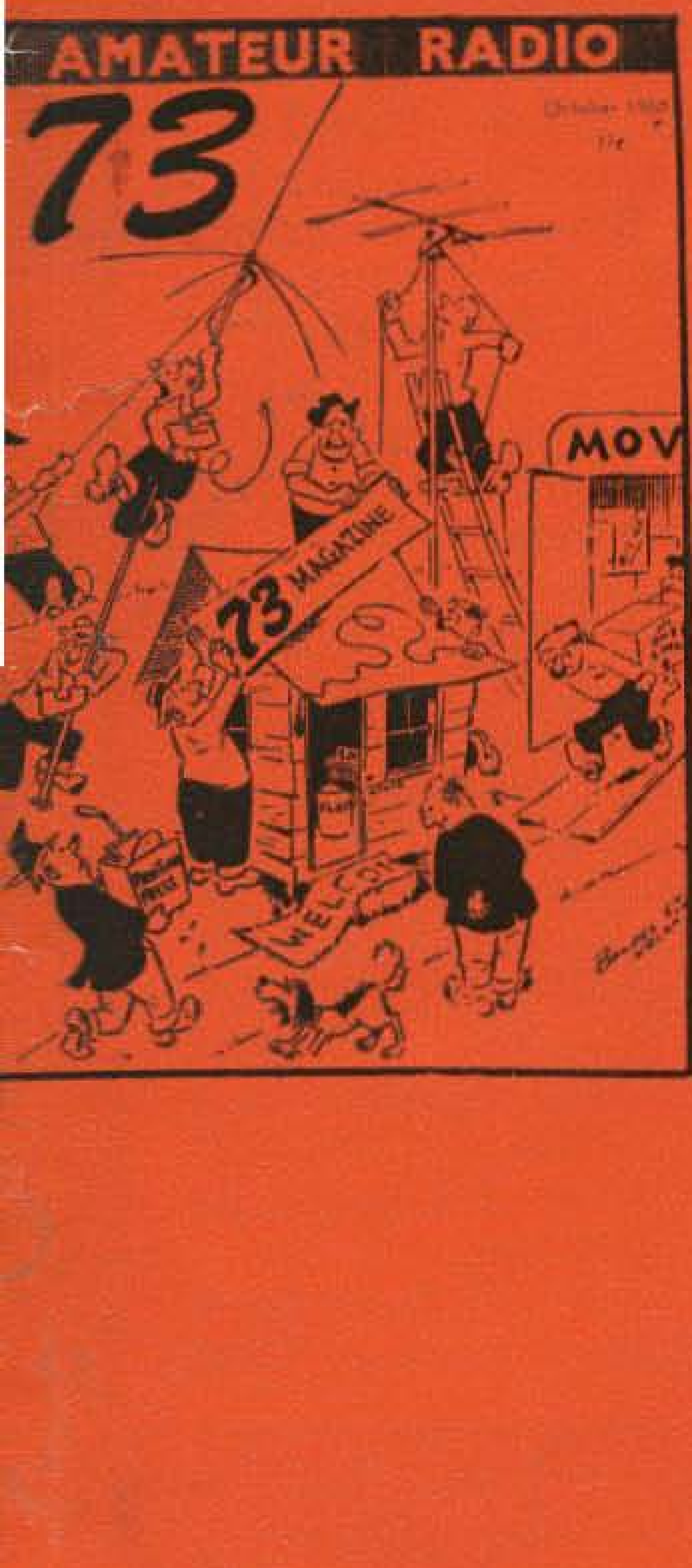
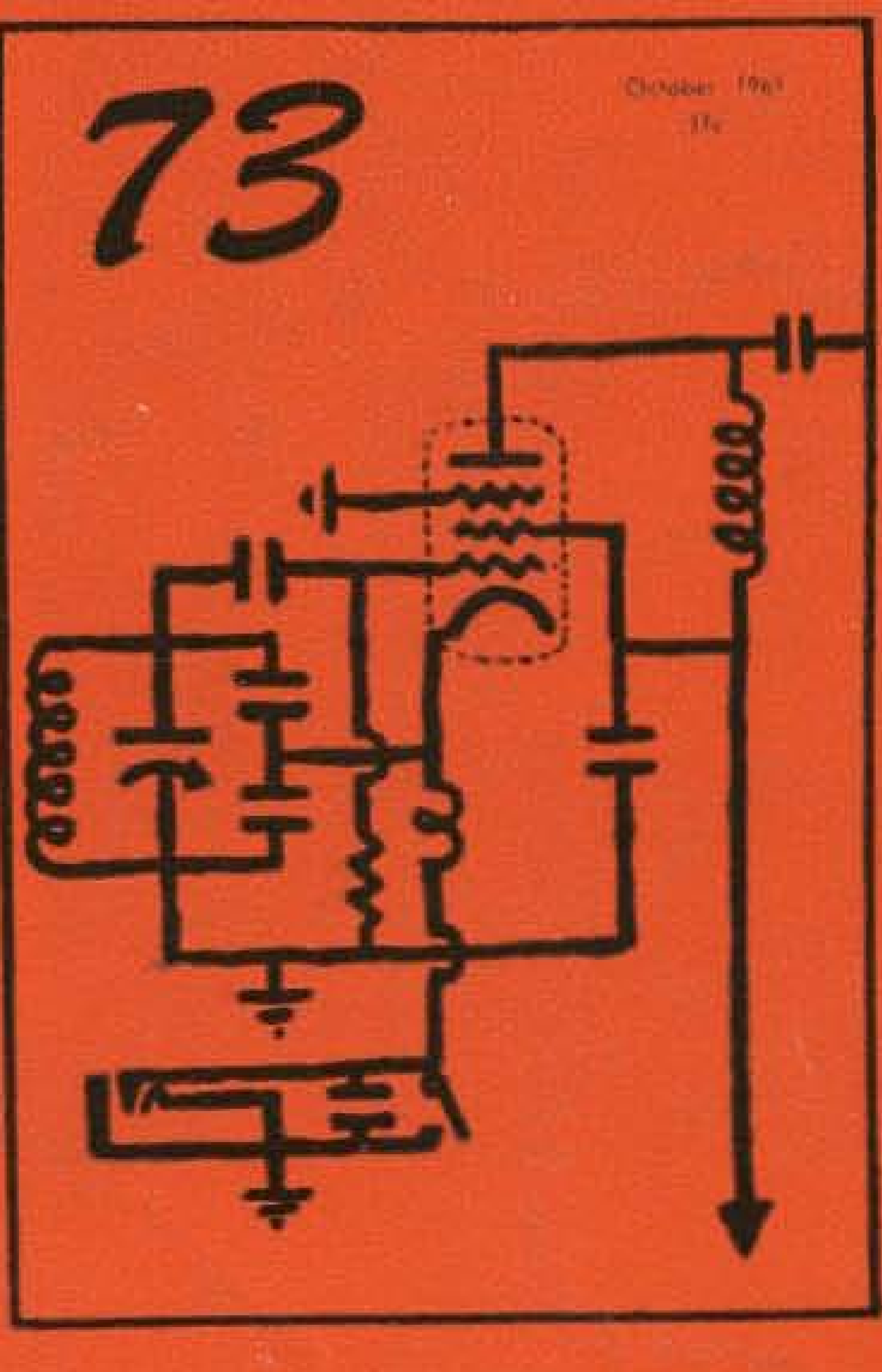
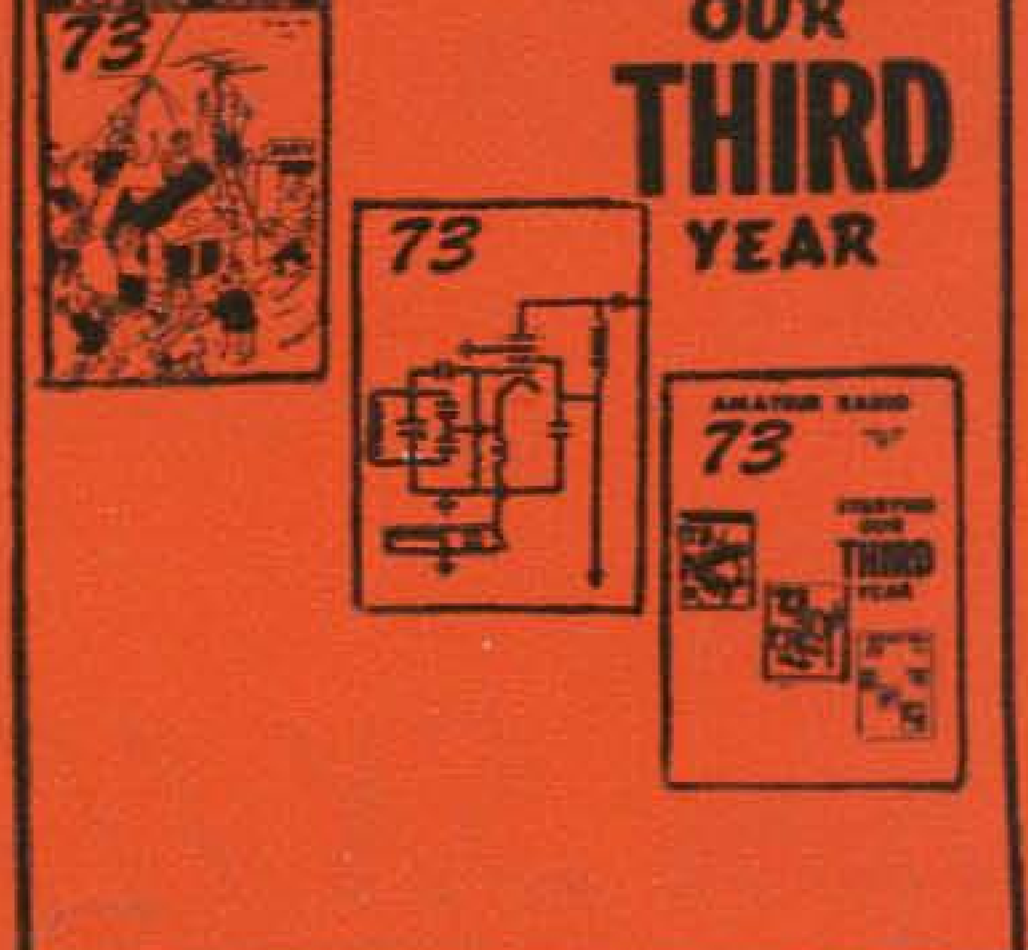
AMATEUR RADIO
73

October 1962
A Steal at
40¢

STARTING OUR THIRD YEAR







HALLICRAFTERS MANAGEMENT:

"Can we build a **quality** receiver, capable of all important coverage from **85 kc through 30 mc,** with at least **3-step variable selectivity,** including a transmitter-type V.F.O. that can be **locked on frequency,** with sensitivity **under I mv** on the high frequency range, a high order of **mechanical** and **electrical stability,** that weighs under 20 lb., is extremely compact . . . and will sell for about **$400** ?"

HALLICRAFTERS ENGINEERING:

"Yes."

SPECIFICATIONS

Exceptionally versatile and compact triple-conversion, superheterodyne communication-type receiver. **Transmitter-type V.F.O.** can be used as crystal locked oscillator; **Selectivity:** Variable in 3 steps, 500-5,000 cycles. Crystal-controlled 1st and 3rd oscillators. Selectable sidebands, constant tuning rate. **Sensitivity:** less than 1 mv. on AM, less than ½ mv. on SSB/CW. **T-notch** for up to 50 db. attenuation to unwanted heterodyne in I. F. pass band. I. F. type noise limiter. Audio inverse feedback. Crystals provided for 3.5—4.0, 7.0—7.5, 14.0—14.5, 21.0—21.5, 28.5—29 mc. Four addt'l. crystal pos. for 500 kc. segments between 85 kc. and 30 mc. Size: 15" x 17⅛" x 13". Net wt. 18 lb. Amateur net price: $379.95.

HA-10 Low freq. tuner adapts SX-117 for 85 kc.—3 mc. $24.95

Additional searching questions and exciting answers will be coming your way from Hallicrafters soon.

new SX-117 Triple-conversion communication receiver by *hallicrafters*

5th & Kostner Aves., Chicago 24, Ill.

Export: Hallicrafters, International Dept., Commercial Div., **Canada:** Gould Sales Co., Montreal, P.Q.

73 Magazine

Wayne Green, W2NSD
Editor, etcetera

October, 1962

Vol. XI, No. 1

Cover: WIMEL.

73 Magazine is published monthly by Amateur Radio Publishing, Inc., 116 Main Street, Norwalk, Connecticut. Please note that the address of the business office where you are to send all correspondence, subscriptions, submitted articles, etc., is 73 Magazine, Peterborough, N. H. The telephone number is 603-924-3873 and we dare you to try to get it from the phone company. Subscription rates, while covered rather completely in the regular subscription ad, are: U.S.A. and possessions, APO, FPO, Canada and Mexico; one year for $3.50, two years $6.50, three years $9.00. Foreign: One year $4.00. Second class postage paid at Norwalk, Connecticut and at additional mailing offices. Printed in the U.S.A.

Postmaster: Please send form 3579 to 73 Magazine, Peterborough, New Hampshire.

de W2NSD/1

Never Say Die

In spite of what a slightly more paranoic person might be convinced was an obviously well organized scheme to keep 73 virtually unknown, we are starting on our third year of publication. An awful lot of friends (?) were convinced when I started that I couldn't possibly make a go of the magazine. Though they were not far from wrong, they were (bless their hearts) kind enough to explain all of the pitfalls in detail so I would be sure and not miss any. I haven't. They were perhaps overly concerned with the fact that we could not advertise 73 in QST or CQ to let the amateurs know that a new magazine had been started. They reckoned without the power of over-the-air advertising from satisfied hams and the impact of writeups in club bulletins and discussions at ham club meetings.

It is plain to see that my formula of running an overwhelming number of technical and construction articles, salted with irritating editorials, is a successful one. We'll keep it up.

One factor that caused the most apprehension was the artificial ceiling on advertising space costs imposed by QST's ad rates, which are about one third those normal for a periodical of their circulation. This, more than any other factor, has held down the number and size of ham radio magazines and has resulted in the failure of most publishers who have tried to enter the field. I felt that I could surmount this difficulty by keeping publishing costs to a minimum (no staff) and by charging fairly high subscription rates. It is a bit discouraging to publish a magazine and have trouble selling ads for $165 a page when magazines in other fields are getting well over $1000 a page for the same circulation!

However, if you continue to buy our advertisers products at the rate you have been, even some of the curmudgeon manufacturers (non-advertisers) may see the light. You may notice that several advertisers, after checking their dollar results against advertising costs, have virtually dropped out of other magazines.

Perhaps you think I dwell unduly on advertising. Well, if you could see how many articles I have to refuse because of limited pages (you do see some in the other magazines since we seem to get first choice on articles), you might share my concern. We could easily publish a magazine twice the size of this issue if we could get the advertising to make it economically feasible. Every time you put in a good word for 73 with an advertiser or prospective advertiser you will be helping.

Reciprocal Licensing

Keep peppering Senator Magnuson, Washington 25, D.C. with letters requesting that he schedule hearings on Senate Bill 2361. If you are able to get away for critical emergencies then ask the Senator to let you know when the hearings are going to be held and join us there during the hearing.

Inertia

I remember a fellow that I used to work every night on 75 meters. W2MSZ. Dexter was the first contact I ever made, matter of fact. Fresh and dewey with my new license and a little 2½ meter transceiver, I called a CQ. W2MSZ came back to me. I walked, transceiver in hand, the mile and a half to his house. Anyway, Dexter had an old ac-dc "communications receiver" which drifted and was as broad as a barn door. He talked interminably about the latest receivers on every QSO and every personal meeting with a ham. He decided a hundred times to get an HRO. Dexter finally died, never having had anything better than that frustrating old ac-dc. Inertia.

Most of us have things that we would really like to do, things we can afford, but just never get around to. Oh yes, it is easy to rationalize putting things off. Next year things will be better. Next year they may come out with a new and radically better receiver. Next year we'll have more time to go places. Good old inertia.

With even a small amount of inertia I never could have started 73. And how about Virginia and I going to Europe back in April? Can you even imagine the number of arguments we could come up with to hold us back? Any normal person knows that it is impossible to walk off and leave a monthly magazine that has been taking your every minute for a year for a full month tour of Europe. We did it though and though this slowed down the expansion of our advertising a bit, there were few other penalties. A few subscriptions got mixed up, a few hundred letters didn't get answered, and I got even further behind on processing articles. But we did get to Europe and we had the time of our life. We would have traded ten times the difficulty for what we got.

What is all this leading to? Not much, really. I just wanted to get across an idea and perhaps blast a few fence sitters loose. If you want a new receiver then go out and get it. By next year you'll find that the Dream Receiver still isn't on the market and you've had a year of a lot more fun in operating than you would have had sticking it out with the old box. Travel? Just make the decision and then set about solving the problems to make it possible.

I'm still figuring on setting up a ham flight to Europe next fall. The more I think about it the more I like the idea. It seems to me that a three week trip would be about right. A month would be better, but this might be as hard for other people as it would be for me. Two weeks isn't worth the trouble. In three weeks we can do a rather good job of visiting five major cities. I have in mind London, Paris, Frankfurt, Geneva and Rome. Though I haven't even started with the airlines yet, I suspect that we can keep the price to an amazing minimum, something on the order of $500! This seems like a lot, but it would include jet flight first class both ways and hotels in all cities plus most meals. There shouldn't be much more needed.

Getting a little enthused? Well, the first step will be in a month or so when we form a little club. You'll have to be a member of this club for a while before you can make the trip. And if any fellows in London, Paris, Frankfurt, Geneva, or Rome read this and are interested in helping to set up a welcoming committee for us when we pour in next year I'd like to hear from them. I'm hoping that the clubs in these cities will be able to work up a hamfest so we can all get together. The dates aren't set yet, of course, but I had in mind around

(More on page 77)

INTERNATIONAL AMATEUR CRYSTALS

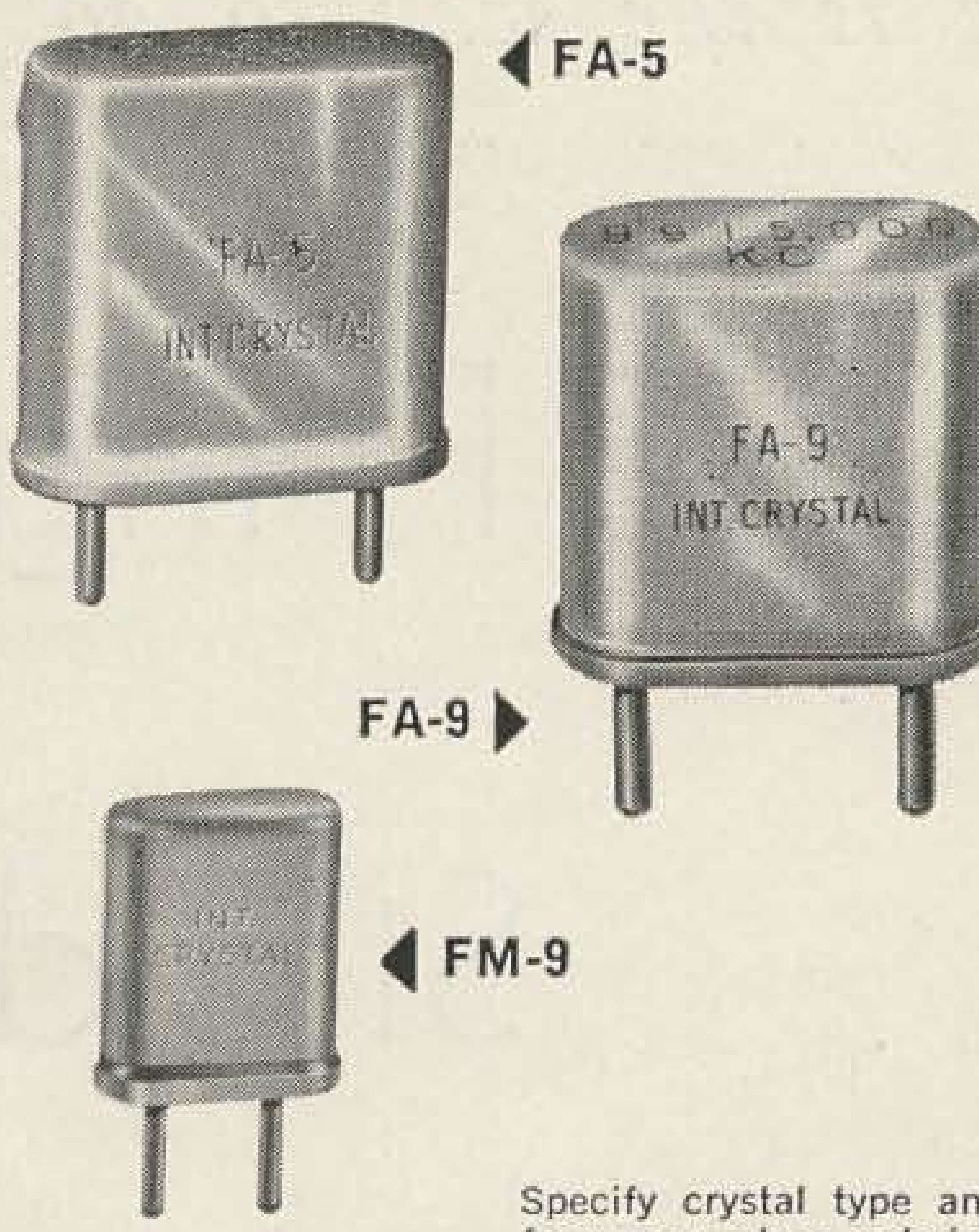
Amateurs throughout the world depend on International crystals for precision frequency control.

Manufactured by the same highly skilled craftsmen who produce International commercial crystals for the broadcast industry, two-way radio communication, and our space and missile program.

International Amateur Crystals
1000 kc to 137 mc — .01% tolerance

Wire mounted, plated and hermetically sealed in metal holders. FA-5 and FA-9 are HC/6U pin type. The FM-9 is an HC/18U pin type.

Priced from $3.30 to $10.00



Specify crystal type and frequency when ordering.

	FA-5 and FA-9	FM-9
Fundamental	* 1000 - 1499 kc * 1500 - 1799 kc * 1800 - 1999 kc 2000 - 9999 kc 10000 - 14999 kc 15000 - 20000 kc	Not available Not available Not available 8000 - 9999.999 kc 10000 - 15000 kc 15001 - 19999.999 kc
Overtone (3rd)	10 - 14.99 mc 15 - 29.99 mc 30 - 59.99 mc	Not available 20 - 39.99 mc 40 - 59.99 mc
Overtone (5th)	60 - 75.99 mc 76 - 99.99 mc Not available	60 - 89.99 mc 90 - 100 mc 101 - 109.99 mc
Overtone (7th)	100 - 137 mc	110 - 137 mc

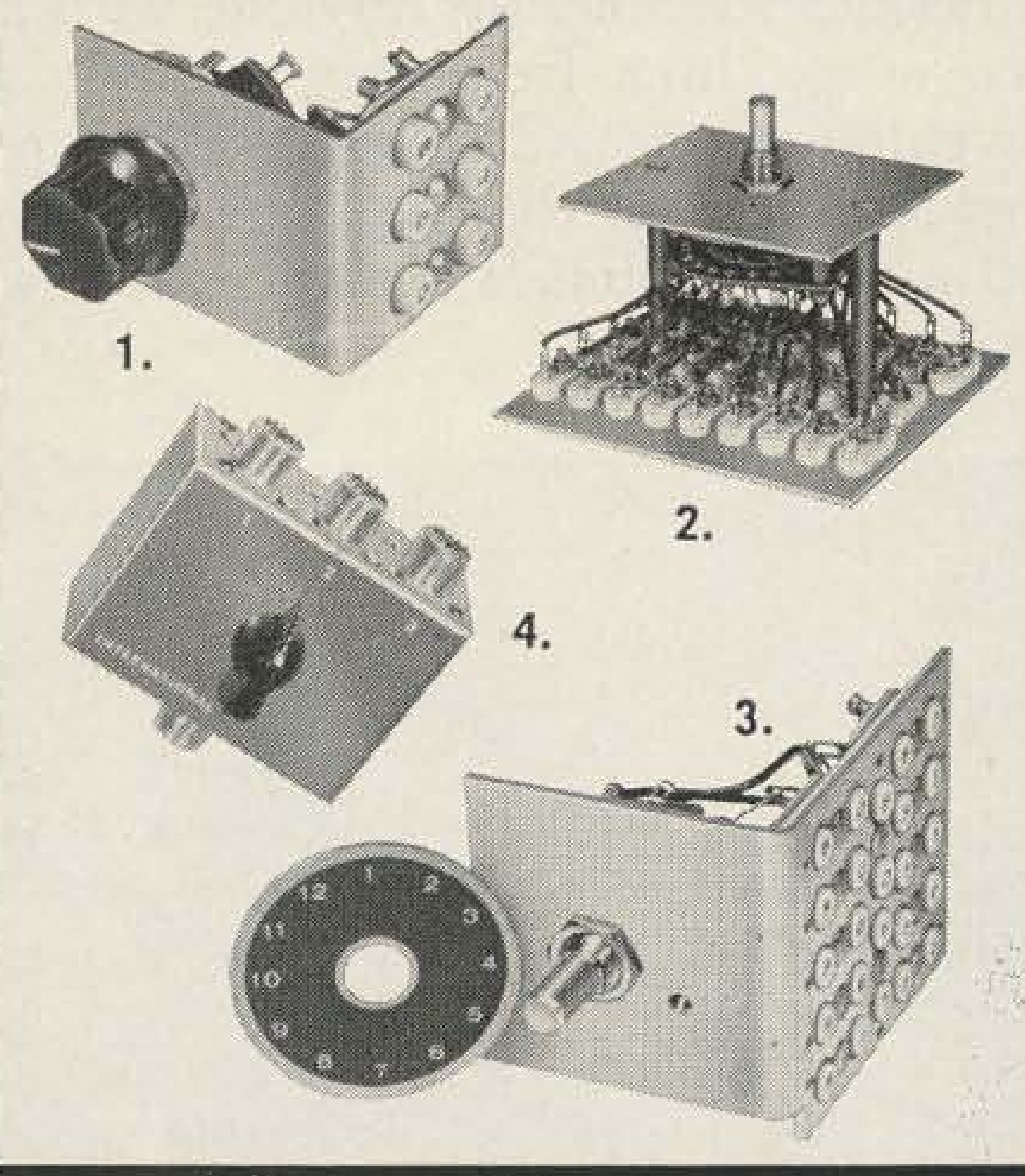
* Allow three to four day processing.

the PERFECT combination for FREQUENCY CONTROL

INTERNATIONAL CRYSTAL SWITCHES

When you design or build . . . combine International crystals and crystal switches. Switches available from 3-position to 24-position. For antennas and laboratory work use International coaxial switches.

Priced from $2.75 to $19.50



1. S-121 Triple Socket Crystal Switch. Cat. No. 150-126.
2. AC-44 Single Pole, 24-Position Crystal Switch. Cat. No. 150-131.
3. 12-Position Crystal Switch. Cat. No. 150-163.
4. 3-Position Coaxial Switch. Cat. No. 100-112.

Write today for International's Free catalog of precision made crystals and equipment.

INTERNATIONAL CRYSTAL MFG. CO., INC.

18 NORTH LEE • OKLAHOMA CITY, OKLAHOMA

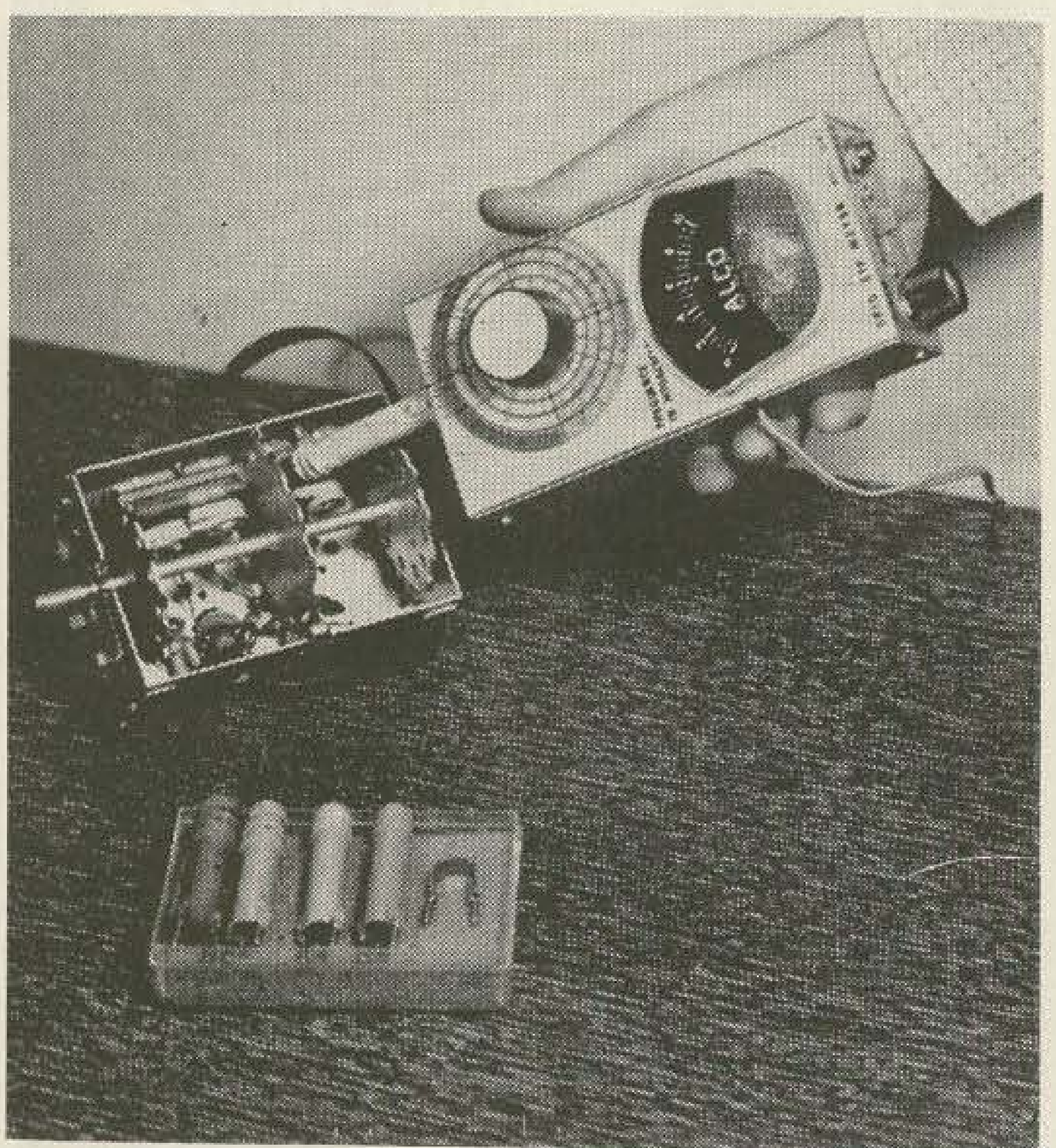
Do you have a suppressed desire to hop about the VHF bands? Here is the way to do it at no cost and with little effort.

VHF'ing with the Standard Coil Tuner

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Photos: Morgan S. Gassman, Jr.

IF you are one of the amateurs who has never explored the spectrum above 30 megacycles, you owe it to yourself to see what is up there besides Channel 5. Any one with a general coverage, high frequency receiver and a free evening can provide himself with a reasonably good converter that will tune any twelve, 2 to 6 megacycle bands between 30 and 300 mc.



By removing all the coil strips except the one being tuned, it is possible to grid dip each rf winding and the if output transformer.

Literally millions of older model television sets are being junked each year and a large percentage of them are equipped with Standard Coil turret tuners. These TV front ends are true engineering masterpieces and, to make a comparison with the automotive industry, combine the best characteristics of the Model T and the Rolls Royce. Rugged, reliable, easy to maintain and mass produced at low cost, they have outlasted the receivers in which they were installed.

Almost every TV shop has a steady turnover of junk sets equipped with Standard Coil tuners and they may be had for the asking or for a token charge. These tuners fall in two general categories, those using a pentode and those using a dual-triode, cascode rf stage. While the cascode tuner, using a 6BQ7 or 6BK7 tube is preferred, the pentode type is usable and will give acceptable performance. While you are at the TV shop, try to locate the schematic of the set and copy the tuner diagram.

While these tuners are all essentially alike, each set manufacturer had his own specifications for *if* output circuitry, mechanical mounting details and supply voltages. Incidentally, we are dealing only with the older model tuners that used the nominal 21 mc *if* frequency. While not too many sets using the modern *if* of 45 mc are being junked yet, check and be sure since these would require substantial modification. W1ICP, in recent QST articles, has treated the amateur application of junk TV components in considerable detail. If you pick up the entire chassis, you are referred to his excellent articles.

The photographs and the exploded drawing show the physical characteristics of the older Standard Coil tuners. Figures 2 and 3 give the circuit diagrams of the two most popular models. As mentioned, considerable difference exists in output coupling networks. Some have a single, broad band, link coupled *if* output transformer. Others have separate video and sound *if* output circuits. Still others use a broad band pi network in which cable and tube capacitance comprise the output capacity.

In any event, the plan of action is similar. Dismount the tuner from the TV chassis. Remove the tube shields, tubes and bottom cover, setting them aside for future use. Remove the bracket securing the fine tuning disk and discard both the bracket and fine tuning shaft. Remove the spring clips holding the turret in place and pull out the drum. Remove all coil strips from the drum and clean all parts, using solvent as required. Clean and polish all coil strip and turret coil contacts using one of the electronic grade cleaning solvents. Inspect the 300 ohm antenna lead and replace, if required, using a 2′ length of new twin-lead. Removing the side plate will give access to the connections.

The external power leads are terminated on feed through capacitors mounted on a shield plate that divides the tuner chassis. Remove the old leads and connect new, 5′ stranded leads. Solder a ground lead to the shield plate and route these leads through the chassis holes used for the old wiring.

Inspect the *if* output circuit of your tuner and if it is already wired as shown in Figure 4D, simply replace the old output cable with a 6′ length of RG-58/U coax cable. However, if the circuit is similar to that shown in Figures 2 and 3, further work is required. Remove the coupling capacitor, shown as C18 in the diagram, and rewire the output circuit in accordance with Figure 4D. Wind a 3 turn link on the cold end of the coil and connect the 6′ length of cable. Temporarily install the 6J6 mixer tube and shield and, using a grid dip meter, tune the output circuit to 22.5 mc. If resonance cannot be reached, pad the coil with a small capacitor of between 5 and 15 mmfd until the coil peaks at the desired frequency.

In the unit shown in the photographs, the tuner is mounted on the front panel of a 6″ x 6″ x 6″ aluminum utility box using ½″ internally threaded brass standoff posts. Install the standoff posts on the tuner and transfer the

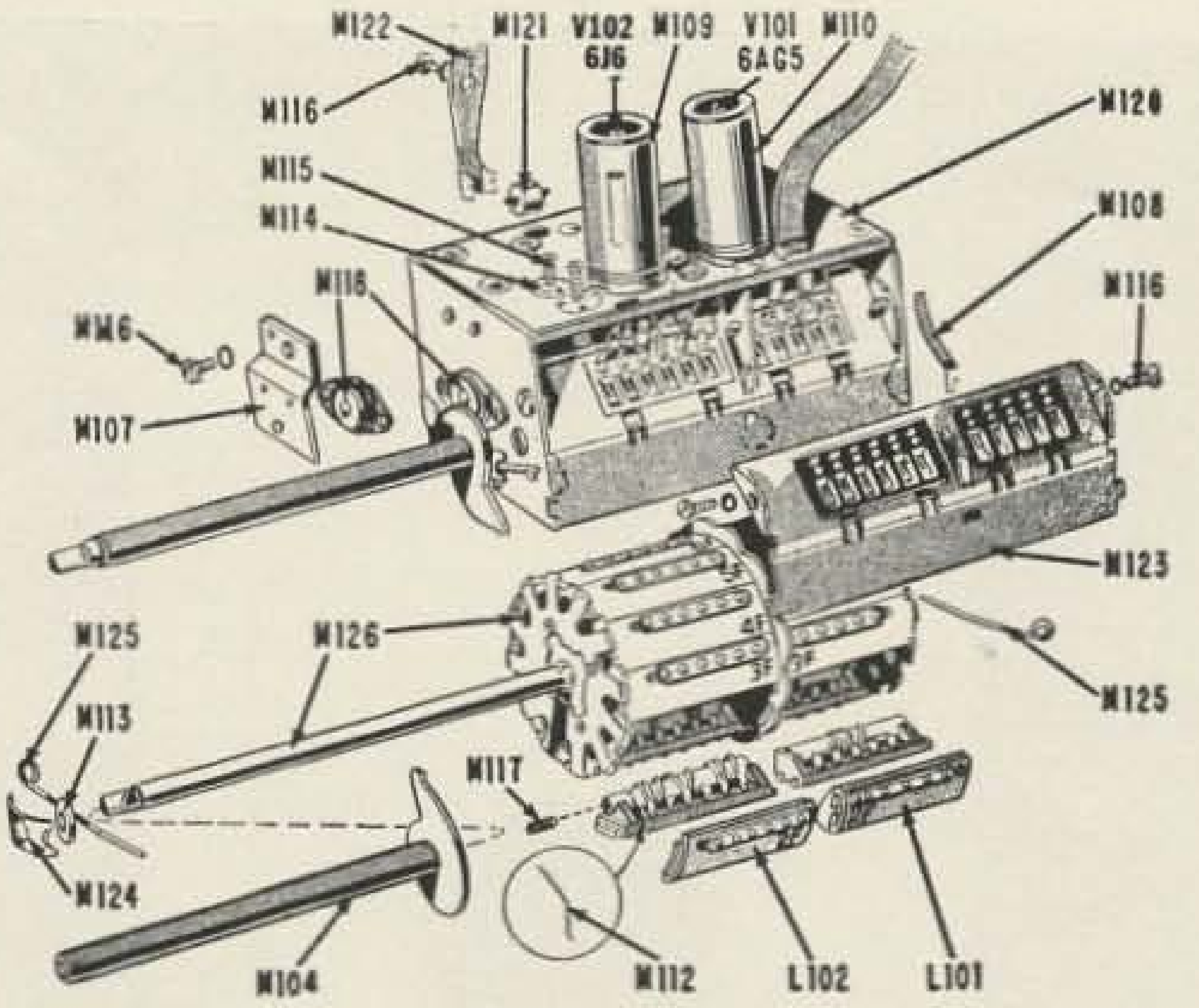
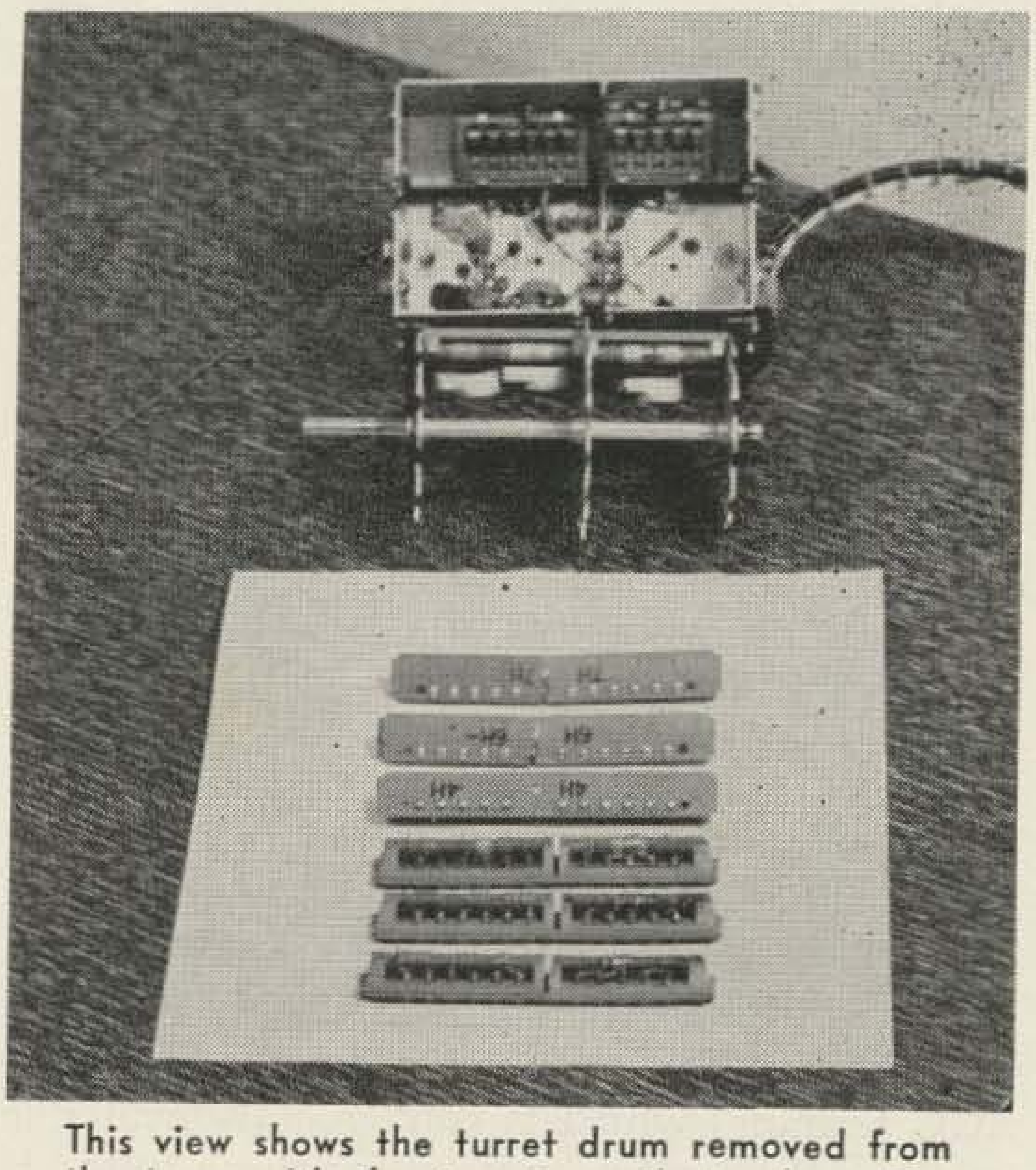
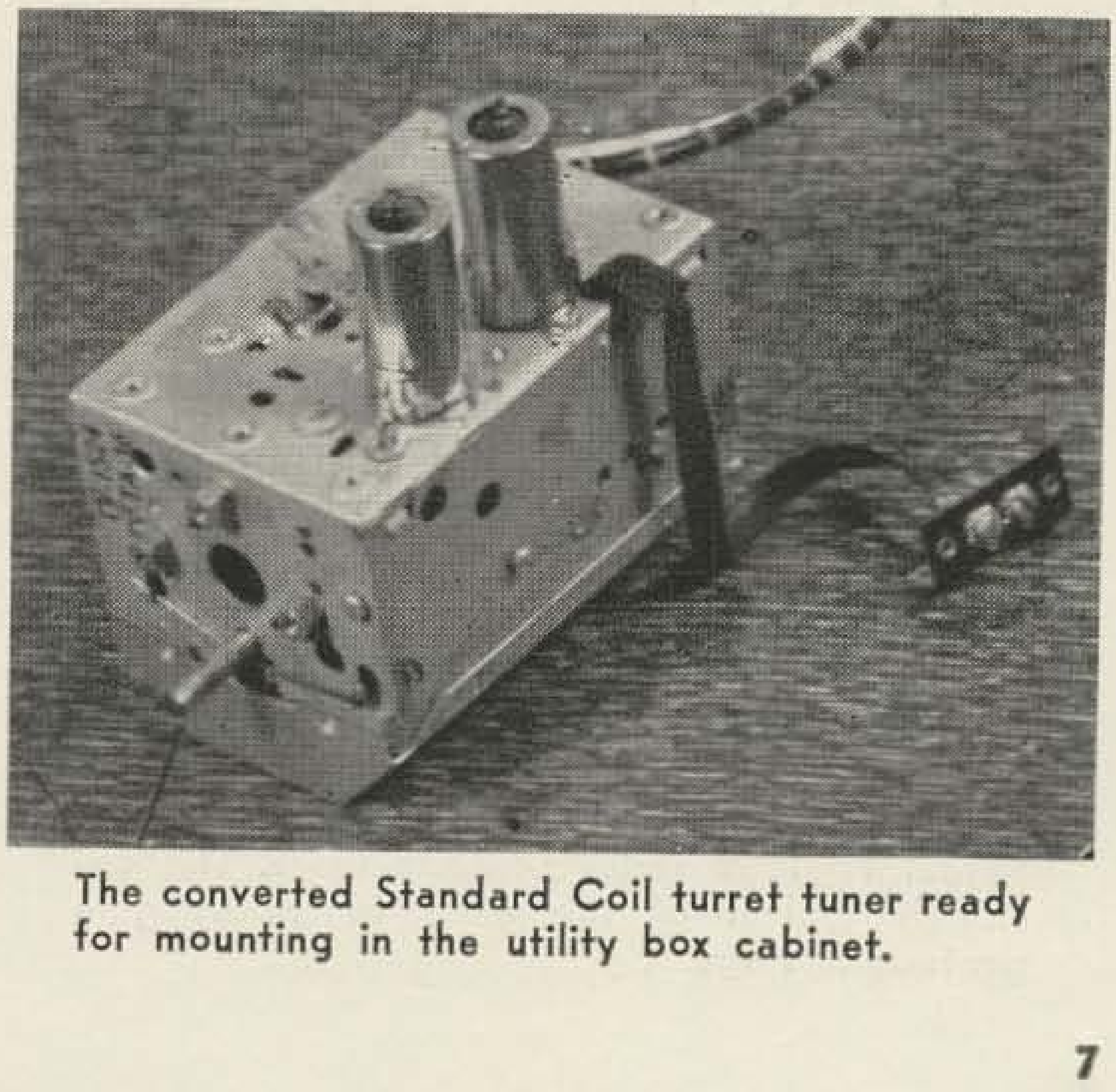
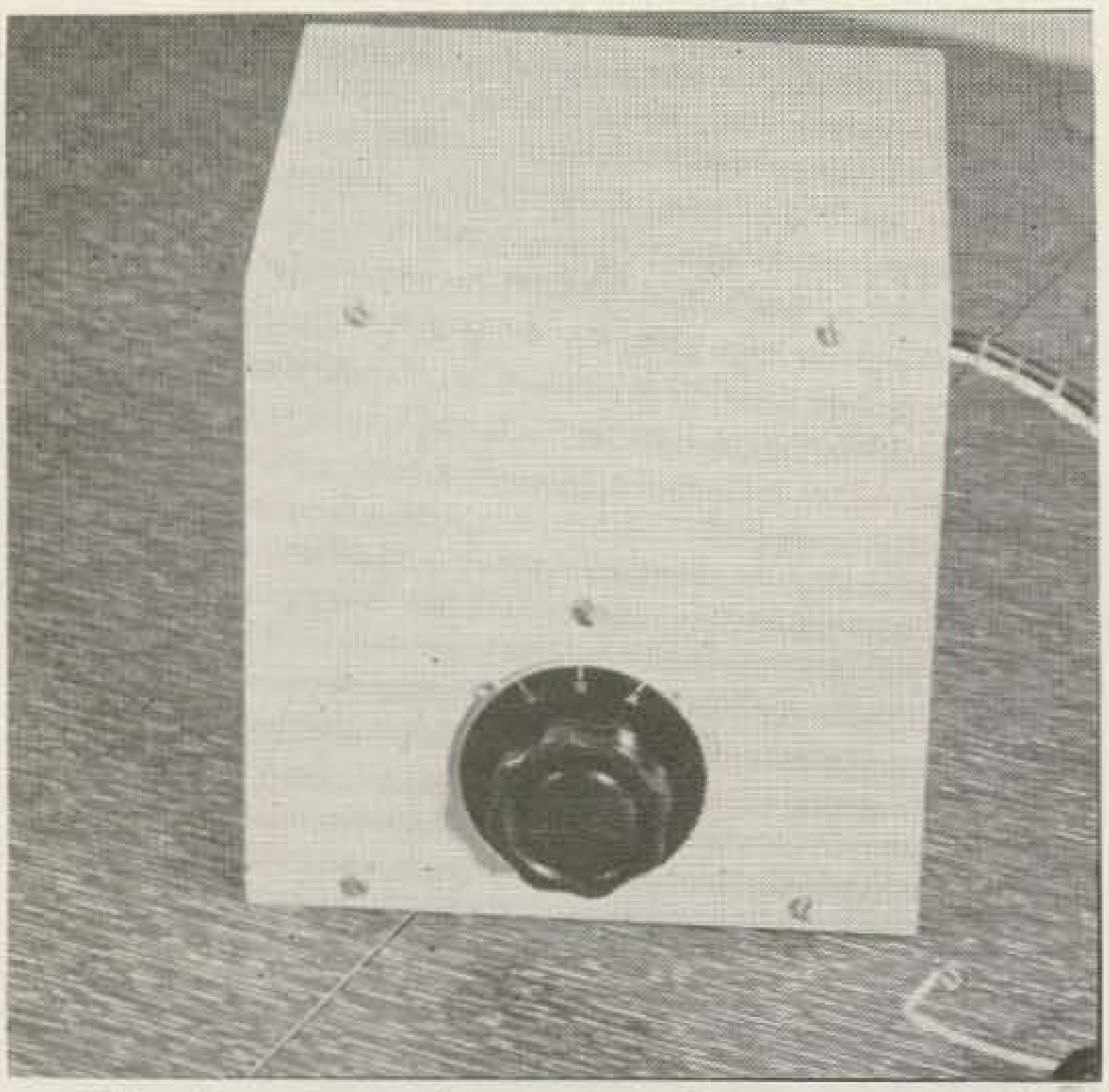


Fig. 1: Exploded view of a typical Standard Coil tuner used in an early Admiral chassis.


This view shows the turret drum removed from the tuner with the 6 meter coils in place. The other coil strips are shown ready for the "treatment."


The converted Standard Coil turret tuner ready for mounting in the utility box cabinet.



This view shows the packaged converter ready to go. The tuner is secured to the panel of a 6" x 6" x 6" utility box, using standoff posts. The octal plug is inserted in the receiver accessory socket and the PL-259 connected to the receiver antenna jack.

locations of the mounting, shaft and oscillator slug adjustment holes to the front panel. Drill the holes, reassemble the tuner and mount on the panel. Cut the shaft to length and install a suitable knob. A snap hole plug may be used to fill the oscillator slug adjustment hole.

Power may now be applied to the tuner. A separate power supply may be constructed or power may be stolen from the station receiver. In the unit shown in the photographs, a plug is installed to match the accessory socket on the receiver and the AGC lead was brought out for connection to the diversity AGC terminal which is conveniently available on the AR-88 receiver used for these tests. If AGC operation is not desired, use one of the optional circuits in Figure 4. While extremely strong local signals may cause blocking of the

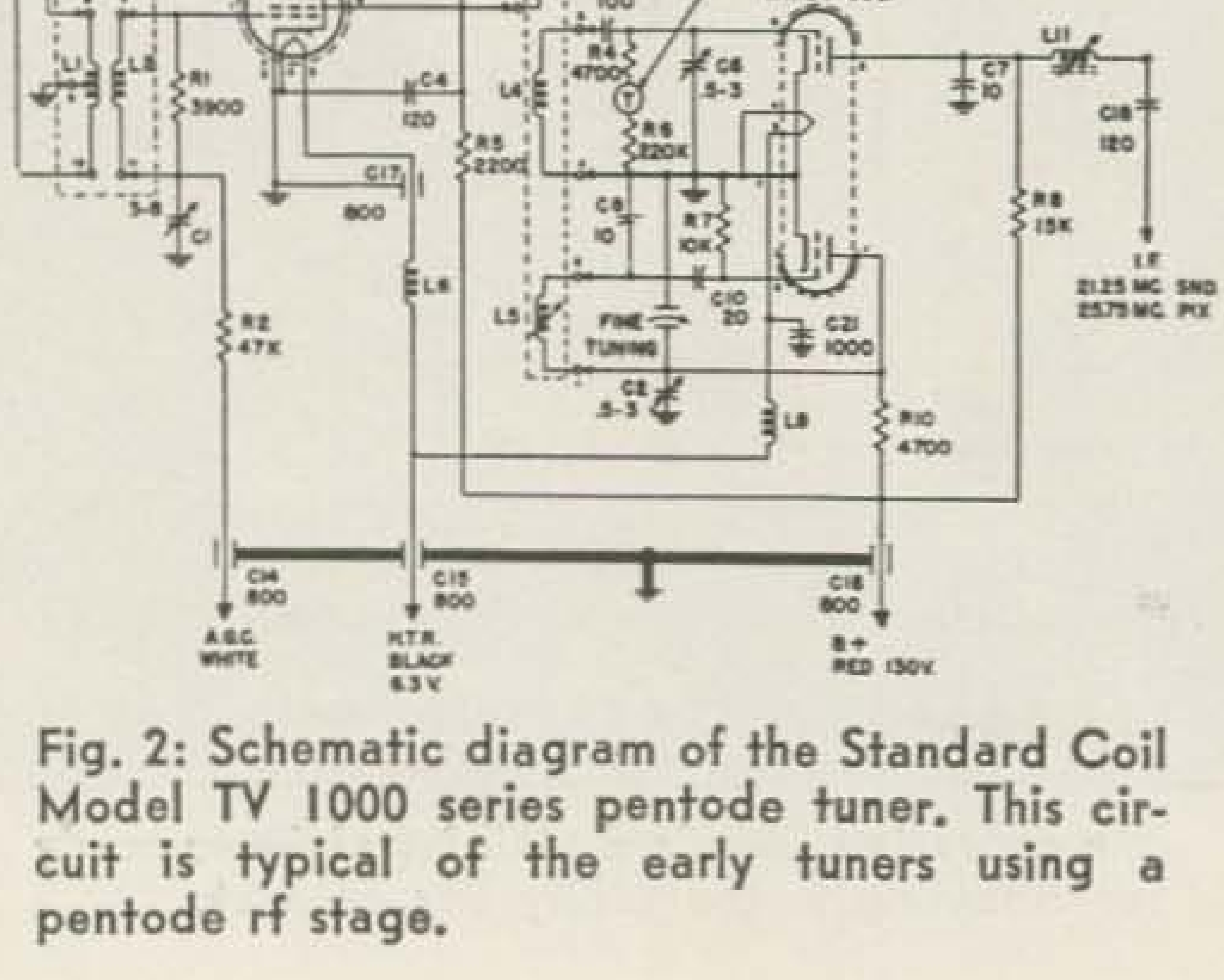


Fig. 2: Schematic diagram of the Standard Coil Model TV 1000 series pentode tuner. This circuit is typical of the early tuners using a pentode rf stage.

tuner if the AGC lead is grounded directly, this condition is rare. The B+ voltage requirements are fairly critical so check the service data on the set from which the tuner was removed and insert dropping resistors to bring the voltage down to the proper value.

With operating voltages applied and the tuner output cable connected to the receiver antenna jack, the converter may be checked out. A good outside TV antenna may be used for test and alignment of the converter and the broad-band characteristics of the conical

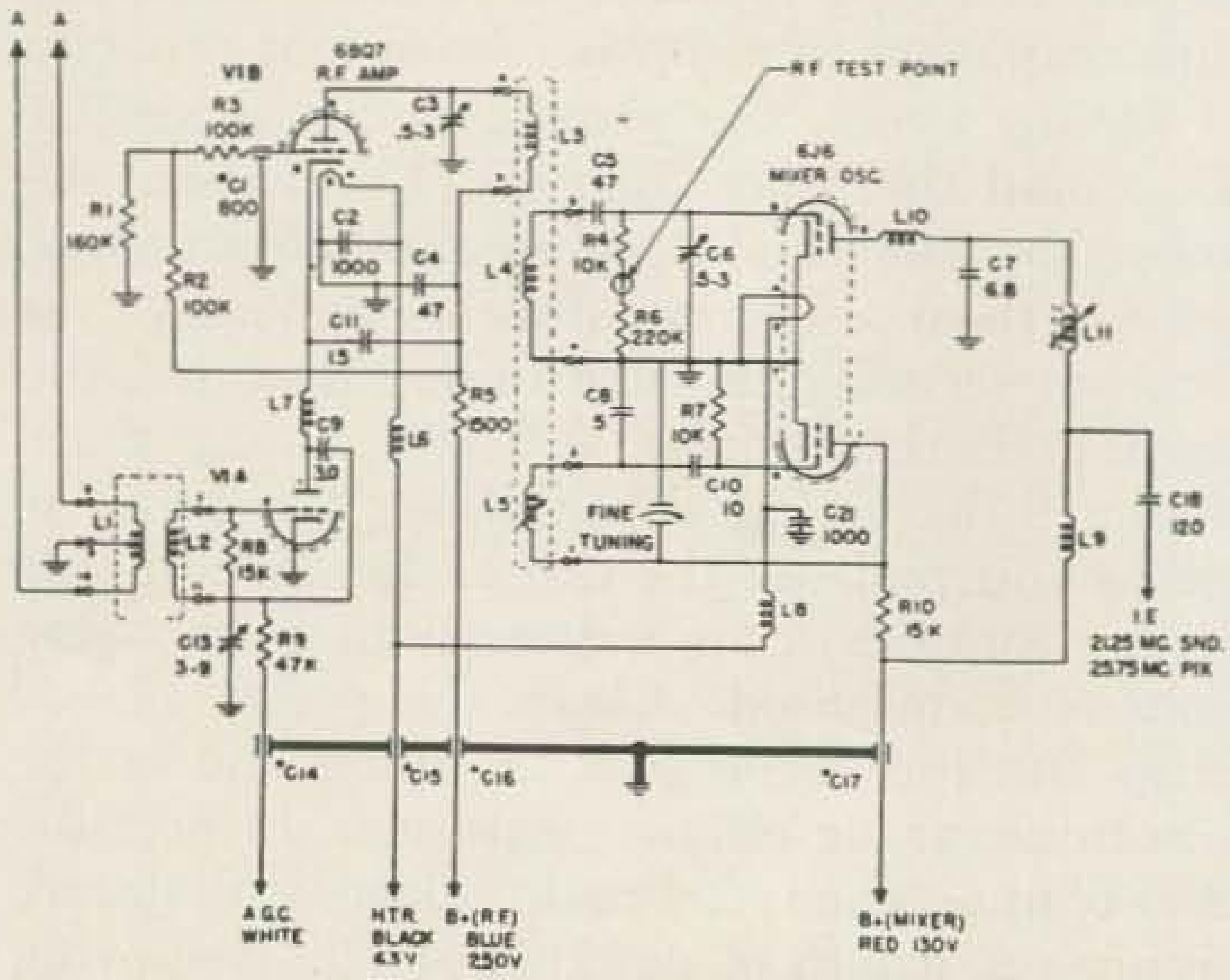


Fig. 3: Schematic diagram of the Standard Coil Model TV 2200 series cascode tuner. This model, along with the others, was subject to many variations in the if output circuit. Also, tube heaters were series connected for use in line operated sets.

type make it ideal for this purpose. Tune the station receiver to 21.25 mc and insert coil strips for a local TV station. Adjust the channel oscillator coil slug to bring in the sound carrier. Since the fine tuning control has been removed, substantial change in slug setting will be required. Now tune the receiver up in frequency to 25.75 mc and video information should be heard across this frequency range. When you are convinced the converter is working properly, you are ready to explore.

A stock of wire, small trimmer capacitors and a small soldering iron are desirable; a grid dip meter is almost essential. The techniques used are shown in the photograph. The example shown is a Channel 2 strip padded down to cover 50 to 54 mc. The rf amplifier grid and plate coils are shunted with 7-45 mmfd ceramic trimmer capacitors and adjusted, using a grid meter, so that the circuits resonate in the center of the band. The oscillator coil slug is now set to the center of its travel and the oscilator grid coil shunted with a 4-30 mmfd ceramic trimmer. The circuit is then adjusted to the nominal *if* frequency plus the 6 meter band center frequency or 75.5 mc. The 6 meter band is then tuned on the station receiver between 21.5 and 25.5 mc. Any favored frequency may be peaked with the slug in the converter output coil.

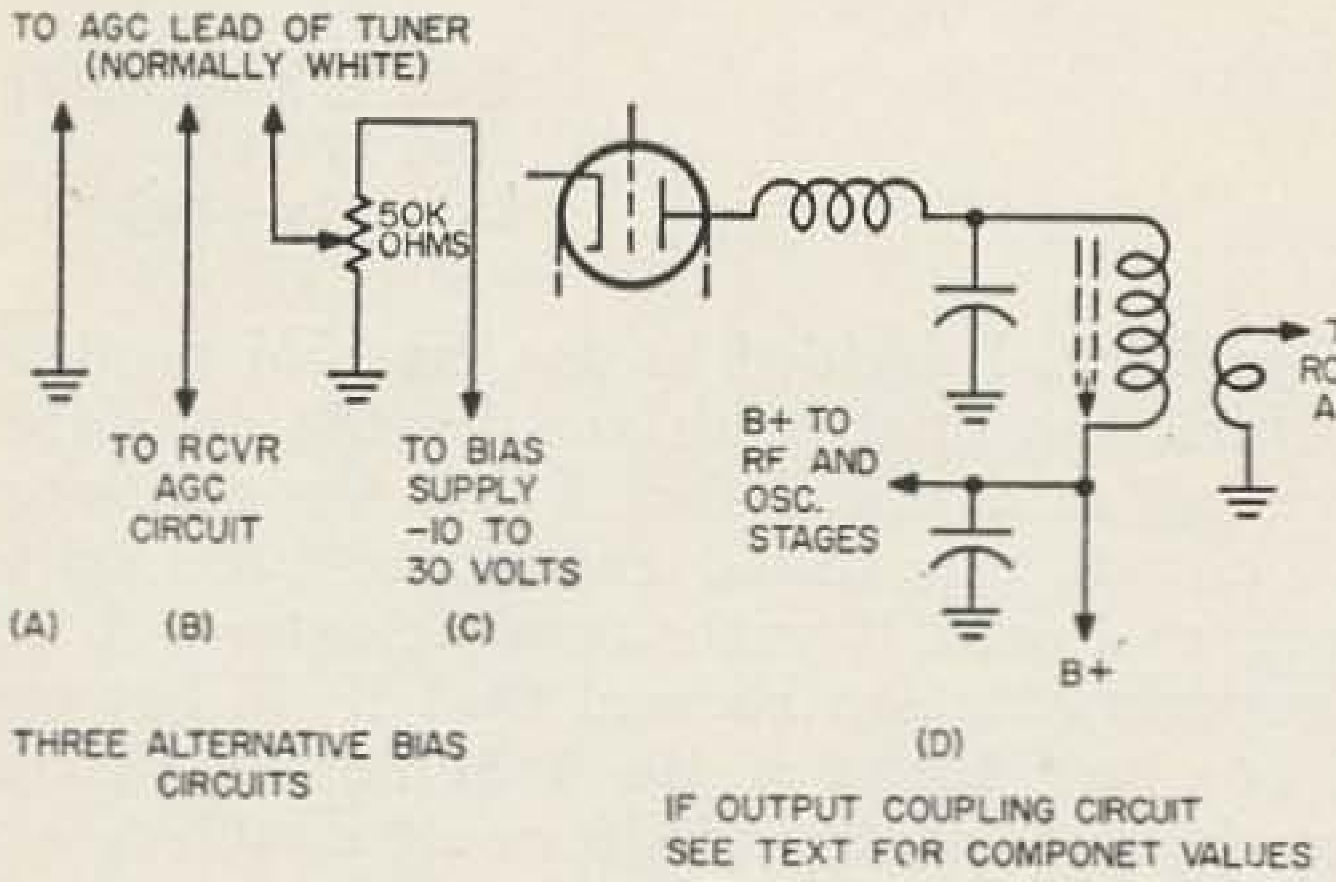


Fig. 4: Three solutions to the tuner bias problem are shown and each has its advantages. See text for discussion. The if output circuit shown is found in some models of the Standard Coil tuners. This circuit is ideal for feeding the low impedance antenna input of your high frequency receiver. See text for details on changing the circuits shown in Figs. 2 and 3 to that shown above.

The same techniques may be used to cover other frequencies. The Channel 7 coils are easily brought into the 2 meter band. Simply add one turn to the rf, mixer grid and oscillator coils, or add small shunt capacitors to these windings. Unless the frequency change is great, in which case the bandwidth would be reduced substantially, it is generally easier to add capacity to the tuned circuits than it is to rewind the coils.

This article outlines the basic techniques. Shortage of time precluded preparation of more elaborate coil winding data. Pick your frequency, fire up the grid dip meter and soldering iron and go to work. I am quite sure that the Editor would be quite receptive to a short article giving complete coil winding data for the entire spectrum from 30 to 300 mc, and this is entirely practical. The technical amateur is famous for his ability to parlay zero cost equipment investment into state of the art performance. While the performance of this converter makes no claim of being state of the art, this project provides a good method of getting a lot of no-cost experience in VHF techniques. . . . W4WKM

Very High Frequency Can often Create a Case of Gout

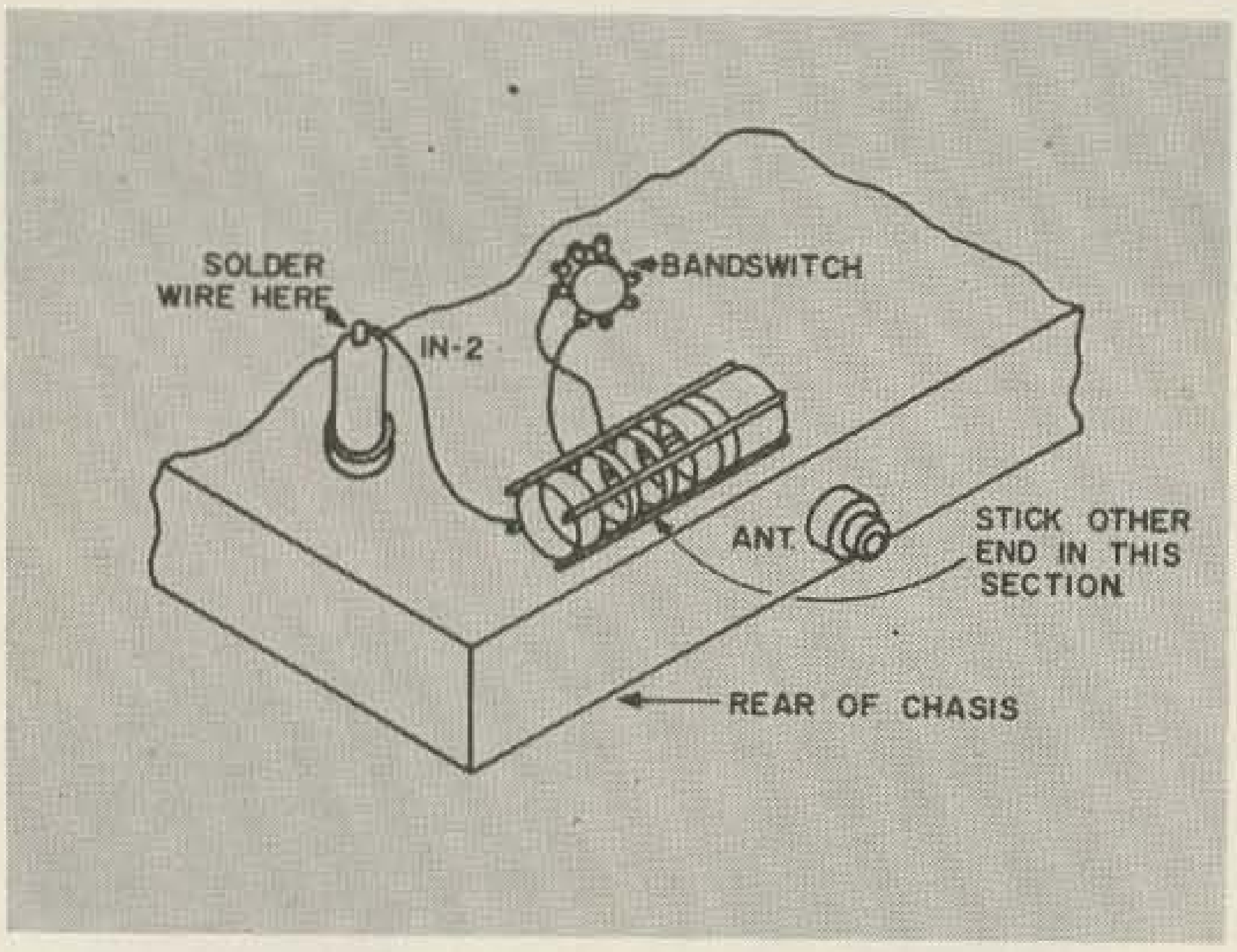
50 watts on 50mc in 50 seconds

Glen E. Zook K9STH
1006 W 16th
La Porte, Indiana

YOU don't believe it can be done, do you. Well, it can! All you need is a Heathkit DX-20, a small soldering iron or gun, a length of solder, and a piece of bell wire six inches long.

The DX-20 is a common low-powered rig found in many Novice (and even General) shacks. It, and its newer version, the HX-11, cover 80M through 10M. The oscillator is a 6CL6, and the final is a 6DQ6. On 80-15 meters the final operates straight through. On 10M the oscillator doubles a 7 mc rock to 14 mc, and the final doubles this to 28 mc.

Because the oscillator operates on 14 mc when the rig is on 10M, I decided not to use this position. I decided to use the 15M position in which the final is driven by the oscillator operating at 21 mc. I found that the oscillator tank circuit was broad enough to tune up to 27 mc, so I used it without modification. A little experimentation showed that if all but one and one half turns of the 15M final tank coil were shorted out, the 6DQ6 would double to six meters.



To make the modification, solder one end of the six inch piece of bell wire to standoff insulator IN2 (see pictorial 3 in manual and attached diagram). The other end of the wire is inserted two turns (at the top of the coil) from the second opening in the final tank coil (see diagram). This wire may be put in and out of the coil whenever you want to change from HF to VHF.

Operation on 6M is the same as on 10M. The bandswitch is placed in the 15M position, the grid current run at between 3 and 4 mils, and the plate dipped at 100 ma.

The transmitter may be returned to the lower bands by just simply pulling the wire from between the coils. This wire, when left soldered on the one end does not affect the operation on the lower bands.

My DX-20 is screen modulated (it runs about 35 watts) and does a very nice job on 6M. Presently I am using a lowly ground plane on six, and reports have been excellent. Best of luck on six, and hpe Cu Sn. ... K9STH

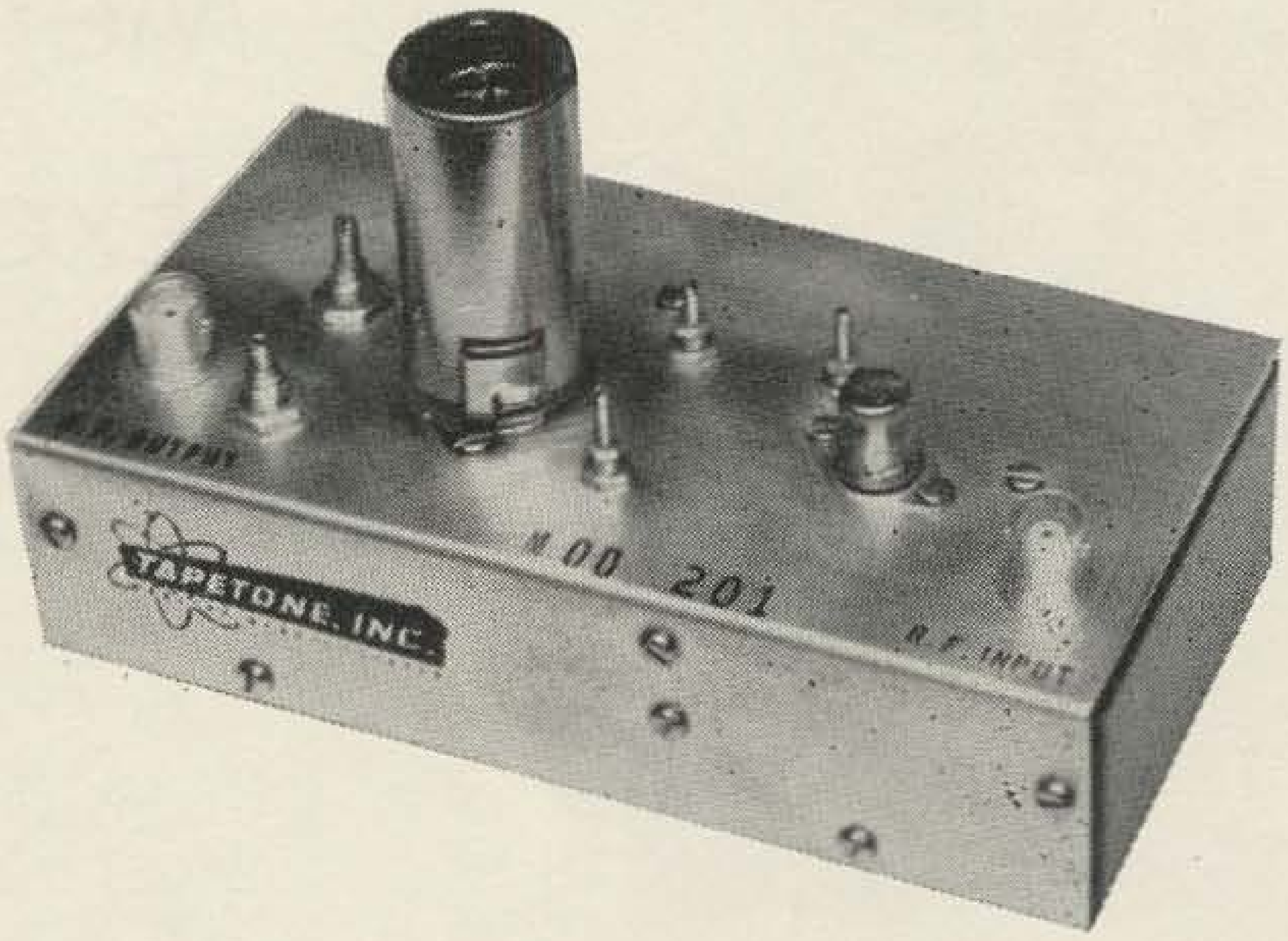
Replacement Auto Antenna has Amateur Application

Amateur equipment and antenna construction projects often require a telescoping whip type antenna. Inspection of available automotive antennas often fails to disclose one with suitable mounting characteristics.

A product that is suitable for many applications is the Ward Products Corporation Model TCFR-1 auto antenna replacement mast. This is a 3 section, telescopic antenna, measuring 57" extended. The antenna does not have a conventional insulator base. Instead, the bottom section of the antenna is drilled axially to accept a 5/16" stud and is provided with set screws to secure it in position. "Original Use" installation is accomplished by cutting off the broken antenna a few inches above the auto body, inserting the stub in the bottom of the replacement and tightening the set screws.

In amateur use, the replacement assembly may be used to extend existing antenna elements, secured to feedthrough insulator studs or fitted over ground-plane antenna casting studs. Coaxial connectors may be modified and a stud inserted to permit use with portable equipment.

Wholesaling for a little over a dollar, this replacement assembly provides a low cost answer to a common problem. . . . W4WKM



REJECT

This model 201 was rejected. It had a noise figure of only 4 db. I doubt if you would have noticed it, but our final check technician sure did. Before a 201 6 meter converter leaves the plant, it must have a noise figure of less than 3 db and an overall gain of at least 22 db. In other words, a model 201 has to be twice as good as any competitor's best six meter converter or it is rejected. No coverter made for six meters has a lower noise figure, higher overload resistance, or more stability.

The model 201 is the absolute ultimate for 6 meters. The 201 is the most popular 6 meter converter made. And because it sells for only thirty-seven dollars and forty cents, anyone can afford to own the best. Input and output impedance is 50 ohms, and the **if** output is 14-18 mcs. If you must have the best on six see your local radio distributor, or order direct.

TE CO **TAPETONE ELECTRONICS LABORATORIES INC.**
99 Elm St., West Newton 65, Mass.

Transistorized 20 Meter SSB Exciter

Bob Smith W5FRC
Design Engineer
Texas Instruments, Inc.

Single sideband suppressed carrier type transmission is rapidly becoming very popular both commercially and with amateurs.

Since the generation of a single sideband signal is normally accomplished at low power levels, there are many advantages to be gained by the use of transistors. These advantages include smaller size, absence of filaments and ideal operation for mobile use from a twelve-volt storage battery. High quality signals can be achieved and all specifications on sideband suppression, carrier suppression, oscillator stability, and distortion products at the output can be obtained.

The exciter described in this article makes use of a Collins mechanical filter for desired sideband rejection. Carrier suppression and unwanted sideband suppression are equal to, or greater than, —50 db. The 300 mw RMS power output capability of this exciter is sufficient to drive a vacuum tube such as the 5763. Increasing the supply voltage on the rf stages to 24 volts will approximately double the available output power. A voice control (vox) circuit is included and an anti-vox circuit is used to prevent the exciter from being turned on by acoustical feedback.

One of the major problems encountered was that of VFO instability caused by the varying load presented by the mixer. This problem was eliminated by the use of a modified Hartley oscillator driving a buffer amplifier. The supply voltage of both of these stages is regulated to 8.2 volts by a reference diode. Oscillator frequency stability was found to be well within acceptable limits. (Less than ± 50 cycles after 1 hour of operation.) Linear operation of the output stages must be maintained in order to minimize signal distortion. This is accomplished by slightly forward biasing the rf driver and output transistors.

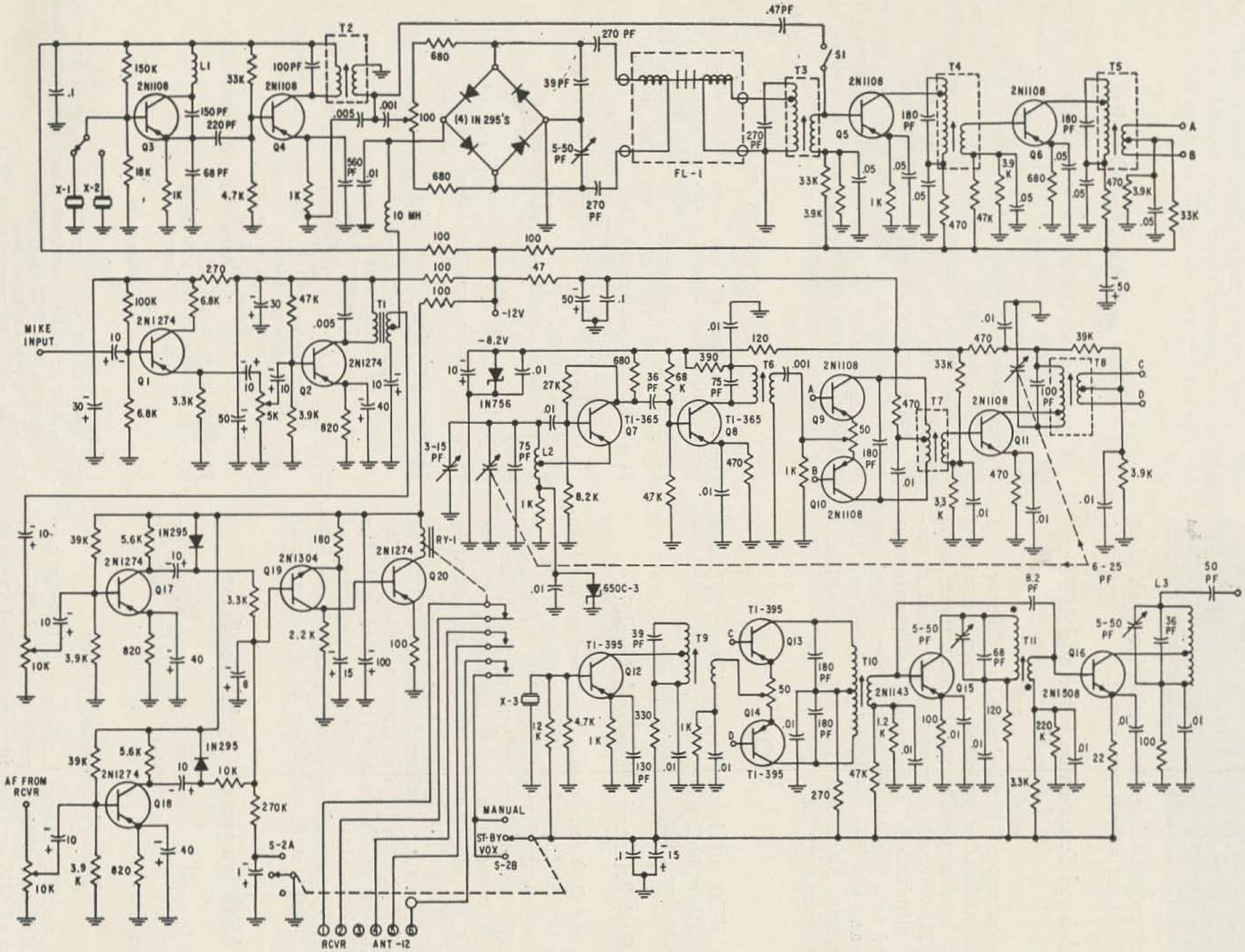
Although designed for 20 meter operation, the rf section can easily be modified for use on other amateur bands. Several contacts have been made using this exciter in conjunction with a 7 watt linear driving a 100 watt linear final. The 7 watt amplifier was mounted directly on the exciter chassis. Signal quality was reported to be excellent.

All transistors shown are available from Texas Instruments Incorporated Sales Offices and authorized distributors.

The audio amplifier, consisting of a common collector stage Q1, driving a common emitter amplifier Q2, is capable of delivering approximately 350 mv RMS to the balanced modulator. Frequency response is —3 db at 150 cycles and 3.5 kc. Power gain is approximately 30 db. The common collector stage presents a high input impedance for microphone operation.

The BFO, Q3, is a crystal controlled oscillator operating on either 453.5 kc or 456.5 kc, depending on the sideband desired. The buffer stage, Q4, amplifies this signal and is matched into the balanced modulator through T2. Approximately 1v RMS is delivered to the balanced modulator.

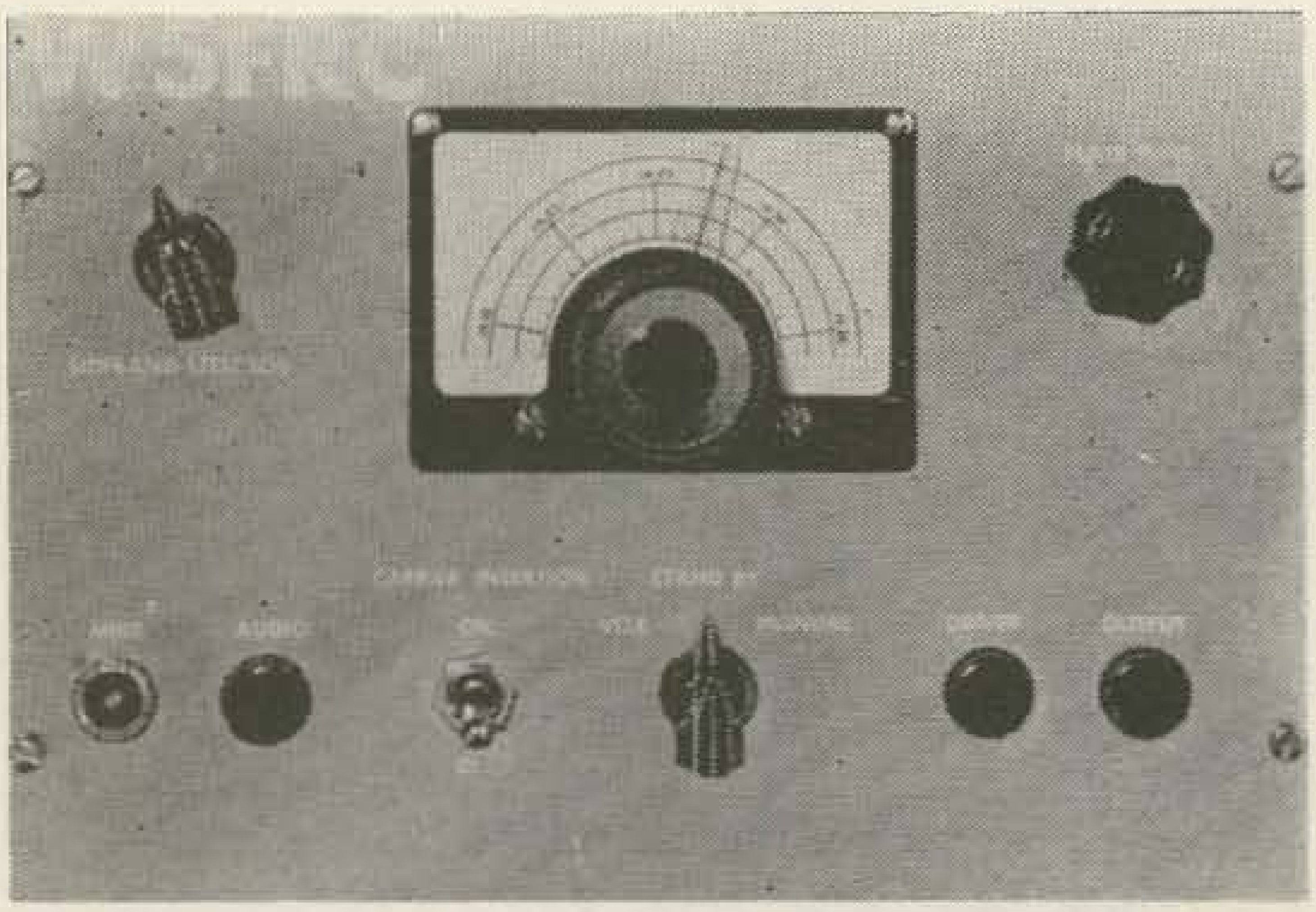
A set of four 1N295 diodes was matched for equal forward voltage drop at 4ma to insure proper balance. Additional balance control is provided by a 100 ohm potentiometer and a 50 pf variable condenser. A portion of the BFO signal is switched to the base of the first 455 kc *if* amplifier, eliminating the neces-



NOTES:

1. ALL RESISTOR VALUES IN OHMS
2. ALL CAPACITOR VALUES IN MFD'S EXCEPT WHERE SPECIFIED OTHERWISE. ELECTROLYTICS ARE USED WHERE POLARITY IS SHOWN.
3. CRYSTAL FREQUENCIES:
   X-1 453.5 KC
   X-2 456.5 KC
   X-3 17.1 MC
4. SWITCHES
   S-1 CARRIER INSERTION SWITCH
   S-2 FUNCTION SWITCH
5. FL-1 MECHANICAL FILTER COLLINS-F455J-31
6. RY-1 POTTER BRUMFIELD TYPE ML
   2 FORM A CONTACTS
   1 FORM B CONTACT
   DC RESISTANCE 300 Ω

20 METER S. S. B. EXCITER



sity of unbalancing the modulator each time the rf output stages are tuned.

Sideband Suppression Filter and 455 kc if Amplifier

The output of the balanced modulator is a double sideband suppressed carrier signal and is fed into a Collins mechanical filter, type F455J31, where the unwanted sideband is virtually eliminated. This signal is transformer coupled into the 455 kc *if* Amplifier consisting of Q5 and Q6. The combined power gain of the mechanical filter and the 455 kc amplifiers is approximately 34 db.

VFO

The VFO consists of an oscillator, Q7, and an isolating buffer amplifier, Q8. Frequency range is from 3200 kc to 3460 kc.

First Balanced Mixer and Amplifier

Q9 and Q10 comprise a balanced mixer into which is fed the 0.1 v RMS output from the 455 kc *if* Amplifier and 1v RMS VFO signal from the buffer. The output of the balanced mixer is tuned to a center frequency of 2875 kc with a 3 db band width of approximately 100 kc. This signal is fed into a tuned amplifier, Q11, having a center frequency of 2875 kc and a 3 db bandwidth of approximately 50 kc. The tuning of this stage is tracked with the VFO to maintain a difference frequency of 455 kc. The combined power gain of the balanced mixer and amplifier is approximately 36 db.

High Frequency Crystal Oscillator

Q12 is used in a conventional crystal oscillator circuit as the master oscillator for the transmitter.

Second Balanced Mixer

The second balanced mixer consists of Q13 and Q14 operating in push pull circuitry The output of Q11 is transformer coupled through T8 into the bases of Q13 and Q14, between which approximately 1v RMS is present. Oscillator injection from Q12 is approximately 3v RMS at the arm of the balance potentiometer.

High Frequency Driver and Output

The output of the 2nd balanced mixer has now been translated to a 20 meter single sideband suppressed carrier signal. This signal is fed into a neutralized driver amplifier Q15 and an output stage Q16. Available power at the collector of Q16 is approximately 300 mw.

Vox and Anti-Vox Circuits

A portion of the audio output signal from Q2 is fed into vox amplifier Q17. This signal is amplified and rectified and fed into a dc coupled relay amplifier consisting of Q19 and Q20. Anti-vox amplifier Q18 receives its signal from the audio portion of the receiver. Its output is likewise rectified and fed into the dc coupled relay amplifier. Adjustment of the vox and anti-vox input level controls assure proper operation of the vox relay. Operation of these circuits can be defeated by switching to "standby" or "manual" operation.

. . . W5FRC

TRANSFORMER DATA

T1—Audio Output 10K:600 ohms CT, 300Mw
T2—455 KC Buffer Amplifier 20K:600 ohms
QU = 100, QL = 50
T3—Mechanical Filter Output to 455 KC IF Amp. 50K:2K
QU = 100, QL = 50
T4—455KC IF interstage 16K:2K
QU = 100, QL = 50
T5—455KC IF output to first balanced mixer
16K:4KCT
QU = 100, QL = 50
T6—VFO buffer amplifier output 10K:1K
QU = 50, QL = 10
T7—First balanced mixer output 40K CT:4K
QU = 50, QL = 35
T8—Low frequency amplifier output 10K:2K
QU = 75, QL = 50
T9—High frequency crystal oscillator
Primary: 14 turns #25 wire close wound
Secondary: 3 turns
Coil form: 9/32" diameter
Core: Powdered Iron
Arnold Type E material #A1-01
T10—Second Balanced mixer output
Primary: 14 turns #25 wire close wound
Secondary: 4 turns
Coilform: 9/32" diameter
Core: Powdered Iron
Arnold Type E material #A1-01
T11—RF driver output
Primary: 16 turns air dux #416
Secondary: 2 turns

Coil Data

L1—BFO buffer and amplifier collector coil 3mh choke
L2—VFO coil 62 turns #30 wire tapped at 20 turns wound on molded powdered iron form Quality Components, Inc. #QS-7-187-QU = 70
L3—RF Output Collector coil
16 turns air dux #416

HERE'S THE VHF COMBINATION THAT BEATS 'EM ALL!

For DX or contests . . . for scatter, aurora or satellite tracking . . . for "rock-crusher" reports or just plain "chewing the rag" . . .

Put yourself behind this power-packed Clegg VHF ham station . . . **we guarantee** you'll "out-talk", "out-receive" any other commercially-built amateur VHF transmitter and receiver now available!

Take, for instance, Clegg's ZEUS VHF Transmitter. It gives you full coverage of the amateur 6 & 2 meter bands and associated Mars frequencies, with maximum TVI suppression. Automatic modulation control with up to 18 db of speech clipping provides magnificent audio with "talk power" greater than many kilowatt rigs. This beautiful unit with its ultra-stable VFO is the ultimate in VHF equipment for amateur and Mars operation.

Clegg's all new INTERCEPTOR VHF Receiver, designed for the serious operator on these bands offers performance features unmatched by presently available equipment for these frequencies. Exactly matching the famous Zeus Transmitter, the Interceptor offers reception with virtually no cross modulation. Nuvistor RF stages provide an extremely low noise figure with high sensitivity. Stability is ideal for the exacting requirements of SSB and CW.

Write for Complete Information!

Amateur Net Prices:
ZEUS, $695.
INTERCEPTOR, $473.

MONDAY, OCTOBER 1

Coming Soon!
Clegg's new Venus
6 Meter SSB Transceiver
also
Clegg's new Thor VI & II
50 watt Transceivers
for 6 & 2!

Clegg LABORATORIES
504 ROUTE 53, MT. TABOR, NEW JERSEY
OAkwood 7-6800

Practical Uses for

Four Layer Semi-Conductors

Fred Cupp K8AOE
3810 East 365 Street
Willoughby, Ohio

THE "information" type article on four layer devices in the May 1962 issue of 73 Magazine delved at length into the theory of operation of four layer diodes with particular emphasis on the "SCR" type. An interesting relative of the SCR is the Shockley Diode (footnote 1). The article wound up by asking where some of these unique properties might be used, and it is the intent of this article to explore the practical applications of these new devices in answer to K4CPR's final question

The Shockley Diode, which is my particular favorite, is a two terminal device, unlike the three terminal SCR. Fig. 1 shows the two-transistor analogy of the externally gated SCR as compared to the same analogy for the Shockley Diode. The two terminal diode can be compared to the conventional SCR but with a Zener diode connected between the anode and gate terminals such that if the voltage is gradually increased across the device a point will be reached where the Zener diode will conduct and thus apply a trigger to the gate. This firing point will always occur at the same voltage, so we now have a voltage triggered four layer diode. Despite the apparent complexity of its operation, the Shockley Diode comes in a glass sealed unit of the same size as the miniature glass 1N34 diodes. Also don't let the small size fool you . . . the diode is capable of peak currents on the order of *ten amperes!* If you wish to delve further into the theory behind its operation go back and look up the article in the May issue. The theory explanations are essentially the same with the exception of the voltage sensitivity.

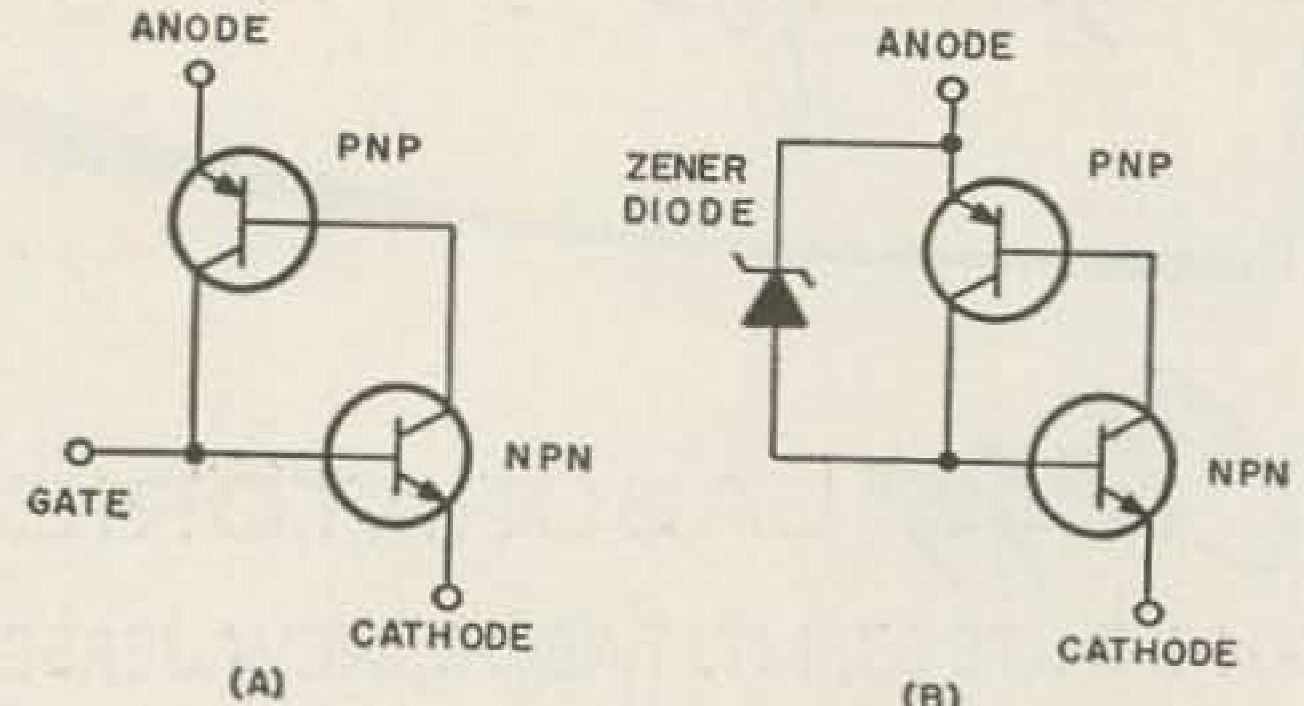


FIG. I

Now that we know how the little gem works, let's get down to brass tacks. Fig. 2 illustrates the simplest use for the four layer diode. This circuit will perform very nicely as a sweep generator for a home brew scope.

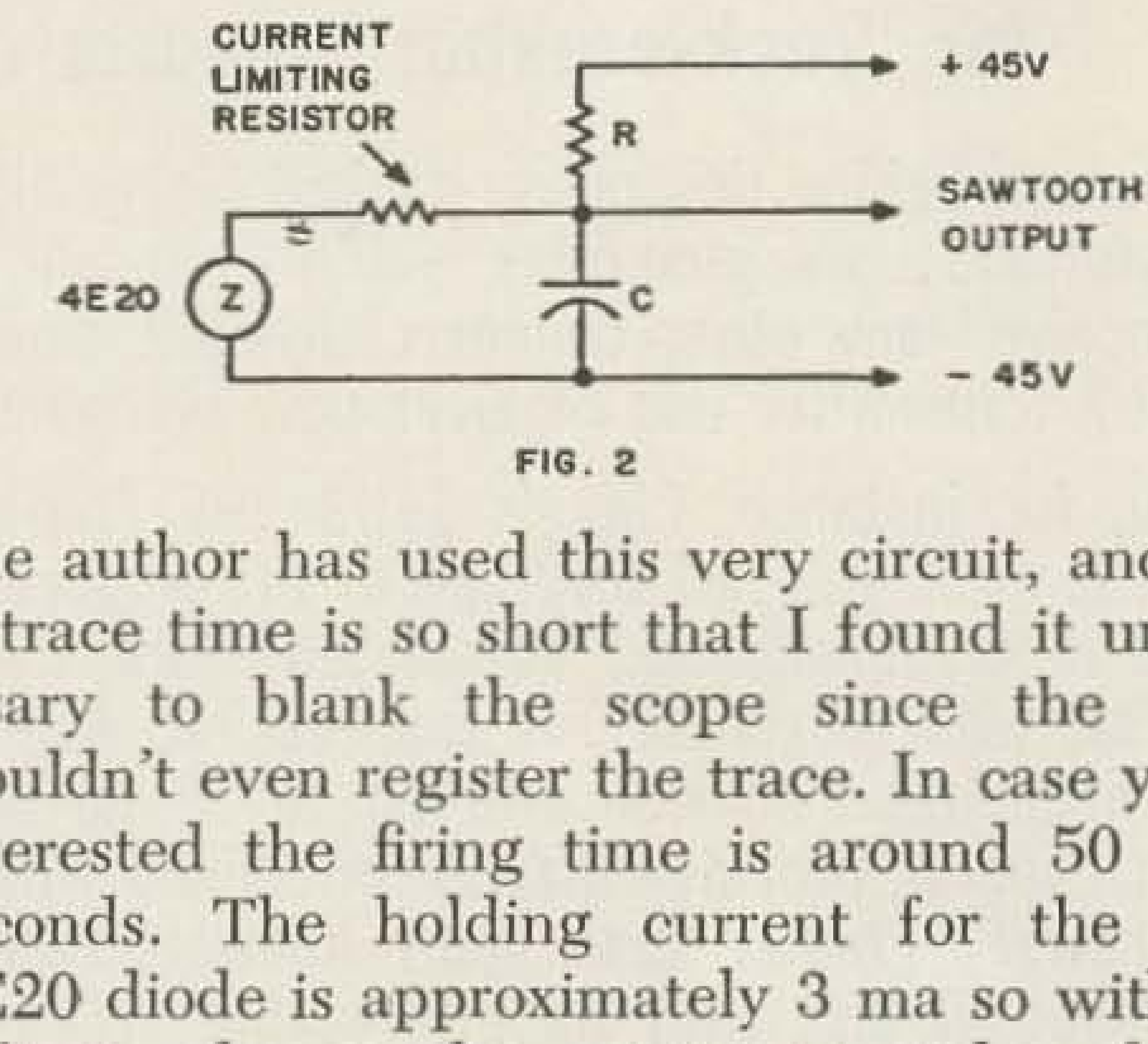


FIG. 2

The author has used this very circuit, and the re-trace time is so short that I found it unnecessary to blank the scope since the CRT wouldn't even register the trace. In case you're interested the firing time is around 50 nano seconds. The holding current for the type 4E20 diode is approximately 3 ma so with the voltage shown the minimum value for R should be greater than 15 K. Values between 22 K and 470 K may be used. The value of C is of course determined by the sweep rate

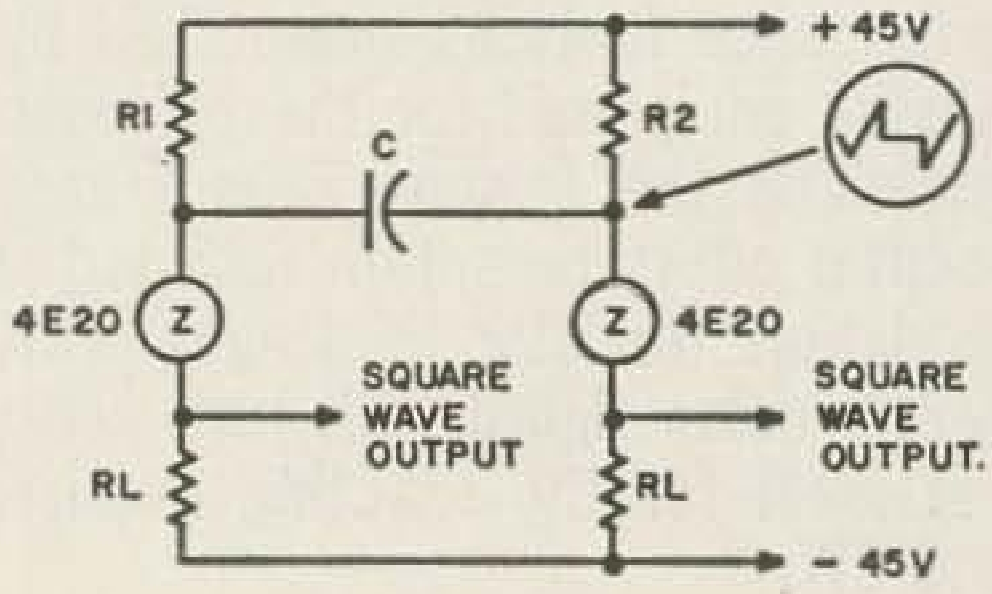


FIG 3

you desire. Since the diode is only good for 10 amps, it is necessary to provide a series resistor to limit the current to a safe value. A ten ohm resistor is sufficient and will not alter the operation at all. For greater linearity, if used for a sweep generator, a higher supply voltage may be used, but again the resistance must be raised accordingly to stay below the holding current. If R is made variable, a resistor of the correct value should be placed in series with the pot to limit the current below the holding value.

Going on to the more exotic circuits, Fig. 3 shows the four layer diodes used in a free running multivibrator. In this case the anode resistance (R1, R2) must be lower in value so that whichever side is conducting will "hold" or remain on. The anode of the non-conducting diode will rise toward the supply voltage as C charges through the anode resistance. When the firing voltage is reached the diode conducts and the anode voltage drops sharply. This drop in voltage is coupled through the capacitor C, thus driving the voltage of the other diode's anode negative. This stops the current flow through this diode and the anode begins re-charging toward the supply voltage. The process is repeated with first one side conducting and then the other. A small value of resistance may be inserted in the cathode leads of each diode, and the voltage across these resistors will be a low amplitude square wave. These resistors are designated RL in the diagram.

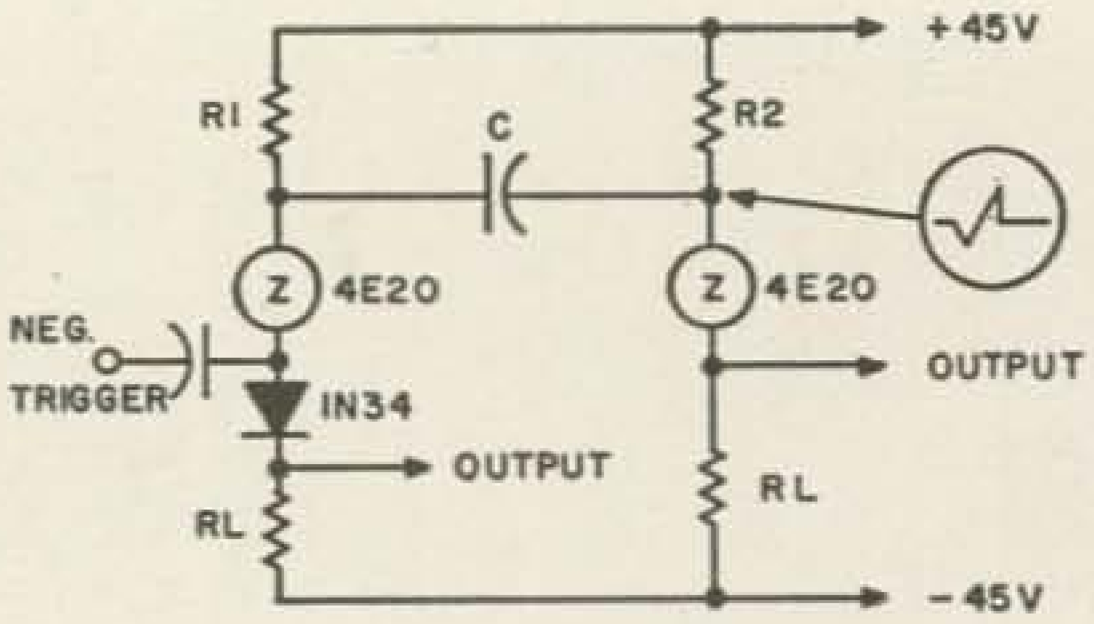


FIG 4

Until this time, we have been talking about 20 volt diodes, as indicated by the designation 4E20. By changing one of the diodes to a higher voltage such as a 50 volt 4E50, the multivibrator will always stop, or hold, with the low voltage diode conducting. The schematic for such a "one-shot" is shown in Fig. 4. A 1N34 diode is placed in series with the cathode of the four layer diode so that a negative trigger may be applied to the cathode.

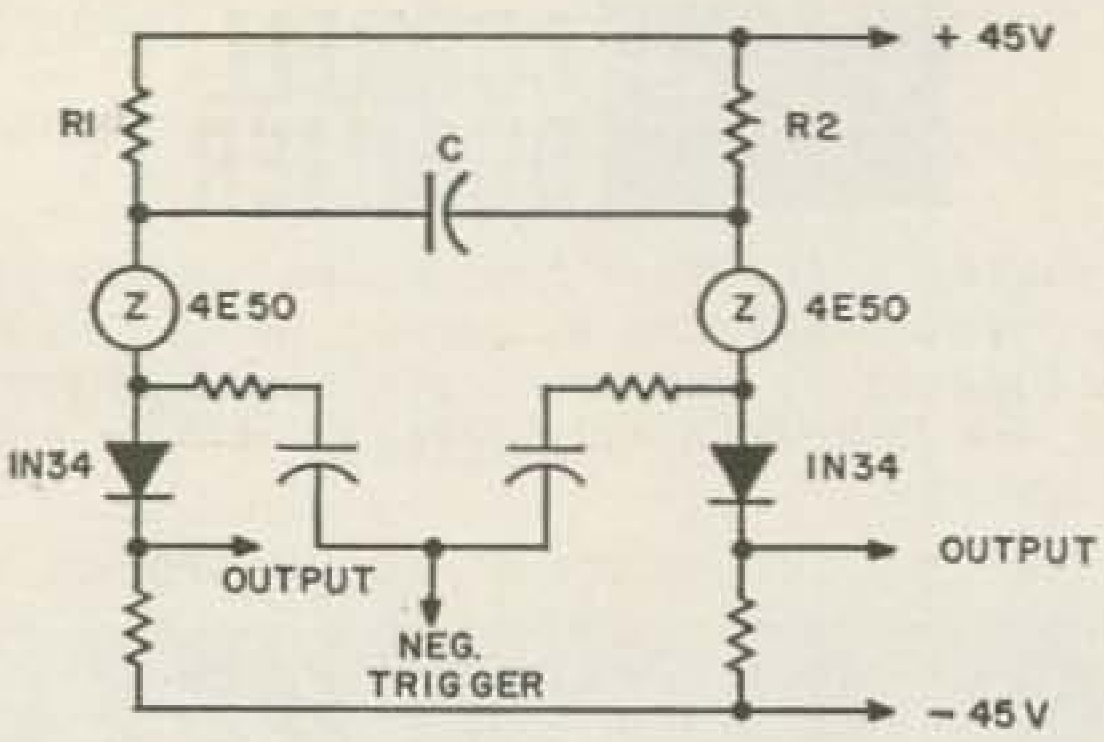


FIG. 5

Since the voltage across the 4E50 is already 45 volts, a negative trigger of slightly more than five volts will cause the total voltage to exceed the firing potential, and the diode will conduct, turning off the 4E20 diode. When C has charged up to plus 20 volts the 4E20 will again conduct, once again turning off the 4E50. Thus one square wave output pulse will be generated for each trigger applied to the input.

Figs. 5 and 6 illustrate two variations of the Bi-stable or Eccles-Jordan flip-flop. In Fig. 5, neither diode has sufficient supply voltage to trigger itself. When a negative trigger is applied, one or the other of the diodes will conduct. A second trigger applied to the input will cause the conditions to reverse. Although the trigger is applied to both diodes, since one is already conducting the trigger will do nothing to that side. The cathode of the conducting side is very low, so the trigger is dissipated across the resistor in series with the trigger line. The cathode impedance of the other diode is very high, so the trigger will show up on the cathode causing that side to fire.

By reversing the respective positions (but not the polarity) of one 4E50 and its 1N34, the polarity of the trigger required to operate the flip-flop is reversed. That is, a negative trigger will "fire" the left hand diode, while a positive trigger will "fire" the right side. Fig. 6 shows this type of multivibrator, which will flip to one state on the first negative pulse and remain in that state, ignoring all following negative pulses until a positive pulse is applied. It will then ignore succeeding positive pulses until reset by a negative pulse. Frankly I haven't thought of a use for this circuit yet but it sure is interesting to watch on a scope.

Now let's have a look at a circuit which can be used specifically by hams. Although there have been many designs published for automatic keys or "bugs" here is one more to add to the pile. This bug does not have a "memory" but it is self completing for both dots and dashes as well as holding off for the space. Fig. 7 shows the complete schematic for the bug. This is not just a "paper design," it has been completed and works very well. The reason there is no picture is that the breadboard model is still the only model and a picture would only serve to reveal my sloppy wiring technique. The left hand portion of the keyer may be recognized as the sawtooth relaxation

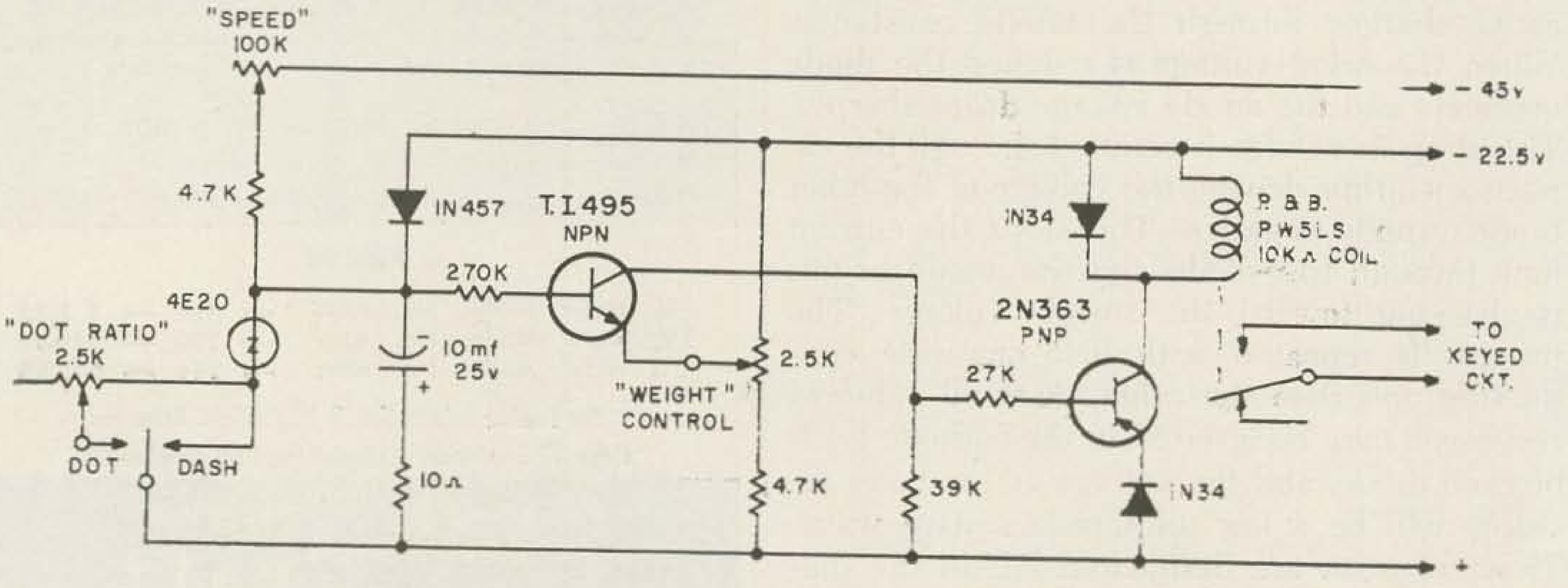


FIG 7

oscillator of Fig. 2. The only difference is that the polarity of all the components has been reversed. Since the diodes are two terminal devices, we can take the output from either the cathode or anode. In this case I chose to light the other end since it reverses the polarity of the sawtooth to go directly into the NPN transistor. The "Dot Ratio" pot changes the holding current or point, causing the diode to stop conducting before all of the voltage has been removed from the storage capacitor. In

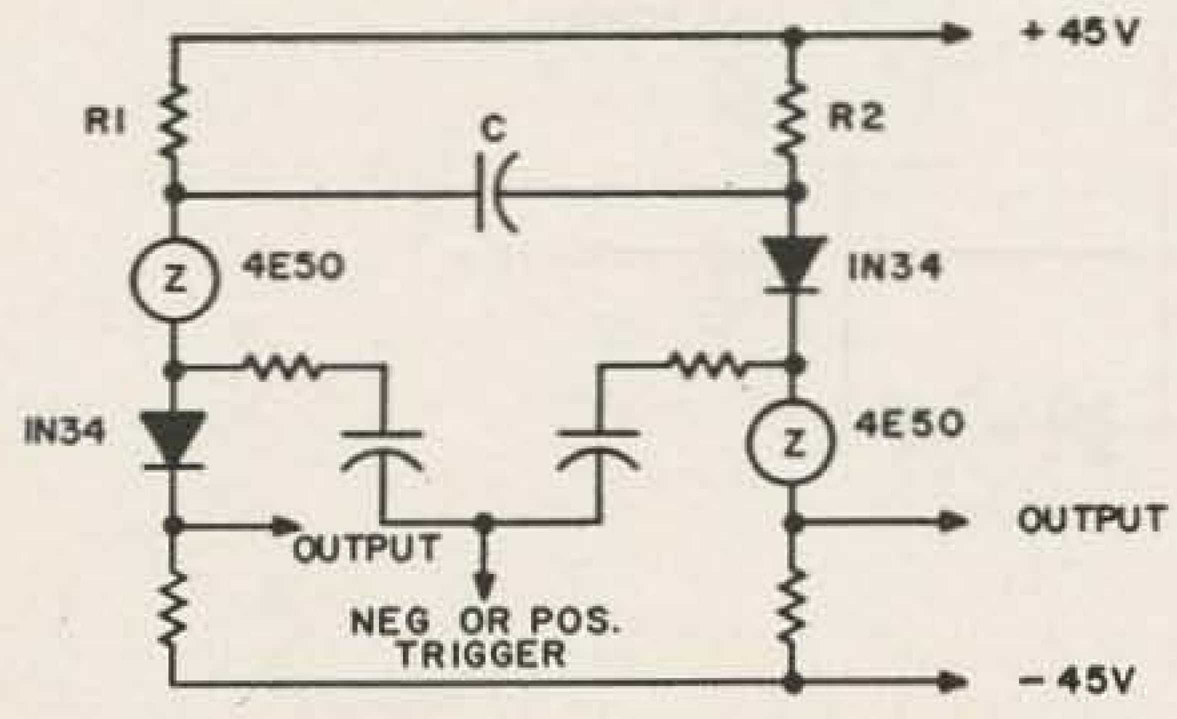


FIG. 6

this manner two different sawtooth frequencies are available depending on which contact of the key is closed. The dot frequency is adjusted to be twice that of the dash. Changing the "speed" control will now vary the rate of both the dot and dash together. The operation of the dc amplifiers is quite conventional except to note that complementary transistors (one NPN, one PNP) are used. The weight control sets the level on the emitter of the T.I.495 thus determining at what point on the sawtooth wave the relay will be operated. The theory of operation and the adjustment procedure is very similar to the speed key in the 1962 ARRL handbook, page 251. Other relays may be used of course, but take care to stay within the current and voltage rating of the 2N363 transistor. If you're a real speed demon you could use a high power transistor instead of the relay and key the transmitter directly. Several transistor keying circuits have been published in other magazines.

Last but not least, here is a four layer diode terminal unit for the RTTY set. Fig. 8 shows how easy it will be for me to get on RTTY when I can find a machine. (I'm still looking.) At the present time I must admit that all I've been able to do is watch the polar relay clatter back and forth and light two pilot lights to represent mark and space. Again this unit has been breadboarded and works fine on the bench. If someone actually tries it, let me know how it works out.

The beauty of this circuit is that no discriminator as such is needed. The 500 ohm output of the receiver is fed first to a pair of

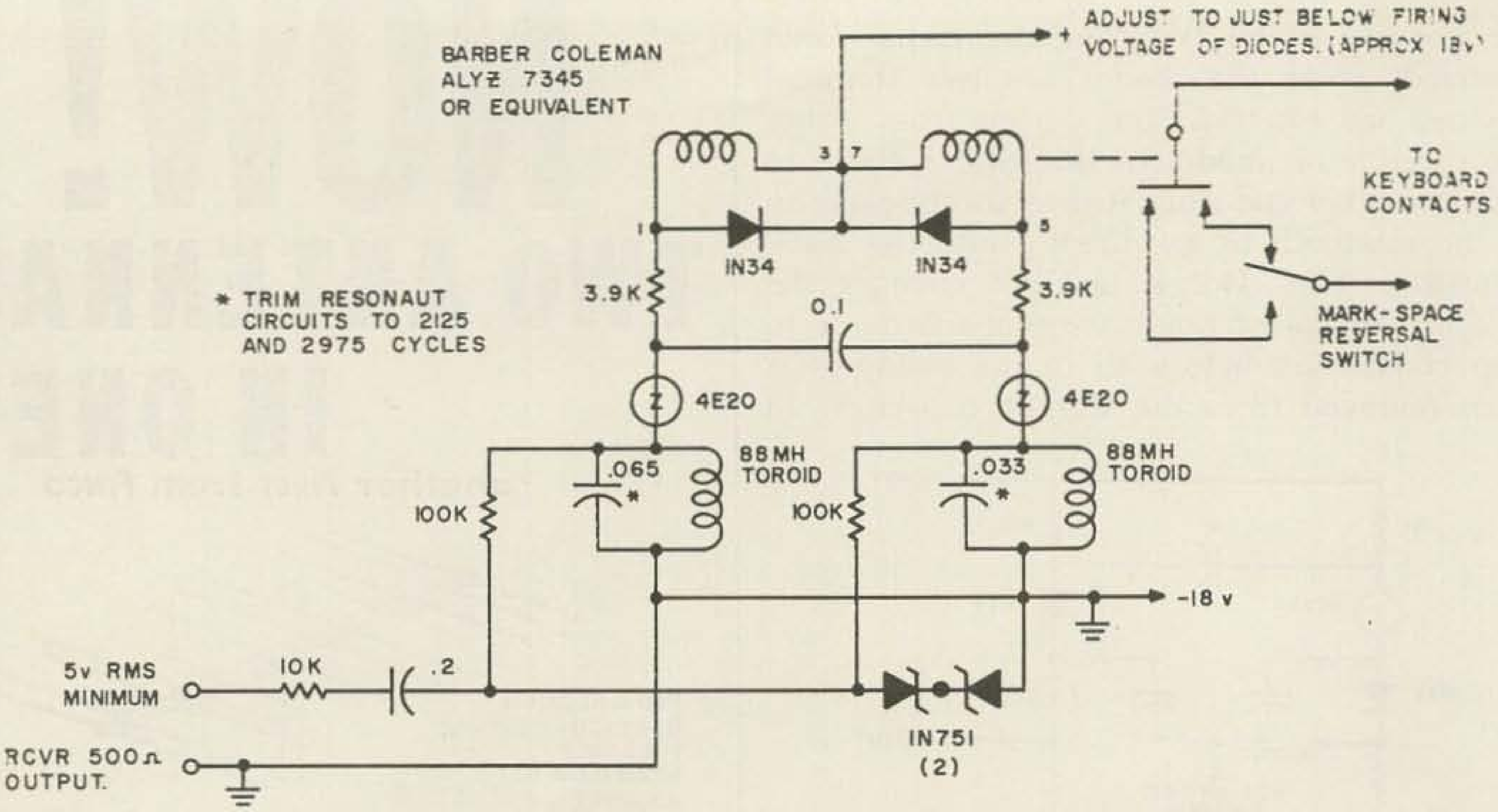


FIG 8

1N751 Zener diodes for amplitude limiting. It is then applied to the two tone filters through 100 K resistors. When the tone voltage swings negative the four layer diode in series with that particular filter will fire, drawing current through both the tone filter and the polar relay or micropositioner. Of course this will swamp out the tone in that filter, but so what . . . it's already fired that side. When a tone is received to excite the other side, the other diode fires, coupling a negative pulse through the .1 mfd capacitor turning off the first side. In this manner the relay will be latched in whichever position corresponds to the tone being received. Other relays may be used, or even two separate relays, or better yet one relay and only a resistor in the other leg to provide the holding current. As you can see, the variations to this idea are endless as long as you stay within the holding current of the diodes.

So there you have it . . . the total of my efforts to increase the popularity of the Shockley diode. Let's see what other uses some of you readers can come up with for it. Now I wonder why the Oscar Association used all those big bulky transistors in their keyer unit instead of four layer diodes? Hmmmmm . . . we could start off with a relaxation clock generator, followed by some Bi-stable flip-flops to divide them. . . .

. . . K8AOE

Footnote 1. Shockley Division of Clevite Corp., Palo Alto., Calif. (Send for their folder of application notes. It's free and makes interesting reading). You won't be able to get them from your local parts distributor. They are in stock at Semiconductor Specialists, 5706 W. North Ave., Chicago 39, Ill. Try any large industrial supplier such as Allied Radio Industrial Dept., $3.30 ea. in small lots.

Improved Base Clipper

"Cleaning up" of messy received signals, both CW and phone, by use of a base clipper, is a technique which is known apparently to only a few amateur and commercial operators. By use of a base clipper, also known as a zero limiter, and a trough limiter, all signals below a given adjustable amplitude are eliminated, and all signals above this amplitude passed. The signal amplitude is reduced by the clipping level, but the signal to noise ratio is, or can be, very greatly improved.

Although the Earle "A. C. Threshold" circuit[1], one of the first base clippers described in open literature, is an excellent performer, it requires quite a few components, and does not permit effective isolation of the audio circuits from the power supply. The much simpler series-controlled base clipper[2], performs the same functions, but has a control that is "hot" to ground, and no definite "off" position.

A similarly-functioning circuit, in which the control is at low potential with respect to B+, and "dead" with respect to af, is shown in Fig. 1. A definite "off" position is provided by means of a switch in the B+ line which provides back bias for the diodes. When the "CLIP LEVEL" control is set to zero resistance, there is no back bias on the diodes, and incoming signals are passed on to the output substantially unchanged (except for a negligible "toe" effect in the diodes). When, however, the "CLIP LEVEL" is set at some value other than zero, a back bias is applied to each diode, and all parts of the incoming signal below this value are blocked, and do not reach the output.

Under ordinary conditions, the base clipper is installed in a receiver after the crash noise limiter. If installed before it, the base clipper can well be a noise accentuator. With constants shown, maximum clip level is at 6.5 volts, which will eliminate most or all of most detector outputs. Maximum clip level can be raised by increasing the infeed voltage, or by increasing the 10K resistors to a higher value. Maximum clip level can be reduced, if desired, by lowering the infeed voltage, or by lowering the value of the 10K resistors.

When the base clipper is not needed for a considerable period of time it can be shut off by turning the "CLIP LEVEL" control past zero, opening the integral switch.

In operation, the signal is tuned in with the base clipper turned to a low level, or off. If the signal is messed up by background noises, the base clip level is advanced slowly until maximum intelligibility is attained. This will be near the peak level of the unwanted background noise, but seldom exactly at it. As we are interested in maximum readability, the operator's ear, and not some formula or some meter reading, is the guide to correct adjustment.

Life of this base clipper is problematical, but long. One built in early 1959, and in almost continual use since, is still working perfectly, and has needed no servicing.

Ronald L. Ives

References:

(1) Earle, W. A. "A-C Threshold Converts to Switch," Electronics, Vol. 31, No. 1, Jan. 3, 1958, 98-100;

(2) 73 Staff, "Stop That Noise," 73, Vol. 1, No. 2, Nov. 1960, 24.

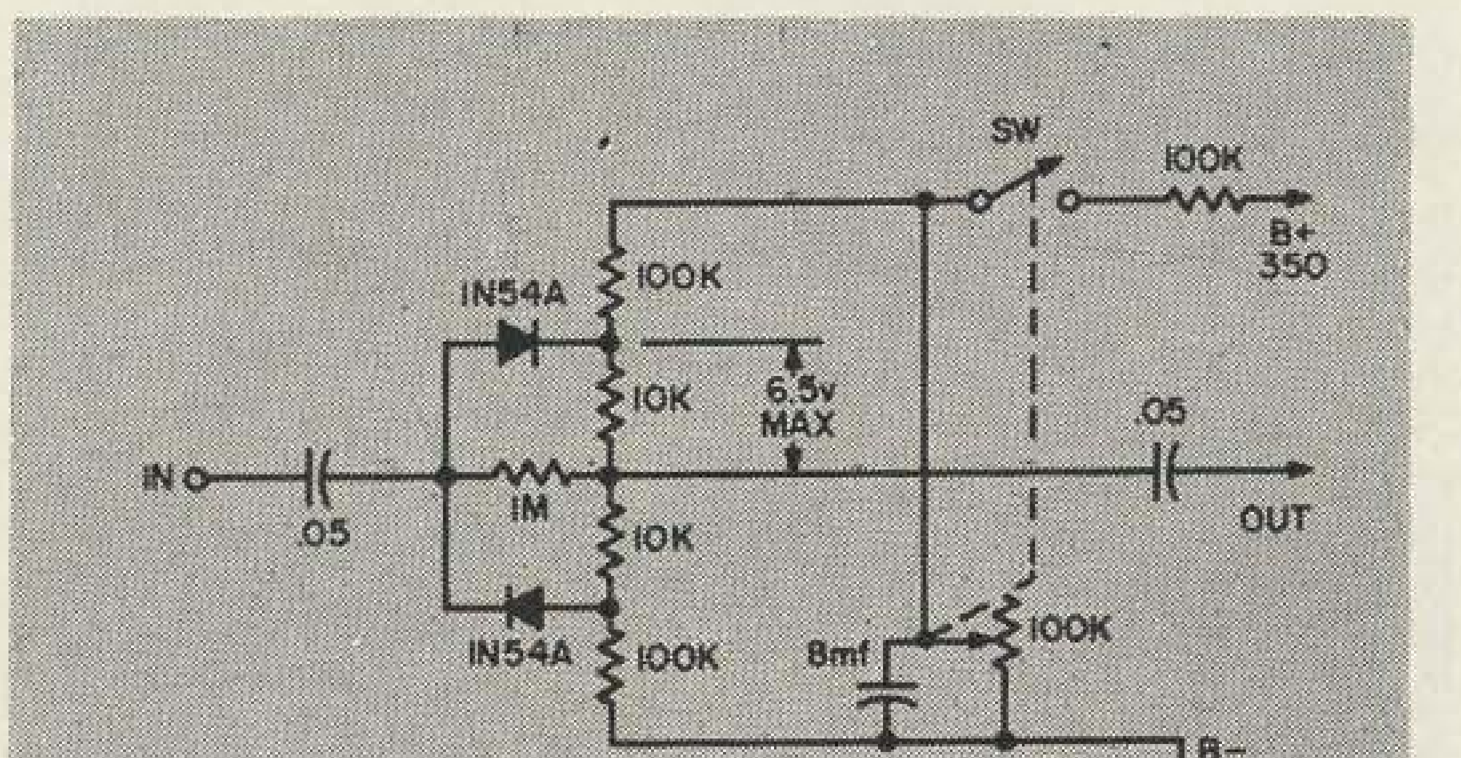


Fig. 1. Improved base clipper.

De-Chirping a VFO

or

Chirp from a surprising source

Harold Carlson K7MSL
Carpenter, Wyoming

FOR many years I was involved in research and development of tuning fork oscillators of high precision. They were designed to a deviation specification of ± 5 parts per million, without temperature control. This accuracy is now maintained, day in and day out, month to month, over wide temperature changes. Of major interest was the fact that mechanical design of the entire assembly was a large factor in the oscillator's stability.

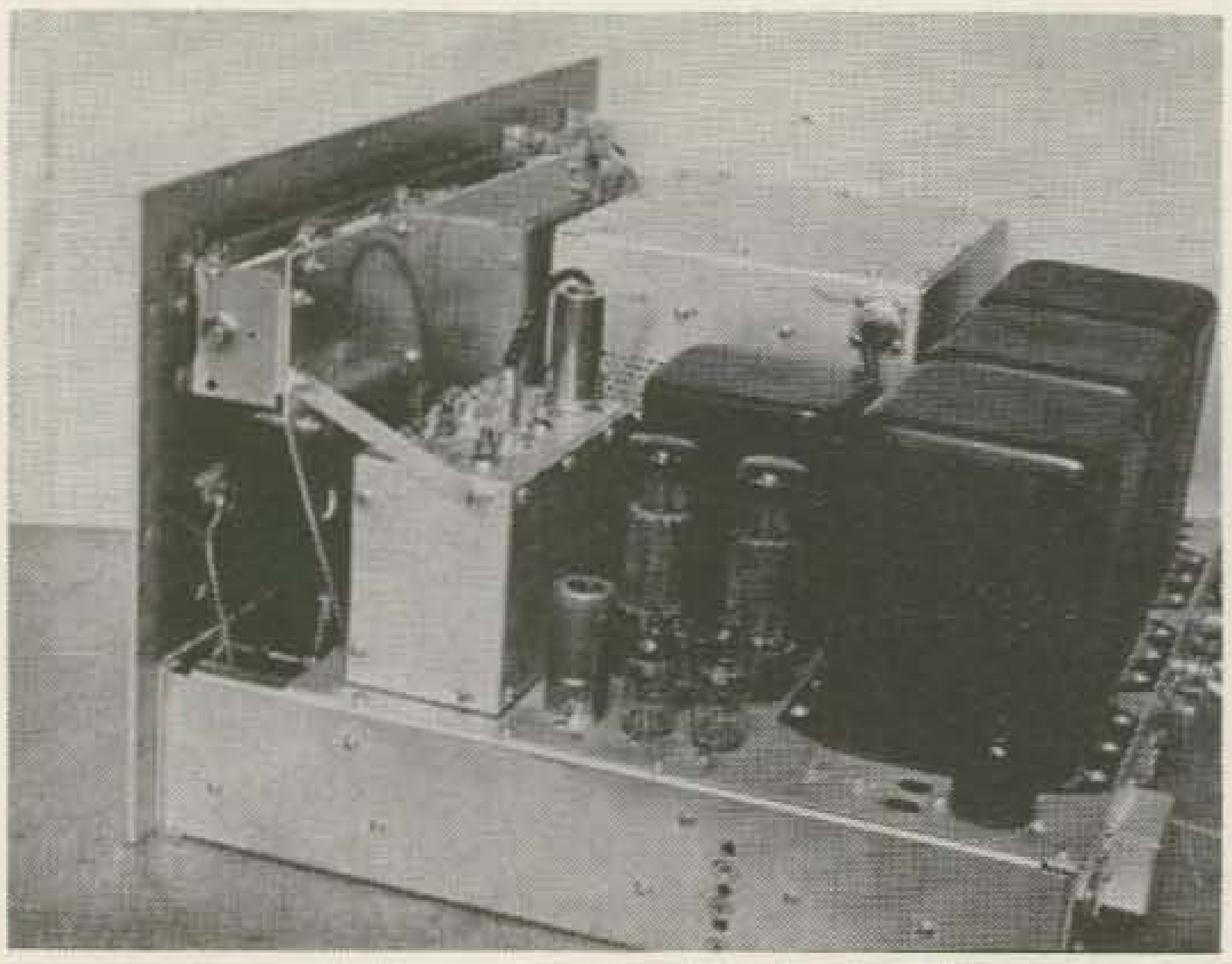
If there is any doubt the mechanics involved in a radio frequency oscillator are a factor in frequency stability, one needs only to loosen or tighten screws in the oscillator, or remove a shield cover, to be convinced. Here's what this is leading up to:

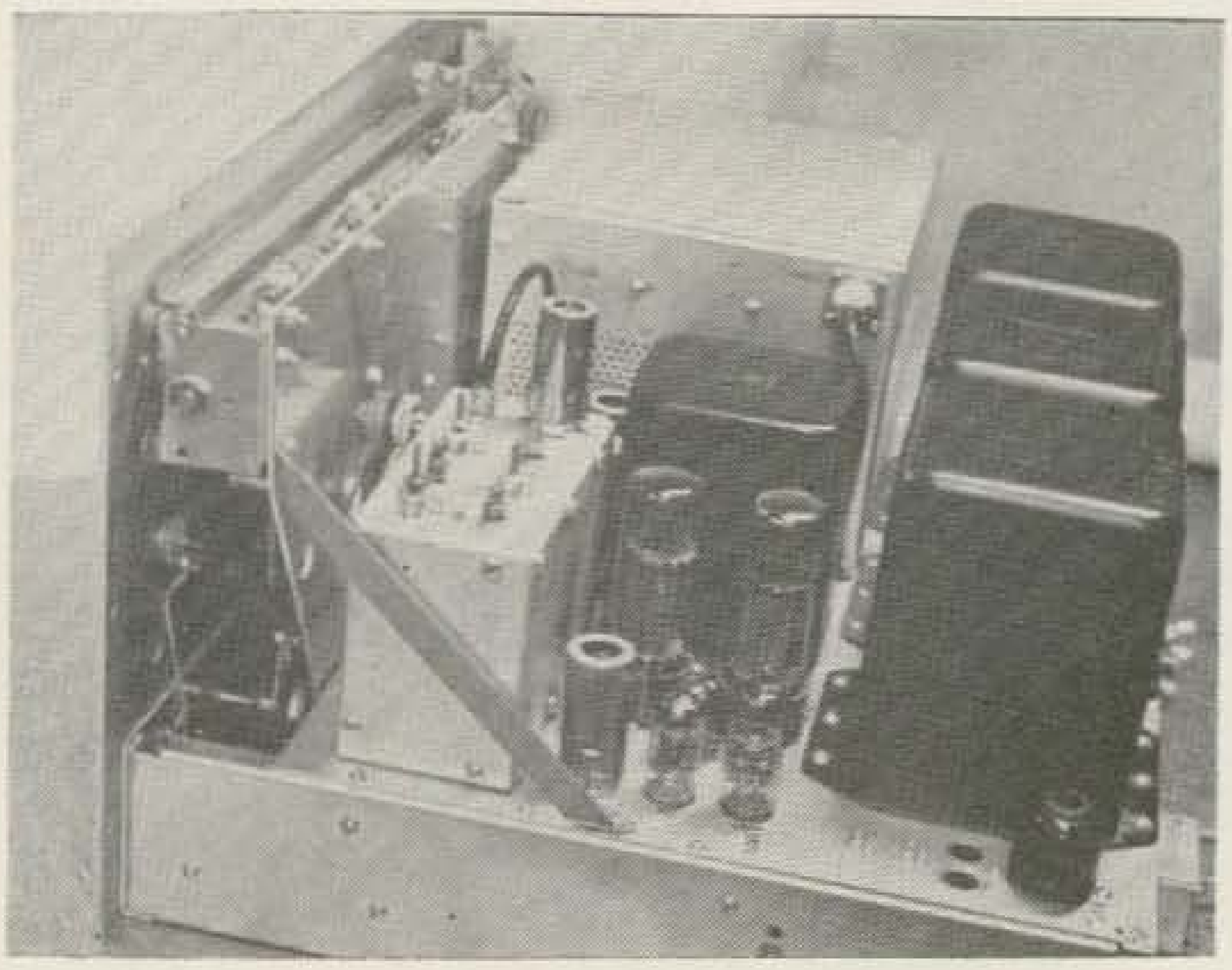
During the last several months I had a great deal of trouble with a kit VFO. It would be stable as a rock one day, and key cleanly, then chirp like a meadow lark the next. Many times I thought I had found the gremlin and eliminated it, only to learn a few days, or weeks later, that I hadn't. My first suspicion was a bad capacitor, and I changed them one at a time in order to determine the faulty component. Each time I changed one, and put the VFO back together, the chirp was gone, and I thought that was it, for a few days.

Noting that exerting any force on the band switch knob affected the frequency slightly, and sometimes caused a chirp, I suspected the band switch. Rapidly switching from band to band would sometimes eliminate the chirp for a while. So, I changed the band switch—and the chirp was gone—for about a week.

Once when the rig was on the lab bench, it was noticed that the key jack had a cracked spring. Feeling a bit foolish, I changed the jack, put the VFO back together without changing anything else—and the chirp was gone. About two weeks later the little canary was back again. The trouble was intermittent, and the tendency was to leave the rig in service until the trouble became persistent enough to locate. But I like to have a clean signal, and took the VFO apart once more, this time with the determination that it would be fixed, or R.I.P.

Now the VFO is fixed, and the cause of the trouble was determined. It is so fundamental in design consideration that it may be a fault in other kits of this type. The fault proved to be mechanical. A brace from the front sub panel to the top of the VFO housing was the culprit. This is why every time I took the VFO apart and changed a component it usually didn't chirp again for a while. I merely had relieved the mechanical stresses being





transmitted to the top of the VFO housing. The brace was a good mechanical coupling to the panel on which the spring loaded frequency dial roller was mounted. This exerted varying stresses on the panel, and transmitted them efficiently to the VFO. This unstable stress condition caused critical frequency stability, and chirps.

The brace referred to is shown in Fig. 1. Removing the screw "A," and bending the brace back out of the way was all that was needed to give the VFO stability, free from chirp, or frequency shift.

With the many years of background that put me in contact with this basic design concept, I was thoroughly ashamed for not having suspected the cause earlier.

Since removal of the brace made the front sub panel a bit wobbly, a longer one was made. A hole was drilled in the chassis plate, and the brace attached at the lower end with a sheet metal screw. This is a change I would recommend to all those who have this, or simiilar, unit and are having trouble. Fig. 2 shows the new brace in position. It was made of ½" wide 3/32" stainless steel, that I happened to have in the junk box. Aluminum would do as well, and be easier to work.

Recently, I put the old brace back for a check. You guessed it—chirp! Now it is gone to stay, and I'll not forget that mechanical design is important around a VFO.

As a bonus, I learned that substitution of *molded* silvered micas for the *dipped* micas in the VFO gave noticeably cleaner keying and better frequency stability. The reason hasn't been determined, but you might like to try it.

Letters

Dear Sir,

Reference the article on Selected Circuits by W4WKM on page 46 of the June issue of 73. As shown the VOX assembly will not work. The 200 volts, pin 4, input is shorted to the ground at the cathode, pin 3, of V18. The 200 volt line should cross the ground line and connect to the 3.3 K resistor R167. Good articles, keep 'em coming.

Ken Mulkey WϕVPH/4

Dear Wayne:

I wish you would get rid of this guy Gridley K6JHJ. A couple of months ago I bought some 85kc. if trans. and was wondering what they would do in a back to back hookup. Then here he comes along with the same thing in his Q5-er.

After reading the article on the panadapter I got to thinking about building a sweep osc. using a diode to change freq. Now he comes along with the "New Broom." How can I learn anything with him always figuring these things out for me?

Andrew R. Becker WϕNVM/KGI

73 tries out the

Irving Electronics Preverter

Irving Electronics has quietly been building up a collection of printed circuit boards and small kits which come as quite a surprise to the fellow who happens to notice the small Irving ads and sends for a catalog. Pappy, W5UB, has little printed circuit kits for almost every article printed in a ham magazine (including 73) where a circuit board is specified or where a circuit board would prove beneficial. He has a lot of other kits too. His most recent gadget is a completed unit, something new for Pappy, a little two meter or six meter transistorized preamplifier.

This $14.95 (postpaid) Preverter, as he calls it, operates entirely from twelve volts. This makes it very handy for mobile installations as well as remote applications such as installation at the antenna as a booster to make up for feedline losses. We sent for the two meter model and found that it was small enough to cram into the back of the Gonset II transceiver. It is 2¾" x 2⅛" x 1⅝". The Gonset is easily modified for this preamplifier.

The installation took only a few minutes. The antenna coax is removed from the receiver and run through the Preverter (this requires a connector change). The 12 volts for the Preverter was borrowed from the Gonset B+ line

via a dropping resistor. A 9 volt battery was tried and worked just as well. The results were a pleasure, though they brought on difficulties. We found that now we coud hear many stations that didn't come through before and that we really needed a linear to boost our signal to keep up with the improved reception.

The Preverters, all wired and set to go, are available from better dealers or direct from Irving, Box 9222, San Antonio 4, Texas.

Letters

Wayne,

Now that 73 Magazine has been out for a year and a half, I thought I'd write to tell you how much I enjoy it. Thinking back over these past twenty-one months, some particular articles come to mind as being exceptionally good. These include W70E's literary works, ALL of your editorials, W2ZGU's How to be an Amateur, W2BNW's From My Side of the Counter, and your excellent technical articles. Talking of technical subjects, I hear that K2PMM is coming out with a shoebox VHF receiver with continuous tuning from 140 to 5000 megacycles, with 60 db gain on 140 megacycles, 40 db gain on 5000 megacycles, and better than a 3.5 noise figure. Will it make the september issue?????

Morgan Spencer K5CHH

73 Magazine:

An enormous improvement in the 75S-1 receiver for A.M. is simply made by replacing T7 & T8 (278-0278-00) with comparable transformers from the 75S-3. These are T4 & T5 (278-0281-00) which cost $3.36 each from Collins—Two are needed.

You can check your 75S-1 by turning on the crystal calibrator, switch to AM, dial 7100 kc., adjust Preselector for S9 signal. Now see how wide your pass-band is by tuning each side of center to dip the S-meter one unit for each 6db. The new transformers will give:

6db	3.2 kc	old 4 kc
12db	4.2 kc	
18db	5.0 kc	
24db	5.8 kc	
60db	10.2 kc	old 20 kc

There is also a very worthwhile increase in gain and hence in the speech from the loudspeaker.

Edgar V. Seeler W1BDF

Dear Wayne,

I will say that your magazine is more fun than the other two together. I feel that ham radio is for me, too, as well as for electrical engineers, space scientists and mathematical geniuses . . . you see, I am but an old bricklayer, 51 years, but when I strap on the phones I become ageless with the thrill of a DX QSO. This ham radio keeps a fellow busy learning, but is sure generous with her rewards. Thanks for a fine magazine, one which does not cater to one group exclusively.

How about a car emblem? Might be a snazzy looking "73" . . . something to extend a greeting to a fellow ham.

Ralph Knoblauch WV6VNF

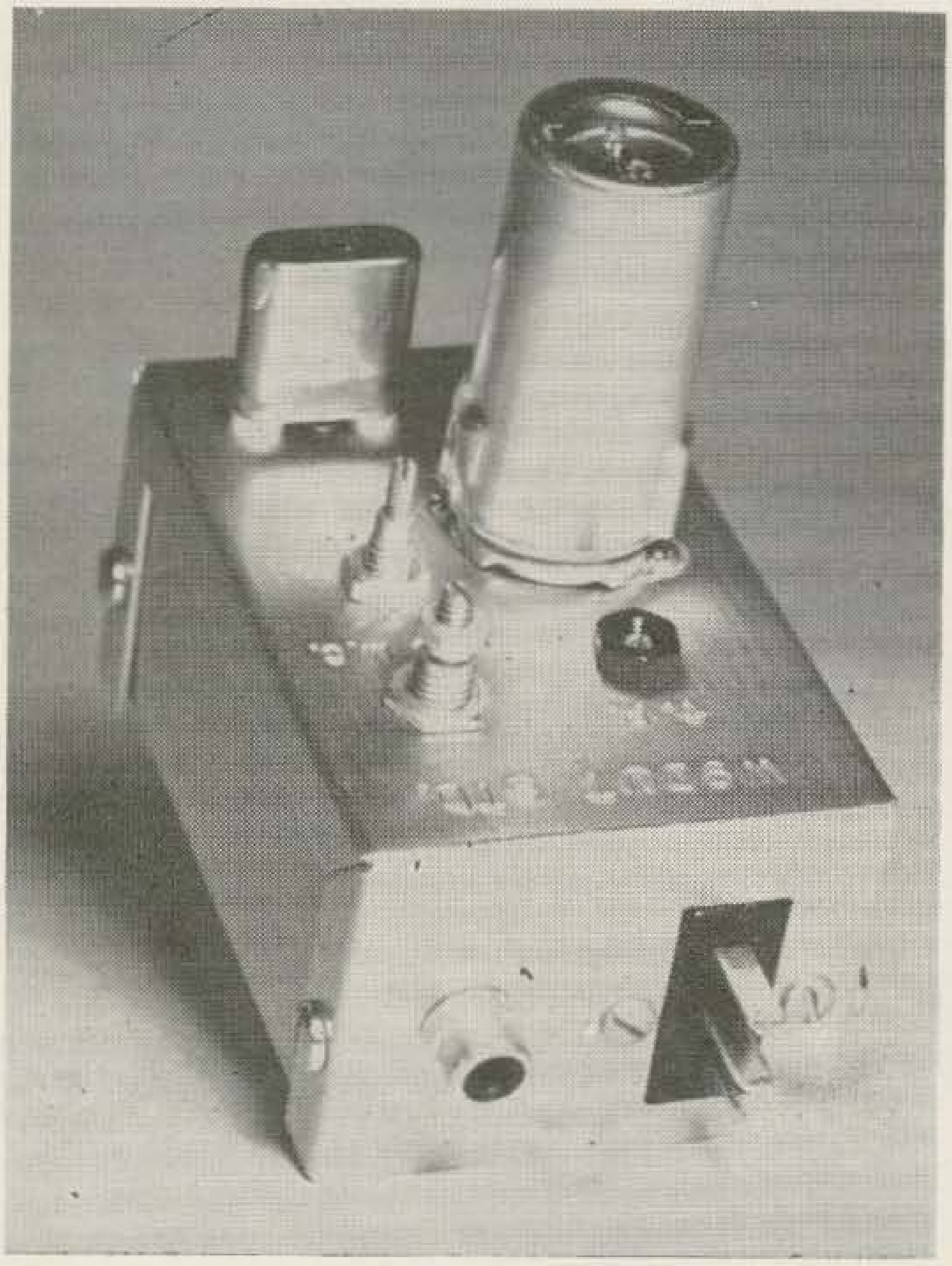
Call letter license plates are doing the emblem job, I suspect, but if anyone would care to design something we might have it made up by one of the sports car emblem manufacturers and make it available. Any designers in the crowd? Wayne

Tone Modulated Crystal Standard

John Wonsowicz W9DUT
4227 North Oriole Avenue
Norridge 34, Illinois

FREQUENCY calibration is very important especially when operating near the edge of the band. It is equally important for accurate setting of the dial in an all band communication receiver used as a tunable *if* strip in conjunction with a crystal controlled converter in the VHF bands. Receivers used in such applications, even if they are calibrated accurately on the lower bands, do not give assurance that the dial is right on the spot due to crystal tolerance in the converter oscillator. Therefore, to be sure, the calibration should be made at the VHF frequency with a known crystal oscillator or generated harmonics which are a multiple of the time signals transmitted by WWV.

Most receivers used with converters are commercial communication receivers with built-in beat frequency oscillator and zero beating with proper frequency standards is rather simple. But a large number of hearing-aids that are also used in this mode of operation do not have BFO's and locating unmodulated signals becomes a problem. To overcome these disturbing obstacles, the little gimmick monickered TMCS was developed, and here is what it will do for you:



Produce signals every one megacycle from 1 mc up to 225 mc and a bit beyond.

Tone modulated signals that can be received on all receivers including those that have no BFO.

The fundamental crystal can be adjusted to zero beat with WWV.

One tube arrangement which means inexpensive and simple to build.

Circuit

The circuit is straight forward and simple. One half of the 6J6 is used as an ordinary crystal oscillator using fundamental crystal of one megacycle. This crystal is shunted by a variable capacitor of 35 mmfd (MAPC-35) and is used to set the crystal oscillator exactly on WWV frequency. The plate circuit of this triode is tuned to one megacycle and the rf energy is coupled through the 50 mmfd ceramic capacitor to the grid of the second triode. This half of the 6J6 is the harmonic generator that extends the one megacycle increments to over 225 mc. The plate of this harmonic generator is tuned to 150 mc, but this frequency is not critical. Any frequency of 100 to 150 mc may be used keeping in mind that the higher the resonant frequency of L2, the higher will be the upper limit of usable harmonics, but the harmonics between the one megacycle osc. and L2 will be somewhat weaker.

Tone modulation is obtained by the use of a relaxation oscillator, as shown on the schematic. By charging the .002 ceramic capacitor

C1 through the one meg. resistor R1 and discharging it through NE-2 neon bulb, a tone of about 2000 cycles is obtained, depending on the tolerance of the components in the associated circuit.

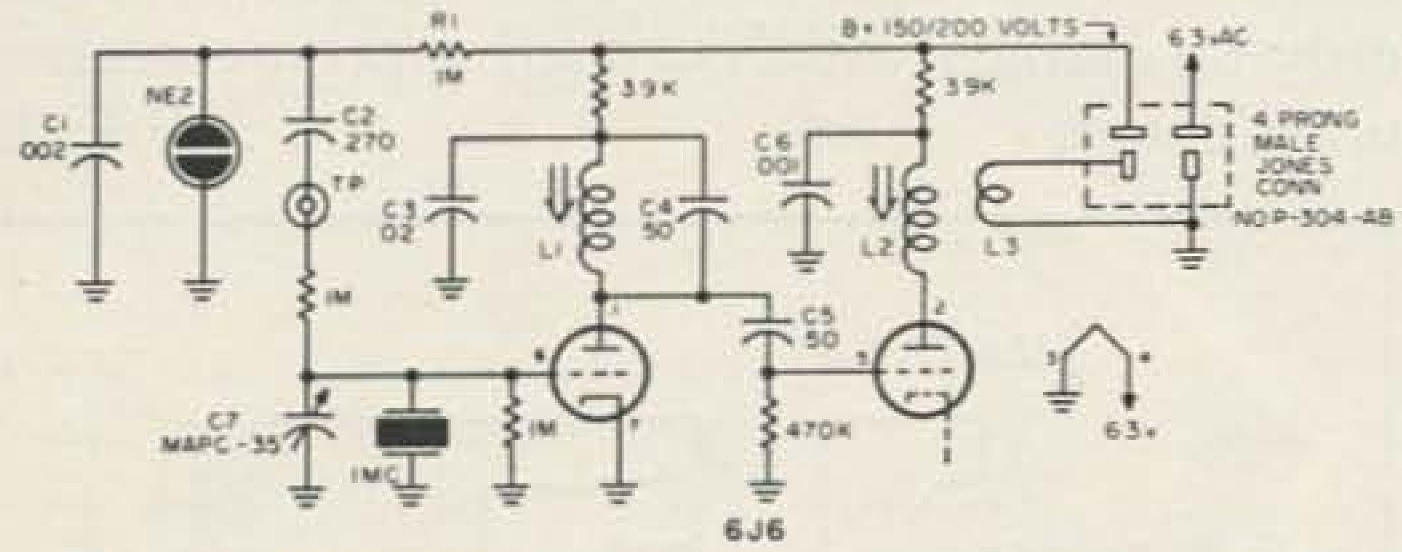
Before starting construction, a word of caution might be in order at this time in regards to the NE-2 glow tube. Some of these little fire flies may not function properly with the values given, due to larger spacing of glow elements in them. If you happen to get one of these just lower the value of the one meg. resistor and slightly increase the value of the .002 charging capacitor to maintain the same tone. Pitch is not too important in a device of this kind just so it is somewhat pleasant and the constructor may want to experiment with different combinations of RC values to suit his fancy.

Construction

The unit can be built in two of the designs shown in the photos, but the preferred design is the vertical plug-in unit which seems to adapt itself a little better in most applications.

All parts used in this project are standard and can be obtained in most electronic stores over the counter. The only mechanical work required to put you in business is the punching and drilling of the mini box used as the enclosure for the small components as well as the necessary chassis. The parts lay-out is not important as long as they fit into the box, so a lay-out drawing is not necessary. However, identification of components is in the following order.

The front view shows the one megacycle crystal on the top side of the box. To its right is the one megacycle slug tuned coil, obtained from J. W. Miller Co., and carries a number 4313. Just behind this coil is L2 which is wound on J. W. Miller ceramic slug tuned form and tuned to 150 mc by the aid of a grid



C1 to C6—RMC discaps ceramic capacitors.
C7—Hammarlund MAPC-35.
All resistors ½ watt.
L1—Miller No. 4513 (190 to 330uh adjustable).
L2—4T #22 space wound to ½" on Miller Ceramic coil form No. 42 A 000CBI (⅜" x 1").
L3—2T #26 plastic, close wound on cold end of L2.
Tip. Johnson nylon tip jack No. 105-251-1.
Mini Box—Bud CU2100-A 2¾" x 2⅛" x 1⅝".

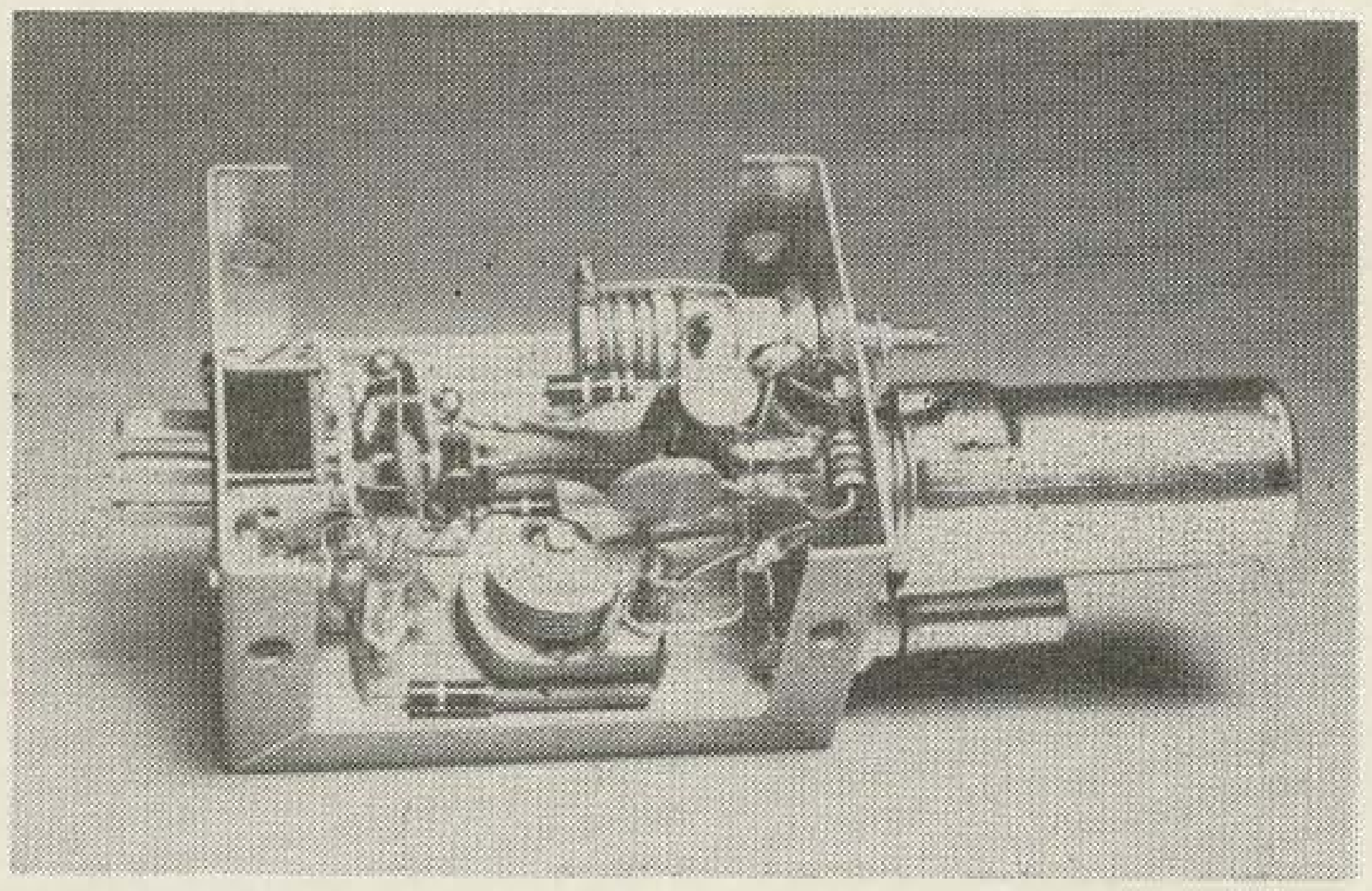
dipper. To the left of this coil is the dual triode 6J6 electron tube with its shield. Below the crystal is the Hammarlund MAPC 35 mmfd frequency adjusting capacitor. Just to its right is a test jack for checking the intensity of the oscillator and the tone modulator. The bottom of the unit has the 4 prong jones male connector for power input and modulated rf output. A separate shielded rf output connector can be used if so desired and an arrangement similar to the horizontal unit shown can be used.

The photo of the inside view shows the MAPC capacitor, to the left of it is the NE-2 relaxation oscillator bulb which is used to tone modulate the crystal standard. To the left and slightly above is the jones connector. The 150 mc multiplier coil can be seen in the upper right hand.

Calibrating and Application

The TMCS can be calibrated on any of the WWV time signal frequencies of 5-10-15-20 and 25 mc in the following manner.

Tune the communication receiver to WWV



and couple the output of the TMCS to the receiver's antenna. Zero beat the time signals with the crystal oscillator by rotating the MAPC capacitor until a slight null is recognized, denoting the center of the carrier. If difficulty is encountered in locating the null, the relaxation oscillator is too strong and should be slightly de-coupled by lowering the value of the 270 mmfd coupling capacitor. The value of this capacitor is chosen so that the tone modulation is strong enough to identify, but not strong enough to cause frequency shift.

Using the TMCS standard with crystal controlled converters, simply connect the rf output of the standard to the antenna input of the converter and tune the previously calibrated communication receiver in the proper section of the band used as the tunable *if*. The modulated signal you will hear every megacycle will appear to be off calibration on the receiver's dial. This degree of differential is caused by the % tolerance of the crystal used in the converter oscillator and is normal in general practice. However, knowing this discrepancy, proper correction can be made to the receiver's dial for accurate frequency spotting.

Now that you have calibrated your receiver and your converter, you are ready to commit yourself on the accuracy of interpreting the correct VHF frequencies.

. . . W9DUT

The Simplest Squelch

George Thurston W4MLE

73 has already provided its readers with a masterly survey of the subject of squelch circuits for receivers (73, Dec. 1960) but the article included two curious oversights.

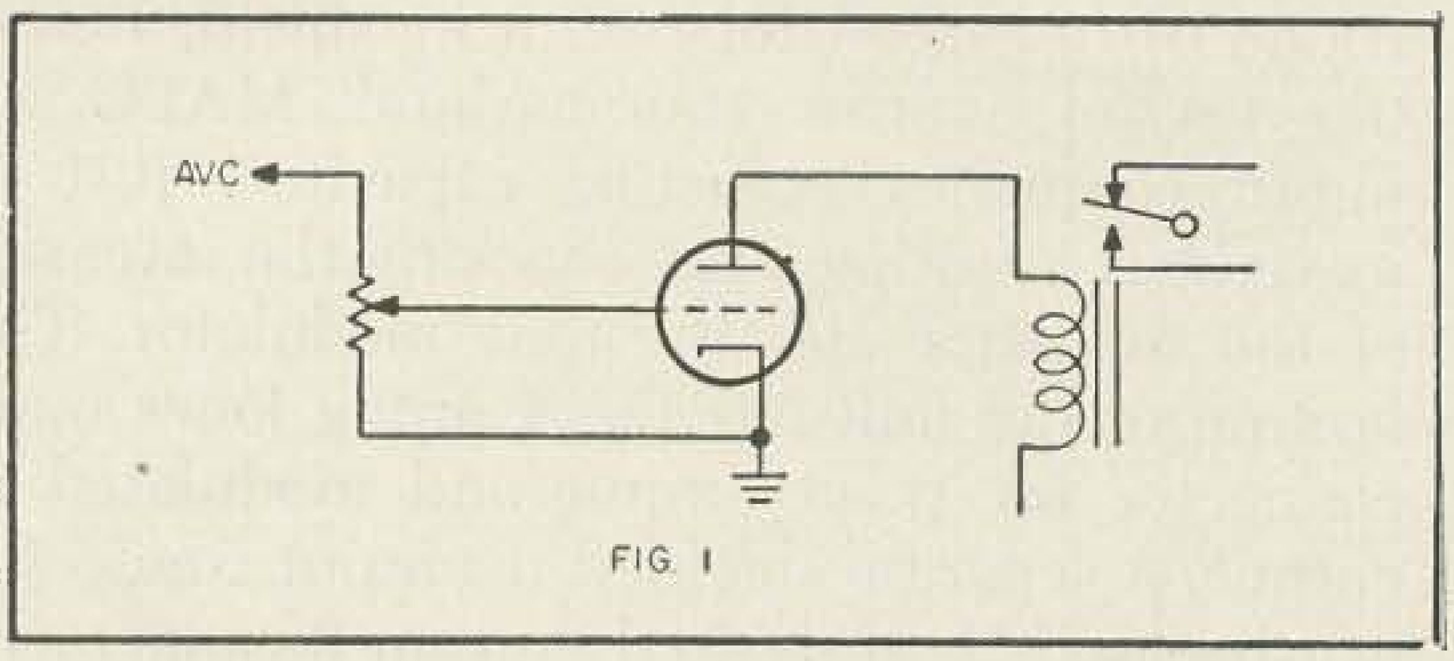


FIG. 1

The circuit shown for the SCR-522 relay squelch (Fig. 1) will, it is true, degrade the receiver AVC operation because of the extra load resistor. However, a very simple modification of this circuit results in an equally simple circuit without any circuit degradation, and with full control of the squelch threshhold. (Fig. 2).

R-1 regulates the bias on the tube and hence the point at which the relay will just pull in. Any increase in this bias will further reduce plate current, causing the relay to drop out and the squelch to "open."

The other interesting oversight is that in the same issue, Roy Pafenberg had an interesting article on "The Multivibrator in Amateur Vox Circuitry." The only difference between Vox and Squelch is that the relay (or other circuits) operate different things. One turns on a transmitter, the other turns on a receiver. Put it in a transmitter, it's VOX. Put it in a receiver, it's squelch.

Every advantage Pafenberg claims for the Schmidt trigger for VOX operation is equally advantageous for squelch. The Schmidt trigger squelch should be especially helpful in areas where received signals are likely to be weak, and fading but where positive squelch action is desired. In noisy locations, this sensitivity to small changes in demodulator bias could be undesirable. But like all squelch circuits, the tripping level can be adjusted to suit any situation and the Schmidt could be set to trigger only on signals which exceed a pre-determined noise level. . . . W4MLE

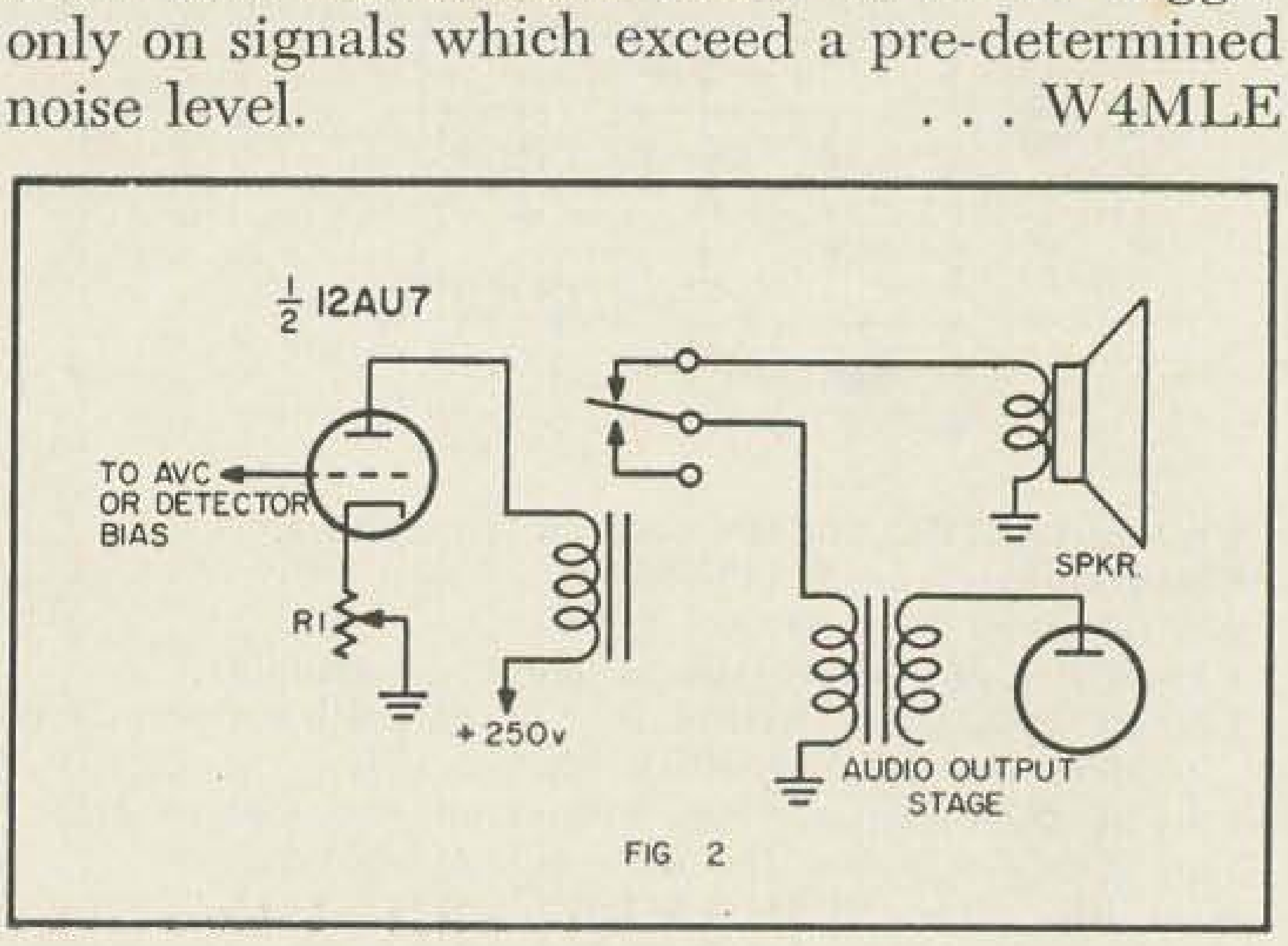


FIG. 2

GET MORE POWER FOR YOUR TRANSCEIVERS FROM TOPAZ

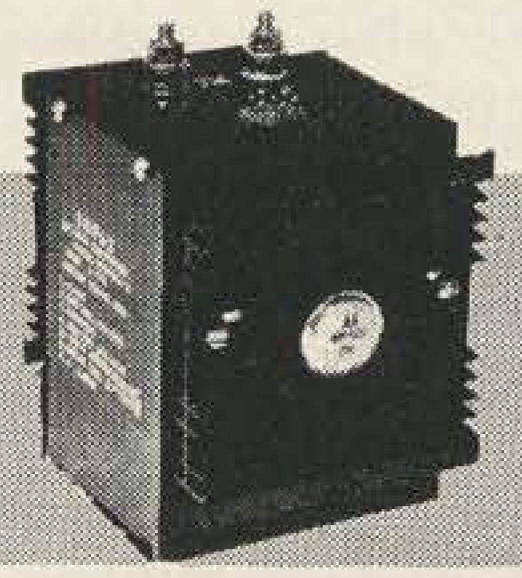
TOPAZ POWER SUPPLIES FOR MOBILE, PORTABLE, FIXED STATION UNITS DELIVER MORE WATTS PER DOLLAR THAN ANY COMPARABLE UNITS!

New concepts in power supply circuitry* enable Topaz Power Supplies to deliver more watts per dollar than any comparable unit, and every unit is unconditionally guaranteed for six months.

TOPAZ MANUFACTURES POWER SUPPLIES TO FIT PRACTICALLY EVERY TRANSCEIVER, MOBILE, PORTABLE, FIXED STATION.

Topaz 12 volt units deliver 250 & 260 watts. from $79.50

Topaz 6 volt units deliver 250 & 260 watts. from $114.95



Topaz AC units deliver 350 watts. from $94.95

12 V POWER SUPPLIES

CYGNET-12 model C10WDG
Offers 600 VDC @ .415 A, 300 VDC @ .5A, 0-120 VDC adj. bias and primary power relay. This unit designed for Swan and adaptable to Collins, Sonar and other transceivers. General Specs. and features: 11-15 VDC input, 85% efficient, wt. 7 lbs., only 3 15/16" x 4⅜" x 6⅛", momentary short circuit protection, epoxy fiberglass printed circuit board, fused regulated drive. Unit is transistorized and "floating." **$99.50**

SNOOPER-12 model C10W
Offers 600 VDC @ .415 A, 300 VDC @ .5A, 120 VAC at 400 CPS & 50 VA sq. wave; other features and genl. specs. same as above. For Swan, Collins and Sonar Transceivers. **$79.50**

DEACON-12 model C10WDD
Offers 650 VDC @ .385 A, 270 VDC @ .13A, primary power relay, hi B+ relay, LC filter. Other features and genl. specs. same as above. For Gonset G-76 and others. **$119.95**

HUSTLER-12 C10XDG 260 w
Offers 800 VDC @ .325A, 280 VDC @ .210A, —50 to —90 VDC, adj. bias and primary power relay, LC filter. Other features and genl. specs. same as above. For Collins KWM-1 & KWM-2, Sonar, Swan and others. **$134.95**

ECHO-12 model C10WG
Offers 600 VDC @ .415A, 300 VDC @ .5A, 0-120 VDC, adjustable bias. Other features and genl. specs. same as above. For Swan, Collins, Sonar and other transreceivers. **$89.50**

6 VOLT MOBILE POWER SUPPLIES FOR VW's PORSCHES, OTHERS. 6 V CARS

CYGNET-6 model C10WDG-6
Offers 600 VDC @ .415A, 300 VDC @ .5A, 0-120 VDC, adj. bias and primary power relay. This unit designed for Swan and adaptable to Collins, Sonar and other transceivers. General specs. and features: 6 —7.5 VDC input, 75% efficient, wt. 9 lbs., only 4¼" x 6⅜" x 5⅞", momentary short circuit protection. Epoxy fiberglass printed circuit board, fused, regulated drive. Unit is transistorized and "floating." **$124.95**

SNOOPER-6 model C10W-6
Offers 600 VDC @ .415A, 300 VDC @ .5A, 115 VAC, 400 CPS & 50 VA sq. wave. Other features and genl. specs. same as above. For Johnson Viking Mobile and Elmac. **$114.95**

HONKER-6 C10XL-6 260 watts
Offers 800 VDC @ .325A, 280 VDC @ .210A, —50 to —90 VDC, adj. bias and primary power relay. Other features and genl. specs. same as above. For Swan, Collins KWM-1 & KWM-2, Sonar and other transceivers. **$138.95**

DEACON-6 model C10WDD-6
Offers 650 VDC @ .385A, 270 VDC @ .13A, primary power relay and hi B+ relay. Other features and genl. specs. same as above. For Gonset G-76 and others. **$138.95**

HUSTLER-6 C10XDG-6 260 w
Offers 800 VDC @ .325A, 280 VDC @ .210A, —50 to —90, adj. bias and primary power relay. Other features and genl. specs. same as above. For Collins KWM-1 & KWM-2, Sonar, Swan and other transceivers. **$154.95**

NOW TOPAZ HAS DEVELOPED AN AC FIXED STATION POWER SUPPLY!

HUSTLER-AC C10XDG-AC BUILT-IN SPEAKER
Offers 800 VDC @ .44A, 280 VDC @ .21A, —50 to —90 VDC, adj. bias, LC filter. This unit designed for Collins, Sonar, Swan, Drake and other transceivers. General Specs. and features: 117 VAC 60 CPS input, wt. 30 lbs., Size 10¼" x 10" x 5¼". Fused, attractive cabinet. **$104.95**

ECHO-AC model C10WDG-AC
Offers 600 VDC @ .58A, 300 VDC @ .6A, 0-120 VDC, adj. bias. Has space available for speaker installation. Other features and genl. specs. same as above. For Swan, Collins, Sonar, Drake and others. **$94.95**

DEACON-AC, C10WDD-AC BUILT-IN SPEAKER
Offers 650 VDC @ .54A, 270 VDC @ .13A. Other features and genl. specs. same as above. For Gonset transceivers and others. **$104.95**

Order these Topaz power supplies at your nearest dealer. If unavailable, order factory direct.

ATTENTION DEALERS:
Write for full dealership information.

---

*Patent pending.

TOPAZ

TRANSFORMER PRODUCTS INCORPORATED
3802 HOUSTON ST., SAN DIEGO 10, CALIF. • CYPRESS 7-4815

Transmitter Design

Jim Kyle K5JKX

IN an earlier technical article, we looked into the basic techniques of amplifier circuit design and showed how to put together a Class A amplifier in a matter of minutes.

But Class A amplifiers are primarily confined to audio and to receiver circuits; to make complete the design of a transmitter, we also have to come up with some Class C amplifier stages. The technique of Class C circuit design differs drastically from that for design of Class A stages, but is no more complicated.

Before going into the detailed procedure of design, let's take a look at the Class C amplifier and see how it works. A good starting point is the conventional Class A circuit.

In this circuit, the tube acts like a variable resistor; incoming signals change the resistance of the tube, and this change in resistance appears as a change of voltage across the tube's load resistor because the tube resistance and the load resistor are in series across the power supply. The simplified equivalent circuit is shown in Fig. 1.

Since the signal will suffer distortion if the tube's grid ever goes positive, the tube is "biased" with negative voltage on the grid to ensure that the incoming signal will never drive the grid into the positive region. This bias is chosen so as to make the tube's gain on positive-going half-cycles of input signal the same as the gain on negative-going half-cycles, or in other words, at a point so that equal changes in grid voltage on either side of the bias point will produce equal changes in plate voltage.

Such a circuit is linear, in that the output signal will be a faithful replica of the input signal although stronger. However, plate current must always flow in this circuit—and in the absence of an input signal, this plate current does nothing but heat the tube. For this and related reasons, the Class A amplifier cannot produce efficiency greater than about 50 percent. Half or more of the input power is wasted.

This waste of power is necessary to obtain linear operation; however, an rf power amplifier need not be linear. Any distortion introduced by the tube will be ironed out by the following tank circuits.

Maximum efficiency is obtained when current flows through the tube as a series of short pulses, with relatively long periods between pulses during which no current flows. Fortunately, the pulses which provide best efficiency are also best suited to driving a tank circuit, and a Class C amplifier is one which is set up to produce such pulses.

Such a circuit, in simplified form, acts like a resistor in series with a switch (Fig. 2). When the switch is closed, current flows through the resistor and is limited only by the value of the resistor and the voltage of the battery. When the switch is open, current flow is zero. Thus, the switch is like the variable resistor of the Class A amplifier, in that it controls the flow of current through the load resistor.

In practice, the tube of a Class C amplifier is made to act like a switch. When the tube grid is made so negative that plate current ceases to flow, the tube is electrically the same as an open switch. When the grid bias is reduced enough to allow a large flow of plate current, the tube is similar to a closed switch (plus a small resistor producing some voltage

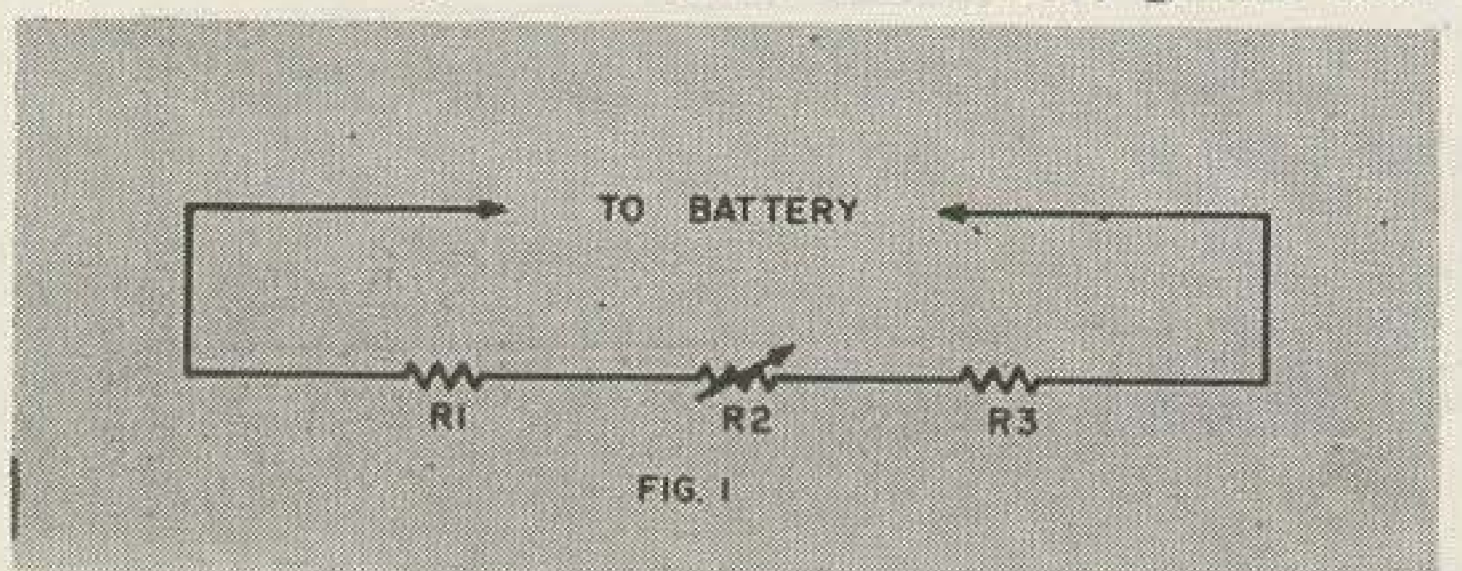


Fig. 1 Class A Circuit.

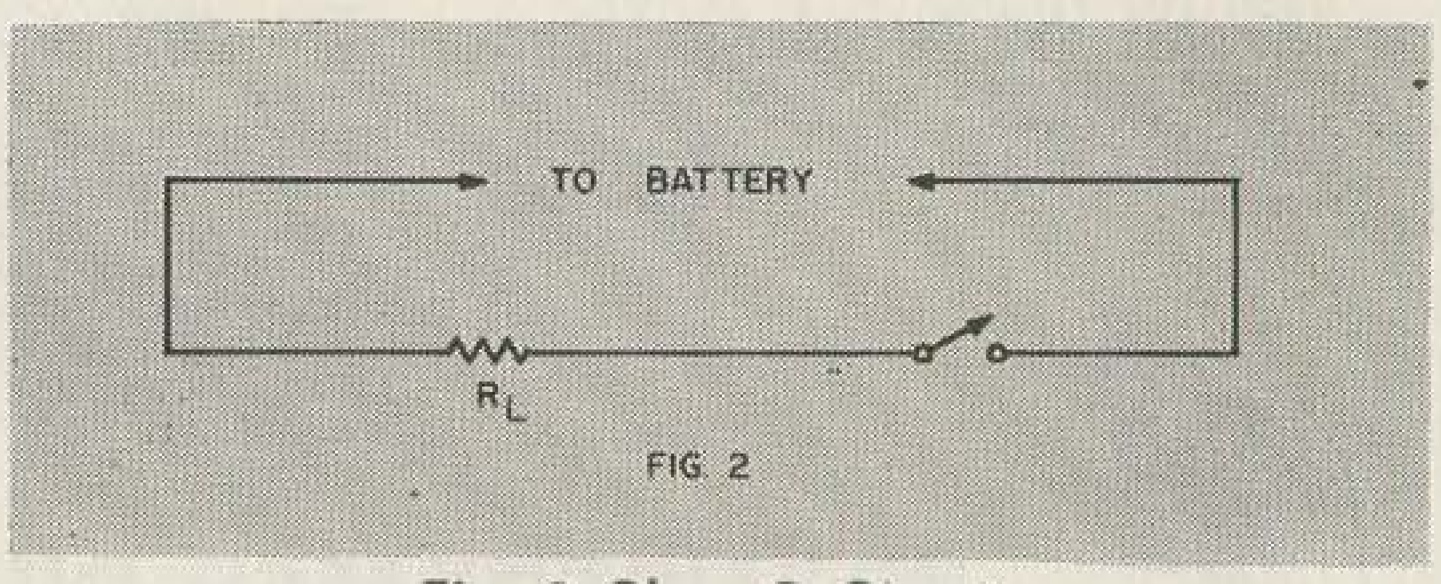


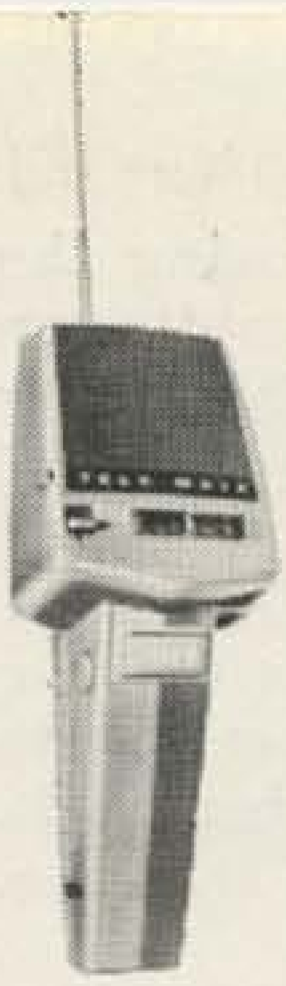
Fig. 2 Class C Circuit.

GOLD LINE MOBILE GENERATOR NOISE FILTER

Eliminates hash and generator whine while charging in any amateur band between 80 and 6 meters. Handles up to 30 amps. Connects in series between armature terminal of generature and "A" terminal of voltage regulator. Suppression adjustment is made with screwdriver with engine running. Specify unit desired for 6, or 11 meter bands. **$3.49 ea.**

TELEMATE, 2-WAY CITIZENS BAND WALKIE-TALKIE

plus Transistor Radio

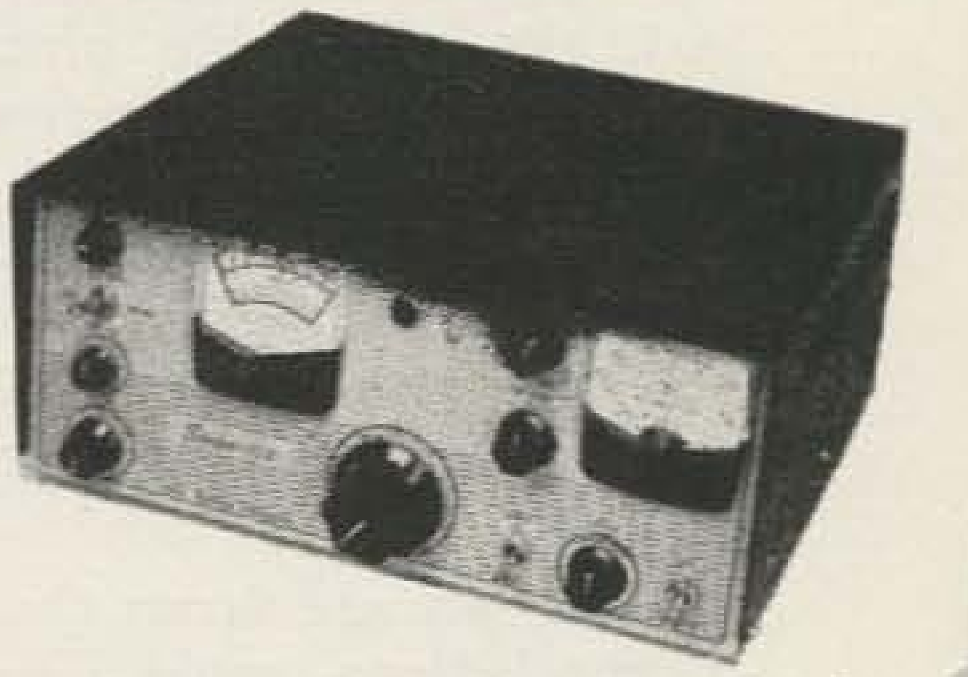


Precision, xtal controlled transmitter and receiver plus AM superhet B'cast band receiver. 150 mw audio power output. Receiver sensitivity 1 microvolt. 97 mw final input to xmtr. 9 transistors, 1 diode and 2 crystals used. Weight: 14 oz. Retractable whip antenna. No license required. Complete with belt clip and desk stand. **$99.95 pair — $51.95 single unit**

SUPEREX HAM HEADPHONES

Full comfort even after many enjoyable hours of continuous use. Superb comfort even for eyeglass wearers. Crisp, distortionless reproduction and high sensitivity allows you to single out that weak signal and hard to reach station. 600 ohms impedance, completely adjustable head harness. **$24.95**

SWAN MOBILE SSB TRANSCEIVER



3 tunable models available: SW175 (3.8 to 4.0 mc); SW140 (7.2 to 7.3 mc); and SW120 (14.2 to 14.35 mc). See QST Aug. '62, pp. 52-54 for details on unit. 180 W. PEP, crystal lattice filter, 3kc bw on Transmit/Receive, exceptional mechanical, electrical and thermal stability. Receiver sensitivity less than 1 microvolt. Tuning controls are common to Transmit/Receive. **Transceiver with mounting bracket. Specify model. $275.00**

SW12A — 12 VDC mobile power supply. $99.50

Shown approx. actual size.

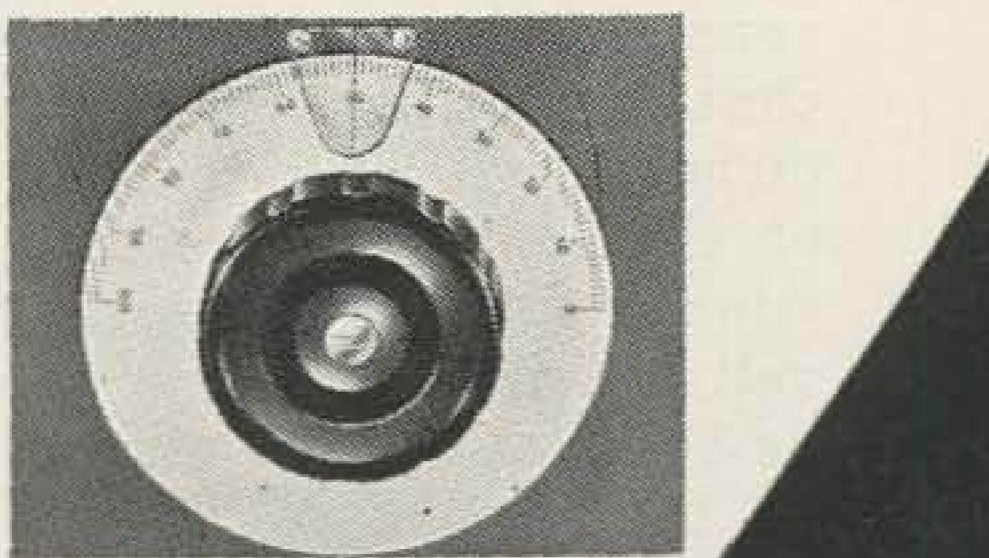
PRECISION PLANETARY-VERNIER for exceptionally fine tuning

Superb craftsmanship by Jackson Bros. of England. Ball bearing drive, ¼" dia. Shaft 1⅛" long, 6:1 ratio. Vy FB for fine tuning. Easily adaptable to any shaft. Comparable value $5.95. **Amateur net $1.50 ea. 10 for $13.50**

BULLSEYE BUYS AT ARROW

hand-picked for hams by hams...

PRECISION BALL DRIVE DIAL



Another superb product of Jackson Bros. of England. 4" dia. dial with 6:1 ball drive ratio. Fits standard ¼" shaft. For that velvet touch... **Amateur net $3.95**

VERSATILE MINIATURE TRANSFORMER

Same as used in W2EWL SSB Rig—March, 1956 QST. Three sets of CT windings for a combination of impedances: 600 ohms, 5200 ohms, 22000 ohms. (By using center-taps the impedances are quartered). The ideal transformer for a SSB transmitter. Other uses: interstage, transistor, high impedance choke, line to grid or plate, etc. Size only 2" h. x ¾" w. x ¾" d. New and fully shielded.

Amateur net $1.39. 3 for $3.49. 10 for $10.75

MAIL ORDERS PROMPTLY PROCESSED. SAME-DAY SHIPMENT FROM STOCK.

SEND FOR FREE CATALOG

Trade-ins welcomed.

TO SAVE C.O.D. CHARGES, PLEASE INCLUDE SUFFICIENT POSTAGE WITH YOUR ORDER. ANY EXTRA MONEY WILL BE RETURNED.

ALL PRICES F.O.B. N.Y.C.
Arrow's Export Dept. Ships To All Parts Of The World!
Prices Subject To Change Without Notice.

ARROW ELECTRONICS, INC.

65 Cortlandt St., N.Y. 7, N.Y. • 525 Jericho Tpke., Mineola, N.Y. • 225 Main St., Norwalk, Conn.
212 — DIgby 9-4730 • 516 — Pioneer 6-8686 • 203 — VIctor 7-5889

drop across the tube). Thus, by choosing the proper grid bias and signal input voltages, the tube may be made to operate only during short parts of the incoming signal cycle, and to rest the rest of the time.

A number of factors enter into the design of a Class C amplifier. These factors may be roughly classified into those which pertain to the type of tube used, and those which pertain to the parts of the circuit external to the tube. Let's examine the tube factors first.

Important tube factors include the plate voltage, the plate current, the screen voltage (if applicable), the grid bias, the power output, the allowable plate dissipation, and the amount of driving power required. These factors are all interrelated for any individual type of tube; Table I lists the key factors for a number of popular tube types. The factors for unlisted types may be obtained from the tube's characteristic curves and associated information.

You can see from the table how some of the interrelations work. For any specific screen voltage, for instance, a given voltage on the grid will allow a certain plate current. If either screen or grid voltage is made more positive while the other is kept constant, plate current will increase. At the same time, minimum plate voltage (the voltage across the tube in its closed-switch condition) will also increase. The power represented by this minimum plate voltage (which we'll call EB_{min} henceforth to save space) is wasted; the output power is determined by the voltage *swing* in the plate circuit, or the *difference* between the supply voltage and EB_{min} as listed in the table.

Since the minimum plate voltage remains constant for any given current, you can see that the swing (and as a result, the power output) will increase to a larger percentage of the input voltage and power as the power *supply* voltage is increased. For instance, 100 volts at 50 ma is the same amount of power as 1000 volts at 5 ma, and if these happen to be the supply voltage and plate current, respectively, of an rf amplifier you would have 5 watts plate input in either case. However, to get 50 ma of plate current you might have to accept a 60-volt value for EB_{min}, which would leave you a swing of only 40 volts in the plate circuit, or a power output of no more than 2 watts even if you could get 100 percent conversion efficiency. With a 1000-volt supply and the same EB_{min}, your swing would be 940 volts, producing a possible power output of 4.7 watts—more than double!

But that's not all. At 1000 volts, you need only 5 ma of plate current, and the value of EB_{min} to produce 5 ma is considerably lower than that necessary for 50 ma. A typical value would be about 25 volts—maybe less. This increases the swing to 1000—25 or 975 volts, allowing a possible 4.875 watts out.

In the preceding examples, we assumed that the output power was determined only by the voltage swing in the plate circuit and the value of plate current. This assumption is not quite true; additional losses are introduced in converting the more-or-less square plate-current pulse into a sine wave, so that the actual power output is only 86.4 percent of the maximum-output figures quoted above. However, the basic principle that high voltage and low current give more efficiency than do low voltage and high current, still remains true.

By this time, you can see that proper operation of a Class C amplifier depends primarily on picking the proper operating point for the tube you intend to use. You must choose the values of plate supply voltage, plate current, screen voltage if applicable, and grid bias. Then, you must determine the amount of power necessary to drive the stage; if a driving amplifier is needed, it must then be designed, and so forth back to the oscillator.

The conventional approach to such design involves several pages of calculation for each stage; however, if we restrict ourselves just a little bit in some of our choices, the procedure can be reduced to nothing more than graph-reading and a little bit of simple arithmetic.

The two most involved calculations of the conventional approach are those to determine output power and to determine the value of grid bias necessary. These calculations (for the power range 0 to 15 watts and for values of grid bias between 0 and 110 volts) are worked out in the graphs of Figs. 3 and 4, reducing the design technique to a series of simple steps.

The first step, naturally, is to pick the power level at which you want to operate. At the same time, pick the supply voltage you intend to use (this is usually fixed by the available power supply). Dividing the value of the voltage into the desired power will give you the amount of plate current (in amps, not ma) necessary. Three of your variables are now determined.

Next, pick a tube type capable of passing the required current and of withstanding the

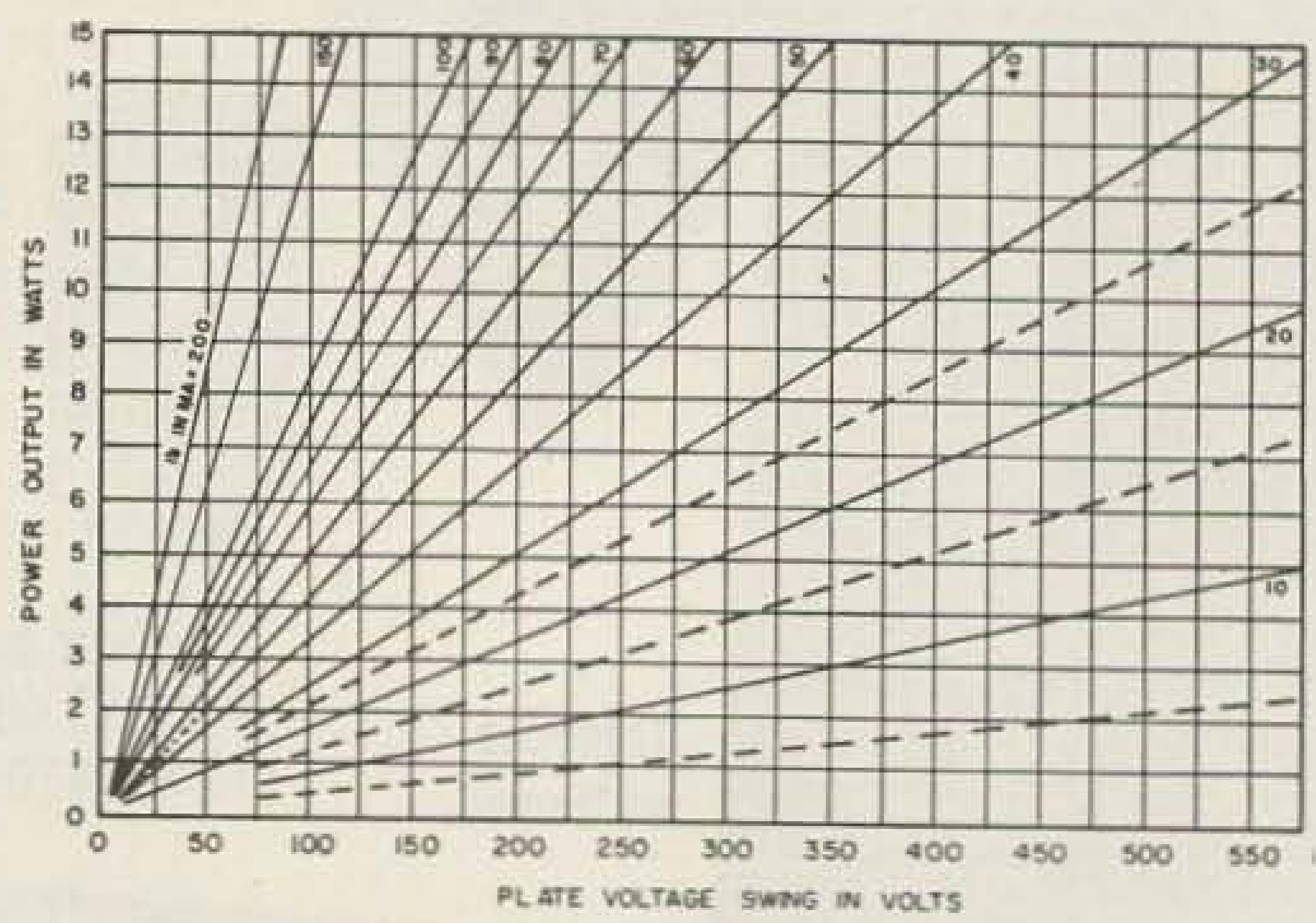


Fig. 3 Output Power Calculation Graph.

required voltage. If several types meet this requirement, choose the one having the smallest value of Eb_{min} at the required current. This will give you the greatest power output. However, if you think you may have trouble getting driving power, then pick the tube type requiring the smallest value of Ec_{max} as listed in Table I.

With a tube chosen, note down its rated plate dissipation, as well as the values of EB_{min}, Ec_{max}, screen voltage, and grid current required to produce the needed value of plate current. Also note down the G1-G2 Amplification Factor. This is listed for newer types; for older types, it is approximately equal to the amplification factor of the tube when triode-connected and this value is usually listed.

Now, subtract the value of EB_{min} from the plate supply voltage to determine the voltage swing. Using Fig. 3, draw a line up from the voltage swing value until it meets the diagonal line for the value of plate current (in ma) you're using. Now draw a horizontal line from this intersection to the scale at the left, and read off the power output in watts.

Next, multiply the plate *supply* voltage and the plate current (this time, in amps) to determine the input power in watts. Subtract the output power found in the previous step from this input power; the remainder is the power dissipated in the tube. If this value is lower than the rated dissipation of the tube, your design is good—go ahead; if it is higher, pick another tube type or a higher plate supply voltage and start over.

The next step is determination of the grid bias required; for this, we use Fig. 4. Draw a line up from the tube's G1-G2 Amplification Factor until it meets the curved line representing the screen voltage you're using; then draw a horizontal line to the left to determine the basic grid bias.

If the grid must be driven positive (that is, if Ec_{max} is positive), an additional bias equal to half of Ec_{max} must be added to the value found from Fig. 4 to get the actual operating bias. If the grid voltage is zero or negative at Ec_{max}, the bias found from Fig. 4 will be the actual operating figure.

Once we know the grid bias required, we can easily determine how much driving voltage is required. Just add together the bias voltage and the value of Ec_{max}. When adding, consider the bias voltage to be positive and take the sign of Ec_{max} as listed, so that if Ec_{max} is positive, the driving voltage will be greater than the bias, and if Ec_{max} is negative, the driving voltage will be smaller than the bias value.

With the driving voltage determined, driving power required can be calculated by multiplying the drive voltage by the grid current (from Table I) and taking 90 percent of the product. Actual drive applied should be at least 5 and preferably 10 times the figure thus

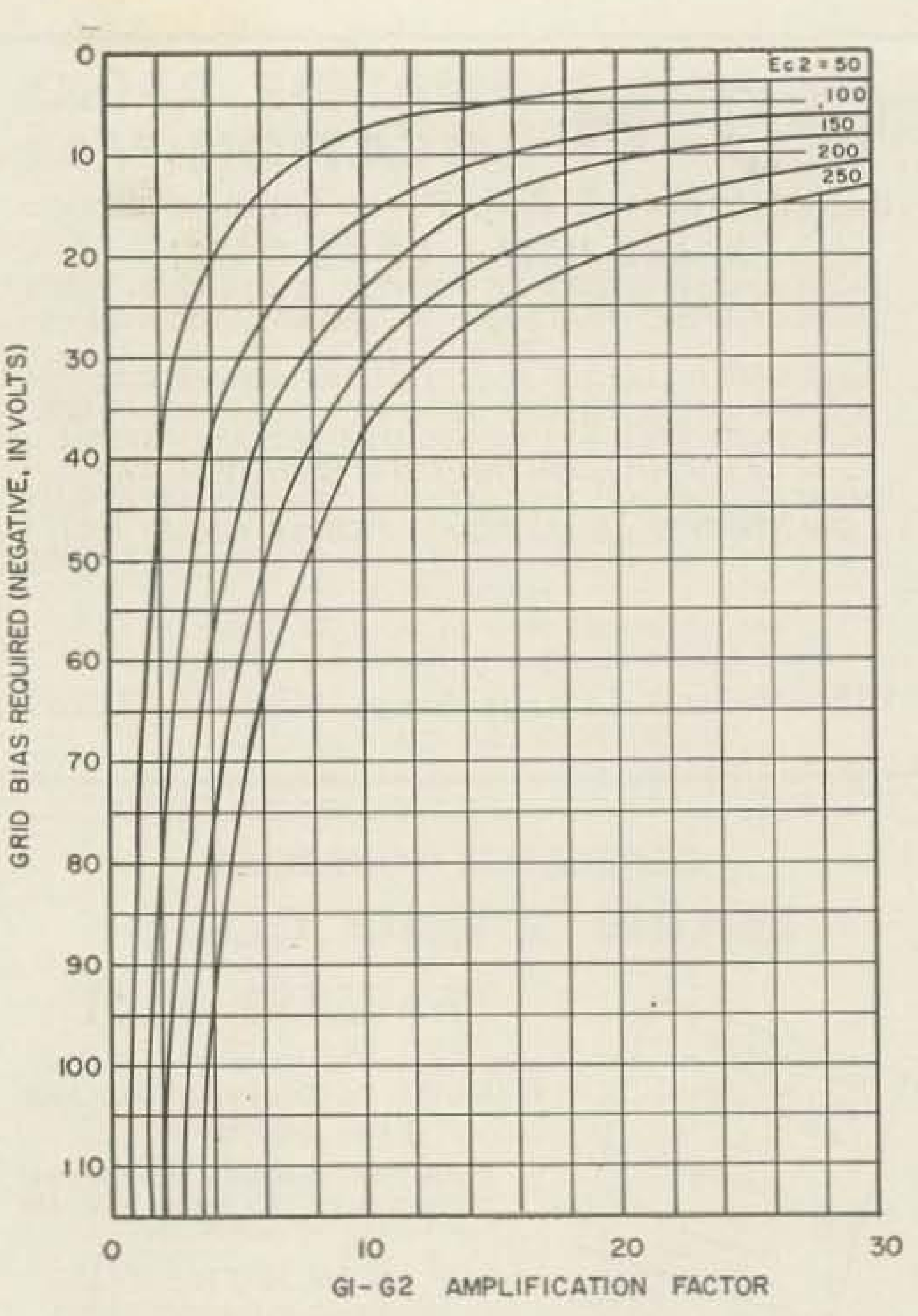


Fig. 4 Grid Bias Determination Graph.

found, since the calculation takes no account of circuit losses which cannot be avoided in practice.

To show you how this procedure works, let's go through an example. Suppose that we want to build a mobile rig in the 10- to 15-watt range. We have available a 300-volt power supply, so our supply voltage is fixed. Space is at a premium in most modern cars, so we want to use only miniature tubes. Before choosing the tube, though, we must find the plate current requirement; we do this by dividing 300 volts by 15 watts, getting an answer of 50 ma.

Scanning Table I shows us several miniature tubes which can handle this assignment: the 6AQ5A passes 50 ma at an Eb_{min} of 60, an Ec_{max} of +13, and 2.4 ma grid current; the 6BQ6 (not a miniature, but a very small octal) passes 40 ma at an Eb_{min} of 50 and Ec_{max} of 0; and the 5763 passes 50 ma at an Eb_{min} of 50, an Ec_{max} of +9, and 2.4 ma grid current.

Were size not an important factor, the 6BQ6 would be the best choice since its Eb_{min} is as low as any of the three, and its driving power requirement is zero. However, considering physical size, the 5763 is our choice. Let's note down all the key factors for this tube, at 50 ma.

TUBE TYPE: 6AQ5A PLATE DISSIPATION: 12 W
G1-G2 Amplification Factor: 9.5 Ec2: 250

Ip	Eb_{min}	Ec_{max}	Ic
10	25	- 7	0
20	35	- 1	0
30	45	+ 4	1
40	50	+ 7	1.6
50	60	+13	2.4

TUBE TYPE: 6BQ6 PLATE DISSIPATION: 11 W
G1-G2 Amplification Factor: 4.3 Ec2: 100

Ip	Eb_{min}	Ec_{max}	Ic
10	25	-10	0
20	30	- 5	0
30	40	- 2	0
40	50	0	0

TUBE TYPE: 829B PLATE DISSIPATION: 30 W
G1-G2 Amplification Factor: 9 Ec2: 200

Ip	Eb_{min}	Ec_{max}	Ic
25	30	- 5	0
50	40	+ 2	2.5
75	50	+ 8	5
100	70	+15	8

TUBE TYPE: 832 PLATE DISSIPATION: 15 W
G1-G2 Amplification Factor: 6.5 Ec2: 250

Ip	Eb_{min}	max	Ic
10	30	-17	0
20	50	- 9	0
30	70	- 3	0
40	90	+ 2	0.2
50	100	+10	0.9

TUBE TYPE: 5763 PLATE DISSIPATION: 12 W
G1-G2 Amplification Factor: 16 Ec2: 250

Ip	Eb_{min}	Ec_{max}	Ic
10	25	- 5	0
20	30	0	0
30	40	+ 3	0.8
40	45	+ 6	1.6
50	50	+ 9	2.4

TUBE TYPE: 2E26 PLATE DISSIPATION: 13 W
G1-G2 Amplification Factor: 6.5 Ec2: 160

Ip	Eb_{min}	Ec_{max}	Ic
25	40	+ 2	0.5
50	50	+11	3
75	75	+22	6**
100	100	+35	10**

** = over ratings

TUBE TYPE: 807 PLATE DISSIPATION: 30 W
G1-G2 Amplification Factor: 8 Ec2: 250

Ip	Eb_{min}	Ec_{max}	Ic
10	30	-19	0
20	30	-10	0
30	40	- 5	0
40	60	- 2	0
50	60	+ 3	0.8
100	110	+20	3.2

TUBE TYPE: 6146 PLATE DISSIPATION: 25 W
G1-G2 Amplification Factor: 4.5 Ec2: 150

Ip	Eb_{min}	Ec_{max}	Ic
25	20	-15	0
50	40	- 3	0
75	50	+ 5	2
100	60	+12	4 (max rating)

Table I Key Characteristics of Popular Tubes.

The characteristics are these: Plate dissipation, 12 watts. G1-G2 Amplification Factor, 16. Screen voltage, 250. Eb_{min}, 50. Ec_{max}, +9. Grid current, 2.4 ma.

With a supply voltage of 300 and Eb_{min} of 50, the swing is 300 — 50 or 250 volts. Turning to fig. 3, we go up from the 250-volt point until we meet the 50-ma diagonal line, then left to the power scale and learn that our output power will be 10.7 watts.

The input power was specified as 15 watts. Subtracting the 10.7-watt output power from the 15-watt input power leaves us with 4.3 watts being dissipated in the tube. Since this is well within the 12-watt dissipation rating, we can proceed.

The next step is determination of grid bias required, from Fig. 4. We draw a line up from 16 (the G1-G2 Amplification Factor) until it meets the 250-volt curve, then move to the left and read the basic bias as 25 volts.

Since our maximum grid voltage is positive, we must add half of Ec_{max} or 4.5 volts to this figure to obtain operating bias as 29.5 volts. A 30-volt figure is easier to handle in calculation, and the half-volt added by rounding off won't affect the accuracy of the design.

With 30 volts of bias on the tube and an Ec_{max} value of +9, the driving voltage required will be 30 + 9 or 39 volts. Drive power will be 90 percent of 39 volts times 0.0024 amps, or approximately 0.084 watts. We multiply this by 5 to allow for circuit losses. Thus, the driving stage should be capable of supplying at least 0.42 watt to the amplifier. This requirement can usually be met by a crystal oscillator.

Even with the design complete so far as tube factors are concerned, though, several factors connected with the circuit itself must be determined. The two most important of these concern grid bias, and the stage load.

You'll recall that we found out, in our example, that we needed a 30-volt bias on the grid of our 5763. We just left it up in the air, at that point, as to how we would obtain this bias.

In practice, though, the bias must be provided; it can be obtained from either of two sources in most cases. We can either provide a fixed bias supply (either a battery or a special negative-voltage power supply called a bias pack), or we can let the tube furnish its own bias through rectification of part of the RF input signal, using the grid current flow through the grid return resistor to develop a voltage drop which provides the proper bias value. This second technique is known as grid-leak bias; you can see that it will work only if the tube draws grid current. If the tube operates with zero or negative maximum grid voltage, fixed bias is the only usable method.

However, if your design will allow the use of grid-leak bias, it is to be preferred for several reasons. The most obvious is that eliminates a number of components. It also tends to be self-regulating, especially if the amplifier is to be modulated for phone transmissions. The only major disadvantage is that all bias disappears if anything happens to stop the driving power (such as oscillator tube failure) and consequently the amplifier tube is subject to damage.

To determine the resistance value necessary for grid-leak bias, just divide the grid current (in amps) into the bias voltage required; the result is the resistance, in ohms, of the grid resistor. If this resistance is smaller than about 10,000 ohms, put an rf choke in series with the resistor at the grid end to prevent the resistor from loading down the driving stage; if the resistor is larger than 10,000 ohms, the rf choke is not necessary.

While we're in the grid circuit, we might as well take a look at the matter of providing enough driving voltage. This is not quite the same as getting enough driving power or current; to go back to our earlier example, less than half a watt of power and only 2.4 ma of current are necessary in the grid circuit—but the voltage must be at least 39 volts peak. If the amplifier is fed from a separate oscillator through a coax link, the voltage across the link may be only about 5 volts for half a watt of power. In this case, a tuned grid circuit to act as a voltage step-up transformer is a must; overlooking this point has caused many a beginning transmitter designer to tear his hair.

On the other hand, if the amplifier is fed by another stage on the same chassis, and is coupled to that driving stage by a simple capacitor coupling, the chances are that the swing across the driver-stage output is greater than 39 volts peak; this means the tube will be over-driven, resulting in excessive grid current and too much harmonic output.

In either event, the remedy is the same; adjust the level of the driving voltage until it matches the calculated value. If you're using grid-leak bias and adjust the drive for rated grid current, the voltage is automatically correct.

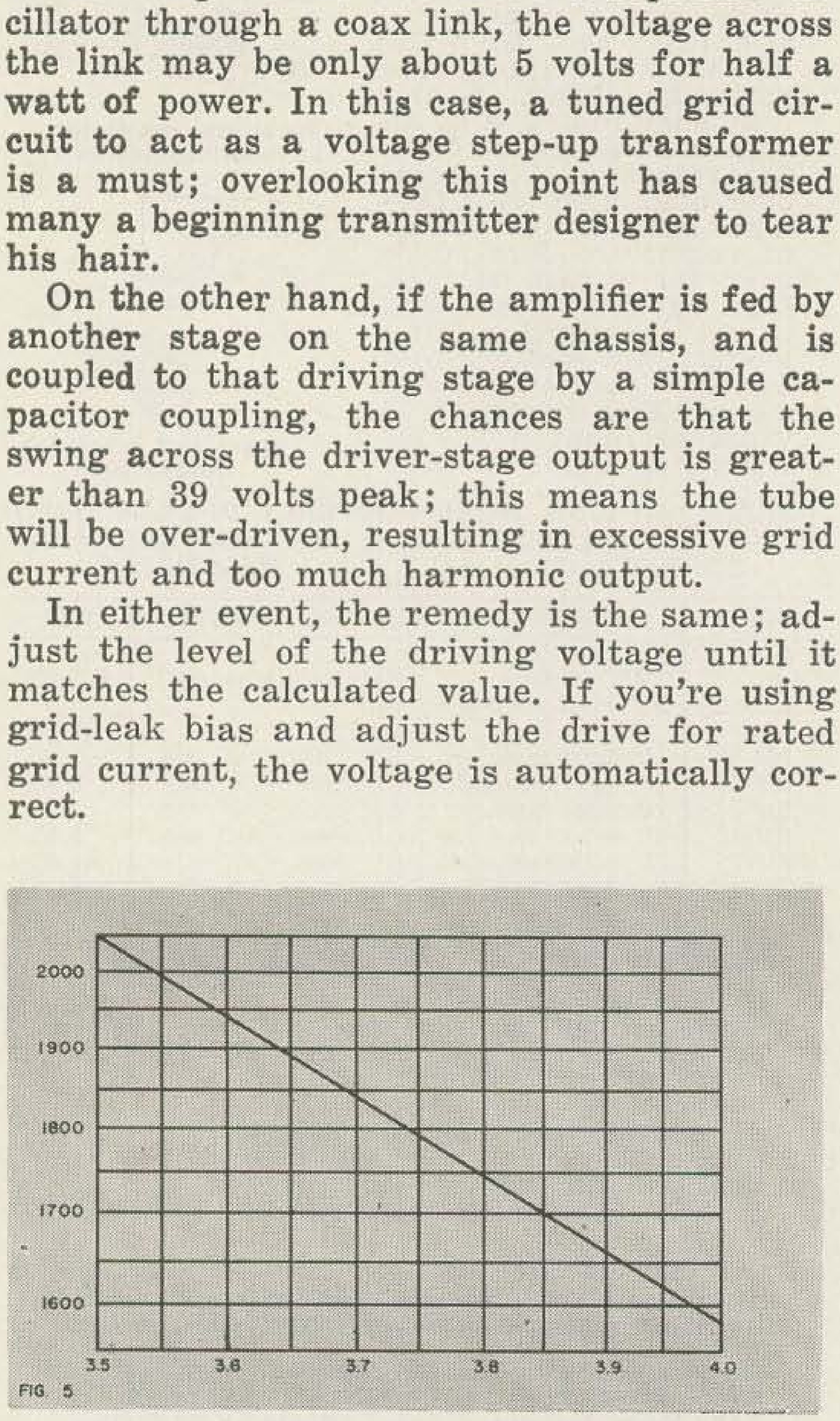


Fig. 5 LC Product Graph 3.5 to 4 mc.

With the grid circuit taken care of, we're ready to look at the stage load. In practice, the utlimate load may be either an antenna, or another amplifier stage—but to the tube, the load is always the same: the impedance of a tuned tank circuit.

You specified the value of this impedance when you picked the values of plate supply voltage and plate current; the load impedance must be equal to the supply voltage divided by *half* the plate current (in amps). However, a wide range of actual tank circuits can be made to have the same impedance, by the technique known as "loading."

Since a tank circuit, when acting as a coupling between an amplifier and another load, performs the function of a transformer, the impedance of the tank circuit will depend largely on the impedance of the ultimate load. However, the design of the tank circuit itself will also influence the operating impedance, irrespective of the load. This is so because of the transformer effect: a 2-to-1 transformer will show higher primary impedance than would a 1-to-1 transformer, if the same load were connected to the secondary of each. Roughly, the amount of transformation provided by the circuit is proportional to the number of turns in the coil.

Thus, a tank circuit with large inductance (many turns) and low capacitance will transform relatively low antenna impedance up to fairly high values of primary impedance. Only a small coupling loop for the antenna is necessary, and the circuit is said to load easily.

However, coupling is only half the job of the tank circuit; the other duty of the circuit is to iron out distortion and remove unwanted harmonic frequencies from the output.

To do this part of the tank task properly, large values of capacitance are needed. The greater the capacitance, the more energy the circuit can store during each driving pulse and the greater will be the "kick" to the "flywheel" between pulses.

Thus, a high-C circuit is needed for good harmonic reduction, while a low-C circuit provides ease of loading. Most designs represent a compromise between these needs.

A popular way of specifying this same characteristic of the output circuit is to specify its Q. This is the same thing we've been discussing, because the Q of the circuit is proportional to the product of the circuit's capacitance and the required circuit impedance. The greater the capacitance, the higher the Q. Q values normally range between 10 and 30, with higher values needed for phone than for CW operation.

Note that, so far, we haven't mentioned much about specific values in the tank circuit except those for the capacitance. The reason for this is that you can choose from a number

NEW hy-gain

DUOBANDER

for the popular 20-40 meter bands

New compact lightweight unit features Linear Decoupling Stub and Beta Match

The 20-meter and 40-meter bands are becoming more and more popular with amateurs because of more room for expansion and low sun spot activity. That's why the Hy-Gain engineering staff has designed this important new antenna. The Hy-Gain Duo-bander has three full-sized elements on 20 meters and two reduced-size elements on 40 meters. It's compact, lightweight, highly practical—and priced right.

Through the exclusive Hy-Gain development, the linear decoupling stub, the ordinarily outsize 40-meter element is reduced to about ⅔ of the normal size. This makes the Hy-Gain antenna practical, usable where others won't work out, but keeps performance standards high.

The exclusive Hy-Gain advancement of the linear decoupling stub makes two-band operation possible. You do away with inductance and capacity traps, yet the Duobander elements sections can be decoupled very efficiently. The linear loading principle, another Hy-Gain exclusive, does far better than a loading coil in reducing antenna size.

A proven Hy-Gain development—THE BETA MATCH makes possible maximum gain and low standing wave ratio into a single 52 ohm coaxial feed line. For perfect pattern symmetry, a broad band balun is an integral part of the matching system.

SPECIFICATIONS

ELECTRICAL

Forward Gain over a tuned dipole 20 meters ....8.1 DB
Forward Gain over a tuned dipole 40 meters ....4.9 DB
Front to back ratio 20 meters ....20-30 DB
Front to back ratio 40 meters ....15-20 DB
VSWR at resonance (typical) 1.2:1
Nominal impedance ....50 ohms
Power Capability.................................5 KW P.E.P., 3 KW AM

MECHANICAL

Net Weight ....54 lbs.
Boom Length ....24 ft.
Element Length ....Approx. 40 ft.
All aluminum construction—Alloy 6063T832—
Tensile strength 45,000 PSI
All hardware iridite-treated to military specifications; all plastic high impact Cycolac
Wind surface area ....6.9 sq. ft.
Turning Radius ....24.2 ft.

price $169.50

See your local Hy-Gain dealer or write for Duobander Bulletin.

hy-gain antenna products
8406 NE HIGHWAY 6, LINCOLN, NEBRASKA

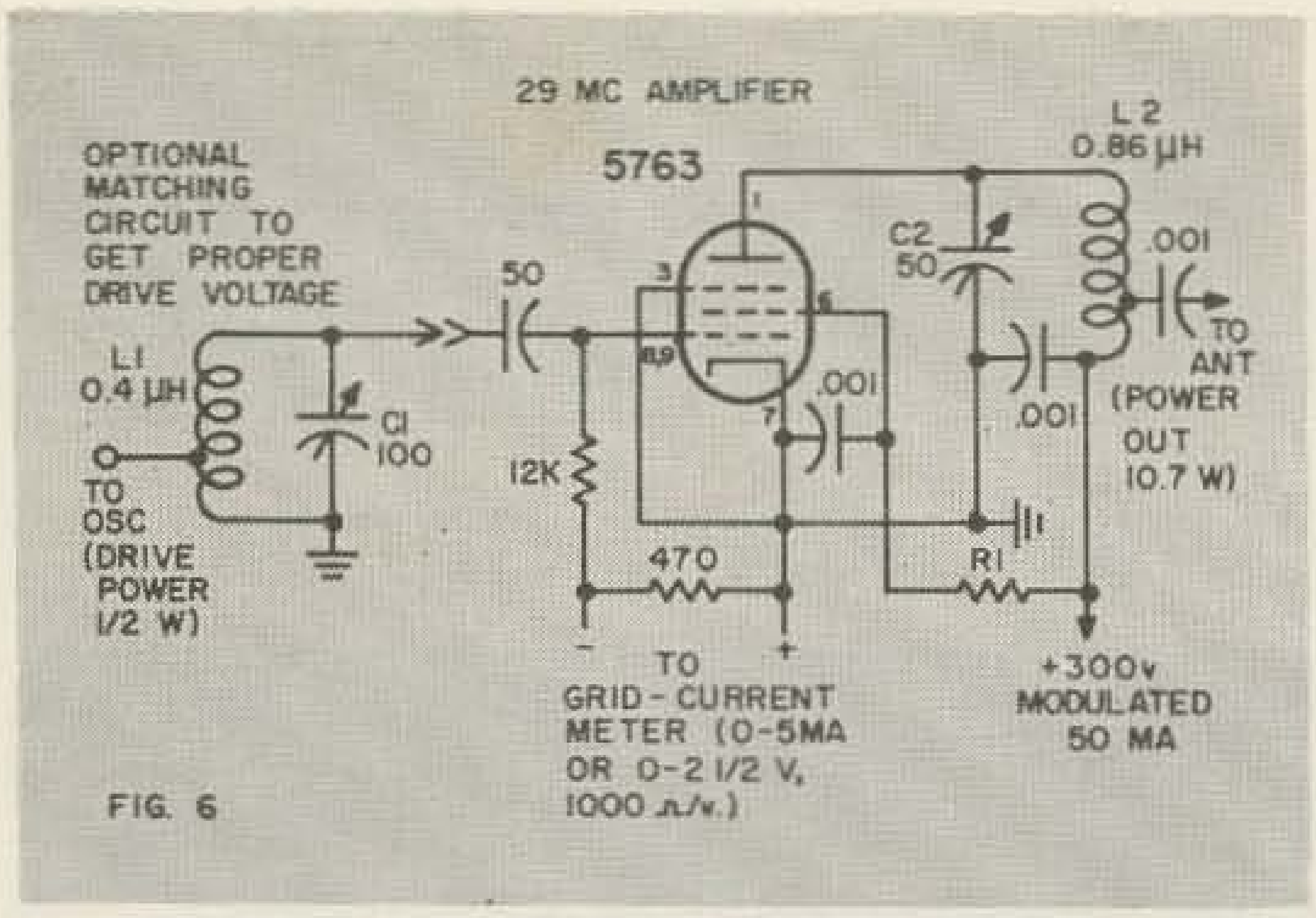


Fig. 6 Example of Class C Amplifier Design.

L1—Slug-tuned coil (Miller 20A477RB1 or equiv.); tap as necessary to obtain proper drive voltage. Try tap ¼ way up to start. Couple to osc. coil with link.

L2—Air-wound coil, 9 turns, 1⅛" long, ¾" dia. (Air-Dux 608 or equiv.); tap as neccssary for proper loading. Start with tap 1 turn up from cold end, move higher by ½-turn steps.

R1—Screen resistor, 2w. Pick for 250-volt reading on screen with normal drive and loading. Start with 50k ohms and work down.

C1—Ceramic or mica trimmer, 10-100 mmf.

C2—Air-spaced trimmer, set to approx. 30 mmf. when in tune.

of types of tank circuit: the conventional single-ended tank, the balanced tank, and the pi-network are the most popular. Details of these circuits differ; however, the effective capacitance across the circuit must be the same for all three, at the same values of loading. Thus, calculation of the capacitance value follows the same procedure no matter which tank circuit you're using.

However, beyond this point the design details differ depending on the tank circuit you choose. The details of output-circuit design are adequately covered in both the ARRL Handbook and the Editors & Engineers Radio Handbook (see bibliography) so we won't repeat them here.

If you do choose the conventional single-ended tank circuit, though, you can complete the design rapidly simply by choosing a value of inductance which will resonate at your desired operating frequency with the capacitance value you just calculated. The simple way of determining the value of inductance necessary is by use of a chart of LC products.

These charts make use of the fact that the product of inductance times capacitance is constant for any specific frequency. Thus, by looking up the LC product for your operating frequency and dividing it by the capacitance value you're going to use, you can determine the necessary inductance.

Such a chart, in graphical form, for the frequencies from 3.5 to 4 mc is shown in Fig. 5. In this chart, capacitance values are in mmf and inductance is in microhenries. To use the chart, simply read up from the operating frequency to the diagonal line, then move to the left to find the LC product.

This chart also applies to frequencies in the bands 7 to 8 mc, 14 to 16 mc, 21 to 24 mc, and 28 to 32 mc by using correction factors. Correct the frequency by dividing the frequency you're using by 2, 4, 6, or 8 to get a figure between 3.5 and 4. Correct the LC product by dividing by 4, 16, 36, or 64, respectively.

For instance, if we're going to operate at 29 mc, we divide 29 by 8 and get 3.625. This is the "frequency" at which we enter the chart; the LC product corresponding to this frequency is 1915. Now, we divide 1915 by 64 to get our true LC product, which is 29.9.

To carry the example on through, let's calculate the tank-circuit values for the transmitter used as an example earlier. Our 5763 was operating at 300 volts and 50 ma and thus required a load impedance of 3000 ohms. Making reference to the charts of capacitance versus impedance to be found in the ARRL handbook, we find that a capacitance of 35 mmfd produces a Q of 20, adequate for our uses.

Now, we divide 35 into 29.9, and learn that our tank coil's inductance should be 0.86 microhenries. A check of available air-wound inductors shows that 9 turns of 8-turn-per-inch, ¾-inch diameter stock (Air-Dux 608 or B&W 3010) will provide this inductance; a 3-to-30 mmf air-spaced trimmer padded with, say, 20 mmfd of fixed capacitance will do for the capacitor.

The complete schematic diagram for this amplifier is shown in Fig. 6, with all pertinent operating voltages and other design factors pointed out.

With this, we wind up our discussion of basic circuit design with electron tubes. If you're satisfied, by now, that circuit design is *not* too complicated and involved for your tastes, you may be interested in some of the books listed in the bibliography below. In reading them, you may find yourself getting in a bit deep in mathematics, or entangled in a tenuous thread of involved reasoning—but don't let them scare you away from designing, the most fascinating part of ham radio construction.

BIBLIOGRAPHY

Anonymous, **Radio Amateur's Handbook, The**, American Radio Relay League, West Hartford, Conn., published yearly, see in particular chapters 2 and 6 of any recent editon.

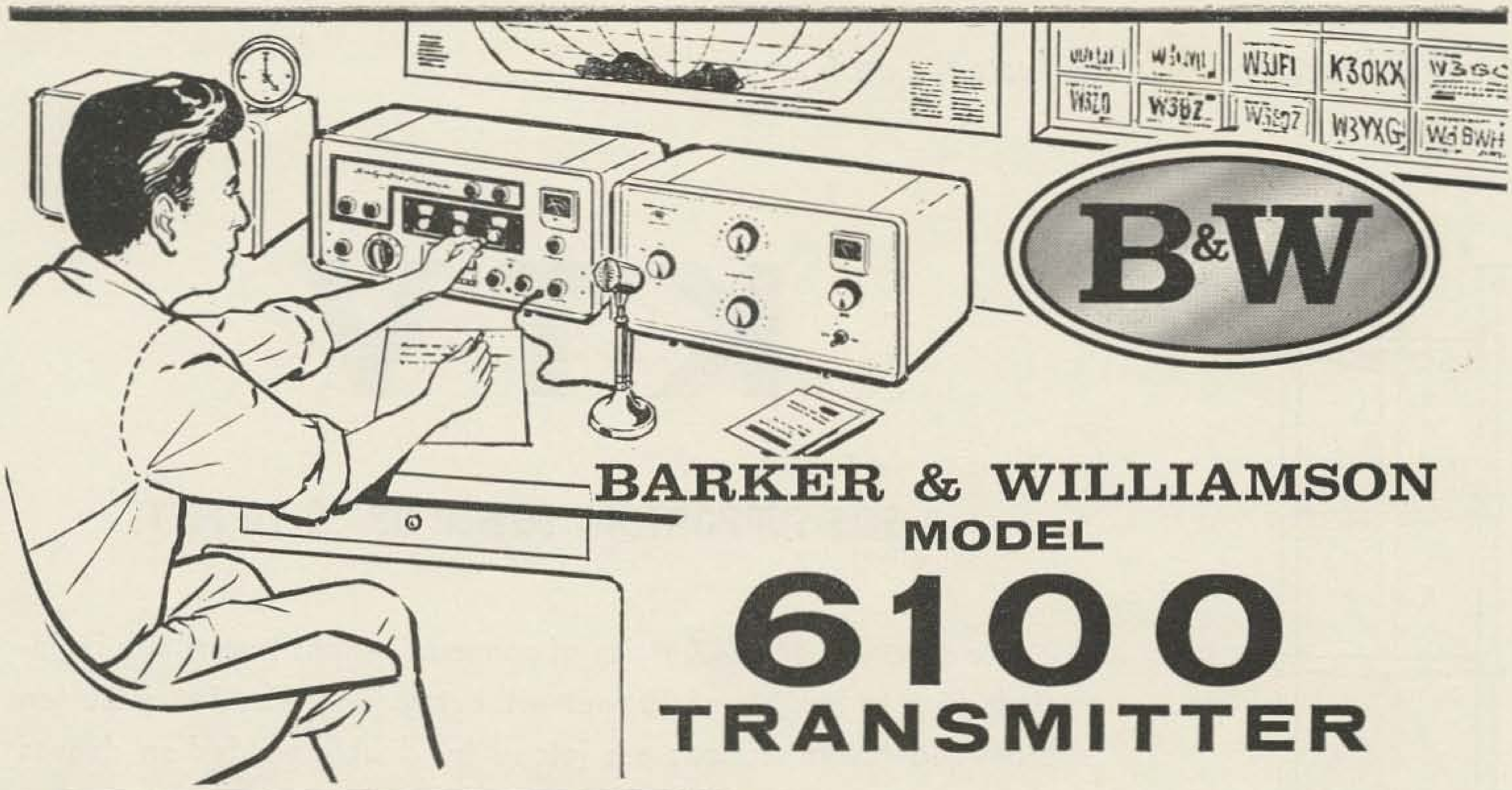
Anonymous, **RCA Receiving Tube Manual**, Technical Series RC-19, Electron Tube Division, Radio Corporation of America, Harrison, N. J.

Anonymous, **RCA Transmitting Tubes**, Technical Manual TT-4, Tube Divsion, Radio Corporation of America, Harrison, N. J.

Anonymous, **Electronic Tubes** (in five volumes), General Electric Company, Schnectady, New York.

Eastman, A. V., **Fundamentals of Vacuum Tubes**, McGraw-Hill Book Company, New York, 1949.

Orr, Willam I., W6SAI, editor, **Radio Handbook**, 15th editon, Editors & Engineers Ltd., Summerland, Calif.



BARKER & WILLIAMSON
MODEL
6100
TRANSMITTER

SSB - CW - AM

With the

ALL NEW

CRYSTAL CONTROLLED

FREQUENCY

SYNTHESIZER

MODEL
LPA-1

GROUNDED GRID 1 KW LINEAR AMPLIFIER

The B&W LPA-1 Grounded Grid Linear Amplifier is the ideal companion high powered final for Model 6100. The LPA-1 produces a signal of extremely low distortion because of a unique negative feed-back arrangement.

MODEL 6100 - *A NEW STANDARD OF FREQUENCY STABILITY*

Engineered and built for outstanding performance and lasting satisfaction. The B&W 6100 is unsurpassed in stability, sideband suppression, signal quality, talk-power and many other features.

It is the first SSB amateur transmitter employing a crystal frequency synthesizer.

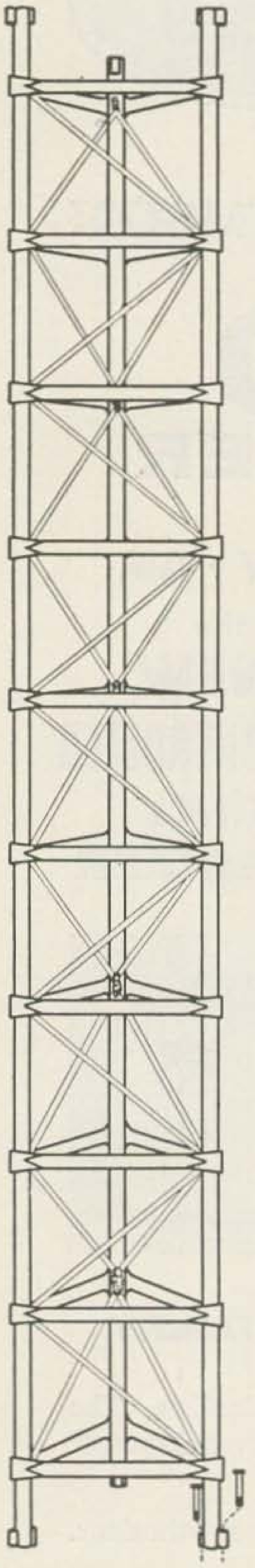
Send for colorful, descriptive brochure.

BARKER & WILLIAMSON, Inc.

Radio Communication Equipment Since 1932

BRISTOL, PENNSYLVANIA • STillwell 8-5581

Order direct from manufacturer and save . . .



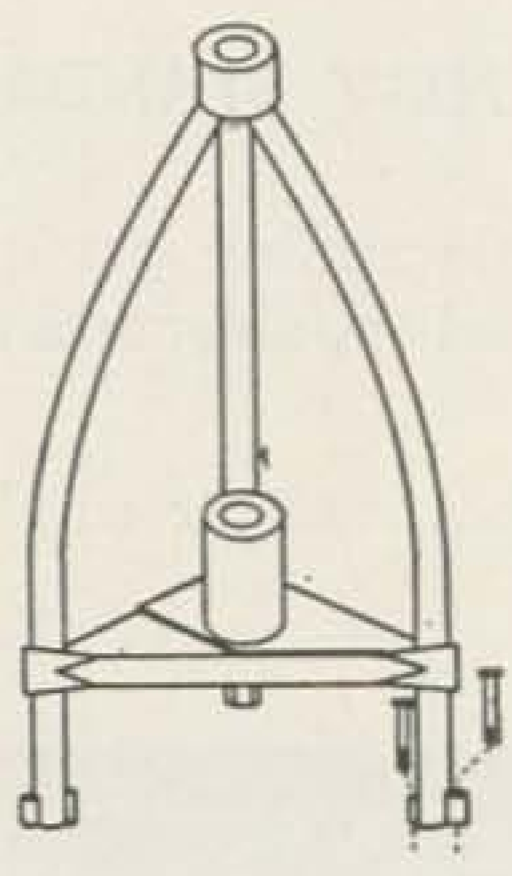
KTV

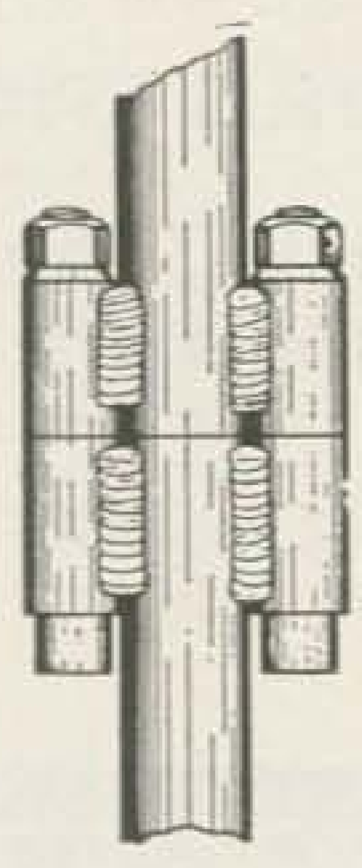
A SELF-SUPPORTING TOWER UP TO 70 FEET!

The new KTV 1600XX series of communications towers can be installed up to heights of 70 feet without guying! The 16" wide ten foot long tower sections are joined by double welded-on sleeves on each of the three legs, making one of the strongest tower leg joints ever achieved and avoiding the usual difficulty of the jamming of tower sections. This also avoids the weakness created by holes in the structural members.

The vertical sections are made of 1" diameter 14 gauge steel tubing and the cross ties are 16 gauge tubular steel, wrapped around the vertical tubing every 12" and welded. Any tendency to twist is prevented by the 5/16" continuous XX steel rods which are welded inside the triangular structure. The end product is a tower that is strong enough to support a tribander easily at 50' without guys. This tower can be run as high as 250' with guying every 40' above 65'.

Order your tower direct from this ad or, if you have any special problems or questions, drop us a line.



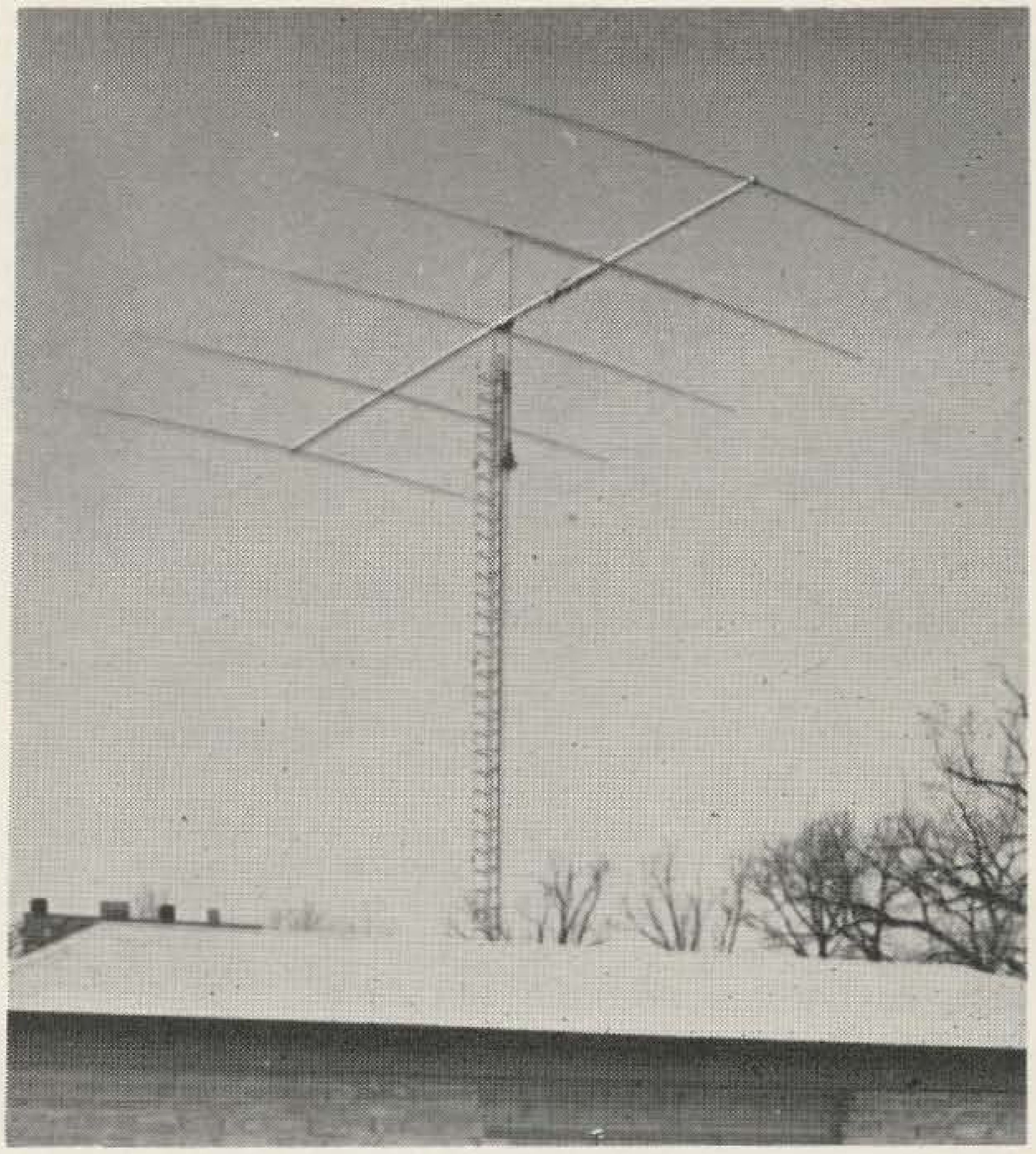


KTV Towers Sullivan, Illinois

PRICES

Figure that each ten foot section of 1600XX tower costs $40.00 and weighs 50 pounds. The short 42" top section is $20 with a 1¼" or 2" mast hole (specify) and $23 with a 2½" or 3" mast hole. For other size masts write for prices. The rotor mount plate is adjustable and can be placed at any level to match your mast length. It is suitable for the popular rotators such as the Ham-M, CDR, and Hy-Gain. Special plates are available for other rotors. All tower sections are made of 14 gauge galvanized steel.

Base for mounting tower in concrete	$26.00	20 lbs
Angle roof mount	$26.00	20 lbs
Three foot roof mount for flat roofs	$32.00	46 lbs
Wall bracket	$18.50	12 lbs
42 gauge galvanized screw anchors	$ 7.50	7 lbs
3/16" aircraft cable 1500 lb test ... ft	.20	65 lbs/M
Cable clamps	.20	
Tower bolts	.30	
10' 1¼" 16 gauge mast tube	$ 5.00	9 lbs
10' 1¼" galvanized pipe	$ 9.00	16 lbs
Erection fixture (jin pole)	$28.00	30 lbs



HY-TRACK

KTV is the only manufacturer of the Hy-Track, an assembly which bolts to your KTV (or other make) tower and allows you to crank your complete rotator and beam up and down the side of the tower in seconds. The Hy-Track consists of a set of rails and a rotator platform and mast bearing which move up and down the rails. On guyed towers it is a simple matter to loosen the guys and lower the beam . . . you don't have to worry about the KTV tower because it is designed to be self-supporting up to 70'. The Hy-Track is particularly handy if you don't want to have to climb up and down your tower to make changes in your antenna, or if you are interested in avoiding the shortage of life that frequently accompanies falling off towers and heart attacks. The complete Hy-Track assembly, all set to go, costs $189.50 to fit on a 30' tower. Add $20 for each extra ten feet of tower. The basic assembly weighs 60 lbs plus 20 lbs for each extra ten foot section.

1800XX and 2400XX

We also have towers available that are 18" on a side which are designed to handle heavier beams or multi-stacked arrays. Write for further information about these extra heavy duty towers. For lighter duty you may find one of our 700, 900, or 1200 series towers is just what you need. We have a tower to match any application from a small TV antenna in a peaceful valley to a huge commercial array on a mountain top.

KTV Towers Sullivan, Illinois

Non-technical article on the veracity or lack-of-it of a useful instrument.

Are You Being Lied to, OM?

S. P. Wilds KZ5SW/W4GVD
Box 2519, Balboa, Canal Zone

Since the advent of the low-priced commercial SWR Bridge, the Standing Wave Ratio of "antennas" has become a major source of conversation, and CONCERN, of a larger percentage of hamdom. The purpose of this article is to dispel some of the mis-information currently going the rounds as "gospel" regarding the understanding of what these gadgets tell us. I think that most people "know" why a low SWR is desirable, but let's list them, as we have heard "on the air." A low standing wave ratio will provide:

1. Maximum transfer of rf from the shack to the antenna.
2. It indicates that the antenna is resonant on the operating frequency. (?)
3. It makes the transmitter load easily.
4. It minimizes TVI from transmission line radiation.
5. Many rigs with limited-range pi-nets or fixed-output-impedance require a close-to-50 Ohm "load."

As a result of this school of thought, a great deal of effort has been put forth by many hams to be sure that the "reflected power" on the bridge reads as close to "0" as possible. However, while this will almost always result in achieving result listed as number 5 in our objectives above, it doesn't necessarily mean that the other four are also being arrived at.

The ability to load easily is of primary importance to just about all of us, as is the "necessity" to be able to state "SWR here is less than 1.01 to one" for prestige purposes if nothing else. This piece is directed to those who are genuinely concerned about getting maximum performance for their dollar investment. First, here is a simple check to find out whether all is what it seems to be at your QTH.

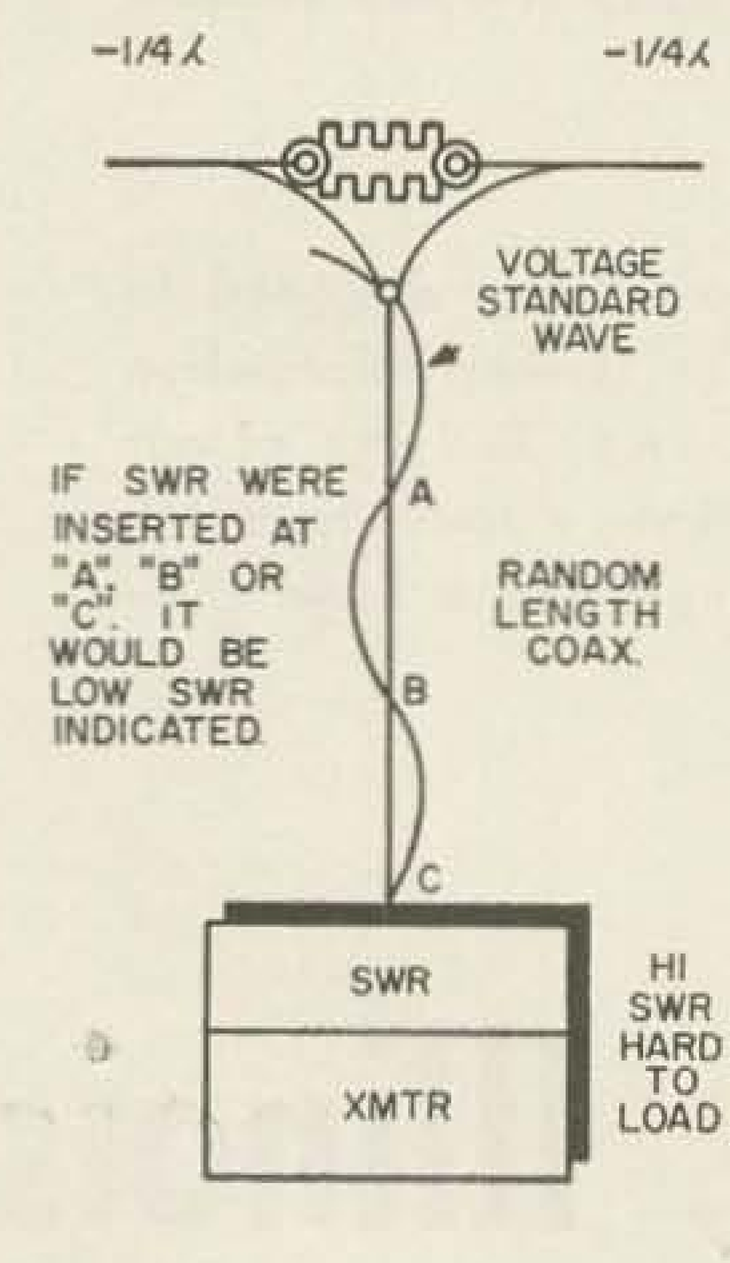
1. Tune up the rig as close to perfectly as possible on your favorite frequency.
2. Make careful notes of the plate current, plate tuning and load control settings.
3. Read and note down the exact reflected power indication.
4. Insert a length of coax about 15 feet long between the SWR Bridge and the end of the transmission line to the antenna.
5. Repeat steps 1, 2, and 3. Compare the two sets of readings.

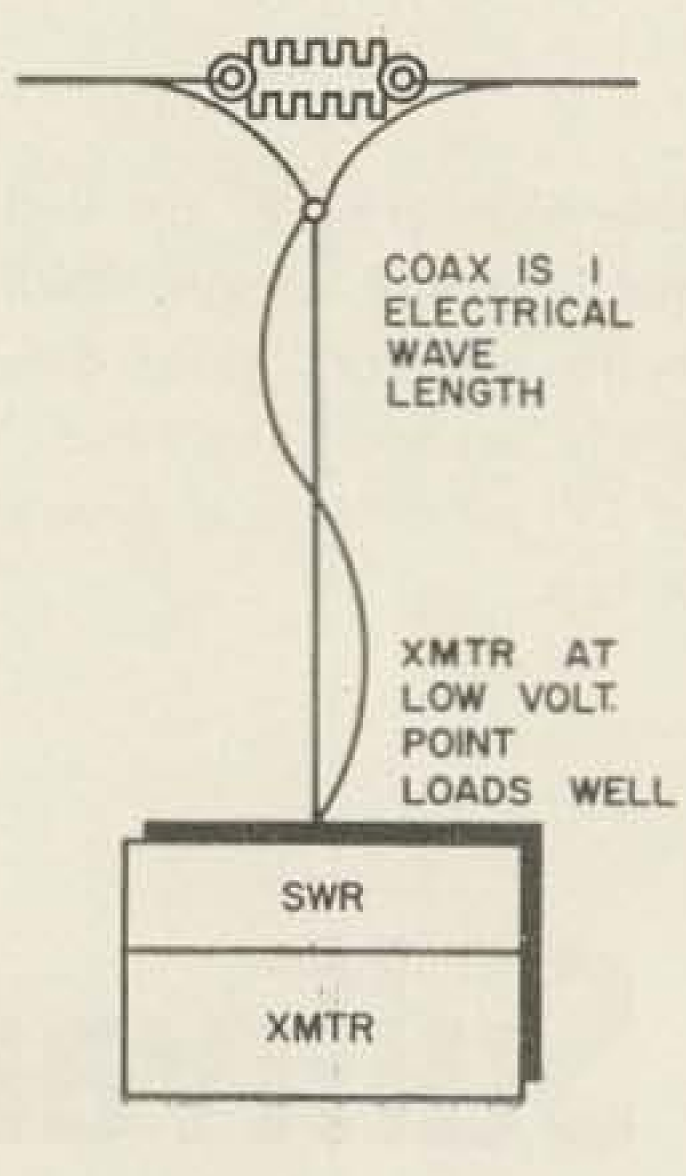
If there is a considerable difference in any or all of the readings or settings, do one of two things. The easiest is to tear up your notes and forget the whole thing. The second requires some antenna work and an understanding of why fate has done you so wrong. (Incidentially if all the readings above stayed close to the same, you are indeed either darn lucky and have the world at your finger-tips or you don't need this article and have skipped it by now.) If you decide that something has to be done bear with us.

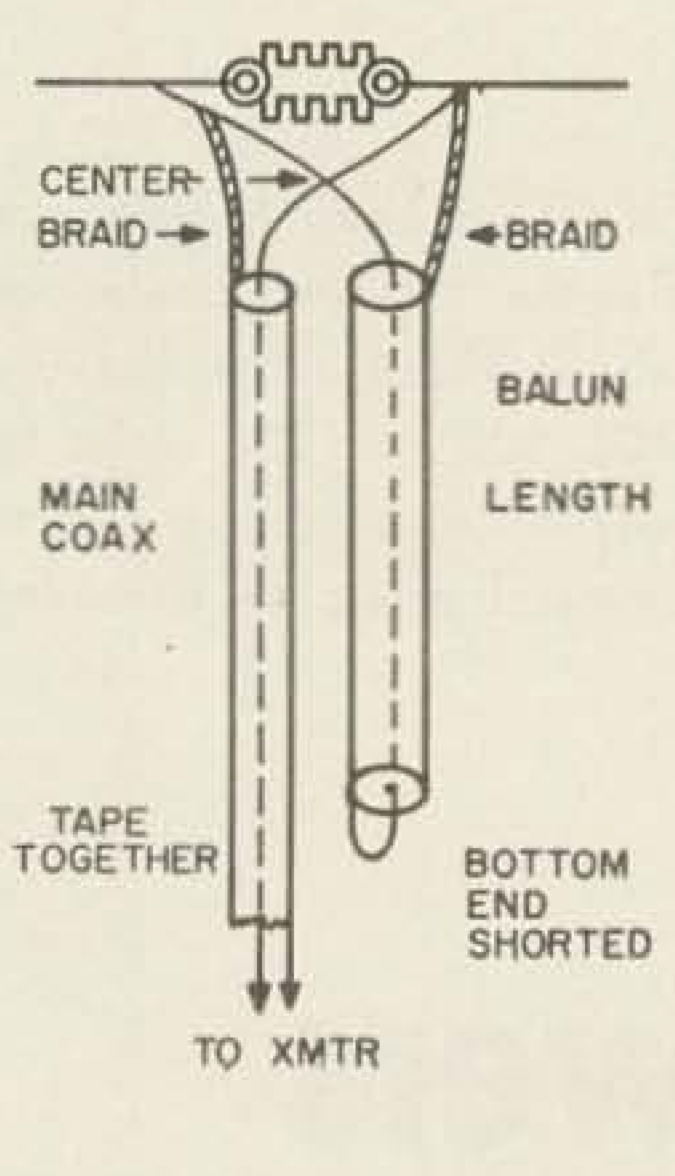
Let's first find out why this miserable condition exists.

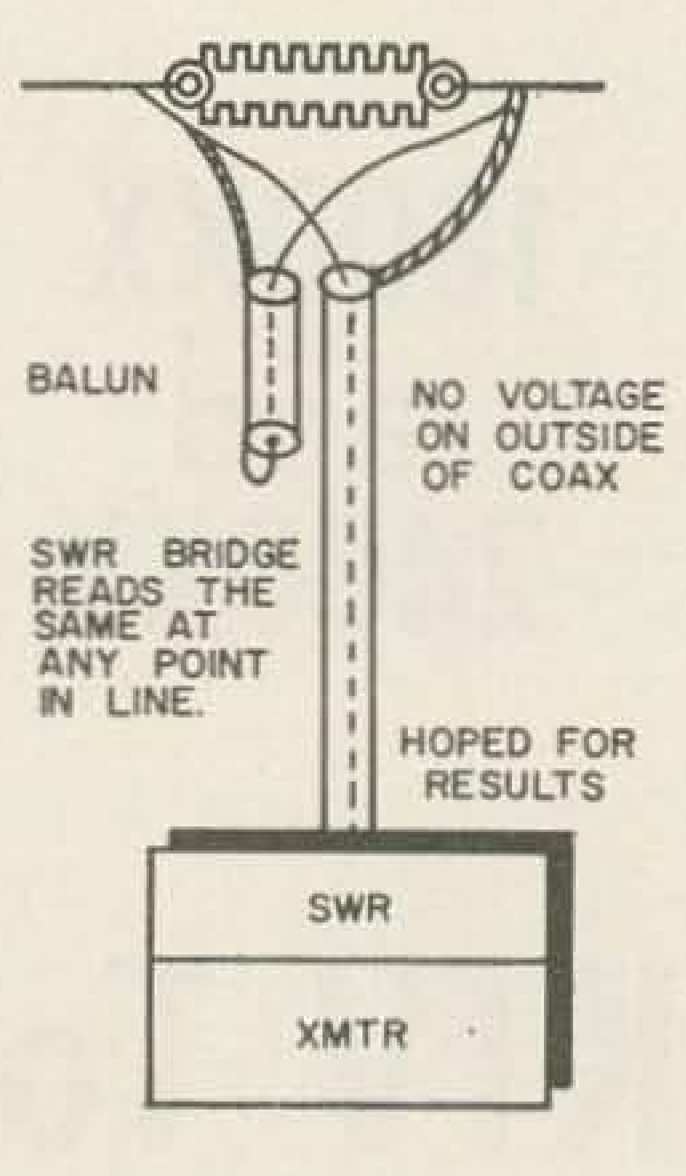
The SWR bridge that most of us play around with is a voltage indicating device and as such indicates voltages existing on the line at the POINT OF INSERTION ONLY.

If the actual standing wave ratio is not too high, say less than four to one, there is a point every half-wave length along the line where the rf voltage is low and the current is high. If the bridge is inserted here, the SWR reading may look *good.* If this is the point where the transmitter feeds it, the rig will load well









(except you may have trouble UN-LOADING to keep the plate current from being to HIGH at minimum loading and at plate current dip!). At this point the bridge may read a low SWR, but the *actual* SWR is high on the transmission line. The purpose of the extra co-ax is to shift the transmitter and the bridge to a different point. Remember that a truly flat line has NO variation to speak of either in current or voltage throughout its length. Hence the bridge could be inserted at *any* point in the line and would read the same as at any other point. Before going further, it would be well to point out that the low *indicated* SWR phenomenon on the line with the medium high *actual* SWR has its distinct uses. It enables many of the "tri-band" type antennas to be loaded with ease. If your tri-bander has neither a Gamma or Omega Match or some type of Balun system, it is undoubtedly being loaded by the system of putting a voltage null at the end of the coaxial line. Hence the instructions to use a multiple of a *specific length* of coax. Have you found on your home-brew antenna that you could "lower the SWR" by trimming the length of the transmission line? Same deal. You get a low indicated SWR, the actual SWR can still be very high. This results in increased losses, possibly high TVI radiation from the line and it does *not* mean that the antenna itself is "on frequency."

What to do about it, will be taken up next. Regarding the commercial tri-band beams, there is very little that can be done by the average ham. The element lengths and trap coils are hard to adjust because they all interact, especially on the low frequency end. There is one change that I found useful on a trap tri-bander that was fed with coax, one side of the driven element being grounded, and no gamma system supplied. I ungrounded the grounded side of the driven element, made a balun of 12 turns of the transmission line into a coil six inches in diameter at the antenna itself. I connected the center of the coax to one side of the split driven element, the braid to the other side, being careful *not* to ground the braid to the boom. This materially helped the indicated and the actual SWR of the system. This is about as far as you can conveniently go with modifications to the manufactured multiband antenna. The single band systems are a different kettle of fish. Remember that a split half-wave element is basically a balanced load. The transmission line is unbalanced. Therefore we must employ a device to match the two or we will have standing waves on the line. This matching may be done with a simple coil balun as just described on the high frequencies or by means of a linear balun on the low bands. See the various antenna manuals for the complete information.

Another means of accomplishing the desired result is to use a Gamma or Omega matching system. This is an excellent means of getting the most from your station. It is very popular with the home-brewer of beams, quads, etc., because it is efficient. Commercially, they have been left behind in order to reduce costs, to make simpler antennas to meet competition, and for ease of installation, (at some loss of efficiency). The perfectionists will dig the rest of the information on how really to get the very most from his antenna from the usual sources. Is it worthwhile? I suggest you listen to the ZL's and VK's on the air. Virtually the only ones that you *hear consistently loud and clear* are the antenna nuts. Be it a beam, quad, Vee, or ZL special, it is tuned to a gnat's eyelash. Conspicuous by their absence are the dipoles, "long wires" and the rest of the make-do, cut-to-formula and sling up affairs. The *properly used* and understood SWR bridge is a very useful device to help you attain best performance. Remember though, if left in one place while making adjustments, it can lie in its teeth.

. . . KZ5SW

How to Scrounge a Deluxe Junkbox

Mikarad Capacitorri Ex-K9AAI

AMATEUR radio operators delight in showing off their junk boxes. Practically every author mentions that his home brew gizmo can be built with junk box parts for little or no cash outlay. But, how are these parts accumulated?

This then, shall be my first (and probably last) contribution to amateur radio in more than fifteen years of being on the air. Study my contribution carefully. It reveals the secrets of a dedicated, A-1 scrounger.

First off, let's define scrounger. To scrounge is to steal slyly, pilfer, cadge or sponge. Since all amateur radio operators are honest, trustworthy, loyal, etc., we have narrowed down scrounging to the fine and respected art of sponging. An amateur radio operator intent on obtaining parts for the junk box for little or no cost, therefore, must become an accomplished sponger.

In all sincerity and with greatest respect, I must reveal that as scroungers, the Green Mountain Boys represent the acme of perfection. It has been my good fortune to become associated with these distinguished practitioners from W1 Land. The United States Government has not yet recovered from the shellacking it took out East in surplus deals after World War II.

The W1's, however, have one serious shortcoming as scroungers. Their Yankee heritage demands they live on interest and forestall using the principal at any cost. The serious scrounger must learn that there is no honor among thieves, that is spongers. He must be quick to recognize when a W1's accumulated interest has depleted to a dangerous level. A W1 would rather lose his right arm than let his townsmen know he is drawing against his principal.

I know of a K8 that recognized this shortcoming in a W1 and scrounged a complete RAS-5 (U. S. Navy version of the HRO) for $15. A surplus dealer already has offered him $35 for the coils alone. Anyone care to make me a better offer? Do not belittle the W1, however. He sold me a gallon of watered, low-grade, genuine Vermont maple syrup for $7.50.

The finest training for scrounging comes from being a Novice. Without discounting the inherent and sterling qualities of the Old Timer, no better apprenticeship is known. Imagine the youngster who can, with a sob and glistening tear, sever the heart strings of the most callous Marine drill instructor. Imagine this very same youngster pleading with his parents (and grandparents and aunts and uncles) for, "Just one little old 75A4, a 3-element beam for 40 meters and an 80 foot, self-supporting tower."

I've seen Novice stations that put the National Bureau of Standards to shame—VFO and all. Here then is the material to replenish the ranks of our most glorious hobby. Heed this prediction well, "Today's Novice will be tomorrow's scrounger."

Our present day world is dominated by the cold war, missiles, nuclear warheads and most important, electronics. What finer place for a scrounger than in an electronics company? There are only two worthwhile positions in electronics; that of general manager and janitor. When making your choice, forget about the lack of formal education, integrity and pride. None of these traits are required for either position, and in truth, can be most harmful to the journeyman scrounger.

Another consideration that must be taken into account is your choice of circuits. Get a

"... they hide parts under garbage"

job with a communications or industrial controls outfit if you prefer working with vacuum tubes. Remember the article in a prominent amateur radio magazine[1] that stated that it doesn't appear that there will be much use made of transistors in amateur work? They may still be right.

The transistor man should get into a digital computer company. Man, do you have a choice of quality diodes, miniature potentiometers, tantalum capacitors and blank etched circuit cards! Components for transistorized power supplies are also available.

There is a decided disadvantage with computers, however. They use transistors for high-speed switching and in amplifiers that operate only up to one megacycle. You may have to buy high frequency transistors.

The mark of an accomplished scrounger is to take advantage of all situations. High cost of living has forced many men to moonlight. That is, to get a second job. Become general manager of a computer company and janitor with a communications outfit.

As general manager you've got it made. Initiate an austerity program as soon as possible. Take a hint from the military. Demand that defective printed circuit cards and modules be discarded instead of repaired. If the chief engineer rebels, back him into a lab and question his intelligence, and better yet, his pedigreee. You'll become hero of the lab and the union will think of you as enlightened management. You will be able to scrounge enough parts to start an electronics distributorship.

Of course the company will start losing money and the stockholders will scream for your scalp. At this point you will probably start acting like a storybook executive and try to save the company. Resist the temptation. You only took the job to scrounge parts. If you want to buy parts for the junk box, forget about amateur radio and get a Citizen's band rig.

Being janitor is another story. At this job you work best at night. However, make sure to get to work at least one hour before the day shift knocks off. This gives you an opportunity to become acquainted with the lab technicians.

Lab technicians are dominated with the constant fear of having to breadboard circuits with parts that have been used before or that have lead circuits shorter than one inch. They live in mortal fear of putting together circuits with some semblance of tidiness and order. To produce a neat circuit is to admit their job is not difficult. In addition, a mechanically and electrically sound circuit usually works within design specifications the first time tried. Any technician making such a circuit will be hauled into kangaroo court and tried for treason. It is these very circuits that louse up overtime by eliminating the need for debugging. Let's face it, most circuits are copies of those found in the Preferred Circuit manuals put out by the military. So why kill the job?

A janitor's job can be dangerous. Most of your scrounging will be done after the lights have been turned off. There are many danger areas in an electronics plant. Relax for a moment and you are liable to find yourself at the bottom of an elevator shaft. With any luck your injury might be minor, like a broken spine or compound fractures of both arms and legs. A head injury, however, may leave you with scrambled brains. Should this happen, beware. The head of personnel will hear about it and before you can decline, you'll be Marketing Manager. But, then, those are the breaks.

So far I've only told you about getting started as a scrounger. Let's get down to the finer points. Teflon insulated wire and coax are easy to come by. Keep your eyes open when cables are being fabricated. Cable lengths are always odd multiples of the amount of wire and coax stored on spools by the manufacturer. There is always a piece left on the end of the spool that is a few inches too short. Glom on to it.

Resistors, transistors, diodes, capacitors, coax connectors, terminal boards and a multitude of other good parts can always be found in waste paper baskets. As mentioned before, technicians discard parts that have been used before and those that have short leads. Because they have a guilt complex, they hide parts

[1] QST Oct. 1948, the "Transistor" — an Amplifying Crystal.

under garbage. Be on the lookout for sloppy waste paper baskets. The ones with half empty coffee cups and partially eaten sandwiches covered with cigarette butts will yield a fortune in parts.

No lab is complete without a Polaroid camera for taking pictures of scope patterns. The empty film spools make excellent spreaders for feedlines. Since lab technicians are the world's worst photographers, your supply of spools is unlimited.

As you can see, opportunities for scrounging radio parts are unlimited. However, I have purposely given you only the bare essentials as a beginning course. For the small sum of $5.99 you can receive a complete home study course. Send your certified check or U. S. Postal Money Order to:

Marketing Manager
QQQ Electronics, Inc.
c/o 73 Magazine

No personal checks, IRC's or stamps, please.

Soldering Iron Tip Tip

You'll get a lot more mileage from soldering iron tips if you rig a way to keep them cool (but not cold) except when you're actually heating work. The idea is to switch a resistance into the line to drop the voltage about 50%, keeping the iron warm but preventing the tip from overheating. When you are ready to solder, short out the resistance and full voltage is applied.

You can use a standard SPST toggle to do the switching. I've put together a soldering iron rest in which the weight of the iron opens a normally-closed microswitch to put the resistance in series with the iron; lifting the iron closes the switch and permits the full 110 volts to go to the iron. For a resistance, I use a 7½-watt, 110-volt bulb, but other irons may require different size bulbs. . . . W2QPQ

The Local Net

How to double the fun of Ham Radio

George Thurston W4MLE
3407 Prock Drive
Tallahassee, Florida

ANY town with two or more amateurs which doesn't have a local net is missing some of the best fun in ham radio. The uses are limitless, the fun is endless and the value is considerable. The cost is small, the junk box comes into its own and the frequency doesn't especially matter, so long as everybody is on the same frequency, and provided it is above 28 mc, where skip, fading and QRM are not major problems.

Tallahassee got into the local net business to provide emergency communication between 80, 75 and 40 meter Key Stations if phone service should go out. But it quickly turned out to be so much fun that practically every active amateur in town now checks into 29,-560 kc several times a week.

The Tallahassee Key City Net is probably typical—or certainly could be. In between emergencies, which so far have been few and far between, there's a continual round of activity which includes checker games, rag chewing, DX chasing on ten, DX chasing on other bands (details in a moment), experiments with extended groundwave communication with other towns, traffic handling, contests, small practical jokes and helping passing mobiles.

We have no scheduled meetings, no roll calls, no membership lists. The trick is to have completely separate stations for the local net, so that you're always on the net, no matter what other band you may also be working.

In addition, each station should use a squelched receiver on the net frequency, and leave it running all the time—24 hours a day, seven days a week.

That's the sine qua non of a good local net —separate stations for the net, using squelched receivers which constantly monitor the frequency.

A separate station is a must. You don't want to limit your operating to the local net only. You normally use the big rig for your favorite HF bands for DXing, rag chewing, traffic or other things. You can't conveniently halt everything and go have a look on the local frequency at scheduled times. Besides, some of the best fun and greatest use of the local frequency comes from using it *in conjunction* with operation on the big rig.

The net station can be quite simple. At W4MLE it came entirely from the junk box, without a cent of original expenditure for it. A crystal oscillator doubles, a driver doubles again to drive an old 815 I happened to have. It runs about 45 watts, screen modulated. The antenna is a fish-pole groundplane (8 feet of wire taped to a bamboo fishpole mounted atop the TV antenna mast). The receiver is a crystal converter working into a command set. Since the receiver is never tuned, calibration is immaterial and the xtal converter oscillator uses a discarded 27 mc citizen's band xtal. Almost any frequency converter xtal will work, if you can find a command set (or other inexpensive receiver) to tune the difference frequency. The *if* should be pretty broad. QRM is not a problem, and transmitting crystals seldom hit the same exact frequency on their fourth harmonics, even when their fundamental frequency is theoretically the same. You don't want to have to retune for each net member station.

The receiver's detector bias (not used for AVC in the command set) is used to operate a squelch control tube. There are dozens of squelch circuits—most of them quite simple. (73, Dec. 1960).

Many commercial transceivers have squelch built into them. The Heath Tenners, Twoers and Sixers make exceedingly fine local net rigs and although they have no built-in squelch, it is simple to provide one.

The squelched receiver bit, though more subtle, is just as essential to a good local net as a separate transmitter. No one likes to listen to receiver hiss, ignition noise and power line interference all the time. The squelch eliminates all this, so long as the channel is vacant. But the receiver is always there, listening for signals without disturbing you until it hears something.

Without squelch, the tendency is to turn the receiver way down, or turn it off entirely when not expecting a call. This tendency is disaster to successful operation of the net for the same reason it would be disaster if the local police turned their radios off after each QSO and maybe listened in only at scheduled times or when called on the phone and told to listen. Squelch is the answer to the old complaint "We had a local net once, but you could never get anybody on it, except for scheduled net drills, and it just sort of folded up."

We undertook the Key City Net as a Tallahassee Amateur Radio Club project with the minimum objective of getting at least the AREC Key Stations equipped with separate 10-meter gear. These stations are capable of auxiliary power operation in emergencies and we wanted to be sure they could keep in touch with each other by local radio in case land lines go out or get overloaded. Each Key Station guards a separate HF emergency net and the Key City Net is used to transfer traffic from one HF net to another when needed, as well as to coordinate the overall operation.

Ten meters was chosen for several reasons. (1) 29,560 had already been established as a Western Florida frequency and was in use in most other cities in the panhandle, where 10-meter nets existed. This opened the possibility of extended groundwave work and long haul relays in case of long-skip or blackout problems on the HF bands. (2) Most mobiles can operate 10 with existing all-band commercial gear. (3) Ten meter equipment is relatively uncritical to build and equipment is simpler than VHF. (4) Many non-Key stations would be able to use the frequency with their big rigs, even before or without getting separate station capabilities on the net.

These were our main reasons for picking 29,560 kc. Other cities may have equally good reasons for choosing frequencies in the 50, 144 or 240 mc bands.

Vertical omni-directional antennas turned out to be a "must." For some reason, horizontal antennas just didn't work well for local contacts, even when worked against horizontal receiving antennas. There is no such thing as getting an antenna too high. And a very low VSWR is essential to good antenna efficiency. These general rules probably will hold true regardless of what band or frequency is chosen.

Unexpected bonuses began to show up almost as soon as a few of us got separate equipment going on ten.

K4YPI, W4CMG and I like to chase DX at the low end of 80 cw, coordinating our digging by using ten meter phone. That's triple-diversity reception using the other guy's antennas and receivers to hunt DX for you. Early one morning my squelch broke and K4YPI told me of a JA coming through on 3509 kc. The fact that I didn't work him for my 3.5 mc WAC was no fault of Norm or the operation of the net.

Our local net rigs have worked short skip stations on Sporadic E from Maine to California; from KP4 to KZ5. Even the boys with the Tenners get out.

Checkers? W4CMG and WA4AMH have great sport.

Mobiles? The tenners work fine from a 50-watt electric shaver inverter plugged into a car's cigarette lighter socket.

Whenever a Florida mobile comes through the area, he knows he has a chance of finding someone on 29,560. The frequency has recently been adopted statewide for local and mobile AREC work. The State Road Department has printed the Official Florida Road Map with a small "box" on the face of the map which says "Statewide Amateur Radio Mobile Calling and Emergency Frequency 29,-560 kc." The map is handed out free to most tourists entering the state at an Official Welcome Station. Eventually, mobiles may be able to drive the thousand miles from Pensacola to Key West without retuning the receiver and without losing contact with fixed stations along the route—provided enough stations keep squelched receivers and separate transmitters standing by on the frequency.

Extended groundwave? Tallahassee is surrounded by towns with only one or two active hams who might be unable to run their own local net—but who can work into the Tallahassee net at will, at distances ranging from 16 or 18 miles to 60 or 70. Some of these stations are so located that they can also work into other local nets on 29,560 in Panama City, Ft. Walton Beach and other towns strung eastward from Pensacola. They can (and often do) serve as relays.

A test message originated in Pensacola travelled the 200 miles to Tallahassee with one relay, was delivered via squelched receiver without the use of a landline and a reply sent over the same route in an elapsed time of not more than 15 minutes—and with no haste or special effort at speed at any point in the chain.

This is old stuff to the two-letter-call 200-meter gang but it is rapidly becoming important again as long skip begins chopping up our 75 and 80 meter nets.

Give it a whirl in your area, or fire up on an existing local net frequency with separate station equipment, including a squelched receiver. If you set up a new net, try to pick a frequency which will let you work in with near-by towns without re-tuning. Especially on 144 mc and higher, the more squelched receivers monitor channels which are in regular use in distant places, the more often you'll discover "DX" openings you might not otherwise have suspected. . . . W4MLE

Clear, Smudgeproof Labels

No need to rack your brains or trace circuits, or wonder what that smudge means that now just reads "6 . . ." Use these labels to mark sockets, trimmers and terminals, or date tubes, etc. (For light-colored surfaces only.)

1. Apply a two-inch, more or less, strip of "Scotch" Brand Magic Tape (3M Co., St. Paul, Minn.) to the roller of your typewriter.
2. Type the label desired on the tape.
3. Apply a second strip on top of the first and press on firmly, allowing no bubbles.
4. Remove the second strip from the first. The typed message will now be on the adhesive side of the second piece of tape.
5. Trim the second piece of tape to appropriate size and stick the label in place.
6. The first piece on the typewriter roller may be now wiped with a cloth and used over as many times as desired.

The tape is nearly invisible and will not yellow with age. The letters show clearly, especially if heavy pressure was used in typing to put plenty of ink on the tape. The labels won't smudge or rub off because the ink is under the tape.

This system also makes neat captions on photographs, notations on diagrams in books and manuals, any place where a neat, short message is needed on a smooth, light-colored surface. . . . WϕOPA

Modernizing the VF-1

Howard Lawrence W2RHD
Munn Lane
Cherry Hill, New Jersey

JUDGING from recent radio contacts, there are still many Heath model VF-1 variable frequency oscillators in use, despite its having been superseded by a later model. The VF-1 used for several years at W2RHD has been modified recently with a resultant improvement in performance that may be of interest to other amateurs. The primary object of the modification was an improvement in frequency stability, particularly on the higher frequency bands. This was accomplished by substituting air trimmers for the ceramic trimmers originally used, providing a more rigid mounting for the two ceramic oscillator coil forms, improving the ventilation of the case, removing some heat generating components from the main case, and adding a double triode oscillator and cathode follower to the circuit.

Very few new components were used. The new schematic is shown in Fig. 1. New components are shown in heavy lines. (Several of the original components are also used in new locations.) The 6AU6 originally used as both an oscillator and amplifier has been rewired to function only as an amplifier as shown in Photo 1. This required a new 33,000 ohm series screen resistor and modification of the grid and cathode circuit. Otherwise the 6AU6 is undisturbed. The OA2 voltage regulator tube and its socket are removed and a 12AU7A 9 pin miniature tube and socket are substituted. The original oscillator circuits are rewired to the oscillator half of the 12AU7A. The grid resistor (2.2K) formerly used with

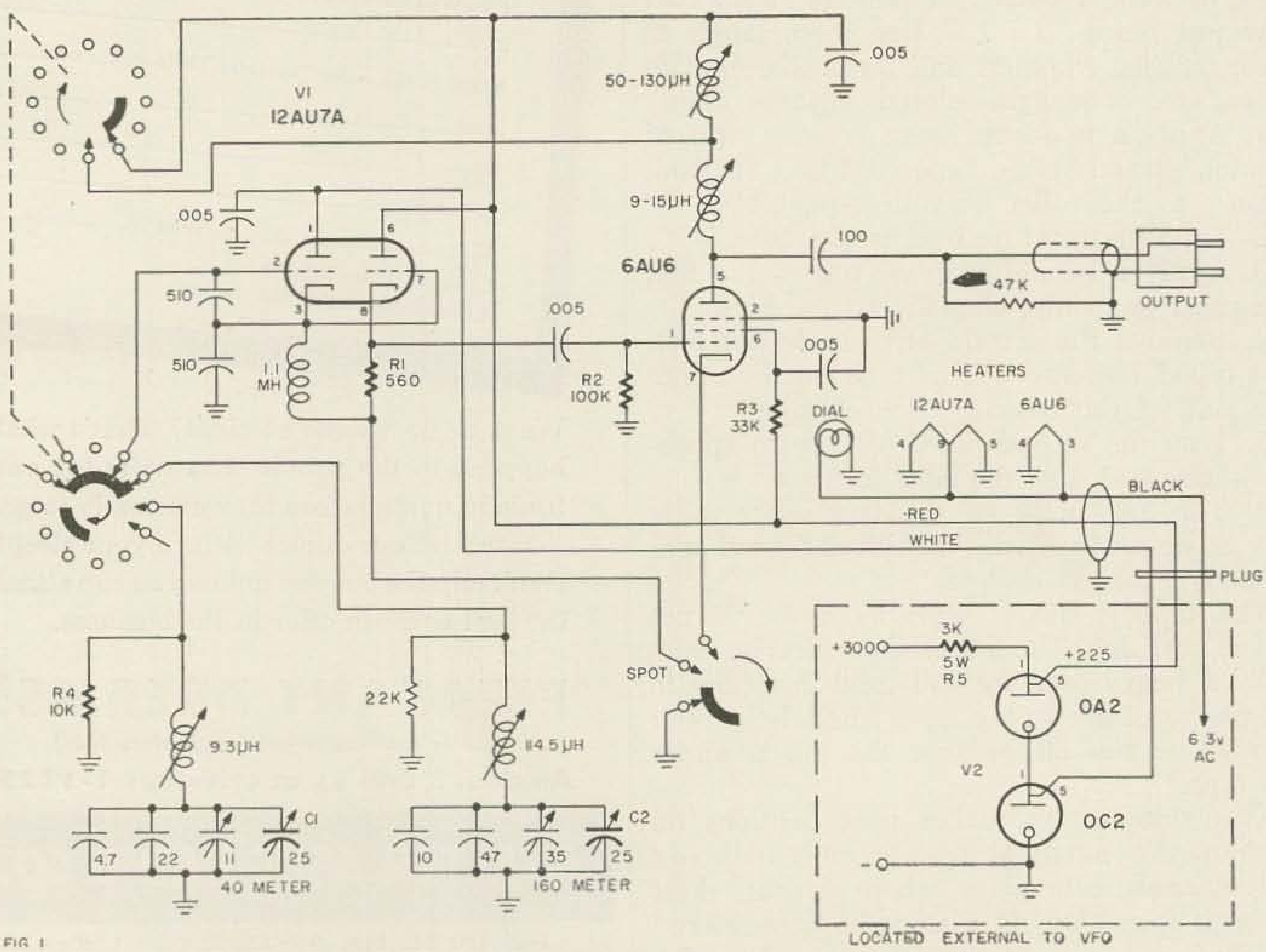


FIG. 1

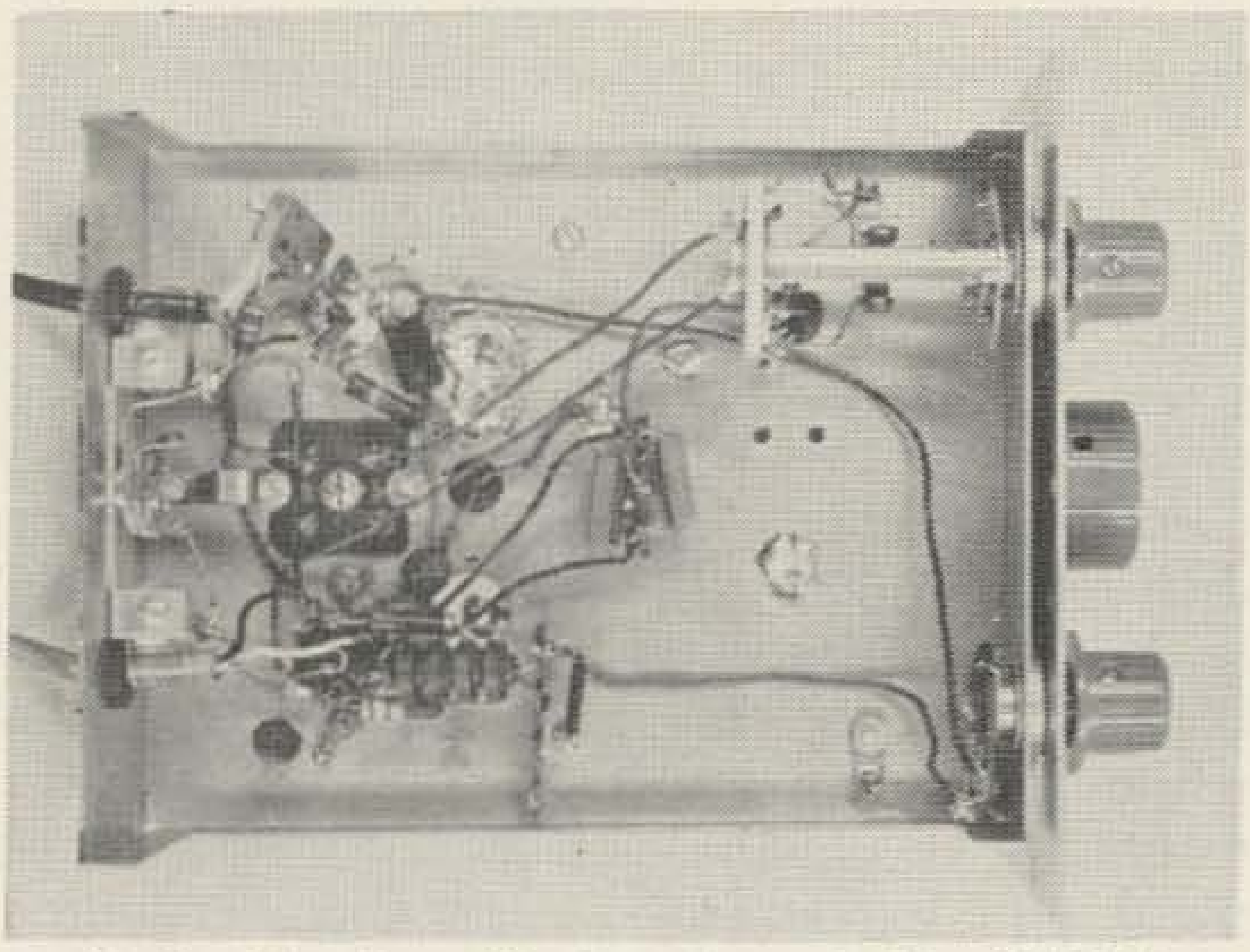
Schematic of modified VFO. New components are shown in bold.

the 40 meter oscillator coil is increased to 10,000 ohms to reduce the power input to the 12AU7A and thus obtain somewhat better stability. The original 2.2K resistor was apparently used to increase output at the higher frequencies, but since a cathode follower type of amplifier has been added, the extra oscillator output is not needed.

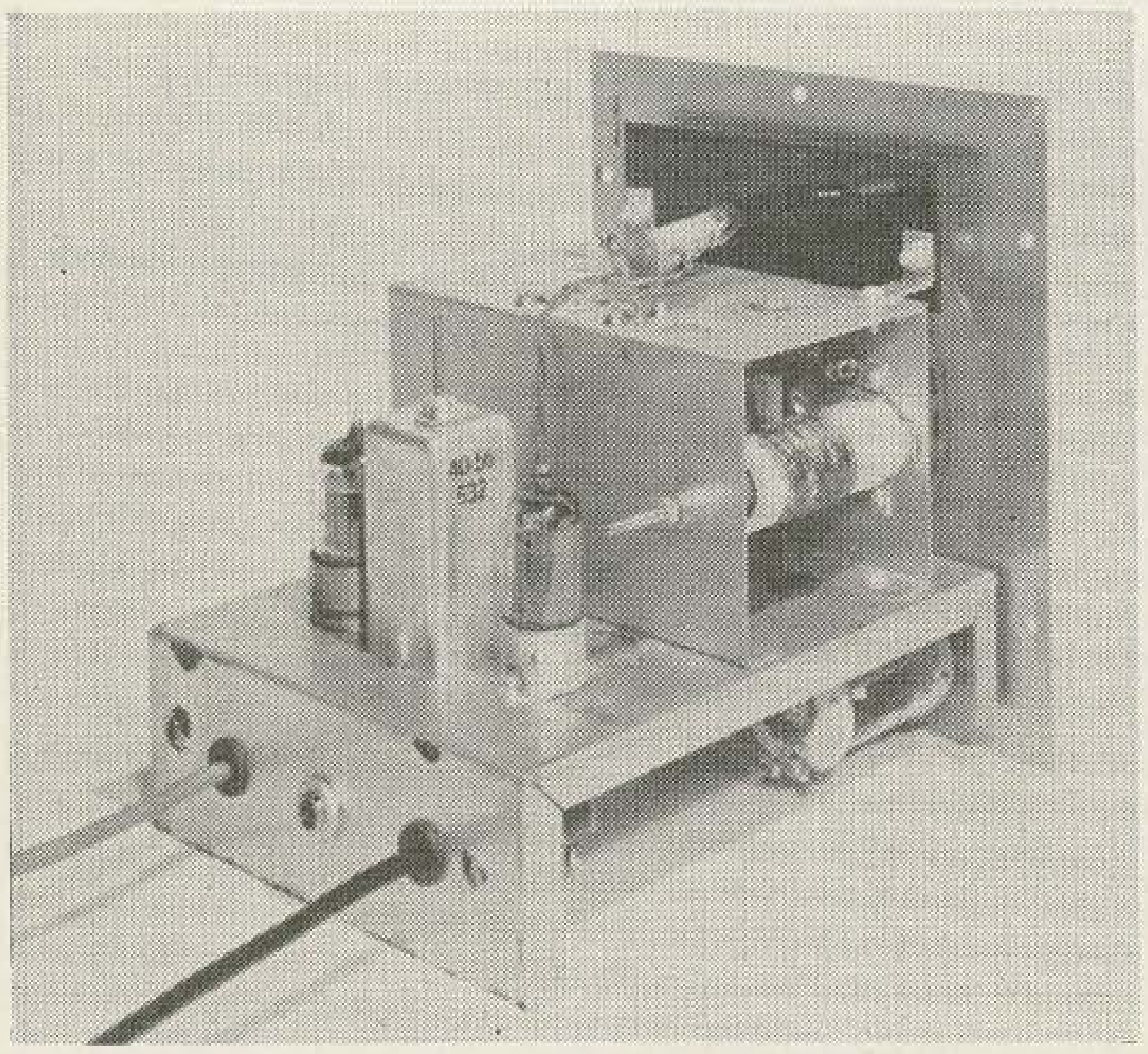
Mechanical rigidity of the two ceramic coil forms upon which the oscillator tank coils are wound has been increased. The mounting screws for the coil forms were loosened and ⅜" by 1" strips of aluminum of a thickness slightly greater than the original spacing between the coil form and the chassis were slipped between the coil form and chassis. The screws were then retightened and the coil forms are now more rigidly supported on their mounting base.

The two 25 mmfd ceramic trimmers used to adjust the oscillator frequency were removed and two Hammarlund APC-25 trimmers were substituted. It was necessary to mount these trimmers slightly towards the rear and towards the centerline of the platform upon which they were originally mounted in order to obtain clearance from the oscillator coils. In the equipment modified, the trimmers adjust near minimum capacity so somewhat lower value trimmers could have been used, making it possible to mount them in their original locations. (See Photo 2.)

The original power switch has been rewired so that the "off" position is now the standby position and the "standby" position has become the spotting position. It was felt



Underside of modified equipment. The 12AU7A is located in the original OA2 voltage regulator position. The voltage regulator and its associated series resistor are externally located to reduce the heat generated within the enclosure.



Top view of modified VFO showing new location of oscillator trimmers.

unnecessary to use the "off" position since power for the VFO comes from an external power unit and this external power unit normally has its own power switch.

It was found that there is a slight difference in frequency between the spotting position and the operating position unless adjustment of the 6AU6 plate coils is properly made. This difference in frequency amounts to two or three hundred cycles, but it is annoying when operating CW. The technique used in adjusting the plate coils for minimum frequency shift is to first adjust the output coils for maximum output and then make a minor adjustment while switching back and forth between spot and operate switch positions until minimum frequency difference is noted.

The oscillator voltage has been reduced to 75 volts, again to minimize heating and its resultant drift. The cathode follower and amplifier are operated at a plate voltage of 225 volts. These voltages are obtained from an external power supply and voltage regulator tubes. The regulator tubes and the related series dropping resistor are located externally to minimize the heat generated within the oscillator cabinet, thus reducing frequency drift and frequency stabilization time. The red lead in the power cable originally used for B+ is used for the 225 volt lead and the white lead in the cable originally used for externally keying the oscillator is used to supply the +75 volts. If the external power source cannot supply a full 300 volts to the regulators, an OB2 can be substituted for the OA2 shown in the diagram.

Additional ventilation was provided by cutting out a 3 x 4 inch opening in the rear of the cabinet above the chassis and then covering this opening with window screen wire. The screen wire is held in place by ¼" wide strips of aluminum. The inside of the cabinet was painted a dull black so that it would absorb any radiated heat and reradiate it to the outside, rather than reflect it back onto the components.

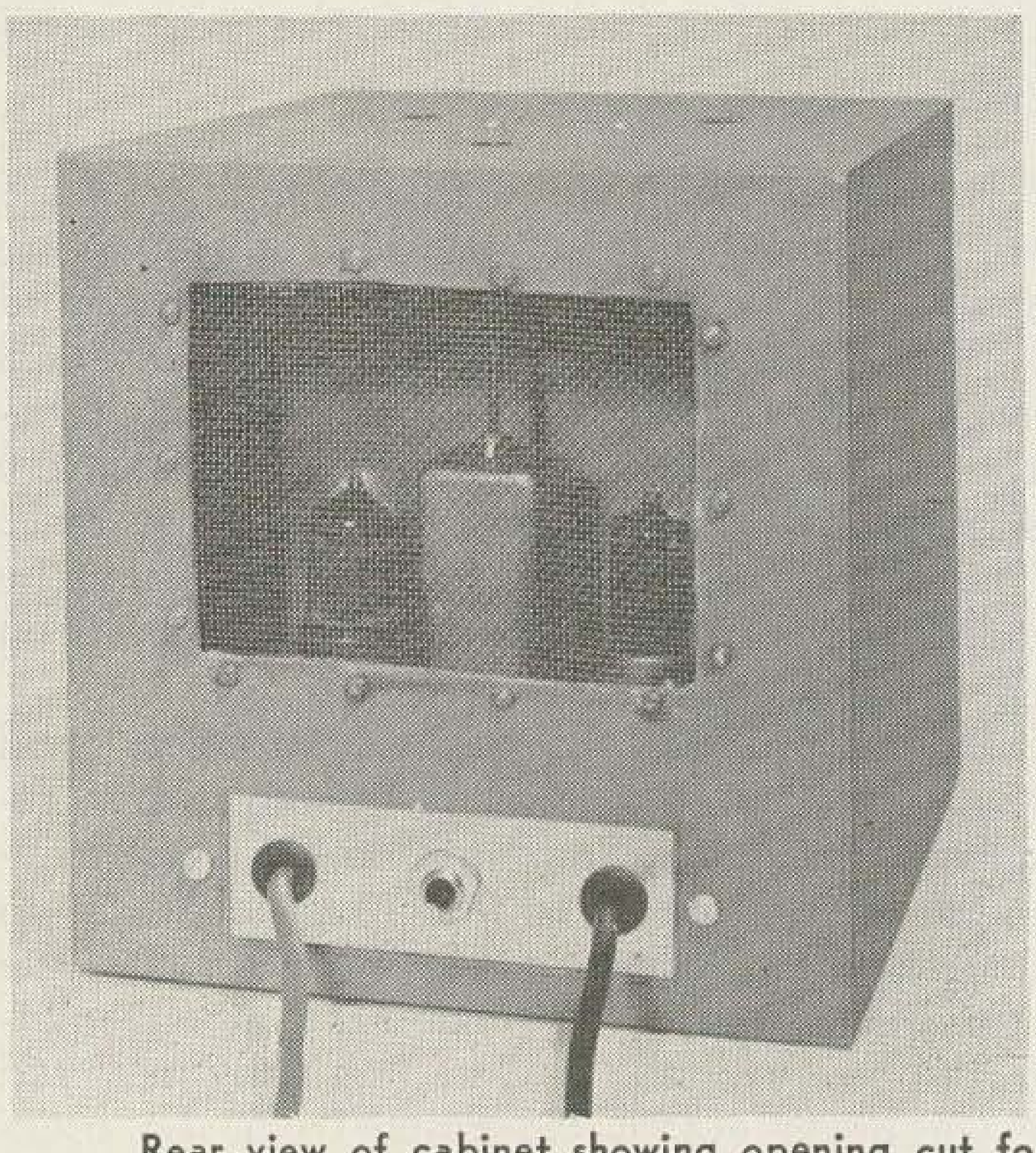
Results

The stability of the VFO is now greatly improved. Since there is very little heat generated, the heat being primarily that of the heaters of the two tubes, the oscillator reaches a stable condition in a matter of a few minutes. Shielding is sufficiently good that on the spotting position most signals can be zeroed in without blanking out the received signal. This is particularly so on the higher frequency bands. The only possible remaining deficiency is the operation of the standby-spot-operate switch. Occasionally when going from operate to standby and back, there will be 100 cycles or so difference in tone. This is completely eliminated, however, if the B+ is shut off at the power supply between contacts instead of opening the VFO cathode circuits.

. . . W2RHD

Parts List (New Parts Only)

R1—560 ohms ½ watt.
R2—100,000 ohms ½ watt.
R3—33,000 ohms ½ watt.
R4—10,000 ohms ½ watt.
R5—3,000 ohms 5 watt.
C1, C2—25 mmf air trimmer (Hammarlund APC-25 or MAPC-25).
V1—12AU7A 9 pin min. tube.
V2—OC2 7 pin min. voltage regulator.

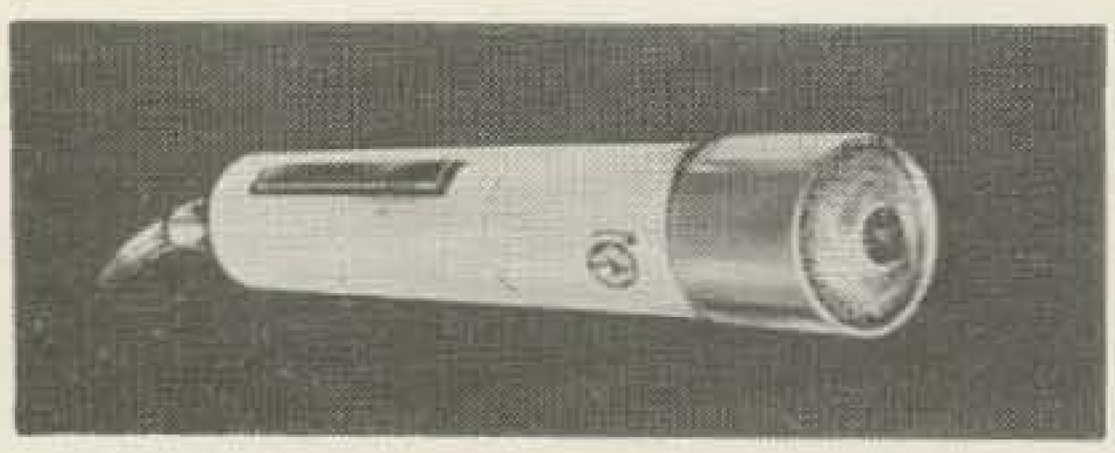


Rear view of cabinet showing opening cut for ventilation.

New Products

1963

Lafayette Radio, one of our strong boosters, is rushing the season with their new catalog. This represents quite a bargain when you consider the cost per page is about $0.00007731958, if you figure that you are getting 388 pages (the largest they've ever put out) for your 3¢ post card. Lafayette has been going great guns in the ham field you know, which means they have all sorts of gear that you won't find sold by anyone else. Same thing with hi-fi. Lafayette Radio, 111 Jericho Tpk, Syosset, LINY.



Big Mike

Communications, Inc., has a new idea for us. They are now producing a combination microphone and transistorized preamplifier all in one unit. This mike gives really high output if you want it and will give results even with rigs that normally are on the low side modulationwise. Big Mike costs $29.95 and features a squeeze-to-talk bar, a magnetic hang up arrangement and adjustable controls for varying the tone and volume output. The mike is only 4½" long and 1½" in diameter. A mercury cell runs the transistorized amplifier for several months of normal operation. Big Mike is available from most dealers or write Communications Inc., 33 Danbury Rd., Wilton, Conn.

HQ-145X

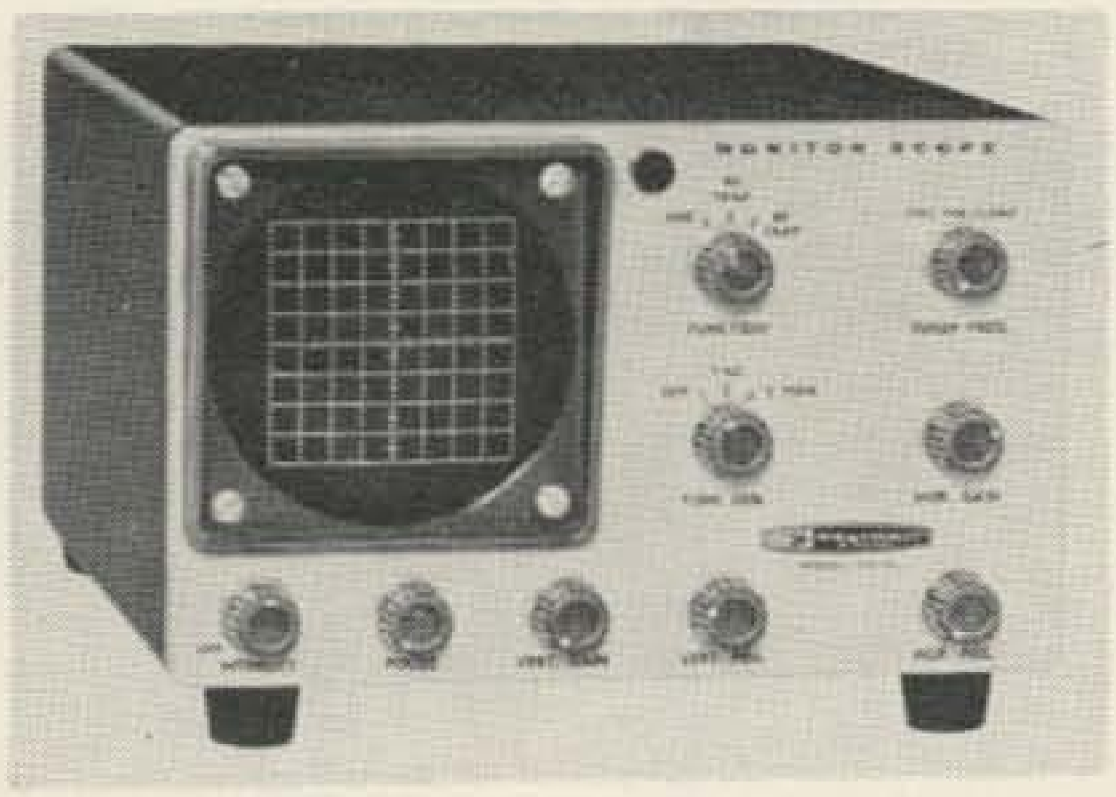
You may have been sitting around taking it easy, but it is obvious that the boys up at Hammarlund have been burning the midnight oil. The latest invention is a modified HQ-145 receiver which has a single crystal controlled channel for any fixed frequency that you may want to be able to monitor without having to return the main tuning control. This will be of great interest to fellows who operate on net frequencies, MARS, CAP, or want to be able to get WWV or CHU at the push of a button. Hammarlund will send info., 460 West 34th Street, N.Y. 1.

Reflected Power Meter

Heath now has a $15.95 SWR meter for your kit. Handles 1 k. ! Six through 160 meters. 50 or 70 ohm lines. Indicates the power rushing up your feeder toward the antenna and the power turned back by the mismatch when it gets there. May be left in the antenna system at all times. Designated model HM-11.

Telrex

Mike, W2BDS, has an all new PL77 catalog available. This one lists their myriad of different ham antennas and beams all in one little booklet, giving all of the particulars as to size, gain, front-to-back, beam width, weight, price, etc. Write Telrex, Asbury Park, N. J. and ask for one.



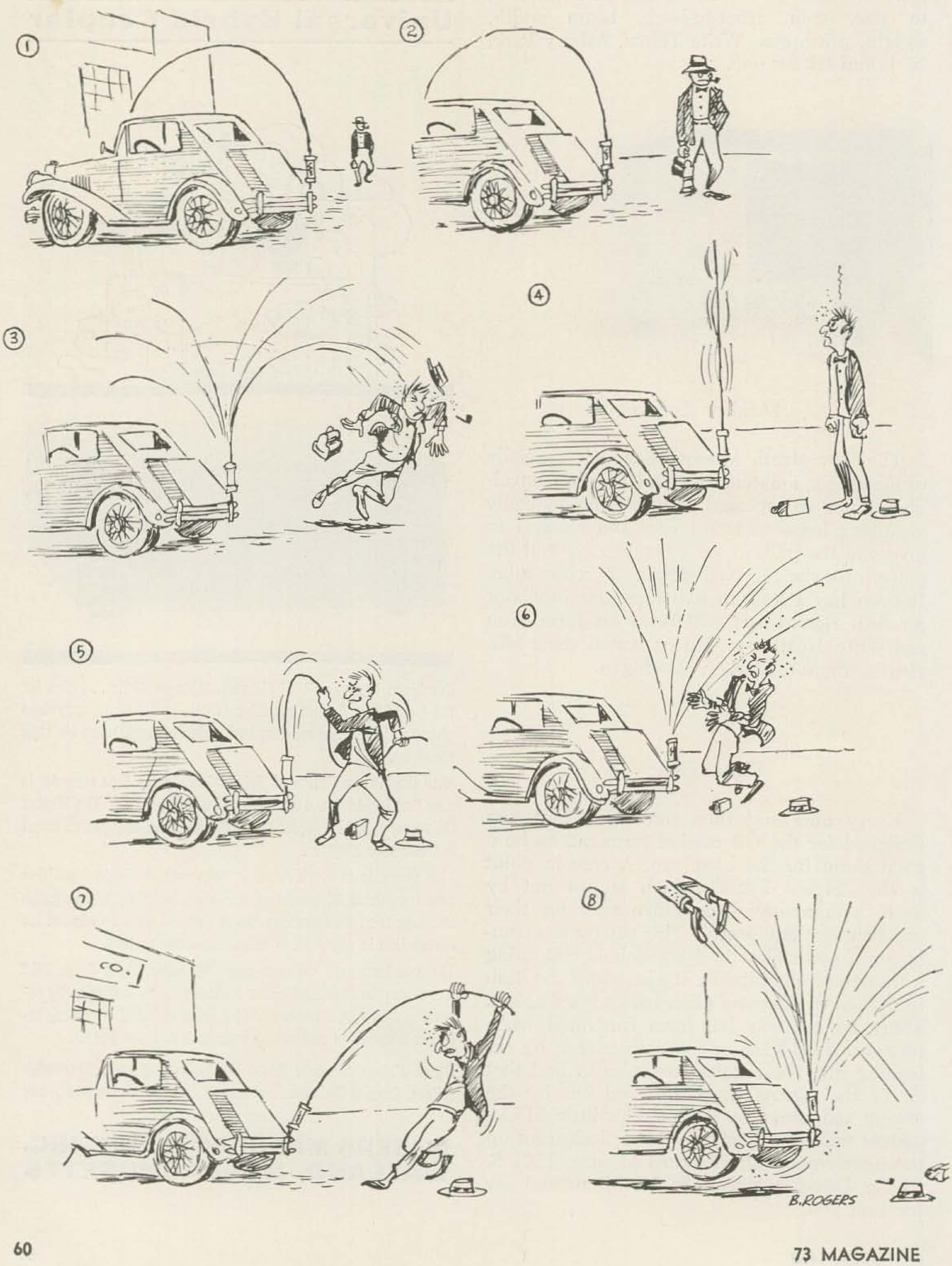
Monitor Scope

The new Heath Monitor Scope is specially designed for amateur use and displays envelope, af and rf trapezoid patterns, automatically switching between transmitter and receiver to give you the pattern for your own rig and the pattern for the received signal. 3" scope tube. It even has a built-in two tone test oscillator for SSB rigs. Costs $59.95 in kit form. You can write Heath for info or watch their ads. Heath, Benton Harbor, Michigan.

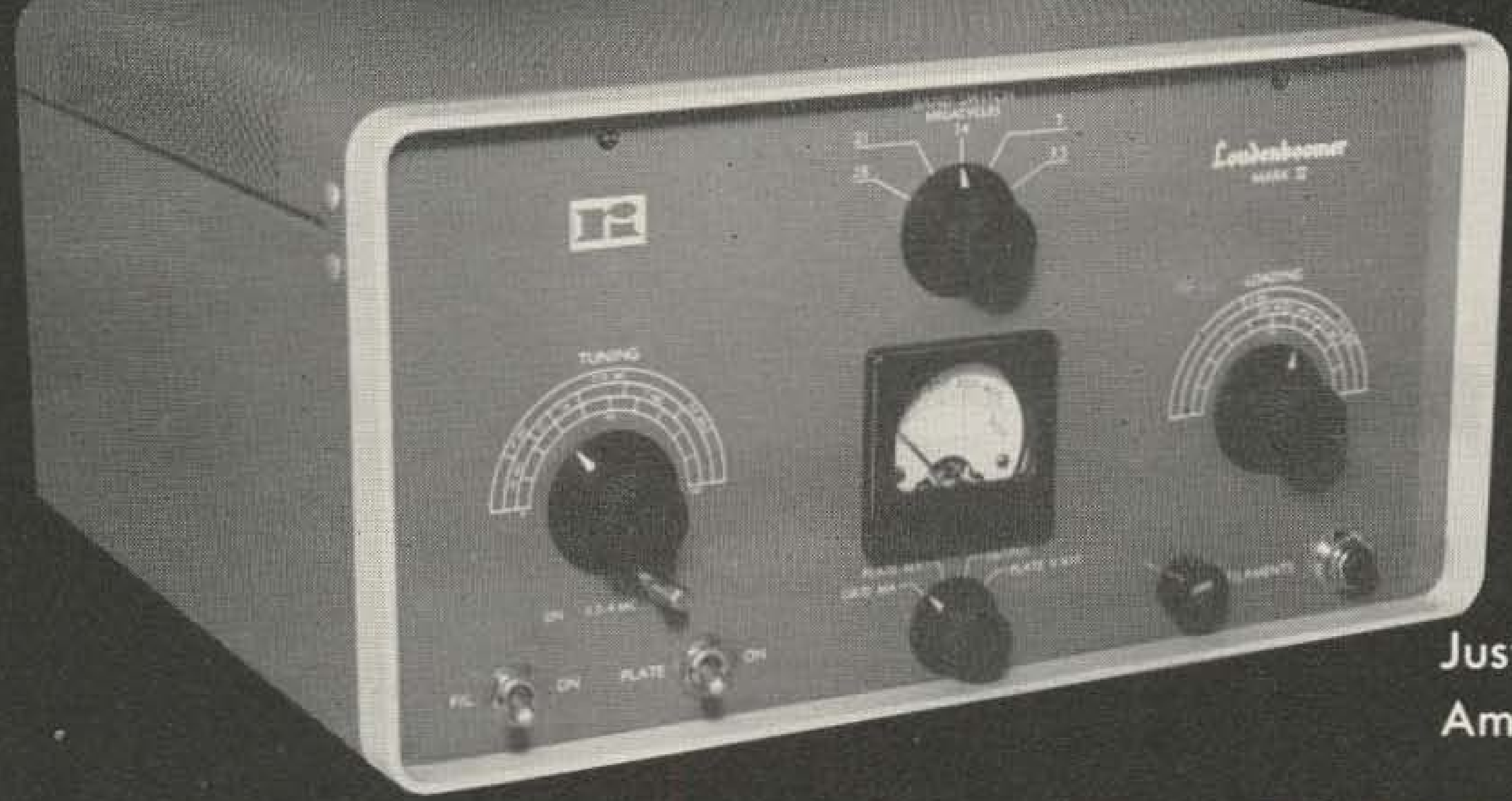
Signal Filter

Every now and then something that was designed for the CB market turns out to be a good thing for the ham, too. A case in point is the "Signal Filter" which is put out by Seco, a company well known now for their excellent test equipment. This gadget is a combination noise filter and squelch circuit using a triode and dual diode. It eliminates the hash from auto engines and other background noises. Many an amateur has been frustrated when he put a good VHF or SW converter in his car feeding into the regular car radio to find that all of the signals were drowned out by the engine and generator noises. This little $15.88 gadget will go a long way toward clearing up the interference. Drop a card to Seco, 1201 S. Clover Drive, Minneapolis 20, Minn. and say Joe sent you.

Mobile Whip



MONEY SAVING! SPACE SAVING! QSO SAVING!



Just $279.00
Amateur Net

THE DESK TOP

Loudenboomer

MARK II RF LINEAR AMPLIFIER
by RADIO INDUSTRIES, Inc.

Features the sensational Eimac 3-400Z high-mu Triode. No Grid or Screen Bias Needed. Low Distortion!

There's something about the MARK II Linear Amplifier that reminds you of the good old days!

Perhaps it is the husky, conservatively rated components—that loaf along without strain. It may be the straightforward layout that makes all components easy to reach. Or, it could be that Total Look of sturdy reliability. Or—the low, low price!

Rest assured, though . . . with all its old fashioned appeal, the MARK II is as modern and advanced as tomorrow! The smart two-tone gray enamel cabinet measures just 14⅛" x 12⅞" x 7⅛"... fits nicely on your operating desk. And the crisp performance of your MARK II will give you consistent QSO successes on even the most crowded bands.

Visit your Dealer soon and examine the great new LOUDENBOOMER MARK II LINEAR AMPLIFIER.

HERE ARE A FEW OF THE MANY MODERN FEATURES:

1. Zero-bias Eimac 3-400Z requires no screen and grid power supplies. 400 watts of plate dissipation.
2. Full legal input power on CW and SSB, 600 watts AM —80 through 10 meters.
3. 45 watts of drive for full input.
4. Grounded grid circuit for improved linearity. No neutralization.
5. Fully metered for grid current, plate current, plate voltage *and* relative power output.
6. 50 ohms input through wide band Ferramic transformer.
7. Adjustable Pi tank output; nominally designed for 50 ohms unbalanced load.
8. Requires just one power supply—2500 to 3000 VDC at 350 MA.*
9. Circuitry supplied for controlling power supply from MARK II panel.
10. 50 C. F. M. blower and self-contained filament transformer requires 115 VAC, 60 cycles. Both front-panel fused.

*NOW AVAILABLE: Matching Power Supply for the MARK II Linear Amplifier. Supplies 3000 VDC at 350 MA Continuous. Transformer Primary for both 115 VAC and 230 VAC. Size, 12" x 14" x 8½". Weight 75 lbs. AMATEUR NET, $159.59.

Write for illustrated Data Sheets.

1307 CENTRAL AVENUE
KANSAS CITY, KANSAS

RADIO INDUSTRIES INC

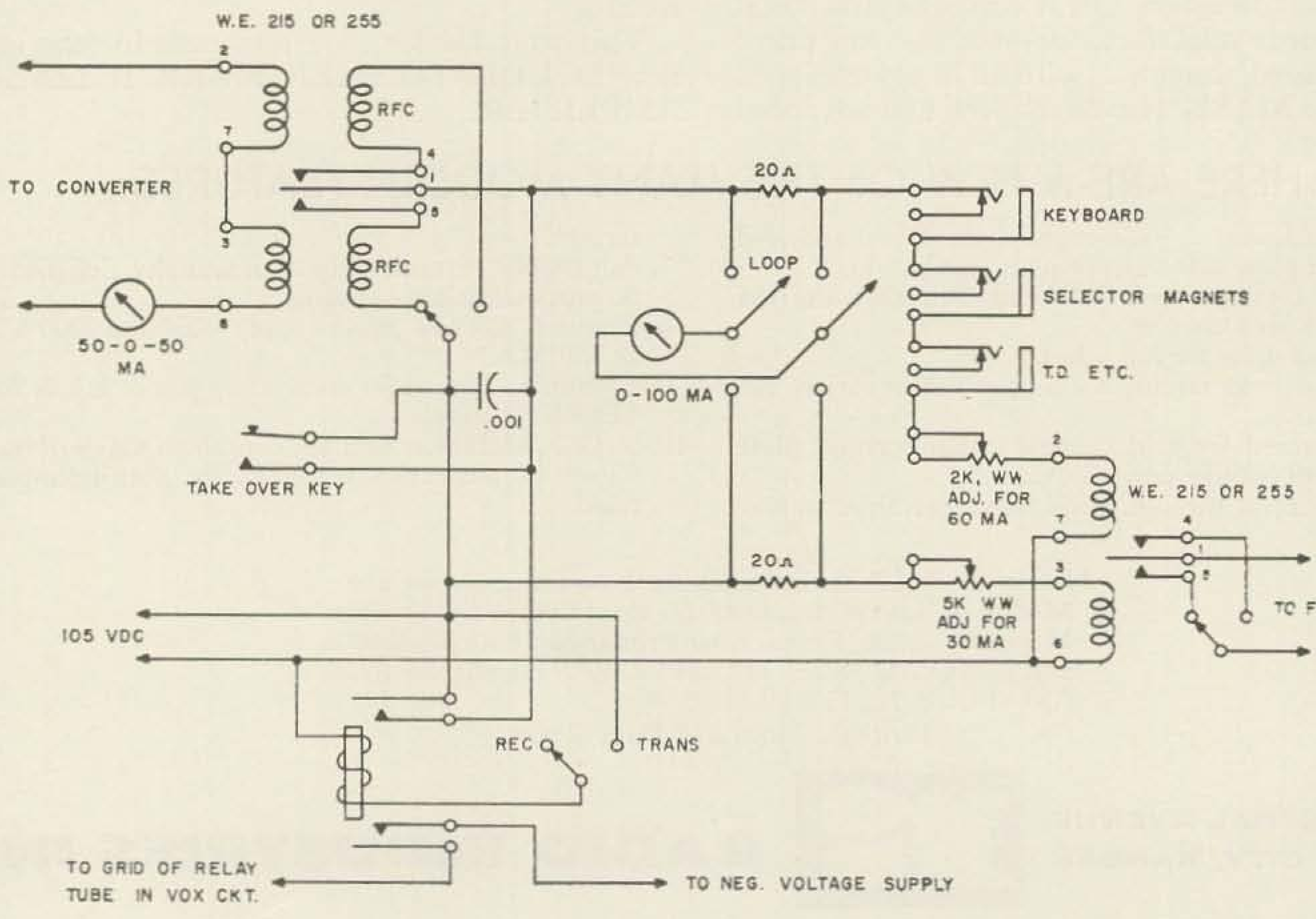
Control Circuit for RTTY

AFTER several years of experimenting with control circuits, I have arrived at one which seems to include all the operating features found desirable. It is simple, is not greatly different from those found published previously but includes features that I have found useful.

The addition of the "Take Over Key" provides for taking over when the copy starts piling up at the end of the line, is overlining or the machine is in upper case when it should be in lower. If any of these conditions exist, merely operate the "Take Over Key" then operate the proper keyboard keys to get the machine into proper condition to receive copy. The "Take Over Key" does not put the transmitter on the air.

Another feature of this control circuit that might be of interest to those who would like to control a transmitter using the VOX circuit is that of applying a negative voltage to the grid of the relay tube in the VOX circuit to provide the same control over the station they now have using VOX. Merely wrap a wire around the pin of the grid of the relay tube in the VOX circuit and the entire station is controlled by one switch.

. . . Lewis Stapp WØPHY



Simplescope,

Part II

Fred Cupp K8AOE
Electronics Design Engineer
Clevite Ordnance Division of
Clevite Corporation
540 East 105th Street
Cleveland 8, Ohio

THE article on the Simplescope (73 Sept. 61) has refocused my attention on the ubject of high voltage—low current power upplies. The power supplies shown in the rticle are fine but. . . .

In the course of some development work on onar equipment, an interesting high voltage upply has come to light. It has one distinct dvantage over conventional supplies. The utput current will remain fairly constant over wide load variations. In most power supplies this condition is to be avoided. For scope use this can be a distinct advantage. In the event of a short circuit (either a component failure or the operator's hand) the voltage will drop under the increased load and maintain nearly constant current. That means insufficient current to kill!

The secret is the use of a series resonant circuit to step up the voltage. Fig. 1 shows

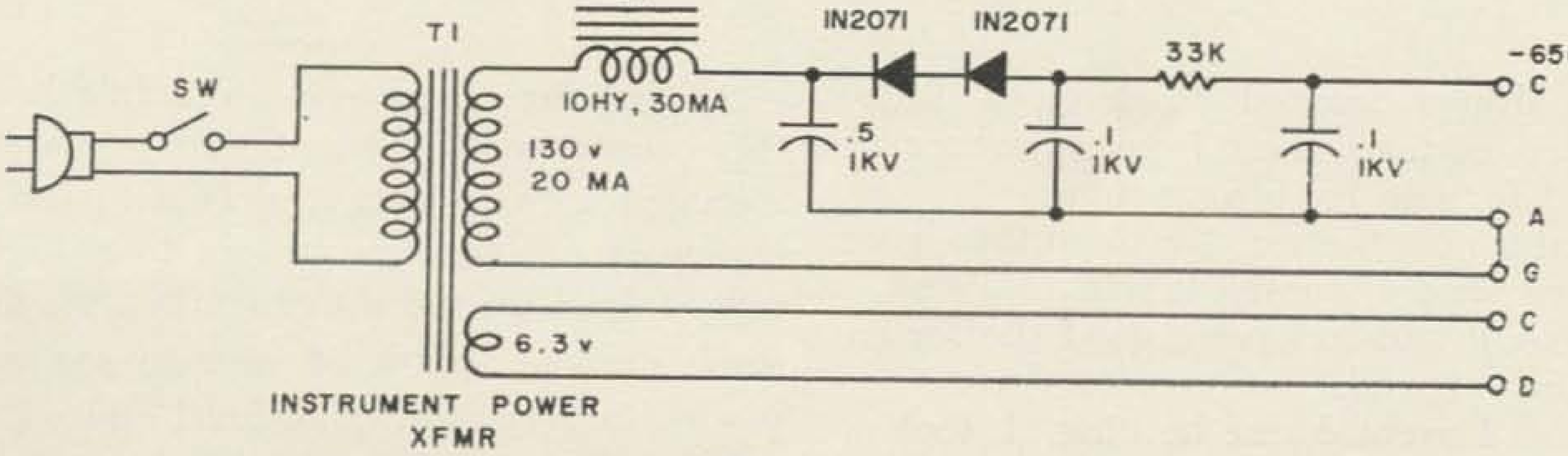


FIG I

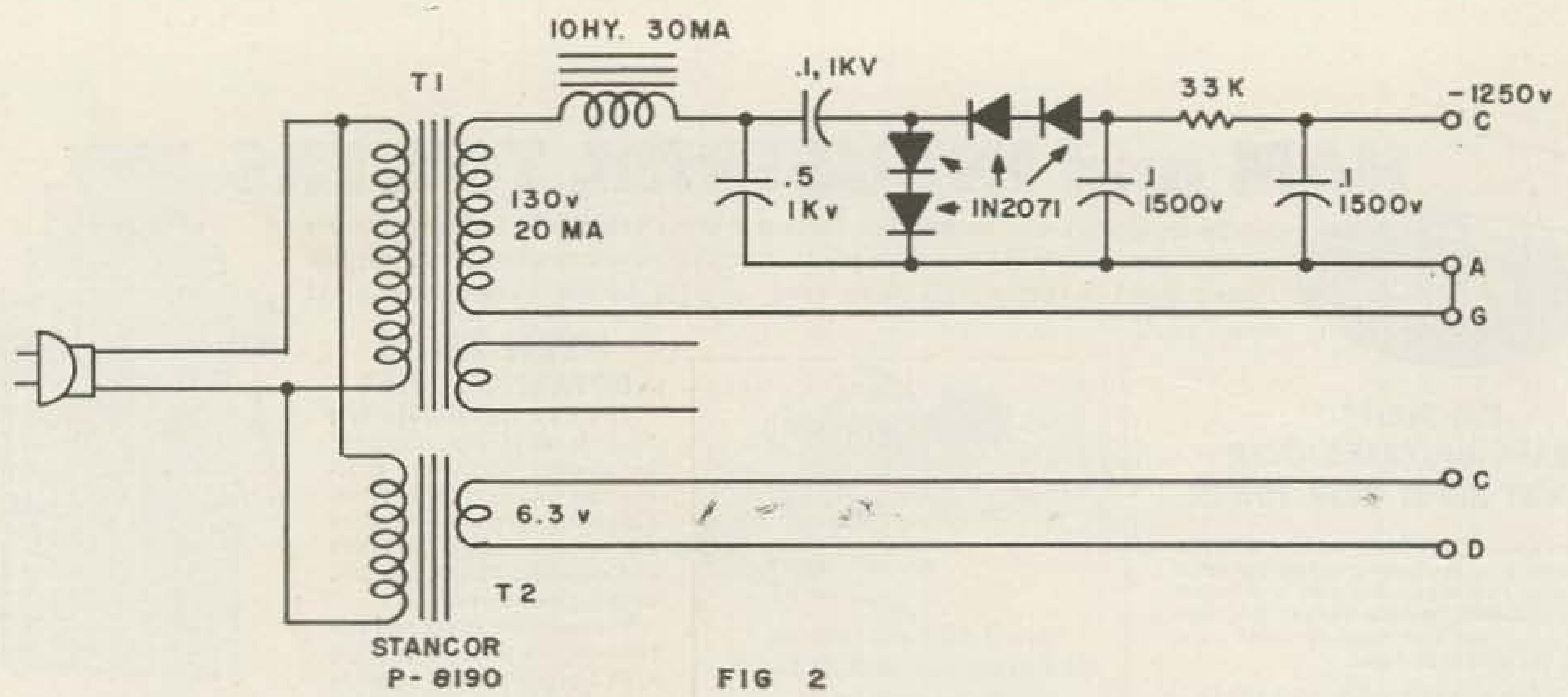


FIG 2

the schematic of the basic power supply. T1 is a common instrument type filament and isolation transformer. L1 is an ordinary 10 hy filter choke of about 30 ma rating. The choke and the .5 mfd capacitor to ground forms a series resonant tank at approximately 60 cycles. The voltage at the junction of the choke and capacitor runs as high as 900 volts RMS under no load. Under short circuit conditions, the choke limits the current to a low value, preventing either the operators hand or T1 from overheating. In this condition the tank circuit is no longer resonant hence no voltage step up.

The remainder of the power supply is a conventional half-wave rectifier which of course uses fewer parts than a voltage quadrupler. In addition the current limiting feature gives greater safety. By trimming the value of the series resonance capacitor the resonance may be shifted from 60 cycles, thereby changing the amount of step up and thus the output voltage.

In case you wish to build a de-luxe version of the simplescope, using one of the many 5 inch scope tubes available on the surplus market, the schematic of Fig. 2 may be used, with a voltage doubler rectifier. The output under typical load (a 5BP1 and its associated components) is approximately–1250 volts.

One further word of caution . . . With voltages as high as 1250 volts on the cathode of the CRT, I don't advise using the filament winding of T1 for the CRT. For the few extra dollars involved I recommend a separate filament transformer of sufficient insulation to stand the gaff. A stancor P-8190 will do nicely.

. . . K8AOE

Edgar Wagner G3BID
5, Ferncroft Avenue,
London, N.W.3. England

A Live and Working V-Beam

or Antenna Farming for the Smallholder

I HAD always wanted to have a little country cottage miles from anywhere; I had looked for one for a long time.

I wanted it near the sea; I wanted it to have a good view; and I wanted it fairly isolated.

Of course, it had to have a good site for an antenna farm as well.

So, when I went house-hunting, I took a portable rig.

At that time there was no mobile license in this country which meant that if the rig was mounted in a vehicle, the vehicle had to be stationary. Whenever we got to a likely cottage, I fixed up the rig generally stringing out some random length of wire to see whether we had a very high noise level and what conditions were like generally.

So, on the occasion when I first saw the cottage I subsequently bought, I fixed up the rig with a random length of wire and 25 watts, called CQ and a 'W' came back. We had a little QSO and signed, then another 'W' called me so this seemed quite a reasonable location.

Another look over the Band located SM5ARP—A very good friend of mine—in QSO with somebody else. I thought I would risk breaking in. He came back at once with a comment—"What are you using? Sounds like a kilowatt, that is above the legal limit in England surely?" But, when I told him this was a portable rig running 25 watts to a random length of wire, and that I was trying out the location for a cottage, the reply which came out of the loud speaker was—

"Buy it, Edgar, buy it; never mind the price, just buy it." Not wishing the price of the cottage to soar rapidly, I yanked out the loud speaker leads and ended that QSO.

So I got a site and a cottage. The piece of land I bought was not nearly large enough to put up V-beams, but as I got to know my neighbour better I discovered they had no objection to my putting a few poles on their land and so—Project V-Beam began.

A pair of wires were strung up on a pole and taken out into the field, just pegged into the ground, without any poles at the far end at all. Even in this way the results were excellent, and so the project grew.

Today I have a telephone pole by the cottage from which radiate six long wires at 45 degrees, one to the other, 275 ft. long. The pole at the apex is the highest and the others are fairly small thin poles so the V-beam slopes downhill a little like the ribs of an umbrella. At 275 ft. long and a 45 degrees angle they are about right for 15-meters, a little too wide for 10 and a little too narrow for 20 but they work beautifully as a compromise on all three Bands. On 80-meters if I take alternate wires I get a 90 degrees V-beam, 1 wavelength long, which is about right. On 40-meters they should not work at all but the joke is they do.

So, W2RWJ can rejoice to think that the V-beam is not only a nostalgic memory but a real live working V-beam, giving me a lot of pleasure. Perhaps I should add, the original reason why I decided to put these beams up was influenced, at least partly, by the fact that my nice isolated location by the sea is exposed to such violent gales that I do not relish the prospect of any form of rotary. These long wire antennas stand up to the gales remarkably well. . . . G3BID

Metallic Rectifiers—Simplified Circuitry

William Tancig K9MYZ
Rt 1
Beecher, Illinois

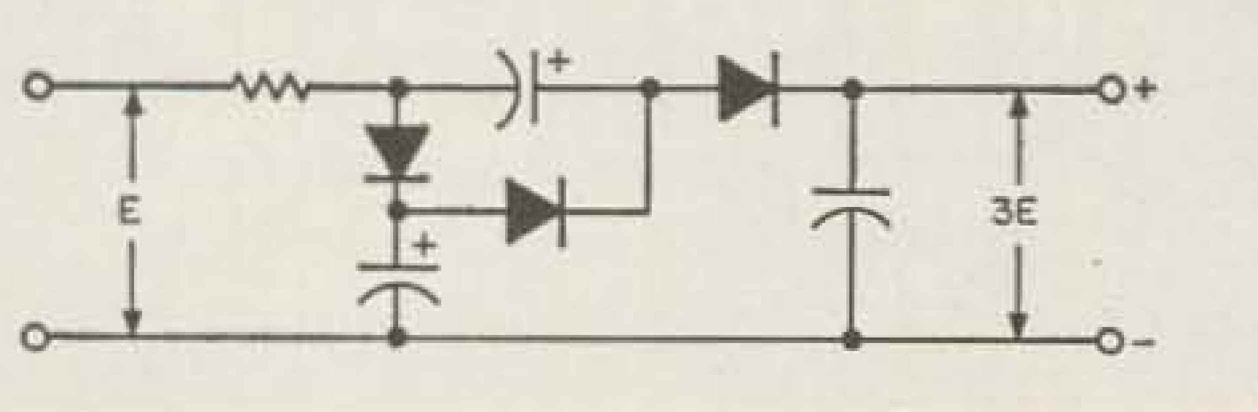


FIG. 1

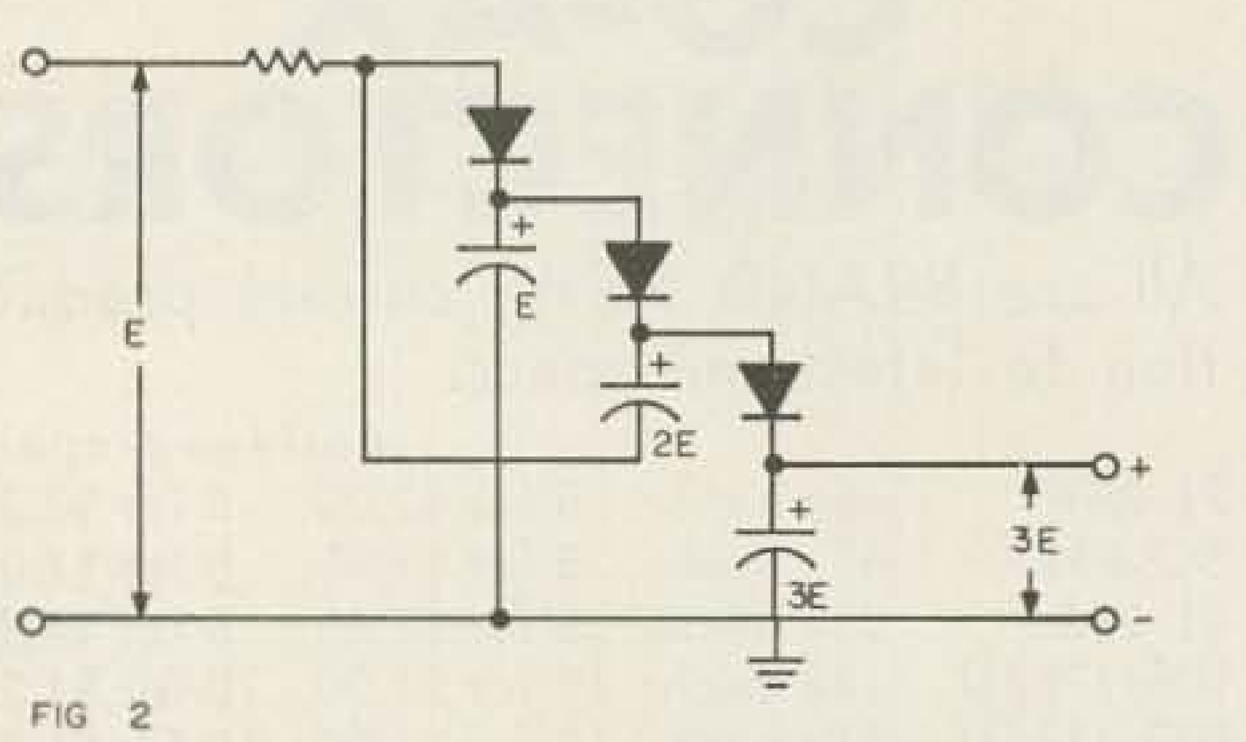


FIG 2

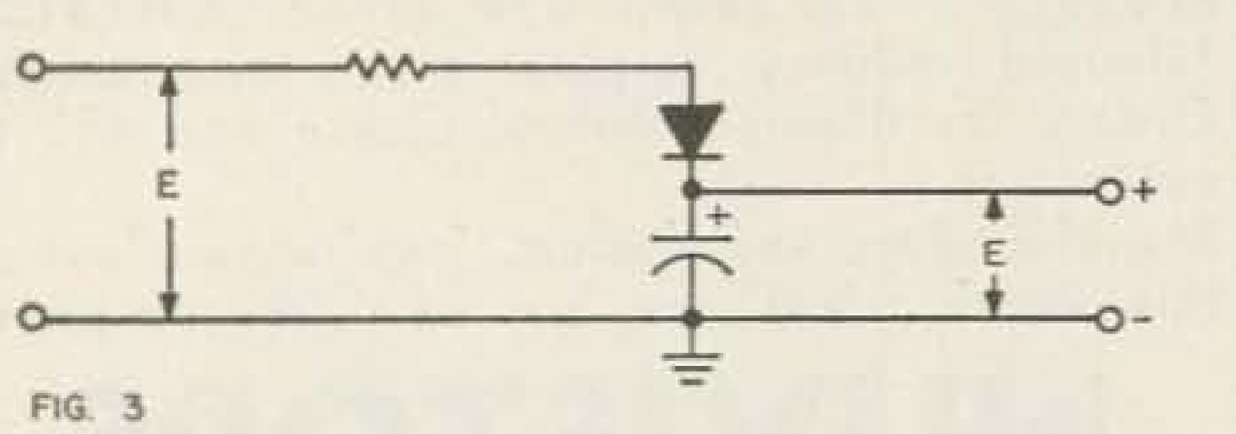


FIG. 3

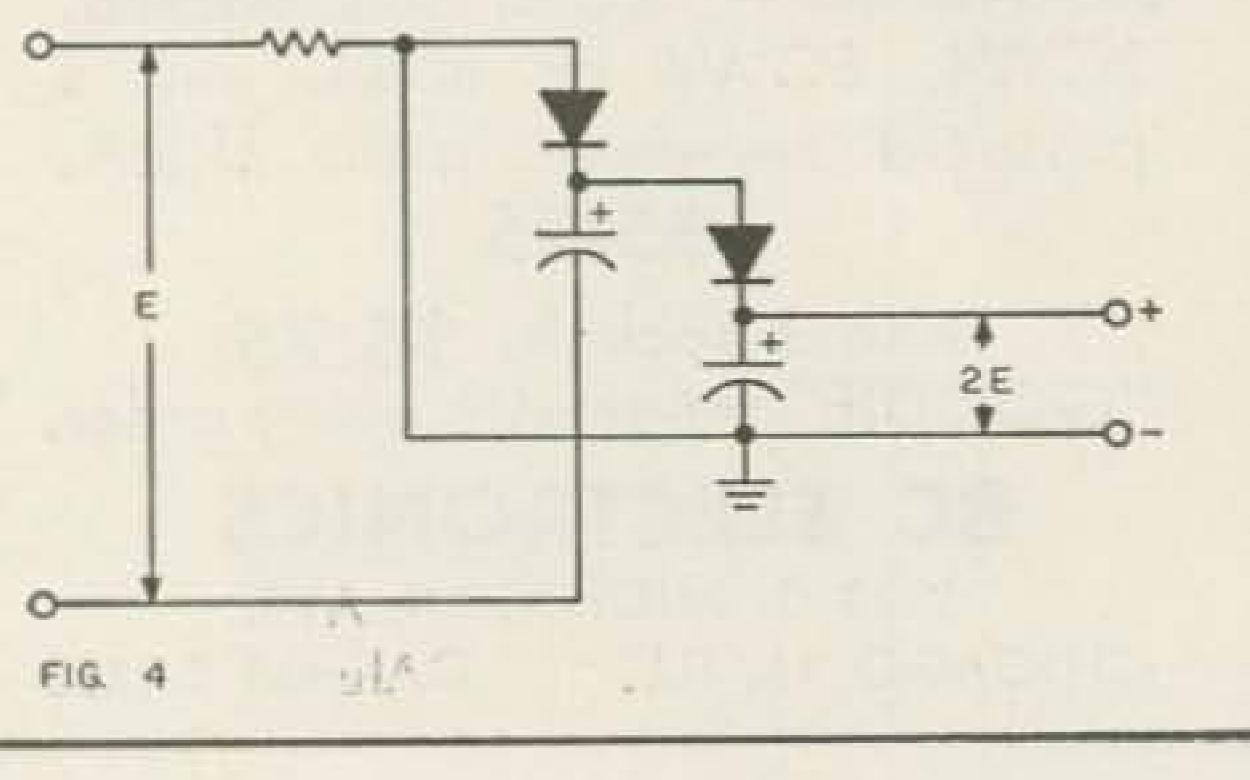


FIG. 4

FOR all of us who go around lashing up the odds and ends of ham-gear on a shoe-string, the building of an adequate power supply can be quite a problem. Many is the project which has come to an inglorious end because someone specified a fifteen or twenty dollar power transformer.

During the last year or two I have been intrigued with the many possibilities for constructing power supplies based on silicon rectifiers. Quite a number have been built, and most have operated to perfection. The numerous advantages of metallic rectifiers have been recounted by others, and need no repeating here.

I suspect one thing which may be limiting the use of these rectifiers, at least by amateurs, is the nearly non-sensical way their circuits are drawn. Fig. 1 is a half-wave tripler circuit in the traditional manner. An expert can follow the machinations of the voltage, with some effort . . . but the rest of us. . . .?

Fig. 1 has been redrawn in Fig. 2 in what is more nearly a self-explanatory diagram. The circuit operation is much easier to follow, or deduce, and unthought of variations in the resultant circuitry immediately begin to suggest themselves. By looking at it as a "cascade," the repetition necessary for additional stages soon becomes obvious.

The simplest half-wave rectifier circuit is shown in Fig. 3, with a multiplier of 1. Fig. 4 has a multiplier of 2 . . . a half-wave doubler. From this point on additional circuits follow in arithmetical progression by simple cascading, and alternating return of the negative side of the final capacitor to one side or the other of

LEO I. MEYERSON, WØGFQ

SAVE

FACTORY TO YOU

NO MIDDLE MAN

WRL SELLS DIRECT

"WHY PAY MORE FOR QUALITY EQUIPMENT WHEN YOU CAN SAVE & BUY DIRECT FROM ME"

NO MONEY DOWN — EASY TERMS

Save....buy direct. Save at WRL on nationally advertised equipment. Big Stock — Big, Big Trade-in Allowance— Over 1000 pieces of "like new" used equipment — No Down Payment — Charg-A-Plan.

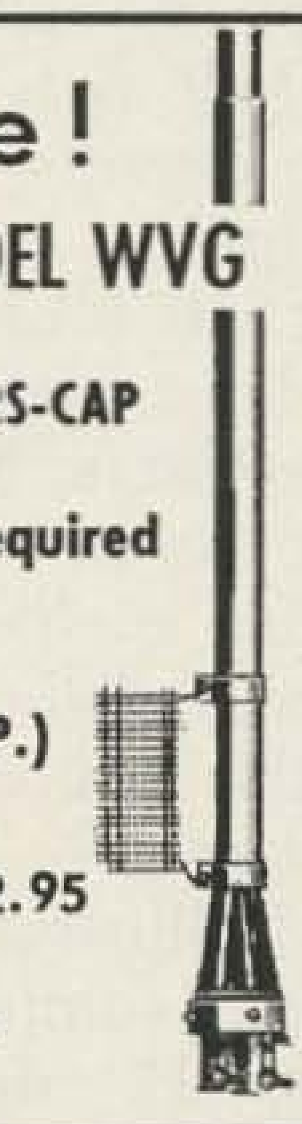
WRL's DESKIT

$29.95

Especially designed for the ham, experimenter or for laboratory use. Functional sloping top, slide out leaf. Rugged ¾" Nova-Ply. Holds over 500 lbs. Size: 49½ x 29¾ x 31". Weight: 99 lbs. Unfinished. Stain and finish kits — Blonde $3.49, Mahogany $3.49.

WRL Exclusive!

VERTICAL ANTENNA KIT MODEL WVG



- ★ Cont. Cov, 3.5-30 Mc. HAM-MARS-CAP
- ★ Matches 52-75 Ohms
- ★ Fully Self-Sup. — Radials not Required
- ★ No Traps — Mts. Anywhere
- ★ 23' Overall Height
- ★ Takes Full 1 KW AM (2 KW P.E.P.)

Model WVB similar except requires supported side mt. $12.95

Only **$14.95** (Express Only)

NEW WRL "WIDE RANGE PREAMPLIFIER" GIVES NEW LIFE TO OLD AND NEW RECEIVERS 6-80 Meters

MODEL DB–68

$39.95 Wired

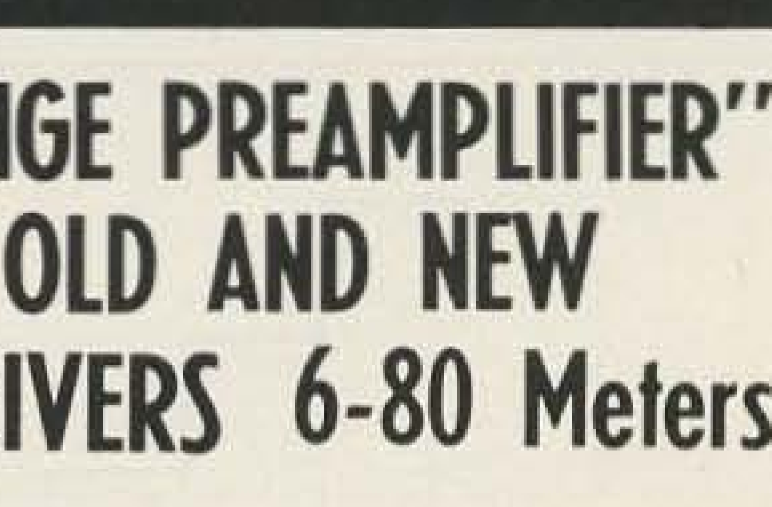
Nothing down $5.00 per month

- 6 Triode Tube Sections

Quality Import
- Built-in Power Supply 115 VAC Operation
- 20 DB — Average Gain on Ham Bands
- Exceptionally Low Noise Level
- Brings in Elusive, Weak Signals
- 6¾" high x 6-5/8" wide x 7-1/3" deep.
- Weight: 10 lbs.

NEW IMPROVED WRL TC6-A

6 METER TRANSCEIVER



$39.95 KIT LESS P.S.

MOST COMPACT IN ITS FIELD! 5x9¼x6"

RECEIVER FEATURES

- Superhet receiver
- RF stage
- Venier tuning 49-54 MC
- Selective (20KC at 6 DB)
- Built-in speaker
- ANL
- Drift, less than .01%

TCD-12 KIT (12VDC/PS) **$24.95**

TRANSMITTER FEATURES

- 5W. input
- Use 8MC Xtals
- Built-in P.T.T. relay
- Plate modulation
- Use Hi-Z mikes

TCA KIT (115VAC/PS) **$15.95**

26 Years of Serving the Amateur from The House The Hams Built.

The World's Largest Distributor of Amateur Radio Equip.

WRL WORLD RADIO LABORATORIES, Inc.
3415 W. B'dway · Council Bluffs, Ia.

Leo, ship me the WRL ☐ TC-6A ☐ DB-68 ☐ WVG ☐ Deskit ☐ Check enclosed ☐ Add to my Charg-A-Plan ☐ Send flyer ☐ Used equipment list ☐ All products list.

73-11

Name ______________ Call ______

Address ______________

City ______________ State ______

Also, I am interested in ______, quote your top offer offer for my ______. ALL ITEMS F.O.B. WRL

- Personal Service
- Quality Merchandise
- Liberal Terms
- All equipment guaranteed
- New guarantee on used equipment with 100% trade-back allowance
- Over 1000 pieces of used equipment

the supply voltage. The quickest way to become familiar with this system is to draw each one a number of times.

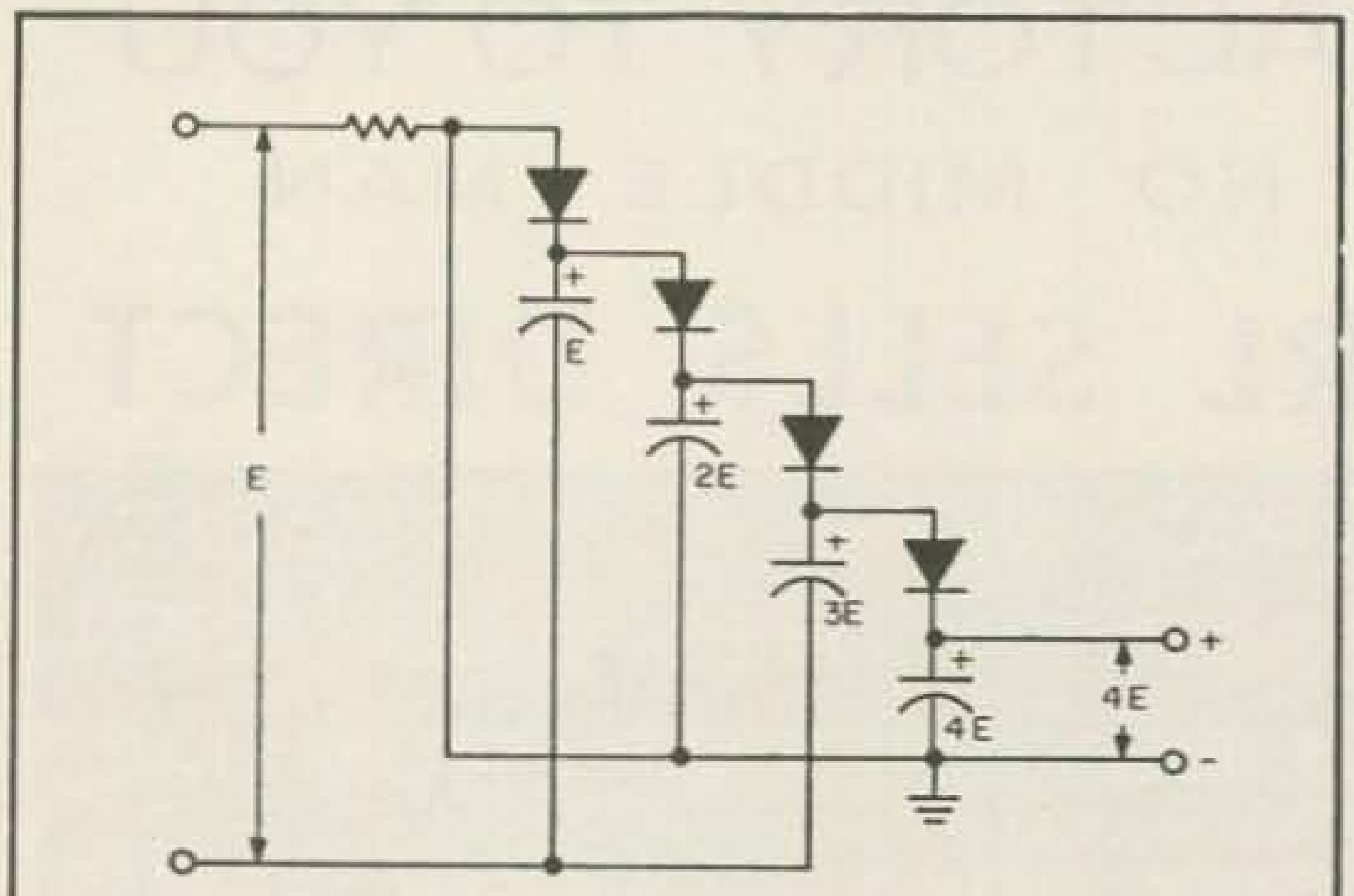


FIG. 5

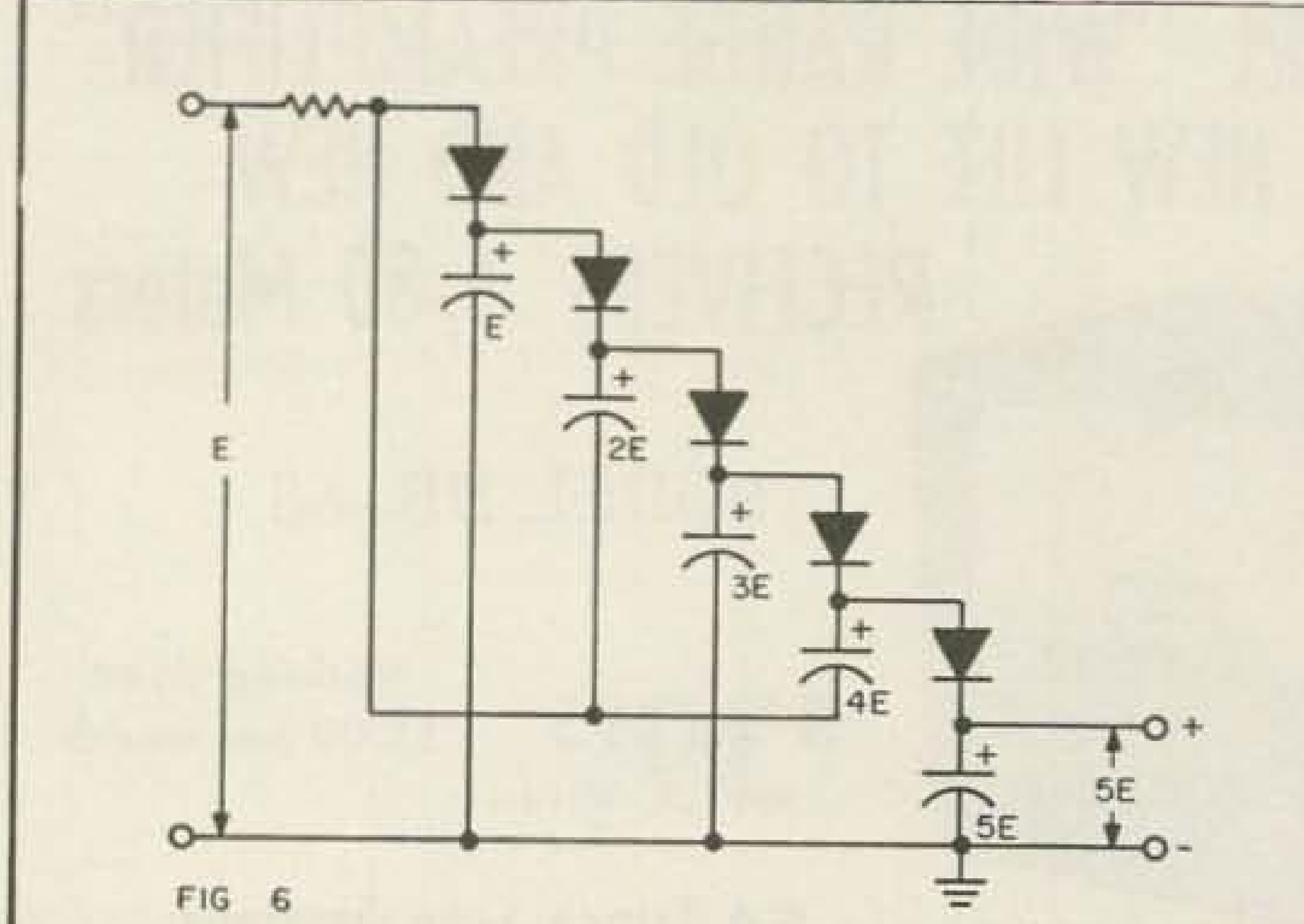


FIG. 6

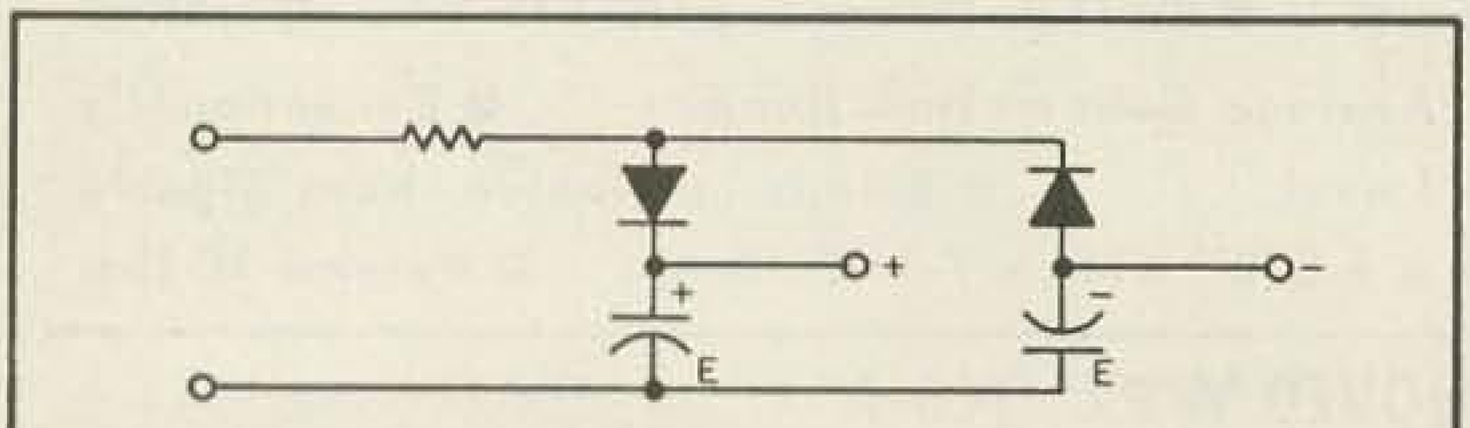


FIG. 7

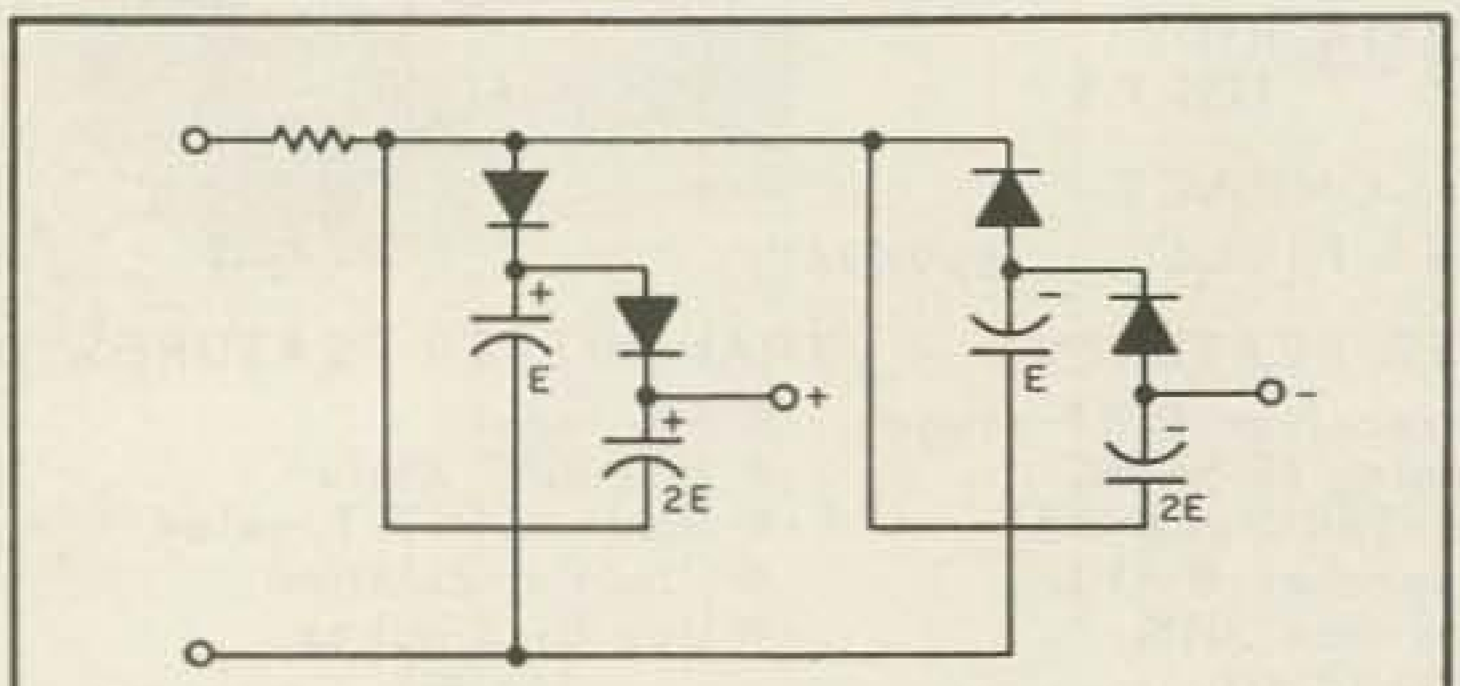


FIG. 8

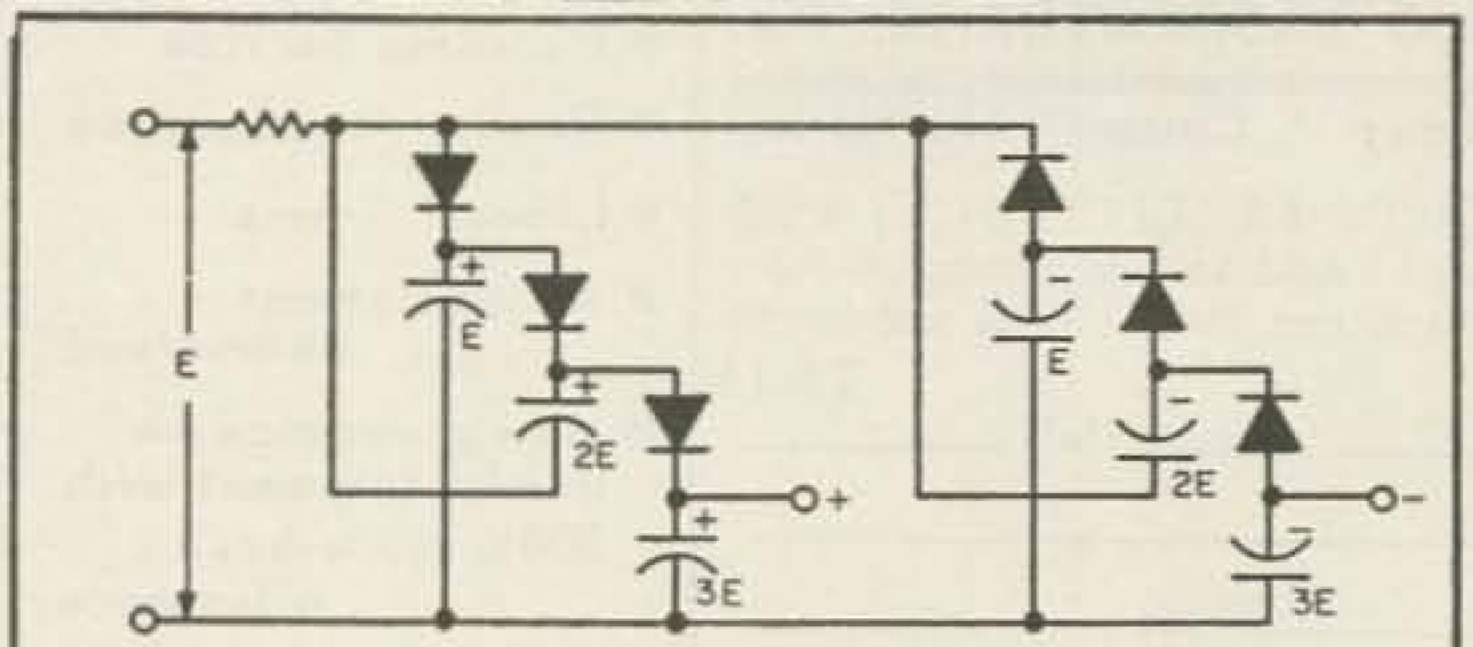


FIG. 9

Fig. 5 and 6 show the corresponding quadrupler and pentupler. With almost no effort the cascades can be correctly drawn until one runs out of paper. Unfortunately, as shown in Fig. 2, 5, and 6, as the cascades increase, so must the corresponding capacitors' voltage rating. Some development by manufacturers at this point would make the use of metallic rectifiers even more favorable. The rectifiers, conversely, are all of the same voltage rating, being only large enough for a multiplier of 1. Because of the capacitor problem I have found it best not to plan on using these rectifiers for applications above 1000 volts. At least, it seems to me, that any dollar advantage in their favor begins to level out beyond that stage.

Fig. 7 is the familiar full-wave doubler composed of two half-wave cascades opposing each other. This circuit is particularly useful, but does suffer from the peculiarity that neither side of the output is common with the supply voltage. An isolation transformer is desirable here, but not absolutely necessary.

Fig. 8 is the analogous full-wave quadrupler and, again, the cascades can be placed in unending opposal to yield full-wave multiplication. Fig. 9 is full-wave with a multiplier of six.

These full-wave circuits, in addition to improved rectification have one additional advantage over the half-wave circuits—their corresponding capacitors, for double the voltage, are only half as large. Unfortunately, with the full-wave circuits, it is not possible to obtain odd multipliers.

In Fig. 10 I have modified Fig. 6 by indicating where various voltages may be picked off the rectifiers. These are easily deduced by following the cascade diagram. It is important to note that each circuit has two negative voltage sources, and they are not common. Nevertheless, this is a convenient manner to obtain lower voltages.

Fig. 11 illustrates a typical half-wave doubler circuit, complete with filter and bleeder, and Fig. 12 describes the corresponding pentupler.

In constructing such a supply the first question one must face is the matter of half-wave rectification versus full-wave rectification. Personally, I'm a half-wave man myself, and I have yet to find a receiver or transmitter that suffers from use of a half-wave rectifier as long as its output is well filtered. There are a number of theoretical objections, but these are not overwhelming in practice.

As one goes to voltages above 600 volts it becomes necessary to use electrolytic capacitors in series which, of course, cuts their capacitance in half. Simultaneously, one must parallel each of the capacitors with equal sized resistors large enough to carry the required current. Normally each resistor should have a resistance approximately equal to the volts being born by the capacitor multiplied by 100.

Where circuits of this sort are utilized, particularly the half-wave type, it is nearly mandatory to use a polarized plug on the supply line. This is a good practice that many European countries adopted years ago. Forgetting this little detail means that sooner or later your eyeballs will light up, briefly, like a neon tube, and your muscles develop a nasty twitch.

And, in conclusion, don't leave out the limiting resistors. In the event of incorrect wiring they will keep the rectifiers from going up in smoke. . . . K9MYZ

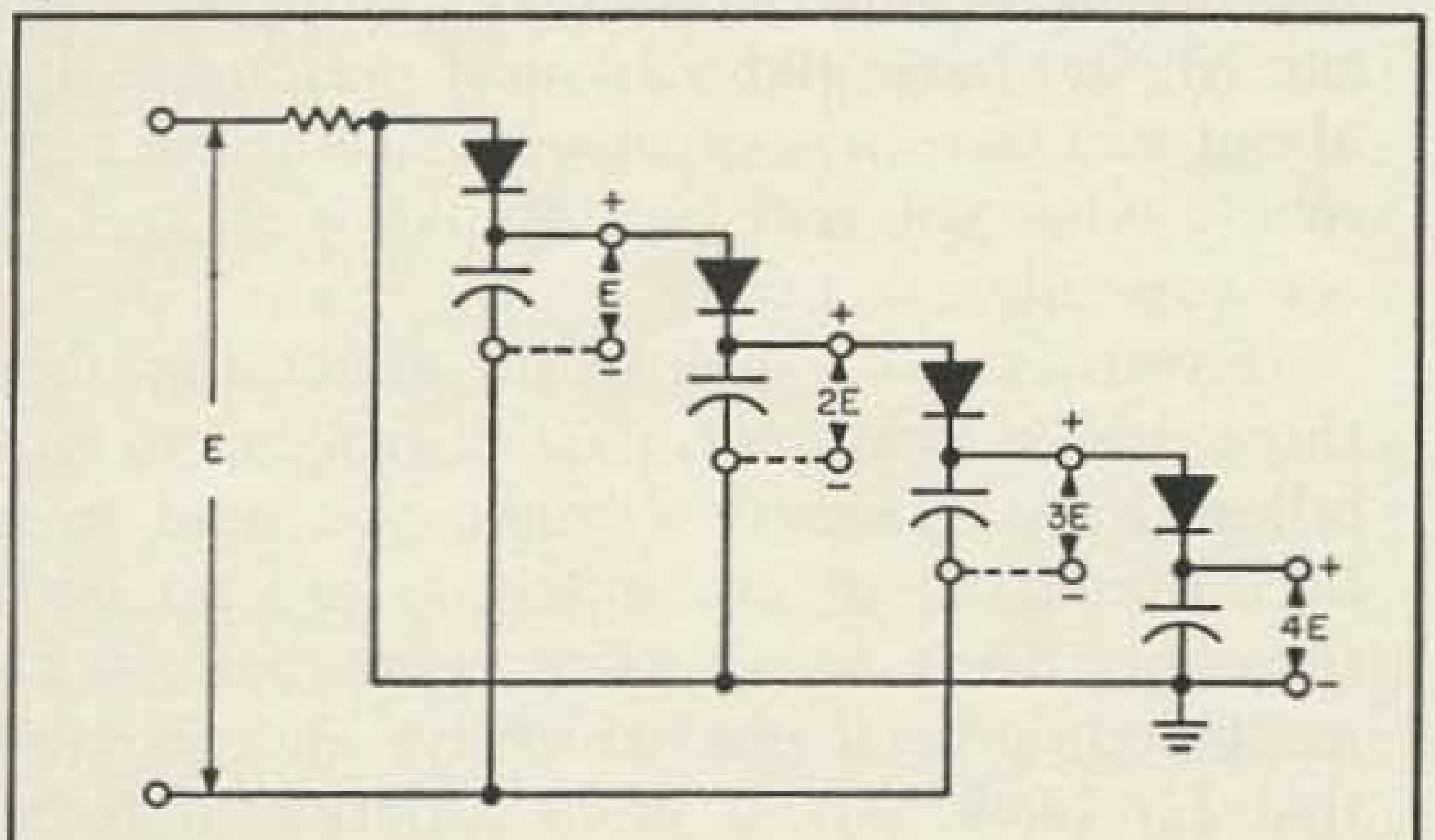


FIG. 10

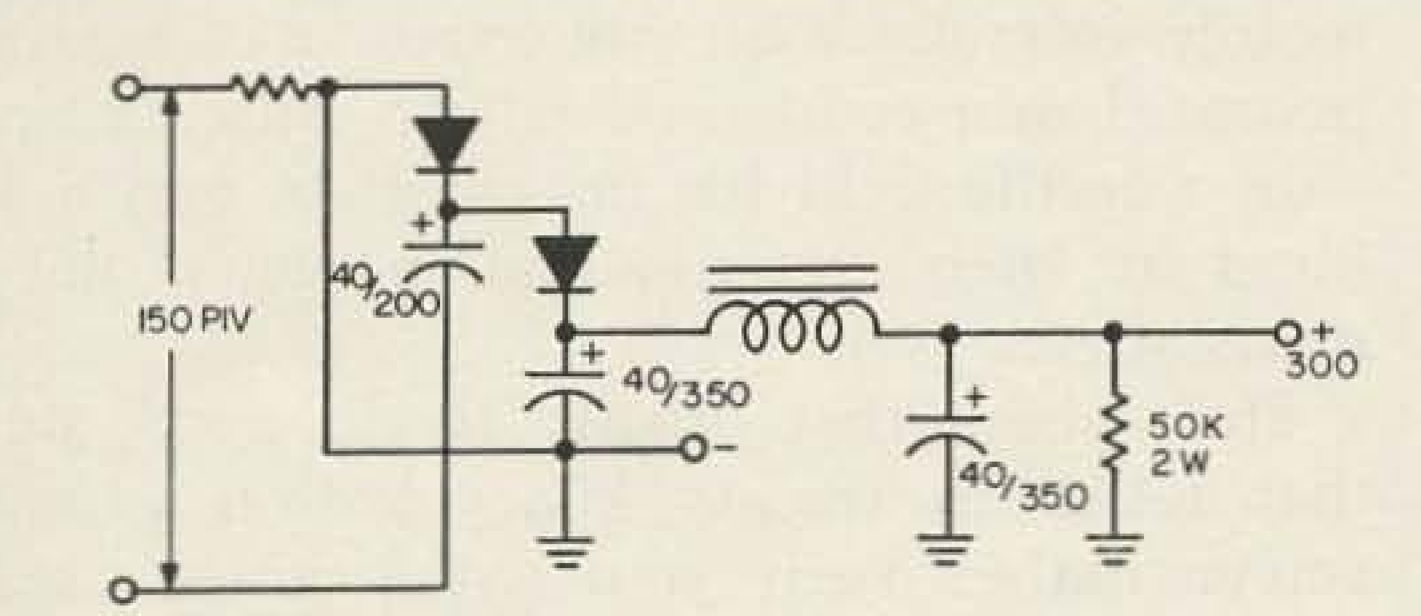


FIG. 11

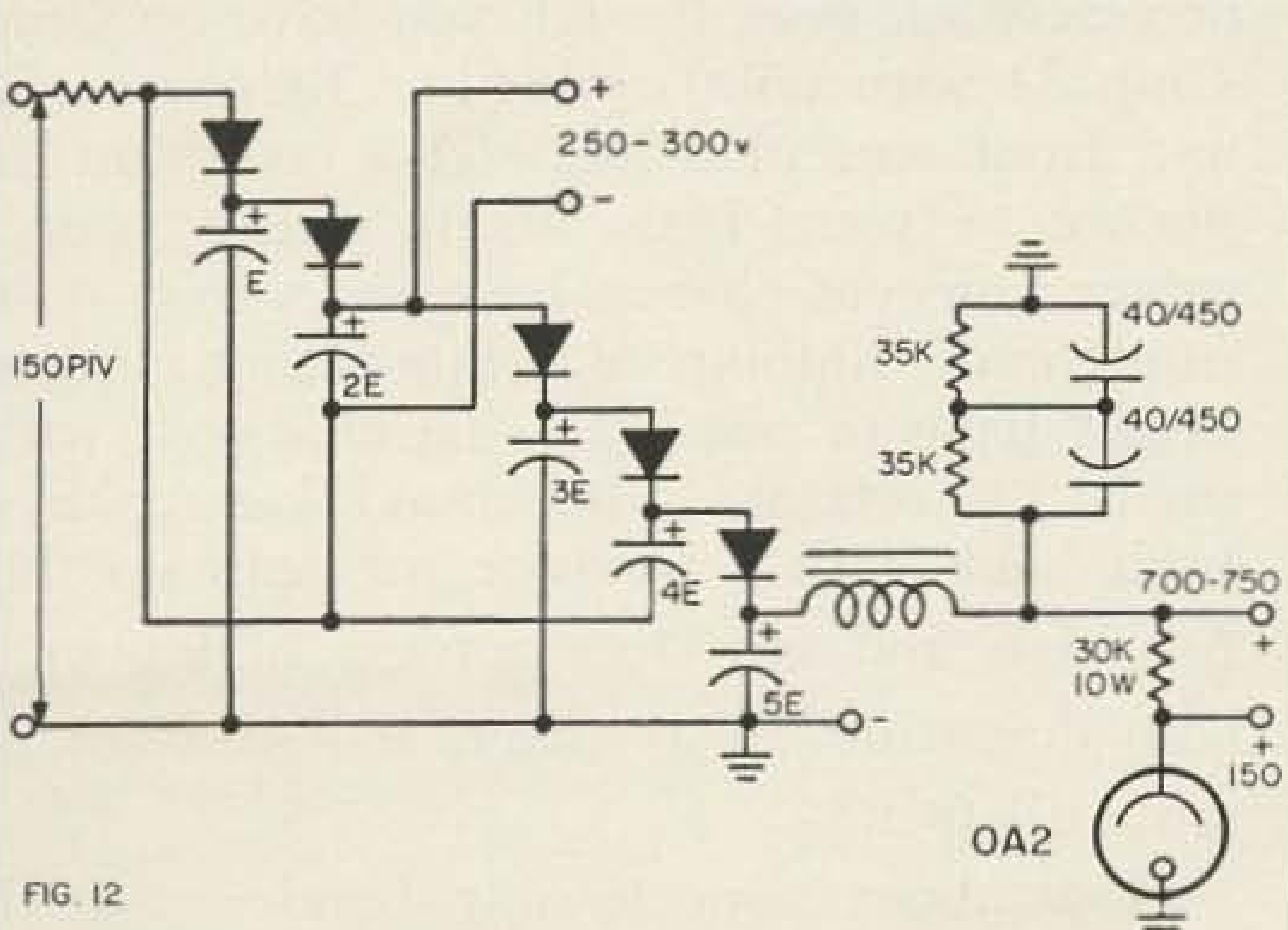


FIG. 12

Imagination

Charles Spitz W4API
1420 South Randolph Street
Arlington 4, Virginia

PROBABLY the most striking thing about amateur radio literature today is the absence, in the main, of the experimental thrills the early days provided. All of the experiments we tried did not work, but we learned something from the failures, too. The modern trend towards the use of manufactured gear has been lamented by many, and construction articles are enjoying a comeback resembling pre-WWII days. Unfortunately much of the construction described resembles a kit enterprise, less the now familiar (S) and (NS) symbols and that manufactured look. I often wonder how many transmitters, receivers or gadgets are actually built from these articles in the periodicals, and from inquiry come to the conclusion that the chief enjoyment consists of an arm chair exercise reflecting upon the absence of critical components in an ever growing junk box. Ho hum! "Maybe the next issue will have something simple that I need and have the parts for."

Let me hasten to say that there is some darn good engineering in manufactured gear, kits and the construction articles. They all have their place, and the experienced experimenter makes good use of such equipment, both as reliable standards and to keep up with the gossip on the air. He does his experimenting outside of, or in conjunction with these standards. The proof of the pudding for any new equipment is in comparison with other equipment.

Some people think that it takes lots of expensive test equipment to develop anything new. The lab approach is not necessary, fortunately, for much that needs being done in amateur radio. Many of us have pet ideas tucked away, workable in thought but never produced Perhaps we are waiting for a vacation to work on them, had idle thoughts about patents or production, or even for an article for 73, but time slides by and nothing is done about it. Once in a great while someone really makes what you had been thinking of, and you see *your* idea in print.

If you are not going to do something about those ideas, why not pass them on to your fellow hams? Doesn't it make you mad to reflect that most of our antennas are no better than they were twenty five years ago? In fact most people used phased arrays and rhombics that far back, which were superior to todays almost universally used yagis. Today's excuse is urbanization—lack of space. But look at our mobile antennas. Can you conceive of anything poorer than a condensed whip? Antennas provide a fertile field for imagination, and a few ideas for *your* experimentation would not be remiss here.

How about that broad "40 db over" signal that takes up twenty kilocycles on your receiver dial. "Turn your gain down," snarls you. Strange as the thought may be to many hams, this could be a fault of your receiver, or receiving, even though you have an Umpty Ump 31 with a 500 cycle filter. Remember TVI and front end blocking? This could be happening to you. How about giving your receiver a decent chance by using a loop on the front end, nulling out interfering stations? Might have to put it on the chimney, with a small TV rotator. The signal loss could be built back with a nuvistor pre-amp up there. Antennas and nuvistors get top billing in the ham magazines. Any takers to build one and write about it?

How about your trap tri-bander now that ten is slated to go? Can't the old tower or rotator take a 40 meter job in addition to the rest of the load? Hate to leave the local gang on ten? There are several ways to add a 40 meter capability to your system. The simplest is to make your dipole element resonant on 7 megacycles so that you have, at least, a rotating dipole. This could be done without disturbing the rest of the setup. One way is to load the center with an inductance. Not too efficient, yet the basis for "minibeams," and relays could do the feedline and inductance switching trick. How about adding another pair of traps? Good idea, but what about the turning radius? Well, remember the old pre-war Plumber's Delight? With the drooping elements? If an eighth wave or less is bent down at right angles from the new traps at each end of the radiator, no greater radius results and it is darn near as effective as a full length dipole. How about *your* building this one on any sunny Saturday afternoon?

What about that mobile whip? Vertically polarized too, isn't it. And a monstrosity at full length on 20 meters. Well, what about the car as a radiator. It is horizontal. Too short for twenty, sez you, and how do you feed it? Remember the folded dipole? And the Plumber's Delight? And that car you did not trade in on a compact? Figure the length of the car, assuming you have a good electrical contact from bumper to bumper. If there is any appreciable resistance, run a bonding braid from front to rear, grounding it at intervals. (A good idea even with conventional antennas!) No antenna insulators are needed in this setup; clamp vertical tubing front and rear as in the sketch to increase the electrical length for resonance on the band you want. Due to the large metallic body, less than the usual wire length should do. Take some RG-8/U and remove the outer braid. This braid could be your bonding material. Connect the unsheathed 8U to the top of each tubing mast, running it under the car. Cut it in the center, which will be your feed point. You might need a balun. Run the feedline directly into the car at this point, keeping it insulated. Your antenna system should now be horizontally polarized. Good idea? Try it!

This is imagination, the experimental stuff ham radio is made of. It is possible to go on and on with these ideas, with a bit taken from here and a bit from there. Why don't *I* try them, sez you? Well, it's raining outside, and this armchair is pretty comfortable. My junk box is pretty low too, all I've got is RG-58/U in it. Pretty light. Maybe I'll wait for a kit.

. . . W4API

The forthcoming Sunspot Low will cause a major problem in the use of the HF spectrum. Now is the time to give some serious consideration to make the best possible use of these bands.

On the Use of the Amateur Bands

S. P. Ted Wilds KZ5SW
Box 2519
Balboa, Canal Zone

SINCE the last time the sunspot cycle hit rock bottom, two significant changes have occurred on the amateur bands. The first is the major swing to phone operation, particularly SSB operation. The second is the vast increase in the number of US amateurs on the air. A recent survey shows that CW operation has dropped below 40% of all operation in the United States. We have in the neighborhood a quarter of a million hams who have a diversified interest in the use of the available frequencies assigned to us. A goodly segment of the group are primarily interested in reasonably long-range communication, be it for rag-chewing, DX chasing, or the handling of traffic. We also have smaller groups interested in VHF, TV, SHF, and experimental work. There are also the Ten Meter Buffs who will stay on 10, no matter what. Also to be counted are the Mobile gang, the QRP boys, the RTTYers, and other small segments (small per-centage wise) who will be adversely affected by the loss of 10, 15, and 20 meters. The big majority of amateurs who now operate on the HF bands will be SEVERELY affected.

When one considers that we have a theoretical allocation of only 800 kc of spectrum on the 40 and 80 meter bands that can be considered reasonably reliable for communication for the period of 1963 thru 1968, it becomes very necessary to make plans now so that these few kc can be used in the best interest of the fraternity as a whole. A study of the current situation as it exists on 80, 40, and 20 shows a condition that approaches the chaotic. As the considerable group now using 10 and 15 drop to 20 and then join the current 20 meter gang in a procession to 40 and 80, in ever increasing numbers, the QRM level, already bad, will become ear-splitting. The days of the Kilowatt Rock-Crusher getting thru anything in its way have given way to the battle of the many KW's fighting for air space. I believe that drastic action will be necessary to preserve some semblance of reality. Drastic action is always controversial. Keeping in mind that there are many sides to any controversy, I would like to make a few suggestions as to what I believe would ease the bedlam that we are currently headed toward.

First, it seems to me, we can no longer afford the luxury of special interest band subsections such as Novice, AM DX listening areas, SSB DX "allocations," phone-patch alleys and the like. I refer especially to 21.100-21.250, 14.100 to 14.200, and the "top 15" on twenty meters. Protected territory for the Novice on 40 and 80 is unrealistic. It just does not make sense to leave any usable frequency that is open to amateur radio by international treaty largely unused by the nation with the world's largest ham population.

Secondly, it seems to me that the segmenting of the phone bands, by custom, with the current acrimony between AM and SSB, will eventually solve itself with the gradual demise of AM, because it will be unable to compete for frequency space with the more potent, and narrower SSB. In the meanwhile, the phone segments, which must be expanded, should be more or less split according to usage of the two modes with AM taking entirely to one end of the band and SSB to the other, not by FCC action, but by ham agreement with NO dividing line between the two modes.

Thirdly, I believe that RTTY has a right to exist. Because this mode is not compatible

Radio Boookshop

There are certain basics which go to make up a hamshack . . . transmitter, receiver, antenna and reference books. The rest of the ads will give you a good idea what to buy in the way of transmitters and receivers, this is where you buy the reference books. We handle all kinds of radio books, but these listed are the ones you should have on hand. Buy.

4—RADIO AMATEUR CALL BOOK—Fall Edtion. $5.00

5—ANTENNAS—Kraus (W8JK). The most complete book on antennas in print, but largely design and theory, complete with math. **$12.00**

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**

18—SO YOU WANT TO BE A HAM—Hertzberg (W2DJJ) Second edition. Good introduction to the hobby. Has photos and brief descriptions of almost every commercially available transmitter and receiver, plus accessories. Lavishly illustrated and readable. **$2.95**

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, 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**

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

45—CURTA COMPUTER. The world's smallest computer. Send for detailed information. Makes the slide rule look sick. Like a big Monroe computer only hand size. **$125.00**

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

53—BASIC ELECTRONIC TEST PROCEDURES—Turner. This book covers just about every possible type of electronic test equipment and explains in detail how to use it for every purpose. Testing: audio equipment, receivers, transmitters, transistors, photocels, distortion, tubes, power . . . etc. **$8.00**

55—TRANSISTOR CIRCUIT HANDBOOK—Simple, easy to understand explanation of transistor circuits. Dozens of interesting applications. **$4.95**

63—G.E. TRANSISTOR MANUAL 6th EDITION. **$2.00**

66—DESIGN MANUAL FOR TRANSISTOR CIRCUITS BY CARROLL. Tested transistor circuits for design engineeds. Interesting reading too. **$9.50**

67—TRANSISTOR CIRCUIT ANALYSIS AND DESIGN by Fitchen. Written primarily as a college text to teach circuit design. **$13.00**

68—HANDBOOK OF TRANSISTOR CIRCUIT DESIGN BY PULLEN—This is a handbook which teaches a systematic system for transistor circuit design. Highly recommended by radio schools. **$13.00**

74—HANDBOOK OF ELECTRONIC TABLES & FORMULAS—Formulas & laws, constants, standards, symbols and codes. Math. tables, misc. data. **$2.95**

76—MODERN OSCILLOSCOPES & THEIR USES—Ruiter. Second edition. Shows what a 'scope is, what it does and how to use it for radio, TV, transmitters, etc. 346 pages. **$8.00**

G94—TRANSISTORS. Selected articles from Radio Electronics on how to test transistors and how to build all-transistor test equipment. **$1.95**

731—HAM—TV—WΦKYQ. This is the only book available on this fascinating branch of ham radio. Describes complete ham TV station that costs under $50. Very simple. **$3.00**

734—INDEX TO SURPLUS—Bibliography of all surplus articles printed in all radio magazines to date. Brief description, etc. $1.50

735—BOUND VOLUME—October 1960 through December, 1961, 15 issues (Vol. 1). **$15.00**

736—Yearly Binders for "73" Magazine October 1960 through 1961, or 1962. **$3.00**

738—SIMPLIFIED MATH FOR THE HAMSHACK BY K8LFI—Unbelievably simple explanation of Ohm's Law, squares, roots, powers, L/C, logs and the slide rule. No student should be without this booklet. **50c**

739—COILS by K8BYN—Wonderfully written and illustrated through discussion of coils, their resistance, reactance, impedance, Q, and distributed capacitance. **50c**

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**

MMD—ELIMINATING MAN MADE INTERFERENCE—What makes it, how to find it, how to cure it in homes, factories, automobiles, aircraft, boats, etc. Or maybe you haven't been plagued lately. 160 pages. **$2.95**

NHP—BUILDING UP YOUR HAM SHACK—Pyle (W7OE). A practical discussion of points to consider when you are buying ham equipment, complete with descriptions of much of the available commercial gear. It's just possible that Pyle might keep you from making a mistake which would cost a lot more than his book. **$2.50**

QAN—SECOND CLASS RADIOTELEPHONE HANDBOOK—Noll (W3FQJ). Everything you need to know to pass the FCC exam and get started servicing two-way equipment. Much more than just a Q & A manual **$3.95**

Circle the book numbers you wish to order. Please include cash, check, money order . . . or something we can deposit in the bank.

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

Address . . . .

City. . . . . State . . . .

RADIO BOOKSHOP

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

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

Add 8½% to Canadian Checks

with either CW or any type of phone at the current state of the art, due consideration should be made by the hams, not the FCC, so as to set aside a few kc in each of the 80, 40, and 20 meter bands for the use of RTTY.

Fourthly, the law-abiding majority must have a great deal more protection from the band-hogs that have been infesting the phone bands in recent years. These Class A lids include the super-power creeps running way beyond the legal limit, the crank-up-the-gain-and-scream lunatics, the 200% modulation jerks, and the "FCC-assigned-this-channel-to-me-personally-so-get-the-heck-off" characters. This motley collection of low-lifes have one thing in common: a self-centered attitude of "Me Me Me Me Me first and to heck with any one else."

This type of operation must come to a screeching halt! The FCC apparently will have to enforce our regulations more effectively. The gentle wrist-slapping of the few offenders that have been written up in the amateur press has destroyed the old image of a forceful FCC. A pink QSL from a far off monitoring station used to be looked upon as a catastrophe! So now we read about an alledged ham who received *eighteen* citations and winds up with only a six *month* suspension! A return to strict enforcement and realistic penalties to the perennial violator is a must. Backing up the FCC Monitors, should be a large and active Official Observer Corps of the ARRL. These stations should pay more attention to the band-hogs than they are now doing. Their primary job in the past has been to check for out-of-band operation. 00s need now to be equipped to make band-width and splatter measurements and report this type of deficiency to the offending station. Most of all, we need a return to the days when Joe Ham took great pride in the signal that he presented for inspection by his fellows. There was precious little of this "but-I-can't-get-out-unless-I-have-the-gain-way-up" school of operation. The newcomers of today are not getting the thorough indoctrination that used to be instilled by his instructor on the weary road to 13 WPM.

Now let's examine each band and try to improve the over-all usage of it.

10 meters. The low end of this band is the last to drop out and the first to come back. A few hundred kilocycles here make a big difference. CW operation is very slight. RTTY is almost non-existent. The FCC should authorize phone operation down to 28.100. The use of beacon stations on 10 would be very useful, but are not now legal. The FCC should authorize 50 watt beacons above 29 mc. Slow-scan TV above 29 mc should also be authorized. To keep the high end active perhaps a band of 200 kc from 29.5 to 29.7 should be opened to Technician Class operators. Remember there are greedy eyes looking at 10 for more 5 watt channels. Hams *must* keep the band busy for the next five years!

15 meters. This band will have to absorb many of the low power boys from 10 meters for as long as it stays open. The CW section is sparsely settled. The QRM on the phone section is severe when conditions are good. The FCC should permit phone operation as low as 21.150 mc. There never has been much Novice operation above 21.150 and with deteriorating conditions 50 kc will be more than sufficient. RTTY channels should continue around 21.090.

20 meters. This band will stay in longer than 10 and 15 and will continue to be of major importance for most of the rest of the cycle except for the three worst years. The FCC should authorize phone operation as low as 14.100 mc. A special DX listening sub-section from 14.1 to 14.2 and the "top 15" are extravagant luxuries that we simply cannot afford! RTTY should have a group of channels around 14.090 by operating agreement. Competition on 20 will probably cause more hams to engage in antenna experimentation and may be responsible for new antenna concepts. There has not been a breakthrough of significance since the advent of the quad. It's time for the hams to come through with something new.

40 meters. This is perhaps the hardest band to make any concrete suggestions about for several reasons. The Short-Wave Broadcasting, booming in along with their associated jammers, are making hash of the band above 7.100 in most parts of the country. This will be THE DX band for quite a long period. It is a favorite CW band for many of the gang here and overseas. It is here that a 50-50 split of the available spectrum seems to be justified. BUT . . . what is a 50-50 split here? From early evening until long after mid-night 7100 to 7300 is a bedlam of propagandists of all persuasions. There is scarcely 50 usable kc. It would seem that phone operation should be permitted in any of the few holes that exist above 7.100. Novice operation on 40 is open to question. If it *is* to continue, it will have to put up with General Class QRM. A better move would be to open up 160 for Novice and leave the highly desirable 40 meter band for those who have learned the ropes. We simply do not have the space for the 5 WPM beginners under the current conditions. RTTY needs some space around 7090 kc by gentlemen's agreement. The SSB/AM controversy will be resolved by the process of elimination. In the meantime, let AM fill from the top down and SSB from 7100 up, with no dividing line between the two.

75-80 meters. Here we have our largest group of amateur frequencies in the lower frequency range. Here also we have a large share of the forthcoming chaos. Many new comers to the band will not conform to the long, well established multi-sided roundtable type of operation that has been typical of this band since it was a Class A band. Many of these so-called "nets" have always been of a strictly local nature. In some areas these groups have moved to two or six meters with real success. 10 watts on VHF can do as well as a kw on 75 for a fifty mile area. Non-amateur QRM will be a factor on this band in the foreseeable future. Remember it is used by other services on a shared basis south of the U. S.

With phone operation up to 65% of total operation a more equitable split of spectrum space on this band is in order. Phone operation should be permitted from 3700 up. Novice operation should be moved to the 3600-3650 segment in order to keep their second harmonics inside amateur frequencies. There have been too many of our beginners getting citations for interference with other services. RTTY channels should be set aside by agreement on the low end or wherever a meeting point can be agreed upon. Until all phone carriers are suppressed, AM should carry on at the high end of the band, SSB expanding upward from 3700 kc.

160 meters. This band needs occupancy even though space is slim. It is highly desirable to open up a small segment in those states not now permitted to operate it. In other areas perhaps two sections of the band could be opened. There is current ARRL thinking along this line. If the band continues to be small segments, Novice CW should be encouraged. It always was a favorite beginners band. Low cost receivers work well here. Transmitters are very simple to get working well. In as much as few of the commercial rigs cover 160 any more, it would encourage the beginning home-brewer to get started "from scratch."

I realize that these are not the whole answers to many of the problems involved. The purpose of the piece is to stir up some thought on the subject by fellow amateurs and get them written up and put before the fraternity for disscussion and eventual action. Write down your own suggestions and send them to the amateur press and especially to YOUR ARRL DIRECTOR of Your Division. Changes will be made for better or worse. Let the careful consideration of the whole brotherhood of American Hamdom make them for the better. . . . KZ5SW

Other Ideas on the subject as picked up on the air.

1. Open all parts of all bands to all modes.
2. Limit power to 100 watts.
3. Allow 10 kw to Extra Class Operators.
4. Prohibit carriers for phone operation.
5. Restrict maximum band width to 3 kc for any type of transmission.
6. Return 40 to all CW operation.
7. Prohibit SSB.

Proposed Band Useage Chart

Band	CW	AM	SSB	RTTY
10	28.0-28.1	28.2 Up	28.1-28.2	28.090
15	21.00-21.150	21.150-Up	21.450 Down	21.090
20	14.00-14.100	14.100 Up	14.350 Down	14.090
40	7.00-7.100	7.300 Down	7.150 Up	7.090
80	3.50-3.700	4.000 Down	3.700 Up	3.690
160	Lower segment	*	*	*

*Other than A1 emission to depend upon expansion of this band.

During hours when DX is heard, strictly domestic QSO's are requested to leave 10 kc band edges to those working the DX stations. Novice: A1 on following sub-sections:

Lower segment of 160 meters
3600-3650,
21.100-21.150
53-54 Mc
Additional 10 Meter authorization
50W Beacon Stations (A∅, A1) and
Slow Scan TV above 29.000 mc.
Technician: 29.5-29.7

FCC Changes Required

Expand phone assignments to 28.1, 21.1, 14.1, 7.1, and 3.7 Mc.

Change Novice assignments on HF bands to 21.1-21.15, 3.6-3.65, and 160 Meters.

Expand 160 meters. Authorize Beacons and slow scan TV above 29 mc. Open 29.5-29.7 to Technician Class Amateurs.

More New Products

DSB

It is encouraging that World has been encouraged by the reaction to their DSB-100 to come out with a new double-sideband rig which covers all bands from 80 through 10 meters. This one, the SB-175, sells for under $100! It runs 100 watts AM, and 175 watts CW. The cathode-grid block keying gives a nice clean CW signal. This small unit will be popular for mobile work too since it is small and doesn't require any difficult bias voltages. Send for info to WRL, Council Bluffs, Iowa and mention that you read somewhere about it, you think.

Irving

Pappy, W5UB, has just brought out a new catalog which lists his 104 printed circuit boards which are in stock. Just about every ham magazine article which has used a P.C. board has been reproduced by Pappy. If you like to build at all you'll want to have this catalog at hand. Irving, Box 9222, San Antonio 4, Texas. Boards #8, 90, 103 and 104 are from 73, I see . . . maybe more.

WWV on the Drake 2-B

This popular ham band only receiver is sold with three crystals which gives full coverage of four of the amateur bands and 600 kc of the ten meter band. To receive any portion of any other band or bands requires the owner to purchase a crystal for the frequency he wishes to cover and to fill the crystal sockets for full coverage is rather expensive. Most hams want WWV for calibrating the receiver and for accurate time checks. 15 mc WWV time signals can be received on the 2-B without the purchasing of a new xtal or the need of shifting one of the present one's to a new position. Set the BAND SWITCH to the 40 meter position, and tune the PRESELECTOR to number 10. WWV will come in loud and clear at 0 on the logging scale. By sliding the glass on the dial to exactly zero the dial scale is calibrated and will track amazingly close for all bands. It will be interesting to note that with the three xtals supplied with the 2-B, that bands can be copied in positions other than indicated; 80 meters also comes in on BAND A with the PRESELECTOR set on 4 position; 15 meters comes in on BAND 10 (2) with PRESELECTOR set on 8; and many foreign broadcast stations can be copied on BAND 20 with the PRESELECTOR set on 10.

It would be interesting to note the many different frequencies that could be copied at different settings of the receiver if all ten xtal slots were filled. Any one tried it?

. . . K4FQU

[W2NSD from page 4]

the end of September since this is after the regular tourist season and accommodations would be available and reasonable.

In the meanwhile, think about that inertia. Life swings along a lot faster and happier if you do things rather than just think about them. I know, it is hard to make that decision.

Earthshaking Inventions

John Campbell, W2ZGU, being editor of Analog Science Fact and Fiction magazine,

New Model 73 Announced!

Peterborough, New Hampshire, October 1, 1962. The publisher of 73 Magazine, an obscure publication for radio amateurs, announced today that starting with the January 1963 issue there will be a completely new model which will replace the old 1962 model 73. The publisher admitted, under close questioning, that the new model will probably be undistinguishable from the old except for the serial numbers. After a short fist-fight with the enraged and disappointed staff, the publisher, Wayne Green, who bills himself as "Never Say Die," triumphed and promised to do the same to anyone he found not subscribing to 73.

Don't Take Chances—Subscribe

name .... call

address (QTH) ....

city .... zone state

☐ $3.50 one year ☐ $40 LIFE
☐ $6.50 two years ☐ Renewal
☐ $9.00 three years ☐ New subscription

Start with: current issue ☐ next issue ☐

73 Magazine PETERBOROUGH, NEW HAMPSHIRE

seems to learn about new inventions way before we read about them in the papers. He explained the Land color process to me months before I saw anything in print about it. John has come up with a couple more corkers that you may be interested in.

I've been holding off on mentioning one invention because I have been expecting to get a technical article or two on the subject. One of the main engineers involved turns out to be a ham, so we may eventually get some ham applications of the invention. The discovery is epochal. It is a simple system of binary coding voice frequencies. When you consider that Bell labs has spent many millions of dollars trying to do this, ending up with a huge, cumbersome system, you can perhaps appreciate the magnitude of this breakthrough.

What does this mean to us? Well, for one thing it means that we will eventually be able to cut our bandwidths down to about 150 cps for phone, allowing much greater use of our bands and the application of lower noise reception systems. Imagine how much room we would have on our bands if we could have 20 stations in the same frequency space now taken by one SSB station!

Won't this new system be too complicated for general amateur application? It doesn't look that way. The encoding device is about the size of a small salt shaker and the decoding device isn't much larger. Basically the encoder takes the third differential of the voice by means of three differentiating circuits. This removes all frequency changes entirely, leaving a monotone voice pattern similar to the speech of someone with an artificial larynx. This leaves a lot to be desired fidelity-wise, but it does make communication possible. The decoding circuit is a series of ringing circuits. Though patents have been issued on the system there is still some hesitancy on the part of the inventor to make too much information available. This is understandable.

This narrow bandwidth system would seem to have particular and immediate application to the moonbounce work now in progress. By the time you put this system together with the synchronous detection system Bill Ashby K2TKN described in September you should be able to get moonbounce into the ham shack and out of the laboratory. We have another little beaut coming up that not only will have application for all VHF'ers, but will be of particular application to the 1296 mc crowd. This is a system for stabilizing VFO's.

Breakthrough number two, and even more startling, was made by a young ham down Texas way. Pat Flanagan has a gadget he calls the Neurophone. This transmits radio waves directly to the brain, bypassing the audio nerve system entirely. I don't have to tell you what this will mean to deaf people . . . or to the earphone manufacturers! Plans are afoot to have an article on this one too. Pat says he does it by changing the waveform of the sound, which is quite logical since sound is detected and passed on to the brain with an entirely different system that we use for hi-fi. Details on this invention may be even harder to come by due to patent problems.

Open House

Sunday, August 19th was a beautiful bright day, one that displayed the Monadnock region of New Hampshire to good advantage. This is one of the most beautiful areas in the country, making it a wonderful drive for the visitors that poured in on us for our Open House celebration.

We had a hectic time getting ready for the event. It takes a lot of bustle to get things in even passable order in only six weeks, in the meanwhile continuing to publish our little magazine and other offshoot publications. Even so, by the time Sunday rolled around, we were set up with our offices operating rather smoothly, a fairly decent looking hamshack, a 100 foot tower with a tri-bander atop, a 64 element two meter beam ready to erect, and a two meter long-john up on a chimney.

The only fly in the ointment was that in the process I managed to worry myself to the point where my back (a weak point with me) gave out and I had to spend the day flat in bed unable to move one inch without searing pain. What an embarrassment!

Some 150 people turned up here, coming from as far away as Pennsylvania for the visit. It was quite a day. Kids were all over the place, tearing up the flowers, putting ten years onto my collection of toy Porsches from all over the world and feeding Virginia's horse hamburgers. Damned near killed the horse. One woman showed up with some of our flower pots and a trowel and was about to help herself to our flower bed, explaining that since Virginia is allergic to flowers we certainly wouldn't want them around. Another went through the house and attics picking out all of the priceless antiques that she liked, explaining that we weren't using them anyway.

CORRECTION

Our artist drew in an extra line which you'll have to remove from page 38 of the August issue. This was a small 6J6 converter for making an SWL receiver out of the 75A4 and other ham-band-only receivers. Strike out the connection between the top of L2 and C7. Move CR1 to between T1 and R6.

Virginia pointed out that though we would like her to have them, that they were the property of the Society For The Preservation of New England Antiquities and were part of the house, which used to be a museum.

We really had a good time and I hope that everyone who took the time and trouble to come over and say hello had one too.

Club

The ham flight to Europe, which we hope to have organized for next fall, requires that participants be a member of a club for at least six months before the trip. This means that we must have some sort of club affiliated with 73 in order to charter a plane.

One factor that has deterred me from rushing into the formation of a club is the possible reaction of the many League-oriented amateurs who might be alarmed, suspecting that I am trying to set up another League. This is not my intention. Perhaps I can put this matter in perspective with a short discussion of the League.

Many of the newer amateurs are not aware of the part that the League has played in the evolution of our hobby. While accuracy would perhaps be less strained if the A.R.R.L. were to blow their own horn, I'll try to generalize without too much distortion.

The American Radio Relay League, which has been with us throughout the lifetime of our hobby, has now grown to a multi-million dollar corporation that is largely involved with the publication of QST, the Handbook and dozens of other publications and products. Their yearly income is well over $1,000,000 and they have a tidy little fortune put away for a rainy day. They are following the time proven thrifty yankee tenet of never drawing on principle by financing their new headquarters building with donations from members.

In addition to the publications, which are a most important part of our hobby, the A.R.R.L. provides many services to the amateurs. These are important services and we would be hard put without many of them. The League provides a framework for the formation and running of ham clubs and encourages this participation with League Affiliation for clubs which qualify. A great deal of the strength of ham radio is derived from the thousands of ham clubs which are the backbone of our hobby.

The League furnishes a series of films and other programs to pep up club meetings, as well as interesting talks by League officials whenever practical. Their well organized traffic system covers the country with a well-knit set of nets which almost rivals Western Union. Many Brasspounders handle thousands of messages a month, year after year. This, the original purpose of the Relay League, is still a strong function.

The League for most of its existence has represented the amateurs before the FCC. Then, possibly due to pressures from the National Amateur Radio Council and other groups, came the sad day when the FCC decided to henceforth deal directly with the amateurs instead of through their League. Docket 9295 specified that the FCC would accept petitions for rule changes and comments on these proposed rule changes from any amateur, group or club and that their decision would be made on the basis of the facts presentd in the comments and petitions. The A.R.R.L. still represents us in the concept that they present comments to the FCC on each proposed rule change and they propose rule changes that are agreed upon by the Board of the A.R.R.L. There can be no question but that these well thought out opinions and suggestions must receive particularly careful consideration. So, in a sense, the League still is representing us.

The League has been generous with legal advice to harried amateurs beset with suits involving towers. TVI, and other battles with

Application for Charter Membership in the Institute of Amateur Radio
(Valid only if postmarked before January 1, 1963)

Name .... Call: ....(must be licensed)

Address ....

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

Class of license: Novice Technician General Advanced Extra Conditional

Year first licensed .... Old calls ....

Charter membership fee of $1.00 must accompany this application. This will pay dues in full until December 31, 1963.

local officials. Though they do not normally provide lawyers or financial assistance, they do provide invaluable help with all other legal assistance.

The League has been particularly outstanding in its leadership in the field of operating awards and certificates. The WAS, WAC, DXCC, RCC, and other awards are the standards in the hobby and much of our operating time is devoted to them. Our DX minded operators are completely submerged in the DXCC award and it governs ham events to an amazing degree. No other awards have achieved the stature of the A.R.R.L. certificates.

The League station W1AW has been sending code practice for many years and few amateurs have passed their license exam without spending quite a bit of time tuned to W1AW. The code proficiency certificates tie in with this program and have spurred many amateurs on to speed up their code ability.

The network of League appointed and elected officials throughout the country has done much to strengthen our hobby. The OO's (Official Observers) help police our bands, the SCM's (Section Communications Managers) encourage activity on a local level and report it each month in the fine print in the back of QST. The directors sound out the wishes of the amateurs in their divisions and act as representatives during the yearly meeting of the Board. All this is important and our hobby would be much weaker should we lack it.

I hope that I have perhaps put the League in perspective for some of the younger hams and that I have not glossed over or omitted any of the functions of the League enough to irritate the older members. It would be interesting to have a book giving the details on the development of ham radio and the League, which have grown hand in hand. Many fascinating events have taken place which have never seen the light of print and these should be chronicalled before they are lost with the deaths of the pioneers who made them happen.

At any rate, we are going to start our little club. It is not designed to take on any of the functions of the League, nor to fight the League. There are some things that we can eventually do which may help our hobby along in directions that are not now being pursued, should the members be interested. Charter membership in the club will be open for only for a short while.

Chartless

Well, the closest thing we had to a regular column seems to have demised. When the propagation charts arrived too late for inclusion in the August issue we waited for the thunder of complaints. Five letters straggled in, which wasn't very thunderous. I mentioned this situation in the editorial last month to see if this would bring forth any extra letters. One came.

This seems to back up my original idea that we should run articles and leave all the columns to QST and CQ. Should CQ drop their ham magazine and concentrate on their Citizens Band magazine we might consider filling the gap this would leave in certain phases of operating such as the World-Wide DX Contest and the Zone award, but we wouldn't go in for such things as SSB columns, Worked all Counties, and other dreadful unnecessaries.

73 Museum

Now that we have some room I can get started with an idea that has been brewing for several years: to have a museum of ham radio gear of the 30's. There are a couple of fine museums of earlier ham gear, but I don't know of anyone who is doing a job of saving samples of the equipment that was popular back in ham radios mid years.

The other day, while looking over the enormous collection of used ham gear at Evans

Radio in Concord, I found an old HRO under the bench, complete with coils, power supply and loud speaker. I grabbed it. This one turns out not only to be an HRO, but one of the first ever made, a plus in this acse. I was a little worried about getting a schematic for it, but on checking with National I found that they had a complete instruction book available for a one dollar service fee. As a matter of fact they apparently have books on almost every receiver they've ever made, each available for $1. In those rare instances where they can't supply the book they will send a schematic and parts list at no charge. They suggest you send order and forward the cash to them when they send the manual.

Now, about this museum, I'd like to have one each of the better known ham receivers from the 30's on display. If you have one kicking around that is in good shape drop me a line. I'm not really in shape to buy as yet, but I would like to have gear on loan or gift for display purposes, complete with a nice card indicating the donor or loanee.

CB or Not CB

Quite a large part of my mail contains worries over CB and grumbles about the way it is being run by the FCC. I wonder what would happen if the FCC were to try out their license fee arrangement on the CB service? A fairly stiff license fee would separate the ranks a bit, leaving, I suspect, the fellows who have a more legitimate need for the service and culling out the fellows who have a more casual interest. I'm sure that the spectre of 1,000,000 CB'ers would fade quickly as would the increasing demands for more channels. This would make it a lot easier for the FCC to get in there and monitor the bands and further weed out the misusers of the license.

As I opined once before, I'm more in favor of the fellow who uses a service paying for it, rather than charging everyone for something just a few will benefit from. In this case the application is fitting. Everyone involved with CB on a legitimate basis would benefit from a license fee. The only fellows who would suffer would be those who don't have enough interest to pay the fee.

How much of a fee? Well, with equipment running around $100 for the average setup, I would suggest something on the order of $50 for a five year license. If it isn't worth that much to someone then he probably doesn't need the frequencies very badly. I don't think the CB magazines will like this helpful suggestion. . . . Wayne

Photography by: Morgan S. Gassman, Jr.

The AN/ARC-2

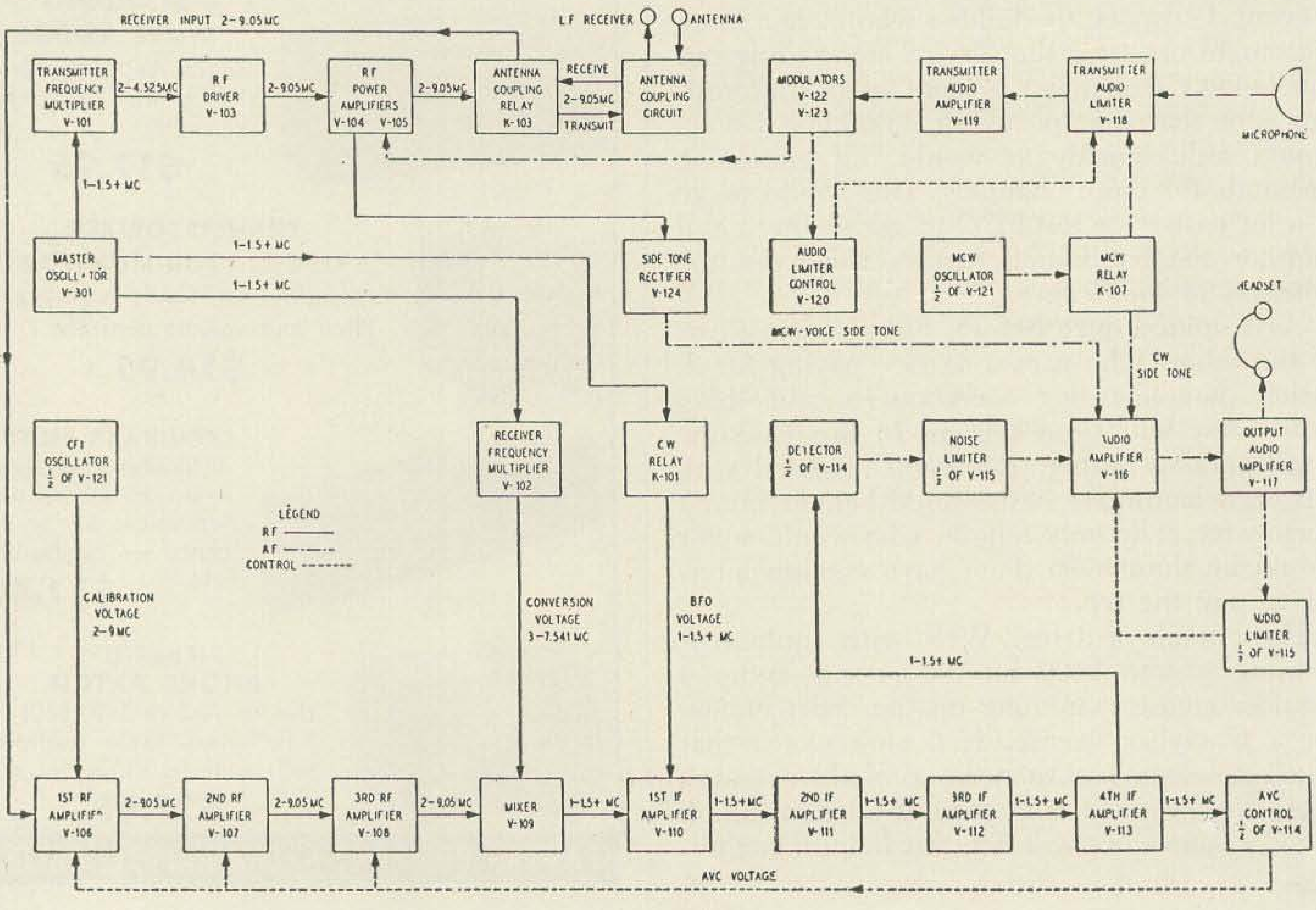
A Modern Transceiver in a World War II Package

Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

A real sleeper on the electronic surplus market is the AN/ARC-2 Radio Set. The major component of this aircraft radio equipment is the Transmitter-Receiver RT-91/ARC-2 or RT-298/ARC-2A. This Collins Autotune transceiver covers the range of 2.00 to 9.05 megacycles in 4 bands and has a *rated* power *output* of 25 watts in the 80 and 40 meter bands. Provision is made for AM, CW and MCW operation. The equipment is housed in a black crackle finished case measuring 7¾" x 15½" x 21½" and weighs approximately 70 pounds with the dynamotor removed. While the proportions are not ideal, it makes a nice table-top package. The transceiver was designed to operate from the normal 28 volt dc aircraft supply and this presents the usual conversion problems.

The going surplus price of $40.00 to $50.00 makes this one of the true bargains on the surplus market. The AN/ARC-2, developed for the Navy late in World War II, incorporated techniques many years ahead of its time. True transceiver operation is obtained using a single Collins permeability tuned oscillator (PTO) which is employed in conjunction with a unique frequency deriving system.

The transceiver uses a total of 25 tubes and features many elements of the conversion techniques used in modern amateur equipment. The receiver and transmitter tuned circuits are all ganged to a single tuning control. Two additional tuning controls permit adjustment of transmitter loading and tuning of the antenna network. These controls are coupled to the familiar Collins Autotune mechanism

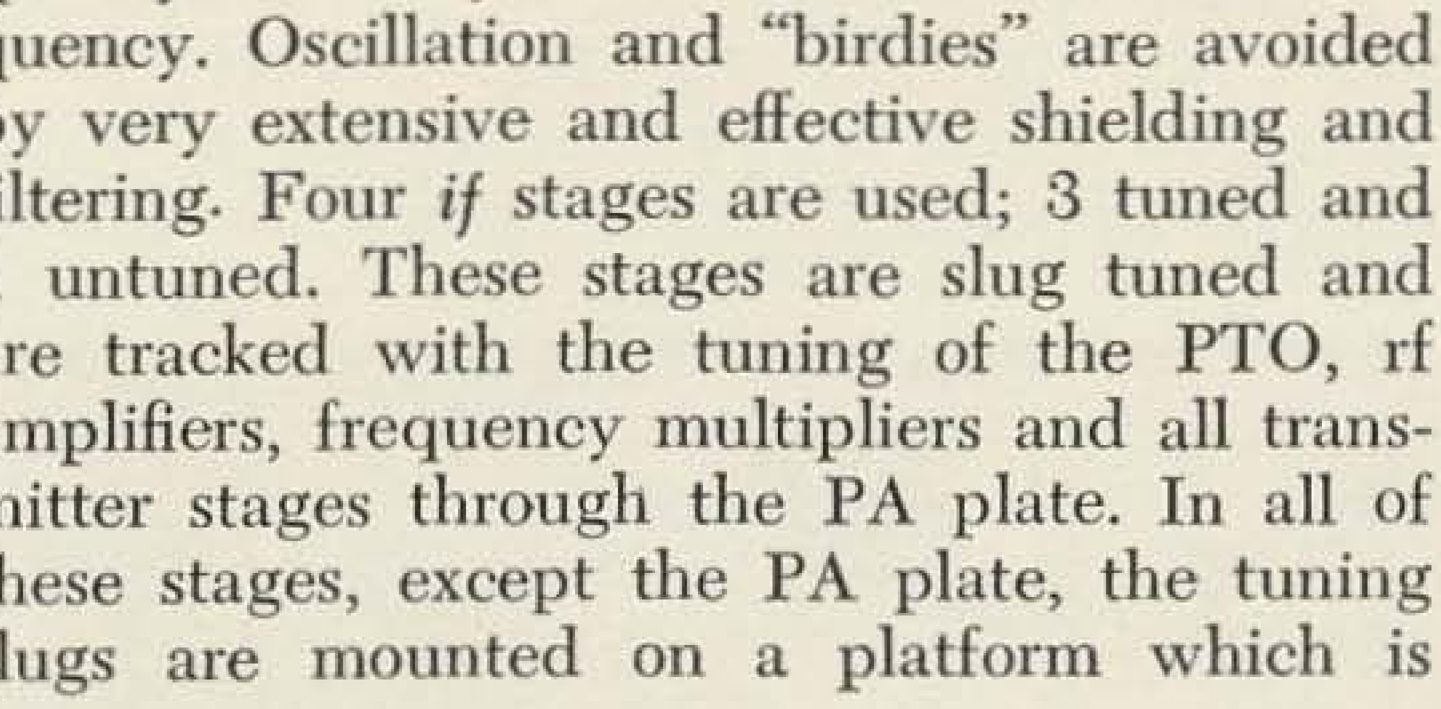


which permits local or remote selection of any one of 8 preset frequencies. This motor driven tuning system may be disengaged and the controls manually operated.

A block diagram of the transceiver is shown in Fig. 1 and will aid in understanding the theory of operation. The frequency conversion scheme is shown in Fig. 2. The transmitter section of the equipment consists of an oscillator (a Collins 70E-1 PTO), a frequency multiplier, an rf driver and the power amplifier. In the two lower frequency bands, the rf driver operates as a straight amplifier and in the two higher bands as a frequency multiplier-amplifier. The rf driver feeds a pair of parallel connected 1625 tubes in the final. The PA tank circuit is inductively coupled to the antenna coupling network. This circuit permits resonating of the network with almost any random length antenna. A variometer is mechanically linked to a switch which selects a variety of LC combinations. The variometer rotates through its complete range for each switch position. This arrangement eliminates the requirement for one front panel control. A relay contact connects the antenna circuit to the receiver input in the receive condition.

The transmitter audio circuits consist of a double-bridge limiter with a control stage and a speech amplifier which drives a pair of 1625 as a class AB_1 modulator. Also included is an MCW-CFI oscillator. When MCW or AM operation is employed, a diode detector feeds a portion of the rectified output signal to the receiver audio input for monitoring purposes. In the CW mode, the modulator is disabled and the output of the MCW oscillator is applied directly to the receiver audio system. The audio input circuit includes a 300 to 3,000 cps band-pass filter. The audio limiter has little effect below 70% modulation but, at higher levels, effectively limits the modulation to below 100%.

The single conversion receiver employs 2 tuned and 1 untuned rf stages. The mixer stage develops an *if* frequency in the range of 1 to 1.5083 mc. The mixer injection signal is obtained from a frequency multiplier stage which is driven by the 70E-1 PTO unit. The result, as shown in Fig. 2, is that the *if* frequency is always identical to the HFO frequency. Oscillation and "birdies" are avoided by very extensive and effective shielding and filtering. Four *if* stages are used; 3 tuned and 1 untuned. These stages are slug tuned and are tracked with the tuning of the PTO, rf amplifiers, frequency multipliers and all transmitter stages through the PA plate. In all of these stages, except the PA plate, the tuning slugs are mounted on a platform which is

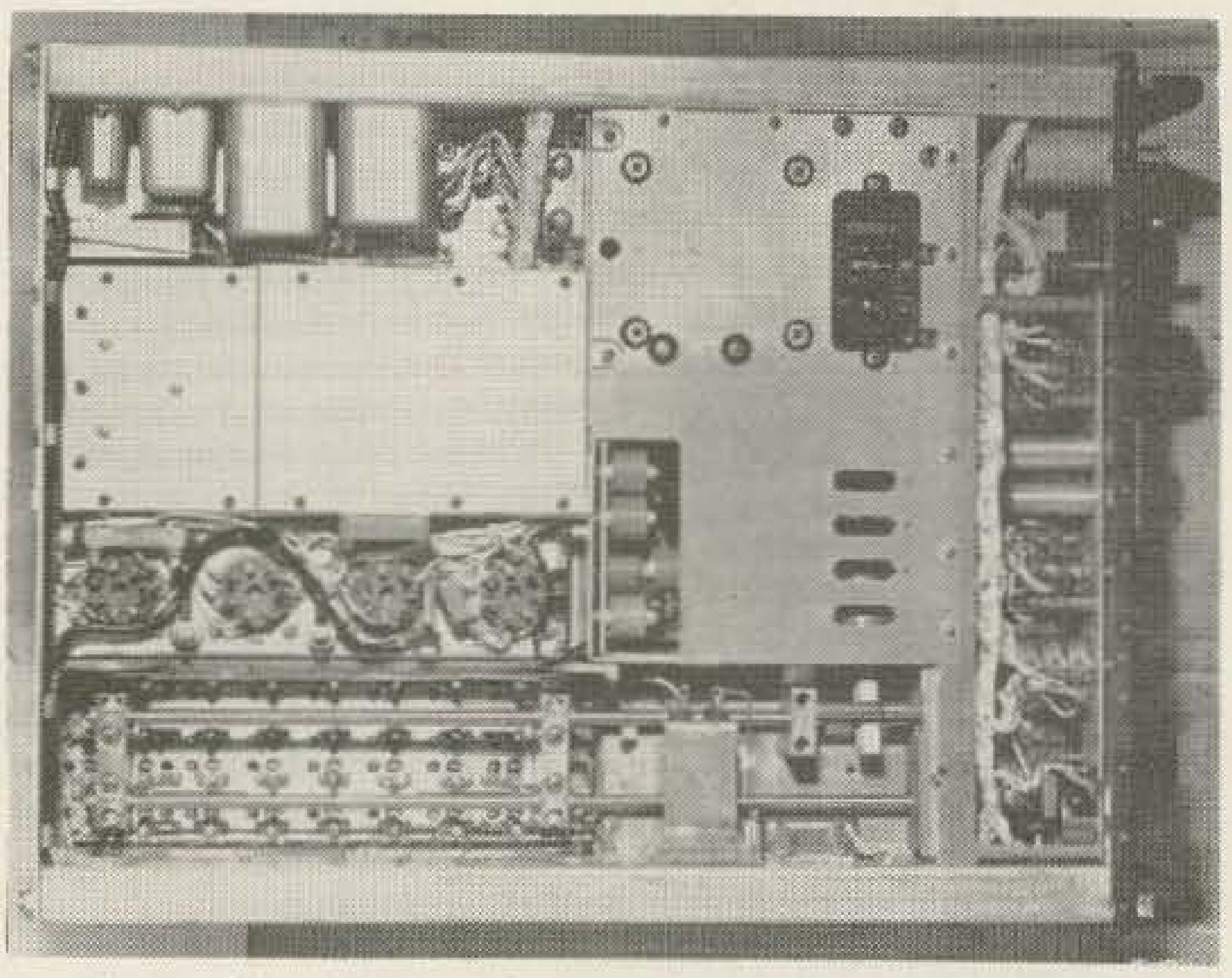


raised and lowered by the tuning control. The *if* signal is fed to the detector through a band-pass filter.

The second detector uses half a 12H6 with the second diode used as the AVC rectifier. A series type noise limiter uses half of another 12H6. This circuit feeds a 12SA7 limiter-audio amplifier. This stage drives a 12A6 tube to an audio output of half a watt into a 300 ohm load. An audio limiter rectifier samples the audio output and, when the voltage exceeds a predetermined level, a voltage is developed which is applied to the control grid of the 12SA7 audio stage. This limiting action maintains a fairly uniform audio output over a wide range of input levels. Audio and rf gain controls are ganged and varied simultaneously. A crystal calibrator circuit is provided which supplies signals at 100 kc intervals through the frequency range of the equipment. A front panel control permits the main tuning dial pointer to be accurately set at any 100 kc check point.

As shown in the photograph, the front panel is remarkably clean for an equipment as complex as the AN/ARC-2. This is achieved by mechanical ganging of controls and by the extensive use of relays. Front panel controls include main tuning, calibration corrector, band switch, volume, power switch, emission selector switch, Autotune channel selector switch, antenna coupling, antenna tuning and an auxiliary sensitivity control. In addition, dial light, meter and auxiliary receiver selector switches are provided. The meter and the antenna, microphone, key and phone connectors complete the front panel appearances.

The 28 volt DC aircraft supply is used to power the transceiver. Tube heaters, pilot lights, relays and microphone require approximately 4 amperes. The dynamotor draws about



The under-side of the AN/ARC-2 is not altered in this minimum conversion.

External view of the converted AN/ARC-2. There is no change in the external appearance of the unit when this minimum conversion with the self-contained power supply is accomplished.

12 amperes under load and the Autotune motor draws an additional 6 amperes. The dynamotor supplies 260 volts at 125 ma for the receiver and low power transmitter stages and 500 volts at 325 ma for the transmitter output stage and modulator.

If a heavy duty, 28 volt supply is available, the AN/ARC-2 is usable "as is" for amateur operation. However, the dynamotor noise and other problems recommend against such usage. Analysis of the circuit and wiring diagrams shows that this conversion falls logically into two phases. Removal of the dynamotor and minor wiring changes are required to permit operation from an ac line operated power supply. This supply may be completely external or may be partly, or even entirely, self contained. The second phase of the conversion makes wiring changes and adds certain features which make for more flexible amateur operation.

Although the relay control system requires a 28 volt dc supply, the current requirement is nominal. The schematic and wiring diagrams were searched in vain for an easy way to separate the relay, microphone and tube heater circuits. Since extensive rewiring would be necessary to accomplish this, it was decided to use a single 28 volt dc supply to meet all of these requirements. The low cost and ready availability of 3 and 5 ampere, stud mounted silicon rectifiers makes this by far the best and easiest solution to the problem.

The first step is to remove the unit from the case and this can be difficult if you are fortunate enough to get a new unit. The case is secured by 2 Dzus fasteners on the back of the case. In addition, the vent ports must be removed. If they cannot be unscrewed with the fingers, use the spanner wrench secured to

BOUND VOLUME $15

We have had a tough job getting enough volumes of 73 bound to meet the demand, even at the price of $15. This may be because so many fellows have seen one around and have a hankering for the bright red cover and the first fifteen issues of the magazine that are bound inside.

YEARLY BINDERS $3.00

These are also in bright red and are stamped either 1960-1 or 1962. You tell us which you want. We managed to get some 1960-1 binders that will hold 14 copies of the magazine. This makes for a better fit if you don't have all 15 issues. Specify large or small binder for this year.

MRT-90 CONVERSION: 50c

This booklet gives complete conversion instructions for converting the little pack-set surplus units into a fine two meter walkie-talkie. An article appeared in 73 on this unit in the October 1961 issue.

HAM-TV $3.00

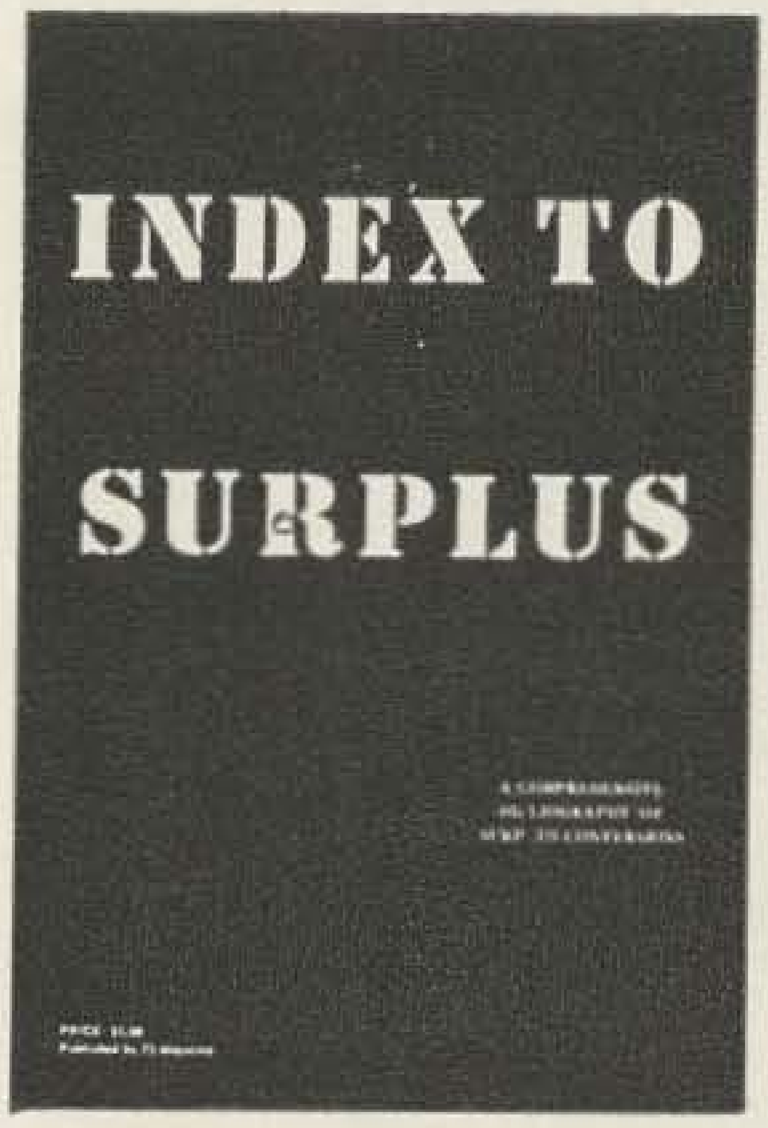
TV is one of the newest and most exciting phases of ham activity. This book gives clear and simple instructions for getting an operating TV station on the air for under $50 outlay! It is no wonder that hundreds of fellows are rushing to get on the air. The interest has been so high that a bi-monthly bulletin has now been started to keep everyone up to date on the advances and latest stations to get into operation.

IMPEDANCE BRIDGE $1.00

Here is a complete set of full scale drawings of the parts for the Impedance Bridge which was featured in the August 1961 issue of 73. This bridge is one of the most useful pieces of test equipment that you could possibly build. It would cost you hundreds of dollars to buy this unit commercially made. This set of plans comes complete with a reprint of the original article.

SSB TRANSCEIVER SCHEMATIC $1.00

There have been many requests for a giant sized schematic of the wonderful little transceiver that appeared in the November 1961 issue of 73. This schematic comes complete with a spare issue of the magazine in case you missed it.



INDEX TO SURPLUS $1.50

This is a masterful compilation of all articles that have ever been printed on surplus conversions, complete with a brief run-down of the content of each article

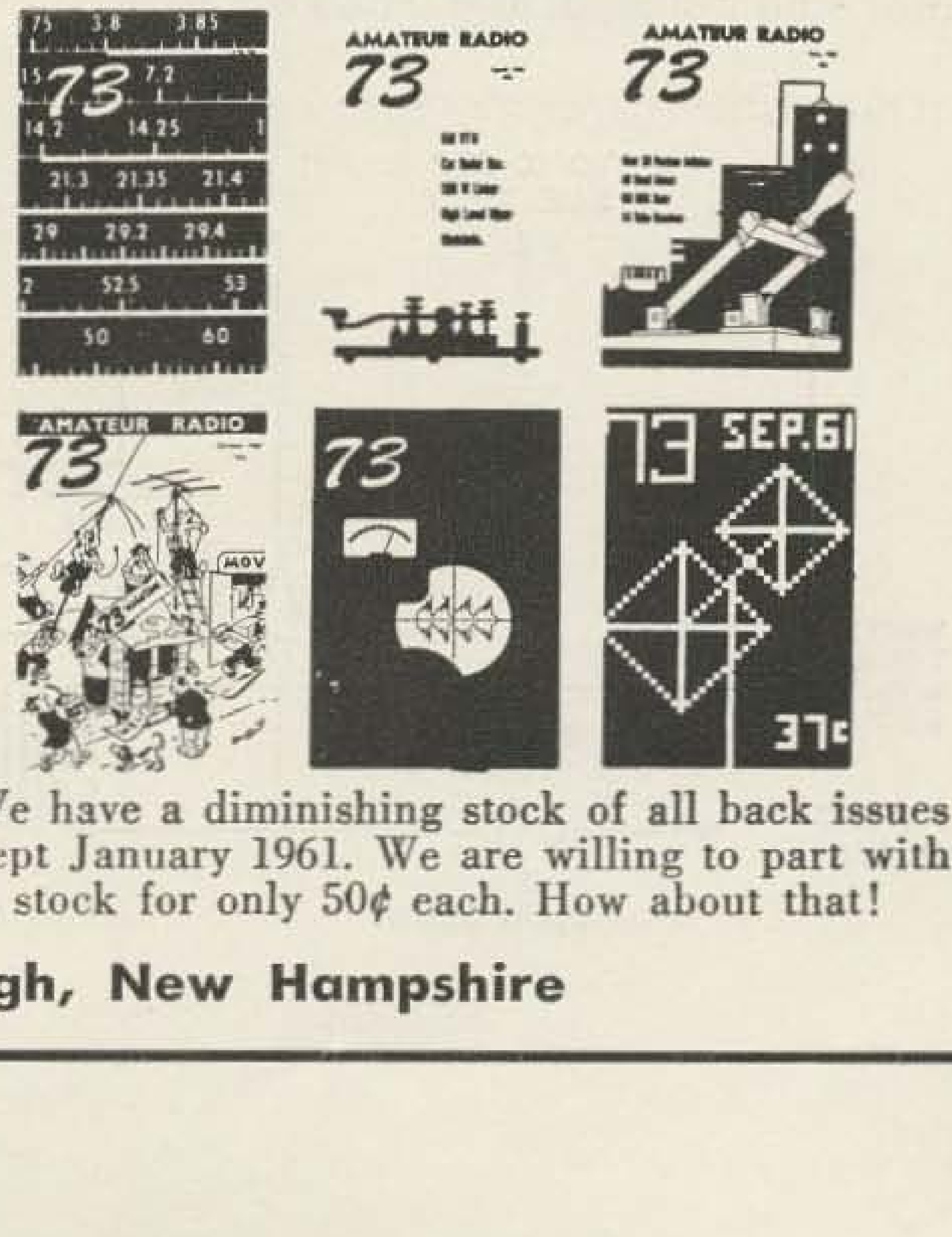
TV BULLETIN $1.00 per year

The first issue of the TV Bulletin is now ready for mailing. This is a bi-monthly bulletin designed to keep all fellows interested in Ham-TV up to date on technical improvements in Ham-TV gear and on all activities. In the first issue of the Bulletin there is a list of all known hams who are reported to be getting on the air on TV. The Bulletin is edited by Mel Shadbolt, WØKYQ, the author of the popular HAM-TV book. Get in on this from the first issue and have a complete set of information at your fingertips. The present plans call for six issues of the Bulletin per year, with at least 12 pages per issue.

MICKEY MIKER 50c

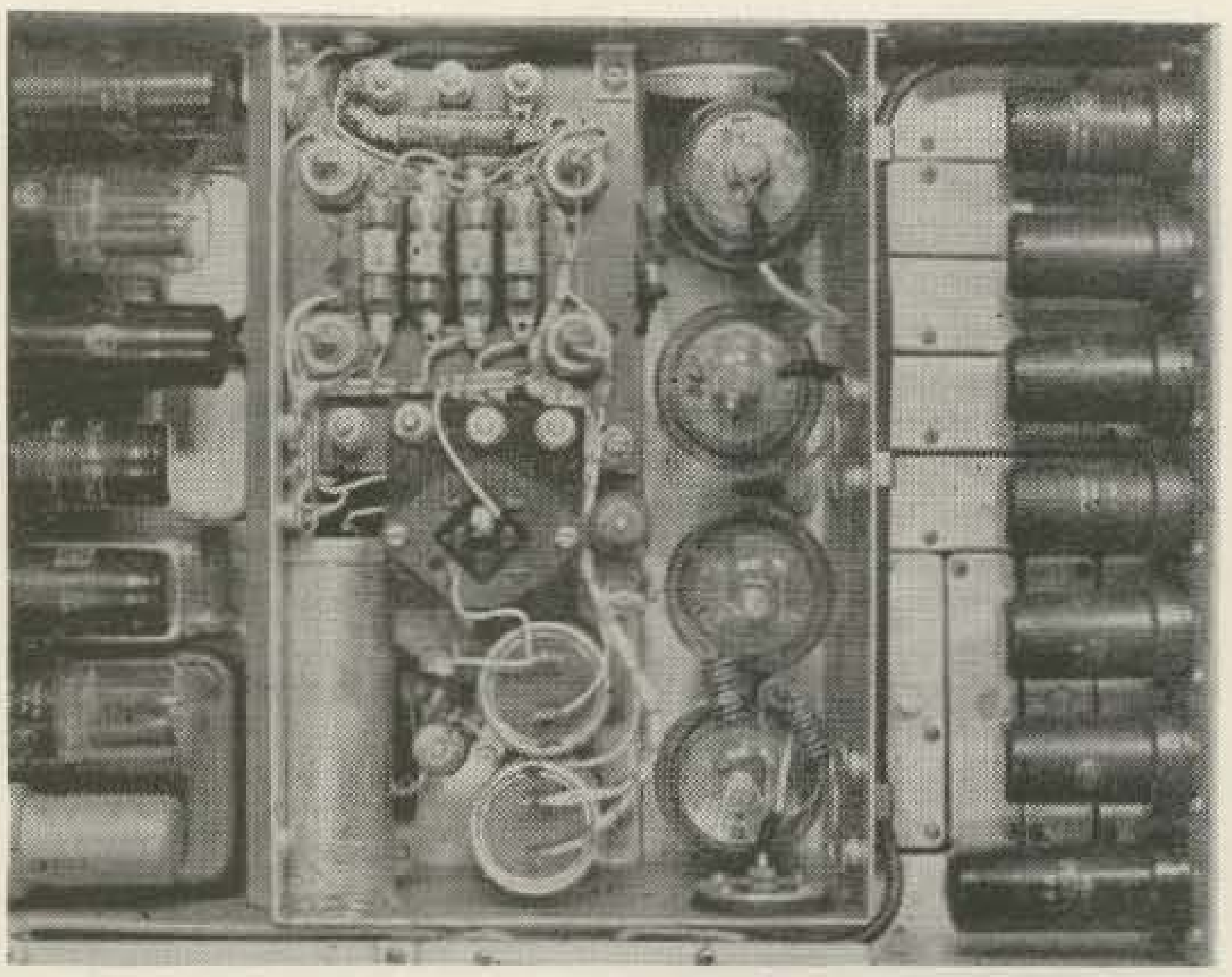
This is the first of our small booklets to come off the press. It is a complete description of the construction and operation of a little device which will measure capacity to a high degree of accuracy. This is a gadget that can be built out of most junk boxes and will forever be a handy item to have around when you are building something new or fixing something old.

BACK ISSUES



We have a diminishing stock of all back issues except January 1961. We are willing to part with this stock for only 50¢ each. How about that!

73 Magazine Peterborough, New Hampshire



The bulk of this conversion is the AC power supply installed in the dynamotor compartment. The 24 volt bridge rectifier, the 300-600 volt doubler-quadrupler diodes and the fuse are all mounted on the transformer terminal board. The filter capacitors and other components are mounted as convenient.

the back of the case. The lip of the case is clamped to the front panel by finger stock so that a substantial pull is required to remove it.

Loosen the snap fasteners holding the dynamotor compartment cover in place and set it aside. Remove the 2 center 1625 tubes, loosen the dynamotor clamp screws and remove the dynamotor. The contoured dynamotor mounting bracket is spot welded to the deck and these welds must be broken loose. The simplest way is to cut the bracket lengthwise with an Adel nibbling tool. Take a pair of gas pliers and work each section back and forth until the welds break loose. It sounds messy but the welds break cleanly, out of the bracket, and leave small, inoffensive "buttons" on the deck. Remove the connector from the dynamotor and install it on the plug in the bottom of the compartment. Discard the dynamotor and reinstall the 1625 tubes.

The dynamotor compartment may be used to house power supply components and a space approximately 4½" x 4½" x 9½" is available for this purpose. The 28 volt dc supply shown in Fig. 3 may be wired as a sub-assembly and installed in the compartment. Switching and control is greatly simplified if this supply is allowed to run continuously. The current drain and heat dissipation of the supply should be negligible and should pose no problem. During extended periods of station inactivity, the unit may be unplugged or, if a station master switch is used, the problem does not exist

Although available surplus diodes and transformer were used in the unit shown in the photograph, the standard items specified in Fig. 3 will do the job nicely. Incidentally, the diodes shown have a sufficiently high rating to permit their mounting on the transformer terminal board without a heat sink. Lower rated diodes, such as those specified, will require the conventional treatment.

Install the assembly at the rear of the dynamotor compartment, locating it so as to occupy the minimum space. It may be necessary, depending on the mounting centers, to temporarily remove some components from under the chassis to drill the mounting holes. Drill a clearance hole in the deck to clear the 28 volt positive lead. Pass this lead through the hole and connect to Pins 1 and 17 of P-101, the main power connector. Clearance is limited and a "long reach" soldering gun tip will help in this operation. Connect the 28 volt supply negative lead to chassis ground and Pin 1 of the dynamotor connector. As shown in Fig. 3, an additional filter capacitor is required in the microphone circuit. Locate C-238, near the front of the right side of the unit, and connect a 250 mfd, 50 WV tubular electrolytic

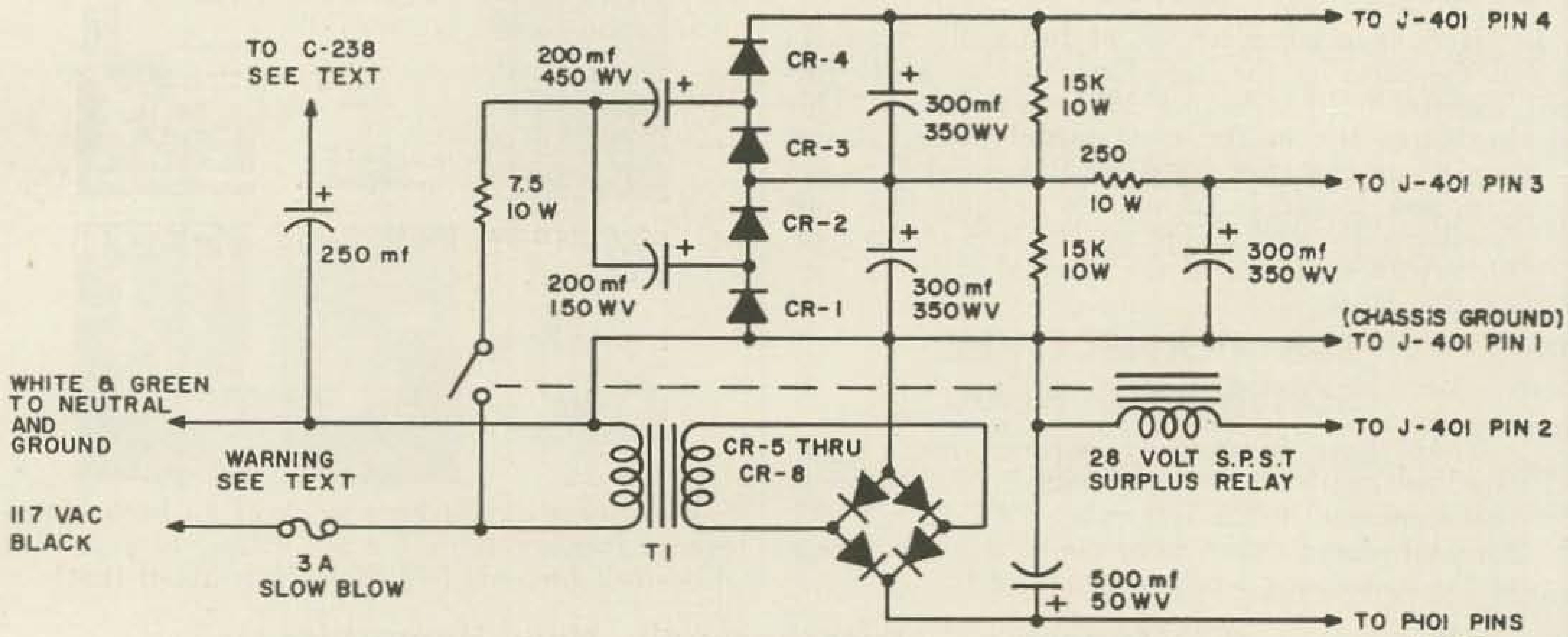
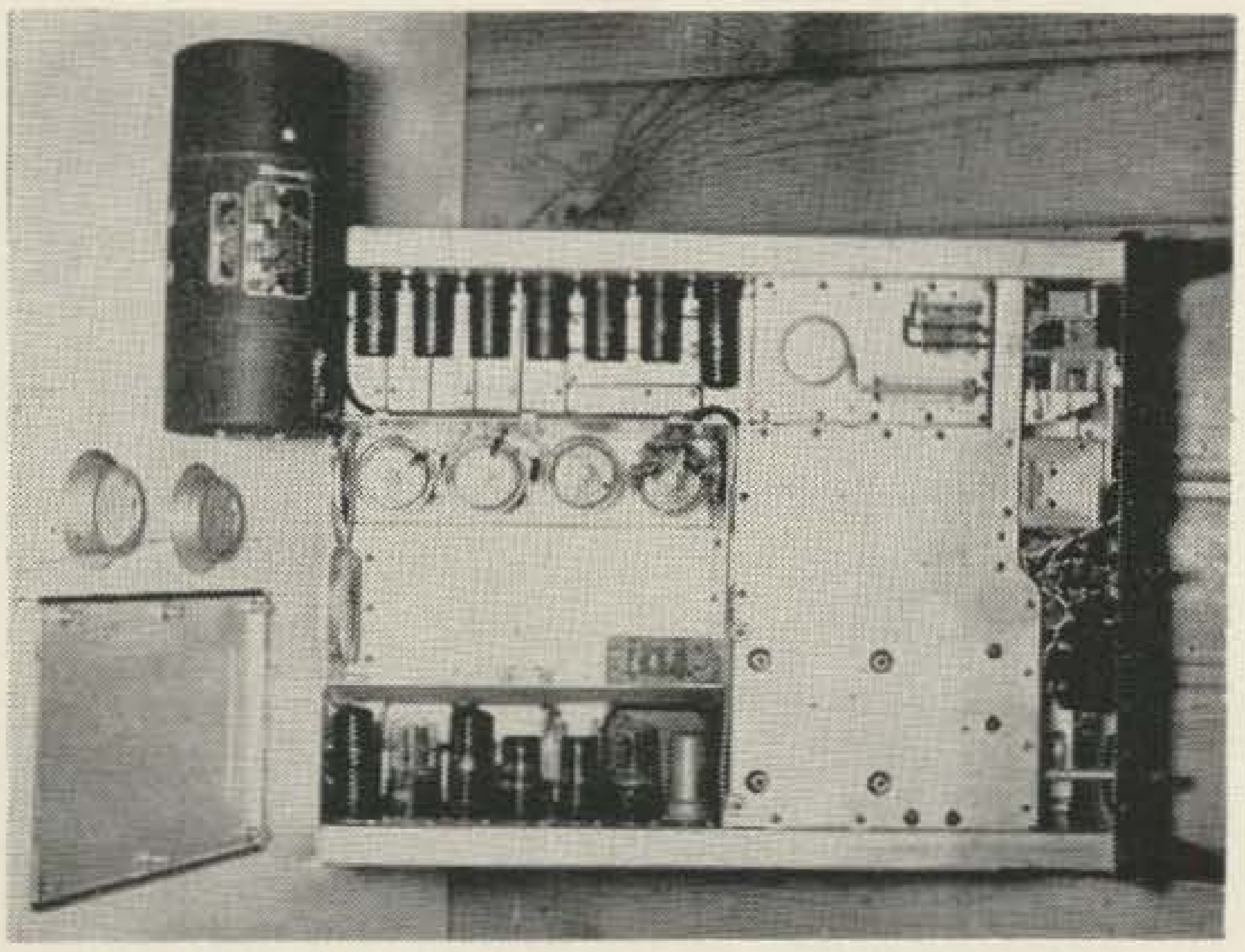


FIG 3

in parallel with the original capacitor. Dress the new part so that it will clear the case, using a clamp if required. Dress the ac cord out through one of the vent holes and the 28 volt supply is completed.

If the 3 ampere silicon diodes are used, the Autotune motor must be disabled. Disconnect the 4 motor leads from the terminal board above the motor and tie them out of the way. If the 6 ampere diodes are used, the Autotune feature is retained. While the Autotune motor imposes an overload in excess of 100% on the transformer specified, it is of very short duration and no damage to the transformer results.

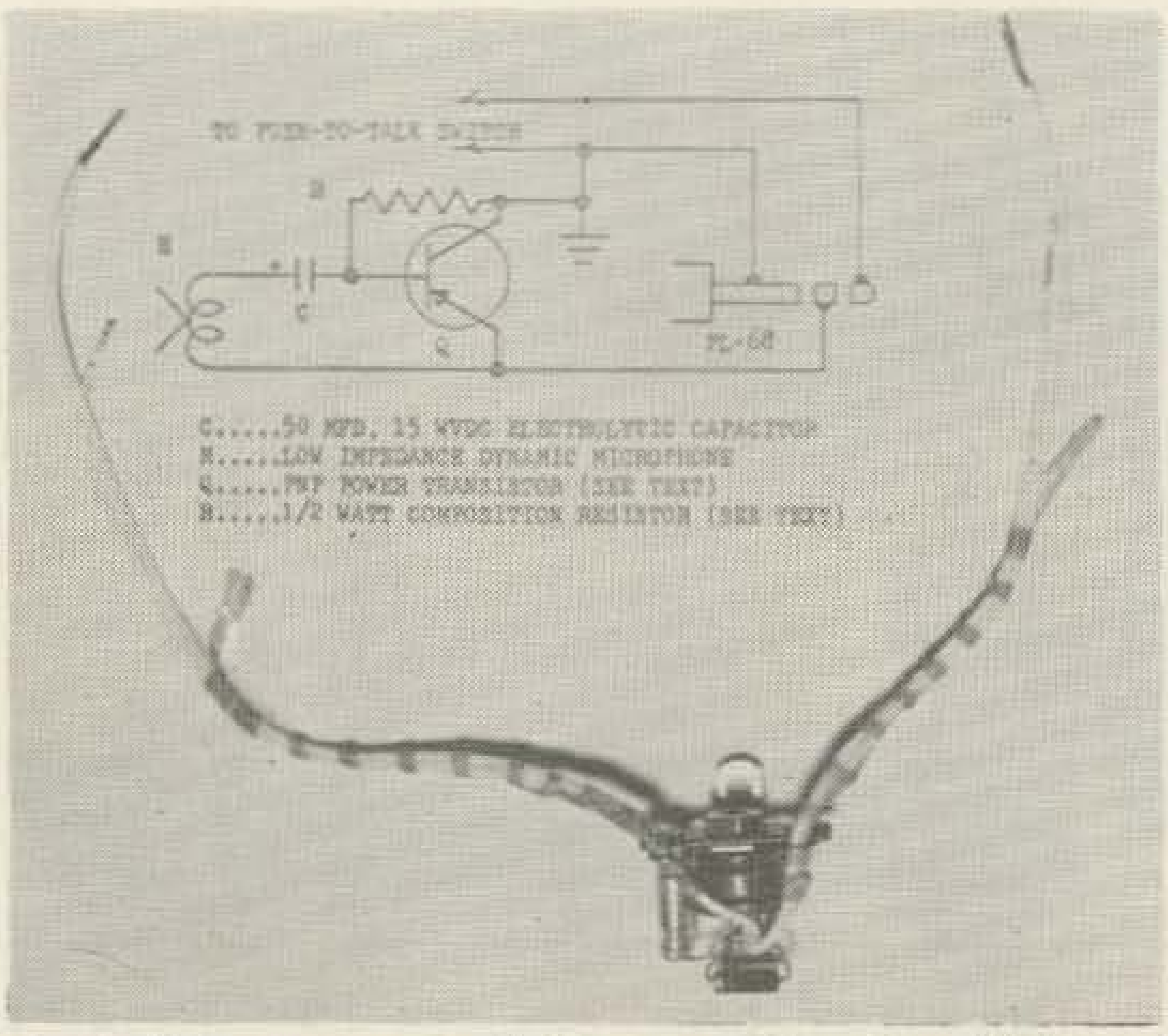
Turn the front panel power switch to the off position and plug in the ac cord. Measure the 28 volt supply voltage which should read about 30 volts. Turn on the front panel power switch; relays should operate, the Autotune mechanism (if used) should cycle and all tubes should light. Voltage of the 28 volt supply, under heater and relay load, will run about 26 volts and the Autotune motor will cause an additional 3 or 4 volt drop.



Top view of the transceiver shows the dynamotor removed and the compartment ready for installation of the AC power supply.

If the Autotune feature is disabled and had previously been stopped during a cycle, it will be necessary to manually complete the cycle. A Bristol wrench will be found clipped to one of the top cover plates of the chassis. Leave power applied and insert the wrench in the end of the Autotune main drive shaft which is accessible through a hole adjacent to the previously mentioned capacitor, C-238. Rotate the shaft until you hear a relay operate. This completes an interlock circuit and will permit normal, manual tuning.

This completes the check-out of the low voltage supply and we are now ready for the two plate supplies. Regardless of whether external or self-contained supplies are used, it is



desirable to control them without additional switching. The relay circuit shown in Fig. 3 provides this function. A surplus 28 volt power contactor is wired between Pin 2 of the dynamotor connector and ground, Pin 1. When the front panel switch is closed, this relay is operated and the contacts are used to supply AC power to the plate power supplies.

While the writer has the usual objections to line operated, transformerless power supplies, their use greatly simplifies this conversion and permits a completely self-contained package. If this approach is taken, use the new UL grounding type ac connector on a three conductor power cord and use only in a receptacle that has been verified as being properly wired with the ground connection carried through. In the event the plug is inserted in an improperly wired receptacle, the worst that can happen is a blown house fuse. In any event, play it safe. *Avoid haywire and adapters and be absolutely certain the chassis is at ground potential. BETTER BE SAFE THAN DEAD.*

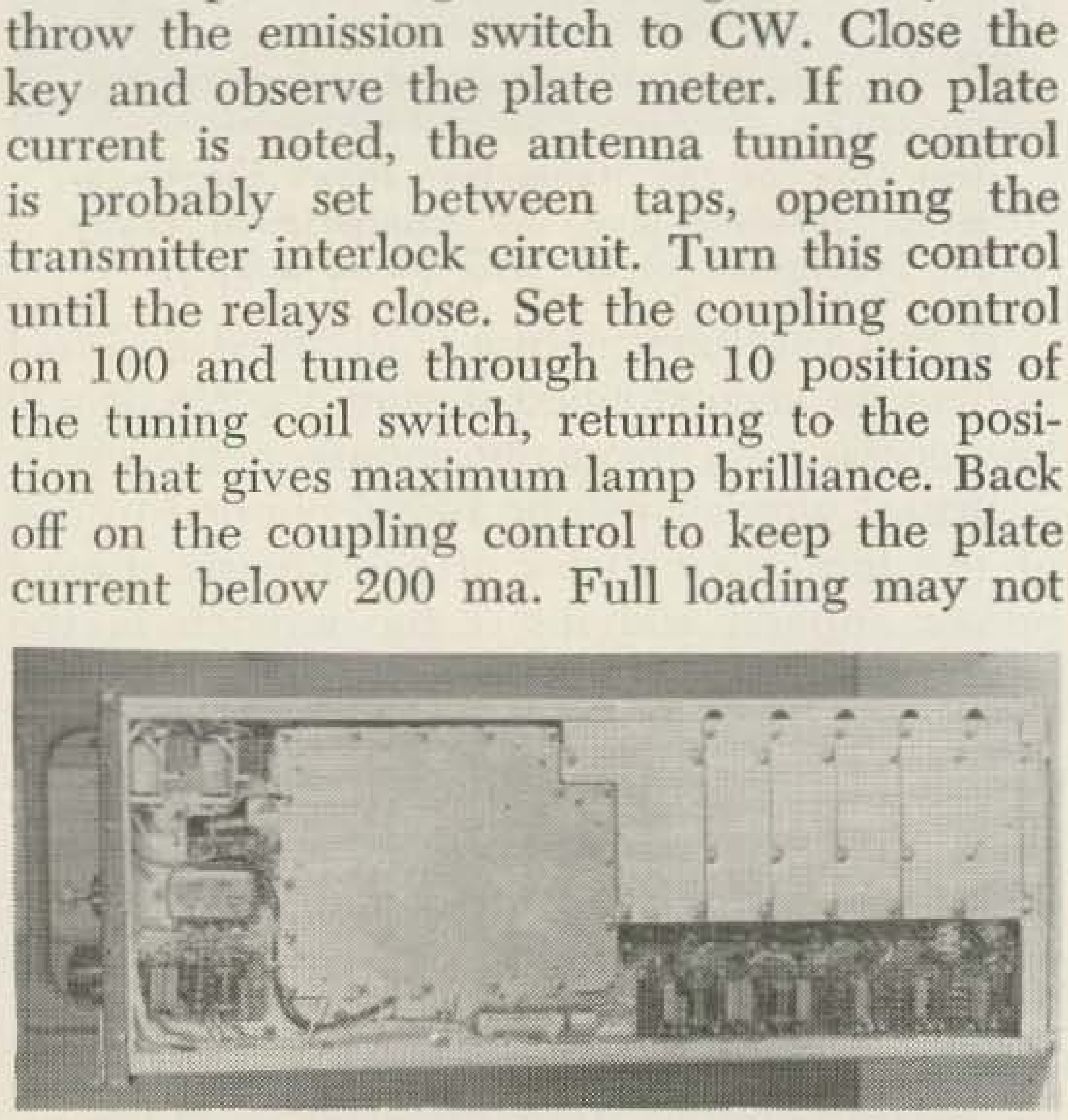
Install the plate power supply components in the compartment and wire in accordance with Fig. 3. No parts placement drawings are supplied since layout will depend on the components available. The photograph shows a practical arrangement. The fuse and all diodes are mounted on the 24 volt transformer terminal board. Over-rated power resistors were on hand and were used. The capacitors are supported by base clamps and are insulated with sections of plastic tubing. Keep in mind that you are dealing with over 600 volts dc and insulate accordingly. Don't skimp on the values of capacitors specified. The result will be poor regulation and high hum level. While the values shown are not available from all manufacturers, all units specified are available in the Pyramid line.

The power supply choice is an individual decision and if external, transformer type plate supplies are selected, connect the nominal 260 volt positive lead to Pin 3 and the nominal 500 volt positive lead to Pin 4 of the dynamotor connector. Use Pin 1 as the common ground. Lift the ground connection on the ac power line and feed the ac to the supplies through the contacts of the added relay.

Check out the wiring of the supplies and if all seems right, turn the front panel power switch off and connect the ac power. Turn the front panel switch on and measure the plate supply voltages. The line operated supply delivers about 270 and 610 volts in the receive and 260 and 580 volts in the transmit condition. Loosen the Autotune locking screws on the control knobs, connect an antenna and a pair of phones and we are ready to test the receiver.

Advance the screwdriver adjusted sensitivity control fully clockwise, turn the emission switch to the "Voice" position and advance the volume control. Tune across the bands and a multitude of signals should be heard. Turn the emission switch to the CW position; the BFO injection relay should operate and CW stations should be received. Throwing the switch to the calibrate position should turn on the 100 kc standard and remove the antenna. To calibrate the dial, tune to zero beat with the nearest 100 kc check point and adjust the corrector knob for precise dial calibration.

With the receiver checked out, we are now ready for dummy load testing of the transmitter. Connect a 150 watt lamp between the antenna post and ground. Plug in a key and throw the emission switch to CW. Close the key and observe the plate meter. If no plate current is noted, the antenna tuning control is probably set between taps, opening the transmitter interlock circuit. Turn this control until the relays close. Set the coupling control on 100 and tune through the 10 positions of the tuning coil switch, returning to the position that gives maximum lamp brilliance. Back off on the coupling control to keep the plate current below 200 ma. Full loading may not

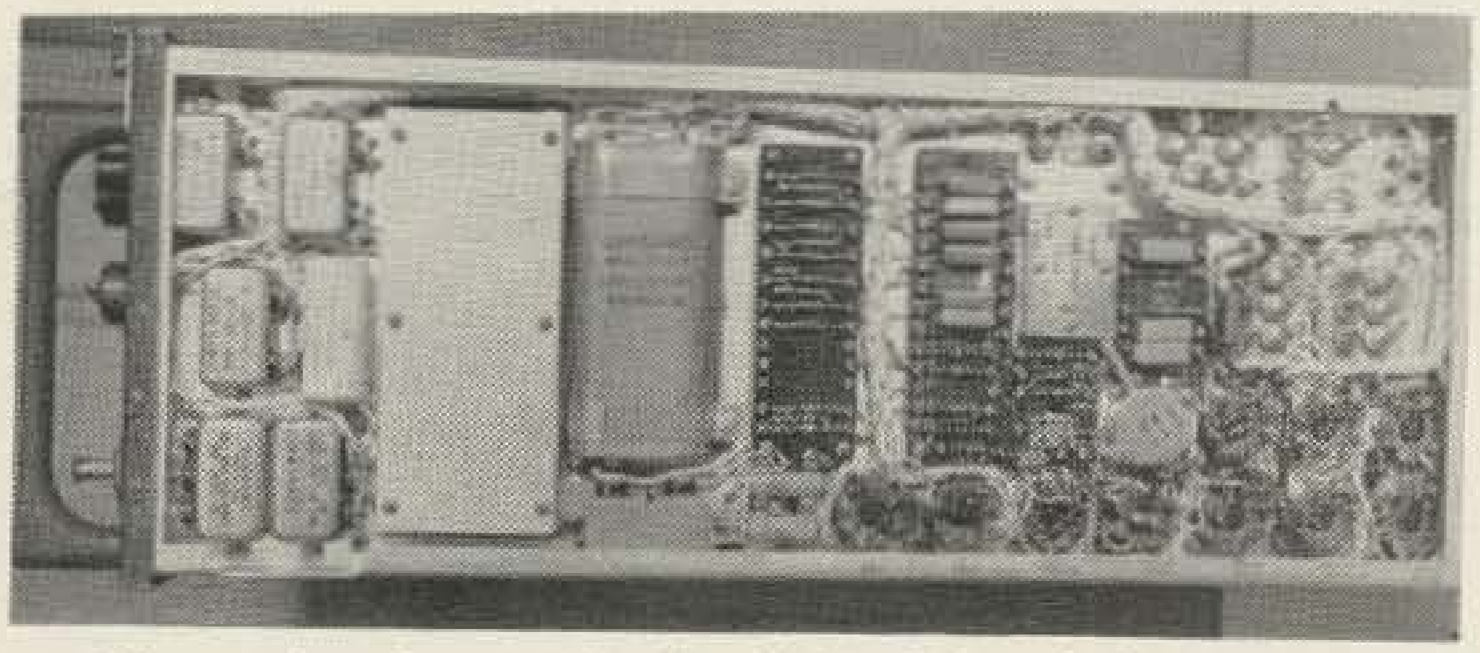


The right side of the chassis is unchanged in this conversion.

be obtainable across the 40 and 80 meter bands but more on this later. Tune in the signal on a local receiver and key the transmitter. Clean keying should be observed, accompanied by the relay clatter that is typical of military equipment.

Turn the emission switch to the AM position and plug in a carbon mike with the normal PL-68 termination. Close the push to talk switch and speak into the mike. Audio should be crisp and have the characteristic "punch" of a good compressor type audio system.

"On the air" testing is next on the agenda. As previously mentioned, the antenna network of the AN/ARC-2 is designed to match the characteristics of the usual aircraft antenna. While ideal for loading a random length of wire, some difficulty may be encountered in loading the conventional 50 or 70 ohm line.



The only change in the left side of the unit is the installation of the additional microphone supply filter capacitor shown in the top of the photo.

In any event, try it with your antenna. Set the coupling control to 100 and tune through the complete range of the tuning control, watching for maximum rise in PA plate current. Back off on the coupling control as required to keep the plate current below 200 ma. It is wise to confirm the settings of the antenna network by peaking the adjustments from "on the air" reports or with a field strength meter.

Autotune setup is simple and will permit the automatic selection of any 8 frequencies within the tuning range of the equipment. Good resetability, coupled with the stability of the PTO unit, make this feature ideal for quickly coming up on MARS and other net frequencies. Turn the Autotune selector switch to the desired channel and, after the drive cycle is completed, calibrate the set to the nearest 100 kc check point. Set the dial to the desired frequency and tighten the screws in the tuning and band switch knobs. Load the transmitter into the antenna as normal and then tighten the screws on the coupling and antenna tuning controls. Set up as many channels as desired, making sure the locking screws are tight before switching channels. Any position may be used for manual tuning by releasing the locking screws. DO NOT CHANGE THE AUTOTUNE CHANNEL SWITCH WITHOUT LOCKING THE CONTROLS OR PRESET DATA WILL BE LOST FOR ALL CHANNELS.

While no component failures have occurred in the prototype, the heat rise in the power supply-PA tube compartment may result in shortened life for the silicon diodes and electrolytic capacitors. If extended periods of operation are contemplated, it would probably be wise to provide forced cooling. A small blower, mounted over the right rear vent port would direct a flow of air over the 1625 tubes, around the power supply components and out the other port. This should result in adequate cooling and long component life.

Rubber mounting feet complete the conversion. Locate and drill clearance holes for the mounting screws about ⅜" from the sides of the case. Transfer these locations to the "U" shaped channels which are formed in the side chassis. Very carefully drill and tap these holes to accept the machine screws used to mount the feet. Extreme care is required to prevent damage to the cables in these channels.

Those who have not experienced the convenience of high stability transceiver operation are in for a pleasant surprise. Performance is excellent with good sensitivity and selectivity that is par for the course. A period of operation will give a feel for the equipment and will also point out possible areas of improvement. Various other modifications have been made to the prototype which, while fairly simple, require reference to the wiring and schematic diagrams. These drawings are available but would require at least 8 pages of 73 Magazine for barely adequate reproduction.

In order to hold this article to an acceptable length and still make the material available, arrangements have been made for publication of a separate booklet. The booklet consists of this article, wiring and schematic diagrams for both the AN/ARC-2 and AN/ARC-2A along with many additional photographs, diagrams and complete instructions for adding the following features to this conversion:

1. Self contained speaker and matching transformer wired to a "normal through" phone jack.
2. Removal of the existing ganged audio output attenuator and rf gain control and installation of a separate low level audio gain control.
3. Replacement of the existing sensitivity control with a front panel rf gain control.
4. Modification of the rf output coupling network to provide efficient operation into a 50-70 ohm load. The versatility of the original network is retained in this change.
5. Removal of the dial light switch and addition of an AGC switch.
6. Removal of the low frequency antenna switch and addition of a sidetone disable switch to permit speaker operation with AM.
7. Inclusion of a transistorized mike input amplifier unit to permit use with low impedance dynamic microphones.
8. Installation of improved break-in keying circuitry to permit higher speed keying and to reduce relay noise.

Both the minimum modification and the full treatment of the AN/ARC-2 result in high performance packages at a fraction of the cost of commercial gear. The stability and high standards of workmanship are difficult to obtain on today's market. The equipment is highly recommended as a complete station and as an auxiliary or emergency rig.

. . . W4WKM

FM Rejecting Stub

Earl Murphy W8HOA

RECENTLY a nearby FM station was put in operation and I discovered to my dismay that I was getting an overwhelming signal from them apparently in the middle of the six meter band. After some sleuthing I determined that the second harmonic of my converter oscillator was beating with the FM signal resulting in an output in the middle of the AM broadcast band where I was trying to listen to six meters. Not much could be done about the second harmonic of the oscillator so it was necessary to reject the FM signal before it got into the converter. I found a simple yet effective solution was to use a shorted stub across the transmission line just ahead of the converter. If the length of this stub is properly adjusted to be a half wavelength at the FM frequency, it will place a short circuit on the transmission line thus attenuating the FM signal and at the same time the converter operation is unaffected since at six meters the stub is very nearly a quarter wavelength long and as far as a six meter signal is concerned the stub isn't there! The length of the stub will depend on the frequency of the FM station and the type of transmission line used for the stub. Fig. 1 gives the required length for the most popular types of coaxial cable as a function of FM frequencies. This was plotted from $L = 5905v \div f$ (mc.), where L is in inches and v is the relative velocity of propagation. For coaxial cables such as RG-5B/U, RG-8A/U, RG-9B/U, RG-11A/U, RG-58C/U, and RG-59A/U v is 0.67 and this was used to plot Fig. 1. If a cable with a different v is used the length must be obtained from the equation. It is interesting to note that it is not necessary to match the impedance of the cable used for the stub to the impedance of the transmission line. The stub can be attached to the transmission line by inserting a coaxial tee at a convenient joint. It is a good idea to cut the cable a little long and prune for best results. Once the length has been determined solder the outer braid to the center conductor being sure the end is completely sealed and the connection is tight. There will be high circulating currents in the stub and a cold solder joint will reduce its effectiveness.

So there you are. For a scrap of cable and two spare coax fittings the blight of FM interference is removed from six meter operation. The technique outlined above can be extended to many other problems involving rejection of particular signals while not affecting others.

. . . W8HOA

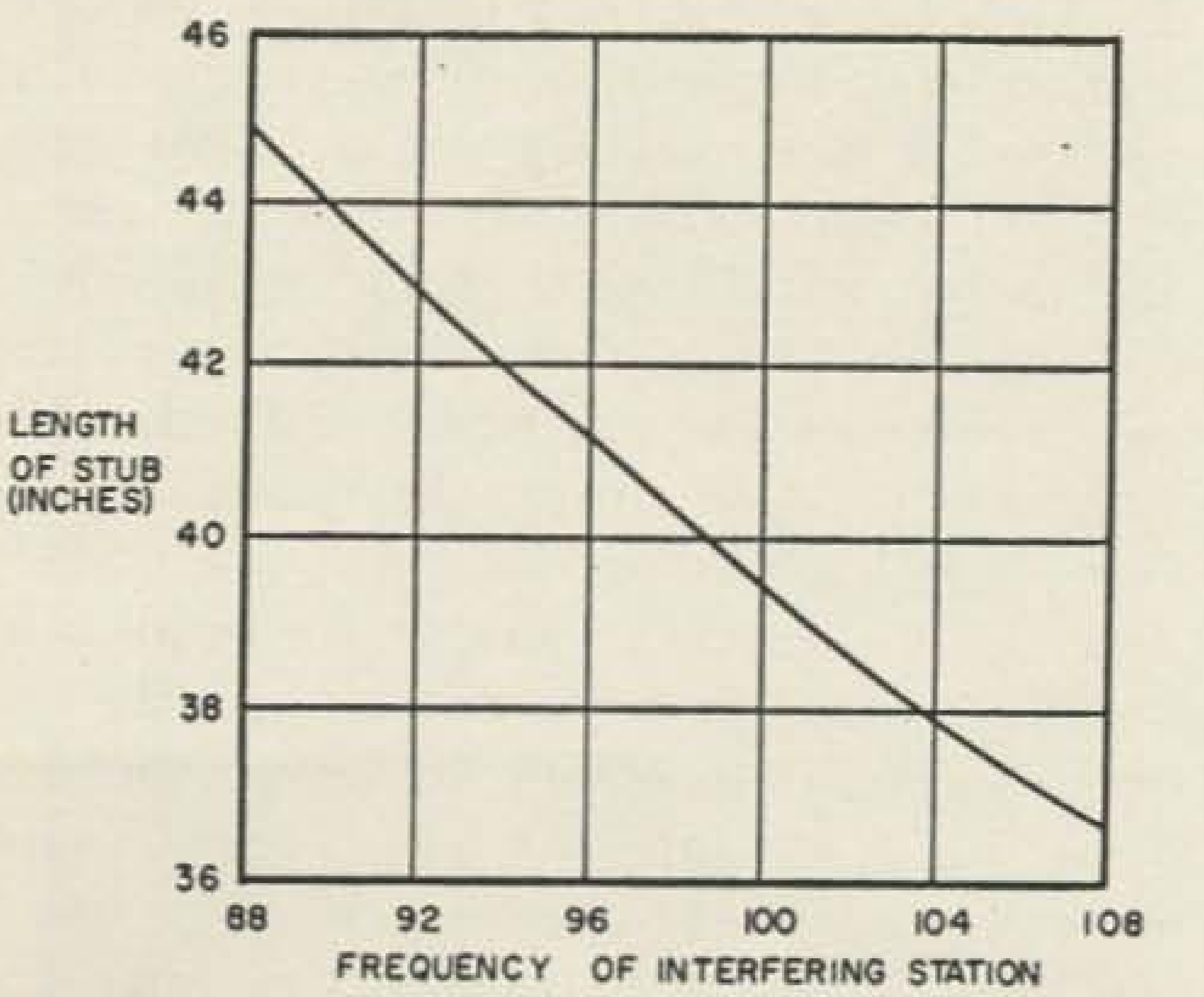


FIG. 1

Gordon E. Hopper W1MEG/A1MEG
75 Kendall Avenue
Framingham, Massachusetts

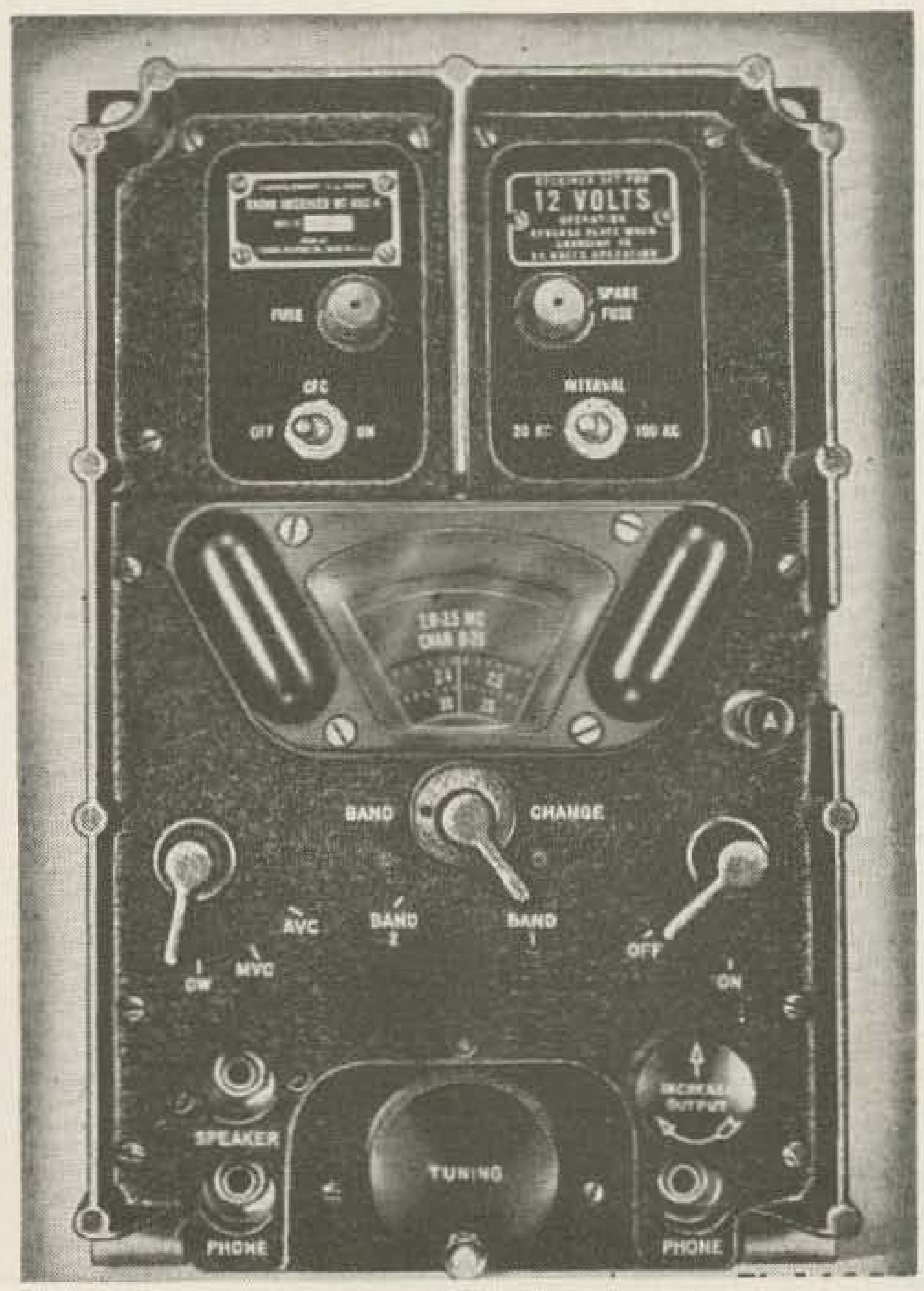
Converting

The BC-652 is an eleven-tube receiver covering the 2 to 6 mc range which has recently become available in quantity to Army MARS members. Although its frequency range is limited, it will cover the MARS 2, 3, 4, and 5 mc frequencies plus the 75 meter and 80 meter amateur bands.

Originally, it was a component section of the SCR-506-A which was designed for vehicular installation. It consisted of the receiver, a BC-653-A transmitter and a choice of either a 12-volt or 24-volt dynamotor.

A crystal frequency calibrator is incorporated in the BC-652 receiver, it includes a noise limiter, and it is capable of receiving AM, CW, SSB and RTTY signals.

Because of the internal interconnections involved in the complete SCR-506-A Radio Set, a small amount of modification is necessary to put the receiver section into operating condition when it is removed as a separate unit. These modifications are very simple as they involve only the addition of a power connector and three jumper wires to complete the filament circuitry.



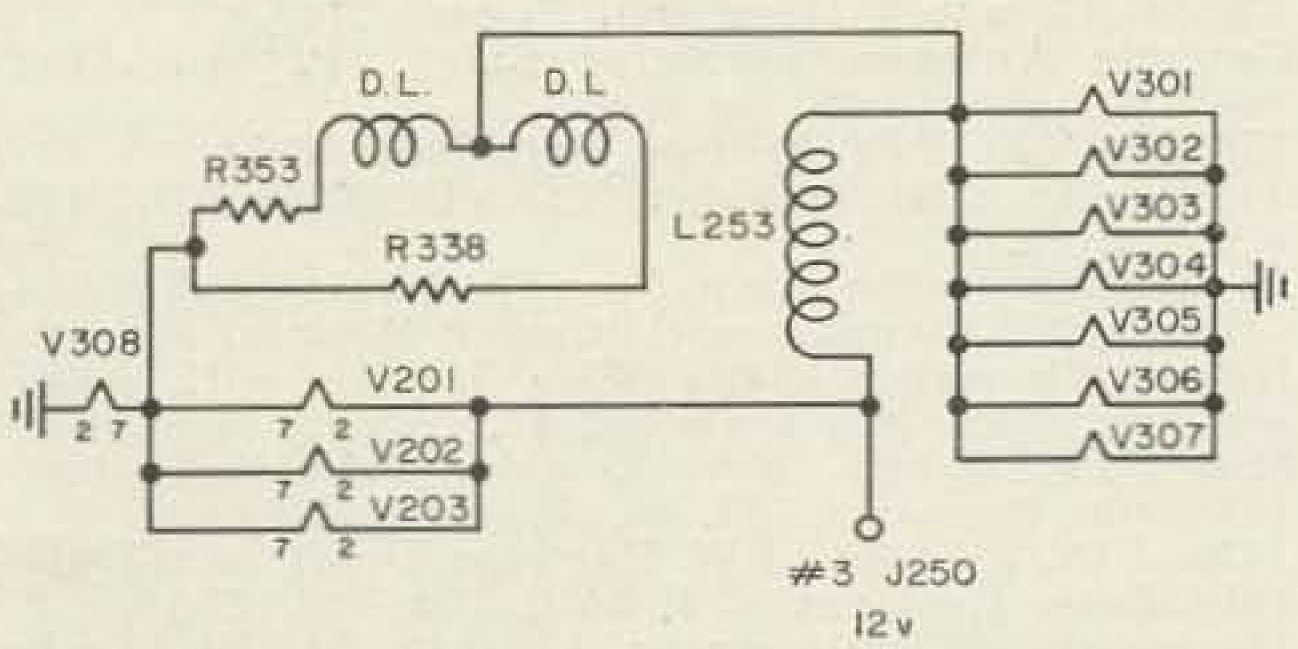
the BC–652

A schematic diagram which is on the bottom of each receiver, plus the revised filament wiring shown below, will be of assistance to those converting this receiver.

Use a Cinch-Jones 300 series connector which will mate with J250 on the receiver and perform the following steps to the *new connector:*

1. Connect nos. 1, 2 and 4 together, this becomes the common ground.
2. Connect no. 3 to 12 volts A.C.
3. Connect no. 6 to 175-200 volts D.C.
4. Connect filament and "B" supply returns to no. 1, 2 or 4.
5. Plug in the new connector.

The modified filament circuitry will appear as follows:



On P302, on the rear of the receiver, connect a jumper wire between nos. 5 and 8 to complete the V305 cathode circuit.

The 6Y6 audio output tube should be replaced with a 6K6GT tube to reduce the power drain on the 12-volt filament transformer.

Swamping resistors originally wired across the three *if* transformers could be removed, but may not make too much improvement in the performance of the receiver.

A three-tube crystal calibrator using a 200 kc crystal is built into the receiver and is controlled from the front panel. The 200 kc crystals do not come with the receiver and are available from Texas Crystals in Fort Meyers, Florida.

As the calibrator functions very well, it was left in the receiver, however, this entire section could be removed and a built-in power supply substituted.

The BC-652 is now available on the surplus market, and is excellent as a stand-by receiver or for use by the newcomers in the ham radio field.

. . . W1MEG

Advertisers