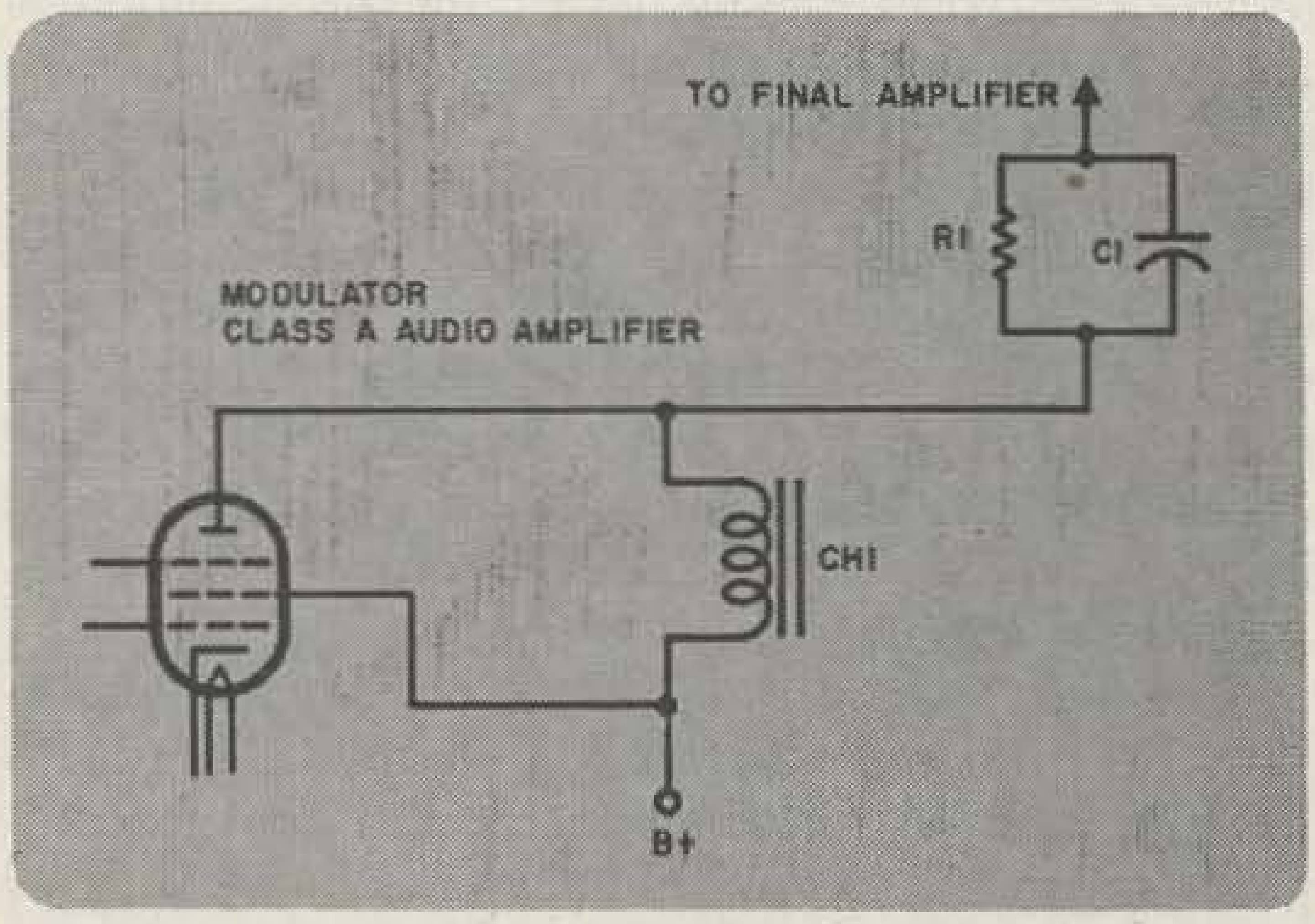



Fig. 1. Choke coupled or Heising modulator. C1—Audio by-pass capacitor. CH1—Audio choke (high impedance at audio frequencies). R1—Dropping resistor (adjusted for 100% modulation by consulting tube charts).

To understand the basic fundamentals of "choke-coupled" modulation take a look at Fig. 1. This is the circuit of the basic Heising modulator and simplicity in itself. The input power to the final amplifier is a combination of the dc power from the plate supply and the audio power from the Class A Audio Amplifier-Modulator. The use of audio choke CH1, rather than a modulation transformer, establishes a 1-to-1 coupling ratio between the modulator tube and the final amplifier stage requiring that the dc plate voltage and plate current to the final amplifier be adjusted to a value which will produce a suitable impedance match between the final amplifier and the Class A Amplifier plate. Even though we may be able to select suitable modulator and final amplifier tubes whose electrical characteristics will provide an impedance match we would not be able to achieve 100 per-cent modulation without severe distortion unless resistor R1 and capacitor C1 were included in the circuit. This is because, with identical plate voltage on both the final amplifier and modulator, the audio frequency voltage developed by the modulator cannot swing to the 100 per-cent modulation level (Zero to twice the plate voltage) without causing distortion as it approaches zero. R1 provides the necessary voltage drop between the modulator and the final amplifier to make possible a sufficient audio frequency voltage swing to permit 100 per-cent modulation with lower distortion. The capacitor C1 provides the necessary audio by-pass across resistor R1. The reactance of C1 should not be more than one-tenth the resistance of R1 at 100 cycles. The value of R1 must be calculated by using the published family of curves for the modulator tube use. Without R1 and C1, the modulation percentage is limited to between 70 and 80 per-cent to minimize distortion in the case of the average transmitter. It can be seen, by these few facts, that the design of the circuit entails a certain amount of calculation in order that satisfactory operation may be obtained.

The circuit of Fig. 2 shows a system of shunt feed that virtually eliminates the need for extensive calculations. One can usually dig up an extra choke in the "J" box, especially the small, low current capacity receiver type. It can be seen that a difference in voltage can be obtained for the modulator and final amplifier either by the use of the dropping resistor R1 or by the use of two separate plate supplies. For the sake of economy the use of the dropping resistor is to be preferred. With a means of obtaining two different voltages, the plate voltage for the modulator tube may be kept higher than the voltage on the final amplifier thus permitting the necessary audio frequency voltage swing at a lower distortion level. The usual simple rf amplifier plate impedance calculations should be made and the amount of audio required for 100 per-cent modulation should be determined. Since the arrangement provides a 1-to-1 coupling ratio, the tube selected for the modulator should be capable of delivering the necessary amount of audio power (usually one-half of the rf amplifier input dc power) at the same plate impedance as the final amplifier. So that the af voltage on the plate of the modulator may swing sufficiently to produce 100 per-cent modulation without the swing reaching zero, the tube used in the modulator should be one which requires a somewhat higher operating plate voltage than the final amplifier. The audio chokes in Fig. 2 may be regular filter chokes of the 10 to 30 henry variety. The inductive reactance of choke CH2 should be at least equal to the Class C amplifier load impedance at the lowest frequency to be modulated. Capacitor C1 should be of the oil type and have a reactance much lower than the Class C rf amplifier load impedance at the lowest audio frequency to be transmitted. In most cases anything from .5 to 2 mfd. will do the trick.

To make things a lot simpler when you start laying out that low power rig, Fig. 3 provides a listing of the most popular tubes which can be used for Class A Amplifier service at low power outputs. Many of the portable rigs and most of the Citizen Band units make use of a final amplifier tube which runs at approximately 250 volts at 20 ma for an input of 5 watts. The plate input impedance runs approximately 12,000 ohms. Approximately 2.5 watts of audio are required. A 6AG7 would do a splendid job in modulating in this case. The 300 volts on the plate would permit sufficient af voltage swing without distortion, the audio power is more than adequate, the plate impedance is close enough to function properly and the 300 volts can be dropped to 250 for the final amplifier tube with no great difficulty. Another combination might be a 6L6 final amplifier running at 325 volts and 70 ma for an input of about 22 watts. The plate impedance would be around 4,600 ohms and the required audio power for 100 per-cent modulation would be near 11 watts. Another 6L6 with 350 volts on the plate would do the job quite well as the modulator.

The shunt-feed system has been used by the author in several low powered transmitters and has proven to be quite successful. It is always a pleasure to have other hams tell you that your low power rig is the best sounding one that they have heard on the air and that you have the audio punch that most low power rigs lack. The next time you start laying out that simple modulator for that portable or mobile unit give shunt-fed Heising a try. You'll be glad that you did. . . . K4ZGM

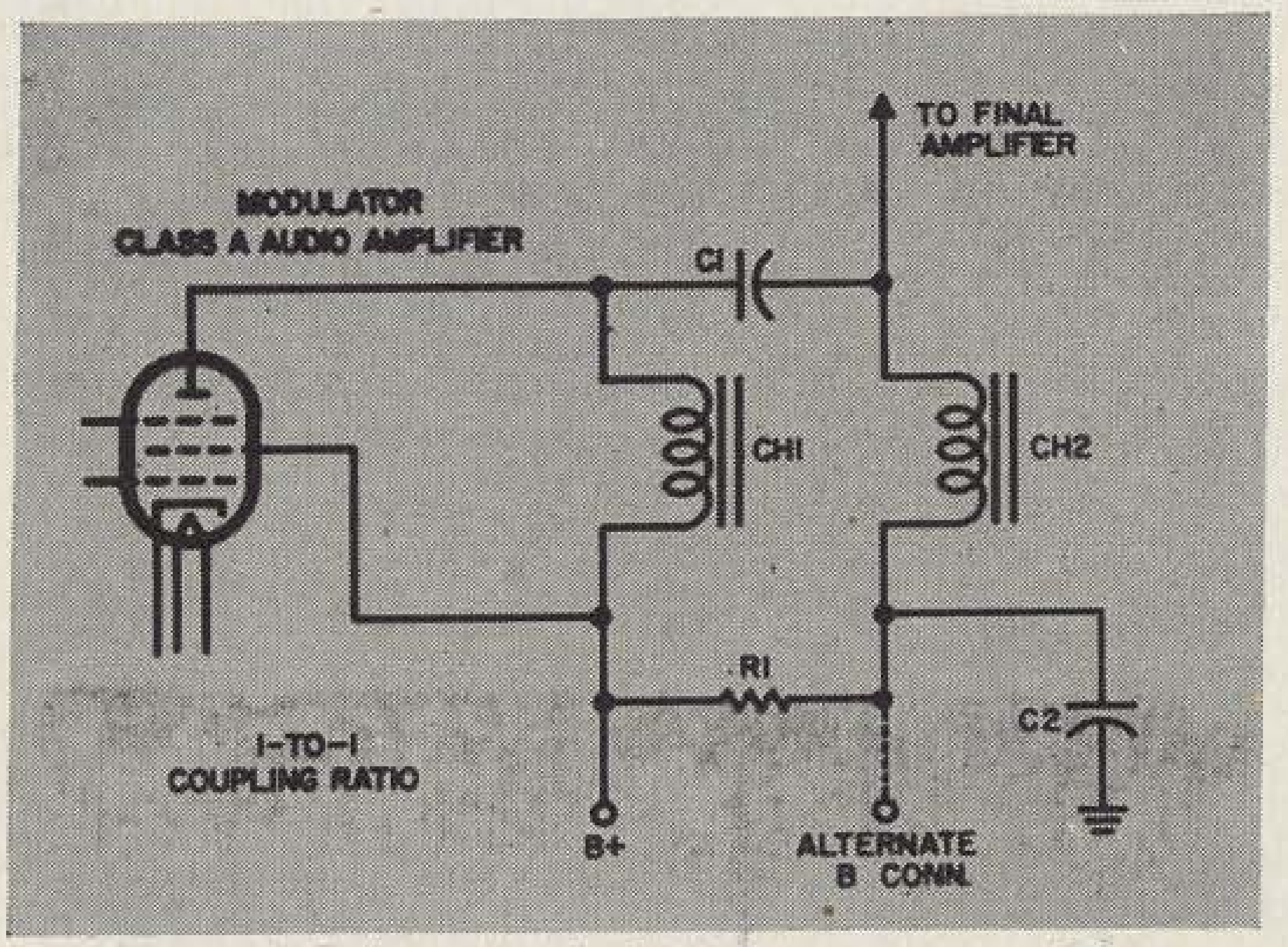
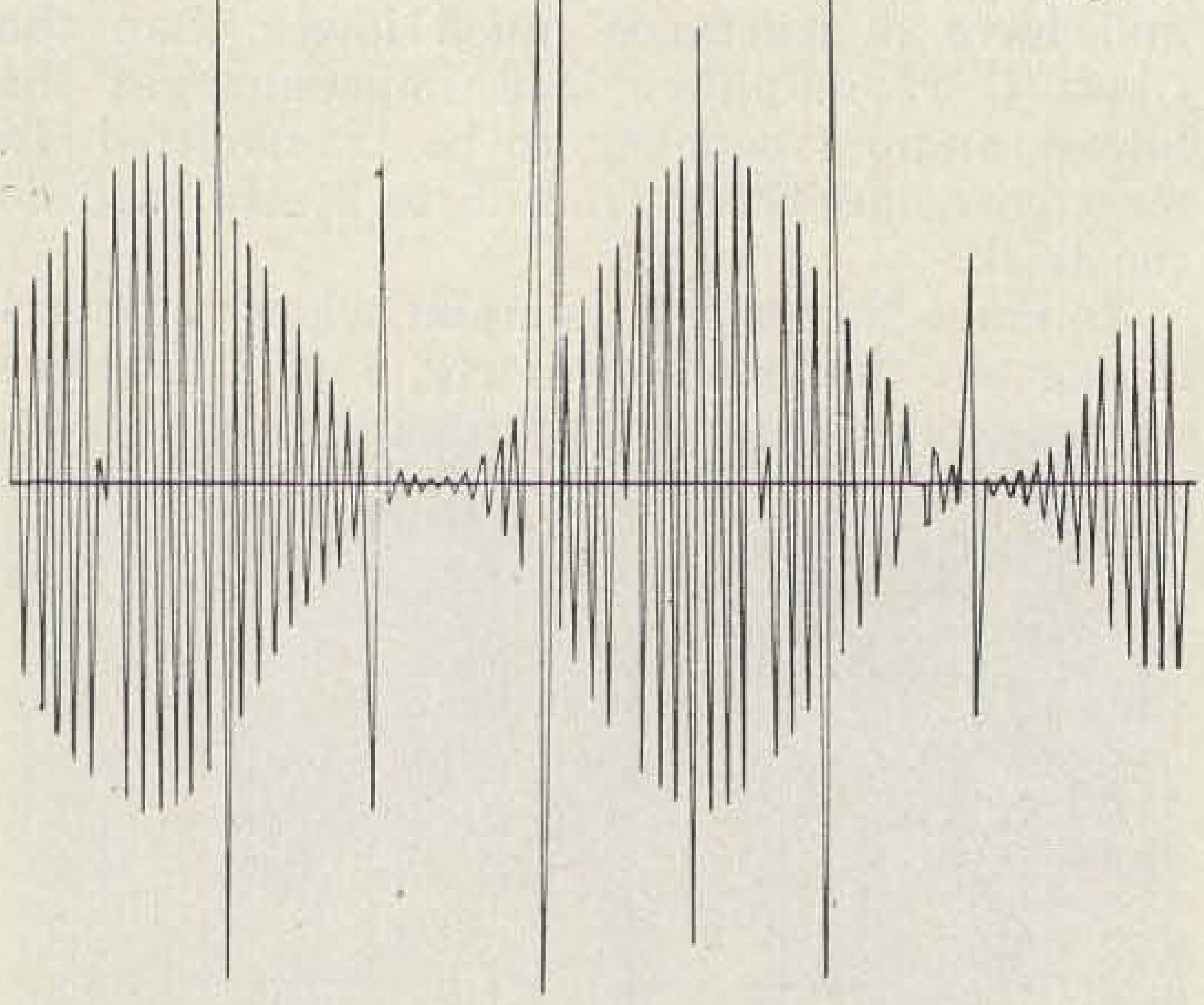



Fig. 2. Choke coupled or Heising modulator using shunt feed. C1—Coupling capacitor (oil). CH1 & CH2—Audio chokes (filter 10 to 30 Hy). R1—Dropping resistor (adj. for correct final amplifier plate voltage . . . see text). C2—Filter capacitor (use only if R1 is used.)

| Type | Plate Volts | Load Resistance Ohms | Power Output Watts |
|---|---|---|---|
| 6AG7 | 300 | 10,000 | 3.0 |
| 6AK6 | 180 | 10,000 | 1.1 |
| 6AQ5 | 180 | 5,500 | 2.0 |
| 6AQ5 | 250 | 5,000 | 4.5 |
| 6AR5 | 250 | 7,600 | 3.4 |
| 6AR5 | 250 | 7,000 | 3.2 |
| 6AS5 | 150 | 4,500 | 2.2 |
| 6BK5 | 250 | 6,500 | 3.5 |
| 6CL6 | 250 | 7,500 | 2.8 |
| 6F6 | 285 | 7,000 | 4.8 |
| 6F6 | 250 | 7,000 | 3.2 |
| 6G6G | 180 | 10,000 | 1.1 |
| 6G6G | 180 | 12,000 | 0.25 |
| 6K6GT | 315 | 9,000 | 4.5 |
| 6K6GT | 250 | 7,600 | 3.4 |
| 6K6GT | 100 | 12,000 | 0.35 |
| 6L6 | 350 | 4,200 | 10.8 |
| 6L6 | 250 | 2,500 | 6.5 |
| 6V6 | 315 | 8,500 | 5.5 |
| 6V6 | 250 | 5,000 | 4.5 |
| 6V6 | 180 | 5,500 | 2.00 |

Fig. 3. Typical Tube Types Useful in Class A Amplifier—Low Power Modulator Service

Fig. 1



# A New Noise-Limiter Circuit

Jim Kyle, K5JKX/6

THE automatic-noise-limiter circuitry is today one of the weakest design links in a good communications receiver. While modern ANL circuits do remove some types of impulse noise, they still leave an appreciable amount in the signal, and it's a rare new-product report that fails to condemn the ANL with faint praise.

Most of today's receivers still use gating-diode noise limiters, which either short the noise pulses to ground when a certain level is exceeded, or open the audio signal path for the duration of the pulse. In neither case is anything done about noise pulses which do not reach limiting level.

In fact, most communications-receiver users habitually set the limiting level to operate at the 50-percent-modulation point, thereby severely distorting the audio signal, in an effort to minimize noise leakage.

The reason for lagging development of noise-limiter circuitry in this country may be that the only groups seriously interested in the problem are hams and citizens-band operators, and neither group is large enough nor vocal enough to demand improvement.

However, our British cousins have been forced to deal with the problem, since TV sound in Great Britain is carried on an AM channel instead of the FM used here. At the frequencies used, impulse noise has been a serious situation for them—and the video audience *is* large enough and vocal enough to demand improvements.

As a result, at least one British writer has declared that (under the proper conditions) AM sound may even be superior in signal-to-noise ratio and in general quality to FM.

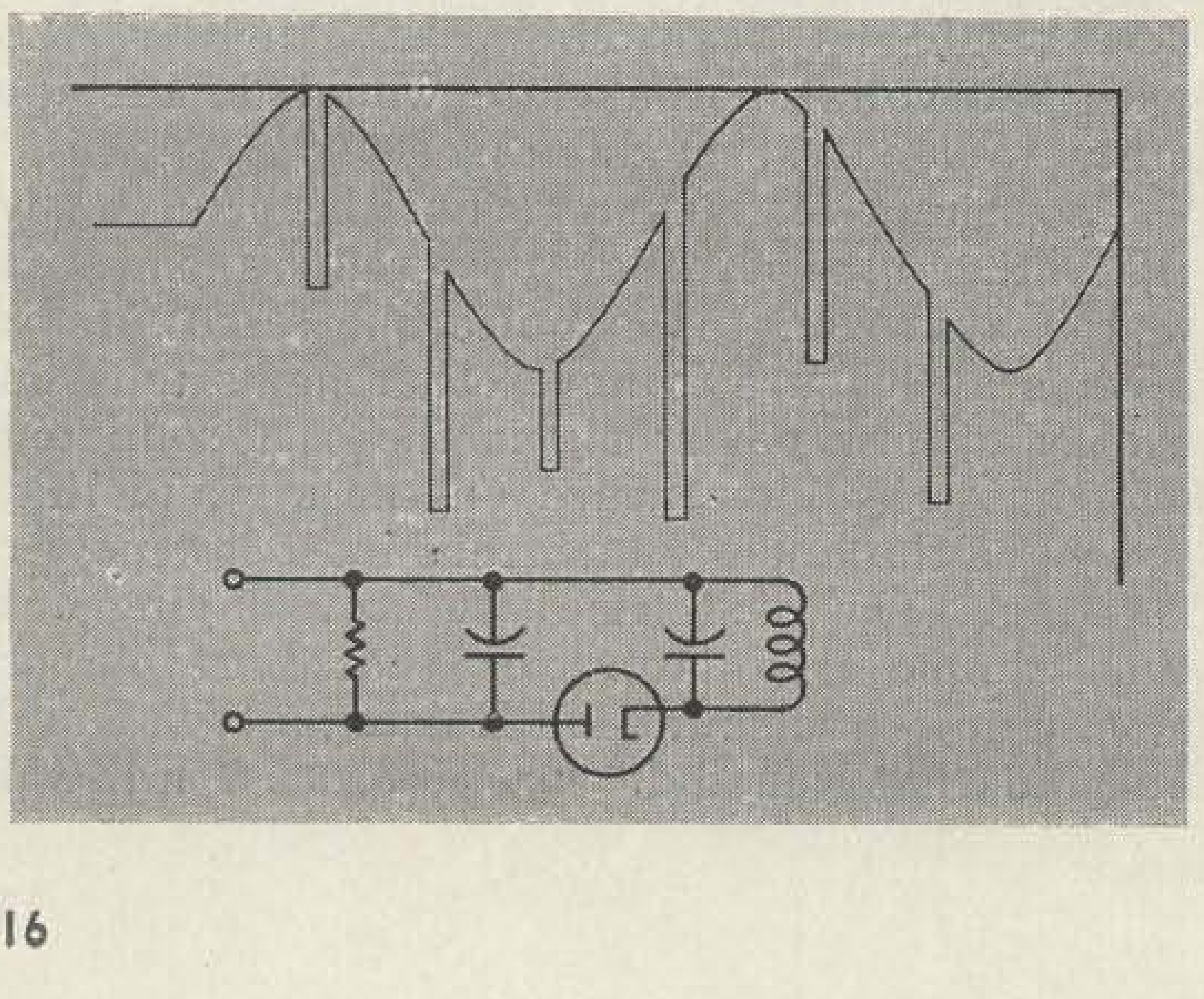
Be that as it may, they have developed some excellent noise limiters. The one shown here was described in the November, 1960, issue of *Electronic Technology* (Television Noise Limiting in AM Sound Channels, by H. D. Kitchin) and is capable of virtually wiping out all ordinary impulse noise from a communications receiver. The circuit as shown has been converted to use standard American tubes and part values.

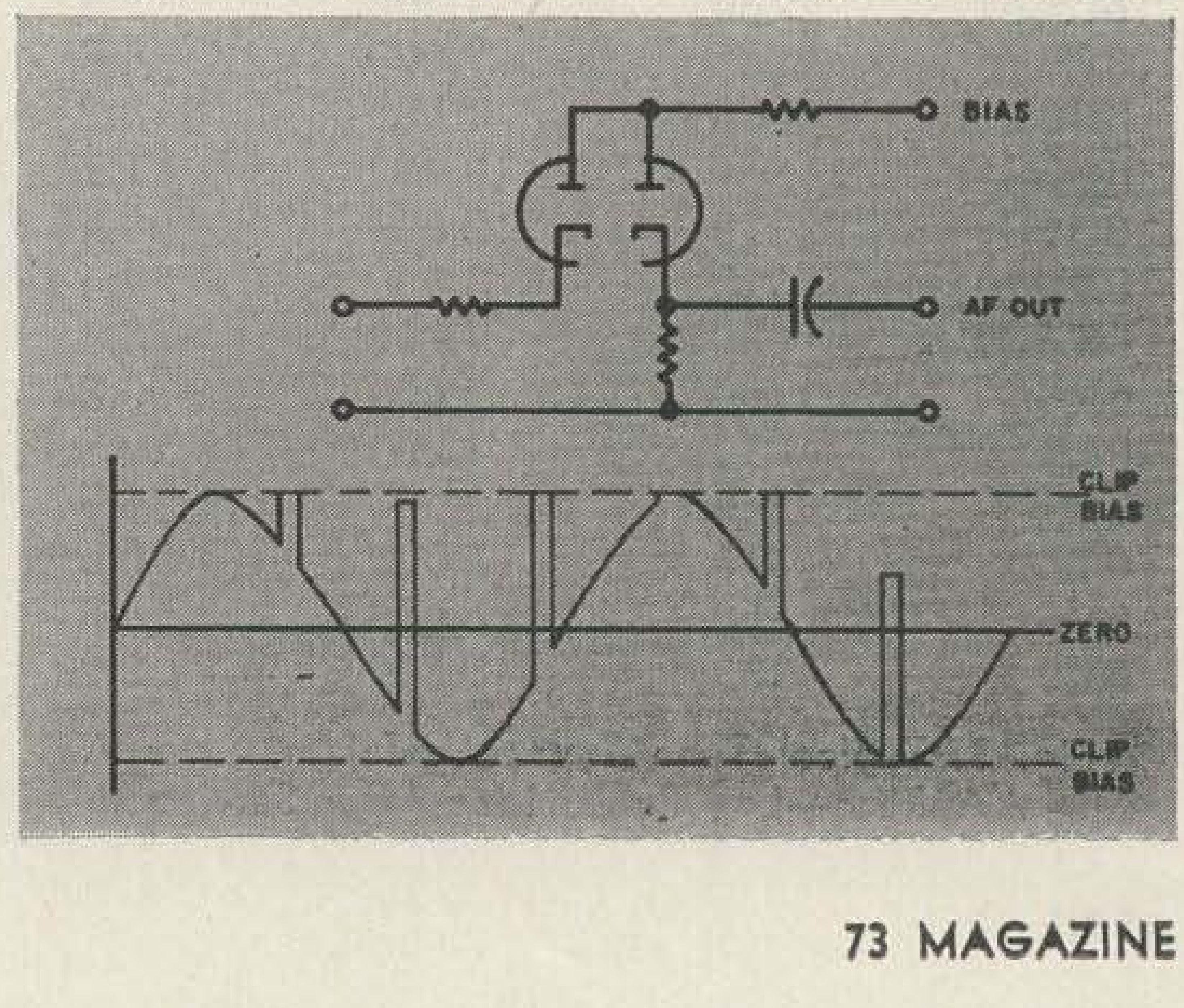
This limiter, though it appears similar to our conventional series-diode gate at first glance, operates on a completely different principle. Rather than rejecting noise pulses because of their amplitude, it rejects them because of their rapid rise time. This enables it to detect even the smallest noise pulses and to wipe them from the audio signal.

To get an idea of how it works, look first at Figure 1. This shows (to accurate scale) a 3000-cycle sine wave modulated on a 100-kc carrier wave, and badly distorted by noise pulses of approximately 10-microsecond duration (most troublesome noise pulses last from 1 to 10 microseconds, so this is the worst usual case). Note that the noise may either add to the signal, or cancel it out. This signal exists at the detector input.

Figure 2 shows the same signal as it would be seen at the detector load resistor. Note that the only noise pulses which survive the detection process are those which momentarily increase signal strength.

Figure 3 illustrates the action of the con-





ventional full-wave series-diode noise limiter, used in most modern communications receivers, when the limiting level is set to clip at 100 percent modulation. While the high noise peaks are eliminated, fairly large "stumps" remain and are frequently clearly audible.

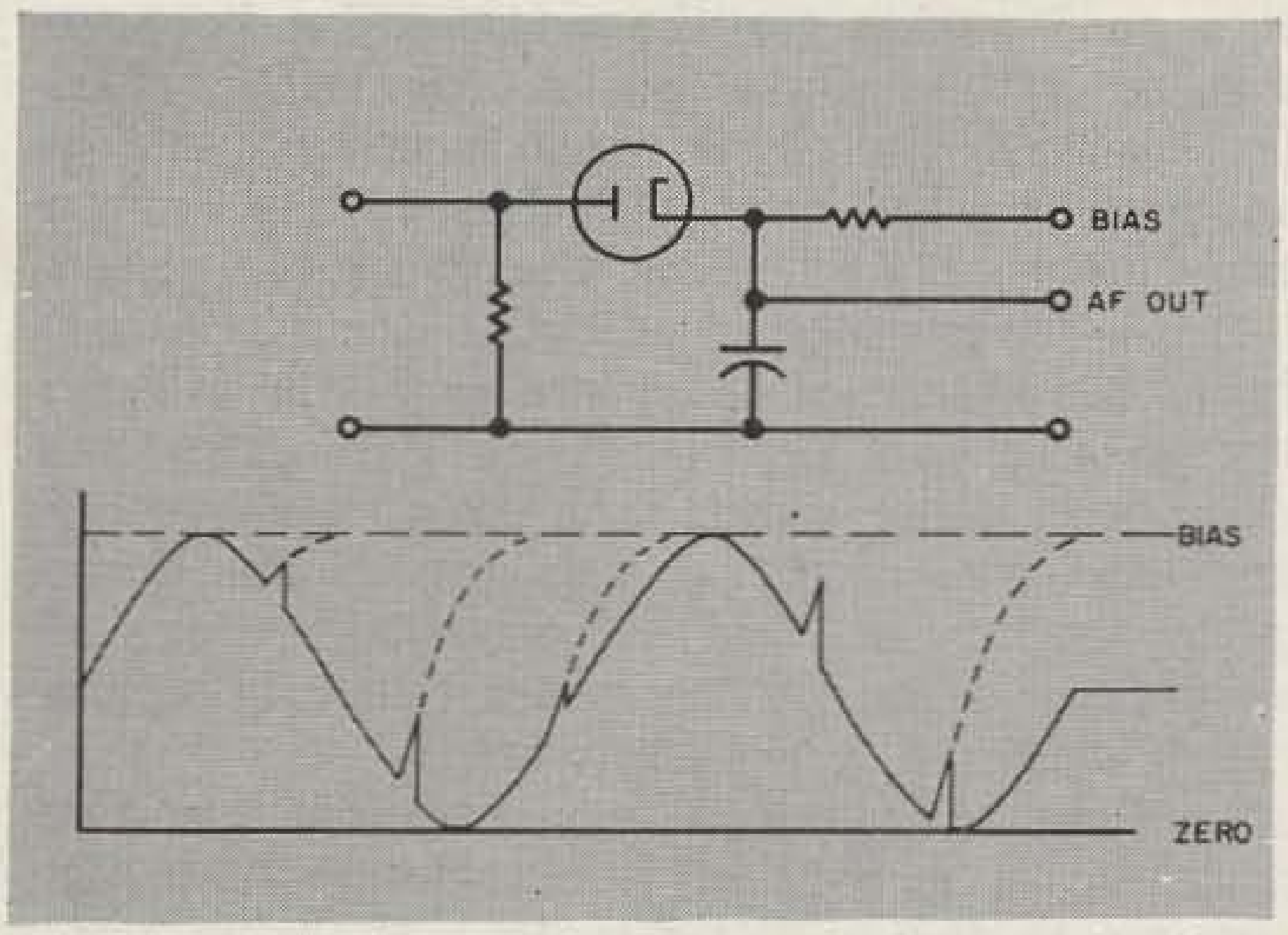



Figure 4 shows the rate-of-change limiter. Incoming audio, containing noise pulses, is applied to the diode plate. Negative bias equal to the peak-to-peak signal voltage is applied to the cathode. The time constant of the bias resistor and the output capacitor, together with the bias voltage, determine the operating point.

When the time constant is properly chosen, the voltage across the capacitor follows the audio signal envelope which passes through the diode, and the output is a replica of the input.

However, when a noise pulse causes a rapid change of the input signal value, the diode is suddenly driven into reverse-bias conditions and cuts off. The capacitor voltage then rises toward the bias value at a rate determined by the time constant (dotted lines in Figure 4). As soon as the input signal returns to a value low enough to reestablish forward-bias conditions, the capacitor discharges to the audio-signal level and output once more follows input.

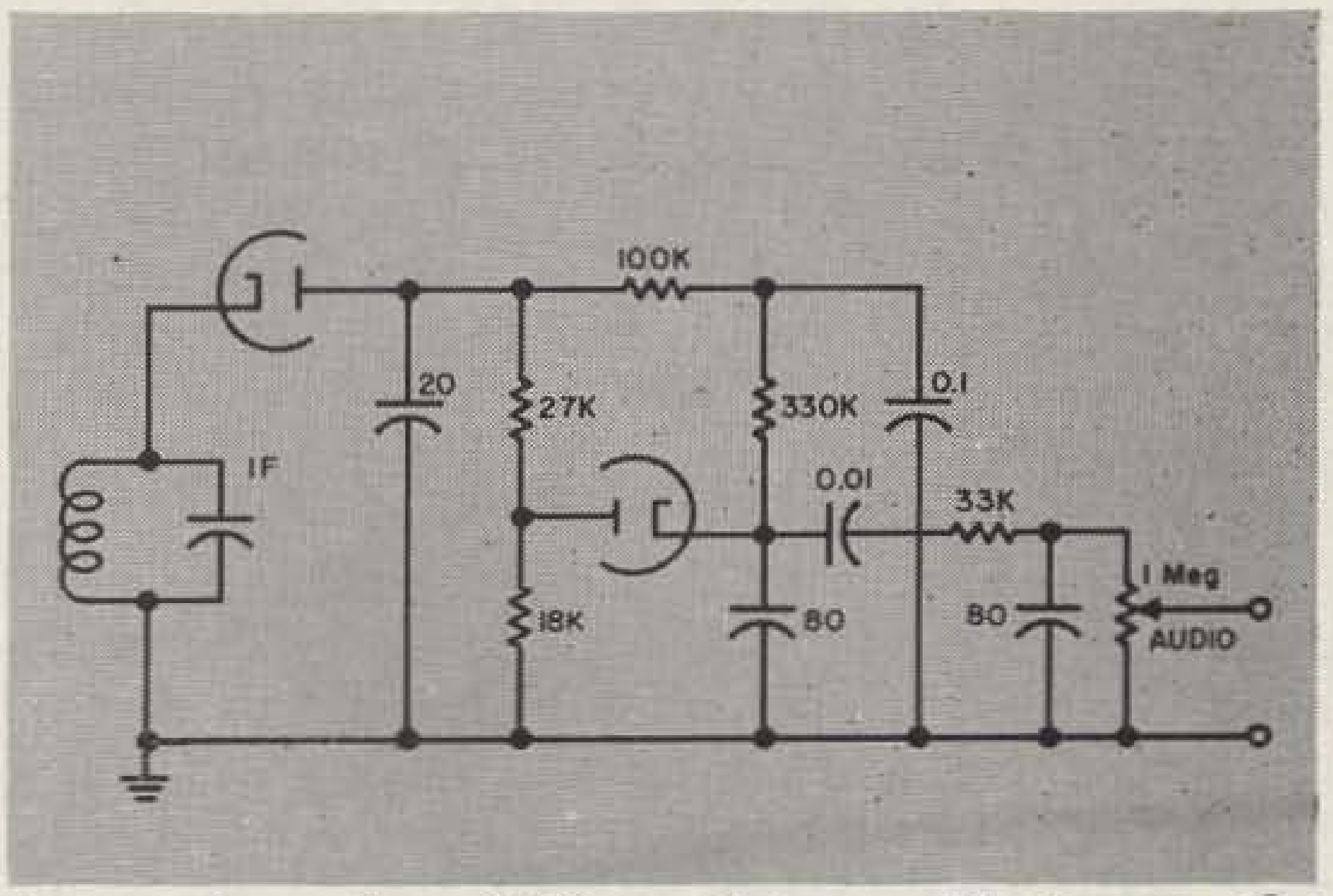
The noise pulse is limited to an extremely small value by this process, if bias voltage is approximately equal to peak-to-peak signal input. However, if fixed bias is used this will rarely be the case, since signal voltage varies from instant to instant.

By taking the bias voltage from the detector load resistor (through a filter) and obtaining the audio-signal input from a tap on this resistor, instantaneous bias voltage can be set at the proper value for minimum noise and zero distortion. A comparison of noise-pulse suppression achieved by this limiter and by the series diode is shown in Table I.

The circuit can easily be added to any receiver now equipped with a diode detector. The schematic diagram is shown in Figure 5. The complete limiter circuit can be assembled on a Vector 7-pin turret and substituted for the existing detector.

Three critical points must be checked during construction. The volume control's total resistance must be 1 megohm, as shown. Any different resistance will vary the load on the limiter, requiring a change in limiter time constant (determined by the 330K resistor and the 80 mmfd capacitor from cathode to ground). Connections to the last if transformer must be as shown; the existing diode load resistor and filter must be disconnected. Frequently, these components are located inside the if transformer case. If in doubt, contact the manufacturer or check service information. Finally, note that all signal-carrying lines are at high impedance to ground and are therefore subject to hum pickup from heater leads. Twist the heater leads together and keep them away from all components.

As shown, the limiter will handle 100-percent-modulated signals without distortion, and will suppress most noise pulses more than 40 db below the signal level. If you should want to suppress the noise more than this, at a sacrifice in distortion, you can change the ratio of the 18K and 27K resistors which make up the detector load resistance. Total value of the two, however, should be maintained between 45K and 50K ohms for proper detector action. Increasing the 18K unit while




decreasing the 27K resistor will lower the effective bias level, thereby suppressing the noise even more. . . . K5JKX/6

### Pulse Suppression Below Signal Level

| Pulse Width (in microsec) | Series-Diode | Modified Rate-of-Change |
|---|---|---|
| 1 | 48 db | 85-90 db |
| 5 | 30 db | 55 db |
| 10 | 24 db | 43 db |
| 50 | 10 db | 15 db |
| 100 | 6 db | 6 db |
| 300 | 0 db | 0 db |
| above 300 | not effective | not effective |

NOTES: These values assume audio cutoff frequency of 3 kc following limiter; higher cutoff frequency will degrade absolute values but will not alter ratio between limiters.

Most noise pulses range from 1 to 10 micro seconds in length.

Suppression of 40 db or more effectively eliminates the pulse for most listeners.

# WHAT IS CALIBRATION?

Conway L. Wilson W4WQT
Route 3, Box 39
Madison, Alabama

We Hams are a lucky group. We all have the National Bureau of Standards right in our Hamshacks. We tune in WWV and use it to calibrate a "built-in" transfer standard crystal oscillator in our receivers. We transfer this calibration right down or up to the band we intend to operate on. We set a dial indicator or slightly change the VFO (local oscillator) frequency and operate all evening on our pet Ham band within a few cycles of the frequency shown on the receiver and transmittter dial. To prove our abilities as calibration experts it is not uncommon for us to argue with each other over our operating frequency—why to miss it by 50 cycles is often a complete disgrace. 50 parts in several million is good and we know it. Yes, we Hams are a lucky group but . . . alas, the next morning we go to work and forget our sense of accuracy completely. On the job we are an omphaloskepsis (you had better look that one up).

It is the purpose of this short article to get just a few of you, at least one in every factory, one in every part of industry, to go to work for better calibration on the job. Just ask yourself if someone on your job is being as exact with calibration as you are when you set your receiver frequency. Calibration is important no matter what you do for a living. If you make shoe laces, work at a service station, a meat market—yes, even dig ditches you or someone makes measurements of one sort or another. If you cannot trace that measurement back through a series of calibrations to the National Bureau of Standards you don't have calibration. Somewhere up the line there is an omphaloskepsis that needs to be awakened.

Let me outline a typical case. Let us follow a typical Ham through a not too typical day. Let's call him Joe Ham and heaven bless the real life Joe Hams who may read this. Old Joe wakes up at 6 AM, plus or minus a minute or two. His alarm clock is always off a little but the local broadcast station blares out the time several times as he tries to shave and catch the morning news at the same time. Incidently, he hasn't noticed that his XYL had to set the little radio to 890 kc to get the station on 900 kc—so the little $24.95 ac-dc set is off a little, what do you expect, Collins dials? Joe tries to turn the shower completely off but knows it will still leak a little. He has never stopped to think that he may never get a good gasket for the water valve because there is little calibration at the gasket factory and all their little washers are just a shade small. Joe finally dashes to the car to head for work and notes the gas gage shows ¼ full—Jr. must have used the car again last night. He dares not try to make it all the way to the job because that gas gage has never been quite right. The great mystery of America—who calibrate gas gages? Joe stops by the service station and buys 10 gallons of gas plus or minus a few pints (usually minus a few) and finally gets to work.

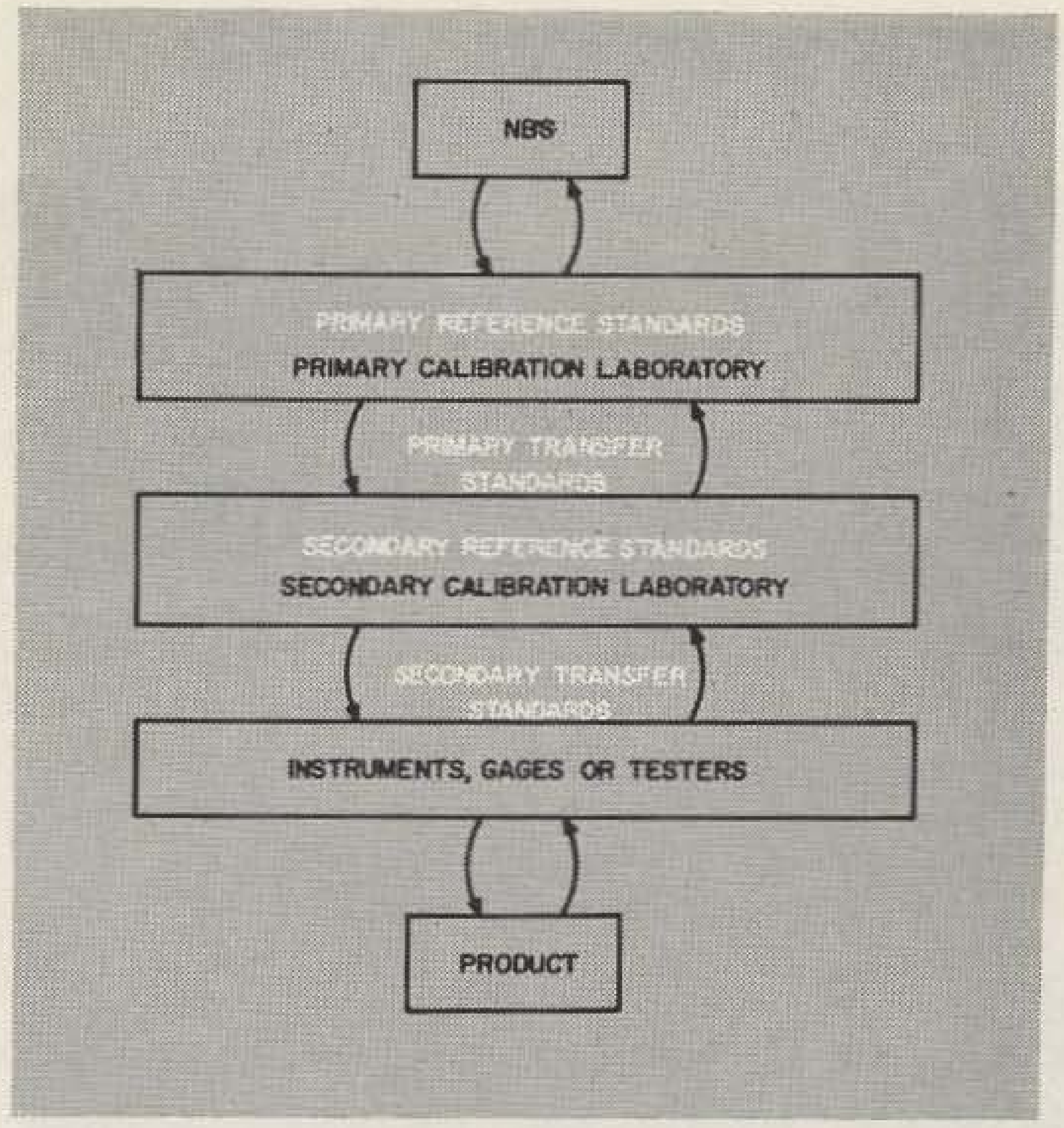
Joe has to make a measurement or two today, he is a part of a test laboratory. He is going to test a little gadget that his company sells to a big Government Prime contractor. He has to look at a waveform or two on a scope and make a few dc voltage measurements. Ask Joe about the calibration of his equipment and he will tell you right quick. "Old boy, look on this meter, it has a calibration sticker on it—why it is due for calibration tomorrow, one of the boys from the standards lab should be around sometime today to get it and supply him with another that is calibrated." The sticker shows that the meter was, indeed, calibrated last summer sometime. Sure enough the calibration expert shows up and takes his meter for calibration. No one has ever calibrated his scope because after all it is the latest model "Technetroonix" and the book says it is accurate to 3%. Old Joe has never stopped to wonder if the book meant it would always be 3% until something went wrong with it or if the book meant that it should also be calibrated periodically.

Old Joe Ham decides to ask a few questions about calibration. When the expert comes for his meter he quite casually asks him. "What do you check my meter against when you calibrate it?" He is told, "Why anyone should know that, it is carefully calibrated against a 0.25% Standard meter, a real expensive job. Boy, you are lucky we have such good calibration in our factory . . . and besides, we do this for you every 6 months." Joe decides to press the subject. "Hey," he says, "how about that Standard meter? Where is it calibrated?" The meter expert looks down his nose and says, "Are you kidding old boy, that's a Standard meter, the manufacturer rates it a 0.25% full scale and it doesn't need any calibration. Who do you think we are, the National Bureau of Standards?" And so it goes. Joe Ham is happy so is the meter expert. Joe thinks he has good calibration and the expert goes back to the lab and brags to the boys how he got that jerk Joe Ham all squared away about calibration.

Actually, of course, it is not this bad at most of the factories. I have, however, seen some that are much worse. Figure 1 depicts a good calibration path to the National Bureau of Standards. It is a series of closed calibration loops, each a link in the path to NBS. Just as with any other chain, it is only as strong as its weakest link. Can you trace every measurement you make along a chain of this type? If not, your job may not be turning out a good product. The wonderful thing about the situation is that it only takes one good wide awake Joe Ham to make a vast improvement in the accuracy of the measurements being done on your job. Just how important measurements are can be shown by a typical example. Did you ever stop to think about the measurement to an accuracy of a millionth of an inch? Measurements of this type are often made in the missile industry.

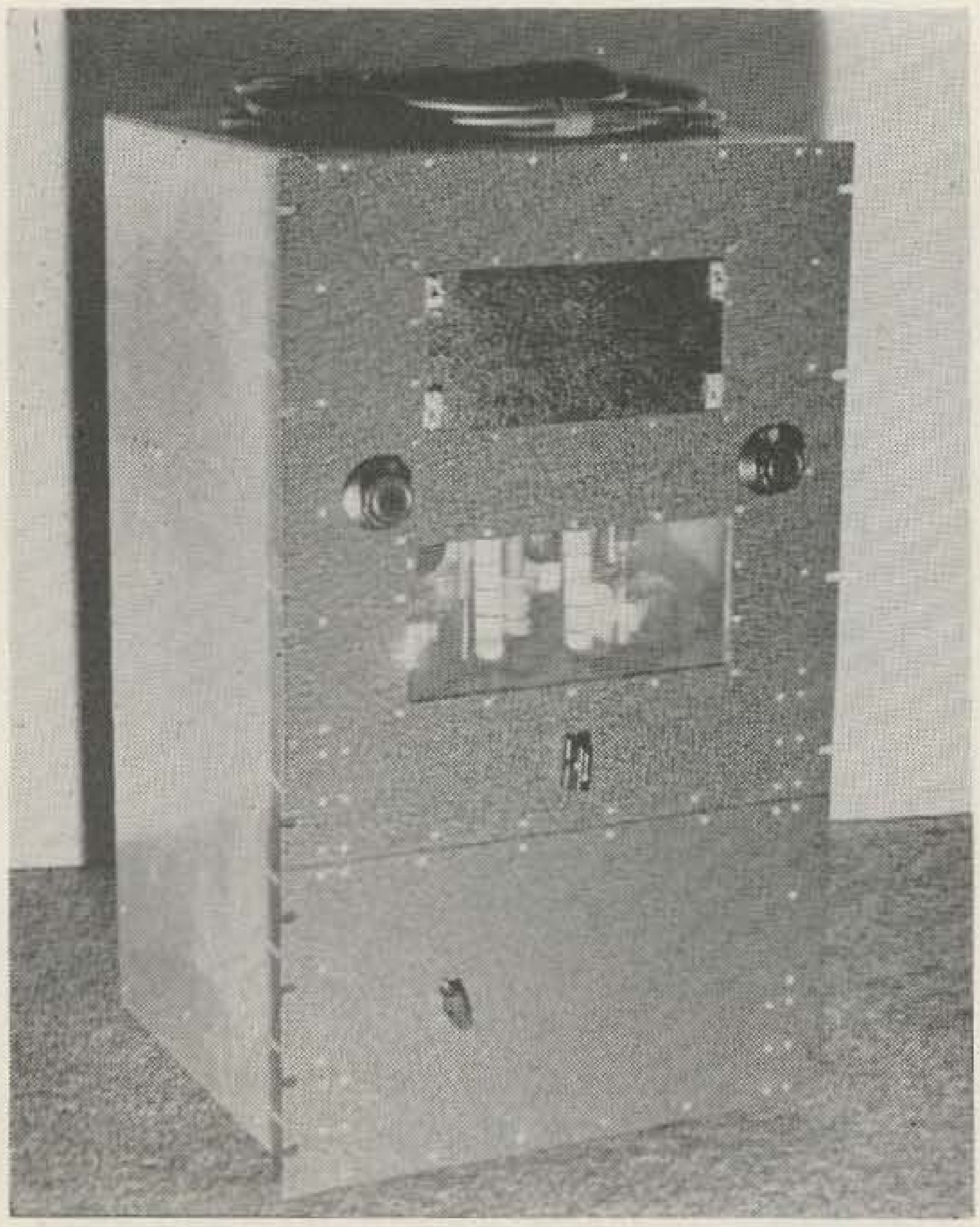
Pluck out one of the hairs from your head (or from the xyls if you have no hair). Now that little hair is about three thousands of an inch thick. If, somehow, you could split it 3000 times, into 3000 little slices you would have a millionth of an inch. Same thing as comparing the width of a dime to a stack of dimes twice as high as the Empire State building. Now if you missed the measurement of certain bore sights in the missile business by just that much, that missile would miss the moon by 1000 miles. Yes, calibration is extremely important and our nation is sadly lagging. The NBS is always faced with a backlog and can't find the necessary time to develop new standards and measures.

A lot of companies lack adequate lab or plant facilities and controls to house a calibration program. Many keep inadequate calibration records with resulting loss of control over calibration intervals. Some, as in Joe Hams case, don't even know when their local standards had last been recalibrated. The important thing for Joe Ham to remember is that rf and microwave measurements is on the problem list. Specific areas in need include: average and peak values of pulsed microwave power, attenuation, voltage standing-wave ratio, unmodulated microwave power. Power and attenuation measurements across the whole rf spectrum actually lag the state of the art. Precision measurement of a-c voltage and capacitance is another big trouble area. We can't shoot for the moon with a flintlock rifle. Improvements in measurements capabilities will ultimately be reflected in savings of many millions of dollars for our nation. Joe Ham can, perhaps, help more than any other segment of our nation. Go out to your job with a solid determination to really find out if all measurements show traceability to NBS. Even if you think you know, prove it to yourself. If there is a missing link, a broken link in the chain—do something about it. See that stand-




ards and calibration are considered at the design and engineering phases, as well as the quality control and test phases of production.

The Army is doing something about calibration in the Army missile business. The Atomic weapons business is, perhaps, leading the nation with their alert calibration program. These are two areas that I can speak for because I have been up to my neck in their programs but how about all the countless thousands of other major industries in our nation. We know that the Russians couldn't have produced the A-Bomb even with a ship load of our secret blueprints unless they had extreme competence in the art of measurements based upon a broad foundation of scientific education and research. Are they concerned with the science of measurements. You bet they are. Their Council of Ministers headed up by Khrushchev himself has a special Committee on Standards, Measurement and Measurement Apparatus. There are five research institutes devoted to improving new techniques of measurement and maintaining precise standards. These institutes supervise the work of a large network of calibration centers, about 129 of them. The new Seven Year Plan to the twenty-first Congress of the Communist Party calls for more than doubling these efforts by 1965. Now, Joe Ham, this is some pretty stiff competition. We have about 1600 scientists and engineers, assisted by a similar number of technicians, skilled artisans and mechanics within the U. S. Dept. of Commerce, called the National Bureau of Standards, trying to offer this competition. They need Joe Hams help. If you will just take the same care as you do in getting on frequency out to your job the results will surprise you. If you know a better way to measure something, tell someone about it. Become a "calibration crank" on your job —your help is needed. . . . W4WQT



# The Big Cannon

Jack Holloway W6VVZ
14607 Blythe Apt. 7
Van Nuys, California

NOT long ago, several locals were holding a postmortem following a DX phone contest, when one of the gang insisted that we should build a BIG CANNON on 20 meters for future contests. With maximum power, we could challenge the antenna farm and mountain top locations for difficult to get European multipliers, without having to move to an antenna farm ourselves. Twenty meters, continued our friend, allows the best reliable long haul communications most of the time. As a result, it is the most competitive band with the most QRM, as every ham realizes. Therefore, power is the only practical means by which we can hope to crack the QRM and thereby increase our number of European contacts.

Some of the gang went along with the power idea, and decided to build a new big final-final. At first, though, it appeared as if we would need far more money for the project than was available to us. But we slowly came to realize that day dreaming about vacuum variables, 1000 watt plate dissipation tetrodes, and silver plated band switching inductors is a luxuriously fascinating pastime, which does not get any final amplifier on the air. We also came to the conclusion that a DX station cannot determine if the incoming signal eminates from silvered inductors or just plain copper. If the signal is clean, it doesn't matter one decibel to the other end of the line, nor should it to you. Therefore, we decided that it is not necessary nor mandatory to spend a great sum of money to build an *effective* high powered amplifier; so we designed a KW amplifier which could be built at a reasonable cost. In order to achieve the reasonable cost stipulation, we scanned the surplus market seeking components for our version of a 20 meter BIG CANNON.

When we finally unveiled the CANNON, some of the locals expressed enough interest to cause us to believe that hams elsewhere might be interested too. Here it is.

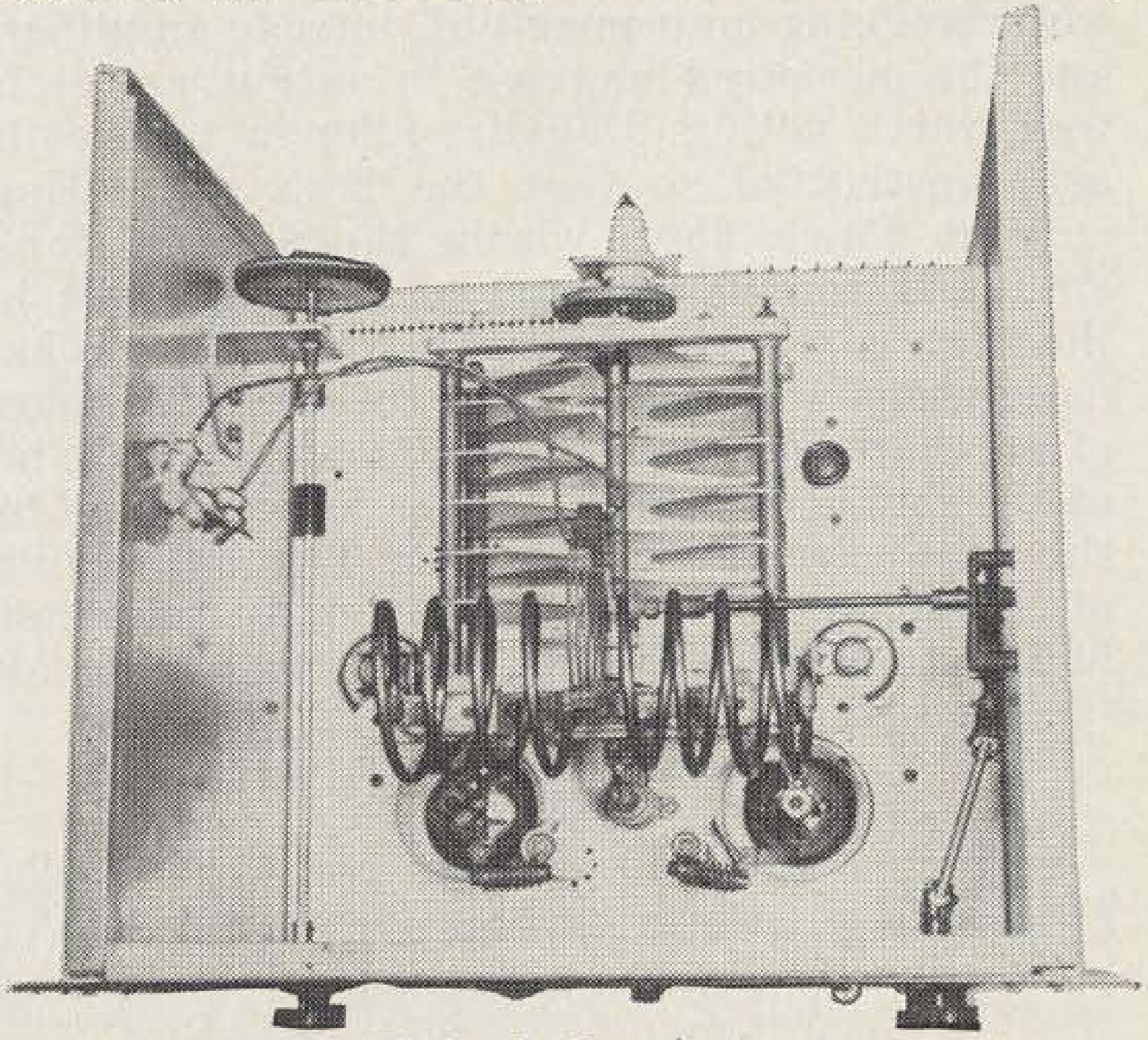
Insofar as a choice of a tube is concerned, the once very popular 304TL still offers the most plate dissipation, and the most long term reliability due to its electrical and mechanical ruggedness, of any tube on the market for the price. Watts per dollar it cannot be beat. That fact still holds true. Its 300 watt plate dissipation can withstand a terrific beating, and so can the filament due to its tremendous reserve emission. It has the advantage, too, of not requiring special consideration for easy to destroy grids, as in a tetrode. However, since we worked unsuccessfully with the 304TL on numerous previous occasions, we were hesitant to try it again; particularly in a single-ended final. Time and again we built single ended 304TL finals, only to have it operate erratically due to uncontrollable parasitics, and never did there seem to be enough available drive power. Always, too, was the ever present problem of attaining neutralizing that would hold from one band to another. So in the BIG CANNON we decided to try our luck with a truly balanced push-pull final. By going push-pull, we figured that physical and electrical symmetry would cancel out the stray inductive and capacitive effects that caused our previous single ended failures. Two 304TLs seem like an awful lot of wasted plate dissipation, but if one anticipates going SSB, a push-pull class $AB_1$ linear amplifier with sufficient power handling capability is an attractive idea, especially if this high powered capability can be had at minimum cost.

Another neutralization headache with the 304TL is the difficulty of obtaining neutralization capacitors of sufficient capacity and voltage breakdown, yet compact in physical size, that will perform without failure. We previously attempted to use every kind of known air gap capacitor with no success, but this time we tried ceramics, and they continue to work perfectly. We found just what we needed on the surplus market in some 7500 working volt, 50 mmfd ceramic doorknob capacitors. When six of these are screwed end to end in a pile, the total capacity is 8.3 mmfd which is within 0.3 mmfd required to neutralize the 304TL. We figure the 45,000 volt breakdown is more than adequate. It is possible of course to stack other combinations of ceramic capacitors to attain the required neutralization value. For example: three, 10,000 volt, 25 mmfd ceramic doorknobs would be a satisfactory substitute, and would be less expensive besides being mechanically more convenient. Insofar as obtaining sufficient drive power for the 304TL, we decided this time to build the driver as an integral part of the final, and to use an easy to drive tube that would have more than enough reserve plate dissipation. We found our tube, again on the surplus market, in the 4E27. A tube that can be driven to full output with one watt drive. Another reason for choosing this tube is that it can operate at the same plate potential as the final, thus eliminating the requirement for an additional power supply.

An approach toward solving the 304TL parasitic problem is made in the same manner, and with the same degree of caution, as is done with tetrodes. First, the 304TL grid cap and internal grid leads are mounted below the chassis deck to achieve isolation between grid and plate circuits. The internal grid collector ring is at chassis level at correct mounting depth. Second, the incoming and outgoing power leads are isolated to minimize external coupling between grid and plate circuits. Third, adequate shielding is used between grid and plate circuits. Last, the plate tank to ground impedance is lowered to a minimum value at parasitic frequencies by shunting each end of the plate tank circuit to ground with a surplus vacuum padding capacitor. These procedures serve another purpose, such as the annihilation of possible TV1, and the improvement of overall circuit efficiency.

Mechanically, the final and driver are housed in one RF tight housing that can be hung in an open frame rack. This eliminates the need for an expensive cabinet, and at the same time allows the unit to be placed on a table top if it should be decided to operate in that way. The two side panels, top, bottom, and rear shield piece for the driver are cut and folded from surplus aluminum stock. The driver panel and final panel are joined rf-tight by permanently securing a right angle strip of aluminum to the bottom edge of the final chassis so that the top back edge of the driver panel can be secured to the right angle strip with sheet metal screws.

In this final-driver unit, inexpensive wire screen mesh purchased from the hardware store is used for shielding the back side of the final compartment, whereas the back side of the driver compartment is closed in with aluminum sheet so the unit can be pressurized. A surplus blower from a Beachmaster amplifier is used for the forced air cooling. Note that holes are drilled into the final chassis deck directly over the 4E27, above the final amplifier grid leak resistor, and around the porcelain feedthrough bushings which support the stacks of ceramic neutralization condensers in the final. These holes allow air escape from the pressurized driver cabinet section and at the same time cool final amplifier components. Cooling the final amplifier is not a necessity



Top view—304TL final. Female coax connectors are hanging free from inside top of cabinet. Black knob on chassis top is grid drive balance control.

in any event, but it was speculated that cool air around the 4E27 might prolong tube life. If the unit is to be operated in a normally cool operating room, 4E27 cooling precautions are unnecessary.

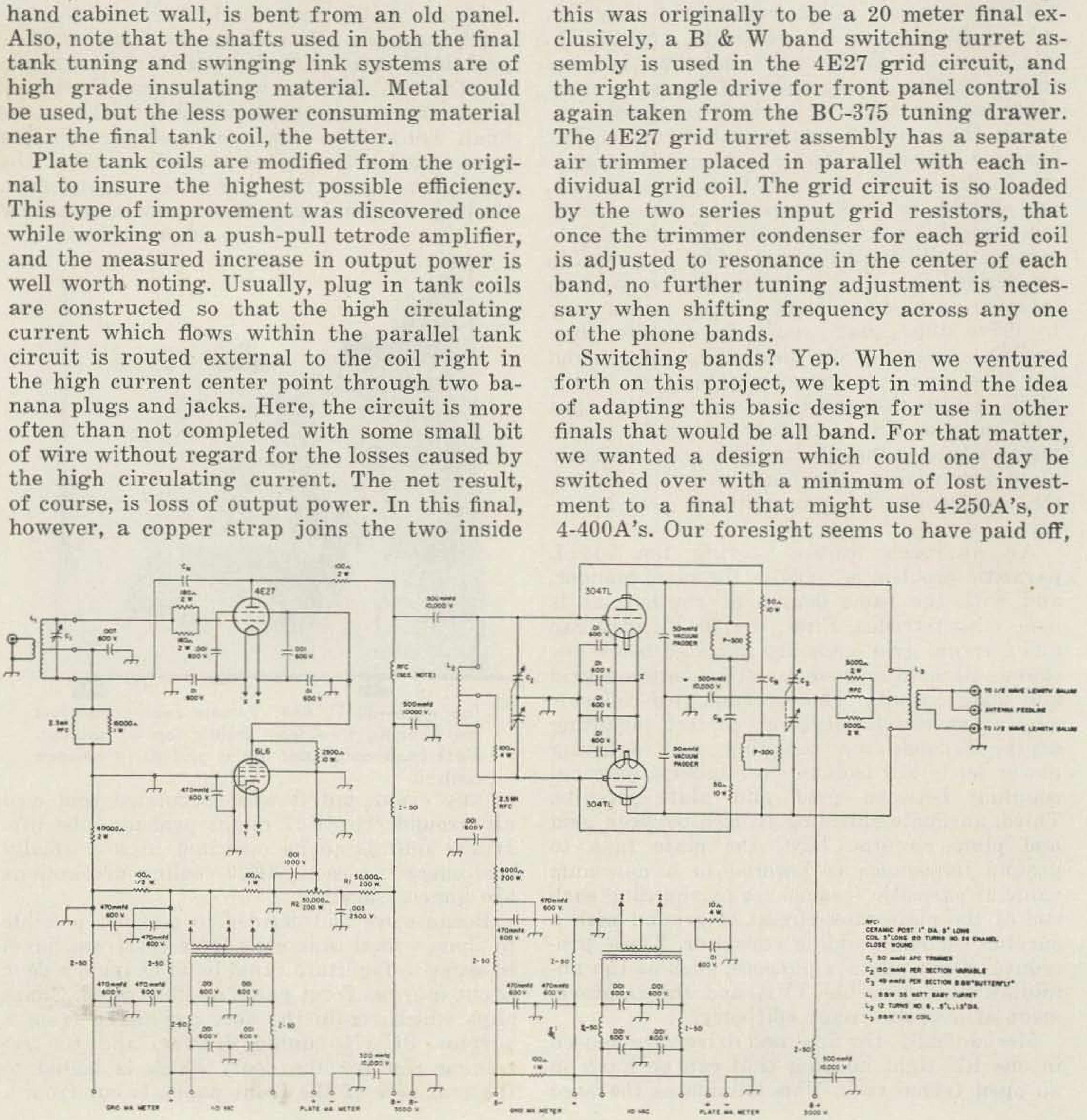
Because we had decided to make it possible to change final tank coils from the front panel in order to facilitate rapid band change, a door is cut into the front panel as illustrated. Snap-clips which retain the door are taken from a surplus BC-375 tuning drawer, and the retaining rim for the door, which is bolted to the rear side of the front panel, is cut from a discarded panel. The right angle reduced gear drive assembly for controlling the final tank swinging link assembly is also taken from the same BC-375 surplus item.

Since the shaft for the final plate tank tuning capacitor would appear through the front panel window when conventionally mounted, an around the back fence tuning system was devised using a pair of broadcast receiver dial string drums. Despite a few raised eyebrows at this "antiquated" string drive technique, no failure has been experienced since we first accomplished a good tight stringing job. A BC drive wheel for the shaft end of the B & W butterfly tank condenser has a ⅜" diameter hole, and is sweated onto the brass shaft of the butterfly tank condenser. The $\frac{3}{16}$" thick aluminum bracket supporting the bushing and drum wheel, mounted toward the rear of the left hand cabinet wall, is bent from an old panel. Also, note that the shafts used in both the final tank tuning and swinging link systems are of high grade insulating material. Metal could be used, but the less power consuming material near the final tank coil, the better.

Plate tank coils are modified from the original to insure the highest possible efficiency. This type of improvement was discovered once while working on a push-pull tetrode amplifier, and the measured increase in output power is well worth noting. Usually, plug in tank coils are constructed so that the high circulating current which flows within the parallel tank circuit is routed external to the coil right in the high current center point through two banana plugs and jacks. Here, the circuit is more often than not completed with some small bit of wire without regard for the losses caused by the high circulating current. The net result, of course, is loss of output power. In this final, however, a copper strap joins the two inside ends of the split winding coil. This is accomplished by removing the two center banana plugs, placing a ¾ inch wide strap of copper under the two center coil support straps, bolting the coil straps and the copper strap together through the steatite bar, and using one of the removed bannana plugs as a B+ connector to the center of the coil. The modified coil is illustrated in figure X. We are so satisfied with this more efficient coil arrangement that coils for all bands have been similarly modified.

The 4E27 driver tube is mounted so that its plate cap is located close to the final grid tank circuit. The perforated shield around two sides of the driver tube is mandatory. Without it, the stage is extremely difficult, if not impossible to tame down parasitic-wise, and neutralization is difficult to maintain. Although this was originally to be a 20 meter final exclusively, a B & W band switching turret assembly is used in the 4E27 grid circuit, and the right angle drive for front panel control is again taken from the BC-375 tuning drawer. The 4E27 grid turret assembly has a separate air trimmer placed in parallel with each individual grid coil. The grid circuit is so loaded by the two series input grid resistors, that once the trimmer condenser for each grid coil is adjusted to resonance in the center of each band, no further tuning adjustment is necessary when shifting frequency across any one of the phone bands.

Switching bands? Yep. When we ventured forth on this project, we kept in mind the idea of adapting this basic design for use in other finals that would be all band. For that matter, we wanted a design which could one day be switched over with a minimum of lost investment to a final that might use 4-250A's, or 4-400A's. Our foresight seems to have paid off,



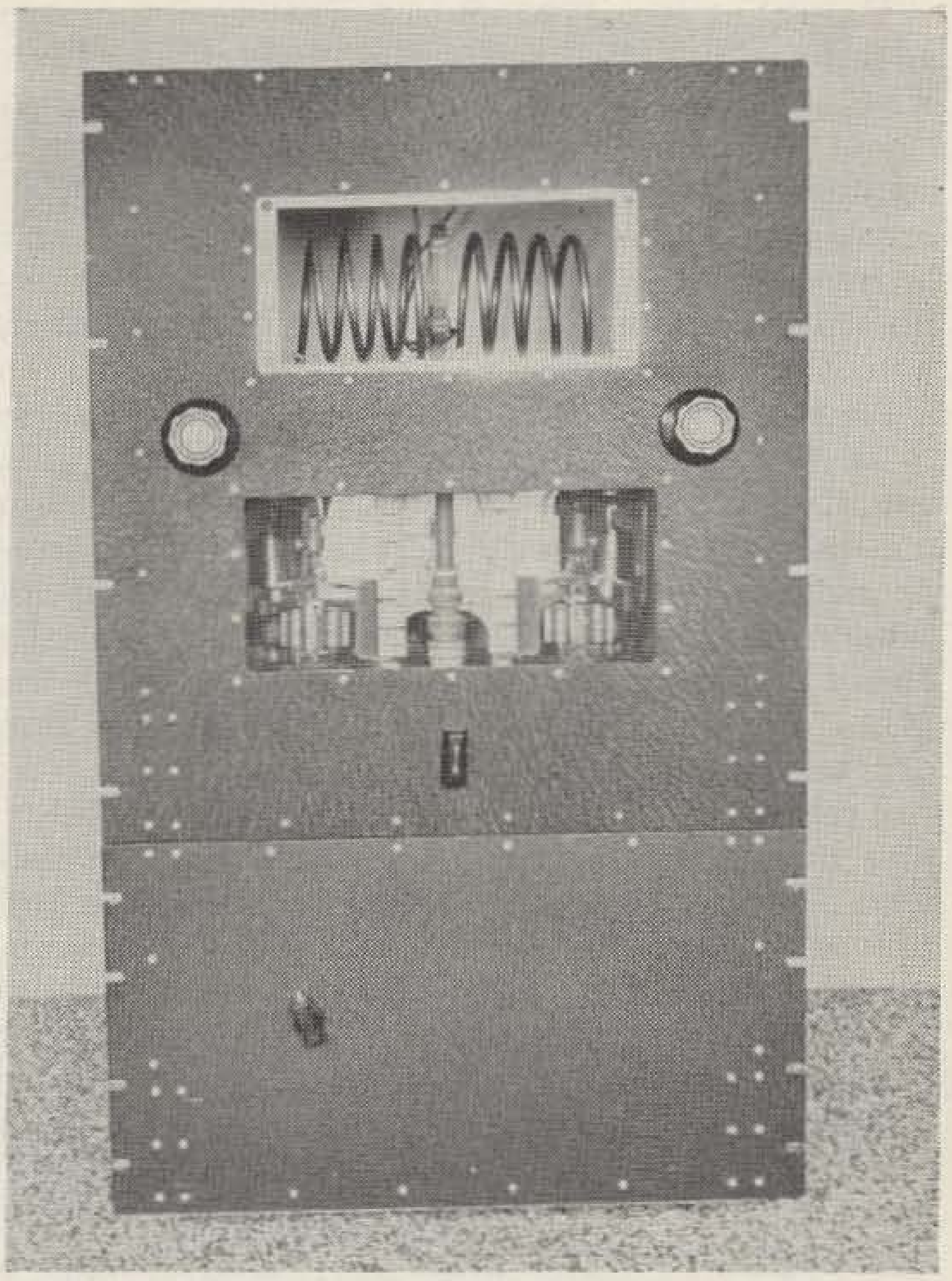
since two other finals have been built utilizing this identical approach. One of these other finals uses a pair of 304TL's, and is a truly all band rig with an MB-150 all band tuner for the grid circuit. In another version, the driver stage is eliminated and a pair of 4-250A's is used in layout identical to the 304TL rig, but with an MB40 all band tuner for its grid circuit.

The 4E27 driver in the 20 meter only BIG CANNON is neutralized for stability, but in the all band version of this rig, it was found to be unnecessary. Parasitic suppressors are required in both plate and grid leads of the 4E27 stage for absolute stability. The RFC in the 4E27 plate circuit is homemade and functions without resonant effects on all ham bands. Its specifications are given in the schematic.

Screen voltage for the 4E27 is supplied through dropping resistors R1 and R2 from the 3000 volt plate supply. The adjustable tap on R1 not only controls screen voltage, but also final amplifier grid drive power. Once the slider tap is set for adequate final grid current on 20 meters, it need not be adjusted further. Since this is primarily built as a class C AM rig, no fixed bias supplies are used. Consequently, in order to protect the 4E27, a 6L6 clamp tube is used with a 2500 ohm resistor between screen and plate to give improved clamp tube operation. The final is protected from loss of exitation by an overcurrent relay located in the HV power supply.

Grid and plate meters for both driver and final are mounted in a standard meter panel external to the driver-final unit. Therefore, as a safety precaution, 100 ohm resistors complete meter to ground circuits within the enclosed cabinet. These are needed in order to maintain completed circuits even if the cable interconnecting the meter panel and driver-final cabinet should be inadvertently disconnected. Without these resistors, for example, full plate voltage would appear between final filament transformer center tap and ground should the final amplifier plate current meter be accidently removed from the circuit.

Because the stack of ceramic capacitors does not supply quite enough capacitance to completely neutralize the final circuit, a slight additional amount is gained through the addition of alumnimum trim tabs. These tabs have a 6/32 inch hole drilled through them which allows the tab to be held in place between the ceramic feedthrough insulators and the bottom of the ceramic condenser neutralizing stack. The size of the tab is not critical, and may be cut to approximately 2 inches tall by 1½ inches wide. Fine neutralization adjustment may be had by slightly unscrewing the ceramic condenser stack from the ceramic feedthrough insulator screw, and changing the relationship of the flat side of the tab in relation to the 304TL plate.



Front view—304TL final. Coil access door is removed to show 20 meter coil in place. Controls, top to bottom, left to right: plate tank tuning, swinging link control, grid tank tuning, and unused grid bandswitch in the 4E27 driver.

Achieving equal grid drive to push-pull circuits is imperative in order to realize the full benefits this circuit has to offer. To attain balance, a 15 mmfd variable capacitor is connected between ground and the grid of the 304TL which is not capacitively coupled to the 4E27. This adjustable capacity allows the input capacity to the 304TL's to be balanced by offsetting the output capacity of the 4E27. In this manner, drive power to the final may be equalized. Approximate balance may be obtained by noting the color of the two final plate tubes, and adjusting the capacitor in small increments until their relative color appears to be equal. A more precise way would be to independently meter the cathode currents of each 304TL, and balance the tubes by obtaining equal plate and grid current readings.

The 50 mmfd vacuum padder condensers shunting each side of the final tank butterfly condenser to ground serve several purposes: One, they help keep high order harmonic frequencies bypassed to ground—thus helping eliminate possible TVI. Two, they serve to keep the plate tank circuit balanced in respect to ground. Three, they add enough capacity to the butterfly condenser so that it is possible to attain a loaded Q of about 20 on twenty meters. A Q of 20 is about optimum for ease of loading and for allowing some degree of harmonic reduction.

Note that two 4700 ohm, 2 watt resistors are added in parallel with the final plate tank RFC. The only RFC we had was an old National R-175; due to its poor design, and circut conditions, it was necessary to dampen out an erratic parasitic voltage that appeared and burned out the bottom segment of the windings. It is probable that this would not happen with the newer versions of the R-175.

Neutralization circuit parasitics always seem to be present in 304TL amplifiers, and in this one it is necessary to have both the 40 ohm non-inductive resistors and the Ohmite PC suppressors in order to completely clean up all tendencies for the final to take-off. In the 304TL all-band version of this final using the MB-150 grid circuit, only the PC suppressors are needed.

Testing of the driver and final for stability and lack of parasitics is accomplished as follows: Three, 200 watt, 1000 ohm resistors are placed in series between a 300 volt power supply and the driver and final (driver and final HV inputs wired together). The cabinet is of course, grounded, no rf input is applied to the driver stage, and no dummy load nor antenna is coupled to the final output link. Actual final plate dissipation under these conditions will be near 300 watts per tube. A sensitive instrument such as an oscilloscope, or an antennascope, is connected to the final output link as an indicator, and the final plate tank tuning and final grid tuning are carefully tuned through all possible tuning combinations. No output signals will be indicated when all is functioning correctly.

As this is conceived as primarily a 20 meter only final, we decided to add a ½ wave balun across the output link to improve loading and matching conditions between the 52 ohm coax line and final tank. The improvement in output power transfer is well worth the trouble, but for all-band operation, the technique is obviously too cumbersome. Length of the ½ wave, 52 ohm coax balun is 22′-9½″.

This final has operated many continuous hours without component failure or breakdown. More important, even though operated on the shadow side of a hill away from TV stations, there has never been a recorded case of harmonically caused TVI. Washout cases have occurred, but these have been easily cured with a high-pass filter. Operation-wise, like the two subsequent copies referred to above, it is a dream. Loaded and tuned in the middle of the 20 meter band, no further adjustments are necessary when moving from one edge of the phone band to the other.

As further comment on the practical versatility of the finals' design, owners of commercially built 100 watt output exciters can use the 304TL amplifier without need for the 4E27 driver stage. The final can be driven to full legal input by 100 watt of exitation and high level modulated in class C, or operated as a class $AB_1$ linear amplifier with negligible required driving power.

### For Linear SSB Operation

Link couple directly into the final grid tank. As is the case with my particular final, a separate link must be wound with insulated wire and inserted into the final grid tank. When an MB-150 grid tank circuit is used in the final, the problem of link coupling is simplified. Use regulated fixed bias on the 304TL's. Remove *all* power from the 4E27 driver stage. Operate the final in class AB-1, and it will drive with negligible drive-power required.

. . . W6VVZ

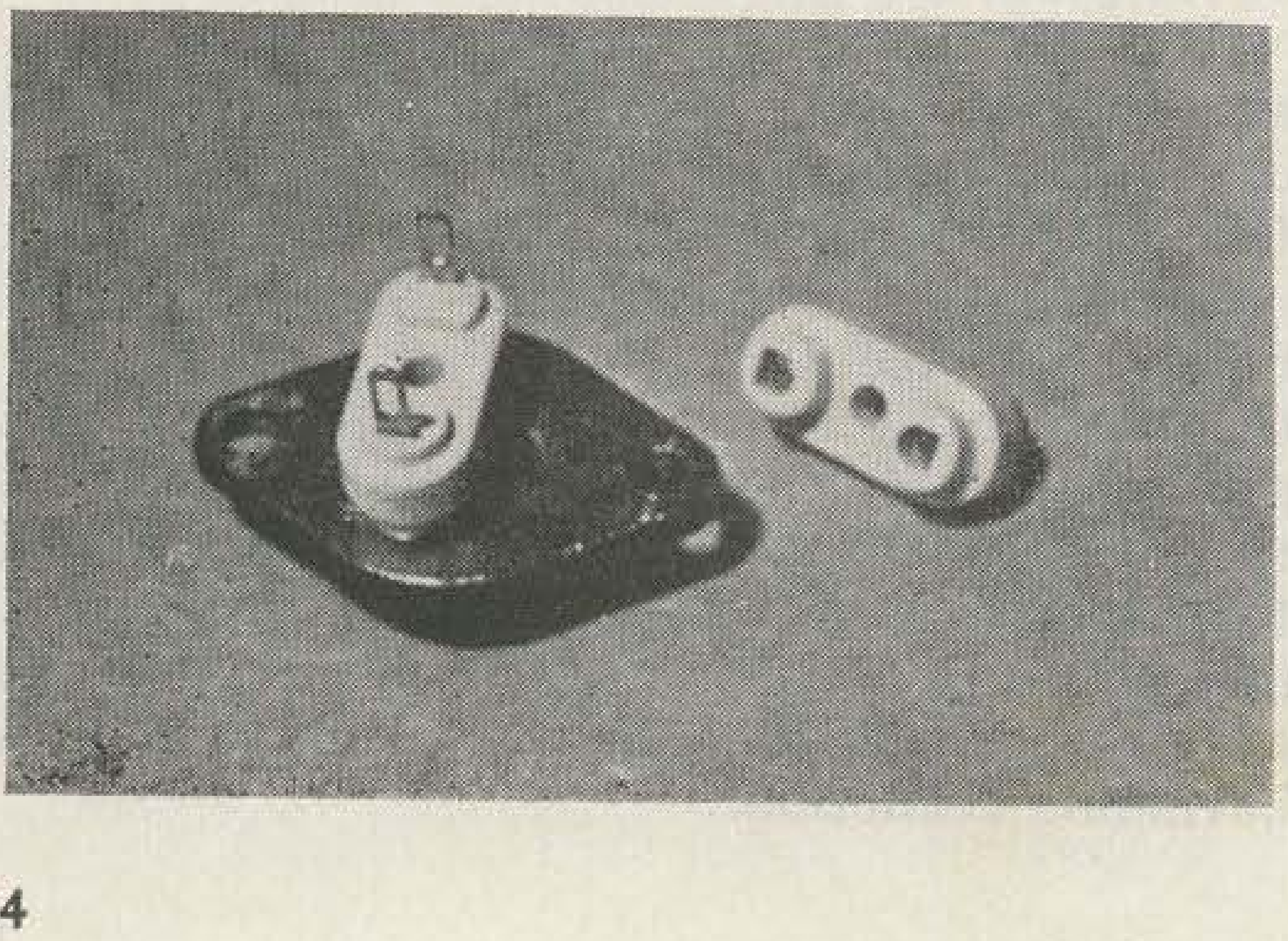
---

## New Use for Crystal Socket

Roy E. Pafenberg

Despite several years popularity, power transistor sockets are still difficult to locate. The power transistor is not strictly a "plug-in" device since the mounting screws and insulators are required. However, socket connection to the base and emitter is a convenience and worth the cost of the socket.

*Photo . . . Jim Gardner*



A socket which is ideal for power transistors is widely available. This socket is designed to accept the small, hermetically sealed crystal units that have become so popular in Citizens Band and other equipment. These holders have a pin spacing of .487″ and pin diameter of .05″. This is in fairly close conformity with the transistor pin spacing of .43″ and pin diameter of .04″. The socket easily accommodates this small disparity and snug seating with good electrical contact is obtained.

The photograph shows a crystal holder socket installed on the transistor and a view of the socket. It will be noted that the unit is designed for under chassis mounting. The socket will flush mount in a 3/32″ chassis, although its use is not limited to this thickness. Many manufacturers make these sockets and the Millen Type 33302 is typical of those available.

# Eight Little – Nine Little Tennessee Indians

Gray Berry K2SJN
Communications Club of
New Rochelle, N. Y.

ONE of the hardest-working committees of The Communications Club of New Rochelle is, unfortunately, the TVI Committee. In a way, we've asked for it by carefully placing stories in the local press from time to time telling fellow-residents how and where to report Tennessee Valley Indians—not to mention their close tribal cousins, the hams that breaks into a hi-fi set, or is picked up on the telephone without benefit of hybrid patch. Which means that our committee has been able to compile a fairly fat file of case histories on interference.

There have been many articles, more than a few books, a section of the ARRL Handbook and so on all dealing with *mechanics* of interference suppression at the transmitter, or in the TV set. Most hams aren't on the air very long before they run into the need for this material. There is no intent in the present article to deal with such matters as low and high pass filters, shielding, stub antennas and so forth; what we think may be helpful is a list of some of the remarks that are thrown at our Committee by more or less (usually less with a capital "L"!) understanding neighbors—and possible ways to cope with them.

Probably the most common accusation is worded more or less like this:

*"You're deliberately interfering with my ba'l game"* This usually occurs in the last half of the ninth, score tied and the winning run on base—no matter what the hour.)

Assuming that the TV owner is willing to listen, we find an answer like this *may* calm the situation.

The ham says: "Mr. Madguy, look at it this way. We hams are on the air to try to reach other hams. They are listening on the parts of the radio bands where they expect to hear other hams. And that's where they are sending out their calls. So why would a ham go on the air on a frequency where no one can hear him or call him? Besides, if we go on any other frequency except those that the FCC assigns to us, we face loss of license, a fine and even a jail sentence."

So he asks "Then how come I hear you?"

And you have the chance to explain quietly and calmly (because he *may* be honestly interested in finding out!) all about signal rejection and so forth. But a word of warning—shun the "snow job" to show how much more you know than he does! He still doesn't like hearing your CQ over Mel Allen's mellifluous tones. Tell him what's and why's in words of one syllable. Lose his train of thought and you're on the way back to an angry neighbor.

So much for the first of our ten little indians.

*"You're an amateur; my professional service man told me. . . . "*

Now here is a real curve! Because the service man told the TV set owner that nothing could be done about interference (Don't laugh—plenty of them will do just that!) you are now on the spot doubly. In the mind of the set owner, you are at fault (naturally) and Mr. Paid-for-what-he's supposed-to-know has said nothing can be done about it. Of course, you know better, but how to tell the TV set owner without reflecting on his judgement?

We've found one helpful come-back to this one. "Mr. Madguy, the Olympics were just held in Rome (or the tennis matches at Forest Hills, the Golf Championships at the local country club or what have you.) Those competitors were all *amateurs* simply because they don't get paid for their skills and knowledge. As a matter of fact, amateurs developed TV in the first place. Amateurs made the first cross-ocean short wave contacts, first coast-to-coast short wave, etc., etc., ending up with "Moonbounce" and "Project Echo". The only reason we're called amateurs is because the Federal Government that gives us our licenses says we cannot be paid in any way for what we do. (Careful, now!) We have to pass an examination before we can go on the air; not very many service men take any test at all."

So now you know something after all, in the mind of your irate neighbor. Next step is to convince him something can be done about his TVI. By the time you've had even two complaints, you'll find one that has been cleaned up to the complete satisfaction of the set owner. It's a smart move to ask him if you can have any other set owner check as to the success. If you once have one or two pleased complaints, the rest is easy. Just refer your latest TV owner to one or two others in the neighborhood . . . and to the sets you *know* are clean next door, or in the same building. "See, there's proof of what I've been saying; something *can* be done."

Indian Number Three—*"Of course, it's your fault; I never had any interference before you put that thing on the air!"*

Ask him to think about it this way; suppose he has a hole in his roof. So long as the sun shines, he doesn't even know it's there. But let the rains come, and that self-same hole lets in the water. If it doesn't rain for months, the roof is still going to leak as soon as the rain does fall. And a TV set that will let interference creep in is just like that roof. If it isn't *your* station, it will eventually be someone else's. What you want to do is to plug the hole before the rain comes.

At this point, you're ready to talk about the set makers and the way they will supply a HP filter. So you tell the TV owner you can get him the filter by working through a regular service man or your Club TVI Committee (you should have one—both a club and a committee). This invariably leads to Indian Number Four.

*"Why should I spend a cent? You do it."* (Pay for the service call, or install the filter.) You see, the TV set owner has, in his own mind, paid the last cent he expects to for the best TV he can buy. Now you're telling him in effect that he's been had—or so he thinks. And wait until your TVI complaint comes from a man who works for the set maker!

You have to assume (dangerous!) that Mr. Madguy can still be logical about this, but here is a tried and trusty answer. "You can see from what we've been saying that the fault isn't with my transmitter, because the FCC would clobber me in a minute if it were. So what you're asking me to do (pay for a service call) is not only to get you *free* a $5.95 piece of equipment, but then to pay for putting it where your set maker should have in the first place. You see, the FCC (the more you can mention Fox Charlie Charlie the better!) says that the TV set makers *know* they should do this, but they take a calculated risk. Out of the thousands of sets they make, how many do you suppose might land, like yours did, near one of the 200,000 hams in the country? And a filter that might cost $3.50 at the factory, installed, could raise the final cost of the set as much as $25.00 or so by the time you figure in labor, mark-up for the Distributor, the Dealer and all the other people who get into the sale. That's why your set *needs* this filter —just a matter of economics. And since you are going to get the filter *free* from the set maker, doesn't that *prove* he knows his sets are not as perfect as they might be? Putting the filter in only takes a couple of minutes, and there won't be any parts charge, just a service call."

This leads to the other related question; "Well, why don't *you* install it?" If you want to take a chance, go ahead. But we don't recommend it. First of all, let *anything* go wrong with that TV set for the next six months, and who do you think will be blamed? Second, your neighborhood servicemen get touchy if they think you're doing them out of a service job. Use the first fact to avoid the second. *Don't get your fingers into the goodies.* Leave it to the service man. And if your neighbor is adamant about not spending a cent, tell him you'll see that he gets the filter as a courtesy, and that your responsiblity ends there. Exit gracefully (if possible) and go on the air when you please. Eventually, he'll figure that he has the filter, and he might as well install it. As a matter of fact, if you show him how easy it is, Mr. Madguy just *may* do it to save the dollar or two he's so worried about! But don't you do it for anyone less closely related to you than your landlord or your wife's Cousin Jake.

Fifth Lurking Redskin—*"You must be interfering; my TV looked (sounded) awful last night!"*

Just maybe you'll be lucky. Last night may have been the night you fried your final (these things *do* happen) Or maybe it was meeting night at the Club. Anyhow, quickly explain the log and what it must show by law. Prove you weren't anywhere near the mike or the key if you can—and half your battle is won. Then try this. "You know, there are many things besides ham stations that can interfere with a TV set, but hams usually get the blame. (You can't duck it if she or he has heard your call signal, bub:) I'd like to help you find out what is interfering with your set. What does the interference look (sound) like?" Many times you can identify its source—like a fluorescent light in the next room that drove our committee bats for a while, or cars going by. Look around for a second set in the house that's beating against the one complained about—or an FM radio. And try to describe "typical amateur interference patterns" so they can compare your description with what they have on their set. You may end up with a clean bill of health. (The ARRL publishes "Patterns of Interference"—a chart you can get for the asking.)

Sixth Indian from the neighborhood warpath is *"What d'ya mean it's my set?"*

"Well, Mr. Madguy, *I* have two sets home. One is right in the same room with my transmitter and nothing interferes with it. I'd like to ask you to come over and see for yourself. (Better be sure your own TV *is* clean!) And I'd like to show you how a ham station is built and filtered so that it won't cause interference. (In the rare event that he does come over, contrast the shielded chassis of your rig with the open construction of TV sets. Compare coax with TV wire and lead-ins. Show him your low-pass filter and explain it in layman's language—of course you have an LP filter in the line, don't you?) If he won't come over—quite likely—talk him through what you would show him. Then add on as many cases as you can from the neighborhood of TV sets that aren't being interfered with while his *is* bothered.

(Continued on page 59)

# Measuring Co Ax Feeders and Stubs

Bill Roberts W9HOV
House of Antennas
1153 East 82nd Street
Chicago 19, Illinois

RECENTLY a brainstorm sent me into intimate consultation with a full set of handbooks and a slide-rule. This resulted mostly in several pages of calculations and a desire to do something else less mathematical. The antenna never did emerge from the confusion of figures, but an interesting chart did.

This chart shows the length of a half wave in free space, the length of a half wave of co-ax such as RG8/U, RG11/U, RG58U, or any other co-ax having a velocity factor of 0.66, the length of a quarter wave of co-ax (half the former, of course), and a multiple of half waves that will give you an all-band co-ax feeder.

Now let us take a hypothetical case and see what the chart will do for us. A half wave feeder for 28,600 kc would be 11.35 feet, or 11 feet 4 inches. A quarter wave stub would be 5.68 feet (5'-8"). It is interesting to note that a line 45'-7" would be 4½ waves on 10, 3½ waves on 15, 2 half waves on 20 and one half on 7 mc.

In multi-band antennas it is often advantageous to have a feed line that is ½ wave long. If you can choose a feedline that is ½ wave long on each band you may solve many problems. As you look down the chart you will see that there is a length around 45-46 feet that works out to be a half wave multiple on all bands. The CW operator would be more interested in the 46 foot length, the phone man around 45.4' or so.

This chart is for co-ax, not for open wire lines or twin-lead.

. . . W9HOV

| | **28000** | **28100** | **28200** | **28300** | **28400** | **28500** | **28600** | **28700** | **28800** | **28900** | **29000** | **29200** | **29400** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ½ Wave ..... | 17.57 | 17.51 | 17.45 | 17.39 | 17.32 | 17.26 | 17.20 | 17.14 | 17.08 | 17.02 | 16.96 | 16.90 | 16.84 |
| ½ Wave Coax | 11.60 | 11.56 | 11.52 | 11.48 | 11.43 | 11.39 | 11.35 | 11.31 | 11.29 | 11.23 | 11.19 | 11.15 | 11.11 |
| ¼ Wave Coax | 5.80 | 5.78 | 5.76 | 5.74 | 5.72 | 5.70 | 5.68 | 5.66 | 5.64 | 5.62 | 5.59 | 5.57 | 5.55 |
| 4½ Waves ... | 46.40 | 46.24 | 46.08 | 45.92 | 45.72 | 45.56 | 45.40 | 45.24 | 45.08 | 44.92 | 44.76 | 44.60 | 44.44 |
| | **21000** | **21075** | **21150** | **21225** | **21300** | **21375** | **21450** | | | | | | |
| ½ Wave ..... | 23.42 | 23.35 | 23.26 | 23.18 | 23.10 | 23.02 | 22.94 | | | | | | |
| ½ Wave Coax | 15.45 | 15.41 | 15.35 | 15.30 | 15.25 | 15.19 | 15.14 | | | | | | |
| ¼ Wave Coax | 7.73 | 7.70 | 7.68 | 7.65 | 7.62 | 7.60 | 7.57 | | | | | | |
| 3½ Waves ... | 46.40 | 46.24 | 46.08 | 45.92 | 45.72 | 45.56 | 45.40 | | | | | | |
| | **14000** | **14050** | **14100** | **14150** | **14200** | **14250** | **14300** | **14350** | | | | | |
| ½ Wave ..... | 35.14 | 35.02 | 34.90 | 34.77 | 34.65 | 34.53 | 34.40 | 34.28 | | | | | |
| ½ Wave Coax | 23.19 | 23.11 | 23.03 | 22.95 | 22.87 | 22.79 | 22.70 | 22.62 | | | | | |
| ¼ Wave Coax | 11.60 | 11.56 | 11.52 | 11.47 | 11.43 | 11.50 | 11.35 | 11.31 | | | | | |
| 2½ Wave ... | 46.40 | 46.24 | 46.08 | 45.92 | 45.72 | 45.56 | 45.40 | 45.24 | | | | | |
| | **7000** | **7025** | **7050** | **7075** | **7100** | **7125** | **7150** | **7175** | **7200** | **7225** | **7250** | **7300** | **7350** |
| ½ Wave ..... | 70.28 | 70.04 | 69.80 | 69.54 | 69.30 | 69.04 | 68.80 | 68.56 | 68.33 | 68.08 | 67.84 | 67.60 | 67.36 |
| ½ Wave Coax | 46.38 | 46.23 | 46.06 | 45.92 | 45.72 | 45.56 | 45.40 | 45.24 | 45.08 | 44.92 | 44.76 | 44.60 | 44.44 |
| ¼ Wave Coax | 23.19 | 23.11 | 23.03 | 22.95 | 22.87 | 22.79 | 22.70 | 22.62 | 22.55 | 22.46 | 23.38 | 22.30 | 22.22 |

## Ohmmeter Polarity Test

Most multimeters are wired so that the black lead is positive and the red lead negative when measuring ohms. But not all are wired that way. When testing diodes and electrolytic capacitors, it helps to know for certain which way particular meter you grab is wired. If you don't happen to have a second meter to test the polarity, you can use a common potato to determine which lead is plus. The plus lead area turns bluish after a bit if you stick both leads into the spud.

A much better method is to simply use the ohmmeter to charge up any capacitor, 0.25 mfd or larger, then disconnect the capacitor, switch to the dc voltage range, and reconnect the capacitor and see which way the meter needle kicks.

This same charged capacitor is frequently used to advantage to measure dc voltages in extremely high impedance circuits. The capacitor is connected to the circuit (through an isolating resistor if needed) and allowed to build up to a full charge. Then a VTVM or dc Scope is connected to the capacitor and the reading quickly made before the charge leaks off. Naturally a good capacitor is essential, such as a mylar or polystyrene type.

. . . K6EAW

# Automation

Jim Kyle, K5JKX/6

## *With a Vengeance!!*

As I opened the door to the shack, Joanne put down her well-chewed pencil and turned off the big switch. "Yes, inventor," she said, "I see you're home."

"Rough day at the salt mine," I grumbled, sinking my lanky frame down gingerly on a box of old 304TLs. "Too many computer circuits. . . ."

"You'd think," mused friend wife to no one in particular, "that with all the gray matter this cat's supposed to have, he could figure out a way to make a station do all its own dirty work. After all, they have machines that build more machines. . . ."

"Yeeow!" I cried, leaping to my feet. A 304TL had given way. But even after the surgeon removed the last splinter of glass from my posterior, the memory of Joanne's suggestion stayed with me piercingly.

Three reams of scratch paper, two gross of pencils, half-a-dozen editions of Terman (and two jobs) later, the evil deed was done. A complete circuit for a fully-automated ham station reposed in my mind. It hasn't yet been transposed to reality . . . for reasons which shortly will become clear. But it *can* be done, and you're welcome to it if you want to try.

Before I send you muttering back to the crystal-set league, though, (and above all don't dare look at the schematics yet!) I guess I'd better outline what this super-duper station will do for you. Like she said, it does all its own dirty work. E.G.:

"I NEED 1024 RELAYS AND $2^{19th}$ DIODES."

1. Turns itself on and off.
2. Monitors for Conelrad alerts continuously.
3. Takes care of all transmit-receive switching.
4. Changes bands automatically.
5. Tells you what's happening at all times.

and 6. Keeps the log.

Those were the design specifications, and they were all met. It took a bit of doing, and many of the circuits are not the familiar ones you're used to seeing.

If you're ready for the shock, though, take a peek at Fig. 1. It's a combined block and logic diagram which shows the overall picture (and when one of these is finished, overalls will be the only thing you could afford, but that's ahead of the story . . .) in a more-or-less understandable way.

The big X in the upper left marks the spot where a switch goes. This is no ordinary switch, though. You know these mat-type foot-switches that work by pressure? Take one of those and put it under the cushion of the chair in the shack. . . . Now, whenever you sit down, the station turns itself on.

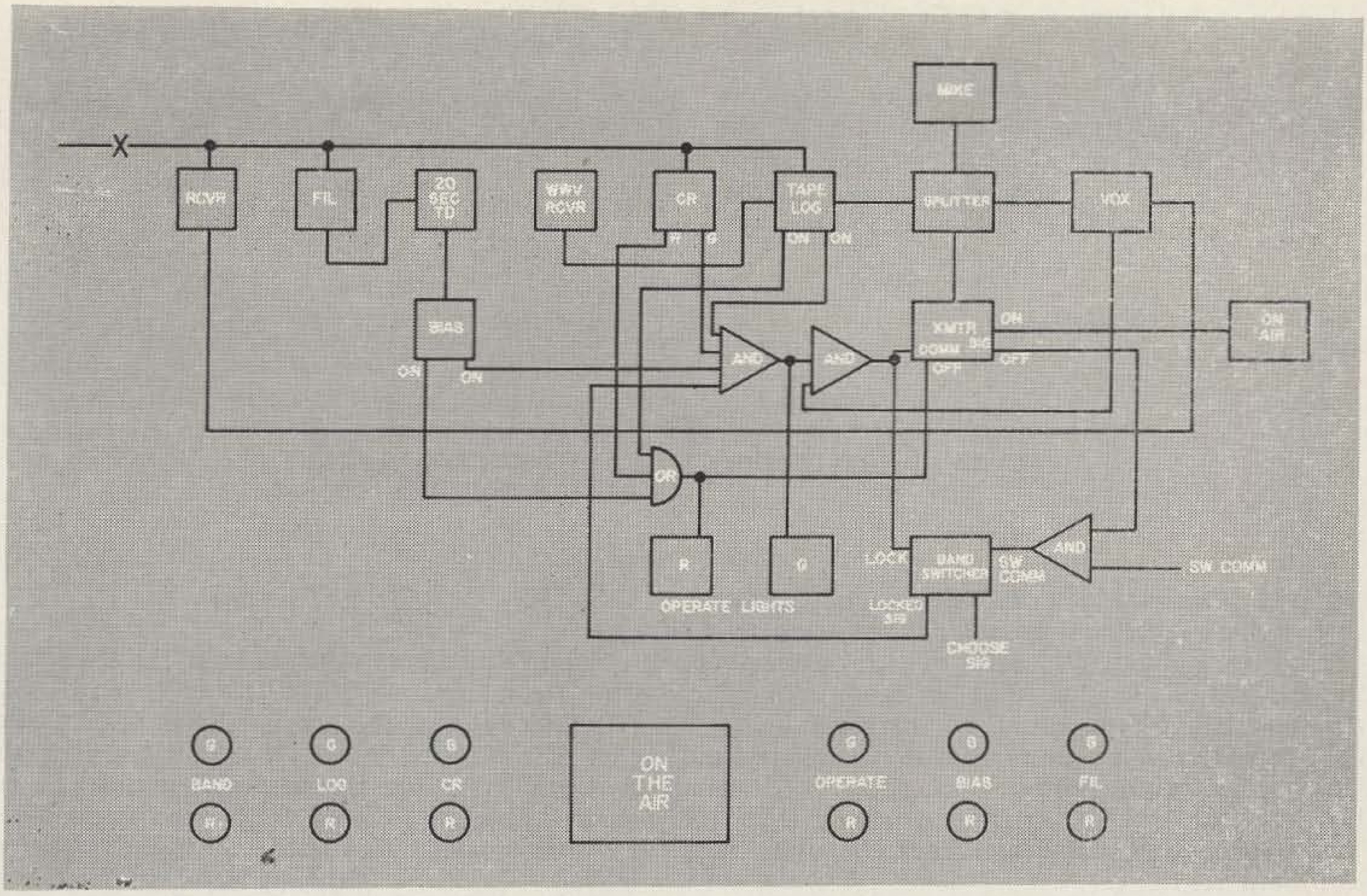
There, that wasn't too painful, was it? Now read on to the right until you come to the box marked "20 sec TD." This houses a 20-second time-delay relay which delays operation of the transmitter bias supply until all filaments have had a chance to heat.

Skip the box marked "WWV Rcvr" for the moment and concentrate on the one labeled "C. R." In its confines nestles the Conelrad alert monitor. Instead of the ordinary system of buzzer or pilot light, the output of this alarm is just a SPDT relay. When all is well, the "G" output line is connected to —12 volts. When the alert sounds, the —12 voltage is switched to the "R" line.

Now move on to the "Tape Log" box. This houses the much-modified tape recorder. The tape recorder has two inputs, as well as an automatic stop to halt it when it runs out of tape, and a relay in its B+ line which switches —12 volts to either the "On" line if all is working or the "Off" line if something fails.

Back to the bias supply. It, too, has one of these little relays, connected in a voltage-sensing circuit so that —12 volts is on the "On" output line until bias rises to rated value. At that point, the signal switches to the "Off" output line.

We skipped the "WWV Rcvr" before. Go back. This can be any additional receiver (a command set will work but a 51J is recommended) which will pick up WWV. With its own antenna, it is permanently tuned to




WWV. Output feeds one of the inputs to the logging tape recorder, providing time markers.

We're almost up to the transmitter itself by now, and the whole confusing mess is about to get really uncomprehensible. At this point, you have to open or close the gates.

The gates, that is, which control the transmitter. They're "and" and "or" gates, swiped from digital computer circuitry (it's cheaper to swipe them—the commercial models cost $25 each!). The smaller "and" gates can be built in the same manner by omitting two legs.

Note that each gate includes a —6 vdc supply, so that in the "and" gate you have to have —12 at each of the input terminals before output voltage will rise to —6 from zero. In the small gate driven from the large one, replace the 6-volt battery with a 3-volt one.

Now, after you sit down (automatically starting the cycle), the bias supply comes on after 20 seconds and the Conelrad and Tape Log equipment sends out "G" and "On" signals respectively as soon as warmup is over. Assume that the "Band Switcher" also has —12 volts on its "Locked Sig" output line, and you can see that the first "and" gate in the transmitter control chain is enabled. This puts —6 volts at the input of "and" gate No. 2. When it gets another —6 volt signal from the vox unit, you're on the air.

On the other hand, should Conelrad sound an alarm, the bias supply fail, or the tape log unit run out of tape, one of the enabling signals will be absent. In addition, a failure signal will go to the "or" gate in the disabling side of the transmitter control, and you're silent.

The fault locator panel consists of red and green pilot bulbs slaved to the enabling-signal lines. My out-of-this-world dreaming did it with transistor switches at each of the 13 bulbs, but it might be cheaper to use DPDT relays instead of SPDT in each signal line and control 6.3 VAC for the pilot bulbs with the other relay pole.

The "Operate" section on the panel, you may notice, is connected to the output of the big "and" and the "or" gate. If all is ready to transmit, the "operate" bulb lights green. If there's any failure, it lights red. If this bulb is red, at least one other will also be red, pinpointing the trouble. After a few months' practice, fault location with this system should be almost as fast as by the old try-everything-until-you-find-what's-wrong technique.

So far, we haven't looked at the "Band Switcher." It's a flip-flop connected so that when the transmitter is on, no signal can get through to a stepping relay which operates slave relays in each stage of the transmitter. If the transmitter is off, the input "and" gate is enabled, and you can pulse the stepping relay (approximate cost, $45) with a pushbutton on the arm of your chair. This steps you from band to band. An added refinement would be a series of pilot lights to let you know what band you're on, but I felt it would be a useless complication.

Note that the "Band Switcher" is connected to the transmitter coming and going, so to speak, so that the transmitter must be off before it can be turned on. This is a precaution against accidental doubletalk. For intentional

(Continued on page 58)

Art Korn K8HDR
4212 17th Street
Wyandotte, Michigan

# Audio Boosting
# The Command Receivers

SOME time ago I needed a receiver that was light weight and portable. Not wanting to carry around the 60 pounds of station receiver, a BC-779, I decided that if the audio of a command receiver could be improved enough for speaker operation that it would be the right size and weight. Also, the BFO was needed for CW reception. A check thru all the old magazines and handbooks brought little of help to light.

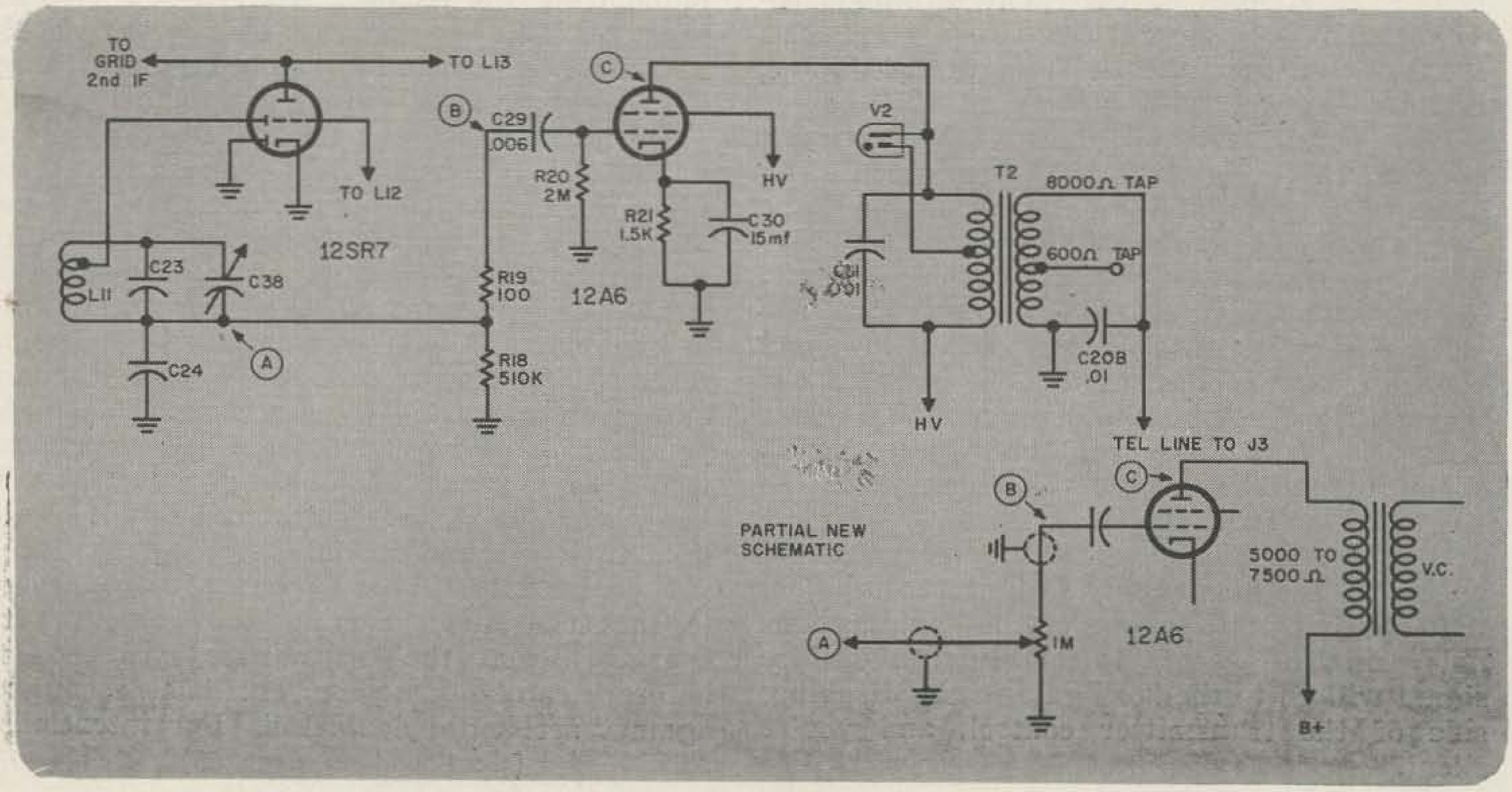
For portability the power supply had to be on the dynamotor well and be transformer operated for safety. This left no extra room for an additional audio stage.

It didn't take much staring at the circuit diagram to see that the reason we were not getting much audio out of the receiver was that it was designed to feed an external audio system or a pair of headphones. Simply by changing the output circuit a bit and using a regular output transformer we could have plenty of decibels.

## Do It Yourself

Remove the screws that hold the two multiple condensers C20 (2X.05) and C16 (3X22mfd) and the audio choke (L15). Locate R19 (100K) and R18 (510K) under the two condensers on the terminal board and remove. The green lead that goes from these resistors to C29 (.006mfd) should also be removed. Solder a shielded lead to this condenser, ground the shield, and loosen the screws holding the other condensers on this side of the chassis to run the lead to the front panel. You might as well take out the coil box across the front of the receiver at this time. Leave this lead long enough to fasten to a volume control which will be on the front panel later. The af choke (L15) and its wiring might as well be taken out completely too. The black lead at the junction of the resistors should be pulled back to the *if* can pin and removed. Replace this with a shielded lead,

The only changes necessary are where new leads should be connected at points A-B-C.



ground the shield at the terminal board, and run this lead to the front panel also. These leads should be insulated from touching the sockets and causing an accidental short and only need to be insulated because there is no voltage but some BC pick-up due to the length and broadness of the *if*'s.

Re-fasten all the condensers and go to the other side of the receiver. Loosen the screws that hold the BFO (Z4) and C15 (3X.05) and output transformer T1. Remove the plate lead at the socket of the 12A6 and B plus lead from the power connection, and C31 (.001). Remove the wire to the phone jack, move all grounds from the phone jack to a direct chassis ground installed at this time in any convenient spot at the side of the chassis, and remove the phone jack. This is where you will put your volume control.

Now start putting a few parts back in! A small 5000 to 7500 ohm to voice coil output transformer should fit in where T1 was taken out. Be very careful when you move the BFO can and the condenser out of your way since these leads break very easily. Solder in the plate lead of the output transformer to the plate of the 12A6 and the B plus lead to the power socket. Run the voice coil leads either thru a convenient hole or to the unused pins on the power socket. Mount a one meg pot on the front panel and solder one lead to the center post, one to the end post, and the shields to the third post. Tighten down all condensers, coils and BFO can securely.

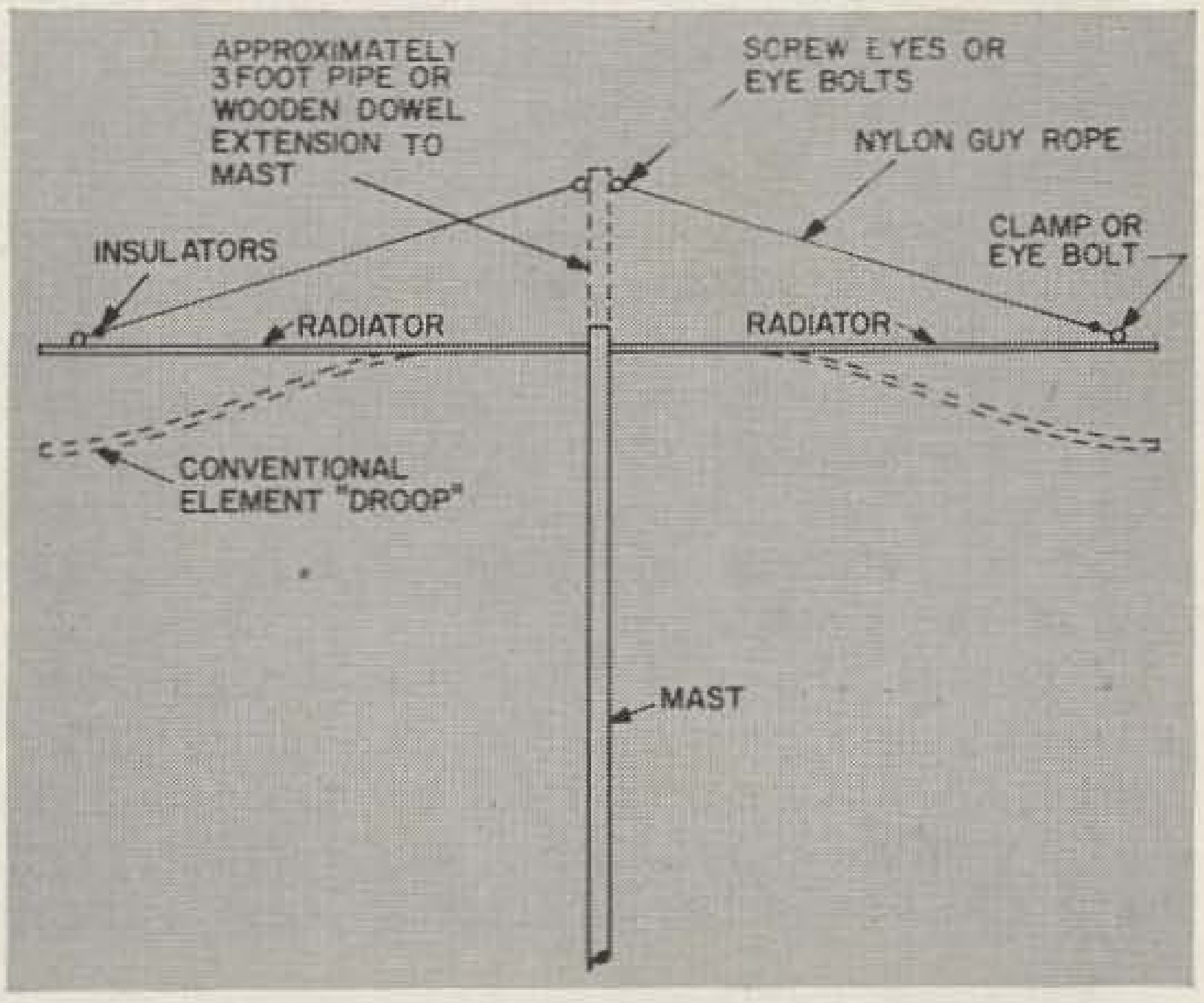
While you are under the chassis it might be well to take out the neon bulb across the antenna trimmer. I found this helped considerably. I left the old gain control in as this helps to cut down background noise on CW reception, but it can be taken out if desired.

### Did it Work?

Now tie on a speaker, turn on the power, and grab something for an antenna. As soon as it warmed up, signals began to bounce thru that I had never heard with this receiver before. I tuned thru the 80-75 meter band and found the results of this little change were most gratifying for the time, parts, and effort consumed. For a stand-by receiver or for the Novice just getting started it is a truly fine receiver to work with. It is a little broad in the *if*, but curing that is another story. . . . K8HDR

---

# Pick Up the 'Droop'




GETTING a bit tired of the "down-in-the-mouth" look of the drooping elements on your rotary beam antenna? Next time you have to service it or when you erect a new one, put a short extension (approximately 3 feet) on your supporting mast. This can be of metal or wood, as you elect. Most lumber yards carry what is known as "full round" stock in several diameters; one will probably fit your mast. If not, a little shaving will fix it.

Ordinary screw eyes (galvanized) in a wooden extension or the equivalent in eye-bolts for a metal pipe, placed at the top, will serve as the upper anchors for the guy lines. Drill through the rod elements near the outer ends to provide an anchorage for the guy lines by means of an eye-bolt or use a wrap-around clamp such as sold by most hardware stores for plastic pipe.

Use Nylon guy cord (any radio distributor) which is non-shrinkable, non-stretchable and of excellent tensile strength. Avoid *wire* of any kind for such guys; it could upset your radiation pattern! Break the Nylon cord with a small 'goose-egg' insulator close to the element. Insert a small galvanized turnbuckle, if you like, close to the top anchor of the guy lines. Glass line is also excellent for this.

Pick up the droop in each element this way; your beam will present a much more workmanlike appearance and the addition of such guys will stiffen the entire assembly surprisingly. It's weight is negligible and the cost is peanuts.

Howard S. Pyle W7OE

# Transistor Modulator

## *Forty Watts*

Monroe McDonald KL7DLC

THE unit I am going to describe in this article is a very efficient audio amplifier suitable for use as a plate modulator for a mobile or portable medium power (sixty to ninety watts rf) transmitter. The audio output is rated at forty watts, but the unit has delivered in excess of sixty watts to a dummy load. No audio quality tests were made at this power level, though. With no filaments to heat, the unit need not be energized during standby (receive) periods, so there is no standby drain. When the unit is energized during transmit periods, the idle drain is less than half an ampere at twelve volts, and the drain at full rated output (forty watts) with a sustained tone is less than eight amperes.

The unit as I use it is built into a power-supply-modulator unit, with a 600 volt 200 mil transistor power supply, so that plenty of "punch" may be supplied to a single 6146 rf section without straining. The power supply uses a *Triad* toroid and the circuit supplied by the manufacturer, so I won't concern myself with it in this article, except to state that the power supply puts two kilocycle noise onto the twelve volt line that takes several thousand microforads of filter capacity to keep out of the modulator.

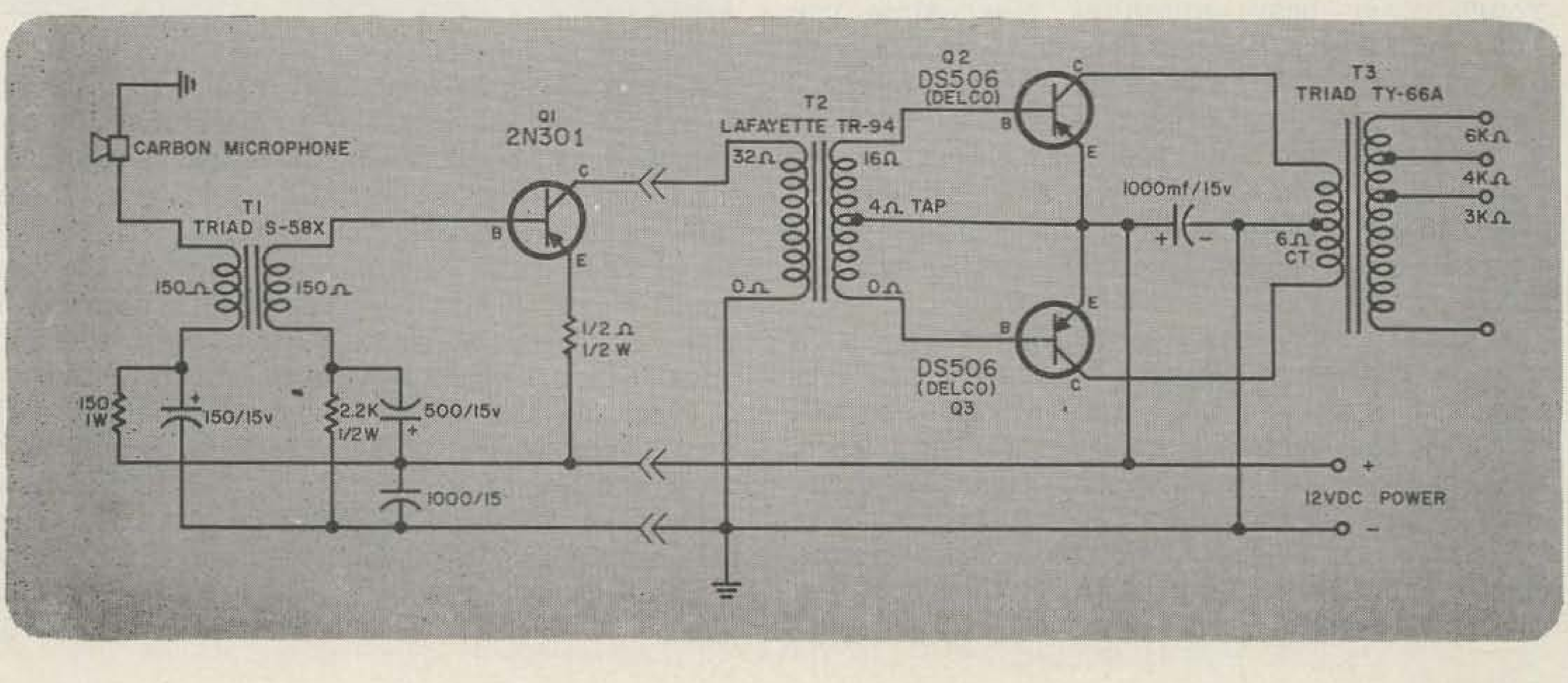
Although the modulator was designed with efficiency and power out as the main goals, I was pleasantly surprised to find that the audio quality is quite good, and compares with fixed stations in "naturalness." I use a carbon microphone, converted to use a Western Electric F1 telephone button.

The modulator and power supply, plus all the associated relays, filters, etc., are mounted in a box about ten by five by four inches, with the modulation transformer sticking out on top. The driver transistor and microphone transformer are included in the rf section of my rig, however, because that is where the mike plugs in, and I wanted to reduce mike lead line pickup.

The modulation circuit is very simple, and therein lies one of its virtues. The construction is nearly all mechanical, with not much wiring to do once the transformers and transistors are mounted. I did mount a terminal strip near the driver transistor to provide tie points for the components in that part of the circuit.

One unfortunate aspect of this unit, or any using recently developed components, is that the parts must nearly always be purchased new. Few people have transistors or transistor transformers in the high power category in their junk box. Using all new parts this unit will cost around forty dollars, and this might discourage those after economy.

The most important part of this modulator is the output stage, which may be used with any speech amplifier capable of delivering a watt or so. This way, microphones other than carbon may be used, or screen-modulated transmitters, such as the Heathkit mobile,



could be converted to plate-modulation, effectively increasing the power output four times. A driving transformer should be used to match the driver tube or transistor to sixteen ohms center-tapped (due to the impedance-match square law, the center tap for sixteen ohms is four ohms.)

Confused by all the complicated bias networks I saw in transistor amplifier circuits, I experimentally determined the characteristics of the transistors I had decided upon, and designed the circuit over two years ago. I have since seen similar circuits in lower-power application with the name zero-bias class-B amplifiers. The output transistors are biased slightly below cut-off by returning the base circuit to the emitters, making full class B operation. This is supposed to introduce some distortion, but it is not noticeable in my unit. The driving impedances of the transistors were also determined experimentally, as Delco would supply no information on the use of their transistors in such applications.

The driver circuit was designed as a class A amplifier using RCA characteristics, and input and output impedances. Since the input impedance of the driver and the output impedance of the carbon mic are about the same, I first tried capacity coupling between the two, but found the stage tended to oscillate because of collector—base coupling through the twelve volt line, even though that line was well-filtered. With a mic. transformer, the phase may be reversed to cancel this feedback. The mic. transformer by-pass filter capacitor must be returned to the emitter supply line, and not ground, to prevent oscillation. The base resistor was selected to give approximately 375 mils idle collector current, and turned out to be 2200 ohms in my unit.

No gain controls have been provided in this circuit, as I believe none are necessary in mobile operation, where the same operator uses the rig all the time. The overall gain may be initially set up by juggling the value of the mic. bleeder resistor, so long as the mic. button current does not exceed about fifty mils. I use about forty mils button current, to get full modulation with my normal speaking, and the 150 ohm resistor was selected for that purpose.

Very heavy filtering is required across the power input to the audio output stage because the current drain varies greatly with modulation, and unless the modulator is connected to a battery with very short, heavy leads, an unfiltered modulator can modulate the twelve volt power line, causing serious circuit interactions. Heavy filtering across the driver is required to reduce receiver and transmitter power supply noise fed into the audio from the twelve volt line. At power transistor impedance levels, heavy filtering means capacity in the thousands of microfarads.

In construction of this modulator unit the transformers should be located according to good audio practice to minimize magnetic coupling. In my unit, the mic transformer is in the rf unit with the driver transistor, the driver and output transformers are at opposite ends of the modulator unit and at right angles to each other, and the power supply toroid is near the output end, as far as possible from the lower level transformer. The output transistors are mounted through the outside of the box using the mica insulators and hardware supplied with them. The driver transistor is mounted on the back sheet of the rf section's metal shell with a mica insulator I made from material kept by hardware stores for stove windows. The transistors must be insulated electrically, but not thermally, from ground, as the transistor shell is the collector connection, and the heat-dissipating element.

I use an F1 telephone carbon button for a microphone, and any other mic. might have different gain or other circuit considerations. This telephone button has very good gain and fidelity, but has the disadvantage that it tends to pick up traffic noise. The "communications" carbon mics. pick up less noise, and require louder talking.

I got the driver transformer on a special sale, and it might be difficult to duplicate exactly. It is much larger than necessary, however, so a smaller substitute might be an improvement. The requirements for the driver transformer are a couple of watts power capability, a sixteen ohm secondary with a tap at four ohms, and a primary to match the driver used, in my case thirty-two ohms, with a half-ampere rating.

The input impedance of the driver transistor is about seventy-five ohms, and as the carbon mic. output impedance is nearly that, a one-to-one transformer with as near to that impedance level as possible is used to couple them. The primary must handle fifty mils mic. current.

It should be borne in mind that the output stage of this modulator draws fairly heavy current, and the power leads, relay contacts, ground connections, etc. should be of sufficient size.

I hope that this modulator will work for other builders as well as it does for me.

. . . KL7DLC

## Very Short Article

### Toroid Tip

A wafer octal socket makes a nice tie point strip if you are building a toroid core transformer for transistor power supplies. Just bend the solder lugs down and attach the leads from the windings. . . . . VE6WT


Donald A. Smith—W3UZN
Associate Editor

# 73 Tests

## HEATHKIT
### "Twoer" .....HW-30
#### Two Meter Transceiver

Size: 7" x 9¾" x 6" deep.
Weight: 6½ lbs.
Power: 115 vac @ 45 watts.
Transmitter: 8 mc xtals.
5 watts input.
Receiver: Super-regenerative.
RF amplifier.
Tunes 144-148 mc (CAP & MARS).
Assembly Time: 7 hours, average.
Price: $44.95 (including mike).

If you'd like to know more about a complete 2 meter station for less than $45.00, read on! Latest in the Heath Companys' line of low priced transceivers is the HW-30, a two meter model, similar to the ten and six meter models. The size, shape and color of all the units are the same, though the insides of the Twoer are somewhat different.

### Transmitter

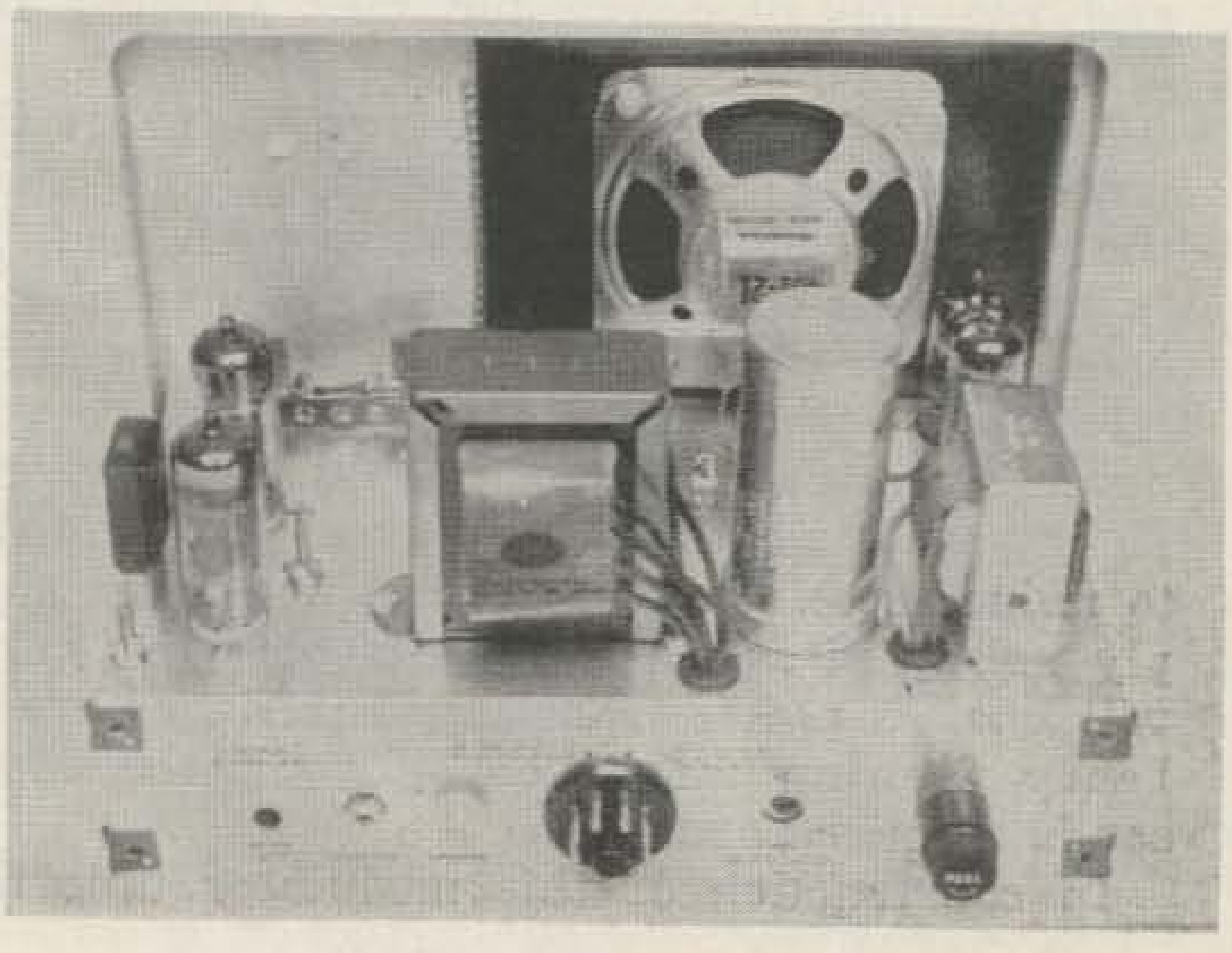
Regular 8 mc crystals with standard .500" pin spacing (FT-243 holders), are used in the oscillator. The pentode half of a 6BA8 tube is used as the oscillator in an electron coupled, Pierce oscillator circuit. The plate circuit of the oscillator is tuned to 24 mc, thus tripling in the oscillator. The second half of a 6BA8 (triode) takes the 24 mc output from the oscillator and triples it to 72 mc. The 72 mc signal is then fed to the triode half of another 6BA8 tube which doubles the signal to 144 mc and drives the final. The pentode half of a 6BA8 is the final, operating straight through on 144 mc.

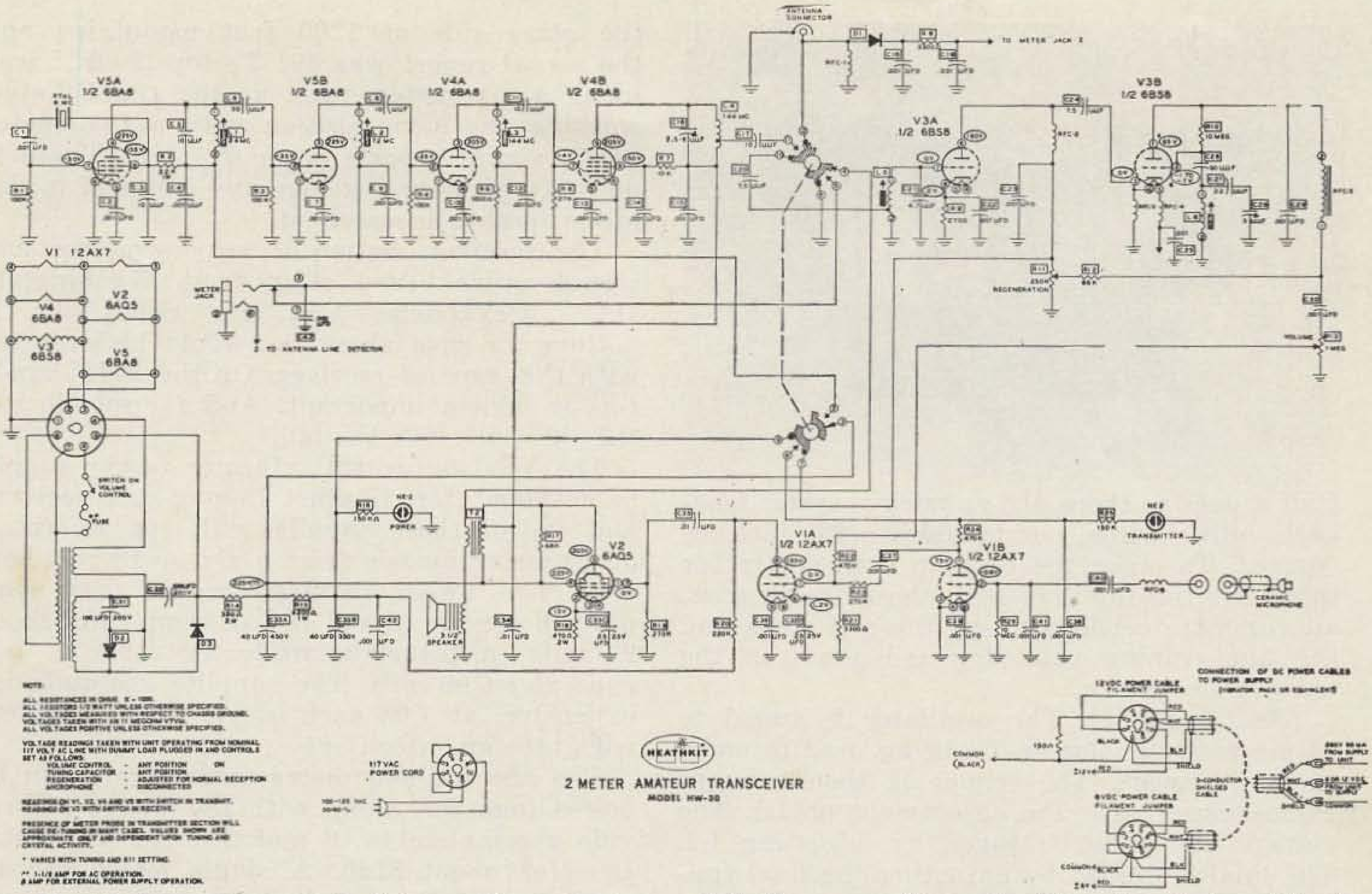
Bypassing in the transmitter is extensive, with over two dozen ceramic disk capacitors being used! All tuning in the rig is done with slug tuned coils, with the exception of the final, which is tuned with a 2.5 to 6 $\mu\mu$fd trimmer capacitor. The final coil is mounted right on the trimmer proper, to keep the lead length as short as possible.

Plate modulation is used, which gives you more "punch" than other types.

### Receiver

The receiving section is very sensitive, even though a super-regenerative detector is used. Heath has improved on the standard super-regen by adding a tuned rf stage. A low noise 6BS8 tube is used in the receiver. One triode of the tube is used as the rf amplifier and the other triode as the super-regen detector. Some Amateurs have never used the super-regen, so I will mention that one of the problems with them that has always been annoying, is what is known as "suck-out." That is, as the receiving frequency is changed, the detector will drop out of oscillation.






Heath has eliminated this problem in two ways. First, they use impedance coupling between the rf amplifier stage and the detector and secondly they made the feed point of the detector a very low impedance. Thus when the regeneration control has once been adjusted properly, you can tune between 144 mc and 148 mc without any further adjustment of the regen control. It should also be mentioned that the super-regen is famous for re-radiating signals from the receiving antenna. The rf stage minimizes this re-radiation.

## Audio

On receive, the audio section includes one half of a 12AX7 as a voltage amplifier, feeding a 6AQ5 output tube. A 3½ inch speaker is mounted on the front panel of the unit. One watt of undistorted audio is available in the receive position.

On transmit, the audio section becomes the modulator. One half of a 12AX7 tube is used as a mike pre-amplifier and the second half of the 12AX7 is used as a voltage amplifier, driving the 6AQ5 output tube. A tap on the output transformer is used to provide the proper impedance for the final rf amplifier, plate modulation being used. An rfc and .001 disk ceramic capacitor are used in the mike input to the modulator, preventing rf energy from re-entering the audio section during transmit.

## Power Supply

A built-in ac power supply is included with the transceiver, using a power transformer. A full-wave voltage doubler circuit is utilized, using two silicon diodes. B+ output is approximately 260 vdc @ 90 ma. The supply is wired in such a way that an external dc supply can be plugged into the rear of the unit and all necessary changes in the rigs circuitry are automatically changed over when the proper cable is plugged into the rear of the unit.

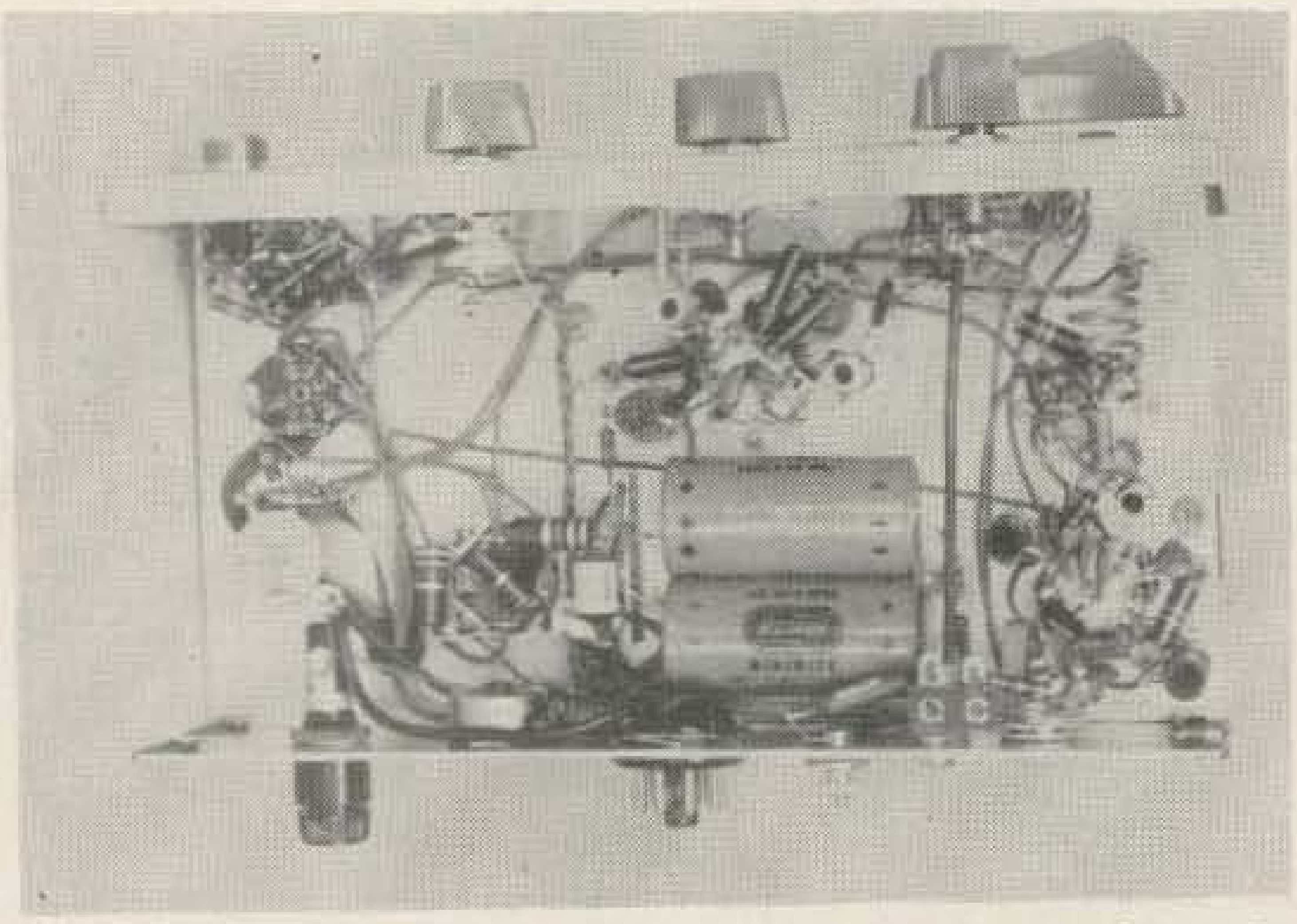
## Building the Unit

Building the rig requires 6 or 8 hours to complete and should NOT be hurried. The design and layout has been carefully thought out, as long leads, parts placement and general layout become quite critical at these frequency. All capacitors used in the rf circuits (both receiving and transmitting sections), are disc ceramics and even tube sockets are of the ceramic, shielded types, for low loss. Note in the photos, that the bottom of the unit looks like there are hardly any parts used in the unit. It gives this appearance because the lead length was kept as short as possible. Actually there are 42 capacitors, 25 resistors, 8 terminal strips, 2 controls, 1 rotary switch, 6 rf coils and 6 rf chokes under there!

The filament circuit and the B+ wiring is done first, with the transmitter section following. The receiver section is then wired, with the power supply and front panel wiring done last. Parts are furnished for making one ac and one dc (6 or 12 volts), power cords.

## Tune Up

The rig, as mentioned before, uses 8 mc xtals and when it comes to tuning up the rig, you're



glad it does as there are no tricky crystal feedback adjustments, or troubles with lack of "drive." To make the tune-up even easier for those not too familiar with these frequencies, approximate settings of all the coil slugs and the final tuning capacitor are given in the tune-up procedure.

(See diagram.) The oscillator is tuned to 24 mc with the slug in L1 being used to make the adjustment. The tripler is then brought to resonance with the adjustment of L2. The doubler can then be tuned by adjusting L3. The final is dipped by adjusting the final tuning capacitor, C16. There is only *one* dip possible in the final! The two meter model has a little different set-up on the meter plug than the other two models. The Twoer uses a two circuit jack, the first position being used to measure the rf output voltage with a standard dc VOM or VTVM. When the unit is tuned properly this voltage will be about 14 or 15 volts on a 20,000 ohms/volt meter. A diode and filtering circuit is built into the rig to provide this reading, which is helpful in tuning up the rig.

When the meter jack is pushed all the way in, (to the second position), the meter is placed in series with the final amplifier, permitting the final plate current to be read. Please NOTE that the meter can not be left plugged into the second position of the meter jack, unless the rig is actually switched to transmit (on the front panel), as the meter completes the final cathode circuit to ground and the final will be operating regardless of the front switch setting.

Receiver tune-up is very easy and a GDO, signal generator, or an on-the-air, two meter signal can be used. The adjustments include rf amplifier tuning, detector tuning and regeneration control adjustment. The receiver adjustments affect each other slightly, so the other adjustments must be checked after making any adjustments to the receiver coils or the regen control.

## Checking Out the Rig

I have to admit, frankly, that I was really surprised at what the rig will do. The first station worked was about 45 miles away, on the *other* side of 1200 foot mountains and the signal report was 59! To top it off, I was using a six meter beam at the time! Later, working the same station with a two meter beam, signal reports were 59+++. There is no drift with the rig, nor any FM and modulation quality is excellent.

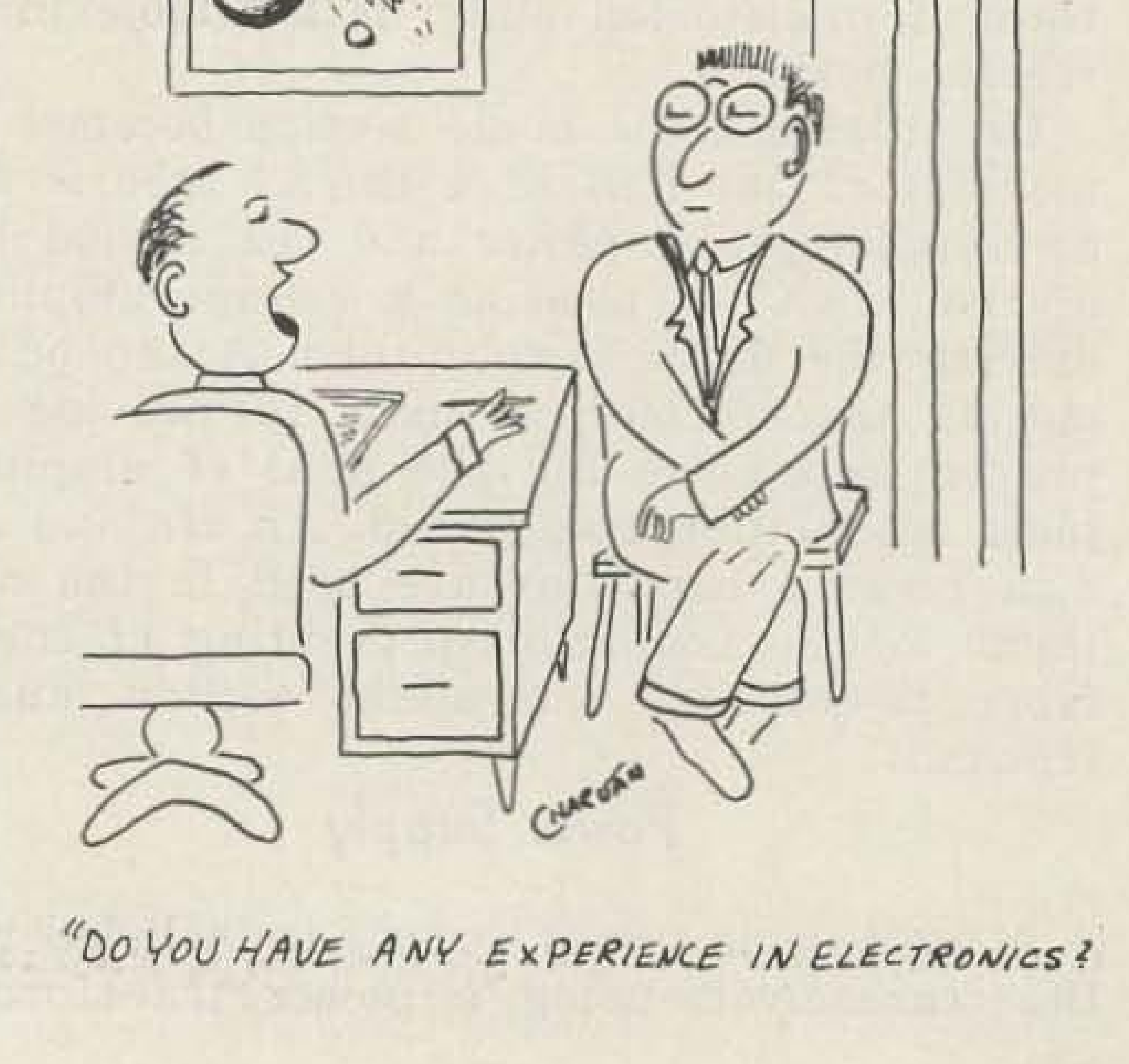
The receiver section is very sensitive and signals were heard often from Washington, D.C., Alexandria, Va., etc. Selectivity is nothing to rave about, as would be expected with this type of receiver. On the VHF bands this is seldom important. And for mobile use the rig really fills the bill.

The VP-1-6 (or 12), vibrator power supply is designed for Heaths' line of transceivers and one of these supplies will operate the 6 or 10 meter models from a six or 12 volt battery. The Twoer requires two of these supplies, however, as the B+ current runs about 90 mils on transmit, while the other models runs about 60 mils. The supplies are quite inexpensive, at 7.95 each in kit form, complete with tube and vibrator!

The six and ten meter transceivers can be bolted together, along with the Twoer to provide a complete 10, 6 and 2 meter VHF station for about $130. A single meter can be used for all three units when they are connected together.

All in all, there is a lot of fun to be had with the little Twoer. At $44.95 it sure is an inexpensive way to get on two meters. It is my personal hope that the rig will encourage others to come up on the higher bands.

. . . W3UZN



"DO YOU HAVE ANY EXPERIENCE IN ELECTRONICS?

# Order Now from WRL's Supermart of Values

**BARGAIN NO. 1A**

**$18.95 VALUE ONLY $8.30**

Chrome-Plated
**24 HR. WALL CLOCK**
Self-Starting
Projection Map of the World

**LOWEST TERMS ANYWHERE**

$20-50 Only $2.00 Down
$50-200 Only $5.00 Down

**BARGAIN NO. 2A**

Big Value! Replated
**COAX CONNECTORS**

83-1R, Doz. ........... $5.88
83-1AP, Doz. ........... $5.88
83-1SP, Doz. ........... $5.88
Any Assortment, Doz. ... $5.88

**BARGAIN NO. 3A**

WRL Exclusive!!!
Self-Powered
**SS-3 Q Multiplier Kit (455kc.)**

★ Boosts Weak Signals
★ 60 DB Suppression
★ One Connection
★ Complete Kit
★ 300cy - 10KC

SPECIAL **$14.95**

**BARGAIN NO. 4A**

New Low Price!
**Push-to-Talk Mike**
Features found only in $30 Mikes
CERAMIC!
HAND HELD OR DESK MOUNT
Only **$11.99**
Made Exclusively For WRL by Electrovoice

**BARGAIN NO. 5A**

**MOBILE MIKE**
As Long As They Last

Just **$3.95**
$10 Value
Excellent Used Ceramic Push-to-Talk Microphones

**BARGAIN NO. 6A**

**SW-59 SHORT WAVE RECEIVER**

★ Transformer Powered
★ Bandspread Tuning
★ Covers 540kc. - 34mc.
★ "S" Meter
Compares to Rcvrs. at Double Price

$60 Value
Only **$39.95**

$ SAVE $$

**BARGAIN NO. 7A**

WRL Exclusive!!!
Self-Supporting
**WRL Spire Tower**
32 ft. Tower
Concrete Mount
Wt. Only 150 Lbs.
Write for Brochure 7A
**$49.95**
Prepaid Anywhere
(Continental U.S.A.)

**BARGAIN NO. 8A**

**Super Savings**
Round Hole
**Punch Set**
Clean and Accurate Holes
5/8, 11/16, 3/4, 1, 1-3/32"
T-Handle and Tapered Reamer
Only **$5.95**

**BARGAIN NO. 9A**

**Amazing Low Citizens Band Price**

**RECONDITIONED CB-100'S**

Factory Reconditioned Globe CB Xmttr./Rcvrs. 3 Channel. Thoroughly Checked. Xtals for One Channel. 90 Day Warranty.

Now **$69.95**

**BARGAIN NO. 10A**

Only **$69.95**

**Complete 80-10M New Transmitter**
40 w. AM
50 w. CW
100 w. (P.E.P) DSB
Globe's famous DSB-100
3-9 mc and 12-30 mc with built-in power supply.
Covers most MARS, CAP, etc.

## WRL WORLD RADIO LABORATORIES

73-4

3415 W. BROADWAY • PHONE 32 8-1851 • COUNCIL BLUFFS, IOWA

PLEASE SEND ME THE FOLLOWING BARGAINS: ________________

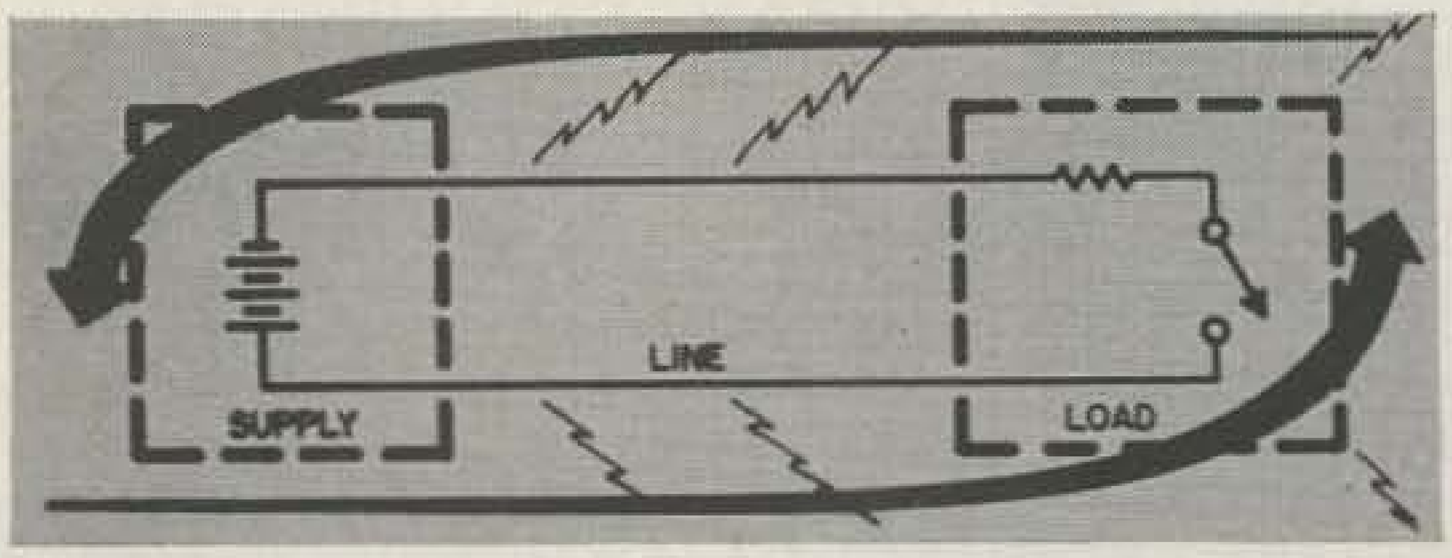
☐ CHECK ☐ DOWN PAYMENT ☐ 30-DAY CHARGE

NAME: ________________ CALL ________

ADDRESS: ________________ CITY & STATE: ________________

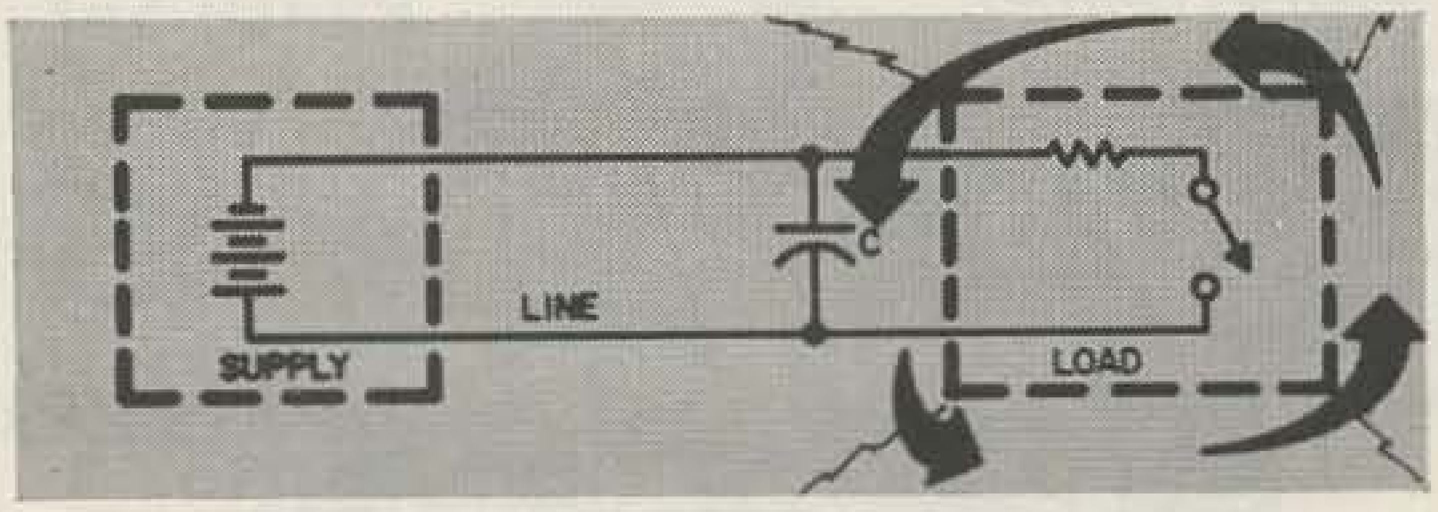
# Radio Frequency Noise Suppression

Bill Ashby K2TKN
Box 97
Pluckemin, N. J.

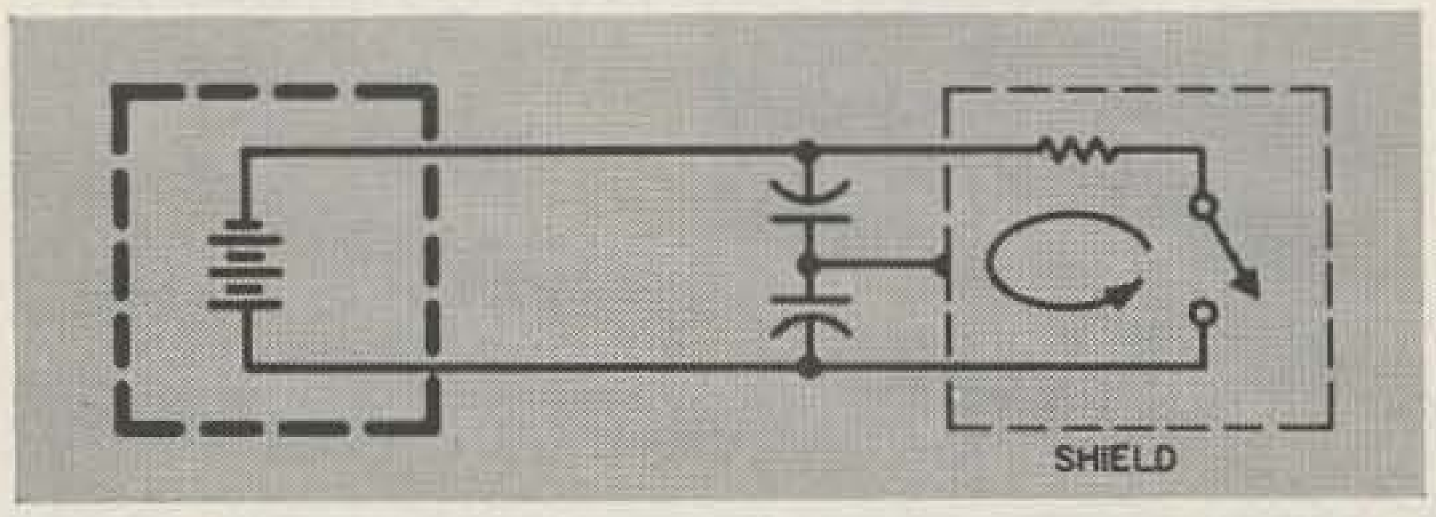



ANY electrical circuit that has a load that is alternately connected and disconnected from the supply voltage can be a source of radio frequency noise. Unless precautions in design and installation of this equipment is taken, severe radio and television interference may result. Units that use a brush type motor, vibrating load contacts, or neon-fluorescent lamps are good examples. This rf interference may be radiated from the unit or its supply lines or both.

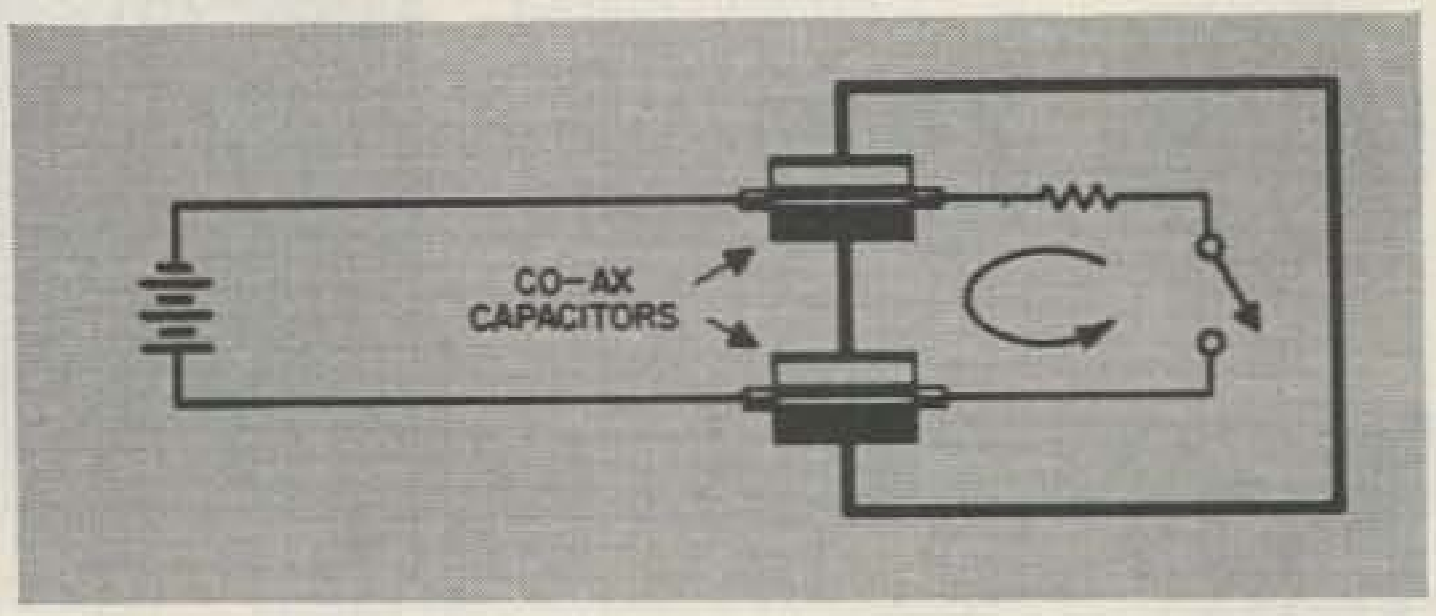
The radiation of this interference from the supply line can be reduced by installation of a capacitor across the line as close to the guilty device as possible.




This capacitor acts as a short return path for the noise and helps to isolate the line.



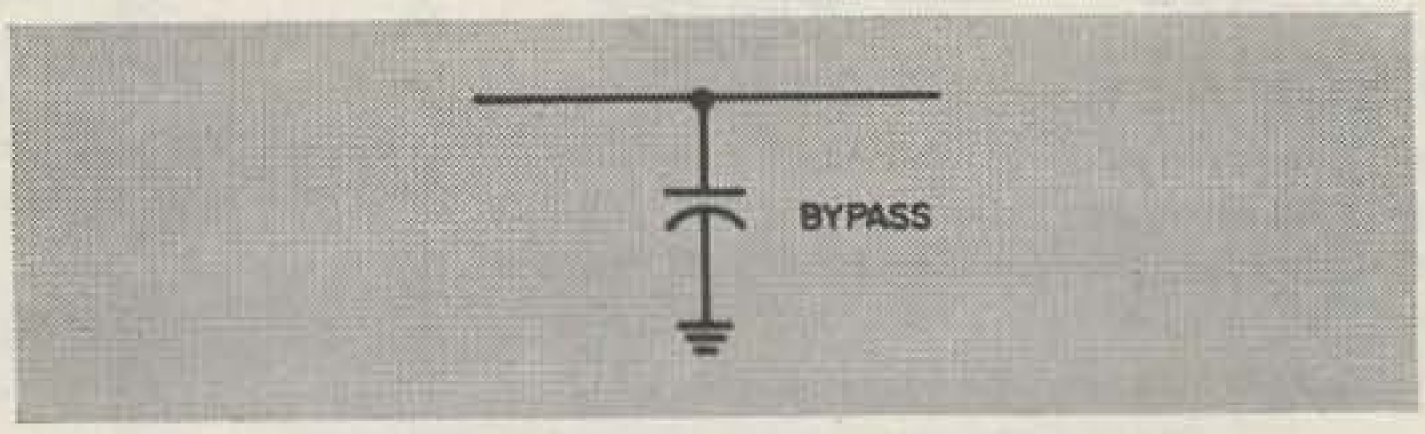

Complete shielding of the unit plus two capacitors will reduce radiation from both the line and the offending load unit. Notice that the use of two capacitors allows both sides of supply line to be effectively shorted out to the shield as far as the noise is concerned. At very high frequencies radiation may occur from even a very short length of wire. Capacitors that appear as low impedance shunts at low frequencies may not be on VHF due to internal impedance. A special type of capacitor called the co-axial capacitor has been developed that has very low internal impedance and is a very effective short circuit for noise from the low frequencies to the very highs.



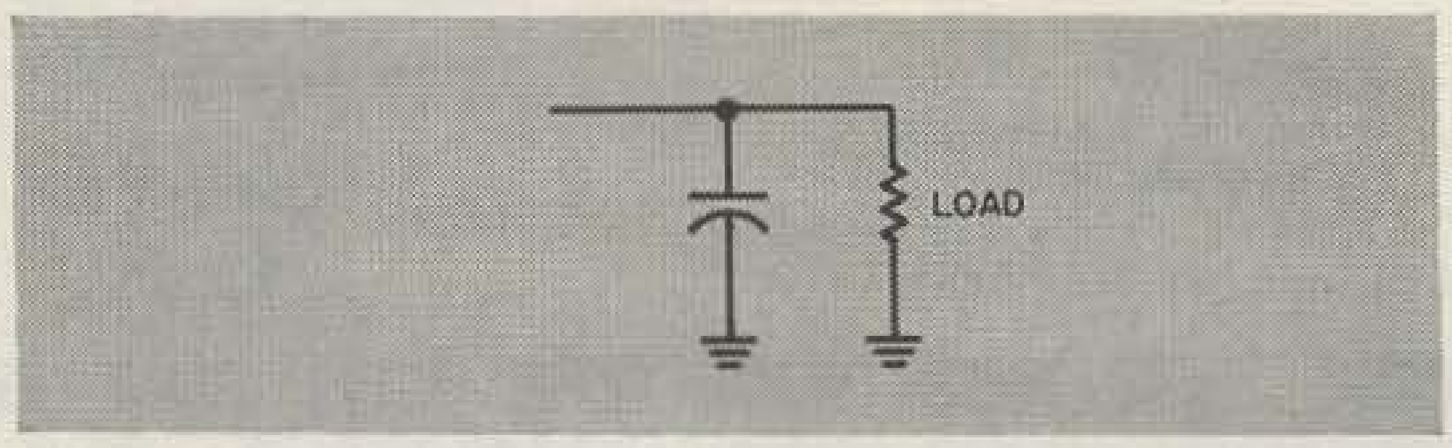

### Radio Frequency By-passing

DC or low frequency ac current travels thruout the area of a conductor, but high frequency ac current travels closer to the surface. At frequencies above approximately 500 kc all energy is traveling on the outer surface of the conductor.

Bypassing of rf energy to ground (stripping noise components from a conductor) has been done in the past by use of a by-pass capacitor.



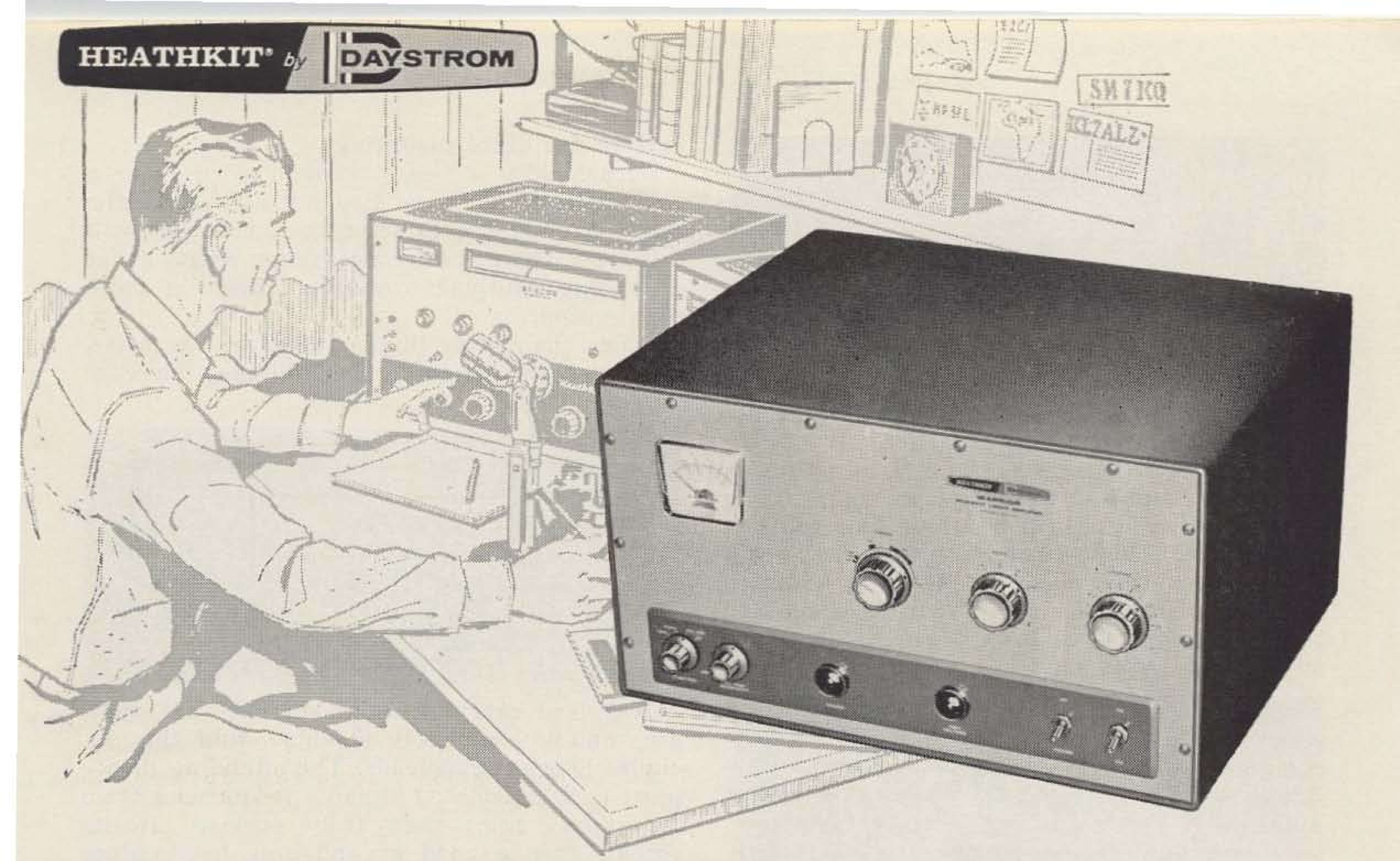

This is only partially effective, and is very dependent upon actual circuit conditions, particularly the actual impedance to the rf energy at the point of bypass.




Given a by-pass capacitor that has a 10 ohm impedance (this is the sum of the capacity and its leads) and a load impedance to rf at this point of 100 ohms, then approx. 90% of the rf will be bypassed. If the load impedance to rf is 1 ohm, just as likely, then the bypass is only 10% effective.

A co-axial capacitor is so designed that it completely surrounds the conductor carrying current. Thus, all rf currents traveling on the surface of the conductor flow to ground.

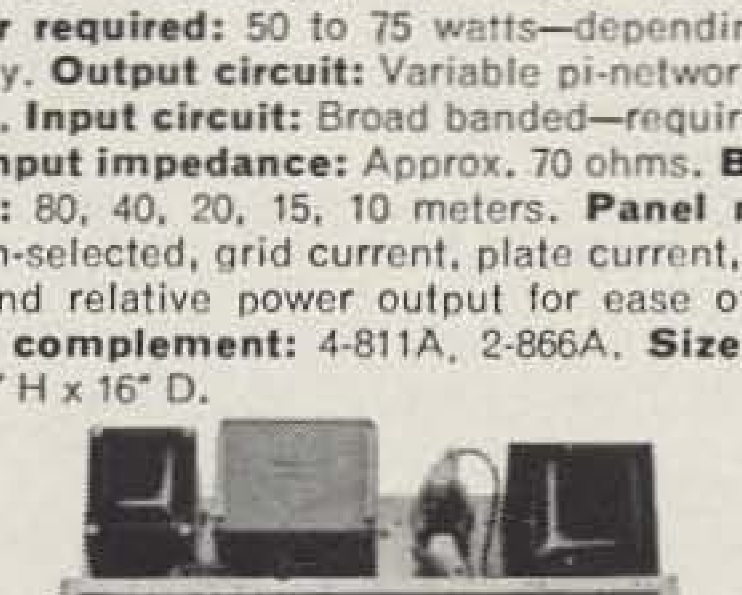
HEATHKIT® by DAYSTROM



# HERE'S A NEW HEATHKIT® GROUNDED GRID KW LINEAR...JUST $229.95

The new Heathkit "Warrior" is a completely self-contained, desk-top kilowatt linear, loaded with special features, at half the cost of comparable units! Compare feature for feature, quality component for quality component, you'll find no shortcuts . . . only the finest watt-per-dollar value in a linear amplifier on the amateur market today!

**Maximum power input:** SSB—1000 watts P.E.P., CW—1000 watts, AM—400 watts (500 watts using carrier controlled modulation), RTTY—650 watts. **Driving power required:** 50 to 75 watts—depending on frequency. **Output circuit:** Variable pi-network (50 to 75 ohms). **Input circuit:** Broad banded—requires no tuning. **Input impedance:** Approx. 70 ohms. **Band coverage:** 80, 40, 20, 15, 10 meters. **Panel metering:** Switch-selected, grid current, plate current, high voltage and relative power output for ease of loading. **Tube complement:** 4-811A, 2-866A. **Size:** 19½" W x 11⅝" H x 16" D.



This inside view shows the neat circuit layout and husky components that emphasize quality. Note the internal shielding of plate circuit for maximum protection against TVI.

**CHECK THESE FEATURES . . .**

*Completely self-contained* . . . HV, Fil. and Bias supplies built in.
*Versatile* . . . May be driven by any 50 to 125 watt transmitter or exciter—no matching or swamping network required.
*Efficient* . . . Stable grounded grid circuitry allows most driving power to appear in output for up to 70% efficiency.
*Oil-filled capacitor* . . . And 5-50 henry swinging-choke provide the excellent dynamic regulation required for high peak power output with low distortion.
*Inexpensive tubes* . . . 4 paralleled 811A's and 2-866A's, forced-air cooled by silent built-in fan.
*Stable*. .carefull design provides a high degree of over-all stability in conjunction with the grounded grid circuit configuration.
*Exclusive* . . . Internal RF shielding of plate circuit for maximum TVI suppression.
*Interlocked switching* . . . prevents accidental application of HV before switching on filament and bias.
*Rugged construction* . . . 16 gauge steel chassis—⅛" aluminum front panel—welded one-piece cabinet.

**Kit Model HA-10** . . . 100 lbs. $23 dn., $20 mo...... **$229.95**
**Assembled Model HAW-10** . . .
100 lbs. $33 dn., $28 mo.......................... **$329.95**

***FREE CATALOG***

nd today for
ur Free Catalog
scribing over
different
athkit products
Hi-Fi, Test,
nateur Radio,
rine and General
nsumer fields.

## HEATH COMPANY

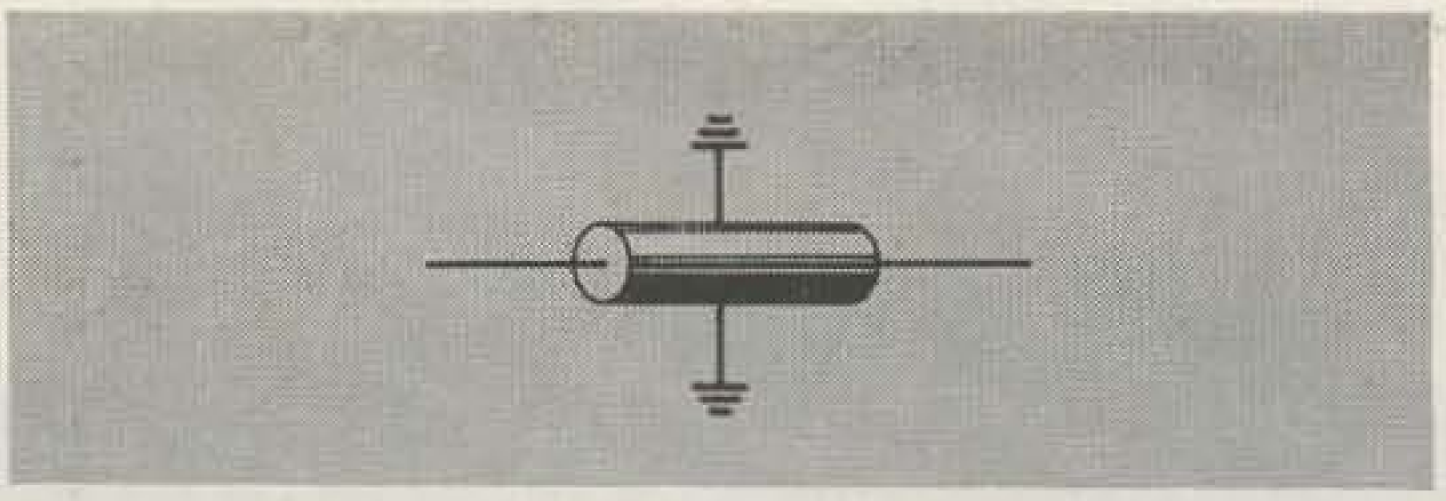
Benton Harbor 11, Michigan

☐ Please send my Free copy of the complete Heathkit Catalog.

NAME

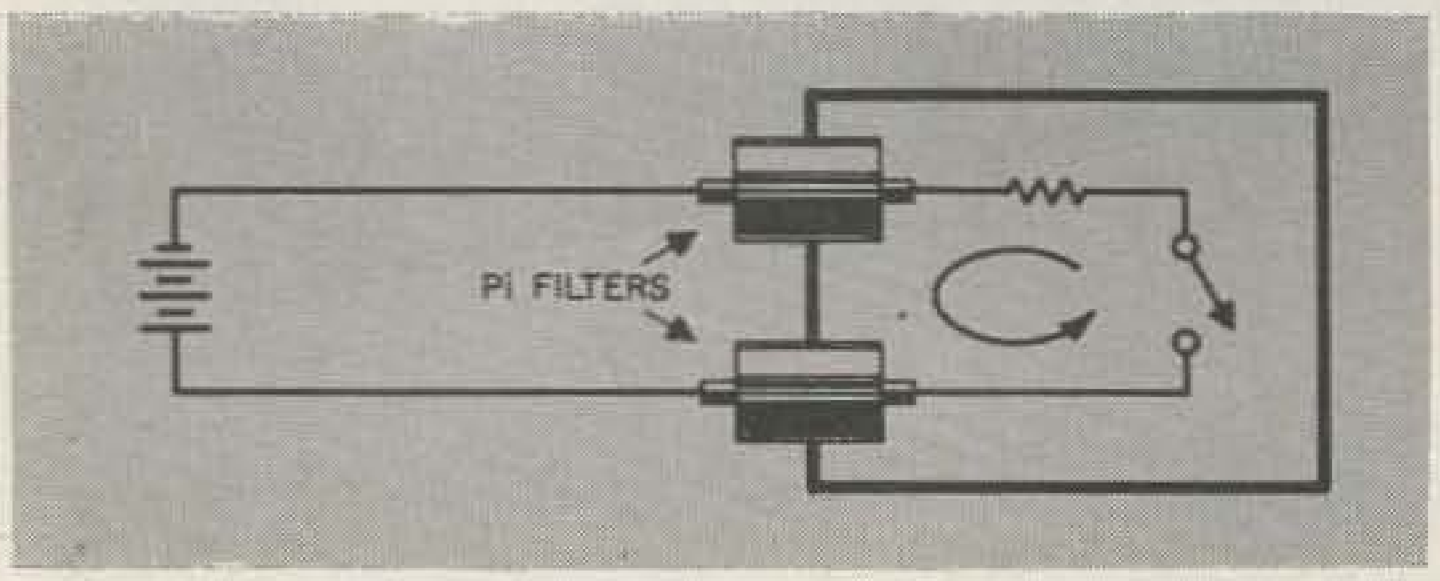
ADDRESS

CITY ZONE STATE



The rf impedance of the load has very little effect, the amount of rf removed depending only on the quality of the co-axial construction and the capacitor installation.

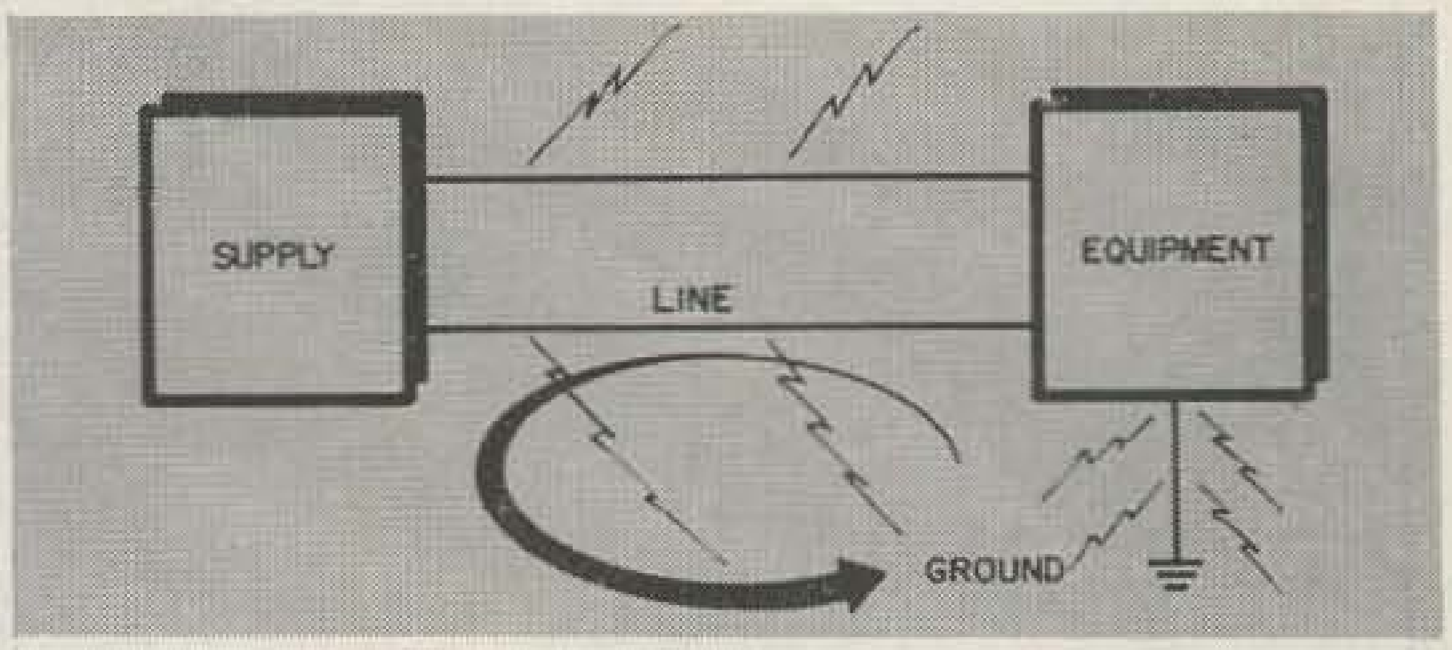
In unusually severe cases of rf interference or where suppression must be complete, a Pi type noise filter can be used. This consists of two special capacitors and an rf choke coil, so arranged that noise is effectively shunted inside the shield, isolated from the line, and the supply line is bypassed. These filters are supplied as single units as shown or as a dual




unit to facilitate mounting.

Occasionally a heavy ground wire from a well installed external ground, bonded to the shield around the interference generator will help, but many misconceptions exist about grounding equipment and its effect on noise suppression.

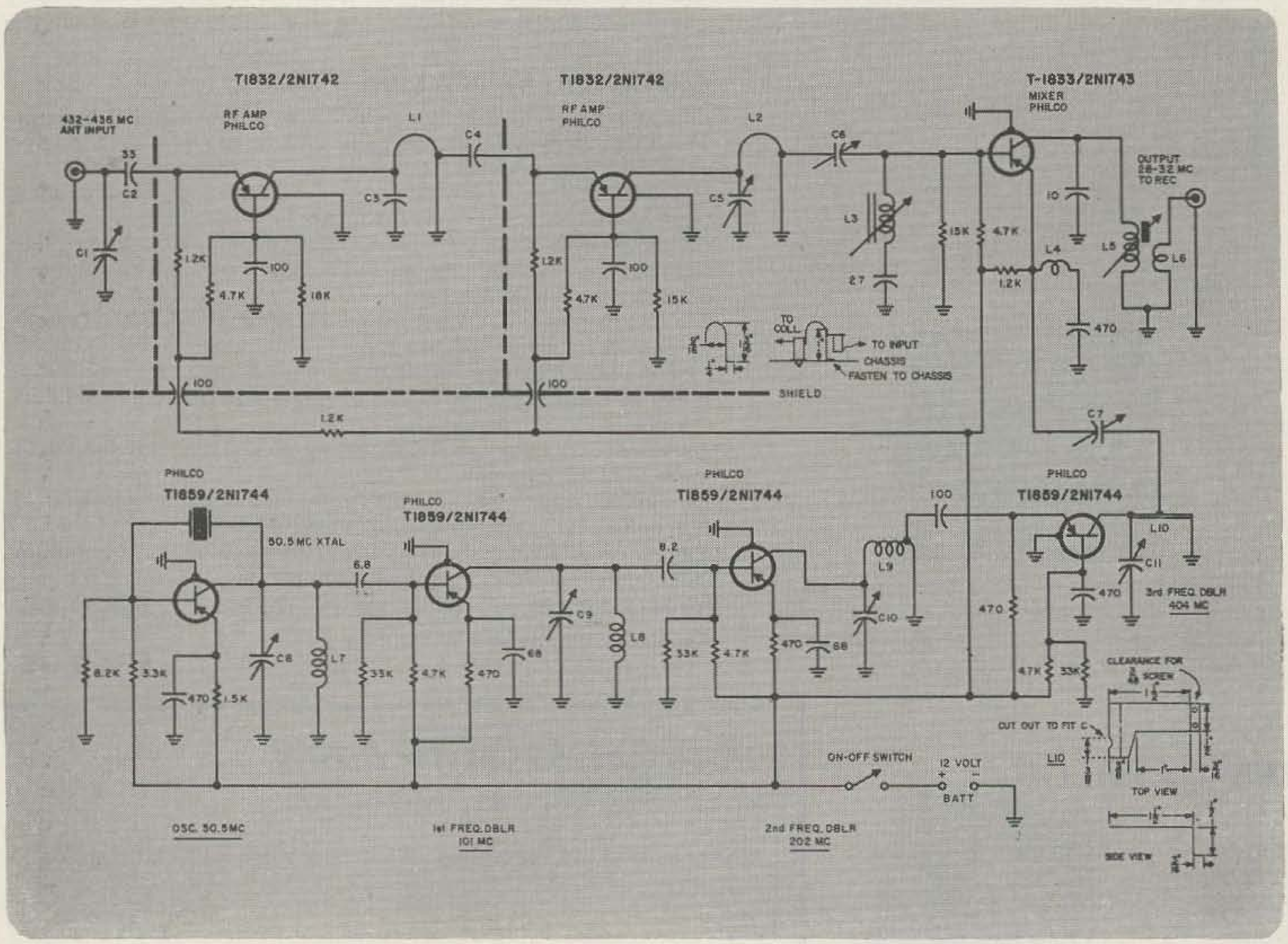
When the supply line is radiating the noise, a ground connection to the unit may increase the radiation.




Any lead carrying noise currents will radiate, unless completely shielded, and this includes long ground leads. The offending device must first be isolated at radio frequencies from its supply line; then fully enclosed in its shield; then a good ground may help reduce the remaining direct radiation from the unit and very low frequency noise. . . . K2TKN

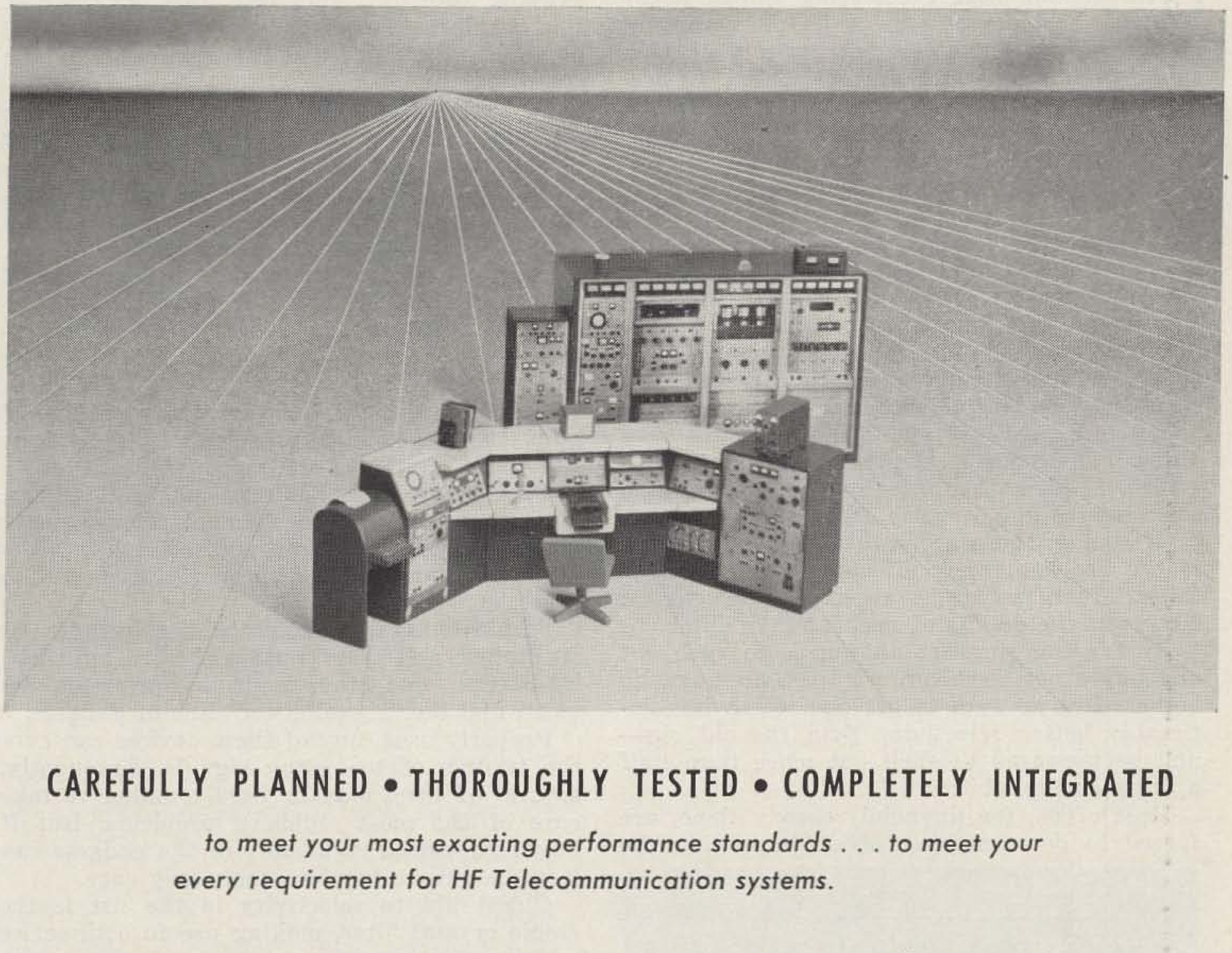
## 432 mc Transistor Converter, Part II . . . W3HIX

(printed as a public service for those few hams that have to have a diagram)



*From* **TMC**

# **COMPLETE** COMMUNICATIONS SYSTEMS *and* EQUIPMENT



## CAREFULLY PLANNED • THOROUGHLY TESTED • COMPLETELY INTEGRATED

*to meet your most exacting performance standards . . . to meet your every requirement for HF Telecommunication systems.*

## TRANSMITTING SYSTEMS • RECEIVING SYSTEMS • TRANSMIT/RECEIVE STATIONS

*Point-to-point . . . Ship-to-shore . . . Shore-to-ship . . . Mobile . . . Fixed . . . Transportable . . . "Fly-away."*

Engineered by men with many years of practical experience and a vast knowledge of those communication problems peculiar to every part of the world, TMC systems planning includes all phases of layout, installation, operation and maintenance to assure optimum performance under all conditions. Full details are available upon request.

**THE TECHNICAL MATERIEL CORPORATION**

IN CANADA: TMC (CANADA) LTD. MAMARONECK, NEW YORK

# Take Your Pick

*or*

*Getting your fill of Filters*

Staff

ONE of the most fascinating things about this business of ham radio (it says here in fine print) is that you can take your pick of conversations—with Europe, Asia, Africa, Australia, the Far North, Antarctica, or nearly any state of the 50. All you have to do is turn the dial of your receiver. . . .

And if you've been in this game for more than 15 minutes, you've undoubtedly wished to high heaven you *were* able to take your pick of the umpty-odd stations roaring through your receiver's selectivity curve and clobbering signals you're trying to copy!

In this country alone, there are nearly 300,000 hams and at any given time it's safe to assume 10 percent of them are on the air. The "popular bands"—75, 40, 20, 15, and 10—have a total of 1,650 kc of space allotted for A3 emission. That theoretically gives each ham something like 5.5 cycles all to himself.

Of course, there are several simple answers to the problem. They all add up to the same thing: increase your receiver's selectivity. However, the details of each answer differ.

By far the simplest answer is to rush out and buy a new receiver. No fuss, no muss, no bother. But be sure to get one which has noticeably better selectivity than the old rig—and be prepared to shell out more than half a kilobuck for it!

Most of us, for financial reasons alone, are forced to do something about improving the existing receiver. And, let's face it, most of the brand-new receivers in the under—$500 class could stand some improvement in the selectivity line.

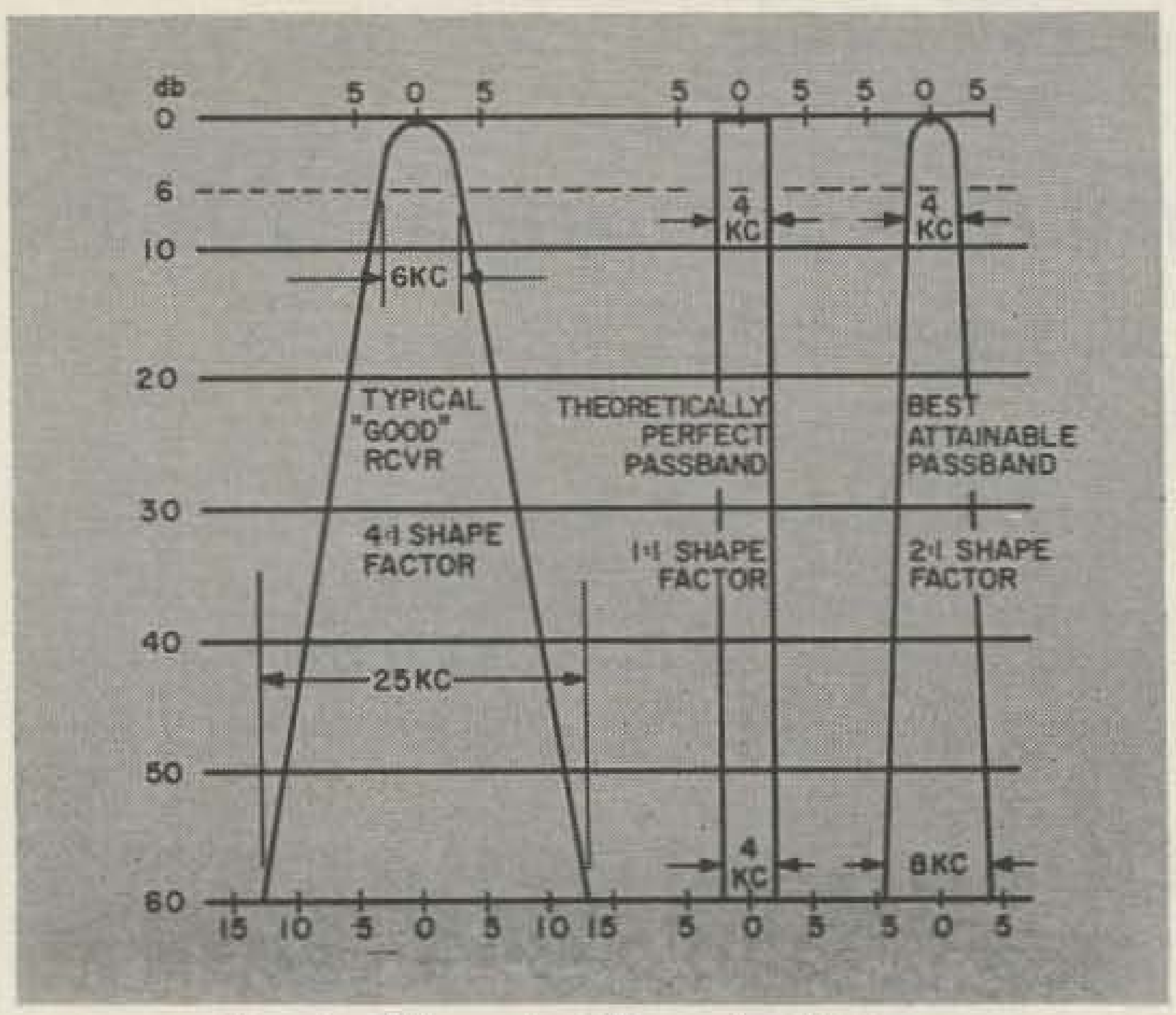



Fig. 1. Characteristic selectivity curves.

Literally hundreds of articles have been written in the past 10 years on improvement of selectivity. It's not possible to cover the content of all of them here. All the major points, though, are included—as well as some which seem to have been unduly neglected.

For a start, let's look at the various ways of achieving ideal selectivity. None will be successful in obtaining the theoretically-perfect 2-to-1 "shape factor" shown in Fig. 1, but some of them come pretty close.

The first thing that comes to most hams' minds when you mention selectivity is a filter. But there are filters and more filters. . . .

There are crystal filters and L-C filters, ceramic filters and mechanical filters, costly filters and costlier filters, and so forth into the night. And any of them, properly used, will do the trick.

Besides filters, though, the list includes Q-multipliers (either outboard or built-in), "Q-Fivers" and other multiple-conversion devices, and the "signal slicer" line of gadgets.

Properly used, any of these devices can cure the trouble of too many signals. Frequently, several of them may be used together to take care of the most stubborn problems. But if they're not used right, any of the gadgets can introduce more troubles than they cure.

Oldest aid to selectivity in the list is the single crystal filter, making use fo both series and parallel resonances in a single quartz crystal at the receiver's *if* frequency to achieve a passband peak and a rejection notch some 40 db deep. Its principles are gone into quite thoroughly in all the ham handbooks and won't be repeated here. Just one thing—for the simple crystal filter to work properly, the entire circuit must be carefully matched to the crystal. It's nearly impossible to hang one into an existing receiver with any degree of success, and equally difficult to substitute another crystal for the factory-supplied unit in a receiver already having a crystal. This is one circuit the homebrewer is well-advised to leave alone.

Don't misunderstand the preceding paragraph. You *can* add a crystal filter to almost any receiver, easily and successfully. However, it won't be the simple, basic circuit. The crystal filter most favored for homebrew installation is the lattice circuit of Fig. 2. Many

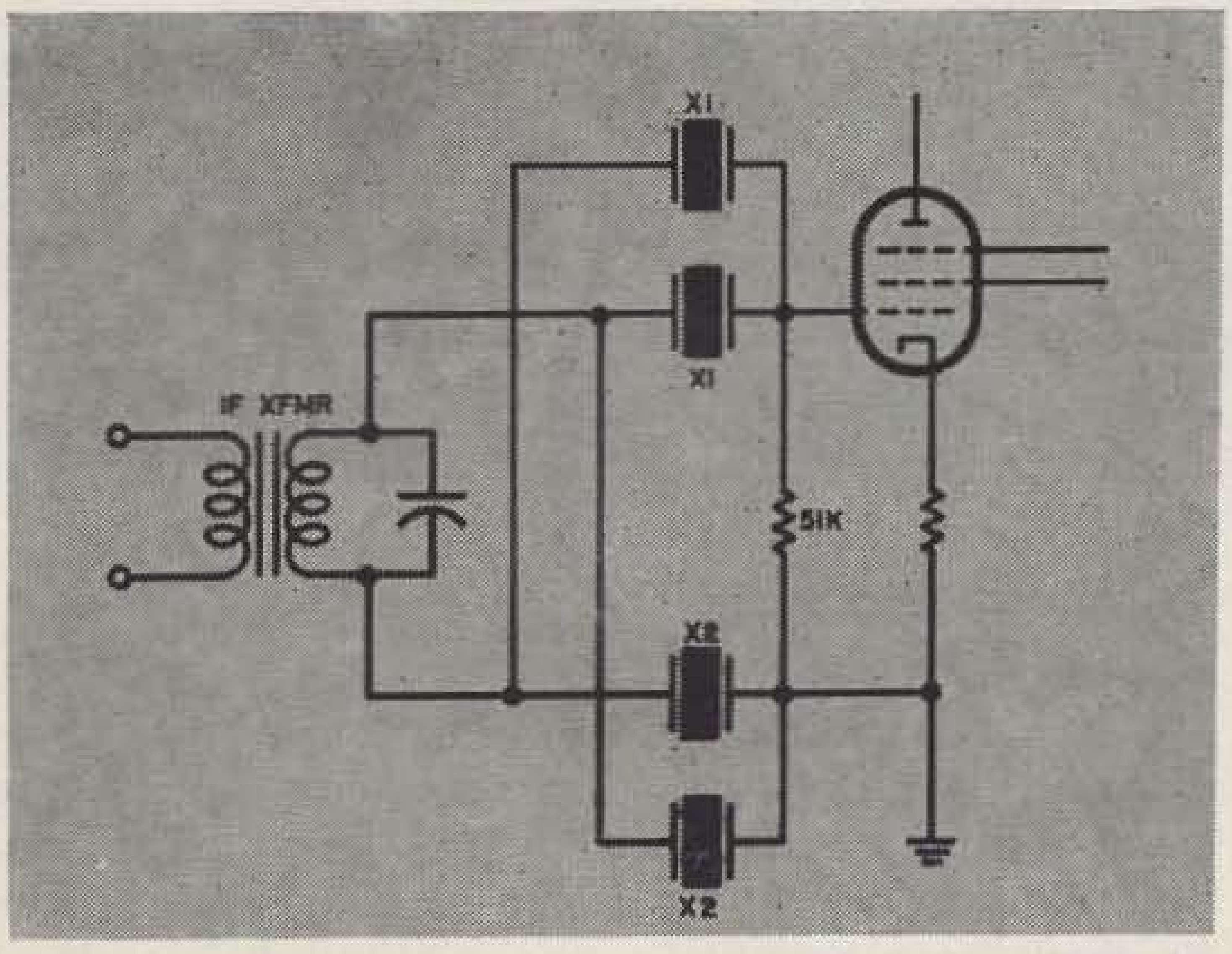



Fig. 2. Full lattice crystal filter. X1 and X2 should bracket the receiver *if* frequency and crystals of the same frequency must be within 50 cycles of each other.

variations of this circuit can be found in the literature, but there's little basic difference in the performance of any. Bandpass is determined by the frequency spread between X1 and X2, and will be roughly equal to twice the difference in frequency of the crystals. All crystals of the same frequency should be within a few cycles of each other. Don't trust the markings—rig up a simple oscillator and listen to the 3rd or 4th harmonics with a BC receiver. You may have to check a half-dozen similarly-marked crystals to find two close enough together for use in this circuit.

Advantages of this circuit include ease of construction, inexpensiveness if surplus FT-241 crystals are used, and general reliability. Disadvantages are the fixed passband and the trickiness of receiver alignment after such a filter has been added. Points to watch in construction are these: Keep the input and output of the filter well-separated to avoid a capacity path around the crystals, and be sure to put the filter as soon after the mixer stage as possible. Out-of-passband rejection averages 30 db with good construction technique. This is enough to help, but not enough to keep that California kilowatt down the street from getting through.

Another crystal-filter circuit operating on entirely different principles is shown in Fig. 3. This one is a complete substitute for the *if* strip of your receiver, and actually can be used to make a good separate receiver if you put an rf stage and mixer ahead of it and follow it with a simple detector and some audio.

This circuit makes use only of the parallel

(Continued on page 44)

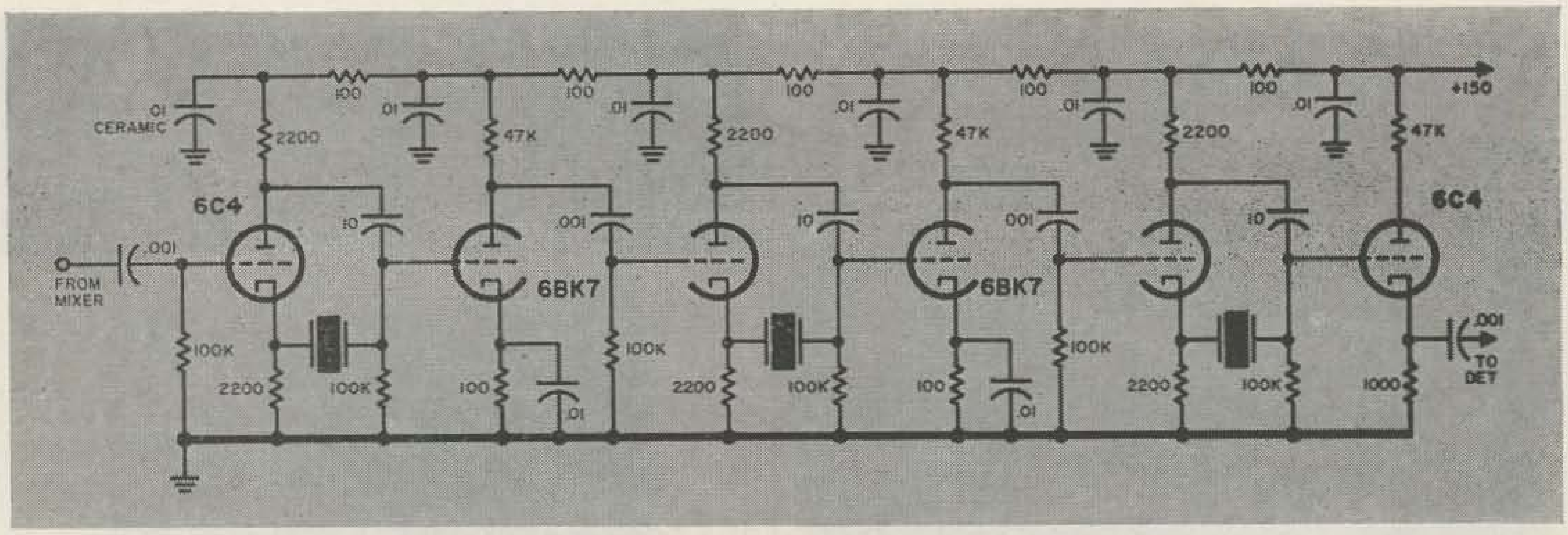



Fig. 3. Crystal coupled *if* amplifier. For CW use all crystals should be within 50 cycles of the same frequency. For AM reception they can be staggered ± 1.5 kc.

resonance of the crystals. Since the crystals provide the only effective coupling between *if* stages, signals must be at or near the crystal's resonant frequency to be amplified. Using 3.5 mc crystals with a frequency spread between crystals of 1 kc or less, the passband will be just about wide enough for an AM phone signal. If you drop the *if* to about 1600 kc and keep the crystals within 50 cycles of each other, you'll get an 80-cycle passband which is ideal for CW if your local oscillator is stable. With a 1600-kc *if* but staggered crystal frequencies (± 1 kc) the passband will again be right for phone use.

This is probably the simplest of all really effective filter circuits, since out-of-passband response is nearly 90 db down. Its major disadvantage is that it requires construction of a separate *if* strip. Even so, its cost is still lower than a mechanical filter—which is the only other type giving equal results.

Closely allied to the crystal filter in many ways, but possessing a few important differences all its own, is the ceramic filter. Developed by Clevite, this device has been used in only one commercial receiver for the ham trade—the Heathkit Mohican.

The ceramic filter operates on the same basic principle as the crystal—that of piezoelectricity. However, since the ceramic filter is manufactured by a process much like that used in making aspirin tablets, almost any desired characteristic can be built in to help cure selectivity problems fast . . . FAST . . . *FAST! !*

One of the first major differences was development of a "first overtone resonator" which shows only a series resonance, with all parallel resonance effects missing (fundamental resonators show selectivity curves almost identical with those of quartz crystals). The "first overtone" ceramic resonator is the electrical equivalent of a very-high-Q pi-network circuit, and as such shows much sharper cutoff above its resonant frequency than below. However, by combining resonator elements the manufacturer has developed a six-section filter with a shape factor of 2.25 to 1.

In application, the ceramic filter is more closely linked to the mechanical breed than to the crystal. It is supplied as a sealed component, with input, output, and common ter-

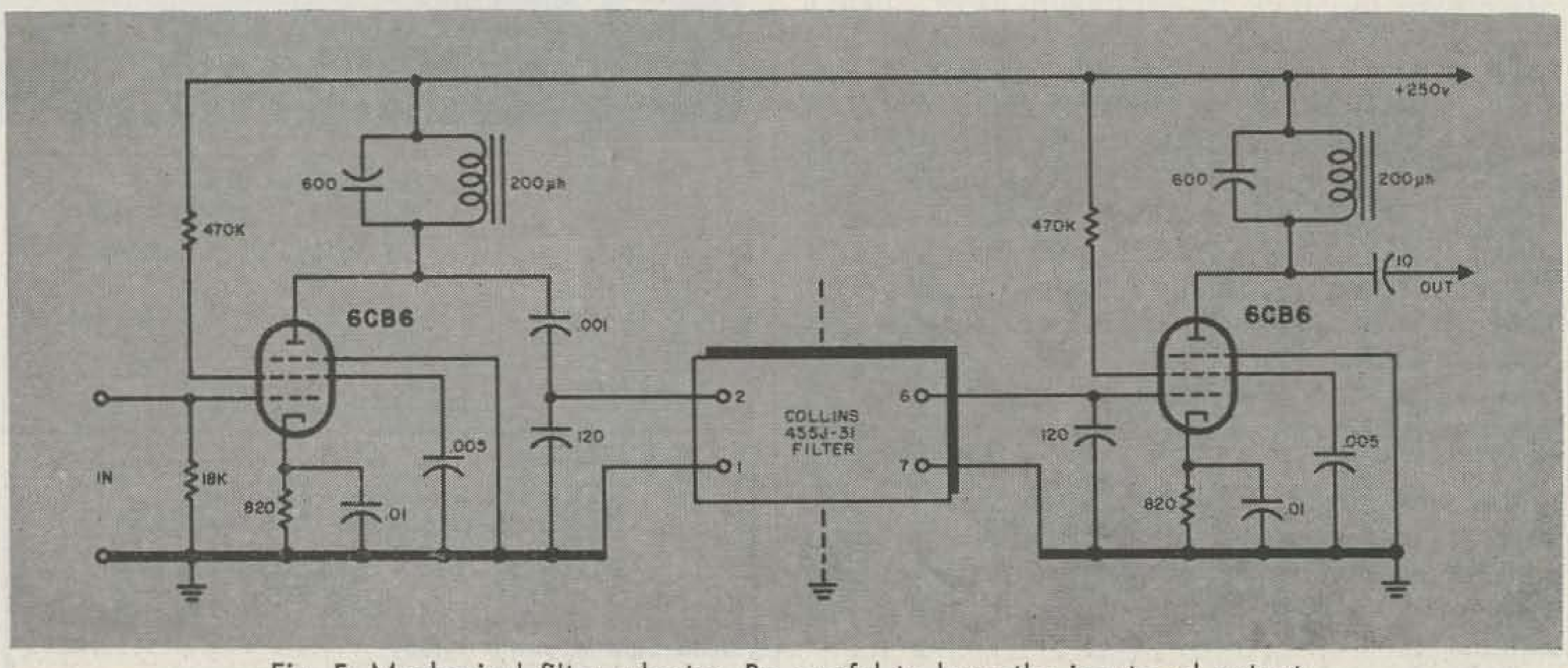



Fig. 5. Mechanical filter adapter. Be careful to keep the input and output of the filter well isolated from each other.

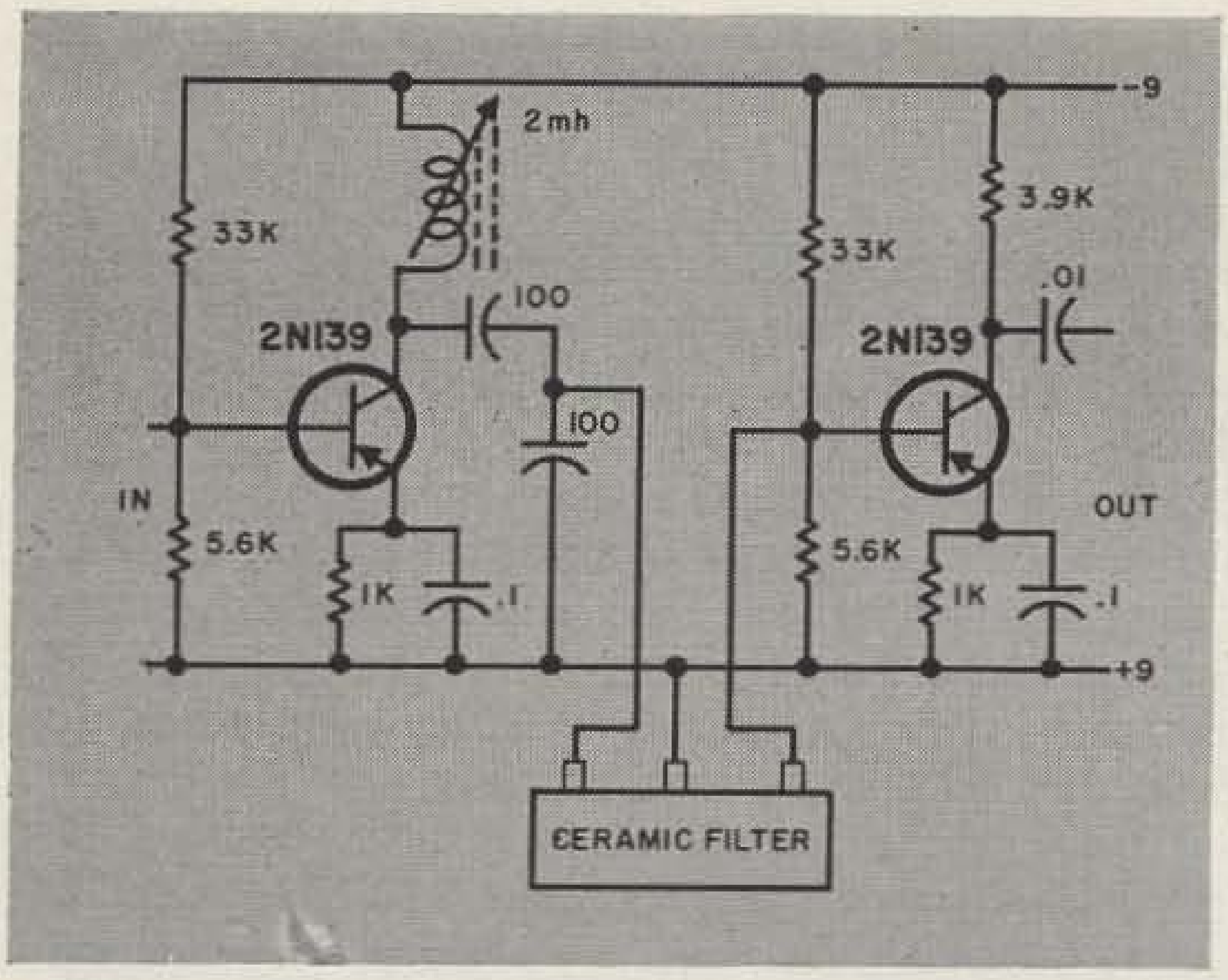



Fig. 4. Manufacturers recommended circuit for installation of a ceramic filter. Transistors are RCA type 2N139.

minals. Unlike other filters, it is most tolerant of variations in source and load impedance, performing equally well in a 2700-ohm circuit and a 10,000-ohm circuit with no change in characteristics. Available passband widths range from 4 to 20 kc at —6 db.

Since impedance levels can be low, the ceramic filter is ideal for transistorized circuitry. The manufacturer's recommended circuit for narrow-band applications is shown in Fig. 4. The only fly in the ointment is this: they're not readily available through ham supply channels. For the nearest distributor's name, you have to contact the manufacturer: Clevite Electronic Components, 3405 Perkins Avenue, Cleveland 14, Ohio.

One of the most popular filters which can be easily added to any receiver is the Collins mechanical filter, which features a 2.5-to-1 shape factor. Based on magnetostriction principles, it provides excellent characteristics with a minimum of adjustment. Its major disadvantage is cost: somewhere near $50, depending on just which of the several available models you get. Equivalent performance is available with other circuits for less money, but they take more time and trouble.

If the cost doesn't bother you, the mechanical filter can be added to your receiver by use of the adapter shown in Fig. 5. Nothing about it is critical except that isolation must be maintained between input and output of the filter to prevent leakage around it. Separate tubes instead of a twin-triode are necessary for the same reason.

Last on the list of filters is the L-C type. While it's possible to design and build a classic-line L-C filter to work at *if* frequencies, the simplest and cheapest way out is to use cascaded transformers as shown in Fig. 6. With the average receiver, addition of four high-quality *if* transformers as shown will in-

(Continued on page 46)

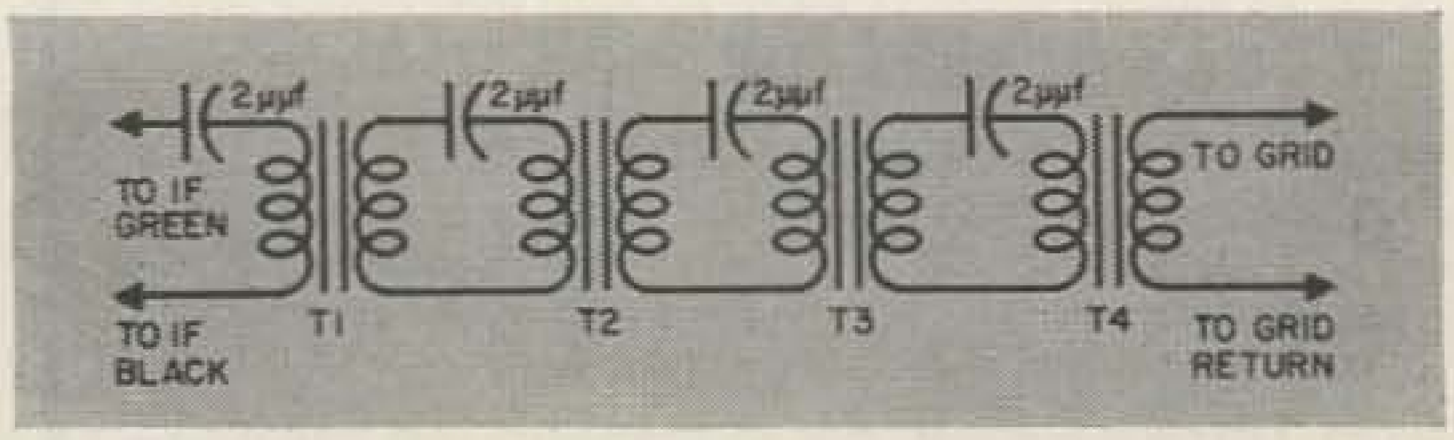



Fig. 6. L-C *if* filter. Use high quality *if* transformers for T1 through T4.

crease skirt selectivity noticeably. Performance won't be up to that of a crystal, ceramic, or mechanical filter, but will be well worth the time and trouble involved.

For best use of L-C filters, conversion to a lower *if* than the customary 455 kc is necessary—but that takes us into the "Q-Fiver" area. Even at the lower *if*, it's usually cheaper and simpler to buy the filter as a ready-made component from UTC or Burnell than to brew it yourself.

If your selectivity problem isn't so drastic as to require addition of a super-sharp filter —and even if you have added one—the Q-multiplier may be your answer. Popularized by Heathkit since its invention by O. G. Villard, this gadget makes use of controlled regeneration to mulitply the Q of a tuned circuit to astronomical values, thereby multiplying its selectivity as well. The resulting peak can be used either to boost or to null a signal, depending on whether you have one or many sources of interference in the passband.

A basic boosting Q-multiplier circuit is shown in Fig. 7, and the full rig including both peak and null functions comprises Fig. 8. Since the controls of the Q-multiplier have no interaction with receiver controls, you can add as many as you like—one in the plate of the mixer, another in the first *if*, etc. The peak or null will have a width approximately equal to 0.1 percent of your *if* frequency, and can be tuned across the receiver's passband.

The simplest of all Q-multipliers (although the term hadn't been heard of when the trick was invented) is that shown in Fig. 9. It requires no outboard circuitry, and the only addition to the receiver panel is a potentiometer which can be installed concentric-fashion with the rf gain control if you desire. C1 is a gimmick capacitor consisting of several turns of insulated hookup wire wrapped around the grid lead, with one end connected to the tube's plate terminal. Resistor R1 controls regeneration of the stage by controlling its gain. R1 will also act as an additional gain control. This circuit works by turning an *if* stage into a regenerative amplifier, which adds "negative resistance" to its associated transformers and greatly increases their Q and selectivity. It has been successfully applied to the S-38 and to the Command Sets.

One popular means of improving selectivity is through use of a "Q-Fiver." While the BC-

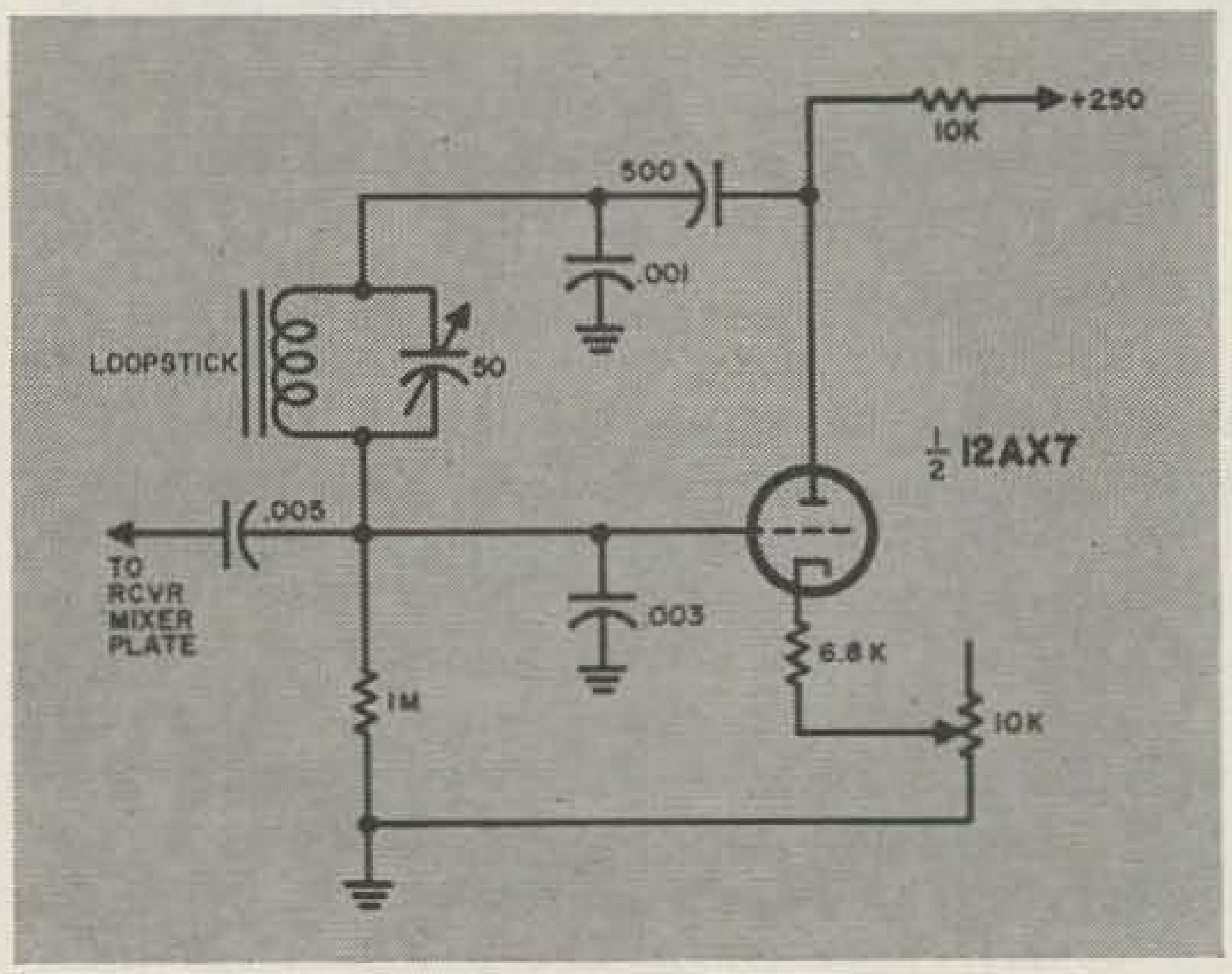



Fig. 7. Basic Q-Multiplier circuit.

453 is the original of this idea, it leaves much to be desired (besides having become nearly unavailable at a reasonable price). Since the basic idea is to convert the 455-kc *if* down to 50 kc or so to take advantage of improved selectivity at the lower *if*, it makes more sense to build a special gadget to do just that, then return the audio to the station receiver for further amplification.

Many such circuits have been published. Some feature crystal control of the second converter, some make use of mechanical, crystal, or L-C filters in addition to the low-*if*

(Continued on page 48)

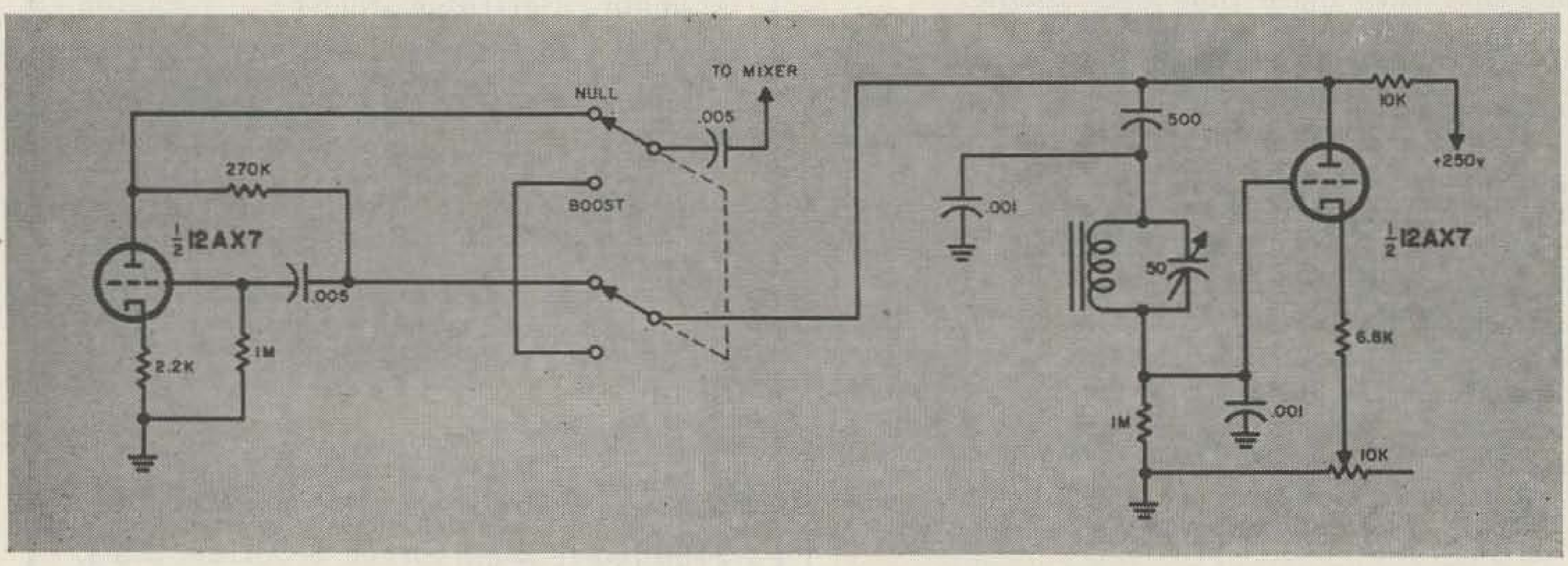



Fig. 8. Complete Q-Multiplier circuit.

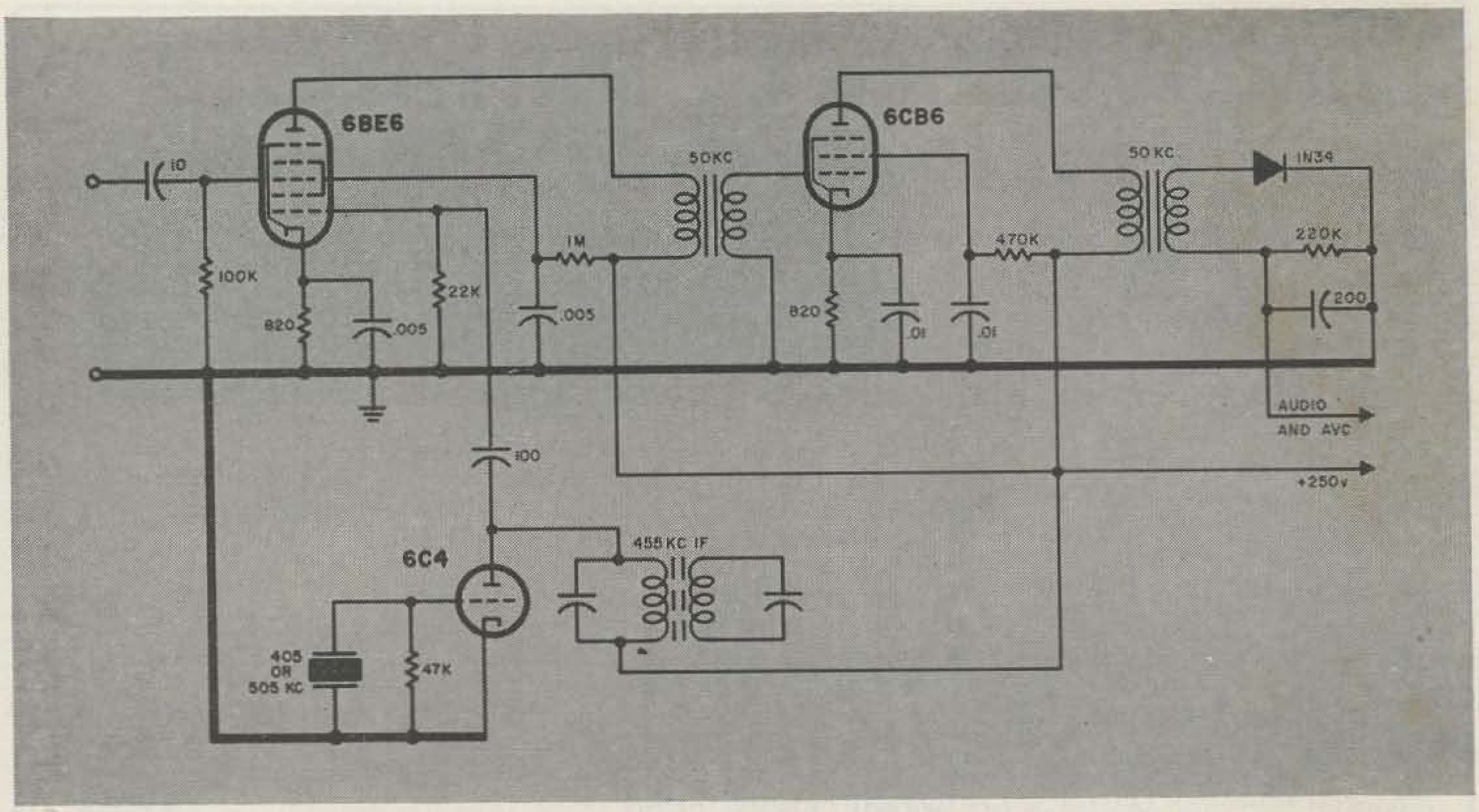



Fig. 10. Q-5er. Input line connects to last *if* grid. Audio goes to the top of the volume control or to the existing detector load resistor if AVC is desired. Crystal frequency will determine which sideband is received. Bandwith is 1800 cps.

selectivity. One of the simplest and most basic "Q-Fiver" circuits is that shown in Fig. 10. It can be built into a small Minibox and connected to the receiver through a pair of short lengths of coax. Though a power supply is shown, required power can usually be stolen from the receiver.

A more-advanced version of the Q-Fiver which allows you to tune the passband across your receiver's *if* bandpass curve is shown in Fig. 11. With this gadget, you'll have a tuning capability offered by only one commercial receiver—the 75A4—and there it's done mechanically instead of electronically. If you add the tunable Q-Fiver, it's best to use the receiver's BFO (readjusted some 50 kc high-

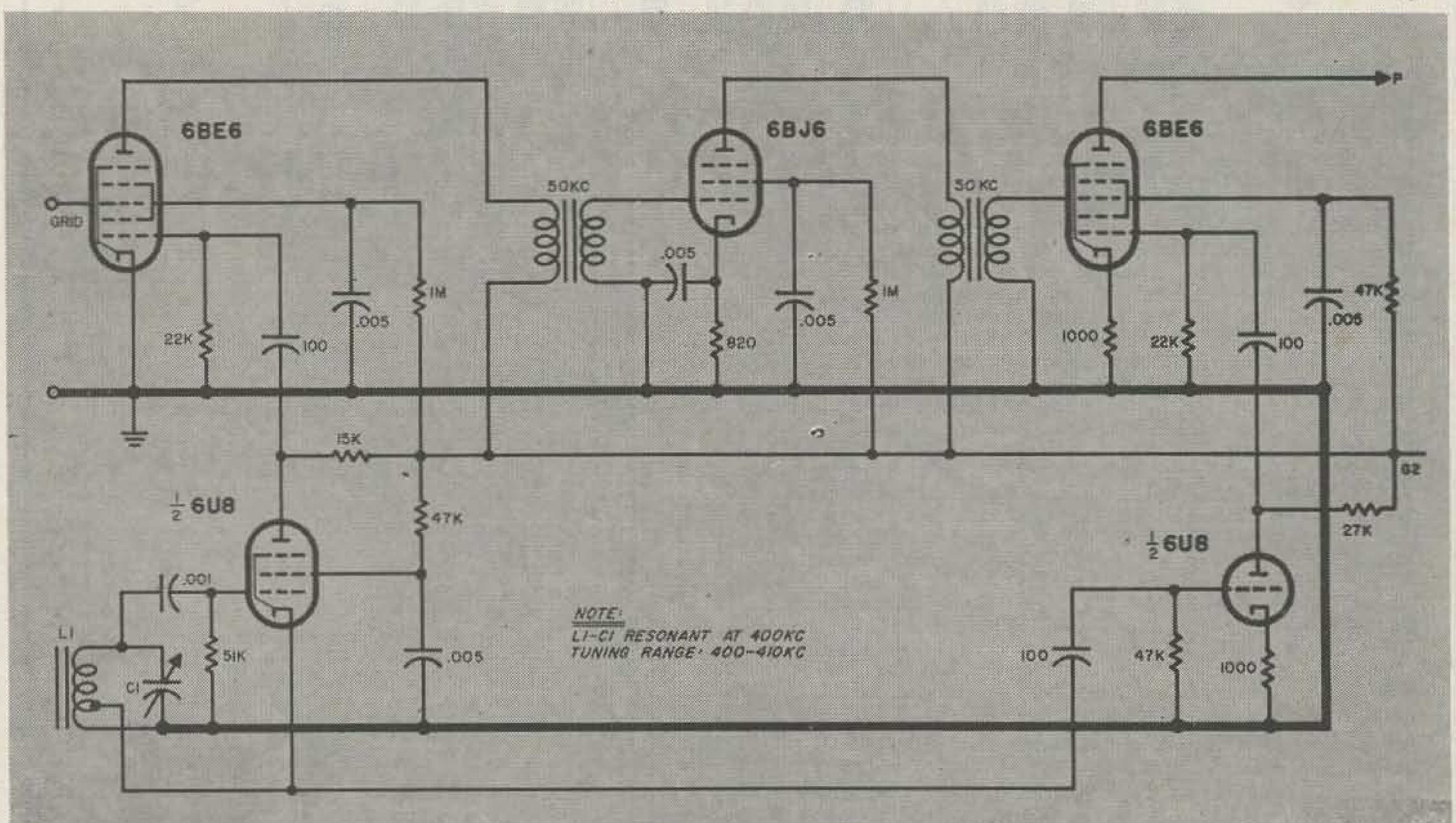



Fig. 11. Tunable bandpass Q-5er. Pentode portion of the 6U8 may be replaced by the receiver bfo to provide front-panel adjustment of the bandpass position. L1 and C1 may be any values which resonate at the *if* frequency 50 kc. All connections are shown with reference to the receiver's last *if* tube socket. Remove *if* tube and substitute Q-5er.

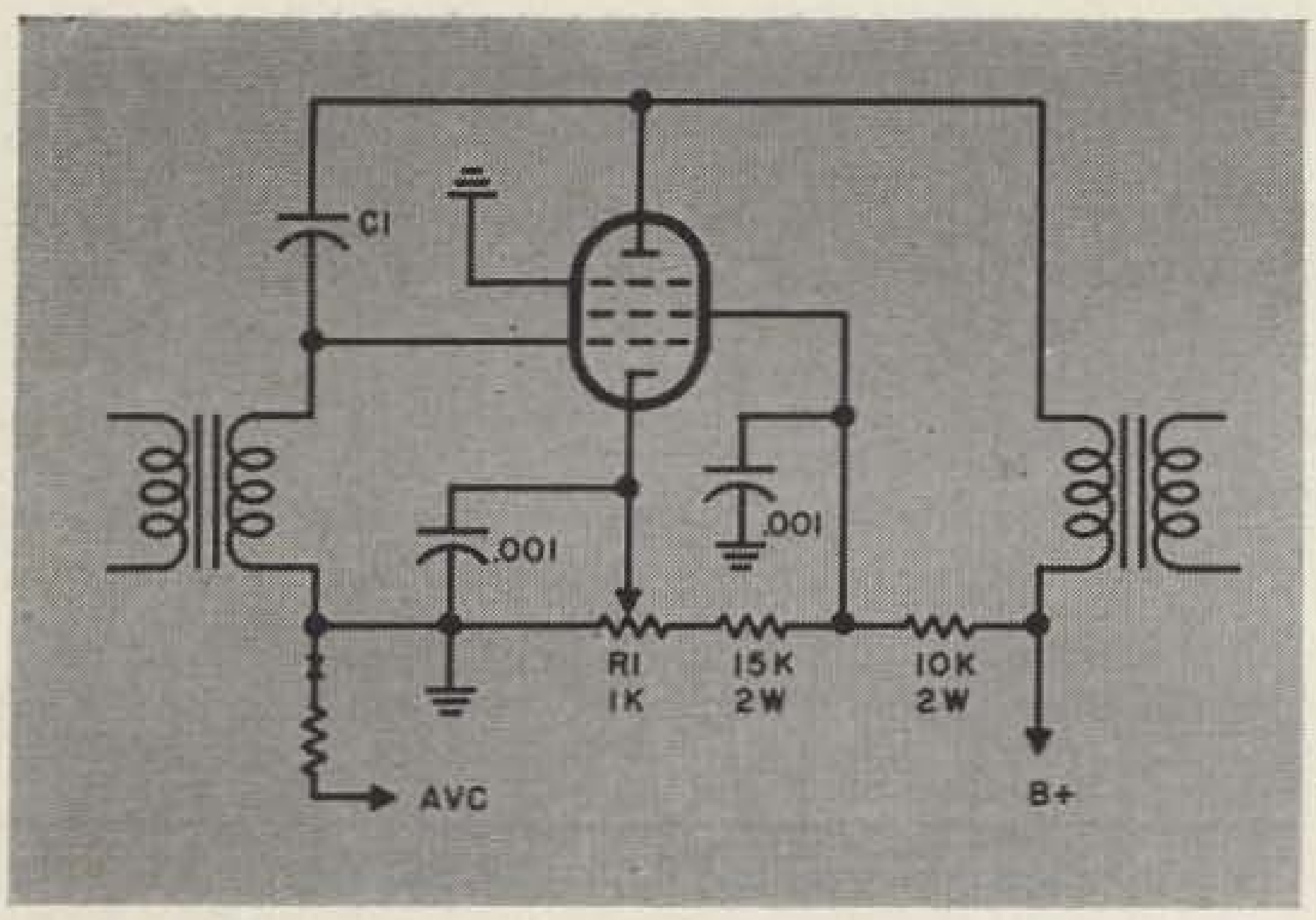



Fig. 9. Simplest Q-Multiplier. AVC line is disconnected at point X. See text for details of C1. Tube is existing *if* amplifier.

er) for the tunable oscillator and substitute a crystal-controlled BFO in the receiver. This will give you complete front-panel control without having to drill any holes in the receiver cabinet, and allow semi-remote placement of the accessory.

The tunable Q-Fiver works by a triple-conversion process; signals in the *if* range of the receiver are mixed with the tunable oscillator and converted to the second *if*. There, selective L-C circuits trim the passband down to 3 kc. The trimmed *if* is mixed again with the tunable oscillator output and returned to the receiver *if*. From there, the station receiver takes over for detection, AVC, and audio amplification. By varying the frequency of the tunable oscillator, the passband's position in relation to the original receiver bandpass curve can be shifted some 5 kc up or down from center, allowing you to push an interfering station "over the side."

Last stop on this selectivity tour is Slicerville. In the six years or so since the term was coined, the name "signal slicer" has been applied to nearly every type of receiver accessory imaginable. Several Q-Fiver devices have been dubbed "slicers," as have some filter circuits. But strictly speaking, a signal slicer is a phasing-type detector (and as such, almost outside the realm of this roundup).

The slicer operates by dual detection, with phase shift deliberately introduced into the bfo channels. Resulting audio is shifted in phase again, and finally the two audio channels are recombined. Phase relationships are such that signals on one side of the bfo frequency add together, while signals from the other side of the frequency cancel out and can't be heard.

Or in other words, the signal is sliced in half at the bfo frequency. That's where the device got its name. The increase in selectivity is obvious—less than half the original passband gets through the slicer to be amplified.

(Continued on page 50)

Complete construction information on the slicer is too long to incorporate here. It was published in GE Ham News Vol. 6. No. 4 (July, 1951) and will be reprinted in a GE Sideband book set for publication in early 1961. A schematic diagram but no alignment information is on page 15 of "Single Sideband Techniques" by Jack N. Brown, W3SHY.

As mentioned earlier, this short listing doesn't include every selectivity-improving trick in the book. If it attempted to do so, there wouldn't be room for anything else in this issue . . . or in the next, either! However, with the gimmicks collected here, you can easily decide which route or routes you want to follow with your own receiver, in order to be able to pull the signal you want to hear out of the normal QRM. Take your pick!

### References


**Crystal Filters**

H. L. Gottfried, **An Inexpensive Crystal-Filter I.F. Amplifier**, QST, February, 1958.

F. Langford-Smith, **Radiotron Designer's Handbook**, 4th Edition.

W. Orr, **The Radio Handbook**, 15th Edition.

American Radio Relay League, **Single-Sideband Handbook.**

American Radio Relay League, **The Radio Amateur's Handbook.**

**Ceramic Filters**

A. Lungo and K. W. Henderson, **Application of Piezoelectric Resonators to Modern Band-Pass Amplifiers**, paper presented at 1958 I. R. E. convention, New York City.

**Mechanical Filters**

Orr, **op. cit.**

**L-C Filters**

Federal Telephone and Radio Co., **Reference Data for Radio Engineers**, 4th Edition.

**Q-Multipliers**

E. L. Campbell, **Transistorized Q-Multiplier**, QST, January, 1958.

R. L. Ives, **Variable Band Width Q Multiplier**, QST, April, 1957.

J. Kyle, **Improve Your AC-DC Short Wave Receiver**, Popular Electronics, December, 1959.

L. M. Temple, **Q Multiplier, S.S.B., Q-5er and SOJ**, QST, September, 1956.

O. G. Villard, **Flexible Selectivity for Communications Receivers**, Electronics, April, 1952.

Orr, **op. cit.**

**Multiple Conversion Adapters**

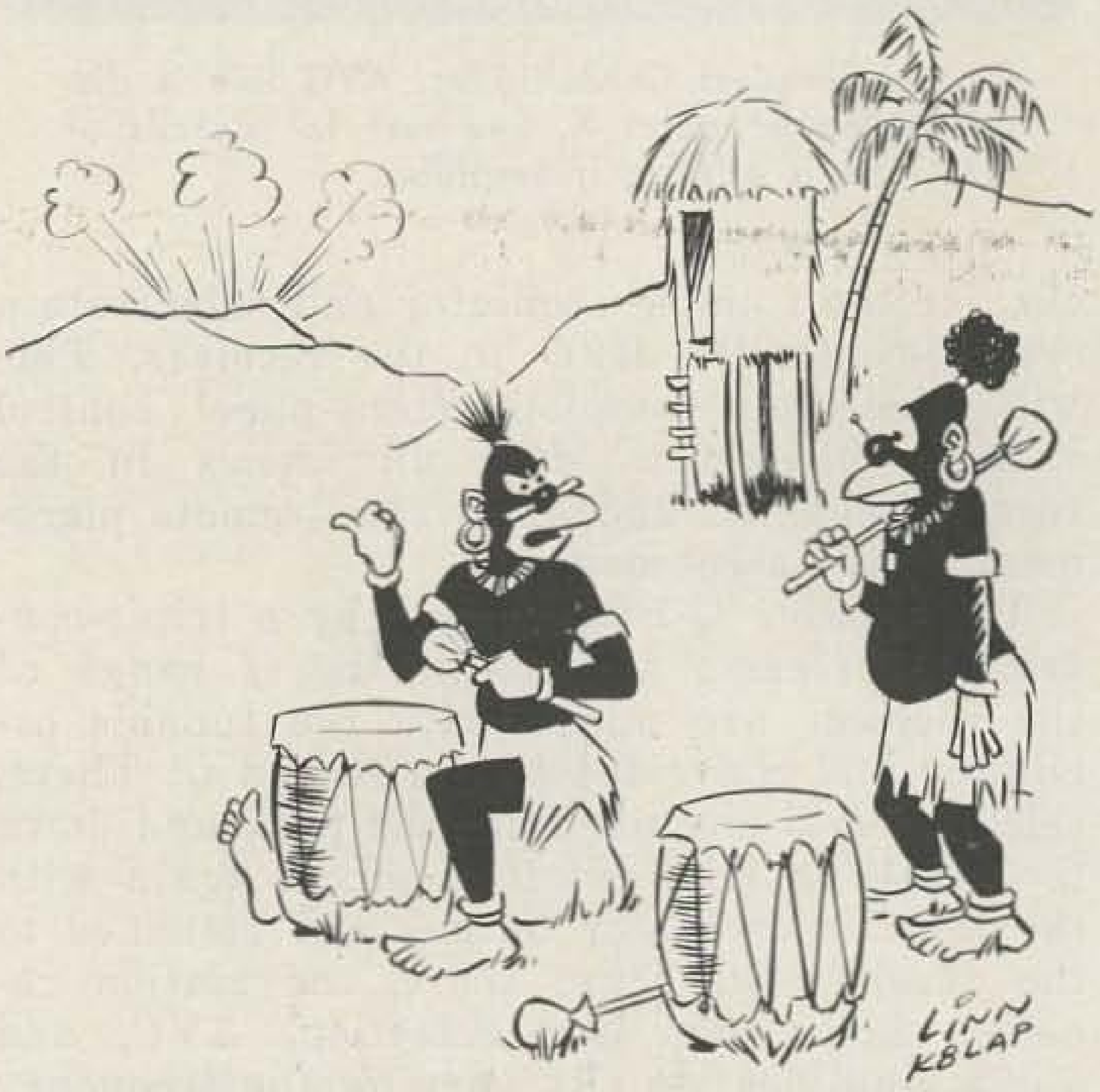
E. P. Alvernaz, **A Novel Side-Band Selector System**, QST, May, 1958.

Orr, **The Radio Handbook**, 14th Edition (omitted from 15th).

**Signal Slicers**

J. N. Brown, **Single Sideband Techniques.**

GE Ham News, Volume 6, No. 4 (July, 1951, out of print).

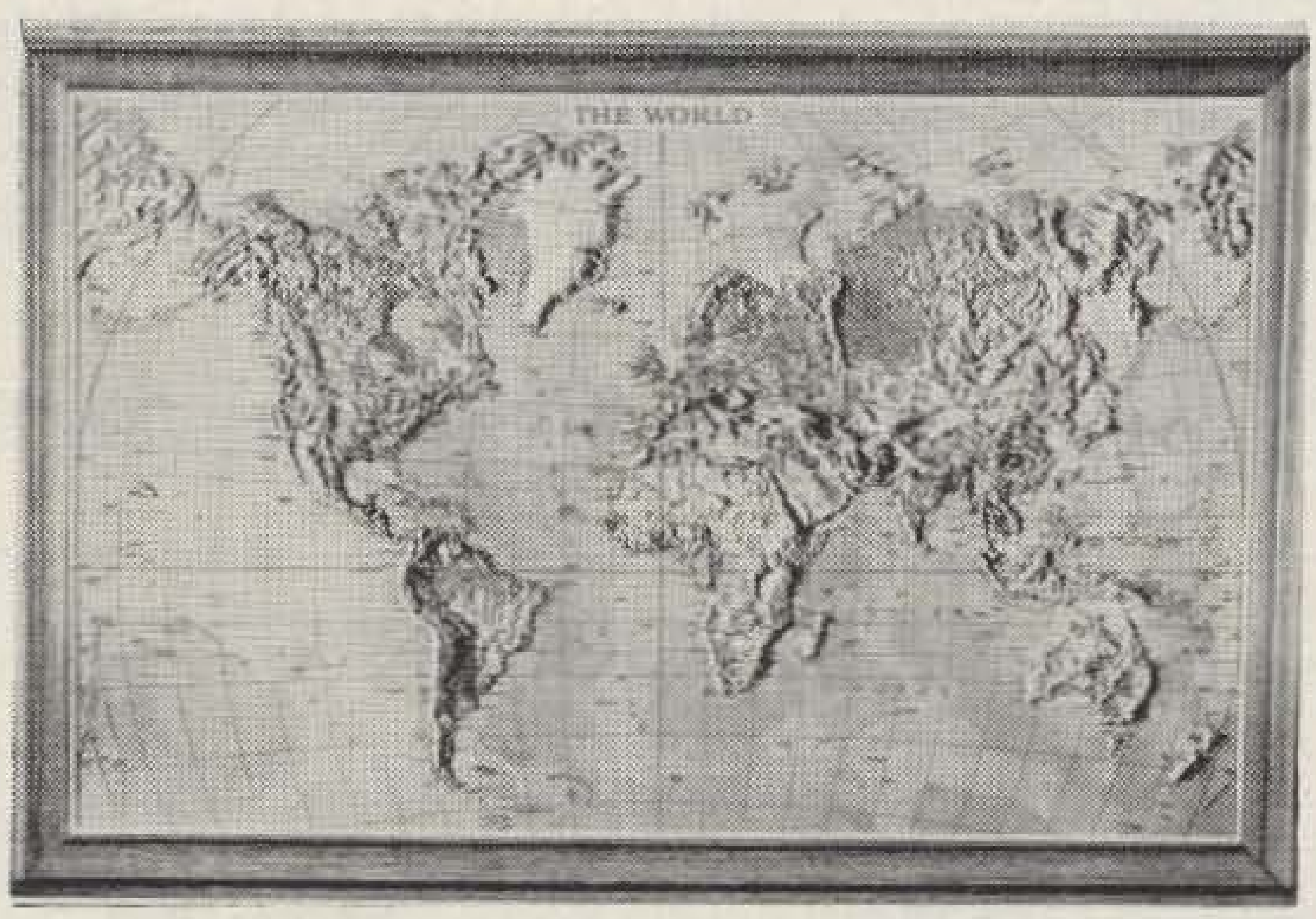




"HE WANTS TO KNOW IF WE CAN PATCH HIM INTO ZAMBOANGO!"

# BIG MAP DEAL

These DDD (3-D) maps are widely advertised at $9.95. Unfortunately we have been unable to make a special purchase of these fine maps and therefore we must bring them to you at full list price: a low, low, only $9.95!

Perhaps a glowing description of the maps will arouse your interest. Well, let's see . . . hmmm. Well, first of all they are pretty big. 28½" and 18½" to be exact. And they are printed with eight colors (all different). But best of all are those mountains that you can feel. They stick right up at you nearly an inch. They are in the right places too. Amazing job. They come complete with the frame and a handy map index which locates all the places for you. You can see the major highways on the U.S. Map.




Sir: 4
Enclosed is $9.95. Please send me one of your 3-D maps immediately. U.S.— World—

Name ........................Call .......

Address ..................................

City ..............Zone ....State ........

Please include at no charge with this order a one year (new) (renew) subscription to 73 starting with the ....................issue. (Two years with two maps.)

Send order to: 73 Magazine, 1379 E. 15th St., Brooklyn 30, N. Y.

# GO FIRST CLASS ON TWO

## The LW-51 Deluxe

## $59.95

***Features:***

- 45 watts input, fully neutralized
- Uses inexpensive 8 mc xtals or VFO
- Plate modulated for efficiency and punch
- Input for crystal or carbon microphone
- In kit form to cut costs
- All hard parts mounted (over 100)
- 6 or 12 volt filament
- Speech clipping & limiting for max modulation

***Order Direct:***

| | |
|---|---|
| LW-51 Deluxe kit, less tubes & xtal .... | $59.95 |
| LW-51 Deluxe kit, with tubes & any xtal. | 74.95 |
| LW-51 Deluxe kit, wired & tested ...... | 89.95 |
| Ship weight 7 lbs.: 77c East Coast; $1.59 Western | |
| LW-72 AC Power Supply for LW51, wired | 49.95 |
| LW-61 VHF Converters ................ | 18.50 |
| LW-80 Pre-Amplifiers .................. | 12.50 |

**L W ELECTRONIC LABORATORY**
**ROUTE 2 JACKSON, MICHIGAN**

## NEW B&W

MODEL 381

## T-R SWITCH

### ...with selectable bandswitching

This compact electronic T-R switch (4¾" x 4" x 4½") does a big job in automatic break-in operation on CW-SSB-AM-DSB. Bandswitch covers 80 through 10 meter bands. Integral power supply. For commercial applications, it will handle more than 1KW AM phone and up to 5KW SSB. "Fail-safe" design automatically keeps transmitter connected to antenna when unit is not energized. Matches 52-75 ohm coaxial lines.

This is the switch you've been looking for. See it at your local dealer, or write the factory direct.

**Price: $60.00**

*Barker & Williamson, Inc.*
CANAL & BEAVER
BRISTOL, PENNSYLVANIA

(Letters, continued from p. 51)

**Grandpa**

Dear Wayne,

Reference your January issue, page 6, "A Letter from Mama." Tch, tch, tch! Wayne, I remember hearing W6SGP and I have heard him do the "Grandpa" bit on the air, but his name isn't Cliff Arkett, it's G. W. Richert.

**Paul Hudson WA6AVJ**

*Do you hear that WØHFK? You're fired.*

---

**Greetings OM:**

December issue, page 30, fig. 8, pot R1 wiper shorted to ground. Page 33, fig. 1, 12AT7 pin 7 shorted to 8. January issue, page 41, the last paragraph should have read as follows: "Instead of being patterned after a half-wave rectifier, this circuit is an adaptation of the **half wave** voltage doubler. Since it is a **voltage doubler** device it utilizes both halves of the input signal cycle rather than only one, with the resulting increase in efficiency."

**Al Newland W21HW**

*Oh pshaw!*

---

**W2NSD**

Your March cover sure frightened me—I thought you'd moved to another planet! My cell-mate explained it to me: the stone face is a California tool shed which is disguised as an Atlas launching pad; the stone blocks camouflage the air intake for the CD shelter and the little ham shack in the center is a neat ham shack just like the ones we have here in Virginia. I sure feel better now and look forward anxiously to all future copies of 73.

**Lynn Wilson W4JXD**
**Alexandria, Virginia**

*Cripes!*

## Club Subscriptions

Quite a few fellows have been clubbing us to announce a cut rate subscription deal. While this is against our basic policy of trying to break even, we must bow to the pressure and start some rustling among the club secretaries. Here's the deal: send us the names, calls and addresses of five or more members at $2.50 per member.. These subscriptions must start with the next published issue.

### Individual Subscriptions

The best way to get 73 is by subscription. Fill out form below. How about surprising a friend? Twelve monthly surprises are only $3.00.

Name .................................... Call ............ $3 yr.

Address ...................................................... $5 2 yrs.

City ........................... Zone ...... State ............ $4 yr. DX

.... years. Start: Oct.—— Nov.—— Dec.—— Jan.—— Feb.—— Mar.—— (Check one)

73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

Name .................................... Call ............ $3 yr.

Address ...................................................... $5 2 yrs.

City ........................... Zone ...... State ............ $4 yr. DX

.... years. Start: Oct.—— Nov.—— Dec.—— Jan.—— Feb.—— Mar.—— (Check one)

73 Magazine; 1379 East 15th St., Brooklyn 30, N. Y.

**Dear Wayne,**

To answer your question in regard to MM operation. I see no reason why a passenger could not obtain permission to operate MM. There are some practical considerations. It would be next to impossible on a normal passenger ship due to the antennad needs, however it could be done on a fregihter. You would have to consider the length of the trip, of course. It would be worth while on long trips such as JA, ZS or round-the-world. First you should arrange with the passenger to meet the Master and get his OK. This is a good time to find out if you will have to bring your own ac source. Then you must notify the FCC that you have the Master's permission and give them your itinerary. The antenna will still be a problem, but one good solution is a vertical whip fastened to the rail on the flying bridge . . . coax fed.

**Pat Miller KV4CI**

---

**Gentlemen:**

We would like to have you announce our forthcoming Birminghamest on May 6th and 7th, our Eighth Annual Affair. The main event will be, as usual, at the Alabama State Fairgrounds on Sunday. Wonder if it would be possible for you to come down? **Bill Bankston W4DFE**

*Love to Bill, but I'm the guest speaker at the Western New York Hamfest on May 6th in Rochester. The Birminghamfest is one of my favorites, I'll sure try to be there next year.*

---

**Dear Wayne,**

Congratulations on your editorial in the February issue! At last there is an editor with guts enough to stand out against the liars and the cheats . . . even if it may cost him a subscription or two.

You can imagine how a bridge or poker club would tolerate a card cheat; that is exactly the attitude decent amateurs should exhibit toward the cheats who lie their way into the ranks (but not the spirit) of amateur radio.

If anyone cherishes any Pollyannaish illusions, let him compare FCC figures on the percentage of flunkers on Conditional Class code vs. General Class code or Technician Class theory vs. General Class theory. One would have to be naive indeed to believe that honesty is an attribute of the vast majority of the takers and the givers of "mail order" license examinations. Their integrity stands self-condemned by the utterly incredible number of passing grades.

Again, Wayne, congratulations and good luck. It may be that if you keep pounding long enough you can persuade the FCC to return amateur radio to radio amateurs.

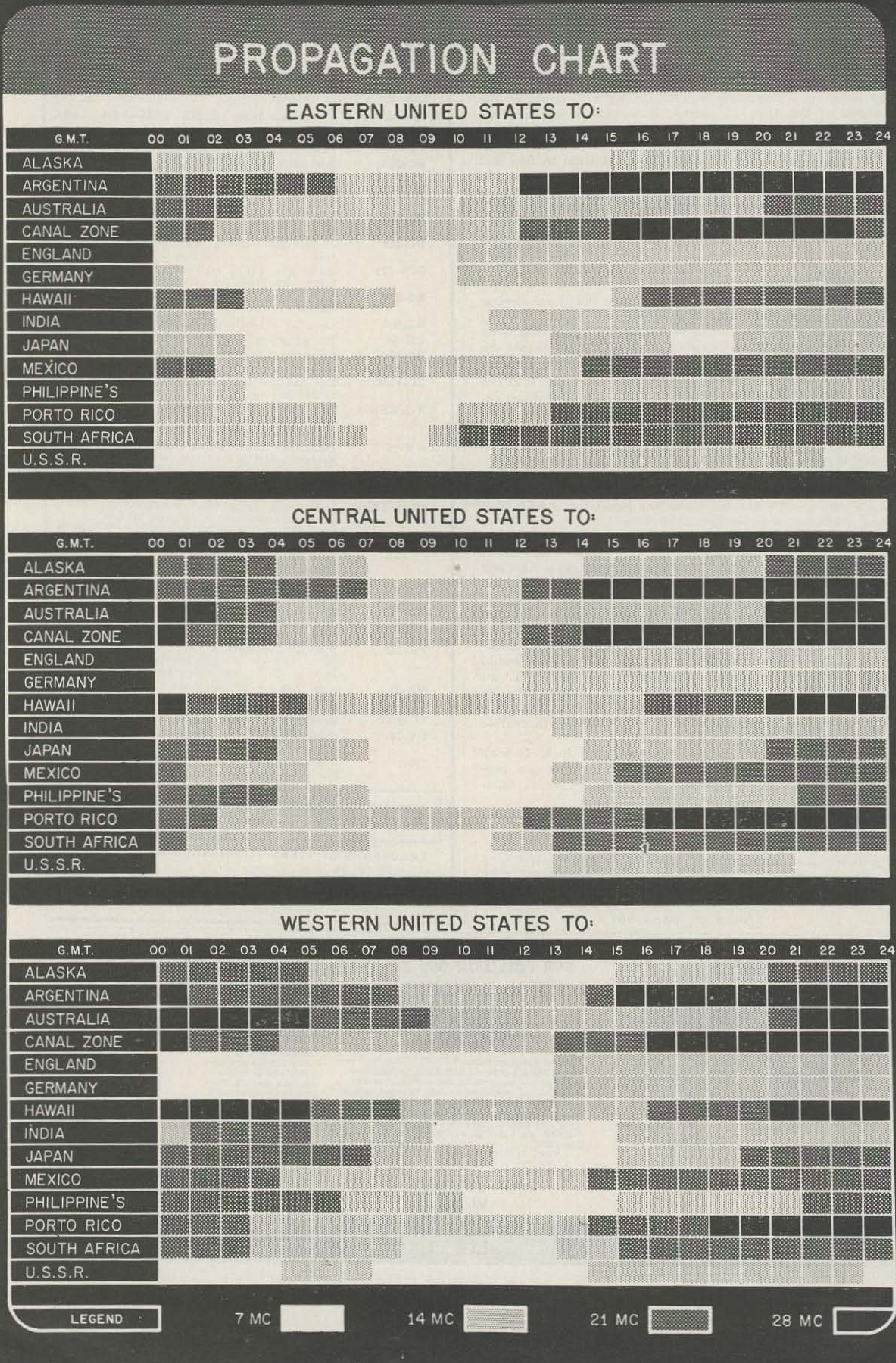
**Carl C. Drumeller, W5EHC**

---

**Dear Wayne,**

All my past issues of current ham journals attest to a failing that I would surely like to see you correct with 73. My covers are well marked with notations as to the contents. Now if one put the contents on the cover,

(More on page 55)


PROPAGATION CHART
EASTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
CENTRAL UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
WESTERN UNITED STATES TO:
G.M.T.
00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
ALASKA
ARGENTINA
AUSTRALIA
CANAL ZONE
ENGLAND
GERMANY
HAWAII
INDIA
JAPAN
MEXICO
PHILIPPINE'S
PORTO RICO
SOUTH AFRICA
U.S.S.R.
LEGEND
7 MC
14 MC
21 MC
28 MC

# Propagation Charts

David A. Brown K2IGY
30 Lambert Avenue
Farmingdale, N. Y.

The bands listed are MUFs and a higher band will not work for the time period listed. Lower bands will work, but not nearly as well. Times are GMT, not local time.

These charts are to be used as a guide to ham load openings for the month of April, 1961 to the various countries listed. I will be interested to hear of your results in using these charts and to know what other areas you might wish included in future charts.

**Advanced Forecast: April 1961**

Good 1-4, 21-30

Fair 5, 8-10, 18-20

Bad 6-7, 11-17

(Letters from page 53)

similar to the Reader's Digest, it would eliminate the necessity of spending long hours opening covers and looking for some particular idea that is half hidden from the longpast.

**L. R. Shackelford K5HSW**

*Boy oh boy oh boy oh boy oh boy. Here we go to you'll never imagine how much trouble to try to make the cover of each issue of 73 different from anything you've seen before and artistic . . . and what do we get? Rats! Look here, L. R., if you don't mind having magazines with covers like that why not just rip off the front cover and page one of 73 and then you'll have the Table of Contents for your cover. I hope someone appreciates our covers. I had for several years made midget notes on the binding edge of my QST's and CQ's of the more interesting contents. It was only natural then that I should institute this scheme when I became editor of CQ. Since 73 will not be having this binding edge due to the saddle stitch binding we are using, this system is not practical. I believe that the convenience of being able to lay your magazine flat on the table is of more importance than having an edge stick out of the bookshelf for you to read . . . particularly since we have so very many construction articles.*

**Dear Wayne,**

The Fiat 500 isn't much of a sports car, but you might be able to direct me to someone who has cleaned the 2 meter ignition noise out of one. I've got one of the little monsters, with a Gonset and a Hi-Gain whip, which is fine when the motor's off, but an ear-basher in motion. (That Gonset is getting a Lamb-circuit nuvistor preamp shortly.) The ignition leads are pretty close to ½ wave, which improves the strength considerably. I've got an improvement over the Gonset transmitter in process, push-to-talk and 10 watts out, which you might think was worth making an article out of. Sound off if you're interested.

Keep up the good work. You've got the right idea.

**Joel S. Look W1KCR**

*Yes, send the Gonset conversion. Check waiting. Does anyone have any suggestions for killing the noise in his "500"?*

# How to Write for 73

Jim Kyle

HAVE you designed or built an original item of equipment? Would you like to have cash in pocket to pay for it? Or prestige among your buddies? Then write it up for 73.

The only way in which we can continue to offer more construction articles per issue than any other ham magazine is for you, dear reader, to describe your design and construction efforts. To encourage you in this endeavor, we pay legal tender for your words. But to make certain that you accomplish what you set out to do, here are some hints on how to write for 73.

The best guide to the type of article, we want, naturally, is the group of articles published in each issue. However, don't carry this to extremes. After we have three articles on the same type of equipment, we'd sort of like to concentrate on other areas for a few issues. But careful study of the published articles with attention to their organization, wording, and approach will pay dividends.

Hamming is a hobby, not a business (though many BFs would question this statement), and your article should read interestingly rather than like a business report. In general, try to describe the equipment as if you were telling your buddy down the block how to build it—for in essence, that's what you're doing.

So far as organization of the article goes, a good rule is to tell your story three times—or in the words of an excellent back-country orator, "First I tells them what I'se going to say, then I says it, and then I tells them what I said."

By this, we mean to give a summary of the entire article in the first couple of paragraphs. This lets the eventual reader know if he's going to be interested in it or not. Then go into the detail. Finally, sum it up briefly at the end.

Speaking of detail, be sure not to leave it out. Not too long ago, one writer (a staff member at that) wrote a long antenna piece—and after doing so, discovered that nowhere in the article did he give any dimensions or tell how to build the skywire! Luckily, this error was caught in time—if it hadn't been, the mailmen would have been deluged (if the article had seen print in such shape).

Include all calibration and adjustment instructions where necessary. This can make the difference between good results and none at all for the guy who duplicates your effort. Along the same line, include a complete parts list, with manufacturer's type number of each part if available.

Remember, always, that you're writing for other hams. This means that acceptable abbreviations and idioms which will be known to every one are acceptable. On the other hand, it's no excuse to be cute with excessive use of Q signals and such (73 is printed, not telegraphed to its subscribers). If your article includes technical discussions, watch the level. Don't explain Ohm's Law in one-syllable words, but on the other hand don't take for granted a detailed knowledge of radar-scattering principles either. Let common sense be your guide here.

Now, let's look at the mechanical details of your article. First, it should be typed—preferably with a typewriter, not a Model 26. The manuscript should be double-spaced, on white unruled paper. Keep a carbon of it, but submit the original. The reason for this is that the carbon tends to smudge during editing, and becomes difficult for the printer to read.

Include your name and address on each page of the article, preferably near the top. This lets us put it back together should a gust of wind mix it up with others. For the same reason, pages should be numbered consecutively.

With the article complete, you're only half done. Illustrations are a must.

At the very least, a schematic is necessary. If chassis layout is critical or important, a sketch of this is needed too. All such line art can be submitted as neat sketches, since it will be redrawn to 73 style by our draftsman. The key point is to make sure that the sketch is not subject to misreading because of crowded lines.

Last but not least are photographs. While we can and sometimes do print construction articles without photos, we prefer that pictures accompany the article.

For one thing, a good photo makes more people want to build the item. For another, it's proof to the unbeliever that the equipment was actually built. And finally, a clear photo will show many details which can never be shown on drawings or explained in text.

Photos must be sharp, clear, and well-lighted. If photography isn't one of your other hobbies, the best bet is to locate a friend who knows it well and enlist his help. We prefer that prints be 8 x 10 glossies, but good 5 x 7 prints are usable, as are prints on *smooth* semi-gloss paper.

Technically, you should either "paint with light" or use bounce-lighting in making equipment photos. Cameras smaller than 6 x 6 CM negative size seldom give acceptable results. And if this paragraph leaves you cold, find a friend as advised earlier. (Maybe later we'll have an article on the taking of equipment photos. Want one?)

With all things accomplished, you're ready to send your manuscript in. Write a short note explaining what it is, enclose return postage if you want it back in case of rejection (unhappy thought—but it sometimes happens) and mail it in. Before very long (the exact time varies with the other activity in the office) you'll either get a check of a rejection slip. If you've followed the advice given here, it will most likely be the former.

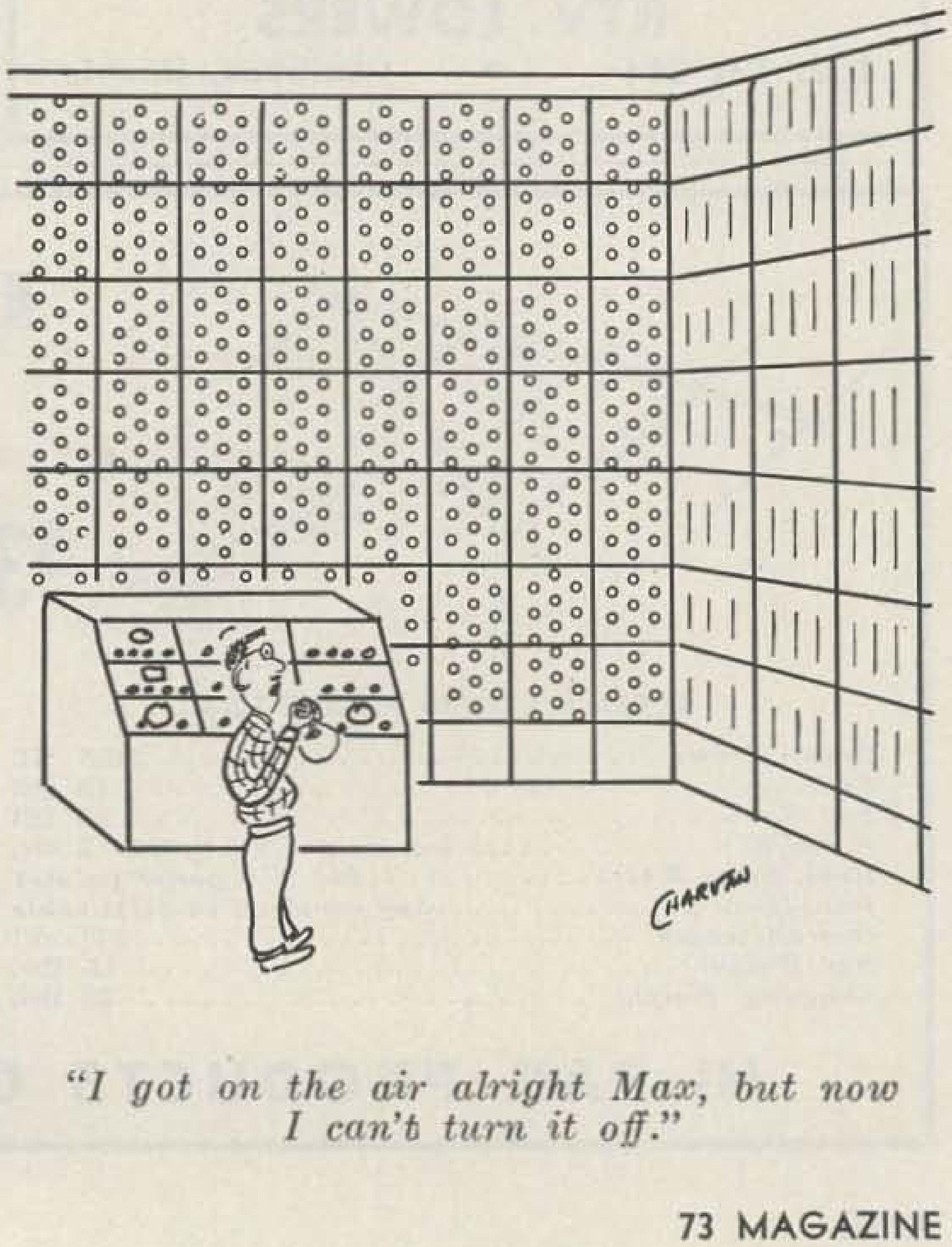
(Automation from page 29)

doubletalk, the circuit can be bypassed by a switch. Be extremely careful to locate the switch properly. Incorrect positioning in the circuit could destroy much of the transmitter.

Having described a spiral of ever-decreasing radius, we are now ready to start over at the microphone. Note that it feeds a three-way splitter. This consists of three triodes whose grids and cathodes are in parallel, but whose plates feed three separate outputs. One output goes to the transmitter itself, one to the vox unit (together with standard anti-trip signals from the receiver) and the third to the Tape Log Unit.

Since the microphone is on at all times in the Log circuits, a permanent and complete log is maintained. Exact time of every word you speak can be determined by comparison with the WWV signal recorded at lower level on the same tape. While not checked out with the FCC, there appears to be no reason why this log could not be used instead of a written document. (If the Radio Inspector rules otherwise, you can always hire a stenographer to transcribe it for you.)

That's it—the whole incomprehensible mess. With care, it could be built in a standard six-foot relay-rack cabinet for something less than $1,568 (if judicious selections are made from surplus). That's why it's never been built here, and probably won't be in the near future. But if you have a pair of oil wells in the back yard, and don't mind a little tinkering, you too can have a completely automated station (and with a little more engineering, it can be made to operate itself, freeing you from the drudgery of contests and the like and leaving you free to read. . . . 73



*"I got on the air alright Max, but now I can't turn it off."*

## AIR FORCE MARS
### Technical Broadcasts

Very interesting talks given each Sunday from 2-4 p.m. (EST) on 3295-7540-15715 kc.

**April 2**—No broadcast today.
**April 9**—Capt. John D. Griffiths: Theory of Speech Communications.
**April 16**—Capt. John D. Griffiths: Modern Techniques in Speech Communications.
**April 23**—Phillip E. Hatfield: Basic Electronics for the Radio Amateur.
**April 30**—Edward A. Neal: Custom Building via Home Construction.
**May 7**—Warren Bonney: Telecetry; Its Purpose, Its Function.

(Indians from page 26)

Makes him think, anyhow. Tell him you actually gave your phone number over the air and *asked* for interference reports (if you did—remember he hears your transmissions!) Tell him how you checked various neighbors and they said "No interference" . . . mentioning makes of sets and approximate age if you can.

*And another redskin bites the dust!* Now for number seven.

"*My neighbor says. . . .*" or his wife's Uncle Louie . . . or the man who checks his wife out at the Supermarket . . . or any other competent and qualified expert.

Here's where the FCC is a real friend! Tell your neighbor that you don't doubt that he has been told thus and so for a minute, BUT . . . and cite the *published statement* of the FCC that about 95% of ALL TVI complaints they have investigated turned out to be due to receiver mal-function (W. L. Kiser, Chief Engineer, FCC New York among others have publicized this fact.) Then you can lead into the filter story and take it from there.

Two more little indians always come in pairs. "*I'll have the FCC run you off the air*" and "*I'll speak to my brother whose on the City Council and have you put out of business.*"

If you get this pair, roll with the punch—

(Now turn the page)



## Fresno Hamfest May 6th

Registration at 8 am, Towne & Country Lodge in Fresno. Technical talks, demonstrations, swap table, mobile field intensity measurements, hidden transmitter hints, ladies luncheon and special entertainment. The banquet at 7 pm is included in the $5.50 registration fee. Reservations: Box 783, Fresno, California.

# Radio Bookshop

**GOOD GRIEF**, don't you ever get the yearn to learn? RB shipping dept. is anxiously awaiting your slightest stir. You know, if you buy one book a month you might end up with a fairly decent reference library? By the way, RB policy has always been Money Back, no questions asked.

**1—ELECTRONICS & RADIO ENGINEERING**—Terman. One of the most complete text books ever printed. 1078 pages. Theory, but easy on the math. $15.50

**2 — ELECTRICAL ENGINEERS' HANDBOOK** — Pender-McIlwain. This huge book should keep you busy for months just reading the interesting facts it contains. There is hardly any problem in communication or electronics that you can't find covered here. Excruciatingly thorough. 1618 pages. **$10.00**

**5—ANTENNAS**—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. $11.50

**13—REFERENCE DATA FOR RADIO ENGINEERS.** Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. $6.00

**20—RTTY HANDBOOK**—Kretzman (W2JTP). A-Z of ham Teletype. Very popular book, low supply. $3.00

**21—VHF HANDBOOK**—Johnson (W6QKI). Types of VHF propagation, VHF circuitry, component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. $2.95

**22—BEAM ANTENNA HANDBOOK**—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, how to install it, how to tune it. $2.70

**23 — NOVICE & TECHNICIAN HANDBOOK** — Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and build a station. $2.85

**24—BETTER SHORT WAVE RECEPTION**—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. $2.85

**28—TELEVISION INTERFERENCE**—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. $1.75

**32—RCA RADIOTRON DESIGNERS HANDBOOK**—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. $7.50

**33—WAVE PROPAGATION & ANTENNAS**—Welch. Highly recommended by the propagation experts as the best Book on the subject. $5.75

**40—RADIO HANDBOOK, 15th EDITION**—Orr (W6SAI). This is far and away the best amateur radio handbook ever printed. Over 800 pages. $8.50

**52—HOW TO READ SCHEMATIC DIAGRAMS**—Marks. Components & diagrams; electrical, electronic, ac, dc, audio, rf, TV. Starts with individual circuits and carries through complete equipments. $3.50

**57—QUAD ANTENNAS**—Orr (W6SAI). Theory, design, construction and operation of cubical quads. Build-it yourself info. Feed systems, tuning. $2.85

**80—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. I** (second edition). This book gives circuit diagrams, photos of most equipment, and rather good and complete conversion instructions for the following: BC-221, BC-342, BC-312, BC-348, BC-412, BC-645, BC-946B, SCR-274N 453A series receivers conversion to 10 meter receivers, SCR-274N 457A series transmitters (conversion to VFO), SCR-522 (BC-624 and BC-625 conversion to 2 meters), TBY to 10 and 6 meters, PE-103A, BC-1068A/1161A receiver to 2 meters, Surplus tube index, cross index of A/N tubes vs. commercial types, TV & FM channels. $3.00

**81—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. II.** Original and conversion circuit diagrams, plus photos of most equipments and full conversion discussion of the following: BC-454/ARC-5 receivers to 10 meters, AN/APS-13 xmtr/rcvr to 420 mc, BC-457/ARC-5 xmtrs to 10 meters, Selenium rectifier power units, ARC-5 power and to include 10 meters, Coil data-simplified VHF, GO-9/TBW, BC-357, TA-12B, AN/ART-13 to ac winding charts, AVT-112A, AM-26/AIC, LM frequency meter, rotators, power chart, ARB diagram. $3.00

**82—SURPLUS RADIO CONVERSION MANUAL VOLUME NO. III**—Original and conversion diagrams, plus some photo of these: 701A, AN/APN-1, AN/CRC-7, AN/URC-4, CBY-29125, 50083, 50141, 52208, 52232, 52302-09, FT-ARA, BC-442, 453-455, 456-459, BC-696, 950, 1066, 1253, 241A for xtal filter, MBF (COL-43065), MD-7/ARC-5, R-9/APN-4, R23-R-28/ARC-5, RAT, RAV, RM-52 (53), Rt-19/ARC-4, SCR-274N, SCR-522, T-15/ARC-5 to T-23/ARC-5, LM, ART-13, BC-312, 342, 348, 191, 375. Schematics of APT-5, ASB-5, BC-659, 1335A, ARR-2, APA10, APT-2. $3.00

**83—THE SURPLUS HANDBOOK, VOLUME I**—Receivers and Transmitters. This book consists entirely of circuit diagrams of surplus equipment and photos of the gear. One of the first things you really have to have to even start considering a conversion of surplus equipment is a good circuit diagram. This book has the following: APN-1, APS-13, ARB, ARC-4, ARC-5, ARC-5 VHF, ARN-5, ARR-2, ASB-7, BC-222, -312, -314, -342, -344, -348, -603, -611, -624 (SCR-522), BC-652, -654, -659, -669, -683, -728, -745, -764, -799, -794, BC-923, -1000, -1004, -1066, -1206, -1306, -1335, BC-AR-231, CRC-7, DAK-3, GF-11, Mark II, MN-26, RAK-5, RAL-5, RAX, Super Pro, TBY, TCS, Resistor Code, Capacitor Color Code, JAN/VT tube index. $3.00

**R235—RADIO CONTROL FOR MODEL BUILDERS**—Winter. One of the best and newest books available on RC. $4.25

**R245—HOW TO USE GRID-DIP OSCILLATORS**—Turner (K6AI). Construction & uses, an important book. $2.50

---

## Order Form

1 2 5 13 20 21 22 23 24 28 32 33
40 52 57 80 81 82 83 R235 R245

Name . . . . . . . . . . . . . . . . . . . . Call . . . . . .

Address . . . . . . . . . . . . . . . . . . . . . . . . . . . .

City . . . . . . . . . . . . . . . . . . State . . . . . . . . .

## RADIO BOOKSHOP

**1379 East 15th Street, Brooklyn 30, N. Y.**

**(N.Y.C. add 3% tax)**

(TVI from page 59)

*and don't argue.* Just give the neighbor the address of the FCC and *relax.* After all, you *know* your rig is clean (you'd better!) and the FCC is on your side . . . so long as you are only cutting up one or two TV sets in the neighborhood and the rest are not bothered. Rip 'em all up, and you're in for trouble with the FCC inspectors.

If the Councilman is a lawyer, he knows better than to try to step into an area that belongs to the Federal Government . . . the regulation of radio activities is *constitutionally* in the hands of Uncle Sam. So relax. Even if the local legal beagle politician does make big noises, the law's on your side. A man's house is still his castle, and what you do in it is your right—so long as it's legal, not a commercial use of residential property, and doesn't interfere with health or morals, the local politician will have a mint of trouble getting you off the air.

Last but by no means least—and sometimes the Big Chief of all Indians—is the really mad individual that won't even talk to you at all. There's only one thing to do here. First of all, have another ham phone him and offer his services to clear up the complaint. It may work. But even if it doesn't, just be *sure* your equipment is operated properly at all times. Check and check again around the neighborhood to be sure you aren't interfering with others. The more careful you are to do this, the more apt, our friend Mr. Madguy is to hear about it—and realize in spite of himself that you really are interested in clearing up TVI. You may not ever win him over, but at least you can throw your rig on the air with a clear conscience!

One last word—no matter how obstreperous your own particular Mr. Madguy may be, *keep your sense of humor and your temper*—even if, as some hams have, you run into problems of cut lead-ins. In the long run, it'll pay off. 73

---

(Nuvistors from page 11)

tivity this can be a problem. If you do get cross modulation reduce the rf gain control just to the point you stop hearing the interfering station. If you live in a neighborhood of strong stations this converter isn't for you but if you are interested in copying some of those weak stations you haven't been able to pull in it may do a good job for you.

We are currently experimenting with front end circuits to reduce cross modulation problems and if we come up with anything real good we'll pass it along later.

Many thanks to Chuck Kuespert, K9JKG for his many hours spent in helping develop this converter, and wiring dozens of circuits, and many complete converters to try to make a converter that is hot and bug free.

. . . K8BYN

# Advertisers Index

# Other Ham Publications

In lieu of half of the magazine being filled with specialized departments, we recommend that you subscribe to the bulletin of your special interest. You get a lot more news and get it faster this way . . . and you encourage the fellows who are putting out these bulletins.

**WESTERN RADIO AMATEUR.** Don Williamson W6JRE, 10517 Haverly Street, El Monte, California. Monthly. Subs are $2 per year, $3.50 for two years, $5 for three years. Operating news of west coast activity, columns on DX, SSB, YL, and some articles. 48 pages.

**MOBILE NEWS.** Published monthly by the Amateur Radio Mobile Society, 79 Murchison Rd., Leyton, E. 10, England. Joining fee and 1 year sub. is $2.50.

**73 HAM CLUB BULLETIN.** Marvin Lipton VE3DQX, 311 Rosemary Road, Toronto 10, Ontario, Canada. Sent free to all editors of ham club bulletins monthly to keep them abreast of what is going on with all the other ham clubs. This is an excellent source of news for putting together your club bulletins. To subscribe to this news bulletin just send a copy of your own club bulletin to Marvin.

**HAM-SWAP.** Published by Ham-Swap, Inc., 35 East Wacker Drive, Chicago 1, Illinois. Editor is Ed Shuey, K9BDK. Subs are $1 per year by 3rd class mail, $3 for 1st class, $5 airmail, and $7.20 special delivery. Published once a month. Contains classified ads entirely. This is your best bet for an inexpensive way to sell or swap some gear in a hurry. Within two weeks people are answering your ad.

**DX BULLETIN.** Don Chesser W4KVX, RFD 1, Burlington, Kentucky. DX news in depth. Published weekly. 3rd Class mail $5 year; 1st class $6; Airmail $7.50. DX rates on request.

**HAM-HOP NEWS.** Published quarterly by the International Ham-Hop Club, G. A. Partridge G3CED, 17 Ethel Road, Broadstairs, Kent, England. 75¢ per year for bulletin, $1.50 full membership. Club devoted to arranging visits between hams and ham families all over the world.