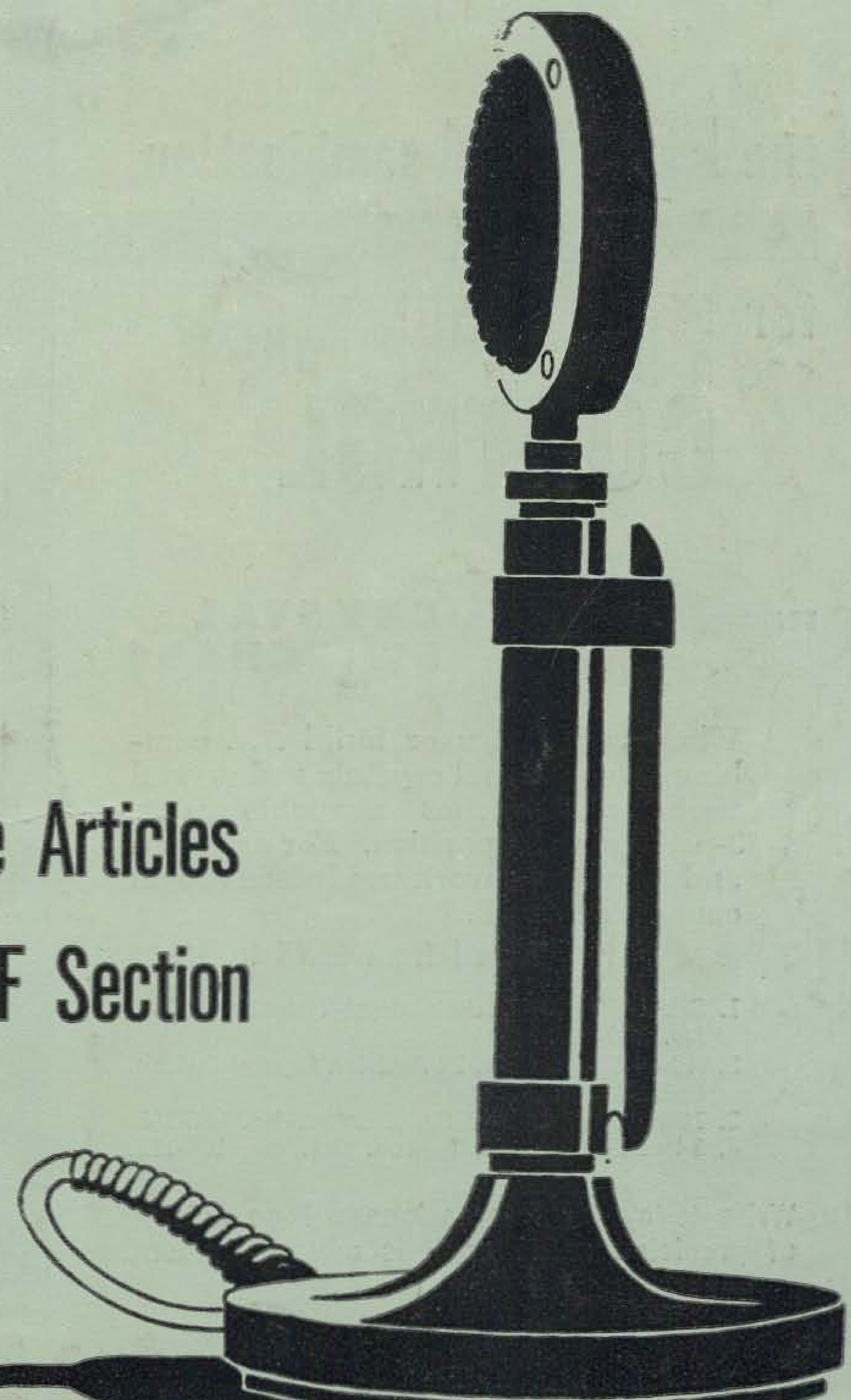
AMATEUR RADIO

73

June 1962

40¢



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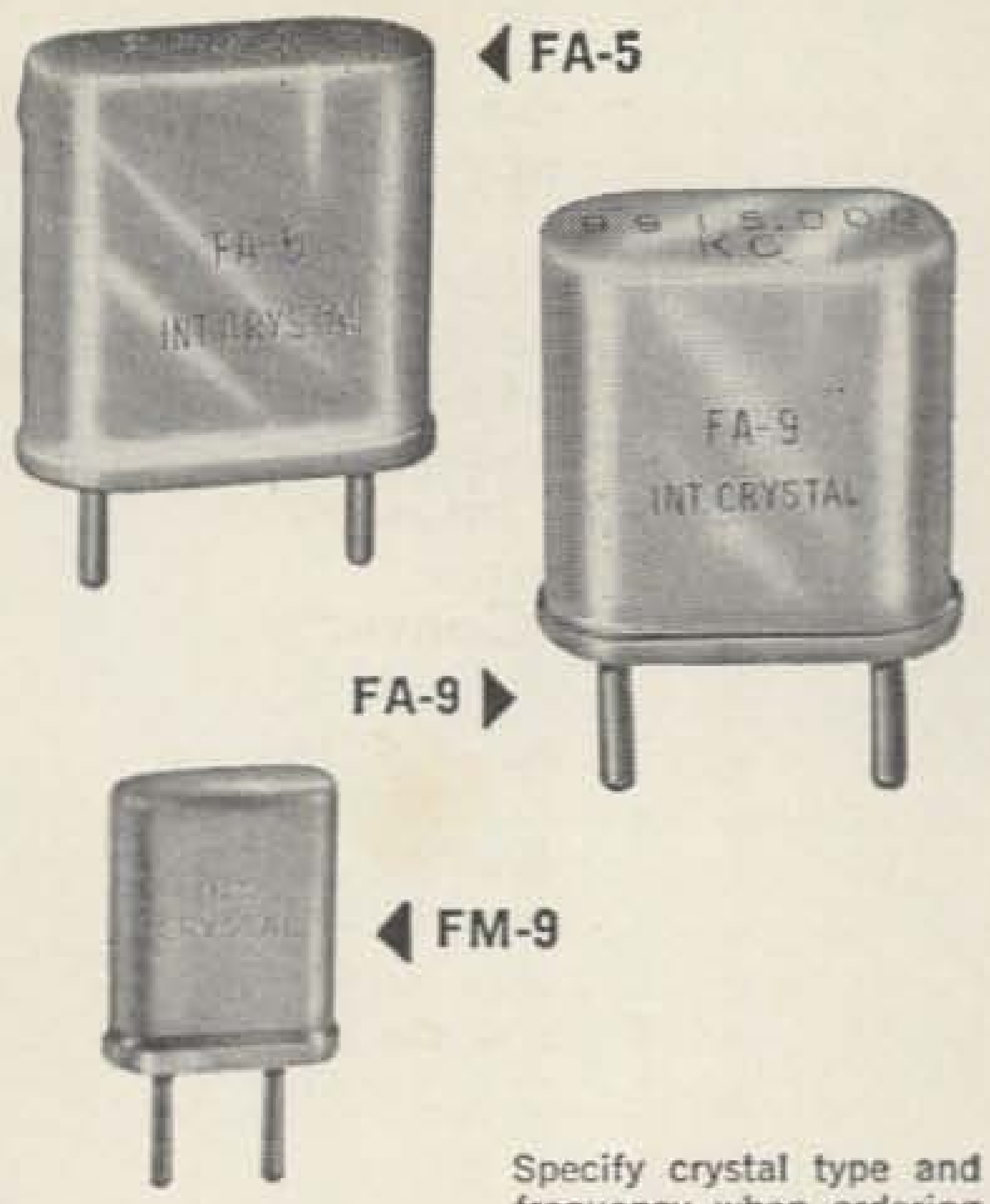

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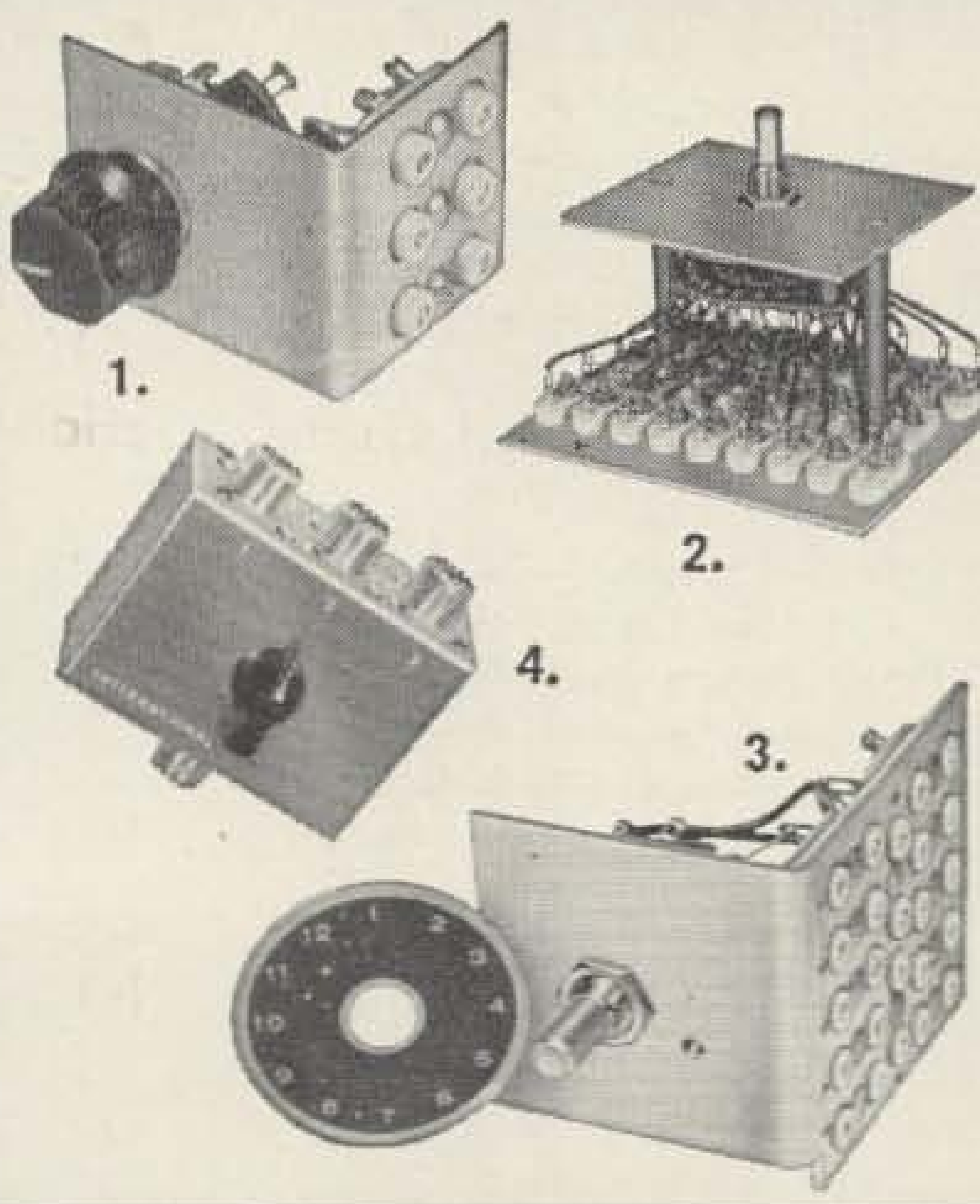

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. . . de W2NSD

. . . never say die

Europe has been visited. In the very best tourist traditions Virginia and I shopped and photographed our way through Germany Austria, Italy, Switzerland, France, Belgium, Luxembourg, and Netherlands. Rather than devote the next twelve issues of 73 to a detailed account of our trip and visits with DX hams, I'll try to encapsulate some of our impressions from time to time for you. The basic discovery of the tourist in Europe is the differentness of everything.

Travelling, as should be obvious by now, is one of my enthusiasms and as such is one more of the things which I try to pass on to others. One of my basic character faults is my innate wish to share pleasures with others rather than just enjoying them myself. This manifests itself as editorials on Porsches, Europe, and the like. I suppose that I am being completely impractical, but strange ideas come to my mind such as ham-club tourist flights to visit ham clubs in major European cities, or even a round-the-world flight with ham gear on the plane, etc. I suppose that trips like this would be way beyond the means of most amateurs though and probably are not something to promote in 73. A twenty day tour of Europe would cost at least $500, including jet round trip fare, an unlimited rail pass for Europe, food and lodging.

Berlin

The strongest impressions of our entire European trip came from our short visit to Berlin. We had, like everyone else, seen pictures of the wall and read many stories about what it is like behind the iron curtain. It was still quite an experience to actually see it in person and see the wreaths marking spots where East Berliners have been killed trying to escape from Communism. It was impressive to see the health and vigor of West Berlin, with its crowds of people, filled stores, busy restaurants, and heavy traffic and compare this with the almost completely deserted streets of East Berlin, where much of the war damage of 1945 is still in evidence and what few people there are around do not dare even look at you.

Perhaps we should keep in mind that only a few voices are now able to get through the curtain: those of a handful of tourists who are mostly kept separate from the people by the ever present Intourist Guide, the reading matter in the few magazines that are able to pass through (they cannot send out money for subscriptions), the radio programs from the Voice of America and Radio Free Europe and radio amateurs. Of the lot we stand the best chance of actually speaking on a personal basis to those behind the curtain. We have to be careful though and not get them in trouble. Probably one of the best approaches is to remember that there are a lot of SWL's there and try to put our best foot forward whenever we are transmitting a signal that might be heard behind the curtain.

If the countries behind the iron curtain are as different from the U.S. as those in the rest of Europe then I suspect that the people there have very little idea what it is really like over here. In talking with European amateurs I found that few of those who had not actually visited the U.S. really had a concept of what our country is really like. We are judged as a whole by the few Americans they have seen. Uufortunately the ones that stand out are the noisy overbearing ones, the rest being generally mistaken for English, etc. It is quite possible that they don't know any more about us than we do about them, eh?

International Ham-Hop

An informal sort of club has evolved, made up of hams who are interested in playing host to visiting amateurs from other countries. The Ham-Hop Club is fairly well established in Europe, with members in most of the larger cities and most of the countries.

Maybe you are interested in this. If you plan to do any traveling you would do well to join the club and let them put you in touch with amateurs in the various countries you plan to visit. Many of these chaps can put you up for a day or two and will be glad to take the time to show you around and head you toward the more reasonable but good restaurants. One of the great joys of travel is the meeting of people in new countries and being able to sit down and learn about them and their country. In return you give them better perspective on our country and yourself. You will be amazed at the strange ideas they have gathered about the U.S. from what few tourits they may have encountered and the movies they have seen.

If you aren't planning to travel it is every bit as enjoyable to have a foreign ham stop for a brief visit with his wife and get to know

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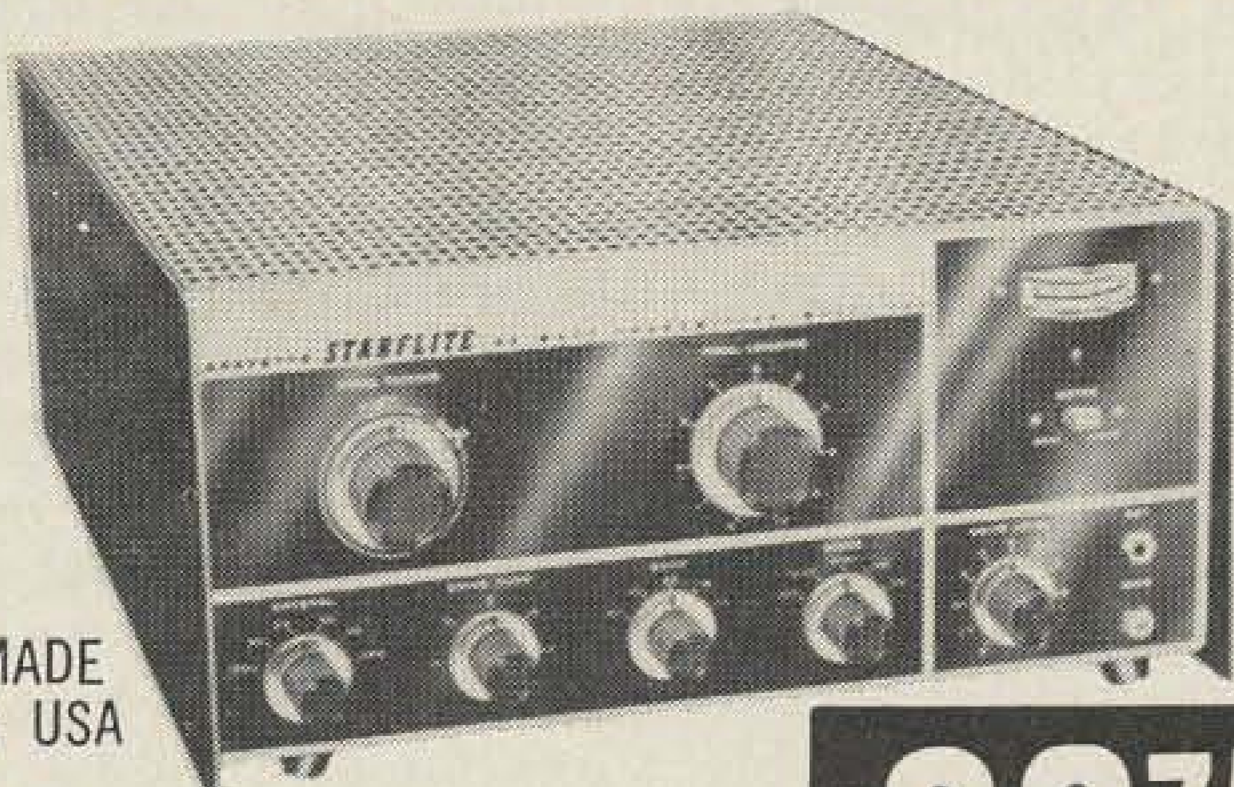

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more about them and their country. You'll learn more about the world in a few minutes of this than you will from any documentary movies or travel books. It is a lot of fun to take these visitors out and show them your town. You should remember that our prices on everything are half again to double anything they are familiar with and to add to the money problem, they probably make a lot less than you do to start with. Make things as easy as you can for them.

Travel in the U.S. is very expensive for the European, so if we can get together and encourage them to come over and enjoy our hospitality through the I.H.H.C. we can do a lot toward international friendship. If you are interested in joining the club drop a note to the U.S. representative W8SZF, 3075 Scarborough Road, Cleveland 18, Ohio.

Repeater

It is heartening to find the old amateur experimenter spirit still popping up here and there. A note from the Arizona Amateur Radio Society says that they are now planning to install a two meter repeater station on Madera Peak near Miami, Arizona (7300 feet up) which should enable anyone in the state to reach anyone else. The repeater will be controlled from Phoenix on 10,000 mc. I sure hope we see some articles coming out of this effort.

Old Man Bites Back

My little piece on the place of certificates in our hobby last month, together with my gentle chiding of people calling themselves OLD MEN, brought a fast, if not concise, response from an OLD MAN. "...stupid...ill advised...half-cocked ... obnoxious...cussing you...don't have brain one...misfit clown... odd-ball...screw-ball...damn fool...crazy... degenerated...garbage...soap-box outpourings ...prankster...", etc. It offends my false modesty to fill the magazine with all this talk about my attributes, so those of you that have a morbid interest in the full text can have one for the price of a stamped envelope. It isn't worth it.

April Correction

The scope monitor, on page 62, should have isolating condensers (.01/1000 v) in series with the arrows coming from pins 8 and 11 of the scope tube. Makes it work better.

April 6M SSB Transmitter

A note from the author catches an error in the schematic which you will want to change on page 7 of your April issue of 73. T2 should shunt C7 and T3 should shunt C8. Put in that

(Turn to page 90)

New! "Valiant II"

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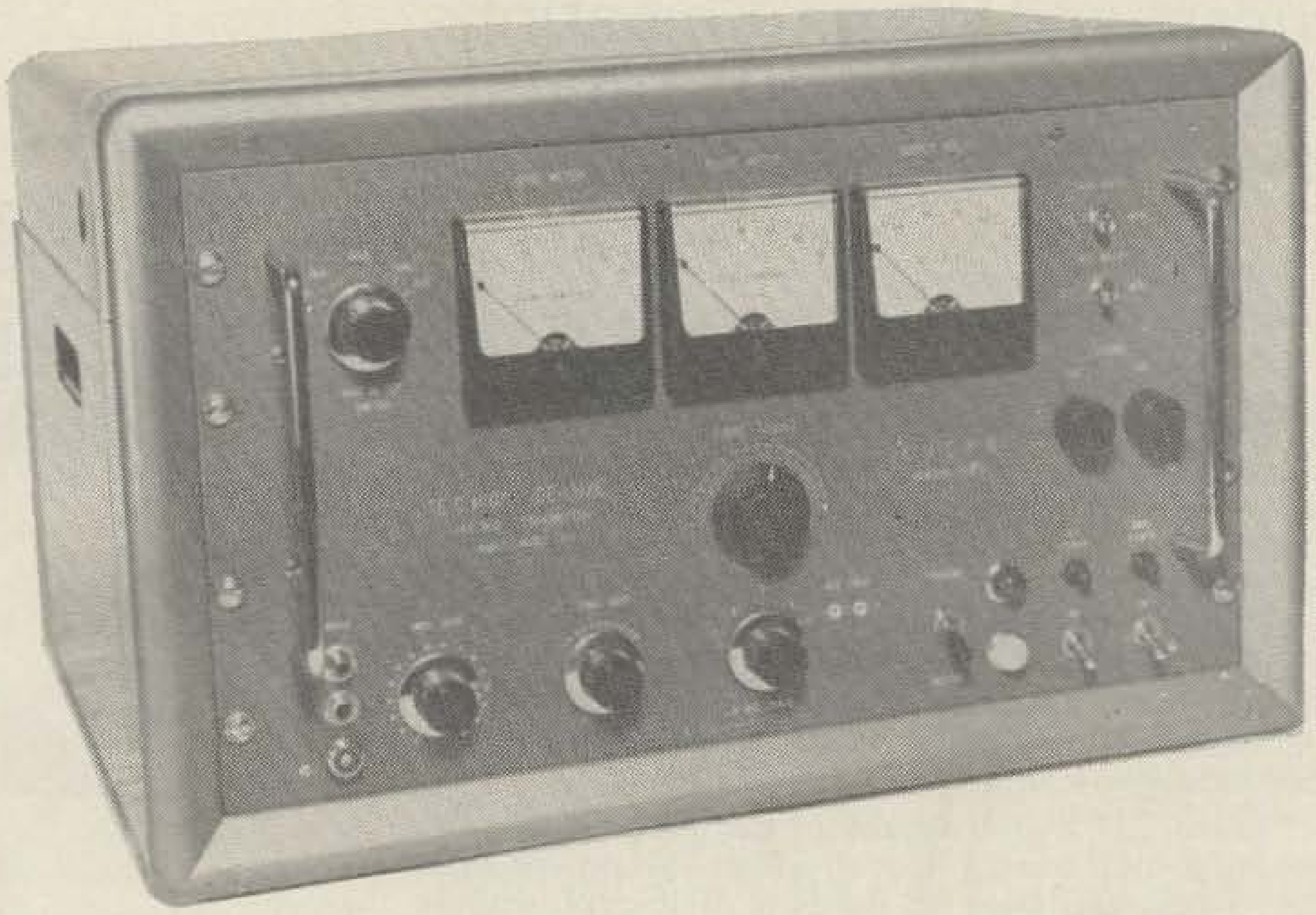
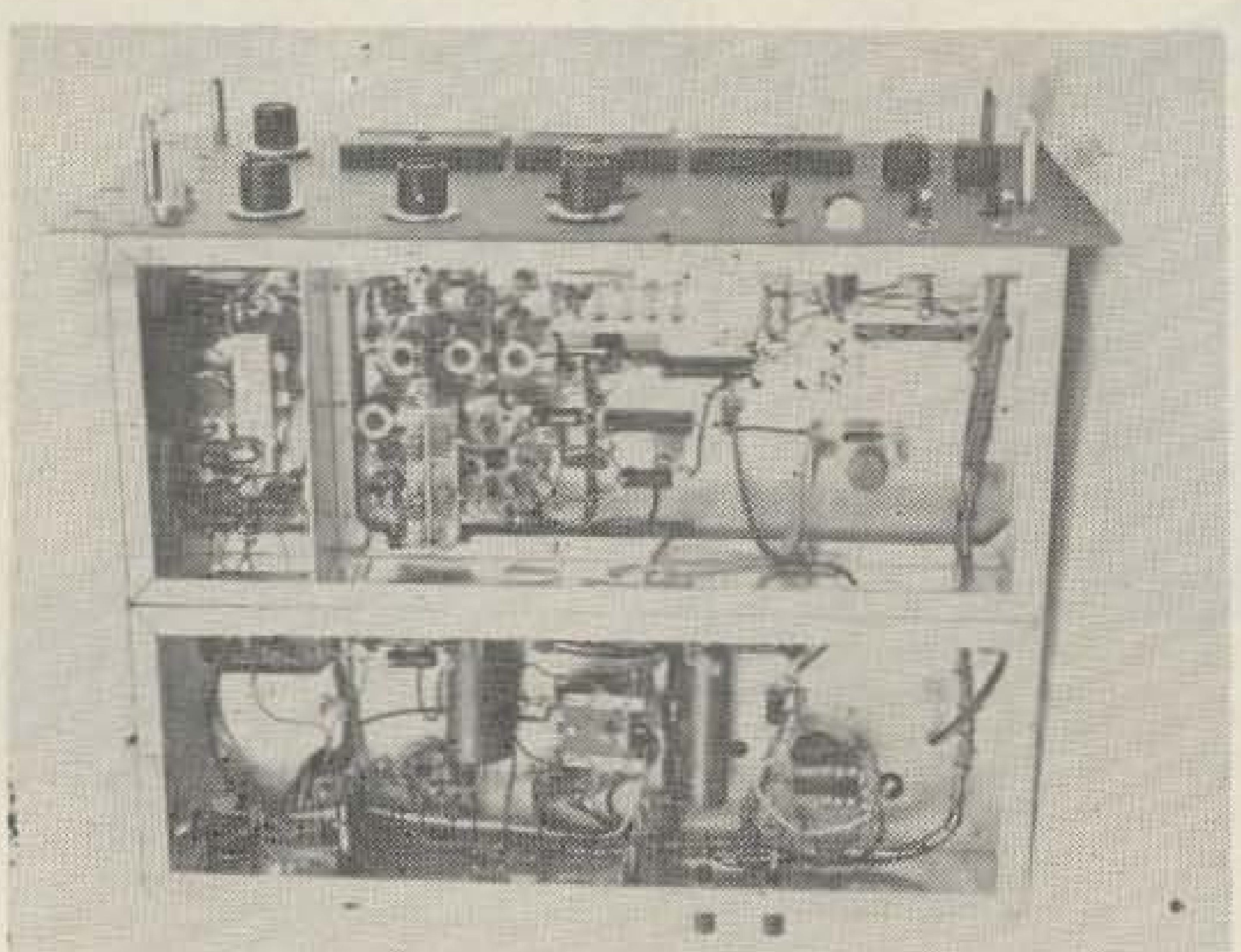


John Wonsowicz W9DUT
4227 North Oriole Avenue
Chicago 34, Illinois

THE two meter transmitter described in the following pages resembles a gallon type powerhouse, however this may surprise you, it is only a 25 watter. The reason behind such construction is better efficiency, good reliability and ease of service. Although such construction is practiced by many commercial manufacturers who stress reliability, some of the whole hearted amateurs who are forever making changes and adjustments to their gear will shy away from it. The remaining minority that take pride in building something with eye appeal and excellent innards will find this rig to be a challenge worthy of undertaking.



Bottom view showing the arrangement of coils and a shield between the rf section and the modulator. The bottom of UTC modulation transformer can also be seen in the power supply chassis.

As you can judge from the photos, the design work required quite a number of hours, not to mention the time of construction; but emphasis was placed on performance and followed through. Although the power input is relatively small, the final amplifier delivers a sting worthy of notice, as can be attested by its proud owner K9EPB.

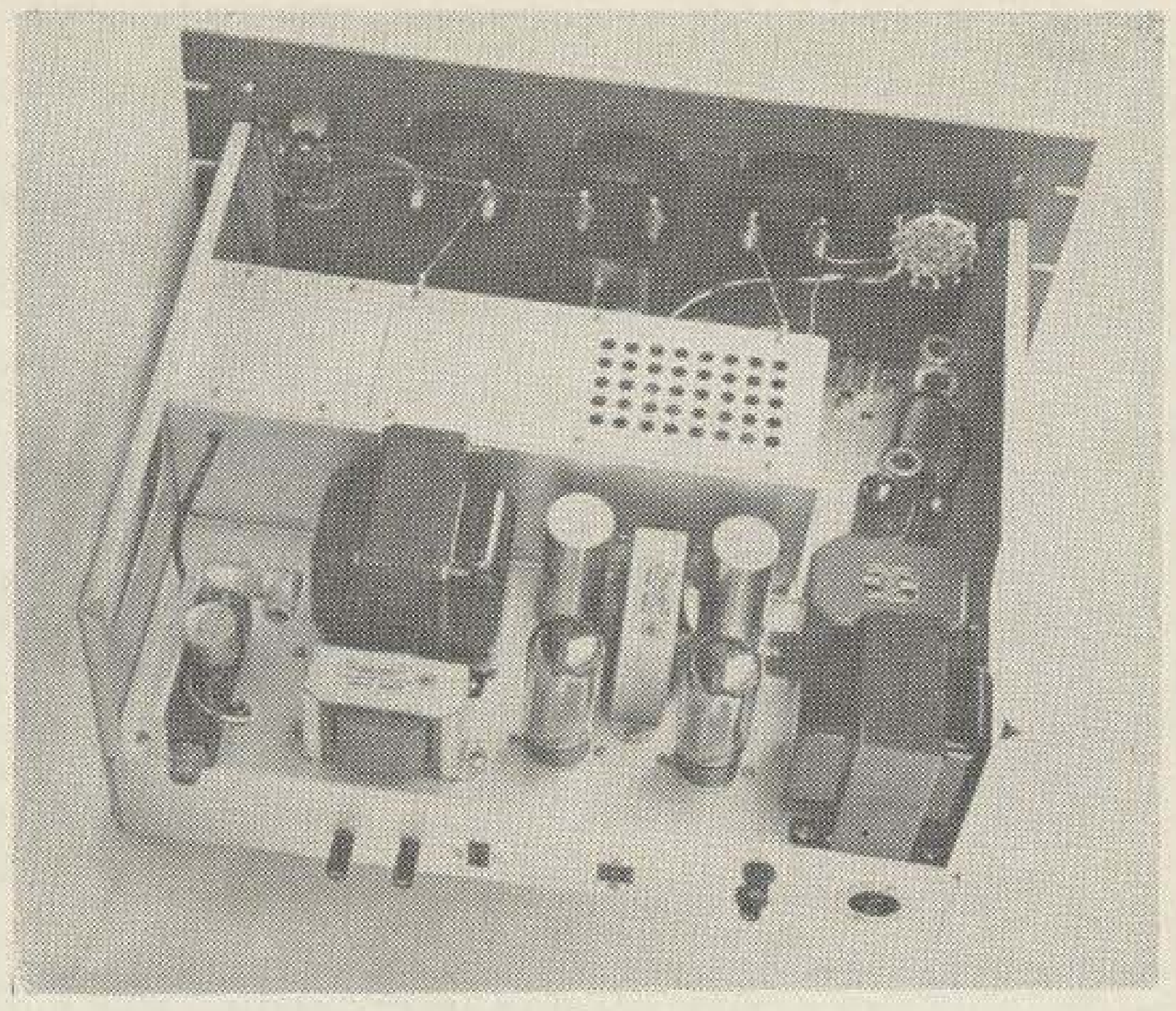
The final amplifier section built around the trusted 832A and using a High Q aluminum tank circuit previously described in 73, represents the nucleus of this power package. This amplifier which is housed in an aluminum shield together with its 6360 driver is shown in the photo.

Multiplier stages located between the front panel and the P. A. enclosure are broad banded and require no adjustments when switching crystal frequency for any "one megacycle" segment in the two meter band.

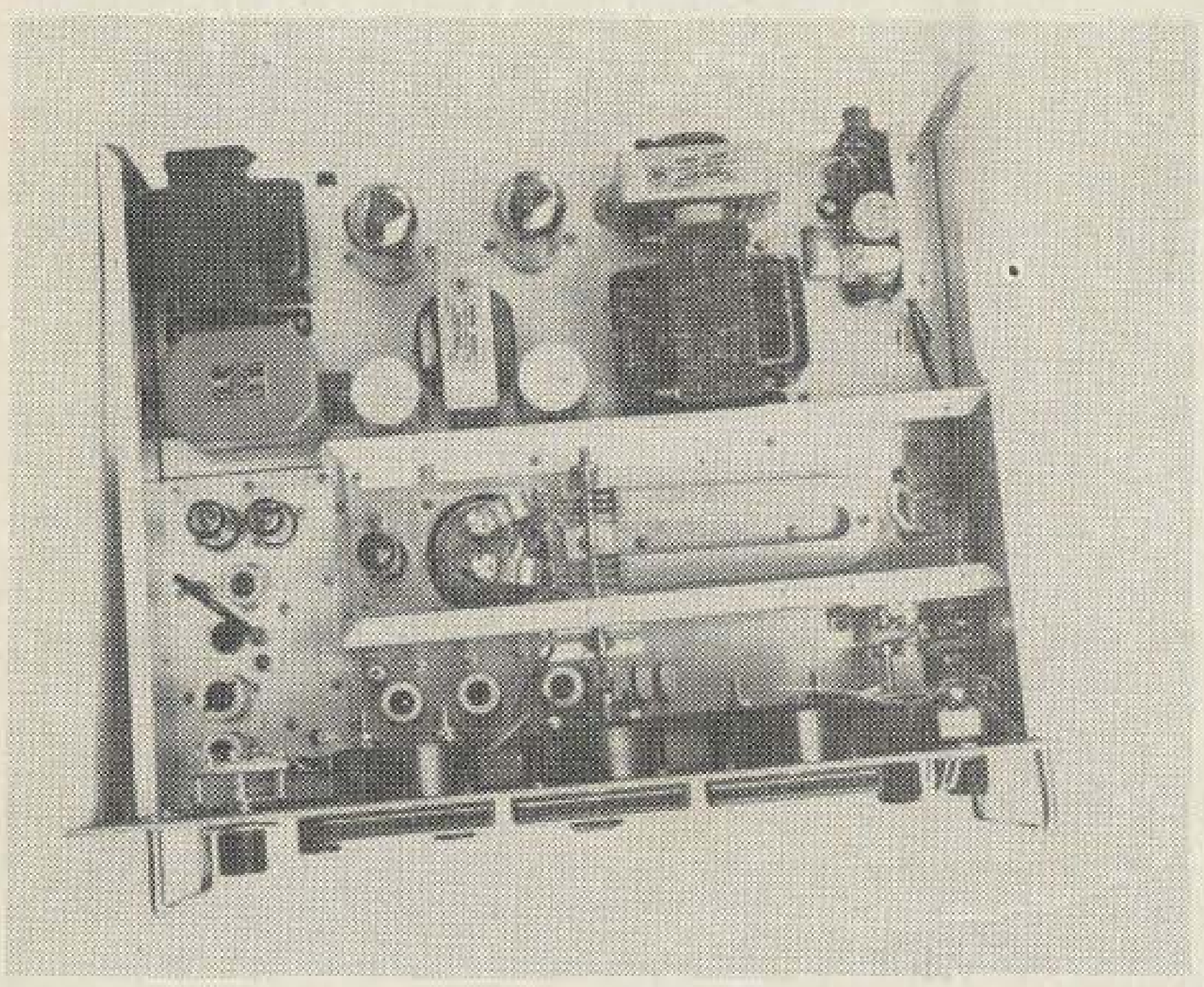
Crystals are of the 8 mc type and are switched in from the front panel. There are 4 crystals behind the panel and one "net" frequency crystal socket on the front panel for easy access to pet frequencies.

Three Simpson meters are provided on the front panel for monitoring all circuits. This includes grid drive to all stages as well as reading plate current and voltage of the power amplifier and current and voltage to the modulator.

The rf module which is complete from crystal oscillator to the final amplifier is forced air cooled. The blower is not shown in the photo, but it is fastened to a bracket and installed as the last item after wiring is completed. The bracket is secured by two screws to the side of the main chassis just opposite the 6360 tank circuit. The complete modulator which is built on a separate 4" x 7" aluminum plate develops 17 watts of audio in class A B 1. This is more than adequate for 100% modulation of the final amplifier operating at the calculated input. A speech clipper and filter is also added to raise the average talking power without sideband splatter. Three different types of mike connectors are used to add flexibility in making a microphone choice, and a modulation gain control is provided on the front panel to offset some weak output mikes.



Back view of the completed transmitter. The gear drive of the final amplifier capacitor can be seen under the middle meter.



Top view of the transmitter with cover over the final amplifier removed. The slug tuned multiplier coils can be seen between the amplifier shield and the 6C4 tube shields.

The two husky well filtered and hum free power suplies are built on a separate chassis and each one is separately fused and independently switched.

Relays are used throughout for switching of circuits and are actuated by the "transmit" switch on the front panel.

The front panel which is crackle gray aluminum, carries all engraved nomenclature enabling anyone familiar with ham gear to set it in operation without the use of operating instructions.

CONSTRUCTION

RF Section

When the power amplifier and the antenna coupling device was completed as per previous article in 73, it was housed on a separate chassis plate together with other components

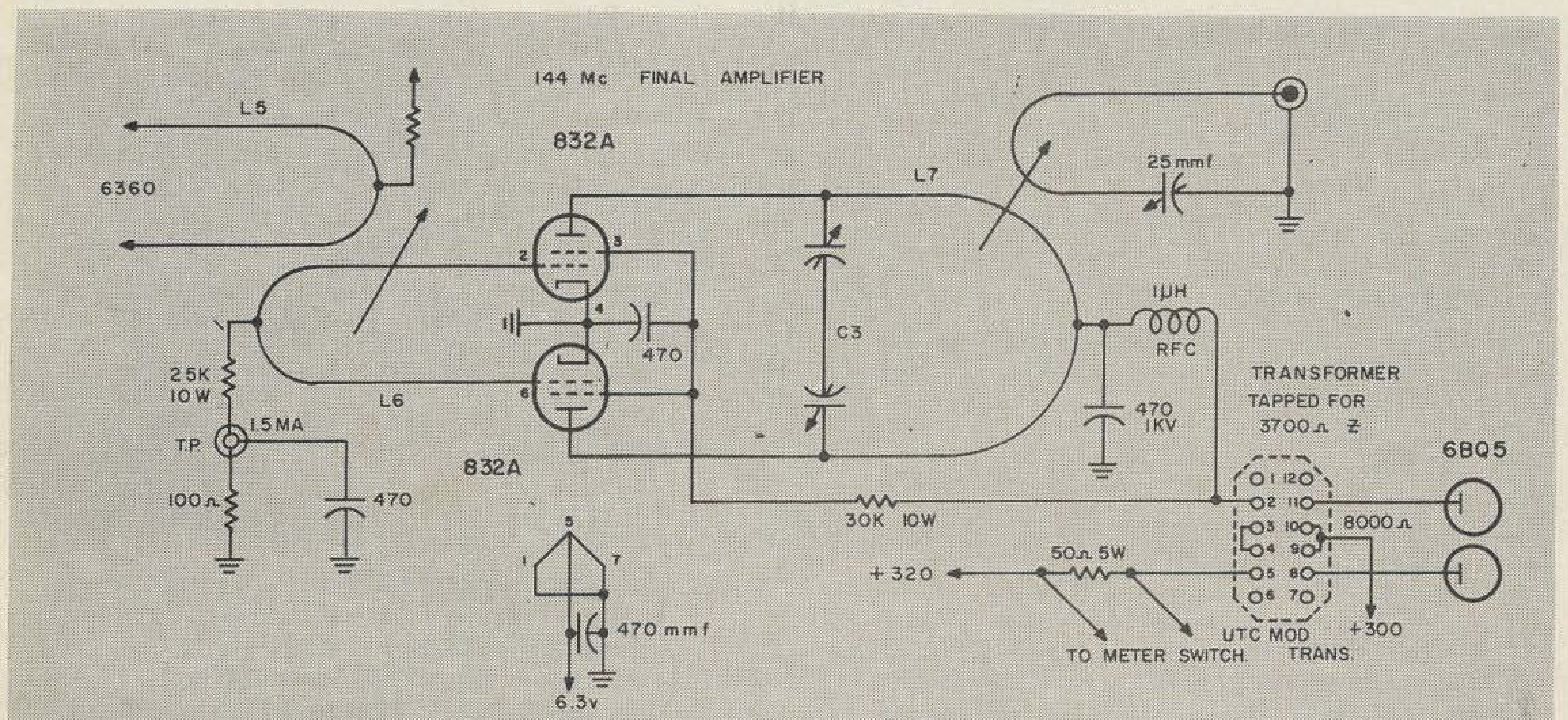


FIG. 1.

C3 Hammarlund MCD 35-SX (2 plates removed from each stator)

L6 1½" x 2¼" #10 hairpin shaped
L7 Aluminum Tank

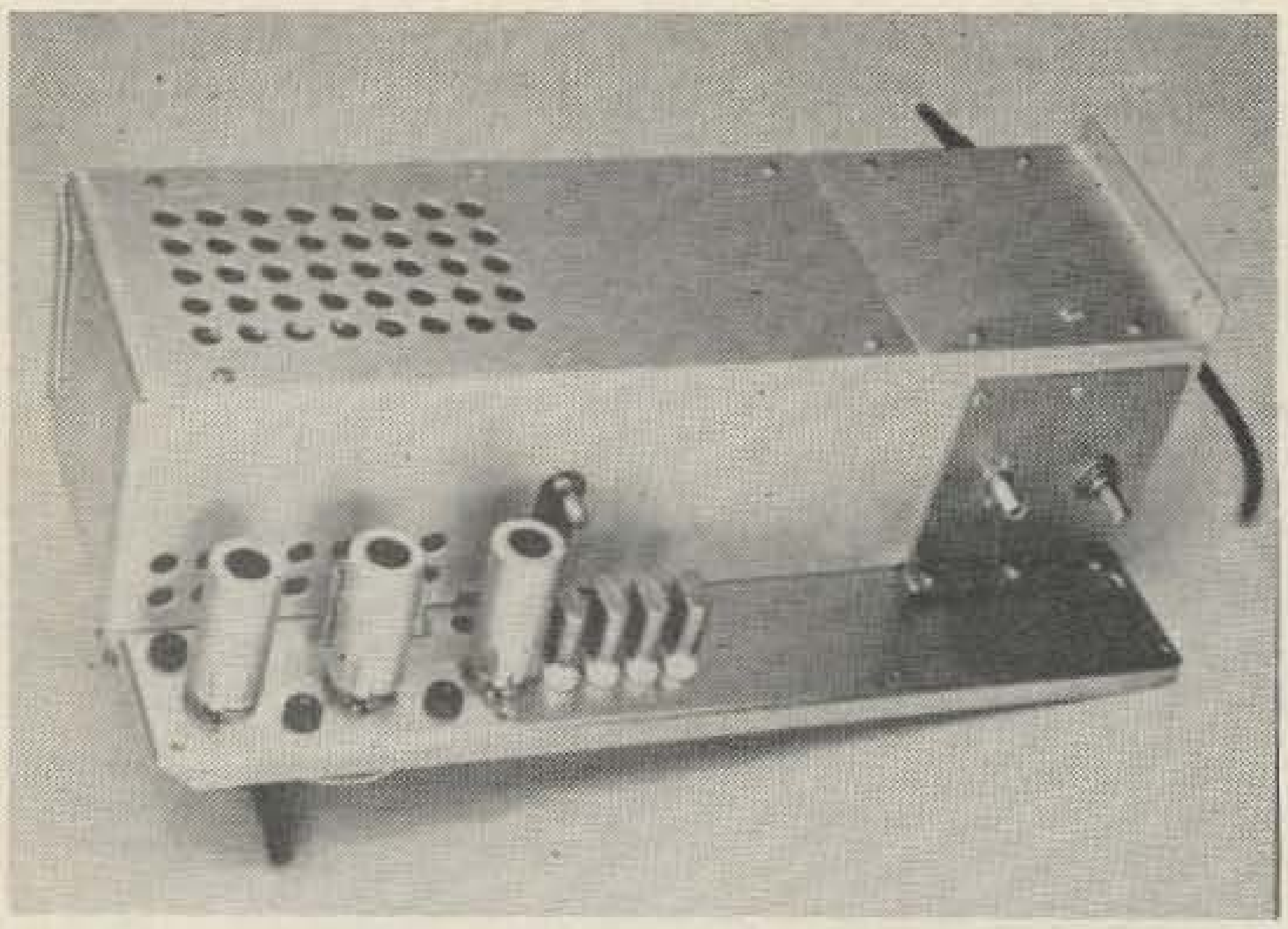


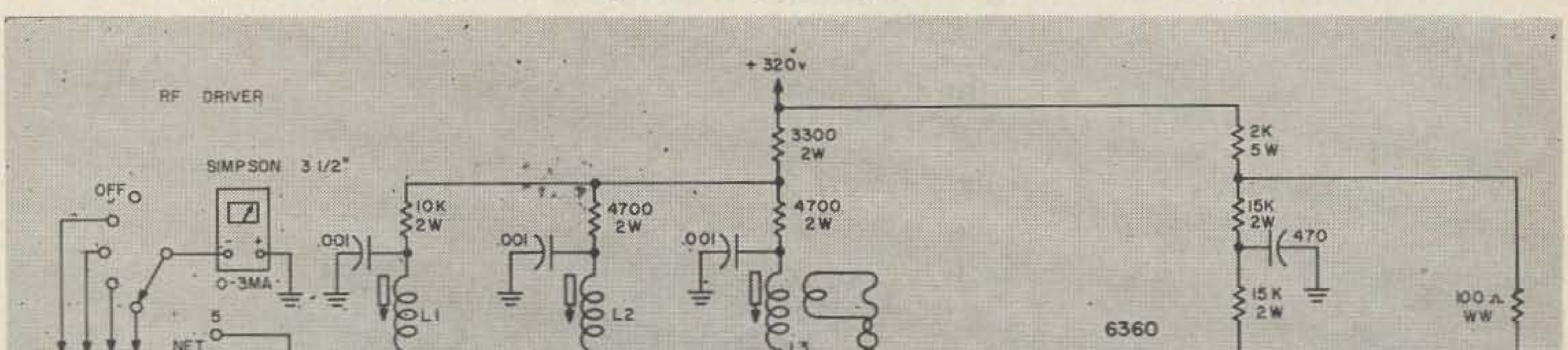
Photo showing the complete rf module.

comprising the entire rf section. The xtal oscillator using a 6C4 tube and the 8 mc fundamental crystals is tuned to 8 mc at its plate by L1. A 50 mmfd coupling capacitor drives the grid of the next stage which is also a 6C4. The plate of this triode is tuned to the third harmonic by L2 and operates at 24 mc. From the plate of this tripler a 33 mmfd is used to couple the energy to the grid of the following 6C4. The plate coil L3 of this triode is tuned to the second harmonic of the incoming signal making it resonant at 48 mc. In order to get balanced drive to the final amplifier a push pull arrangement was used and a 6360 dual tetrode which operates as a tripler and drives the grids of the final amplifier at 144 mc was selected. The grids of this tube are driven at 48 mc by link coupling of the preceding stage as seen on the schematic. Plate and screen voltages to the 6360 are low, allowing it to just loaf along. As seen in the bottom view, the hair-pin tank circuit with its Hammarlund HFD 15X split stator capacitor is mounted over the 832A socket to tune the plate circuit of the 6360 trippler. Parallel to this tank a similar loop and of the same dimension is soldered to the grid posts of the 832A socket and adjusted for maximum grid drive of the final. Sufficient drive is obtained in this manner, eliminating an extra control and a possibility of tuning the final grid to some odd harmonic.

Since the power amplifier is operated below the CCS tube rating, protective cathode bias was dispensed with for the sake of better parts arrangement and better by-passing. Accidental loss of grid drive by tube failure cannot damage the final due to the relatively low voltages and adequate metering of the circuits to detect such faults. Off resonance loss of drive can only result by rotating the dials beyond the engraved portion of the drive capacitor. In either case, damage to the transmitter can only result from prolonged unorthodox practice.

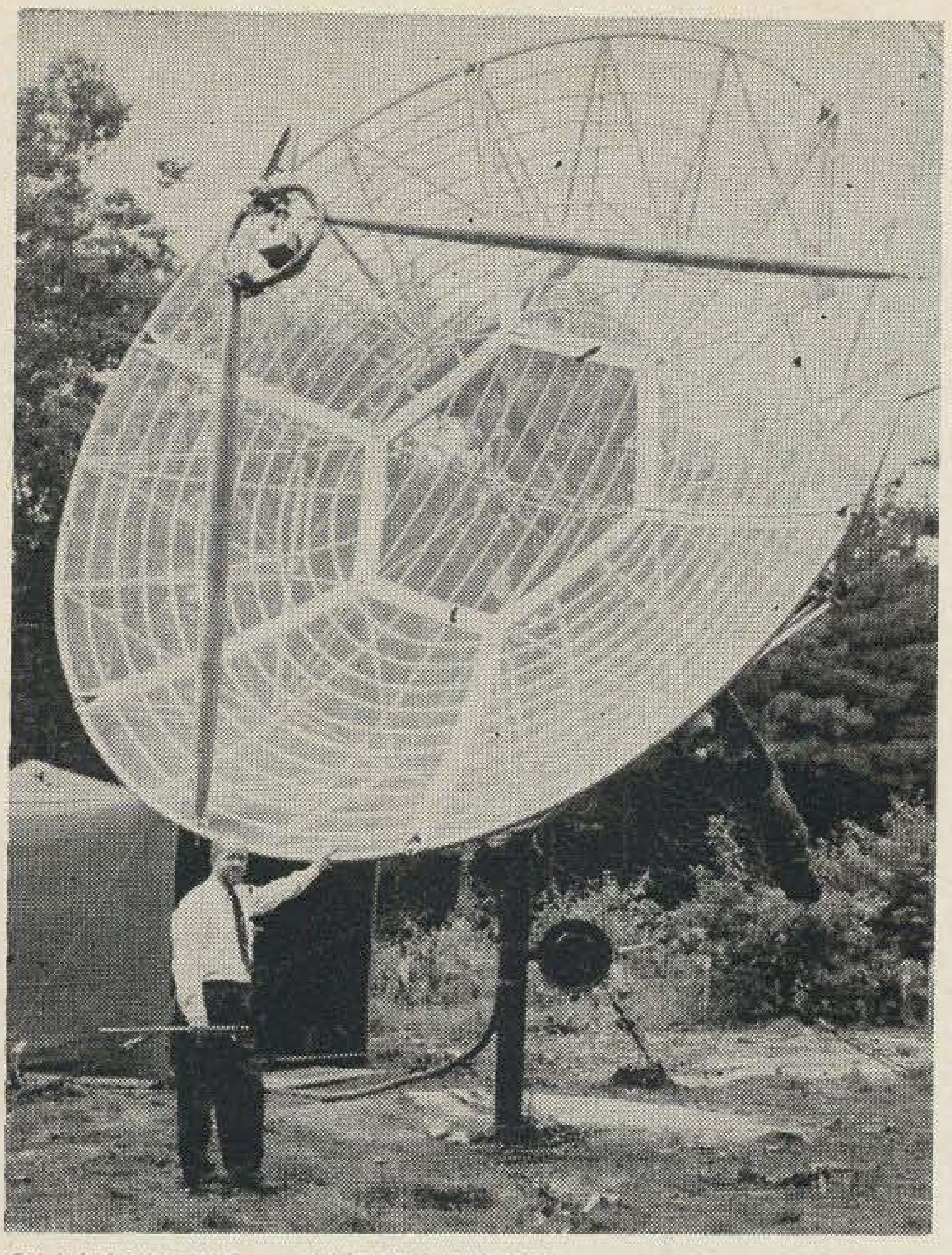
The wide-vue 3½" Simpson meter to the left, is used to meter all grid circuits and is a 0 to 3 ma full scale. With one to one and a half mills of grid current to the final amplifier, the negative grid voltage developed is up to 37 volts which is sufficient to drive the 832 at the figured input with good efficiency.

Coils for the oscillator and the multiplier stages are ½" O. D. slug tuned ceramic coil



L1 30T #26E close wound (8mc) J. W. Miller (ceramic form) #43A000CBI
L2 17T #26 close wound (24mc) J. W. Miller #43000CBI form
L3 11T #20 close wound last 4T spaced to fill form and two turn link on cold side J. W. Miller form #43000CBI (48 mc)
L4 13T #20 spaced to fill form (slug removed) tapped at center, and 2T link form #43000CBI (48 mc)
L5 #10 bare copper 2½" long (144mc)
C1 Johnson 11 MB 11 10.8 mmfd
C2 Hammarlund HFD 15X two plates removed from each rotor

All rf by-pass capacitors are RMC discaps



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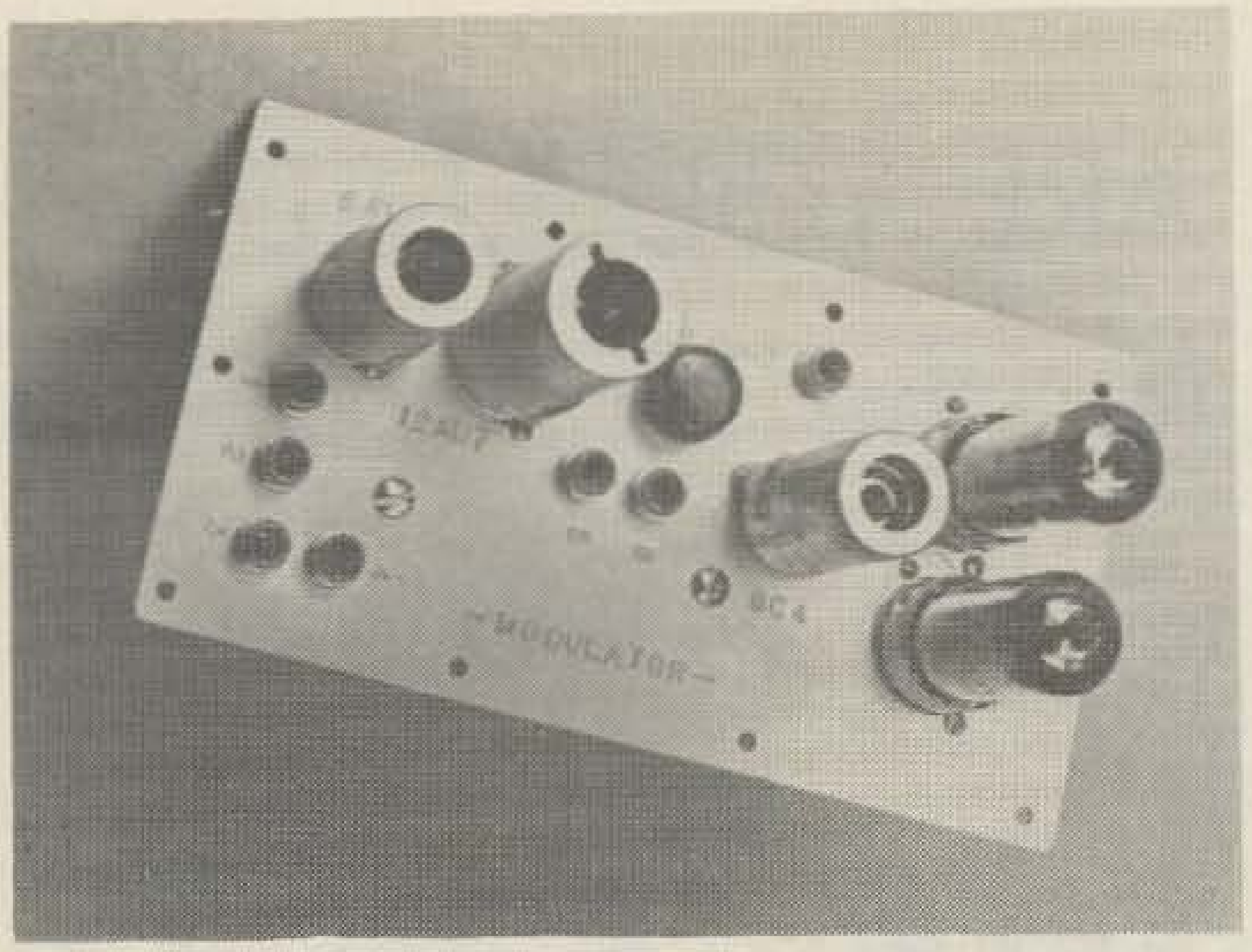


Photo showing the complete audio section jack 1 to 6 are for jumpers to by-pass the clipper if desired.

forms obtained from J. W. Miller Co. and carry a number of 43A000CB1. These coils are ruggedly built and adapt themselves for broad band rf circuits very nicely. In the design of these coils broad banding was considered to eliminate extra tuning controls and such was accomplished by making the coils resonant to the design frequency without the use of shunt tuning capacitors. This called for a few extra turns to build up the necessary inductance and with the use of a grid dipper this presented no problem.

Crystals as cheap as they are today, overruled the built in VFO for that extra stability, although provisions have been made to feed the VFO into the front panel xtal socket if so desired. The xtals selected for this transmitter have a differential of 100 kc and can be switched through the entire set of 5 during "on the air" operation without touching up the multiplier or driver stages.

Detailed description and parts lay out of the rf section seemed unnecessary since the photos and the schematics encompass such information.

RF Section Tuning

The best way to handle rf circuits is to work on one stage at a time and this calls for setting the crystal oscillator on frequency and making sure that it takes off without hesitation when power is applied to it. When all components are soldered to and around the 6C4 oscillator tube, check it for oscillation by connecting a 1 meg resistor to the grid and read the negative grid voltage with a VTVM or 20,000 ohm per volt meter at the 1 meg resistor and ground. Tune the slug in the plate coil L1 for the highest reading, then trigger the B+ several times to make sure that the oscillator kicks in every time. After the second stage which is the tripler and operating at 24 mc is wired in, the oscillator can be peaked by observing the grid current of this tripler stage. This should read approximately .6 ma at the test point. Same procedure can be carried out to the other stages by simply reading the grid current in the following stage. The 6360 plate circuit can be checked for 144 mc operation by listening to it on a receiver. Better assurance of the proper frequency can be obtained by a grid dipper or a simple wave meter.

The final amplifier stage should be close to design frequency if the dimensions of the tank circuit were carried out as per article. Optimizing the completed rf module may be undertaken for the assurance that maximum efficiency is derived from all stages, particularly the 832A final. The sugested way to bring the power where it will do the most good is by using a load resistor shown on the drawing and reading the voltage developed across this load.

Proceed as follows:

1. Use twenty 1000 ohm 2 watt composition resistors to make up a 50 ohm 40 watt non-

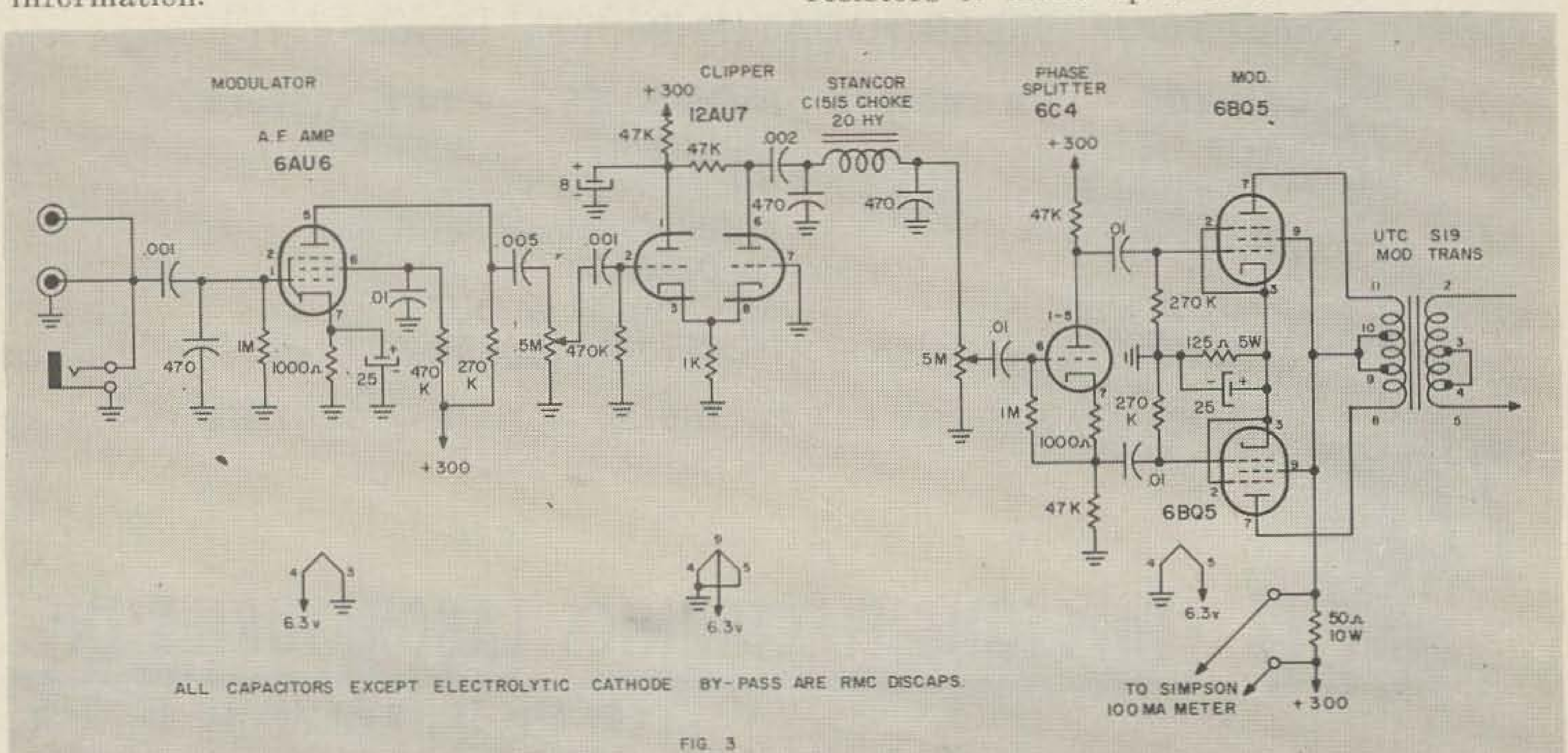


FIG. 3

The engraved front panel showing handles for protection of meters and dials. The final tuning knob is driven by a 2 to 1 gear ratio.

inductive load simulating the antenna. See detailed drawing.

2. Connect the dummy load to the output of the amplifier through a piece of coax.

3. Connect a 1N34 or similar diode in series with a voltmeter such as the Simpson 260 and read the dc voltage across the dummy load.

4. Calculate the power output by the equation $E^2 \div R$. Of course this is not the true power indication, but it is reasonably close and can be regarded as such in practical cases.

Once the set-up is made, adjustments in the grid drive, size and variations of the pick-up loop will tell you just what happens to your carrier. Therefore "on the air" information which in most cases is erroneous can be avoided.

Modulator

As can be seen in the photo, the 6BQ5 push pull modulator with its driver stages is made up as a complete module and fastened over a cut out in the main chassis which measures 17 x 7 x 3 and houses the completed rf unit. The first tube facing the front panel is a 6AU6 voltage amplifier running wide open. The next tube is a 12AU7 which is used as the speech clipper and following it is the 20 hy clipper filter choke which connects with the gain control in the grid of the 6C4 used as a phase splitter. This tube in turn drives the grids of the 6BQ5 modulator tubes. A UTC universal modulation transformer S19 is used and the primary side to the 6BQ5 is tapped to present a load impedance of 8000 ohms. The secondary of this transformer is tapped for 3700 ohms which is close to the final ampli-

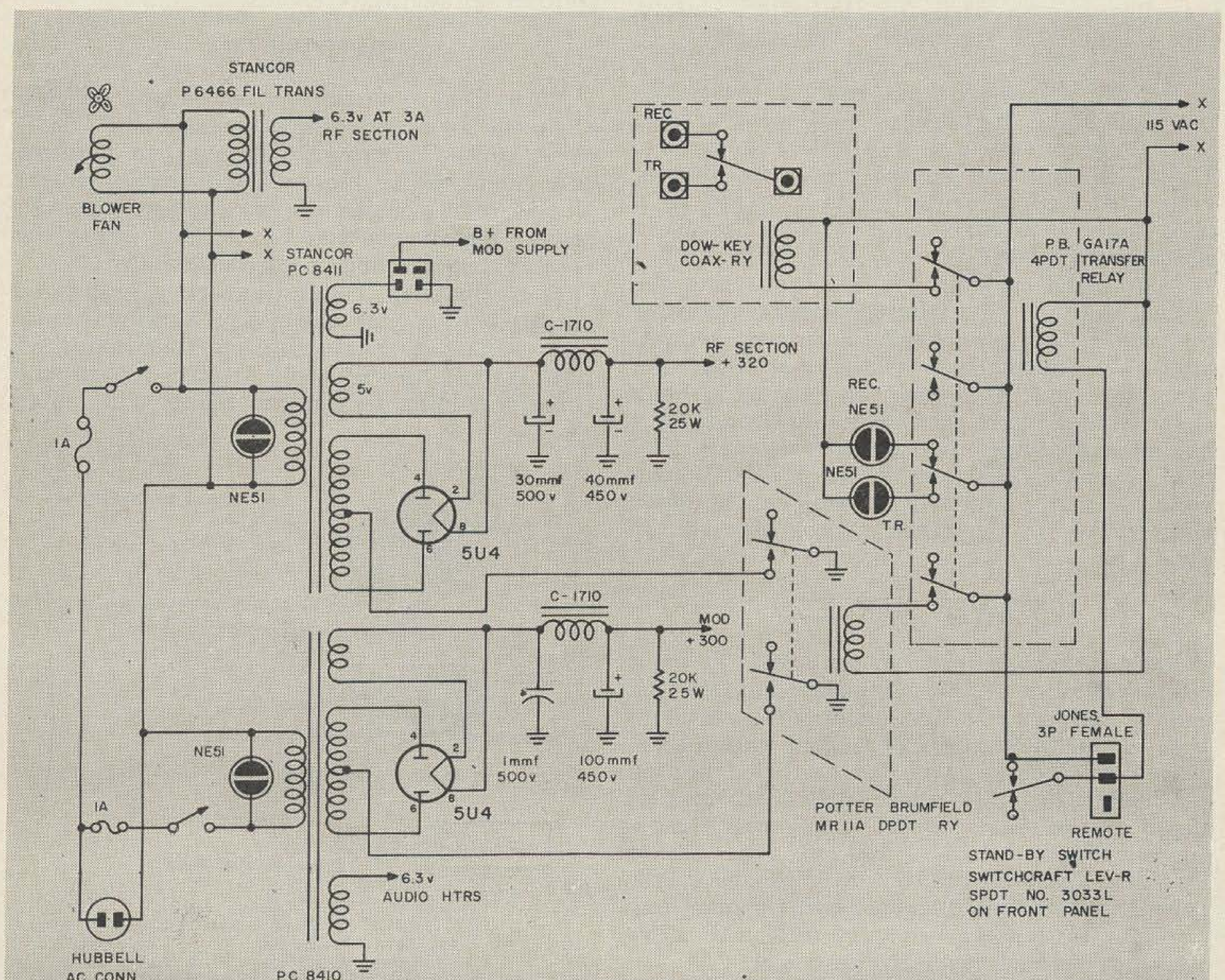


FIG. 4

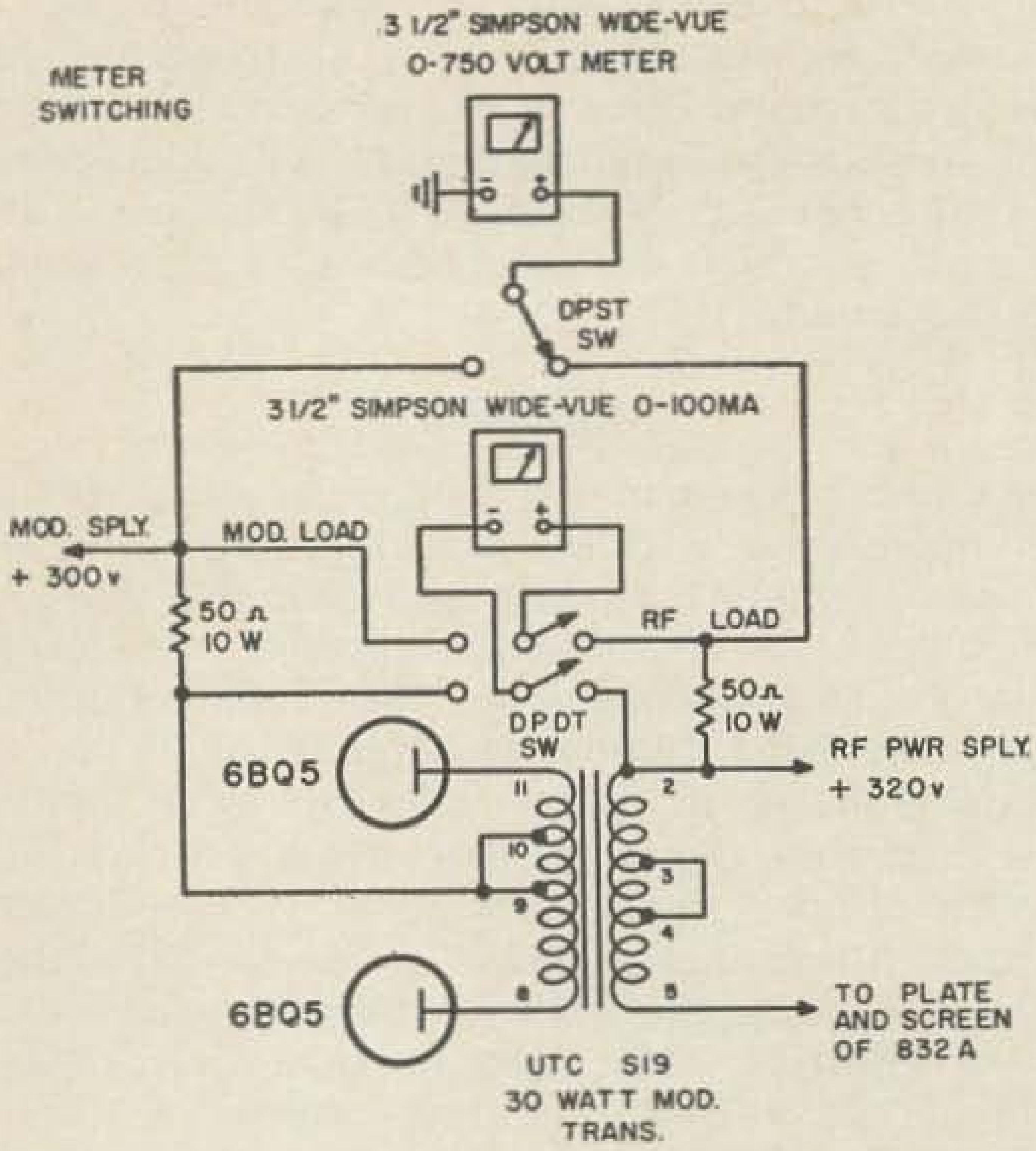


FIG. 5

fier load of 4100 ohms. Although the modulator is capable of only 17 watts of audio, a 30 watt transformer was used for that extra safety factor that is so frequently overlooked.

Coupling capacitors in the audio amplifier stages are purposely made small to pass only the high audio frequencies that seem to give that added punch to a well balanced carrier. The C-1515 Stancor choke seen in the bottom view is the clipper filter. It is mounted on 1 inch spacers to allow extra room for other components around it.

Testing the modulator before connecting the rf load to it can be accomplished by connecting an audio output transformer across the secondary of the modulation transformer using the same taps as the rf load, and listening on a speaker. Make sure that the audio transformer has an input impedance of approximately 4000 ohms to match the taps on the UTC S19 secondary. In this way adjustments can be made if necessary in the shack rather than on the air.

POWER SUPPLIES

Both of the power supplies are built on a standard 17 x 6 x 3 aluminum chassis and are of full wave design, using 5U4 rectifiers because of their ruggedness and ease of replacement. The supply used in the rf section produces 320 volts under full load, and is made up of Stancor PC8411 power transformer, Stancor C-1710 150 ma filter chokes and the electrolytic capacitors indicated on the schematic. Extra filament transformer was used for all heaters in the rf section to allow the power transformer to run cooler.

The supply used in the modulator section starts with a Stancor C-8410 power transformer, a C-1710 choke, and the filter capacitors. As noted on the schematic, a 1 mfd capacitor is used in the input to hold the dc voltage down to 300 volts. A 100 mfd electrolytic capacitor is used in the output of the pi section filter to eliminate all traces of 120 cycle ripple.

Values of the four filter capacitors in the two pi-section power supply filters should be in mfd., not mmf. as shown.

Each supply is separately fused and switched from the front panel. Above each switch is a neon pilot lite indicating that power is applied to the primary of the transformers. DC is obtained by grounding the center tap of each transformer through a double pole Potter Brumfield relay MR11A.

Two toggle switches are provided on the front panel just to the right of the meters to monitor the current and voltage of each supply. Trouble can immediately be spotted in either unit by unusual indication of the instruments.

Remote control receptacle is provided on the back of this chassis and wired in parallel with the transmit-receive switch on the front panel to allow one switch operation; either from the transmitter or the receiver.

SWITCHING

All switching pertaining to "on and off" the air mode is accomplished by relays as indicated on the drawings. This system requires only a simple toggle switch to apply power to the relays which carry the load through heavy plated contacts that can easily be reached for cleaning in case of need.

The Dow-key coaxial antenna relay is mounted on top of the power supply chassis and is coax connected to the final amplifier link through a ¾" hole in the top of the chassis as seen in the top photo. This relay

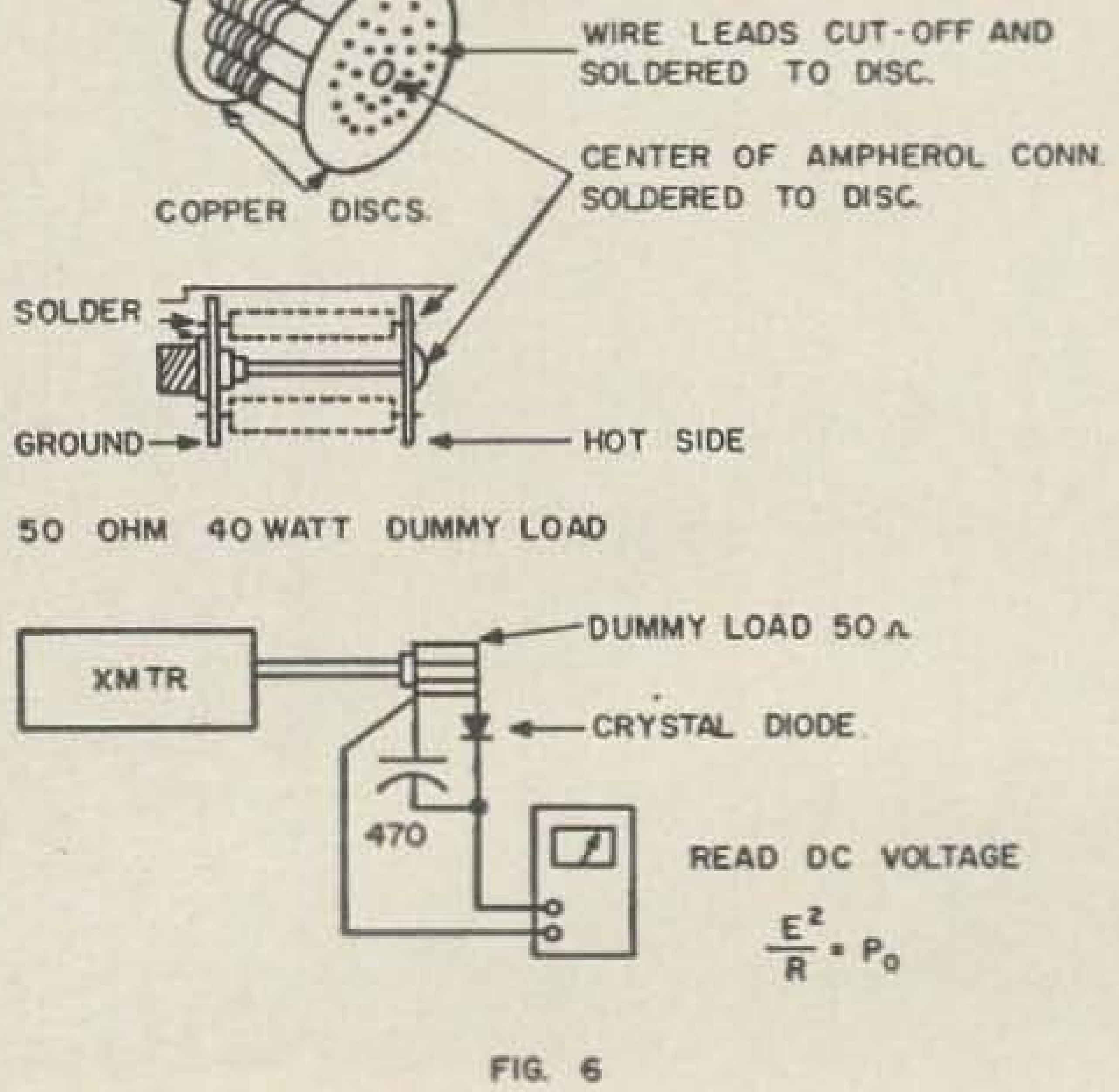


FIG. 6

is operated through a P & B GA17A transfer relay that also applies power to the pilot lites and the P & B MR11A. All long wires running to and from relays and pilot lites are color coded and laced for easier circuit tracing and neat appearance.

OPERATION

Under nominal operating conditions the power amplifier operates at a plate voltage of 320 volts and drawing 78 mills of combined plate and screen current. This conditions figures to an input power of 25 watts and a rf load impedance of 4100 ohms. At this power input to the amplifier, 28 volts rms was measured across the pure non-inductive dummy load previously mentioned, and power output calculated by the equation of $E^2 \div R$ figures to be 15.7 watts.

The calculated efficiency which is $(P^{o} \div P_{1}) \times 100 = 15.7 \div 25 = 62.7\%$.

This is better than average power amplifier efficiency considering the operating frequency at which it was calculated, and comparative tests on the air have proved it.

My thanks to K9EPB for processing all photos. ... W9DUT

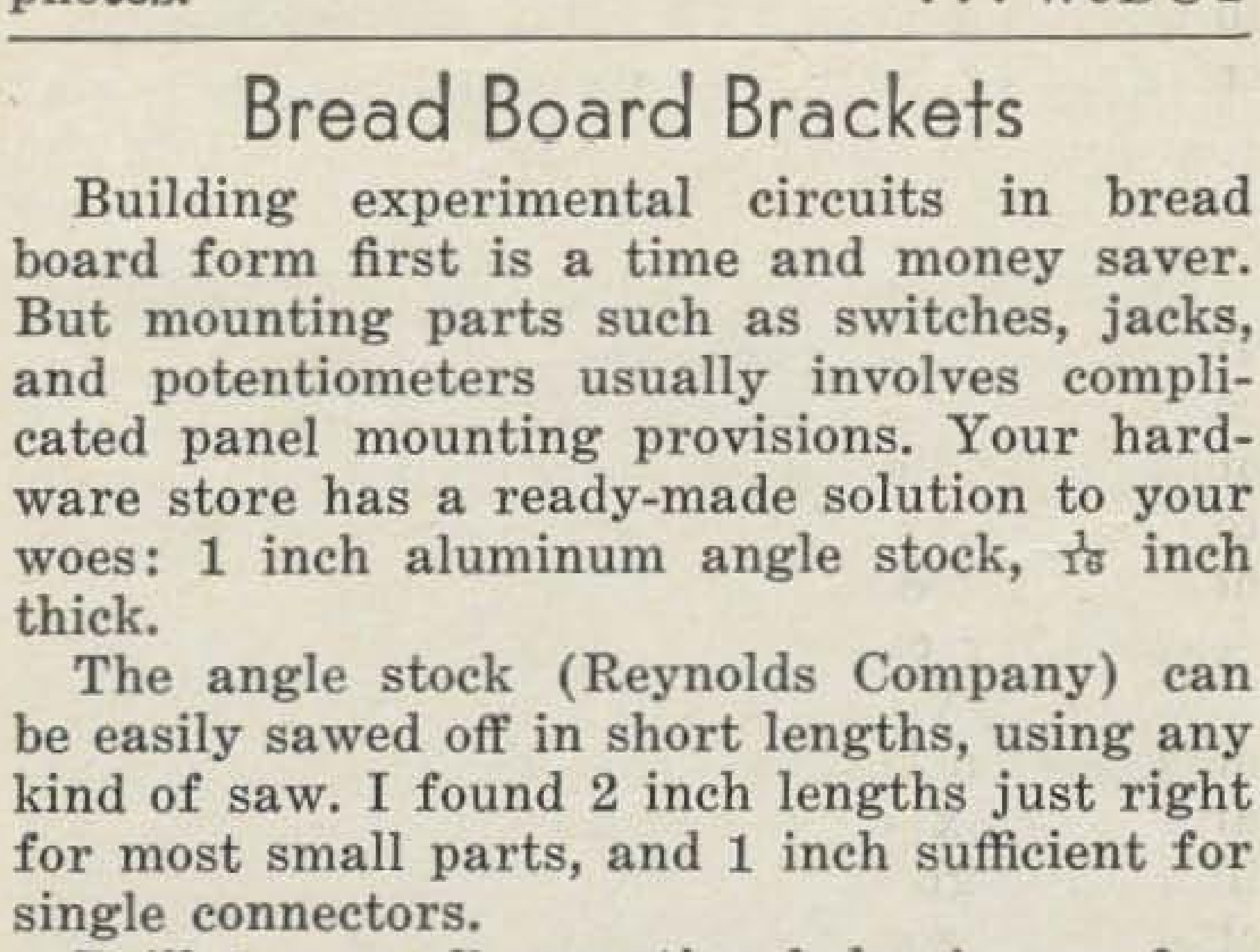
Bread Board Brackets

Building experimental circuits in bread board form first is a time and money saver. But mounting parts such as switches, jacks, and potentiometers usually involves complicated panel mounting provisions. Your hardware store has a ready-made solution to your woes: 1 inch aluminum angle stock, $\frac{1}{16}$ inch thick.

The angle stock (Reynolds Company) can be easily sawed off in short lengths, using any kind of saw. I found 2 inch lengths just right for most small parts, and 1 inch sufficient for single connectors.

Drill two small mounting holes in one face of each bracket, and the component mounting hole in the other face. Plan the mounting hole locations so that you can mount or remove the bracket while the part is in place.

... Bentley



Operating the "Friendly Frequency"

Lloyd Hanson W9YCB
Electrical Engineering Department
Tri-State College
Angola, Indiana

Photos by Gentry K9GLL

There are available through the various surplus outlets a large number of FM transmitter receiver combinations which may be readily and economically modified for operation on six and two meters. The challenge for

improved circuit operation and convenience is present in a degree seldom found on the "DC bands."

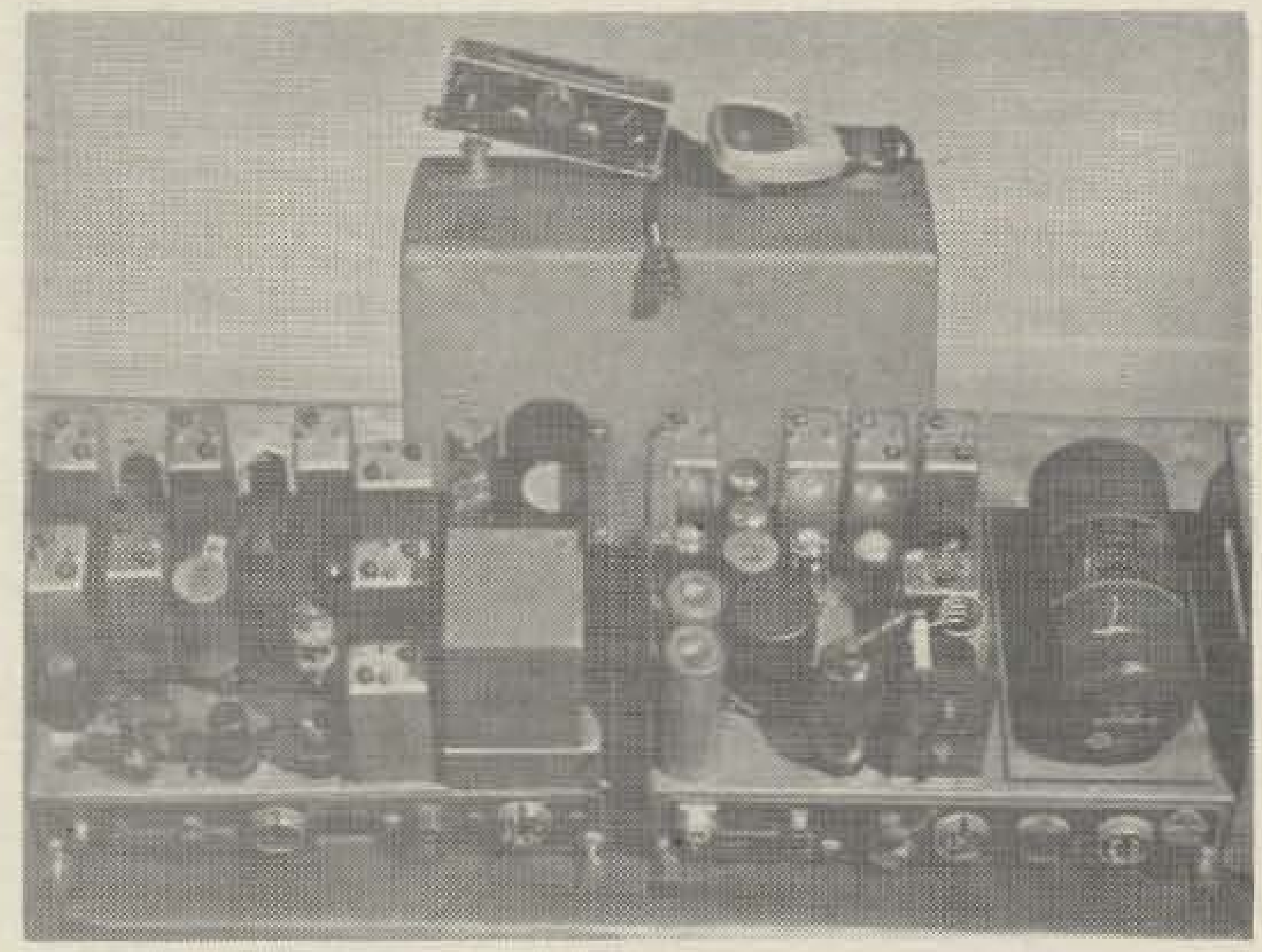
Typical of the equipment available at low cost is the AN/VRC-2 and the AN/VRC-2X. These units are crystal controlled wide band FM units (40F3) which before modification cover the frequency range of 30 to 40 megacycles.

These units when complete consist of a radio transmitter T-322, T-193, T-193A or a T-193B; a receiver R-435, R-237, R-237A or R-237B; control head, fuse box, loudspeaker, antenna and cables. The suffix units differ mainly in primary power source and voltage.

Complete information on these and similar units may be found in TM 11-668, "FM Transmitters and Receivers," available from GPO. TM 11-607 or TO 16-30VRC2-5 available from surplus outlets and "Motorola 25 to 44 mc Instruction Manual," Motorola part number 84P474783-0. These manuals will supply diagrams, theory and adjustment procedure.

Now that you have the inside facts on the equipment examine the photos for a typical mobile 12 volt version modified to operate on the "Friendly Frequency" of 52.525 mc and typical ac conversion which operates on 52.525 mc and 52.640 mc at the flip of a switch. It is possible to introduce another frequency of 52.775(1) mc for three channel operations all without retuning, just push the button. Nice, huh?

There are well over 250 mobile and base station units of this type on 52.525 mc within the United States. Interest is spreading rapidly



and groups are springing up from coast to coast and Hawaii. DX is common and will improve as more units are put into operation. For AREC and other types of emergency work there are few systems available which offer such low cost, high reliability and interference free communications.

Also there is a move afoot to register 52.525 as a national calling frequency with repeater stations and all. Twenty-four hours a day you will find help and companionship on "The Friendly Frequency" of 52.525 mc. Climb aboard for the best thing that has happened to amateur radio in many a year.

Remember FM is the Finer Medium.

. . . W9YCB

(1) 52.775 mc. was chosen as it represents the extreme frequency which can be used without retuning.

Cascode 6 & 2 Meter Nuvistor Pre-Amps

John R. Lange Jr. K9ARA
1703 N. Karlov Avenue
Chicago 39, Illinois

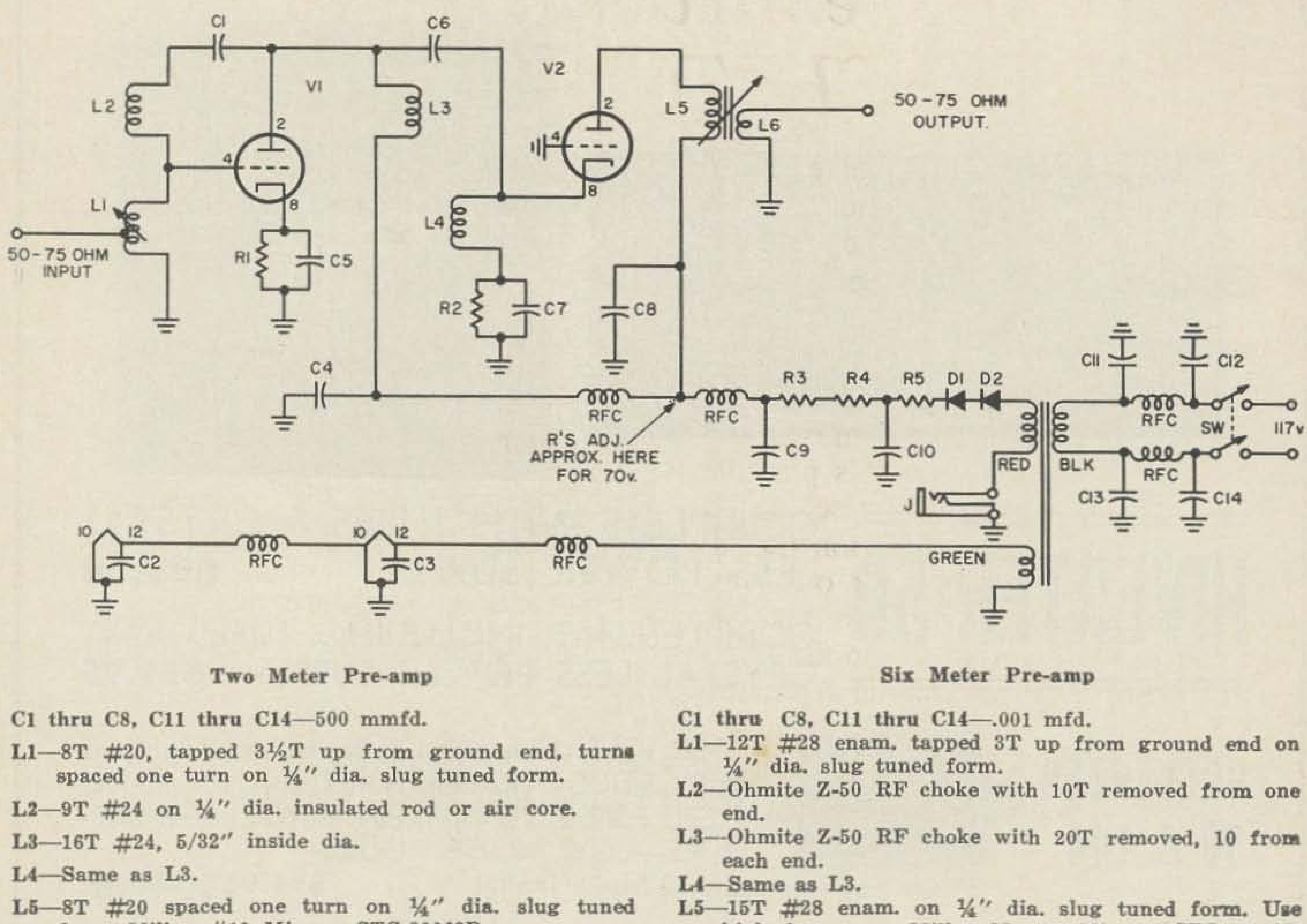
NUVISTORS have been around for a year now and enough has been written about them so they probably will soon be called Oldvistors. By way of encouragement to those few VHF'ers who haven't yet succumbed to the 6CW4, I thought I'd pass along the results of my bout with 'em.

The results are indeed good. Careful comparison tests between these Nuvistor preamps and a set of 417A converters using a 5722 noise diode and a switchable 3 db pad result in only .25 db difference in favor of the 417A's. The six meter unit gives 2.25 db vs 2.0 db and the two meter unit 3.25 db vs 3 db. This ought to be enough to get you into action.

The pre-amps were built on 2"x4"x10" chassis. In the interests of simplicity of use I included a small power supply with each preamp. The whole works for each unit came in for under $12.00.

The use of two nuvistors in a cascode circuit makes for less critical neutralizing adjustments, better gain and a good noise figure.

Try them! . . . K9ARA



Two Meter Pre-amp

C1 thru C8, C11 thru C14—500 mmfd.

L1—8T #20, tapped 3½T up from ground end, turns spaced one turn on ¼" dia. slug tuned form.

L2—9T #24 on ¼" dia. insulated rod or air core.

L3—16T #24, 5/32" inside dia.

L4—Same as L3.

L5—8T #20 spaced one turn on ¼" dia. slug tuned form. Millen #19 Mix or CTC-20063D.

L6—1½T #20 insulated and wound in opposite direction around cold end of L5.

RFC—25T #28, 5/32" inside dia. or Ohmite Z-144.

Six Meter Pre-amp

C1 thru C8, C11 thru C14—.001 mfd.

L1—12T #28 enam. tapped 3T up from ground end on ¼" dia. slug tuned form.

L2—Ohmite Z-50 RF choke with 10T removed from one end.

L3—Ohmite Z-50 RF choke with 20T removed, 10 from each end.

L4—Same as L3.

L5—15T #28 enam. on ¼" dia. slug tuned form. Use high freq. core. Millen No. 19 Mix or CTC-20063D coded white.

L6—3½T #28 enam. wound in opposite direction around cold end of L5.

RFC—Ohmite Z-50 RF choke.

Same for both Pre-amps

R1, R2—56 ohms
R3, R4—1.8K, 2W
R5—47 ohms
J—Closed circuit phone jack for T-R switch.
D1-D2—Silicon Rectifier diodes, 400 PIV 500 ma. RCA IN1763 or equiv.
T—125v 15 ma transformers, Stancor PS8415.
Socket—Cinch 133 65 01 001.

Here's the VHF Receiver you've dreamed of—CLEGG'S new INTERCEPTOR for 6 & 2!

Clegg's new Interceptor Receiver for 6 & 2 meters introduces revolutionary new concepts in VHF receiving techniques. Now you can realize the benefits of engineering features that are years ahead of their time!

Just imagine, for example, a receiver so free of cross modulation, images and noise, and so sensitive that it's possible to work duplex (on antennas separated by no less than 60′) with stations transmitting within 25 kc of your own frequency. Imagine, too, tuning in SSB with the ease of amplitude modulation . . . selecting any CW signal from the "pile-up" at will.

Take a look at all of the advantages you get with this great new receiver:

- ★ **Virtually no cross modulation.**
- ★ **Maximum rejection of spurious signals and responses.**
- ★ **Nuvistor RF stages that give minimum noise figures on both 6 & 2 meters.**
- ★ **Stability equal to exacting requirements of SSB and CW.**
- ★ **Hermetically sealed 10.7 Mc crystal lattice filter that provides optimum selectivity for both AM and SSB. Selectivity 3.1 kc at 6 db points; 8 kc at 75 db points.**
- ★ **Sensitivity of better than .1 microvolt.**
- ★ **Frequency tuning accuracy of less than 3 kc in calibrated 1 Mc ranges.**

And that isn't all! Here are some other great Interceptor features — ones that will help make your station second to none:

- ★ **Input provision for 220 Mc, 432 and other UHF converters.**
- ★ **A slide rule dial with full electrical band-spread and flywheel loaded, no backlash tuning makes it easy to separate the weak ones.**
- ★ **Maximum hash suppression with specially designed noise limiter.**
- ★ **Output terminal for Pan-adapter and monitoring scope.**
- ★ **Tuning meter calibrated in both S units and db above reference.**
- ★ **Cabinet and panel matching the Zeus transmitter.**

No doubt about it — if you are a serious operator on 6 & 2, don't wait!— see the Interceptor at your Clegg dealer's today. Or write for complete information!

Amateur Net Price: $473.

Clegg LABORATORIES

OAkwood 7-6800·

504 ROUTE 53, MT. TABOR, NEW JERSEY

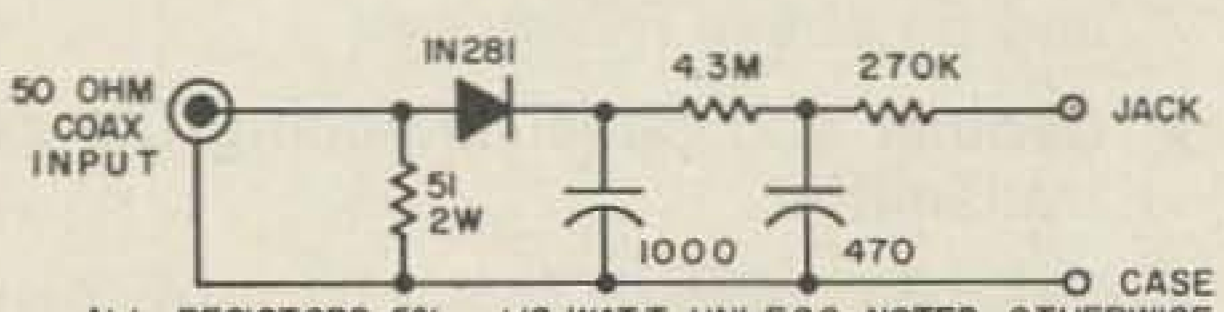
Accurate Milliwatt Level RF Power Measurements

David J. Bernays K4UWX
HAMBOARDS
Box 13158
Pine Castle, Florida

ACCURATE measurement of rf power in the milliwatt range is frequently a difficult task and one whose results may often be more a matter of opinion than measurement. With the advent of transistors and the resultant low power transceivers and transmitters developed using them the need to make such power measurements has increased. This problem arose recently at K4UWX during the design of a two meter transistor transmitter. A quick examination of the catalogs showed conclusively that commercial equipment designed for this job was priced completely out of reach! An inexpensive rf probe for the VTVM on the other hand had such lengthy leads and spread out internal circuitry as to be unreliable at even the lowest VHF frequencies.

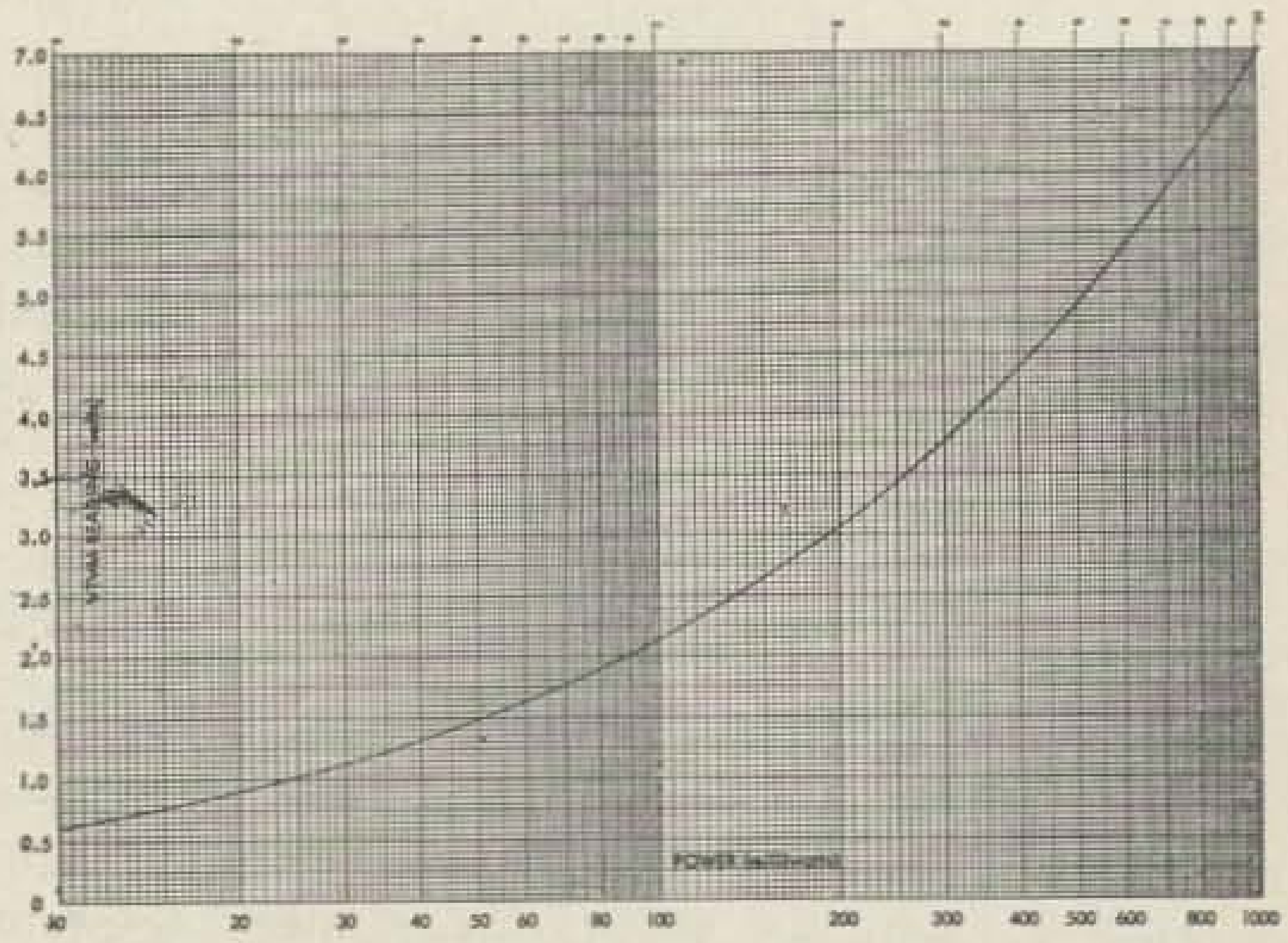
After much head scratching and several cans of beer, the solution finally appeared and ultimately took the form of the circuit shown below. The adapter, because of its compact design, gives accurate results at all frequencies from 160 to 1¼ meters. It may be modified, as noted further on, to extend its range to include transmitters up to 5 watts input. Best of all, the parts, even if purchased new, cost less than $5.00. This assumes, of course, that you have, or can beg, borrow or steal a VTVM! The graph, Fig. 3, is provided to read power directly in milliwatts.

A circuit description is as follows. The two watt, 51 ohm composition resistor provides an accurate 51 ohm load for the equipment under test. It is usable continuously up to power dissipations of one watt. This resistor is followed by an rf version of the familiar ac-dc power supply type half wave rectifier. The rectifier in this case is a gold bonded germanium diode,



type 1N281. The following filter is capacitor input and in operation charges up to one half the peak rf voltage applied across the load resistor. The 4.3 megohm and 270K resistors, combined with the 11 megohm impedence of a typical VTVM, form a voltage divider, so arranged that the VTVM will read a dc voltage equal to .707 times the voltage the .001 capacitor has across it. Net result—the VTVM reads rms rf voltage. One tenth of a volt should be added to the VTVM reading to take into account the drop across the diode.

The adapter is constructed on a 5 lug terminal strip inside a 3¼ x 2⅛ x 1⅝ Minibox. Fig. 2 shows the parts layout and lead dress. The screw which holds the terminal strip should extend an extra ¼ inch beyond the outside of the case to provide a convenient place to clip the VTVM common lead. All leads should be kept as short as possible. Care must be taken when installing the diode to be sure it is not damaged by excessive heat. This is true to a lesser extent of the resistors as changing their values will obviously throw the calibration of the adapter plus VTVM combination off.



The probe is made of a short section of RG-58U 50 ohm coaxial cable. An rf connector, in this case type BNC, is installed at one end. The other end is stripped clear of insulation, taking care not to cut the braid under it, for about four inches. The inner conductor is then carefully worked out through the side of the braid. After this is done, alligator clips are fastened to both leads approximately one inch from where the inner conductor is brought out. Insulators on the alligator clips prevent accidental short circuits. It is important that the distance from the point where the inner conductor is brought out of its braided jacket to the alligator clips be kept at a minimum since that section of the cable no longer represents 50 ohms. If the separated leads are excessive in length, serious errors can occur in the observed voltages.

The adapter is simple to operate and requires in addition only a VTVM. (A VOM won't work). Connect the adapter to the equipment being tested using standard coax hardware. If this is not possible use the probe, with the inner conductor going to the "hot" rf point and the braided lead to ground. A .001 capacitor may be connected in series with the inner conductor to block dc if necessary. Plug the VTVM dc probe into the adapter jack and clip the common lead to the adapter case. Test. The VTVM should be set on an appropriate negative dc scale. (If it makes you happier to read positive voltages, reverse the diode!)

During actual operation the voltage drop across the diode must be added to any voltage reading to get an accurate rms rf voltage. In the case of the 1N281 this amounts to approximately .1 volt. This voltage drop also creates a small error in any power readings that may be made unless it is taken into account. The graph in Fig. 3 has been drawn for an adapter using a 1N281 diode. It may be used to read power directly in milliwatts.

For those who like to calculate things, this graph was derived as follows. The actual rms voltage is equal to the voltage observed on the VTVM plus .1. This, plus E=IR and so on can be scrambled to yield $P = (V_{DC} + .1)\frac{(V_{DC} + .1)}{51}$

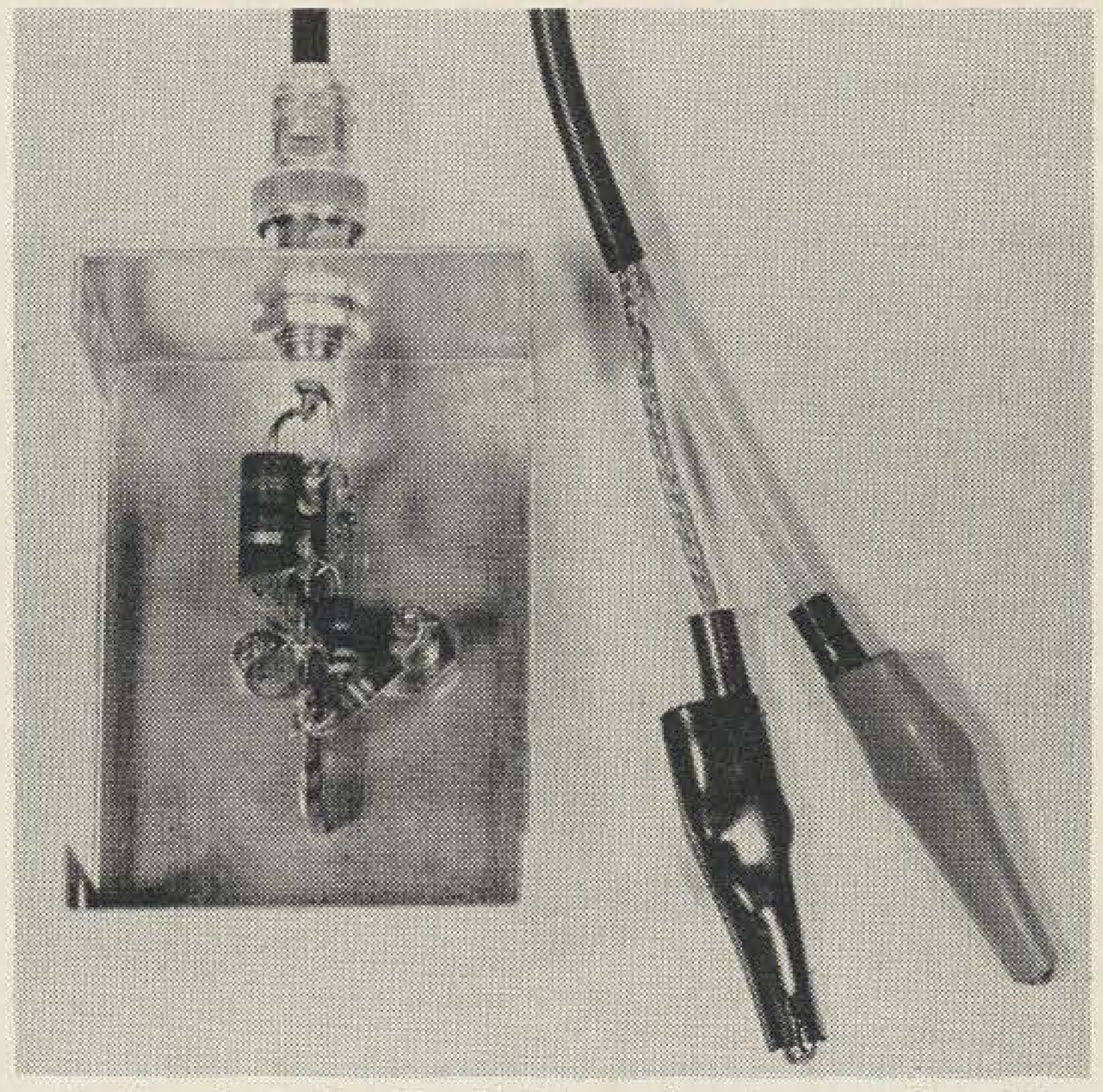
or, in milliwatts, $P = 20\,((V_{DC})^2 + .2\,V_{DC} + .01)$

where V_{dc} is the voltage read on the VTVM.

If a different type of high frequency diode than the gold banded germanium 1N281 is used the diode drop should be changed accordingly, about .13 volts for a regular germanium diode and .30 to .35 for silicon types. These drops are considerably less than those usually associated with such diodes. This is easily explained, however, as published values are normally measured with rated current flowing through the diode. Conduction in the microampere range actually begins at much lower voltages. Since the currents flowing in the diode portion of the adapter circuit are minute, to obtain accurate results it is necessary to use the diode voltage drop when conduction begins rather than that present with rated current flowing.

Power outputs greater than 1 watt can be measured if two parallel 100 ohm, 2 watt, composition resistors are substituted for the 51 ohm unit shown. Do not try to substitute wire wound resistors. They behave like inductors rather than resistors at rf frequencies! Power may then be calculated from $P=E^2/R$ using the VTVM reading as the diode drop contributes negligible error above one watt. This modification will permit the adapter to be used with transmitters running up to 5 watts input, which includes the Heath Tener, Sixer and Twoer as well as all CB rigs.

This unit can also be used where the device to be measured presents an impedance greater than 50 ohms if a series resistor is placed between the point of rf voltage to be measured



and the hot lead of the adapter probe. For instance, 200 ohms may be matched to the meter by inserting a 150 ohm series resistor. Power as shown with this adapter would then, of course, be one fourth that which was actually available. The voltage indicated would also be one fourth, minus the .1 volt diode drop, of the actual voltage available. This technique has proven handy when developing oscillator, doubler and driver stages.

In the few months since it was built this little adapter has become one of the indispensable pieces of test equipment at K4UWX. If your interests are similar, it will probably do the same in your shack. ...K4UWX

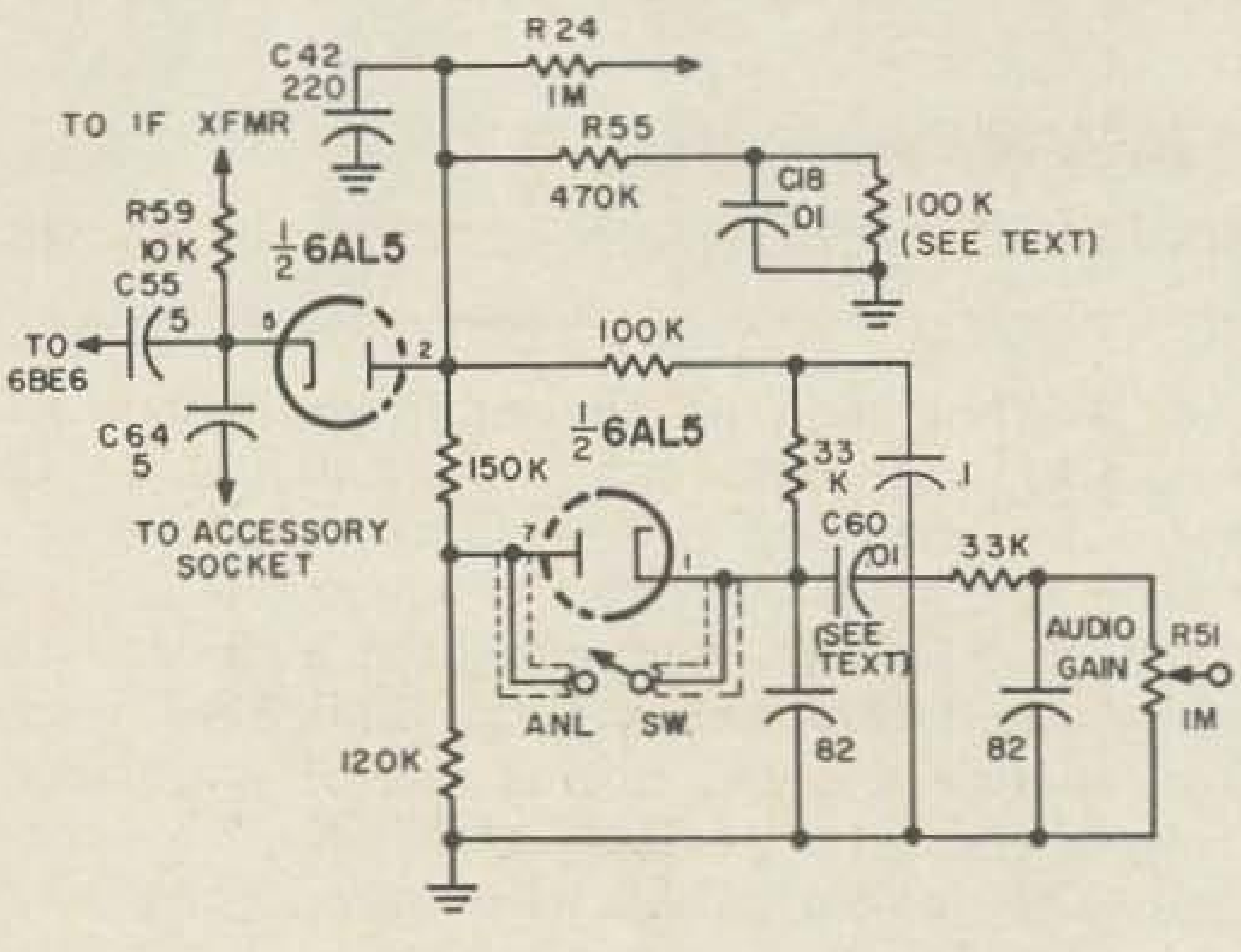
Bill Davidson W8IQN
79 Central Avenue
Dayton 6, Ohio

Why clip the noise off at the same level as the desired signal—*when you can yank it out by the roots?* Here's how . . . a

Rate-of-Change Noise Limiter

for the NC-300

ONE common complaint of NC300 owners is the difficulty of copying certain AM signals with the noise limiter on. Although the noise is substantially reduced, the distortion introduced greatly impairs legibility. In addition, the standard full wave series-diode limiter is far from being the most effective but is used by most equipment manufacturers due to its simplicity and low cost. This article describes the circuit modifications of an NC300 for incorporating a new type limiter which overcomes the limitations of most limiters.



As stated in April 1961 73* the "Rate-of-Change" Noise Limiter is considerably more effective, especially on short duration pulse noise (such as automobile ignition), and introduces no distortion.

The NC300 is easily converted because (1) the receiver already utilizes the one megohm volume control and 6AL5 tube required, (2) changes are necessary on only three pins of the 6AL5 tube socket, and (3) the off-on switch of the existing noise limiter can be utilized (if desired) without rewiring.

The only complication encountered in adapting the Rate-of-Change Limiter to the NC300 was caused by the S meter circuitry incorporated in the receiver. If this circuitry is not modified, the result is a loss of audio and unsatisfactory limiter action. Fortunately, no changes were required in the AVC circuit.

In the NC300 three changes were required in the April 73 circuit. It was noted that distortion on very strong signals resulting from detector overload occurred when load resistors of 27K ohms and 18K ohms were used. Upon substitution of 150K ohms and 120K ohms, two improvements were noted: (1) No distortion was present regardless of signal strength and (2) absolutely no loss of audio occurred with the limiter on. Limiter action remained very good, as before. In view of these improvements, the use of the ANL off-on switch is not mandatory, but it's nice to be able to check how effective the limiter actually is on various types of noise.

The second change from the April 73 circuit was the use of the existing 220 mmfd detector filter capacitor (C42) rather than the 20 mmfd specified. This caused no detectable change in limiter performance.

The third change is the use of a 33K resistor in place of the 330K in the April circuit. This results in maximum limiting action as evidenced on an oscilloscope. A slight decrease in audio will be noticed but the receiver still has plenty of gain to spare.

The following changes should be made at tube socket V6 (6AL5):

Pin 1 Disconnect one megohm resistor (R29); add 33K resistor and 82 mmfd capacitor.

Pin 2 Disconnect brown striped shielded lead (from ANL potentiometer); add 100K and 150K resistors.

Pins 3, 4, 5 and 6 No changes.

Pin 7 Disconnect 33K resistor (R43); add 120K resistor and connect 150K resistor from pin 2.

Connect .1 mfd capacitor as shown in schematic diagram. Complete wiring of components listed above as shown in schematic. Disconnect 27K resistor (R30) from junction of 33K (R43) and 470K (R55). Connect lead from this junction to junction of AVC line, one megohm resistor (R24) and 220 mmfd capacitor (C42).

Add a 100K resistor from V9 (12AT7) pin

*"A New Noise Limiter Circuit" by J. Kyle, K5JKX/6 April 1961 "73," Page 16.

7 to ground. The value of this resistor determines the sensitivity of the S meter and may be as low as 50 K or as high as two megohms depending upon personal preference. Since the NC300 has a reputation for being overly generous in its S meter readings, the 100K value results in more accurate S meter action. However, if generous readings are desired, a one megohm resistor may be substituted.

Now for the changes on the topside of the NC300: Disconnect either end of jumper wire from switch on ANL to ANL potentiometer. Disconnect shielded lead from lower end of .01 mfd capacitor (C60) on Mode Switch. Add 33K resistor from the shielded lead to lower end of C60.

Add 82 mmfd capacitor from junction of shielded lead and 33K resistor to ground lug nearby on mode switch.

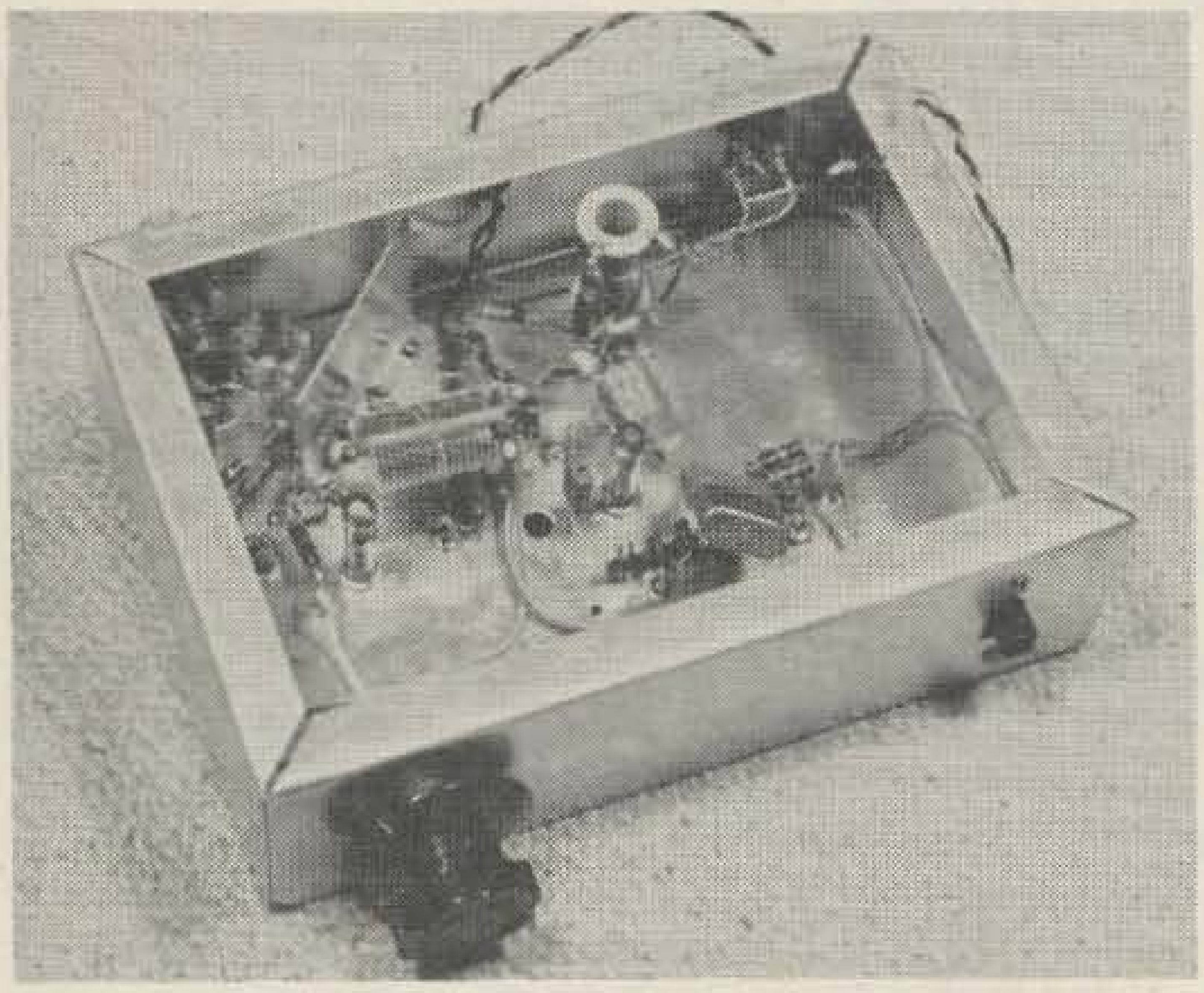
That should complete it. Double check against the schematic to be sure no errors have been made.

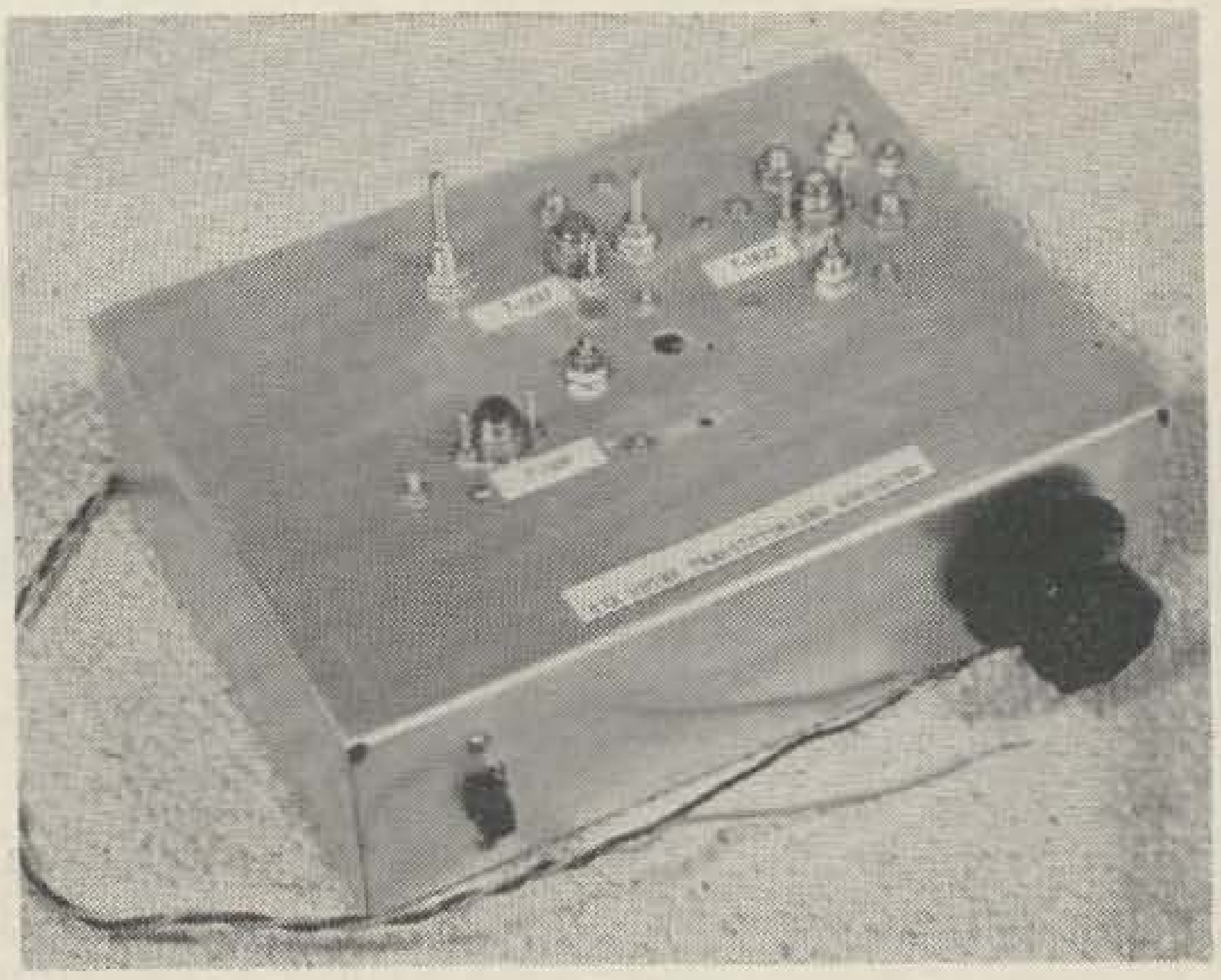
K4ZAJ reports that this same circuit has been incorporated into his SX100 with excellent results. We both agree that for the short time required to accomplish the receiver modification, the benefits of improved limiter action without distortion are indeed worthwhile. Many thanks to Jim Kyle, K5JKX/6 for bringing the Rate-of-Change Limiter to our attention!

... W8IQN

Transistorized C.C. Converter for Six

John Specialny W3HIX
Philco Corp.
Lansdale, Penna.





THE article describes a six meter converter using three Philco MADT VHF transistors. It operates at a supply voltage of 12 volts and works into a communications receiver capable of tuning the 7 to 11 mc frequency range.

Circuit Description

A Philco T1832 transistor is employed in the neutralized rf amplifier stage. It operates as a common emitter stage with the incoming signal being applied to the base through the input tuning network consisting of coil L_1 and shunt capacitor C_2. It works with either a 50 or 70 ohm antenna system. The output utilizes a double tuned circuit made up of coils L_2 and L_3. Capacitors C_6 and C_8 tune the coils to the desired frequency. Neutralization is provided bp capacitors C_7 and C_4. The tuned circuits are sufficiently broadband so that they can be fixed tuned.

Manual forward gain control is used to reduce the gain on strong signals. This method of rf gain control is accomplished in the following manner. As the collector current is increased, the voltage between the collector and emitter drops due to the series resistors R_4 and R_5, hence, the gain of the stage drops. The Micro Alloy Diffused-Base type of transistor is well suited for this type of gain control and provides much better overload performance than the conventional reverse gain control method. If gain control R_2 provides maximum stage gain when set fully clockwise. By varying the gain control counter clockwise, the value of collector current increases causing the

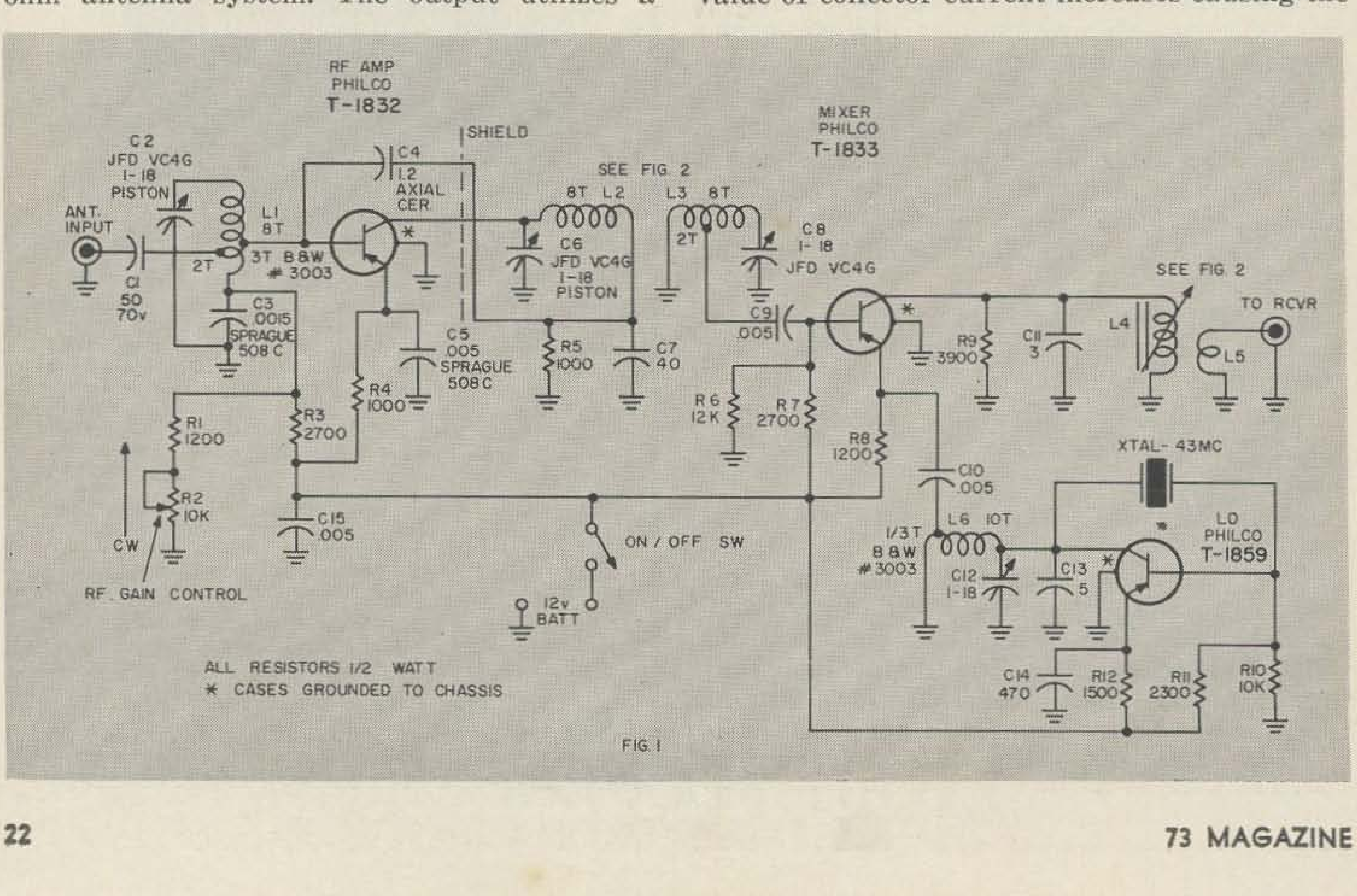


FIG. I

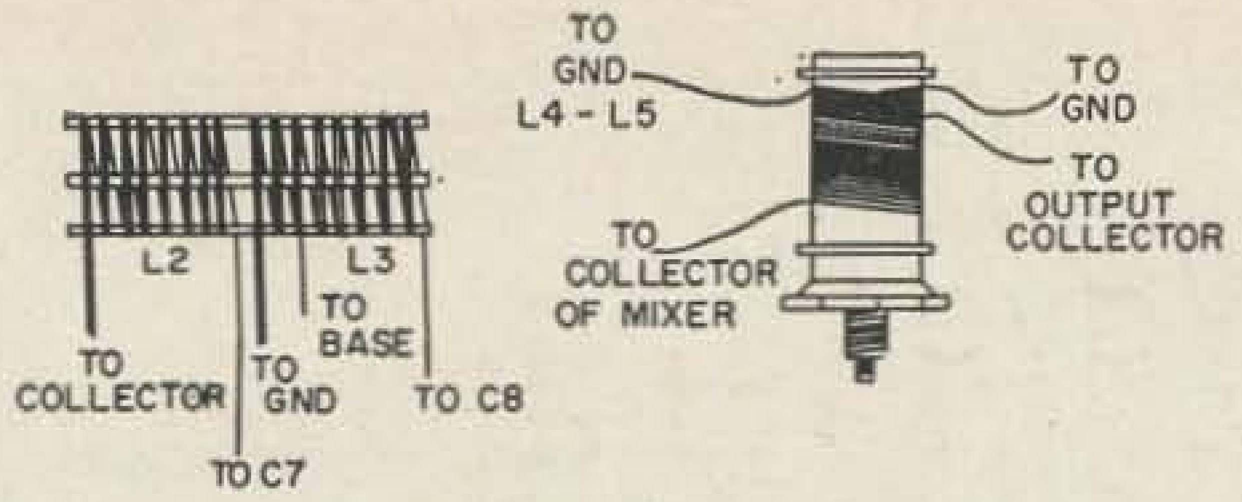


FIG. 2

L2-L3—Made from a single section of B & W Miniductor No. 3003, ½" dia. 16 turns per in. The coil is cut at 8½ turns and both leads are then unwound a half turn in both directions and are used to connect the cold ends of L2 & L3 to the proper points.

L4—Closewound No. 30 Nyclad copper wire on a ½" dia. form to occupy a winding length of 13/16". L5—15 turns No. 28 Nyclad copper wire closewound over cold end of L4. Form: Cambion LS7. Iron core: Cambion X2018D Red Dot.

gain to drop. Emitter resistor R_4 and the bias dividing resistor network consisting of R_1, R_2 and R_3 provide the necessary dc stabilization for the rf stage.

A 1833 is used as a mixer with the signal being applied to the base through a tap on the coil L_3. The output transformer T_1 tunes to about 8.5 mc and couples the output from the collector to the output connector. A loading resistor R_9 is placed across the primary winding L_4 of transformer T_1 to flatten the *if* response of the output circuit with some sacrifice of converter gain. Emitter resistor R_8 and bias dividing resistors R_6 and R_7 provide the dc stabilization for the mixer stage.

Emitter injection is obtained by tapping the emitter capacitor C_{10} on the oscillator tank coil L_6. An injection voltage of 0.15 to 0.25 v rms should be measured at the emitter te nals of the mixer. Emitter resistor R_{10} and b dividing resistors R_{11} and R_{12} provide dc stabilization in the local oscillator stage. A 43 mc overtone crystal is used to control the frequency of the local oscillator. A Philco T1859 is used for the local oscillator.

Note: Figure 1 shows a value of 2300 ohms for R11. A value of 3300 ohms is preferable (preferable—that means the draftsman read my "3" as a "2").

The converter was constructed on a 7" x 5" x 2" aluminum chassis. The accompanying photographs show the placement of the circuit components. The top view of the chassis is shown in photograph A whereas the bottom view is shown in photograph B.

Performance

With the gain control set for maximum, an overall power gain of 45 db was obtained at 51.5 mc. The gain drops off to about 42.0 db at 50 and 53 mc. A noise figure of 4.1 db was measured using a noise diode generator. Table I indicates the value of collector current flowing in each of the stages. ...W3HIX

TABLE I

RF Amp	(max. gain)	Mixer
I_C	1.2 ma	1.0 ma
Lo		Total with divider current
1.7 ma		7.0 ma

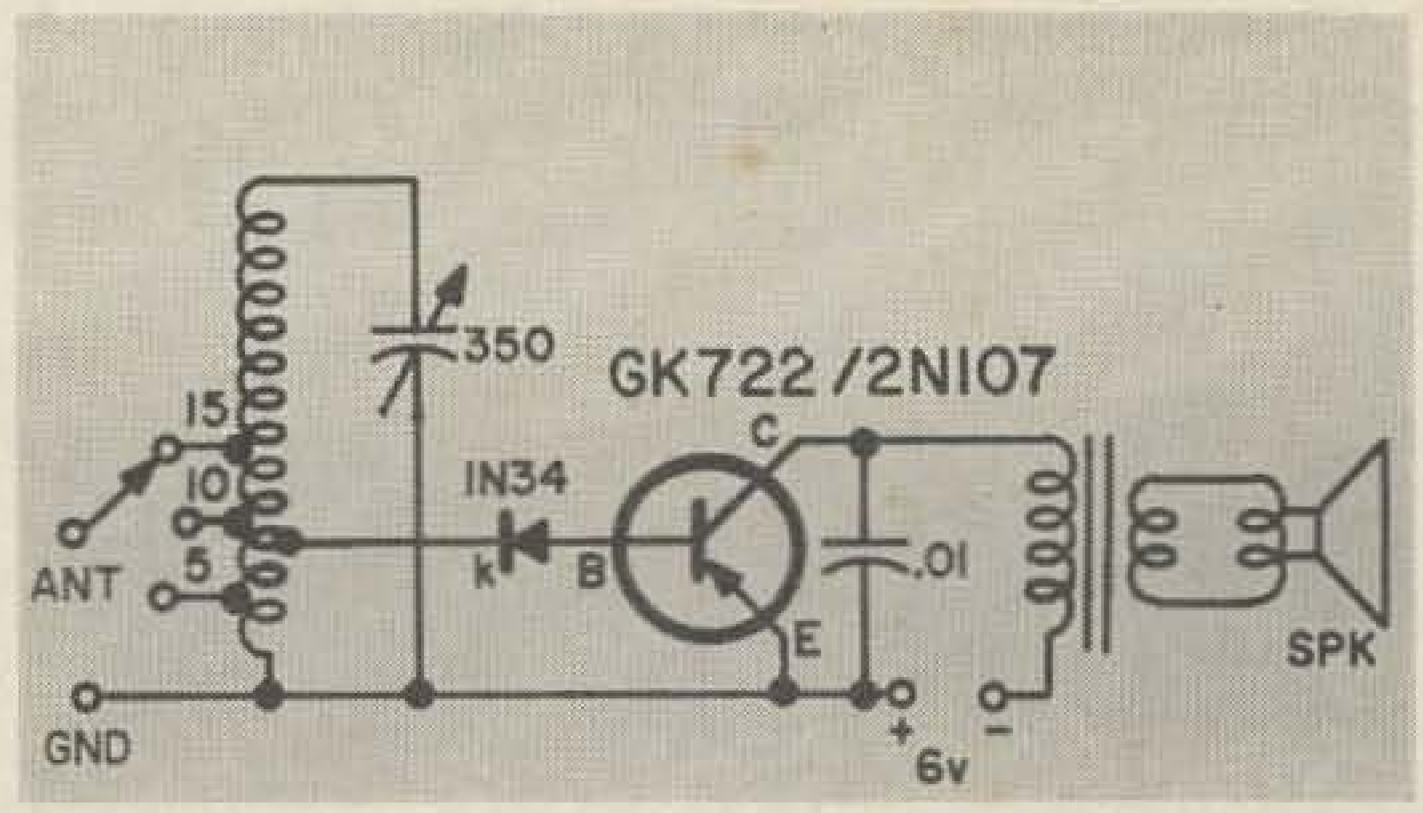
...imple Tuner for Long Waves

W. G. Eslick KøVQY

THE growing use of ham-band-only receivers, while it makes for better ham communications, is depriving more and more chaps from the fun of tuning other frequency bands and hearing some of the interesting things going on there. One badly neglected band is the 200-550 meter band. Though most stations have moved up into the shorter wavelengths down through the years, and many right up into the VHF's, there are still a few stations operating in this old band. Here is a simple tuner which will let you listen in to these remnants of another age.

You can build this tuner in just amout any small box you may happen to have around. I installed it in an old antenna rotator control box, using the dial space for a small speaker. You'll need an antenna . . . about 20 feet did fine for me. You don't have to worry much about lead lengths at these low frequencies. I didn't even put in a volume control, depending upon detuning the stations for this. Simple as this is, it produces enough volume to be heard all over the basement.

I put in four flashlight batteries back in November and they're still going strong, running day and night since I didn't put in an on-off switch. This unit takes so little current that even old tired batteries will give several months operation. You may want to increase the voltage to 12 volts for weaker stations. Six volts is fine for nearer and gives less distortion.

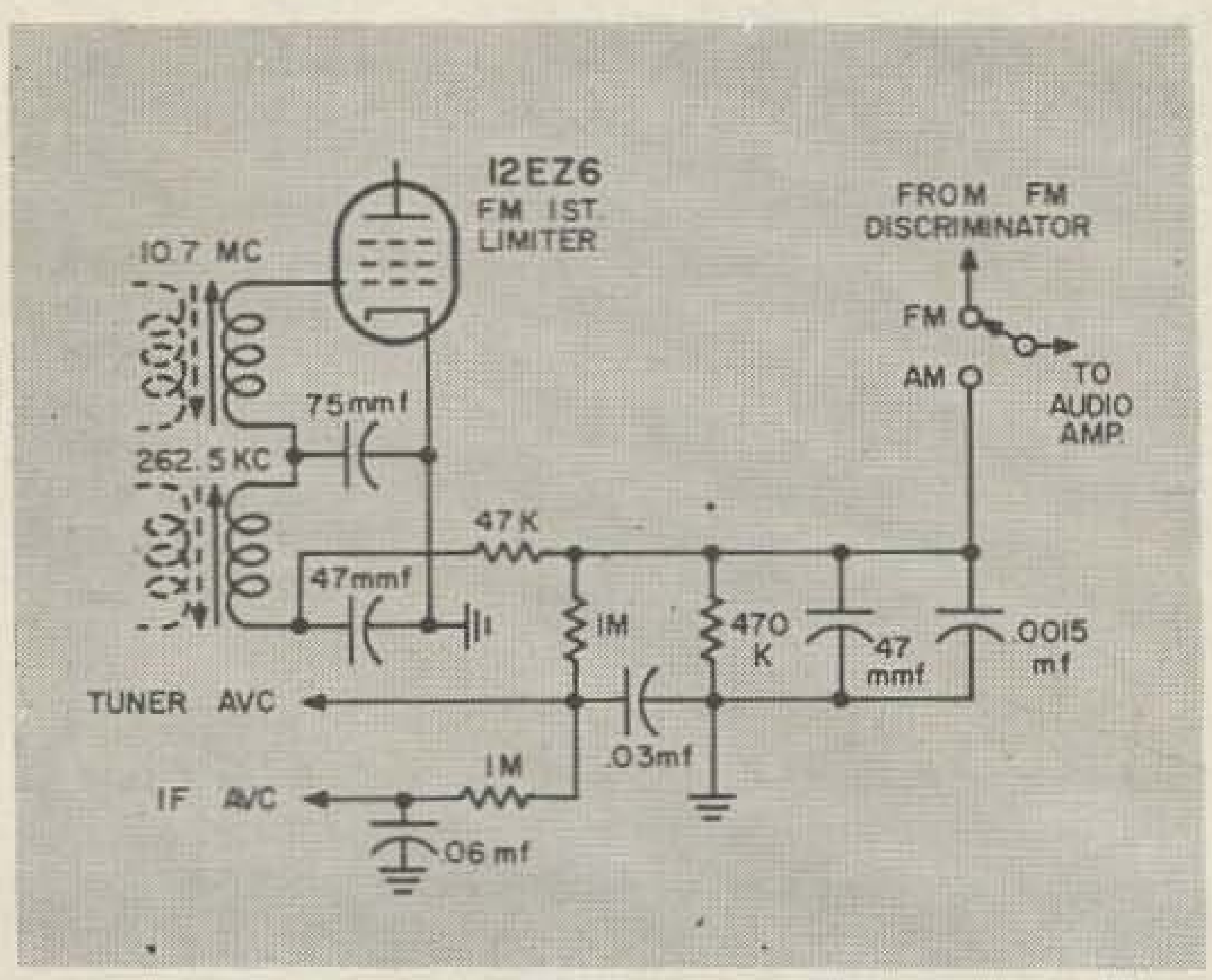


The parts can be juggled to match your junk box. Any diode will do just fine. If you use an NPN transistor then reverse the battery. A 5OL6 output transformer is better than one for a 6V6 or 3Q5 since it matches the transistor better. Tap the coil for loudest signals with your antenna. The coil consists of 80 turns of #22 or #24 wire closewound on a 2" form.

Perhaps, if enough of you start listening to this band, we can get 73 to publish a listing of the stations still operating there. I hope you'll get as much enjoyment as I have out of tuning this relic of the early days of radio communications. . . . KøVQY

More of FM to AM

The original short article[1] on the use of grid rectification in an FM receiver limiter for AM detection cited a fairly old item of military surplus equipment in which this technique was used. This method of AM detection has obvious advantages in surplus conversion work since few additional parts are required and the original FM reception capability is not impaired.



A more modern equipment using this technique is described in the 20th issue of "TUNG-SOL TIPS," published by Tung-Sol Electric Inc. The article, "Hybrid AM-FM Auto Receiver," by W. Guell, describes a unit designed by the Advanced Development Department of Tung-Sol's Radio and T.V. Tube Division. The purpose of the project was to demonstrate to the auto manufacturers the desirability and feasibility of such an automotive receiver. The receiver uses many common circuits which include use of the FM limiter as the AM detector.

Figure 1 shows a simplified and redrawn schematic of the AM detector. This ciruit is more versatile than the one described in the original article and provides AM detection, along with *if* and rf stage AVC voltage, from the first limiter grid. This technique is of great value in surplus conversion work and should be considered in the design of any dual-mode receiver because of the inherent simplicity and economy. . . . W4WKM

[1] "FM to AM," W4WKM, April, 1962 73 MAGAZINE. ZINE.

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James G. Lee W6VAT
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Los Angeles 45, California

WITH the declining sunspots, usage of the lower frequency bands is definitely increasing. The resulting increased QRM is helpful to no one and only efficient equipment and operating procedures will result in a maximum number of QSO's. The SWR/PWR meter described here won't make you a better operator, but it can help you be sure that you are delivering the most rf to your antenna from your rig. Fig. 1 shows a front view of the meter.

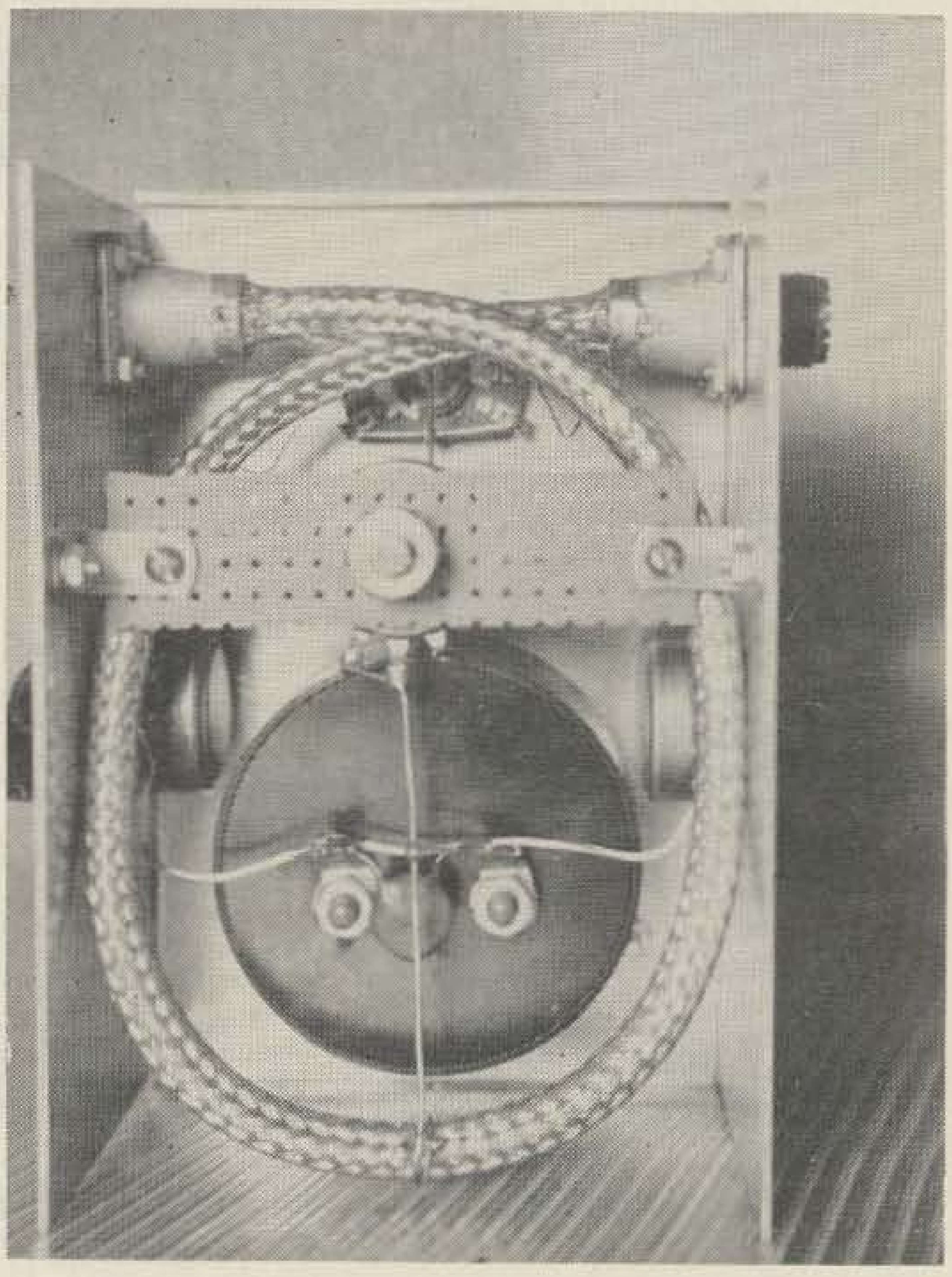
The basic circuit is a directional coupler switched to sample either forward or reverse voltage and a voltmeter to read this voltage.

This type of coupler has an output proportional to length, power, and frequency. The longer it is, the more output it gives. Since it puts a small impedance "bump" in the line, the length of the coupler should be limited to not over 1/20 wavelength at the highest frequency, or it may begin to contribute noticeably to the SWR itself. For a given power, if the frequency of the rf flowing through the coupler is reduced, the maximum coupler output is reduced. This means that you can get full scale readings on 10 M with a lot less power than on 80 M. The meter described here gives half scale deflection on 40 M, at maximum sensitivity, with about 350 watts of forward power. If your rig is a KW this meter will fill the requirements for SWR/PWR measurements nicely. It can be left in the line at all times to monitor SWR or Power delivered to the antenna or other load. If desired, a Barker and Williamson type 551A coaxial switch can be used to insert the meter in the line for test purposes and then switch it out during operating periods.

Construction

The unit is built in a gray hammertone LMB type 141 box. The dimensions of this box are 3" x 4" x 6". Fig. 2 shows the parts placement and should answer any questions concerning layout.

The coax directional coupler is made from a 14" length of RG-8/U. The outer covering is slit lengthwise with a knife and peeled off. Take care here not to cut into the woven braid. The woven braid is then bunched toward the center to loosen it. Next, a length of #22 enameled wire is passed through the braid at about 2¼" from one end and run under the braid next to the inner insulation. It is brought out at the other end, again 2¼" from the end of the shield braid. When this is done, smooth the braid back to its original position carefully to avoid scratching the enamel on the #22 wire. The #22 enameled wire should lay as straight as possible under the braid. It should have no slack nor should it twist around the inner insulation to any



great degree. The ends of the shield braid are trimmed back far enough to be soldered to Amphenol 83-1H hoods. The inner insulation is trimmed off so as to expose about 3/16" of the inner conductor. The inner conductors are then soldered to Amphenol 83-1R female type chassis mount coax connectors. The coupler may now be set aside and the rest of the meter constructed.

Potentiometer R_1 is mounted on 1/16" x 1" x 4" piece of bakelite and positioned approximately in the center of the box to minimize capacity to ground. The metal rear cover is removed from the pot for the same reason. The pot ground lead is to the center of the coax and is wire in last. The diode D_1 should be protected from damage by heat when soldering it in the circuit. Long nose pliers gripping the leads near the body of the diode are satisfactory. The directional coupler is the last item soldered in place. As can be seen in the photos—the coax connectors are mounted from the inside of the box. When the #22 enameled leads are soldered to S_1 they should be the same length, and again, take care not to scratch the enamel or a short circuit may occur and you'll have to do it all over again.

Calibration

There are any number of ways to calibrate the SWR/PWR meter, but the way most hams will use is their own rig and a suitable dummy load. Though very limited in power, a 2 watt 50 ohm resistor such as made by Ohmite, IRC and others, mounted inside an Amphenol 83-1SP male coax plug makes a very good dummy load. Although not completely non-inductive, this dummy load is far superior to such real unknowns as light bulbs, electric iron heating elements, etc. This particular load is 50 ohms shunted by 6 mmfd over the range of 3-30 mc. It is a good dummy load—though a low power one.

With the back cover off, attach the dummy load to J_1, the load jack. Set R_1, the Sensitivity Control, to maximum and S_1 to FORWARD. Next apply power by hooking your rig (or other rf source) to J_1, the transmitter jack. Make sure that the rf applied is 28-30 mc, or, the highest frequency you operate in the 3-30 mc region. This meter is sensitive to frequency. Stray capacities and other unbalances will have their greatest effect at the highest frequencies. In any event, calibrate the unit on the highest frequency your rig will tune in the 3-30 mc region. With power applied, set R_2 so the meter reading is at least half scale and switch S_1 to REVERSE. This will result in a lower meter reading. R_1 should then be adjusted for a minimum reading on the meter. Using the suggested load, you will not get a complete null, but the null should not be much more than 50 ua for half scale deflection in the FORWARD position on S_1. Don't put too much power into the dummy load since excessive dissipation can ruin it and change its characteristics greatly. If you have a higher power dummy load whose characteristics you know accurately, by all means use it, but remember a light bulb is not a good load. Once nulled, lock the nut on R_1 taking care not to disturb the setting. Replace the back cover and using the dummy load, recheck the null to make certain that it has not shifted.

Using The Meter

To make SWR measurements you need only insert it in the line and set S_1 to FORWARD and S_2 to SWR. Adjust the sensitivity control for at least a half scale reading. Then switch S_1 to REVERSE and read the value. SWR is then calculated by the following:

$$SWR = \frac{I_{fwd} + I_{rev}}{I_{fwd} - I_{rev}}$$

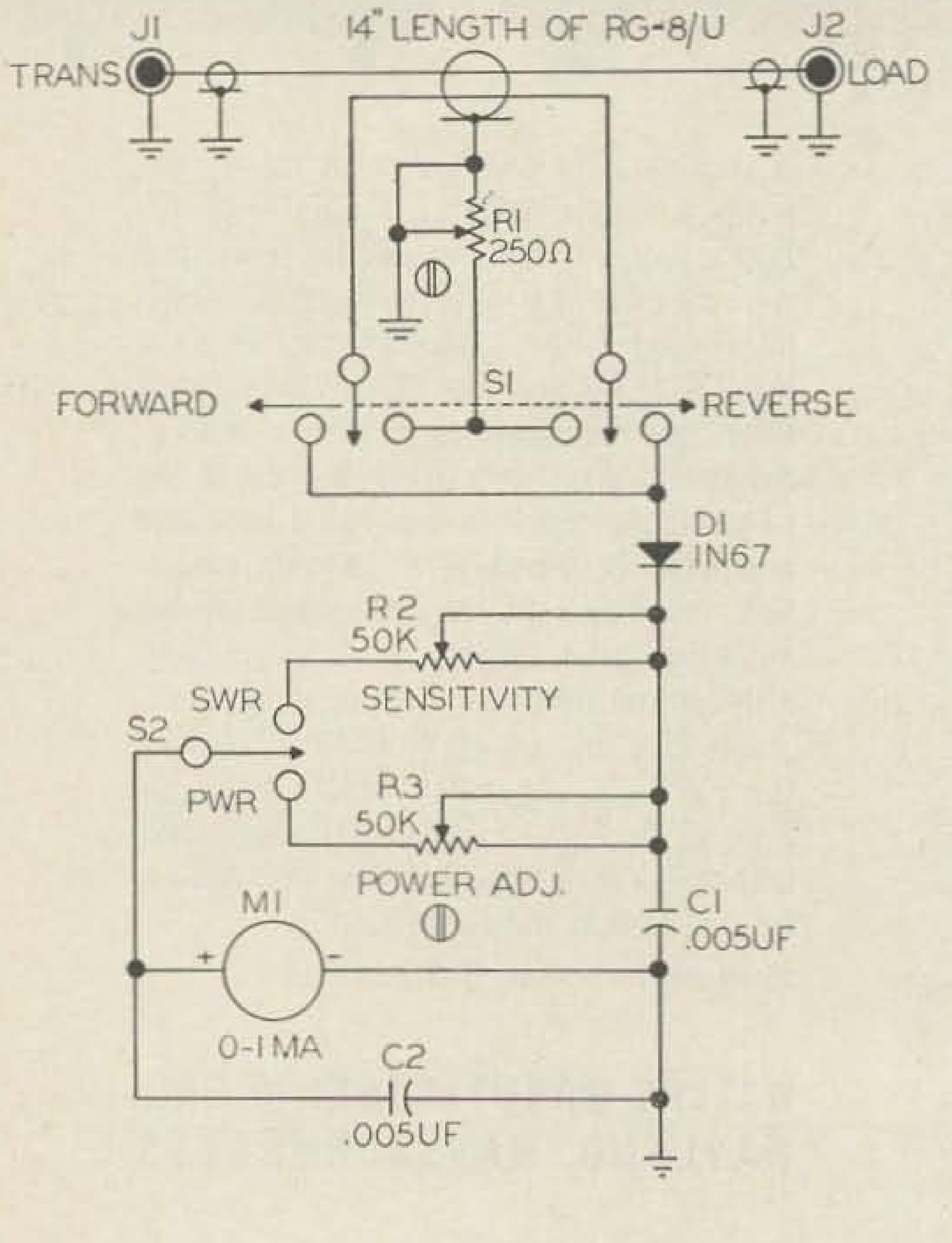
For example:

let $I_{fwd} = 500$ ua and $I_{rev} = 50$ ua, then

$$SWR = \frac{500 + 50}{500 - 50} = \frac{550}{450} = 1.22{:}1$$

The meter is useful for tune-up purposes where exact SWR is not needed. Just keep the FORWARD reading at a constant value and tune for minimum REVERSE readings. The exact SWR can be calculated when you have found the lowest REVERSE position.

The POWER position may appear to be essentially the same as the SWR position and it is. When measuring power into a load of known fixed value you only need to know the voltage across (or the current through) the load. The POWER position on S_2 is used with S_1 set to FORWARD. R_3 is merely set to a scale reading that is convenient for all bands if only a relative reading is used. If a good 50 ohm high power dummy load is available, you may make accurate calibrations by using a VTVM plus high frequency detector probe and measuring the actual voltage across the load. Just put a T-connector on the load jack J_1. Put the dummy load on one arm of the "T" and read the voltage at the other arm. 200 volts across a pure resistive load of 50 ohms is equal to 800 watts of power. If your rig delivers a key down 800 watts to a load then you could set R_3 at 0.8 ma on the scale, etc. The scale will not be precisely linear, particularly at low powers, but if enough resistance is used at R_3 the effects should be minimum. Since the coupler voltage is frequency sensitive one setting of R_3 will not hold for all bands. If desired, R_3 could be replaced with a switch and a number of selected resistors (one for each band). This would keep the scale factor constant between bands. This could be done for R_2 as well, but complicates an otherwise simple device



Operation

Once calibrated, the meter is very simple to use. Just hook it in the line at some convenient point and apply power. With S_1 set to FORWARD and S_2 set to SWR, adjust R_2 for at least a half scale reading. Switch S_1 to REVERSE and you will then be able to continuously monitor your reverse power. For power measurements, set S_1 to FORWARD and S_2 to PWR. Apply power and the meter will be monitoring your forward power continuously. R_3 is a screw driver adjusted pot. It can be set, and locked at a point which allows operation on all the bands you operate. The scale reading on each band will be different, but once set, these readings can be jotted down in your log book and any change quickly noted. This meter is also an excellent device for the antenna "tinkerer," or if you have coax coupling between stages in your rig it can be used to provide proper power transfer. Best of all, it is not expensive nor difficult to construct. Try one and you won't be without one again. . . . W6VAT

Parts List

R1—250 ohm pot, screwdriver adjustment w/locking nut—Ohmite CLU-2511.
R?—50K pot—Ohmite CB-5031.
R3—50K pot, screwdriver adjustment w/locking nut—Ohmite CLU-5031.
C1 & C2—.005 uf, 600 V disc ceramic.
D1—1N67 diode.
S1—DPDT rotary switch—Centralab 1462.
S2—SPDT slide switch.
J1 & J2—Amphenol 83-1R female chassis connectors with two 83-1H hoods.
M1—0-1 ma 3" meter—Triplett #321.
Chassis—3" x 4" x 6" LMB #141,, gray hammertone.

Marion Culver W9OFD
1841 South Calhoun Street
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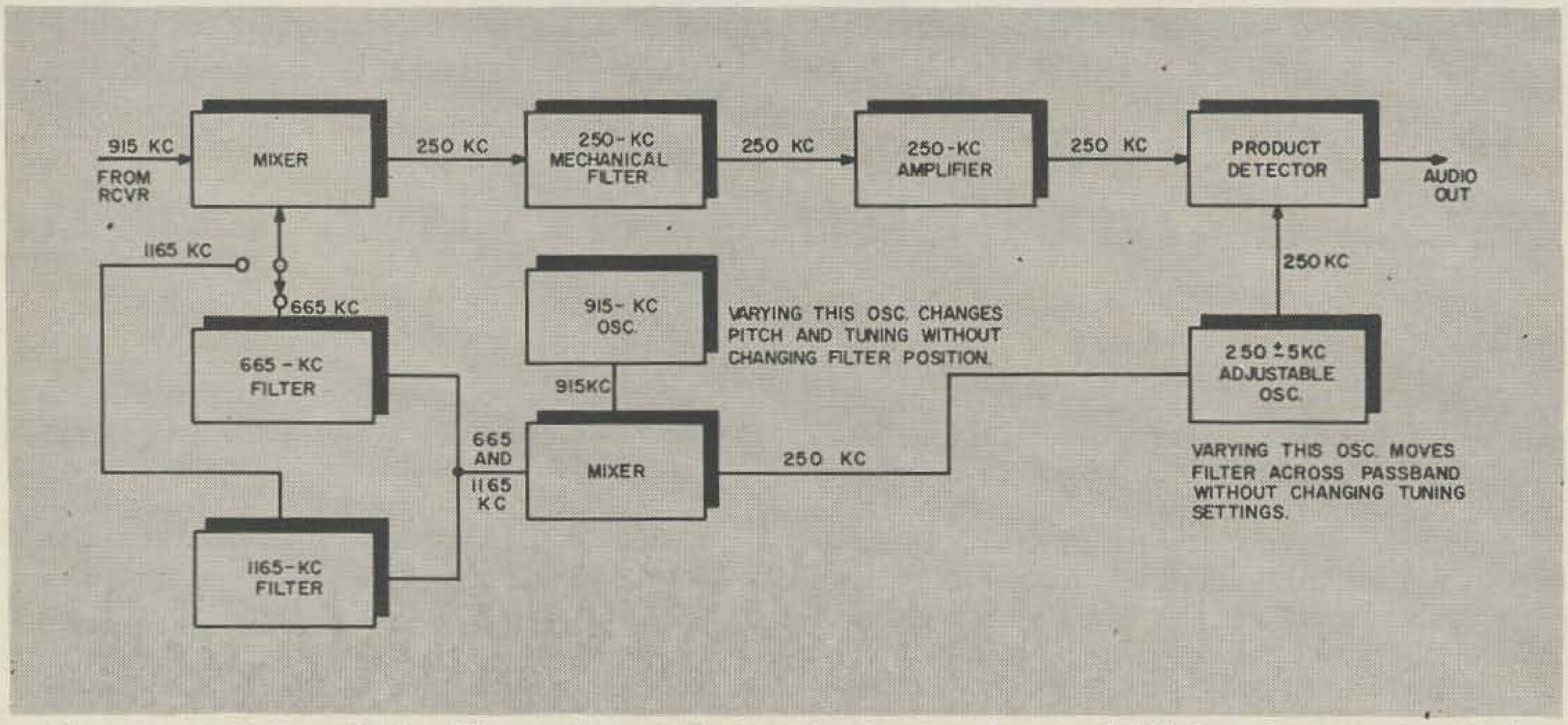
Selectivity Plus!

IT'S not original to observe that the amateur bands are more crowded than they were in the not-too-distant past (if I said how distant, I would be telling my age). For this reason the decision was made to try to do something about the condition, in regard to the receiving end of the station here. After a lot of thought, it seemed the mechanical filter bought the most selectivity per dollar.

These filters are compact and need no tedious adjustment. While they are not quite as rugged as a battleship, they can be expected to give a lifetime of service if they are given the same sort of handling as, say, a fine wristwatch. Their cost varies from a ten spot to three times that much, depending on which ad you read.

The mechanical filter is a compact unit which can be likened in many ways to an *if* transformer. Because it has little mechanically resonant discs within it, though, it has properties of selectivity which will separate stations on the crowded bands like a whole battery of Q-multipliers.



Indeed, this analogy is most applicable because whereas the Q of an *if* transformer can be increased to something in the vicinity of 5000 with the aid of positive feedback in the Q multiplier circuit, the Q of *each* of the six resonant discs in the mechanical filter is in the region of 5000 also, without benefit of any tricky regenerative circuits.

Electrically, there is no difference in the hook-up of the filter and of an *if* transformer. The filter can be said to have a primary and a secondary winding, each of which has to be brought into resonance with a small trimmer, just like an *if* transformer. The difference is that in the case of the *if* can, the *if* energy in the primary is inductively coupled to the secondary, and in the mechanical filter there are six little resonant discs between the two windings.

The primary drives one disc headphone style. It, in turn, drives the next one mechanically, and so on down to the end of the string. This last disc has a special coupling to the secondary coil. The filters are symmetrical and thus can be turned end for end without altering the characteristic.

While a mechanical filter can be used to merely replace an *if* transformer[1], in many cases realizing selectivity such as the operator has never experienced, the nearly ideal selectivity characteristic of one of these filters makes possible design of a much more exotic system.

In the case here, a filter was obtained which had a bandpass of 3.2 kc at a carrier design frequency of 250 kc. The official description of the unit is an "upper sideband 250 kc" filter. An incoming carrier in the *if* strip is tuned to fall on the lower-frequency slope of the filter and is about 25 db down in response. Some 200 cycles higher, the filter rises to its maximum response. This response continues unchanged to a frequency of approximately 253.2 kc. With the BFO operating at 250 kc and an AM station tuned to zero beat, only the upper 3.2 kc of his signal will be received, and

[1]See "Take Your Pick," our technical article in the April '61 issue for a usable circuit—editor.

this will be received in exalted-carrier fashion. The response on the low-frequency side of 250 kc is down 60 to 80 db because of the phenomenal selectivity characteristic. In the receiver built here, in daily use for the past two years, no audio image has been strong enough to be detected even under the most ideal conditions.

To put it in figures, the response of the lower side of this filter falls 60 db in half a kilocycle, while the upper side falls the same 60 db but takes a full kc to do it. Thus, the response of the flat top is 3200 cycles wide—but the response 60-db down (limit of audibility for most people) is still less than 5 kc, instead of the 12 to 20 kc to be found in many receivers. Also, you can see that for best sideband rejection, only the lower side of the filter should be tuned to a carrier.

When one becomes accustomed to using a receiver with this characteristic, he finds holes in the band which cannot be located with more conventional setups. Indeed, on many occasions, I have tuned in broadcast stations on adjacent 10-kc channels, each having a signal which rocks the boat, and then have returned to put the 3-kc passband exactly between them and watched the S-meter fall almost to zero. If the modulation of each station is voice, the receiver goes almost silent. For our purposes, such an opening on a ham band would be considered a clear channel.

If I wanted to listen to an AM station's upper sideband and get nearly infinite rejection of the lower sideband, the system to use would be simply the mechanical filter by itself as described above. A system of sum and difference heterodyning with separate oscillators would give sideband selection. But please don't stop reading yet; there's more to come. Passband tuning!

While the homebrew receiver I'm using this device on has many other features (product detection, hang avc, always-active S-meter, squelch, and a panoramic display in the works) the thing I'm talking about here is simply the mechanical filter circuitry.

The device is basically a superhet circuit with a restricted tuning range (10 kc at the most) and an input frequency derived from the original receiver's intermediate frequency, which in my case is 915 kc. The block diagram identifies components.

Since the receiver *if* is 915 kc and the intermediate frequency of the device (which I'm going to call the slicer from here on in) is 250 kc, determined by the filter, obviously we must have a mixer somewhere.

This mixer is the first stage of the slicer. To develop the desired 250 kc output, we must feed it either 665 kc or 1165 kc in addition to the 915 kc input from the receiver.

As I said earlier, you could use separate oscillators to get these frequencies—but that approach gives you four separate oscillators (first L. O., two slicer oscillators, and the BFO) in the complete receiver. This approach does it with three.

To eliminate the extra oscillator, we build up a stable oscillator at the receiver *if* of 915 kc. The important thing in construction of this oscillator is to keep it reasonably isolated from everything but the circuit it feeds if you wish to have tweet-free tuning without the BFO on. Physical separation between this circuit and the *if* input, shielding of long leads, ceramic bypasses across the heater leads, and short component leads within the circuit accomplish this isolation.

The 915 kc signal produced by this oscillator is fed into a mixer circuit along with a signal from the 250 kc BFO. Everything about this mixer is standard, with one exception. In its output you have a choice of two bandpass filters, one tuned to 665 kc and the other to 1165 kc. They are selected by a tap switch, and the output of the selected filter is fed to the mixer which is the slicer's first stage.

The remainder of the slicer is conventional *if* and detector circuitry[2] which should give no trouble to a confirmed homebrew addict.

Bandpass tuning is achieved by bringing out what would normally be the BFO pitch control to the front panel. Now, when the BFO frequency is changed, let's see what happens. Assume you're listening to a station on 14.105 kc. The receiver is tuned so that his signal is at exactly 914 kc when it enters the slicer. With the BFO at 250 kc and the injection switch set to 1165 kc, his signal is transformed to 251 kc to go through the filter. In the detector, it beats with the 250 kc BFO signal to give you a 1000-cycle output. All is well.

Now, assume a kilowatt opens up on 14.107 kc. His signal comes to the slicer at 912 kc, is transformed to 253 kc, goes right through the filter along with the signal you want, and beats with the 250 kc BFO in the detector to give you a screaming 3 kc QRM signal. All is distinctly not well at this point.

However, you adjust the BFO "pitch" knob and change the BFO frequency to 252 kc. The injection frequency fed to the slicer's mixer is automatically changed to 1167 kc. This mixer transforms the incoming 914 kc signal (the one you want) to 253 kc which goes through the filter and beats with the 252 kc BFO to give you the same 1000-cycle output you had before. The interfering 912 kc signal becomes 255 kc after mixing with the 1167 kc injection of the slicer, and is rejected by the filter.

This electrical ganging of the BFO and the slicer mixer let you push interference over either side of the filter. It works equally well in either position of the sideband selector switch, but the 1165 kc injection position gives you a steeper cliff to push the QRM over.

For the CW gang, about the only thing left to be said is that 300-cycle-wide mechanical filters are available now for as little as ten bucks.

Needless to say, the BFO pitch is attained by tuning the signal to the desired part of the passband with the main tuning controls. The BFO frequency controls only the position of the passband with relation to the receiver *if*. However, this is no drawback in operation. Once you tune the station to the pitch you want, you can sweep the passband back and forth around it and the pitch won't change by even a cycle.

A word about schematic diagrams. The receiver of which this system is a part was designed to fill my own special desires, and I'm sure that not one of you would want to duplicate it item by item. Every circuit in the system is standard and has been published elsewhere[3] only the way in which they're put together, as shown in the block diagram, is unusual. Therefore schematics have been omitted as unnecessary; use the idea with any pet circuit you have. . . . W9OFD

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[2]See the technical article "The Diligent Detector" in the January issue if you need AM detector ideas, or "Beat Generation" in the February issue for SSB and CW detector circuits—editor.

[3]For schematics of indivdual circuits which may be used, see our series of technical articles on receiver circuits in the November through July issues. Other circuits may be found in the Radio Amateur's Handbook or in the Radio Handbook (available from Radio Bookshop)—editor.

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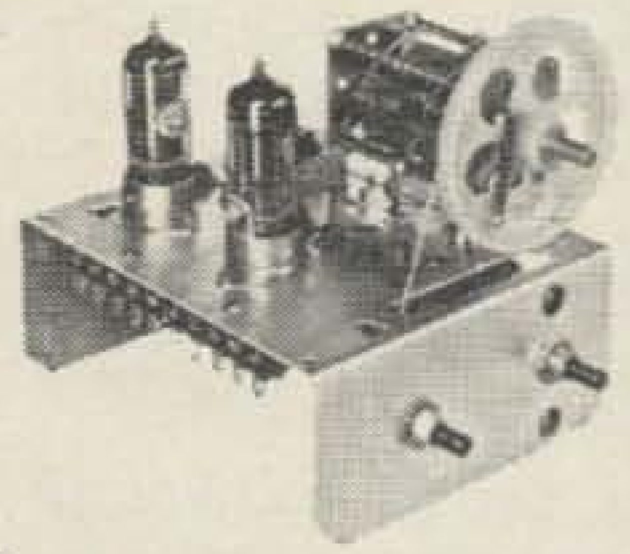

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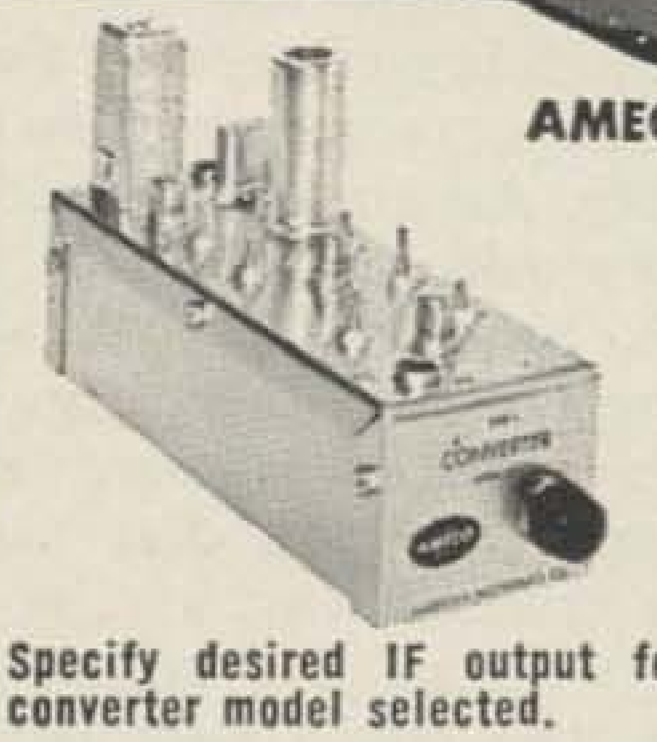

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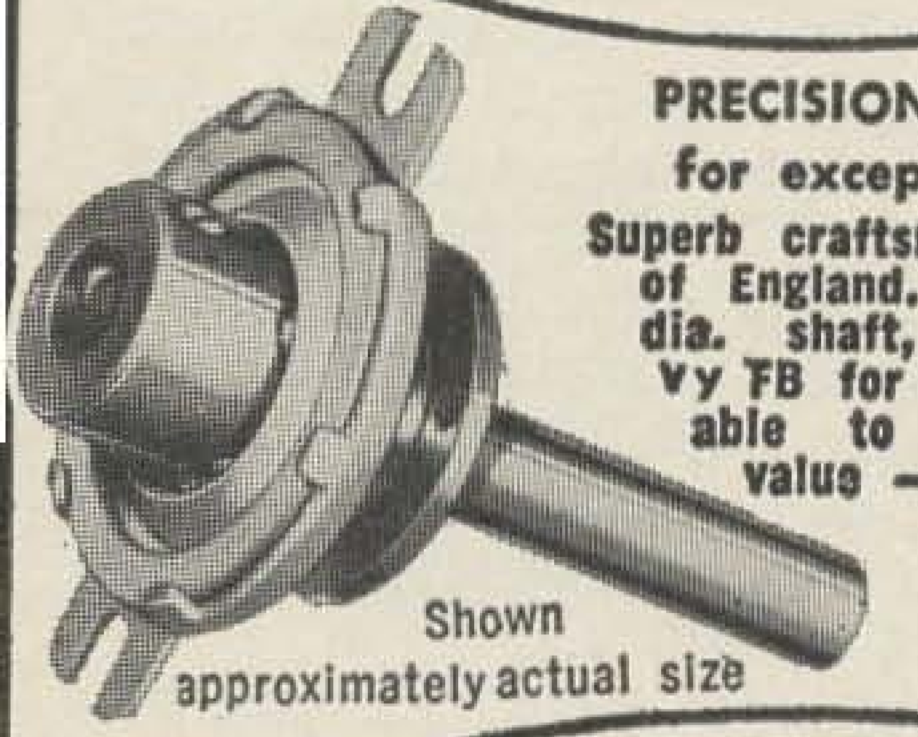

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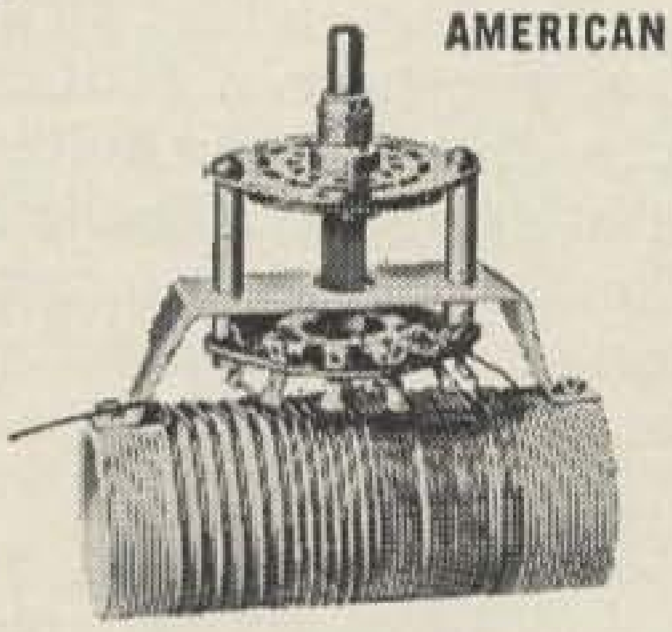

Units have 6 posit. tap switch mounted on ceramic coil form. Mod. 4/111 designed for use with two 807's or 6146's (in parallel). Freq. Range 3.5 to 29.7 mc.

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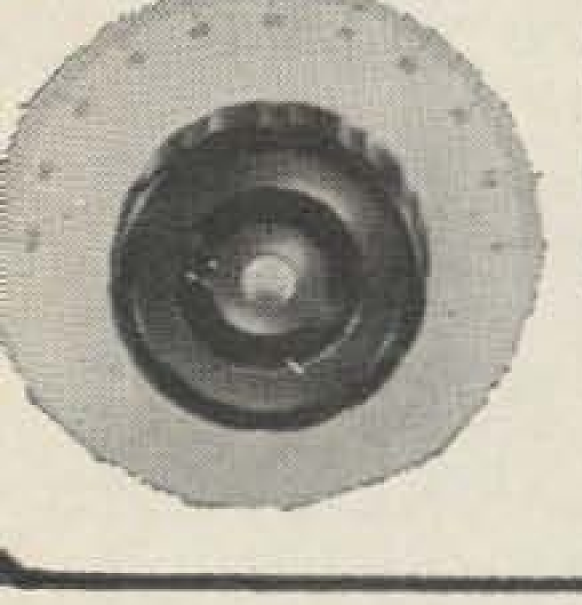

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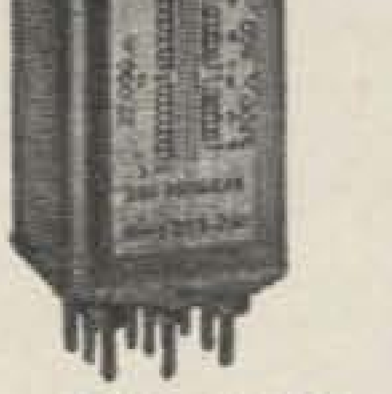

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HERE'S a fast-acting, low-cost circuit breaker for any transmitter or power supply that must be fused for over 150 ma and can afford to lose about 10 to 15 volts in the device. It uses a dpdt 24 vdc surplus relay, any make or model, plus a capacitor and some resistors.

Observe Fig. 1. With a relay connected thus, it will just buzz when the current exceeds the pull-in value for the relay. An audible warning, but no protection. If we add a capacitor, the buzz slows to a rattle, as the contacts stay open while the capacitor charges (see Fig. 2). Still no protection. If we add a resistor, as in Fig. 3, the relay will pull in and disconnect the load and substitute the resistor. If the resistor has a low-enough value, the relay will remain in this position, the load disconnected, until the power supply itself is turned off, cutting the current and releasing the relay.

This is fine, except it doesn't protect the power supply too well, and the pull-in point depends entirely on the relay. So let's see Fig. 4. Here a variable shunt has been added to adjust the pull-in current. And a pair of contacts are used to disconnect the shunt so the holding current will be just that of the relay. The holding resistor now does double duty too, as part of the power supply bleeder. And a neon light indicator shows if the breaker is open and still connected to a load.

To add this gadget to a power supply, you must know ohm's law and have an ohmeter. Proceed as follows—First, find a 24 to 28 volt relay, DPDT. Measure its resistance in ohms, and determine from that the current it will draw at 24 volts. This will be somewhat greater than the pull-in current, of course, and about 50% greater than the hold-in current, but to be safe it's best to use this value in our calculations. The shunt resistor, R1, is so calculated that in parallel with the relay resistance, the voltage drop at the overload current is 24 volts. Use a wire wound variable, but be sure the wire will handle the current. The series resistor, R2 is calculated to pass the relay current at the power supply voltage. The bleeder resistor, R3, is calculated to pass 10 ma at the power supply voltage with R2 in series with it. The neon resistor, R4, is figured as 150 K ohms for every 100 volts of power supply.

Supposing we have a relay for 24 volts that measures 300 ohms. The normal current will be 24 ÷ 300 = .080, or 80 ma. We want to protect a 600 v power supply at 250 ma. 250 ma — 80 ma = 170 ma, the current thru R1. R1 then equals 24 ÷ .17, or 141 ohms. An adjustable resistor good for about 200 ma or more can be used. R2 will then equal 600 v divided by 80 ma, or 7500 ohms. Its wattage is 600 × .08 or 48 watts. R3 plus R2 equals 600 divided by .01, or 60,000 ohms, so R3 should be about 50 K ohms. R4 is 6 × 150 K, or 900 K ohms, so a 1 meg. resistor will be OK. Capacitor C is .5 at 600 v.

Should you wish to experiment, R2 can be a higher value, perhaps, as the holding current will be less than 80 ma. R1 could be determined precisely by placing a milliammeter in the circuit to measure the load and with the load set

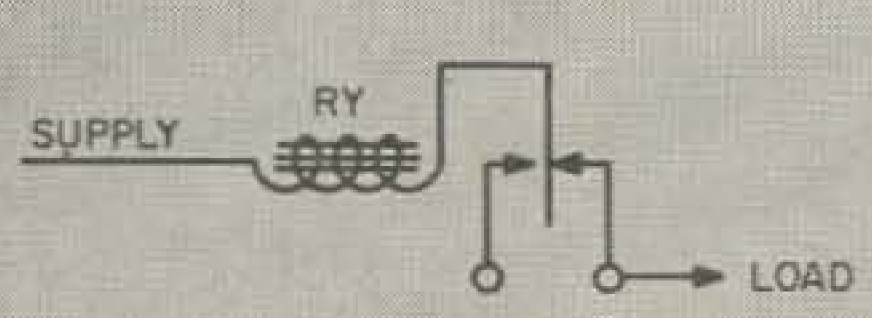


FIG. 1

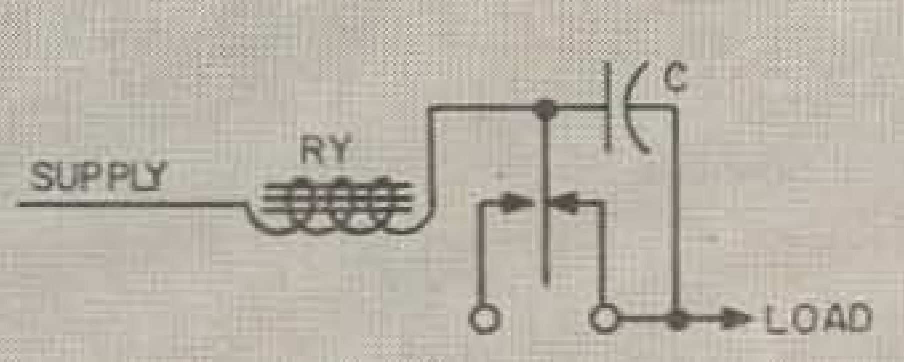


FIG. 2

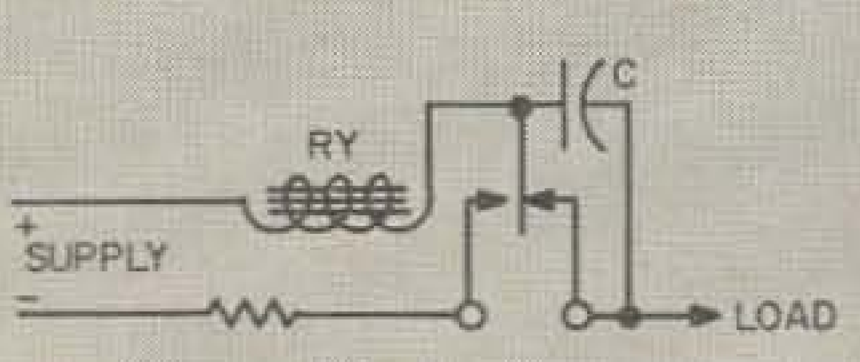


FIG. 3

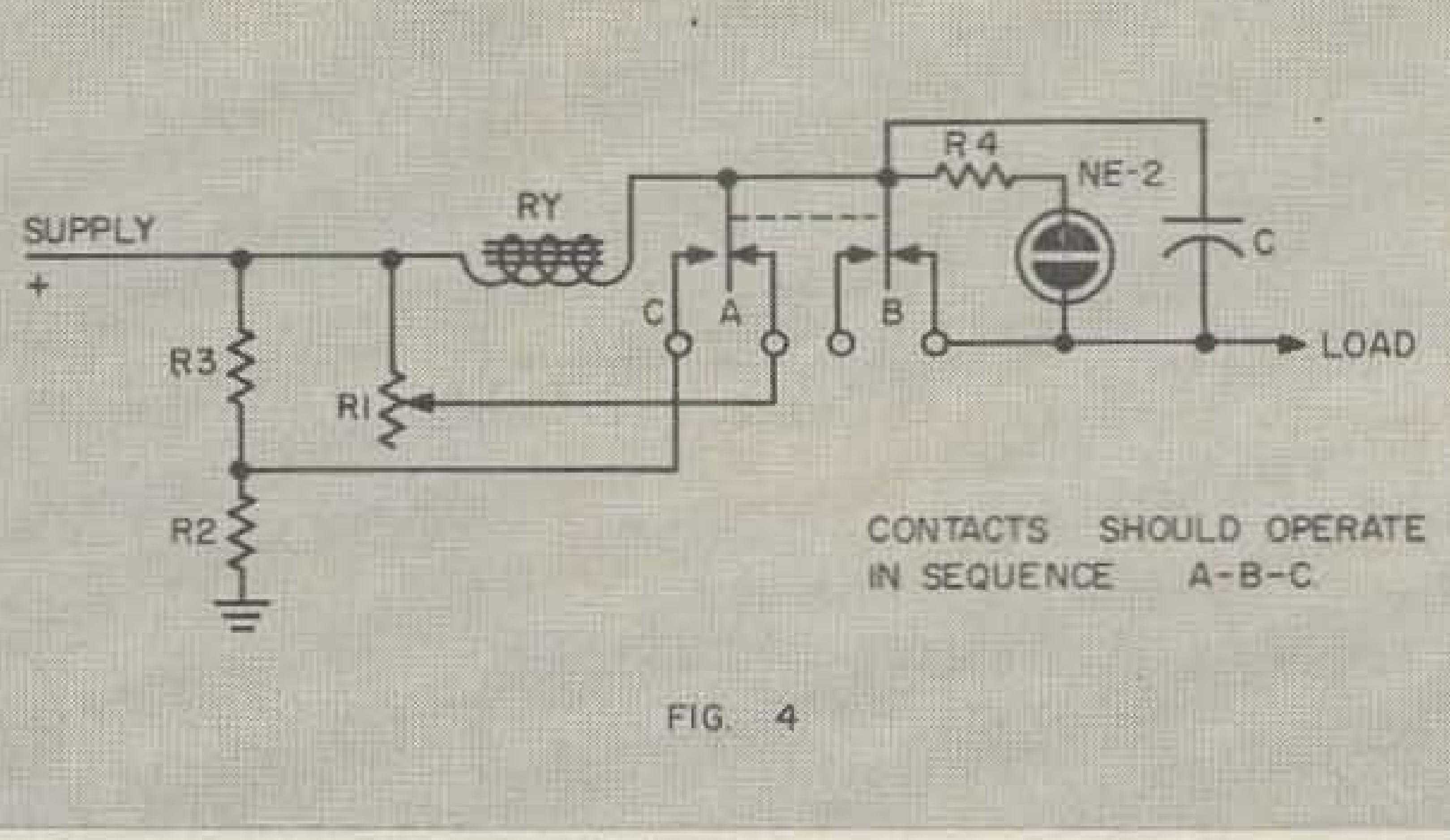


FIG. 4

at the desired value increasing R1 until the breaker trips. R1 can be an adjustable rheostat, and its pointer calibrated in ma.

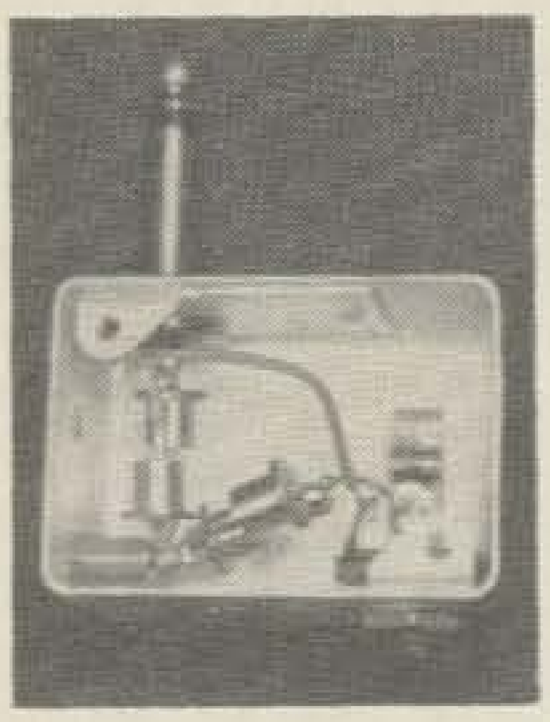
While any relay of the DPDT variety will work, it is better to have one that requires moderately low current so that the size (wattage) of R2 will not be too large. Higher voltage relays entail higher voltage drops and more loss of power supply voltage. 24 vdc relays, so common and cheap, will seldom cause more than a 12 v drop in normal use. 12 v relays can also be used, but many of them take more current than you may want to protect against (250 ma is a common 12 v relay current.)

To re-set the breaker, just turn the voltage off. If the short or overload continues, the breaker will break again as soon as voltage is applied. It can be made adjustable from the panel if desired. About the only precaution to be taken in installing it is in insulating the relay from ground, as most 24 v relays were not insulated for high voltages (over 250 v). The capacitor C should be able to withstand the high voltage and should be of fairly high capacity, at least .5 mfd. If adjustments can be made to the relay, contacts "B" (load) should open after "A," and just before "C" closes. It is sometimes possible to reduce the current requirements of the relay by reducing the spring tension a bit. These last suggestions are for the experimenters.

Put one of these things in your rig. It may save its cost or more in rectifiers the first time it works! ... WφOPA

A 73¢ Noise Clipper

James F. Garrity KφWML
1228 Ashland Avenue
St. Paul 4, Minnesota



Photography by Bob Jacobs.

ONE of the handier accessories in the shack is the noise clipper. Connected between the audio source and the headphones, it will chop off noise peaks and prevent excessively loud signals from getting through to your ears. In most cases it can be used without modification to the receiver, which should appeal to the owners of commercial gear. Best of all, it costs only 73¢ (or rather, it cost me 73¢; it will cost you somewhere in the neighborhood of 57¢).

The circuit is shown in Fig. 1. The clipping action relies on the forward conduction curve of silicon diodes, shown in Fig. 2. So long as the signal peaks stay below the knee of the curve, the clipping is insignificant. However, if a noise peak goes over the knee, the diodes will conduct heavily and, combined with the internal resistance of the source, limit the peak to one or two volts. Another way of looking at the clipping action is to picture a five ohm resistor which is shunted across the headphones during noise peaks. The resistor bypasses most of the noise. Incidentally, this also explains why the clipper will not work effectively with a speaker. Five ohms shunted across a four ohm speaker won't reduce the volume appreciably.

Although any of the common silicon power rectifiers will work in this circuit, the TAB diodes were specified from an economy standpoint. Similarly, the MC-385 provides the chassis, plug and jack at minimum expense. Originally, it was used to transform low impedance headphones for use in high impedance circuits, and the miniature autotransformer it contains should have some possibilities in transistor work.

Construction takes about thirty minutes. First, remove the cover to the MC-385 and remove the transformer. Next, connect the diodes in pairs, as in Fig. 3. Don't allow the diode cases to touch. Solder one end of the first pair to the plug connection. Use short leads or the diodes won't fit in the case. Connect one lead of the second pair to the ground lug on the jack, again with short leads. Connect the remaining leads of each pair together in mid-air or to a solder terminal. Finally, connect a wire from the plug to the remaining lug on the jack.

To use the clipper, connect it between the audio output and the headphones. The clipper will work in any of the common output circuits, except the ones shown in Fig. 4. In that case, the dc voltage drop across the phones will bias one set of diodes into conduction, effectively rectifying any signal (new detector, maybe?). A word of warning: if you have a high-powered audio system (like push-pull 6L6's) it is possible to exceed the dissipation ratings of the diodes on high volume levels. At one watt each, the limit for the clipper is four watts. . . . KφWML

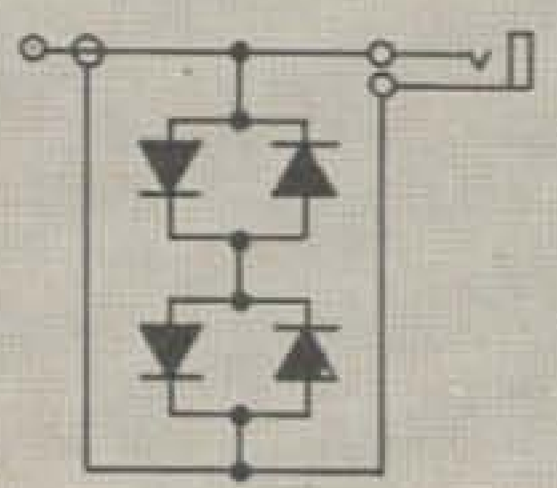


FIG. 1

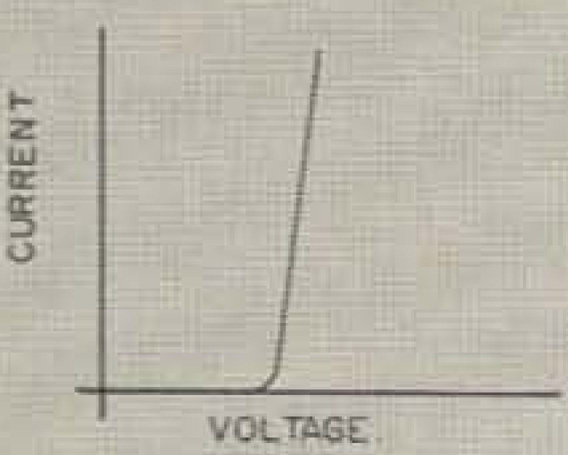


FIG. 2

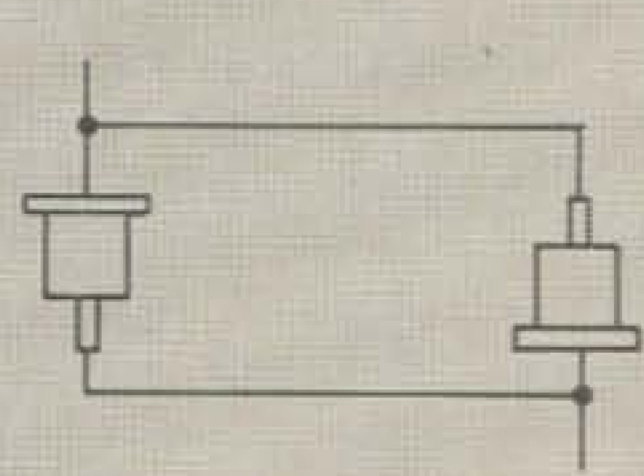


FIG. 3

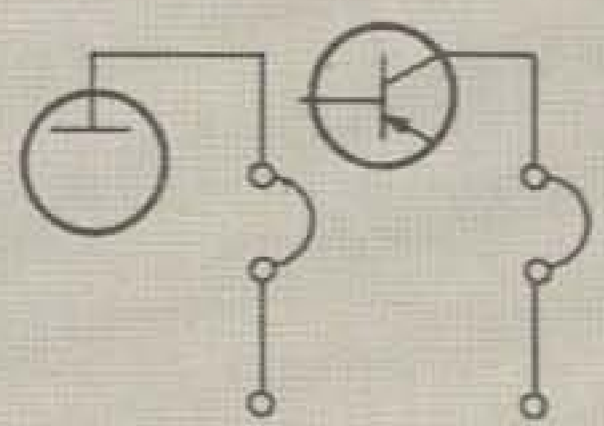


FIG. 4

Fig. 1 4 diodes 25 piv 750 ma @ 9c each from TAB, 111 Liberty Street, New York 6, N. Y. One MC-385 @ 6 for $1.00 from Selectronics, 1206 S. Napa Street, Phila., Pa.

Fig. 2 Forward conduction curve of silicon diodes.

Fig. 3 Arrangement of diode pairs.

Fig. 4 Clipper won't work in these circuits.

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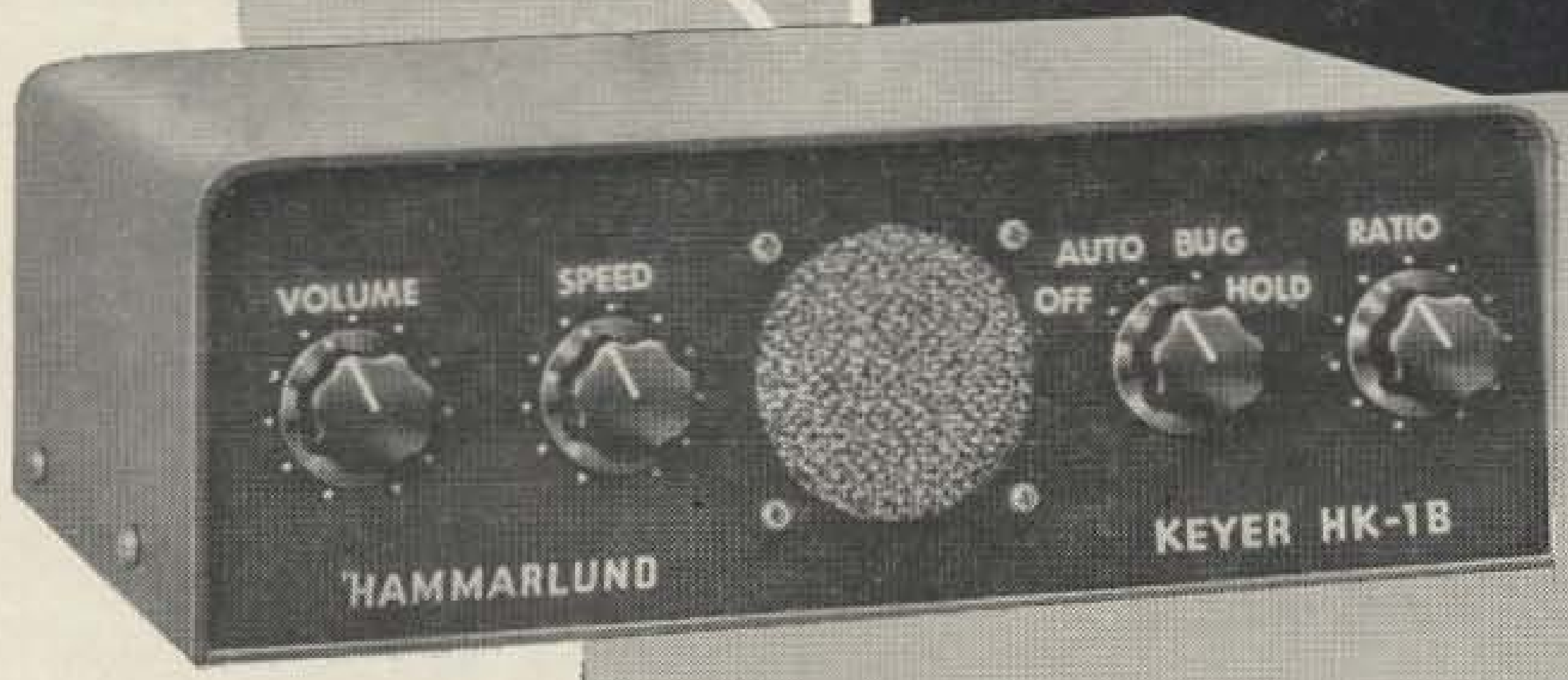

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Ted Wilds KZ5SW
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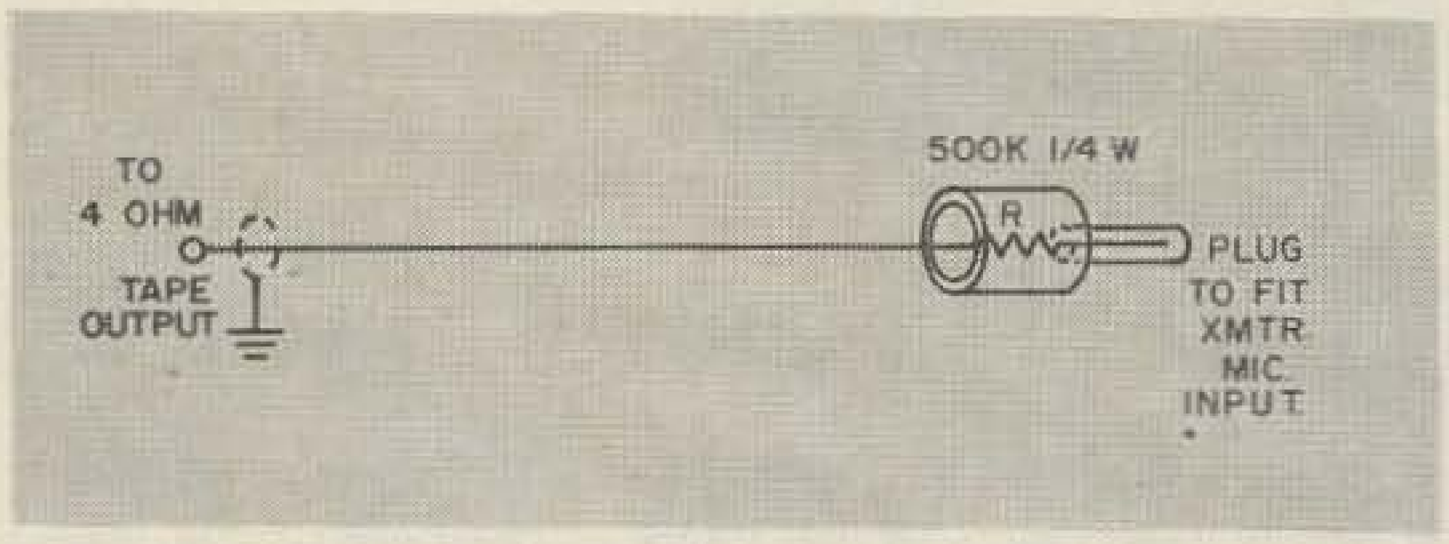
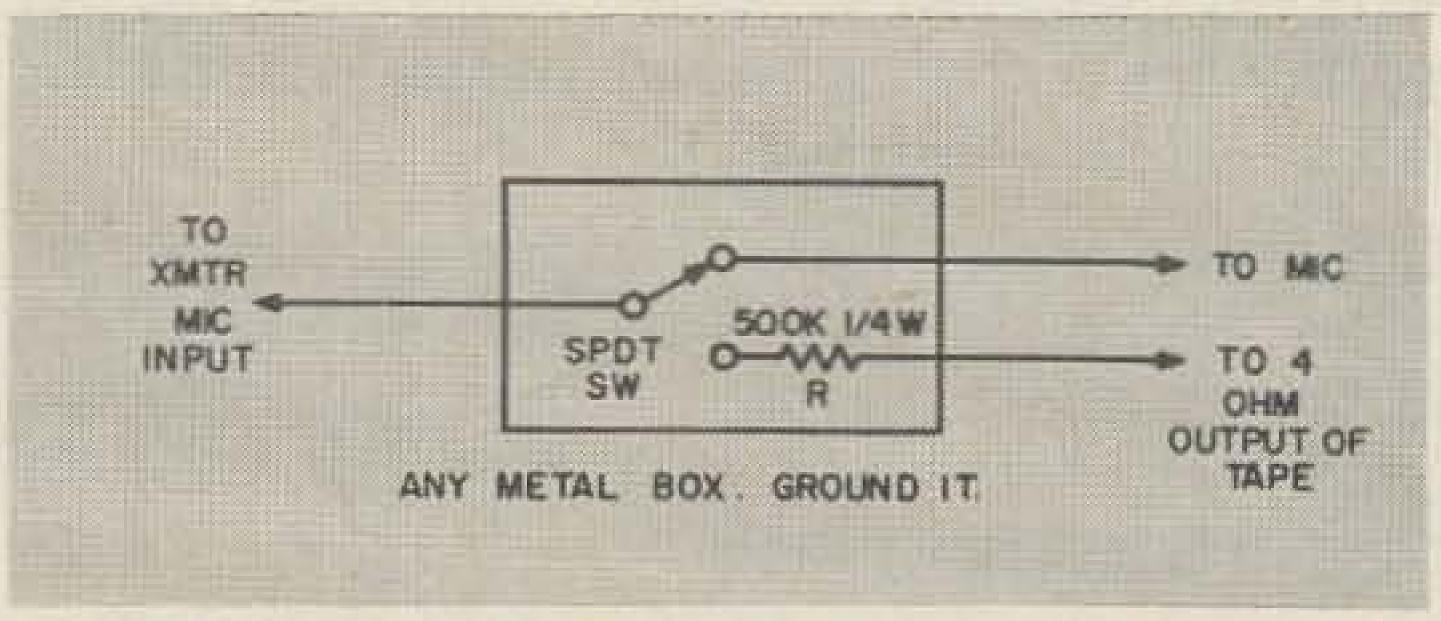
A FEW years ago with the advent of the low-cost tape recorder many of us obtained one for family use. After the "new" had worn off recording the children, party tapes, and not-so-hi-fi dubbings of the top ten tunes of the day, many of these units were either relegated to the storage closet or saw temporary service in the ham shack. It usually did not stay in the shack too long because of the tedious procedure used on AM. It necessitated recording a CQ or directional call, rewinding the tape, playing it back on the air, and if no results were obtained, rewinding, rethreading, usually, and going thru the process over again. It wasn't worth the effort. With sideband, or other VOX operation, the tape recorder can be a real convenience. It is possible to use a tape deck to advantage with practically no effort. The secret of this new convenience is the "closed loop" of tape. With it you can make a 15 or 20 second call followed by a period of listening, then the whole deal repeats itself all automatically. I find it particularly useful for calling schedules, directional CQs, and for opening up a band that sounds dead from lack of activity.



Tape output may be up to 16 ohms Z. If 500 raise value of R to prevent input stage overload. Try 3 megohms to start, and adjust as required.

Basically, this is how it works. You cut an 8 to 10 foot length of heavy duty (MYLAR preferred) recording tape and splice the ends together forming a loop of tape. This you put on your recorder, with the excess hanging over the back of the table or desk. A small weight in the form of loop solder is hung on the dangling bottom of the loop. This pulls the tape so it won't foul up in the capstan. When you make the splice in the tape, use a colored cellophane tape or the regular white splicing tape. The reason for this is to have a visible "beginning" and "ending" spot. Set your recorder on the slowest speed usually 3⅓ i.p.s. and time the interval that it takes the colored splice to make one trip thru the machine. This should be from 25 to 40 seconds. If it is less than 25 seconds make a new and longer loop. Now, using the microphone that comes with the recorder (for simplicity) make a 15 second "TESTING" transmission and sign your call. This will leave about ten seconds of dead air on the tape. Play it back and listen for two possible defects. One is noise on the tape during the dead air period. If any shows up, let the tape run thru the machine on "record" with the volume down to clean off any previous recording, so that the noise won't trip the VOX in the "listen" period. Re-record your brief test transmission. Secondly listen to yourself for undue pauses between words that will allow the VOX to drop out unnecessarily during the transmitting period of the cycle. The object is to make a smooth transmission followed by a dead air period when the VOX will drop out and turn the receiver on.

Now let's consider the use of the tape machine with the rig. The simplest way is to put the station mike in front of the recorder speaker and let it run. Adjust the volume of the recorder so that it trips the VOX smoothly. At the end of your test transmission, the dead air period will let the VOX drop out and the receiver operate. This will repeat itself over and over again until you shut the darn thing off. Unless you have an unusual fondness for the sound of your own voice, you will want a silent means of doing this, particularly if your scheduled station is a few minutes late!



Most home type tape machines have a 4 ohm external or auxiliary speaker output jack. Make up a connecting cable with a plug on one end that will fit the microphone input jack on your transmitter. On the other end put a plug that fits the 4 ohm output jack on the tape recorder. In series with the *hot* lead in one of these plugs put a half megohm ¼ watt resistor. If you want to get real fancy, make up a small switching box as shown in the diagram.

The on-the-air procedure is to make a recording calling your scheduled station using his call about three times followed by your call once, with the rest of the loop blank. Turn on the tape in the playback position and sit back and relax. All you will hear will be the receiver noise during the "listen" portion of the tape until your station comes back to you. When he does, turn off the tape, plug in your

(Turn to bottom of page 40)

Phase Inversion

Dean Cupp W4JKL
Route #4
Morristown, Tennessee

Since the advent of phone transmission, hams (engineers too) have been striving to increase the effectiveness of the modulator be it AM, SSB, or FM while keeping the size, cost, weight, and complexity of the circuits to a minimum.

Although the circuit shown here may not increase the effectiveness of a rig to kilowatt proportions, I feel it will help with all the other qualities mentioned. Now, before someone dies of curiosity, Fig. 1 is a unique circuit

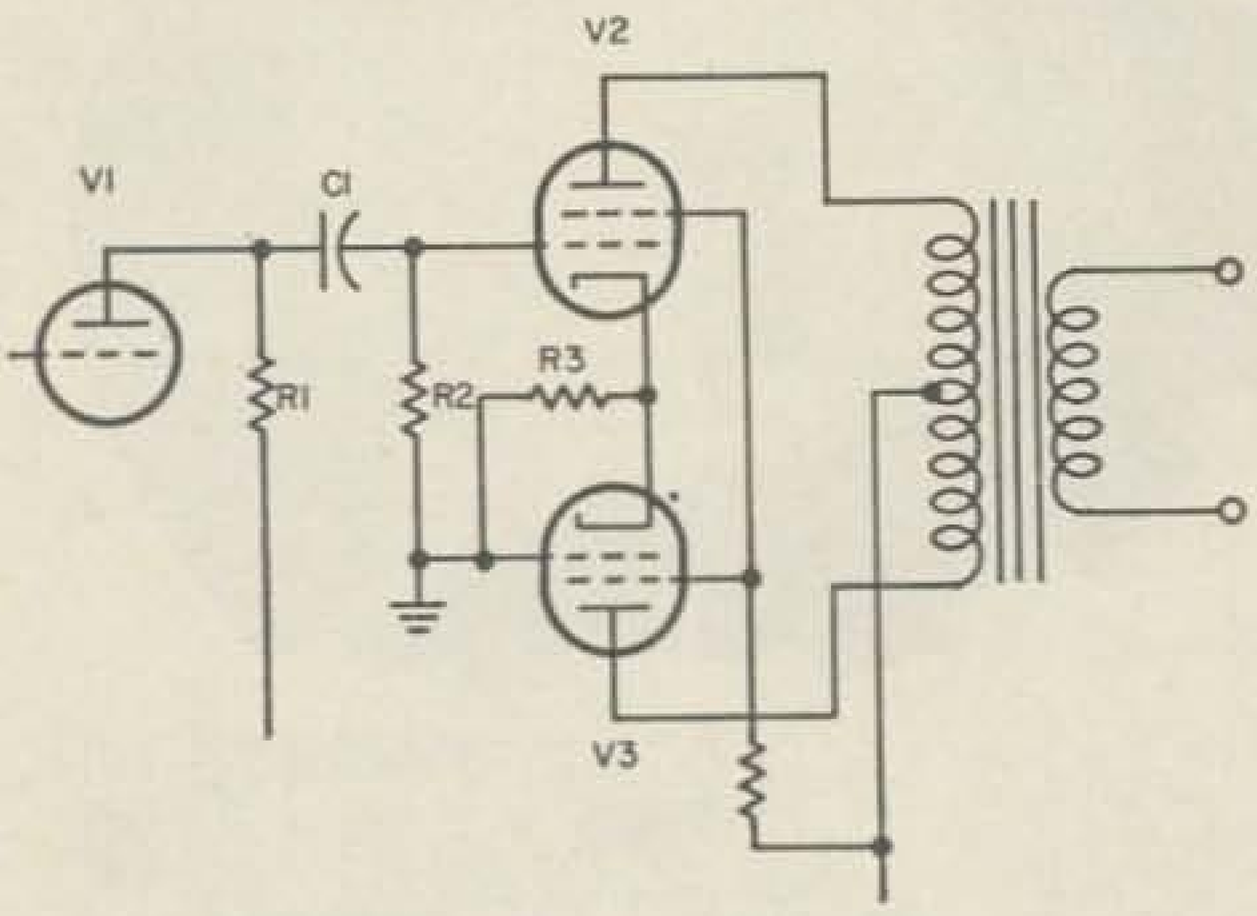


FIG. 1

that provides phase inversion right in the push-pull output stage of a driver, modulator, or audio amplifier. This eliminates the need for a phase inversion stage (complex) or interstage transformer (heavy, large, and expensive). At this time all CW men should QSY to the page labeled de W2NSD, unless they care for hi-fi or some such.

V1 is an ordinary speech amplifier stage, V2&3 is the yank-shove output stage. Assume the signal across R2 goes positive (less negative) causing larger plate current to flow in V2, which causes more voltage drop across the cathode resistor R3 (cathode more positive to ground). The grid of V3 is grounded and the increasing bias reduces the current through V3. When the grid of V2 goes more negative the opposite happens: less current flowing through V2 causes less drop across the cathode resistor, and more current in V3. Presto: phase inversion, exactly 180 degrees with no worries about matching resistor and capacitor values or paying for a transformer. R3 is the normal cathode resistor for class A or AB1 operation.

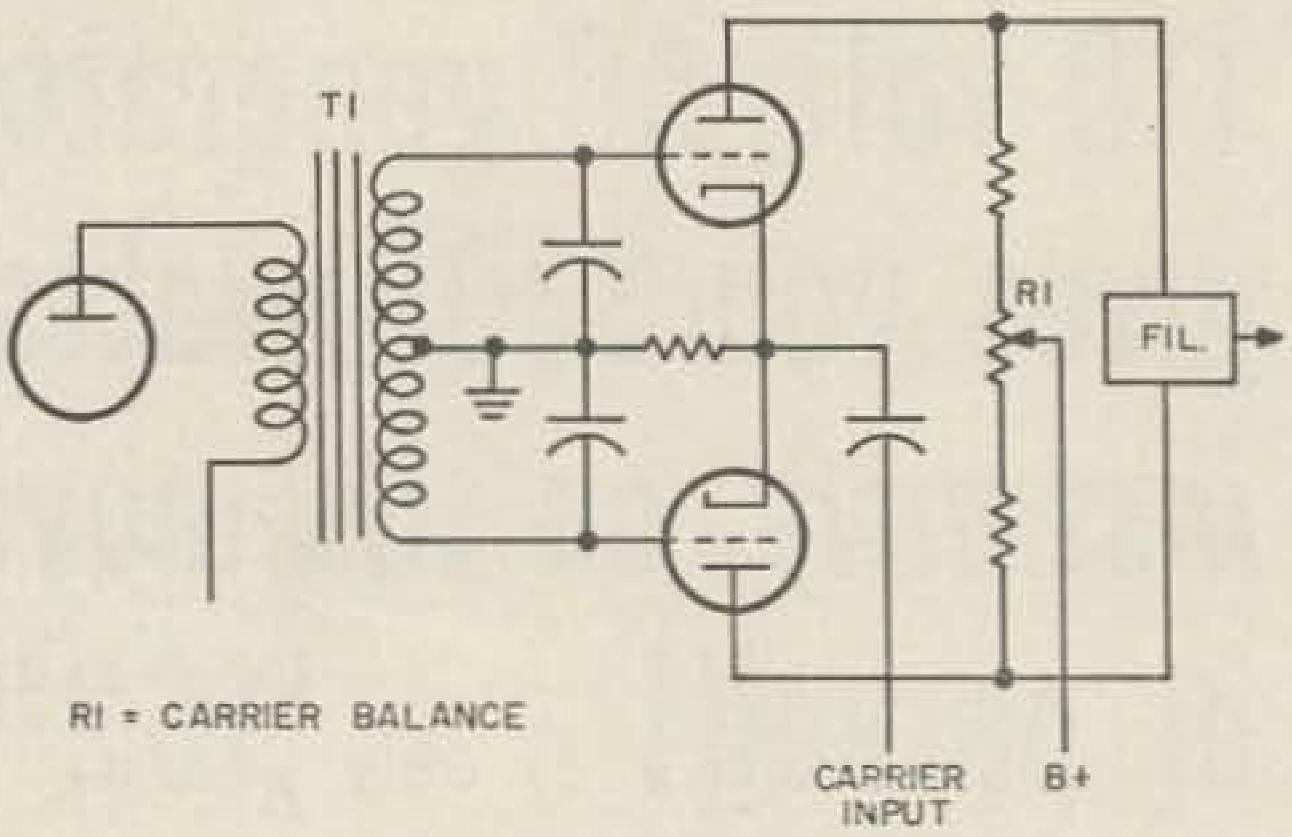


FIG. 2

Other classes of operation should not be attempted since they require power that a voltage amplifier can't deliver. There's little choice but to use a transformer when using AB2 or B, since a phase inverter can't supply the power either. R1, R2, and C1 are the values

FIG. 3

normally used with V1. *Do not* by-pass the cathodes of V2&3, this would make V3 inoperative. (Note: this circuit also saves the cost of the by-pass.) AM fellows may stop here and let the SSB fans read on.

The following is not solder-no solder directions, but food for thought. Fig. 2 is a common balanced modulator. Fig. 3 is a modified version using the circuit of Fig. 1 to achieve phase inversion. The audio is fed to the grid, rf to the cathodes. This might be tried with different types of balanced modulators. Although I have not tried the SSB version everything indicates it would work and I am quite interested to hear from anyone who tries it. How brave are you?

. . . W4JKL

(Continued from page 38)

station mike instead of the recorder cable and proceed normally.

This gadget is particularly useful for contest operation, where you make the same CQ Contest call many many times during a weekend. The MYLAR tape was suggested earlier because I find that acetate tape will wear out in a relatively short time. A MYLAR loop lasts me about three months of daily use. (For the uninitiated: you *must* have VOX operation for the system to work!!!). If you want to have some fun, tape-call your local buddy on the air and call him on the landline at the same time. He do get confused!

. . . KZ5SW

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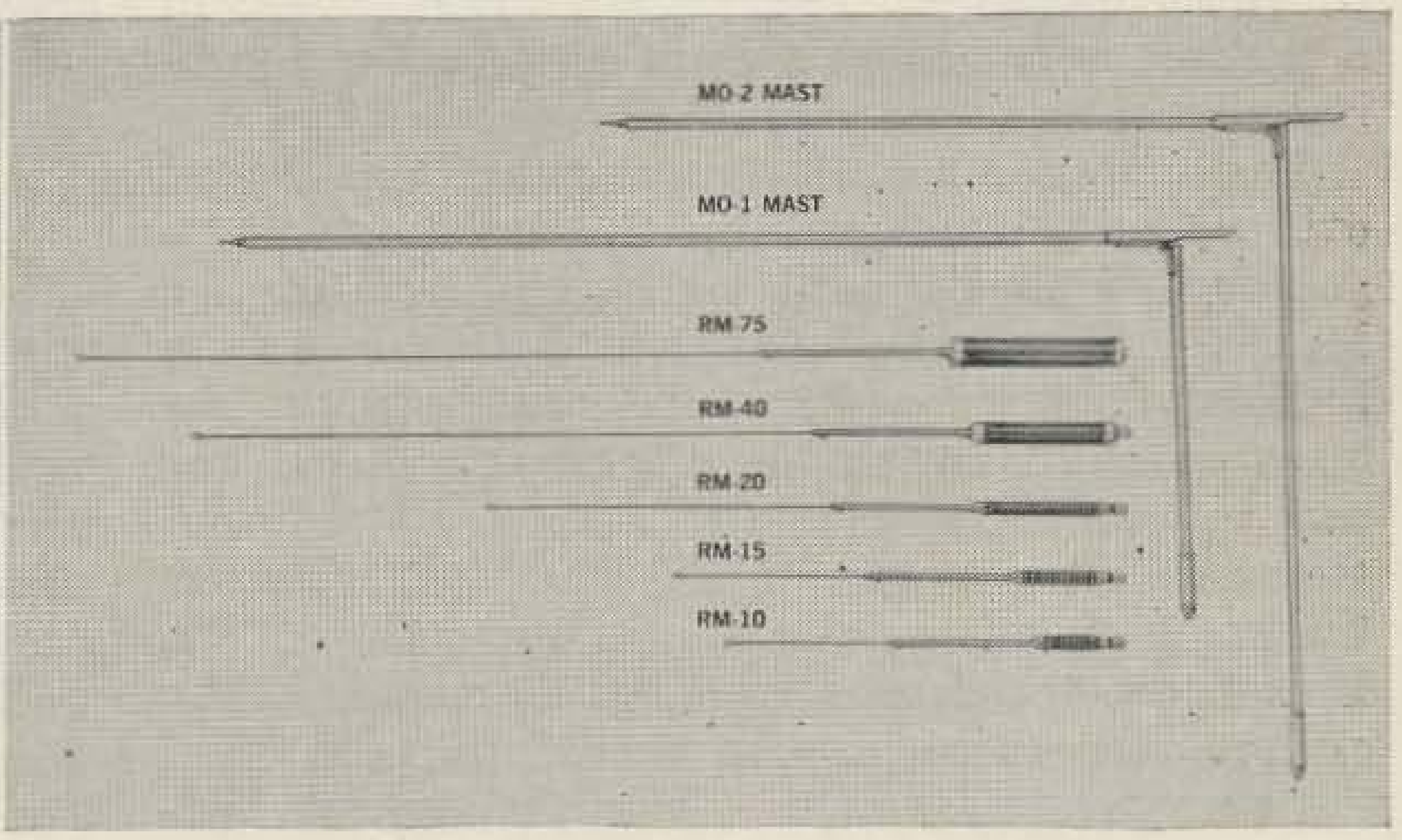

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RM-20	20 Meter Resonator	Maximum 83" — Minimum 78"	7.95
RM-40	40 Meter Resonator	Maximum 92" — Minimum 87"	9.95
RM-75	75 Meter Resonator	Maximum 97" — Minimum 91"	11.95

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an Electronic Keyer

Al Brogdon, W4UWA/K3KMO
316 West Fairmount Avenue
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for lazy, stingy perfectionists

IF you are by nature a lazy person, who likes to be able to send CW without having to poke out each character—and stingy, so you want an electronic keyer for under $20—and a perfectionist, so you want nice self-completing characters—read on.

The original circuit from which this keyer evolved was developed by G. Franklin Montgomery, W3FQB, and was published in the March, 1952, issue of CQ magazine. As an indication of its quality, the basic circuit has been outright copied or slightly modified for use in composite circuits over a half dozen times in later issues of CQ and QST. This is the same circuit as the one in the 1960 ARRL Handbook, which was the first electronic keyer circuit ever to appear in the Handbook.

Correspondence with Jack Gallagher, W5-HZB—another electronic keyer designer of wide-spread fame—brought to the attention of the author (me, in other words) the W5HZB simplification of the W3FQB circuit. This modification produced equal quality CW with one less triode section than the original circuit. After a few more simplifications by the author, the circuit as shown in Fig. 1 was found to be the simplest possible circuit that would produce good, reliable CW.

The Field Day Special

The local Nittany Amateur Radio Club was making plans for Field Day 1960 and was desperate for CW operators. As a last resort, they invited the author, who holds the Amateur Extra First Class Lid License, to participate on the 420 mc CW position. Since the author had previously traded his electronic keyer in a horse-trade, it was obvious that another keyer must be built in short order. The keyer as shown in Fig. 2 was built in a great hurry. This model was built on a used chassis, utilizing existing holes, and was rewired several times in the process of getting the best performance. This resulted in the rat's nest of wiring as shown in Fig. 3. Allow me to digress. Most amateur radio magazines show pictures of the undersides of electronics equipment with nice, neat work, wiring harnesses and the works. The author is sure that the readers of 73 will enjoy, for a change, seeing a piece of equipment that looks as bad as anything they ever built.

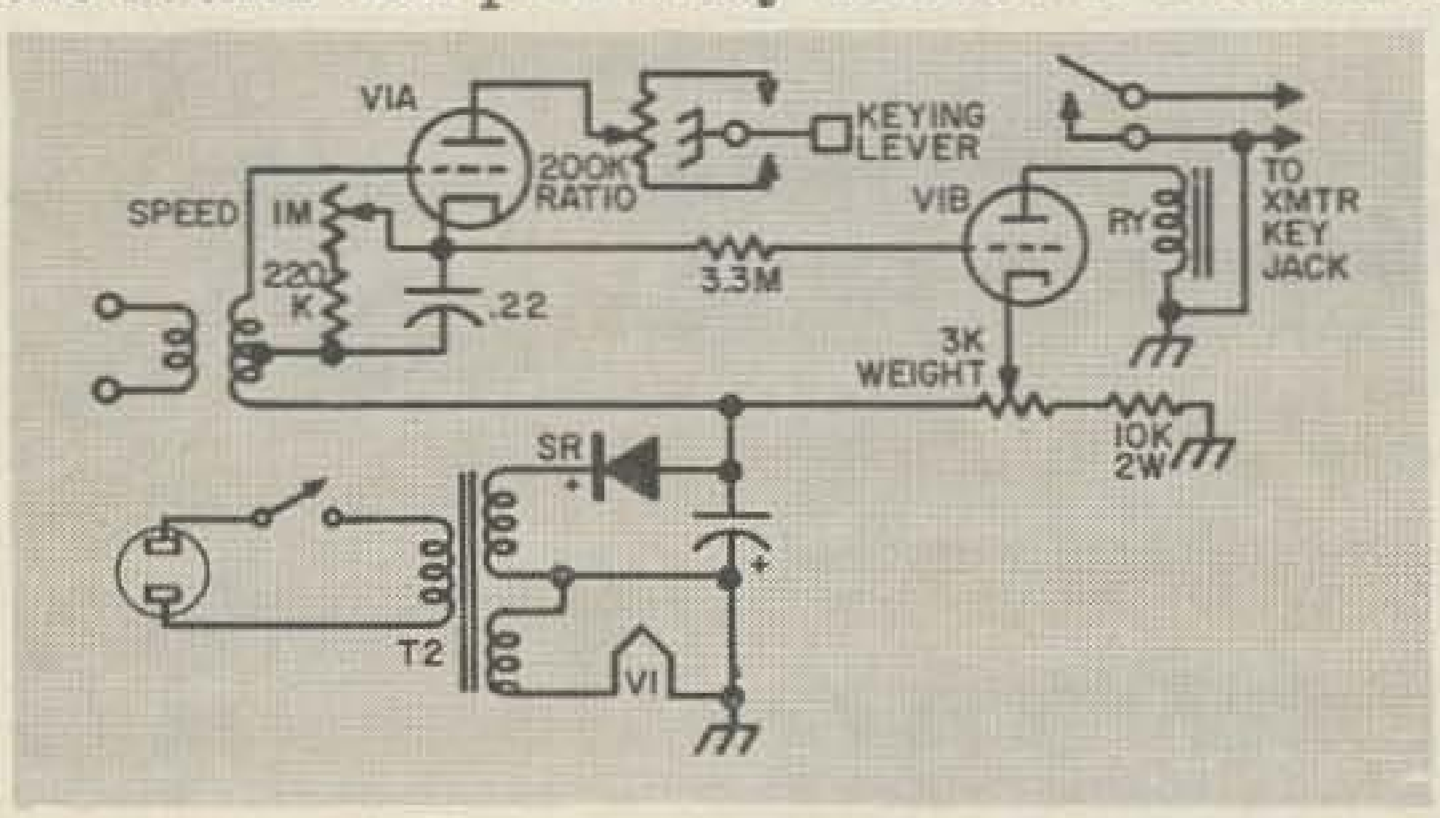
The Stikky Peanut Butter jar is actually the plate-sensitive relay. The jar was part of the relay, serving as a dust cover. The label was added as a touch of color, and came from Mad magazine. The switch hanging by one hand from the left side of the chassis is a SPDT spring-return switch which is used to close the key in one position, for tuning purposes, and to turn the VFO on in the other

Fig. 2

position, for frequency spotting. It is not shown in the keyer schematic, but may be added as desired.

For a discussion of the theory of operation of this keyer, refer to either the 1960 ARRL Handbook, or the original article in March, 1952, CQ. Basically, V_{1a} is a saw-tooth oscillator, and V_{1b} is a limiter, so that the output is approximately a square wave.

The relay used for this circuit should be a plate-sensitive relay that pulls in at 3 ma or less. The Sigma 41F-5000S-SIL or equivalent (5000 ohm coil) would be a good relay for this keyer. However, a good buy in a relay may be found in the current Burstein-Applebee general catalog (bargain section, where else?). The catalog number for this relay is



Parts List

VI—Dual triode: 6SN7, 12AT7, 12AU7, 6CG7 are OK.
T1—AF Transformer with push-pull winding. Secondary not used.
T2—120v @ 20 ma, 6.3v @ 300 ma, minimum.
SR—Selenium or silicon rectifier, 50 ma minimum.
C1—30mfd is good, more is better. 150vdc.
RY—See text.

18B156, and the cost is $3.95. This is a Sigma relay (Sigma number unknown) with a 16000 ohm coil, and fully adjustable contacts, which is a necessity for the best adjustment and, consequently, the best operation. This relay is shown on W3SMV's keyer in Fig. 4. W3SMV's circuit is the same as Fig. 1, using a 12AT7. From his observations, the 12AT7 is the best miniature tube for this circuit, with either a 12AU7 or 6CG7 being perfectly acceptable substitutes.

Incidentally, while you have the B-A catalog open to the bargain section, check for a small power transformer and an audio transformer with a push-pull winding. You will find they also have good prices on these items.

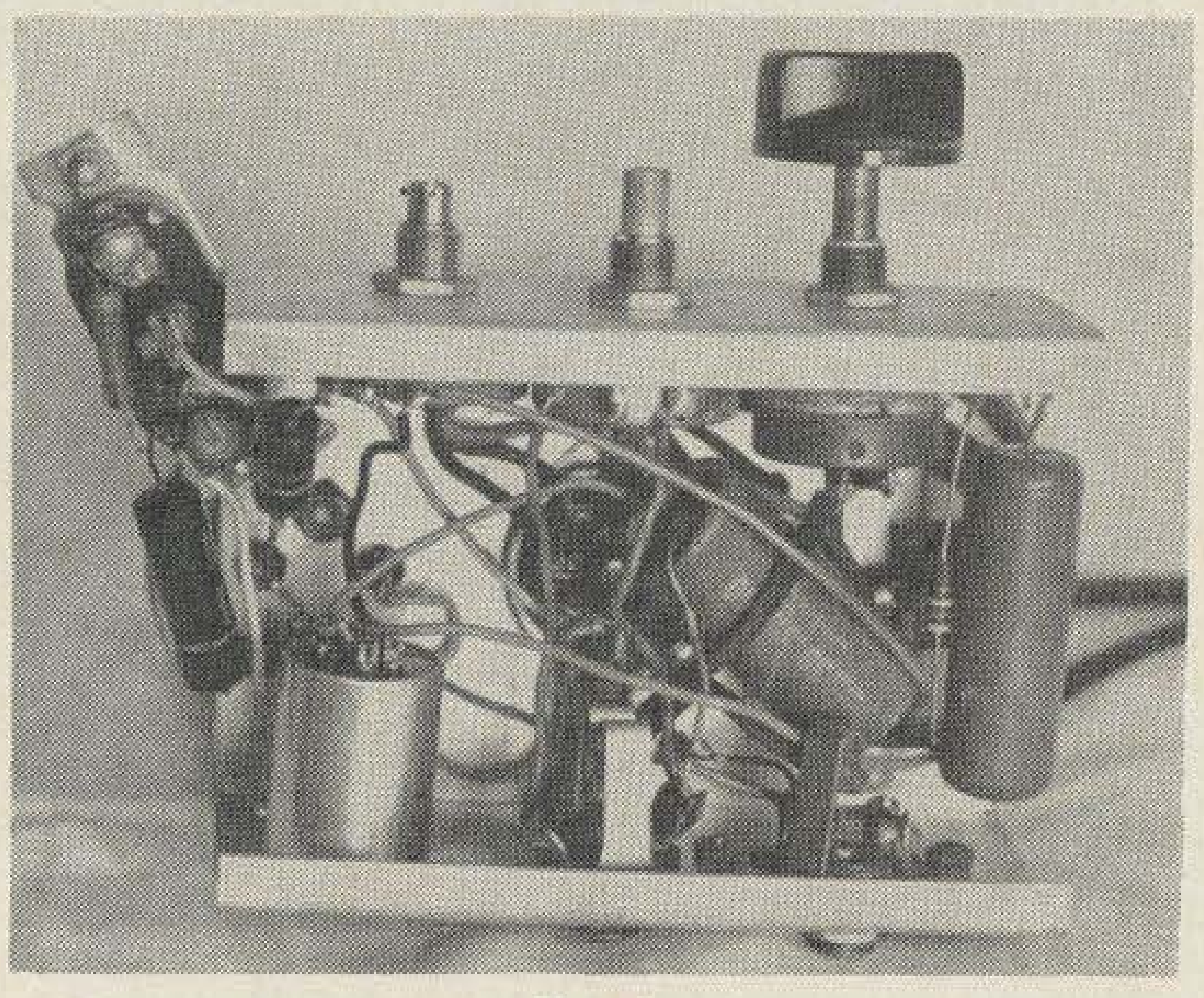


Fig. 4

Keyer Adjustment

The relay should be carefully adjusted for best operation with this circuit, or any electronic keyer circuit. First, push the relay closed by hand and adjust the closed contacts so that good, solid contact is made. Then, with the relay in the relaxed position, adjust the relaxed contact so that there is 1/32 inch or less spacing between the keying contacts.

Now set the weight control at minimum, and the other two controls (speed and ratio) near mid-range. Advance the weight control until closing one side of the key produces characters of some sort. Now adjust the ratio control for a dot:dash ratio of 1:3. One of the easiest ways to adjust this ratio is to send "dididididahdahdidididididahdah," etc., adjusting the ratio so that the dit strings take exactly the same amount of time to send as the dah strings (four dots and the enclosed three spaces is equal to two dashes and the enclosed one space). After this ratio is adjusted, adjust the weight again so that the space between dots or dashes is equal to the length of the dots. Once these two adjustments are made (ratio and weight) they will not have to be touched again, so the controls may be put on the back panel or some other out-of-the-way place. The speed control may be varied throughout its entire range without upsetting these adjustments.

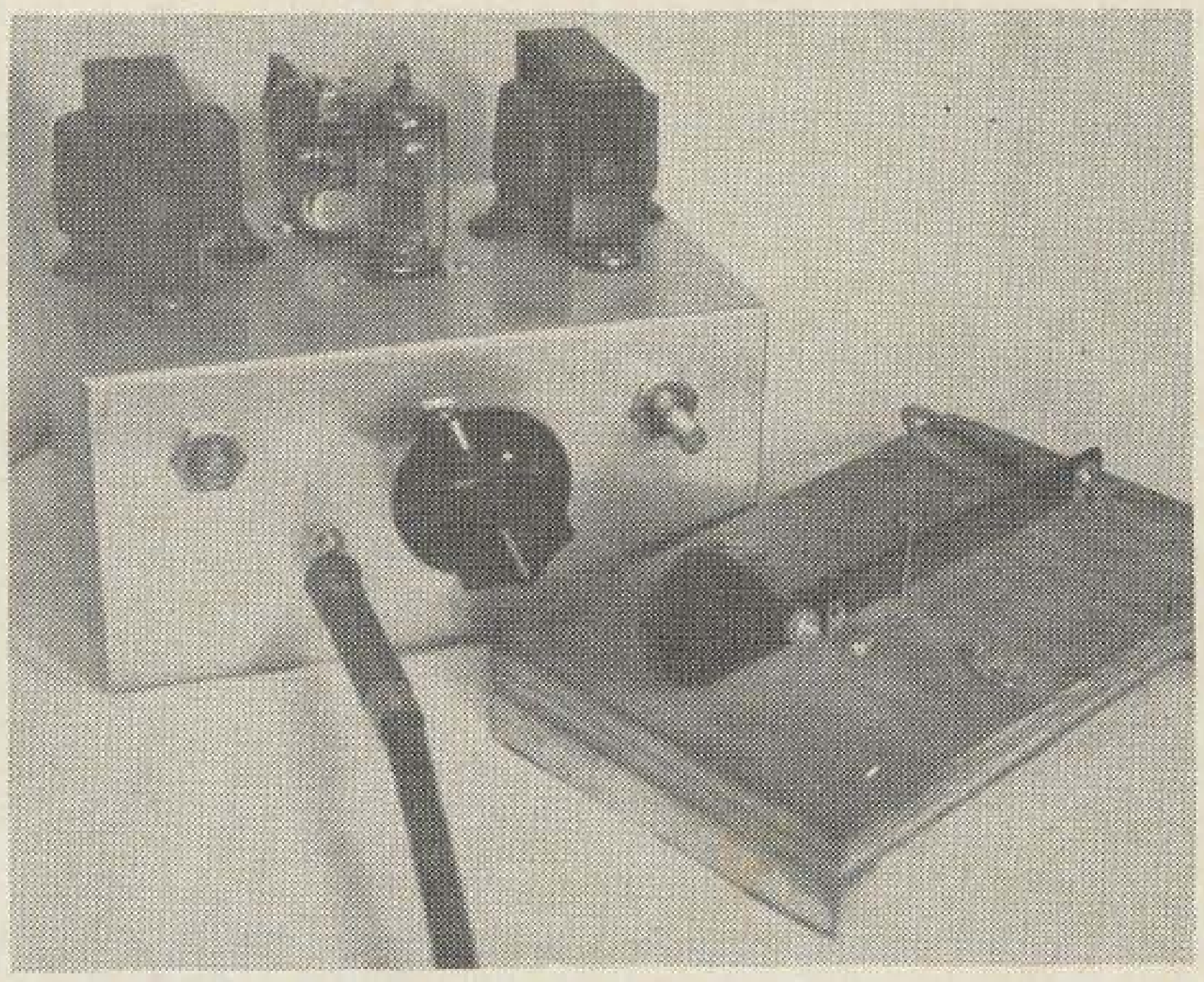


Fig. 3

It should be noted that a good relay with soft silver contacts should not be used to key high currents, as in a transmitter where all stages are simultaneously cathode-keyed. Such use will cause the relay contacts to become dirty, eventually pitted, and will likely cause them to weld themselves together just as you snag some rare DX (Murphy's Law). The author's keyer is used to key a grid-block time-sequence system, where little current flows through the relay contacts. W3SMV uses his to key a Vackar VFO circuit, with all buffers and the final operated either with fixed bias or cathode bias.

If the speed range provided by this keyer is not what you want, changing the value of the speed control and the fixed resistor in series with it will change both the range of variation, and the highest (or lowest) speed available. Adding resistance causes the keyer to operate at a slower speed.

After you have built this circuit, and have the keyer operating properly, practice with it until you can send decent CW before putting it on the air. Nothing sounds so downright embarrassing as a ham learning to use an electronic keyer by getting on the air with it. Don't be like the fellow on 40 CW with a new Whaleyscrathers Straddyvarious keyer who said, "MHE KIYEL HR IH W J9TO MODEAS, 50W DOIS IT HOUNB?" The FCC, unfortunately, does not permit our telling him how it sounds.

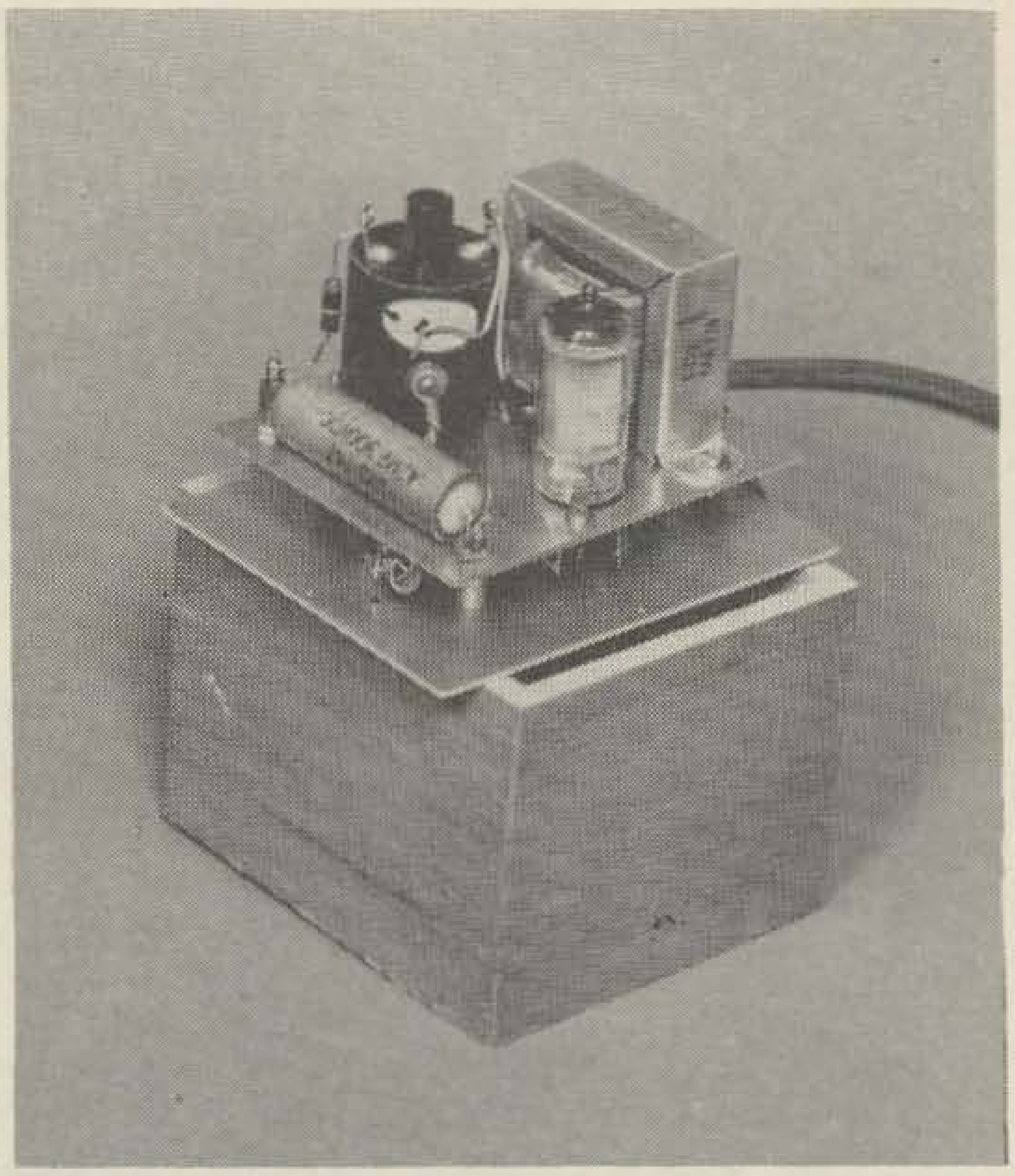
If you would like to hear the "Field Day Special" in operation, look for K3KMO either on the WPA traffic net or on the low end of 80 meter CW chasing DX.

Photo credit goes to Carl Volz, Jr., W3SMV. For the benefit of the photo bugs in the reading audience, Carl made the pictures indoors with available light through a single window, using wet plates. . . . K3KMO

This gadget saves gas and patience if you are building a noise limiter.

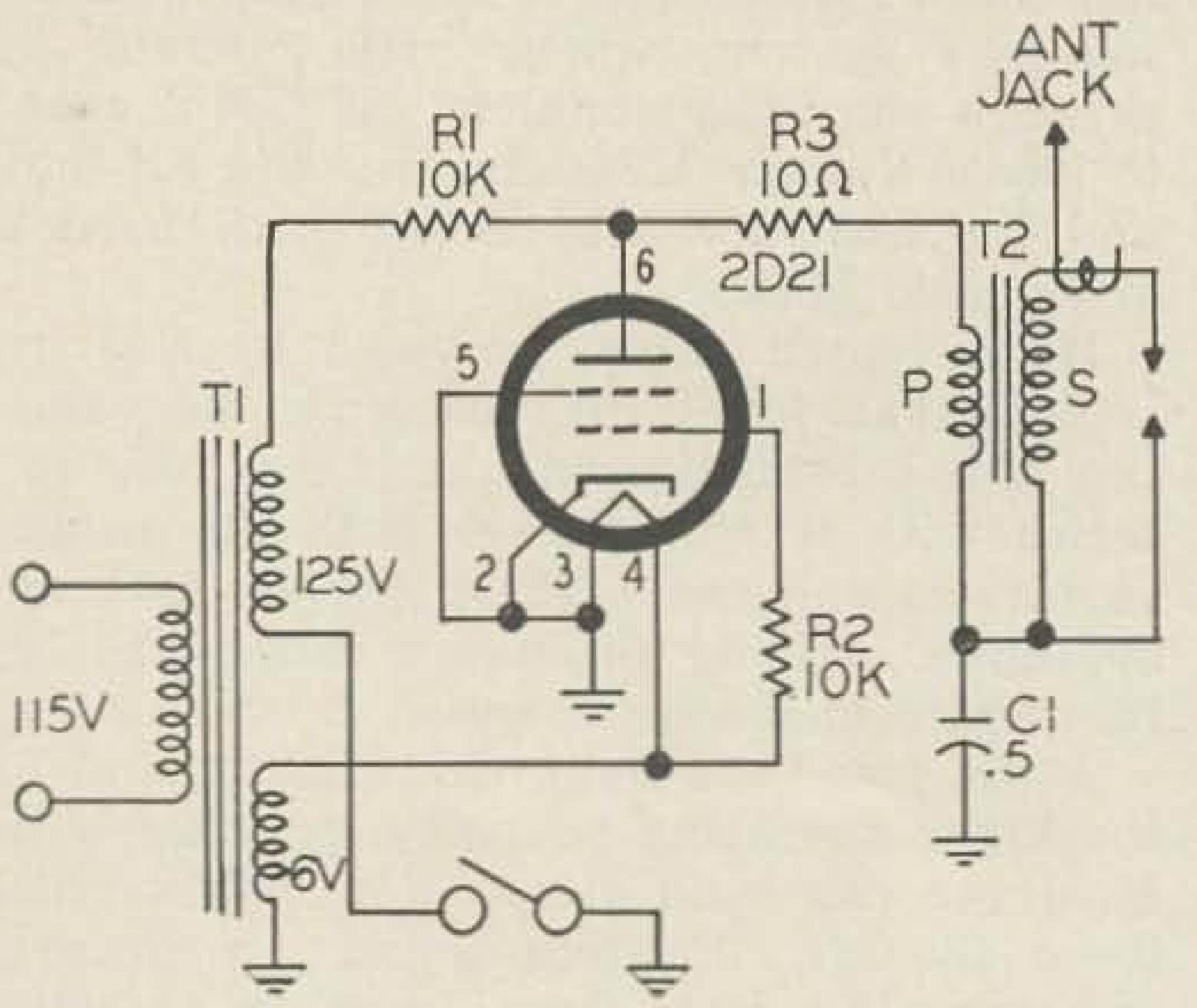
Tom Lamb K8ERV
1066 Larchwood Rd.
Mansfield, Ohio

the "Pop" Box



Now why would anyone want to generate ignition noise when 199,999 hams are trying to get rid of it? I'm not really sure, but don't tell Wayne or he may not print this. One possible reason would be to save gasoline. You did run the buggy to check that last noise limiter circuit, didn't you?

Actually, it is quite fashionable to fight noise with noise. Just as wide band noise generators are used to measure converter performance, so the Pop Box generates a stable ignition type of noise useful in testing the effectiveness of a limiter.



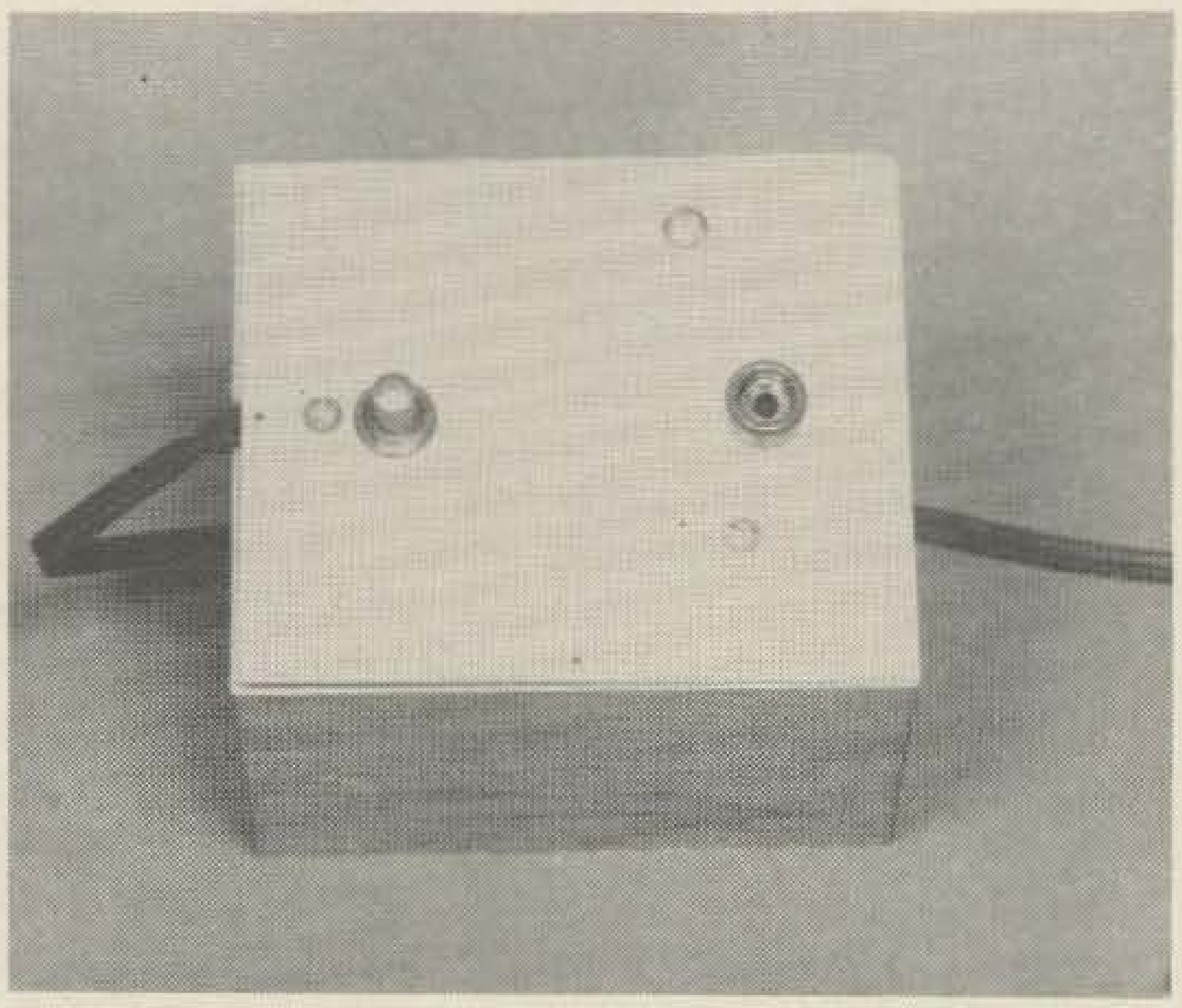
The schematic shows the Pop Box to be a miniature ignition circuit, with a thyratron for the points and a model coil for the spark. The thyratron grid is fed out of phase with the plate to prevent too early firing. Should the circuit not operate, reverse the 6v *or* the HV leads.

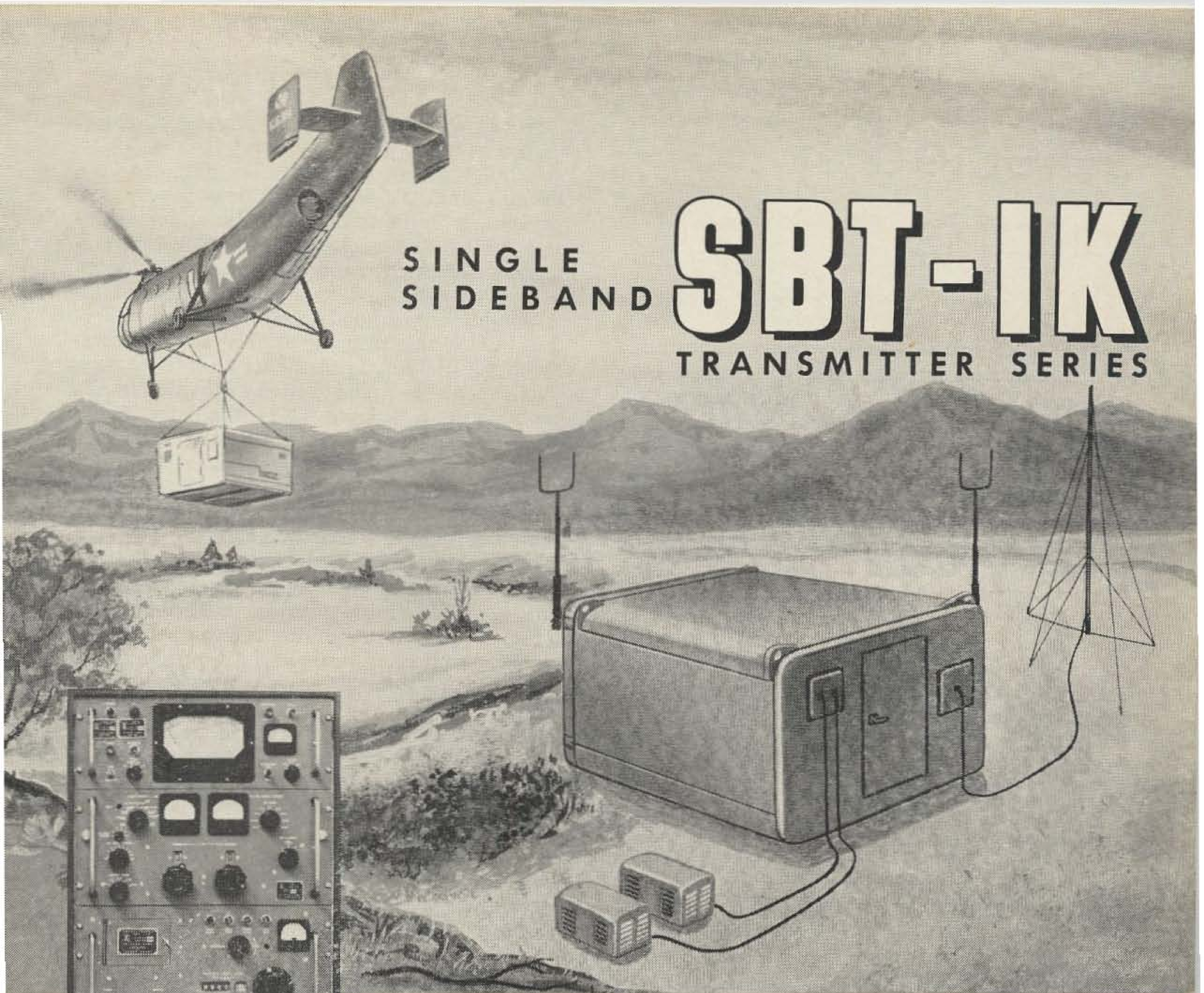
Construction

While I used a wood box, it would be better to use a shielded enclosure, such as a Minibox. The parts placement is not important. A piece of insulated wire wrapped around the HV terminal on the coil couples the spark pulse to the antenna jack. The spark gap is not critical so long as a stable spark is obtained. My gap was about ⅛″.

Use

To use the Pop Box, just set it near your receiver and turn it on. If necessary, plug a short whip or piece of wire into the antenna jack to obtain the desired pulse strength. Now turn on the noise limiter and note the noise reduction. The main idea is that with a scope to show just what is happening, and the Pop Box to cause it to happen, a noise limiter circuit can be adjusted for best performance in your receiver. . . . K8ERV





SINGLE SIDEBAND

SBT-1K

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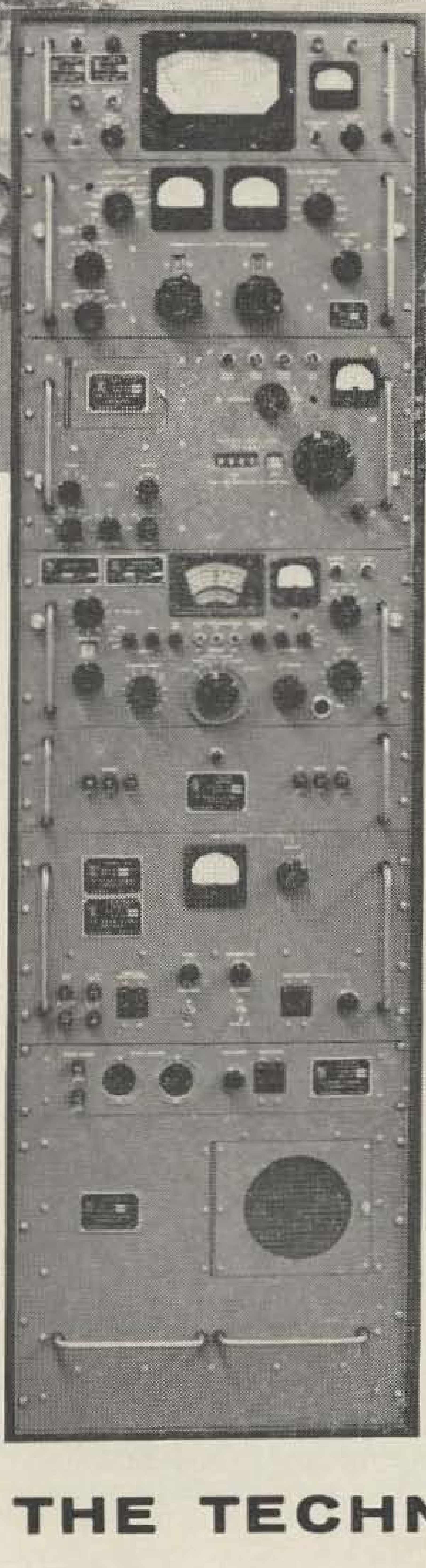

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Selected Circuits

Roy Pafenberg W4WKM

MUCH communications equipment, designed for other than the amateur market, contains circuit features worthy of incorporation in amateur constructed gear. One such equipment is the Model SB-6F single sideband transceiver manufactured by RF Communications Associates of Rochester, New York. This transceiver is rated at 125 watts PEP and is provided with 6 fixed tuned channels in the range of 1.6 to 16 mc.

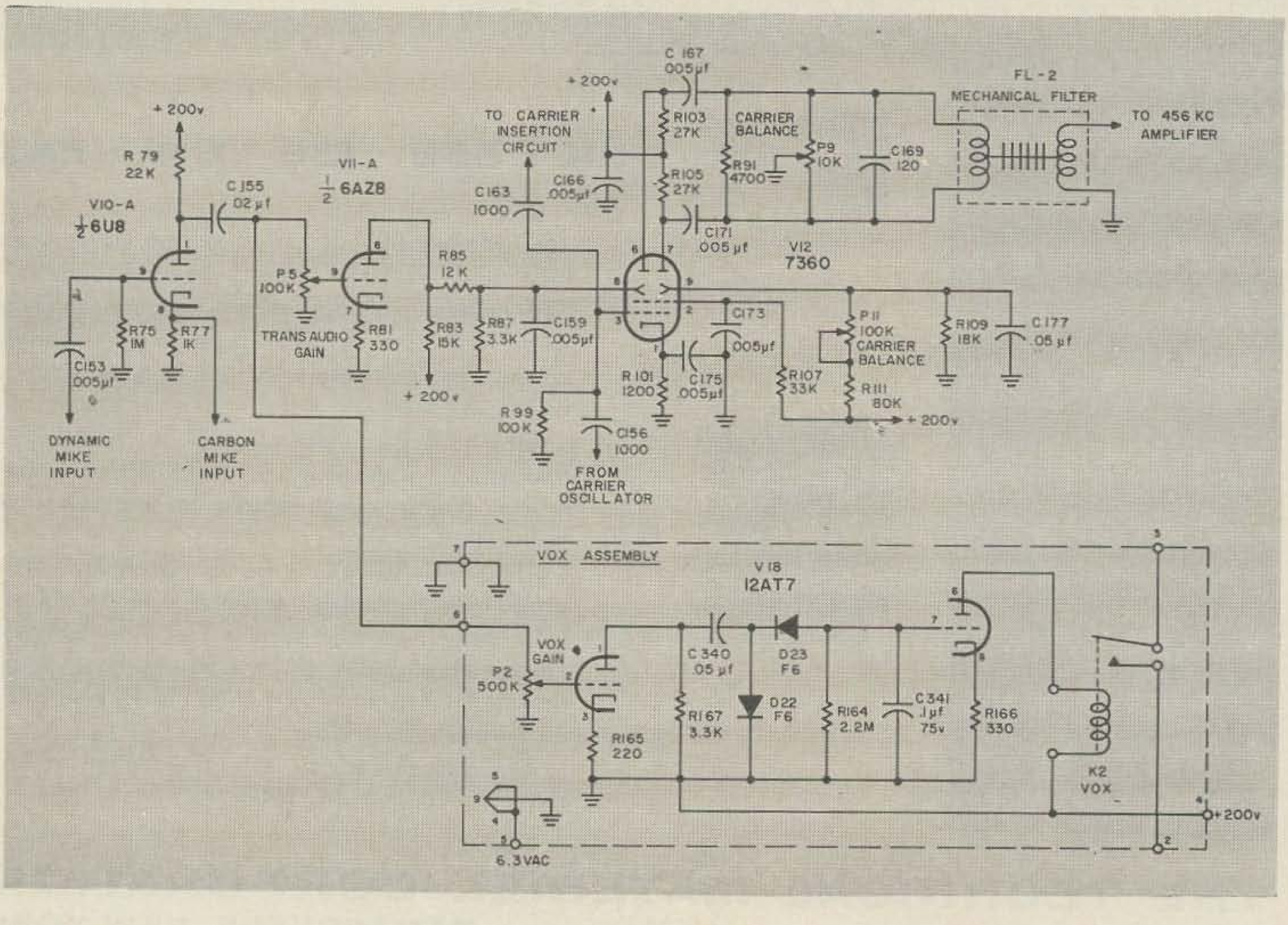
The equipment is aimed at the commercial communications market and is designed to be operated by non-technical personnel. Built to commercial standards, it provides top performance and, for such equipment, is nominally priced at around $1,300. While few amateurs would be interested in the transceiver for use in the ham bands, certain circuit details are worth considering for your next SSB rig.

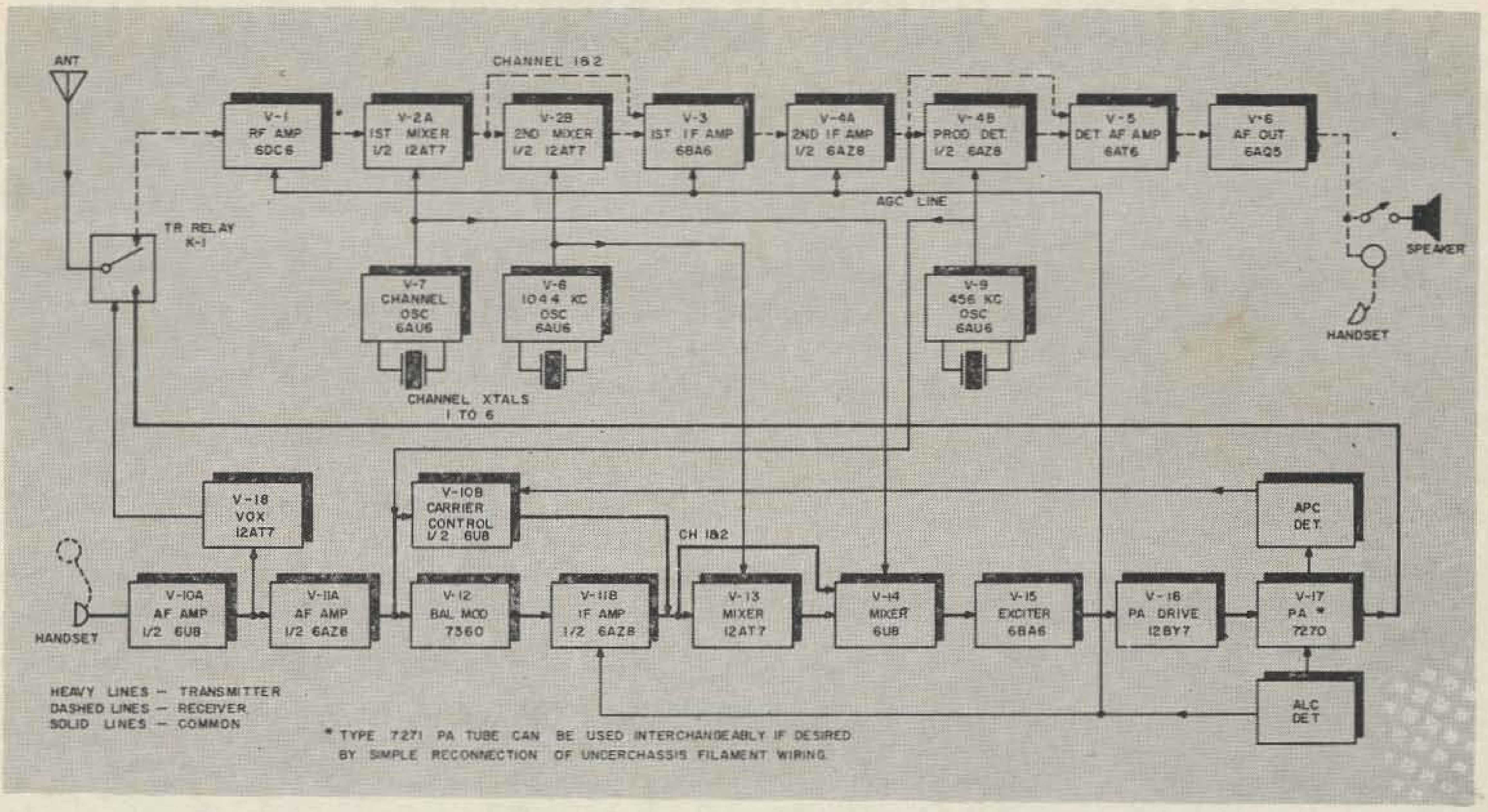
The schematic diagram shows the sideband generating portion of the SB-6F, along with the audio and VOX circuitry. The block diagram shows how it fits into the system. The schematic has been simplified by removing some of the Transmit-Receive switching circuitry and showing the circuit in the transmit SSB condition.

Although the speech amplifier uses the conventional dual-triode circuit, two inputs are provided. A high impedance dynamic microphone may be connected to the 6U8 grid circuit or a carbon microphone connected between the 6U8 cathode and ground. The unused input should be grounded in either case

The VOX assembly, available as an accessory to the SB-6F, is about as simple as such a device can be. The voltage doubler audio detector uses a pair of 1N2484 silicon diodes and insures adequate control voltage for reliable operation. This voltage doubler technique is a good one to remember since it can often save a stage of amplification. The relay, K2, is a 10,000 ohm, 2.5 ma unit.

The heart of any sideband exciter is the sideband generator proper. In this transceiver, an RCA 7360 beam-deflection balanced modulator feeds a 2.1 kc Collins mechanical filter. This happy marriage results in a *maintainable* 50 db suppression of carrier and undesired sideband. Those who have fought the battle of maintaining transmission standards in SSB communications systems will appreciate the importance of this claim. The 7360 circuit is less complex than some that have been published, however it is capable of providing good balance and excellent carrier suppression. Both carrier (P11) and quadrature (P9) balance controls are provided. Carrier is injected to the control grid of the 7360 through C156





which is connected to the untuned plate circuit of a 6AU6 Pierce oscillator. C163, which is also connected to the 7360 control grid, couples a portion of the carrier signal to an AM carrier insertion circuit which is not shown.

The information presented here has been made available by RF Communications Associates, Inc., with the understanding that its publication does not constitute a license for commercial use of the proprietary portions. However, if some of the circuit features discussed turn up in amateur constructed equipment, then this article will have served its purpose.

. . . W4WKM

Review of the

Cornell-Dubilier AR-22 Rotor

The CDE Model AR-22 Rotor was my choice to rotate an 8-element 2-Meter beam because I was mounting a ground-plane above the beam and needed a rotor rugged enough to withstand the combined weights of the two antennas. In addition, I planned to eventually mount a stacked 8-over-8 on this rotor, and one of the offset rotors probably wouldn't stand the strain for very long. The in-line design of the AR-22 makes it the only TV-type rotor that would be dependable enough for the job and still provide the convenience of automatic positioning.

Because of the automatic positioning feature, I am able to log the dial readings for the directions of those stations with whom I hold repeated QSO's and thus be able to put the beam on them with a flick of the control knob. The pointer of the control knob is set at the given direction, and the rotor then turns until it reaches that direction, where it automatically stops. The accuracy with which the antenna finds the chosen direction makes it possible to spot weak stations that I must find for nets, skeds, etc.

The AR-22 is very easy to install. It uses inexpensive, readily available 4-wire control cable. Although there are detailed instructions for synchronizing the rotor with the control box (an easy procedure), I found that mine was already perfectly synchronized when I first tried it.

A transformer in the control box changes the 110 volts A-C to 24 volts for the control cable and rotor unit, in accordance with electrical codes. (Many hams are illegally and hazardously using rotors that have 110 volts on the control cable and rotor unit.)

I can give one word of caution to anyone installing any rotor: Be sure to leave a large enough loop in the antenna transmission line where it passes around the rotor. I learned this the hard way, because I didn't leave enough on my ground-plane lead. The first time I rotated the antennas, the AR-22 showed off its mighty power by snapping my coaxial cable in two!

My installation has been up for about nine months, and neither blizzard nor extreme cold has affected its operation. There has been no sign of drift, even in the extreme winds that whipped across my hill-top location last winter.

The AR-22, together with plenty of control cable, cost less than $35. Since this is only about $10 more than the cheapest TV rotors, it is certainly a bargain in extra performance features.

. . . Lloyd N. Gardiner K2PSW

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SPECIFICATIONS—Types of emission: SSB (Upper or lower) and CW. **Power input:** 90 watts PEP, SSB and CW. **Output impedance:** 50 to 75 ohms with not more than approx. 2:1 SWR. **Frequency range** (MC): 3.5 to 4; 7.0 to 7.5; 14.0 to 14.5; 21.0 to 21.5; 28.0 to 29.5 (using crystals furnished; extra crystal required for 29.5 to 29.7 MC). **Frequency stability:** Overall frequency stability within 100 CPS after warmup. **Carrier suppression:** 50 DB below peak output. **Unwanted sideband suppression:** 55 DB below peak output. **Keying characteristics:** Grid block keying throughout. **Audio input:** High impedance microphone. **Power requirements:** 6.3 V at 8 amps. or 12.6 V at 4 amps.; —125 volts 20 milliamps; 300 volts 100 milliamps; 600 volts 130 milliamps (uses Heath. HP-20 or HP-10 power supplies). **Cabinet size:** 12¼" W x 6¼" H x 9¾" D.

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SPECIFICATIONS—Frequency range: 80 thru 10 meters in 5 bands· 3.5 to 4.0; 7.0 to 7.3; 14.0 to 14.35; 21.0 to 21.5; 28.0 to 29.7 MC. **Intermediate frequency filter:** Center frequency, 3.0 MC; Bandwidth at −6 db, 3.0 KC; Bandwidth at −60 db, 10.0 KC Max.; Hermetically sealed. **Panel controls:** Sideband Select; R.F. gain; A.F. gain—Off—On; Noise Limiter; AVC select; main tuning; band switch; antenna trimmer; SSB, CW-AM switch. **Signal-to-noise ratio:** 10 db at 1 microvolt or less. **Output impedance:** 500 ohms and 8 ohms. **Power requirements:** 6.3 V at 8 amps. or 12.6 V at 4 amps. AC or DC, 300 volts DC at 120 MA. (Uses Heathkit HP-10 or HP-20 power supplies). **Cabinet size:** 6¼" H x 12¼" W x 19¾" D.

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Roy E. Pafenberg W4WKM
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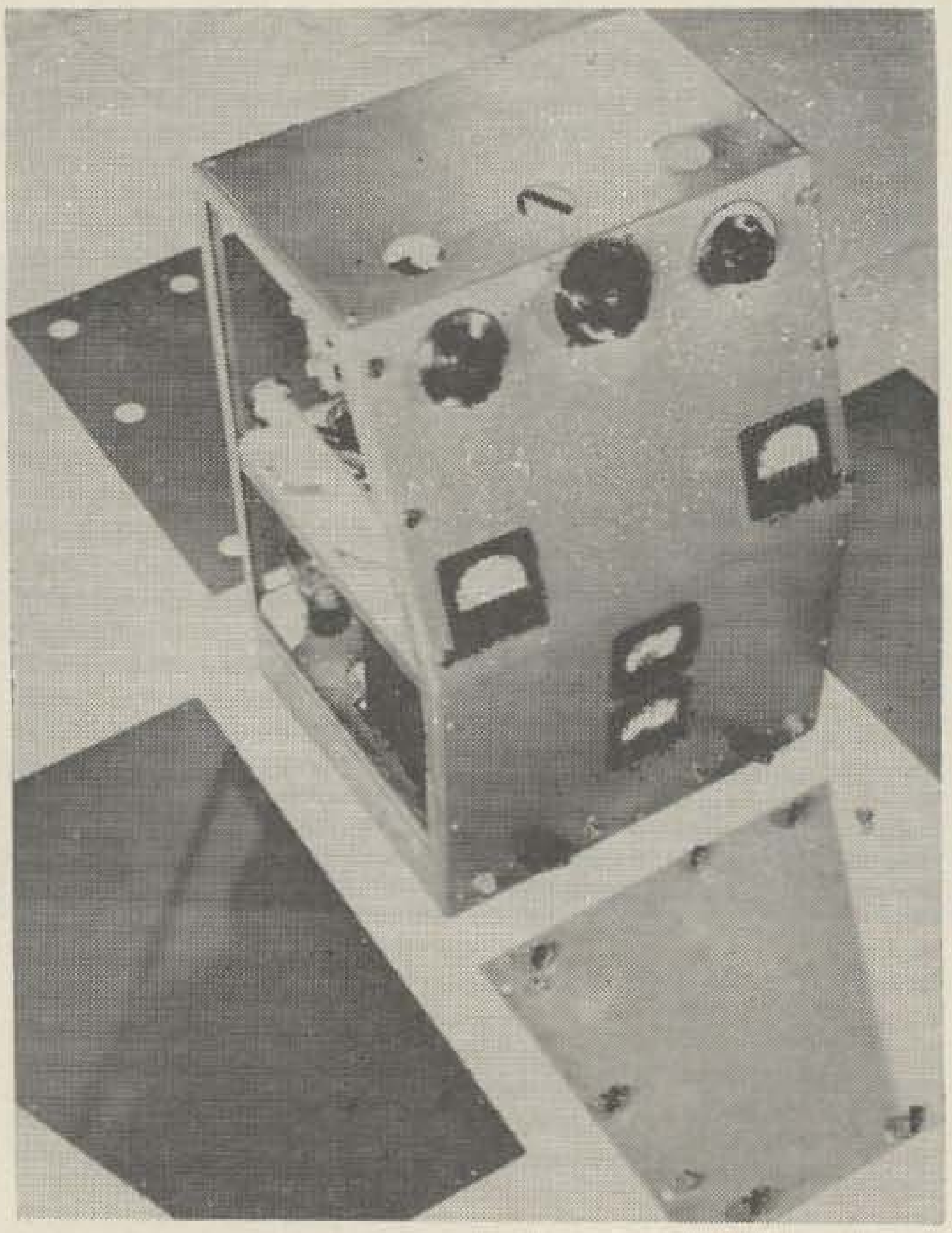
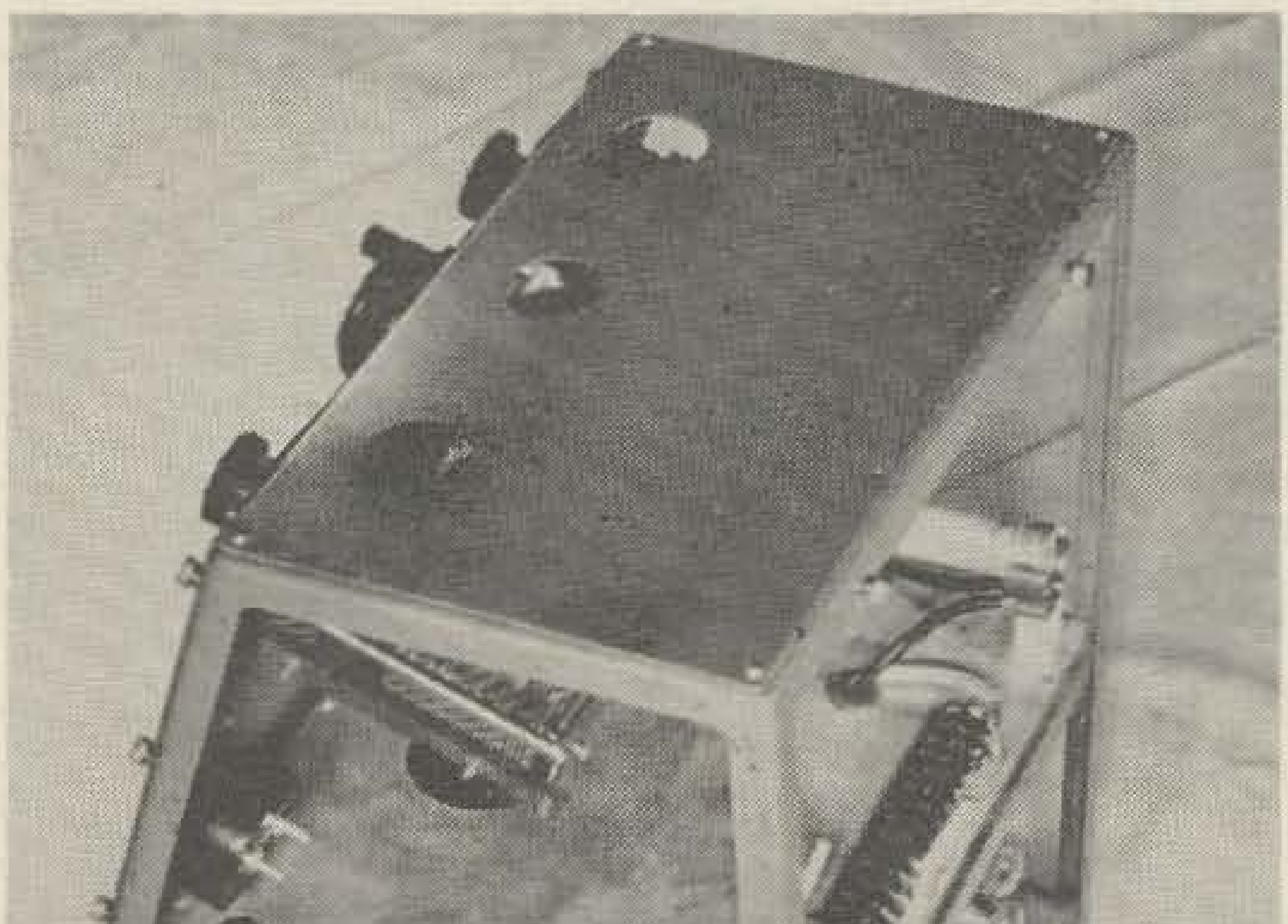
Ionospheric Heaters

MANY newcomers to amateur radio may not be familiar with the wandering, raw ac signals that once rendered large segments of the high frequency untenable. Medical treatment diathermy equipment manufactured in the late thirties and early forties consisted of a high power oscillator fed from a raw ac or, at best, a rectified and unfiltered dc plate supply. No means of frequency stabilization was employed and adherence to allocated frequencies was a hit or miss proposition. The powers used and the application of this equipment are such that complete and effective shielding of the equipment and the treatment room would be required to reduce interference to a tolerable level.

With these devices becoming more popular, showing up in doctor's offices and clinics all over the country, something had to be done and was. The FCC outlawed the use of the older equipment and set up strict standards governing the design and use of radio frequency heating equipment. Older equipment was made obsolete by these regulations and, having little if any resale value, rapidly became a drug on the market. Much of this gear was given away or junked. However, even at this late date, there is a substantial quantity gathering dust in doctor's basements and clinic storage areas.





The amateur who will search out this equipment can acquire a good selection of heavy duty power supply components at little or no cost. Also, the configuration of many diathermy "machines" is ideally suited to amateur construction. The schematic diagram of a Burdick Corporation device, a fairly typical unit, is shown in Figure 1. Plug-in assemblies are used to provide output on 3.75, 12 and 50 megacycles to meet various treatment and surgical requirements. The rf components used in most equipments will have little attraction for the amateur; primary interest lies in the power supply and possibly the enclosure.

Power supply components in this equipment were heavy duty and designed for continuous service. Control systems in some models were

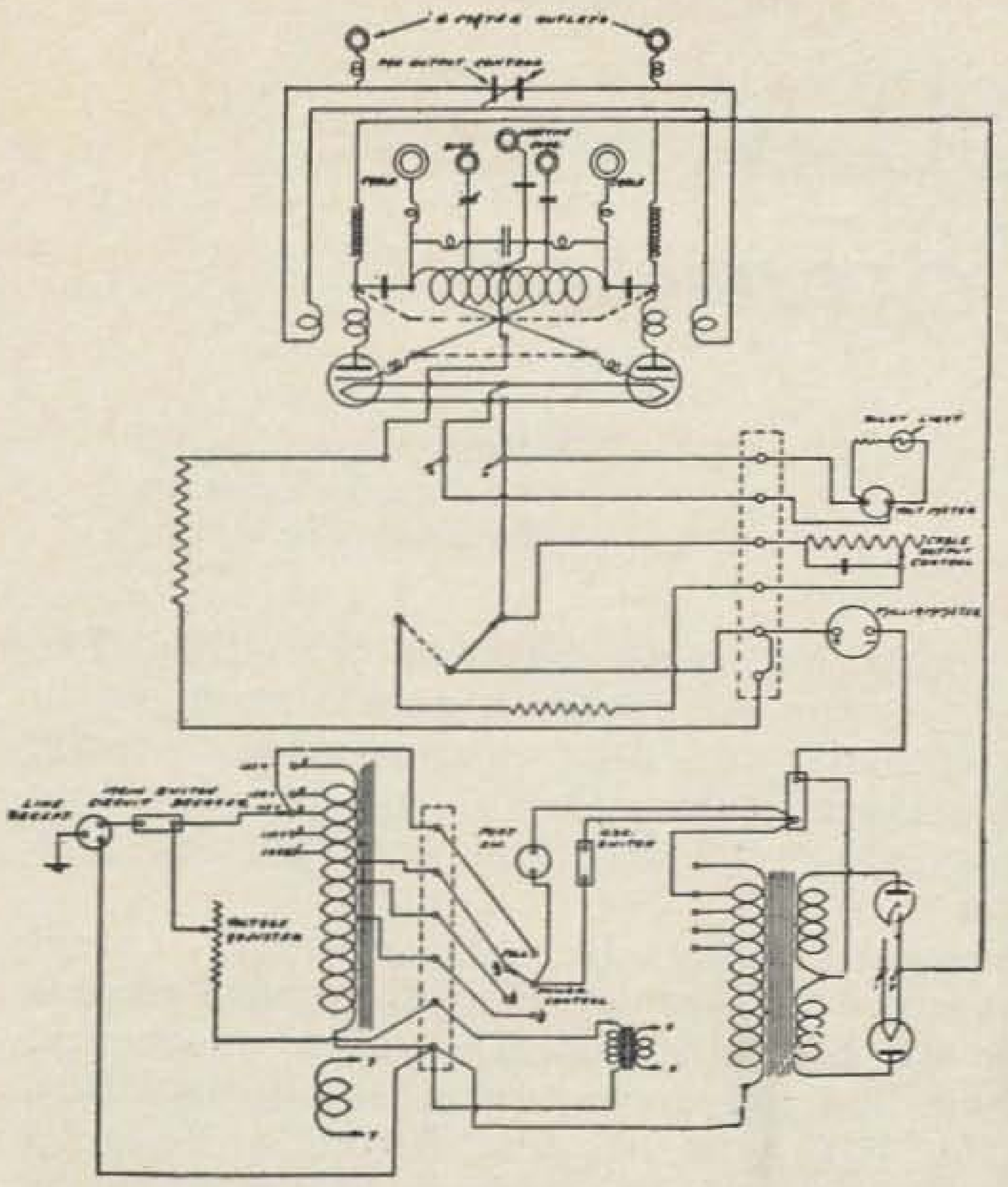


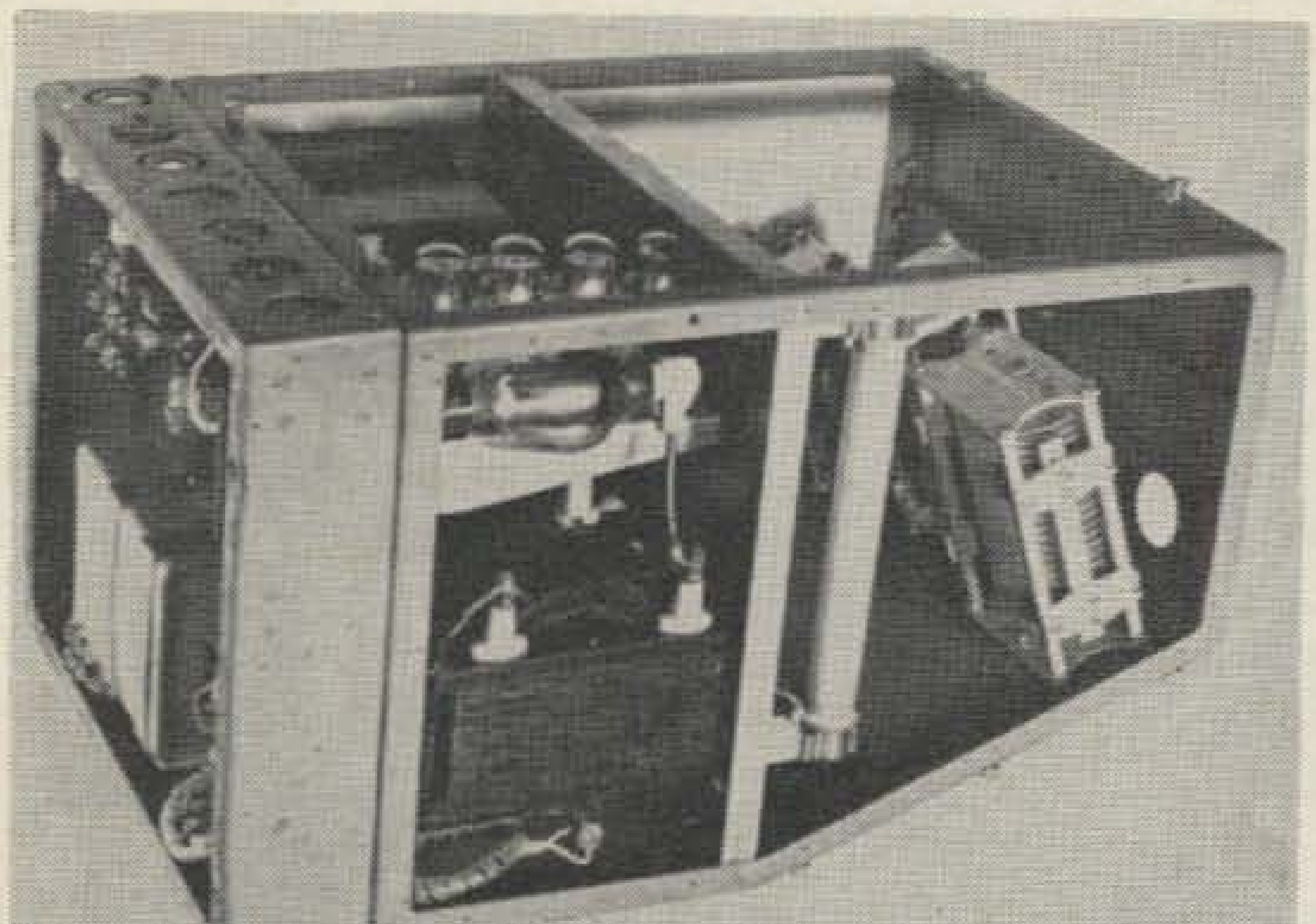
Fig. 1: Schematic diagram of a typical diathermy unit. This equipment was manufactured by Burdick Corporation and provided output on 3.75, 13 and 50 MC.

quite elaborate and easily adapted to amateur equipment requirements. Tapped power transformers with selector switches or Variacs were almost always used to compensate for a wide range of primary voltage and to permit adjustment of output power.

Inspection of Figure 1 will disclose that the addition of a filter choke and capacitor would result in an excellent high power plate supply. The photographs show a diathermy unit of unknown make and model adapted to amateur use. The power supply components of this particular unit are good for 2,500 volts at 500 ma which is a full kilowatt in anyone's book.

The captions tell the story and it is convincing. So get on your horse and start looking before it is too late. One word of warning: Wear old clothes and take help with you. Basements are dusty and these beasts are heavy!

. . . W4WKM



Photographic Credit: Morgan S. Gassman, Jr.

160 M Converter

Henry Cross W1OOP
111 Birds Hill Avenue
Needham 92, Mass.

LAST year the 75-meter DX was pretty good, so Dana W1HKK figured that this winter he should give 160 a whirl. He had a brand new 75S3 and wanted to be able to use it without messing up its other functions and features, so we made him a converter.

Before starting projects that look like work (for me) I like to get advice (free). W1BB said that coverage from 1750 to 2015 might be desirable for working foreign stations. W1FZJ said put in a good preselector Four guys on six said they used to like 160. Somebody on 220 said I was nuts. W1QXQ said there was no accounting for tastes, but he painted the panel.

After a month of discussion, I was nudged into doing something by Dana, who bought crystals, dug up a cabinet, and drilled some holes in the chassis (this explains the spare tube socket—I hadn't really made up my mind, but he was in a hole-punching mood.) The

crystals were to make the Collins tune 28.2 and so on to 28.8. Thus a 26.5 converter rock made the two US bands come out 100-125 on "28A" and 75-100 on "28B." It turns out the PRESELECTOR knob on the 75S3 need not be touched, but the rf knob on the converter wants repeaking about every 5 kc.

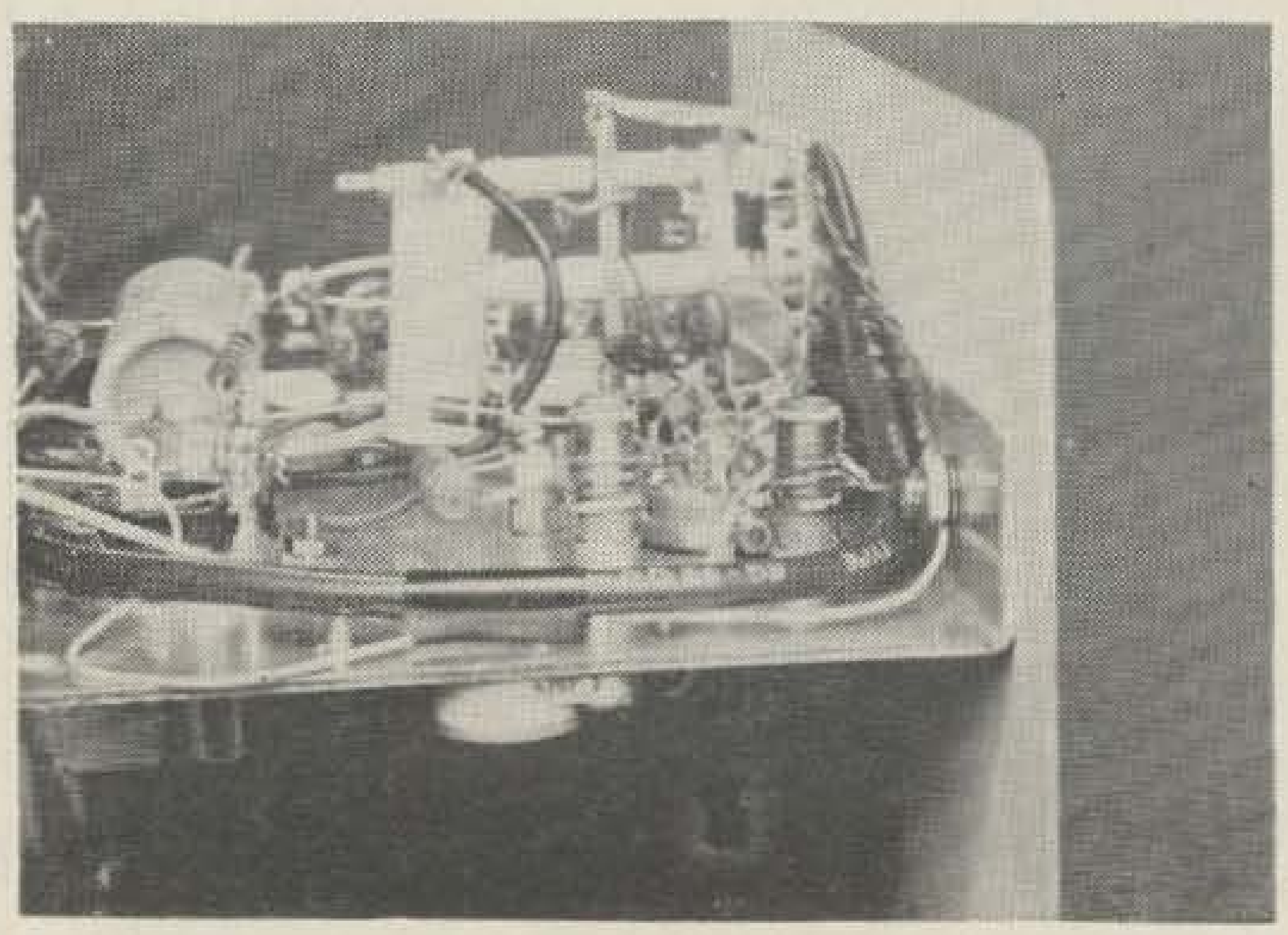
The photos and schematic show the final product. The converter could have been made smaller, but we can't imagine how it could work better. Power is stolen from the line cord (11-pin) socket of the Collins; only unfiltered 150 volts is available, so a choke and electrolytic are included. The filament drain (600 ma) seems small, and the main power transformer still runs cool. The receiver has no regulators, so we didn't bother either. The rf stage was set up for a gain control pot in the cathode, and this was installed recently. The schematic shows how to put one in. (More turns in L3 will give you some gain to turn down.)

The mixer stage is pretty ordinary, except that converters going UP usually have trouble with the LO being near the output frequency. An oscillator-frequency trap usually fixes this, so the 6U8 plate has one. To get injection a two turn coil in the cathode of the mixer is wound over the oscillator plate tank turns; the reactance is not enough to bother at two mc.

High Q in the rf coils is important; luckily the National "Blue Chip" series of chokes was built for use by filter-makers and the ferrite coils are excellent at 2 mc. I found that by removing 48 turns from no. B17331 220 microhenry coil I got the right inductance (tunes 2.1 mc with about 100 mmf) and a Q of 190. I tried Ferri-Loopsticks and other commercially available coils, nothing better than 130. The photos show a toroid input coil: it's better (I hand-wound it with 20/44 litz on carbonyl iron), the Q (unloaded) is 250, but how to get another? Incidentally, the National coils are wound with self-stripping litz, just push the celanese back and solder to the enameled strands. Be sure to get equal inductance in the two coils.

The crystal, and the circuit, are from International Crystal Mfg. Co. Ours hit within fifty cycles of 26.500.

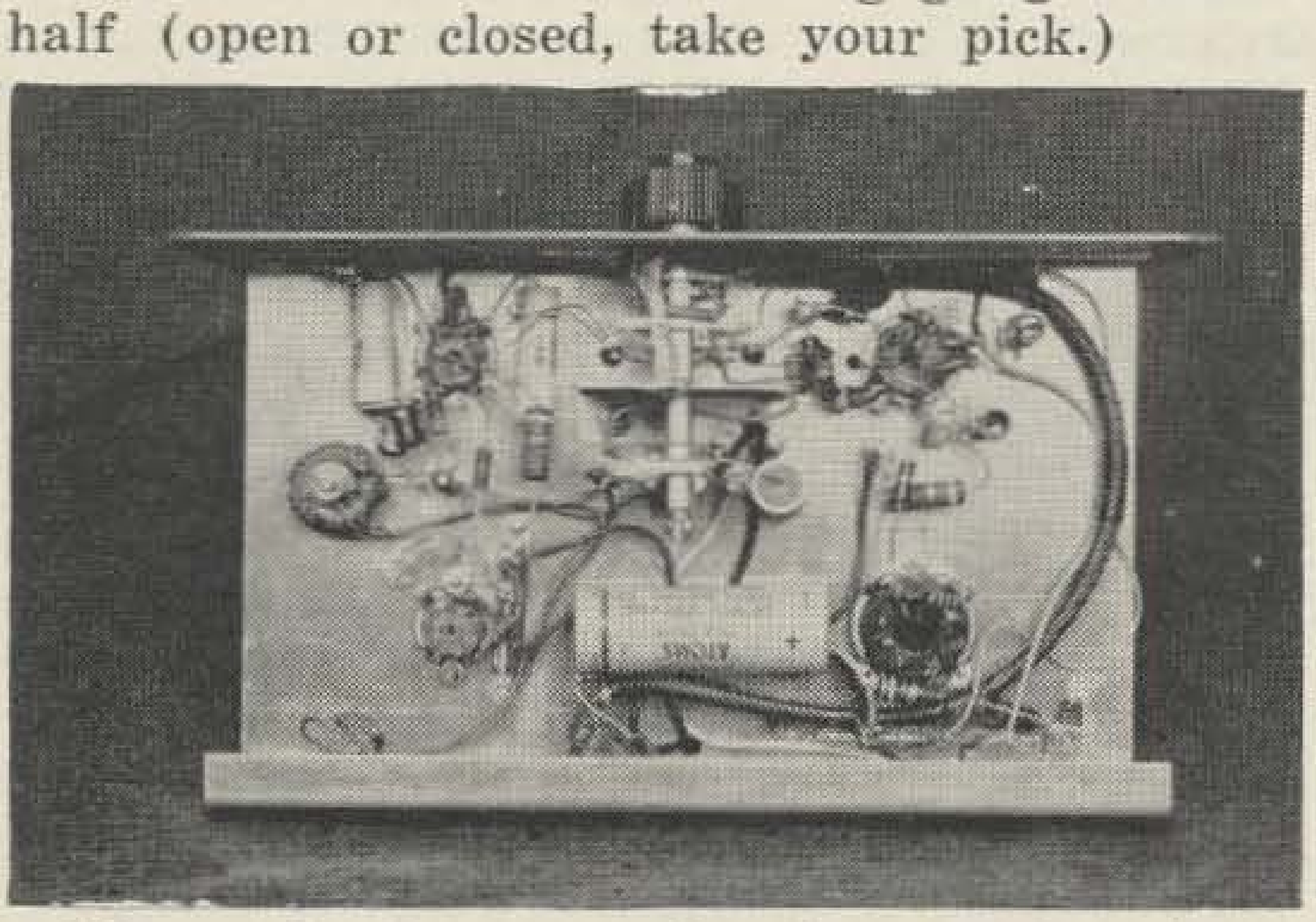
The "normal-through" switching (familiar to Gonset converter users) demands a two-section switch with a shield. A sheet of 1/32



inch brass did this; the switch was stretched, for convenience, by putting it on a separate index assembly (PA-302). The other shielding problem was that I forgot to ground the metal plate between the stators of the tuning condenser. The 6BJ6 oscillated until I remembered.

Tune-up

The B plus should be off the crystal oscillator. With a BC348, or a Sky Buddy, or something tuned to 1.9 mc plugged in the output (that 28 mc coil passes a *little* at 160) put a 1.9 mc signal in the input and peak the two trimmers while the tuning gang is about half (open or closed, take your pick.)



If you don't own a signal generator, try a BC set tuned to 1445 kc (good about half a mile). Peaking should be sharp but not jumpy. Turn off the signal, and maybe you can do it on noise (I did). Next make the oscillator go. Remember if things are tuned below 26.5 it may decide that 8.8 mc is where to oscillate—be sure it is working properly.

Find the 26.5 juice with a grid dipper coupled to the mixer output tank. Now suck it out by tuning the trap trimmer. To check that the trap tunes (it's easy to get mixed up) take power off, short 6U8 plate to ground and dip the trap coil, which is mounted above chassis. Dip at 26.5 mc-*one* dip. It tunes the same place, almost, with the short off and properly adjusted.

Hooked up to the 75S, the output coil slug can be peaked at 28.3 or 28.4; the rf should be retrimmed on the antenna you're using, and you ought to be in business.

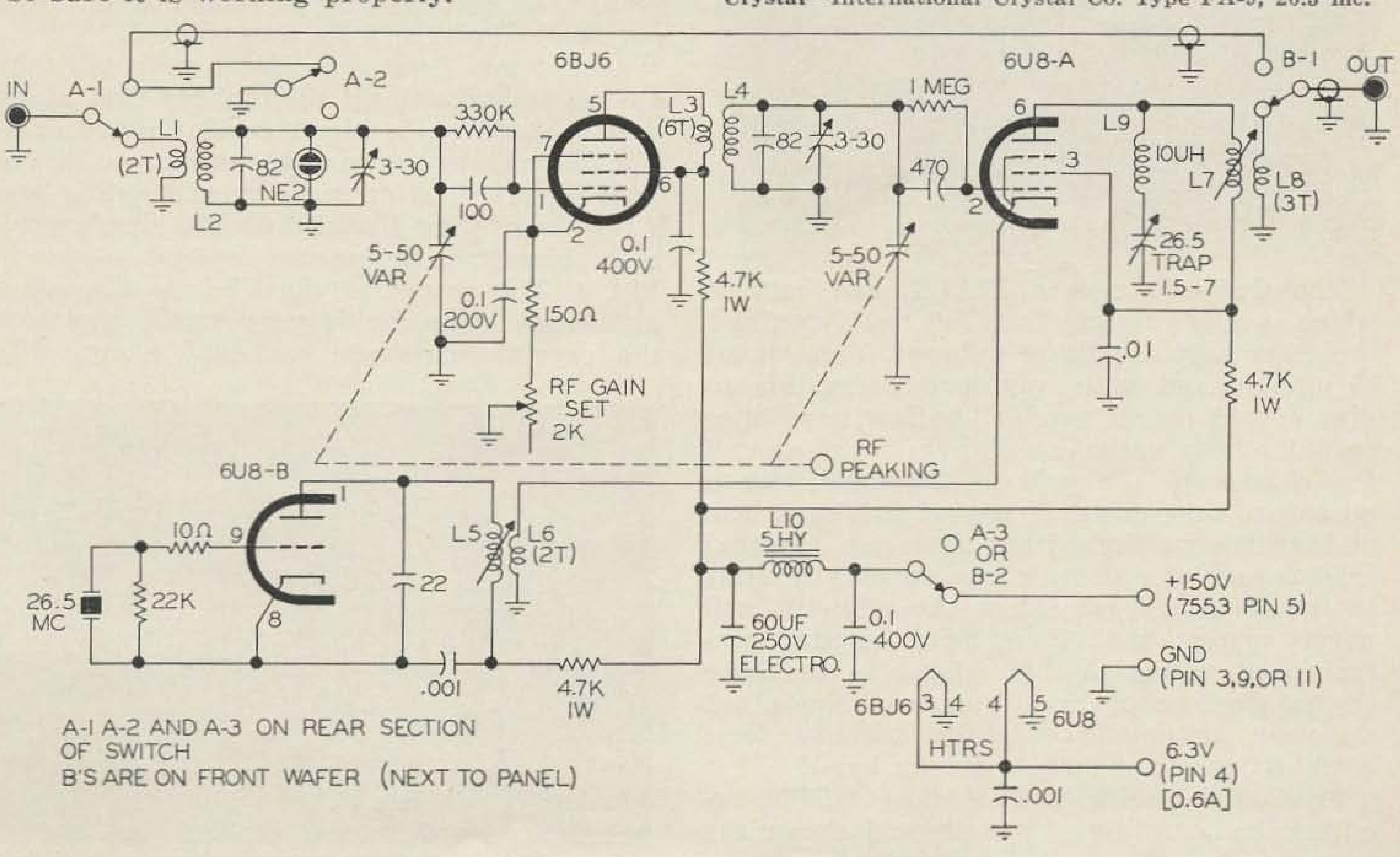
The neon bulb and RC net might save you an antenna coil, as one or two watts can cook it.

73 and good hunting. See you on 432.03 when the long waves start to pall.

. . . W1OOP

Coil Table

L1—Ant. pri. Wound on L2 form, next to pie.
50 ohms 2t. any kind of magnet wire.
300 ohms 5t. as above.
L2—National Co. B-17331 remove 48t. Q=190.
L3—RF plate 6t. wound on L4 form, no. 24 sse or such.
L4—Mixer grid same as L2.
L5—Xtal osc. plate 22t. no. 26 formvar on CTC LS6 form, green slug.
L6—Mixer cathode,, 2t. wound over L5.
L7—Mixer plate, 20t. like L5.
L8—Output link, 3t. wound over L7.
L9—Trap coil National B15976 10 **microhenry** choke. If you can't get above wind your own on ¼-inch plastic rod.
L10—Filter choke. (Stancor C-2318, C-1279, C-1706) 25 ma or more dc. 5 henry or more. 400 ohms or less.
Tuning Condenser—Hammarlund HFD-50 (HFD-100 will work.
In/out switch—Centralab PA-2021 (2 pos., 3 poles used rear section, 1 pole front section). PA-302 index.
Crystal—International Crystal Co. Type FA-9, 26.5 mc.



Crystal Control for the GSB-100

Edson B. Snow W2BZN
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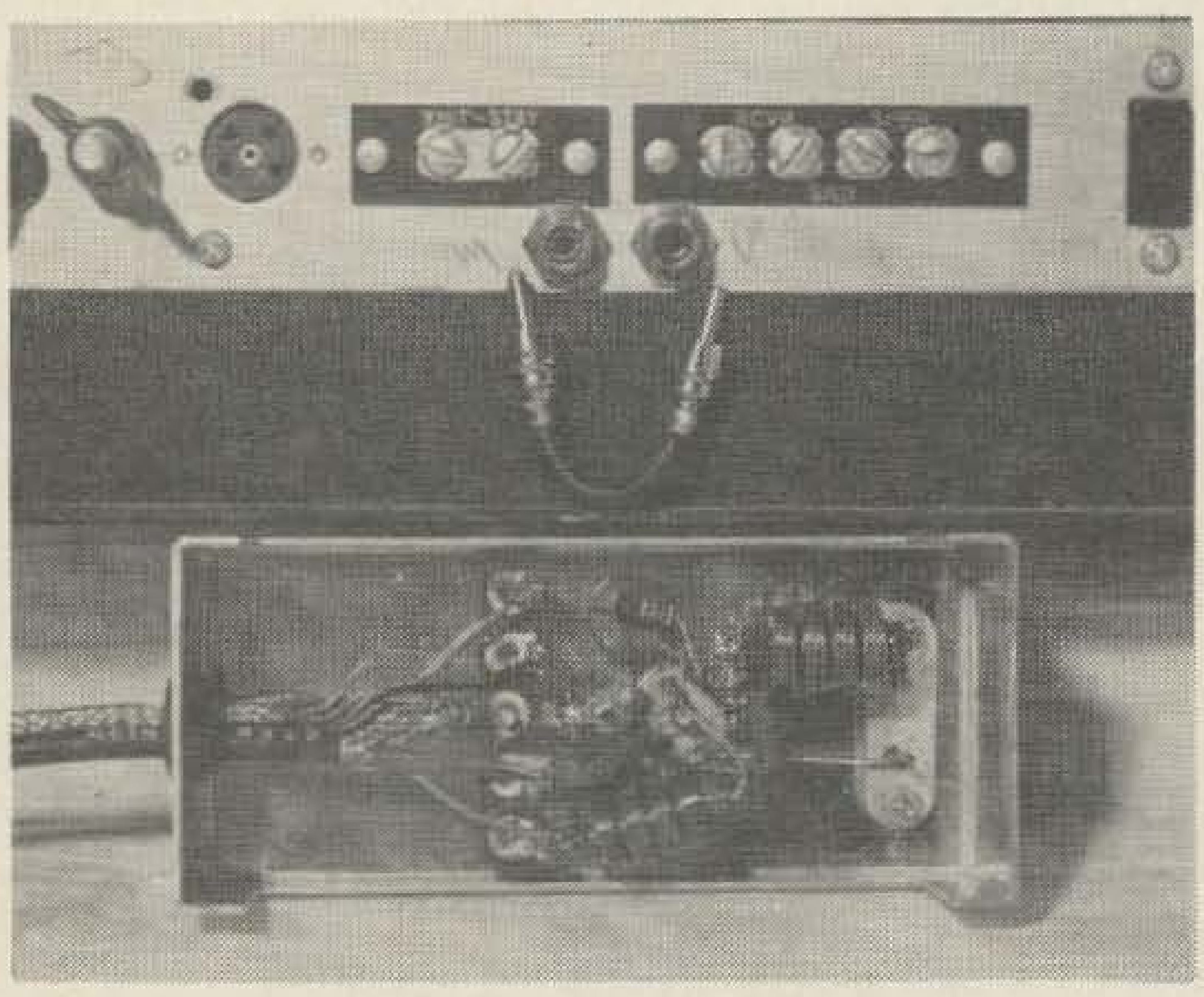
COMMERCIAL Sideband Exciters like the Gonset GSB100 put out a beautiful CW signals, run at the right input and would be fine for Novice use except for one thing: they have no provision for crystal control.

Modification of this rig for crystal control is not difficult. The trick is to do it without destroying resale value or affecting its normal operation. This precludes extensive internal wiring changes and extra knobs on the front panel. If the modifications can also serve a future purpose, the value of the rig could be enhanced! The following applies specifically to the GSB-100 but probably could be applied to other rigs.

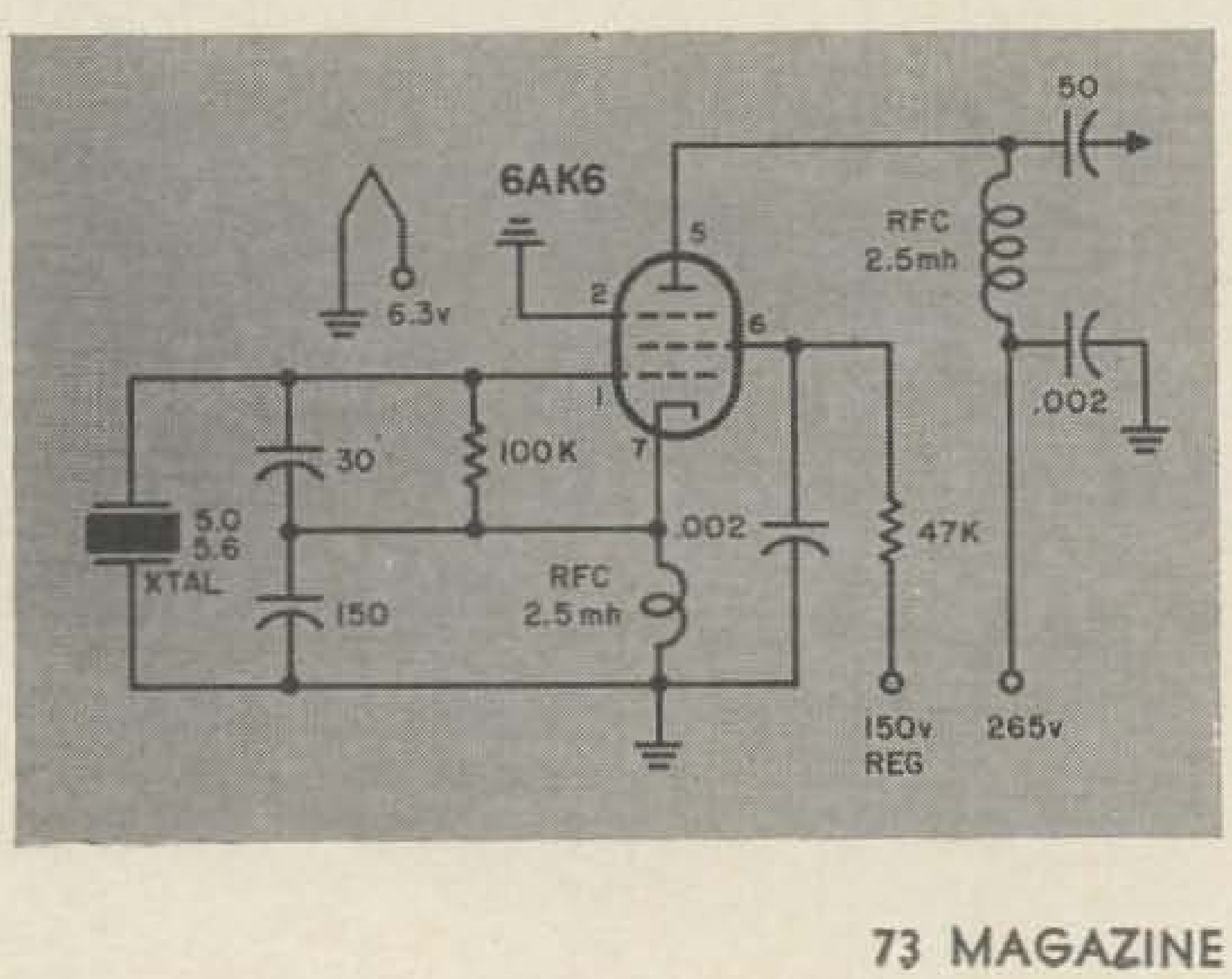


The GSB-100 uses a 12AU7, one half of which is a vfo tuning from 5.0 to 5.6 mc, and the other half a cathode follower. This signal is later mixed with appropriate crystals to give output on all bands. The low impedance output of the cathode follower is led around the chassis to the grid of the mixer via a miniature coax cable. If we cut this coax lead and switch in the output from an external crystal oscillator using cheap surplus crystals in the 5.0 to 5.6 mc range, the GSB-100 will never suspect that it is being crystal controlled. A bonus to this scheme is that one crystal gives output in a number of bands, but do your arithmetic carefully because some combinations land outside a ham band!

Minimum modification of the GSB100 requires the mounting of two phono jacks on the rear apron. Use Switchcraft 3501FP jacks which mount in a single ¼" hole. Locate the holes carefully to clear components on the inside and not to interfere with the replacement of the cabinet. Remove the coax lead that runs from pin 8 of V9 (the vfo tube), to the capacitor C63 which is tied to pin 1 of the mixer tube V5. From each of these points run separate coax leads (Amphenol sub minax type 21-597) to the two jacks that you have just mounted. Leave C63 still in the circuit. Mark the jacks "VFO" and "MIX" respectively so you won't be confused when the rig is buttoned up again. To restore normal operation while you are working on the external gear, make a jumper using two RCA type phono plugs and a short piece of RG59U.

The external gear may be run from its own power supply, but while you have the GBS-100 opened up it is easy to add a socket to steal power. I relocated the grounding bolt and used its hole for a ⅝" socket punch which makes the right size hole to mount an Amphenol #78-S4S socket. This provides the common ground, six volts ac for the filaments, 150 volts regulated, and 275 volts unregulated.

Almost any crystal oscillator that will take a 5 mc crystal will fill the bill. My first model used a 12AU7 as a Pierce oscillator and cathode follower to provide the ultimum of isolation. However, after some experimenting and a little cogitation I settled for the simple grid-plate circuit with untuned output shown in Fig. 1. The output of the VFO to the mixer in normal operation is very small, therefore the crystal substitute can loaf along, with



output to spare. The circuit works with any crystal. There are no tuning adjustments, and the electron coupling in the tube provides good isolation. Even the high impedance output with the coax cable capacity shunting the output still permits adequate drive to the mixer. Even with these losses, the output may still be more than is required. This is easily corrected by increasing the value of the 47K screen resistor. Also note that this oscillator runs continuously as did the VFO.

The unit pictured, was built in a Minibox, 4" x 2⅛" x 1⅝" (Bud 3002A) and used a 6AK6 Tube. This tube was selected because it has a low filament drain, is well screened and because I had one. A 6AH6, a 6CL6, a 5763 and probably several others would work just as well. There is nothing critical about construction or placement of parts.

When Novice days are over, you have the choice of VFO, or crystal for spot frequencies. You have a utility crystal oscillator for many uses around the shack. You can FSK the crystal for RTTY. Also, with the jacks on the back of the GSB100 making it possible to control its frequency from an external source, you might want to investigate the idea of using the VFO in your receiver and a suitable mixer to be able to "tranceive." For example the oscillator in the Drake 1A tunes from 4.0 to 4.6 to cover the same ranges as the GBS100. A couple of tubes and one crystal should do the job!

73 test the Knight CPO

Larry Levy WA2INM

Before you turn to the next article, thinking that since you already have your ticket, what use would you have for a code practice oscillator, I would like to point out that there are many uses that a ham has for one of these versatile gadgets aside from learning the code. The Knight code practice oscillator is a one transistor oscillator powered by a single penlight cell. It has enough output for comfortably driving a pair of headphones and is very useful for learning the code or for increasing your code speed, the use that it is intended for. There are other uses. The kit costs only $3.89, very little for such a useful accessory. The construction takes about ½ hour. There are several large, clear, diagrams which speed up construction, as do the step-by-step instructions.

Besides learning the code, the oscillator can be used for sending *ICW*. It is only necessary to put a 5k resistor across the phone jack and couple the audio into the microphone jack through two .05 condensers (one in each lead). This should help the use of code on VHF where many of the stations have no bfo's in their transceivers and therefore cannot copy a normal CW signal. By using it in the same basic manner, it can be used for an audio signal generator for trouble-shooting modulators and other equipment. It can be used for a monitor and for sending *MCW* by building the following detector. The detector consists of a diode, capacitor, rf choke, and a way of obtaining the proper rf voltage. For high power transmitters, it is only necessary to have a piece of hookup wire near the transmitter (see Fig 1). For lower power rigs, the power should be taken from the coax through resistor "R." Resistor "R" should be determined by placing a 10k resistor across the output and adjusting the output until the voltage is about 1½v. The voltage should be checked even if a wire is used. The battery is removed from the osc. and the detector is connected to where the battery was. Be careful to observe polarity. The key jack is then shorted. Whenever the carrier is turned on, the oscillator will oscillate. The oscillator only requires a few milliwatts so it takes very little power from the transmitter. I'm sure that monitoring will improve the fists of a lot of amateurs and make many more solid contacts. For MCW, connect the oscillator to the detector as for monitoring, but connect the output to the microphone input as in ICW. The carrier is keyed. The oscillator will provide a note to the modulator whenever the carrier is on. This type of emission is useful on VHF during an aurora when you cannot tell if a station is tuning with his BFO on or not.

. . . WA2INM

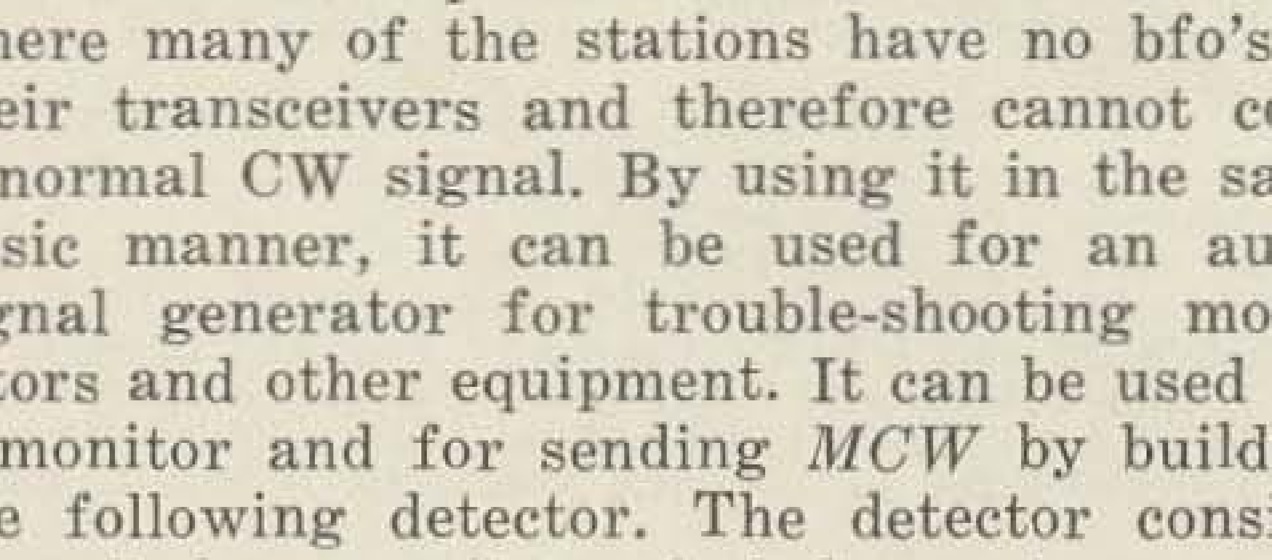


FIG. 1

Audio Filters for Selectivity

It now seems that everybody is getting filter-happy. No wonder, with the bands as crowded as they are. W4THU stirred up a new wave of interest with his article in the March issue, "Cure That Angry Band," starting a run on FL-5 and FL-8 filters. Best price we've seen so far is from S.E.G. Sales, 1306 Bond St., L. A. 15, Calif. FL-5 or FL-8, $2.49 each. So cheap it's unreasonable not to have one or two handy to insert in your receiver audio output lines for added selectivity.

Newcomers to this particular gimmik are astounded to find they can copy signals they never heard before. We old-timers and W-tens knew *that*.

De-chirping the Heath VFO

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THERE are no doubt literally thousands of Heath VF-1 VFO's in use today, and the majority of them are most likely being used with Heath DX-40's. In my case—and I've heard of others with the same problem—the chirp on CW when using the VFO was very noticeable, especially on 10 and 15 meters.

Considering that with the cathode—keyed DX-40 the VFO input voltage would vary about 20 volts from key up to key down, it was not surprising that the VFO chirped. The VR tube in the VFO regulated the screen voltage okay, but the 6AU6 plate voltage shifted enough to cause chirp. One solution to this problem, of course, is to use a separate power supply for the VFO; another approach is to voltage regulate the 6AU6 plate. I elected to do the latter, and it worked out so well that, even on 10 meters, my CW note is very close to crystal quality.

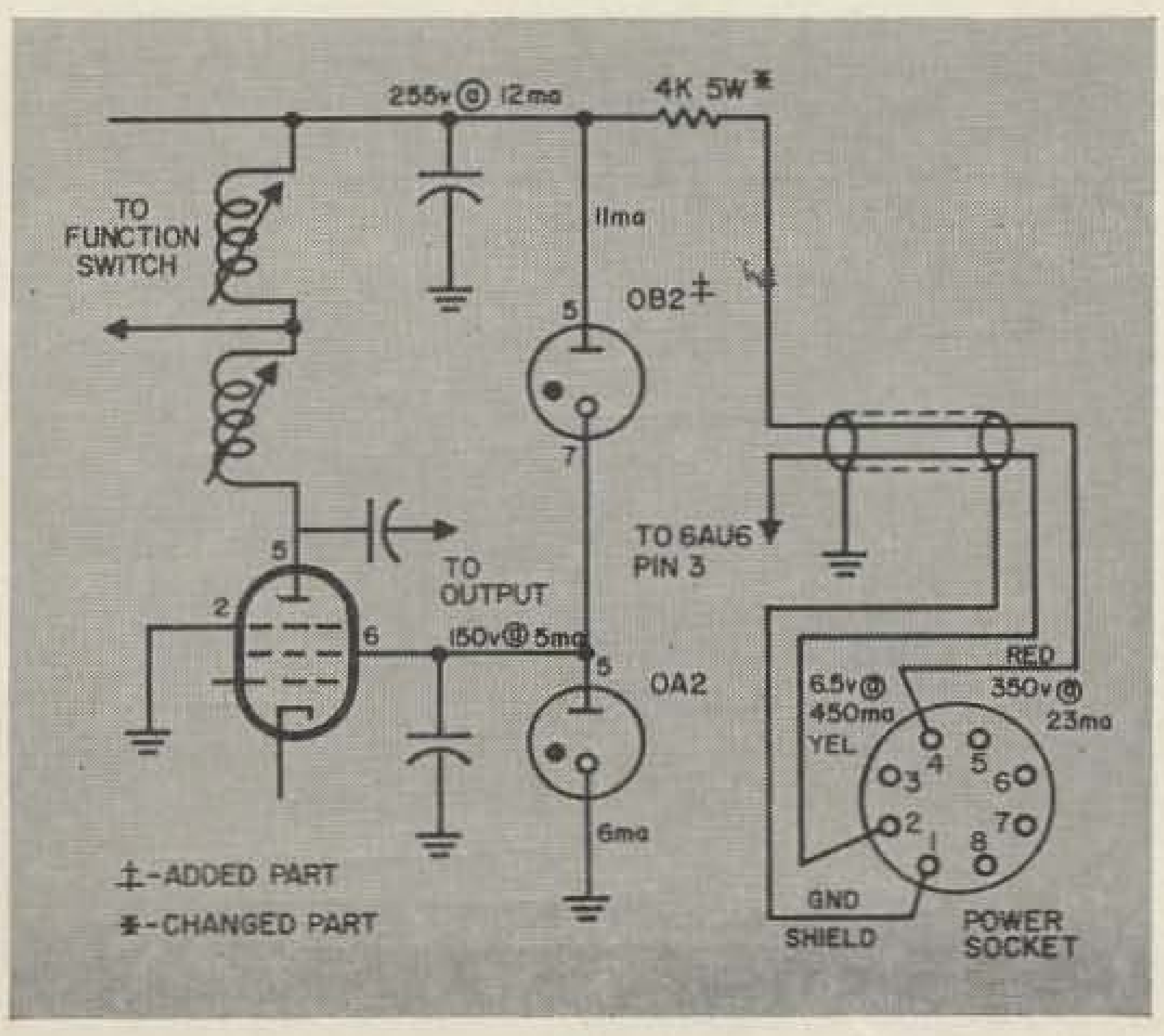
The modification involves the substitution of a resistor, addition of a VR tube, and upping the VFO source voltage to 350 volts (changing one 35¢ resistor in DX-40). See Fig. 1.

All this amounts to is adding an OB2 regulator tube between plate and screen of the 6AU6, and changing the current limiting resistor.

Step-by-step instructions follow:

(1) Remove the 15K 5W resistor from lug #2 of terminal strip J and lug #5 of tube socket B. Put in your junk box.

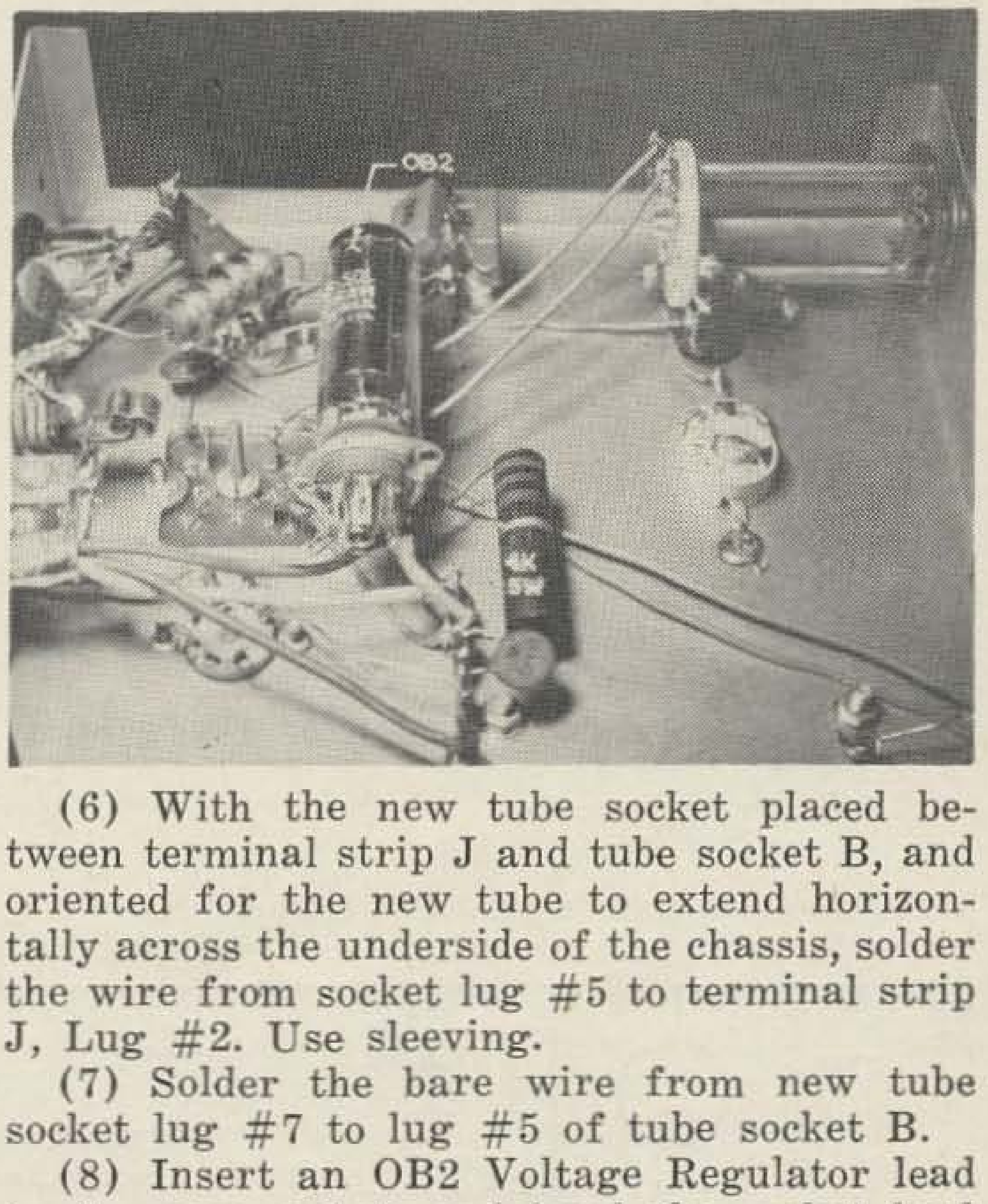
(2) Remove the red power lead from lug #2 of terminal strip J.



(3) Connect one end of a 4K 5W resistor to lug #2 of terminal strip J. Place this resistor in the area between terminal strip J and the ceramic trimmer capacitor.

(4) Solder the red power lead removed from lug #2 of terminal strip J to the free end of the 4K 5W resistor. The resistor lead is stiff enough to support the connection.

(5) Prepare a 7-pin miniature tube socket by soldering a 1-inch long #18 bare wire to lug #5, and a 1½-inch long #18 bare wire to lug #7.



(6) With the new tube socket placed between terminal strip J and tube socket B, and oriented for the new tube to extend horizontally across the underside of the chassis, solder the wire from socket lug #5 to terminal strip J, Lug #2. Use sleeving.

(7) Solder the bare wire from new tube socket lug #7 to lug #5 of tube socket B.

(8) Insert an OB2 Voltage Regulator lead in the new socket, and bend the socket lead wires as required to support the tube.

Make sure the VFO input voltage is increased to about 350 Volts. With a DX-40, this is easy; just replace the resistor attached to pin 4 of the accessory socket with a 10K to 12K 10 watt resistor. The lowered resistance means less voltage drop, and therefore higher voltage at the VFO.

Operate the VFO in the same manner as previously. All switch functions are unchanged. Power consumption is not increased enough to talk about. On phone operation there should be less tendency to FM when modulating the transmitter. . . . K6UGT modified VOX

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Break-in CW with the 20-A

IT is possible to operate full break-in CW with your present SSB exciter, providing it incorporates a VOX circuit.

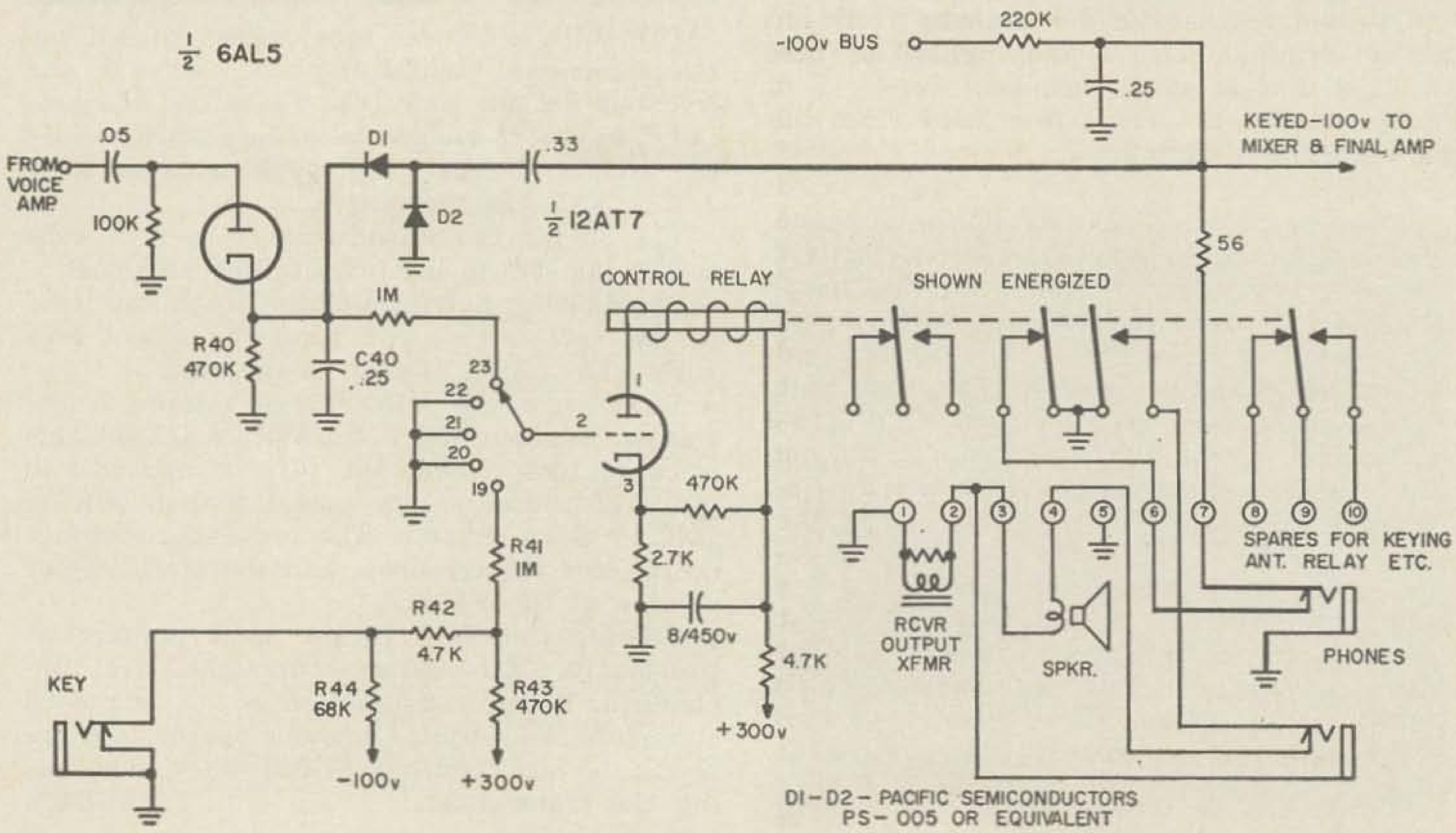
Various systems of voice controlled break-in are in use, but they are all basically the same. Some of the audio from the speech amplifier is amplified again and rectified, and the resultant dc signal is used to key a relay control tube. This high speed relay is in turn used to key one or more stages in the SSB exciter or transmitter, blank the receiver at the time when the signal is on, and also actuate the antenna relay at the appropriate moment. Voice-controlled circuits must have a small amount of "hold" or time constant built into them so that they will hold in between words, but turn on rapidly at the slightest voice signal coming through the speech amplifier.

For operating convenience the voice rectifier time-constant and relay control tube may be utilized, as described below, as an automatic transmitter "turner-onner" for CW. The station switches over to the complete "transmit" condition when the first dot is sent, and holds in as long as the operator maintains about 10 words a minute or faster. The system can be classified as full-break-in in that it permits hearing the other fellow whenever the key is up for more than but a few milli-seconds.

Full break-in operation with excellent keying characteristics is easy to come by if you are a proud owner of a Central Electronics 20-A, but with little imagination the idea might well be applied to the 10-B, SB-10, and other similar exciters. We shall confine our discussion to modification of the 20-A.

In the 20-A, as shown in Fig. 1, one section of a 6AL5 dual diode load resistor, R40, and a .25 mfd capacitor, C40, determines the VOX time constant. The rectified voltage is positive at this point. The other section of the 12AT7 voice amplifier tube is used to operate the VOX relay which in turn keys the transmitter on and off by a grid-block type action. In standby, negative 100 volts is applied to the grids of the mixer and amplifier stages. This voltage also appears at the rear strip, terminal #7, for block biasing any external amplifier. In transmit, this voltage is shorted out to ground by the VOX relay with the operation switch in the manual or VOX position when any small positive voltage from the voice rectifier will trip the relay with the resultant keying of the transmitter.

Additional contact sets are provided on the relay, and are connected to the rear terminal strip. These contacts are usually used to key an antenna change-over relay and mute the receiver when ever the transmitter is "on." Section 2 of the operation selector switch connects the grid of the relay control tube to the positive output of the voice rectifier for VOX operation, or to a voltage divider for manual operation. This divider consists of R42 and



R43, which is connected between plus 300 volts and ground. It furnishes about 30 volts positive through a 1 meg current limiting resistor to the grid of the control tube. When an open key is inserted in the key jack, 30 volts negative appears at the junction of R42 and R43. When the key is closed, the voltage at the junction returns to 30 volts positive. The application of the negative voltage while the key is open provides faster relay release for high speed keying. However, as should be obvious, the VOX relay is actuated with the resultant auxilary antenna change-over and muting, for each and every dot or dash pounded out on the key or bug.

Fig. 1 also shows the relatively simple modifications necessary to incorporate the VOX time constant and relay control circuitry for CW operation while still maintaining its original functions for VOX phone use. Only two diodes, a .33 mfd. capacitor and a few minor wiring changes are required.

The combination of the 6AL5 diode and its time-constant load, R40 and C40, together with the additional diodes D_1 and D_2 and the .33 mfd capacitor form in essence what is known to computer people as an "OR" gate. Simply, the R40 C40 timing circuit may be charged either by voice energy rectified by the 6AL5 diode or by the discharging of the .33 mfd capacitor through D_1 whenever the key is closed.

With no key inserted in the jack, the circuit functions as normal for VOX and Manual operation. In this case transmitter keying is handled as usual through contacts of the control relay.

When an open key is inserted, the path through the relay contacts is broken. The .33 mfd capacitor is allowed to charge to the negative 100 volt bias level through diode D_2. When the key is then closed, the stored charge in the capacitor is released through diode D_1, and the charge is thus transferred to the R40/C40 time constant. C40 takes on a good share of the charge previously stored in the .33 mfd coupling capacitor. The new charge on the R40/C40 circuit drives the grid of the control tube positive with the resultant energizing of the relay. The above sequence occurs when the first dot or dash of a transmission is sent and in effect reoccurs for every dot and dash sent for that particular transmission. C40, however, cannot discharge as fast as it can be recharged by successive charging and discharging of the .33 mfd capacitor due to the keying operation. The very low forward resistance of D_2 provides the short charging time constant for the .33 mfd capacitor so that it may receive a new charge between every dot or dash while the high back resistance helps to maintain the necessary energy level required to supply the R40/C40 VOX time constant circuit.

C40, therefore, maintains sufficient positive potential on the grid of the control tube to hold in the control relay as long as a certain minimum code speed of about 10 words per minute is maintained. The relay hold-time together with the minimum code speed requirement may be modified somewhat to suit the operators taste by varying the size of C40. The receiver at the authors QTH is muted by interrupting the speaker line while transmitting. The spare contacts, on terminals 8, 9, and 10 of the rear terminal strip are used to key the antenna change-over relay.

With but a few minutes of actual on-the-air operating, you will be quick to realize the advantages of this type of system.

. . . K2ISP

Seneca Modulation and Keying

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Rochester 21, New York

MANY times when a Seneca user gets on the air someone will remark that the rig sounds good but doesn't have the punch of plate modulation. This is quite true—it isn't quite like plate modulation.

First of all, we must understand that by plate modulation we don't mean basic Heising modulation. We mean regular, run-of-the-mill transformer coupled, plate modulation. We now want to know whether plate modulating the Seneca will be an advantage or disadvantage. Let's consider good and bad points of both plate modulating the Seneca or leaving the rig as the factory recommends—with controlled-carrier screen modulating.

True, with plate modulation you can run a little higher plate current, but not as much as you would for CW operation. Since you are doubling your plate voltage with 100% modulation you cannot run the Seneca at as high a level of plate current as on CW because you would exceed normal plate dissipation by doing so. In practice you can run the 6146's at 140 watts plate modulated, however, many tricks have to be employed such as changing your final plate feed-through capacitor and using forced-air cooling. Heath, however, frowns on this since it still exceeds the published ratings on 6146's in push-pull.

When running the Seneca with plate modulation, you can always watch the average plate current on the meter, which now should remain steady. You would also have an advantage inasmuch as your signal would always be "covering the noise-level" more than with screen modulation that Heath uses. These are a few of the reasons for using external plate modulation. Before running out to buy an Eico modulator let's look at the advantages of playing with the screen modulation Heath says is more practical.

The major reason for leaving the screen modulation alone in the Seneca is probably the best: money. The second reason is almost as good: time and work.

When using the Seneca as is, I have found that it has a certain punch to it that no amount of clipping or speech compression in a plate modulator can deliver. This is due to the fact that you nearly fully modulate the carrier at any instant during the talk cycle. Since the carrier power varies with speech, your voice will cause enough modulation of available carrier at any instant to give "solid modulation" of what power there is instantaneously. Since no form of clipping is employed to get this punch, no distortion occurs as it does when a high level of speech clipping is used. This seems to me to be a definite advantage over plate modulation. This punch is especially useful on aurora openings where the "mush" of the reflection seems to swallow the signal. The punching effect of controlled-carrier modulation will get through when other forms will fail. This can also be seen in single-sideband where the carrier is not important, but where the modulation pulls through because of its punch. A Seneca can be tuned in during an aurora opening the same as a sideband station and the effect is much the same. When a plate modulated station is tuned in this way the carrier is much more steady and therefore the "mush effect" has a greater action on the modulation.

These aren't all the pro's and con's on the subject, but are to be considered seriously before making a decision about it. I have been plate modulating my Seneca for about five months with an Eico model 730 modulator and have gotten excellent reports. I have gone back to screen modulation recently for aurora DX'ing. If you are interested in plate modulating the Seneca, you will be surprised how easy it may be done.

For the CW man on 6, a simple modification on the Seneca will give you better keying. Change the key to key the triode section of the 6AN8 multiplier. This will reduce receiver blocking and reduce the possibility of clamp tube oscillation.

Step-by-step instructions:

Referring to pictorial #15, page 42 of the manual, install a .001 mfd capacitor between lugs #1 and 4 on socket V-9. Next install a small #6 solder lug under the mounting nut adjacent to lug #4 of the same socket. Place it close to lug 4 and solder. This will prevent the clamp tube oscillation which may have occured.

Remove the lead between pin 7 of V-10 and ground lug on V-11. Install an insulated lead from V-10, pin 7 to terminal strip GG-4.

Referring to pictorial 18, page 52, install a .005 mfd disc capacitor between lugs #1 and 3 on terminal strip DD. Disconnect the negative lead of the 40 mfd capacitor from ground lug GL and reconnect to lug #2 of relay at location K.

These changes will connect the OA2-VR tube and 40 mfd capacitor to the center tap of the low voltage transformer and should reduce receiver blocking.

Referring to pictorial #8, page 20, and pictorial #29, 74, install a .001 mfd feedthrough capacitor in a convenient location near FT-4 so it will not affect the operation of the multiplier bandswitch. Disconnect the ground end of the 1000 ohm resistor coming from pin #3 of the 6AN8 socket and reconnect to the feedthrough capacitor. Connect a lead from other end of feed-through capacitor to FT-7 on driver housing.

This modification should be of definite advantage to the CW man, and if you're an AM man like myself you may wish to perform this operation on your rig just in case some good aurora comes along. . . . WA2GCF

Polaroid Plugs

Unbeknown to many hams who own or use Polaroid cameras, is the fact that many useful objects may be salvaged from a box of Polaroid film. The first item is the container which holds the print coater. This little gem can be used as a coil form or as a container for hardware or non-corrosive liquids. Mounting the tube on a chassis or workbench is accomplished by drilling a small hole through the cap and fastening this to its mounting with a small screw. The print coater itself can be used to coat decals (if you're careful not to press too hard). The empty film reel can also be saved and used as a spacer (up to three and three quarter inches) for open lines, etc. So the next time you finish a roll of Polaroid film save all that "junk," it might come in handy. K2KQJ

Martin W. Krey K7NZA

How Is Your Ham Image?

THIS IS the age of images, the age of building a special picture in the mind of the public. Keenly intelligent advertising men work hard at this task. President Kennedy is said to be more conscious of his political image than was any other President in history. By a constant effort to appear to advantage, he hopes to retain favor in the public eye. Observant Americans everywhere may well see in the President's example, encouragement to use a little spit and polish on their own personal images. One very prominent politician and former ham operator, Senator Barry Goldwater of Arizona, has taken a step toward alerting the ham fraternity to the significance of its image abroad.

Speaking in Phoenix before the 1961 Southwest District Convention of the ARRL, Senator Goldwater stated that courtesy in DX operating might go a long way toward correcting the distorted, vicious picture that the world has of the United States. We must make a conscious effort to present a good "ham image" every time we go on the air. It stands to reason that if we are sincere in letting hams everywhere know what we are really like, they will want to use our example in judging Americans as a whole.

Since we are on international display every time we press the mike button, regardless of whether or not we are talking to a foreign ham, we should improve our ham image in the area of courtesy. Courtesy was singled out by Senator Goldwater as being the area in which we could spruce up a bit.

Eactly what are we doing wrong? Well, let's look at a few specific complaints that this writer has known hams to make about other hams and about themselves.

One otherwise excellent ham confides that he always tunes his transmitter on any frequency the pointer indicates, just so it's on the band. He honestly admits that he never listens to make sure the frequency is clear. Then when the rig is all tuned, he simply moves to a clear spot to operate. Naturally this creates beautiful heterodynes and makes a shambles of QSO's. Is it courteous? No. Is it fair? No. Does it create a good ham image in the mind of any listener, foreign or American? In a pig's eye!

One of the most brazen bits of discourtesy happened to this writer on 20 meters recently. After I had called CQ, a ham in California came back to me and immediately requested that I note my "S" meter. "I'm going to swing the ol' beam around toward Honolulu," he said. "Then you can give me a comparative report off the back end." I provided the comparative report and turned the QSO back to the other ham. He was still pointed toward Honolulu. "O.K. old budy," he said, "and now I'm going to say 73 to you. Gotta get into the Islands." With that he signed out and immediately began calling CQ on my frequency. This treatment still rankles in my brain, as it would in any ham's.

There is an old ham out in the Southwest who is on the air almost daily. He's got a lot of years on him, and he's got his troubles. Sometimes he makes the mistake of unloading vitriol on something or someone who has gone against his hardened grain. Result—people are offended; and before you know it, other hams are on the frequency giving the old spark-gapper a piece of their mind. One ham zeroed in on him one day and spent half an hour carefully timing CW transmissions to the old ham's phone receptions. The old ham went off the air, but not before delivering himself of a barrage of epithets and offensive claims to the point that his adversary didn't even have a window to throw something out of and had brains to match. One could only hope that there were a limited number of foreign and domestic hams on the frequency.

We owe a lot to the shrinking band of old spark-gappers, and when we hear their gravel voices in QSO, we ought to maintain a respectful distance from their frequencies. They make mistakes, but they were surely right on a lot of things way back when ham radio was trying to get certain privileges. Besides, the whole world respects those who show proper regard for age and experience.

Recently an Arizona ham tried without success to make a scheduled contact with a ham in Wisconsin. Every time he finished calling the Wisconsin station, a ham in Indiana answered with a booming signal that dominated the frequency. The Arizona ham ignored this discourtesy several times, but in desperation he finally answered. What did the Indiana ham want? Nothing special. He was just kind of wondering what the weather was like down in Arizona.

Also a problem is the ham who is so anxious to get on the air that he doesn't think of the other hams operating in his immediate vicinity. In my neighborhood, where there are a number of hams within the proverbial stone's throw, we have an unwritten agreement to look out for each other. Time was when it was every man for himself, with no holds barred. I once folded my ear all over the speaker, trying desperately to hear a mobile in Colorado tell what my old home QTH now looked like. But all I heard was the ham next door reading down the list of Joneses in the phone book, trying to find the right one for another ham who had just called in with phone-patch traffic. I asked for numerous repeats through that interminable list of Joneses, but finally gave up. I wonder how that ridiculous contest sounded to a ham, say, up in Canada.

Some hams practice the annoying habit of breaking into QSO's during transmissions, and then they pull out and aren't around when asked to identify The practice of breaking helps to give a lot more hams a chance to "get in" on the lower frequencies, but it ought to be done when the frequency has just been turned from one ham to another in the QSO. Also, logic seems to demand that anybody who breaks a QSO be around when the door is opened to let him in.

With the advent of sideband has come still another discourtesy: calling on sideband, a CQ to "anybody on the frequency," and then refusing to answer the AM ham who comes back. One AM operator acknowledges that he responds to every sideband CQ that does not clearly rule him out. If the sidebander ignores him, the AM ham begins a relentless dogging of the sidebander, following him all over the the band on occasion and stopping only when the sidebander answers or gives up. This practice would not appear to have much immediate prestige value to add to the American ham image. The solution is simple: Sidebanders should be specific about whom they will talk to; and AM hams should realize that if a sidebander does not answer them, it is because he forgot to reveal that he was partial to sideband come-backs.

One of the most thoughtless of all hams is the one who fires up the old rig and then settles down to a solid five minutes of calling CQ. Most hams will move off in despair long before he gives them a chance to answer, and so he is impelled by a lack of comebacks to lengthen his CQ'ing on the next crack. This practice effectively ties up a frequency for long periods of time. And does it engender thoughts of admiration in the minds of foreign and domestic hams? Hardly.

The cruelest ham in America is the one who unloads this bombshell: "I don't think we can make a go of it, old man. Either you ain't running much power or your antenna ain't right. I sure can't read you." Then he sometimes adds, "I'm running a full gallon myself. That rig of yours ought to be used on the higher frequencies." This must really turn lights on in the other ham's head—red lights. Particularly if he happens to be in a less fortunate land and has built his rig out of hard-won odds and ends.

We all do a good job of operating, generally; but we all make mistakes. Unfortunately our mistakes are the kind we cannot call back, because they are indelibly printed on another ham's mind. The truth is that the American ham is usually, in nearly all areas of hamming, helpful, thoughtful, generous, and intelligent. How ironic that he is often judged solely on his operating "ham image"!

Bobby Burns, the amorous Highlands poet, once took his arm from around a lassie's waist long enough to observe that if we could see ourselves as others see us, we might change our ways. Although he had some difficulty in following his own advice, it is conceivable that his idea can be for us hams a pretty Scotch way of illuminating that isolated fault that each of us might have. Then we can each polish up our technique, and all of us can take pride in having done our bit to spruce up the American "ham image." And if Senator Goldwater's hunch is right, there could be a corresponding improvement in the attitude of foreign peoples toward our fair country.

. . . K7NZA

Allie Peed, Jr., K2DHA
34 Ashley Drive,
Rochester 20, New York

Calibrate Your Antenna System

STANDING wave ratio instruments are now fairly common items of equipment in ham shacks since there are several good ones on the market at inexpensive prices both in kit form and fully assembled. Since these are passive devices (requiring no power supply) and since most of them can be left in series with the antenna lead at all times, there is a tendency to install them; play with them for a few days; and then, more-or-less ignore them thereafter. Oh, they probably receive an occasional glance to assure that all is well; and if found to be reading excessively high, the average operator will try to find out what's wrong . . . Did one end of the antenna fall down? Did some water get inside the coax? Has wind-whip broken the feed line someplace? But this is the extent of the attention that they will receive in the average operation. They are used, in essence, as a casual sort of "go/no-go" gauge.

This situation is unfortunate because the SWR meter is capable of giving you more information if you'll but take the time to work it out. You probably have all sorts of calibrated devices on your bench—VFO, grid-dip meter, signal generator, frequency meter, etc. —none of which would you feel secure in using without the calibration. Yet, one of the

Fig. 1—The Heathkit Reflected Power and SWR Bridge is typical of several such instruments currently on the market.

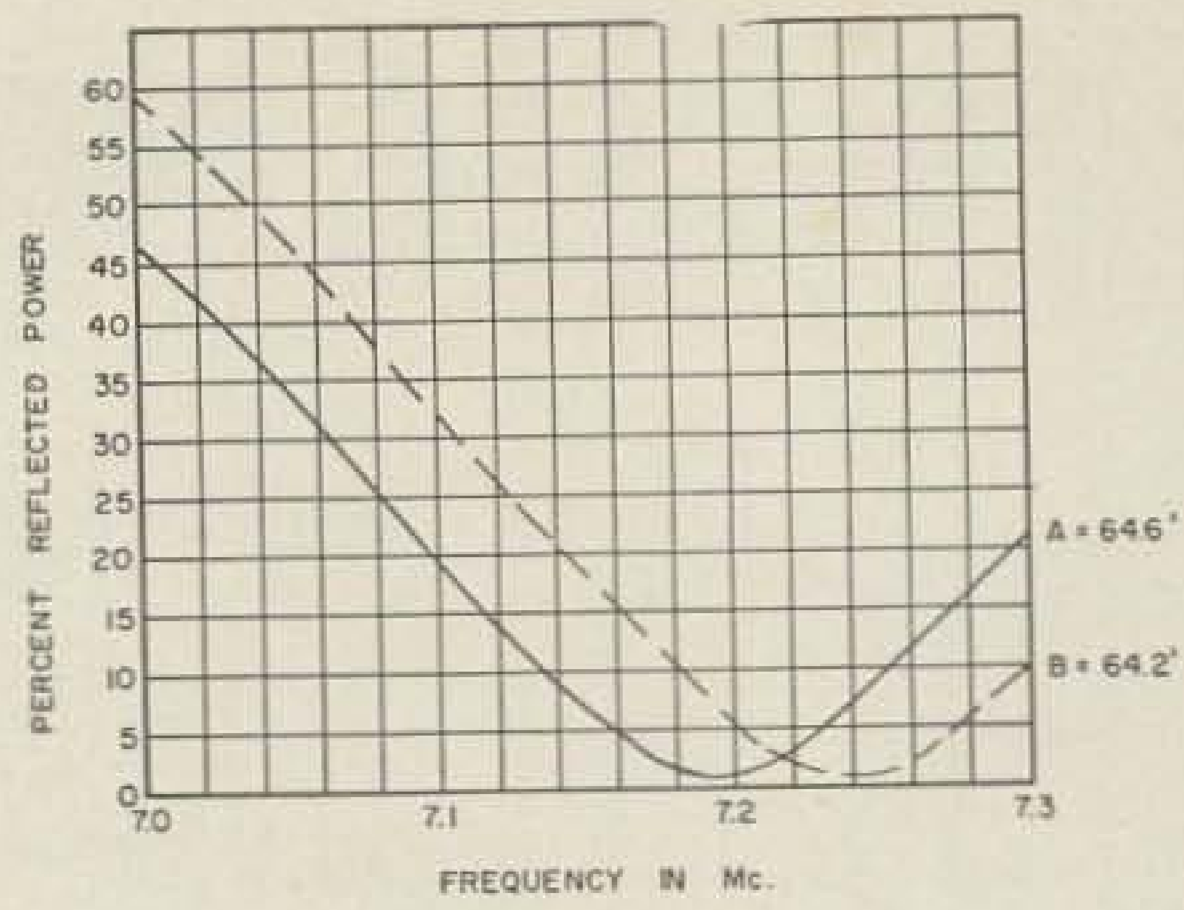

FIG. 3

Fig. 3—Graphical plot of the 40-meter dipole described in the text. Curve A is the performance of the antenna as originally cut. Curve B is the performance after trimming as described.

most important parts of your transmitter system is probably totally uncalibrated. This is the antenna system, and your SWR meter is just the gadget that you need to do a calibration job on it over the frequency range covered by your transmitter.

All that is necessary is a basic understanding of what you want to accomplish here, a working procedure to suit your particular hardware and skywire configuration, and a little time.

Pick an afternoon when there isn't much doing on the bands anyway. In fact, a day when the "bottom has fallen out" is a good one since you will then be causing a minimum of interference to others and you won't be missing any juicy QSO's either. Those sad times when we have a three or four day magnetic storm are fine. On the higher frequency bands you can do your work during times of the day when the bands are closed to all except local traffic.

Fundamentally, all that you are going to do is tune and load your transmitter on a program throughout its full range of coverage in such a way as to get a big-picture view of the system's performance. The data resulting from this investigation you will preserve in graphical form for future easy reference.

This work will go much faster if you will first decide on the frequency ranges that you are going to cover, and the sampling intervals. Then prepare a data sheet which will serve to guide you in your manipulations and also give you a place to note your data for later transcription into graphical form. Of course, you can modify this data sheet to suit the frequency ranges which you wish to cover and you may choose different intervals of testing depending on the degree of precision that you wish to have in your curves. Naturally you will work only on those frequencies which are covered by your equipment and authorized by your license. (If you have antennas for only two bands, you won't try to run curves on other bands. Or if you work only the CW sub-bands you may not wish to run your curves into the 'phone sub-bands. When you are testing in the CW sub-bands, you will be sure that your modulator is off and that you properly identify your test emissions in code.)

A word about recording the data—some SWR meters have both a linear "Percent Reflected Power" scale and a logarithmic SWR scale. For the sake of recording and plotting, the percentage readings are a little easier to use. You can put both scales on your graphical plots and have both types of information even though you originally record only the reflected power data.

In drawing up your data sheets, the following intervals are suggested: For 160, 80, and 40-meter bands, appropriate calibration intervals are 20 or 25 kc. Fuss-budgets might go to 10 kc intervals, but this doubles the work and doesn't give a great deal more information in most cases. For 15 and 20 meters, intervals of 50 kc seem advisable although 20 kc can be used here too if desired. On 10 meters, a 50 kc interval is usually adequate and even 100 kc can be used if your antenna is sufficiently broadband in its response. On the bands above this, 100 kc or even 250 kc intervals may be sufficient. In the course of determining the data, you may find that your antenna has a rather sharply defined resonant dip. If so, it would be well to decrease your frequency intervals on either side of this point in order to arrive at a good resolution of the curve in the vicinity of resonance and thus locate the point of resonance rather precisely. For this reason, when you discover a region of sharply dipping reading on your meter, you'd better decrease your testing interval to half the nominal value and obtain some additional points. You'll need them later when you start plotting the data graphically.

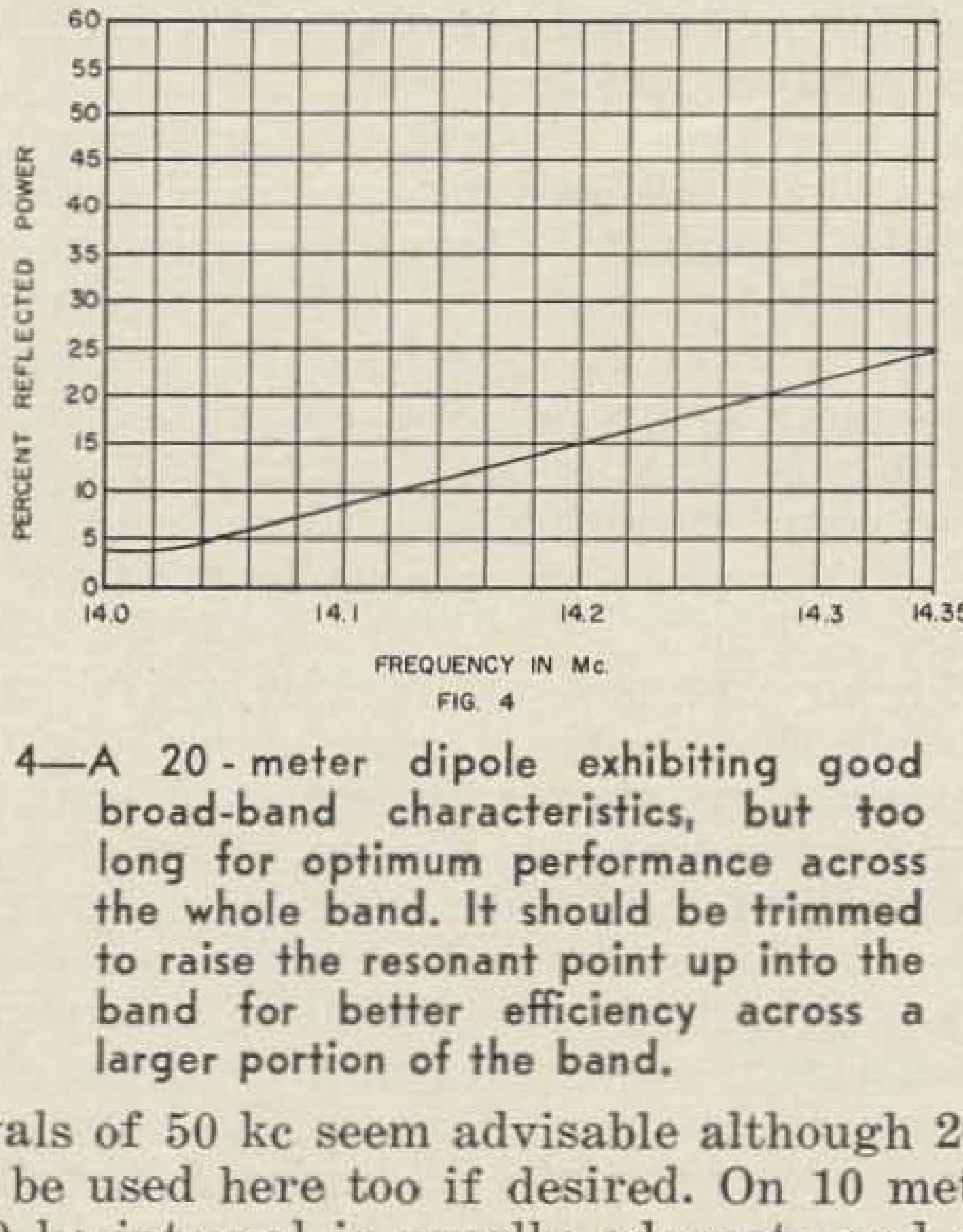

Fig. 4—A 20-meter dipole exhibiting good broad-band characteristics, but too long for optimum performance across the whole band. It should be trimmed to raise the resonant point up into the band for better efficiency across a larger portion of the band.

Having drawn up your data sheet, you are ready to begin. Start at one end of the first band and adjust your transmitter for the indicated frequency using the minimum amount of power that you can obtain from your transmitter and still achieve a full-scale deflection on your SWR meter in the forward measuring mode. Calibrate your frequency carefully, preferably using a hetrodyne frequency meter (vis. a BC-221, borrowed for the occasion if possible) or other reliable method of frequency checking which you may have (crystal calibrator, calibrated receiver, etc.). It is important that your frequency readings be reasonably accurate in this testing or your results will not be reliable. When you come to frequencies at the band edges, for safety's sake you may wish to do your testing at a spot 2 or 3 kc inside the band rather than using the exact band edge. Just plot the exact frequency used. You can extrapolate the curve out to the band edge when you are plotting the data later.

After zeroing-in the desired starting frequency, tune the transmitter accordingly and adjust the SWR meter for full-scale deflection in the forward measuring mode. Then, switch to the reverse reading and determine your reflected power or SWR, whichever you have decided to read. Record this on your data sheet. Then note the next test frequency on your data sheet and move the VFO to it. Touch up the rest of the transmitter tuning. Check the adjustment of the SWR meter and make your second reading. Continue through the remainder of your data sheet for the range of frequencies and bands which you have elected to calibrate. (Be sure to change antennas when you change bands if you have separate antennas rather than a multiband array.)

If your antennas are fairly narrowband in their response, you may not wish to run data for the whole amateur band. Establish some

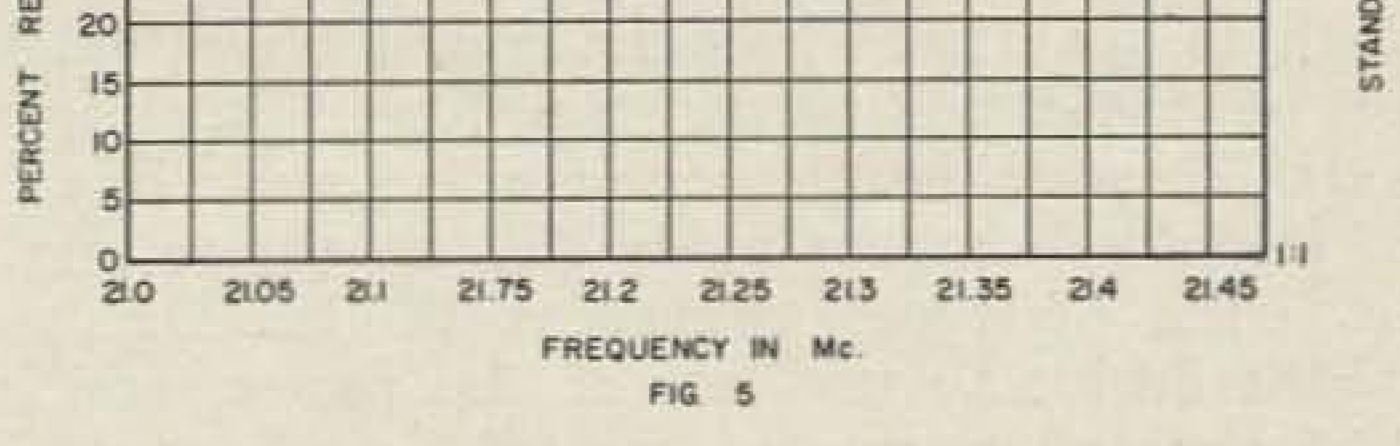

Fig. 5—Third harmonic performance of an inductively loaded 40-meter dipole on 15-meters. Optimum efficiency is not very good since the SWR does not drop below 2:1 at the resonant frequency. This antenna could be used with fair effectiveness only in the 'phone sub-band.

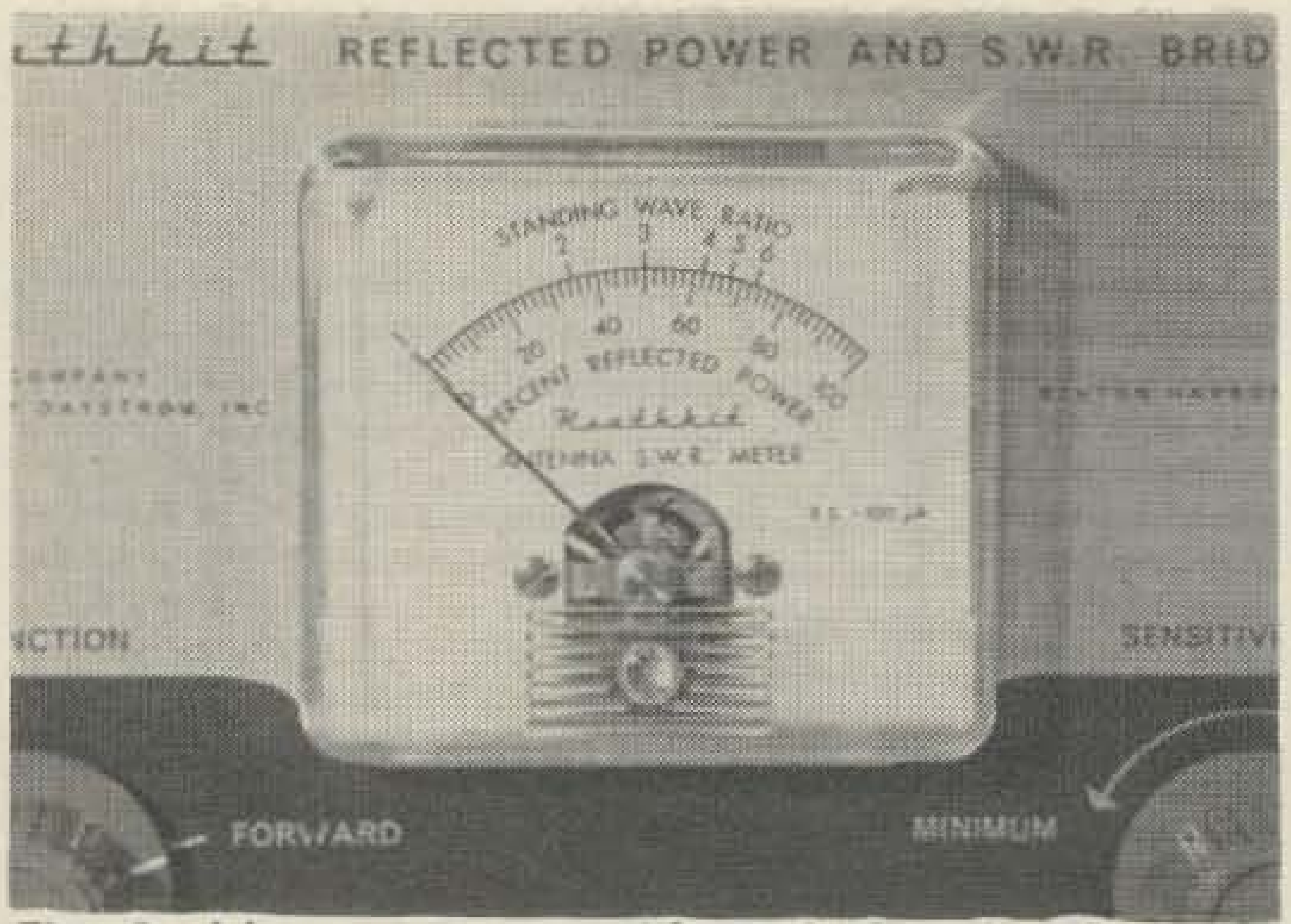

Fig. 2—Many meters provide a dual scale. The linear percentage reflected power readings are easier to read and plot graphically.

arbitrary limit of reflected power or SWR beyond which you would not consider use of the system anyway—say, 75% reflected power, or a SWR of 6:1 for example. When your readings exceed this value, cease your efforts on that band.

Now, with your data neatly tabulated, you are ready to plot the graphs which will give you a picture of your antenna's performance. Obtain some rectangular coordinate graph paper (from a stationery store, drawing supply house, or even the "five-and-dime" store). The type of ruling is of no great consequence. That which has heavily ruled squares of the order of one-quarter to one-half inch on the side with each of these blocks then divided into four or five smaller squares by lighter green or gray lines is quite satisfactory. If you have an ARRL logbook, you'll find one sheet of paper of this type bound into the back of the logbook, and this is a good place to keep your antenna calibration curves. If you wish to put all of your curves on one sheet of paper, it will be best to draw the curves of the different bands in various colors of ink or pencil and use the same color for the corresponding frequency scale along the bottom of the paper for each band.

Having obtained your graph paper, choose a reasonable scale for the band of frequencies of the first band along the horizontal scale of the paper (oriented with the short dimension vertical). For example, if the first band that you wish to plot is 80 meters, you'll have 500 kc to be indicated along the lower horizontal axis. If your particular graph paper has 25 of its large squares along this axis, you might let each of these represent 20 kc. Or, you might decide to use less of the paper, and let 12.5 squares represent the total scale at 40 kc each. Letter in the points on this frequency scale along the horizontal axis.

Next decide on your vertical scale. If you are plotting percent reflected power readings, let each of the larger blocks represent 5% or 10% and carry your scale up to your arbitrary upper limit of 60 or 75%. If you have recorded SWR readings start your vertical scale in the lower left hand corner of the plot with I (not zero) and proceed upward in increments of 0.2 for example to your abitrary limit of 5:1 or 6:1.

When you have established this coordinate framework, it is but a few minutes work to transfer the points from your data sheet to the graph paper. Locate each frequency point and go up vertically from that point until you come to the corresponding percentage point on the vertical scale and make a dot with your pencil. When you have plotted all of these for one band, use a French curve to connect these dots with a smooth curve which conforms to line of dots as nearly as possible.

After you have finished with the first band, draw up a new set of coordinates on a fresh sheet of paper for the next band. Or, if you wish to place all of your curves on one sheet of paper, you can use the same vertical scale for all, but you will have to plot different frequency scales along the horizontal axis and use different colored pencils for the scales and corresponding function lines.

You now have a complete calibration of your antenna system's performance over your total operating spectrum. Thereafter when you wish to band-hop, or operate a contest you can refer to your curves in selecting the frequencies where your system is most efficient. In setting schedules or making decisions to QSY, you can make your frequency selections with assurance of how your rig will perform at the new spot.

If your antenna system is typical, you'll probably find in the course of making these determinations that your system is not performing exactly at optimum. You may find that it favors one end of the band at the expense of the other and perhaps you like to work both ends equally well. Or, you may find that it favors one end when in fact you prefer to work the other end. From the information in the curves, you can determine fairly closely what should be done to optimize the situation and then proceed directly to do it without a lot of guesswork or cut-and-try.

You'll probably be surprised to find that antennas cut by "the formula" when erected under your actual set of conditions do not necessarily perform according to the mathematical predictions. Surrounding objects, height above ground, and similar practical considerations alter the performance over the theoretical ideal conditions assumed by the mathematics.

You can use the data contained in your curves to make some alterations to optimize these conditions. For example, assume that your 40 meter antenna exhibits its lowest SWR at 7.2 mc on your curve. Assume further that you work very little CW on this band, but that you like to work the whole 'phone subband. Obviously, the ideal condition using this

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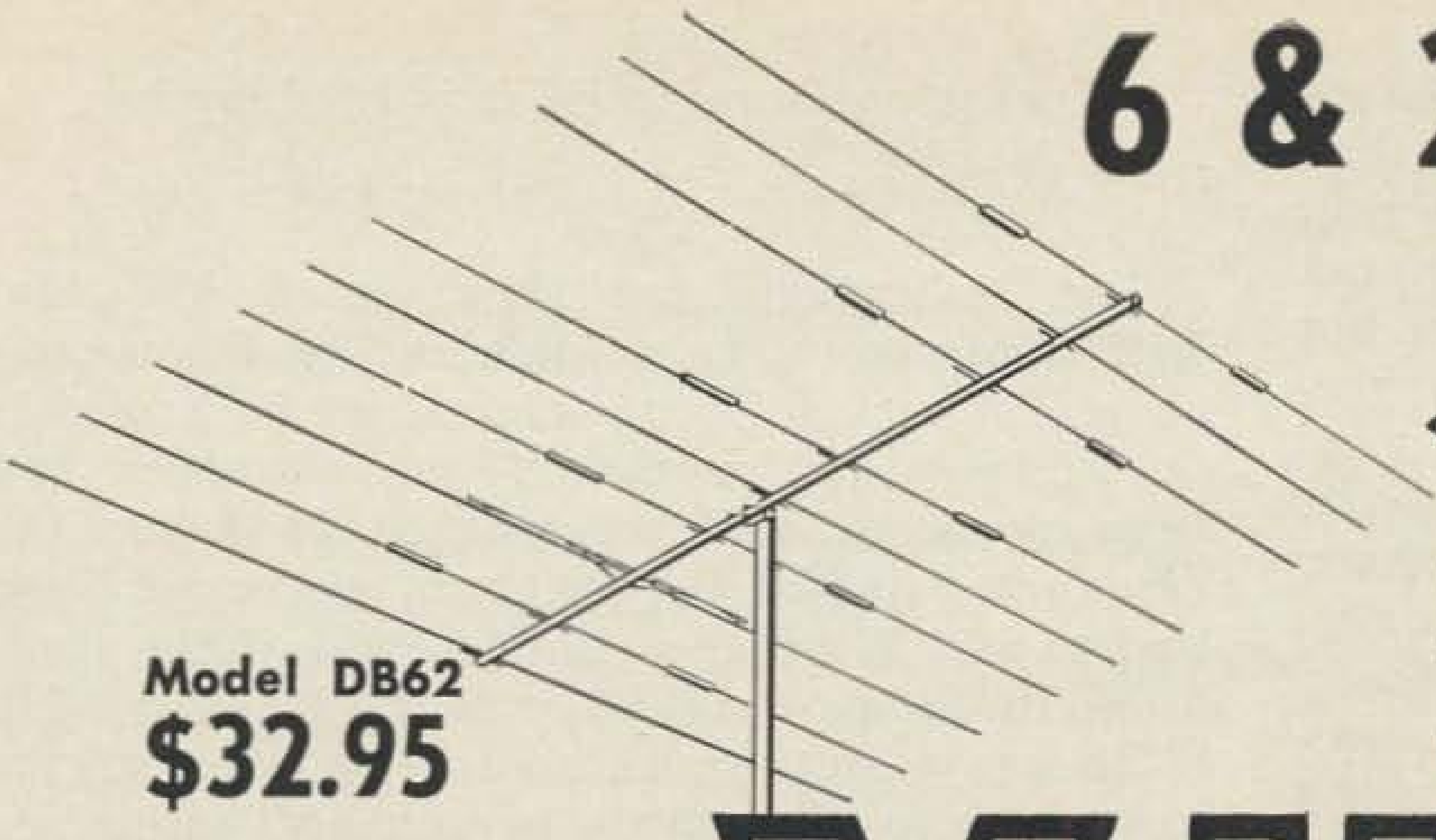

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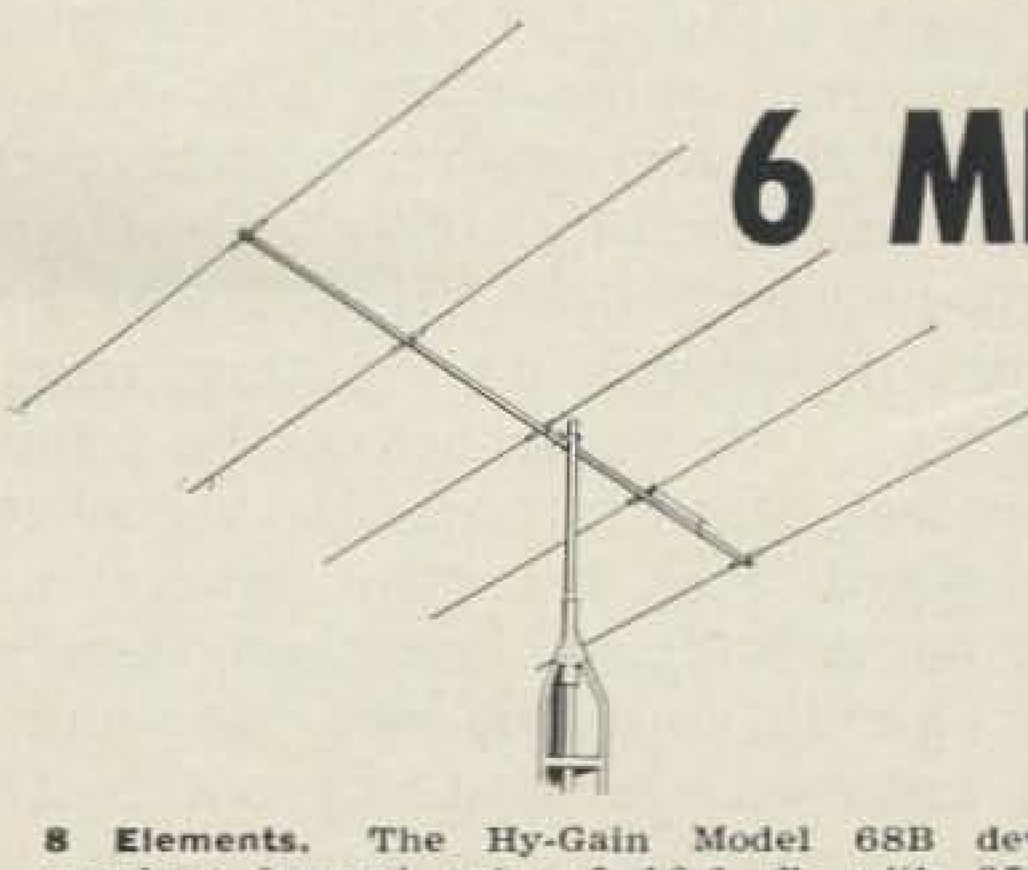
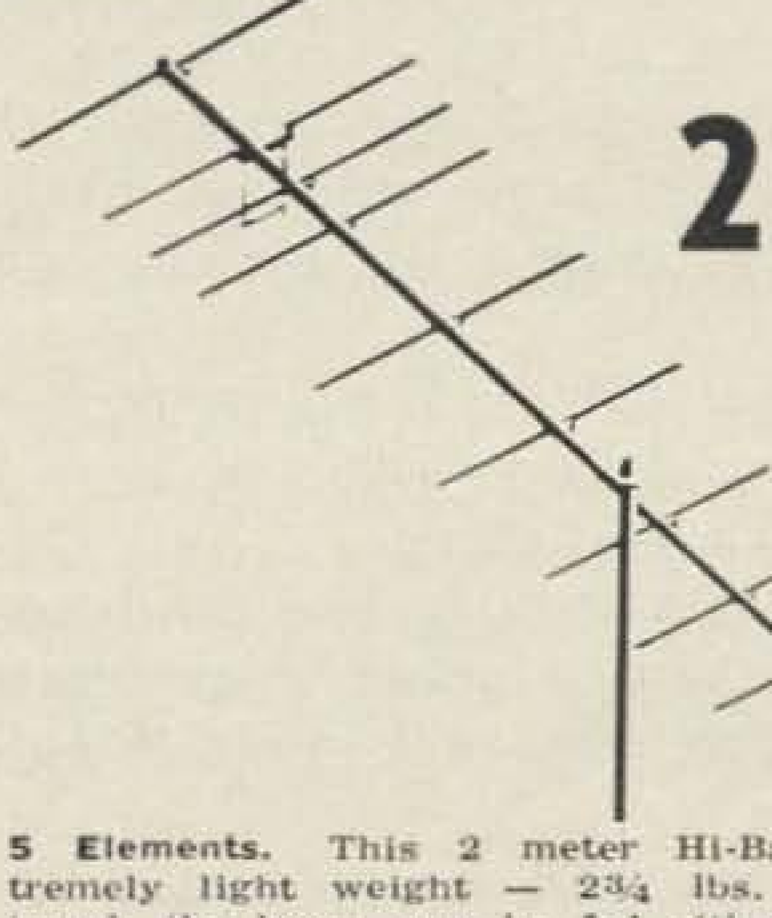


2 METERS



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Just use the formula to calculate the electrical length of your existing antenna using the resonant frequency determined from your curve. In the case cited above, subtract this from the actual physical length. This will give you the few inches difference which must be trimmed from your wire. Divide this in half and clip this much from each end of the wire. No need to re-measure the whole antenna.

To make this clear, we'll go through the calculations for the problem outlined above. The antenna was cut originally by this calculation:

$$\text{Length in feet} = 468 \div \text{freq. in mc}$$
$$= 468 \div 7.25$$
$$= 64.6 \text{ feet}$$

The curve indicates that under the conditions of erection and operation it actually resonates at 7.2 mc and thus it acts as if it is electrically the following length:

$$\text{length in feet} = \frac{468}{7.2\text{ mc}} = 65 \text{ feet.}$$

Thus it performs as if it is too long by:

$$65' - 64.6' = 0.4 \text{ feet or 4.8-inches}$$

The indications are that we should trim half this amount from each end of the wire—about 2½ inches from each end would probably do the job. Of course, if the situation had been reversed and we wanted to lower the resonant point of the antenna, we would have had to add 2½ inches to each end of the radiators, or cut new radiators to the longer length if there wasn't enough surplus wire in the end-wrap to allow this amount of extension.

You may also find that on some of your plots you really do not have a dip in the curve indicating the location of the resonant point of the system. In these cases, if the curve starts high at one end of the band and generally declines toward the other end, the chances are that the resonant point is actually outside the band beyond the end with the lowest reflected power reading. In such cases, you might do well to shorten or lengthen the antenna slightly (depending on whether resonance appears to be above or below the band) and run a new set of data to see if this moves the resonant point back into the band. Once the resonant point is found, you can then go through the calculations outlined previously to place resonance at the desired spot in the band for your particular operating needs.

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A Review of the National NC–155 and the NC–190

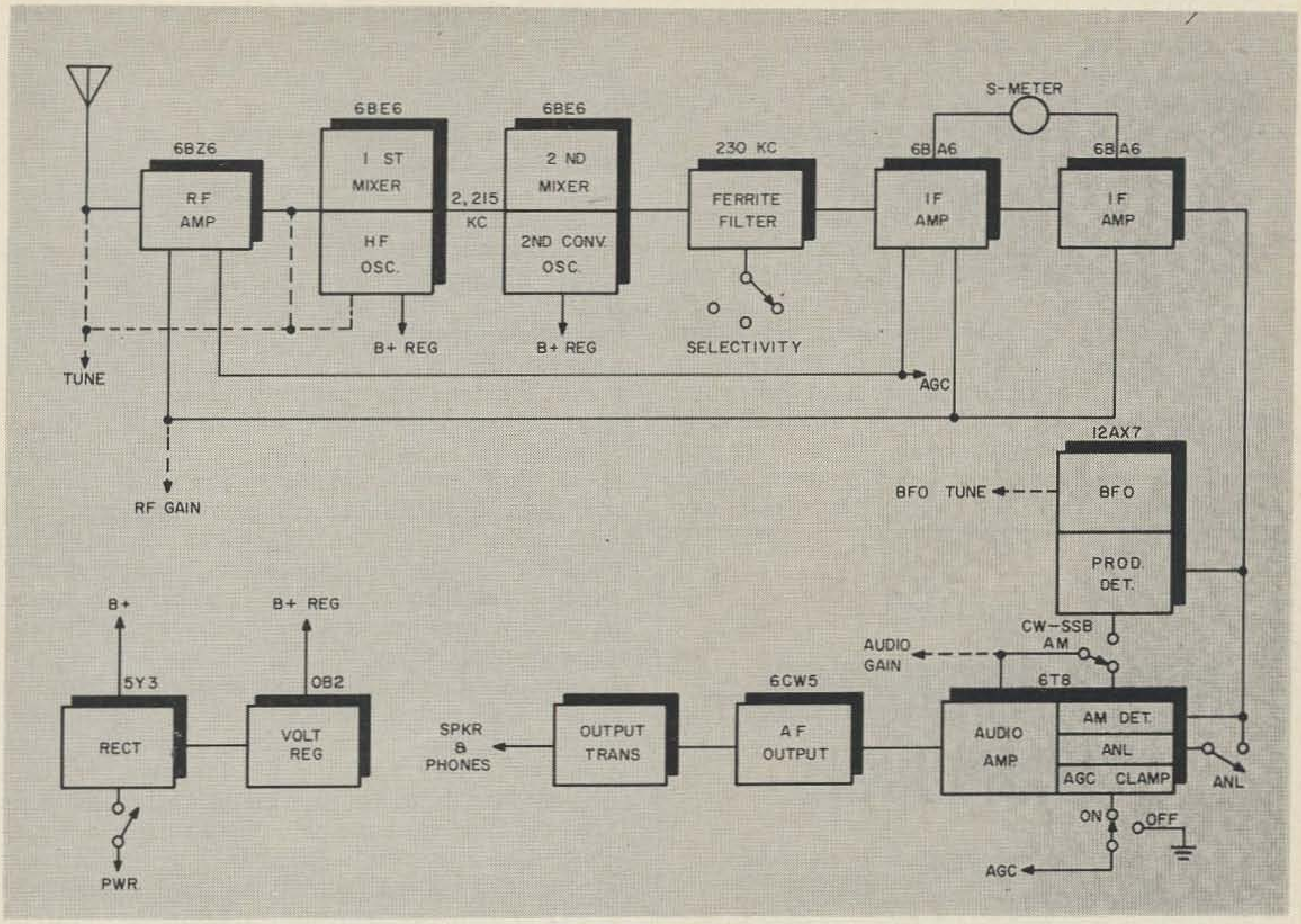
Two of the most popular receivers to appear on the ham market in the past few years are National Radio Company's new NC-155 and NC-190. The NC-190 is a double conversion general coverage receiver tuning 540 kc to 30 mc, and the NC-155 is its ham-band-only equivalent covering all amateur bands between 80 and 6 meters. While both receivers are priced at the lower end of the National line, they offer features and performance equal to most receivers of similar types selling in the medium to high price area, and in a couple of instances (which we will take up separately) provide conveniences which are found in no other units that we are aware of.

Both receivers are quite similar in appearance and identical in size. They are both finished in a handsome color combination of dark blue and silver gray, and measure a very compact 8⅝″ high, 15⅝″ wide and 9″ deep. With the exception of front end circuitry, the two receivers are extremely similar electrically (see block diagram Fig. 1). A 6BZ6 is used as a pentode rf amplifier exhibiting semi-remote cut-off characteristics to provide good AVC control and low intermodulation. The 6BE6 first mixer with its self-contained local oscillator converts the signal frequency to the first *if* of 2215 kc. Great care has obviously been taken in the local oscillator portion of the first mixer in both receivers to obtain maximum stability through the use of ceramic coil forms, rigid wiring techniques and the use of a solid ⅛″ steel front panel rather than aluminum. The 2215 kc *if* signal moves along to the second 6BE6 mixer and local oscillator combination, where it is converted again to 230 kc and introduced into the Ferrite Filter. This little package, which was first developed by National for use in the well-known NC-270, is composed of ferrite cup cores with Q's of 500 to provide a high degree of selectivity at a relatively high intermediate frequency, thus reducing secondary images. Capacitive coupling between the cup cores is varied to obtain bandwidths of 600 cycles, 3 kc, and 5 kc for CW, SSB, and AM respectively. Coming out of the Ferrite Filter, the signal is fed to two 6BA6 *if* amplifiers also operating at 230 kc after which (depending upon the mode of reception) the signal passes to either a diode AM detector or a triode product detector using one-half of a 12AX7. The other half of the 12AX7 is used as the variable BFO. The triode section of a 6T8 is used for the first stage of audio amplification, and the three diodes available in the 6T8 envelope are used for AM detection, the extremely efficient AM noise limiter, and the clamp to provide delayed AVC operation for maximum sensitivity on weak signals. The audio output from the 6T8 is fed to the grid of the 6CW5 which provides up to one watt of audio at the 3.2 ohm speaker terminals. So much for the circuit description—Now let's see how they work!

The NC-190, the general coverage receiver, is a little wonder—This is the first general coverage unit we have laid our hands on (with the exception of some equipment designed primarily for the military in the two kilobuck price region) which handles like a conventional ham-band-only box—Probably the greatest single reason for the "feel" of the NC-190 is the miniature Velvet Vernier employed in the bandspread dial to provide a drive reduction of 60:1—As a result, the tuning ratio of the '190 approximates that of the average ham-band receiver. We understand from National that the planetary drive in question will be soon available as a separate component. We foresee a happy future for this little gadget since it provides a 5:1 reduction in a package the size of an overgrown shaft bushing—Drill one hole, slip in the vernier, tighten up the lock nut and the job is done (if you are wondering how the 60:1 ratio is achieved, the 5:1 vernier drives a 12:1 pinch mechanism—5 x 12 = 60) A shiny little knob under the bandspread scale entitled *Dial Selector* caught our attention as soon as the receiver was unpacked. A quiver with anticipation, we approached the knob carefully, pulled it out a fraction of an inch and rotated it 180 degrees. Lo and behold, a whole new set of bandspread scales appeared in the dial window calibrated for the five most popular foreign broadcast bands! You fellows who occasionally like to listen to foreign broadcast stations finally have a receiver that allows you to locate a station by frequency! Another immediately apparent advantage of the NC-190 is the use of *five* main tuning bands rather than the usual three or four—Thus instead of covering the 10 to 30 mc range in one fell swoop, this range is divided into two 10 mc bands which thereby afford greatly improved calibration and stability (the latter as a result of more efficient temperature compensation over a reduced tuning range).

We operated the NC-190 for approximately two weeks on AM, CW, and SSB. We found the receiver to be remarkably sensitive in all modes of operation (National claims sensitivity better than one microvolt for 10 db), with excellent electrical and mechanical stability. SSB operation is easier than we ever thought possible on a general coverage receiver, and this is accounted for in large part by the very high tuning ratio together with the excellent product detector and SSB/CW AGC system. Sideband selection is by means of a USB/LSB calibrated BFO control, which takes the guess-work out of properly setting the BFO for proper reception. CW performance was excellent, and with the Ferrite Filter set in the 600 cycle position, single signal CW reception was easily attained.

In summary, the NC-190 offers a surprising amount of performance for 220 bucks, and seems to us to be an ideal receiver for the



Block Diagram

ham who wants excellent ham band performance along with general coverage at a relatively low price. We forsee a couple of other areas where the NC-190 will be quite popular—as a general coverage stand-by receiver for the snazzy ham-band-only shack and as a tunable *if* for some of the new VHF converters—The combination of price and performance on this package is hard to beat!

The trial of the ham-band-only NC-155 was viewed with some trepidation in view of the $199 price tag. Twenty-five years ago it was possible to buy an awful lot of receiver for this kind of money, but the cost of labor and materials has risen to the point where it takes around $250 to start getting the kind of performance necessary for today's more sophisticated operation. We were, therefore, prepared to be disappointed in the NC-155 even in view of its handsome appearance and high quality of finish and construction. This feeling began to be dispelled as soon as we laid a hand on the main tuning dial, and by the end of our first forty-five minute session with the NC-155 our original opinion was completely replaced by the happy conclusion that the NC-155 was more than able to hold its own in far higher priced company! Just as in the NC-190, the first operating feature noticed was the extraordinarily smooth tuning mechanism. The NC-155 also uses a 60:1 dial reduction, and the combination of the heavy flywheel on the tuning dial and the Velvet Vernier in a ham-band-only receiver results in a "feel" which closely approaches that of our own NC303. According to National, the 60:1 reduction on the NC-155 is almost twice as high as that of any other ham-band-only receiver, and as a result it is possible to work in on sideband almost as easily as AM (advanced modulation). Dial calibration and illumination is excellent, and electrical features are basically the same as those of the NC-190 since both receivers are almost identical from the first mixer back to the loudspeaker. The NC-155 seems to be as mechanically stable as any receiver we have yet tried with a crystal-controlled front end—We tuned in a relatively strong CW signal on 20 meters, picked the front of the receiver up three inches and let go—There was a slight microphonic bong when the Flip Foot crashed on the tabletop, but the receiver had apparently not shifted a cycle. Electrical stability was almost as impressive—Total observed drift over a four to five hour period from a cold start on 15 meters was in the order of 1 kc.

Six meter stability was naturally not nearly as good, but sensitivity on this band certainly exceeded our expectations—National claims six meter sensitivity better than one microvolt for 10 db, and while we did not actually measure sensitivity, the '155 dug up all the weak ones and had enough hop in the front end to show an appreciable decrease in noise when the antenna was replaced with a 50 ohm resistor. Six meter signals were quite easy to tune as a result of the excellent dial ratio, and we are presently toying with the possibility of using the six meter range on the '155 as a tunable *if* for 2 and 1¼ meter converters because of its complete 4 mc coverage and excellent performance.

Both the NC-155 and NC-190 fill big holes in the current crop of receivers.

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The Perfect Setup

Douglas G. Hedin KøOFB
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THE key to good hamming is a good station setup, and this is a lot easier to achieve than you may think. Whether you are trying to decide how to set up the new h-f station or have been operating for a while but aren't getting out like you should, this article is for you.

For all the sour-grapes balderdash one hears on the bands about system-engineered ham equipment, the idea is perfectly sound: each part of the system must work properly with at least one other part. If we investigate this working-together concept more closely, however, we find that such a system really is just a number of "twosomes." For example, the following twosomes will be found in any amateur station: space-antenna, antenna-feedline; feedline-transmitter; and feedline-receiver. It makes no difference whether they are made to work together at a factory or you make them work with ingenuity and hot solder.

In fact, it is because of these twosomes, or "interfaces," as they are properly called, that it is easy to set up an amateur station properly and at low cost. It isn't necessary to perform a set of simultaneous equations in a half-dozen unknowns, but on the other hand, a station cannot be set up just one part at a time. (Can you imagine only one connector connecting?)

In general, the antenna, especially the high-current, center portion, should be as high as possible. There are several reasons for this. The higher the antenna is above the average terrain, the lower (and better for d-x) will be the minimum usable radiation angle. The higher the antenna is above trees and other conducting objects, the less power they will absorb during both transmission and reception. The higher (up to a point) an antenna is above ground, the higher will be its radiation resistance and, hence, its efficiency.

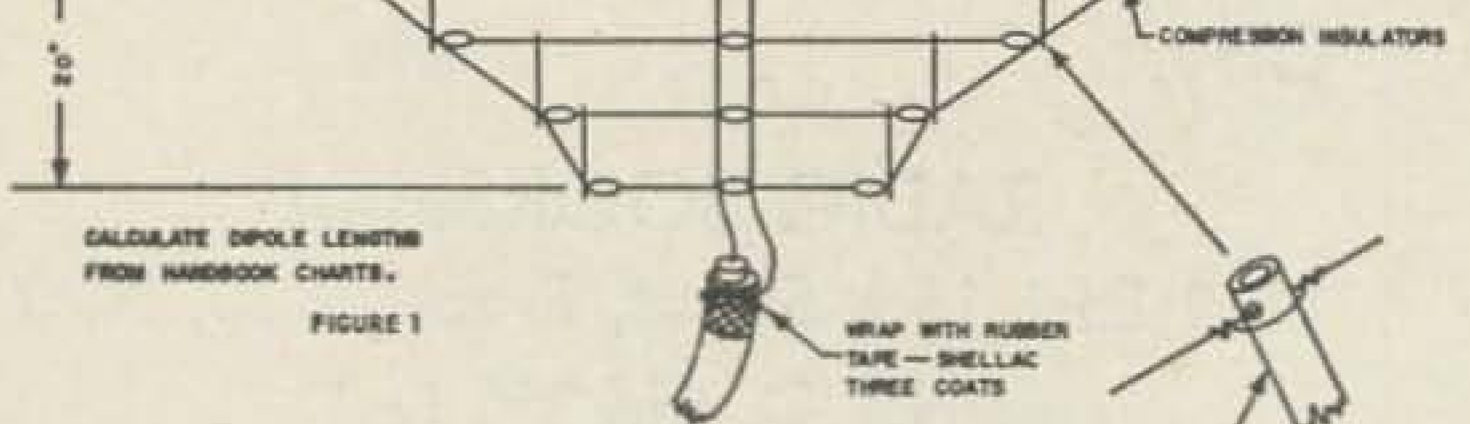


FIGURE 1

Horizontal, half-wave dipoles usually are used on the h-f bands, primarily because, dollar for dollar, their simplicity and light weight permit them to be erected at greater heights than any other antenna. To be sure, the low radiation angles of vertical antennas are ideal for DX work; but efficient vertical h-f antennas are cumbersome and difficult to erect, they are more vulnerable to man-made noise, and unless a good artificial ground is constructed for them a prohibitive amount of power will be lost in the earth.

A widely-held, somewhat erroneous idea is that the user of a horizontal antenna can communicate in only two general directions, because the horizontal radiation pattern of a horizontal dipole is two lobes at right angles to the antenna wire. But what about the vertical radiation pattern?

It should be remembered that from a horizontal doublet, only part of the total energy is radiated broadside to the wire and that the polarity-versus-amplitude of the energy radiated in any direction depends on both the elevation angle and the azimuth considered. Much of the energy is radiated from a horizontal dipole in line with the wire, or "off the ends." This energy will be received just as well by an antenna the end of which is toward the transmitting antenna as will the energy radiated at right angles be received by an antenna which is broadside to the transmitting antenna. This vertically-polarized energy is radiated at somewhat high radiation angles; but the only shortcoming of the end-radiated rf is that the skip, or maximum range of communication will be somewhat shorter than that for the horizontally-polarized energy from the same antenna.

It is relatively easy to work all bands, from 3.5 to 29.7 mc, with only one feedline if single-wire, center-fed, half-wave dipoles are used. The dipoles are merely cut to the proper length and connected together as shown in Fig. 1. Most of the amateurs who use this multi-dipole antenna system do not include a dipole for the 15-Meter band, because the 40-Meter dipole will load up fairly well on 15 Meters. However, the radiation pattern thus produced contains several narrow lobes instead of the two wider lobes characteristic of a half-wave dipole when operated on its resonant frequency. The author once used one of these multi-dipole antenna in which a 15-Meter dipole was omitted; operation was excellent on all bands except 5-Meters, until a 15-Meter dipole was added. The new dipole really made a difference, and the author heartily recommends that it be included.

While the impedance of a half-wave dipole may be about 72 ohms in free space, it varies considerably at the heights amateurs have to work with. Most amateurs should be familiar with the standard graph of theoretical antenna impedance (for a half-wave dipole) versus height above perfect ground. The graph also is fairly accurate for heights of more than 0.3 wavelength above "real" ground level. However, it gives no indication of what the actual impedance of a dipole over "real" ground may be for lower heights, because the impedance is shown to approach zero as the height of the antenna approaches zero.

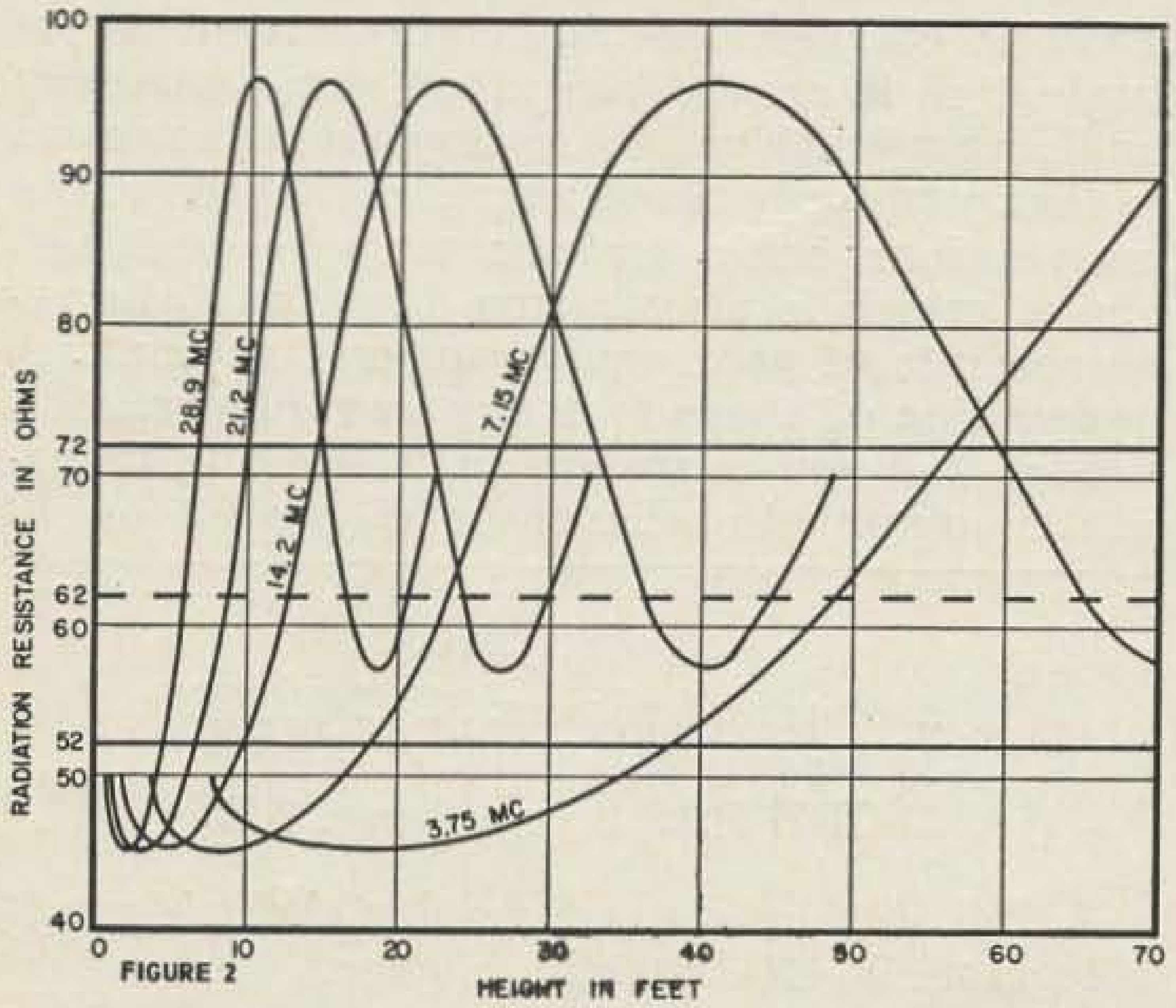


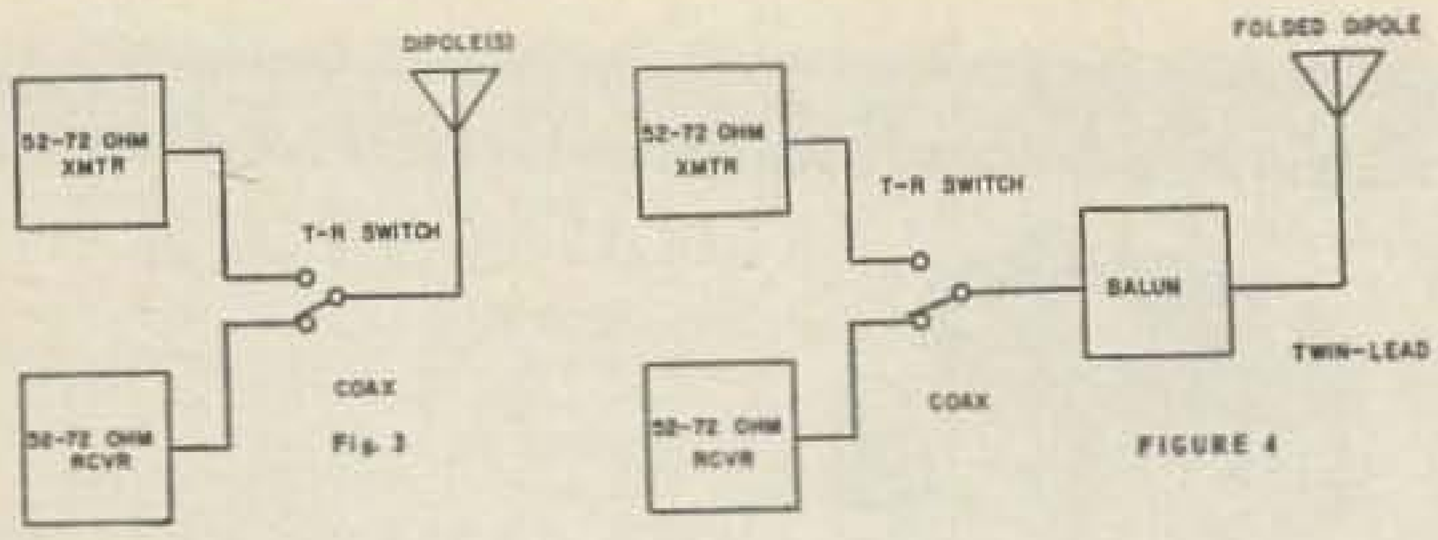
FIGURE 2

Actual measurements* over "real" ground, however, have shown that the antenna impedance falls no lower than about 45 ohms at 0.06 wavelength (16 feet at 3.75 mc), and in fact begins to rise quite rapidly as antenna height decreases further. Fig. 2 shows the antenna impedances to be expected on the h-f bands for heights up to 70 feet or 0.7 wavelength, whichever is lower for a particular band.

Of course, the depth of electrical ground below "real" ground level will vary from location to location, and thus will affect the accuracy of Fig. 2. It should be remembered, however, that electrical ground usually is no more than a few feet below "real" ground at 30 mc, and less than 10 feet below "real" ground at 3.5 mc. Thus, the accuracy of the graph will vary only slightly for different locations, probably not enough to be detectable.

Amateurs usually use either 52- or 72-ohm coax or 72-ohm twin-lead to feed half-wave dipoles. Referring to Figure 2, the dashed line represents 62 ohms, or half-way between 52

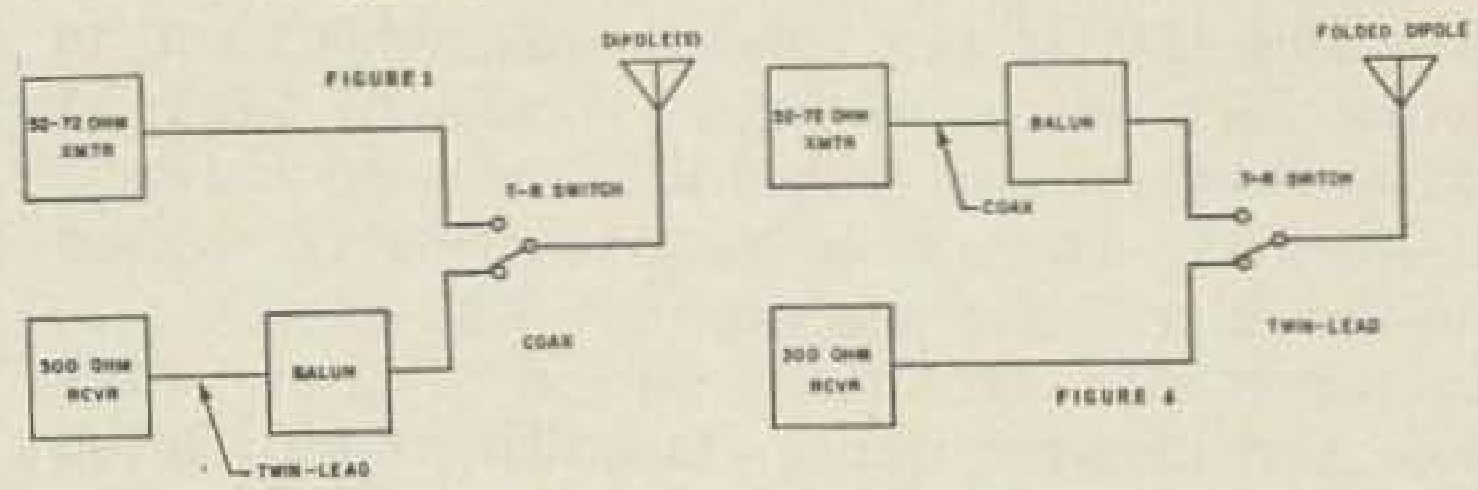
*Henny, Keith. **Radio Engineering Handbook**, Fourth Edition, 1950, McGraw-Hill, page 635 (graph).



ohms and 72 ohms. The closer the impedance of the feedline matches the impedance of the antenna, the more power will be transferred between the antenna and the feedline, and the lower will be the standing wave ratio. Therefore, if the impedance of an antenna (as determined from Fig. 2) will be higher than 62 ohms, it should be fed with 72-ohm twin-lead or coax. If the impedance will be lower than 62 ohms, the antenna should be fed with 52 ohm coax.

Just as maximum power will be transferred between the feedline and the antenna if the impedances are the same, maximum power will be transferred between the feedline and the transmitter or receiver if the feedline impedance is the same as that of the transmitter or receiver.

Before the days of pi-output circuits, transmitters usually were link-coupled to the feedlines, if feedlines were used at all. The impedance or the link didn't matter much, because the coupling of the link to the final tank coil could be changed to compensate for wide ranges of link-feedline impedance mismatches. Receivers had all kinds of input impedances; each manufacturer apparently threw dice or else counted tea leaves, which was about all that could be done anyway because there were no standard impedances at the time. Standing waves could stand until they got tired, and open-wire feeders were the thing. Those were the days of the universal, indispensable antenna coupler.



Today, however, the impedances most often encountered in amateur installations are 52, 72, and 300 ohms. With only these three impedances to match, amateurs now can use baluns instead of antenna couplers. Unlike the antenna coupler, the balun never requires retuning, so it can be tucked up out of the way and forgotten. Even more important, however, is that with only three values of impedance to match, four basic systems may be designed, one of which is almost sure to satisfy the requirements of your equipment and antenna. A description of these four systems follows.

Fig. 3 shows a system in which the transmitter output impedance is either 52 or 72

Heath SB-10 on Six

Captain George M. Hunt W4NUT/Mm

1218 SW 21 St. Court Fort Lauderdale, Florida

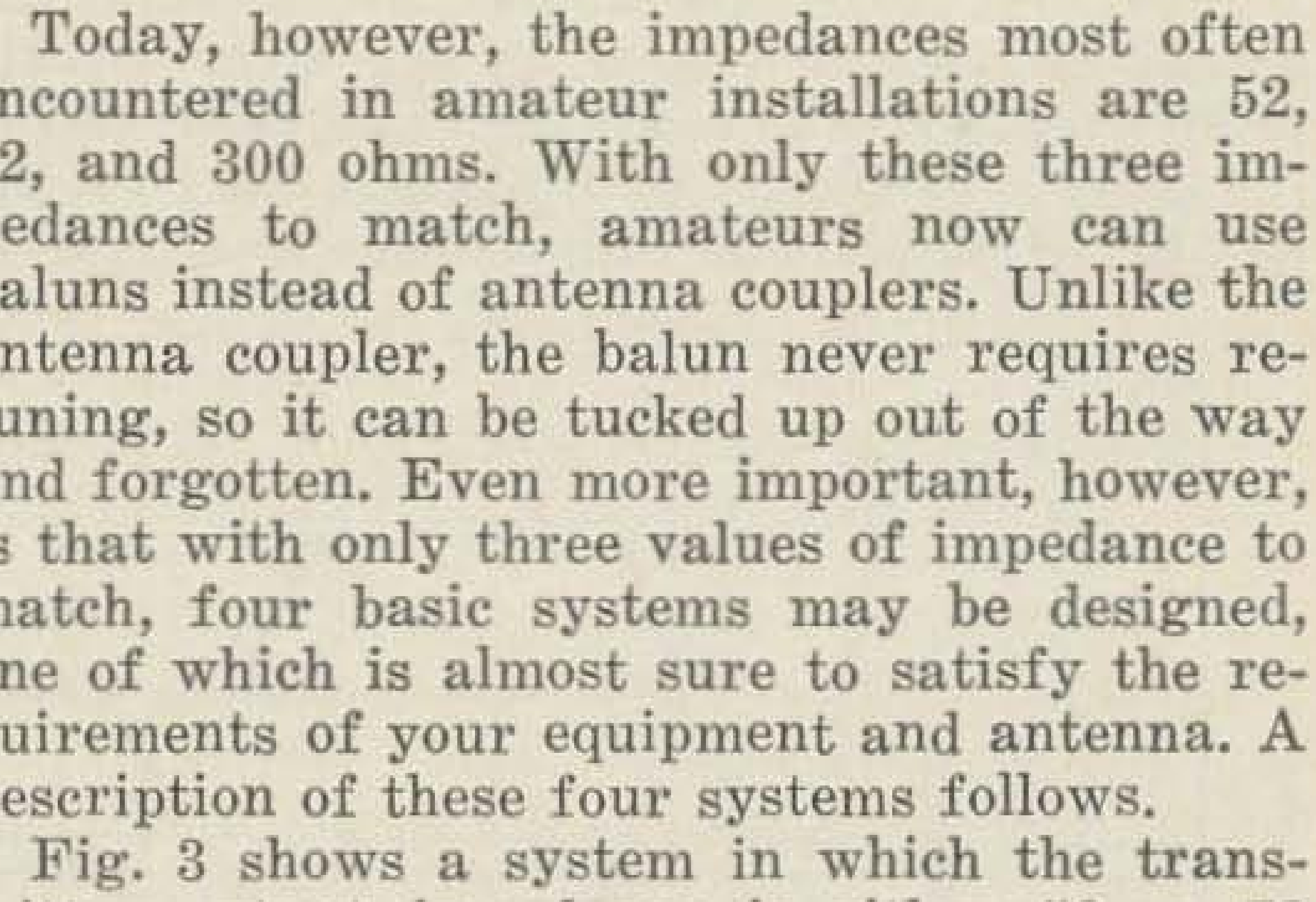
Being a VHF addict, I recently purchased a SB-10 from Heath for the express purpose of putting this phasing type Single Sideband Adapter on 6 meters. The object was to use it in conjunction with the Heath VHF 1 "Seneca." Using the 50 mc drive from the Seneca, converting to single sideband with the SB-10, then driving either the Seneca final in AB or other linear that would require no more than 8 watts of drive.

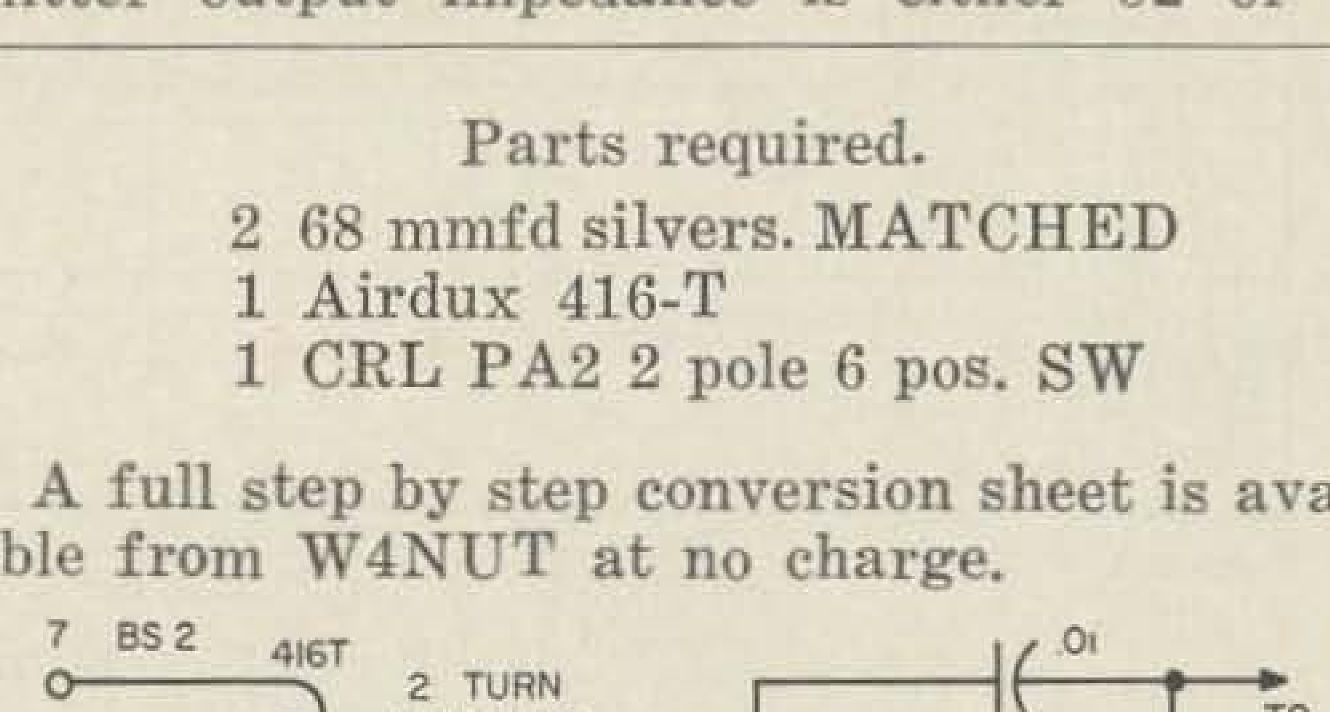
The operation was successful, the SB-10 works as intended, 50 mc sideband driven from the Seneca. The SB-10 conversion is as follows. Disconnect the 10 meter section of the adapter, and insert 6 meter coil sections outboard of the existing coils, using the wafer switch points formerly used for 10 meters. Add one more ceramic wafer switch to the existing stack, replace the 110 mmfd 1% micas in the phasing stack with a matched pair of 68 mmfd silvers. Remove 3 turns from the 10 meter slug tuned coil, feed three watts of 50 mc drive and 8 watts PEP 50 mc single sideband, upper, or lower comes out the back end. Easier than hetrodyning, no mixers, just tune as per the SB-10 instructions.

Parts required.

2 68 mmfd silvers. MATCHED
1 Airdux 416-T
1 CRL PA2 2 pole 6 pos. SW

A full step by step conversion sheet is available from W4NUT at no charge.





ohms, the receiver impedance is 52 or 72 ohms, and the antenna is either a dipole or a multi-dipole system. Although it is the simplest system possible, it also is the best, because everything except the antenna is shielded by the outer conductor of the coax (keeping spurious radiation in and noise out). Incidentally, coax (unbalanced) feed is just as good as twin-lead (balanced) for h-f work; feeding a balanced antenna with coax becomes a problem only when the diameter of the coax becomes more than a small fraction of a wavelength.

Fig. 4 shows a 52- or 72-ohm receiver and transmitter used with a balun and 300-ohm twin-lead for feeding a folded dipole. Notice that the balun, which matches the receiver and transmitter to the 300-ohm line, is on the antenna side of the T-R switch, and it must carry the output power of the transmitter.

Figure 5 shows a 52- or 72-ohm transmitter used with a 300-ohm receiver and either a dipole or multi-dipole antenna. In this system, the balun is placed between the receiver and the T-R switch, and thus does not carry appreciable power.

Fig. 6 shows a 52- or 72-ohm transmitter and a 300-ohm receiver used with 300-ohm twin-lead and a folded dipole. In this system, an open relay or switch may be used.

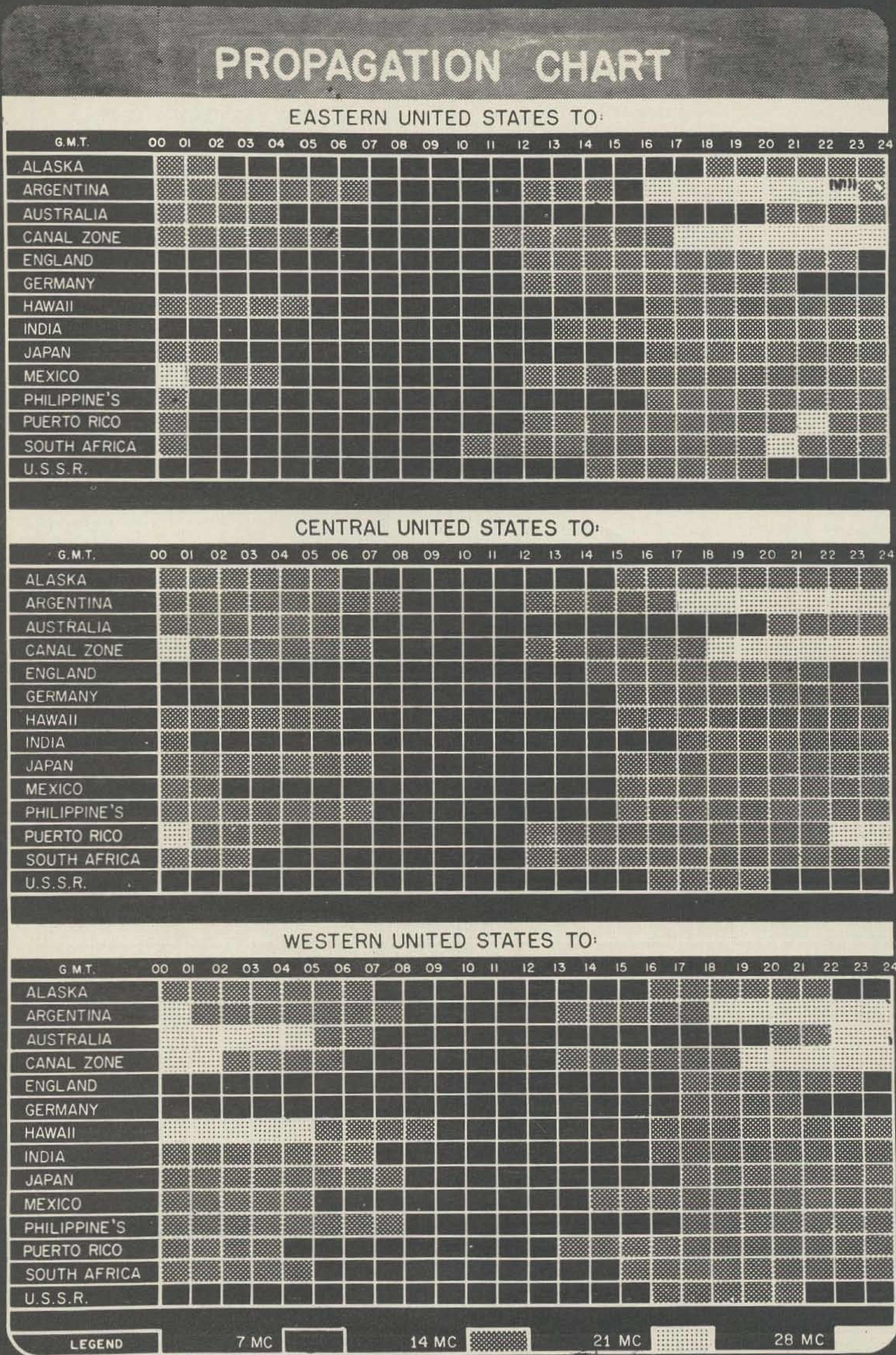
In summary, if your equipment is in good operating condition, and if all connections are made properly, a very satisfactory amateur station can be assembled if the following suggestions are heeded:

(1) Place the antenna as high in the air as possible.

(2) Use horizontal, half-wave, center-fed antenna(s).

(3) Select the feedline impedance on the basis of the antenna impedance.

(4) Use a balun to match impedances.


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

Propagation Charts

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

For the DX propagation chart, I have listed the HBF which is the best Ham Band Frequency to be used for the time periods given. A higher HBF will not work and a lower HBF sometimes will work, but not nearly as well. The time is in GMT, not local time.

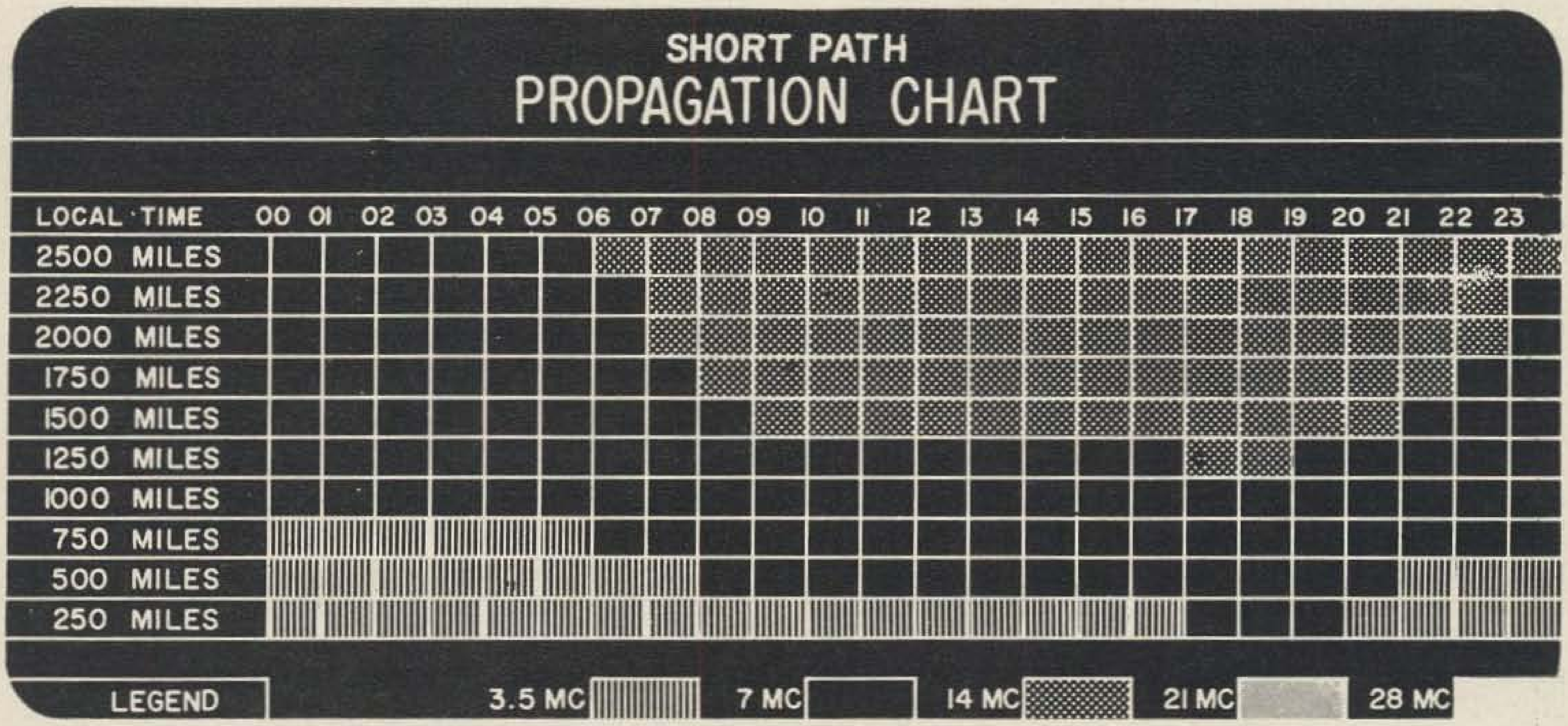
The Short Path propagation chart has been set up to show what HBF to use for coverage between the 48 states. Alaska and Hawaii are covered in the DX chart. The use of this chart is somewhat different than the DX chart. First, the time is the local time centered on the mid-point of the path. Second, the distance given in miles is the Great Circle path distance because of the Earth's curvature. Here are a couple of examples of how to use the chart. A.) To work the path Boston to Miami (1250 miles), the local time centered on the mid-point of the path is the same in Boston as in Miami. Looking up the HBF's next to the 1250 mile listings will give the HBF to use and the time periods given will be the same at each end of the circuit. B.) To work the path New York to San Francisco (2,600 miles), the local time centered on the mid-point of the path will be 1½ hours later than at San Francisco and 1½ hours earlier than in New York (the time difference between New York and San Francisco is 3 hours). Looking up the HBF's next to the 2,500 mile listings will give the HBF to use. In San Francisco subtract 1½ hours from the time periods listed for local time and in New York add 1½ hours to the time periods listed for local time.

Advance Forecast: June 1962

Good: 7-24, 26-30

Fair: 5-6, 25

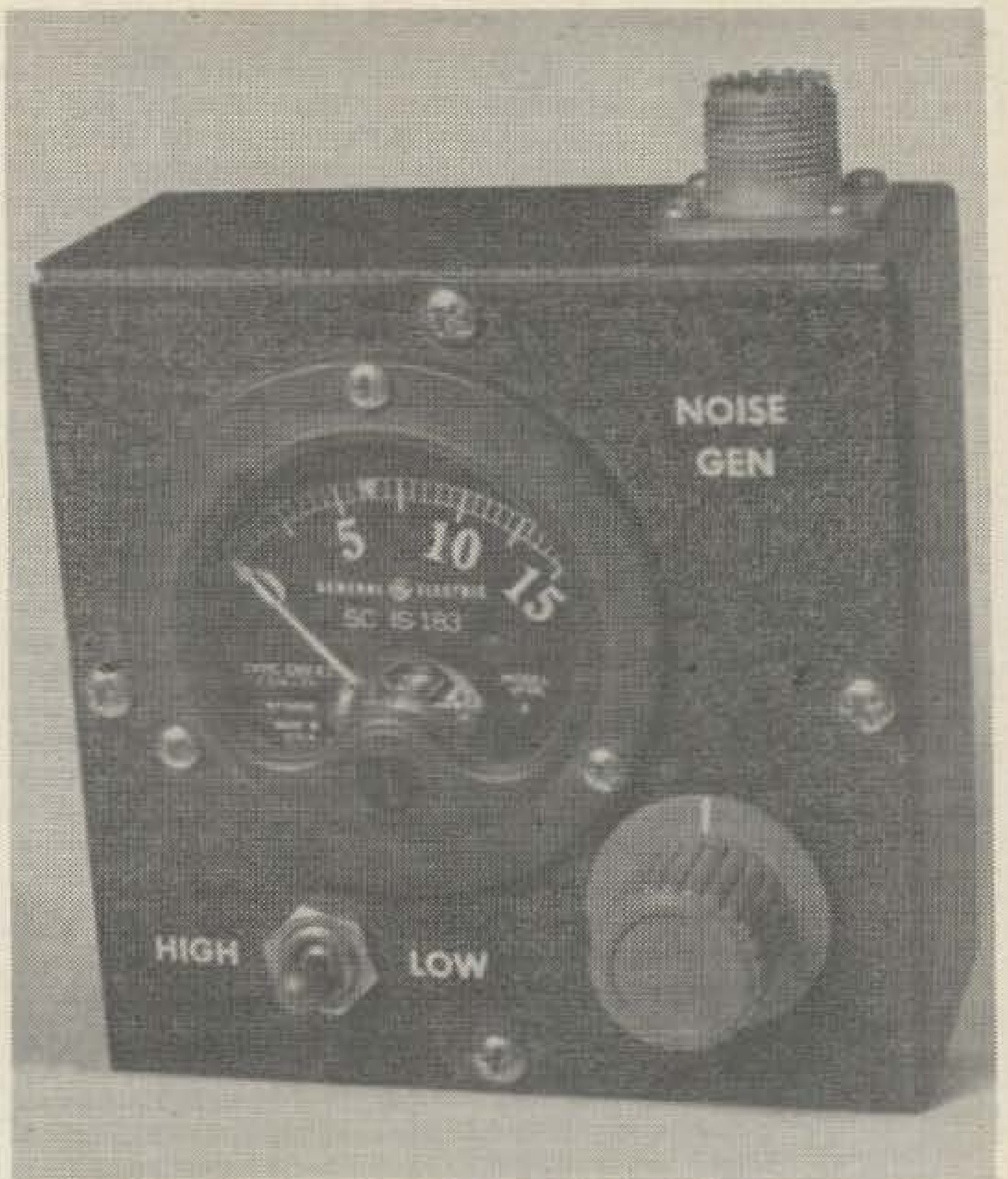
Bad: 1-4



A Crystal Diode Noise Generator

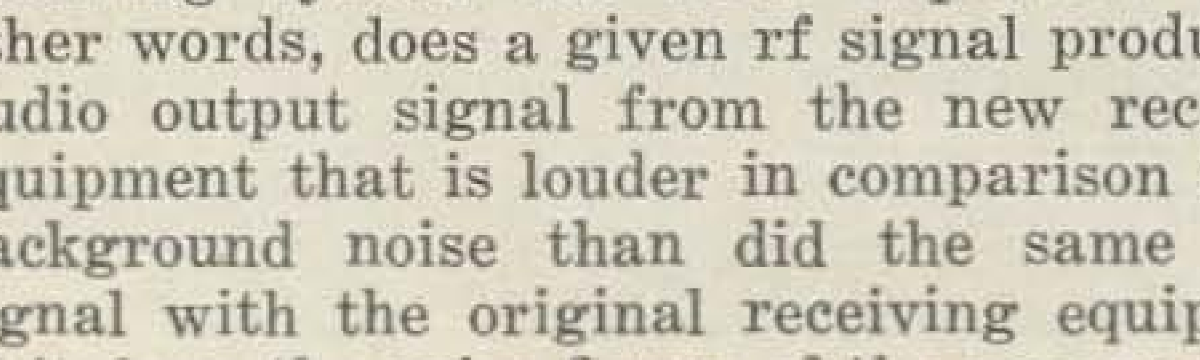
Construction and Use

Karl Tipple W5TEV
Dept. of Electrical Engr.
Southern Methodist Univ.
Dallas, Texas



MOST amateurs who do very much operating at the higher frequencies where receiver sensitivity rather than QRM often determines success eventually come to the conclusion that their present receiving equipment is not as sensitive as would be desirable and that a change is in order. And once that change has been made, whether it takes the form of a new converter or modification of existing rf stages, one nearly always wonders whether the new really *is* better than the old. Comparisons of signal strength with new and old equipment are erratic and unreliable at best and do not necessarily give the desired information since the absolute output level or "S" meter reading is not the problem. What is actually of concern is whether the signal to noise ratio of the receiving system has been improved. Or in other words, does a given rf signal produce an audio output signal from the new receiving equipment that is louder in comparison to the background noise than did the same input signal with the original receiving equipment. If it does, the noise figure of the new receiving equipment is smaller (better) and it should be possible to copy a weaker signal than before.

Unfortunately few of us own or have access to a signal generator of the proper frequency range, with an accurately calibrated attenuator and shielded output, for making the type of measurements mentioned above. For the majority of amateurs something less expensive and more readily available is needed. A crystal noise generator, which can be constructed for a few dollars and which will enable anyone to make before and after comparisons of noise figure, is such a device.



R1 = 10,000Ω POT-- LOG TAPEP PREFERRED
R2 = 1/2 WATT NON-INDUCTIVE RESISTOR EQUAL TO LINE IMPEDANCE.

FIG. 1

Briefly, the theory behind the use of the noise generator follows. The sensitivity of a receiver is highly dependent on the ability of the rf stages to amplify a weak signal as much as possible while adding a minimum amount of noise to the signal. Noise of this type will be heard at the receiver output as a familiar hiss or "rushing" sound. Now, if an external source of broadband or white noise (random noise independent of frequency) is connected to the receiver antenna terminals, an increase in noise or hiss will be noted at the receiver output. And if the noise generator output is adjusted to provide exactly twice as much receiver output noise as existed before the application of the noise generator, then the generator must be providing a noise signal equal to that generated in the receiver. Thus, if the receiver can be modified so as to reduce the noise generator signal required to double the receiver noise output, the noise figure of the receiver will have been improved.

A noise generator of the type described in this article can not be used for measurement of absolute noise figure without additional calibrating equipment. It can, however, be used for *comparison* of noise figures. It enables one to determine whether a receiver really has been improved and it can be used to determine which of a number of possible modifications will yield the best results in terms of minimum noise figure (maximum sensitivity). Use of the device will be discussed in more detail later.

A basic noise generator circuit is shown in Fig. 1. The noise is produced by CR1, a silicon diode of the 1N21 or 1N23 variety. These diodes have been widely available on the surplus market for several years. They are also readily available new at small cost; however as will be explained later, it may be desirable to use a surplus diode rather than a new one.

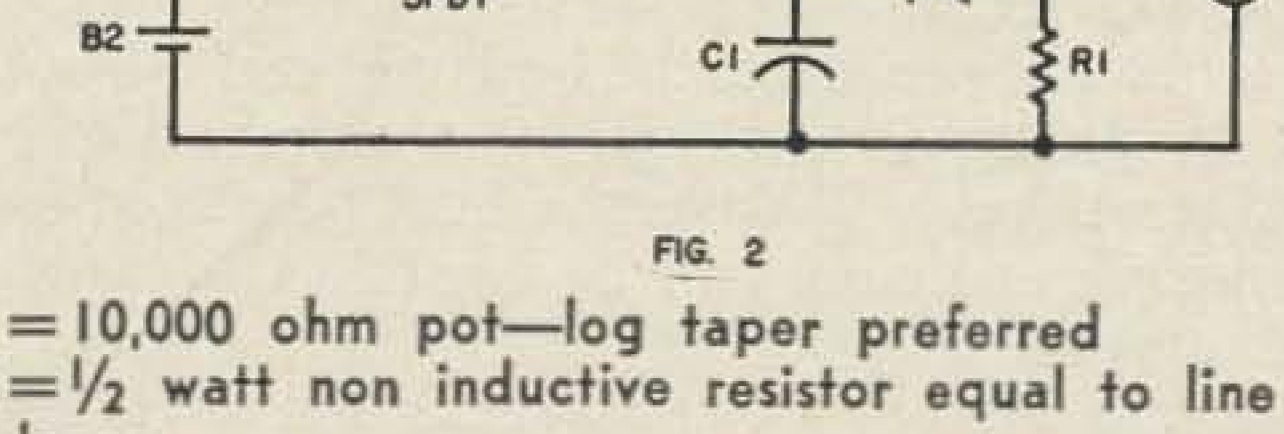


FIG. 2

RI = 10,000 ohm pot—log taper preferred
R2 = 1/2 watt non inductive resistor equal to line impedance
Other parts same as Fig. I

The current supplied to the diode from the battery and therefore the noise generated by the diode is determined by the setting of R1. The best value for R1 is necessarily a compromise since in its maximum resistance position it must limit the current to a low value but it must also not change resistance too rapidly at the low resistance end of the range or the normal operating range of the instrument will be limited to only a few degrees rotation of the R1 shaft. A 10,000 ohm log taper pot should prove satisfactory.

The value of R2 should be about the same as the transmission line impedance. A good value might be 56 or 68 ohms, although if it is desired to use the noise generator with equipment which normally operates from higher impedance lines, a larger value should be selected for R2. In this case one might compromise with a value of 100 ohms. C1 serves as bypass capacitor and may be either mica or disc ceramic.

A more elaborate arrangement was used in the construction of the unit shown in Photo. 3. A schematic of this generator appears in Fig. 2. Here a tapped battery (2 pencells) was used to minimize the range to be covered by R1. It should also be noted that the diode is shown reverse biased in Fig. 2. Many of the surplus diodes available have very poor reverse resistances, which will allow reverse bias operation, and when operated under these conditions will generate considerably more noise for the same bias current than when operated in the more conventional configuration shown in Fig. 1. The diode must have a reverse resistance of only a few thousand ohms or less if it is to work successfully in the reverse bias connection. Therefore unless the reader can obtain some surplus diodes and select one with a low reverse resistance, it will probably be necessary to operate the diode forward biased and to use the higher battery voltage of Fig. 1.

The meter range depends upon the battery voltage and the resistance of the diode in whichever connection it is used. The meter used in Fig. 2 was a 0-4 ma surplus meter. However, if the diode is operated in the forward biased connection a meter of somewhat higher current rating will probably be needed. Therefore, it is suggested that a low range meter be obtained and if more than full scale current is required for the diode to develop sufficient noise, a shunt resistance can be placed across the meter terminals to extend the meter range. An inexpensive meter can be used since all that is needed is a relative indication of current.

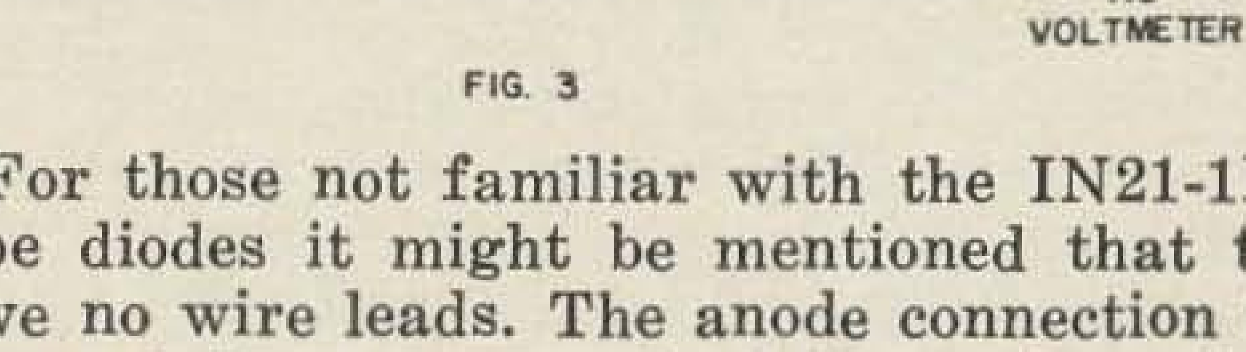


FIG. 3

For those not familiar with the IN21-1N23 type diodes it might be mentioned that they have no wire leads. The anode connection is a brass shell on one end of the unit and the cathode connection is a brass pin at the other end. Although external connecting wires might be soldered to the brass ends, there is danger that the diode will be over heated and destroyed by such techniques. It is safer to make connections by clamps made from small plate or grid caps or fahnstock clips.

It should be evident from the above discussion that there is nothing critical about the construction of a noise generator of this kind and that a number of different circuit variations are possible. Even if the device were constructed entirely of new components the cost should be less than $8 and with a little ingenuity the cost can be reduced substantially through the use of surplus parts.

Perhaps use of the noise generator can best be illustrated by considering an example of noise generator application. Suppose that you want to use either one of two available 6 meter converters with your low band receiver and that you wish to determine which converter will provide the best weak signal reception. A test set-up is shown in Fig. 3.

The ac voltmeter is used to measure the audio output of the receiver and may be either a multimeter or a VTVM. It can be connected across the speaker terminals or across the headphone line. Higher voltages can generally be obtained from the headphone output and this connection will probably have to be used if a multimeter without a very low ac range is used.

The measurements can be started by measuring the ac noise output voltage from the receiver with the noise generator turned "off". Then the noise generator should be turned "on" and the generator level adjusted until the output meter reading has doubled. At this point a note should be made of the noise generator setting. The above procedure can now be repeated with the second converter connected to the receiver. Whichever receiver-converter combination requires the smaller noise generator current setting to double the noise output is the combination that will provide the best weak signal reception.

The noise passed by the receiver is a function of the bandwidth of the receiver. Also the reading given by a particular output meter is dependent on its bandwidth. Therefore the bandwidth of the receiver should not be changed during measurements and the same output meter should be used thoughout a set of measurements.

The technique described above can also be used to determine which of a number of rf amplifier tubes will give the best performance. The noise generator can be used for alignment of rf stages.

For the man who constructs his own converters or receivers the device is a tremendous boon since such adjustments as determining the optimum antenna to grid coil coupling can be made simply by adjusting for maximum increase in noise when the generator is switched "on". (This technique gives the same results as adjusting for minimum noise generator setting to double noise output and it is a bit easier to use when adjustments must be made.) If the input circuit uses a single tapped coil instead of two coils, the best tap position can be determined.

The uses mentioned above are only a few of the possible applications of this noise generator, and for the amateur who constructs his own receiving equipment the device is indispensable. . . . W5TEV

REFERENCES

Ionospheric Radio Propagation, National Bureau of Standards Circular 462, June 25, 1948, pp. 31-33.

Tilton, **Noise Generators—Their Uses and Limitations**, **QST**, July, 1953, p. 10.

Receivership

Raymond De Vos W2TAM
140 Summit Avenue
West Trenton, New Jersey

HAVE you ever wondered what happened to *Hogarth?* He was the little fellow with the big eyes, the oversized glasses, steel helmet and fatigues who used to peer at us from the pages of various amateur magazines promising us a new and better receiver as soon as the war was over.

The war has gone, but I am beginning to suspect that Hogarth never made it. Poor fellow! While waiting for the promised receiver I bought some other post war samples, just to stay in the field. I knew exactly what I wanted. First of all it had to be stark. This means, no chrome trim or aluminum strips, no multicolored dials and various shades of grey finish . . . just plain black crackle finish with bare knobs. I assumed that the more functional it looked, the better should be the insides, and even if this were not the case, the casual onlooker would never suspect that it wasn't all it appeared to be. Then it had to have razor-sharp tuning with at least 10 cycle resetability, noise limiter, AVC, BFO and you name it.

Guess what I settled for? Tuning characteristics at least 10 kc wide, this in order not to miss anything (which it didn't), resetability fair with luck and a crystal calibrator (outboard type), no noise limiter, no S meter and a barely functioning BFO. The color scheme ranged from emerald green to dull beige, with a green on-off switch lamp and red and white dial lights, aluminum ventilating louvres, chromed skirting and gilded knobs. The dial mechanism was a wonder to behold. It looked like a spider web of string held taut by some half dozen springs all propelled by a counterweighted knob of gargantuan proportions. A flick of the dial knob would cause the pointer to travel from one end of the slide rule dial to the other with incredible speed, and unless you were agile enough to stop the revolving knob before it reached the end of the dial scale, the pointer would disappear from sight and could only be retrieved from the innards by dextrous use of tweezers, forceps or haemostats. It was easy to hear the rare ones with this receiver because they were all rare.

After struggling with this unit a few months and wondering why there were so few amateurs on the air I finally succumbed and traded it in on another one. This one was sure to be better, at least it had an S-meter and less color. The dial mechanism was alledgedly gear driven, but sprocket driven would have been more exact. A quarter turn of the knob would move the dial fine, but somehow the tuning condenser failed to get the message. This receiver was advertised as a "surprise" and it sure met all qualifications. It was a surprise when one turned the band change switch to 20 meters and actually got the 20 meter band, it was a surprise to see that the S-meter was not pinned, that the BFO functioned when it was needed, that there was no smoke coming from the power transformer, and that you could actually hear someone returning your call. The biggest surprise, however, I reserved for the dealer who took it in as a trade on another venture.

You guessed it, I was going to make my own. I faithfully copied a parts list from the article describing the receiver to be built and left the list with the owner of the radio emporium. A few days later he called me to come and pick up my order and mumbled something about it being complete but with a few minor substitutions. I was too worried about paying for the parts to care much about a few "minor" substitutions so I let the matter ride. When it came to the actual assembling and building I began to realize what "minor" substitutions are. Nothing would fit the original plan. The variable condenser was too long, the power transformer too big, the dial mechanism different, etc. . . . I did the best I could by changing the layout and stressing the economy factor, thus saving face. If anyone asked me, I could always claim that it was "more economical" that way. I hope secretly that I will never have to say that again. The receiver, when finished, performed remarkably well on the broadcast band. I cannot say what it could do on the other bands since I never heard anything there. Eventually I dismantled the "thing" and put the parts in "stock" and set out to buy another one. This time I was going to get what I had always wanted, no matter what the cost, and I was not to be swayed by honeyed words from specialists in selling radio receivers. As luck would have it, by the time I had enough cash scraped together to make a downpayment I heard of an amateur on the other end of town who was moving, or going into the army or to college (a standard one) and was obliged to shed his equipment including a very very excellent low mileage receiver. I fell for it and he got my money and I got his "junk." I hope he went into the army and was sent to the North Pole. I know for certain that he had no choice but to move after he sold his equipment. Of course I had a "try before you buy" test, but I had no standard of comparison since my previous experience had been limited to practically dead silence. To me it sounded good, and evidently my friends had been bribed to say nothing since none advised me against this purchase.

After a few months of extensive dial twisting, band changing, tube changing, trimmer adjusting, *if* adjusting and broadcast listening I gave up and advertised it for sale very cheap. To date no one has come forth, and perhaps no one will. I hate to give the thing to a young amateur for fear of giving him the wrong impression of amateur radio. In all fairness I must say that the dial mechanism incorporated in this receiver was the MOST. It looked like a four speed synchromesh transmission and even had a clutch to match. I could scan the BC band in first, second, third or fourth and if I just wanted to turn the knob and change nothing I even could do that. Secretly I think it was the gear box that sold me and sometimes I am tempted to remove it and put it on the desk just for the amazement of visitors or as a conversation piece.

Since I absolutely had to have a receiver and cash was a bit hard to come by, I saved what I could and plunked it down for a surplus receiver. Even when I bought it I knew it would only be a stop-gap, a temporary measure, until I could save more and buy the best. Since I paid for it by the pound there was little justification in complaining. Sure, it had some drawbacks but they were only "minor" ones. The receiver tuned from 4 kc to 18 mc and picked up every signal between these frequencies. The forty meter band was covered in 1/8" of dial and the 20 meter band in 1/4" space. It took a steady hand to separate stations, but I still had one then. The lack of bandspread was admittedly a little inconvenient, but a magnifying glass and holding the breath while tuning overcame this handicap to some extent. There was no S-meter, but I surely did not need one after all these years. In retrospect, I believe the feature that finally made me get rid of it (trade-in) was a rather peculiar phenomenon which went as follows. There were four bands with a band switch to select any one band. The receiver functioned very nicely about the center of each band, but at either end, when tuned for maximum gain, it would issue the most agonizing howl ever heard. I am strictly against cruelty to animals and this sounded too much like a shot rabbit. Even the XYL and the kids begged me to stop. Rather than having the family ostracize me and getting the SPCA to issue a summons or to make an investigation, I decided to part with the surplus gem. Honestly, it did not take much urging, and this time I had the family on my side so I went in hock, but good. I bought the latest and most super-duper job available to my limited means. There are no more shrieks from the receiver, but only moans from the operator when the monthly payments are due. So, how do I like it? Well . . . of course, I have an S-meter and lots of other goodies but I also have a rubber dial. The manufacturer of this unit must have a ball of pure latex between the dial and the tuning condenser. If I set the dial of 3620 kc and release the knob it promptly jumps back to 3610 kc. Perhaps the idea is to tune 10 kc. high and then let go. This may be an idea in the field of semi-automation, but since I can hardly keep up with new developments the understanding of this new tuning system escapes me. At any rate, it confuses my friends and leads to no end of merriment all of which does not help me to tune in any wanted stations.

In looking back I see that every receiver I ever owned had at least one redeeming feature. Now, why should I not be able to find one that had the best of all my previous ones and none of the bad features? Basically there is circuitry and tuning mechanism. I promise myself that the "next" one will have the best of each. Oh well, I guess I will have to buy another receiver. . . .

. . . W2TAM

Letters

Dear OM:

I read your reply to W6RNC in December 73 Magazine and feel very strongly about your reaction. If you had ever read the Communist Manifesto, the book, Masters of Deceit or "The Naked Communist" you certainly should know that no Communist can be trusted. If these hams have talked with Americans it is not in good faith, but to learn something. You should know that they would never be allowed to operate unless they were fully indoctrinated in communism. I am actively engaged in educating the people as to the facts of communism.

John L. Satterlee K9LLT

It is obvious that you are not a DX'er and haven't yet worked a Russian station. I'd like to see you find one single U.S. amateur who does contact the USSR stations to back up your statements. Are these the kind of "facts of communism" you are engaged in educating? Yes, I've read Masters of Deceit. Since my interest in nudity hadn't progressed beyond the Danish sunbathing magazines I hadn't thought to read "The Naked Communist." Howsomever, the following letter may be interest. . . . Wayne.

Dear Wayne:

Do you suppose that "Super American" W6RNC failed to pay his dues in the John Birch Society, got a Section 8 from the California Vigilantes and now figures to make a name for himself by stirring up ham radio? I was dismayed to read his ad in CQ because he will undoubtedly attract some other do-gooders like himself, not even to mention some communists (non hams) who will seize any opportunity to forment dissent. It was a relief to read your reply to his letter. I hope enough hams read your letter to kill this deadly idea.

Despite the wrangling that sometimes goes on over the air on ham problems, we have a pretty democratic hobby. If you went to a ham club meeting and saw the gang whom you had known many years, could you guess how many were Democrats and how many were Republicans? . . . or Communists for that matter? K2JFV spent six weeks in Russia this summer and he tells me that their hams are the same way. The common interest is the hobby and they just don't talk politics. For a Russian to get to be a ham and to have equipment capable of working the U.S. means that he has to be a pretty smart fellow and have learned to speak our language. How many of these are there? How many would listen to a U.S. ham give him a line of propaganda? We are certainly much better off to let him listen to a happy bunch of W-hams enjoying their hobby and leave him just a bit envious.

Edson Snow W2BZN

Dear Wayne:

Re your 73 Reviews the QZ-535 Receiver on page 66 of the December issue; I have used this receiver in conjunction with my HQ-110 for about six months and find it will do all W4UWA says it will. On the 20 and 40 meter bands you can cut the selectivity down to one or two kc by throwing in the Q-multiplier. These receivers are made by the handicapped persons of the Sheltered Workshops, Inc., Santa Monica, California. When you buy one of these receivers you get a nice little certificate.

Al, W4LSA

Values, etc.

Jim Kyle K5JKX

MANY things prove puzzling to the newcomer to ham radio construction: what kind of tube sockets should he use, how should he arrange the parts on the chassis, what tube can he substitute for that XYZ-34ABX his dealer never heard of?

For lo these many months we at 73 have been trying to help him find the answers, as well as to help his more advanced brethren find new projects and ideas for construction. Most of the newcomer's questions can be answered speedily.

But one question which comes up frequently may leave even an old-timer at a loss for a good answer: "Why don't they make, say 41,300-ohm resistors? Why do resistors come only in these odd-ball values like 33, 39, 47, or 56 ohms?"

It's a good question, too. Often, when we calculate the size of the resistor we need for some circuit where both voltage and current are critical, we come up with non-standard values. It's only natural to wonder why we can't go out and buy the size resistor we need.

There was a time—nearly 20 years ago now—when you could do just that, almost. Before World War II, resistors and capacitors were marked according to a decimal standard system. The values went something like this: 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100. Then the series started all over again 150, 200, 250, etc. Then, if you needed a 50,000-ohm resistor, you got one of that size—not one marked 47,000 ohms instead.

That is, you got it if your supplier had it in stock. With 18 different values of resistor to stock in each 10-to-1 resistance range, he had to keep 90 different sizes of resistors in stock to cover the range from 10 ohms to 1 megohm; on top of this, he had to stock each of these 90 sizes in ½-watt, 1-watt, and 2-watt units, and each of the 270 resulting kinds of resistor in

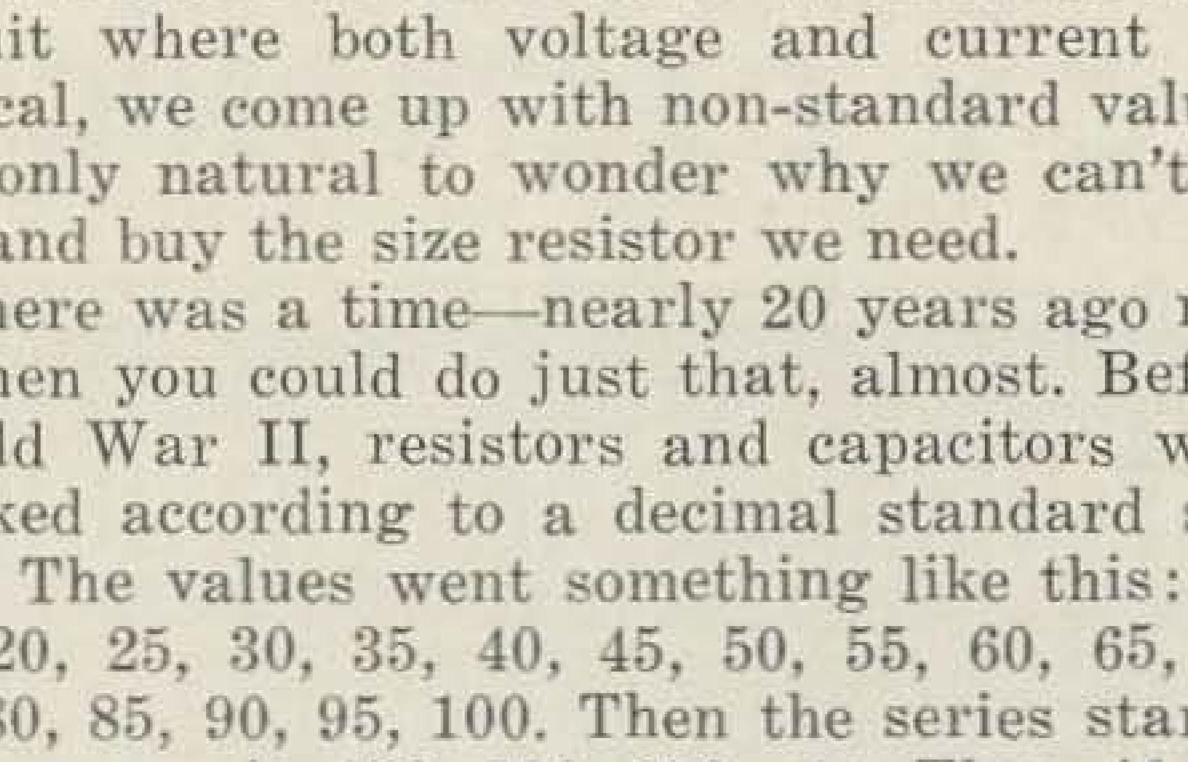


FIG. 1

5-percent, 10-percent, and 20-percent tolerances. With 810 different resistor bins on the shelf, it's small wonder one or more of them was often empty!

With the need for rapid increase of electronics manufacturing capability in World War II, 810 different kinds of resistors (not to mention the additional 810 units introduced by the need for both wire-wound and composition types) proved too much of a good thing for the armed forces.

About that time, somebody figured out that it was totally senseless to make resistors in such value steps as "75, 80, 85" if the tolerance was no closer than 20 percent. The reason is simple: a resistor marked 80 ohms, with 20 percent tolerance, may have an actual value anywhere between 64 ohms and 96 ohms. In such a case, why even bother to have values of 65, 70, 75, 85, 90, or 95 in the series—you couldn't tell the difference!

This two-pronged idea—to reduce the number of different types in stock, and to make the resistance steps more realistic—produced the set of odd-ball values we can buy today. The steps, for 20 percent tolerance, run: 10, 15, 22, 33, 47, 68, and then repeat for the next decade. Thus, a 10-ohm resistor with 20 percent tolerance may be as large as 12 ohms. A 15-ohm unit, also 20-percent tolerance but on the low side, may be as low as 12 ohms. In this manner, the possible resistance values meet and the total 10-to-1 range is covered.

You can see how the number of values is cut down, too. The old system had 18 different values between 10 and 100; the new one has 6, for 20 percent units.

If you need closer tolerances, of course, you purchase 10-percent rated units. These, naturally, won't cover the entire range with only 6 values; the number of units moves up to 12. The steps, for 10-percent units, run: 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82. You can see that these include the original six values, plus the six "halfway-between" values which mark the tolerance limits of each of the original six values.

For 5-percent tolerances, the "halfway-between" points of the 10-percent scale must be added as well; this results in 24 steps. While this is six more steps than were used in the older scale, the old scale didn't cover the entire range (there were holes between values). The 5-percent tolerance scale is: 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91.

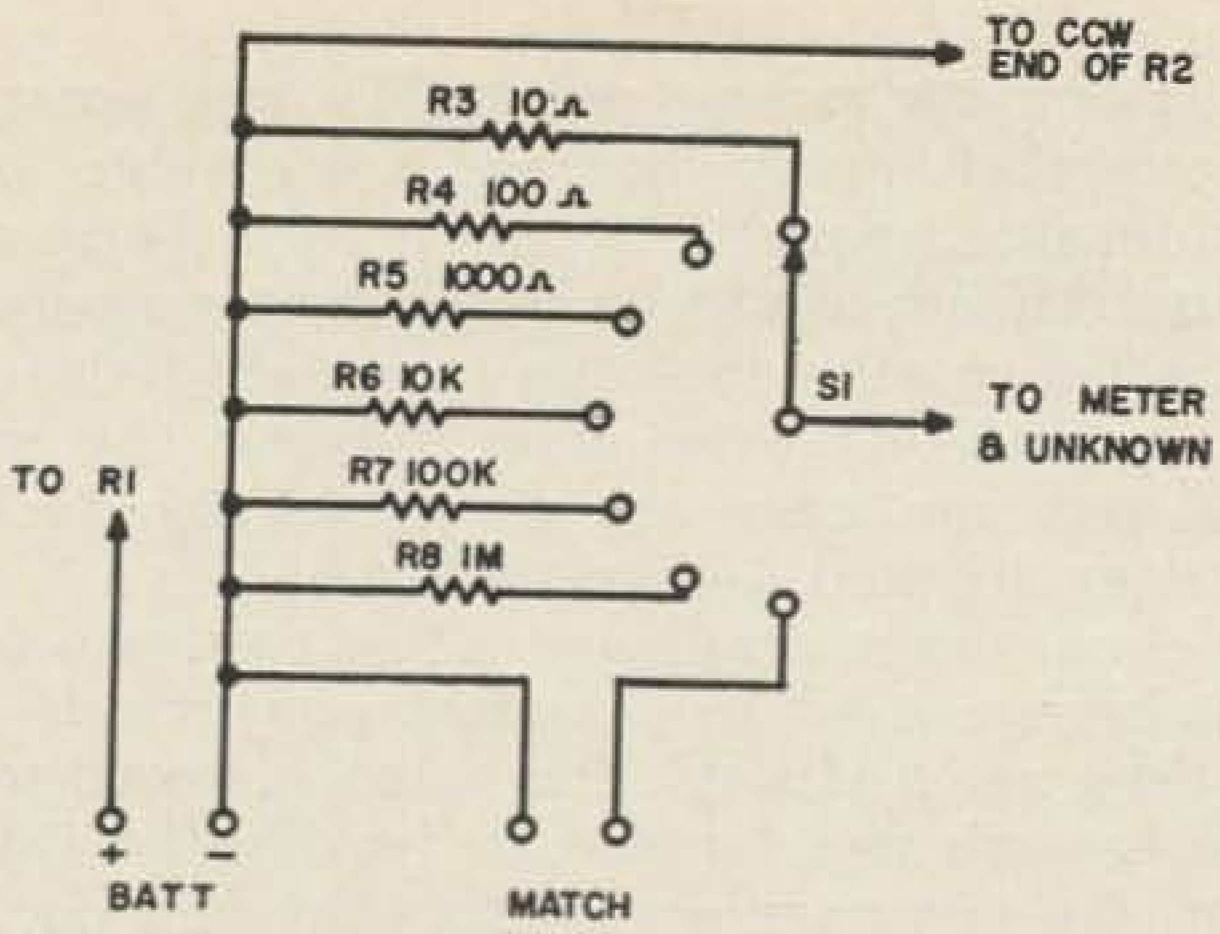


FIG. 2

Fig. 2. For added accuracy, add three more steps to the MULTIPLIER switch as shown here. Parts not shown or listed are the same as in Fig. 1. The MATCH terminals are used when matching two resistors to be the same value, when the closeness of the match is more important than the absolute resistance value. This position is handy in alignment of phase-shift filters, and in audio work.

Thus, with the old scale of 18 units per decade, 54 values were needed in each decade to include all three tolerances; with the new scale, only 42 values are needed. The dealer need stock only 630 types of resistor, instead of 810 as before.

When the new sets of values were first introduced, they were applied to resistors only. However, they are also applicable to the marking of capacitors—with the same advantages—and so the industry began switching over its capacitor markings to this scale also. This switchover is still in progress; for instance, most firms make 0.005 mf disc ceramic capacitors, but it's hard to find that value in a paper tubular unit (but easy to get a 0.0047 mf one).

This answers the question, "Why the oddball values?" Yet to be answered is the implied question, "How do I get a 41,300-ohm resistor if I need it?"

The obvious answer, of course, is to connect a number of resistors in series to get the desired value: say, a 33K, a 6.8K, and a 1500-ohm resistor. These values total 41,300 ohms exactly.

But this answer isn't always right. The "33K" unit could actually be anywhere between 27,000 and 39,000 ohms if you use 20-percent-tolerance resistors. Likewise, the 6.8K could be anything from 5600 to 8200 ohms, and the 1500-ohm unit could be between 1200 and 1800 ohms. Thus, your "41,300 ohms" would come out to be somewhere between 34,100 ohms and 49,000 ohms.

If this range of possible values is satisfactory to you, there's no need to use three units; two resistors (33K and 10K) in series total 43,000 ohms nominal value, with about the same spread of possible values. And by going to a 10-percent unit, you could buy either a 39K or a 47K resistor; either of these falls within the range of the composite unit's tolerance.

The closest single resistor available of those we've listed so far would be a 43K, 5-percent unit. This is only 1700 ohms (about 4 percent) away from the desired actual value, and the 5-percent tolerance guarantees that actual resistance is between 40,850 ohms and 45,150 ohms. Cost of a 1-watt, 5-percent resistor is 35 cents.

If, though, you must have 41,300 ohms plus or minus as little as possible, you have one of three courses open to you: you can select from a number of 43K, 5-percent units, using an accurate (1-percent tolerance) resistance bridge, until you find one that is the exact value you need; you can use a variable resistor of about 50K ohms (or a 33K fixed resistor in series with a 10K variable, for "bandspread") and again adjust it to exact value with the aid of an accurate bridge; or, finally, you can build up the value you need from 1-

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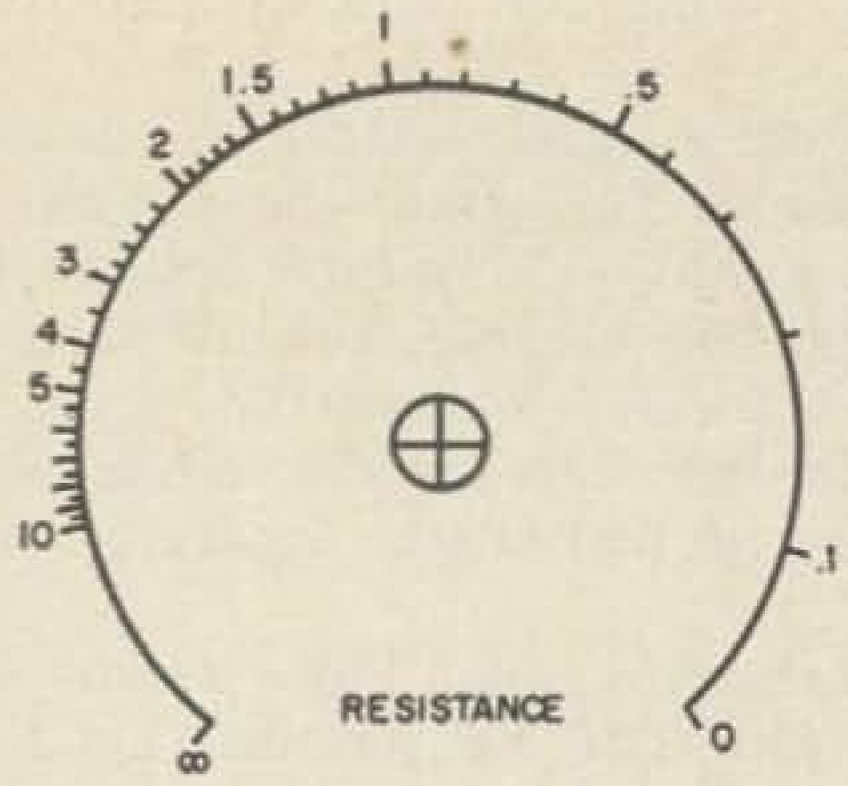

FIG. 3

percent tolerance resistors. A 41.2K unit in series with a 100-ohm unit would give you 41,300 ohms exactly (nominal value), with tolerance limits of 40,882 and 41,718 ohms.

Since the standard values for 1-percent units include 96 steps per decade, it's a bit large to include here. It's printed in full on page 112 of Lafayette Radio's 1961 catalog, however, together with the prices of 1-percent units: 1-watt, 1-percent resistor prices *start* at 90 cents each, so be sure you need that kind of accuracy before investing in precision resistors.

Earlier, we menitoned an *accurate* bridge as a help in selecting exact resistance values from a number of similar units. As in everything else, accuracy isn't cheap. While the $20 variety of R-C bridge available from almost every kitmaker is a great help around the experimenter's bench, "four-digit" accuracy is not among its strong points. To get accuracy to four significant figures in a bridge costs considerable amounts of cash; as a ham, such an investment would be much better spent in, say, a Tektronix 545 scope (around $1000) and the surplus left over after buying the scope could put you up a set of 80, 40, 20, 15, and 10-meter stacked 3-element beams!

We may have exaggerated the cost of a four-digit bridge a bit in that last paragraph—but not very much if any. The point is, you'll never have enough use for one to justify the investment. On the rare occasions that you *do* need such a gadget, contact the physics department of your nearest college or university; most of them have such instruments, or can at least tell you where one is located.

For general use, though, in *matching* resistors against each other to 1-percent accuracy or in measuring individual resistors to within about 2 percent, an inexpensive bridge is a handy thing to have. As mentioned earlier, you can buy one in kit form from Heath, Eico, Paco, or almost any other manufacturer of test instrument kits.

However, if you already have a VOM in the shack (you mean you don't! Get one!) you can put one of these bridges together for considerably less than $5. The schematic is shown in Fig. 1; as shown, you can measure resistance between 10 ohms and 10 megohms, but accuracy falls off somewhat at each end of each of the three ranges. You can get better accuracy (at slightly higher cost) by adding three overlapping ranges as shown in Fig. 2.

Construction is simplicity itself—the only essential thing is to make sure the indicator dial can be read to the accuracy you want. A sample dial face suitable for the specified potentiometer *only* is shown in Fig. 3; if this dial face is enlarged to 5 inches in diameter, you can easily read values to 2-percent accuracy. Enlarging the dial face to 10 inches would allow 1-percent accuracy of reading, but the components specified won't give you more than 2 percent accuracy anyway so making the dial face larger than 5 inches is a waste of time.

In case you may be wondering about the calibration of the scale (especially if you're hep about Wheatstone bridges), this scale compensates for a slight irregularity in the potentiometer as well as reading out the multiplier for the resistance.

To use this bridge, connect a dry battery (at least 3 volts) to the BATT terminals, connect the VOM to the METER terminals, set the MULTIPLIER switch to the approximate value of the resistance to be measured, and set the SENSITIVITY knob to its full-clockwise position. Now, set the VOM to the lowest current scale which does not pin the needle. Set the RESISTANCE knob to the extreme clockwise position (below 0.1), and adjust the SENSITIVITY knob for a full-scale reading on the meter.

Now, connect the unknown resistance to the UNKNOWN terminals and adjust the RESISTANCE knob for a dip on the meter. When you achieve the dip, readjust the SENSITIVITY knob for full-scale reading again and attempt to deepen the dip. When the bridge is properly balanced, the meter will indicate zero current on its most sensitive scale, with the SENSITIVITY knob in its full counter-clockwise position. At this point, the product of the readings on the RESISTANCE and the MULTIPLIER scales will be equal to the resistance of the unknown resistor; for instance, if the MULTIPLIER is set to 10K and the RESISTANCE scale reads 0.92 at balance, the unknown resistor is a 9,200-ohm unit. Since accuracy of the bridge is 2 percent, it would be more precise to say the value of the unknown resistor is between 9,016 and 9,384 ohms.

One caution is in order—when you're working near the balance point, most of the protective resistance (inserted by the SENSITIVITY control) is out of the circuit; thus, if you should joggle the RESISTANCE knob far off the rated value, you might send enough current through the meter to damage the movement. There's no danger to the meter if you're careful—but always return the SENSITIVITY control to its extreme clockwise position before either moving the RESISTANCE knob or disconnecting the unknown resistor.

(W2NSD from page 4)

correction right now, eh? John assures us that the rig does a beautiful job in spite of its great simplicity.

Advertising Pays

Cne of our advertisers dropped us a note with a breakdown of his advertising costs and the results obtained therefrom. Interesting. His cost per unit sold through advertising in 73 came to about half his cost in Brands X and Y. I am running into more problems selling advertising in 73, particularly with the smaller new companies, due to their not being able to keep up with the orders than I am with lack of available money. Perhaps you have noticed the growing number of products that are being advertised exclusively in 73 these days? A few manufacturers still are not supporting us. You wait, when they come in then make 'em rich.

National announced their one year guarantee last month. This is a new and welcome idea for the industry. This may have a side benefit in the building up of service facilities for ham gear such as, to mention an advertiser of ours, Amatronics, Incorporated. One facet of the National announcement which you may have noticed was the varied colors of the seals in the ads in the three ham magazines. I mention this with a note of triumph since we ran the seal in gold while QST managed a beige color and CQ used the usual red.

Dear FCC

I see you are now officially proposing a license fee for us. In my usual role as champion of unpopular causes must cheer you on. I sort of wish that your proposal had mentioned even briefly that we would get something extra for our money. It is difficult to have to start paying for something that you are used to getting for free . . I will refrain from giving any examples as proof of this statement. It would be nice if you could give us little extras such as regular FCC examinations for the Technician license instead of the present "honor" system. We'd like to have a chance to get special call letters where there are extenuating circumstances, as we used to. We'd like to have more leeway for experimentation with special licenses for repeater stations and other new projects that don't quite fit in our present system of rules. We are not interested in just having the radio tax join all the other tax monies in the big pot in Washington.

If my experience in twisting arms for magazine subscriptions at hamfests and conventions for over seven years is any indication you may find the amateur ranks thinning faster than they are growing at present. Five dollars seems like a modest sum when you compare it with the money that fellows will spend for cigarettes, drinking, movies, and Collins gear. Join me at the next convention and hear about 2000 hams stop by the booth and explain that they sure want to spend the $5 to subscribe, but they just don't have that much saved up yet. Some bring along their wives and try pitifully to coax them out of this enormous sum.

Now, though I'm basically opposed to the doctrine of "Something for Nothing" and prefer to pay my own way whenever I can rather than taking a free ride, I must admit that the proponents of free ham licenses have a good point. We hams do provide a rather fine pool of technical talent for tapping in time of emergency, as we proved during the last big fray. We also provide a pool of otherwise non-subsidized experimenters whose output dwarfs even the largest commercial or military laboratories. In case you're suffering from shortness of memory I might remind you that the parametric amplifier was first operated on six meters We more than pay our way every time there is a local emergency anywhere in the country. Ham radio is the most flexible and ubiquitous emergency communications system there is. For every real public service performed by a commercial-broadcast or TV station we can point to 50 amateurs who have done more.

(Turn to page 92)

To sum up: if your purpose in proposing the $5 license fee for amateurs is to provide us with better service and you are not concerned with the drop in our numbers that will probably result, then tax away. We are already taxed, double taxed and triple taxed on just about everything we buy or do, many of us probably won't really notice this extra dun.

June Last Year

Advertising was up a little in June, so we increased from 64 pages to 72. The supply of June issues is running short, so if you want one don't put it off for long. Still only 50c.
One of the best articles was by John Reinartz K6BJ on precision capacity measuring. His simple method is one you'll find very useful if you do much construction and experimentation. You can get it right down to the fraction of a mmfd. Bill Orr W6SAI came up with some good ideas on improving the Lafayette KT-200 receiver. The ideas also apply to most other lower priced receivers. K2TKN introduced his Abe Lincoln two meter antenna. This has a lot of advantages over the halo for both mobile and home use, the only problem seems to be one of construction . . . and unusual looks. WA6DZL ran a short article on a little transistorized 75M converter. W4API tested the Electrotone M-100 modulator. K2IGY's part II of his two articles on the sunspot minimum which we are approaching . . . discouraging. W5SUC came up with an elaborate AM modulation monitor. W6AOI presented part I of his two part article on a simple padapting adaptor which connects your receiver to your oscilloscope so you can see the bands while you tune. Then we had a transistor gadget for preventing overmodulation, clever idea. The big staff article started to tackle power supplies and found it too much for one article. K5JKX showed us how to use punched cards for keeping track of magazine articles. W6NKE imparted some ideas on DX chasing which should be reread by everyone. There were a lot more short articles filling in the cracks between the big construction and technical articles. Better send for a June '61 now. 50c.

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- Kit 100 Ceramic Condensers
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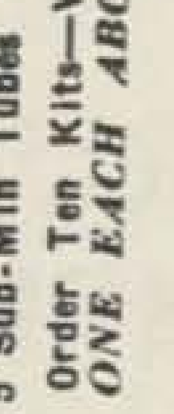

TYPE	VRMS/PIV	AMPS	PRICE
T866	5000/10400	0.3	$16
T5R4	1900/2800	0.5	$7

Leece Neville Charger Systems Sealed Silicon Stud Rectifier Finned Stack, Direct Replacement
FOR 6 or 12VDC @ 100A. Type YJ9 $18

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½	$1.00	$1.90	$3.85	$5.00
1	1.30	2.00	4.90	8.15
2	2.15	3.00	6.25	11.10
3	2.90	4.00	8.60	13.45
6	4.15	8.00	18.75	31.90
10	6.10	12.15	26.30	41.60
12	7.75	14.90	30.95	43.45
20	12.85	24.60	*Write For*	
24	15.00	29.45	*Rectifier Catalog*	

One Year Gtd!

Send 25¢ for New Catalog

"TAB" BARGAINS

New Variacs/or equiv 0-135V/7.5A $15.30
New Variacs/or equiv 0-135V/3 Amp $10.65
DC-METER Dejur 800 Ma/2½" $3@.
DC MTR 100Ma/2½" ....$3@.
RF-MTG GE/475 Ma & 5 Amp $4@. 2/$7
DC-METER One Ma/4" Rd...$5@. 2/$8
SNOOPERSCOPE TUBE 2"...$5@. 2/$9
MINI-FAN 6 or 12VAC/60 Cys $2@. 3/$5
Xmitting Mica's .006 @ 2500V. 5 for $1.00
4x150 Ceramic/LOKTAL ....2 for $1.00
866A Xfmr. 2.5V/10A/10KV Insl...$3.95
Microswitch B1/SPNC/30 Amp 49¢@.
Tube Clamps Birtcher............5 for $1.00
.012 at 25Kv CD Condenser....$'@.
WE Choke 4Hy/450Ma/27 Ohms $4@.
Line Filter 50Amp/250VAC...$10@.
Line Filter 200Amp/130VAC..$18@.
Bruning Parallel 6" Rule....69¢@.
KS15138 Linear Sawtooth Pot...2 for $1.00
"CTC" Delay Line 1 Microsec'd $1@. 3/$2
Vacuum Condsrs 50Mmfd/7.5Kv.$3@.

"TAB" THAT'S A BUY

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

OA2	1.00	6J7	.99	5651	1.20
OA3	.95	6K7	.79	5656	3.00
OB2	.65	6L6	.99	5670	.89
OC3	.65	6SN7	.72	5687	.90
OD3	2/$1	6T8	.98	5725	.75
OZ4	.79	6V6GT	.70	5732	.65
1B3	.99	6X5	.49	5751	1.00
1L4	2/$1	12AT6	.59	5814	.60
1R4	5/$1	12AT7	.85	5879	2/$1
1S4	.60	12AU6	.63	5894	13.50

We Swap Tubes! What Do/U Have?

1T4	.60	12AU7	.69	2AP5	3.00
1T5	.55	12AX7	.75	3BP1A	5.00
1U4	5/$1	12AY7	.89	3KP1	6.00
1U5	.65	12BA7	.90	3SP1	3.00
1X2	.99	12BE6	2/$1	5GP1	5.00
2C39A	10.00	12H6	3/$1	5CP4A	6.00
2C40	5.00	12J5	.69	5MP1	6.00
2C43	5.50	12J7	.69	5MP4	6.00
2C51	1.25	12K8	.70	5NP1	6.00
2D21	2/$1	12SC7	3/$1	5ABP1	20.00

Send 25¢ for Catalog!

2E22	1.75	12SG7	.60	5AQP1	20.00
2E24	1.80	12SH7	.60	5AQP7	20.00
2E25	2.50	12SJ7	.60	5AP1	5.00
2E26	1.80	12SK7	.75	5ADP1	35.00
2K25	6.50	12SL7	.59	5ADP7	25.00
2V3G	2/$1	12SN7	.69	5BP1	6.00
2X2	2/$1	12SR7	.69	5BP2	6.00
3C24	3.00	24G	3.00	5BCP7	25.00
3D23	2.40	25A6	1.25	5BGP2	35.00
3E29	5.90	25L6	2/$1	5BHP2	25.00

All Tubes Stocked at Low Prices!

3Q5	.85	25T	5.00	5CP1A	7.00
4-65A	9.50	25Z5	.72	5CP5	4.00
4-125A	21.00	25Z6	.75	5CP7A	4.00
4-250A	33.00	35Z5	.85	5CP11A	5.00
4X150A	14.00	RK39	2.50	5FP1A	18.00
4X250	34.00	50L6	2/$1	5FP4A	18.00
4X500	37.00	75	.81	5FP5	3.00
5R4	1.00	83V	2/$1	5FP7A	3.00
5T4	2/$1	2000T	150.00	5FP14	3.00
5U4	.75	4X150G	12.00	5FP14A	6.00

PNP Transistors Mixer ★ Oscillator ★ Converter

Equal to CK760, CK766, 2S52, 2N112, 114, 135, 136, 137, 140, 219, 411, 412, 414, 415 and Others.

SPECIAL at 49¢, 5 for $2, 100 for $35.

IF Amplifier 2S53, GT760, 2N111, 112A, 139, 218, 409, 410, 413, 414, 416 and Others.

SPECIAL at 49¢, 5 for $2, 100 for $35.

5V4	.89	4X250B	30.00	5HP4	10.00
5Y3	.59	4-400A	33.00	5JP1	2.00
5Z3	.89	250TL	18.00	5JP2	1.00
6A7	.99	307A	3/$1	5JP14	25.00
6A8	.99	VR92	5/$1	5LP1	18.00
6AB4	2/$1	388A	2/$1	5LP1A	25.00
6AC7	.69	350A	1.00	5LP4	6.00
6AG5	.59	350B	1.00	5LP7A	6.00
6AG7	2/$1	6146	2.45	5RP1	25.00
6AK5	.69	450TH	25.00	5SP7	15.00

Wanted Test Sets and Equipment

6AL5	.59	450TL	24.00	5SP7A	21.00
6AQ5	.65	460	11.50	5QP4	8.00
6AR6	.75	707B	1.25	5UP1	6.00
6AS7	2.85	715C	10.00	5XP21	36.00
6AT6	.65	723AB	2.50	5YP1	25.00
6AU6	.70	725A	3.50	7BP1	5.00
6B8	.80	805	3.35	7BP4	5.00
6BE6	.59	807	1.10	7BP4A	5.00
6BG6	1.49	811	3.90	7BP7	2.00
6BH6	.79	811A	4.75	7BP7A	5.00

Top $$$ Paid for 304TL, 813, 811A, 812A Tubes

6BK7	.99	812	3.95	7EP4	5.00
6BL7	1.30	813	12.00	7GP4	7.00
6BX7	1.11	815	1.75	9AUP7	5.00
6BY5	1.19	829B	7.50	9JP1	5.00
6BZ6	.73	832A	5.00	9LP7	1.00
6C4	.45	833A	36.00	10BP4	6.00
6C5	2/$1	837	1.50	10KP7	11.00
6C8	2/$1	866A	1.50	12GP7	7.00
6CB6	.70	954	10/$1	12QP4	9.00
6CD6	1.49	957	10/$1	12KP4A	9.00

Top $$$ Paid for XMTR Tubes!

6E5	.79	991	5/$1	12SP7	11.00
6F4	1.85	1619	5/$1	14EP4	10.00
6F5	2/$1	1620	1.00	16GP4	12.00
6F6	2/$1	1625	3/$1	16DP4A	12.00
6F8	.74	1626	12/$1	17AVP4	14.00
6H6	4/$1	1629	4/$1	17AP4	14.00
6J4	1.72	2050	1.20	17CP4	14.00
6J5	2/$1	5517	2/$1	17KP4	14.00
6J6	2/$1	5608	3.95	19DP4	16.00

"TAB" TERMS: Min Order $3—25% with order F.O.B. New York. Ten day guarantee, price of mdse. only. Our 18th year.

Prices shown are subject to change.

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"TAB" SILICON 750MA* DIODES

Factory Tested Gtd.!
NEWEST TYPE! LOW LEAKAGE D.C. or Batty. Derate 20%

rms/piv	rms/piv	rms/piv	rms/piv
35/50 .07	70/100 .14	140/200 .19	210/300 .29
280/400 .34	350/500 .44	420/600 .53	490/700 .69
560/800 .85	630/900 .98	700/1000 1.08	770/1100 1.50

Low Priced T300 Silicon Diodes Rated 400 pvi/280rms @300Ma @100°C .25 each; 30 for $7; 100 for $20;

Diode order $10 shipped Post free

ZENER DIODES 150 to 400 MW CASED TO24 Pckg. Within 20% V'Range $1, 3 for $2, 20 for $10, KIT ZENER DIODES up to 400MW, SINGLE & DOUBLE ENDED 2 for $1; 12 for $5; 100 for $36.

"TAB FOR TRANSISTORS & DIODES!"
Full Length Leads Factory Tested & Guaranteed! U.S.A. Mfg.

PNP Hi Power 15 Amp. TO3 & TO36 Round Pckg. 2N441, 2N277 $1.25@, 10 for $11, 2N442, 2N278 $3@, 2 for $5; 2N443, 2N174 $4@, 2 for $7; 2N677 $1@, 12 for °10; 2N677A $2@, 6 for $10; 2N677B '3@, 4 for $10; 2N677C $5@, 2 for $8. PNP 2N123, 2N107, CK722 5 for $1; NPN 2N292, 293, PNP 2N223 30¢@, 12 'or $9, 100 for $65; PNP 2N670/300MW '0¢@, 10 for $4; PP 2N671/1 Watt 75¢, 10 for $6.

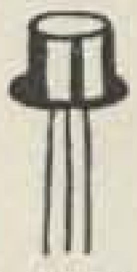
RND(TO36), or Diamond (TO3) mica kit 30¢ ea. Power Heat Sink Finned (80" sq.) $1.39.

GTD! Power-Diamond-Transistors

Factory Tested
***MFGRD in U.S.A.
Univ. Replcmnt
2N155, 2N156, 2N234, 2N256, 2N307, 2N554
SPECIAL TO3GP ....55¢, 10 for $5 100 for $45; 500 for $200
$10 or more this item we pay P.P./U.S.A.

Kit Glass Diodes equiv. 1N34A, 46, 48, 51, ¢0, 64, 87, 105, 109, 147, 267, 268, 295, 12 for $1, 100 for $7.50.

SPECIAL! TRANSISTORS & DIODES!!!
Factory Tested & Guaranteed!
FULL LENGTH LEADS



2N123 PNP 45¢, 12 for $5, 100/$37
2N292 NPN 45¢, 12 for $5, 100/$37
2N293 NPN 45¢, 12 for $5, 100/$37
2N223 PNP 80¢ .... 100/$65
2N597 PNP $1.90 .... 6/$10
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$10 or More. This item Postpaid U. S. A.

"SUPERIOR" Powerstat Type 10 165W to 132V $6 each; 2 for $10

SILICON POWER DIODE STUDS*

Operation Up to 125°C Case Temp.

D.C. Amps	50Piv 35Rms	100Piv 70Rms	150Piv 105Rms
2	.23	.34	.42
3	.60	.85	1.10
6	.70	.95	1.15
12	.85	1.15	1.35
35	1.80	2.20	2.95
70	3.75	4.50	5.00
240	4.50	5.40	7.70

D.C Amps	200Piv 140Rms	300Piv 210Rms	400Piv 280Rms
2	.49	.60	.84
3	1.25	1.50	1.80
6	1.40	1.65	1.95
12	1.60	1.85	2.07
35	3.25	4.90	6.10
70	5.60	8.80	Query
240	9.00	Query	Query

**Derate 20% for Battery or Capacitive Load or D.C. Blocking!*
**Stud mounted on Heat-sink*

TWO 866A's and FILAMENT XFMR 10 Kv Insltd SPECIAL $6

NEW BATTERY CHARGER BC6-12V FOR 6V OR 12VOLT BATTERIES, TRICKLE & FULL CHARGE up to 10 AMPS

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ALLIED SUPER-BONUS PACKAGE

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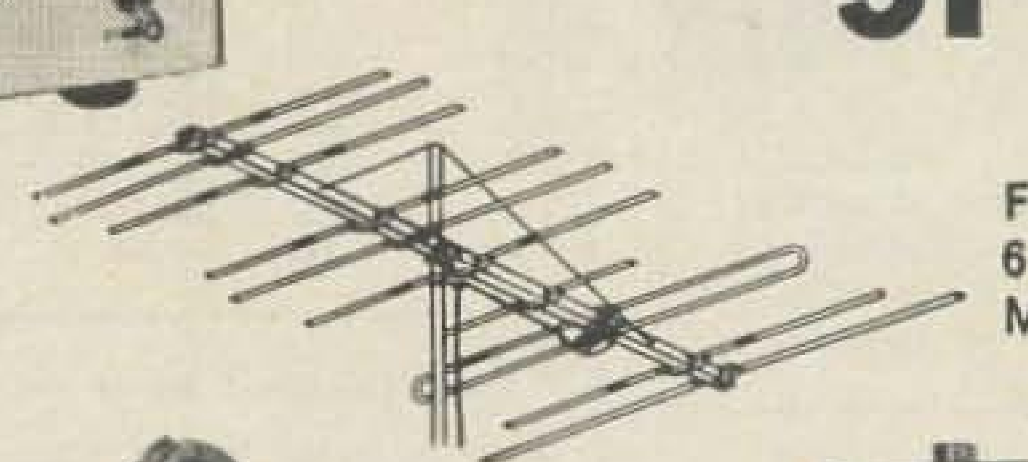

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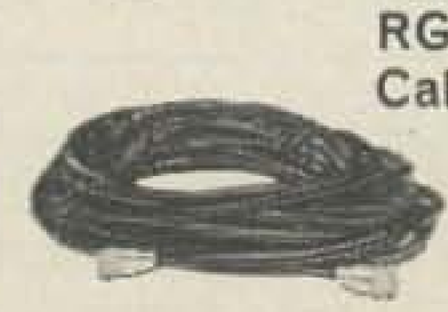

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185 WATTS OF SOLID "TALK POWER"

Get the most in carrier output and highest level of modulation power. Have 185 solid watts on *both* AM and CW, with *automatic* modulation control that will actually let you "out-talk" many kilowatt rigs! Put a ZEUS on 6 and 2 and watch the QSO's roll in!

SPECIFICATIONS: 2-unit construction—handsome 15 x 9 x 9" tabletop unit (illustrated) contains all RF stages, audio preamp and VFO; remote unit 17 x 11 x 13" (not illustrated) contains all power supplies, audio driver stages and Class B modulator system • Automatic feedback control of low level speech clipping permits 120% positive modulation peaks for maximum splatter-free talk power • Visual monitoring of modulation • Frequency response flat ±2 db between 400 and 3400 cps and down at least 18 db at 150 and 4500 cps • Hum and noise levels down to at least 40 db below 70% modulation • Up to 18 db speech clipping, adjusted with calibrated panel control • VFO maintains frequency stability of 1 part in 10^6 per degree F. per hour after 15-minute warmup • Zero back-lash flywheel dial • Maximum TVI suppression • 6 meter output fed through pi network • 2 meter output coupled to high efficiency tank • Units supplied complete with 10-ft. interconnecting power cable. Complete shpg. wt. 111 lbs.

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FROM QST — JANUARY 1961

"Stability, both mechanical and electrical, is exceptional . . . The NC-270 works well enough on 50 Mc. to encourage a v.h.f. enthusiast to design his converters . . . so that they will work into the 6-meter range rather than into the lower bands. This would give him full coverage of the 144-Mc. band and a four-megacycle spread in any of the bands from 220 Mc. up . . . and he can skip the construction of a 50-Mc. job. The NC-270 should do all he'll need in that range."

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". . . retains all the "feel" of the more expensive receivers for which this company is known . . . It is unusual to see a front panel NOTCH DEPTH control in this price class . . . The a.n.l. circuit in the NC-270 is exceptionally good . . . Mechanical stability is impressive. It is possible to tune a s.s.b. signal on one of the high frequency bands, lift the front of the receiver up several inches and let go. Unless the main tuning knob moves, the signal will still be there . . . (The National NC-270) is an extremely stable and sensitive receiver . . ."

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"I would like to congratulate you on one of the finest communications receivers on the market; the NC-270. (At RACES center during hurricane Carla) communications were maintained with schools and hospitals . . . Your receivers performed for over 60 hours. The thing that impressed me most was its extreme stability under the most adverse conditions. Emergency power and, at best, poor antennas did not help our situation, nor the 70 mph winds which blow at the airport where we were set up. The selectivity of the NC-270 helped to maintain contact with other stations with low power and bad antennas. On 6 meters, we rarely needed a relay and when this did happen it was due to their receiving conditions, not ours . . . performed like a high priced receiver . . ."

If you want a proven medium priced receiver, we strongly suggest that you hear the NC-270 at your dealer's. Write today for technical information.

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