73

AMATEUR RADIO

JUNE 1968

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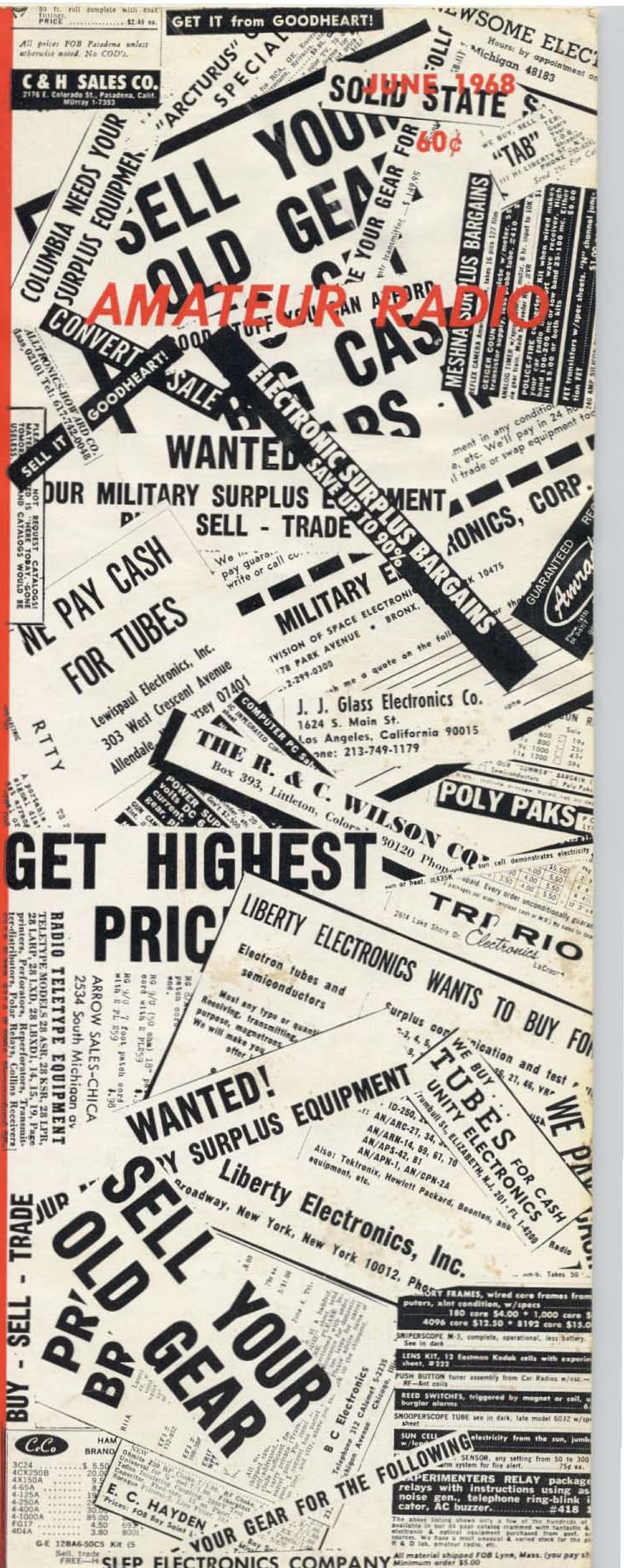
SURPLUS



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Editor

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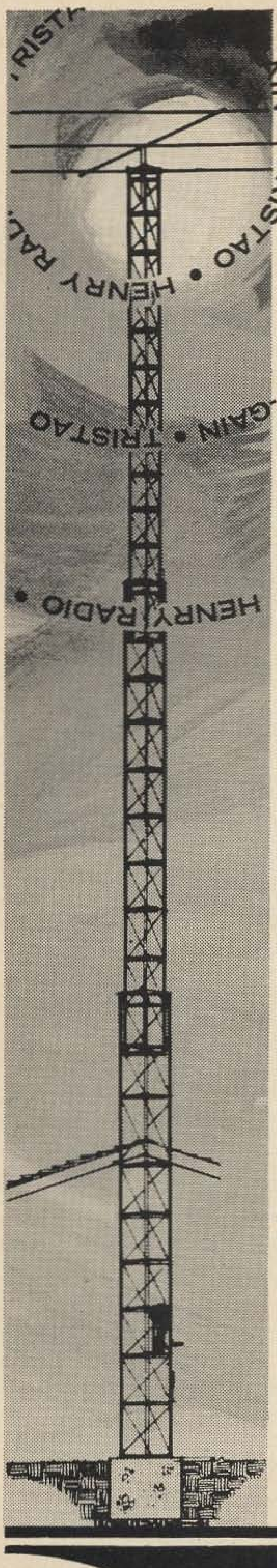

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CDR TR-44 rotator
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100 ft. Control cable

Complete with one of the following:

Hy-Gain TH-3 Jr. antenna	$325.00
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A savings of approximately $70.00

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100 ft. Control cable

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"World's Largest Distributor of Amateur Radio Equipment"

de W2NSD

This UFO Network idea has led me into some interesting circumstances.

While trying to get Noel Nelson W3SSB to run another ad for Uncle George's Hamshack, I mentioned my net scheme and his ears perked up. Seems he has a friend who has been following the UFO news for some twenty years or so now. Sure enough, a bit later the phone rang and a Harold Salkin was calling from Washington, D.C. to find out what I was planning. I think we talked for an hour, for he was a mine of information. He gave me leads on getting UFO photos and fan bulletins.

A few weeks later Harold called again to say that he was down near Boston with a "contactee." He invited Lin and me to come down the next day and talk with Woody Derenberger, who claims to have talked with the UFO people and gone with them for a visit to their home planet. Woody was in town with Harold to give a lecture the next night and a radio interview.

Well, I couldn't pass up heady stuff like this.

We drove down and talked with Woody for a couple of hours and found his story fascinating. I'm afraid that Harold was disappointed that I came away still a skeptic. Woody most certainly was not an obvious fraud and I have to admit that there is a chance that he may be telling the truth. Perhaps we shall see, for he told me that the UFO people had recently bought some transceivers and that I could expect to be in direct contact with them within a month on our ham bands.

He explained that since their telepathic ability was so well developed they had never needed radio as a communications or entertainment medium. However, since they are now anxious to contact us without creating panic, they will be using radio. Woody felt that the radio amateurs might be the first large group contacted.

I wonder what prefixes they will use? Just about everything has been allocated by the ITU except, I believe, the calls starting with Ø, 1 and 2. Miller has kind of used up the 1's, so perhaps our friends from Lanulos (that's the name of the planet they come from over in Alpha Centuri . . . the trip only takes a few minutes by space warp drive) will use the Ø calls. I do hope they check with the ITU before starting though . . . we don't want another upset over the use of illegal call signs.

They might use the call letter prefix of the area they are flying over as part of the call. Like ØW1NSD might be my call if I were fortunate enough to get a ride in a UFO equipped with a ham rig . . . or should I use ØW2NSD/1? Why not use a simpler call, as long as I'm making it up anyway, such as ØW1A? And if they decide to subscribe to 73 . . . which I assume they would do . . . what address should we use?

Say, it you work some of these fellows before I do, you'll let me know about it, won't you?

The E.I.A.

The manufacturers of amateur radio equipment are now organized as a section of the Electronic Industries Association. I may be putting the matter bluntly, but I don't think I am exaggerating if I say that this organization was born out of frustration with the League over the Incentive Licensing proposals. This is a large and powerful force and may well have a good deal to say about the future of amateur radio.

In its first move, the EIA has petitioned the FCC with regard to the Novices to:

1. Reduce the code speed requirement to the minimum consistent with the Geneva Convention of the ITU. Since the ITU regulations specify no code speed this would mean merely the recognition of the Morse characters and the ability to send them.
2. Restore phone in the 145-147 MHz band.
3. Set up a phone/CW band for Novices on 29.4–29.6 MHz.
4. Make the Novice license a five year renewable license.
5. Permit the Novice license to be issued to previous holders of licenses.

It will be interesting to see what the ARRL reaction is to these proposals and if they are published in QST.

The problem of code speed is one that

Turn to page 114

Look! Look! Look!

W 6 J U K

Magnetic Call Letter Sign

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Made of weather impervious plastic—adheres to side of car at speeds of over 90 MPH. **RED LETTERS** and **NUMBERS** on white background. Be identified at hamfests — conventions — vacations — transmitter hunts. Sign is of finest quality and style. Guaranteed satisfaction and at 1/2 of what you would expect to pay. Money order or certified check accepted.

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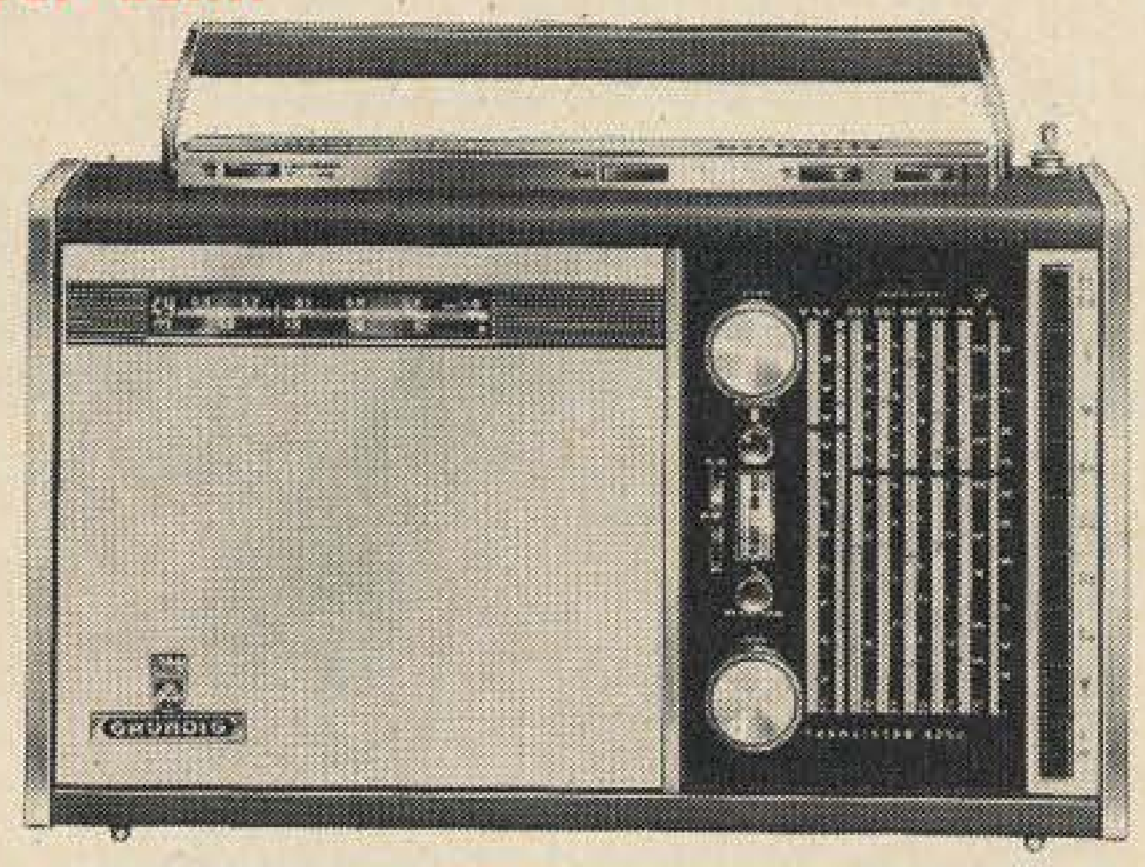

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Transformer Tricks

An Air Force Mars Member had just been issued an SP600. I happened to walk in as he finished connecting an 8-ohm speaker to the 600 ohm output.

"I won't be able to use it this week end," he said ruefully, listening to the faint distorted sound. "I won't be able to get in a supply house till Monday to buy a 600 to 8 ohm transformer."

"Where's your junk box?" I asked.

"Nothing in there," he protested. But he dragged out a carton of odds and ends.

I selected a small potted power transformer from the mess. Quickly we soldered wires from the 110v winding and connected them to the SP600. Then another pair from the 6.3 winding to the voice coil of the speaker, leaving the H.V. winding unused.

Again he fired up the receiver. Sound blared.

"Well, I'll be darned," he exclaimed. "How did you know that would work?"

He was genuinely amazed, yet he had held a ham ticket over ten years.

The incident recalled to my mind another instance when a fellow ham had been scrounging for a modulation transformer. I handed him a 220v primary, 350-0-350 v secondary, surplus power transformer.

"Put the rf B-plus through the 220v winding and the modulator plates to the 350v taps," I told him.

"But that's a power transformer," he objected, "won't there be a mismatch."

"Probably," I had agreed. "And I'm sure the slide-rule boys will give you a dozen reasons why. But I've built a half dozen rigs with power transformers for modulation."

A week later I listened to my friend's six meter rig in an on-the-air test. The audio quality was as good as any on the band as far as my ear could tell.

Bob turned the audio on the SP600 back to a respectable level and my mind returned to the current situation.

"Nothing to it," I finally got around to answering him. "I use the same deal at home, between my 600 and my RATT converter. And speaking of different uses for transformers, the input transformer of the converter is an output transformer turned around. In fact, I'd say offhand that there has never been a transformer manufactured which couldn't be used for a half dozen other applications beside the one it was specifically designed for. Sooner or later a ham who likes to build can find a use for just about any transformer."

Bob grinned. "Even the 400 cycle variety?"

"What's the voice range in cps?" I asked.

He got the point.

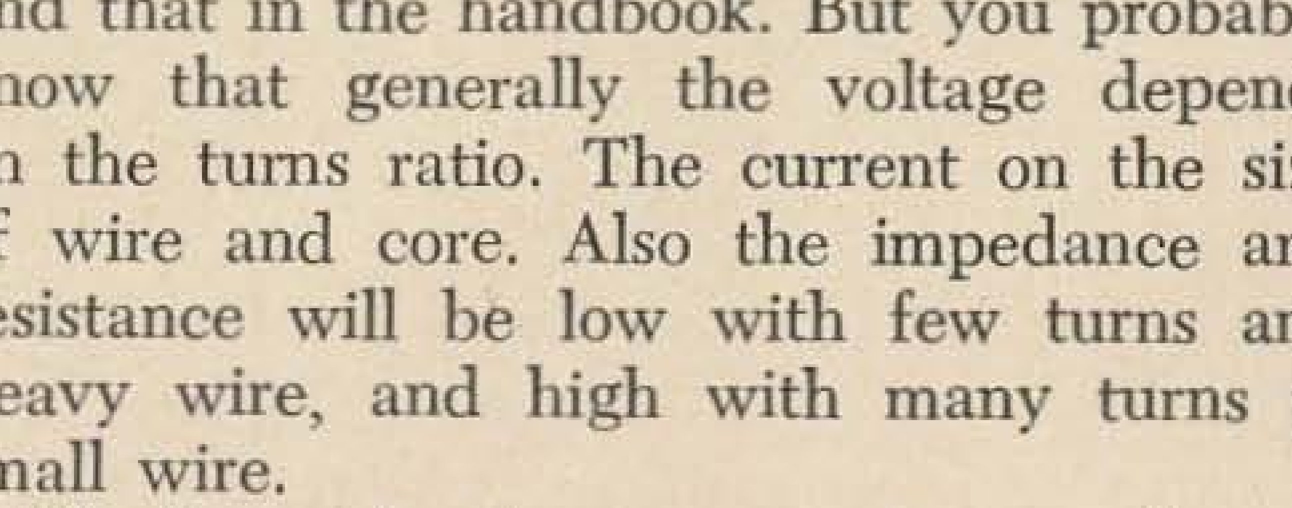
"Actually," I went on, "just a little common sense will get you a long way with transformers, and I don't mean to be giving a lecture on transformer theory. You can find that in the handbook. But you probably know that generally the voltage depends on the turns ratio. The current on the size of wire and core. Also the impedance and resistance will be low with few turns and heavy wire, and high with many turns of small wire.

"So the trick when you need a transformer for any application is to determine the ratio, impedance and resistance range acceptable, and look for this.

"Why I bet I could make a list of a dozen and a half transformer tricks and substitutions in ten minutes—which can save a lot of dough."

"I wish you would," Bob said.

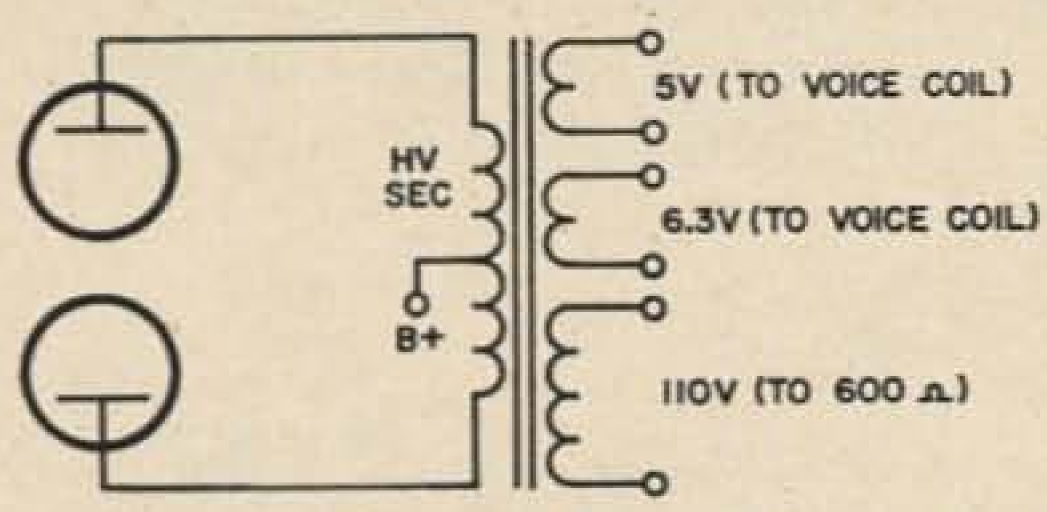
So my neck was stuck out. It turned out to be a long ten minutes, but I made the list for Bob. Here's hoping many other hams will find it helpful too.



Simple Test Set up for ratio and voltage

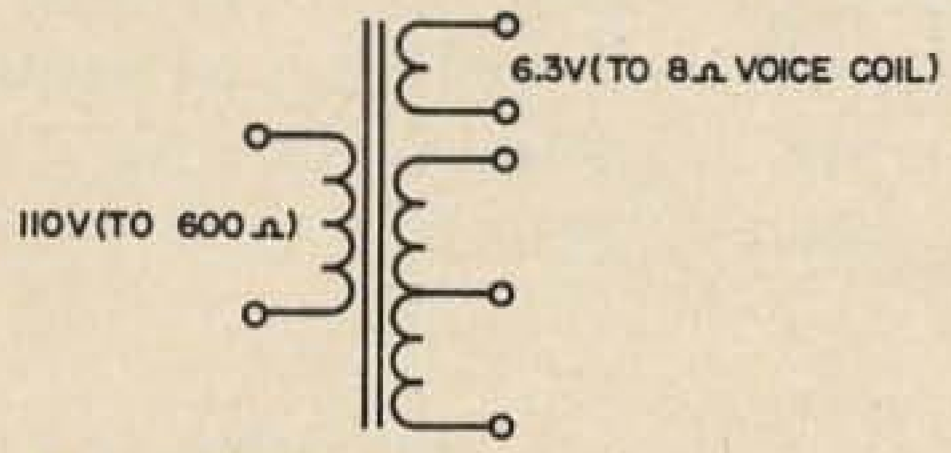
1. Test set up

With an unmarked power transformer, proper identification of the windings may usually be made with an ohmmeter. The low resistance being filament, high resistance the high voltage, and the one in the medium-low range being the primary. To determine the ratio, and voltages under use, the test set up below is recommended. Apply 5 volts (Or other convenient filament voltage) to the primary (if known,) and read the resulting voltages on other windings. This test set up is particularly helpful in avoiding handling lethal voltages when checking out high voltage transformers.



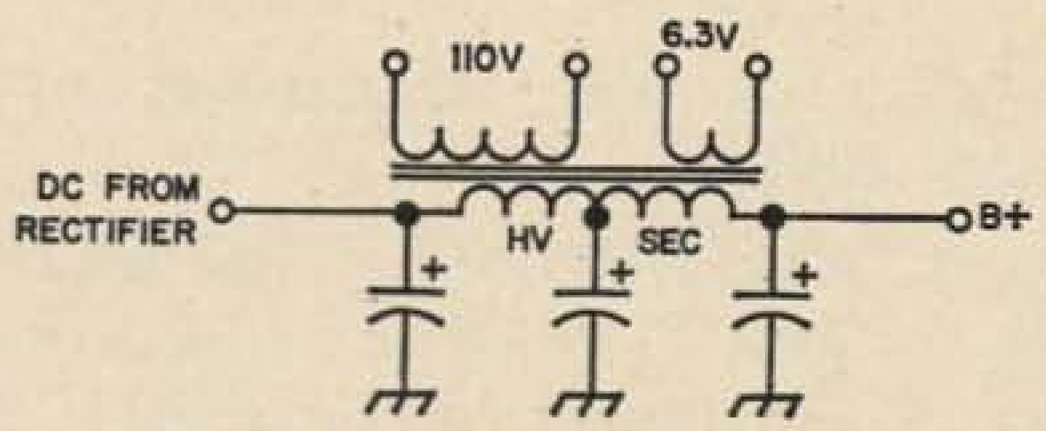
2. Power transformer for audio output.

Generally ½ of the secondary (hv) winding may be used as the primary to a single output tube, or the full winding to P.P. tubes and the 6.3 or 5v winding of the voice coil of the speaker. The 110v winding will handle a 600 ohm line, or headphones.



3. 600 ohm to 8 ohms, using power transformer or filament transformer.

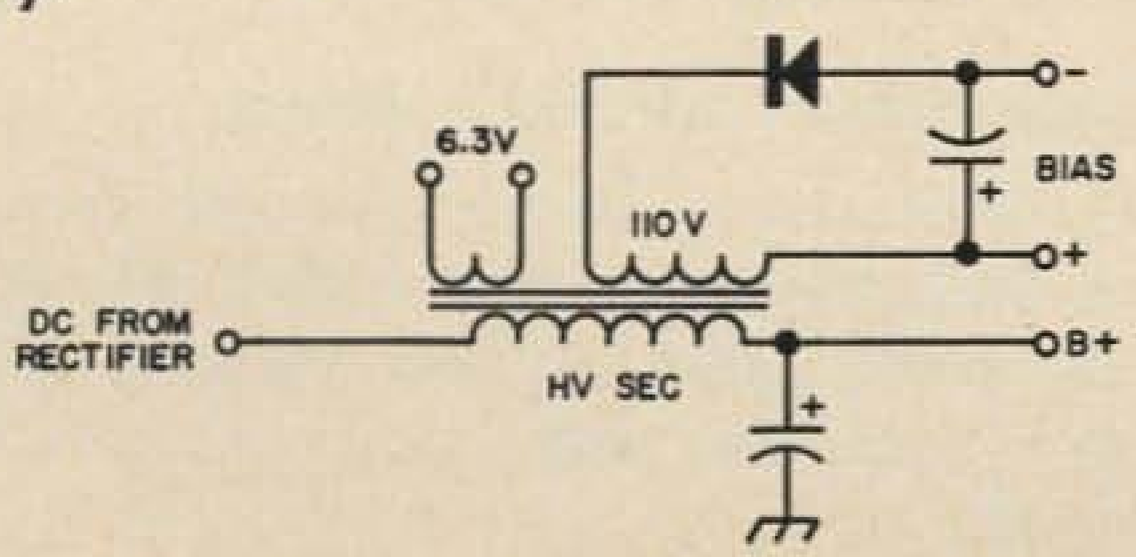
Use adequate size transformer. 110v to 600 ohm. 6.3v to voice coil. H.V. secondary (power transformer) unused.



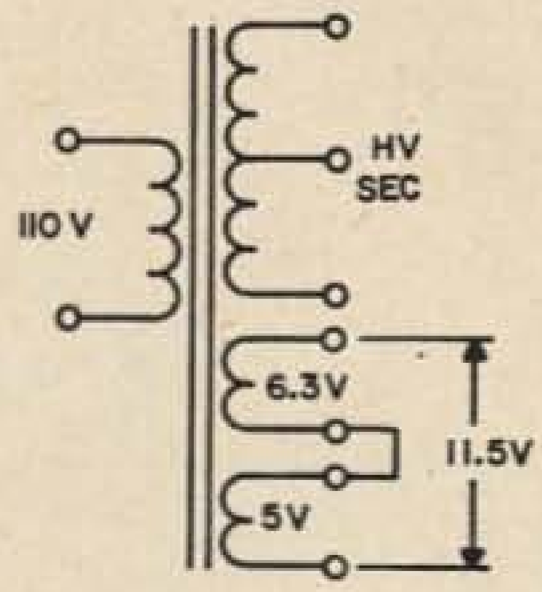
4. Power transformer as choke

Use secondary as a choke for hv supplies. Be sure current rating is high enough. Other windings unused.

5. Power transformer as choke and bias supply.

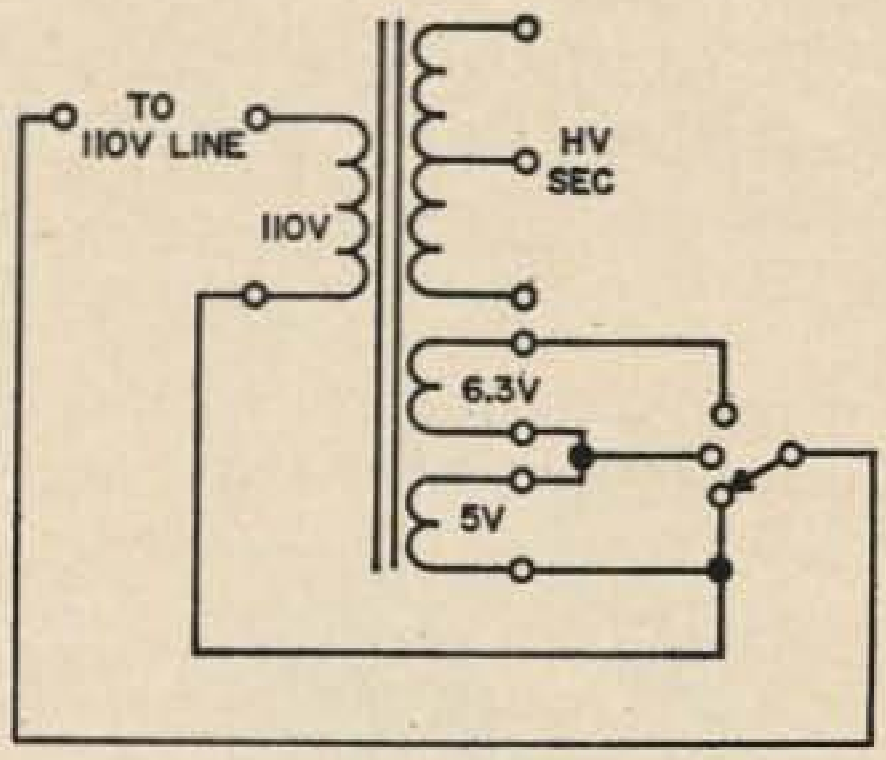


Connect choke input and rectify 110v winding for bias.



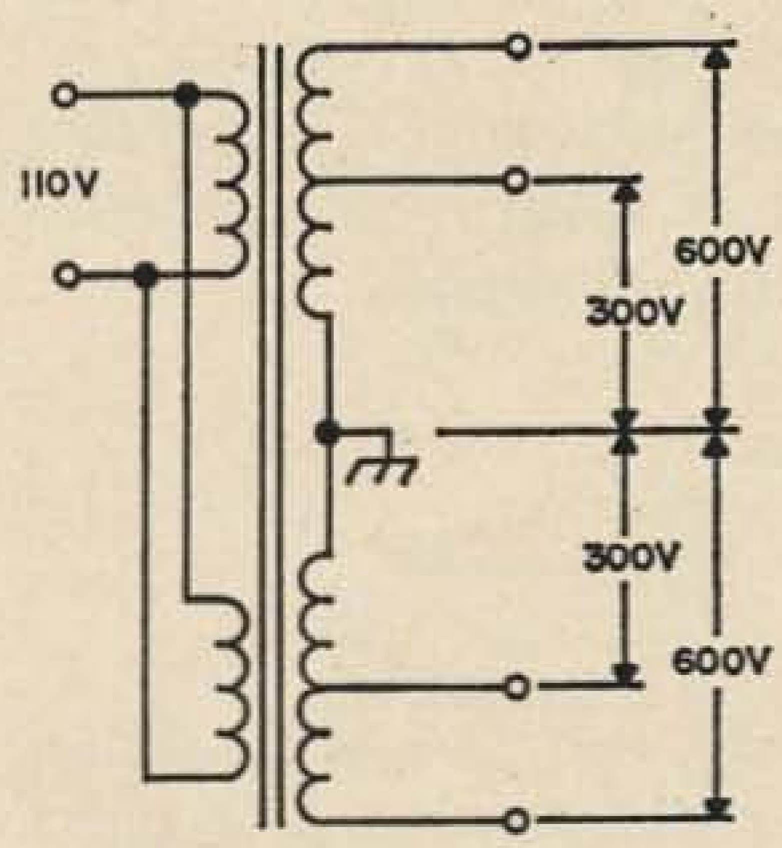
6. Series adding filaments

An oldie but a goodie for 12v filaments from 6.3 and 5v windings.



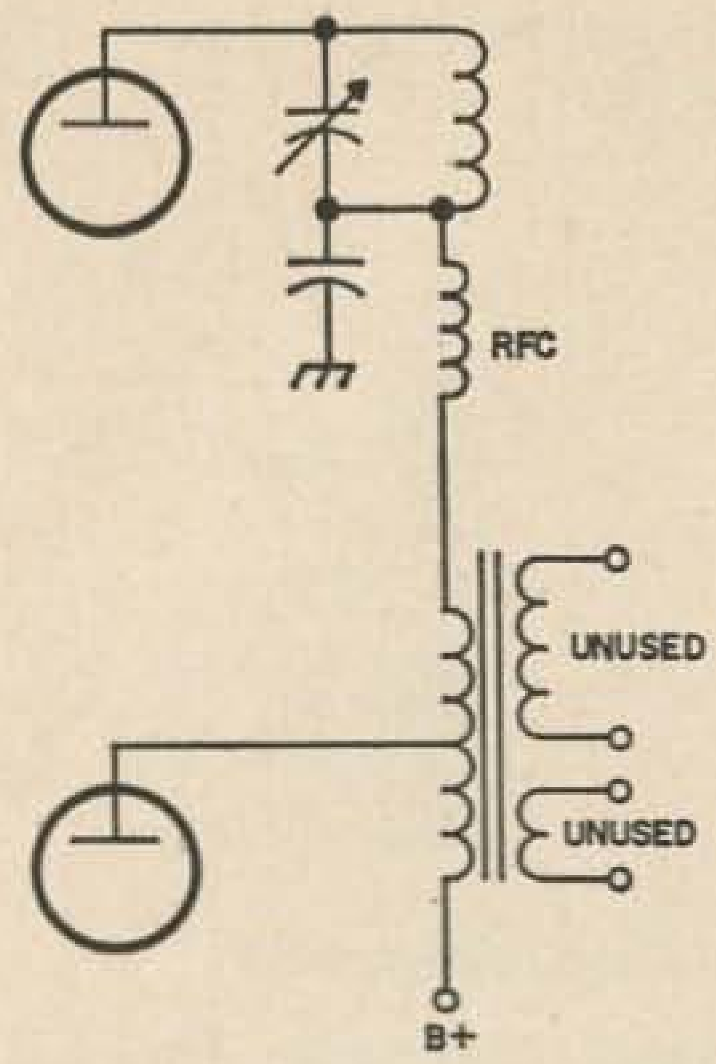
7. Filament windings to vary output

Here the filament windings are connected in phase, (or out of phase with the primary) to vary the hv as much as 20 to 30%. Test set up #1, is useful in determining phase.



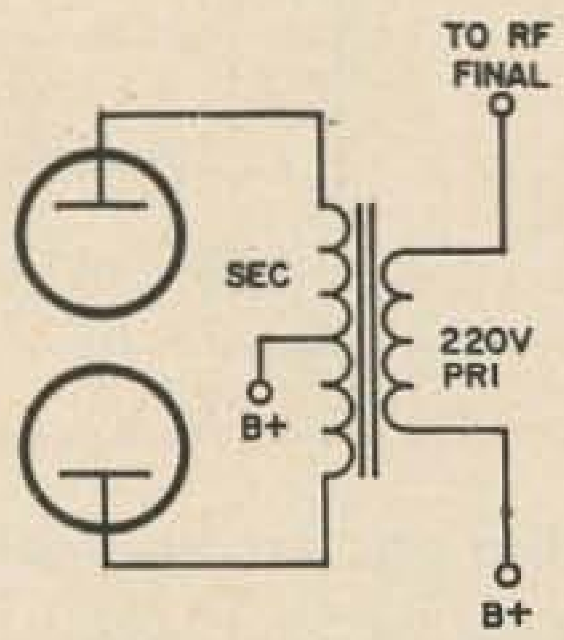
8. Series adding secondaries for high voltage.

Another oldie. Secondaries must be connected in phase. If more than two transformers are used, transformers must be mounted on insulating board and filament windings not used. Transformers vary greatly in breakdown point. Note half voltage may be taken from center taps if both supplies do not exceed current ratings.



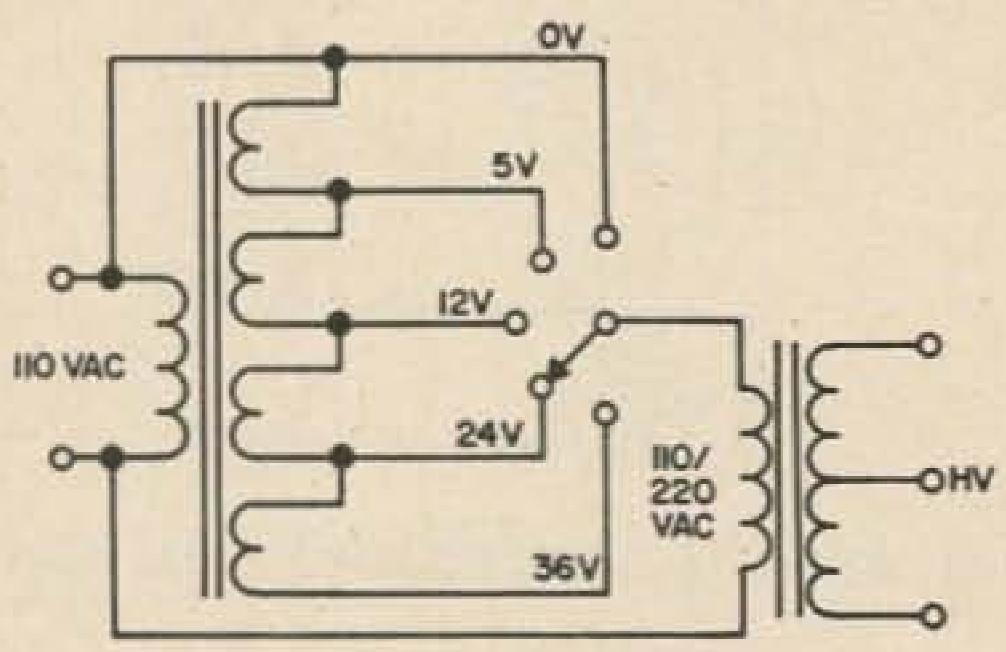
9. Power transformer as Heising modulation transformer

Requires a transformer of high current rating as power to rf final and modulator must be drawn through the winding. All other windings unused.



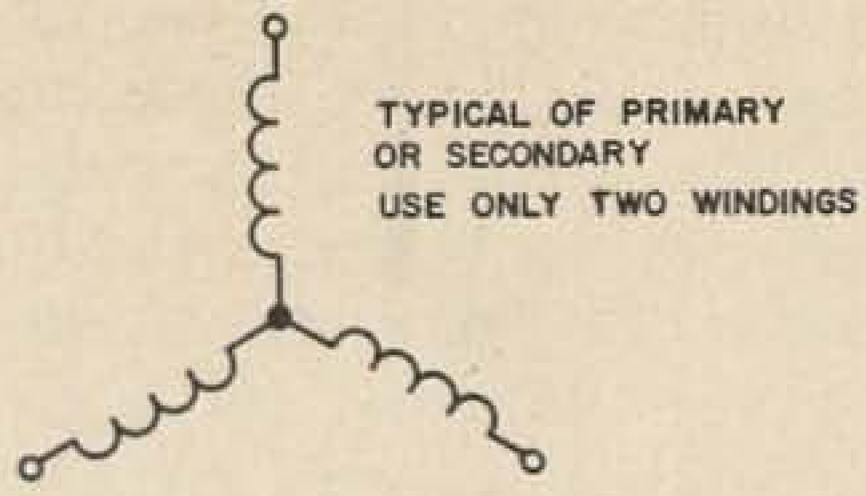
10. Power transformer as modulation transformer

Generally this application requires a rather low voltage secondary which is used as the modulator primary, and preferably a 200 to 240v secondary so the turns ratio is held as nearly as possible to 1-1. 110v TV transformers have been used successfully. Also 400 cycle transformers.



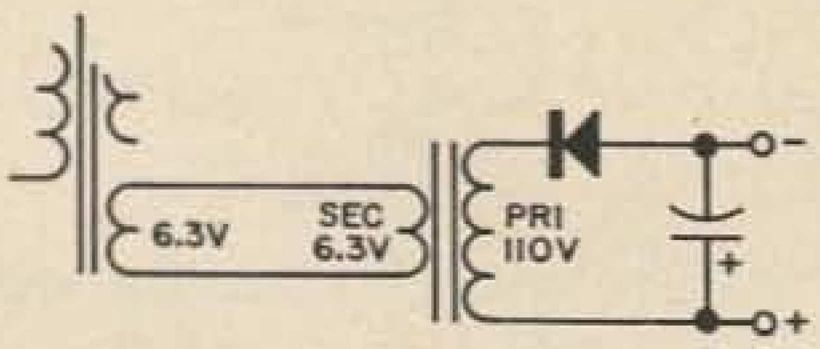
11. Filament transformer as Variac

The same circuit may be used in series subtracting for lower voltage from the transformer. This circuit should find wide application in using 200v Surplus transformers on 110v. Many heavy tapped low voltage transformers are available through MARS or surplus sales.



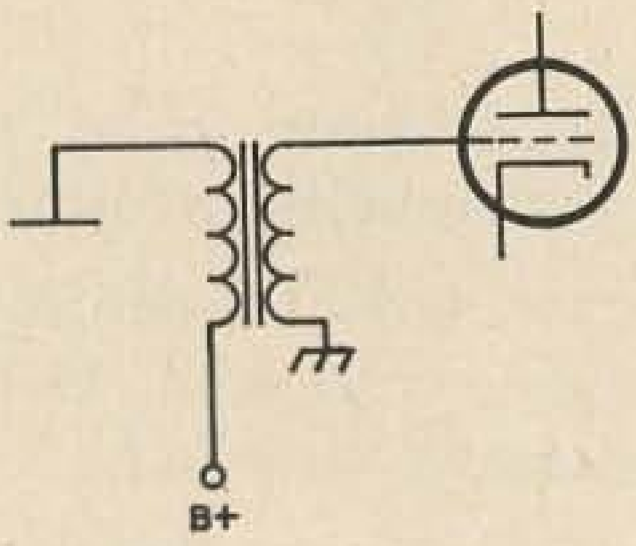
12. 3 phase transformer on single phase

Use only two of the three delta windings. Use the test set-up to check. One winding will be found to cancel both on primary and secondary if delta wound.



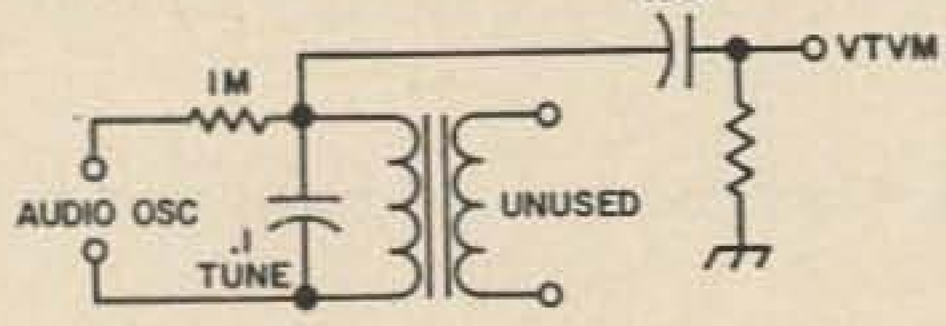
13. Use filament transformer reversed for bias supply.

Don't over look the fact that unlike filament voltages can be connected together for different output voltages. For example a 12 volt winding to 6.3 supply to get approx. 60 volts from 110v winding of transformer. Small power transformer can also be used with hv winding unused.



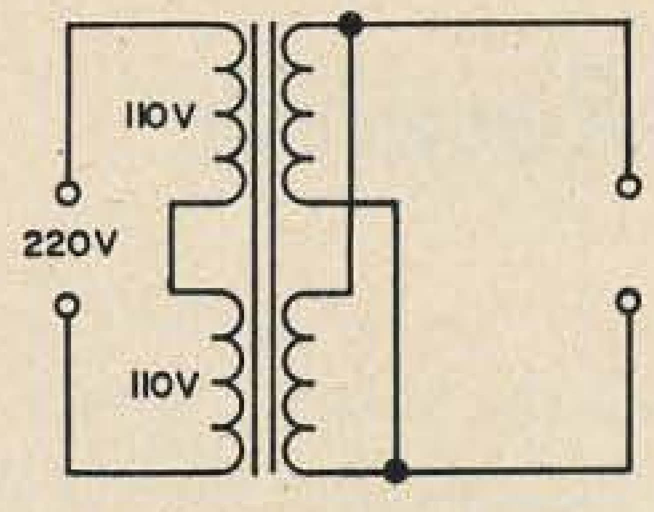
14. Isolation or bias transformer as interstage audio.

Surplus 400 cycle and 220v bias transformers are ideal here. Use lowest turns ratio as primary and highest as secondary. Should be 1-1, 1-2, or 1-3 ratio.



15. Transformers as audio filters.

All transformers have resonant frequencies. A little trial and error with fixed capacitors, an audio oscilator, and vtvm may provide you with that sharp or band pass filter you need.



17. 110v transformers on 220v.

Series the primaries and parallel the secondaries. The same circuit may be used on 110v if half voltage is needed. Series primaries and series secondaries may be used for double voltage from hv on 220 volts.

. . . W4LLR

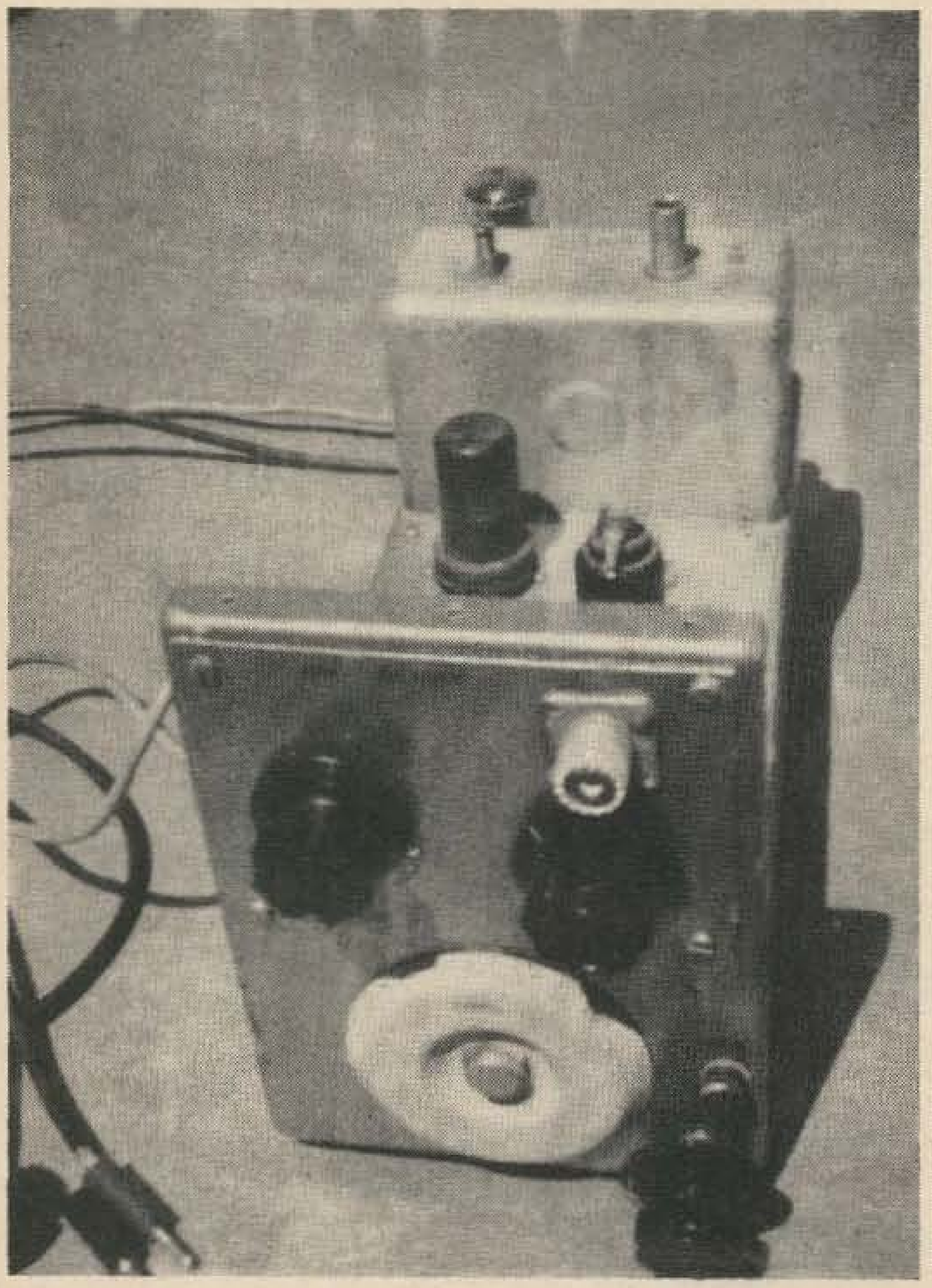
SB2-LA Note

Your 6JE6 tubes will last a lot longer if you reduce the static plate current to 200 mA instead of the 300 called for in the manual. This reduces the plate dissipation from 240 watts to 160 watts for the six tubes, each of which is rated at 30 watts.

. . . K6SHA

CORRECTION

On page 69 of February, change #2 in column 2 to IEE instead of IEEE. The reference was to the British Journal.



Clifford Klinert WB6BIH
520 Division St.
National City, Calif. 90250

In my version a 6SA7 was used as a mixer and a 6J7 was used for the rf amplifier. A VR-150 was added to provide stable plate voltage for the oscillator, a 6J5. Standard circuits were used, and each constructor probably has his own ideas about what circuit is the best for him, or his junk box. An ideal approach would be to use a 7360 to avoid the rf stage, and perhaps a complete receiver could be built on the chassis.

All components not related to the VFO were removed, with the exception of the PA tuning capacitor, C-65. This supports the dial and tunes the mixer's seven MHz. input circuit. The top of the chassis was cut out and a panel was mounted in its place to provide a chassis for mounting components. The grid circuit of the rf stage was kept above the chassis. The front panel was replaced in a manner similar to the chassis top, and all holes were filled with automobile body putty. The panel and sides were sanded, painted with a spray can, and the controls labeled with decals. The chassis with the power supply, *if*, and audio circuits was placed away from the operating table in a convenient place. The two units were connected with one cable carrying voltages for power, and a lead from the rf gain control mounted on the converter panel. A length of RG-58 was used for the *if* output lead.

Thus, our venerable friend the ARC-5 transmitter has provided a simplified and inexpensive approach to receiver front end construction.

. . . WB6BIH

The ARC-5 Transmitter Receiver

Countless articles have been written on the conversion of ARC-5 and BC-458 transmitters. Much time and effort have gone into making these units operable on amateur bands. Often components are removed for use in other circuits, but a use for the complete chassis with a majority of the components still in place is always more attractive.

The 5.3 to 7.0 mHz ARC-5 transmitter provides an unavoidable opportunity for someone who has been thinking about building his own receiver, but is discouraged by the cost and difficulty involved in the mechanical construction of a stable high frequency oscillator. I was in this position a few months ago. A product detector, crystal controlled BFO, and high selectivity FT-241 crystal bandpass filters were added to an old S-20R, but a stable front end was still needed. The ARC-5 provided the answer. Tuning just below the forty meter band, the VFO provided a stable and calibrated means of tuning a forty meter receiver. Converters can be added for other bands.

Modifying

The Clegg 99'er

Paul Porcaro WB2JOS
106 Bleecker Street
Brooklyn, N.Y. 11221

Most hams are experimenters, and are constantly modifying their equipment. Two of the most popular pieces of amateur gear at present, are the Heath "Twoer", and the "Sixer", and articles concerned with increasing the capabilities of these "Lunchboxes" have been widely published.

There has been relatively little material devoted to showing how to modify the Clegg 99'er, and my purpose here is to show some really simple changes for this rig.

Changing this already "Hot" little set into an even "Hotter" one can be accomplished both easily and inexpensively. I will take you step by step, and show how the input power can be raised from 8 watts, to something a little over 15 watts. That's a gain of approximately 3 db.

Starting at the final, change the screen grid resistor (R32), connected to pin 8 of the 7558 (V9), from 33,000 ohms to 10,000 ohms, 1 Watt. With this change the final will draw more current, and the input power will increase.

Moving along to the audio section, we find that the Clegg 99'er has such excellent audio action that not much has to be done here. Just to be on the safe side however, change the 330,000 ohm resistor (R43), connected to the plate of the 12AX7 (V7A), pin 1 to 470,000 ohms. This change will increase the audio sufficiently to fill the carrier.

Now to probably the most important modification. Remove the rectifier tube 6BW4 (V10), and leave it out, it won't be needed any more. In its place install two silicon diodes. Sylvania F8 diodes worked out well for me. But any with similar or higher ratings will also work well.

One of the diodes is soldered between pin 1 and pin 9 of the 6BW4 (V10) tube socket, and the other diode is soldered between pin 7 and pin 9 of the same tube socket. Be sure to observe polarity, and don't forget to use a heat sink when soldering.

This last change will increase the B+ throughout the set, due to the lower voltage drop of the diodes when compared with the 6BW4 rectifier tube. With this increased B+ voltage, the rig will now have about 15 watts input. As an added bonus, the increased B+ will also hop up the receiver section.

To increase the efficiency of the Clegg 99'er still further, replace the 6AL5 (V5) detector and ANL with a pair of solid state diodes. This will save a little filament power.

To accomplish this task, solder one diode from pin 5 to pin 2 of the 6AL5 tube socket. Now solder another diode from pin 7 to pin 1 of the same tube. Remove the 6AL5 and leave it out. The diodes I used for this purpose were 1N198's, but any general purpose diodes having a good front to back ratio will do the job.

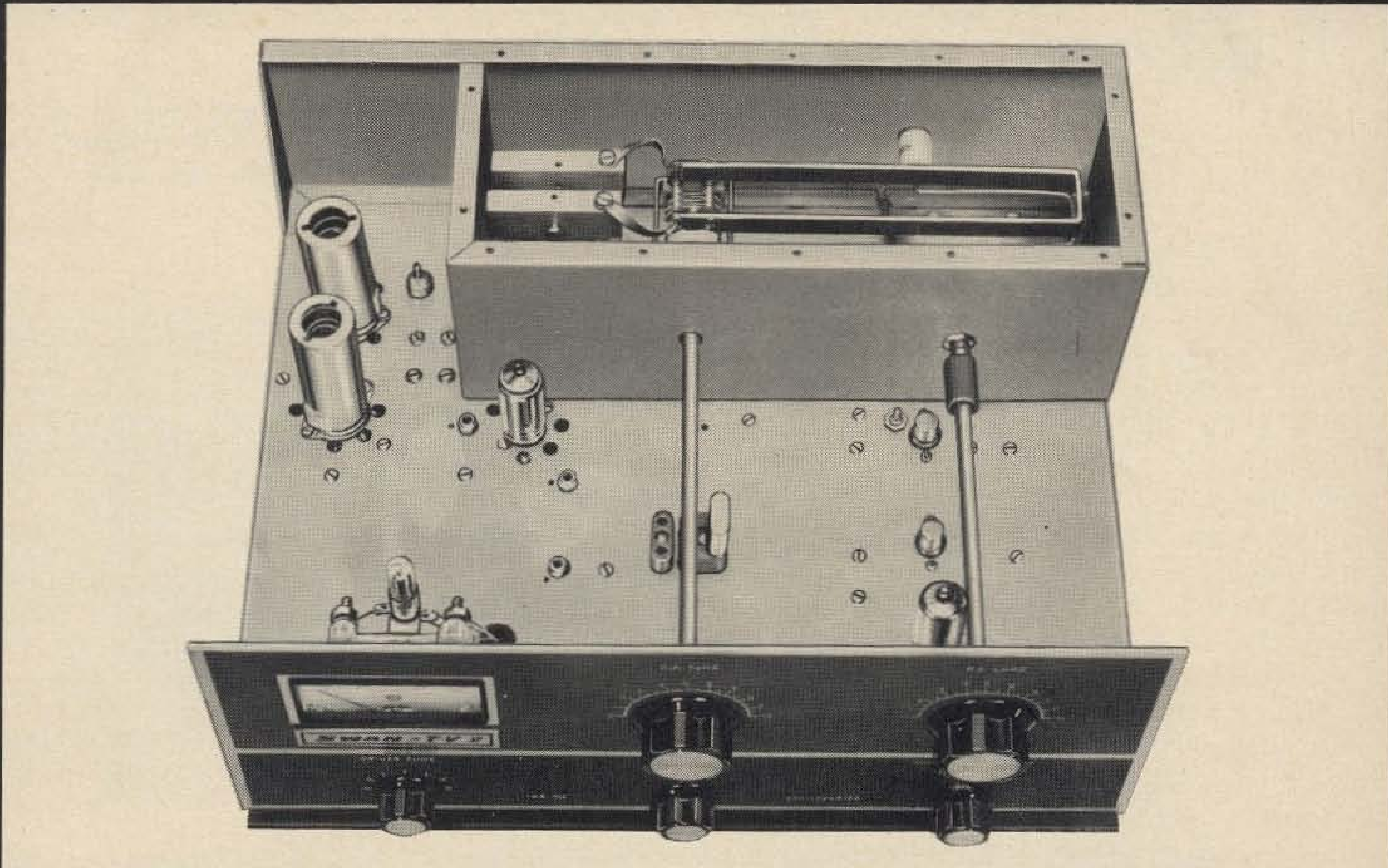
Every little bit of efficiency gained is a big help, especially if the rig is to be used mobile.

Want some proof of performance? The modifications I have described were incorporated in my own rig in September of 1963, and it is still operating as well as it always has. I think this test period is really long enough to prove that no great harm will be inflicted on the gear.

Good Luck With Your Higher Power!

2 METER SINGLE SIDEBAND

144-148 mc 240 WATTS P.E.P. INPUT



THE NEW SWAN TV-2 TRANSVERTER

A receiving and transmitting converter for the 2 meter band, designed to operate with Swan Transceivers, models 250, 350, 350-C, 400, 500, and 500C.

SPECIFICATIONS:

14 mc intermediate frequency is standard. Thus, when operating the Transceiver from 14 to 14.5 mc, the Transverter functions from 144 to 144.5 mc. Additional crystals may be purchased and switched in for other portions of the 2 meter band, such as 144.5-145, and 145 to 145.5 mc. Three crystal positions are available.

Alternately, the TV-2 Transverter may be ordered for an I.F. in the 21, 28 **or** 50 mc bands, if desired. Of course, for use with a Swan 250 six meter transceiver, the Transverter must be ordered for 50 mc. Otherwise, the standard 14 mc I.F. is recommended since bandspread and frequency readout will then be optimum. The Transverter can easily be adjusted in the field for a different I.F. range, if required.

A 5894 B Power Amplifier provides a PEP input rating of 240 watts with voice modulation. CW input rating is 180 watts, and AM input is 75 watts.

Receiver noise figure is better than 3 db, provided by a pair of 6CW4 nuvistors in cascode.

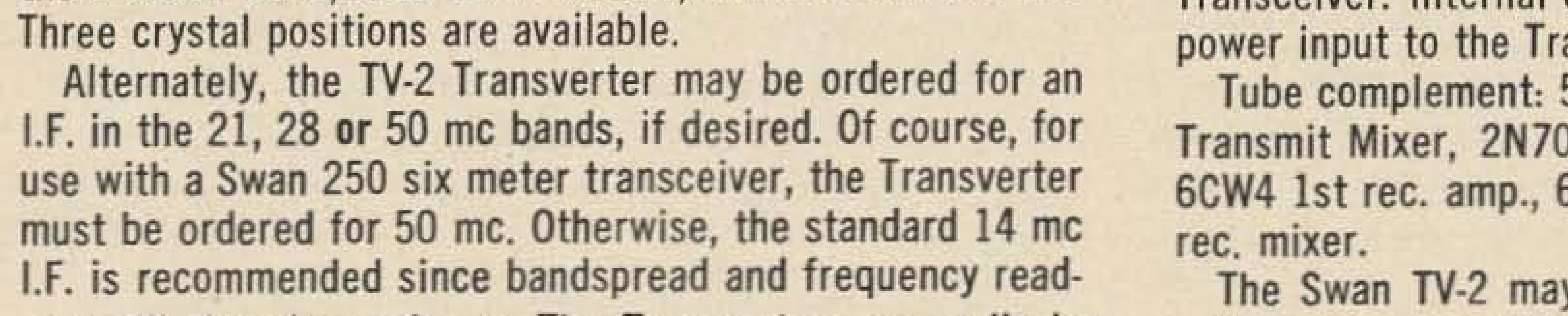
Only a Swan Transceiver and Swan AC power supply, Model 117-XC, are required. The power supply plugs into the Transverter, and the Transverter in turn plugs into the Transceiver. Internal connections automatically reduce the power input to the Transceiver to the required level.

Tube complement: 5894B Pwr. Amp., 5763 Driver, 12BY7 Transmit Mixer, 2N706 crystal osc., 6EW6 Injection Amp., 6CW4 1st rec. amp., 6CW4 2nd rec. amp. in cascode, 6HA5 rec. mixer.

The Swan TV-2 may also be operated with other transceivers when proper interconnections and voltages are provided. A separate Swan 117-XC power supply will most likely be required.

Dimensions: 13 in. wide, 5½ in. high, by 11 in. deep. Weight: 13 lbs.

$265



MODEL 250 ...... $325
MODEL 350C 420
MODEL 500C 520

MODEL 117-XC
AC POWER SUPPLY .. $105

MODEL TV-2
144 mc TRANSVERTER

SWAN
ELECTRONICS
Oceanside, California
A SUBSIDIARY OF CUBIC CORP.

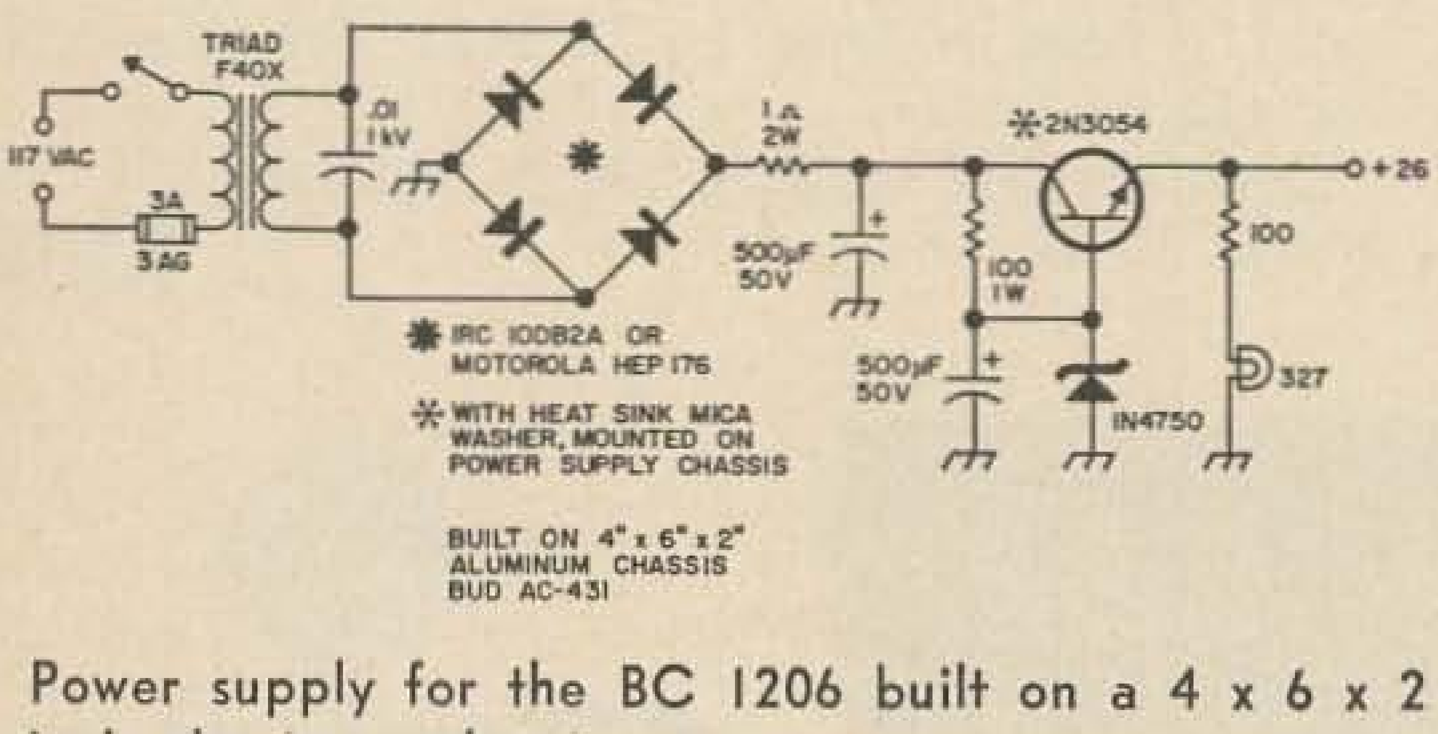
Modifying The BC1206

Hank Olson W6GXN
3780 Starr King Circle
Palo Alto, Calif.

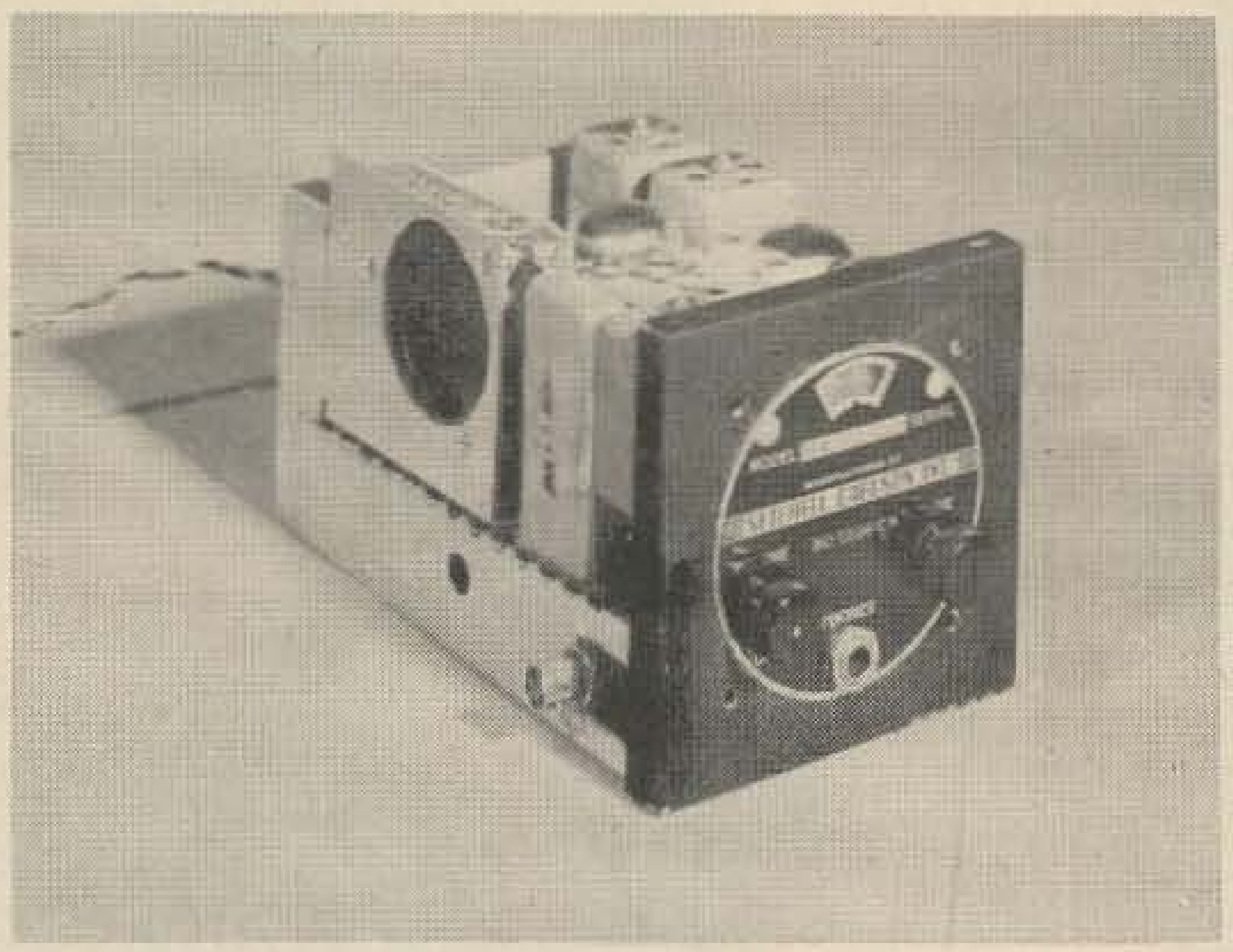
At first glance at the BC1206 receiver, it would appear that this 200 to 400 kHz receiver is of solid-state design. After all, it runs directly on +28 volts dc, makes no vibrator or rotary converter noise, and it is only 4 x 4 x 6⅝ inches in size. Yet this tiny lf receiver is really a tube-type design, using five Loctal type tubes. The plates of the tubes are supplied directly from +28v, very much as many auto radios operated directly on 12 volts, which were built in the early 1960's. (these auto radios were the so called "hybrids" using tubes in the rf and *if* circuits and transistors in the audio stages). Apparently, the BC1206 was twenty years ahead of its time!

If one can power the BC1206, it makes a worthwhile lf receiver for monitoring the FAA weather broadcasts. These broadcasts give continuous weather summaries and also give forecasts which may be of interest to amateurs.

The set may be used with all of the original tubes in it, but then that wouldn't be "converted", would it? You can save a lot of current and get much better audio by taking out the 14R7 detector and first audio stage and the 28D7 (probably the world's oddest receiving tube!) audio output. Replace the 14R7 by a 1N270 or similar germanium point diode, connecting the output of T5 through the diode to ground. The 14A7 filament depended on the 14R7, so replace the 14R7 filament with a lN2976 Zener, the anode (stud) of the Zener being bolted to the chassis. Bypass the Zener with a 50 mfd 15 volt capacitor. This point can be a source of 12 volts for the new audio amplifier.



Power supply for the BC 1206 built on a 4 x 6 x 2 inch aluminum chassis.



I used the audio section from an old Japanese transistor radio. I changed the transistors to NPN germanium units (2N388) so it could work from the plus 12 volts. The HV15 bias compensating diode is left in, but turned around for polarity.

A small speaker is added inside the case so that you don't have to use phones.

Since the total dc current required by the converted BC1206 is only about 350 mA, it can be operated from a relatively small power supply. Such a +26 volt, regulated supply is shown in **Fig. 1.** The power supply uses an emitter-follower series regulator which not only regulates the output dc voltage, but acts as a "capacity multiplier" to smooth out 120 Hz ripple.

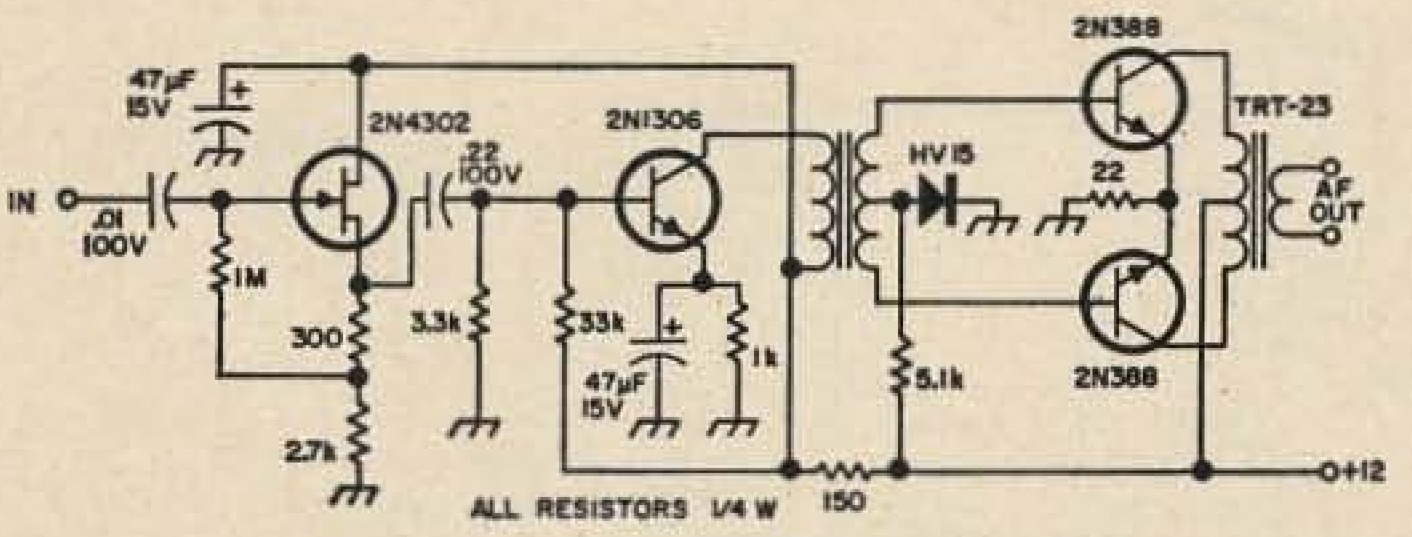
The antenna jack was changed to a type BNC. A UG 1094/U fits the ⅜ inch hole left after removing the original bayonet-style fitting.

Since the audio amplifier has an input impedance of only a few thousand ohms it would load down the detector and agc line. To prevent this, a simple FET source-follower precedes the amplifier, offering a very high input impedance to the detector.

If it is contemplated building the amplifier from scratch one could use a IN2326 (R.C.A.) as the compensating diode, and Lafayette 99R6126 and 99R6129 as the driver and output transformers.

The amplifier was built on a piece of

vector multihole circuit board (Vector 85G24WE) that was 2¾ x 2½, using Vector T28 pins. The amplifier board was mounted, on edge, behind the speaker in the space left by the 28D7 and its output transformer. The speaker is a 2 inch, 8Ω type; it was removed from the same Japanese transistor radio from which the amplifier parts were taken. 13 additional holes were drilled in the BC1206 cabinet, to allow sound to pass out the side of the receiver.



AF section of a typical Japanese transistor radio as modified for use in the BC 1206.

Finally, while you have the receiver "opened-up" you might just as well replace the four or five paper tubular capacitors that are easily accessable. 100 volt mylar-type capacitors are perfect for this, being smaller than the original and more adequate in voltage rating. The total capacitor cost will be less than a dollar for this "stitch in time", and will save time in the long run.

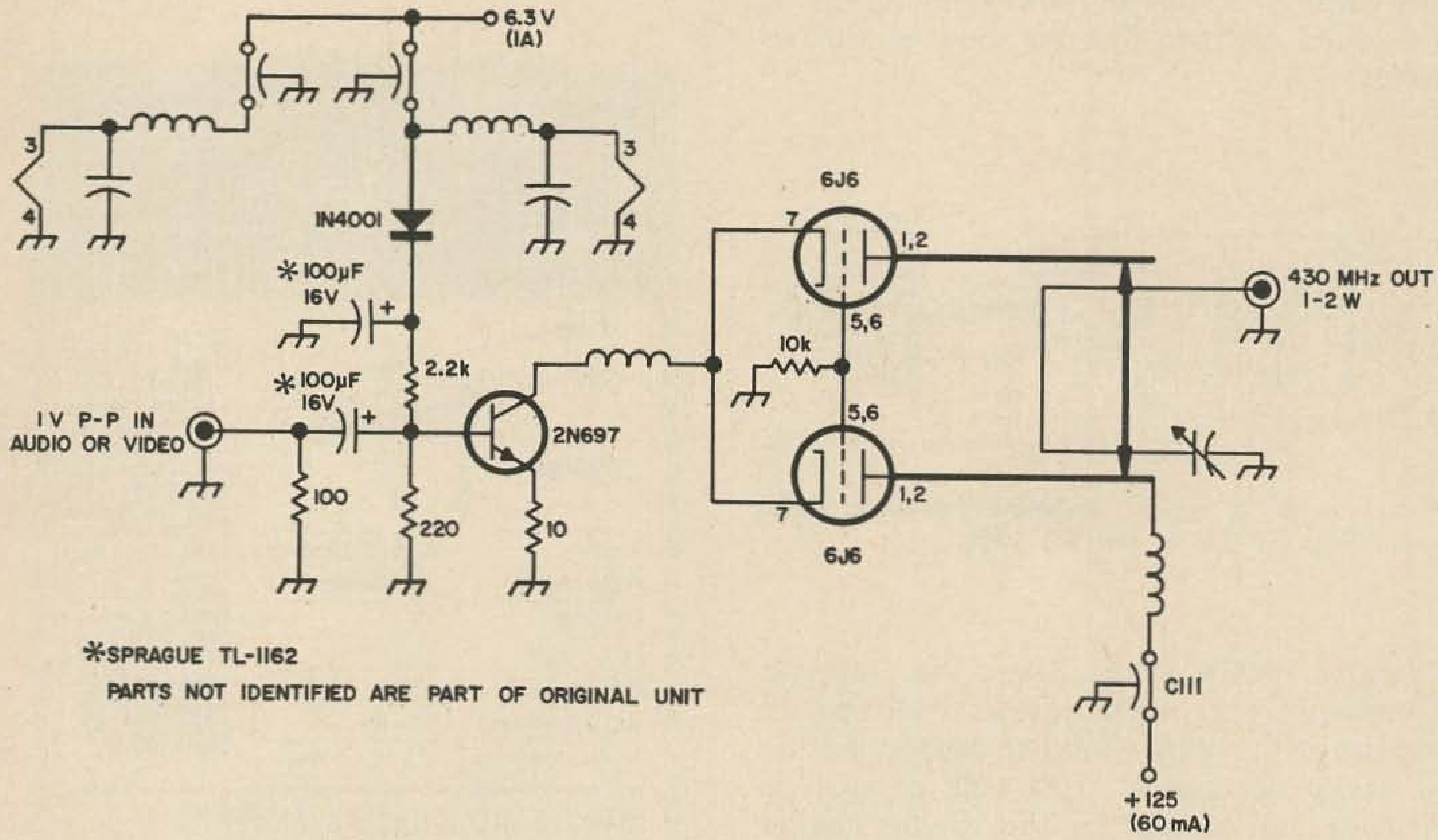
The modified BC1206 has proved to be quite satisfactory for receiving OAK on 362 kHz some twenty miles distant. In addition to the weather station OAK, perhaps another half dozen MCW signals can be heard. These other stations are probably marker beacons. . . . W6GXN

K3OLG Hears S-O-S

Jerry Lewine K3OLG was just tuning around a few weeks ago when he heard an S-O-S coming through on CW. He called the local Coast Guard just in case they didn't have the word. Turned out that they didn't and that Jerry's quick action helped 32 crew members and three passengers be saved from a burning Greek ship about 650 miles off the coast of Southern California.

APS-13 ATV Transmitter

Tom O'Hara W6ORG
10253 East Nadine Street
Temple City CA 91780



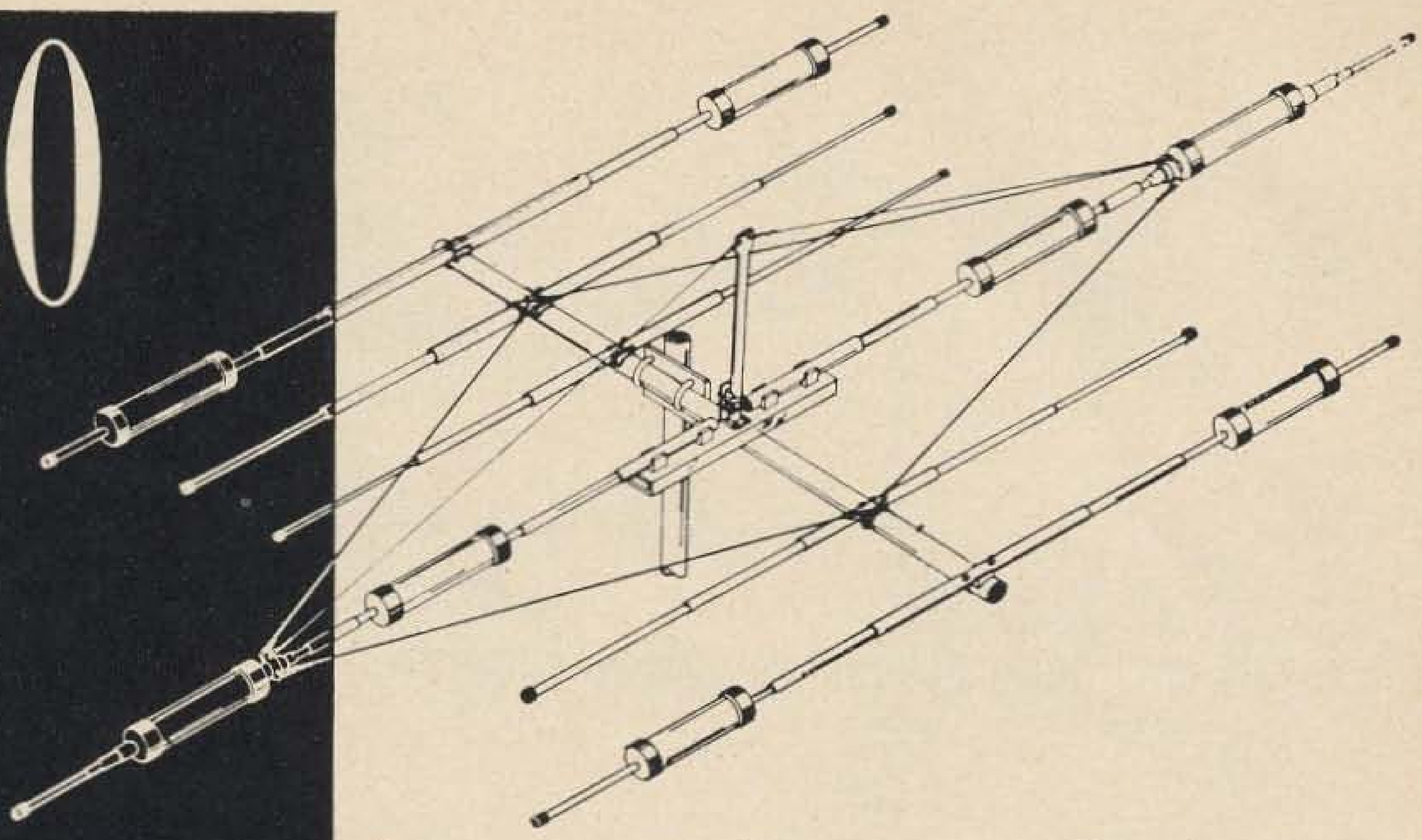
*SPRAGUE TL-1162
PARTS NOT IDENTIFIED ARE PART OF ORIGINAL UNIT

The APS-13 has been around for a long time in the surplus houses for about $2 each. The Tail-end Charlie, as it has been nicknamed, was used in the tails of B-17's to detect approaching aircraft. It contains both a transmitter and receiver. The receiver is not worth the effort to convert for video as the 30 mHz *if* strip and 430 MHz converter module are very noisy by present day standards and aren't wide enough in frequency response for good TV resolution. It does work fair for audio, with some work. The transmitter module can be dug out of the unit with a little prying, cutting, and unscrewing. The module has two 6J6's on top, cocked at an angle. It was originally used as a pulse modulated oscillator. This conversion changes it into a cathode modulated continuous running oscillator.

Modification

Change the grid resistor from 270 ohms to a 10K ½ watt. Remove the 39 ohm cathode resistor. Ground pin 4 of the 6J6's socket. Jumper the filaments together at the capacitve feedthroughs. Remove the tube shields and the part that holds them by twisting with a pair of pliers. This is necessary to raise the frequency to 430 MHz as they added too much capacity. Set the sliding short on the plate lines to about ⅜ of an inch from the end.

Construct the transistor modulator and bias supply on a 1 x 1½ piece of vector board. Mount a UHF chassis connector for the video input on the side opposite the UHF connector for the rf output. Mount the completed transistor modulator board against the side next to the input UHF connector on the inside. Connect the free end of the cathode RFC directly to the collector of the 2N697. Connect the rectifier diode IN4001 to the 6.3 vac filament feedthrough capacitor. Connect a ground lead and video input lead to the UHF connector. All leads must be direct and short. The power required is 125 vdc at 60 mA and 6.3 vac at



1 amp. These leads connect on the outside of the can to the feedthrough capacitors.

Operation

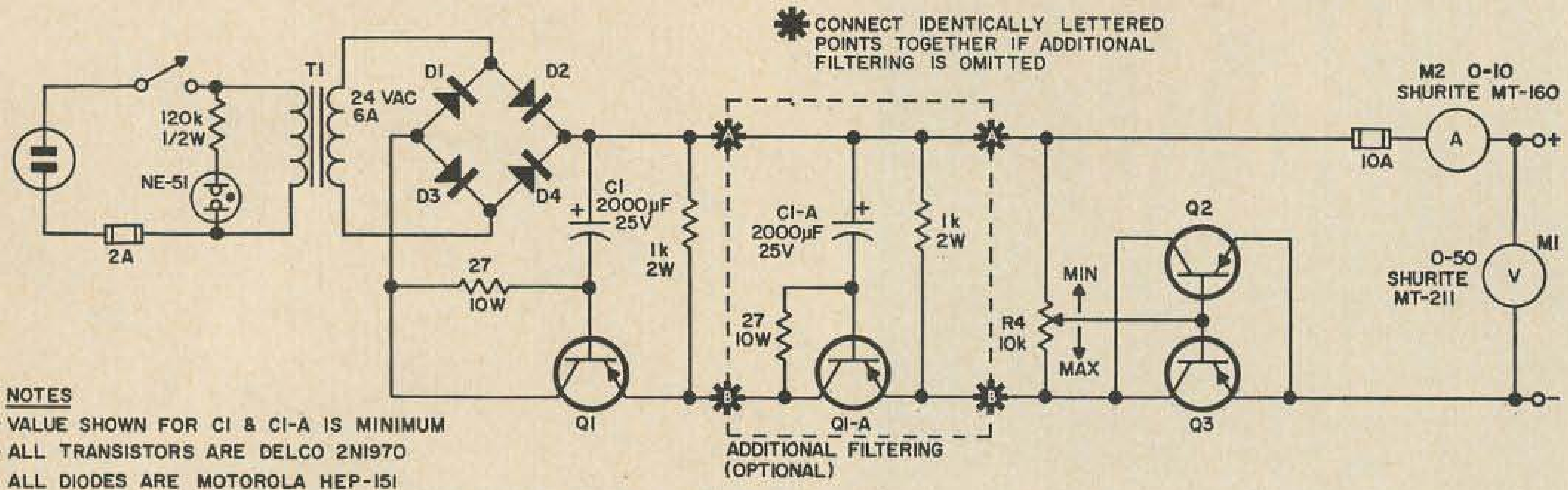
Like all modulated oscillators, rf loading affects the linearity of the modulation. TV is much more critical than voice. Consequently, the maximum power out does not necessarity correspond with the best picture. The power supply plate voltage must be in the range of 100 to 150 volts. The loading capacitor on the pickup link should be adjusted for the best received picture on a set located at least ¼ mile away. If you try to do it in your own shack you may get a bad picture from front end overloading. Try changing 6J6's also, as some work better at 430 MHz than do others. So far, the best has been 2 watts output, which put in a good picture 27 miles away. It's just the thing for portable and field day operation.

If you don't have a receiver for ATV on 430-440 MHz it is much easier to convert a commercial UHF TV converter than it is to play with the one in the APS-13. For most commercial UHF converters it usually only takes a one pF capacitor across each tuned circuit to tune it down. If you are low enough it will move the channels up 10 (channel 34 tunes in at 44 on the dial). If you can't see your carrier below channel 14 from the ATV transmitter or the third harmonic of a 2 meter transmitter, it could be that the local oscillator dropped out. In that case add a 1 pF capacitor in the feed back path (plate to cathode, etc).

The Blonder-Tongue model 44 tunnel diode Ultraverter is excellent for ATV as it has two variable capacitors which you can adjust in order to lower the frequency. Add an antenna, preferably of the broadband type such as the Cushcraft 16 element collinear CL-416, and you're ready to go.

This is the easiest and cheapest way to get on ATV, you also need a camera, flying spot camera, or color bar generator. Our audio is usually on two meters, on 146.7 for Techs and 144.45 for Generals. You can put audio on another APS-13 by adding a carbon mike and 150 ohm bias resistor, disconnecting the 100 ohm resistor, and hooking up the mike to the video input, which requires 1 volt p-p of video or audio. *See* you on the air.

. . . W6ORG



NOTES
- VALUE SHOWN FOR C1 & C1-A IS MINIMUM
- ALL TRANSISTORS ARE DELCO 2N1970
- ALL DIODES ARE MOTOROLA HEP-151
- FOLLOWING PARTS AVAILABLE AT INDICATED PRICES FROM BAY ELECTRONICS, 2315 ARTESIA BLVD, REDONDO BEACH, CALIFORNIA, 90278 (ADD POSTAGE)

C1, C1-A (25,000 uF 25V)	2.88 EA
D1,2,3,4	.79 EA
Q1,1-A,2,3	.99 EA
T1	6.88 EA

Versatile Variable Power Supply

Ray Couch W6SLP
2610-182nd. Place
Redondo Beach, Calif. 90278

How often have you picked up some goodies at the local surplus market and rushed home to hook it up for trial, only to find that your 12 volt car battery or battery eliminator did not supply enough of the 24 volts needed to make it go? Or when the kids' transistor radio quit working, did you run all the way down to the radio store and buy a new battery only to find that it wasn't the right battery after all? The variable power supply described here can help you out of these situations as well as many others. You can even toss the battery eliminator out and use this unit to charge the jalopy battery, or convert the eliminator into the type of supply described here, using many of the original components.

This supply is simple to construct, small in size (I built mine in a 9" x 6" x 5" box, with room to spare), economical to build (if you have the major components in your junk box), has very smooth control, good regulation and excellent filtering.

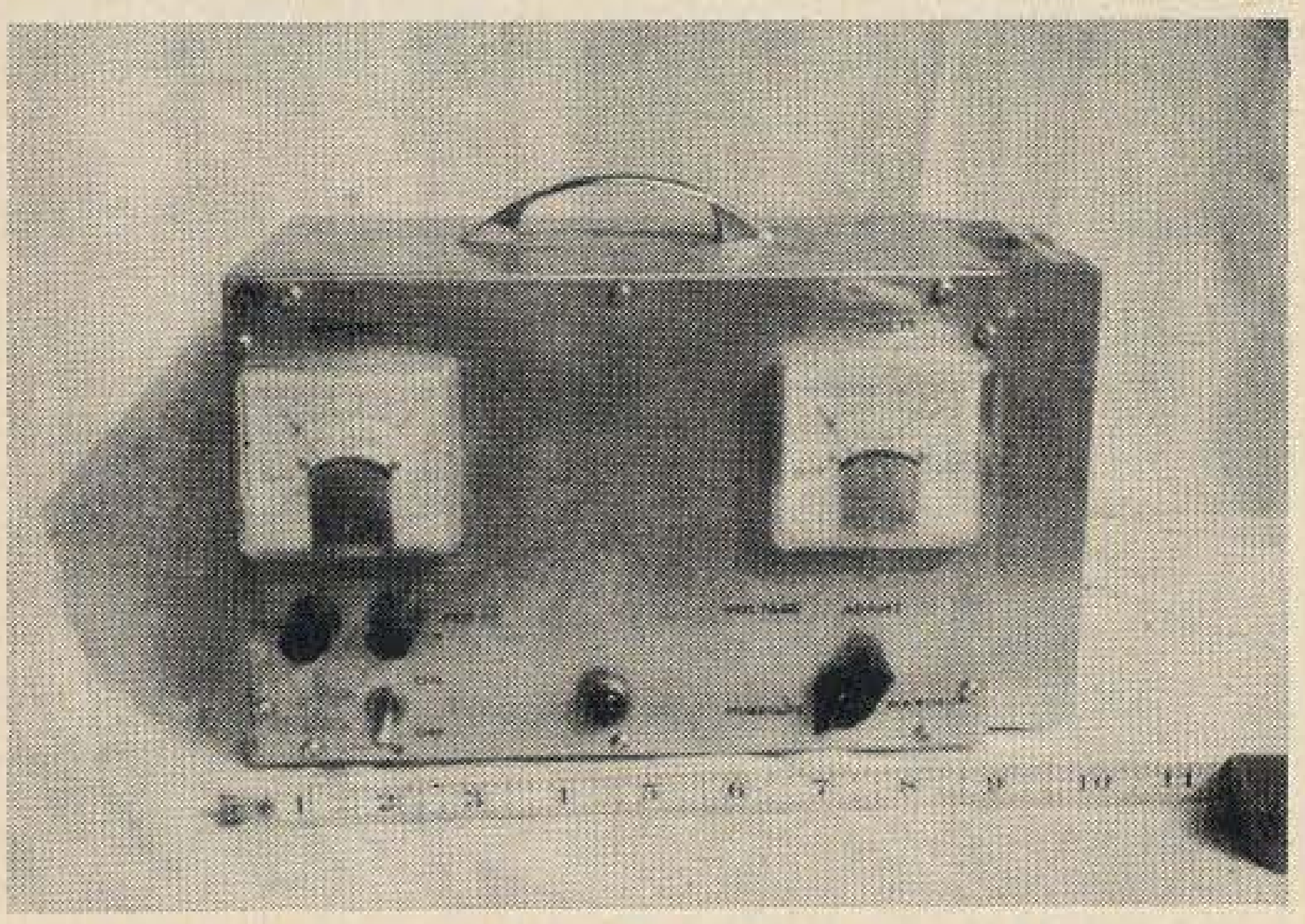
I was able to salvage all of the needed components from my junk box with the exception of the 10k linear potentiometer. Many of the components I used were not labeled as to part number, manufacturer, etc., but their ratings are similar to those shown. I should also mention that this same circuit can be used for supplies other than 0-24 volts, just don't exceed the voltage and current ratings for the diodes and transistors used.

About the Circuit

T-1 as shown on the schematic is hooked up to a conventional bridge rectifier circuit. If you happen to have a center tapped secondary transformer and only a couple of diodes, the circuit will work just as well with that arrangement. Likewise, a higher voltage transformer up to about 50 volts would make the supply even more useful (I used a 36 volt 5 amp. transformer).

The first transistor, Q-1, is the filter regulator part of the circuit. It is hooked up in what is sometimes called a capacitance multiplier circuit. That is, the filtering at the points marked A and B on the schematic is equal to the beta of Q-1 multiplied times the capacitance of C-1. For instance, if the beta of Q-1 is 40 and the capacitance of C-1 is 2000 mfd, the dc output is filtered to the equivalent of an 80,000 mfd capacitor across the output. This part of the circuit can also be duplicated to give still additional filtering. If you have no 2000 mfd capacitor, but do have a couple of 500 mfd capacitors, rather than parallel them into a single unit, use one in the base of Q-1, add another transistor and use the other capacitor in its base circuit. This will give you the equivalent filtering of 50 mfd times the beta of Q-1 (40) or 20,000 mfd. The additional transistor will give you an additional 20,000 mfd equivalent, and will also improve the regulation somewhat.

The second two transistors, Q-2 and Q-3, are the voltage control transistors. Two transistors are hooked in parallel to allow for the power that must be dissipated in that part of the circuit and will change with the change of voltage control R-4. If necessary a third or fourth transistor can be added in parallel with Q-2 and Q-3 if your transformer is capable of higher current output than 5 amps. In that case additional transistors will have to be parallel with Q-1 also. On the other hand, if your transformer is only capable of a couple of amps., a single 2N1970 will suffice. Even a cheaper transistor such as the 2N307A may be used for Q-1, Q-2 and Q-3 for lower voltage, lower current requirements. In any case, all



The heat sink for Q-1, Q-2 & Q-3 can be seen attached to the right hand side of the case. The ammeter is on the left and voltmeter on the right. Output terminals are the two binding post below the ammeter, with the power switch just below them. The pilot light is at the bottom center. The voltage control potentiometer can be seen at the bottom right hand side below the voltmeter.

three transistors should be mounted on a good heat sink as they will run warm. You don't have to be fussy about components to build yourself a good well filtered power supply. Take inventory of your junk box, decide what voltages and current you would like to have, and if you have the transformer to fill this requirement you can use almost any type of diodes, transistors and capacitors by using them in series, parallel, etc., to fill the current and voltage requirements. Uses for this supply are limited only by the imagination. The filtering is sufficient to allow its use for transistor radios, tape players, etc., yet it has enough current available to charge car batteries or run solid state mobile rigs on the workshop bench. ...W6SLP

these famous Clegg VHF units are now available from stock

The quiet one . . . lets you hear all thats going on, on 6 and 2 meters. All solid state design with FET RF and mixer stages for less than 2db noise figure; immune from overload; built-in regulated power supply; ten crystal positions selectable from front panel for full band coverage. Each Classic converter customized to your receiver before delivery.

CLASSIC VHF CONVERTER

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22'er 2 METER TRANSCEIVER

Here's the twin brother to the 22'er and Clegg's worthy successor to the famous 99'er. This 22 watt, PTT, six meter transceiver with selective, dual conversion receiver performs like a champ from a dual built-in 115 VAC or 12 VDC power supply. Amateur Net $245.00.

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Here's a compact, self-contained, 6 meter 675 watt linear amplifier that makes the ideal companion for the Clegg VENUS 6 meter, SSB transceiver. Featuring highly efficient circuitry, the Apollo delivers a clean, powerful 6 meter SSB signal. The Apollo also delivers a big AM Signal when driven by the Clegg 66'er or 99'er six meter AM transceivers. Amateur Net $245.00.

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Here's the time-tested and proved performance champion AM and CW transmitter for 6 and 2 meters. Clegg's exclusive automatic modulation control makes the 185 WATT ZEUS outperform many kw rigs. Self-contained VFO provides full coverage of both bands. The ZEUS has scored more VHF contest points than all other commercially built rigs combined. Amateur Net $525.00.

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Low-Cost Conversion Of Surplus Oscilloscopes

Glenn Brown W8JZI
689 Drummond Ct.
Columbus, Ohio 43214

There are many oscilloscopes available on the surplus market at bargain prices of ten to twenty dollars. These 'scopes either do not include power supplies, or have power supplies which operate on 400 cycle current.

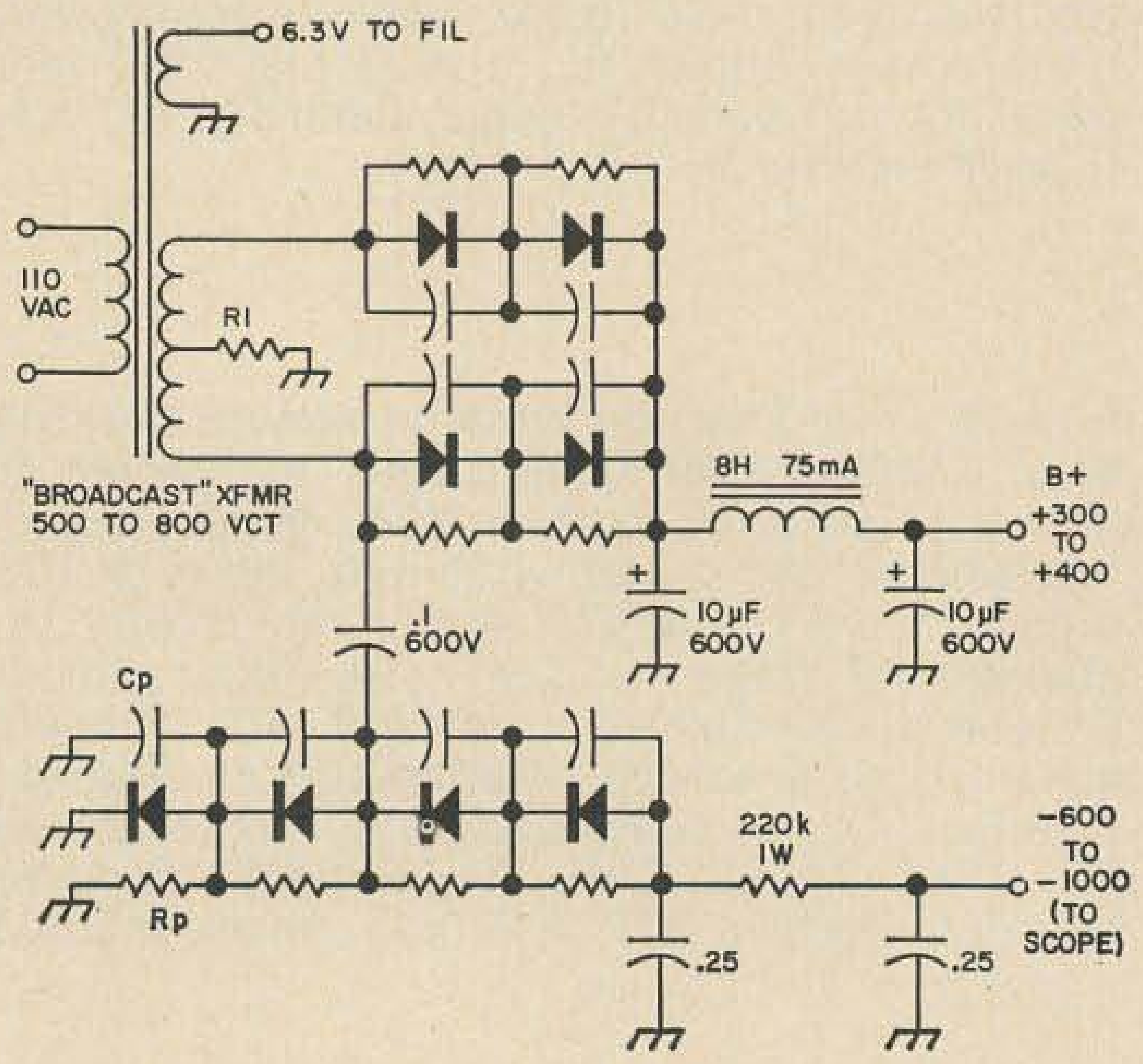
Past conversion articles invariably specified a new 60 cycle oscilloscope transformer in the conversion. Such transformers cost as much as the 'scopes, and the availability of transformers with the required voltages is limited.

This article describes an approach to power supply design which will supply all the necessary voltages, will fit into limited space, and best of all, cost the average amateur only a few dollars.

The design shown was built into a 1P-69/ALA-2 Panadapter. Silicon diodes eliminated the two rectifier tubes. This also eliminated the current demand of their fillaments. The space occupied by the tubes then became available for the new 60-cycle supply. This provided enough added space to allow the silicon rectifier board to be mounted vertically on the chassis. No butchery with the hack saw here. And, since tubes were eliminated, no heat dissipation problems developed.

The method of obtaining the high voltage, low current required for the cathode ray tube is not new. It has two very good features, however, that make it very desirable in this application. Voltages can be obtained from "broadcast receiver" type transformers, which keeps the cost down. Despite the simplicity, this circuit works reliably.

The transformer and filter choke can be taken from an old radio, hi-fi, or small TV set. The high voltage circuit for all circuits except the cathode ray tube is quite conventional. The use of two 600 volt PIV silicon diodes in series in each leg of the circuit provides protection against an inverse voltage of approximately 1000 volts quite adequately. If the builder prefers, three 400 PIV diodes may be substituted in each series string. While many power supply circuits do not include the .01 disc ceramic capacitor and the ½ meg. resistor in series with each diode, it is recommended these be included to provide protection of the diodes.



The negative high voltage for the cathode ray tube is provided by a separate series of diodes. The low current demand of the cathode ray tube is supplied from the transformer through the .01 mfd 600 volt paper capacitor. The actual voltage measured in this circuit is almost 700 volts. Be sure the filter capacitors are rated for this kind of potential. In the original circuit these capacitors had a value of .25 mfd, 1000 volts.

Since the cathode ray tube has a high potential on the filament circuit, a separate filament transformer was used here. This filament transformer was rated at 1500 volts insulation, adequate to prevent breakdown. It may be possible to supply the filament with the extra windings on the broadcast power transformer (intended for the rectifier tube) without ill effects, but since I had a transformer available, this was not tried.

In the original circuit the 1000 ohm, 10 watt resistor was included in the center tap of the transformer to lower the voltage to 350 volts as shown. If this is not required, it can be eliminated. It does take up space, causes added heat, and adds to the power demand on the transformer. This proved to be a small problem however, when compared to the expensive alternates available.

Detailed conversion of the 1P-69/ALA-2 was covered in an excellent article in the June 1964 Issue of **73** Magazine by William Parker. Anyone interested in conversion of this or similar panadapters are referred to that fine source. With the nomenclature shown in the wiring diagram, modification of the original power supply using the economical approach suggested here will be a simple matter.

In this, as in any conversion, I suggest that the first step of conversion be kept to the very minimum required to get the equipment working. Further conversion is easier and more interesting if you can see the step-by-step results.

With the above approach to oscilloscope power supplies, a bargain scope can be converted at a price proportional to the small scope investment. A bargain scope can truly remain a bargain! . . . W8JZI

Crystalize That FM Rig

Glenn E. Zook K9STH/5
425 Salem Drive
Richardson, Texas 75080

During my last two years in college I was associated with the manufacture of the equipment most available to the amateur FM enthusiast, Motorola Communications and Electronics, Inc. During this time I was besieged with many requests for information on the equipment available. Most of these requests were for one item, crystal information. Information on the oldest Motorola equipment such as the 30D, 16V, 5V etc. are easily available from places as FM Surplus Sales. However, the newer equipment now reaching the amateur market, 80D, 140D, T-33, T-43, T-41, T-51, T-44, etc. are not as easy for the average ham to find crystal information on. This information is available from most two-way radio shops, but, unfortunately many of these shops do not have the time or inclination to furnish amateurs with the necessary information. Of course there are many exceptions with many amateurs now working for and/or owning two-way radio shops, but these are still the exception and not the rule. Thus, I have written this article for 73 listing the transmitter and receiver types for 41 V and newer equipment with the respective crystal types.

These crystal types are designed to work in the circuit of the piece of equipment listed. However, other types may work if the circuit is modified. But, I strongly recommend that the correct type of crystal be purchased from a reputable supplier. International Crystal Company can and will furnish commercial grade crystals when given the Motorola type and the operating frequency (e.g. 146.940 MHz). In my opinion this is the best supplier. Commercial grade crystals cost more than the ordinary run-of-the-mill crystals or even the .005% crystals listed by many suppliers. Commercial grade crystals are .0005% or better.

For those amateurs who have many crystals, or who grind their own, or who just like to experiment, the crystal formulas for the respective types of crystals are also listed. Remember that even though the fundamental frequencies are the same, crystals of different types (cuts) will not necessarily operate on the same frequency when placed in a circuit designed for another type. However, it is possible to make some types pull onto frequency, but this sometimes requires substantial modification of the circuit. Therefore, if at all possible, use the correct cut of crystal.

Now, for those who feel they cannot complete modification of their equipment without help, please do not write me concerning your problems. I would like to help you very much, but my present schedule does not give me ample time. Information on conversion of many units is available from other sources. Included in these are the books published by FM Surplus Sales and others.

Now, to get down to business: The transmitter type of the respective unit is listed on the manufacturer's identification tag as "Trans Type" and the receivers are marked somewhere on the chassis. The transmitters also *may* have an identification number on the chassis, but this does not always hold true. Also, other identification numbers, not the transmitter type, are stamped on some chassis.

Well, here's the information everyone has been waiting for:

Transmitters Chassis No.	25-50 MHz Crystal type
TA 104	RN3
TA 105	RN3
TA 130	RN3
TA 169	RN3
TA 179	RN3
TA 180	RN3
TA 181	RO4
TA 193	RO4
TA 194	RO4
TA 200	RN3
TA 201	RN19
TA 202 series	RN19
PA 7203B	RO4
P 8620	SFMT3
P 8620B	RO6
PA 8625B	RO4
PA 8671 series	RO4
PA 8672 series	RO4
PA 8673 series	RO4
PA 8691 sereis	RO4
PA 8692 series	RO4
PA 8693 series	RO4
P 9030 series	R10
P 9050 series	R10
TTB 1011 through TTB 1016 AA, AB	RN3
TTB 1011 through TTB 1015 AC, AD	RN19
TTB 1021 AG to TTB 1026 AB	RN19
TTB 1031 AA to TTB 1036 AA, AB	RN3A
TTB 1036 AC, AD	RN19A
TTB 1041 to TTB 1046 AA, AB	RN3A
TTB 1046 AC, AD	RN19A

Receivers Chassis No.	25-50 MHz Crystal type
TA 108 (25-30)	R29
TA 108 (30-54)	R28
TA 111 (25-30)	R29
TA 111 (30-54)	R28
TA 111A (25-30)	R29
TA 111A (30-54)	R28
TA 111B (25-30)	R29
TA 111B (30-54)	R28
TA 111C (25-40)	RM14
TA 111C (40-54)	RM15
TA 162 (25-30)	R29
TA 162 (30-54)	R28
TA 162A (25-30)	R29
TA 162A (30-54)	R28
TA 164 (25-30)	R29
TA 164 (30-54)	R28
TA 164A (25-30)	R29
TA 164A (30-54)	R28
TA 165 (25-30)	R29
TA 165 30-54)	R28
TA 189	RO2
TA 189 A series (25-40)	RM21
TA 189 A series (40-54)	RM22
TA 189-R2	ZO3
TA 192	RO2
P 8028 series (25-44)	A14
*P 8028 series (39-54)	A14
P 8116A (25-44)	A14
*P 8116A (39-50)	A14
P 8116B (25-44)	R14
*P 8116B (39-50)	R14
P 8116C (25-44)	R14
P 8116C (39-50)	R14
*P 8116C (39-50)	RO2
PA 8619B	R14
PA 8633 series	RO2
PA 8633A (#2 Rx)	R32
P 8658 series	ZO2
PA 8663 series	RO2
PA 9034	RO8
PA 9034A, B, C, F (25-30) (40-50)	R16
PA 9034A, B, C, F (30-40)	R18
PA 9074	ZO4
PA 9074A, B, C (25-30)	ZO6
PA 9074A, B, C (30-40)	ZO7
PA 9074A, B, C	ZO6
PA 9137 A	RO2
PA 9145	RO2
PA 9146	RO2
P 9181	ZO2
PA 9219A	RO2
PA 9244 series (25-30)	R25
PA 9244 series (30-54)	R22
PA 9265	RO2
PA 9266	RO2
PA 9273	RO2
WE 9273	RO2
TRB 1050AA (25-40)	RM21
TRB 1050AB`	RM22
TRB 1071 through TRB 1071 series (40-54)	RM/RP 15
TRB 1081 AA through TRB 1984 AA (25-40)	RM/RP 14
TRB 1081 AA through TRB 1084 AA (40-54)	RM/RP 15
TRB 1091 AA through TRB 1094 AA (25-40)	RM/RP 14
TRB 1091 AA through TRB 1094 AA	RM/RP 15

Transmitters Chassis No.	144-174 MHz Crystal type
TA 139 series	RS1
TA 170 series	RS1
TA 190	RO3
TA 192	RO3
TA 205 series	RS1
TU 402-C4	ASLX-1
TTD 1060 series	RN1A
PA 7291C	RO3
P 8320 series	SFMT-1
PA 8461 series	RO3
PA 8462 series	RO3
PA 8463 series	RO3
PA 8491 series	RO3
PA 8492 series	RO3
PA 8493 series	RO3
P 8520, A, B	SFMT-1
P 8520E	RO5
PA 8664B	RO3
PA 8665B	RO3
P 9020 series	RO9
P 9040 series	RO9
TTD 1000 series	RN1
**TTD 1020AA	RN1, RN1A
TTD 1044AA, AB	RN1
TTD 1060A series	RN1A
TTD 1070 series	RO3A
TTD 1080AA	RO3
TTD 1090 series	RO3
TTD 1100A	RO3
TTD 1120AA	RN1A
TTD 1140 series	RN1
**TTD 1240AA	RN1, RN1A
TTD 1320 series	RO3A
TTD 1330AA	RO3
TTD 1340 series	RO3
TTD 1350AA	RO3
TTD 1370AA	ZNN-1A
TTD 1137AD	ZNN1-1A
TTD 1380 series	ZNN1-1A

Receivers Chassis No.	144-174 MHz Crystal type
TA 101	R27
TA 140	R27
TA 140A	R27
TA 140B	RM10
TA 161	R27
TA 163	R27
TA 163A	RM10
TA 178	R27
TA 182	R27
TA 182A	RM10
TA 191	RM16
TA 191-R2	ZM16
TA 198-R3	RM10
TA 199-R4	RM10
TA 206	RM10
PA 7250 series	ZM16
PA 7251 series	ZM16
PA 7254 series	RM16
PA 7265 series	RM16
P 8328, A (152-162)	R14
P 8328B, C (152-162)	R14
PA 8433 series	RM16
PA 8438 series	RM16
PA 8443 series	RM16
PA 8476 series	ZM16
P 8528	R14
PA 9033	RO7
PA 9033A, B, F	R15
PA 9073	ZO3
PA 9073A, B	ZO5
PA 9147	RM16
PA 9148	RM16
PA 9243 series	R21
PA 9267	RM16
PA 9268	RM16
TRD 1040AD	RM27
**TRD 1011 through TRD 1022	RM10, RM10A
TRD 1031 series	RM27
TRD 1032 series	RM16
TRD 1041 series	RM27
TRD 1042 series	RM16
TRD 1051 series	RM27
TRD 1052 series	RM16
TRD 1080A	R15
TRD 1090A	R15
TRD 1100A	RM27
TRD 1111AD	RM10
TRD 1112AD	RM10A
TRD 1121AD	RM10
TRD 1122AD	RM10
TRD 1151 series	RM10
TRD 1152AA	RM10
TRD 1171 series	RM10
TRD 1172AA	RM10A
TRD 1181AA, AB	RM10
TRD 1182AA, AB	RM10
TRD 1260AA, AB	RM10
TRD 1311AB, AD	RM10
TRD 1312AB	RM10A

* Converted from lower frequency range (e.g. 25-44).
** A letter "A" following crystal type designates 12 V oven.

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Crystal Type Formulas

Fx = crystal frequency in MHz
Fc = carrier (operating) frequency in MHz
Fi = 1st IF Frequency

Crystal No.	Formula
SFMT-1	$Fx = \frac{Fc}{48}$
SFMT-2	$Fx = Fc \pm 5\ Fi$
SFMT-3	$Fx = Fc/16$; $Fx = Fc/36$
SFMT-5	$Fx = Fc/24$; $Fx = Fx/32$
SFMT-6	$Fx = Fc/24$
AC-1 through AO-5 if Crystal	
AO6	$Fx = Fc + .455$
A14	$Fx = \frac{Fc - 4.3}{4}$
	$Fx = \frac{Fc - 4.3}{5}$
	$Fx = \frac{Fc - 4.3}{10}$
AM-9	$Fx = \frac{Fc - 8.045}{14}$
AM-12	$Fx = Fc - 4.55$
AM-13	$Fx = \frac{Fc - .455}{5}$
AM-18	$Fx = \frac{Fc - 72}{32}$
AN-1	$Fx = Fc/24$
AN-2	$Fx = Fx/16$
AULX	$Fc \pm .455$
ASLX-1	$Fx = Fc/24$
CO-1	$Fx = Fc/32$
CO-2	$Fx = \frac{Fc + 2.1}{5}$
CO-3	$Fx = \frac{Fc - 2.1}{6}$
CO-4	$Fx = \frac{Fc + 2.1}{4}$
CO-5	$Fx = Fc/18$
CO-6	$Fx = Fc/18$
CO-7	$Fx = Fc/18$
GO-1	$Fx = \frac{Fc + .455}{17}$
GO-2	$Fx = \frac{Fc\ (25\text{-}30) + .455}{4}$
	$Fx = \frac{Fc\ (30\text{-}40) + .455}{5}$
	$Fx = \frac{Fc\ (40\text{-}50) + .455}{6}$
RO-2	$Fx = \frac{Fc + 2.9}{3}$
RO-3	$Fx = Fc/24$
RO-4	$Fx = Fc/16$
RO-5	$Fx = Fc/48$
RO-6	$Fx = Fc/16$
RO-7	$Fx = \frac{Fc - 5.5}{5}$
RO-8	$Fx = \frac{Fc + 2.9}{3}$
RO-9	$Fx = Fc/24$
R10	$Fx = Fc/16$
R12	$Fx = Fc/36$
R13	$Fx = \frac{Fc + 5.5}{3}$
R15	$Fx = \frac{Fc - 8}{5}$
R16	$Fx = \frac{Fc + 4.3}{3}$
R17	$Fx = \frac{Fc - Fi}{8}$
R18	$Fx = \frac{Fc - 4.3}{2}$
R19	$Fx = \frac{Fc - Fi}{8}$
R20	$Fx = \frac{Fc + 4.3}{3}$
R21	$Fx = \frac{Fc - 8}{5}$
R22	$Fx = \frac{Fc + 4.3}{3}$
R24	$Fx = Fc/24$
R25	$Fx = \frac{Fc + 4.3}{3}$
R26	$Fx = \frac{Fc + 4.3}{3}$
R27	$Fx = \frac{Fc - 12}{5}$
R28	$Fx = \frac{Fc + 5.5}{3}$
R29	$Fx = \frac{Fc + 5.5}{3}$
R35	$Fx = \frac{Fc + 5.5}{3}$
R37	$Fx = Fc/144$
RM-10	$Fx = \frac{Fc - 12}{5}$
RM-14	$Fx = Fc + 5.5$
RM-15	$Fx = Fc - 5.5$
RM-16	$Fx = \frac{Fc - 5.5}{5}$
RM-21	$Fx = Fc + 2.9$
RM-22	$Fx = Fc - 2.9$
RM-24	$Fx = Fc + 5.5$
RM-27	$Fx = \frac{Fc + 5.5}{5}$
RN-1A	$Fx = Fc/24$
RN-3	$Fx = Fc/12$
RN-19	$Fx = Fc/18$
RN-20	$Fx = Fc/216$
RN-31A	$Fx = \frac{Fc + .455}{4}$
RN-32A	$Fx = \frac{Fc + .455}{5}$
RN-33A	$Fx = \frac{Fc + .455}{6}$
RN-34A	$Fx = \frac{Fc + .455}{16}$
RS-1	$Fx = Fc/24$
YM-14	$Fx = Fc + 5.5$
YM-15	$Fx = Fc - 5.5$
YM-29	$Fx = \frac{Fc - 12}{3}$
YM-35	$Fx = \frac{Fc - 11.7}{3}$

The author claims no originality in the above information. Crystal information for Motorola equipment appears in the catalogs supplied by Motorola to its authorized service stations. Also, the crystal formulas appear in older editions of these same catalogs. However, to my knowledge these formulas and lists have not appeared in full in any of the well-known amateur publications.

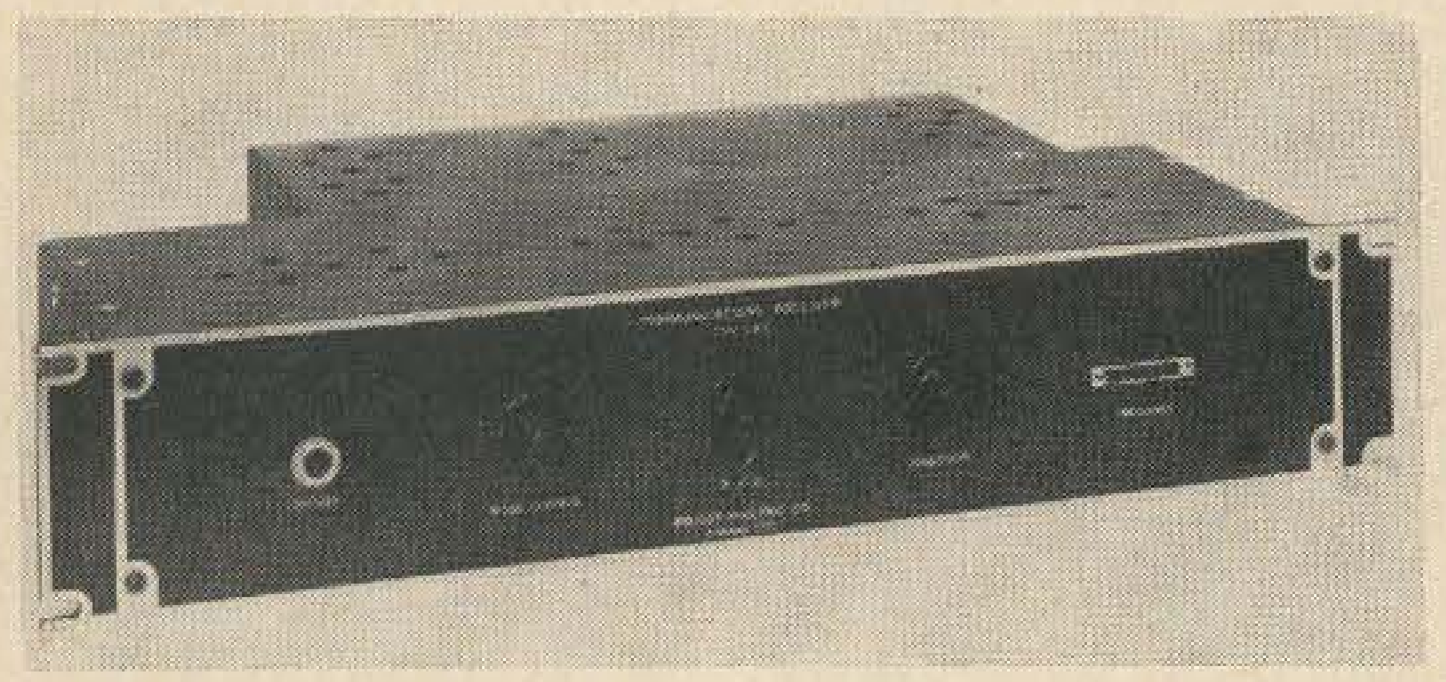
. . . K9STH/5

CLUB SECRETARIES NOTE

Club members would do well to get their club secretaries to drop a line to 73 and ask for the special club subscription scheme that we have evolved. This plan not only saves each club member money, it also brings badly needed loot into the club treasury, if desired. Write: Club Finagle, 73 Magazine, Peter Boro Ugh, New Ham Shire 03458.

Use of the Wilcox F3 as a WWV Receiver

Hank Olson W6GXN
Stanford Research Institute
Menlo Park CA 94025



The Wilcox F3 and its sister receiver the CW3, are relatively old as military surplus items go. However, as fixed-frequency receivers they are quite adequate for WWV reception on 2.5, 5, 10, or 15 MHz. Having one of these receivers set up for the best WWV frequency at *your* QTH is a handy adjunct to amateur operation. This is true even if one uses a general coverage receiver, because then he doesn't have to tune "way down the band" to get WWV. The owners of "ham-band-only" receivers will welcome the F3 on WWV even more so.

My CW3 arrived sans *rf* coils and rectifier, but otherwise intact. Apparently the only schematic that is available, is for the F3 and it is in the Cowan "Surplus Schematics Handbook." This book lists the "groups" of frequency coverage (covering 1.9 to16.5 MHz in four " group"), and identifies the *if* frequency as 455 kHz. Table 1 shows which "groups" cover the various WWV frequencies.

Table 1

WWV Freq	Group	Frequency Coverage
2.5 MHz	#1	1.9 to 3.6 MHz
5 MHz	#2	3.1 to 6.1 MHz
10 MHz	#3	5.1 to 10.0 MHz
15 MHz	#4	8.1 to 16.5 MHz

Since no rf coils came with my CW3, the first order of business was to make some. It is apparently the coils alone which determine to which "group" one's receiver belongs. Coils were made for 10 MHz.

Three Amphenol 86-CP8 plugs (octal/male) were used as coil bases (old tube bases could have been used as well). L1, L2, and L3 (as shown in **Fig. 1**) were made from C.T.C. X2060-2 slug-tuned coils (3.5 to 7.0 μH). On each coil a #10 solder lug is mounted which electrically connects the threaded mounting to the nearest coil terminal. Then two pieces of #14 bare bus-wire are soldered into the appropriate pins of the 86-CP8 plug and also soldered to the coil ends. This provides both electrical connection and adequate mechanical support for the coils. The link windings on each of the three coils are then wound using #28 enameled wire, and the ends soldered into the plug pins directly.

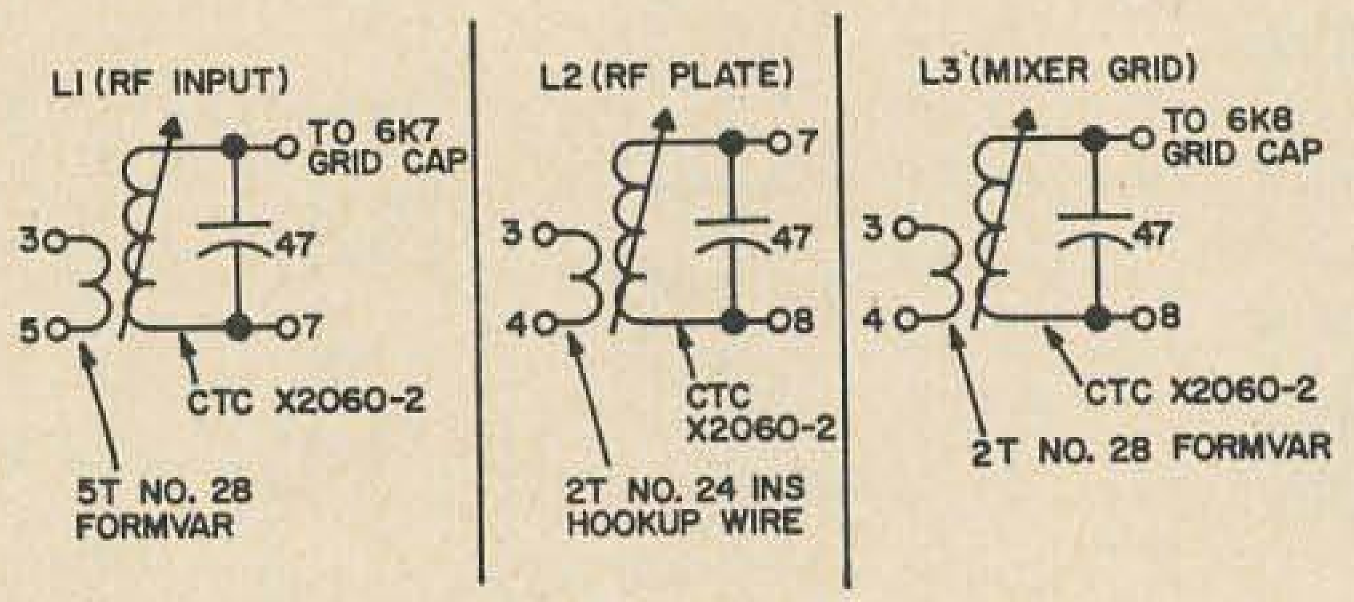


Fig. 1. Coil information

Replace the original antique crystal socket with an HC6/U crystal socket. Two pieces of #14 tinned bus wire are pushed through the pin holes of the existing FT249 socket and soldered *inside the chassis*. The HC6/U socket is then soldered to these wires on the outside, close enough to the old FT249 socket so that the crystal shield can will fit over an HC6/U crystal when in place.

To apply power to the receiver, and ac cord was made up using a Cinch-Jones S-304-CCT, and this connector plugged into P1 so as to connect the line to pins #7 and 8.

Coils L1, L2, and L3 were "tuned cold" using a grid-dip meter before the receiver

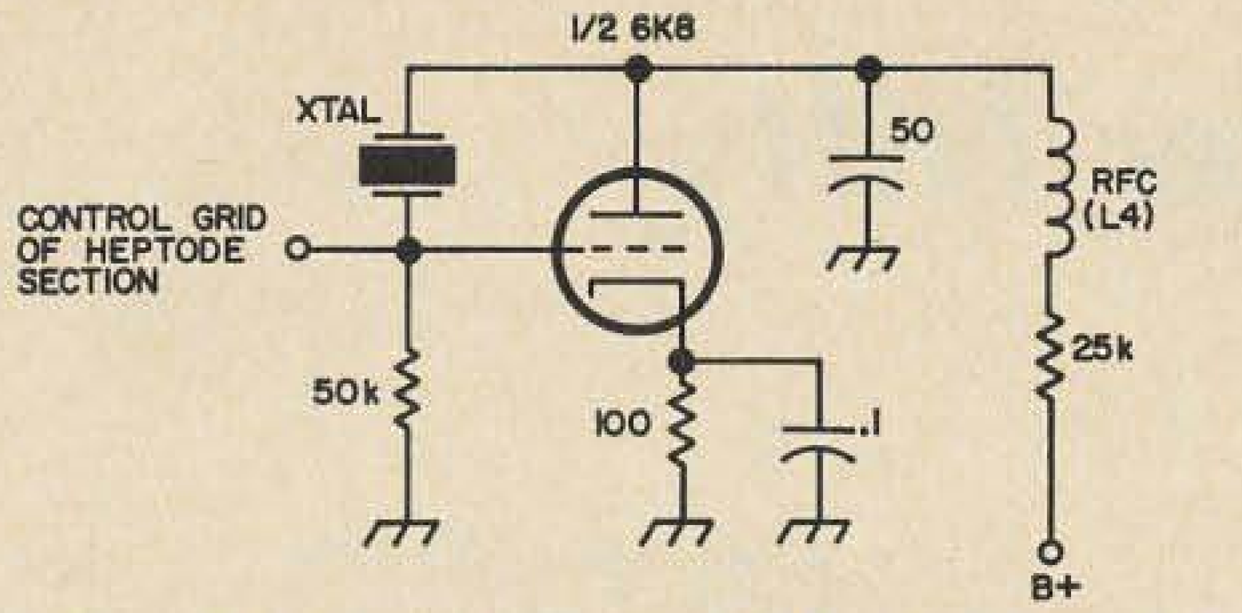
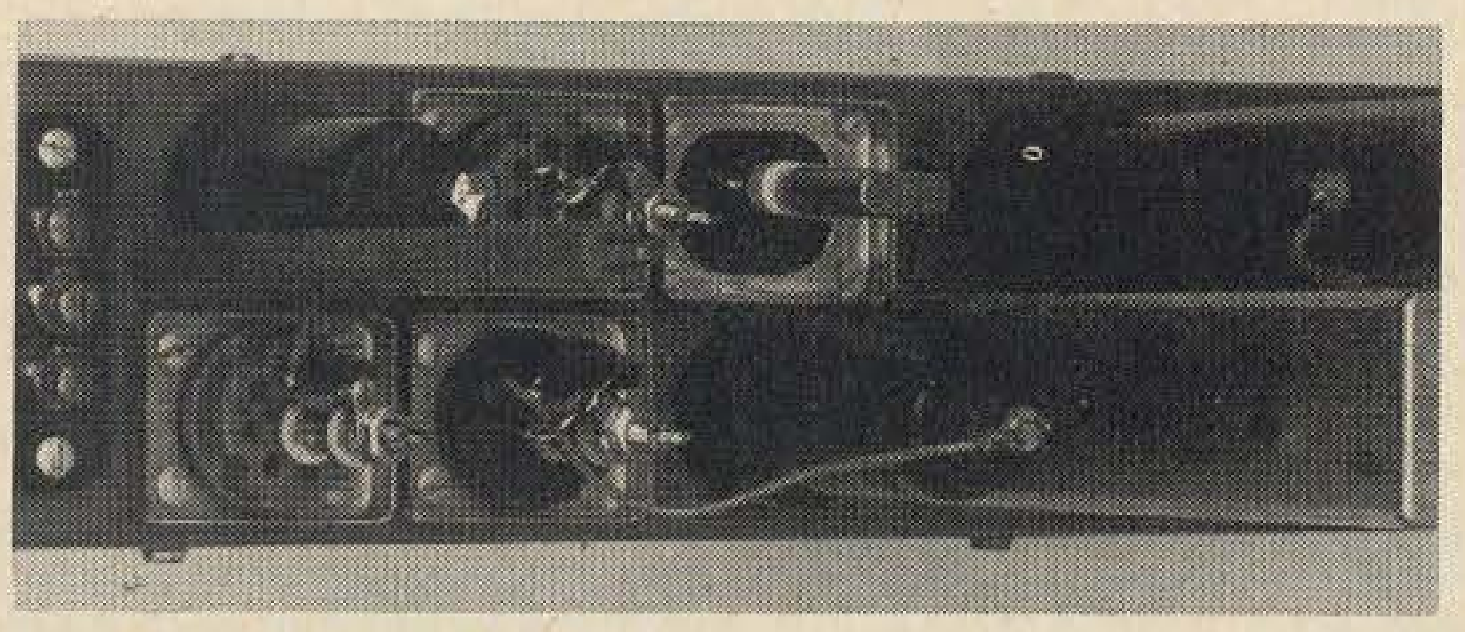


Fig. 2. Simplified oscillator circuit for the F3 or CW3.

was turned on. The crystal oscillator (half of the 6K8) is of the Pierce type and requires no adjustment. Assuming that the *if* is not out of alignment and that a good WWV signal is "in," one can tune up the receiver by just tweaking L1, L2, L3, and the *if* transformers for maximum audio output.

The crystal (10.455 MHz) was obtained from JAN Crystals for $2.55, ground to order. When ordering a crystal it is always wise to send a copy of the oscillator circuit. The simplified oscillator circuit of the F3 or CW3 is shown in Fig. 2, for use by the crystal company that you patronize.

A few additional notes about the F3-CW3 receivers may be in order. The type 80 rectifier tube is the oldest type in the receiver, and can be replaced (with a socket change) to a 5Y3GT. There are about half a dozen bypass capacitors (0.01 μF and 0.1 μF "micamold" types) in the original receiver, that are potential trouble sources. These ought to be replaced, simply as preventative maintenance, by 400v mylar types. Some surplus dealers still have coils for the F3 and CW3, and if you are worried about coil shielding (my unshielded coils gave no troubles), they can still be obtained for some frequency groups.*



Looking inside the F3

. . . W6GXN

*Red Johnson Electronics, 3311 Park Blvd., Palo Alto, California.

The Dollar Fifty-Super Nifty

Allan Joffe W3KBM
531 E. Durham St.
Phila, Pa. 19119

Through 73 Magazine I was introduced to John Meshna and this resulted in the chance purchase of what was described as "A brand new frequency determining network for use in Northern Electric Teletype converters." Price $1.50.

Among other goodies beside the grey box marked 1445 Cycles were two 300 Millihenry chokes plus assorted capacitors and connectors, which same made their way to the satin lined junk box, I felt that the 1445 cycle filter could be made into a good C.W. filter and the results achieved were very satisfying.

As **Fig. 1** shows, I used the filter backwards, using input for output and output for input. This was the result of trial and error to make the gadget work. If you check the filter with an ohmmeter you will find dc continuity between OUT and COMMON but no dc continuity between IN and COMMON.

The capacitor, switched in and out by Sw-1, serves as a filter bypass if you wish to copy an AM or a SSB signal. It is also helpful in the CW mode to open your ears to a segment of the band to find the signal before you sharpen it. This filter is extremely sharp, with a measured bandwidth of about 50 cycles. This means that if your receiver is not stable, and I mean stable, you may not be able to enjoy the full benefit of the filter's possibilities. The converse is also true, if the rig sending the desired signal tends to drift.

Due to the extreme selectivity there is some ringing evident but this is much better than a jumble of signals blotting out the signal you want to copy, and this the filter will eliminate.

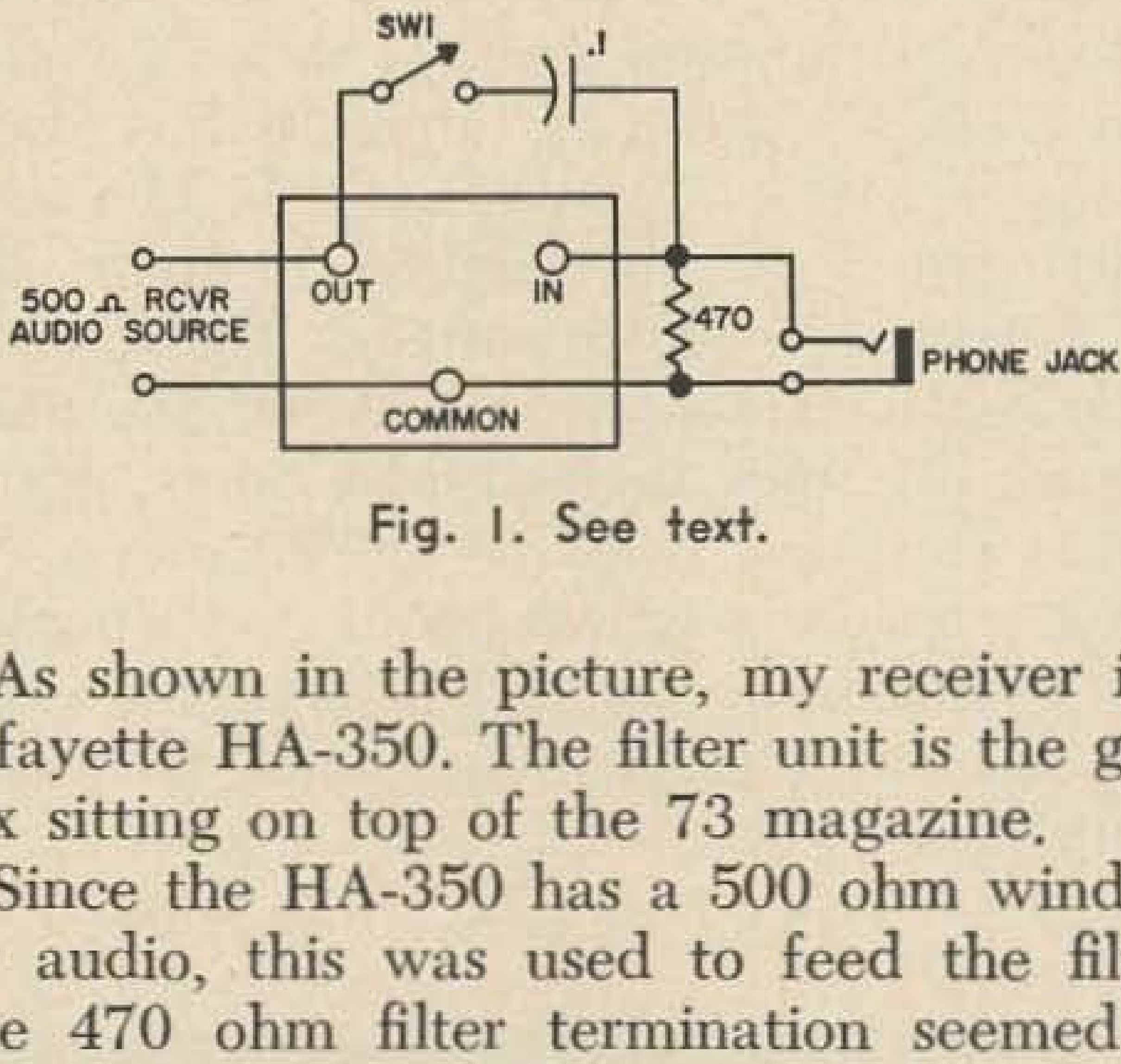


Fig. 1. See text.

As shown in the picture, my receiver is a Lafayette HA-350. The filter unit is the grey box sitting on top of the 73 magazine.

Since the HA-350 has a 500 ohm winding for audio, this was used to feed the filter. The 470 ohm filter termination seemed to have the effect of reducing the "ringing" encountered without affecting the selectivity of the unit.

. . . W3KBM

D. E. Hausman VE3BUE

Banana Plugs Fit Into Coax Jack

So you just got that new receiver, and being a typical ham, you found to your dismay that your junk box held nothing resembling a PL-259 coax plug with which to connect your sky wire to the receiver. In accordance with Murphy's law, you decide that you want to connect that experimental circuit to a piece of gear with only an SO-239 jack as an input connector; of course you are too lazy to disassemble a coax plug and solder the blasted thing into what is only an experiment!

If the above sounds like you, there is no need to dispair. The simplest and easiest thing to do is to use a common banana plug instead of the PL-259. The banana plug fits nicely into the coax jack as does a 'no solder' post scrounged from an electronics educational kit. In order to ground the connection, loosen one of the four screws holding the SO-239 and fasten the ground conductor to it.

Either a banana plug or non-soldering terminal may be plugged directly into an SO-239 jack with no modifications.

Another advantage of this kink is that it can be used with *all* kinds of cable and wire—not just one or two types of coax.

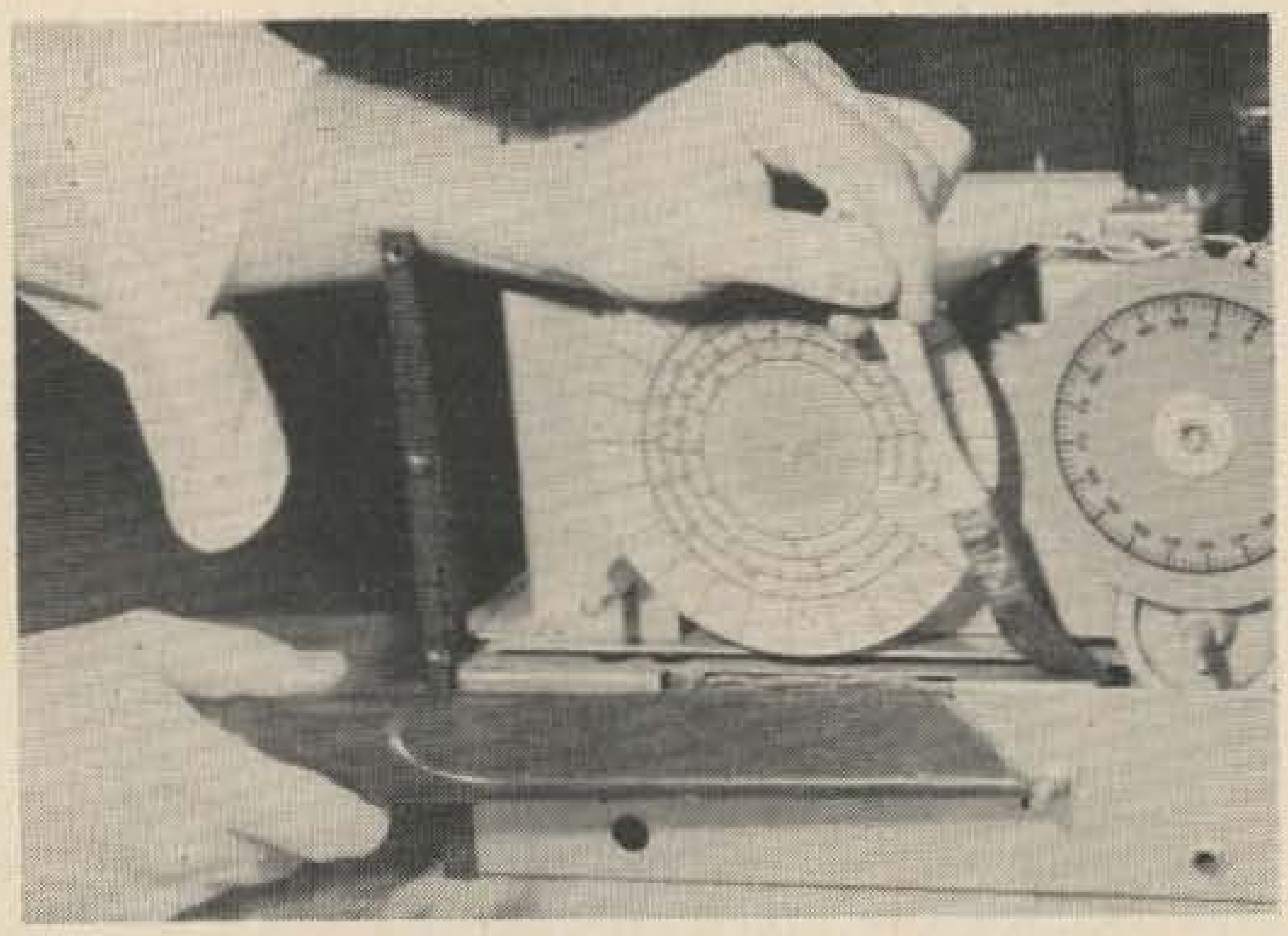
Restoring Old Equipment

George P. Schleicher W9NLT
1535 Dartmouth Lane,
Deerfield, Ill. 60015

You know the feeling. I mean the one you get when you are browsing through an unfamiliar radio surplus store and you suddenly come across a little gem of radio gear that you have always wanted to own. The pulse rate goes up a notch and the hair on the back of your neck bristles a little. In order to get a better look you gently remove a layer of other old chasis—maybe "carcasses" is a better word—and uncover the whole gem. "Is it too far gone or can it be made to play?" you ask yourself.

Inside of you a battle begins. Hope tells you that the gem is in working order. Your ego says that whatever is wrong, you can fix it. Experience tells you to grab your wallet and run, do not walk, to the nearest exit. As a compromise, you turn the gem over and look at the wiring on the bottom side of the chassis. Well, well; not too bad. And no obvious signs of modifications. Back to the top. Some tubes gone; minor dents in i.f. cans. And the panel is hopeless. Hmm . . . look around; maybe there is another one in better condition. Nope. You approach the dealer warily and indicate lukewarm interest in an old receiver chassis. Without knowing which one you have in mind he will say something like: "That's a three hundred dollar instrument." You counter with: "It's a basket case now; utterly hopeless." You know how the script goes. Each of us has his own approach to a deal; it always ends with the dealer pocketing the money and you hoping that you can clean the beast up a bit before the family sees what you paid good money to get.

A lot of man-hours are spent every year fixing used or war surplus equipment. More often than not, the gear is some kind of a receiver or uses receiver-type circuits. Having restored many sets over the last quarter of a century I have had an opportunity to learn a few lessons the hard way. I have also learned that you can develop an order of procedure that will work well with almost any item of electronic equipment. My recent experience was so typical that it should serve as a step by step guide for anyone who hasn't done this sort of thing before but is ready to try.



Brush and vacuum are used for the initial cleanup.

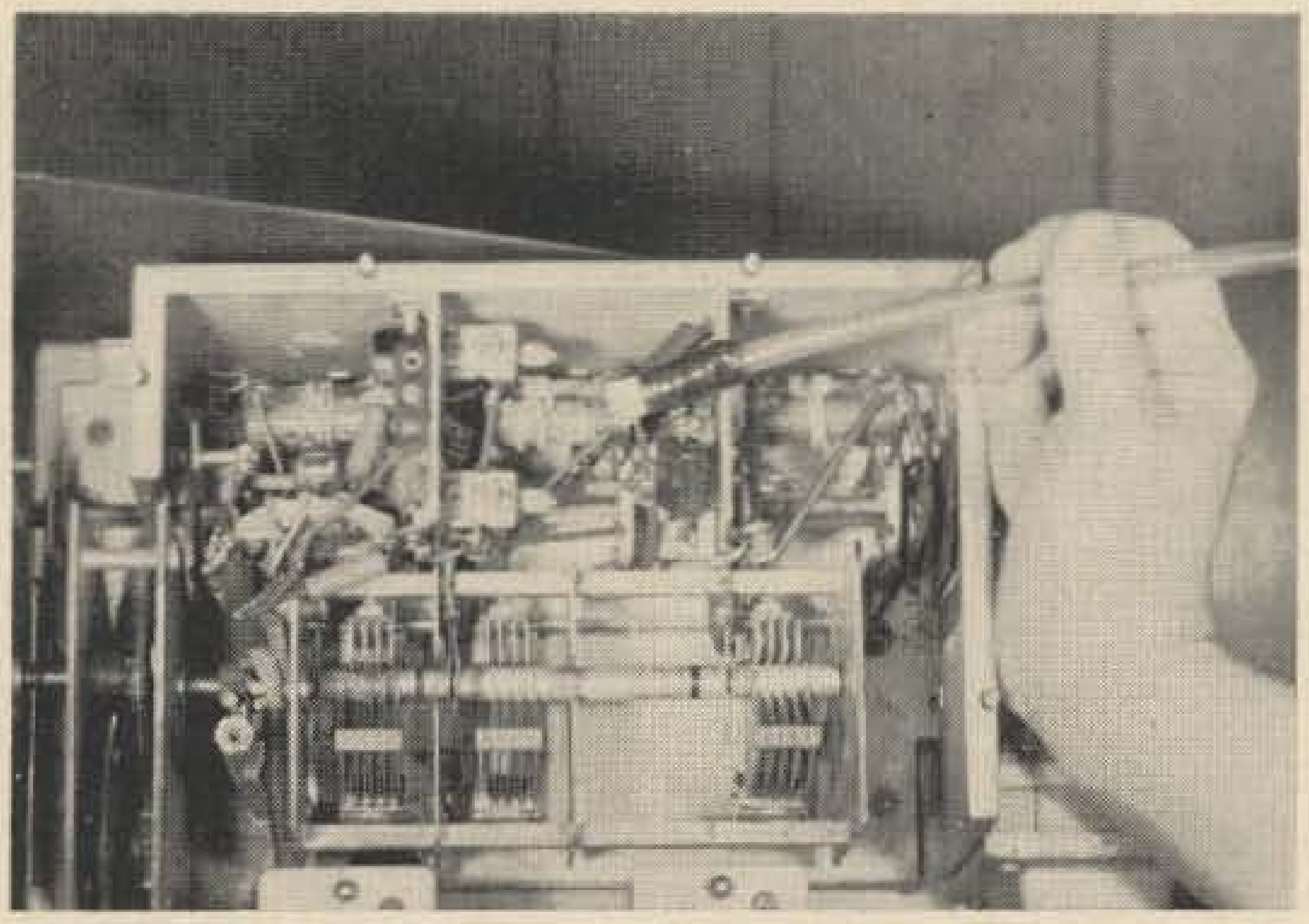
The little gem that I took home in the back of the family station wagon happened to be a Hallicrafters S-36. Made around 1940-1945 this receiver tunes from 28 to 144 megahertz in three bands. It has both AM and FM detectors; a bfo is provided for receiving code. I wanted the S-36 to complete a set of consisting of an SX-28, an S-36 and an AN/APA-10. Many of you will remember that the APA-10 is a panoramic receiver that was designed to work with airborn versions of the S-36 and the SX-28 which were designated ARR-5 and ARR-7, respectively.

In addition to tuning across the ten and six meter bands it would cover the 42 MHz output of a vhf/uhf television tuner. I intended to use the tuner as a converter for two meters and the higher frequency bands. As you can see, my potential uses for the S-36 would justify spending enough time on the restoration to do the job properly.

Mechanical work

The restoration began with the removal of the knobs and the front panel so as to permit cleaning away dust and foreign matter. A tank vacuum with its crevice tool is excellent for this work. As shown in **Fig. 1**, a small, dry paint brush will loosen surface dust, helps in cleaning threaded parts, gets dirt that hides between *if* cans and is useful in joints and corners. I do *not* recommend blowing dust off with compressed air as it can be damaging. I have seen the mica insulation blown out of a compression trimmer capacitor when it was used. If dust can be removed no other way, use the low pressure stream from the tank vacuum (you put the hose on the other end of the tank) and be careful! If any iron filings are present they can be removed with a small magnet. Cover the magnet with a piece of plastic to make its cleaning easier. Of course, a thorough cleaning of the set will require that all of the tubes and any other plug-in components be removed. In older equipment each tube socket is usually marked with the tube type number. If the socket is not labeled it is a good idea to make a diagram showing the location of each tube as it is removed from its socket.

As a rule, the case, front panel and side braces can easily be removed from the chassis. They are cleaned by immersing them in



A special brush was made to extend the vacuum into tight spots.

a hot solution of household detergent and scrubbing them with a bristle brush. If you rinse them in hot water and dry them immediately they won't rust. The knobs, nameplates and dial escutcheons can be given similar treatment. Bakelite parts should be dried with a soft cloth, preferably flannel.

You may have to deal with dented *if* cans. If the dents are minor they are best left alone. Larger dents may detune the transformer and may be associated with internal damage. If this is the case, remove the transformer carefully from the chassis and then slide the parts out; try not to force anything. After taking the dents out of the shield, the core and windings should be inspected. Check the trimmer capacitors and test the windings for continuity with an ohmmeter. If permeability tuning is used, be sure that the tuning slugs have not become detached

Silver cleaning solution is applied to plated switch contact with a cotton swab.

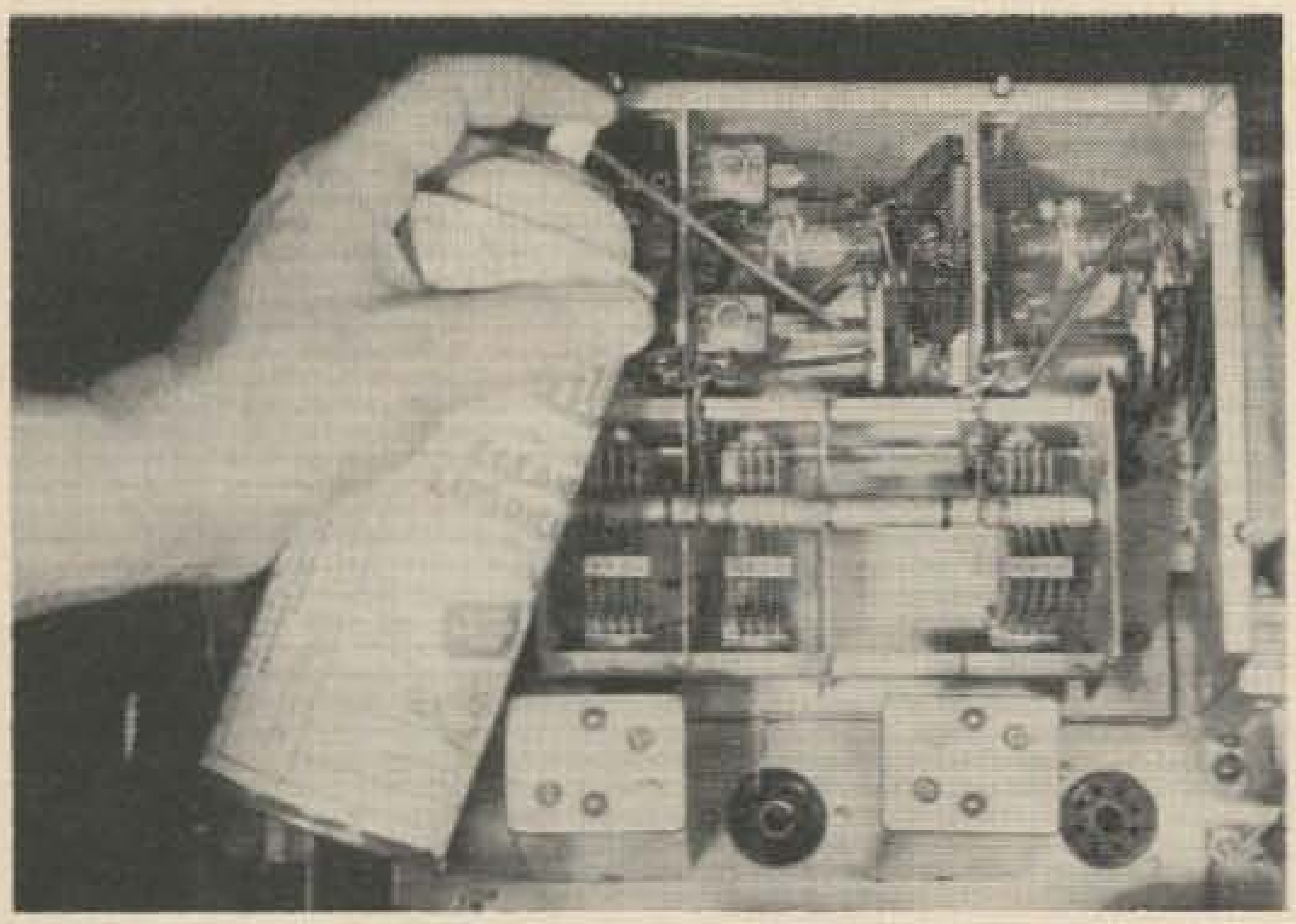
from the threaded rods. Cement them back in place if they are loose. Remove any small chips of ferrite material.

Be careful when you are vacuuming underneath the chassis. Use a brush to get at the dirt; move the wiring harness and components as little as possible. Hookup wire seems to get brittle with age and it breaks easily; not in the middle but where it is soldered to a terminal or where it has been bent sharply. Be willing to suspect any lead of being open when you are trouble shooting.

I don't advise any removal, bending or other disturbance of the rf coils in a vhf receiver. Don't even straighten out bumps or unevenness in the end turns unless you are *sure* that they are the result of accidental damage. They may have been put there during manufacture to adjust coil inductance. It is similarly unwise to straighten the end plates of variable capacitor rotors. They are often slotted to permit minute adjustments of circuit capacity at several points across the tuning range for proper tracking.

To help clean the rf coil compartment I made a tubular brush out of firm ½" plastic tubing, bristles from an old brush, string and glue. The brush is connected to the vacuum cleaner hose by means of a cork that has been drilled to accept the plastic tubing. The plastic tubing should not be longer than ten or twelve inches if strong suction is to be maintained.

After the set had been cleaned I looked it over for mechanical troubles and found a common one. When the tuning capacitor was fully meshed the dial was obviously not at the low-frequency end of its scale. Inspecting the gear train and shafts disclosed a flexible coupling with loose set screws. I loosened it further so that I could move it



Wafer switch contacts are lubricated with a silicone spray.

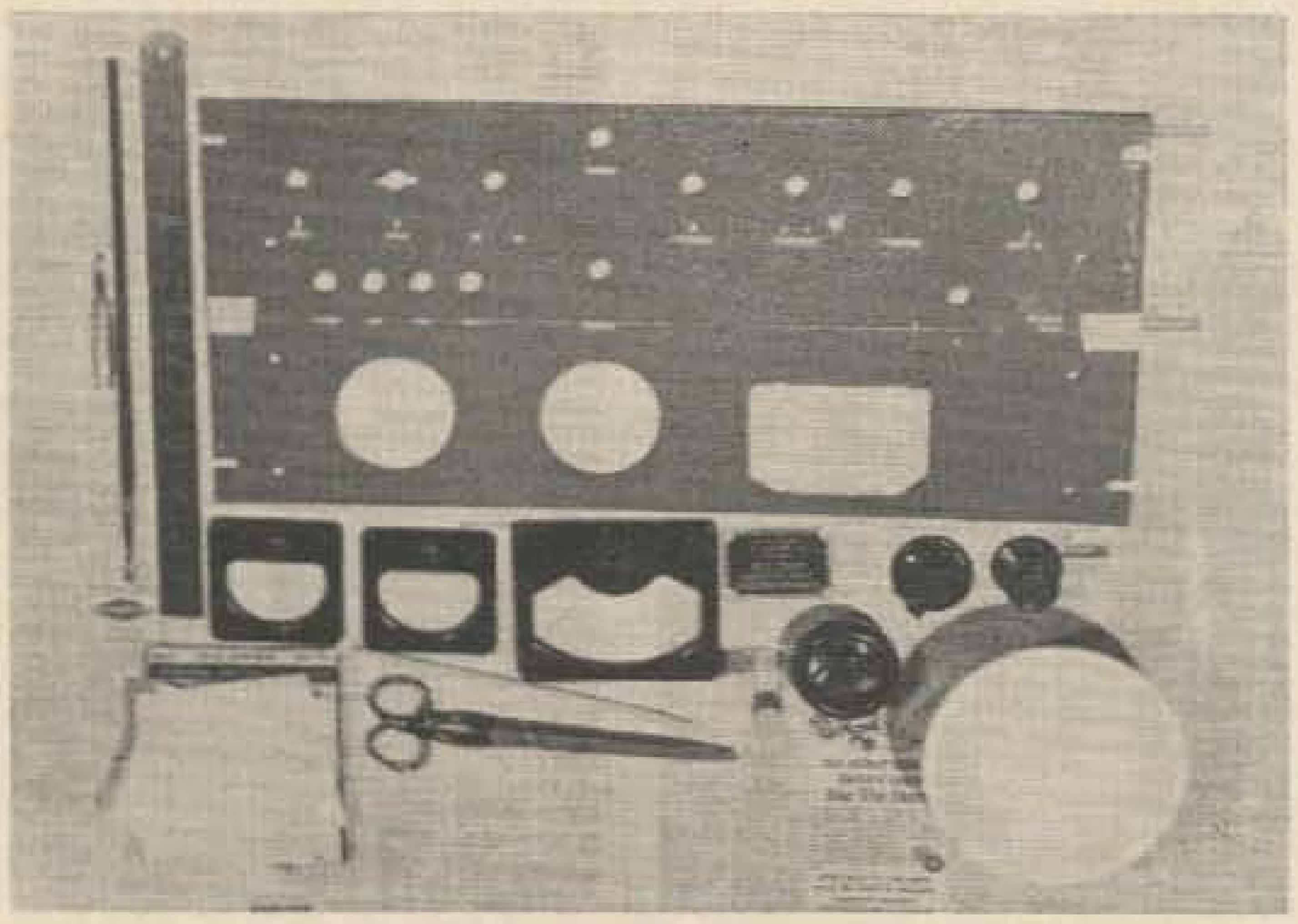
enough to see the marks made on the shafts by the set screws when the set was manufactured. That helped in restoring the shafts to their original relationship. With a little care you can get setscrews to seat in an old depression. I was lucky; when the work was finished the dial and the tuning capacitor were in proper alignment.

At this point in the restoration of a set you can check it for loose mounting screws, bent brackets and general wear and tear. You can replace worn dial cords, install new controls to replace any having bent or broken shafts and replace broken antenna or loudspeaker terminals. Look at all of the capacitors, too. Some of them may be leaking oil or electrolyte. Wax dripping from a tubular capacitor may be a sign that it is passing some direct current and heating up as a result. Replace it if that is the case.

Electrical Tests

The set had not yet been engergized and I wanted to apply power as carefully as possible. Of course, anyone who gets a new piece of gear is tempted to plug it in and see if it will play. If the equipment is old or has been used extensively you may be running the risk of burning out the power transformer or rectifier because of an electrical fault. I usually choose to avoid the risk just mentioned by using a different procedure. With all of the tubes out of the set I turn on the power switch and check the line cord with an ohmmeter to see if it shows an amount of resistance that is normal for a transformer primary winding. You may find a shorted line cord or an open line switch this way. Many communication receivers are equipped with line-to-chassis bypass capacitors. I never trust them very far since you can get a nasty shock from the chassis if one of them is defective; check them with the ohmmeter, too. If the items listed above are all okay, turn on the power. Pilot lights should operate at full brillance and the transformer should run cool and quiet. If it continues for ten or fifteen minutes you can assume that there are no shorted turns in the transformer or shorts in the filament wiring. My set passed this test so I shut off the power and plugged in the rectifier tube and turned the power on again. In a few seconds I heard an ominous growl from the transformer and I got a distinct odor from the set. I cut the power immediately. After turning the set upside down so that I could see the components I again applied power for about ten seconds. The transformer noise resumed and a wisp of smoke came from a well-cooked resistor that my first inspection had overlooked. Under it was a moulded paper bypass capacitor of the type commonly used in equipment of World War II vintage. It had a suspicious-looking bulge on one side. Tests with the ohmmeter confirmed that the capacitor was shorted and that the resistor had dropped radically in value. Finding a definite cause of trouble like this is encouraging; you may have discovered why the set was taken out of service. Presumably fixing this case of trouble should restore the set to operating condition.

By good fortune I had been able to obtain an instruction manual for the set and so had no trouble identifying the faulty components. My faithful old junkbox yielded replacement parts of the proper kinds and values. I made the repairs indicated and tried the smoke test again. All was quiet so I



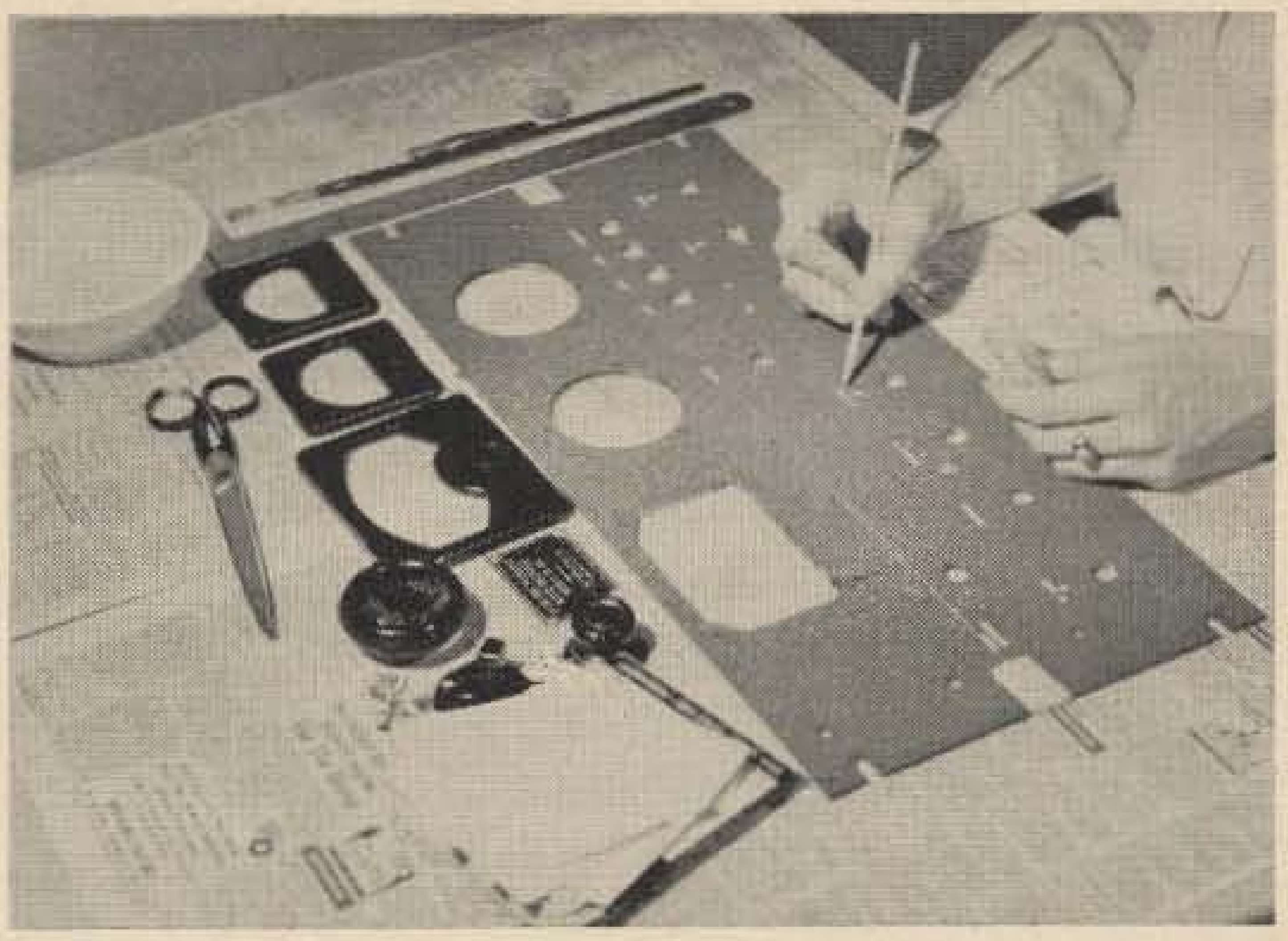
A length of thread helps to get the decals on in a straight line.

checked the B+ circuit with the voltmeter; I found the voltages above the values listed in the manual. That seemed normal, of course, since removing the tubes from the set would also remove most of the load from the plate voltage supply.

My next step was to check the contacts of all of the toggle switches with an ohmmeter (power off, naturally). As is often the case I found one with a nice crisp snap but it showed appreciable resistance in one position. It was replaced. I also recommend cleaning and lubricating the contacts on rotary wafer switches and the fingers that make sliding contact with the tuning capacitor sections. To do this I use a cotton swab that is saturated with silver cleaning solution—the "dip" kind, *not* the abrasive kind. About ten seconds of contact with the chemical is enough to reduce the black silver sulphide on a plated contact and leave it as bright as new. Other silver plated parts such as coaxial connectors respond well to this cleaning method. Don't be alarmed if you notice a hydrogen sulphide odor when using the chemical. Wafer switches tend to develop more sulphide on the end position contacts where wiping action is at a minimum and so these contacts should be given greater care than the others.

After the switch contacts have been cleaned I spray them with a combination of cleaner and lubricant. The lubricant in such sprays is a silicone compound that should not affect set performance in the hf and vhf bands. The propellant is usually a flurocarbon which is a highly volatile solvent. When using it you may want to put a piece of cloth under the part being sprayed. The cloth will catch the dirt that washes off of the part so that it won't muck up the chassis or other parts. It is best to buy a spray can that comes equipped with a long plastic tube to help you get the spray into places that are hard to reach.

When you are confident that you have done all that you can to put the set in good working order it is time to put in the tubes. If you have a tube tester, be sure to use it. If you don't have one I recommend that you buy new tubes for the *rf* and *if* stages. If you don't want to do that, at least reserve judgement on the quality of the set until you have put in the tubes that will give it a fighting chance to do a good job for you. Incidentally, be sure you are putting the right type of tube in each socket. The fact that you found a given type in a particular socket is no guarantee that it is the type that belongs there; it may have been put in as a temporary substitute; it may also have been selected at random and installed to give the set the appearance of being complete so as to add to its sales appeal.



Thinned lacquer is applied to the decals to give a "silk screened" appearance.

With tubes in the set you can align the *rf* and *if* stages. If you have a copy of the service manual try to follow it as closely as possible. There is no need for me to describe receiver alignment procedures here. They are a routine part of receiver maintenance and are described in considerable detail elsewhere.

Restoring the appearance

When you have spent a lot of time and effort building or restoring radio equipment you want it to look good. Suprisingly enough, many hams have failed to discover some of the tricks that are essential to giving the commercial look to their homebrew. The use of some of these methods will not only increase your pride in your work and your pleasure in using your equipment but it can add materially to its resale value.

A dull-looking wrinkle finished cabinet can often be improved. After scrubbing and drying it thoroughly fill in any scratches with matching paint. A draftsman's ruling pen may be useful with narrow scratches that expose the underlying metal; a brush will have to be used on chipped or worn places. After the touch-up paint has dried thoroughly, give the whole surface a *very* light coat of clear, glossy lacquer. Spray cans are handy for this kind of work. Each surface should be sprayed from two opposite directions, allowing time for each coat to dry. Care must be exercised not to apply too thick a coat as that will fill in the valleys in the wrinkle finish and spoil the effect. Any new labels or decals that are needed should be put on before the lacquer is applied. While the finish on the case is drying you can turn your attention to some of the other parts.

Nameplates can be rejuvinated by filling etched areas with black lacquer or india ink; after it has dried it can be sprayed with clear lacquer or with a clear, semi-gloss finish that is used to protect paintings and watercolors. This particular kind of spray finish is available at art supply and paint stores. I prefer to use it in a situation like this as it does not contain any lacquer solvent and so will be quite compatible with the coating under it.

Knobs should be polished with a soft cloth and any missing setscrews replaced. If a line, dot or an arrow has been molded into the knob it can be renewed by filling the reference mark with white lacquer or with one of the white decorative caulking compounds that are sold for use around plumbing fixtures. They are available at many hardware and variety stores. The kinds that are water soluble until dry are especially easy to work with.

Your set may need the replacement of a specially-made knob, dial or decorative device that is available only from the manufacturer. If the set was made for the commerical market (rather than for sale to the military) you will usually find that the manufacturer or his authorized repair agency can supply the parts at a reasonable cost. Use of the correct replacement part is usually well worth the expense as it helps to preserve the resale value of the set. Orders for components should be addressed to the "Service Parts Department" at the manufacturers main address; the model number and serial number of the set should be given as well as a brief description of the part or its function. This information will help the factory to handle your order promptly.

The new panel

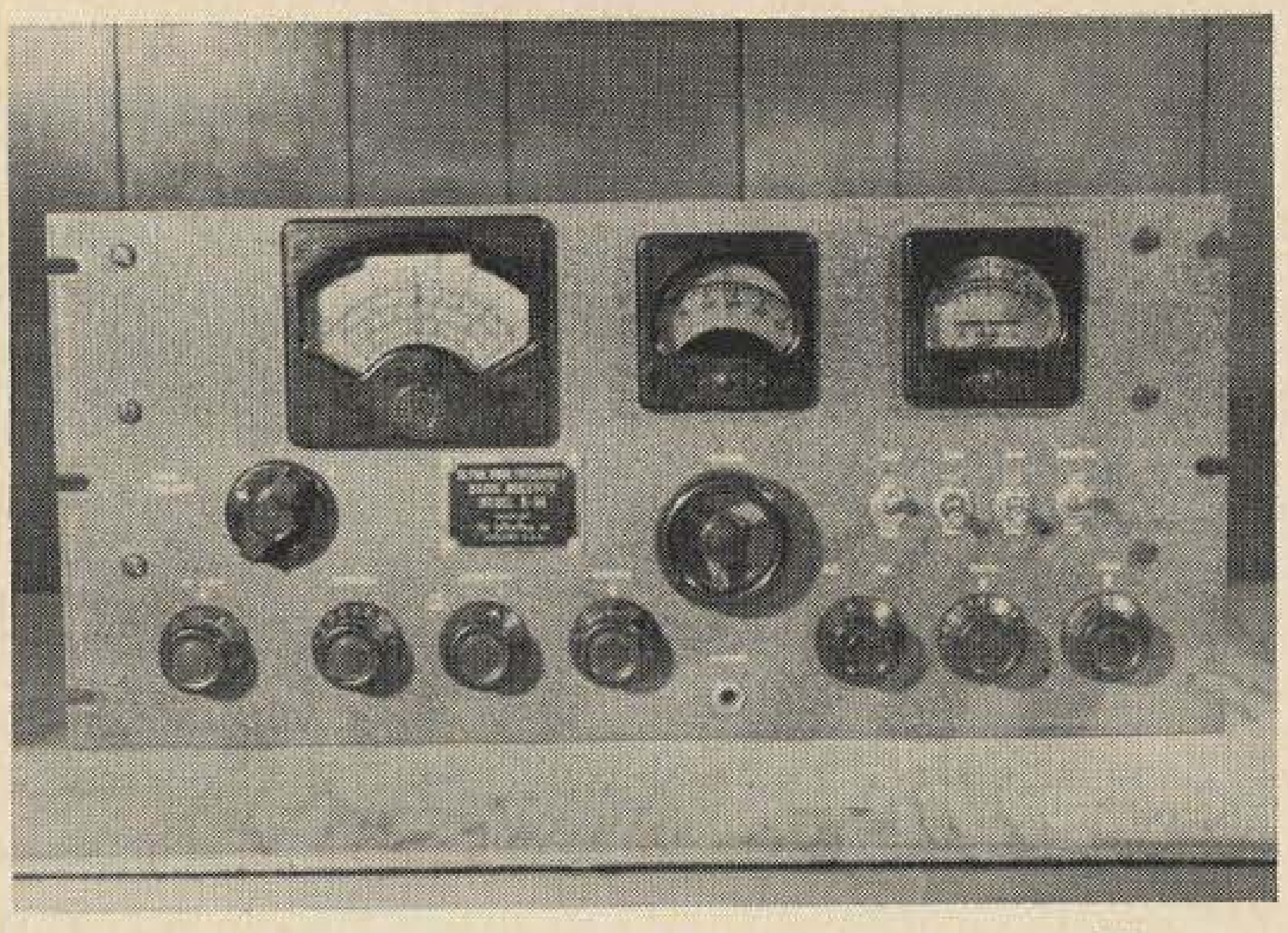
Producing a new panel is a real challenge to a true homebrew artist. It may be for use on equipment of original design or it may be for replacement on commercially-made gear. In either case you are constrained somewhat in that the location of some controls are fixed by the design of the device and its chassis layout. On the other hand, there will be some controls, switches or meters that can be placed in a way that will give the panel a balanced appearance. You may also recognize an opportunity to employ functional grouping of the controls for operating convenience. For example, the S-36 was originally designed with the avc, anl and bfo toggle switches located along the bottom of the panel. When planning the new panel I chose to place them under the "S" meter with the send-receive switch.

When you are laying out the locations for the various holes in the panel remember the old carpenter's adage, "Measure twice and cut once"; it's good advice. If you are replacing a damaged panel use the old one as a guide. If you are starting from scratch then make all of the measurements from two references such as a vertical centerline and either the bottom edge of the panel or a horizontal line on the panel that will correspond to the location of the top surface of the chassis. Remember to let the panel extend below the bottom of the chassis by an amount at least equal to the thickness of the bottom plate (if one is to be used) and the heads of the screws that hold it in place.

I usually prefer to use prefinished aluminum panels because they are easy to cut or drill. I selected a steel panel for use on the S-36, however, so as to avoid the possibility of corrosion between dissimilar metals.

Incidentally, panel colors differ slightly between different suppliers and over periods of time. If you want prefinished panels to match each other exactly, buy them at the same time and get them all of the same brand.

To begin work on the panel, locate and mark the centers of all of the holes that are to be made in the panel. Outline any large ones that are to be cut for dials or meters. It is often convenient to draw these on the heavy paper in which the panels are wrapped at the factory. Any kind will do, of course. After all of the holes have been located make a note of the diameter that each hole should be when the panel is finished. At this point you have an opportunity to place all of the knobs, meter, dial trim, etc. on the panel to get an idea of what the final appearance will be. When you are satisfied with the position of those controls whose location is optional you can then begin to cut metal. *Recheck all of your measurements.* Centerpunch each hole that is to be made and then drill a pilot hole of about 1/16" diam-



With a new panel the set even seems to sound better.

eter. Small pilot holes can be accurately positioned and they will make the cutting of larger holes much easier. Drilling the pilot hole also transfers all of the hole locations to the back of the panel so that you can work on it from the rear; then if a tool should slip and scratch the surface it won't show when the job is done. Try to keep the front side of the panel away from you especially when doing such manual operations as filing the edges of a rectangular hole. You may want to protect the front of the panel by covering it with a cloth or paper during some operations; if that is done, don't let the chips or shaving accumulate between the panel and the cover as they will scratch the finish.

When all of the holes have been drilled and the burrs removed, you are ready to apply the designations. I recommend the use of decals on a panel because when they are properly applied they most closely resemble the silk-screen process lettering used by manufacturers. Lay the panel on a flat surface that you can sit at comfortably. If you use the family card table remember to cover it with a newspaper. Have at least one of each size or style of the knobs, dials and nameplates at hand. Lay them in place on the panel so that you can decide exactly where the decals will look best. A piece of thread fastened to the panel at each end with masking tape will help you to get all of the labels level and in line with each other. Follow the marker's instructions in applying the decals. A wet decal is fragile but it can be moved around a great deal with a wet artist's brush. An art brush is stiffer than a camel's hair brush and is easier to use. When the decal is in place press it lightly with a dry cloth or a blotter. That will force some of the water out from under the decal and cause it to stay in place. Let the decals dry thoroughly.

The next step is important to give the panel a commercially-built appearance. Decals made for use on radio equipment rely on a thin film of clear lacquer to support the individual letters or dial markings. When the decal is dry, light reflecting from the lacquer makes this backing objectionably obvious. With a little care you can dissolve the film without disturbing the letters. When that is done the letters will appear to be printed directly on the panel. To do this, mix one part clear lacquer with two parts of lacquer thinner. A thimblefull is all you will need. With a very small brush or a wooden dowel that has been pointed in a pencil sharpener apply some of the thinned lacquer to the bottom edge of the decal. Put it on *very* sparingly; let the fluid be carried under the decal by capillary action. Too much of the mixture will cause the letters to soften; too little will fail to dissolve the decal backing. You apply the solvent only to one half—the top or bottom—of a designation; the untreated half will hold everything in place while the solvent dries. Let it dry completely before you attempt to do the second half. The pointed dowel will be handy for treating the center of such characters as "O" or "G" as a final touch-up. You may have a teenage daughter or sister around the house. Girls are especially dexterous and can do this sort of job very well if you can get them away from the telephone long enough.

Before assembling the panel to the receiver I had one last job to do. The original panel had a circular cutout almost 6" in diameter over the main tuning dial. It was covered with a thin metal stamping. I had decided earlier that I could not cut a six-inch hole cleanly enough and I certainly couldn't reproduce the stamping. I had decided to provide a smaller opening and cover it with a dial escutcheon that I had left over from previous repair activity. The bakelite trim was supplied without any window material in the opining. I used a piece of 1/16" clear acrylic plastic for the window after cutting it to fit. I scribed a vertical line in the middle of the plastic and filled it with india ink; the line serves as an index for the dial. Some designations were added to the plastic and it was fixed in place by means of a drop of cement in each corner.

With all of the preliminaries out of the way one is ready for the final assembly. Dial trim, nameplate and the meter were fastened to the panel; the meter and pilot lights were connected. Sometimes these connections can be made more easily if you can move the panel around a little bit so I completed those steps before I fastened the panel to the side braces and chassis. Finally I put on the knobs and the set looked the way you see it pictured.

Except for some trimming of the *rf* stages to put the dial calibrations on the nose, that is the story. Four basic operations were involved: cleanup, trouble shooting, repair and refinishing. A lot of work? Usually; that will depend on the set. But if you follow the routine outlined above your chances for success are excellent. Furthermore, as a reward for your efforts you will gain both valuable experience and the pleasure of having another fine instrument in your shack. Good hunting! . . . W9NLT

Correction

In the article "Mighty Four on Six" in the November 1967 issue, the coil data was inadvertantly left out of the schematic. With due apologies, we now print this information.

L_1 is 8½ turns of #22 enamel wound on a 5/32" slug tuned plastic form. The tap is at 3¾ turns from the cold end.

L_2 is 3 turns of #22 enamel wound around the cold end of L_1.

L_3 is 5 turns of #16 air wound with a 5/16" inside diameter.

RFC_1 and RFC_2 are approximately 6.8 microhenries. (A Z-50 or 20 turns of #30 enamel wound on a ¼" powered iron slug.)

R_6 is the 100 ohm resistor supplying −V to the modulator.

R_5 is the 10 ohm resistor connected to RFC_1.

The crystal is a third overtone—50 MHz.

SB-33 Note

Some distortion has been noticed when the SB-33 is used with some linear amplifiers. This is usually due to rf feedback and can easily be cured by inserting an rf choke in the 10 volt line and bypassing it. This is pin 7 on J1. Insert the rf choke (1-2.5 mh) and bypass with a .001 mfd 200v ceramic to ground on the end of the choke away from pin 7. Use short leads. . . . K6SHA

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New Life for an Old Work-Horse

A quick look at the advertisements appearing in the amateur magazines show an old work-horse receiver, this receiver sells for between $150 and $200 used. What is it? The Collins 75A1, that's what. This receiver, although designed in 1947, is still superior to many receivers being made today. The calibration, selectivity, and stability can only be equalled by other Collins receivers. Even though this receiver was designed before side-band was popular, it still does a remarkable job receiving SSB as well as RTTY, CW, and AM. However, there is still something to be desired in the 75A1. This is obvious, for if the receiver were perfect, Mr. Collins would not have authorized the newer receivers (75A2, A3, A4, etc.). These problems may be corrected easily and without great expense.

The problems? Well, the audio quality can be improved. Also, the design of the input circuit (antenna) is such that it does not match coax on any band. The input impedance is about 200 ohms on 80 meters and keeps going up until an impedance of 1500 ohms or greater is reached at 10 meters. Third, the bfo circuit is fine for CW with 1 kHz either side of frequency. However, RTTY and SSB need about 3 kHz.

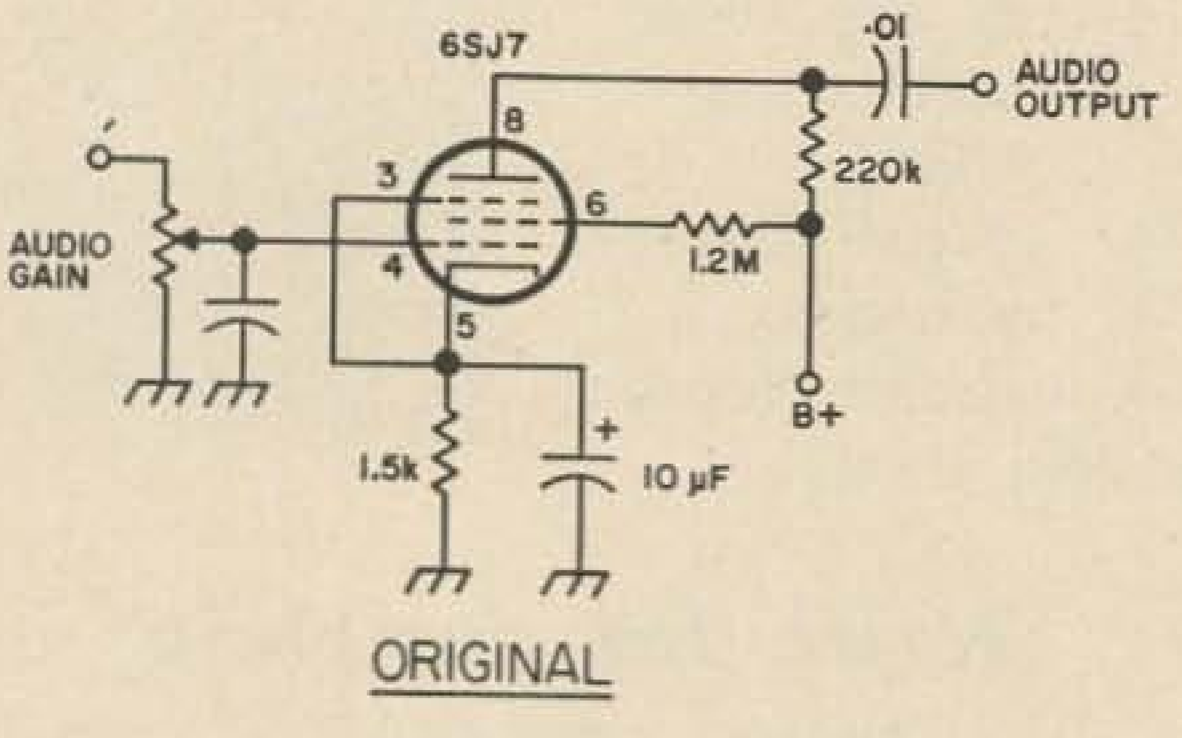

Fig. 1. The Original circuit for the first audio stage of the 75A1 receiver.

Each of these problems are easy to correct. The audio quality may be improved greatly by rebuilding the first audio stage; the input circuit may be easily modified; and the bfo may be expanded by the addition of one component. How to do this? Read on.

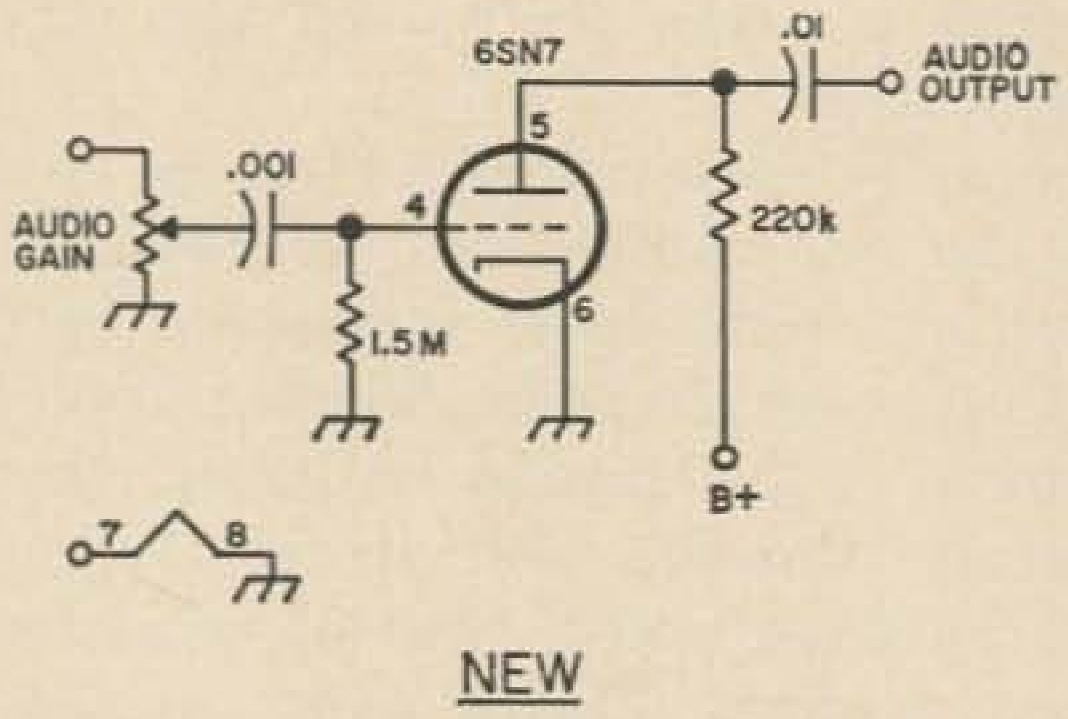

Fig. 2. Modification to the first audio stage, using 6SN7.

The existing first audio stage in the 75A1 is a 6SJ7 noted as VII on the schematic. This stage is capable of high gain, but severe distortion often takes place on voice peaks. This may be corrected by the simple rewiring of the socket to accept a 6SN7. A total of one capacitor and one resistor are needed to complete the operation. **Fig. 1, and 2,** give the original circuitry and the new circuitry. Also, the audio output stage may be modified with the addition of a cathode by-pass capacitor and a tone control (**Fig. 3**). The tone control is a great help on CW and Voice. However, the reduced bandpass does not allow the RTTY tones to pass sufficiently. Thus, I did not add the tone control to the K9STH 75A1. However, the circuitry was tested and it worked very well.

The antenna input circuitry may be easily modified to accept coax. The modification consists of removing the twisted pair going to the existing antenna input coil. A new coil is wound over the grid coil. This new coil consists of three turns of number 22 wire close wound at the end of the coil nearest the chassis. Then the remaining wire is twisted and connected to the antenna input terminals on the receiver. If desired, a coax connector may be installed on the rear of the chassis and the twisted pair connected to it. This operation takes about fifteen minutes and is well worth the trouble, for the input impedance is reduced to a value which will easily accept coax-fed antennas. This idea is not new, but it has been a long time since I have seen anything on it.[1]

The third trouble spot may be eliminated by replacing the tuning capacitor with a capacitor of similar size but with approximately three times the capacity. The capacitor in the K9STH receiver was similar to the surplus APC variety. This capacitor had four rotor plates. This was replaced by a similar capacitor from which all but thirteen rotor and stator plates had been removed. The replacement capacitor came from a BC-610 tuning assembly and had an original maximum capacity of 100 pF. However, many of these capacitors may be found in other places. Even other types of capacitors may be used, but one of the same physical dimensions as the original makes things much simpler. Just in case there are other types of capacitors used than in the K9STH receiver, it would be advantageous to examine the existing bfo variable. A rule of thumb is to multiply the number of existing plates by three and add one for good measure. The capacitor added to the K9STH receiver gave three kHz either side of center when the indicator mark on the knob was at the old 1 kHz marks.

After the modifications are complete it would be advisable to completely realign the receiver. If the original manual is available, follow the instructions in it. For the benefit of those amateurs who do not have access to a 75A1 manual, a brief alignment procedure follows:

Low *if*

1. Turn on the receiver.
2. Connect a 500 kHz signal to the grid cap of the 6L7 noted V4.
3. Place the selectivity control in position 4.
4. Tune the signal generator for maximum "S" meter reading.
5. Place the selectivity control back in the "0" position.
6. Align the *if* cans for maximum reading on "S" meter.

High *if*

1. Place the receiver bandswitch on 80 meters with avc on.
2. Inject a signal at 2.5 MHz into the grid of the 6SA7 noted V2 (pin 5).
3. Tune the receiver to approximately 3.2 MHz on the dial. Peak the signal on the "S" meter with the tuning dial.
4. Tune the trimmer capacitors in the section of the chassis marked "*if* 2.5 to 1.5" for maximum "S" meter reading.
5. Change the input signal to 1.5 MHz and tune the receiver to 4.2 MHz. Peak the signal on the "S" meter using the main tuning dial.
6. Tune the slug-tuned coils on the traverse bar in the section marked "*if* 2.5 to 1.5" for maximum reading on the "S" meter.
7. Repeat steps 1-6 several time.
8. Switch to the ten meter band.
9. Inject a 5.5 MHz signal as in step 2.
10. Tune the main tuning dial to 28.0 MHz, peaking the signal on the "S" meter.
11. Tune the capacitors in the section marked "*if* 5.5 to 3.5" for maximum "S" meter reading.
12. Tune the receiver to 30.0 MHz.
13. Inject a 3.5 MHz signal as in step 2.
14. Peak the slug-tuned coils in the section marked "*if* 5.5 to 3.5" for maximum "S" meter reading.
15. Repeat steps 9-14 several times.

Note: The above adjustments may be made with input at the normal received rf frequency. Use an 80 meter signal for the low and first high *if* alignments. A 10 meter signal may be used for the second high *if* alignments. However, use a signal generator if available.

Wiring Changes

In changing the new 6SN7 for the old 6SJ7 connect 6SJ7 pins 4 to 6SN7 4, 7 to 7, 8 to 5, and ground 6SN7 pins 6 and 8. The rest are unused.

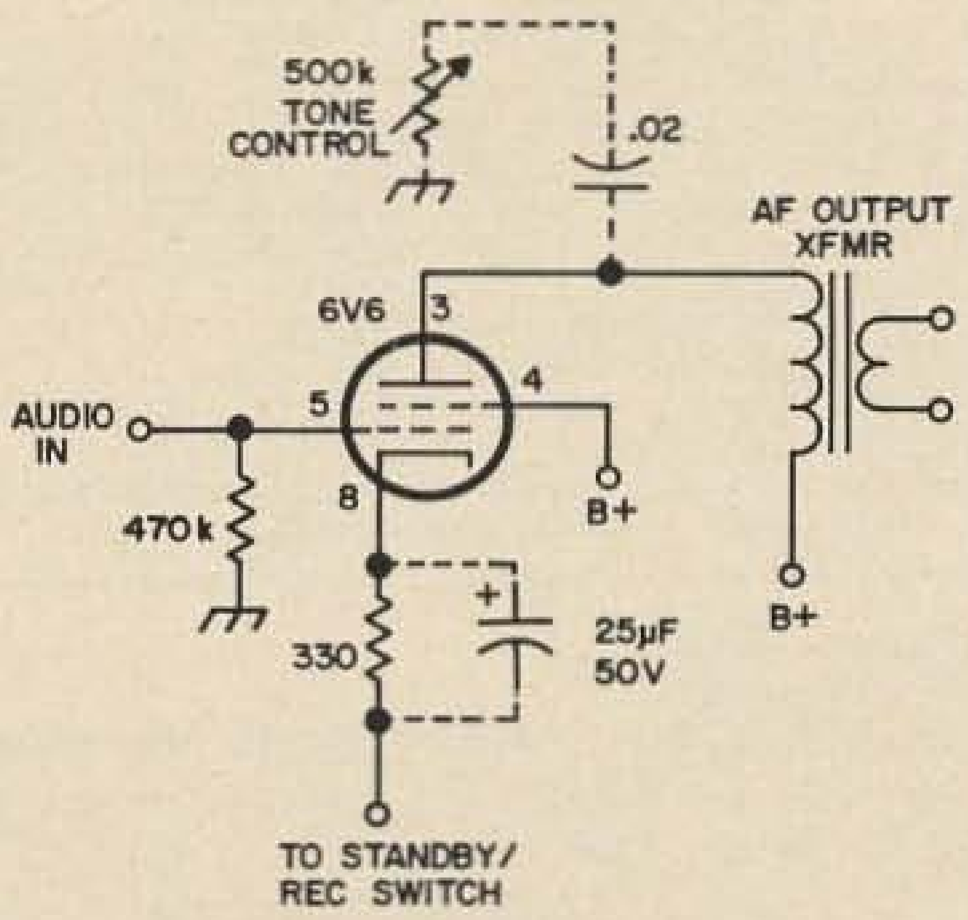

Fig. 3. Audio output modifications.

1. Second Guessing the Experts, by W. I. Orr, *CQ* magazine September, 1951, p. 21.

RF Adjustments

Tune the receiver to the high end of the respective amateur band and adjust the capacitors in the Antenna and rf portions marked on the chassis. Then tune to the low end of the band and tune the slug tuned coils in the same section. Each time peak for maximum "S" meter reading and repeat several times for each band to obtain optimum performance. The proper adjustments for each band are plainly marked on the 75A1 chassis. Tune the bands in the following order: 80, 40, 20, 15, 10, 11.

The frequency may be checked with WWV at 15 MHz. By use of a 100 kHz crystal calibrator, the calibration of the other bands may be checked. The proper adjustment for each band is plainly marked on the chassis.

After completion of alignment the receiver is ready for use. A quick tune across the amateur bands will show why Collins receivers have become the most desired of units. The 75A1 is superb for regular amateur work, and, with the addition of converters, is an excellent VHF receiver. By using 11 and 10 meters for the tunable *if*, complete coverage of the 6 and 2 meter amateur bands is available. Also, the low noise figure of the receiver makes it an excellent tunable *if*. Thus, it is impossible to lose with the 75A1.

So, unless you have another Collins receiver, run to your neighborhood amateur supply store and beg, borrow, or even buy (!) a 75A1 and get to work and give that old work-horse new life.

. . . K9STH/5

D. E. Hausman VE3BUE

Stop Those Slipping Knobs!

Radio knobs have the annoying habit of loosening to the extent that they slip. This looseness can be corrected by tightening the set-screw, but after some time the control shaft which is turned by the knob becomes scored with marks from the set-screw. Retightening the set-screw leads to more problems as the knob will likely crack. An easy way to solve this predicament is to slip a piece of fine sandpaper—grit side on the control shaft—between the inside of the knob and the circumference of the shaft. The sandpaper grips the shaft tightly and prevents the knob from cracking.

1968 HAMFEST AT 73

Come on up July 6th and visit New Hampshire

Ever since our last hamfest, in 1965, everyone has been after us to have a repeat performance. The editorial in February explained some of the reasons for the delay.

This year we are going to do it again. July 4th comes on Thursday this year, so we will schedule our Hamfest for Saturday, July 6th. We'll try to have lots of entertainment for you on Saturday. We'll have more details on this later, but it looks as if the VHF gang will have a chance to bring their 144 and 432 MHz antennas for a measuring contest run by Leger Laboratories. I expect that André of Vanguard will be up here with all of his latest products; plus many other 73 advertisers.

We'll organize an auction of gear, so bring stuff you want to sell and lot's of money to grab the bargains. Last time thousands of dollars worth of gear changed hands and I'm afraid the buyers got some incredible bargains.

Saturday evening I will show some of the slides of my DXpedition to those interested in seeing some pictures of weird places.

Early Sunday morning we will form a caravan heading north into the White Mountains, about 100 miles away. There we will visit some of the tourist attractions that have made New Hampshire the most visited tourist state in the East. We will see the famous Old Stone Face, the great New Hampshire Man of the Mountains. We'll see and walk up through the Flume. We'll take the tramway to the top of Canon Mountain for one of the panoramas of a lifetime. We'll see the beautiful Old Man's Foot Basin. We'll stop off at Clark's Trading Post and see and hear some of the old time music boxes and see the trained bears. We'll visit the historic Morse Museum and, if we can work it in, climb through the caverns of Lost River.

New York is just a little over 300 miles of turnpike driving away, so those that have to get back can make it Sunday evening. For the rest we can drive or take the cog railway to the top of Mount Washington on Monday morning. The more athletic can start from the cog railway station at the base and climb the mountain.

This will be an outing that the whole family will enjoy. There are many beautiful picnic spots near Peterborough and we show them on a special map that we have printed of the Monadnock region of New Hampshire. You can get one of these maps when you arrive or send us a SASE and we will send you one right away. This map also shows points of interest in this area, restaurants, etc.

Mobileers will want to try their luck from the top of Pack Monadnock, just 3.5 miles east of the 73 headquarters. You can drive right to the top of this mountain and get a straight shot right into Boston and down to New York.

At any rate, if you can get away for a couple of days or so, why not join us up here at 73 for a couple of days of fun and sightseeing around New Hampshire?

. . . W2NSD/1

Del Crowell K6RIL
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Mountain View, California

Modification of the TRA-19 Amplifier Cavity to 432 MHz

In the past several years this amplifier has been showing up quite consistently on the surplus and Mars outlets. The cavity was used in conjunction with a wide band FM field telephone system, the driver section used an FM oscillator plus multiplier stages using two 829B tubes covering 230 to 250 MHz. The driver is not too popular, but the 4X150 power amplifier makes a very nice 220 MHz final for CW-AM or SSB use. The amplifier was used as a separate unit complete with its inter-connecting power supply, many of the units are available without this power supply which delivered 830 volts at 250 mA. As most hams agree, this supply is not too important and much higher B+ voltage is generally used. This conversion covers the modifications of the cavity to use it on 432 MHz.

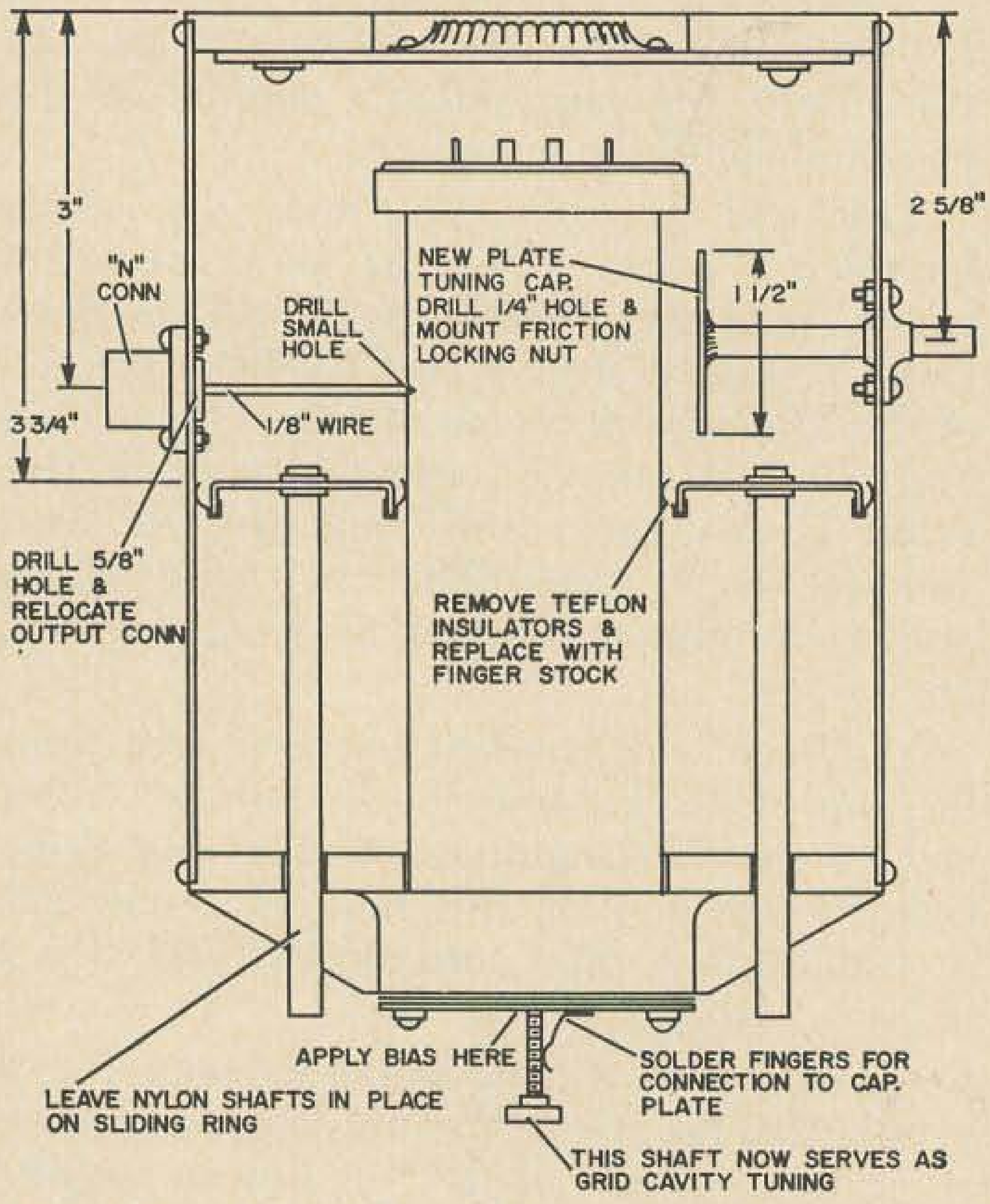


Fig. 1. Detail drawing showing plate cavity modifications.

Disassembly and conversion

Be sure to mark all mating sections before taking apart, this helps as the parts are again assembled after the modification. After the cavity is completely disassembled, drill the new holes as shown in **Fig. 1.** Relocate the output connector, using a larger wire for the coupling loop, and drill a small indent in the inter line as shown. The plate tuning capacitor is assembled from a ¼-28 thread shaft and a 1½ inch disc. The disc is soldered to the shaft and a little care must be used to get the shaft centered in the disc. Two metal friction plate nuts, such as used in aircraft work, were fastened to the cavity wall. This provides a good rf contact and also serves as a friction lock. The nut is very tight at first, so it is best to use a short bolt or tap to open the threads a bit so the capacitor shaft will turn smoothly.

In original operation the plate tuning was done by a sliding ring with Teflon insulators. This ring was simply a movable capacitor. To change the cavity frequency, this ring is converted to a shorting device which is a new bottom for the cavity. Once in position the tuning is done by the new capacitor previously described. Leave the nylon rods in place to help in positioning the ring. The tube plate collet is modified for high voltage by cutting down the outside diameter. This provides the necessary spacing to prevent arcing at 2500 volts. It is recommended that 4CX250 type tubes be used if this high voltage is used.

Grid cavity

When this cavity was designed the designer really did us a favor. Simply remove the bakelite tuning slug and the spacer at the end of the line. This cavity now will tune thru 432 MHz. The coupling wire is bent and soldered to the line as shown in **Fig. 2.** The large spacer can be removed by

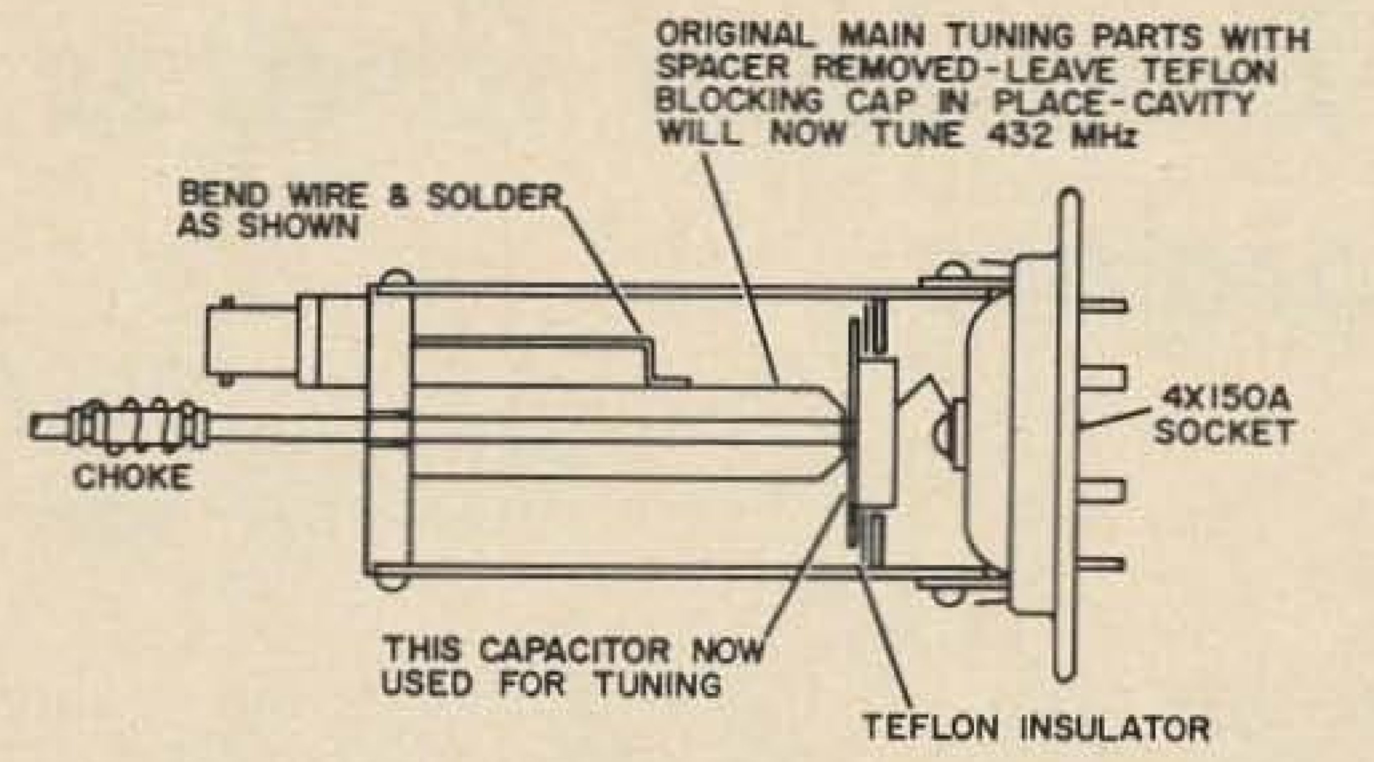


Fig. 2. Grid cavity modifications. The original main tuning parts are removed.

heating with a torch or a very large soldering iron. Soft solder was used in the assembly and the cavity is again assembled as it came apart.

Final assembly and operation

The complete cavity can now be assembled using the marks to position the sections. A spring finger should be soldered to the capacitor plate at the end of the main cavity. This finger makes a constant electrical connection to the capacitor plate (the rod used for grid tuning also is a bias connection).

The main iron frame in which this cavity was originally mounted can still be used; however, the original tuning mechanism will no longer be usable. The cavity also can be mounted on a new chassis along with the driver stages. However, at this station two identical cavities were modified and mounted on a common chassis. These cavities were connected to form a 1 kw amplifier by using ¼ wave phasing lines on input and output.

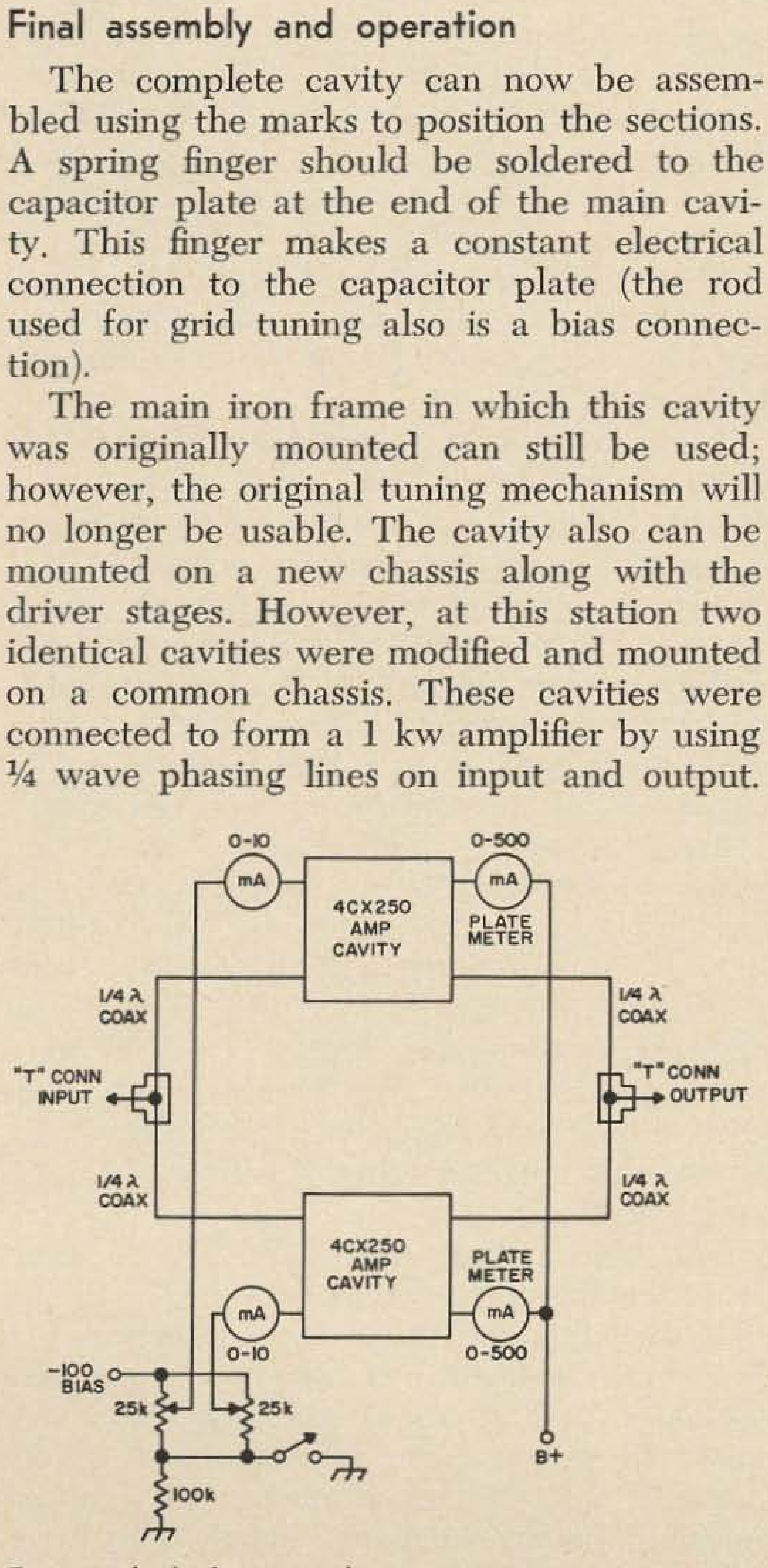


Fig. 3. Block diagram showing cavity connections.

Each cavity was tested individually before mounting on the amplifier chassis. The results were as follows: plate power 228 watts dc; grid current .5 mA; rf output 120 watts. The tubes used were 4CX250B's.

The completed amplifier (using both cavities) operated quite well. At first the filament voltage was too high, which resulted in excessive back heating and ruined a pair of tubes (let this be a lesson to all). The voltage was reduced, and the problem was solved. The system has tuning controls for each cavity, so each has to be adjusted for maximum power out and equal currents. The results were as follows: for CW operations at 1 kw input, the output was over 650 watts. This amplifier performed very well and was used to work KP4BPZ via moon-bounce.

A final comment: this method of phasing two identical cavities will work quite well at all bands. Home brew cavities such as in the VHF handbooks will work equally well. Refer to block diagram in **Fig. 3** for reference in connecting the cavities.

. . . K6RIL

Salvage Those Old Transistor Radios and Recorders

W. G. Eslick KØVQY
2607 E. 13th.
Wichita, Kans. 67214

This may be 'old stuff' to you old timers and you will 'turn up your nose at it, but think of the younger ones who have yet to learn all this! They have to be taught to scrounge, and the uses for what they get.

What good are the little cheap tape recorders, too cheap to go to the service shop for repairs? They are usually a three transistor amplifier in the cheapest units and better in the more costly ones. My wife and I usually investigate every noise at night that sounds strange, so I mounted a small three inch speaker in the garage and one at the rear basement window. I mounted the little three transistor amplifier, a six volt lantern battery, a SPDT toggle switch and the vol. control in a metal box. The switch throws either input line to the amplifier. I used a little transistor output transformer backwards to match the speakers and microphone to the input of the amplifier. I also mounted a jack connected to the output. I can use either a small speaker or phone. Now at the least noise, I can check each place with ease.

Using output transformers (scrounged from transistor radios) backwards (two of them, one for input and one for output) plus two switches and two speakers and either a battery or homebrew power supply, you have a nice intercom.

These amplifiers, mounted in a small case with battery and speaker (omit and use phone if desired), a 500 $\mu\mu$F capacitor, a resistor of about 3 to 5 k, a IN34 diode and a .001 by pass will make a fine rf/audio signal tracer. The input to the amplifier connects to a phone jack. One shielded wire with test probes at the other end is the audio probe. Be sure you have a paper input condenser of .25 to .5 μF instead of a electrotytic or you will find that the wrong polarity on the probe will kill the amplifier, resulting in no signal. For the rf, mount the diode (polarity doesn't make any difference) with a 500 $\mu\mu$F going to the probe and one end of IN34, and the .001 from the other side of the diode to the shield and, of course, the hot wire of the shielded cable going to the junction of the diode and .001 condenser. This can be mounted in some of the test probes designed for meters. Use mike cable as it is flexible. This will make a fine signal tracer.

The amplifiers can be used as an 'already made' audio system for your receivers. I keep one around to connect to various super regen and vhf receivers I test board up, that way I don't have to breadboard an audio system. Again be sure of polarity of the input capacitor if you use pnp and npn transistors in your receiver. If polarity is wrong, the amplifier won't work right.

Many more uses can be thought up as the need arrives, as they are handy when you can buy them from 25¢ to $2 at rummage and garage sales.

The radios? I have one unit on which I stripped the front end (loop, gang condenser and oscilator coil), and mounted an *if* transformer (be sure you complete the old mixer emitter circuit which probably went to the osc. coil.) Usually one *if* stage will have to be detuned as there is too much gain you could just as well remove the mixer/oscillator transistor and bring out the collector lead of the transformer to a test point. I used the above method but I think the latter method would be better as there is too much gain. I use this an an *if* audio system for converters (vhf of course). Now I will tell you the faults! Due to the low 455 Hz *if*, there are birdies. Tunable converters are not drift free I have found, and with a low *if* frequency it is worse. Still, I have this unit around as it comes in handy now and then.

Sets with a short wave band can be used as a tunable *if* for converters but I found that the autodyne mixer (one transistor for both mixer and osc.) is subject to too much oscillator pulling, so in one junk model, I used the mixer as an oscillator and added another transistor as a mixer with emitter injection of the oscillator signal. This type of receiver has enough *if* range, plus image rejection due to high input frequency and is also 'double conversion' when used with a converter.

On receivers for the FM band, rewind the coils for six meter operation. Again I frown on autodyne mix/osc. I have not tried changing one to two meters but I would advise changing transistors—change the mixer, in any case, as it is probably working at it's highest frequency where it has gain, and on 2 the gain may be low so you will have to experiment.

You probably have seen in other magazines about converting the CB walkie/talkie's to 6 (I remember the article on a cheap three transistor unit). The only help I can give may be worth it to some of you. I had a pair and even on CB the modulation was low. With one at each end of the basement I could not get enough audio to set up an audio howl. I mounted two small output transformers backwards in hookup to match the speaker vc to transistor input when the switch was in transmit position and the speaker was then a mike I had to solder them to the speaker frame as there wasn't room anywhere else if I wanted them inside the case. Anyway, with a better match from the 'mike' (in transit position) I now had enough modulation to set up a good audio howl. Use this idea on CB or 6 meters

. . . KØVQY

Correction

Two rather serious errors have been found in the circuit for the NBFM article in March 73.

In **Fig. 6**, page 9, the collector resistor from the 8.2 battery terminal should read 100 K, *not* 1 MEG as it appeared.

In **Fig. 7**, page 10 (the vacuum tube version of **Fig. 6.**) a 200 K resistor was omitted from the diagram. To correct this error, omit the line from the plus 250 terminal to the 5.1 K resistor as shown and insert a 220,000 ohm 1 watt resistor from the 250 volt terminal to the junction of the 1 Meg. resistor, the 25 mF 25 volt capacitor and the 5.1 K resistor. Approximately 6 volt positive voltage will be found at this junction, depending upon the resistance tolerances of the divider. This is the bias voltage for the voltage variable capacitor V15E or 6.8SC20.

Labels for Homebrew Gear

Using your typewriter to make neat labels.

Jack Grimes W4LLR
Box 16004
Memphis, Tenn. 38116

How many times have you bought a prefinished panel to be used on that pet building project, then exercised all the care of a skilled engineer to make the layout and wiring plus-perfect, only to end up with that home brew look. Usually because you could not find the decal you needed.

Perhaps you settled for leaving the panel blank; resorted to one of the tape-label-printers, or maybe even engraved (polite for scratched) the information you considered absolutely essential onto the surface.

It was the completion of a T U and the absence of any RTTY decals at the local distributors which sparked this idea.

The best source of print available to the average ham, or other home project builder, is the typewriter. But it seems somewhat ridiculous to mention sticking a box, cabinet, or ⅛ inch panel in a typewriter. Typing on a piece of paper and scotch-taping the paper onto the equipment hardly produces a commercial look.

The new invisible Scotch Tape looked promising. This is the type which looks cloudy until pressed in place. The 3M Company advertises: "You can write on it."

Why not type on it?

So a small piece was stuck on the typewriter platten and keys pounded.

The result looked good, but alas, when the tape was pulled from the roller and rubbed onto the panel, the printing smeared and came off. The printing needed to be under the tape.

The logical thing to do about this time was forget the whole thing, since if you type on the bottom of the sticky stuff the printing would be reversed.

But the old do-or-die-spirit refused to give up. After deep thought, many sleepless nights, and a good friend pointing out the obvious, the brilliant inspiration came.

Why not transfer the letters from the top of one piece to the bottom of another piece of the Scotch Invisible Magic Tape.

Tape went on the platten, sticky side down, Peck out the words:"Jack Grimes, AF4LLR, Memphis, Tenn."

Then another piece of tape right over the top while the first piece was still on the platten.

Would the tapes separate?

They did easily, The nice commercial print lifted from the top non-sticky side of the first piece of tape and came off on the bottom, sticky side of the second piece.

Quick! Press it down on the nearest grey crackel finish. The front of the typewriter. (Who could wait to hunt up an old panel?)

The invisible tape practically disappeared, but standing out sharp and clear, on the typewriter, was the professional look every home constructor would like to achieve.

Surely anyone would have been satisfied to quit at this point. But one problem remained. The black type looked plenty sharp on grey panels, but it was worse than useless on a black panel.

Red or Blue ribbons were almost as bad, and you can produce some mighty peculiar expressions on a clerk's face when you go in an office supply store and ask if they have a white typewriter ribbon in stock.

However all the stores do carry some little white sheets, or ribbons of white carbon, which are used to stick behind the typewriter ribbon and "type-out" errors.

This gimmick did the trick.

Hold the white paper behind the ribbon. Keep moving it a slight amount so you get nice clean print on the invisible scotch tape. You may need to back-space and print the same letter more than once. Transfer the print to the bottom of another piece of tape. Trim the finished label to size and press firmly on your latest creation.

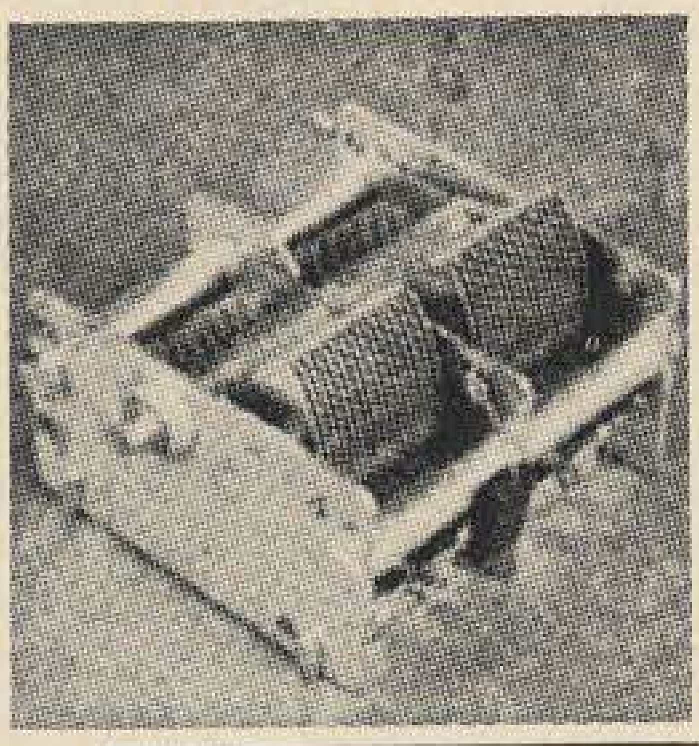
Or you may wish to affix identifying labels to brief cases, musical instrument cases. etc. The results will amaze you, and won't fracture your pocketbook.

. . . W4LLR

SOUND SURPLUS VALUES

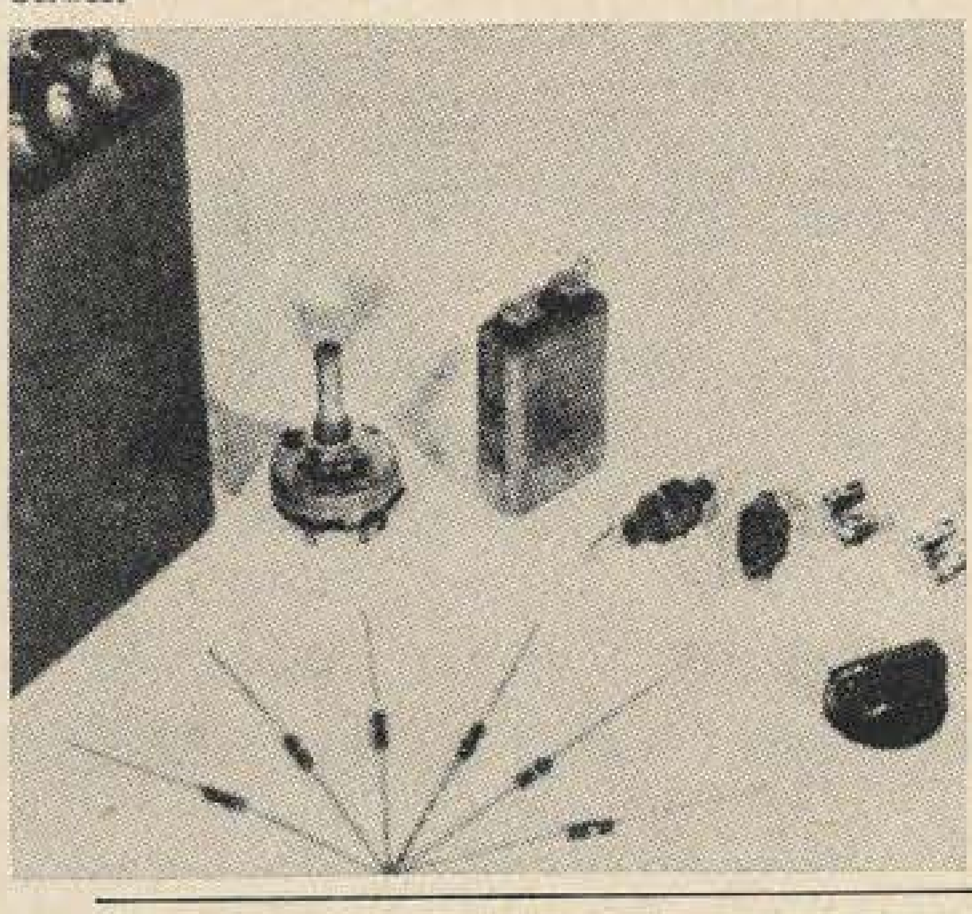
RCA MI17583 DC Upverter, accepts 6 volts DC in and converts to 12 volts DC out, maximum 7 amperes, solid state, 5 pounds, worth over $100.00, checked out, with instructions, our price, $12.95.

Muffin Fan, checked out, 100 cubic feet per minute, excellent for extending the life of electrical equipment. May be used to blow or to suck air. 14 watts each, 1 pound, 115 volts for $7.50; 230 volts for $6.50.



2 section loading capacitor. Each section 20-600, Tied in parallel equals 40-1200. Suitable for linears, rated 2 kilowatts or more. 2 pounds, $3.00.

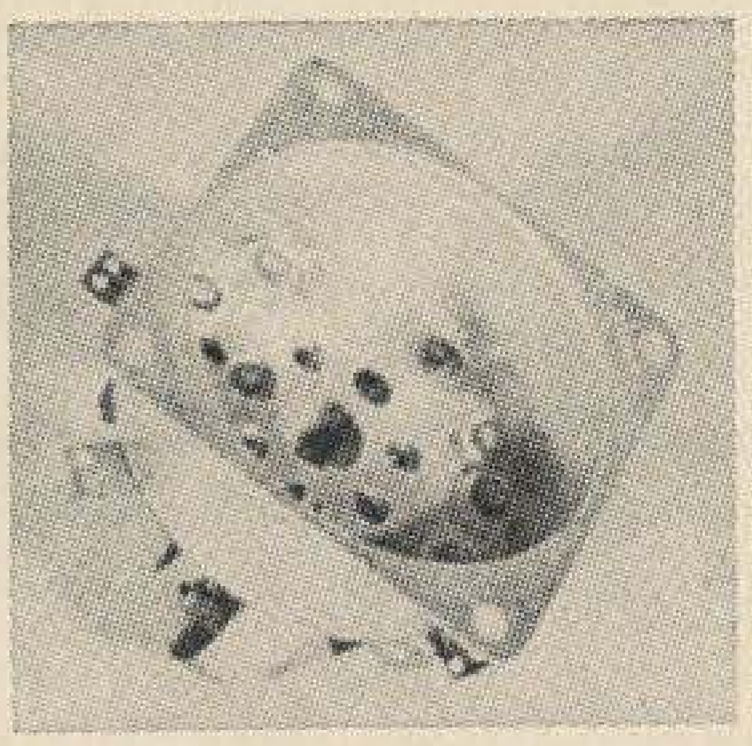
3½ inch panel meter, 0-10 ma, brand new, 2%, high quality American made—Triplett, Hickok, and other brands. Absolutely new, no pull outs. 1 pound, $3.50 each.



Our popular phone patch kit, 4 pounds, $5.95; line to grid transformer for same, 4 pound, $2.50; line to voice coil transformer, 1 pound, $1.50.

RG 58 factory fresh, made by Phalo, 100 foot reel, 4 pounds, $5.00.

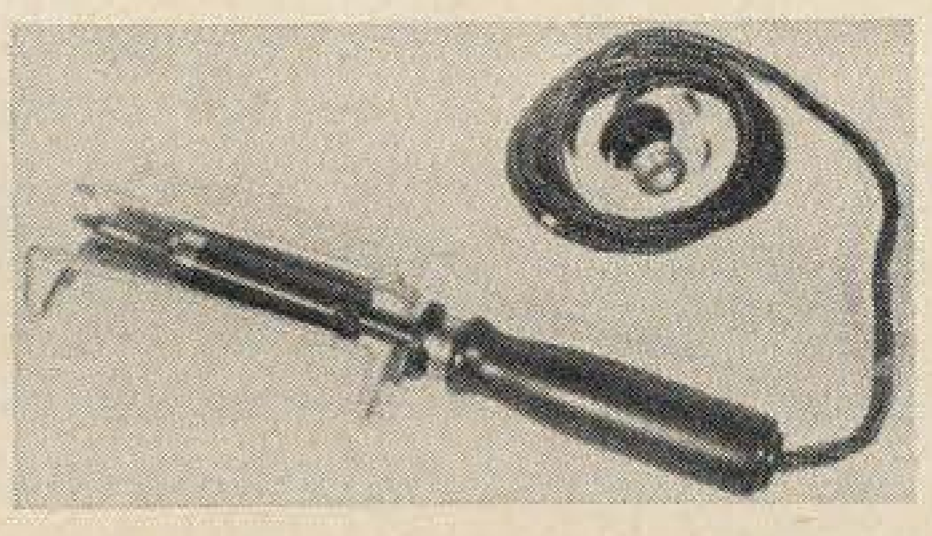
200 watt fixed resistor, 350 ohms, 1 pound, $.90.



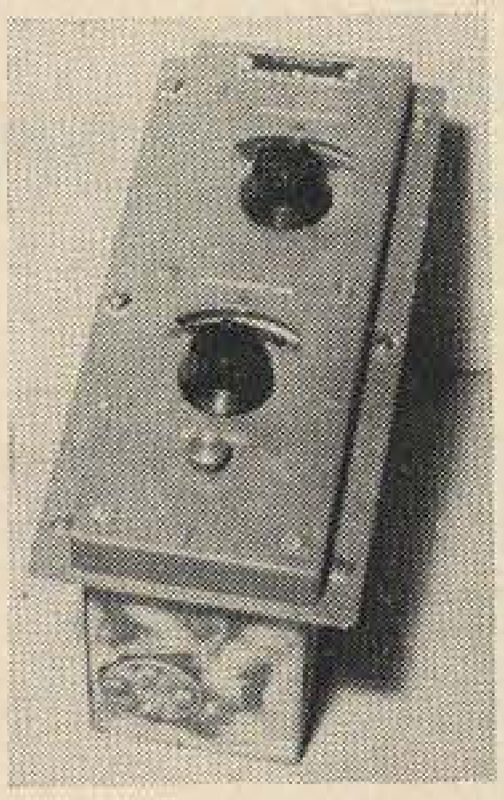
RCA socket 9935, for 829B, 832, etc. With capacitors, ½ pound, $1.50.

General Electric mobile 2 meter antenna, 2 pounds, $3.50.

Hickok 56RO, 15 ma DC, 3½ inch regular panel style, new, 1 pound, $3.50.



American Beauty 3138 soldering iron, 100 watts, standard of the industry, 2 pounds, $5.00.



←

0-12-UPM-1 cavity oscillator, 10 pounds, $9.50.

Wave Meter TS 133, 5 pounds, $5.00. ↓

Fixed resistor, .555 ohms, 200 watts, made by Ward Leonard, 1 pound, $.35.

GE 43F885CA6, 1400 mfd, 400 volt DC working, 475 volt surge, splendid for home brewing your own power supply, 3 pounds, $7.40.

RCA SSB-5 TRANSCEIVER

A limited number of new RCA SSB-5 transceivers are now available. Because quantity is so small we are offering these 4 channel devices on a first come basis at the following prices: for the basic transceiver with microphone, speaker, and ovens, covering the range of 3-15 MHz, $200.00; filters for upper or lower sideband are available at $62.50 each; power supply may be home brewed or you may use our meat and potato power supply kit at $50.00, or the National AC 200 at $75.00.

These transceivers are especially suitable for MARS and CAP work, or other point to point communication requirements. The filters are made by James Knight and operate on a carrier frequency of 1400 KHz. Quartz crystals for operating frequencies as may be required are available to fit the ovens. They are CR27 and cost $7.50 each.

The SSB-5 provides in a small compact package a means of operating sideband on MARS or CAP frequencies with 200 watts PEP rating; upper or lower sideband with or without carrier. When we had these two years ago they sold out very quickly. Now we have only a very few to offer, and suggest that you order at once, if you don't want to be disappointed.

Herbert W. Gordon Co.
Woodchuck Hill, Harvard, Mass. 01451
Telephone: 617-456-3548

William L. Smith, W3GKP
1525 Spencerville Rr.
Spencerville, Md. 20868

Counter Connections

Regardless of whether you got it from MARS, found it in the junk yard, built it from scratch or paid money for it—if you're fooling with a frequency counter you should find an idea or two here.

So you've got a counter working. Now what?

The first thing you'd better do is find out what the counter will do. The most important things you need to know are the frequency range, the input sensitivity, and the accuracy.

If you have an ex-commercial or military unit the chances are that all this info is set out in the specs or instructions. Most of these types, even the oldest, will count up to 100 kHz. If the front end tubes are in good shape and everything adjusted properly don't be surprised to find that it works okay up to 20 percent or so above the rated top frequency.

If you don't have the specs, or if you have a home-brew counter, you will have to measure the performance yourself. To start out, a hook-up something like **Fig. 1** is called for. Starting at a low frequency, say about 1000 Hz, vary the output up and down until you know what signal level is required to make the counter indicate properly. Then, maintaining the output at about twice this level, slowly increase the frequency by tuning the oscillator upward while observing the counter indications. If it is necessary to change bands on the oscillator or signal generator repeat the "output level" adjustment to make sure you are above the minimum voltage required for counting. You may find that the signal level needed increases gradually as you tune upwards.

Sooner or later you will reach a frequency where the counter either fails to indicate at all, or indicates lower as you tune higher. Increase the oscillator output in an attempt to make the unit keep counting. Lower the frequency if necessary to make the counter indicate correctly. By now you know with reasonable accuracy the limits of voltage and frequency for normal counting. You should keep these limitations in mind when designing accessory circuits for your counter.

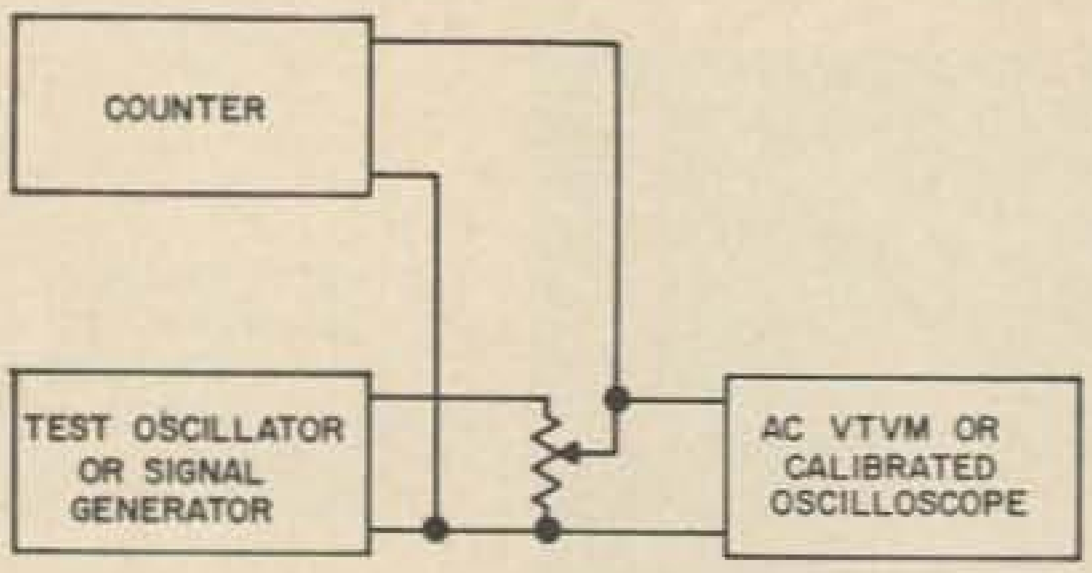


Fig. 1. Measuring the sensitivity and frequency range of a counter.

This is not the place for a long dissertation on oscillator stability, but I think it should be obvious that every counter contains or uses some sort of a frequency standard, and the counter indications are no more accurate than the standard. For example, many older counters use a 100 kHz crystal oscillator operated without an oven and trimmed to "exact" frequency by a big mica compression trimmer capacitor. Such a unit can be no more accurate than the oscillator (which will never put WWV out of business) and its indications will probably be affected by temperature and humidity. Simpler units may use the power line as a frequency standard, and these will be even worse. It has been a few years since I measured the local line frequency on good apparatus. At that time it was fairly common to find it off a few hundredths of a hertz, but I never found it off as much as one-tenth of a hertz. In other words the instability was a little under one part in 1,000.

Another factor which affects accuracy is the fact that the counter can't split a count. This applies chiefly at low frequencies where the number of digits indicated is low. For example, if the counter reads "50" (fifty hertz or fifty millihertz or fifty anything) the true value might be off by as much as one digit, that is, it might be 49 or 51, so the error might be as much as 2 percent. The solution in a case like this it to make the measurement repeatedly and to average the results.

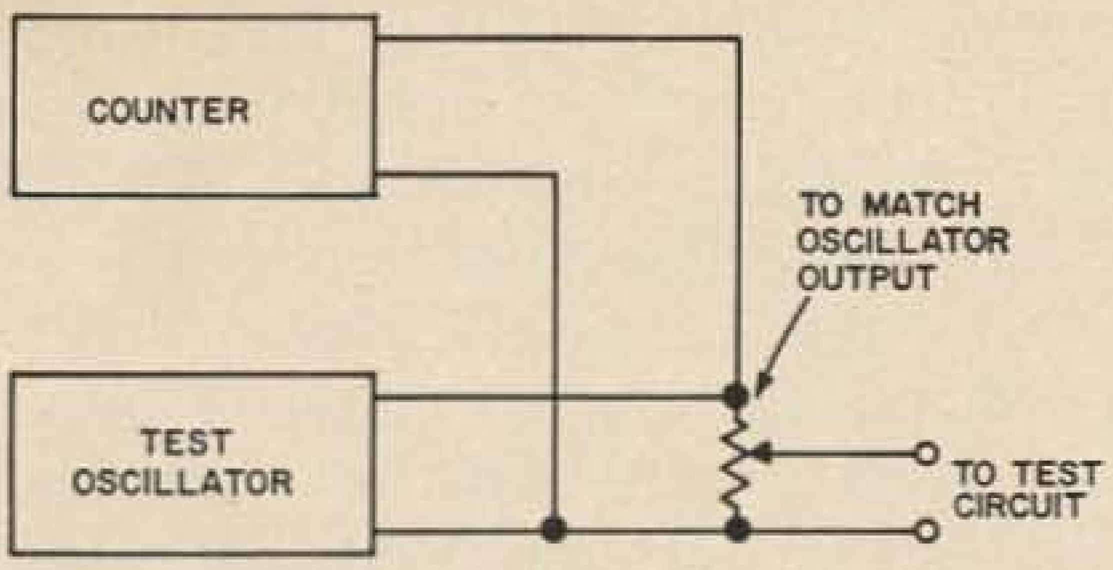


Fig. 2. The counter as a precision dial.

For many jobs you will be using the counter as an accessory for some other piece of test equipment, to enhance its utility or improve its accuracy. An example is shown in **Fig. 2**, where the counter serves as a precision dial for the test oscillator. The use of an external attenuator or "volume control" allows the oscillator to be run at a high output level (to provide a big signal for the counter) while the level to the circuit under test is adjusted to suit whatever conditions prevail.

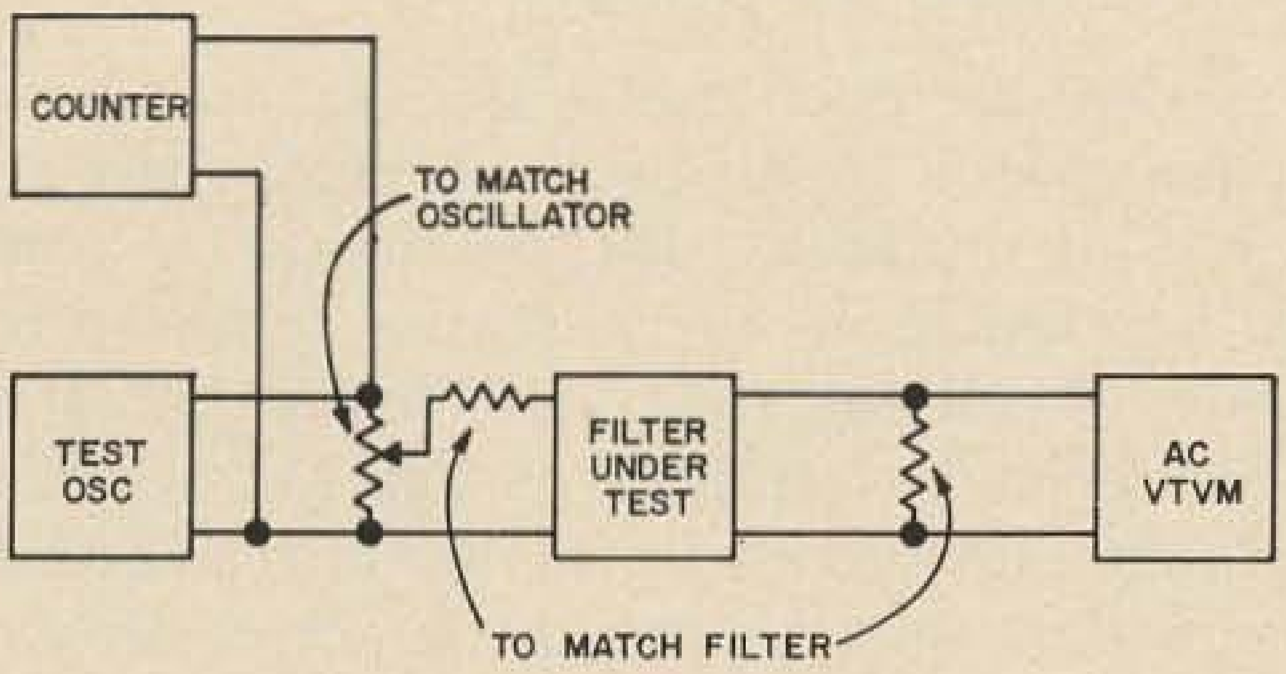


Fig. 3. Measuring filter response.

Fig. 3 shows the use of this circuit in testing a filter for frequency response. In doing a job like this without a counter it is usual for the operator to set the oscillator to some "even" number of hertz or kilohertz, etc., and read the output level. When a counter is used it is much more convenient to do it the other way. Simply tune the oscillator to a point of peak response, or a null, or to any point of interest on the curve, and read the frequency from the counter. This procedure gives improved accuracy and avoids the possibility of missing any little bumps or valleys in the response curve. **Fig. 4** shows the response of a pair of audio filters built for low-shift RTTY.

If the counter and the oscillator operate at receiver intermediate frequencies the same procedure can be used for testing mechanical filters. A suitable test circuit is shown in **Fig. 5.** The main difference between this and the preceding figure is the provision of the two variable resonating capacitors, which are needed to tune the input and output coils of the mechanical filter. **Fig. 6** is the response curve of a mechanical filter taken with this circuit.

In lining up tuned circuits for use in L-C filters the circuit of **Fig. 7** is useful. This is like **Fig.** 2 except for the 1-ohm resistor, which guarantees a low and non-reactive source impedance for the circuit being tested. (Many readers will recognize this as the basic circuit of a Q-meter). While it is usual to use an available toroid or other high-Q coil and select a capacitor or group of capacitors to match, I have done it the other way; i.e. pick a capacitor and adjust the toroid by peeling turns until the desired resonant frequency is reached. For temporary filters or for experiments the quickest way is to use an available toroid, pick out a capacitor which is "close but not quite" on the high-frequency side of resonance, and then do the final trimming with a big compression-mica trimmer of the type made by Arco.

Once the components have been selected in the circuit of **Fig. 7** it is fairly easy to measure the "Q". After locating the frequency of peak response, detune the oscillator on one side of resonance until the VTVM (or scope) indication drops 3dB (i.e. to 7/10 of its peak value), and note

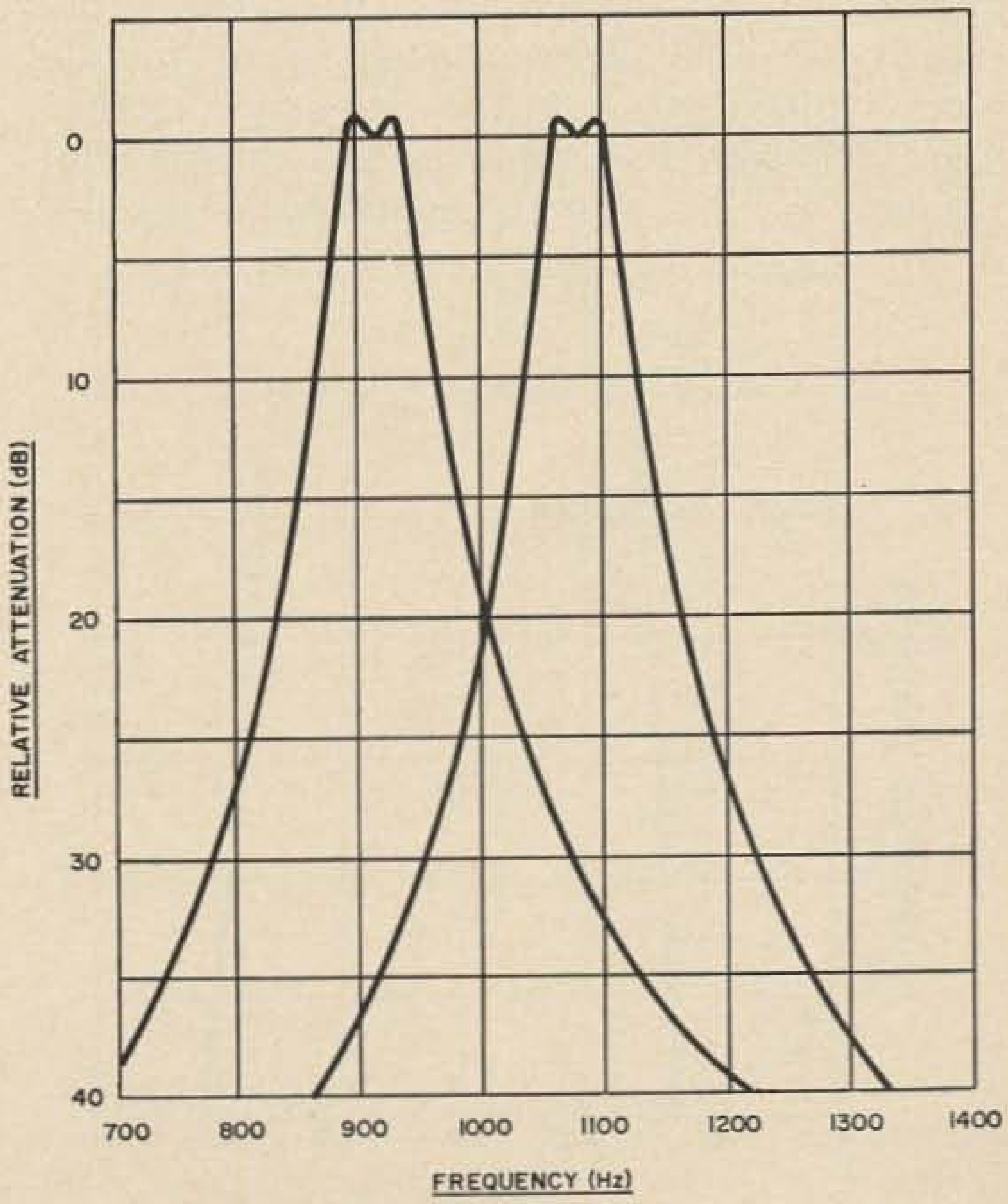


Fig. 4. The response of a pair of audio filters as measured with the circuit of Fig. 3.

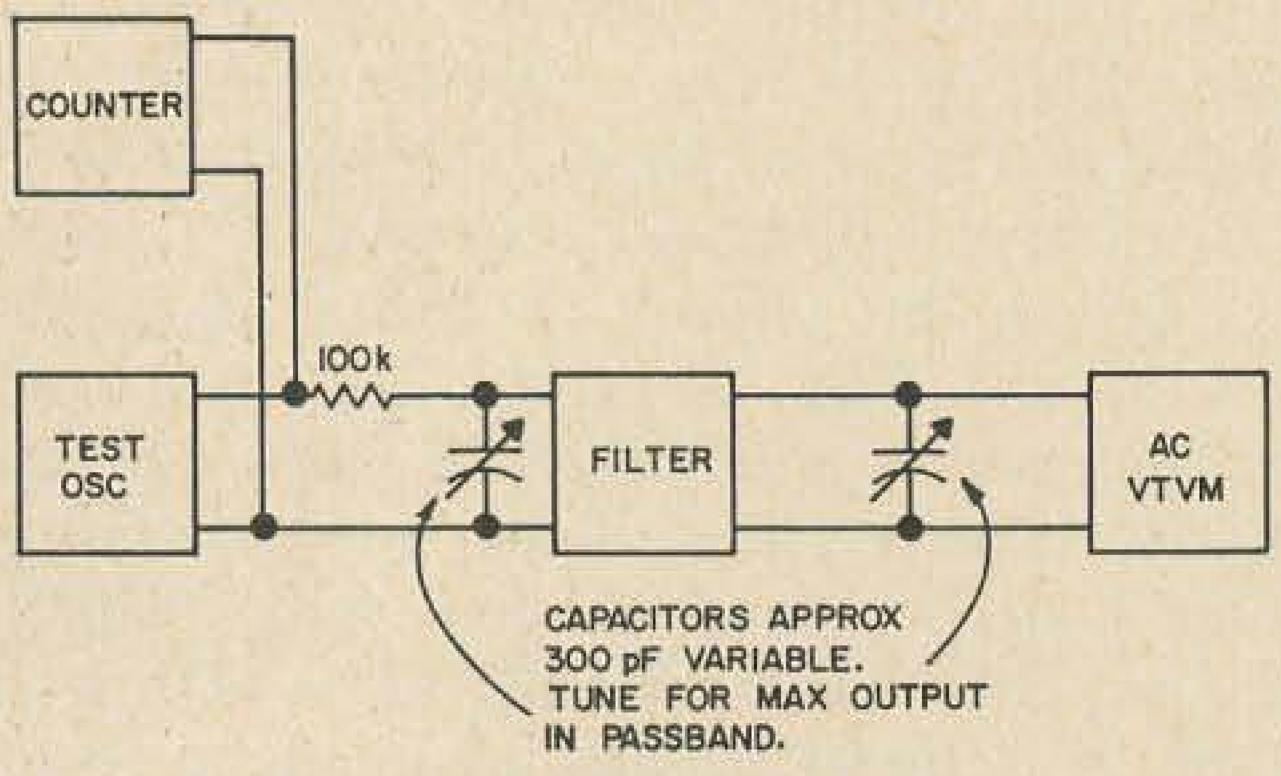


Fig. 5. Testing a mechanical filter.

the frequency. Do the same thing on the other side of resonance. The "Q" is equal to the resonant frequency divided by the difference between the two 3 dB frequencies. This is an essential check if there is any question at all about the quality or suitability of the components. Old paper capacitors which read fine when tested for dc leakage sometimes turn out to have low Q when checked by this method. Purists will note that the 1-ohm resistor degrades the circuit Q slightly, and are permitted to indulge in corrective mathematics.

With a few simple "standard" components the same circuit (**Fig.** 7) can be used to measure inductance and capacity over a considerable range. I have a 0.02 microfarad one percent capacitor and what I think is a "good" 100-millihenry toroid. After I peak the circuit with them I am ready to add other capacitors in parallel (or in place of), note the frequency change, and compute the value of the added component by the usual handbook formulas.

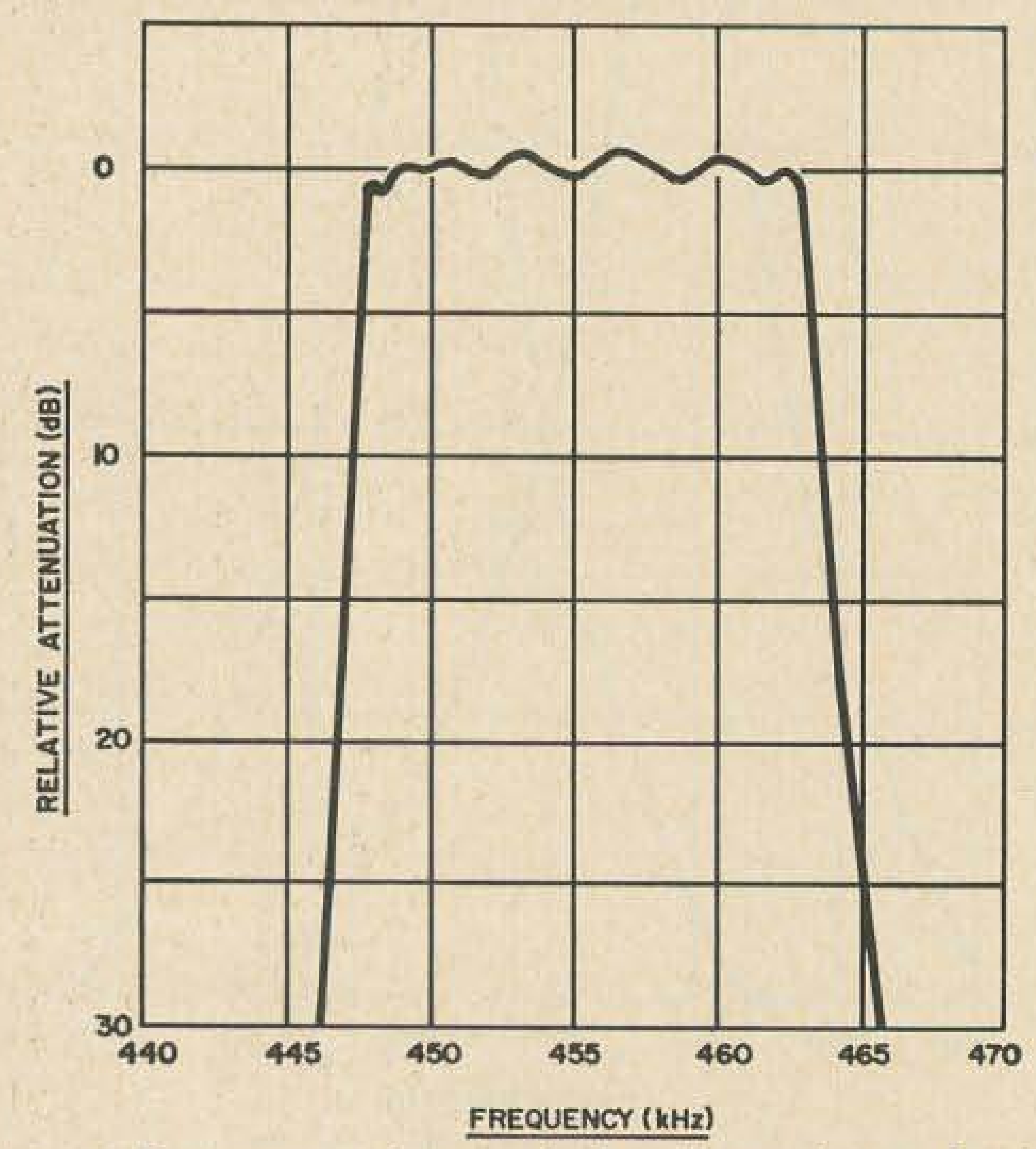


Fig. 6. Response of a wide-band mechanical filter measured as in Fig. 5.

Of course, other coils can be substituted, and unknowns of low impedance (low inductance or high capacitance) can be inserted in series rather than in parallel.

By now the rf enthusiasts may have wandered off to another page. I hope not, because it is about time to consider how to make precise HF and VHF measurements with a low-frequency counter.

It takes some more gear, and the first thing you need is a frequency standard, and possibly a divider chain. The one I use

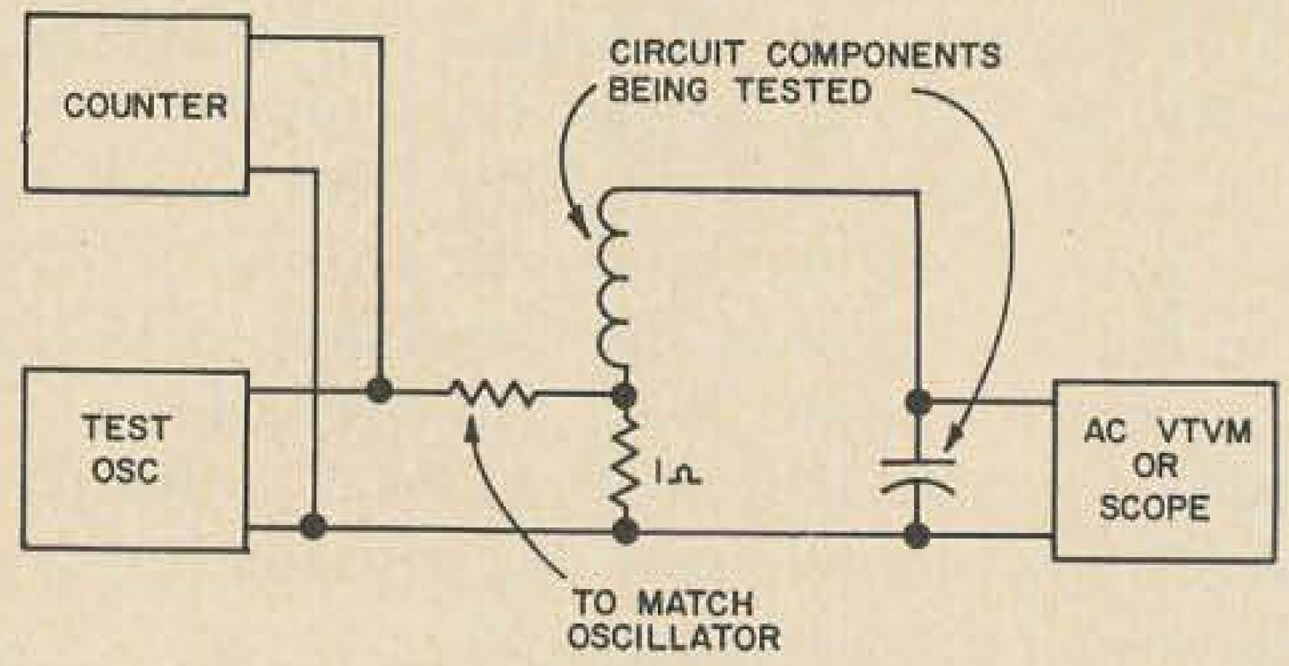


Fig. 7. Checking filter components.

is shown in block form in **Fig. 8.** Details of the circuit seem out of place here, as something suitable can be found in most any handbook. In my case the standard-frequency oscillator runs at 1 MHz and a divider chain is required to get the standard markers close enough to permit interpolation with a low-frequency counter. If your oscillator operates at 100 kHz or lower you may not need the dividers. If you have to build this from scratch it pays to consider transistors, as they eliminate most aging problems and make the power consumption so low you can let the whole works run continuously. My dividers are simple locked multivibrators; they work satisfactorily and have stayed locked for years without adjustment. My divider chain goes all the way down to 500 Hz, but the most-used output is at 50 kHz.

The output of the divider chain at 50 kHz drives a harmonic generator and modluated amplifier, as shown in **Fig. 9.** (A detailed schematic of this circuit was presented in QST for July 1967, page 92, by W4HHK.) This circuit produces markers at 50 kHz intervals up to several hundred MHz. For routine ham operation these tweets are loosely coupled to the receiver input and serve as a full time calibrator and band-edge marker. (Perhaps next year I will change to 25 kHz to mark the extra-class segments precisely!)

The output of the circuit discussed above

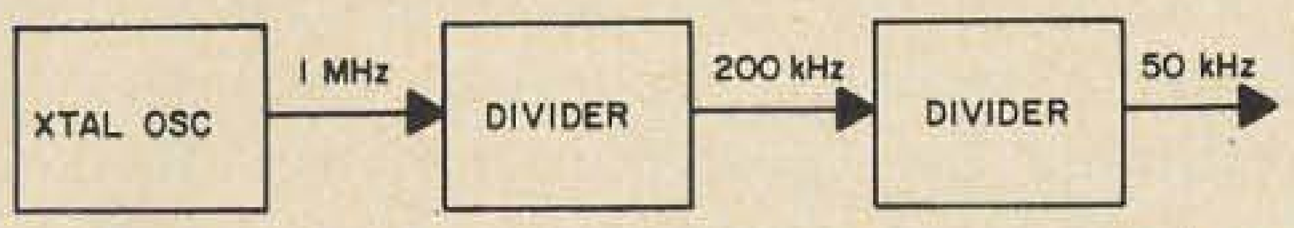


Fig. 8. Standard-frequency oscillator and divider chain.

may be visualized as shown in **Fig. 10.** Now if the modulated amplifier of **Fig. 9** is driven with the low-frequency oscillator of **Fig. 2**, each of the 50 kHz markers will grow a

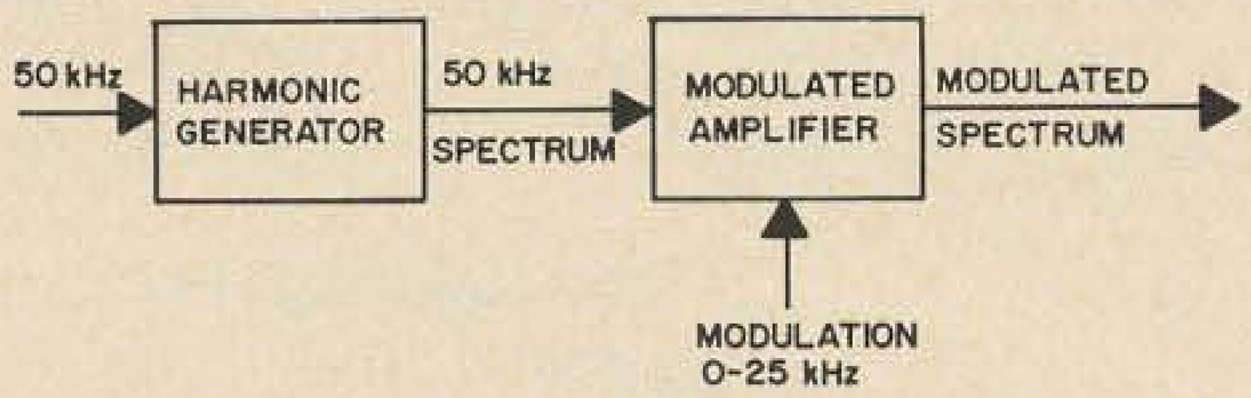


Fig. 9. Harmonic generator chassis.

pair of sidebands, as shown in **Fig. 11.** The separation of each sideband from its parent carrier is equal to the setting of the low-frequency oscillator.

Now we have a scheme for zero-beating any signal which turns up in the band.

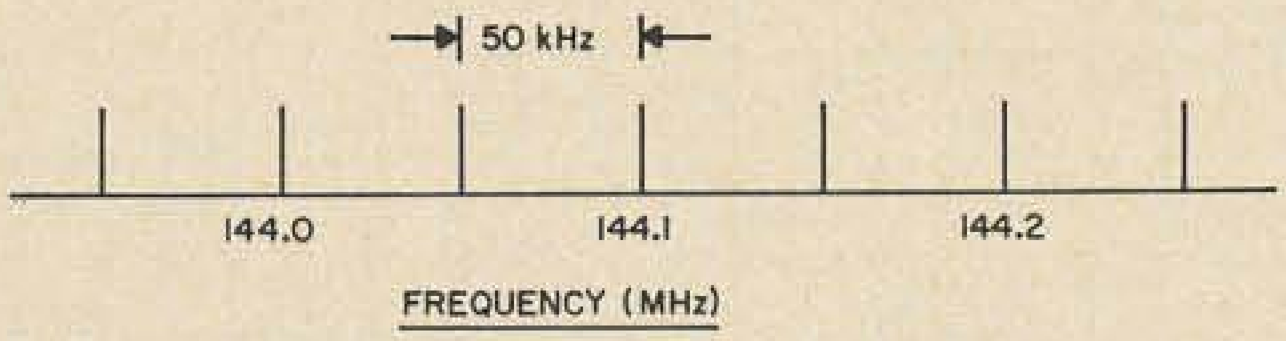


Fig. 10. Output of Fig. 9 without modulation.

For example, assume a signal appears at 144,161 kHz in the two-meter band. The nearest marker is at 144,150. From the receiver dial reading we can tell that the signal to be measured is about 10 hHz above this, or near 144,160. So we set the low-frequency oscillator near 10 kHz, turn up the output, and rock the oscillator tuning until we hear the sideband come close to

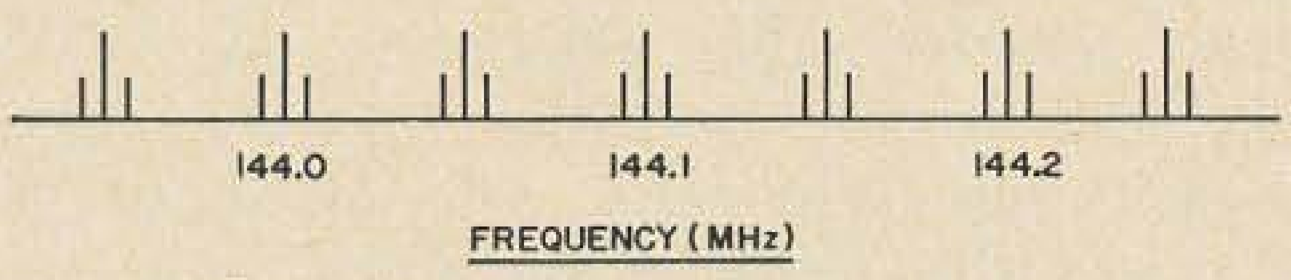


Fig. 11. Output of Fig. 9 with modulation.

the signal being measured. Now we can adjust the oscillator frequency very slowly and carefully until zero beat is achieved. (In doing this it is helpful to adjust the oscillator level—and thereby the sideband level—to obtain the clearest beat.) When zero beat is obtained we read the frequency of the LF oscillator from the counter. The frequency in this case would be 11 kHz. The frequency of the signal being measured is the sum of the marker, 144.150 and the modulator, 11 kHz, or 144.161 kHz.

In using this method you must take care not to get confused. You must be absolutely certain which marker is the nearest, you must know whether the unknown signal is above or below the marker, you must make sure that you use the lowest possible frequency from the low-frequency modulating oscillator and you must not overdrive the modulated stage. Obviously the better the receiver dial calibration is to start with the less the chance of getting mixed up. I have found it a good practice to write down the approximate frequency as read from the dial right at the beginning, to make sure I didn't add when I should have subtracted, etc.

The system just described was set up in 1961 to measure the frequency of the Oscar I satellite. The counter was an old commercial unit with a top frequency of 150 kHz. The low-frequency oscillator was a commercial R-C audio oscillator which tuned above 25 kHz. The system worked so well that I had a try at the ARRL frequency measuring contest using it. In this case operation was in the 3.5 and 7 MHz bands and the signal being measured was W1AW. The procedure used is for W1AW to transmit for about five minutes in each band, sending long dashes with the call letters inserted at frequent intervals. Since the dashes are each only a few seconds long the precision of zero-beating is limited to a fifth of a hertz or so, even under ideal propagation conditions.

On 3.5 MHz the conditions were good and the signal in the clear. I obtained 13 readings with a total spread of 4 Hz. On 7 MHz the conditions were not as good and there was some interference. I obtained 9 readings with a total spread of 9 Hz. I corrected these figures for equipment errors (see next paragraph) and submitted the averages of my various readings for each band. The result was a top-of-the-field listing with an error of zero hertz and zero parts per million for both 3.5 and 7 MHz (see QST for June 1962, page 92).

In making precise measurements it is necessary to know what errors are in the measuring equipment. The error, if any, in the standard frequency oscillator can be determined by comparing one of its harmonics with WWV. If there is any question about whether the standard oscillator is high or low it may be resolved by twisting the frequency-adjusting trimmer. If frequent

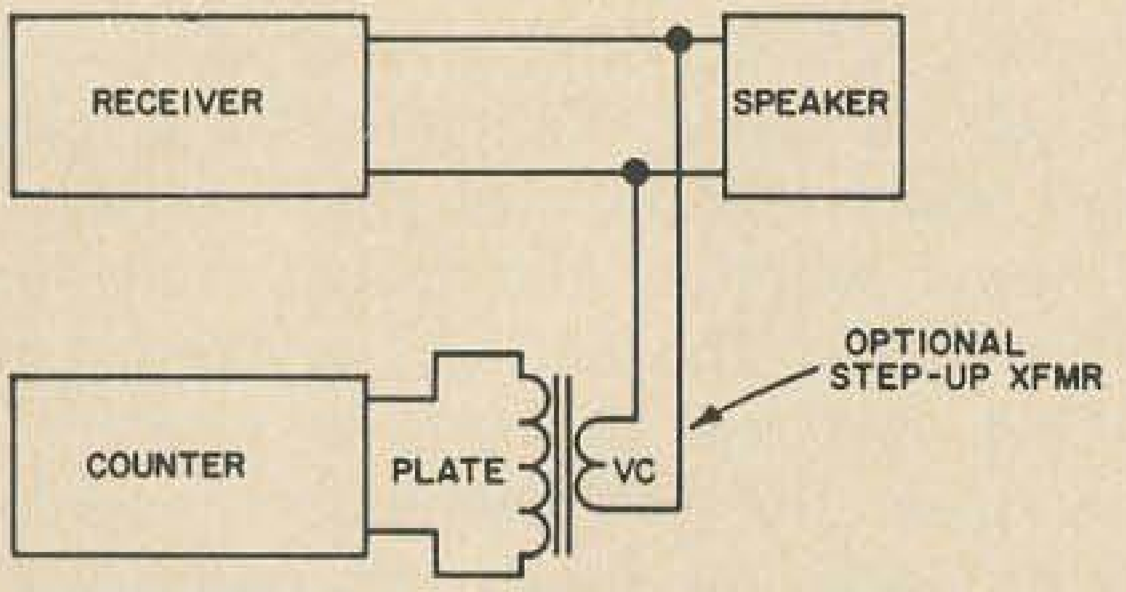


Fig. 12. Counter connected to receiver output.

adjustments are considered undesirable it may be simpler to adopt a policy of always running the oscillator off by a hertz or two at 15 MHz. This is not enough to seriously affect its use as a calibrator, but if it is always run off on the same side the correction will always be in the same direction. A second but less serious source of error is the error in the counter, or in its internal frequency standard. It is less serious because the portion of the total frequency synthesized in the zero-beating process which is contributed by the LF oscillator is very small. The simplest way to measure the counter error is to measure the marker frequency (50 kHz in my case) on the counter. If the marker reads high it is a sign the counter is reading high (its internal oscillator is low) and all counter readings must be reduced accordingly.

A good overall procedure to reduce error is the following:

1. Check standard oscillator against WWV and determine error.
2. Check counter against standard oscillator.
3. Measure unknown frequency.
   a. Note approximate frequency from receiver dial.
   b. Note nearest marker, and whether unknown is above or below marker.
   c. Estimate frequency for LF oscillator.
   d. Turn up LF oscillator level and adjust for zero beat.
   e. Read LF oscillator frequency from counter.
   f. Repeat a, b, c, d several times if possible.
4. Repeat 1.
5. Repeat 2.
6. Correct the indicated frequencies for the apparatus errors.

There are a number of tests which can be made with the counter connected to the output of a receiver. In making this connection it is a good idea to use the "high-impedance" or "6 ohm" output of the receiver if it has one, so that the counter will get a signal of adequate level without overdriving the speaker or headset. If there is no high-impedance output circuit and the counter is insensitive it may be necessary to use a step-up transformer between the speaker circuit and the counter input. An ordinary plate-to-voice coil transformer connected backwards works fine. See **Fig. 12.**

If a strong signal can be obtained from a standard frequency station or any other source known to be stable, it can be used to measure the warm-up drift of the receiver.

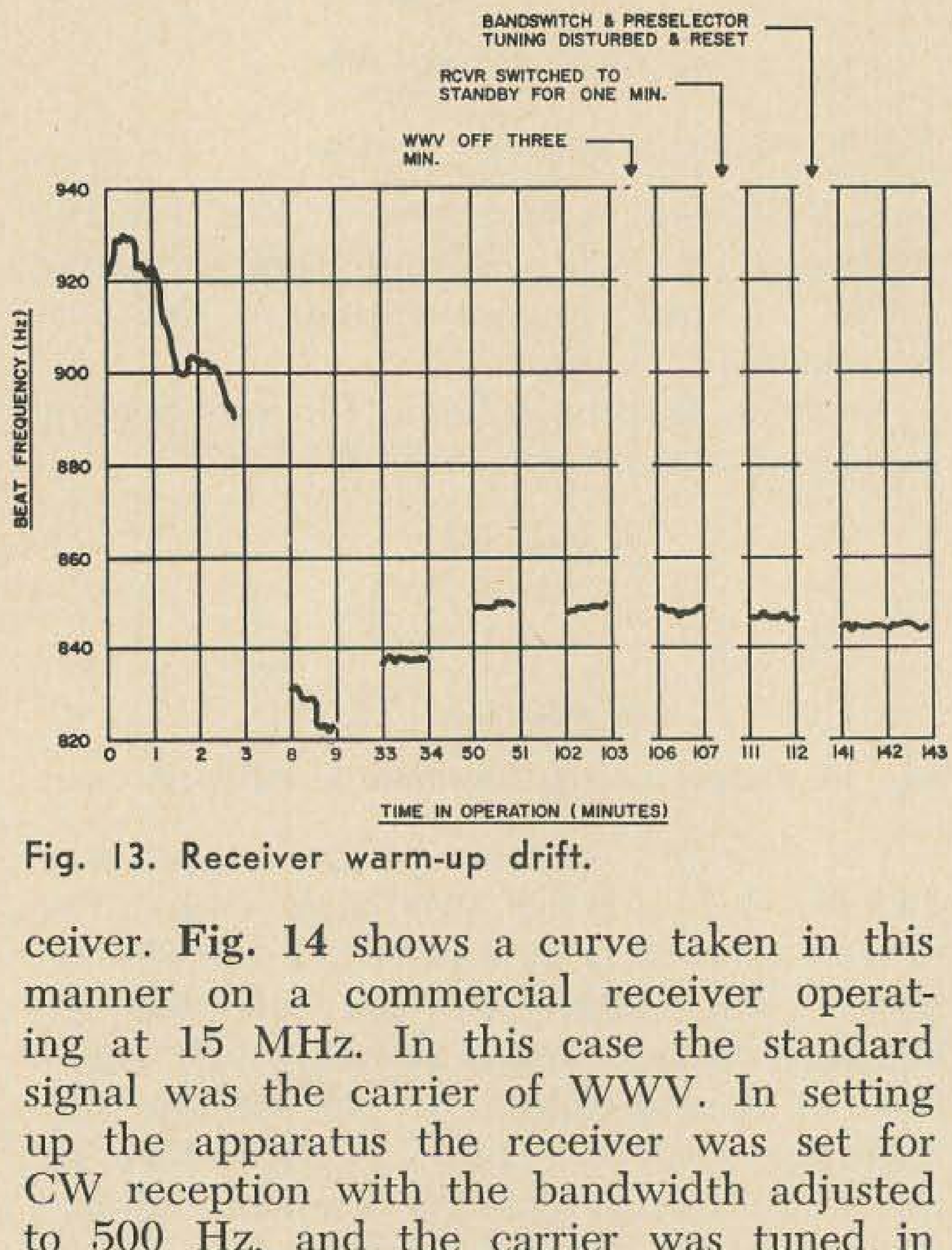


Fig. 13. Receiver warm-up drift.

Fig. 14 shows a curve taken in this manner on a commercial receiver operating at 15 MHz. In this case the standard signal was the carrier of WWV. In setting up the apparatus the receiver was set for CW reception with the bandwidth adjusted to 500 Hz, and the carrier was tuned in carefully. The high selectivity of the receiver rejected the sidebands of WWV (ticks and tones), and the receiver output was a single clear beat note of about 900 Hz. After the initial adjustment, which required about five minutes, the set was turned off for 4 hours so as to stabilize in the "cold" condition.

The counter was warmed up for a few hours before turning on the receiver. After switch-on counting was started as soon as there was any detectable output. It was a simple matter to write down the frequency changes as the receiver warmed up. **Fig. 14** shows that the "peak-to-peak" drift was only 110 Hz. After warm-up, the residual drift was less than 10 Hz per hour.

With a receiver of known stability it be-

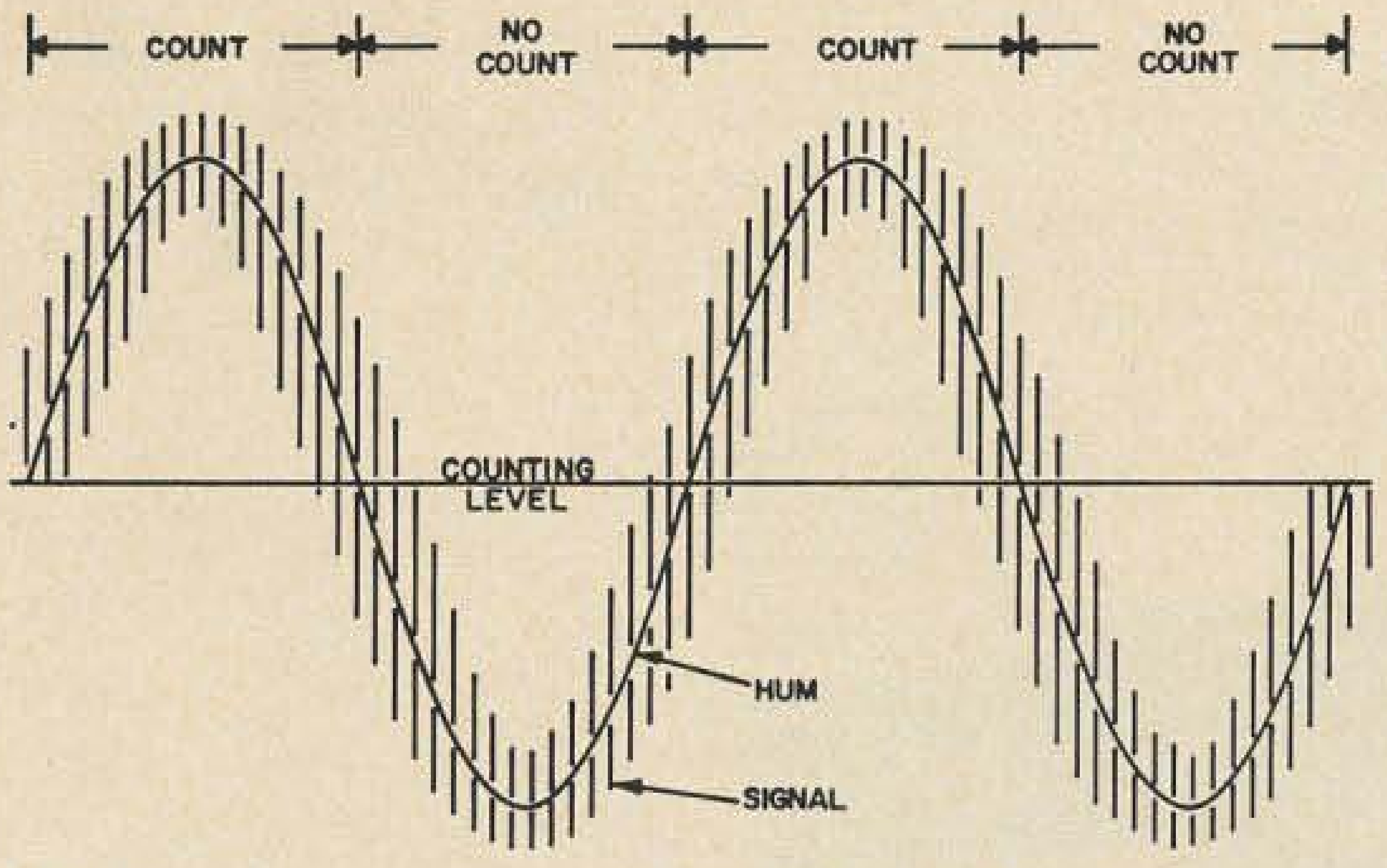


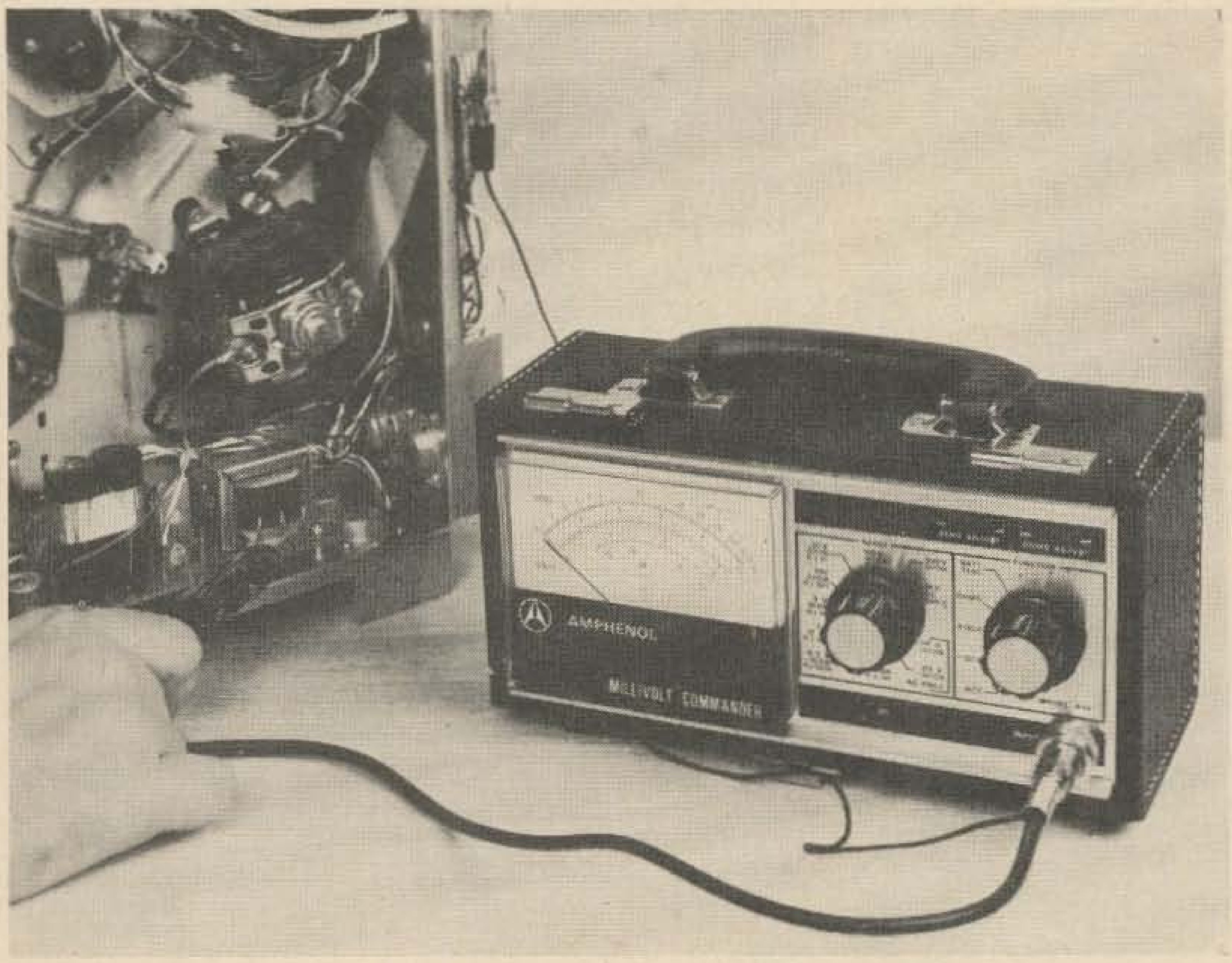
Fig. 14. Incorrect counting with multiple inputs.

comes practical to use it and the counter to measure the drift of other signal sources, such as vfo's, other transmitters, etc.

With the bfo turned on and the receiver selectivity slacked off a bit, the combination may be used to measure the shift of a RTTY transmitter. To do this it is necessary to put the transmitter alternately on steady mark and steady space for several seconds each. In most RTTY set-ups this can be done by opening the "break" switch on the keyboard. Several readings should be taken on both mark and space and each group averaged, so as to eliminate any drift in either transmitter or receiver.

Counters don't always tell the truth. Some can be made to lie by changing or subnormal line voltage, high temperature, out-of-tolerance tubes, etc. But there are times when even the best units lie. In experimental hook-ups the most frequent causes of erroeous indications are multiple inputs and modulated inputs. **Fig. 14** may help to explain how this can happen. Here we show a counter attempting to measure the frequency of an audio signal, about 1 kHz, in the presence of excessive 60 Hz hum. The desired 1 kHz signal rides up and down on the undesired 60 Hz hum, and the counter operates only when the sum of the two signals exceeds the minimum input. As a result the counter operates in little spurts, one spurt each sixtieth of a second, and counts only about half the cycles of the 1 kHz signal. In short, the counter reads low! The same thing can happen with an amplitude modulated signal. Never try to count a modulated signal, and never try to count with more than one signal applied to the counter input terminals. When in doubt connect a scope in parallel with the counter so you can see what you are counting.

Probably we will never see the day when there is a counter in every ham shack. But the day is already here when a counter can be put to use consistently in ham operation and experimentation. If you find a surplus unit at a reasonable price don't pass it up just because the frequency range doesn't go up to 432 MHz. Grab it and see what you can do with it. And if you come up with a new application, write it up so the rest of us can try it. . . . W3GKP



Kayla Bloom W1EMV
P.O. Box 224
Dublin, N.H. 03444

The Amphenol Millivolt Commander

A Field Effect Transistor Voltohmmeter

If you are looking for a VOM with superb quality, extreme reliability, portability, and accuracy, you would do well to consider this as one of the best buys in the field.

Externally, the unit is housed in a handsome saddle-stitched carrying case. The cover can be removed easily for bench use, and, with the cover removed, the center of gravity is low making it extremely stable. There is little chance of it being knocked off the bench by accident.

This unit was checked against a highly reliable meter which had just been calibrated at the factory, and the amphenol proved to be accurate in all ranges, according to the specifications shown in the manual with the exception of the 1 KVdc position. This position read 10 volts high at 360 V dc. This is well within tolerance, however, and shouldn't deter the potential buyer.

The Ohms scale was checked with precision resistors (1%) and proved to be accurate within the indicated specifications. The AC Volts was checked on the 10 V and 300 V scales with complete accuracy. The low voltage, high impedance characteristics of the probe makes this an ideal unit for in-circuit measurements.

The power source for the Millivolt Commander consists of 2 "AA" 1.4 V Mercury cells (Eveready E9 or equivalent) and 8 "AA" 1.35 to 1.5 V cells (Eveready 915 or equivalent). The batteries used are in three different circuits. The ohms battery is discharged only when resistance measurements are being made. This battery should be replaced when the ohms adjust control will no longer calibrate the ohm range to full scale. The Zero reference battery supplies a bias potential required by the amplifier. To eliminate drift, these cells are constantly loaded by a small current. The amplifier load is approximately 0.8 mA in the dc mode and 1.2 mA in the ac mode. The unit has a built in battery test position to alert the user to possible battery failure. This battery test indicates the quality of the cells in the amplifier supply only.

The high sensitivity of the Model 870 allows measurements which are not possible on other meters. The ac sensitivity of .01 V

Specifications:

Power Source
Batteries:
2 "AA" 1.4 V Mercury cells
8 "AA" 1.35-1.5 V cells
DC Voltmeter +DCV, —DCV
Ranges:
0-0.1, 0.3, 1.0, 3.0, 10.0, 30.0, 100, 300, 1000.
Accuracy:
±2% of full scale all DC ranges.
Input resistance:
10.6 megohms on all ranges.
AC Rejection:
A voltage at 60 Hz 40 dB greater than full scale affects reading less than 1%.
AC Voltmeter—ACV, dB
Ranges:
0-.01, .03, 0.1, 0.3, 1.0, 3.0, 10., 30., 100., 300.
—40, —30, —20, —10, 0, +10, +20, +30, +40, +50 dB (—12 to +2 Scale).
Accuracy:
±3% of full scale on all ranges from 50 Hz to 50 kHz.
Input Impedance:
10 mv to 1 v
10 megohm shunted by 31 pF.
3 V to 300 V
10 megohm shunted by 20 pF.
Ohmmeter
Resistance Range:
Resistance from 10 ohm center scale to 10 megohms center scale.
Accuracy:
3 degrees of arc.
Voltage:
1.5 V open circuit.
Weight

With batteries	5 Lbs.
Without batteries	4.5 Lbs.
Shipping	8.5 Lbs.

Overall Size
9¼ x 5¾ x 6⅜ inches.
Price: $99.95

full scale, allows measurement of tape head and other magnetic transducer outputs directly. The dc sensitivity of 0.1 V full scale allows measurement of semiconductor bias levels easily. More accurate nulls can be resolved. Also, current measurements can be made with little circuit disturbance.

The decibel scale can be used to determine power level based on 0 dB = 1 mW in 600 ohms. The numerical value is indicated by meter scale and added to the dB value for the position of the range switch. The following formula may be used to convert the dB reading into watts:

$$P_{(watts)}\ (1 \times 10^{-3})\ \text{antilog}\ (db/10)$$

$$P_{(mw)}\ \text{antilog}\ (dB/10)$$

or, a convenient chart is given in the manual to make it easier.

In the dc mode of operation, an amplifier using a FET at the input provides impedance conversion and drives the meter. Precision voltage dividers extend the range from the basic 100 mV sensitivity and permit resistance measurement. In the ac mode, an additional amplifier provides the necessary gain for 10 mV sensitivity.

. . . W1EMV

A Poor Man's Mil Spec

Roy E. Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

How often have you picked up a surplus component, marked only with a string of cryptic symbols, and wondered just exactly what it was? If you have, join the party. Today, most all electronic components destined for military applications are marked with what is known as the Military Specification Number. If this Mil Spec number is in addition to the usual value and rating markings, you are in luck. However, in many cases, the Military Specification Number is the only identification on the component.

The actual military specifications are, in general, quite voluminous and are phrased in legal-technical languages designed to fix, in no uncertain terms, the precise characteristics of a family of electronic components. While ideal from a procurement point of view, they leave the casual experimenter or non-military technician cold. These Mil Specs are difficult to obtain and just as difficult to use when all you really want to know is the value and taper of that surplus junk box "control, variable, composition".

The Industrial Electronics Division of Lafayette Radio Electronics Corporation has recognized the problem and published a guide to the simplified interpretation of Mil Spec numbers. This booklet, *Lafayette Electronic Procurement Guide and Directory**, is a limited distribution publication for Lafayette's military-industrial customers. However, Lafayette has granted permission to reproduce excerpts of their copyrighted booklet in this article. Because of space limitations and the limited utility of certain of the condensed specifications, only those of greatest value to the experimenter and technician are presented here.

. . . W4WKM

CONTROLS, VARIABLE, COMPOSITION
MIL-R-94B

Example: **RV4NAYSB104B**

	a	b	c	d	e	f	g
Explanation:	**RV4**	**N**	**A**	**Y**	**SB**	**104**	**B**

a) Style of potentiometer.

b) **Bushing:**

N	Standard
L	Locking
S	Shaft and panel seal

c) **Switch:**

A	None
B	S.P.S.T.

d) **Temperature and Moisture Resistance Characteristics:**

	Max. Ambient Oper. Temp.	Max. Resistance change due to humidity test	Min. Insulation Resistance during humidity test
X	120°C	±14%	50 megohms
Y	120°C	±10%	100 megohms

e) **Operating Shaft:**
First letter indicates style.

F	Flatted
S	Slotted

Second letter indicates length from mounting surface.

	Flatted ¼" Dia.	Slotted ¼" Dia.
A	—	⅝"
B	—	½"
D	—	⅞"
G	—	1¼"
K	2½"	2½"
L	—	—

f) **Resistance in ohms:** First two digits are significant and the last digit is the number of zeros that follow.

g) **Resistance Characteristic and Overall Resistance Tolerance:**

A	Linear ±10%
B	Linear ±20%
C	10% Res. at 50% C.W. ±10%
D	10% Res. at 50% C.W. ±20%
E	10% Res. at 50% C.C.W. ±10%
F	10% Res. at 50% C.C.W. ±20%

CONTROLS, VARIABLE, WIRE WOUND

MIL-R-19A

Example: **RA30NASD103A**

Explanation: **RA30** (a) **N** (b) **A** (c) **SD** (d) **103** (e) **A** (f)

a) Style of potentiometer.

b) **Bushing:**

N	Standard
L	Locking
S	Shaft and panel shaft

c) **Switch:**

A	None
B	S.P.S.T.

d) **Operating Shaft:**

First letter indicates style.

F	Flatted
S	Slotted

Second letter indicates length from mounting surface.

	Flatted .¼" Dia.	Slotted ¼ Dia.	Slotted ⅛" Dia.
A	—	½"	—
B	—	⅝"	—
D	—	⅞"	⅞"
G	—	1¼"	—
K	2½"	2½"	—
L	—	—	5/16"
M	—	—	7/16"

e) **Resistance in ohms.** First two digits are significant and the last one is the number of zeros that follow.

f) **Resistance Characteristics and Tolerance:**

A	Linear Taper	±10% tolerance

RHEOSTATS, VARIABLE, WIREWOUND, POWER TYPE

MIL-R-22A

Example: **RP102FD252KK**

Explanation: **RP10** (a) **2** (b) **FD** (c) **252** (d) **KK** (e)

a) **Style:** Denotes type of rheostat, specific size and power rating.

b) **Off Position:** Some rheostats furnished only without "off position". Types RP10, 11, 15, 16, 20, 25, 30 are available with "off" position.

Symbol	Off Position
1	No electrical off position
2	"Off" at end of counter-clockwise position
3	"Off" at end of clockwise position

c) **Shaft:** First letter describes the shaft of the rheostat. The second letter indicates the length of shaft.

1st letter	
F	Flatted
R	Round
S	Slotted

2nd letter	Round or Flatted* (±3/64")	Slotted† (±3/64")
A	—	½"
D	⅞"	⅞"
E	1"	—
G	1¼"	1¼"
H	1½"	—
J	2"	2"
K	2½"	2½"
N	4"	—
R	6"	—

*Shafts with flats:

Shaft Diameter	**Flat Length
.250" +.001 —.002	.625"
.375" +.001 —.002	1.5"

**Or to within .156" of mounting bushing where shaft is too short for flat length. Flat is diametrically opposite the contact arm.

†Not in styles RP35, 40, 45, 50, 55.

Dimensions of slot: Depth .063" +.015 —.000; Width ±.005.

d) **Resistance:** Three digit represents the resistance in ohms. First two digits are significant figures; the third represents the number of zeros that follow. The letter "R" represents a decimal point, thus the figures following the "R" are significant. Example: 7R5 represents 7.5 ohms.

e) **Tolerance:**

	Tolerance
JJ	±5 %
KK	±10%
LK	+15% —10%

RESISTORS, FIXED, WIRE WOUND (POWER TYPE)
MIL-R-26C
Example: **RW47Y152T**

Explanation: **RW47** (a) **Y** (b) **152** (c) **T** (d)

a) **Style:** Indicates size, shape and wattage.
b) **Characteristic:**

	Max. Operation Temperature	Min. Insulation Resistance at end of moisture-resistance test
G	275°C	2.5 megohms
V	350°C	2.5 megohms
Y*	350 C	100 megohms

*Y characteristics available in styles RW30, 33, 37, 47.

c) **Resistance:** Indicated by three digit number. The first two digits represent significant figures — the last specifies the number of zeros that follow.
d) **Center Tap:** Certain resistor styles under MIL-R-26C cannot be center tapped. See individual catalog listings for styles that can and cannot be center tapped. For center-tapped resistors, the power rating should be reduced 10%.

RESISTORS, ADJUSTABLE (VARIABLE), WIRE WOUND
MIL-R-19365B
Example: **RX33V152**

Explanation: **RX33** (a) **V** (b) **152** (c)

a) **Style:** Indicates type of resistor and wattage and size.
b) **Characteristic:** "V" identifies the maximum continuous operating temperature (350°C).
c) **Resistance:** Indicated by three digit number. The first two digits represent significant figures — the last specifies the number of zeros that follow.
Tolerance: Under MIL-R-19365B ±5%.

Solder

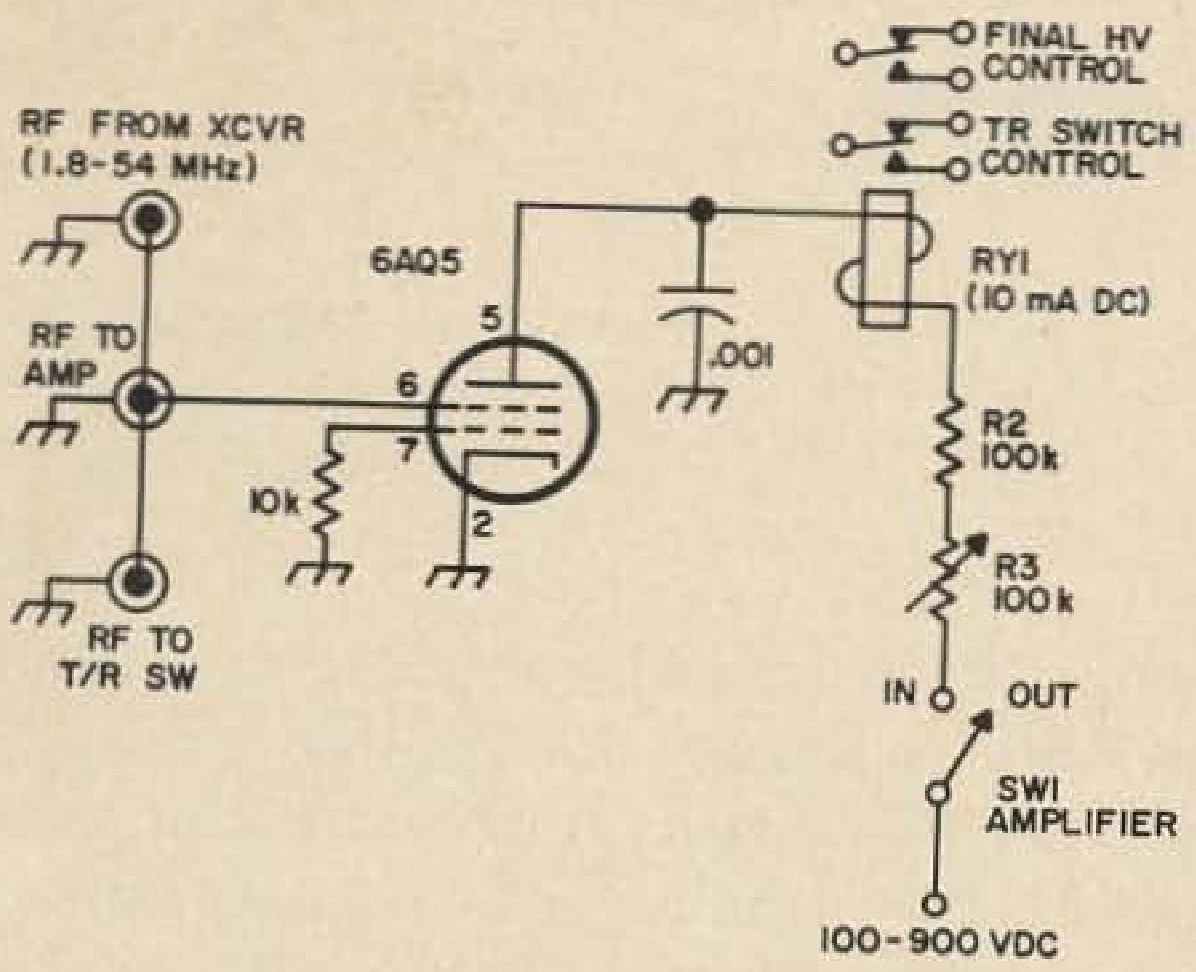
In stating solder type, the tin percentage is given first. 60/40 solder, melting at 371 degrees F., is preferable to 50/50 solder, melting at 415 degrees F. 63/37 solder melts at the lowest temperature of any tin/lead mixture, at 361 degrees F.

. . . W2DXH

YOUR CALL

Please check your address label and make sure that it is correct. In cases where no call letters has been furnished we have had to make one up. If you find that your label has an EE3*&* on it that means we don't know your call and would appreciate having it.

RF Controlled Switch



So you're going to build a pair of shoes for that peanut whistle. Want to keep the control cables from the transceiver to the amplifier minimum? Build this rf controlled switch into the unit and the only connecting cable will be a coax line from the antenna terminal of the exciter to the amplifier.

Its operation is simple. During receive, the 6AQ5 is cut off, keeping the relay (RY1) open and allowing signals to pass through to the receiver. When the exciter is keyed, the rf causes the tube to conduct, pulling plate current, thus closing the relay and activating the amplifier.

Adjust R3 for smooth "kick-in" of the relay when the rf is applied. Be sure to keep the leads of C1 as short as possible to avoid any trouble with rf radiation. Because a carrier is used to key the amplifier, CW and SB are impractical. Only continuous carrier modes such as AM, FM or RTTY are recommended.

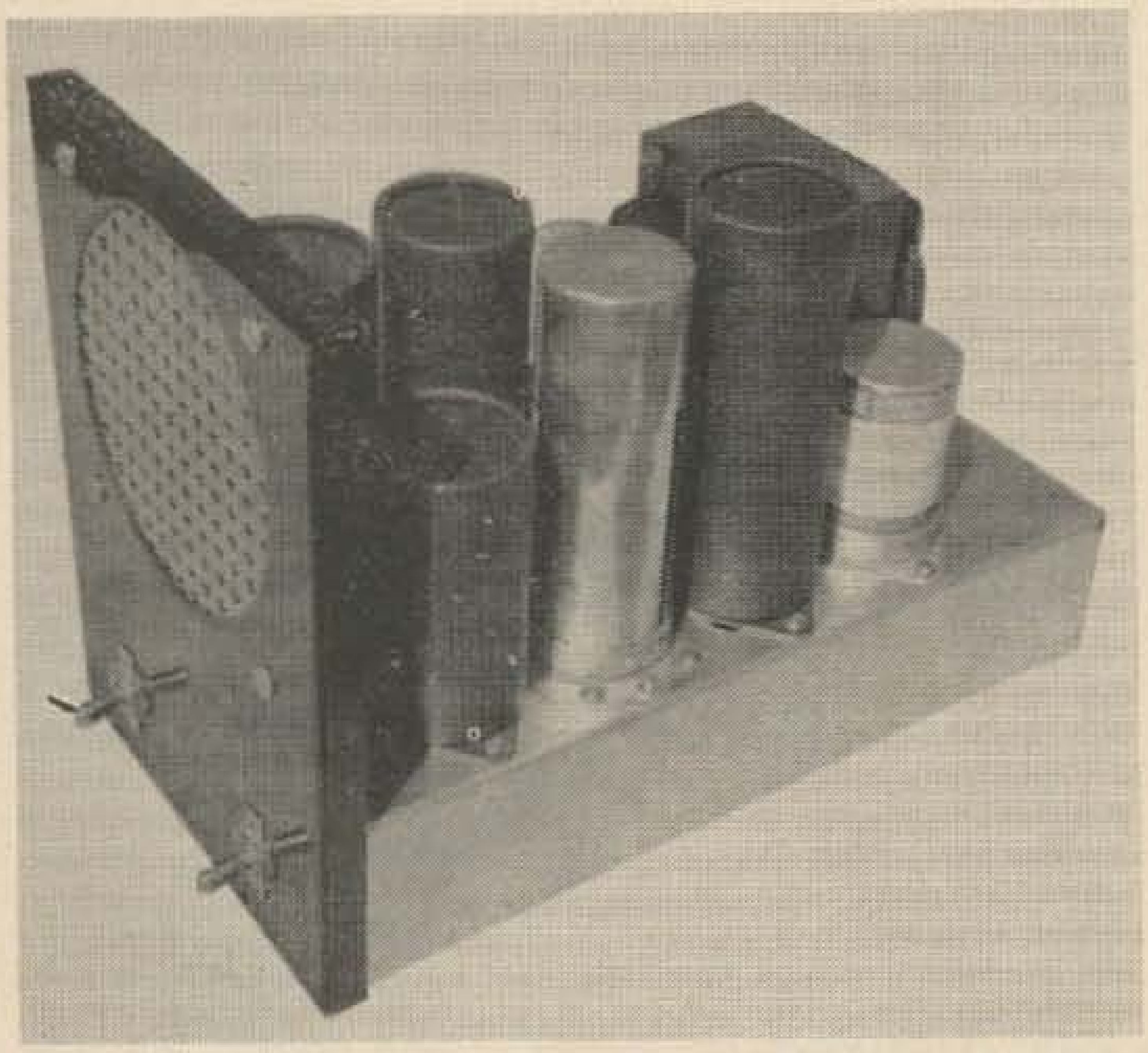
. . . WA3AQS

Call Prefix QUIZ

Let's see how up to date you are on the prefixes. List all of the W and K prefixes which are currently in use or which would be used if someone in that particular area applied for a license, in the case of Novice calls in some areas. After you've had your try at this you can turn to page 72 and see our list. 72 prefixes is average. 73 is excellent. 75 is very excellent. 78 is incredible. 80 is unbelievable.

A Transformerless Transceiver Power Supply

John Bell W5NGX
208 Pat Street
Levelland, Texas 79336



The quadrupler power supply weighs only 5½ lbs. The front panel holding the transceiver speaker is 5 x 7". The cardboard covers are on electrolytics with cases operated above ground.

Quite a few power supply articles have appeared in the ham publications in the past three years, to power the SSB transceivers on the market. An average ham can save around fifty to sixty dollars on the ac power supply by building his own. Most all of the articles written have followed the same general pattern in that they use a TV set power transformer in a full wave bridge rectifier circuit, to obtain the high voltage, from 600 to 800 volts, and use the transformer center tap to obtain the low voltage of 250 to 300 volts. Bias is usually obtained from a small isolation transformer, or a back to back filament transformer arrangement is used.

The power supply described in this article deviates from the ordinary considerably in that it uses no HV Power transformer whatsoever, but still delivers the necessary high voltage, low voltage, variable bias and filament voltage.

The circuit used is a modified, half wave quadrupler. It's not anything new, as voltage multiplier circuits have been around for about thirty years, and are covered in the radio amateur handbooks. The conventional half wave quadrupler is shown in **Fig. 1.** The incoming 120 volts ac is "multiplied" four times through the use of the four diodes and four capacitors. Actually the resultant output dc voltage is more than four times the average value of the 120 volts input, because the capacitors charge up to the peak ac value. (Peak value is 1.414 of the average). Advantage can be taken of this peak charge by using large values of capacitances. The larger the value of the capacitors, the more current can be pulled from the unit.

Referring to the schematic in **Fig. 1,** C1 has a voltage times 1 of the line voltage (peak value), C2 has twice the line voltage on it (peak), C3 has three times 120 volts (peak) and C4 has a voltage of four times the peak AC line voltage, or well over 600 volts. Here we first run into capacitor trouble, because there are no high value-electrolytic capacitors available at this working voltage. So, a modified quadrupler circuit was derived, and is shown in **Fig. 2.** This modification puts C4 in series with C2, and we can now use standard electrolytics of lower voltages for the output capacitor, plus getting a low voltage tap, at ½ of the output voltage. Again, this is not a new circuit. It is in the power supply chapter of the Radio Amateur's Handbook. The final schematic diagram of the complete power supply is shown in **Fig. 3.** Bias is a half wave arrangement taken from the hot side of the 120 volt line and ground, and consists of the components, R5, D5, R6, C5 and R4. The photographs show the parts layout although it is not critical. The supply is built on a 5 x 9½ x 2 inch aluminum chassis. The front

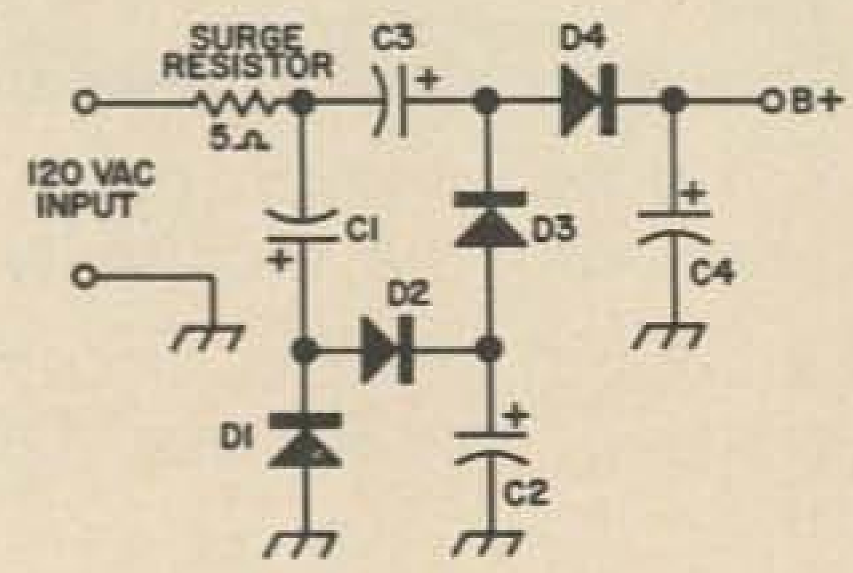
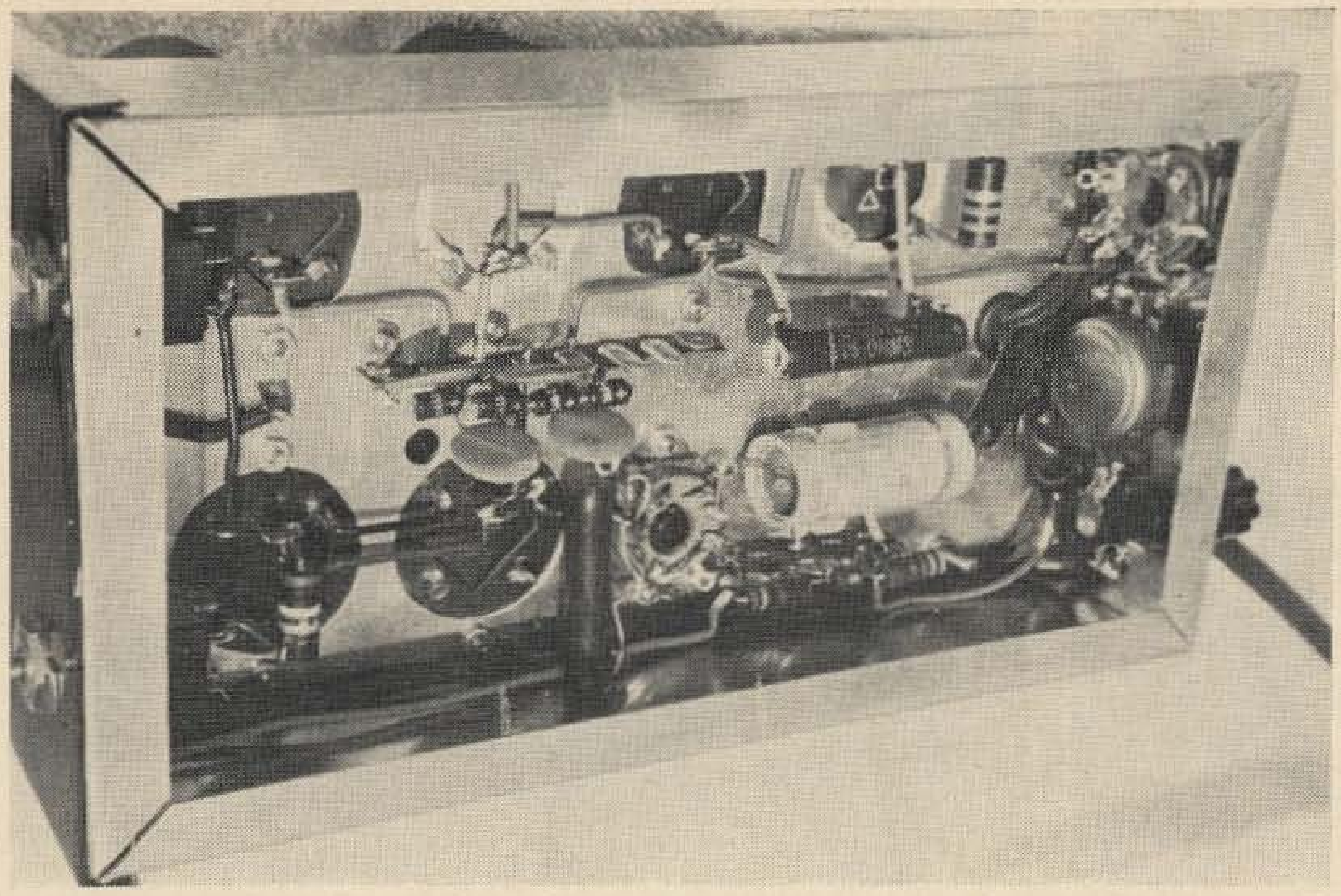


Fig. 1. Conventional half wave quadrupler. Full output voltage is across C4.



Underchassis view shows no overcrowding of components.

panel holds a 4 inch speaker, making a very compact unit.

Referring to **Fig. 3**, diodes 1, 2, 3 & 4 and Capacitors C1, 2, 3a, 3b & 4 make up the quadrupler. The one and only transformer T1, is a 12.6 Volt at 5 Amp. filament transformer. R1 is a surge resistor to protect the diodes, because when the supply is first turned on, the capacitors look like a dead short, and the sudden inrush of current through the diodes can exceed the ratings for a few microseconds, and believe me, this is enough to ruin a silicon diode. K1 is a 30 second time delay relay, that shorts out the surge resistor after 30 seconds, which gives the capacitors sufficient time to charge up to 90% of their peak voltage.

A lot was learned from constructing this power supply. You will notice that C3 is made up of two capacitors in parallel with a 500 volt rating. When this unit was first constructed, a 200 μF, 450 volt capacitor was used for C3, and lasted for about 5 minutes, then it blew, spraying wax under the chassis and all over my workbench. Actual measurement of the voltage showed that 495 volts was across this capacitor, so we had to find a solution. Electrolytics come in the 500 volt size in reasonably high capacitance, so two 80 μF were used in parallel, but 495 volts is just too close to their maximum rating. So the value of the bleeder and equalizing resistors across C2 & C4 was lowered from 100 KΩ each to 10 KΩ at 20 watts. This brought the voltage on C3 down to a safe value of 475 volts dc.

As to the performance of this power supply, it is used on a Drake TR-3 transceiver, and they recommend a power supply with 650 volts with a regulation of 10% from 100 mA for the high voltage and 250 volts at 180 mA with 10% regulation, for the low voltage. Bias requirement is 65 volts, adjustable. With the power supply hooked up to the TR-3 and in the receive position, high voltage is 630 volts on the high tap, and 260 volts on the low voltage tap. Pressing the mike button and the final amplifier in the TR-3 drawing 100 mA of static plate current, the high voltage drops to 615 volts. On 300 mA voice peaks the voltage under load drops to 600 volts. The low voltage tap only drops about 5 volts on 300 mA voice peaks. Here's where the large value of capacitors really pay off in regulation with a capitol R: 5%. I have never, in my 20 years of hamming had a power supply that would even approach this type of regulation, because all previous power supplies I have used had power transformers in them, and they have losses and reach saturation of the core

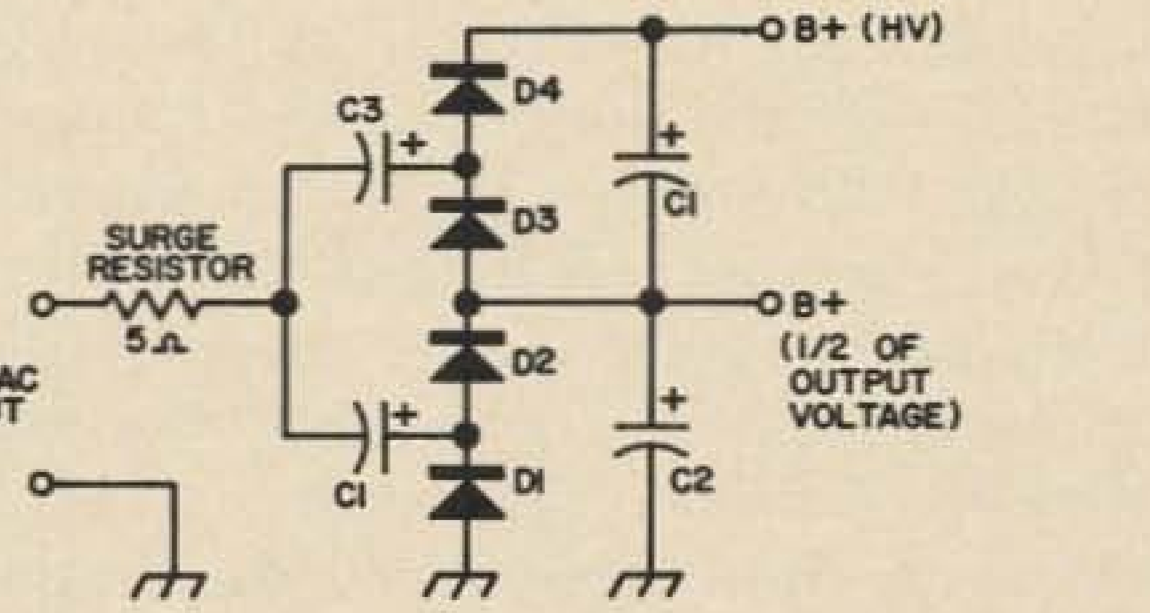


Fig. 2. Modified and redrawn quadrupler. By putting C4 in series with C2, a lower voltage capacitor can be used for C4.

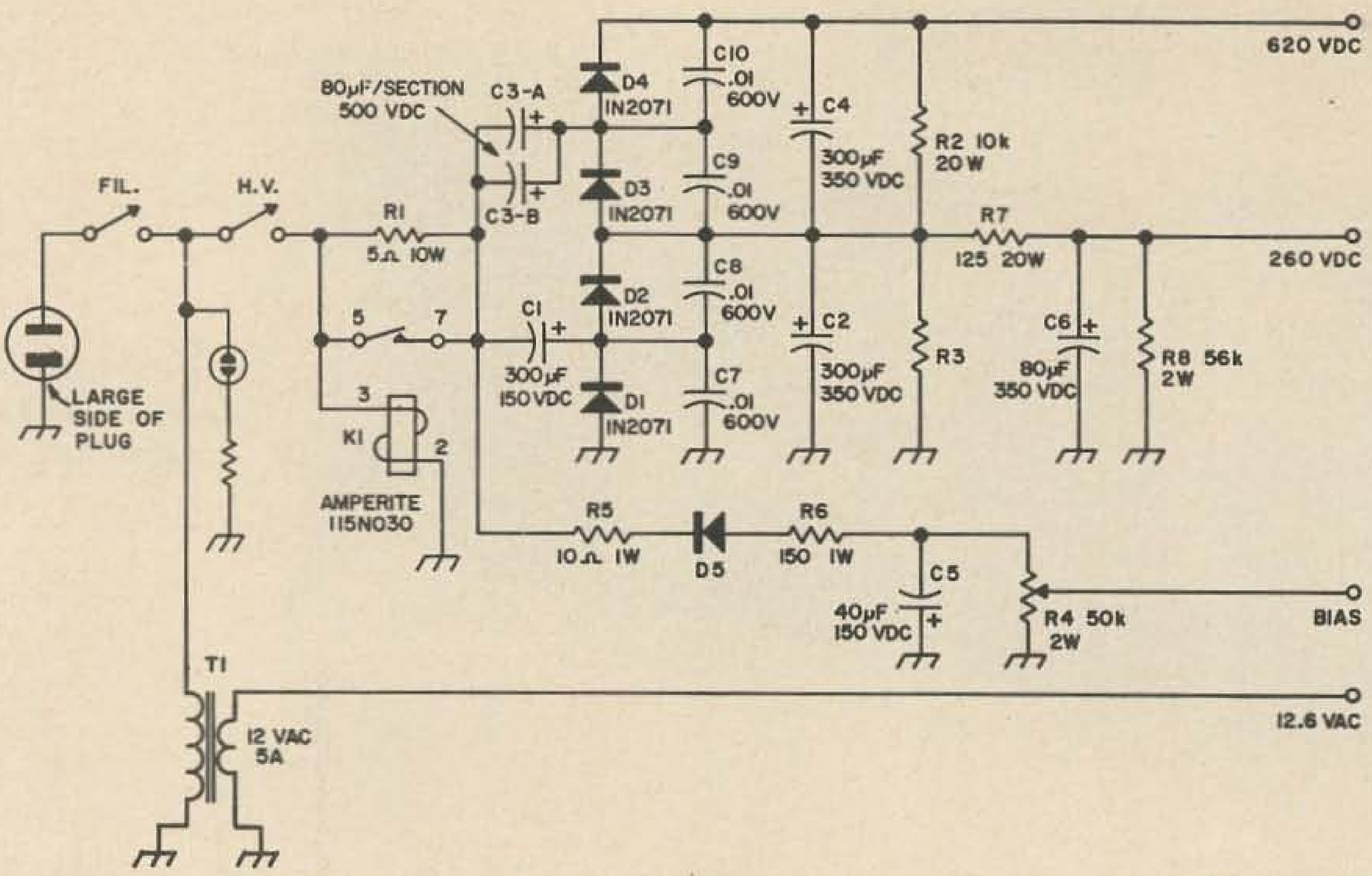


Fig. 3. W5NGX's transfomerless transciever power supply. A few safety precautions are necessary with this type of supply. The chassis is grounded directly rather than through the ac plug, and only one wire is run to the ac receptacle. The unmarked neon bulb and resistor should be for 115 vac operation.

rapidly under peaks. Six hundred volts at a total of 680 mA, plus the bleeder current, with a regulation of 5% is an excellent figure, and it certainly is a nice feeling to have a transceiver in the momentary tune-up period, drawing 500 mA of final plate current and not hearing a power transformer groaning and rattling. Another advantage is weight: This supply only weighs 5½ pounds, and a transformer-type supply of the same voltages weighs 30 pounds. Purchasing all of the parts new, this supply can be duplicated for about $36.00. This power supply runs very cool. The only component showing a very small amount of heat is the filament transformer.

Transformerless power supplies scare many hams, but if you're careful, you shouldn't have any problems. In fact, if you follow the schematic, the circuit is as safe as any other supply capable of putting out this voltage. Notice that the schematic doesn't show a wire from the ground of the plug to the chassis of the supply. The power supply chassis should be grounded directly to a GOOD ground with only one wire coming from the ac plug to the supply. All modern ac receptacles are polarized; the hot side is slightly narrower than the grounded one. Connect the single wire from the power supply to one pin of a regular ac plug and solder part of a paper clip over the other pin. Now the plug can only be inserted one way, and if your house is wired properly, the pilot blub in the supply should light when you turn on the filaments. If it doesn't, you should check your house wiring.

With this set-up, the supply simply doesn't work if you have the plug reversed since there is no voltage on it. But you MUST have a good ground for the chassis; if the ground isn't good, the chassis could be slightly live.

A few other precautions: Don't turn on the supply without a load as it could damage the capacitors or diodes. Don't short out the high voltage with a screwdriver just after you've turned off the supply. Let the capacitors discharge about five minutes.

I hope I've made a good case for transformerless power supplies. If a few safety precautions are followed, they are not to be feared and they work well.

. . . W5NGX

Cool-Amp

Metal parts can be silver plated without a special bath by using Cool-Amp powder, supplied by the Cool-Amp Co., 8621 S.W. 7th Ave., Portland, Oregon 97219.

. . . W2DXH

J. C. Sieg K1AQI
4 Cathy Rd.
Burlington, Massachusetts

ACL for the C E 100V and 200V

ALC circuits are the vogue and have some real advantages when you want to get through and still not put your exciter and amplifier into flattopping. Jim Kyle's excellent writeup in the Jan. '65 73 gave most of the details, but here is information on ALC applications to the Central Electronics 100V and 200V.

On these CE rigs, there are no *if* stages, and the grids of the mixers are all tied up in a bias string which makes the conventional means of ALC insertion impossible. Here is one solution for the 200V. This was made up for both exciter and linear ALC, but it works if only one is used.

The ALC signal from the PA grids is taken from the wiper of R422 (bias readjust rheostat to grid of 6550 PA tubes). This is easiest to reach at the terminal strip of the driver transformer (w-bk-gn wire).

The bias string is isolated from the 1st mixer tube during transmit by inserting a diode in the sideband generator to mixer lead so it will conduct during standby, but not on transmit. This point is reached by snipping the white lead off at R402 and inserting the diode. The signal is inserted between the diode and R402.

For internal ALC only, a five lug terminal strip with all components fits nicely in the rf exciter compartment with no wires to run. Additionally, external ALC from the linear signal can be fed into the compartment, then to the socket from one of the jacks on the rear panel.

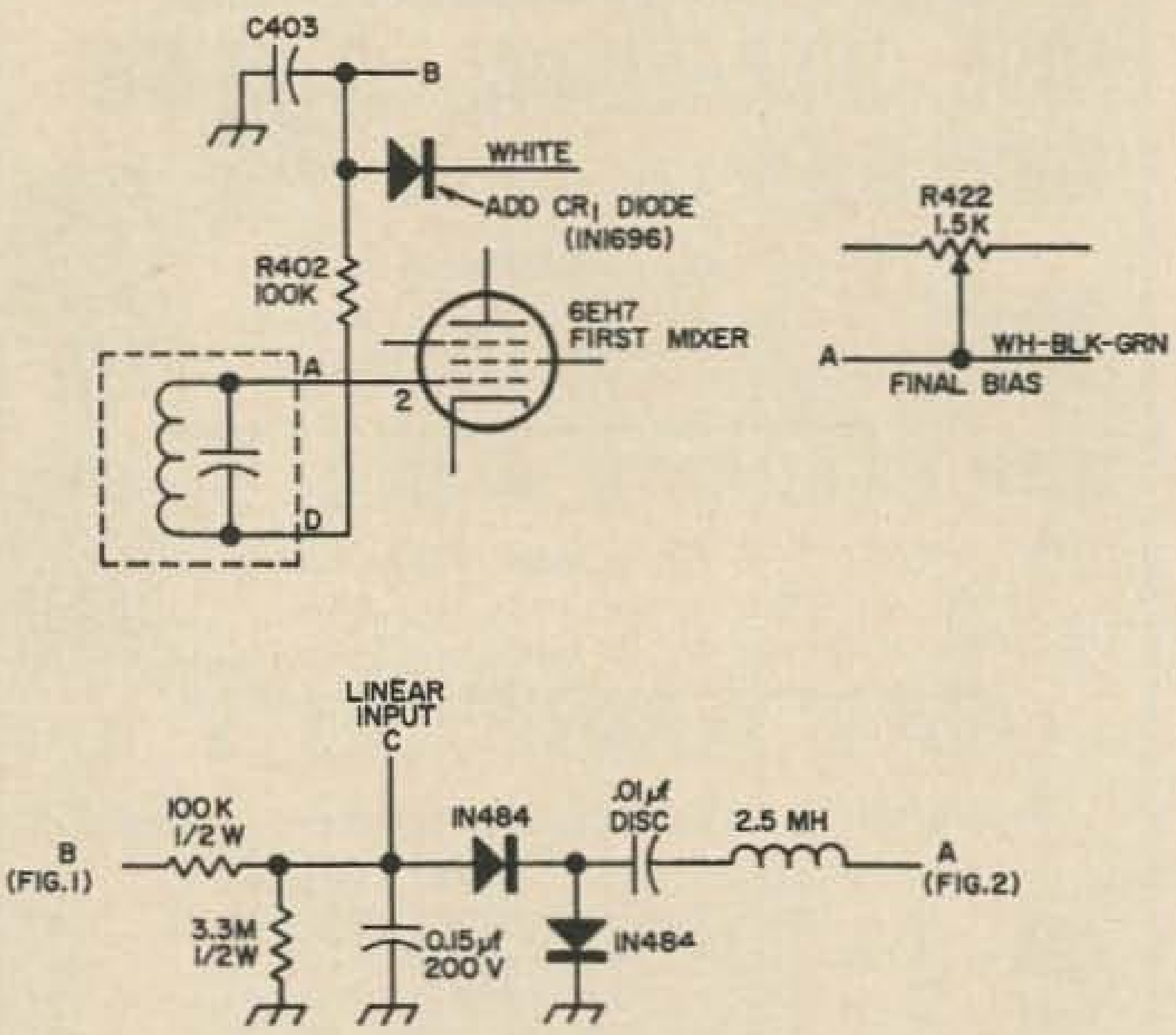


Fig. 1. Schematic diagram for ALC circuit. IN484 or equivalent should have high back resistance. CR1 (IN1696) should be rated for 300V PIV. Feed ALC from linear into point C.

Operation of the 200V alone showed a complete lack of distortion products on its scope and when the NCL 2000 linear was used, grid current was held to less than 1 mA, no matter how much input was used. Incidentally, I have found the best method of proper tune-up is by testing with a friend who has a strong signal with no skip conditions present.

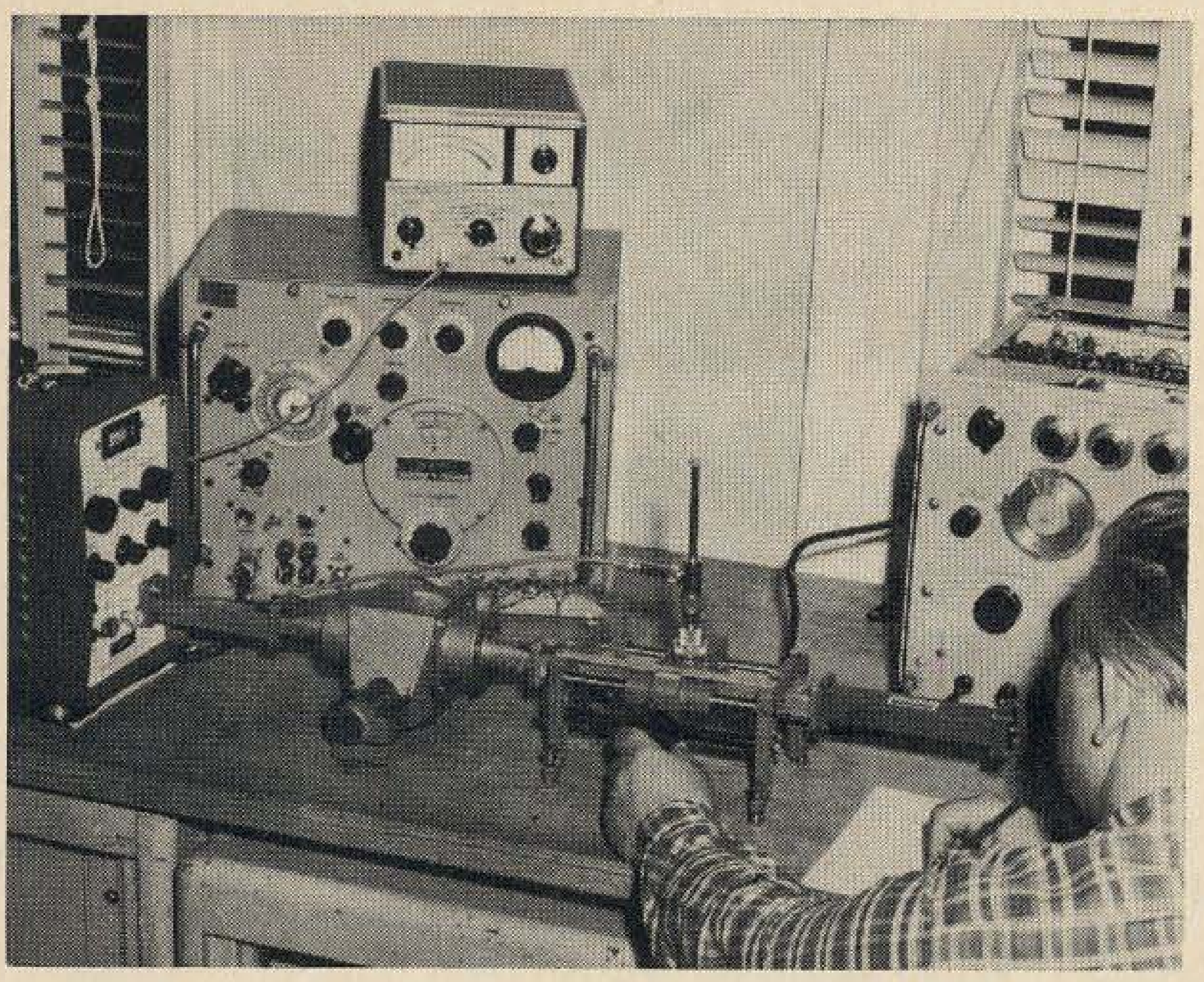
. . . K1AQI

The Electronic Invasion

We've read a lot about electronic snooping in the newspapers, but not so much in our electronic journals. Bob Brown W2ZSQ has gathered the facts for us in the 184 page book published by Haden Books, 116 West 14th Street, NYC 10011. While most of the book discusses the state of the art, there are some circuit diagrams for bugs, bug detectors and bug jammers. This aspect is rather lightly treated though. It is particularly interesting to read the debunking of some of the more popular myths about bugging.

Radio Control Manual

This new book is radio control circa 1968, transistorized and very sophisticated. The book, published by Tab Books, Blue Ridge Summit, PA 17214, at $3.95 in paperback, starts with the fundamentals and is quite satisfactory as a text for a course in radio control. There are home construction projects and just about every one of the 192 pages has at least one circuit diagram. If you are interested in radio control you'll need this book.



One of our technicians doing VSWR measurement using Hewlett-Packard and PRD Xband scource

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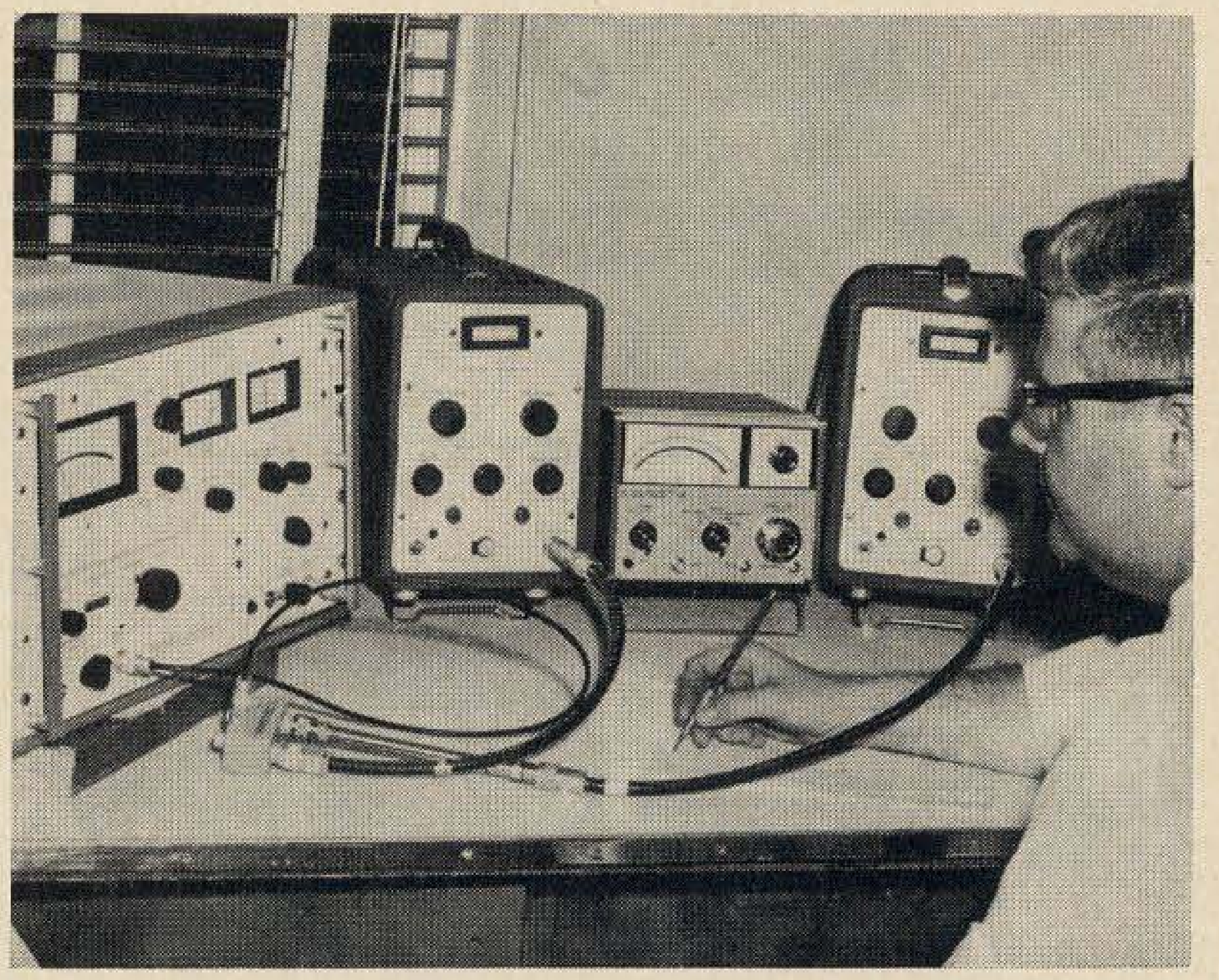

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Ships of Mercy

Twenty minutes from the battlefield to a hospital bed aboard the USS SANCTUARY and her sister ship the USS REPOSE. These two Navy hospital ships ply the waters of the South China Sea from Chu Lai to the DMZ doing admirable duty in saving the lives of many casualties helicoptered aboard. Each is a floating hospital of 750 beds, staffed with expert physicians, nurses, medical technicians and hospital corpsmen, on call 24 hours a day. The mission of both ships is to provide hospitalization services for U.S. Armed forces personnel.

Both ships have complete amateur radio facilities. The equipment on the SANCTUARY is the Collins KWM-2A with a 30L-1 linear and a Johnson Matchbox but since the later part of January a Henry 2K-2 linear has been added. The antenna now in use is the Telrex 99D with rotor. It is 175 feet above the water on the Mainmast. The equipment on the USS REPOSE is the 32S3 transmitter with the 30S1 linear and the 75S-3B Collins Receiver. The antenna

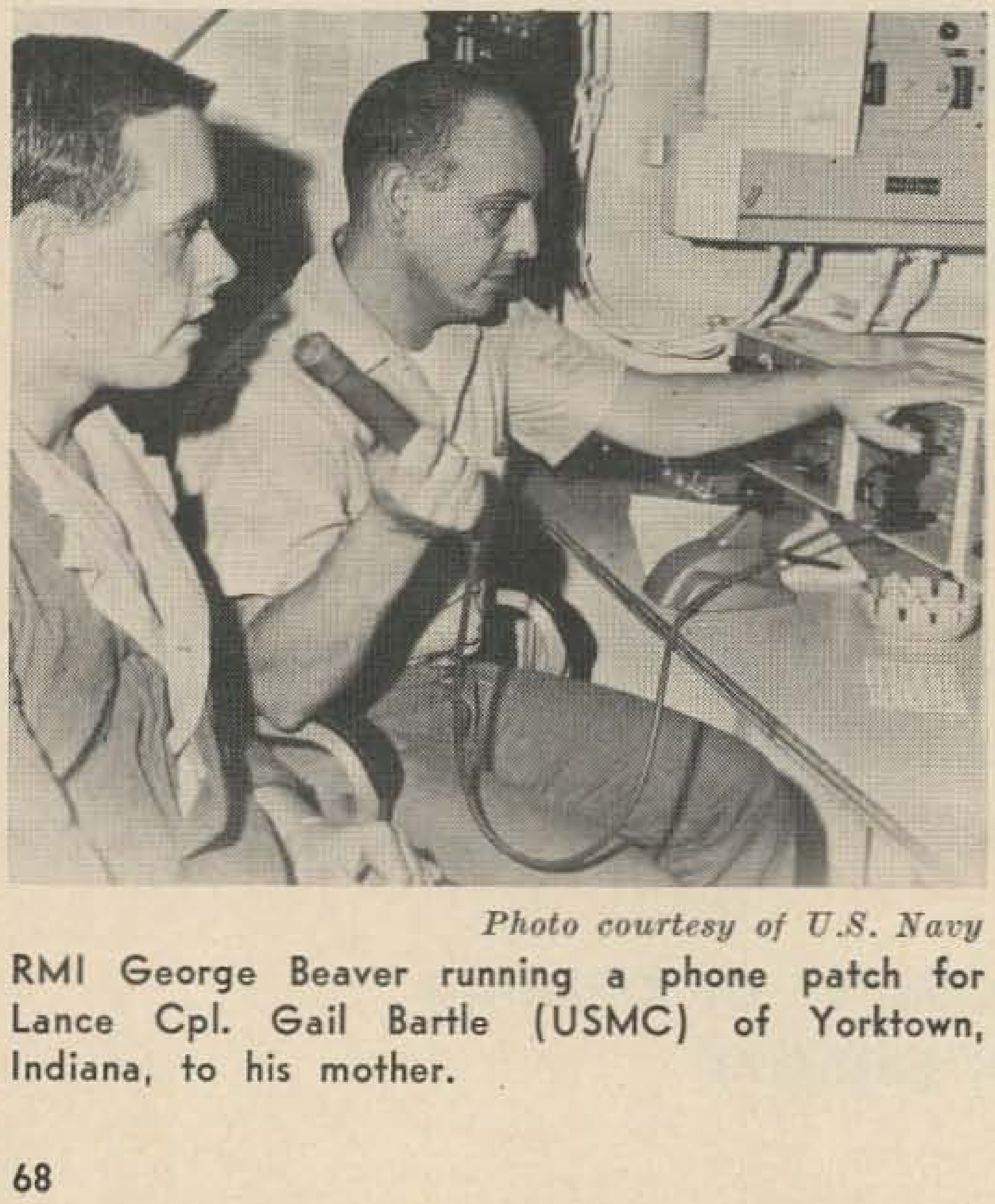

Photo courtesy of U.S. Navy

RMI George Beaver running a phone patch for Lance Cpl. Gail Bartle (USMC) of Yorktown, Indiana, to his mother.

Official U.S. Navy Photo

The U.S.S. Sanctuary. A hospital ship near the battle area which supplies immediate medical aid to the wounded in Viet Nam.

system is Telrex with a Telrex rotor. The antennas are on the Rearmast up 145 feet above the water.

The amateur radio station aboard the USS SANCTUARY first went on the air April 13, 1967, off the coast of Vietnam, using the call WA4LGD. Unfortunately after two weeks using this call, the operator Gene Nation (WA4LGD) had to give up operating the station due to sickness. For several months afterwards, the call WB6VXT was used until the licensee, Jim Lencioni, was transferred back to stateside. On October 10th, George Beaver, WB4HVF, became custodian and chief operator of the station.

More than 3000 phone patches have been completed since the station started operations on April 13, 1967. Most are routine but at times drama or humor can be heard. For drama, a mother learning for the first time that her son has been wounded. The courage of some of these fellows is something to behold, some with arms or legs missing. They take it in stride and, as Chief Operator George Beaver remarked," I am no more patriotic than the next guy but, for the first time in 15 years in the Navy, I feel I am doing something worthwhile. You work 17 to 18 hours a day and fall in bed exhausted . . . . . . but you feel good."

On the USS SANCTUARY there are three more hams in the crew who work with George Beaver, WB4HVF, and they are Dennis Shultz, WA3IHH, Frank Stover, WA3HPX and Bill Crosby, WAØKEN who just reported aboard in December. Others who volunteer for work in the ham shack, on their free time, are Lt. Finucan, Jim Monk, Richard Pease and Bob Reilly.

With a large crew and a full capacity of patients aboard the ship, the ham shack is a busy place when the phone patching gets underway. Ambulatory patients form lines by the ham shack, sometimes 15 or 20 at a time, while the bed patients are patched into the ham shack from their beds.

Many west coast operators are part of a team that handle the phone patches from the USS SANCTUARY and the USS REPOSE. Some who have regular schedules with these ships are Syd Fass, W6NZ of Berkley, California, Dean Burnett, W6BJ, of La Mirada, California, Jim Smith, W6RT, of Solano Beach, California, "Slats" Johnson, W6KVH of Riverside, California, Frank Sarver, W6AOR of Van Nuys, California, George Cooper, W6PKK, of Hollywood, California, Bill Barge, WB6DIU, of Lawndale, California, Richard Levor, of Capistrano, California, Howard Shepherd, Jr., W6QJW, of Los Angeles, California, Southern California VHF Club of Paramount, K6BPC, Gerry Johnson, K7YRU, of Kent, Washington, George Murphy, of Cowallis, Oregon and O. R. Queen, W7KYM of Phoenix, Arizona. There may be more regulars that deserve mentioning but if we missed anyone may we say "Thanks for Your Dedicated Work".

In some communities funds are raised to pay for the long distance calls of the servicemen who are patients aboard the SANCTUARY and the REPOSE. Through the efforts of Dean Burnett, W6BJ and the editor of the local paper, *The La Mirada Lamplighter*, the civic organizations of La Mirada, California have organized a SANCTUARY-REPOSE FUND. The mayor with other business men of the city take care of handling the contributions which come from many sources. In Seattle, Washington, Gerry Johnson, K7YDO has an arrangement to pick up the tab on long distance calls through the generosity of the local Veterans of Foreign Wars post. Plans are being arranged in other cities for civic organizations to contribute to this type of phone patching.

Words of praise should go to the long distance operators of the telephone companies who handle the phone patch calls. These girls are exceedingly interested in having the calls completed even though many require time to locate people in distanct places. As one of the phone patch radio amateurs remarked, "The telephone operators are really good. They will find them if they are to be found." When phone patching is at it's peak usually one long distance operator will take ten to fifteen calls and she will have them all ready to talk, one right after the other. Sometimes it takes a couple of hours to clear all the calls but the operators stay right on the circuit. There are also cases where company officials have assisted in locating hard to find parties, sometimes at all hours of the night. Phone patching is a necessary part of life these days and the phone companies are doing all they can to help with the morale of our servicemen.

Hundreds of letters of appreciation have been received from the families of the wounded men on the hospital ships, thanking the phone patching amateur radio operator for arranging the call from the ships. One letter received was from a woman expressing her thanks and explained that she forgot to show her appreciation to the operator after talking to her son. In her excitement of being able to talk to her son, she did not find out the name of the radio amateur who did the phone patching. She waited for her monthly telephone bill to arrive and then had the telephone company trace the name and address of the radio amateur so she could express her thanks. There is no doubt that all recipients of phone patch calls are thankful for hearing and talking to their loved ones.

This story would not be complete without mentioning Rear Admiral George H. Reifenstein, W3CKN/K6LZI who has taken great interest in phone patching by other radio amateurs who are of extreme value to the morale of the patients aboard the hospital ships. Although his work at The National Medical Naval Center in Bethesda, Maryland does keep him very busy, he does find some time to participate in amateur radio activities. At present he is working with temporary antennas from his home in Bethesda but will shortly have a three band beam in operation. When he lived on the west coast, his station, K6LZI, was very active operating C.W. and SSB.

With phone patching so important to the morale of our servicemen, might we mention that frequencies should be kept clear from QRM so that phone patch calls from these ships can be completed.

. . . K6GKX

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Amateur Applications For Inexpensive Tape Recorders

In this article we will explore how, with simple modifications, one of the inexpensive tape recorders, widely available, can be used for a variety of functions for either the phone or CW operator.

The consumer radio market is overflowing with a number of inexpensive tape recorders costing as little as $10. The quality of some if these units for home entertainment might be somewhat debatable, but for amateur use, where restricted frequency response and some variation in tape speed are tolerable, they can be put to a number of interesting uses. The obvious use is as a CQ caller for phone work. However, they can also be used as a CQ caller on CW by use of a transistor switch.

Additional uses consist of a compression amplifier, and a CW monitor/keying shaping circuit. All of these functions can, in fact, be built into one tape recorder simultaneously by the use of relatively few parts.

This article presents the conversion information separately for these functions so the reader can incorporate as many or as few as are desired to suit his situation.

The basic circuit of most inexpensive recorders is similar to that shown in **Fig. 1.** A 4 or 5 stage transistor audio amplifier serves as a microphone amplifier to drive the recording head in the record position, and then as a playback amplifier to amplify the playback head pickup to drive a loudspeaker in the playback position.

In order to be able to use the amplifier as a microphone amplifier also, either with or without a compression feature added, another position has to be added to most recorder selector switches, to allow microphone amplification with the speaker connected to the output, instead of to the recording head.

On some recorders, another switch, with an additional position, can be substituted for the present selector switch Other recorders, which do not allow selector switch substitution, will require a separate switch. The output to the microphone input of the transmitter can most simply be taken, via a 1 µF capacitor, from the primary of the output transformer (as shown in **Fig. 1**).

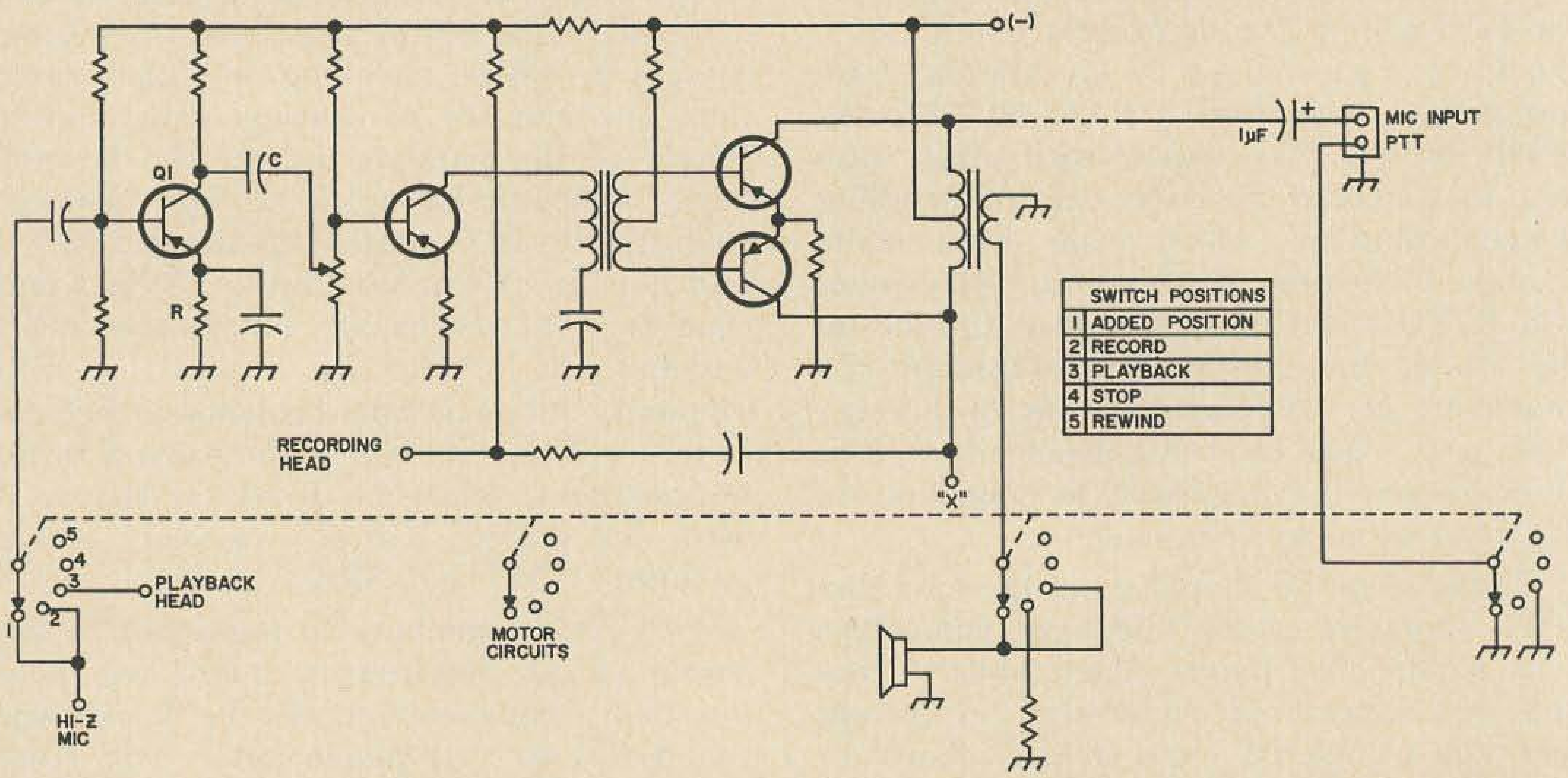
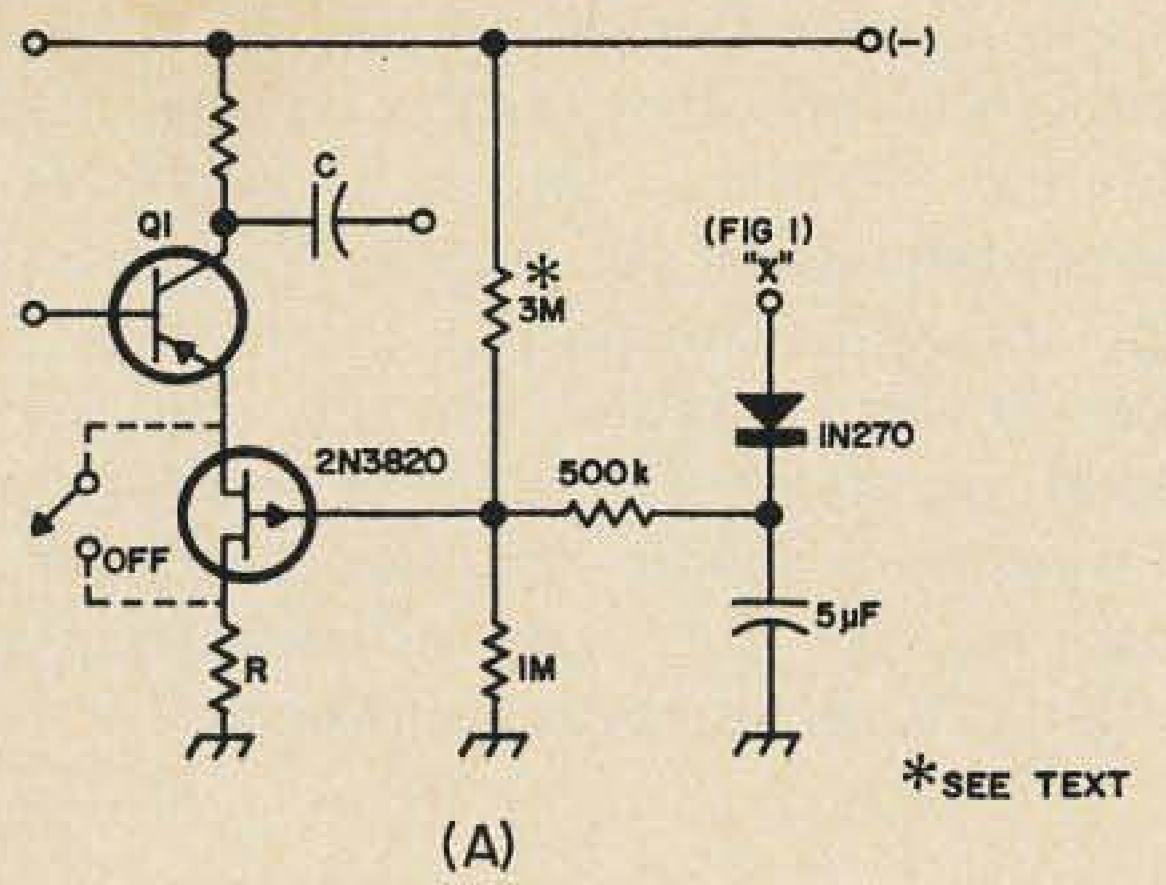
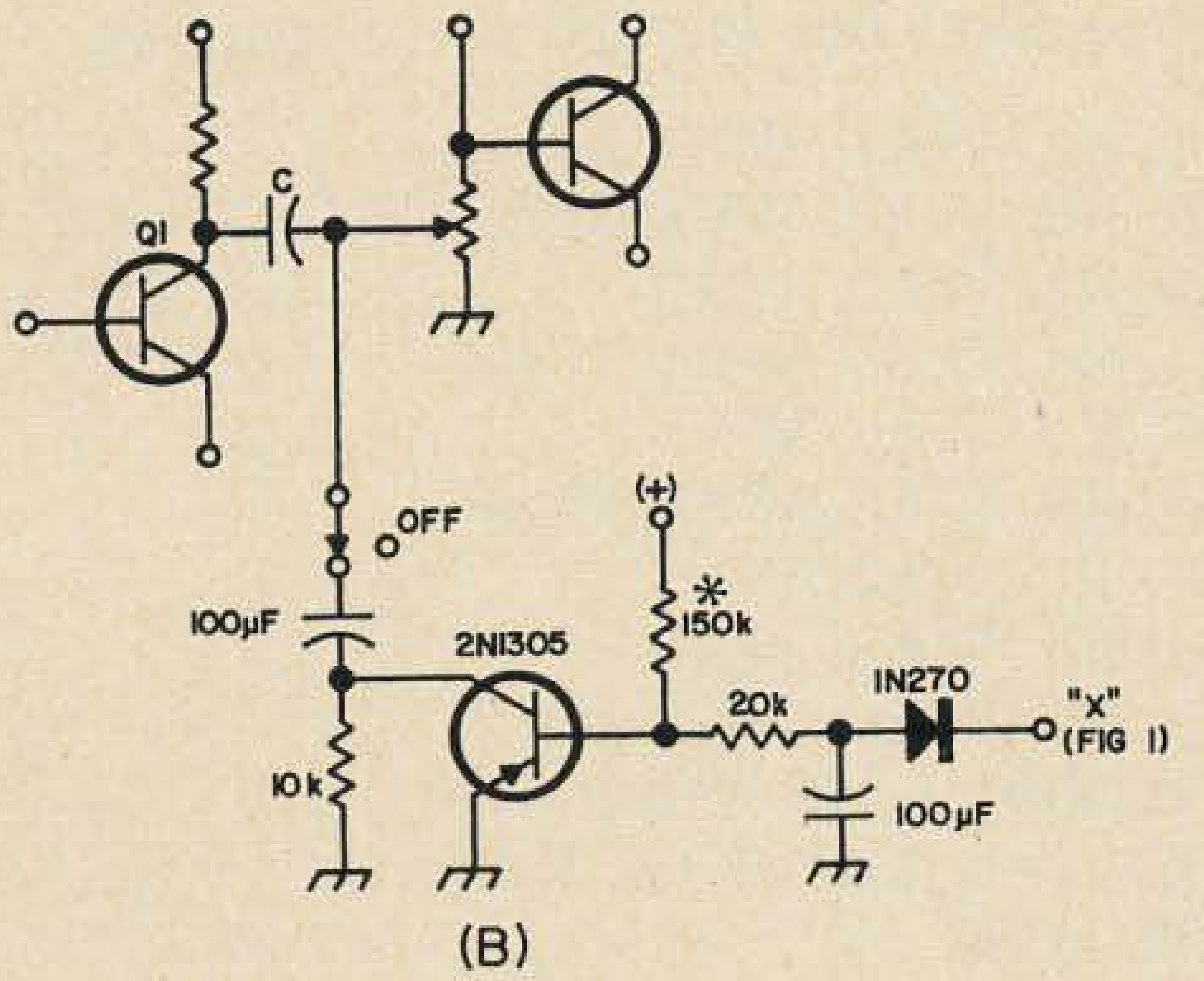


Fig. 1. Typical small recorder amplifier circuit with an extra position added to the selector switch to enable the use of the amplifier as a microphone preamplifier.



(A)



(B)

Fig. 2. Two simple feedback control circuits which can be added to a recorder audio amplifier to make it into a compression amplifier.

Some recorders have a monitor output which can also be used.

If push-to-talk operation instead of VOX is used for the transmitter, the relay control circuit lead from the microphone can be carried through the recorder by using miniature 3 circuit jacks and plugs, or an additional contact on the recorder selector switch can be used to energize the transmitter in the microphone amplify and playback positions. It might be possible, in some recorders, to utilize existing ground contacts on the switch for motor control for this purpose.

Almost all simple compression circuits operate in some manner to reduce the output of the first audio amplifier stage as a function of increasing overall amplifier output. This is accomplished by rectifying part of the output and using it as a control voltage to regulate the characteristics of a control transistor which modifiies the gain of the first audio amplifier stage. Two methods which are easily adapted to simple recorder circuits are shown in **Fig. 2.**

In **Fig.** 2(a), the drain and source connections of a FET transistor are placed in series with the emitter resistance of the first audio amplifier. The bypass capacitor normally used across this resistor must be removed or it will act to "wash out" the variations in the control action. Removal of the capacitor will reduce the overall gain of the audio amplifier somewhat, but usually not enough to cause difficulty.

In operation, increasing the output from the amplifier produces an increasing positive control voltage at the gate of the FET. This, in turn, cuts off the FET, increasing its source to drain resistance and, hence, the negative feedback of the first audio amplifier stage.

The circuit of **Fig. 2(b)** uses a similar principle. Increasing audio amplifier output produces a negative control voltage which decreases the collector-emitter resistance of the control transistor, and more effectively bypasses the 100 μF capacitor to ground. The output of the first audio amplifier is reduced, because its output is increasingly bypassed to ground. No changes are required in the original recorder amplifier circuitry. The 3 megohm resistor shown going to a negative voltage in **Fig.** 2(a), and the 150 k ohm resistor going to a positive potential in **Fig. 2(b)**, act to prevent compression action from taking effect until a certain minimum output level is reached. This allows the amplifier to operate at maximum gain for low-level input signals. These resistors may not be necessary in all cases and their value can be varied for best compression action. Both circuits will provide very effective compression with about a 20 to 0 db control range.

If desired, a switch can be added, as indicated in **Fig. 2**, to switch out the compression action.

In order to use the recorder as a CQ caller on CW either of two methods can be used. A SSB transmitter will produce a single carrier output when a single sinewave audio signal is fed into the microphone input. Therefore, approximately a 1,000 Hertz keyed tone can be recorded and played back into the transmitter audio input. It is important, however, that the tone be a pure sine wave of constant frequency, or spurious carrier outputs will emanate from the transmitter. Recorder speed variations will change the output tone, and the length of the call must be kept short if a

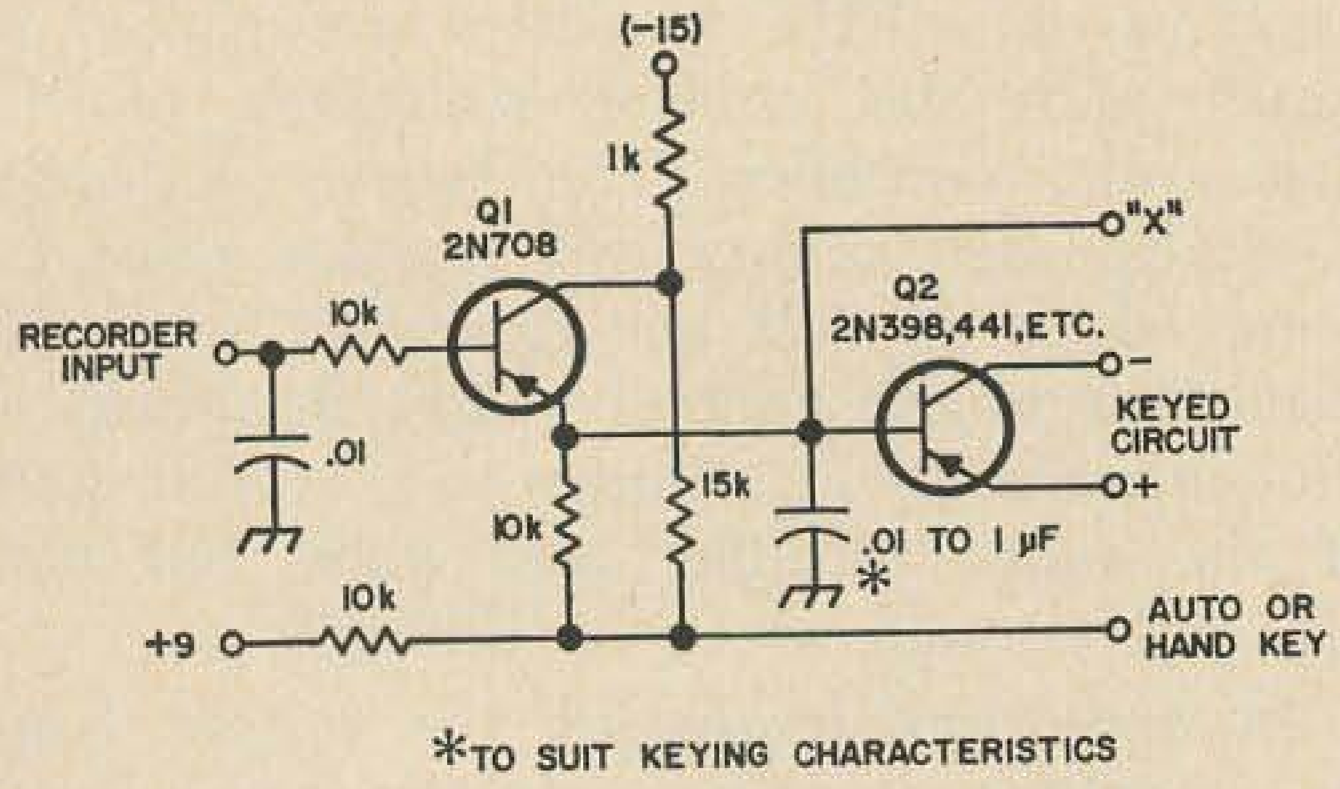


Fig. 3. Two stage switch used to modify a recorder as a CW CQ caller.

recorder without a constant speed capstan drive is used.

The requirement for a pure audio tone can be eliminated by using the recorder to operate a transistor switch, connected directly across the contacts of the transmitter keying circuit, rather than using the recorder output to feed the transmitter directly. One circuit for doing this is shown in **Fig. 3.** Basically, the recorder output used to make Q_1 in turn causes Q_2 to conduct and and key the transmitter. The ratings of Q_2 determine the maximum keyed voltage and current ratings.

Q_2, as shown in **Fig. 3**, can only be used with grid-block keying systems having less than 100 V open circuit voltage, or with cathode keyed circuits operating at less than 20 mA.

In contrast to the previous keying method, it is desirable that the recorded keyed tone be as close to a square wave as possible, rather than a pure sine wave.

If desired, the station key can be connected between Q_1 and Q_2 instead of keying the transmitter directly. Because of the low voltage across the key when it is used in this manner, sparking is essentially eliminated. By experimenting with the RC combination in the base of Q_2, it is possible to achieve almost any degree of hard or soft keying characteristics.

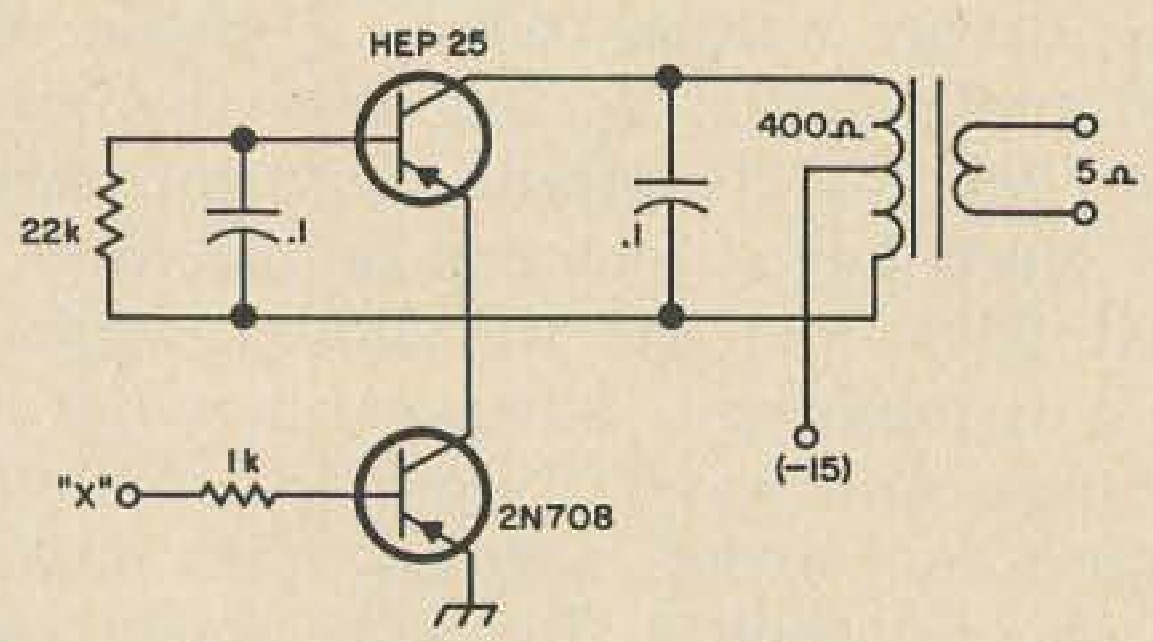


Fig. 4. CW monitor with additional switch which can be added to the circuit of Fig. 3.

If the transmitter does not have a keying monitor, one can easily be included in the keying circuit as shown in **Fig 4.** It can be activated either by the CW station key or the recorder output.

The keying/monitor circuit can be assembled on a small piece of vector board and mounted inside of the recorder enclosure or, in the case of ultra-miniature recorders, in a separate mini-box.

. . . W2EEY/1

Prefix Quiz Answers

We count 78 W and K prefixes. We are not perfect, but we are pretty perfect.

W1, K1, WA1, WN1
W2, K2, WA2, WB2, WN2
W3, K3, WA3, WN3
W4, K4, WA4, WB4, WN4
W5, K5, WA5, WN5
W6, K6, WA6, WB6, WN6
W7, K7, WA7, WN7
W8, K8, WA8, WN8
W9, K9, WA9, WN9
WØ, KØ, WAØ, WNØ
KA2, KA5, KA7, KA8, KA9
KB6, WB6
KC4, KC6
KG1, KG4, KG6, WG6
KH6, WH6
KJ6, WJ6
KL7, WL7
KM6, WM6
KP4, WP4, KP6
KR6, KR8
KS4, KS6, WS6
KV4, WV4
KW6, WW6
KX6
KZ5

That's 78 prefixes. Did we miss any? And how many did you miss? Sorry about those KN and WV prefixes, but they are all out of date now.

Electronic Engineering Nomographs

Over 100 nomographs of conversion charts, attenuators, filters, transmission lines, passive components, tubes, transistors, etc. Nomograph fans will go right out of their minds at this collection. Published by Tab Books, Blue Ridge Summit, PA 17214, $9.95, a big book and spiral bound. 175 pages.

Surplus Conversions

Hardly a week goes by without receiving many requests from readers asking where to find information regarding a particular piece of surplus gear they have picked up without a manual or any conversion information.

In addition to the following literature, *73's Index to Surplus* should give all the information as to where to find conversion for almost any surplus equipment. This handy reference is available from 73, Peterborough, N.H. 03458 for the modest sum of $1.50.

Editors and Engineers

Editors and Engineers, P.O. Box 68003, New Augusta, Indiana, have published three *Surplus Radio Conversion Manuals* by Evenson and Beach and the *Surplus Handbook, Vol. I* by W6NJV and W6NJE. Each costs $3. Here are the pieces of equipment covered in each manual:

Surplus Radio Conversion Manual, Vol. I. BC-221, BC-342, BC-312, BC-348, BC-412, BC-645, BC-646, SCR-274 (BC-453A and BC-457A series), SCR-522, TBY, PE-103A, BC-1068A/1161A.

Surplus Radio Conversion Manual, Vol. II. BC-454, AN/APS-13, BC-457, ARC-5, GO-9/TBW, BC-946B, BC-375, LM, TA-12B, AN/ART-13, AVT-112A, AM-26/AIC, ARB.

Surplus Radio Conversion Manual, Vol. III APN-1, APN-4, ARC-4, ARC-5, ART-13, BC-191, BC-312, BC-342, BC-348, BC-375, BC-442, BC-453, BC-455, BC-456-9, BC-603, BC-624, BC-696, BC-1066, BC-1253, CBY-5200, COL-43065, CRC-7, DM-34, DY-2, DY-8, FT-241A, MD-7/ARC-5, R-9/APN-4, R-28/ARC-5, RM-52-53, RT-19/ARC-4, RT-159, SCR-274N, SCR-508, SCR-522, SCR-528, SCR-538, T-15 to T-23/ARC-5, URC-4, WE701A.

Surplus Handbook, Vol. I. This book, subtitled, *Receivers and Transceivers,* is composed of schematics and pictures of the following gear. It doesn't give conversions. APN-1, APS-13, ARB, ARC-4, LF and VHF ARC-5, ARN-5, ARR-2, ASB-7, BC-222, BC-312, BC-314, BC-342, BC-344, BC-348, BC-603, BC-611, BC-624 (SCR-522), BC-652, BC-654, BC-659, BC-669, BC-683, BC-728, BC-745, BC-764, BC-779, BC-794, BC-923, BC-1000, BC-1004, BC-1066, BC-1206, BC-1306, BC-1335, BC-AR-231, CRC-7, DAK-3, GF-11, Mark II, MN-26, RAK-5, RAX, RAL-5, Super Pro, TBY, TCS, VT tube cross index.

CQ Handbook

CQ has two handbooks on surplus out. They can be ordered from CQ, 14 Vanderventer Avenue, Port Washington, N.Y. The first book, the *Surplus Schematics Handbook,* by Ken Grayson W2HDM, costs $2.50, and contains schematics and short comments about this gear: APA-38, APN-1, APR-1, APR-2, APS-13, ARB, ARC-1, ARC-3, ARC-4, ARC-5, ARC-5 VHF, ARJ-ARK-ATJ, ARN-7, ARR-2, ART-13, ASB, AS-81-GR, ATK, BC-AR-231, BC-189, BC-191, BC-221, BC-312, BC-314, BC-342, BC-344, BC-348, BC-375, BC-438, BC-474A, BC-603, BC-610, BC-611, BC-620, BC-640, BC-645, BC-652, BC-653, BC-659, BC-683, BC-684, BC-728, BC-733, BC-745, BC-779, BC-794, BC-906, BC-969, BC-1000, BC-1004, BC-1023, BC-1206, BC-1335, BN, BP, C3, CRC-7, CRO-208, CRT-3, DAE, F3, GF-11, GO-9, GRR-5, I-122, I-177, I-208, JT-350A, LM, Mark II, MD-7, MN-26, PRC-6, PRS-3, R-174, RAK, RAL, RAO-7, RAS, RAX, RBH, RBL, RBM, RBS, RC-56, RC-57, RDC, RDR, RDZ, RU-16, SCR-274, SCR-284, SCR-288, SCR-300, SCR-506, SCR-522, SCR-578, SCR-585, SCR-593, SCR-608, SCR-610, SCR-624, SCR-628, SPR-1, SPR-2, TBS, TBW, TBX, TBY, TCK, TCS, TG-34, TS-34/AP, TS-251/UP, VRC, VVX-1.

The other CQ book, the *Surplus Conversion Handbook* by Tom Kneitel K3FLL, ($3) contains conversion on these pieces of gear: ARC-1, ARC-3, ARC-4, ARC-5, ARC-36, ARC-49, ART-13, ATA, ATC-1, BC-191F, BC-224, BC-312, BC-314, BC-343, BC-344, BC-348, BC-375E, BC-453, BC-454, BC-455, BC-457A, BC-458A, BC-459A, BC-603, BC-604, BC-620, BC-624A, BC-625A, BC-659, BC-669, BC-683, BC-684, BC-696A, BC-779, BC-794, BC-946, BC-1004, BC-1068A, CBY-52232, PE-73, PE-103, R-129/U, RAX-1, SCR-177, SCR-188, SCR-193, SCR-274N, SCR-399, SCR-499, SCR-508, SCR-509, SCR-510, SCR-522, SCR-528, SCR-542, SCR-608, SCR-609, SCR-628.

Additional Notes on the IC Electronic Counter

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The article in February on the IC counter has apparently generated a considerable amount of interest. Unfortunately, several errors appeared in the diagrams that might cause trouble. When I checked the copies of my original drawings I found that many of the errors were my own, for which I am sorry. I should have checked the drawings more carefully.

In **Fig. 4**, C1 must go to the 0 output on the JK and output can be taken from the 1 output. In **Fig. 3** all of the 0 and - outputs are reversed. This makes no difference on the JK flip-flops on which both the S and C inputs are grounded, but on every JK where S and C inputs are not grounded either the S and C inputs must be reversed or the 0 and 1 outputs reversed (not both!). The 1 kHz signal from S1 can come from either output of the fifth JK from the left in the top row.

In **Fig. 5**, C1 should be 100 pf. The 10K resistor to the right of R3 should be marked R4. IC6 can be a Fairchild 900, not 800.

In table I., the truth table for **Fig. 6**, the row B, A, D, C, F, E, H, G, should be $\overline{B}$, $\overline{A}$, $\overline{D}$, $\overline{C}$, $\overline{F}$, $\overline{E}$, $\overline{H}$, $\overline{G}$. In **Fig. 6**, "D" should go to the 1 output of IC2. IC10 thru IC12 can be the same types as IC5 thru IC9.

On page 7, the last digit vacillates because of the one cycle per gating period or one count per gating period error inherent in a digital counter. This is one place where it is still correct to use cycles since we mean cycles per gating period and not necessarily cycles per second. The error will be 1 Hz with a 1 second gate, 10 Hz with a .1 second gate or 100 Hz with a .01 second gate, etc.

The cost of the oscillator in **Fig. 2** can be reduced by using a Motorola MPF-102 instead of the 3N126. It is advisable in this case to reduce the oscillator supply voltage to a value between 9 and 12 volts regulated.

A decade using incandescent lamps appears in February, 1968 Popular Electronics, page 27. It has nicer looking lamps than the neon decade and is available in kit form at a price slightly less than that of the neon decades with parts bought separately. The kit includes a printed circuit board making construction easier. To use it, pins 1 and 3 on IS-1 of the units decade must be lifted from ground and used for the gate input and the lamp blanking circuit on the present counter must be modified to give 6 volts.

Pin connections for the IC's can be found in reference 6 or from the manufacturer's data sheets. The more recent Motorola data sheets designate the outputs of a JK flip-flop as Q and $\overline{Q}$. Q is the same as 1, $\overline{Q}$ is the same as O. All IC's in the counter must be supplied with +3 volts V_{cc} and ground even though not shown.

To test a decade before the rest of the counter is built an IC electronic keyer such as the Micro-Ultimatic or the Kindly Keyer is a good signal source. Output must be taken from one of the IC's, not from the relay contacts. Another possibility is to build a "noiseless switch" using two gates or inverters connected as a flip-flop as in **Fig. 1**.

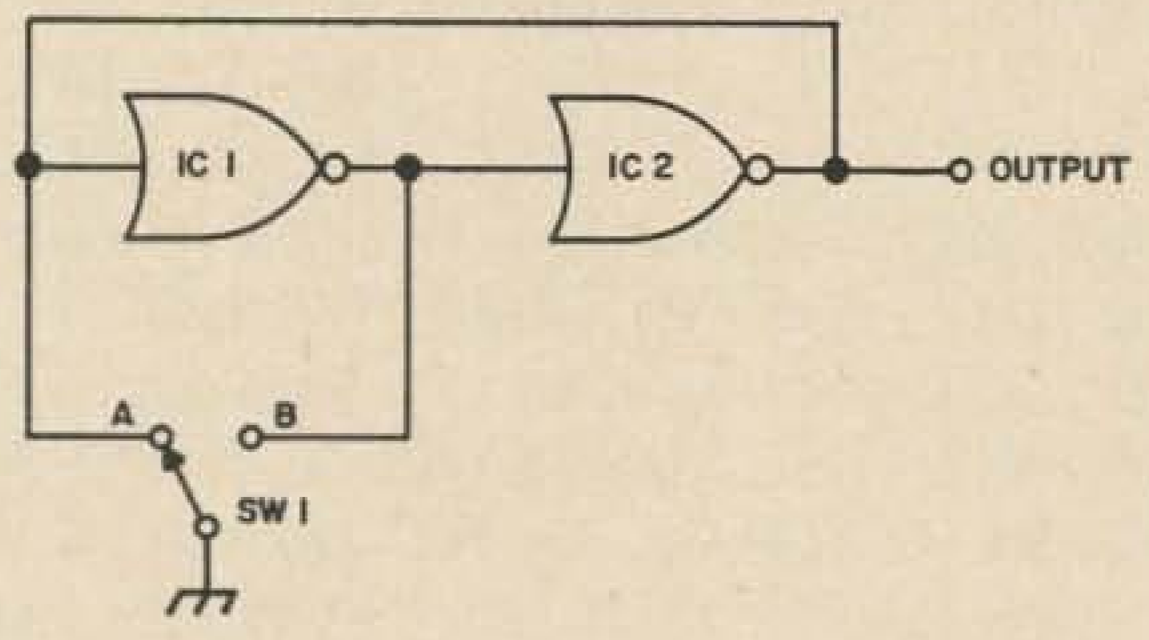

Fig. 1. Noiseless Switch for testing decades. IC1 and IC2 can be any gate, inverter or buffer. SW1 can be any type switch, preferably momentary, and can even be a piece of wire touching A and B alternately.

The builder can build as few or as many decades as he wishes but adding decades of the same type as shown does not increase the frequency range since this is limited by the units decade and is slightly over 10 MHz. for the decade shown. To go higher in frequency more expensive IC's such as the Motorola MECL series would be needed for IC8 and IC9 in **Fig. 5** and for the units decade only. Another approach would be to beat the unknown frequency with a crystal oscillator to get a frequency below 10 mHz. The frequency of a transmitter above 10 mHz can be determined by using the counter to measure the fundamental oscillator frequency if it is below 10 mHz provided the other stages are known to be multiplying correctly. . . . W1PLJ

Soldering Is Easy

P. Stankiewicz, WB2ZNC

Well, soldering is exactly what I've said it is—easy. Even if it is quite simple one can have some of the wildest experiences with soldering, as I have. The most frequent of these is when you go to knock that excess of solder off the iron and it lands right on you. If there's one thing that can give you a nice jolt, that's hot solder. This knocking the solder off can also lead to other circumstances. The one time I can remember was when I hit the iron so hard on the table that the tip cracked right off. One of my not so frequent stunts is grabbing the iron as if it were a pencil. After much pain and a few scorched fingers, I discovered what that handle was for.

How about that time when you had some real tight work. There it was, that little connection buried down in there among countless wires, capacitors, and resistors—how to get that iron in there with that big fat tip was another problem. Mine usually end up in a mass of melted insulation, scorched capacitors, and a huge blob of solder wedged in there. The connection usually isn't even touched with the iron or solder.

What about soldering guns. Did you ever press down on that connection a little too hard, and have the tip do a right angle bend?

Well, so much for the soldering guns and irons. How about the solder? Solder on a spool is easy to use, except when someone solders it all together. Another thing is that one can rarely spend more than a half-hour over a soldering gun before becoming asphyxiated by the smoke.

Oh, oh. I've got to stop now since I just remembered I put the iron down on the very seat I'm sitting on. That's all for now 73*eeeeee!!!* . . . WB2ZNC

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Reviewing the Heath HW-16 CW Transceiver

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If you're jaded with high power SSB operation and tired of short-range QSOs on the VHF bands, how can you put some life back into your hamming?

If you live in a tiny apartment and are putting most of your time into the intellectual pursuits on a university campus, what do you do to keep your operating hand in?

Revert to the womb, go back to the good old days, soak yourself in nostalgia and get your kicks—that's what you do.

Fix yourself up with a lower power CW transmitter, a reasonably sensitive and selective receiver, an old J-38, and a handful of crystals for various spots around the CW bands. Hook it all up to a decent antenna and you can be back in the swing of it in no time at all.

There's hardly anything easier to build than a QRP CW rig. Crystals are cheap. A J-38, or similar key, is easy to come by. And modern technology permits small, inexpensive receivers with excellent sensitivity and selectivity.

So, you get all set to put together just such a rig. You reach for the parts catalog and the Heathkit wish-book falls off the shelf. By coincidence, it flips open to the pages showing equipment designed for Novice operation. You decide to take a look at some Heath circuits. Maybe you can pirate a good idea for the transmitter you hope to build.

What's this? A three-band CW transceiver? With a price tag that won't cut into next semester's tuition? You pick up the book and take a closer look at the Heathkit HW-16.

The piece turns out to be a complete, crystal-controlled transmitter and separate VFO-tuned receiver in a small, table-top package. The receiver tunes the first 250 kHz of 80, 40, and 15 meters. That means you can work 40 after classes in the afternoon; you can check into that 80 meter traffic net later in the evening; and you can start on a really challenging DXCC on 15 meters; what with the sunspots opening the band to all points on the globe.

Bandswitching is in one front-panel switch and transmitter tuning is simple. All you do is dip the final plate current reading on the front panel meter—or peak the power output reading on the meter, whichever you choose. There is a power level control on the front panel which lets you vary the screen voltage on the 6GE5 final, raising or lowering the input power of the transmitter. That way you can stay within Novice limits or boost the rig's input to over 100 watts.

There are separate af and rf gain controls on the front panel so you can operate the way you used to, running the af gain wide open and adjusting the rf gain for listening level.

To keep operation simple, the only other controls Heath has put on the front panel are the large (1¾ inch) main-tuning knob (which has that important smooth and hefty feel) and two sizes of crystal sockets.

Key jack, speaker output jack, earphones jack, antenna jack (phono type), ground connector, VFO input jack, and VFO power output socket are all on the rear chassis apron.

Inside, the rig is quite simple and straight forward.

The transmitter uses a 6CL6 as a modified Pierce crystal oscillator and buffer amplifier. The signal from that stage is amplified by the second 6CL6, the driver. The driver stage functions as a tripler to 21 MHz for 15 meter operation. The final is a 6GE5 getting 600 volts from a voltage-doubler power supply. Low-power transmitter and receiver sections receive 300 volts from the power supply. The primary of the power transformer is protected by a circuit breaker and turned ON/OFF by a switch on the af gain control.

Grid-block keying controls the flow of cutoff bias to all three transmitter stages.

The front-panel meter measures a sample of rf output voltage at the antenna ("Rel Pwr") or final cathode current ("Plate").

Stray transmitter rf, which might tend to migrate toward the receiver sections, is kept out of the receiver's rf amplifier stage by bypassing to ground. A silicon diode, acting as an "antenna relay," is biased during transmit operation, permitting flow of current to ground only. During receive, the diode is unbiased and is effectively an open circuit at low received-signal voltages.

The pi network is used in both transmit and receive. Incoming signals follow a path through the receiver from the rf amplifier to a heterodyne mixer (with fixed-tuned heterodyne oscillator) to a VFO mixer (with manually-tuned VFO) to an *if* amplifier, an xtal-controlled product detector, and two audio amplifiers.

The manual rf gain control varies the amount of cathode bias on the rf amplifier tube (6EW6). It also controls the cathode bias to the 6EW6 *if* amplifier.

The heterodyne mixer is ½ of a 6EA8 and the heterodyne oscillator is the other half of that tube. The VFO and mixer share another 6EA8. The VFO tunes 1900 kHz to 2150 kHz. The *if* is at 3396 kHz. A 500 kHz crystal filter couples the VFO mixer output to the *if* amplifier grid(6EW6).

One-half of a 12AX7 is the bfo, crystal-controlled at 3396.4 kHz. The other half of that tube is the product detector which produces an audio signal equal to the difference in frequency between the bfo and *if* of the two input signals. The product detector output goes through the af gain control to two halves of an 6HF8, twin-stage audio amplifiers. The final audio is coupled through a transformer to either speaker or headphones (speaker connected at all times). When the 'phones are plugged in, their high impedance mutes the speaker. There is a 2N1274 bias switch for receiver muting.

So, you consider a compact, three-band, crystal-controlled, good-looking transceiver, with full break-in and built-in sidetones so you can hear your own fist in the speaker or 'phones. You send in your check and the twenty pounds of gear comes by return mail. You unlimber the trusty soldering iron and spend a few hours wiring the rig. You make typically Heathkit-simple alignments. And you hook up a 50 ohm, unbalanced antenna.

Having gone through the thick and thin of ham radio over 14 years, you need a vacation from building and testing wierd, special-purpose antennas. You have little room for anything fancy. So, you invest in a Hy-Gain 18AVQ and relax (after pounding in four eight-foot ground rods).

You dig through the recesses of your apartment-sized junkbox-in-a-suitcase. Crystals at 3625 kHz, 7007 kHz, 7025 kHz, and 7044 kHz turn up. They will hit the three bands just right. The old J-38 comes out of the junkbox. A cotton swab makes a good cleaner for the key contacts and your old Novice call where it is scratched into the wood-block base.

You hook everything together and warm up the transceiver. Firing it up on 40, you call a W8 in Toledo. He comes back with a FB signal report. You tell him he's your first with a new Heath HW-16 CW Xcvr. He says your signals are loud and clear despite strong QRM on the band. Later, you have a solid QSO with a W2 in New York and another with a W4 in Georgia, both on 80. The next morning you fire up for a quick check on 15 at mid-morning. It sounds as if the entire Communist bloc is on the air, so you plunge right in, working three countries toward that new DXCC.

One of your hang-ups is contest operating—nothing hot-shot, just leisurely. Not the little contests, but the SS, VE/W, DX, FD, and like that. You check the calendar. The VE/W contest is coming up in a couple of weeks so you make the necessary arrangements with the XYL for a free weekend.

The contest weekend arrives and you knock off about 7000 points with easy operating. You work all the Canadian geographical areas, save one. At three a.m. Sunday on 40 mtrs you connect with a 3C5/VE8 and you know the little rig is sweet.

. . . K3RXK

Dilemma In Surplus

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Do you have an AN/TSQ–1? I had one for about three days, after which time I was obliged to sell it back to its original owner. Besides the one I had there is one other, and I wouldn't be at all surprised to learn that it is in the hands of some ham who intends, perhaps, to salvage parts from it or convert it into something useful around the shack. What, you want to know, is an AN/TSQ–1? Well, that's something that I can't really answer. I have a feeling that I was just beginning to discover its capabilities in the fashion of the blind man examining the elephant. I got it working so that it did something, but it probably has potential that I didn't even suspect.

My introduction to the "Tisk–One" came on a Saturday morning last June while I was on one of my periodic scrounging trips to Andy's Super Surplus Store. Andy has quite a variety of odds and ends, all of military origin. Here one could find everything that was required to equip an army—twenty years ago. According to local legend, Andy has, from time to time, done a very lucrative business with various persons from Central America. Knowing Andy as I do, I'm sure this is nothing but rumor and imagination. His pricing policy, if he has one, is a secret he keeps to himself, though I am positive that no one will ever accuse him of not operating by the profit motive. Basically he is a man of considerable integrity and as honest as anyone I know.

This Saturday morning Andy's curt greeting and dejected look signaled his feelings as soon as I walked in the door. Directing me to a huge pile of junk in his back room, he explained that he had been tricked into buying a bunch of worthless surplus from a nearby Air Force base engaged in research and development work. It seems that he had made a bid on a group of items that included some slightly used uniforms and field packs. It wasn't until his bid had been accepted that he found that he had also purchased a truck full of assorted electronic equipment. Normally Andy didn't like to stock much radio or other electronic gear as he found the demand rather unstable. Usually, when I wanted something specific, I would ask him for it and within a week or two he would locate it somewhere and buy it for me.

His new purchase was a windfall for me and I quickly selected an armful of priceless items which I would be certain to need when I finally got around to building my super-dooper band-blaster. Then I came upon the "Tisk–One", packed in three olive drab, metal shipping cases. It looked brand new and was complete with everything, it seemed, except instructions, a fact I quickly pointed out to Andy. It looked like there were some good high-voltage filter capacitors in it as well as some other components that could be useful. There was no sense letting him know that it was just the thing I needed; It would probably cost more than I could afford anyway. Naturally I was surprised when he let me have the whole thing, metal shipping cases and all, for twenty-five bucks.

Examining my find at home I began to think I had gotten a pretty good bargain. It didn't have that smooth mass-produced look of production models, but it was very well built and obviously new. One of the units was sure to be a power supply. It had a very ordinary looking ac line cord and a single ON/OFF switch. Its packing case held a large cable that was evidently intended to connect it to the second unit, which appeared to be the heart of the device. Its inside was crammed with some of the most sophisticated electronics that I have ever seen. This was definitely state-of-the-art construction, or perhaps beyond the state-of-the-art, as most of the world knows it. It had, on the front panel, a set of buttons like a push-button telephone and a single button labeled "ACTIVATE". The third unit looked very similar to a small refrigerator and was made to be connected to the second unit with a cable provided for that purpose.

Why not connect it up and see what it does, I thought. Surely that couldn't hurt and might prove to be very interesting. Being one of those persons who thinks instructions are something to be used only as a last resort, their absence didn't bother me. I was sure that my analytical mind could ferret out the secret of this device with just a little experimentation. While hooking it up I was thinking about the possible uses it might have. Obviously the business end of this thing was the box-like unit with the door on it. It was roughly cubical in shape, about eighteen inches on a side. Perhaps it was designed to process, in some way, something that was put inside this box. What were the possibilities? The inside of the box provided no clues, as it was a plain metal box, the walls about an inch thick, possibly insulated. Could it heat or cool? X-ray? Irradiate? Speculation, it appeared, was useless, so I decided to go ahead with an "on-the-air" test. Upon plugging it in and turning it on, a previously invisible sign with the word "STANDBY" lit up just next to the "ACTIVATE" button. Amazing! What had been a plain metal panel became a postage-stamp-sized sign. This would bear investigating, but still the primary problem puzzled me: What did this thing do? While pondering this, the "STANDBY" sign went out and an "OPERATE" sign winked on. Why not, I thought, and punched the "ACTIVATE" button, expecting almost anything. Anything, that is, except what happened. Nothing. Not a thing. It just sat there and said "OPERATE". So it appeared the machine was going to challenge my ingenuity. This, I could see, was going to require some deeper consideration.

Of course it didn't really matter if I got it to do anything or not, since I was just going to disassemble it for parts, but I knew that I would be bothered by my curiosity, at least until I had exhausted all possibilities. Since the box part of it was certainly meant to hold something, I decided that it needed something to work on. So I popped an ash tray into the box and again hit the button.

And it was gone! The ash tray had disappeared! A solid cast aluminum ash tray had vanished without so much as a trace of ash or dust remaining.

Well, that's the important part of the story. The next day I "disappeared" some other things without the slightest idea of what was happening to them or where they were going. I was still as innocent of its purpose as I had ever been and now a little scared to boot. I was playing with power and forces whose magnitude I couldn't even imagine.

Monday morning during breakfast I was visited by an Air Force major and some fellow from a very large electronics firm I hesitate to name. The civilian explained that the object I had, the AN/TSQ–1, had been built by his company and was being tested by the Air Force. The tests showed it to be unsatisfactory, though he didn't say why. Nor did he offer to explain just what it was supposed to do, or how it happened to get in with a batch of surplus equipment. Considering the price I paid for it, the major made a very generous offer to buy it back. Without being given the option of saying no, or bargaining, I accepted the cash he handed me and watched them load it into their car.

As they left I did hear the civilian remark to the major that he hoped the other one would be as easy to find. This, of course, makes me believe that somewhere, somehow another one has gotten outside the area of their control, possibly the same way mine did. If this is the case and if it should happen, in some way, to fall into the hands of a radio amateur, I hope that person will tell me about his experiences. I won't call him a crackpot or say he is imagining things, because I will know he has something really different. Whatever it is, the AN/TSQ–1 is a piece of hardware right out of the future and I want to know more about it. ■

Getting Your Higher Class License

Part III — Oscillation, Feedback, and Harmonics

So far in this study course for the new Advanced class license examinations, we have gone into radio wave propagation and single sideband. This installment has somewhat more immediate practical application for the homebrewer—and warrants even closer study if you happen *not* to be a soldering-iron addict. This round, we're dealing with some principles of transmitter design, construction, and operation.

The questions from the FCC study list which we're examining this month are:

5. What are harmonics? How can the generation of excessive harmonics be avoided?
12. How do parasitic oscillations affect circuits? What can be done to prevent or eliminate parasitics?
13. What is backwave radiation? How can it be eliminated?
17. What are some common types of oscillators employed in amateur equipment? How can each be identified in circuit diagrams? What part does feedback play in these oscillators? What points in the circuits should be coupled to provide good feedback?
18. Why is neutralization important in amplifiers? What points in an amplifier circuit should be coupled to provide good neutralization?

As usual, we will shuffle these questions around a bit to pick out the subjects common to all five, then set up some new questions to bring up the key details of these common subjects. Incidentally, these are not all of the questions on transmitters; two more installments later will discuss the rest.

Of the five we're examining this month, two deal directly with oscillation and a third deals with the prevention of oscillation by neutralization. All three of these, indirectly, are involved with feedback. A good question for us, then, is "What is feedback?" and a natural companion to that one is "What are feedback's effects?".

"Backwave" is connected rather intimately with the keying of CW transmitters. Let's examine the whole area, with the question "How can CW transmitters be properly keyed?"

And harmonics are always with us. In this case, let's use one of the commission questions: "What are harmonics?" However, to go deeper, let's not restrict ourselves to the prevention of excessive harmonics; instead, let's ask "How can we use harmonics properly?"

Finally, let's return to the subject of oscillators and try to answer the question, "How many types of oscillators are there?" These six questions should provide enough answers for the five on the study list, even with their multiple parts.

What Is Feedback? Feedback—in its most general meaning—is apparently one of the most basic ideas in existence. One example of it is the concept of "cause and effect"; any time the effect "feeds back" and modifies the cause, resulting in any action, we're seeing feedback at work.

As another example, when you come to the end of this page and turn the sheet to continue reading, that's feedback. Your eyes told you that the page had been completed, and your hand turned to a fresh page. This feedback of information from eye to hand resulted in the eye receiving new input, in the form of the fresh page.

As we normally use the term, though, we tend to think of feedback as something bad—like a cold—which happens to us only when we're unlucky. When the mike line picks up rf and we transmit an annoying series of howls rather than speech, we say "Feedback!" When the final decides not to wait for any rf to reach it, and takes off on its own, oscillating wildly, again we yelp "Feedback!" And we're right. The only thing bad about it, though, is that we have *uncontrolled* feedback at work.

Fig. 1 shows the basic principle of feedback in block-diagram form. A little of the output of an amplifier is "fed back" to provide an input signal. In any practical rf amplifier, we can't help feeding back at least some of the output to the input. After all, we're radiating our signals throughout all space—and the input of the amplifier is also in that space. This doesn't always cause trouble, though, because we can make the portion of the output which reaches the input as small as we like, by proper shielding and circuit layout.

Some types of circuits are more sensitive to feedback than others, and some types of components have feedback built right into them. For instance, a high-gain amplifier is more sensitive to any kind of signal than one with a lower gain. And a triode tube, with its high grid-plate capacitance, has a built-in feedback path.

What Are Feedback's Effects? Contrary to our general beliefs, the effects of feedback are not always disastrous. In fact, as pointed out a few paragraphs back, any cause-and-effect relationship involves feedback. Without feedback, we couldn't function.

The oscillator, a necessary item in both our transmitters and our superhet receivers, is an example of this. Feedback is essential to the working of any oscillator.

The kind of feedback which gives us trouble is uncontrolled feedback. So long as we have it under control, feedback is useful.

But in order to control it, we must know its effects. Up until now, we've been talking about feedback in general. From here on, we will talk about feedback only as it applies to an ac signal. After all, that's the kind of feedback we're most interested in, in examining amplifiers and oscillators.

All ac signals have not one but two characteristics, known as "amplitude" and "phase". Amplitude is the quantity we most often call "voltage" or "current"—the relative "strength" of the signal. However, voltage or current must be specified as peak-to-peak, RMS, or "average"; amplitude is only relative and needs no units or modifiers. Phase refers to the number of full cycles since some arbitrary starting point for the signal, with all full cycles removed from the calculation so that only a fraction of a cycle remains. Relative phase between two signals of the same frequency, for example, refers to a difference in *time* between the starting points of the two signals. Normally, phase is called either "leading" or "lagging", depending upon which signal began first, and is measured in "degrees" with 360 degrees equal to one full cycle.

A phase difference of either 0 or 360 degrees means that the two signals have no phase difference at all.

A phase difference of 180 degrees means that one signal reaches its most positive peak value of amplitude at the same instant that the other reaches its most negative peak value, and that both signals pass through zero amplitude at the same instant. In other words, one is the mirror image of the other.

Two signals of identical amplitude but 180 degrees phase difference cancel each other out. If amplitude is equal and phase difference is 0 degrees, the result is a single signal with twice the amplitude of either of the original signals. If the phase difference is anything other than 0 or 180 degrees, the result will be a single signal differing in both amplitude and phase from either of the original pair.

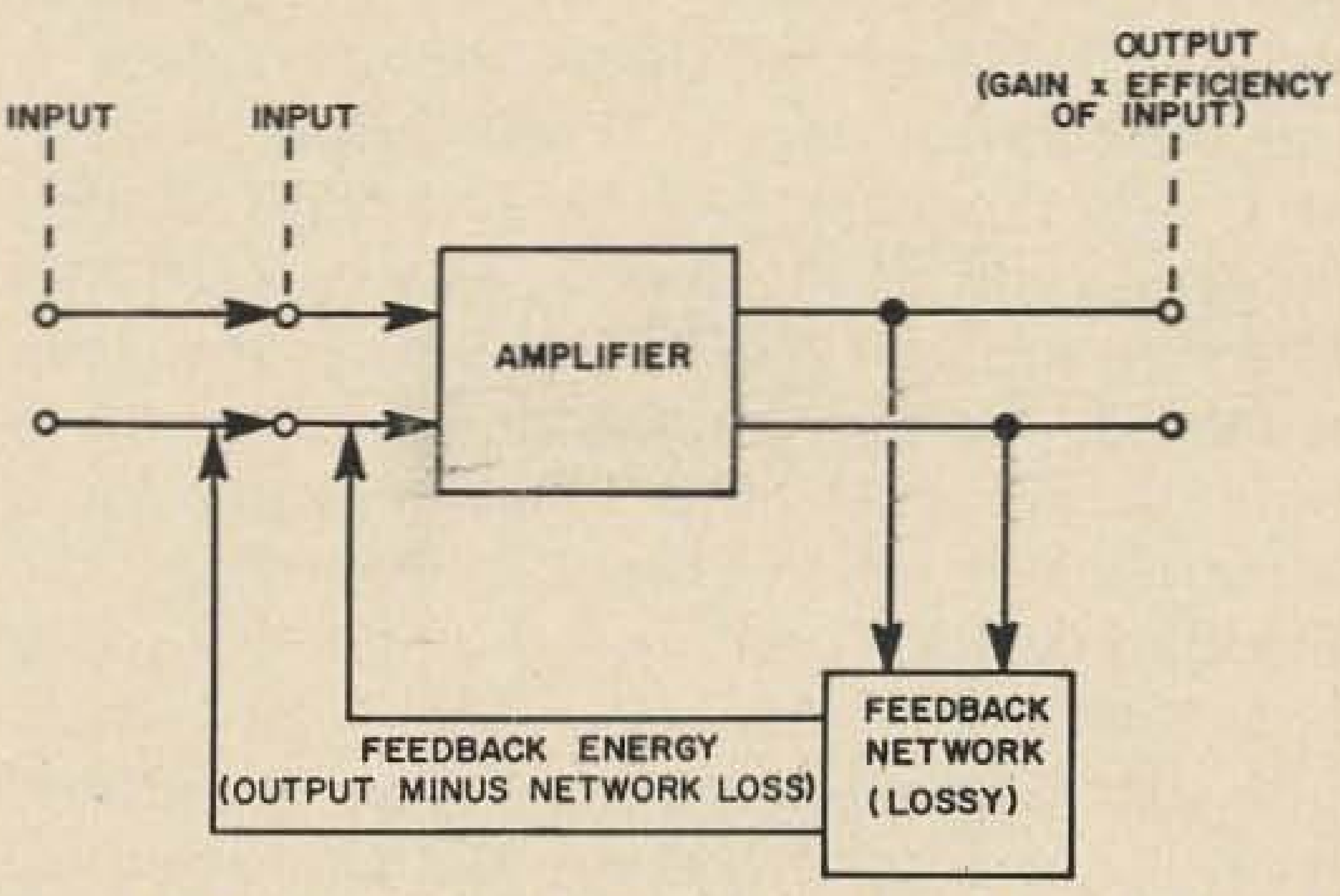


Fig. 1. Here's how feedback works. The feedback network takes amplifier output and reduces it to the desired "feedback fraction". This feedback energy is applied to the input and either cancels out or adds to the actual input energy, to produce the "effective input". The effective input is amplified so that output is equal to effective input times amplifier gain.

When we take the circuit of **Fig. 1** and apply a bit of the amplifier's output back to its input as an additional input signal, we can always control both the amplitude and the phase of the "feedback" signal. This statement is true only if the feedback is deliberately designed into the circuit; accidental feedback cannot be controlled.

Suppose, for instance, that we had an amplifier with a gain of 10, and that we take 1/10 of its output back to the input. Suppose, additionally, that we arrange for this feedback signal to be exactly 180 degrees out of phase with the input signal which produces it.

A 1-volt input signal, in the absence of the feedback, would produce a 10-volt output. One-tenth of this, or 1 volt, is used as feedback. Since it is 180 degrees out of phase, it would exactly cancel the original input signal.

But this leaves us with no input signal at all, and this in turn makes the output level zero. One-tenth of zero is still zero; this means we have no feedback now. Nothing is available to cancel out the input, and output comes back to 10 volts.

The apparent contradiction here actually doesn't happen in fact, because it takes a finite amount of time (even though it's only a few billionths of a second) for the feedback to appear and do anything.

For example, when the 1-volt input is first applied the output rises to 10 volts—but to get there it must pass through all the voltage values between 0 and 10. And as it does so, 1/10 of each of those voltage values is fed back to the input. When output level is at 1 volt, feedback is 1/10 volt. This cancels out 1/10 volt at the input, leaving 9/10 volt effective input signal. By the time this loop is closed (because of the amplifier's built-in time delay) the output has already risen some. If it is up to 2 volts by this time, the feedback is 2/10 volt and the effective input is cut down to 8/10 volt. With 8/10 volt input the maximum output value is reduced from 10 to 8 volts; before this can level off, though, the output has still been rising.

When output level gets up to 5 volts, the feedback voltage has risen to 5/10 volt. This leaves an effective input level of 5/10 volt; since the amplifier's gain is 10, the output level with a half-volt input will be 5 volts. Output level stops rising and stays fixed at the 5-volt level.

The net effect of feedback upon this amplifier, then, was to reduce the gain from 10 to 5.

Any time the feedback voltage is 180 degrees out of phase with the input signal, the primary effect is to reduce the amplifier's gain. The amount of gain reduction depends upon the original gain of the amplifier, and upon the amount of feedback. Gain can be reduced almost, but never quite, to zero. Remember that any gain value less than 1 represents an actual *loss* in voltage or current (but may represent a gain in power, and frequently does so). The cathode follower is an excellent example of such a use of feedback; in this case 100 percent of the output is fed back to the input. Gain is always less than 1.

Let's take that same example amplifier with a gain of 10 and try another application of feedback to it. Let's feed back only 1/100 of its output this time, but we'll feed it back with zero phase difference. This—in-phase feedback—is known as "positive" feedback; feedback out of phase (180 degrees difference) is known as "negative" feedback.

With an input signal of 1 volt, output without feedback is 10 volts. The feedback, 1/10 volt, adds to the input signal though, raising it to an effective 1.1 volts. Output then rises to 11 volts. This increases feedback-plus-original input to 1.11 volts, and output comes up a little more to 11.1 volts. The loop goes on and on, with output climbing a little higher each time. Every increase in the output increases the input signal by 1/100 as much, and in turn increases the output by 1/10 as much.

While it might appear that the process could never end, it comes to a practical halt when the new increase in feedback signal is so small that it's smaller than the random noise level always present in any electrical circuit, and the output will stabilize at about 1.11111111 volt (the exact number of decimal places to include depends entirely upon the accuracy of your test equipment).

If we increase the positive feedback percentage to be 5/100 of the output with the gain still fixed at 10, we get similar results but with a much larger increase in effective gain.

A 1-volt input gives 10 volts out, and a feedback signal of 1/2 volt. This raises the effective input to 1.5 volts and gives us a 15-volt output signal. This, in turn, increases the feedback signal to 3/4 volt and brings effective input level up to 1.75 volts. Output, in turn, climbs to 17.5 volts. Now the feedback amounts to 7/8 volt, or 0.875 volts, and effective input climbs to 1.875 volts. Output comes up to 18.75 volts.

No matter how many times we follow this loop around, though, the output will never get higher than 20 volts with a 1-volt input signal. In fact, it won't even reach 20 volts in any practical number of repetitions. Since it takes only a few billionths of a second for our signal to make the trip around, it can reach the 20-volt level rather rapidly.

To prove that the 20-volt level can't be

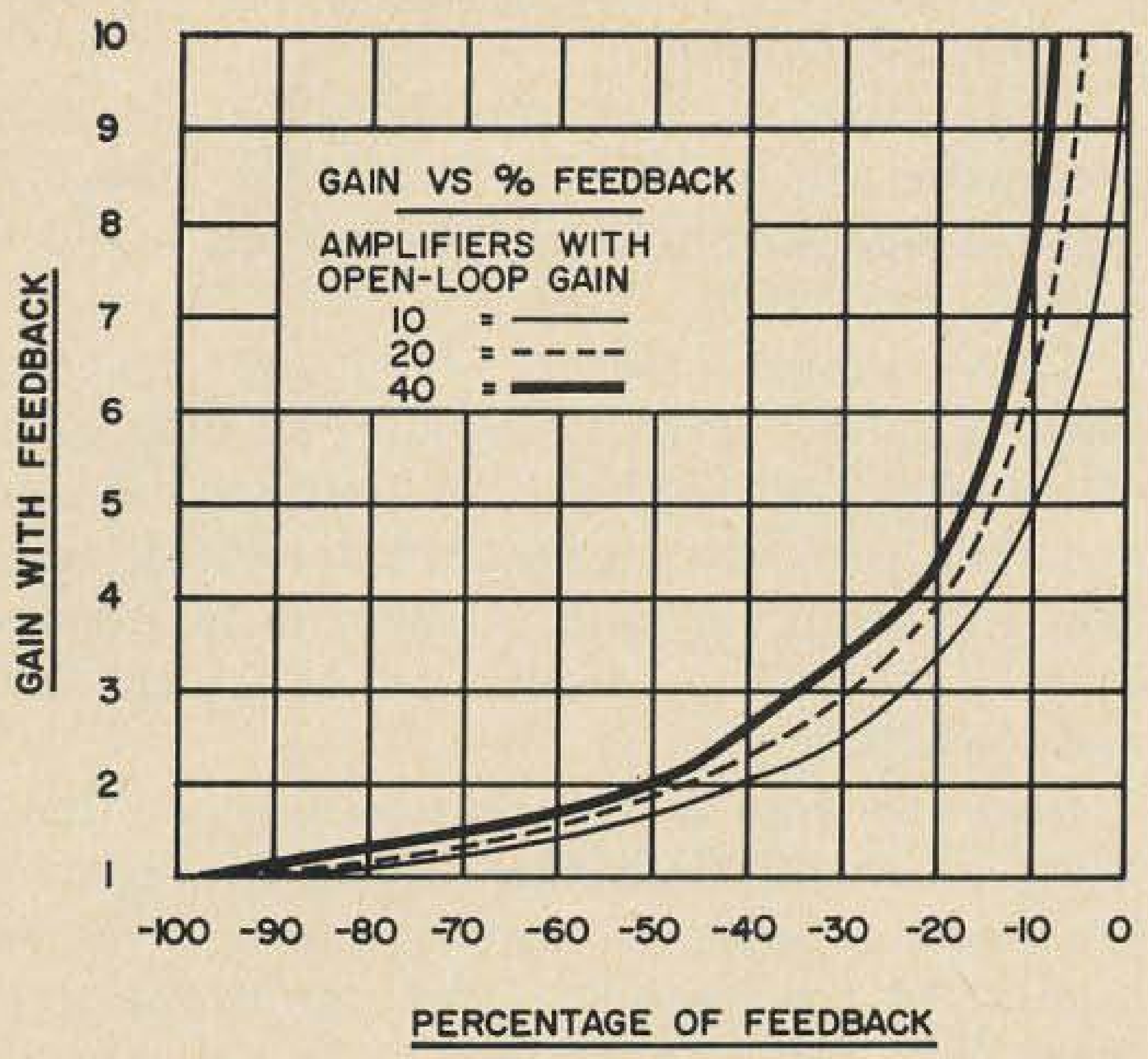


Fig. 2. Gain-with-feedback for various feedback fractions ranging from 100% negative feedback up to 10% positive feedback.

exceeded, let's assume that we have reached the 20-volt point. Our feedback fraction is 5/100 so the feedback voltage is exactly 1 volt. This 1 volt adds to the original 1-volt input for 2 volts effective input. The amplifier's gain of 10 brings this up to 20 volts. But that was the output we assumed we already had; there was no increase in output.

If we increase the feedback percentage to 99/1000 of the output, we get fantastic gain from our originally modest amplifier. Without going through the loops to prove it (you can, if you like, just as we did above), we'll just say that the effective gain is 1000. This is 100 times greater than that of the amplifier alone.

What we have been showing is that negative feedback always reduces gain, and positive feedback always increases it.

In older days, positive feedback was known as "regeneration" and negative feedback as "degeneration"; you may find this language on examination questions since it is still in wide use among oldtimers. One of the clearest examples of the use of positive feedback is the regenerative receiver.

The effects of feedback upon gain are wrapped up in a single algebraic formula which is just as worthy of being memorized as is Ohm's law. It goes:

$$\text{Gain}_{fb} = \frac{\text{Gain}}{1 - (\text{FB}) \times (\text{Gain})}$$

And means that the gain *with* feedback is equal to the gain *without* feedback, divided by the remainder when the product of feedback fraction and gain is subtracted from 1. If feedback is negative, the sign of the feedback fraction is also negative and the "subtraction" process turns into addition. If feedback is positive, the feedback fraction is positive and the product is subtracted from 1.

The results of this formula are shown as graphs in **Figs. 2** and **3**. These graphs were traced from several produced by an electronic digital computer solving the feedback formula for amplifiers with fixed gains of 10, 20, 30,, and 40, and show the gain-with-feedback for various feedback fractions ranging from 100 percent negative feedback up to 10 percent positive feedback.

Notice how rapidly the gain-with-feedback figure climbs, in **Fig. 3**, when the product of feedback fraction and amplifier gain gets close to 1. With amplifier gain of 10 and feedback fraction of 10 percent, or amplifier gain of 20 and feedback of 5 percent, or gain of 40 and feedback of 2.5 percent, the gain figures run right off the top of the scale despite several changes of scale calibration.

A look at the formula shows why this happens. When the product of feedback and gain equals 1, and feedback is positive, the gain-with-feedback becomes Gain/0. Division by zero, though technically not possible, appears to yield a quotient of "infinity." This would indicate that gain becomes infinitely large under such conditions.

Assume, for example, that we take our gain-of-10 example amplifier and put in 10 percent positive feedback. We already know that if it has 9.9 percent (99/1000) feedback, it has a gain of 1000 and that increasing the feedback any more will increase the gain also.

Remember, too, that every circuit has at least a microvolt or so of random "noise" signal circulating at all times.

This millionth-of-a-volt "noise" signal would be amplified by at least 1000 times to produce a 1-millivolt output, with 9.9 percent feedback. With feedback of 9.99 percent, the output would be 10 millivolts. With 9.999 percent feedback, we would get 1/10 volt output. With 9.9999 percent, 1 volt out. The closer we get to 10 percent, the closer the gain becomes to "infinite".

But if gain is "infinite", then we need have no input signal at all—not even the

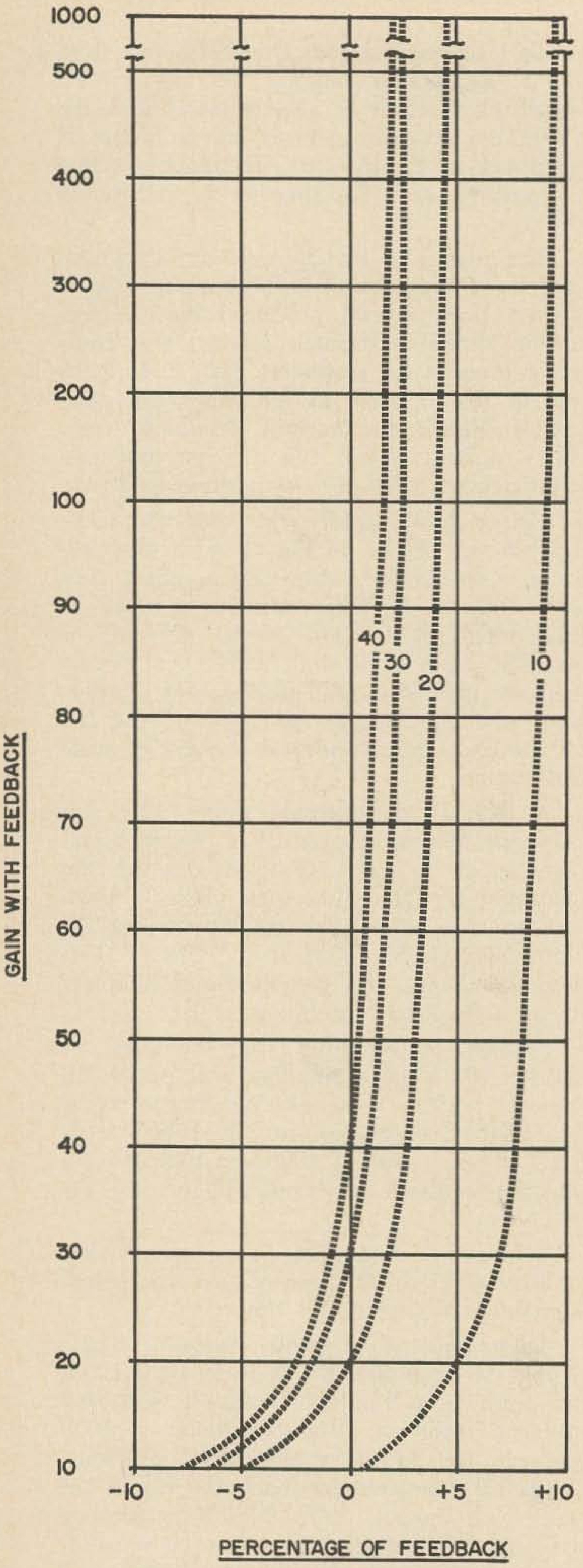


Fig. 3. The gain-with-feedback figure climbs rapidly when the product of feedback fraction and amplifier gain gets close to 1.

inescapable "noise"—to produce all the output we might want!

The result is that this amplifier is now producing all the input it needs; no "outside" input is necessary. We have, in fact, made it into an oscillator.

That simple factor, feedback fraction times amplifier gain, is actually an indication of whether any circuit can oscillate. Whenever the product of positive feedback fraction and amplifier gain is equal to or greater than 1, then the circuit not only can but *must* oscillate.

And this fact is the reason why we have spent so much time developing the idea of feedback, in order to answer questions about oscillators, parasitics, and neutralization. Now that we know why a circuit can oscillate, we're ready to look at the details.

We have two major types of feedback, positive and negative. To oscillate, a circuit must have positive feedback, and the "criterion of oscillation"' that feedback times gain must equal 1 (or more) must be satisfied. Any less feedback will prevent oscillation.

If both positive and negative feedback are present in a circuit, that feedback with the smaller feedback fraction will cancel out part of the other kind, so that the result is always just one kind of feedback—but with a smaller amount of it.

This means that if we have an amplifier which has, by accident, enough positive feedback built into it so that it oscillates, we can deliberately add some negative feedback to cancel out part (or all) of the positive feedback and halt the oscillation.

This process is called "neutralization" when it is applied to an rf amplifier.

In some cases, it's easier to visualize the neutralization process with some other images of it, but it always involves putting in some negative feedback to make oscillation impossible.

"Parasitics" are oscillations in an rf amplifier (or other rf circuit) which are not wanted and which have no apparent relation to the desired functioning of the circuit. For instance, many amplifers in the HF range (3-30 MHz) have parasitic oscillation in the VHF range between 40 and 400 MHz.

These oscillations usually occur because of accidental feedback paths from output to input, which are effective only at the higher frequencies. Often, they are due to

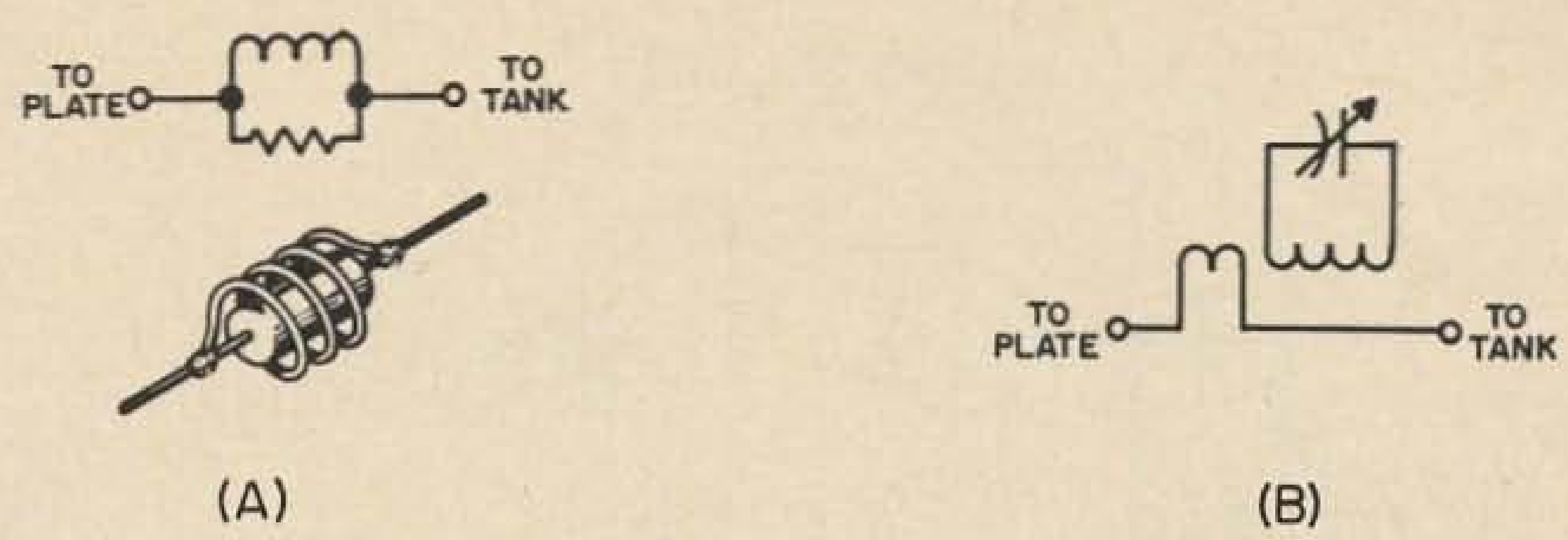


Fig. 4. Parasitic suppression is simple to accomplish. These suppressors kill gain at the parasitic frequency without appreciable effects at the desired frequency of operation. See text for details.

physical charactistics of the tubes and other circuit components. For instance, the connecting leads from amplifier-tube plate to its tank circuit may show up as a high-impedance resonator at VHF, while the tube's gain may still be adequate to make oscillation possible.

In addition to providing spurious and illegal output signals, parasitics are rather destructive to equipment. Since they were not accounted for in the original design or in the operating and tune-up procedures, they often cause tubes to draw excessive current. The high voltages generated by the resulting unloaded oscillator also cause breakdown of insulation and overheating of coils. And it's almost an inviolable rule that an amplifier full of parasitics won't amplify the intended signal properly. The parasitic changes the tube's operating point in an unpredictable manner. Linear circuits become mixers, mixers act as distortion generators, etc.

Fortunately, parasitics are relatively easy to control once they are identified and traced to their originating stage. The control is so easy that most published construction projects, and virtually all factory-designed gear, includes parasitic suppression as a basic part of the design. The trick is simply to destroy gain at the parasitic frequencies. Then oscillation is impossible.

Two of the most common techniques for killing gain at parasitic frequencies are shown in **Fig. 4**. The simplest of the two works in most cases, and is recommended whenever the parasitic is at a frequency far removed from that at which the circuit is supposed to operate.

This suppressor consists simply of three or four turns of No. 18 or No. 20 wire wrapped around a 47-ohm 1- or 2-watt composition resistor. The wire acts as a tuning coil, tuned by its own distributed capacitance, for the parasitic frequency, and the resistor swamps out the Q of the circuit. This reduces gain below the critical amount needed for oscillation. At the normal operating frequency, the few turns of wire have almost no effect except—and this is vital—to short out the resistor so that it can't affect normal operation either.

When parasitics occur close to the desired operating frequency, though, the simple and direct approach doesn't do much except cut down on desired output and burn up suppressors. Then the link-coupled suppressor of **Fig. 4** must be used. In this one, the trimmer capacitor and small coil together couple all the parasitic energy out and trap it, without affecting output at the desired frequency. The trapping tank reduces circuit gain at the parasitic frequency so much that it can't oscillate, but has little or no effect at operating frequency. This is especially recommended for the 50-MHz operation and higher frequency use.

Another key point in the prevention of parasitics is to take care in construction of the circuit originally. Make sure that no "sneak" paths exist to couple output back to input at parasitic frequencies. Use single ground points whenever possible. VHF and UHF operators normally experience less parasitic troubles than do their HF brethren, simply because the construction care required to make VHF and UHF amplifiers function at all also acts as built-in parasitic suppression. The moral is: build every rig as if it were a UHF unit, and less parasitic problems will result.

When we *want* a circuit to oscillate, we still want to be certain that it oscillates only at the frequency we desire. Contrary to some beliefs, it's not only possible but easy for an oscillator to suffer parasitics. It's only more difficult to find them, since the desired rf oscillation is always in the circuit and many of the standard tests for parasitics (output in the absence of input, etc.) do not apply.

At low power levels, such as those in-

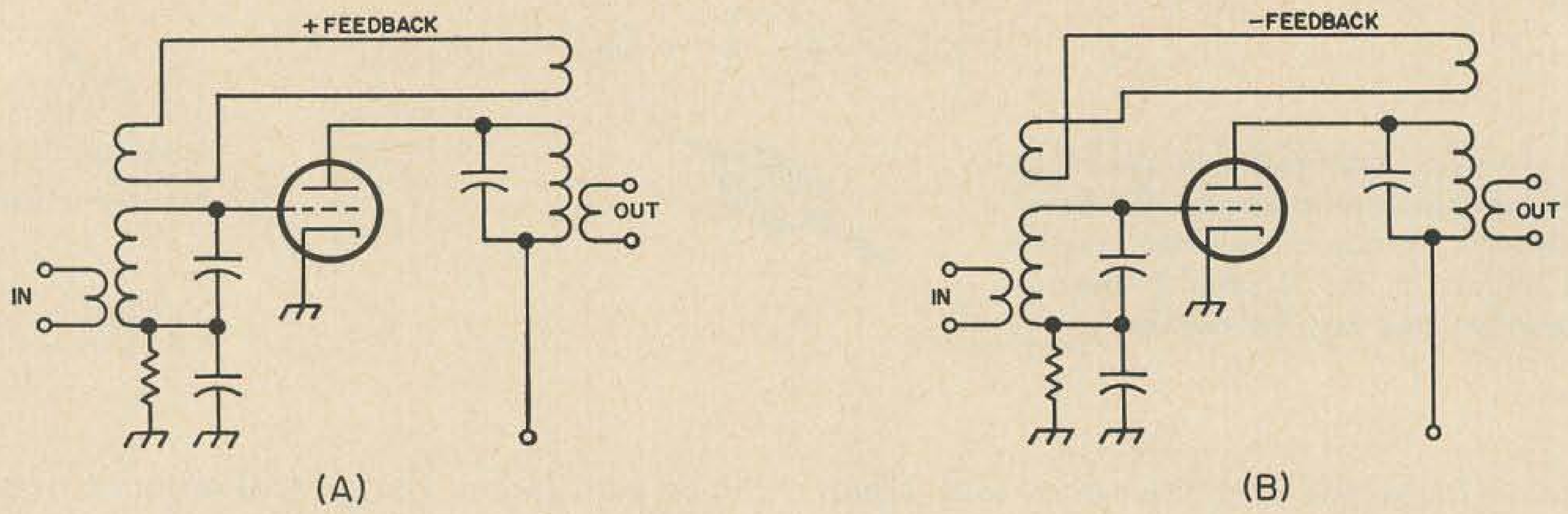


Fig. 5. Similarities between oscillator (A) and neutralized amplifier (B) are shown here. Particular type of neutralization shown is called "link neutralization" since link coupling of input and output are used. Note that only difference is reversal of connections between links, to reverse phase of feedback energy.

volved in most oscillators and all receiving rf amplifiers, and at low frequencies, one of the most effective parasitic-stoppers is a 1000-ohm ½-watt composition resistor connected to the grid pin of the tube, in series with all other grid connections. This reduces gain slightly, but the reduction is much more marked at parasitic frequencies than at the normal operating point.

While we're on the subject of oscillators it's a good time to go into some of the details we need about them. The only major difference between an oscillator and a neutralized amplifier is the phase of the feed back. It follows that there are as many ways to arrange an oscillator circuit as there are to apply feedback around a loop—and each way has its own name.

When dealing with rf oscillators, though, we find there are two major classes. All, of course, are tuned to some specific frequency, and the classifications deal with their tuning.

The two major classes are "fixed tuned" and "variable frequency" oscillators. Most "fixed tuned" oscillators employ quartz crystals as their tuning elements, and consequently the more common names for the classes are "crystal" and "variable frequency" oscillators.

This isn't the right place to go into extreme detail on how a quartz crystal works. We'll just say for now that it acts the same as a very-high-Q tuned circuit, and looks the same to the oscillator.

The tuned circuit, whether fixed (crystal) or variable (L-C), can be considered as a part of the amplifier inside the feedback loop. It serves to make the amplifier's gain variable with frequency. At the frequency to which the circuit is tuned, gain is maximum; at all other frequencies, gain is lower.

The feedback formula shows us that any feedback circuit will oscillate if feedback is positive and the gain-feedback product is greater than "1". This, in turn, shows us how feedback affects an oscillator.

If too much feedback is used the gain-feedback product will exceed "1" over a band of frequencies rather than at a single point. If not enough feedback is available, the product will never be greater than "1" and the circuit cannot oscillate. For most stable operation, the gain-feedback product should equal "1" *only* at the frequency at which output is desired. This means that control of feedback is somewhat critical.

The higher the "Q" of the tuned circuit, the greater will be the gain and the less feedback will be necessary for high stability. This is sometimes described as a "lightly coupled" tuned circuit, but either image of the process is equally correct.

Fig. 5A shows one type of oscillator circuit; we'll look at quite a few other types in a later part of this article.

Right now, let's move over to "neutralization." The major difference—in theory, at least—between a neutralized amplifier and an oscillator is the phase or "sign" of the feedback.

For example, **Fig. 5B** shows a triode rf amplifier neutralized by the "loop" method. Notice the similarity between this circuit and that of **Fig. 5A.**

Neutralization is necessary in most rf amplifiers which operate at any appreciable power level because inescapable stray feedback usually exists. Since it is not controlled, it may be either positive or negative in sign.

If it's positive, and if the amplifier has enough gain, oscillation will result.

Even if no oscillation occurs, the "regeneration" that does exist will make the amplifier's performance somewhat unpredictable. It can easily cause a "linear" to produce distortion at only one or a few specific output power levels. This means distortion may occur during only a part of a syllable, with the amplifier operating perfectly at all times. Such problems are difficult to locate and correct; neutralization of the amplifier is always a recommended first step.

A *perfectly* neutralized amplifier will have no effective feedback; all that is accidentally present has been cancelled out by that put in during the neutralization process. Most neutralized amplifiers are slightly over-neutralized. The only effect of this is a slight reduction in gain—coupled with the provision of a safety margin, should operating conditions change slightly. A badly overneutralized amplifier, though, *may* oscillate. In theory, it shouldn't but when excessive feedback of either sign is present an rf amplifier often changes its characteristics so that the sign of the feedback changes also. This is sometimes attributed to Murphy's First Law of Physics, which declares that "If anything *can* go wrong, it will!"

We mentioned in passing earlier that in some cases, the "feedback" approach might be more complicated than an alternative. **Fig. 6** shows this alterantive. **Fig. 6A** shows the actual circuit of the "bridge neutralization" idea, while the active part of the circuit appears in **Fig. 6B**.

The idea here is to account for all feedback paths as legs of a bridge circuit, and then to balance the bridge so that no path exists between the input and the output of the amplifier except that feedback-free path provided by the electron stream within the tube. Stray capacitances involved are shown as dotted-line components and leads in **Fig. 6A**, to identify their nature, and similarly in **Fig. 6B**, to show where they fit into the bridge.

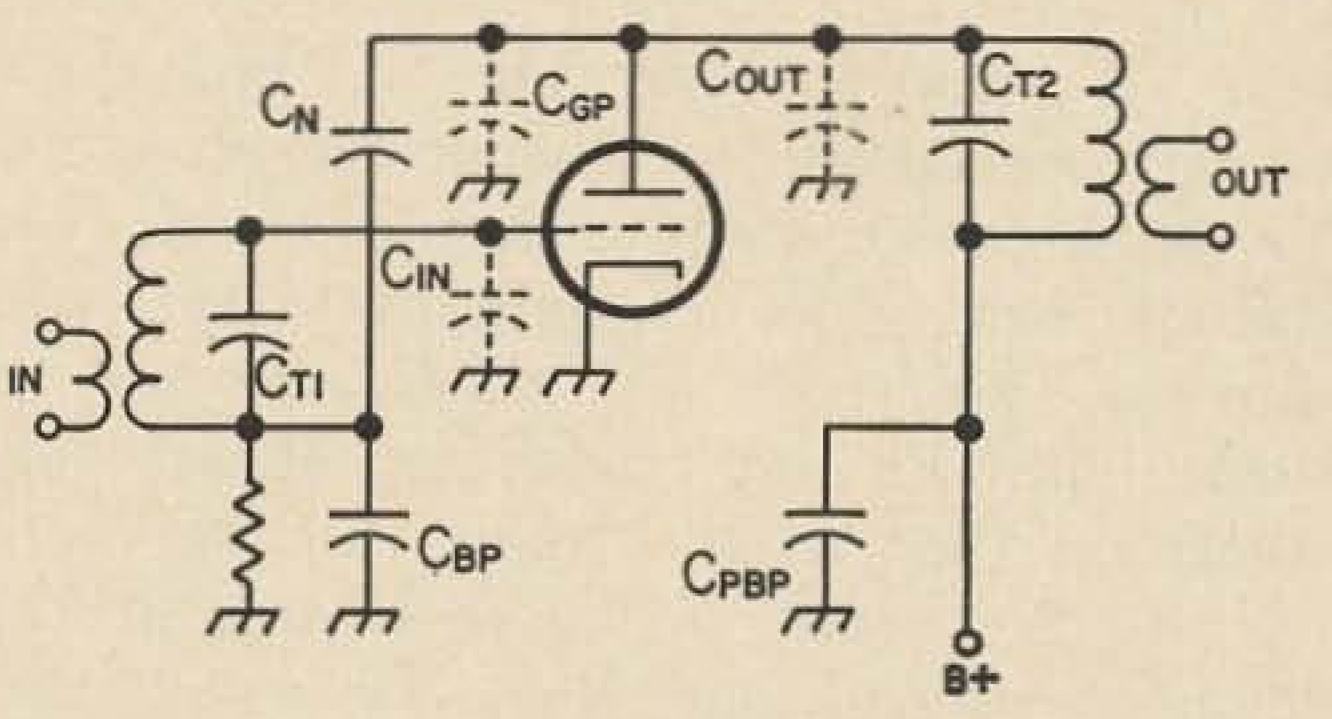
This circuit is neutralized by adjustment of the value of capacitor C_n. The great advantage of this circuit over more common means of neutralization is that it may be adjusted with full power applied, under operating conditions, since the adjustment is far removed from the high-voltage area of the amplifier. More conventional feedback approaches usually may be adjusted safely only when power is off; feedback paths change when power is applied, so they are more difficult to adjust accurately.

Even the bridge circuit, however, is a feedback affair. Note that the output is coupled to the input by *two* paths, and that these paths have opposite phase relationships. This is what balances the bridge—but it's also a feedback cancellation.

How Can CW Transmitters Be Properly Keyed? We could use twice as much space going more deeply into feedback, oscillation, and neutralization—but if we're going to cover all the questions this time, we must turn our attention to keying.

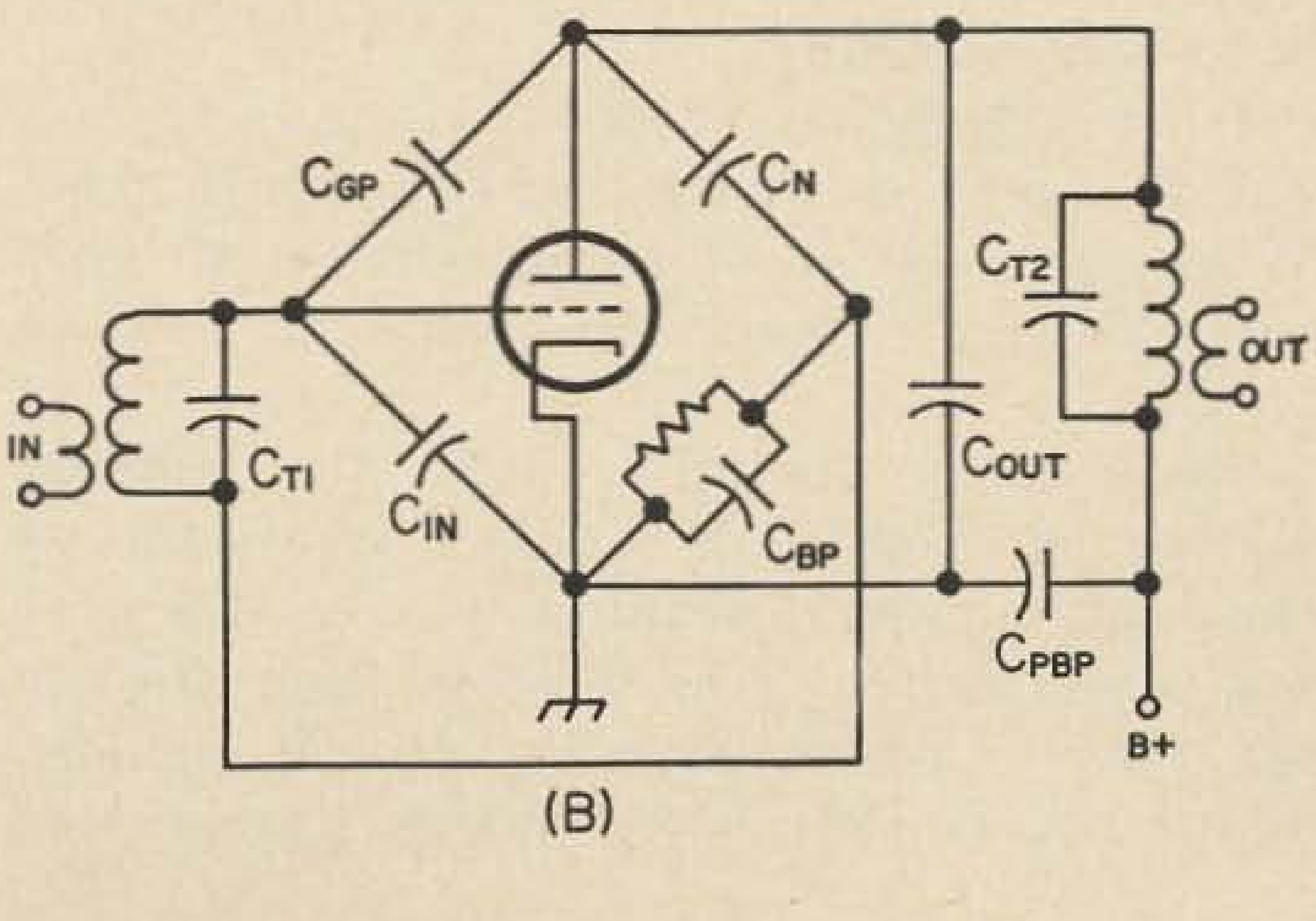
It might appear that keying of a CW transmitter is the simplest thing imaginable. All we need to do is to let the rf go out when we want a dit or a dah, and hold it in the rest of the time.

Unfortunately, it's not all that simple. The keying waveform cannot be a simple and di-



(A)

Fig. 6. "Bridge" neutralization is the most common type. Circuit A is the way it is normally drawn. Circuit B amphasizes the balanced-bridge method of operation. When ratio Cn/Cbp equals Cgp/Cin, the bridge is balanced and no output signal can get back to input. Alternate viewpoint is that negative feedback through Cn balances positive feedback through Cgp.



(B)

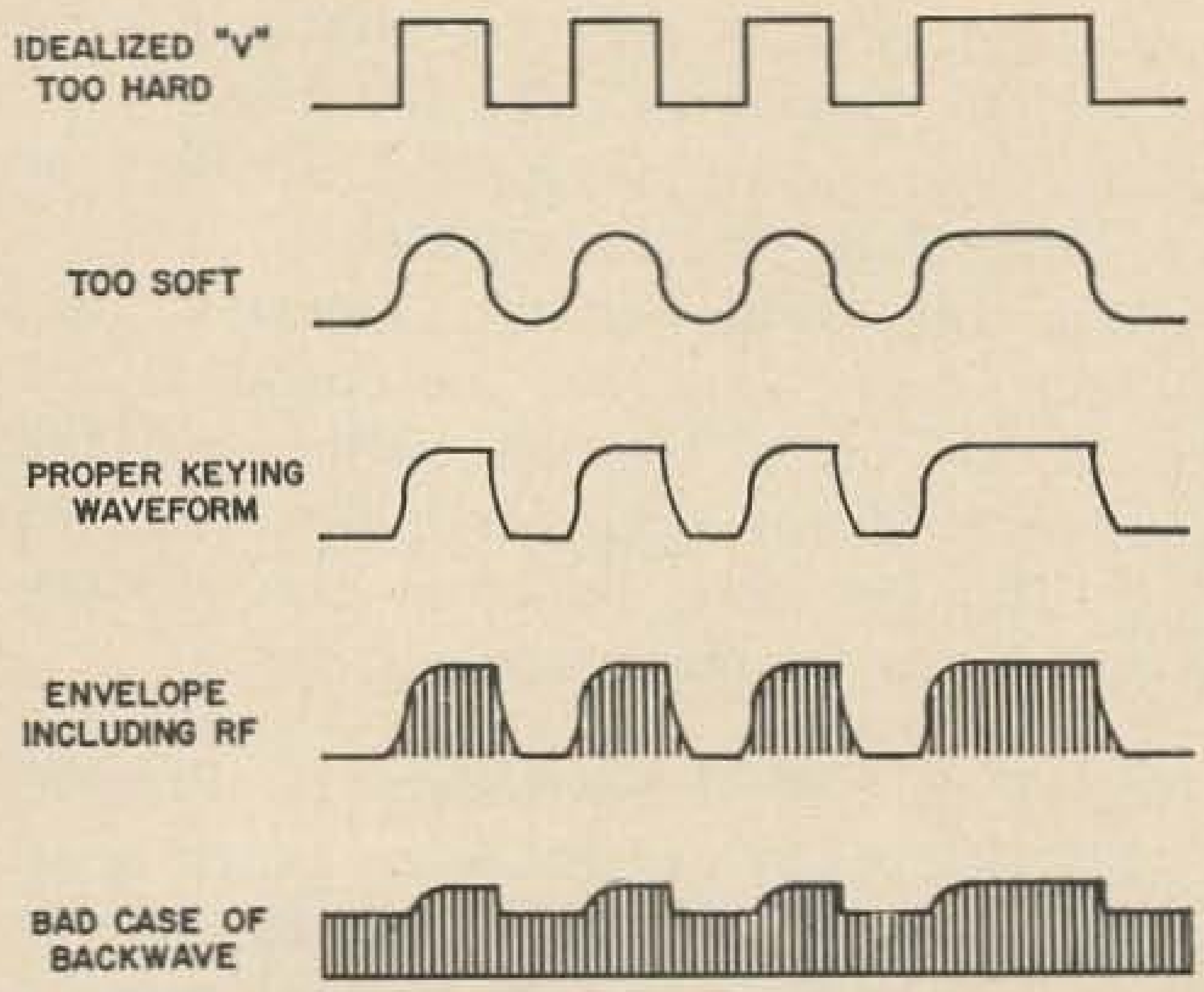


Fig. 7. Various factors in the keying of CW transmitters are illustrated here. The third and fourth lines from the top show the ideal case; the remaining three are to be avoided.

rect "make and break", because this will produce a splattering type of interference known as "key clicks". Other things can also go wrong.

Fig. 7 shows a few of the considerations involved in proper keying. All the lines in this picture represent the waveform of the letter "V", sent in CW. The top line shows the way we normally think of the character. The squared-off sharp edges, though, will produce key clicks (which are exactly the same as "splatter" or "buckshot" on the phone bands), and clicks are illegal. This waveform, then, is too "hard" for use.

If all the edges are severely rounded, as shown on the second line, we won't have any key clicks—but it may be difficult to tell when a dit or a dah ends. This keying is too "soft"; that is, it tends to run together.

The happy medium is something in between, as shown on the third line. Edges are slightly rounded, but the transitions are sharp enough to be readily distinguishable.

All three upper lines show only the keying waveform. The lower two show the actual rf output signal, both with the properly keyed waveform.

If everything is working right, you will get the output shown on the fourth line. When the key is down, maximum rf goes out. When the key is up, output is nothing at all.

Many rigs, though, suffer the ailment known as "backwave", which is shown on the bottom line. Maximum power still goes out when the key is down—but with the key up, power doesn't drop to zero. It remains at an appreciable level. We've exaggerated it here, but if even as much as 1 to 10 watts goes out (from a 1000-watt rig) that's enough backwave to be heard around the world!

Radiation of this backwave occurs because of faulty keying-circuit design, and the only cure is to bring the keying circuits up to standard. If low-power stages are keyed, then you must make sure that all stages from the keyed stage to the antenna cannot produce output when the key is up.

One of the most certain cures for backwave radiation is the installation of "full break-in"' capability. This requires that the oscillator be inoperative whenever the key is up; without any rf generator in action, it's difficult to get rf radiated. There's not room here to go into the details of achieving this (and it's beyond our scope anyhow) but most of the manuals have extensive information on break-in keying.

How Can We Use Harmonics Properly? In an earlier portion of this series, we brought out that "sidebands" were not an unmentionable ailment, but were actually necessary for any communication. "Harmonics" fall into the same category. The only bed harmonics are those which we aren't controlling.

The word "harmonic" as we use it in radio refers to a "harmonic frequency", which is any frequency that is an even multiple of some other frequency.

This is, if our original frequency happens to be 3500 kHz, then the first harmonic is the starting frequency times 1, or 3500 kHz itself; the second harmonic is 3500 times 2, or 7000 kHz; the third is 3500 times 3, or 10.5 MHz; the fourth is 3500 times 4, or 14 MHz, and so forth.

The "official" textbook definition for a harmonic is "a frequency which is an integral multiple of" another frequency. The "other frequency" which we start with is known as the "fundamental", and the fundamental and the first harmonic are always the same frequency (any number times 1 equals itself!).

It doesn't take much imagination to discover that *any* frequency must be a harmonic of at least one other frequency; the mathematicians in our midst have probably already concluded that any frequency is a harmonic of an infinite number of lower frequencies. This should make it obvious that harmonics can't be *all* bad.

As we use the term, though, we usually think of our intended output frequency as the "fundamental", and the "harmonics" we speak of then are multiples of this intended output. These harmonics, since they are *not* the intended output, are usually undesirable. The Commission frowns upon them heavily; "excessive" harmonic content for legal purposes amounts to just about any harmonic radiated at levels strong enough to be detected outside your shack.

Inside a transmitter, we frequently generate harmonics deliberately. Examples include VFO's running in the 160-meter band to produce final output at 7 or 14 MHz, and the frequency-multiplier chains which make crystal control possible at VHF and UHF.

To generate these harmonics, we usually run higher-than-normal grid bias levels on the amplifier stages involved, and drive these stages rather heavily. In addition, we tune the output circuits to the frequency of the desired harmonic, rather than to the fundamental frequency at which the stage is driven.

To avoid the generation of excessive harmonics where they are not wanted, such as in final-amplifier stages of CW or AM transmitters, we can simply reverse these practices: run the minimum necessary grid bias, hold drive to the lowest level to get desired output, and take care that the output circuits are tuned to fundamental rather than harmonic frequency.

These three simple precautions frequently are all that are necessary to control harmonics. Occasionally, though, even more steps are necessary.

One excellent method of control is to use an antenna tuner between transmitter and antenna. This puts one or two (in some designs, three) more tuned circuits in the transmission line, and helps reject any harmonic energy which may be sneaking out.

Use of single-band dipole antennas (half-wave center-fed) provides excellent reduction of even-order (2nd, 4th, 6th, etc.) harmonics since these frequencies see very bad mismatch at the antenna. It doesn't help much against the 3rd, 5th, 7th, etc., though, since odd-order harmonics see almost as good a match as does the fundamental frequency. Fortunately, most antenna tuners do an excellent job of reducing the 3rd and higher harmonics, and if any harmonics get through one usually only the 2nd gives trouble. This means that using both a tuner and a single-band antenna will normally assure freedom from harmonics.

Low-pass filters of the TVI-prevention type are frequently used in efforts to reduce harmonics, but their effectiveness is appreciable only in the 10-meter band. Any low-pass filter which will pass 10 meters cannot reject the 2nd harmonic of 20-meter energy —and usually won't do very well at reducing 2nd harmonics on 15 meters either!

Experience has shown that most hams having trouble with too many harmonics are also having trouble in tuning their finals. A careful check on the final-amplifier tuning will go far toward eliminating the most frequent cause of citations for "excessive harmonic radiation".

How Many Types of Oscillators Are There? One of the FCC study questions—number 17 on the list—calls for a listing of "some common types" of oscillators employed in amateur equipment. To answer this one, you'll need to know the characteristics of several of the common oscillator circuits.

Any oscillator consists of an amplifier together with a positive-feedback network to permit oscillation. Additionally, any oscillator used to generate rf at a fixed frequency contains a tuned circuit or "resonator" to control the frequency of oscillation.

Either an L-C circuit or a quartz crystal may be used for frequency control. The two are equivalent in their action, but the crystal is much more precise (and much less easy to vary in frequency rapidly). Most of the common oscillator circuits come in either VFO or crystal varieties.

The feedback network may be located almost anywhere in the circuit, so long as it manages to couple a part of the output back to the input. It may be in the plate circuit (Armstrong, TPTG), in the grid circuit, or in the cathode (Colpitts, Hartley).

Figs. 8 through 12 shows some of the more common rf oscillators used in amateur equipment. In each of these, the feedback network is indicated by heavy lines. While all are shown with link-coupled output from the resonators, in practice many other types of output coupling are possible. We'll go into this in a little more detail after we examine the features of the various types.

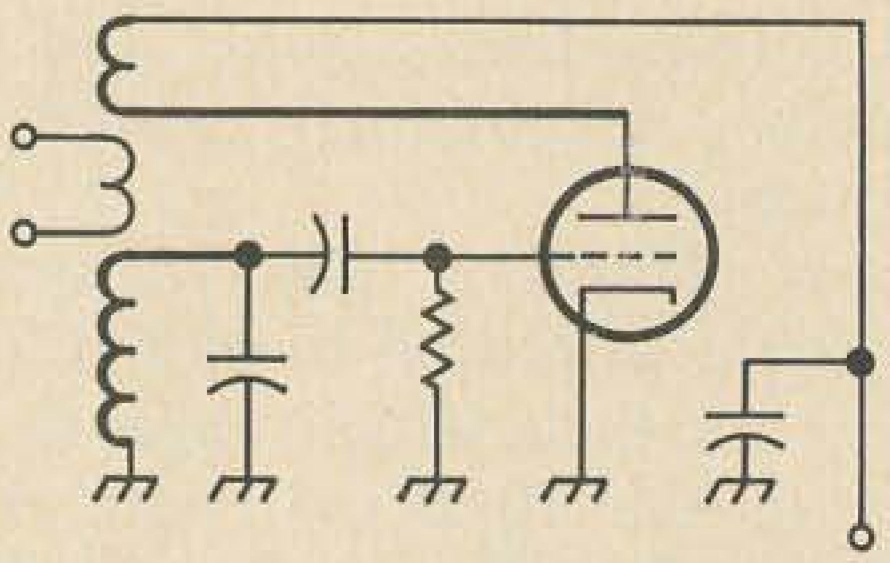


Fig. 8. Armstrong oscillator; feedback is via "tickler" coil.

Fig. 8 shows the circuit known as the Armstrong oscillator, which places the resonator in the grid circuit and couples the output back through a link or "tickler coil" directly to the resonator. This was the original oscillator circuit, but is now used only in receiver circuits if at all.

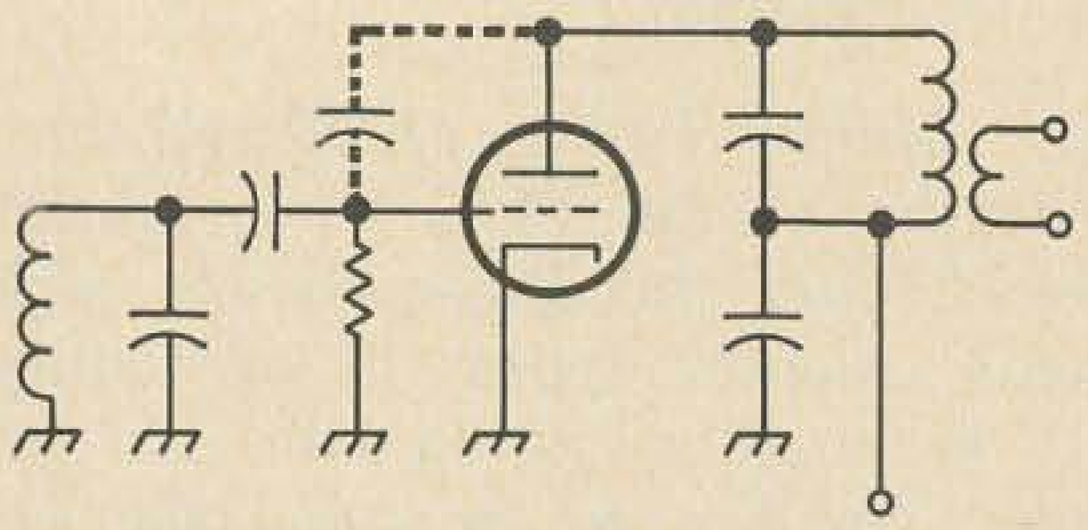


Fig. 9. Tuned-plate tuned-grid oscillator has feedback through grid-plate capacitance of tube.

Fig. 9 shows the "tuned plate tuned grid" circuit, with separate resonators in the grid and plate circuits. The feedback path here is through the tube itself; the circuit is identical to a triode amplifier *without* neutralization. To oscillate, the plate circuit must be tuned to a frequency slightly different from that of the grid. Stability isn't the best; the circuit is now used only seldom in this form.

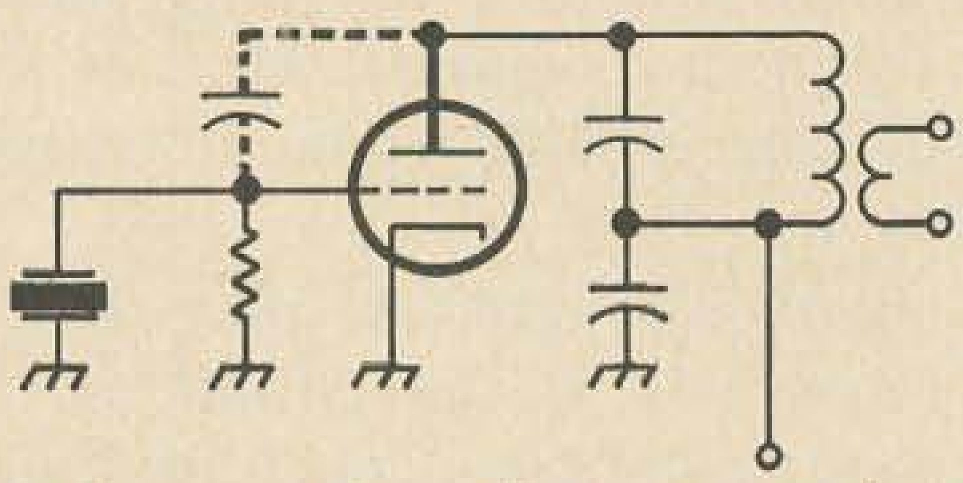


Fig. 10. Miller crystal oscillator is simply a crystal version of TPTG circuit (Fig. 9.), with crystal replacing grid tank circuit.

It does, howevr, lead directly to the Miller crystal oscillator circuit of **Fig. 10**; the only difference is that a crystal is used as the grid resonator. This circuit is extremely stable and is widely used at all HF and VHF frequencies.

Fig. 11 shows the Hartley circuit; its identifying characteristic is the tapped resonator which provides feedback by means of the cathode circuit. This circuit is widely used in receivers, and to a smaller extent in transmitters.

Fig. 12 shows what is probably the most widely used oscillator circuit now in existence; it goes under three different names, which identify the three variants shown as "A", "B", and "C".

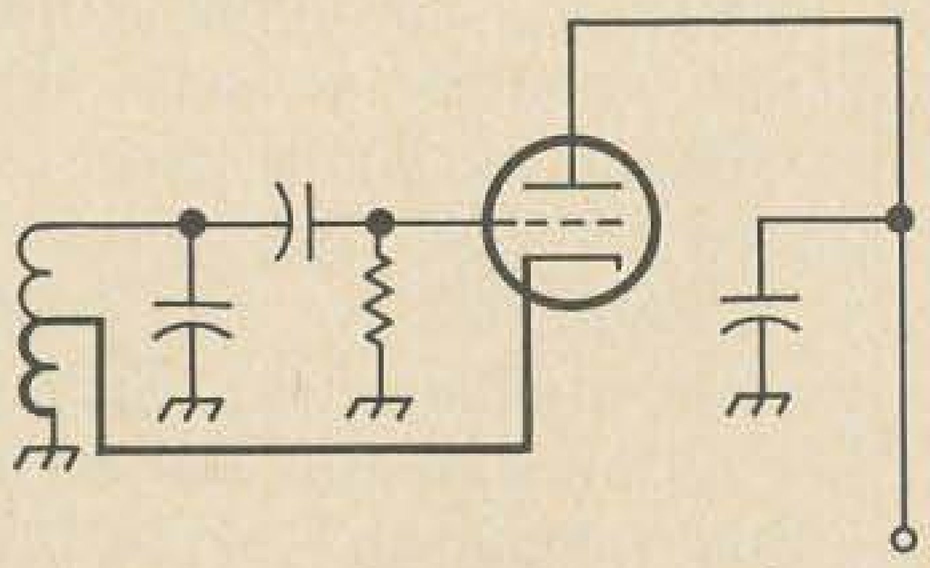


Fig. 11. The Hartley oscillator can always be identified by cathode tap on coil.

Differences in the three are exclusively in the resonator arrangements. The circuit at A is known as the Colpitts oscillator; it features a high-capacitance, low-inductance resonator, and can be designed for exceptionally precise tuning. That at B is called the Clapp oscillator; its resonator is high-inductance, low-capacitance, and is series-tuned rather than parallel-tuned. It has good frequency stability but covers a wide tuning range with very small changes of capacitance.

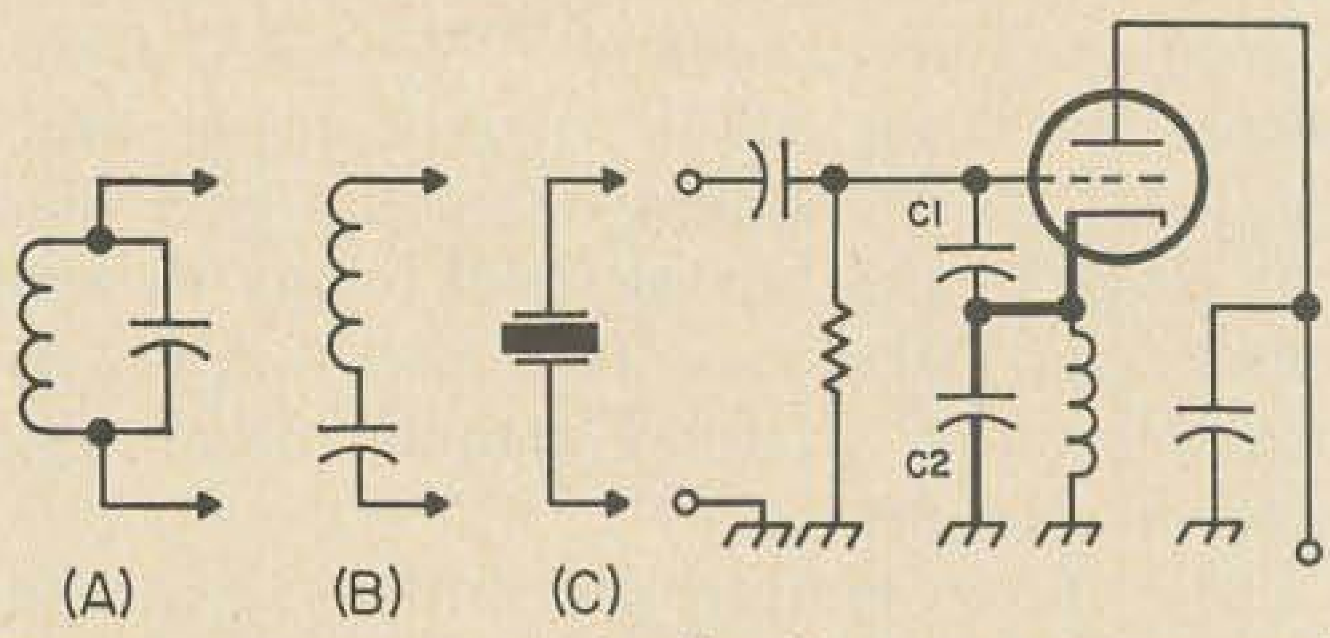


Fig. 12. Capacitance feedback circuit goes under various names, depending on the tuned-circuit arrangement. See Text.

When a crystal is used as the resonator, the circuit at C results. It is known variously as the grid-plate circuit and as the crystal Colpitts circuit.

All three obtain their feedback from the voltage divider composed of capacitors C1 and C2 in the grid-cathode circuit. Effectively the circuit is identical to the Hartley arrangement, but the feedback is easier to adjust since C2 can be a trimmer capacitor, adjusted for best operation in any given layout and conditions. This capacitance voltage divider is one of the identifying features of this group of circuits; the resonator differences are the other, which distinguishes which member of the group is being shown.

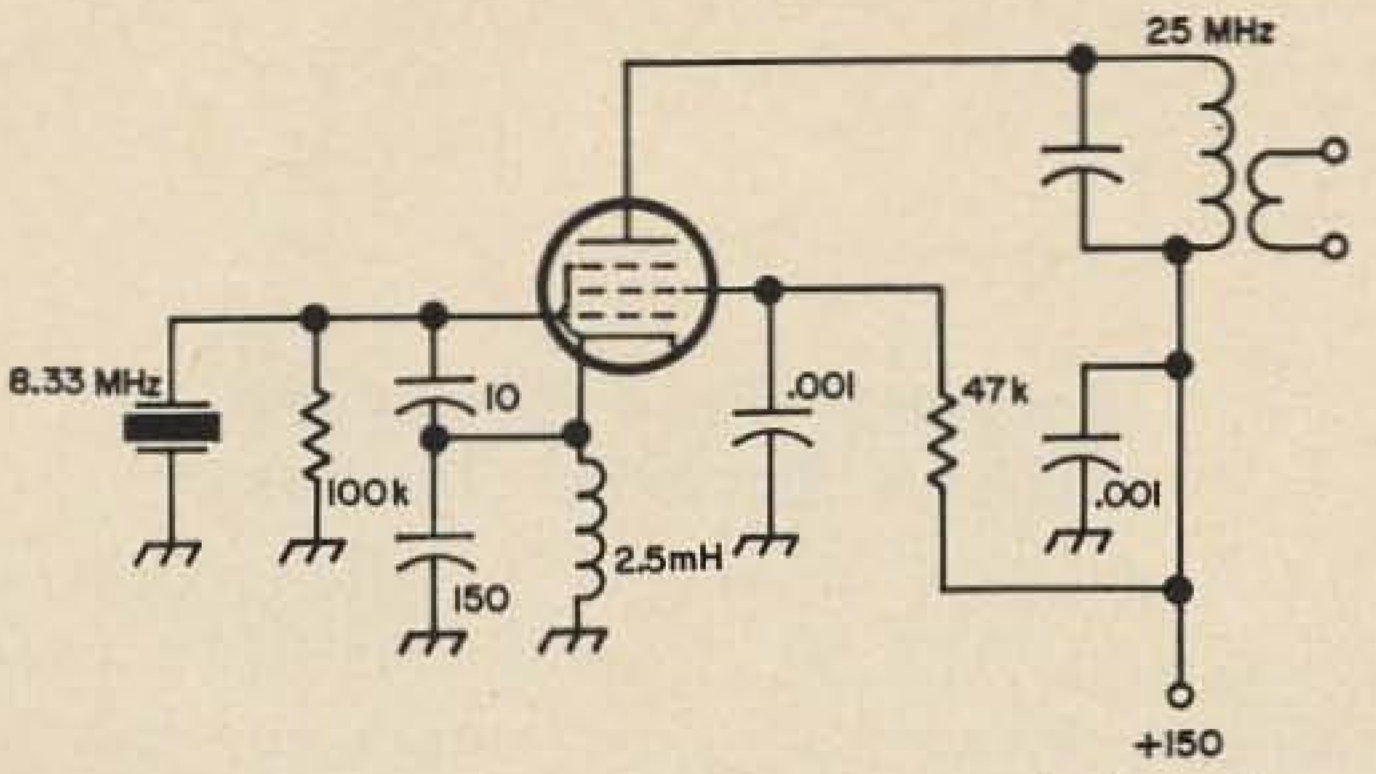


Fig. 13. Typical circuit of electron-coupled oscillator. Screen grid serves as "plate" in crystal Colpitts circuit here, while output is taken from the actual plate. Values shown are suitable for use from 7 through 9 MHz, for output from 7 through 36 MHz.

All of these circuits are illustrated with triode tubes. Any of them, however, can be made "electron-coupled" by treating the screen grid of the tetrode or a pentode as the triode plate shown in these illustrations. Output can then be taken from the actual plate, with little effect upon oscillator operation. **Fig. 13** shows a crystal Colpitts oscillator connected in this manner. The tuned circuit in the plate is adjusted for output at the third harmonic of the crystal frequency. This circuit is ideal for getting 25-MHz output from 8.3 MHz crystals, for 50-MHz transmitters.

This brief listing doesn't by any means exhaust the list of possible oscillator circuits. Almost any means of getting feedback around an amplifier can be, and has been, used. One example is shown in **Fig 14.**

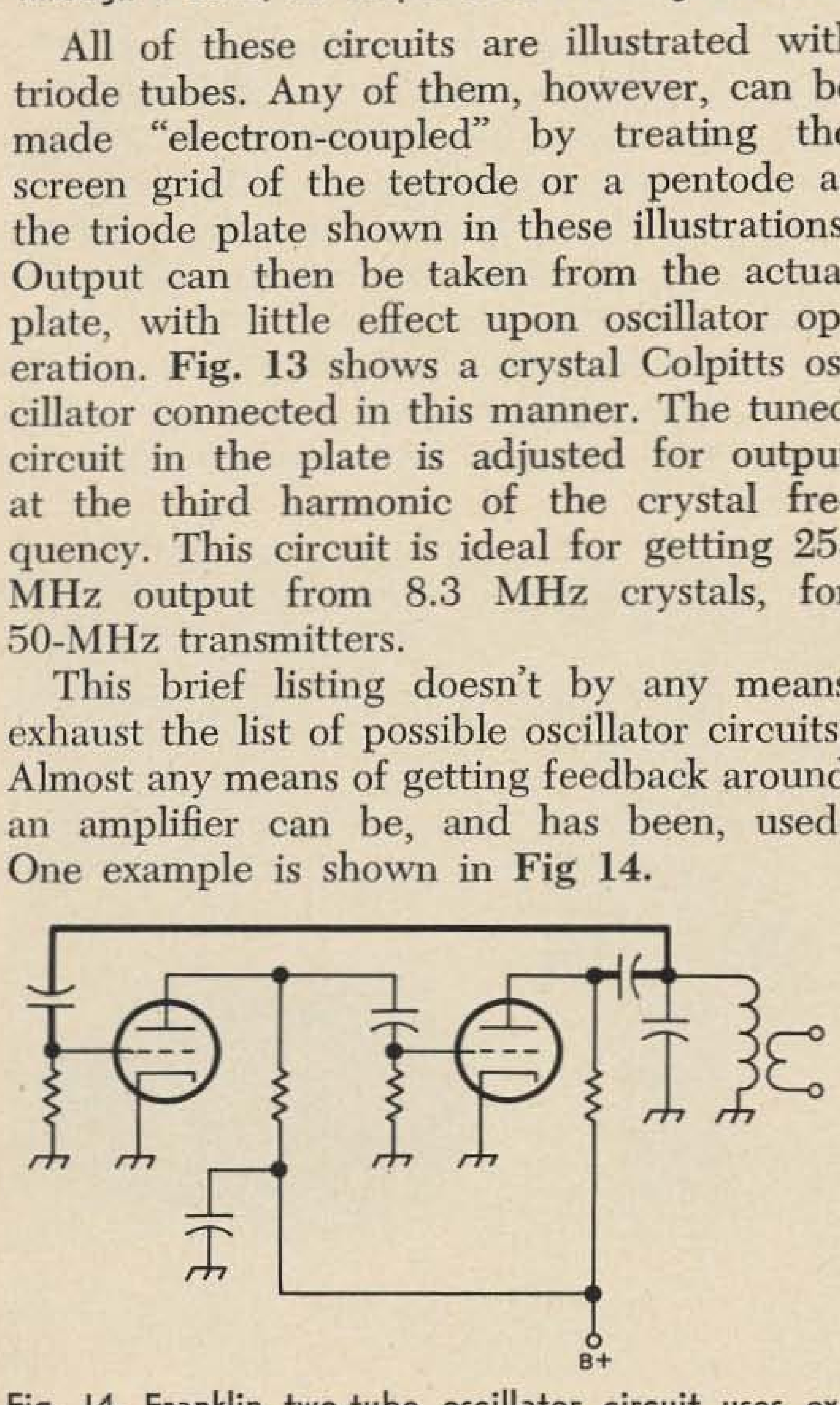


Fig. 14. Franklin two-tube oscillator circuit uses extremely small coupling capacitors to eliminate frequency drifts. This circuit, if well made with solid construction, can outperform most crystal oscillators. Output, however, is exceptionally low.

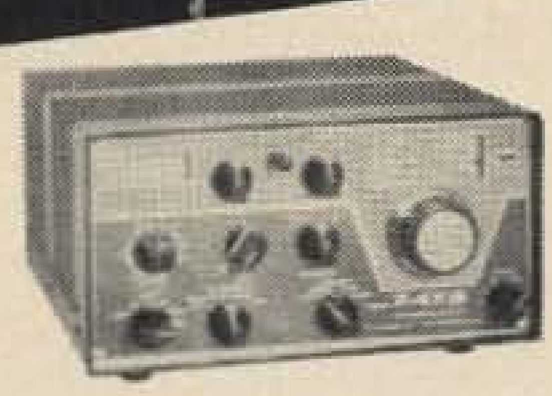
This is known as the "Franklin" oscillator; it consists of not one but two stages of amplification, connected in a loop which provides virtually total feedback. In fact, if the resonator were not connected, this would act as a multivibrator rather than as an rf oscillator.

The two capacitors which couple to the resonator are very small. One pF is a typical value for each. The resonator effectively shorts out all energy except that at the frequency to which it is tuned, and the net result is a very low actual feedback fraction —just enough to permit oscillation.

Output is very low, several stages of buffer amplification are necessary before the circuit's output can be used for any purpose.

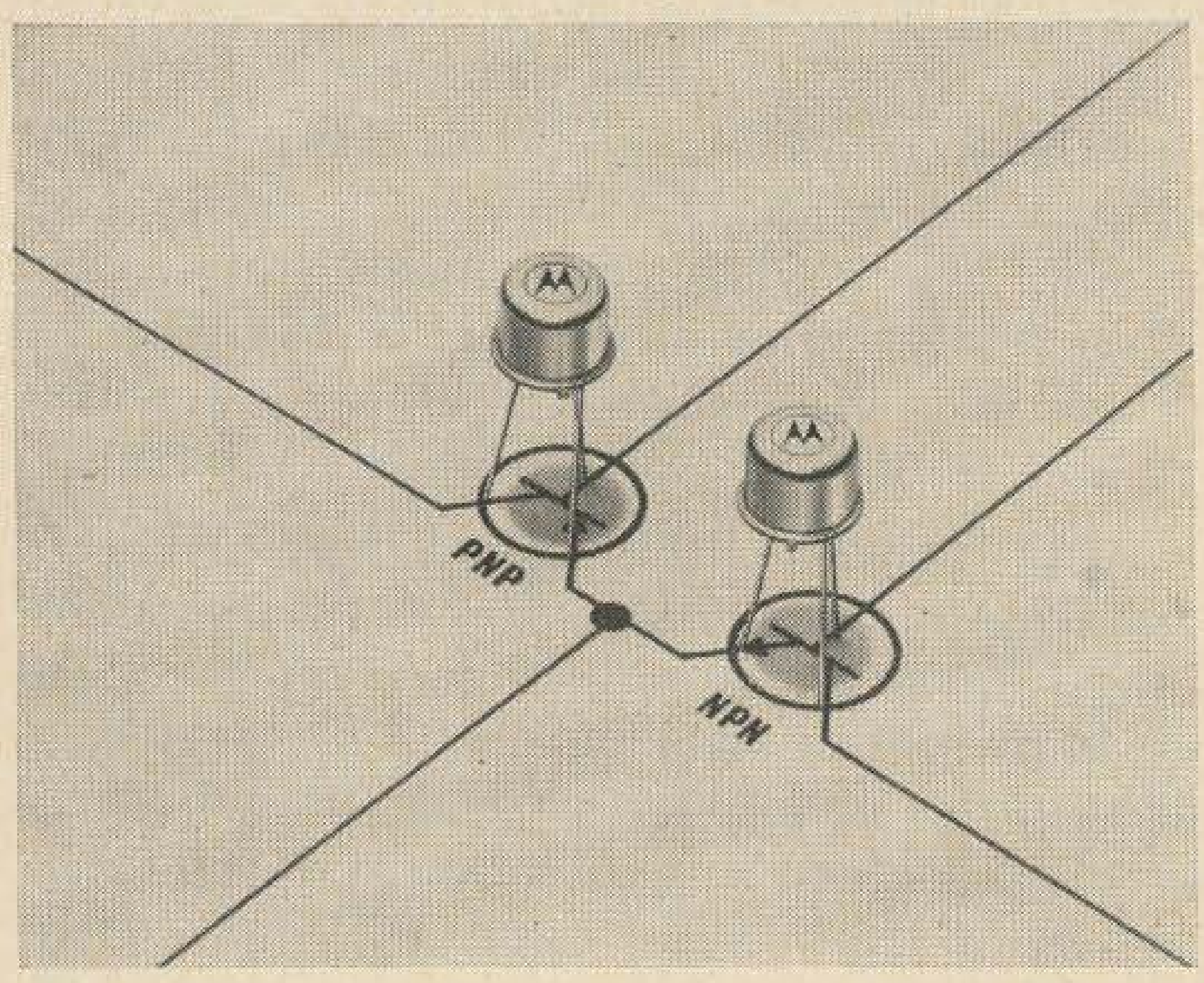
The only advantage of this circuit is that it is a VFO which is *more* stable than most crystals. Drift is almost undetectable in a well-built Franklin oscillator. Much more circuitry is needed to do this, however, and so the circuit has not gained popularity. The circuits shown in **Fig. 8** through **13** should be sufficient to permit perfect scores on this portion of the license examinations.

Next Installment. This has been an overlength installment because of the material on oscillation and neutralization. Next time out we'll attempt to even the scales by forgetting transmitter design for a while, and looking at the problems of antennas and transmission lines. Until then, good DX and happy studying. ■



NEW PRODUCTS

Motorola PNP VHF/UHF Transistor



The first silicon PNP large signal VHF/UHF power transistor available to the electronics industry is announced by Motorola Semiconductor Products, Inc. The 2N5160 was designed as the PNP complement of the NPN 2N3866 for use in PNP/NPN complementary circuit configurations such as VHF and UHF amplifiers. RF amplifier designs which must be accomplished with positive ground supply voltage will be able to keep the rf ground at the same level as the dc ground, thus eliminating by-pass problems.

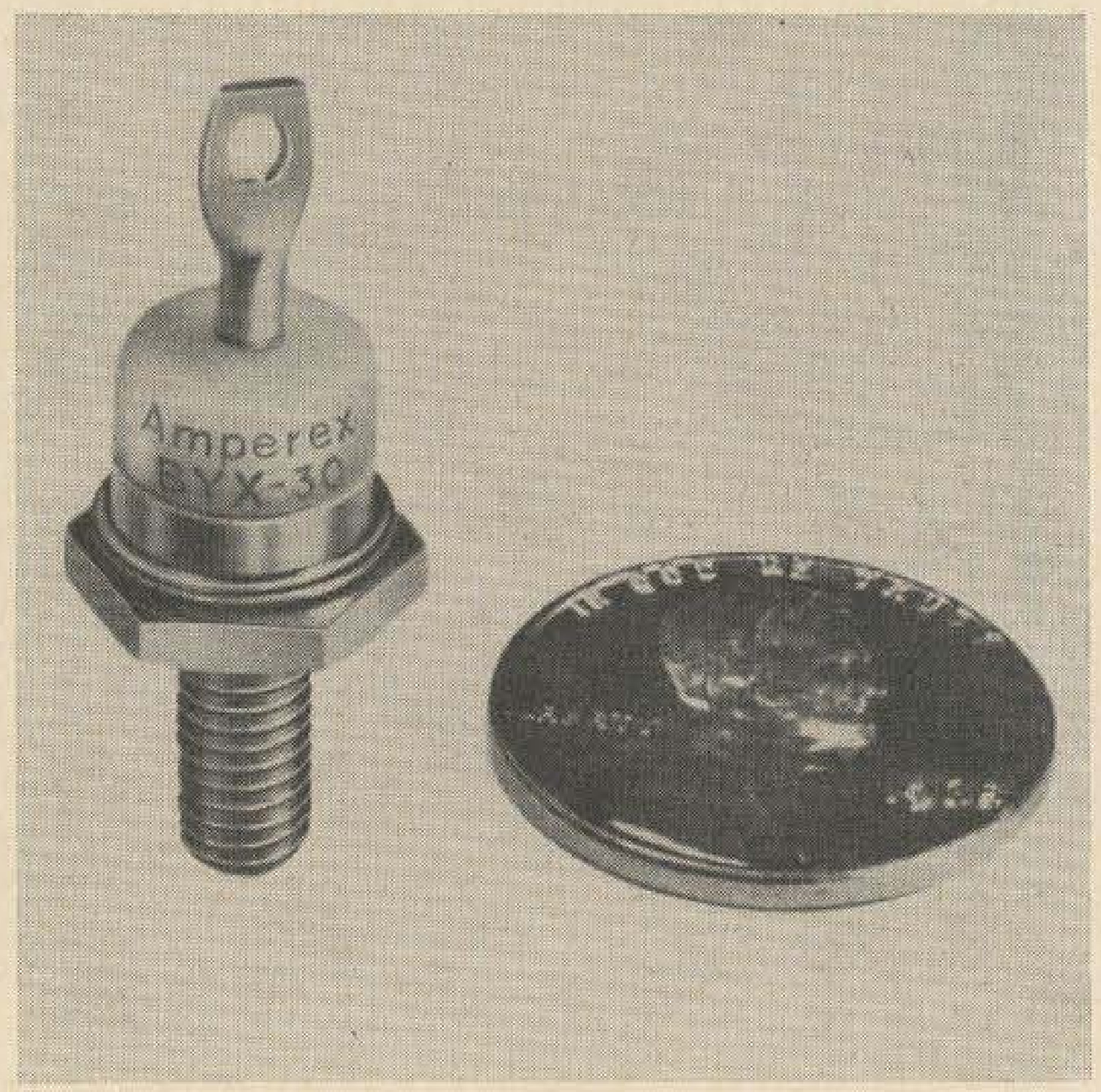
Further information and complete specifications are available from Motorola Semiconductor Products Inc., P.O. Box 13408, Phoenix, Arizona 85002.

FET Applications Handbook

While this book is heady stuff for the average amateur, engineers working with transistors will find it a must book. The $12.95 price tag is professional too. It is hardbound, has 288 pages and 225 illustrations, mostly circuit diagrams. It covers FET oscillators, linear applications, chopper and switching circuits, integrated circuits and photo-FET's. It is published by Tab Books and is available from most good parts distributors.

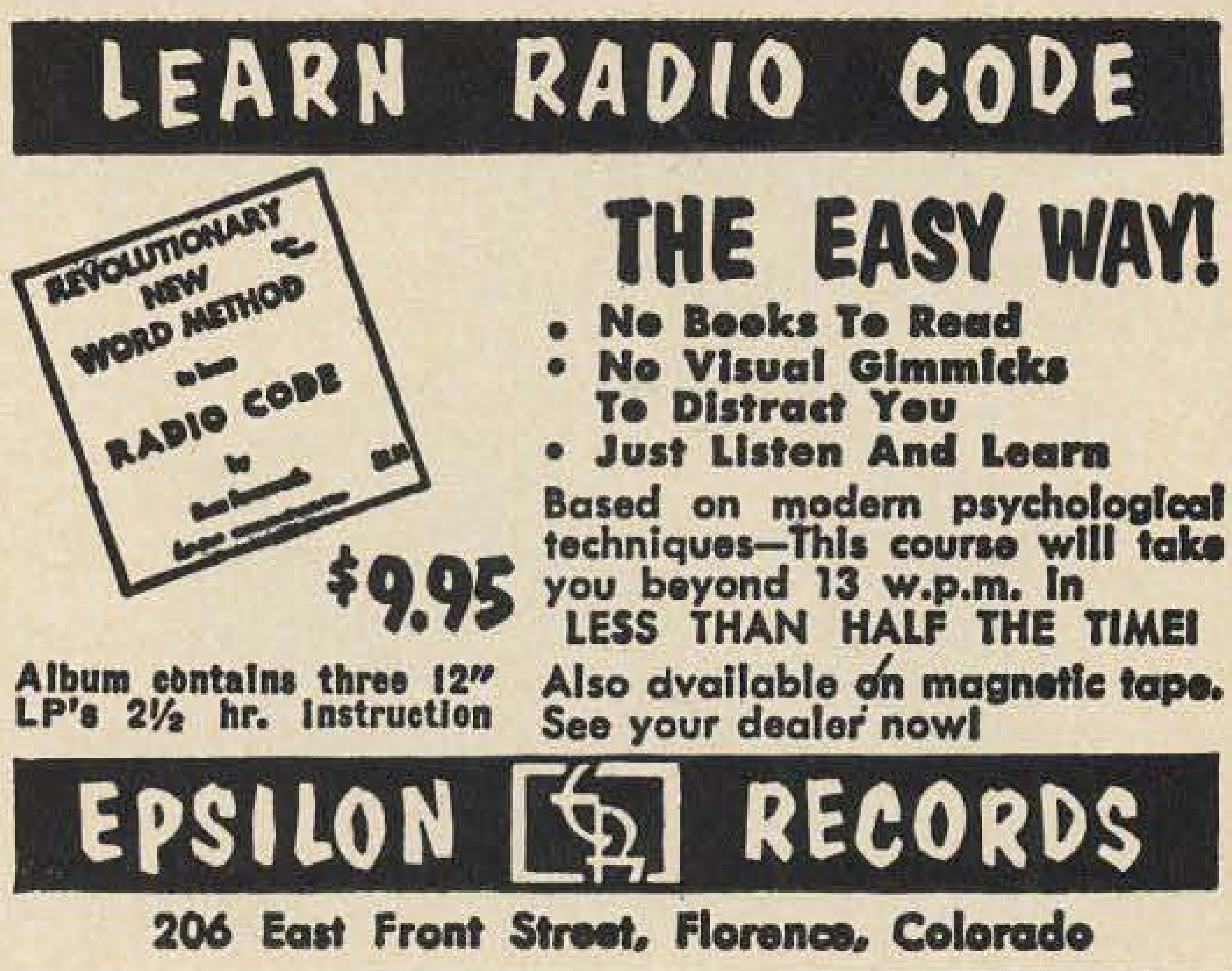
Amperex Fast Recovery Silicon Rectifier Diodes

A new series of power rectifying diodes, designated BYX-30, is now available from Amperex Electronic Corporation for use in fast switching applications such as high frequency power supplies, thyristor inverters, and multi-phase power rectification circuits. With working voltages from 200 to 600 V, the BYX-30 series offers switching speeds up to 200 amperes per microsecond at frequencies as high as 50,000 Hz with minimum power loss due to reverse recovery. Average forward current capability for the series is 14 amperes. Controlled-avalanche characteristics for the 200 Volt unit are 250 volts minimum breakdown and 515 volts maximum. For the 600 volt unit, the minimum and maximum breakdown values are specified as 750 and 1050 volts respectively.



Given specified avalanche breakdown characteristics, the designer can optimize or eliminate transient-suppression networks and can employ smaller safety factors than would be needed with less completely specified diodes.

Complete specs and applications data may be obtained by writing to Amperex Electronic Corp., Semiconductor and Receiving Tube Division, Slatersville, Rhode Island, 02876.



Altec 687B Microphone

This is a rugged moving coil dynamic microphone tailored to amateur requirements. The Altec 687B provides a continuously variable low frequency response characteristic. It permits reduction of unwanted interference while maintaining excellent speech reproduction without masking or distortion caused by low frequency overloading of the audio stages by the unique method of rotating a shutter on the rear of the housing.

The price is $42.00 and further information may be obtained by asking for data sheet AL-1478-2 from the advertising department, Altec Lansing, 1515 South Manchester Ave., Anaheim, Calif. 92803.

Ameco License Guides

Long recognized as the leader in Amateur Radio Theory course material, AMECO has come out with two new license guides for the Advanced Class and the Extra Class exams. They contain the FCC questions and easy to understand answers, with FCC type multiple choice practice exam. The guide for the Advanced License is 50¢ and for the Extra, 75¢. These two excellent guides are available now at your radio distributors. In addition, there will soon be a 33⅓ RPM record for code practice to permit the ham to prepare for the increased code speed requirement for the Extra-Class exam.

Car Call Letter Sign

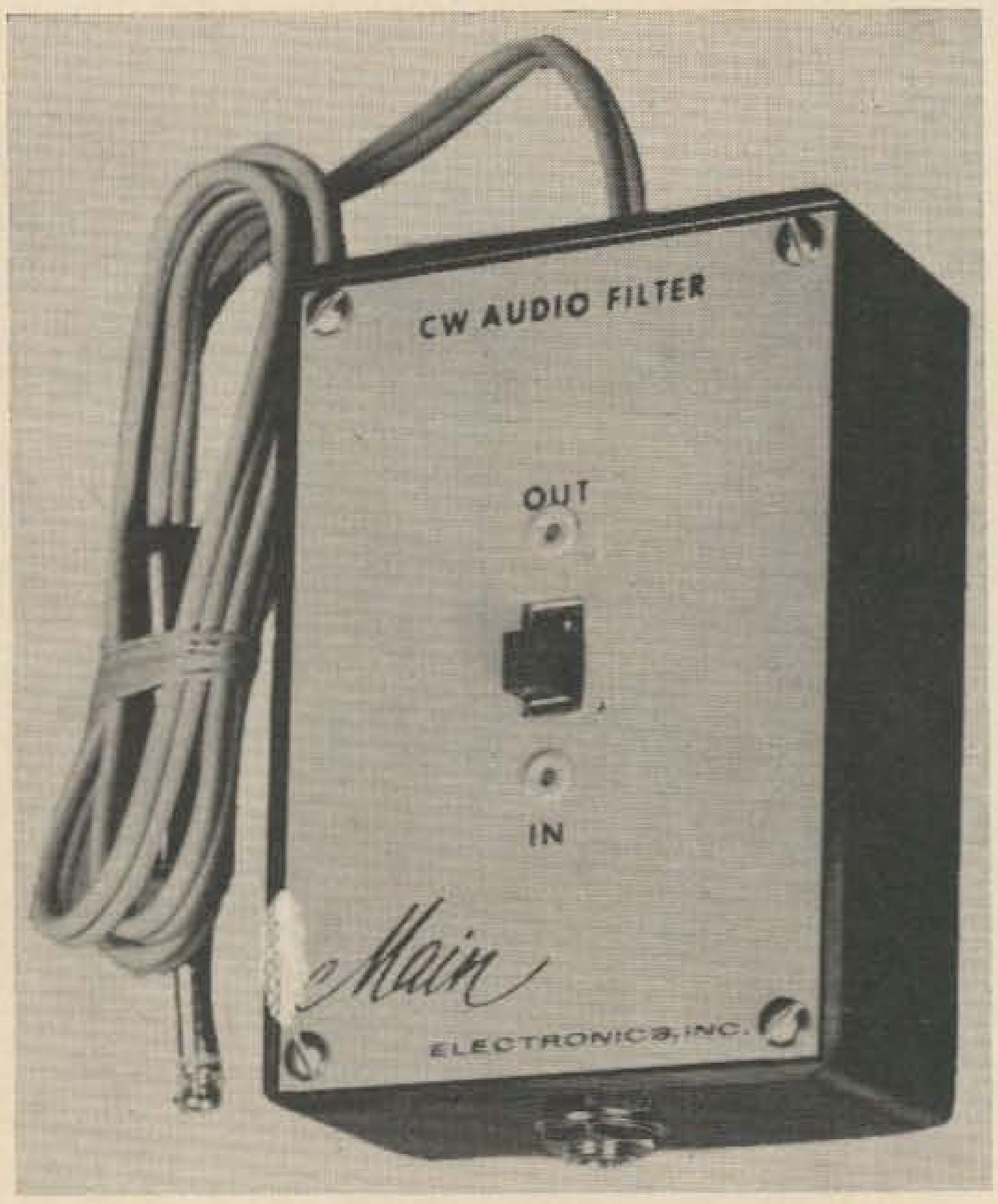
Many of us are reluctant to put a permanent call letter sign on our cars. It may be that we use the car for business, or that it is also driven by other members of the family. Also there might be just a bit of hesitation about drilling those so permanent holes in the car door or trunk.

Dymond Electronics has come up with a slick answer to this whole problem. The call letter sign is plenty big enough to really stand out and be seen by passing hams. It is 21″ long by 6″ high and is made of brilliant white plastic with bright red call letters that are raised about a half inch. And best of all, this sign has strip magnets all around it so that it will stick to your car even at speeds over 90 mph. It doesn't come off unless you pry it off.

This certainly seems like a great answer to having your call on your car for club meetings, hamfests and vacations.

The price is $7 postpaid from Dymond Electronics, 515 Blackstone, Fresno, CA. 93701.

The Model TS-4 Tenna Switch is an inexpensive remote switching system which allows up to four separate, remotely located, antennas to be fed from a transmit/receive site through a single transmission line. It is ideally suited for remotely switching between 3 or 4 bands of a multi-band cubical quad antenna. Both sides of the transmission line are switched, affording complete isolation and offering a decided advantage over the "Co-Ax Relay" type of remote system which switches only one side of the line. The TS-4 uses 2 low loss ceramic switch decks to perform the dual switching function. It operates on 115 VAC and employs an 18 V step-down transformer which draws current only during the short switching cycle. The system requires only lightweight control cable (4 wire cable to switch 3 bands; 5 wire cable to switch 4 bands). A single Co-Ax or Balanced transmission line connects the remote unit to the transmit/receive system. Separate short sections of either Co-Ax or Balanced transmission line connect up to 4 individual antennas or driven elements of a quad into the remote unit, mounted on the boom, mast or tower. The switch is capable of handling inputs of 2 KW PEP or 1 KW AM-CW. The Tenna Switch is manufactured and distributed by Cubex Company, Box 732, Altadena, CA 91001, and sells for $15.95 at dealers or direct PPD USA.



Main Electronics CWF-1

If you are irritated by the QRM level on the CW bands these days, this new device will be of interest to you.

A new CW audio filter with high selectivity is being marketed by Main Electronics, Inc.

Called the CWF-1, the unit offers very high selectivity for the reception of CW on all transceivers and receivers which many times have deficiencies in this mode.

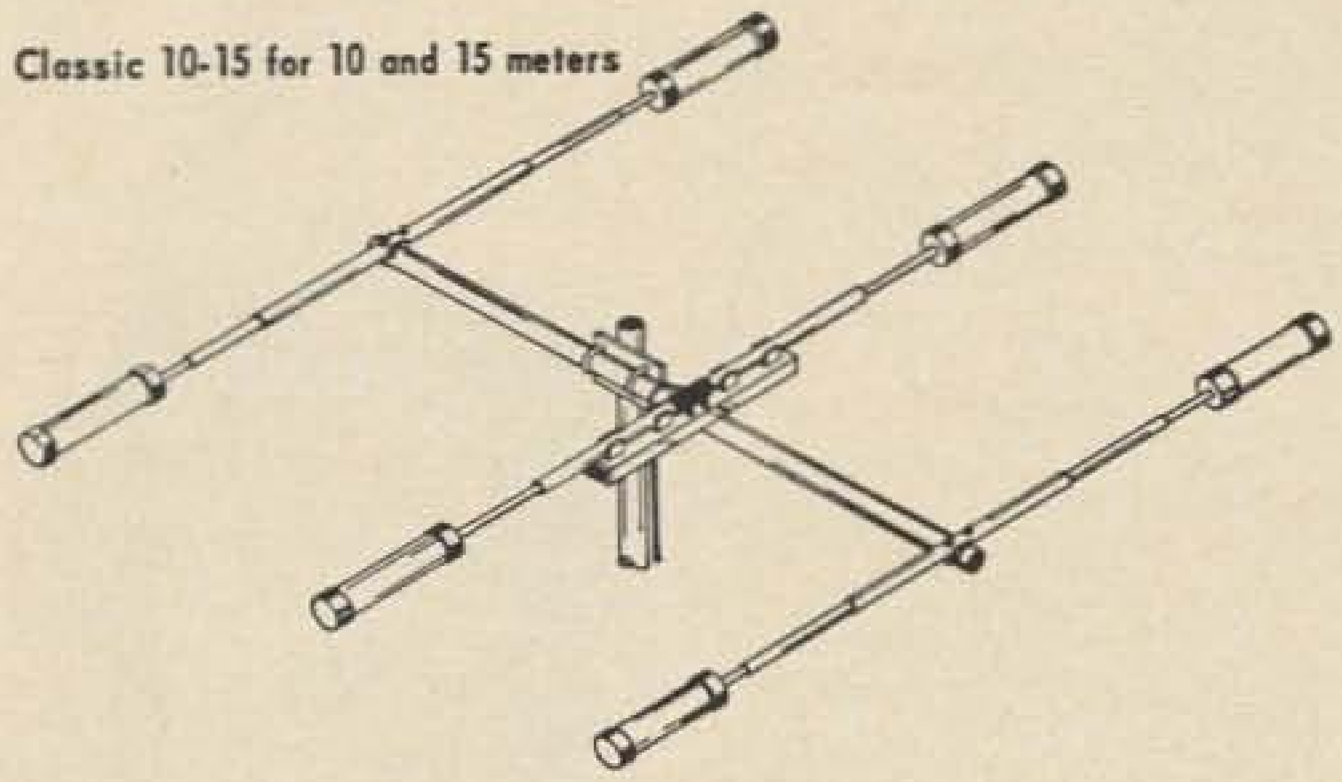
The "Black Box" is merely plugged into the 2 to 4 ohm audio output of a receiver and headphones plugged into the CWF-1. It has a switch for taking the filter in or out of the circuit as interference dictates.

The selectivity is 120 cycles wide at the 6 dB points and 200 cycles wide at the 10 dB points. This is achieved by the use of high-Q toroidial inductors in a four pole filter circuit. The output is designed to match 2000 ohm headphones.

The filter not only separates the wanted signals out of the QRM, but also improves the signal-to-noise ratio when receiving weak CW signals close to the noise level such as in VHF DX work.

The device measures $2\frac{3}{8}$ inches wide, $1\frac{5}{8}$ inches high, and 4 inches deep.

A descriptive brochure is available upon request. The price is $19.95 postpaid from Main Electronics, Inc., 353 Pattie, Wichita, Kansas 67211.



Classic 10-15 for 10 and 15 meters

Two New Beams from Mosley

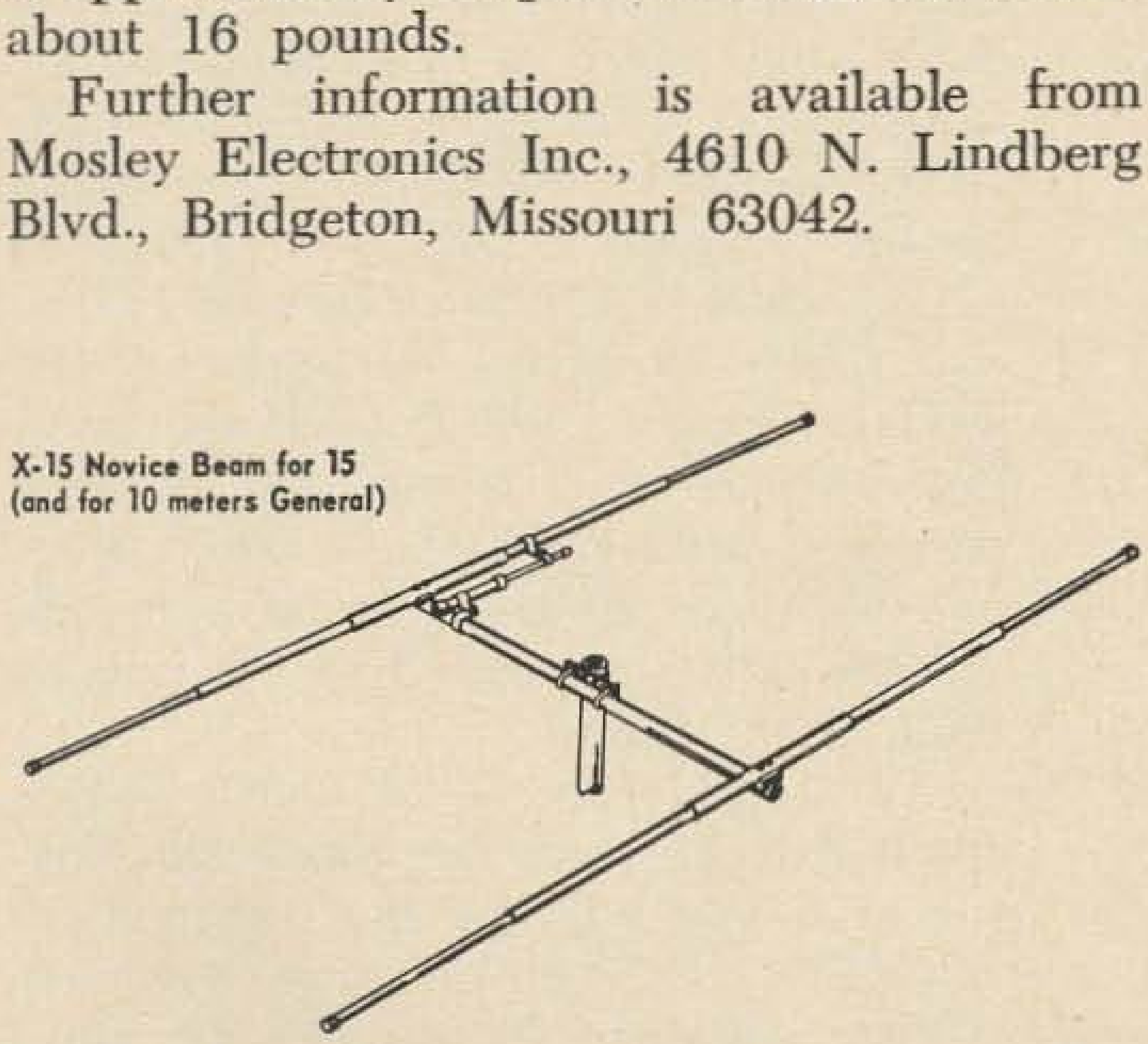
Mosley has announced two new antennas. One a duo-band 10/15 meter beam to take advantage of the openings on these bands which are now improving; and a single band 15 meter beam for the Novice.

The Classic 10-15 has a maximum front-to-back and a forward gain of 8 dB compared to reference dipole. It is power rated for 1 KW AM/CW, and 2 KW PEP SSB input to the final. This antenna has a maximum element length of 9′ 10″, a boom length of 12′, and a turning radius of 11′ 7″. It will withstand a wind load of 110 pounds (EIA standard at 80 MPH) Shipping weight is approximately 32½ pounds.

The X-15 is a two element, easily constructed antenna with a forward gain of 5 dB with a 20 dB front-to-back ratio. It is full power rated up to legal limit. Maximum element length is 22½′. Assembled weight is approximately 13 pounds. Shipping weight about 16 pounds.

Further information is available from Mosley Electronics Inc., 4610 N. Lindberg Blvd., Bridgeton, Missouri 63042.

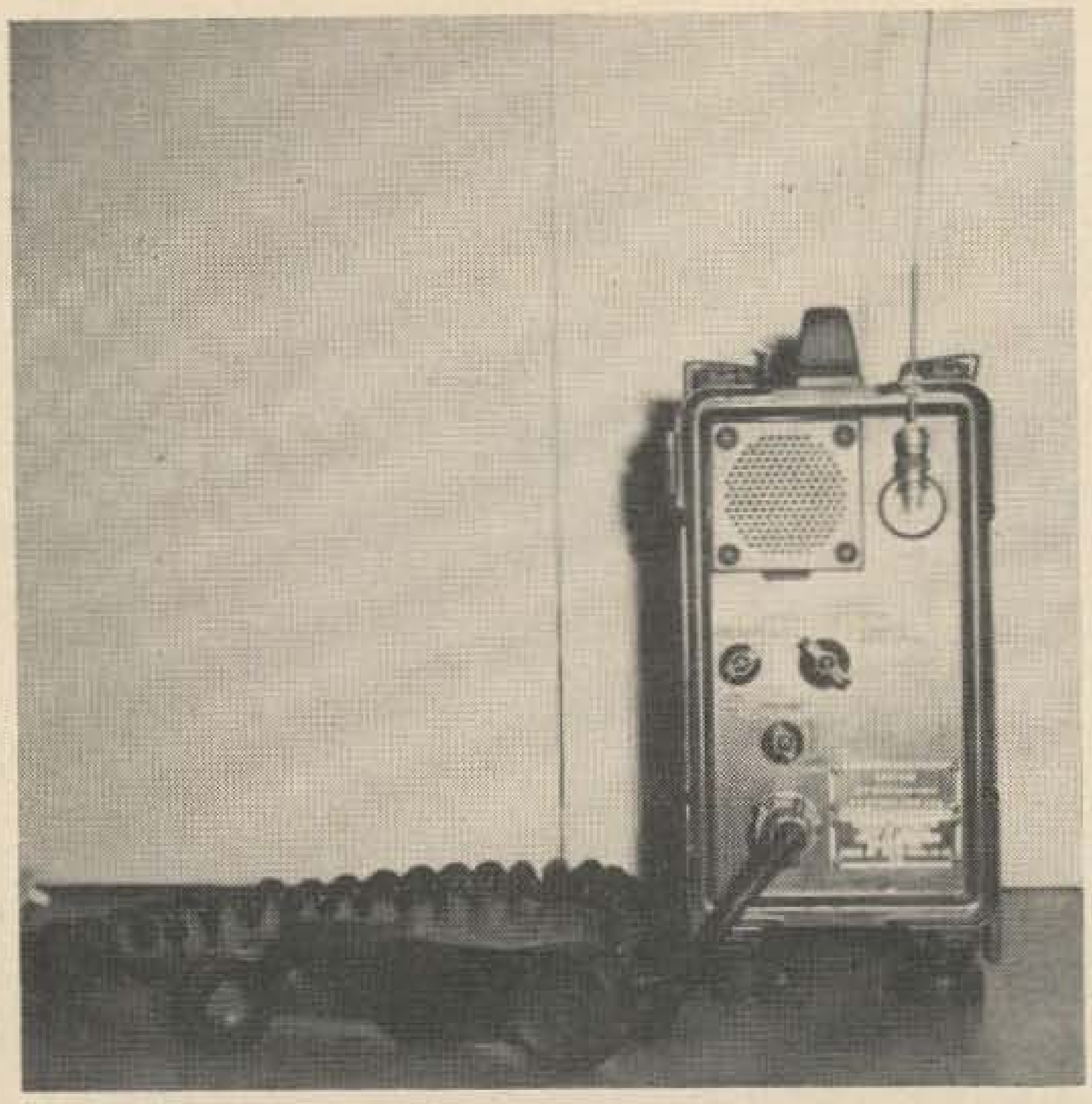
X-15 Novice Beam for 15 (and for 10 meters General)



Continued on page 134

Putting The RT-209/PRC on Two Meter FM

Joe Owings KØAHD
10217 St. Daniel Lane
St. Ann, Mo. 63074



Recently a number of RT-209/PCR Walkie Talkie sets have appeared thru U.S.A.F. MARS programs. With a not too complex job of conversion these make nice units for the two meter FM frequencies. This equipment is also known as Radio Set AN/PRC-21 and operates on a single crystal controlled frequency in the 152-174 MHz range. Most of the units I have seen were set up in the 160 MHz range.

The receiver uses a non-oven crystal unit CR-23/U and the crystal formula is:

$$\text{xtal freq.} = \frac{\text{operating freq.} + 2.5 \text{ MHz}}{5}$$

This is a small hermetically sealed crystal unit like the HC-6/U and is available from most manufacturers. The transmitter uses a non-oven crystal unit CR-18/U (also similar to the HC-6/U) and to select the desired crystal frequency, the formula is:

$$\text{xtal freq.} \times 32 = \text{carrier freq.}$$

In first looking at the RT-209, you will notice that there are four trunk type fasteners on the top and the bottom of the case. The two rear ones on the top and the bottom are for access to the battery compartment. The front four are for removing the receiver-transmitter unit from the case. This set has an internal loudspeaker and the audio connector on the front is for an H-33/PT type handset, a type common to military mobile equipment. This handset also contains the push-to-talk switch. In opening the front door of the unit, you will see that there is a main chassis frame containing individual circuit modules by stages. Basically, the modules on the outside edge house the transmitter and the inside modules house the receiver.

Transmitter Modification

1. Remote Z201 (XMTR-OSC) from the frame and place a 2.7 pf capacitor across the coil terminals. Use a Grid Dipper to resonate the circuit to approximately 4.5 MHz and re-install in the frame.
2. Pass up Z202 (MODULATOR), no modification necessary.
3 Remove Z203 (1st DOUBLER), Z204 (2nd DOUBLER), Z205 (3rd DOUBLER), Z206 (4th DOUBLER) in that order and place a 2.7 pf capacitor across their respective coil terminals. Grid Dip the modified coils to near the proper frequency for each–Z203 (9 MHz), Z204 (18 MHz), Z205 (36 MHz), and Z206 (72 MHz). In replacing the modules in the frame, check the numbers on each as it is replaced to make sure it is in the right place. When properly installed, the test point tab on each module will be oriented to the outside edge of the frame.
4 Remove Z207 (5th DOUBLER-XMTR PWR AMPL) from the frame. In looking at it you will see that the coil for the 5th DOUBLER is a wide-spaced, 4 turn coil and it is this coil that must be removed from the module. Unsolder both wires from it, noting that the blue

wire goes to the end of the winding nearest the mounting lug, and unsnap the spring mounting clip removing the coil from the module. Using a small screwdriver, scrape the varnish from between and holding the coil turns carefully, and compress the coil so that it is close-wound at the bottom end of the form, spaced about wire diameter.

5. Replace the modified 5th DOUBLER coil in the module, resoldering the wires as originally connected. Place a 2.7 pf capacitor across the coil terminals and grid dip the coil to about 146 MHz.
6. Look at the other coil in the module which is the final tank coil. It has a plate winding with a one turn link for the Antenna which is wound over the P.A. coil. Here there seems to be a difference in some units I have seen as on some the top two turns are wide-spaced and in some, they are close-spaced. If the top turns are wide, carefully take a screwdriver and compress them so that the coil is spaced about wire diameter. This may be accomplished satisfactorily without removing the coil from the module. Look at the coil terminals on the bottom of the coil and you will see that one side of the ANT. link is grounded with the other end connected to a white wire. The Plate winding is the other two terminals across which you should connect a 2.7 pf capacitor. Replace the module in the frame. Modification is complete.

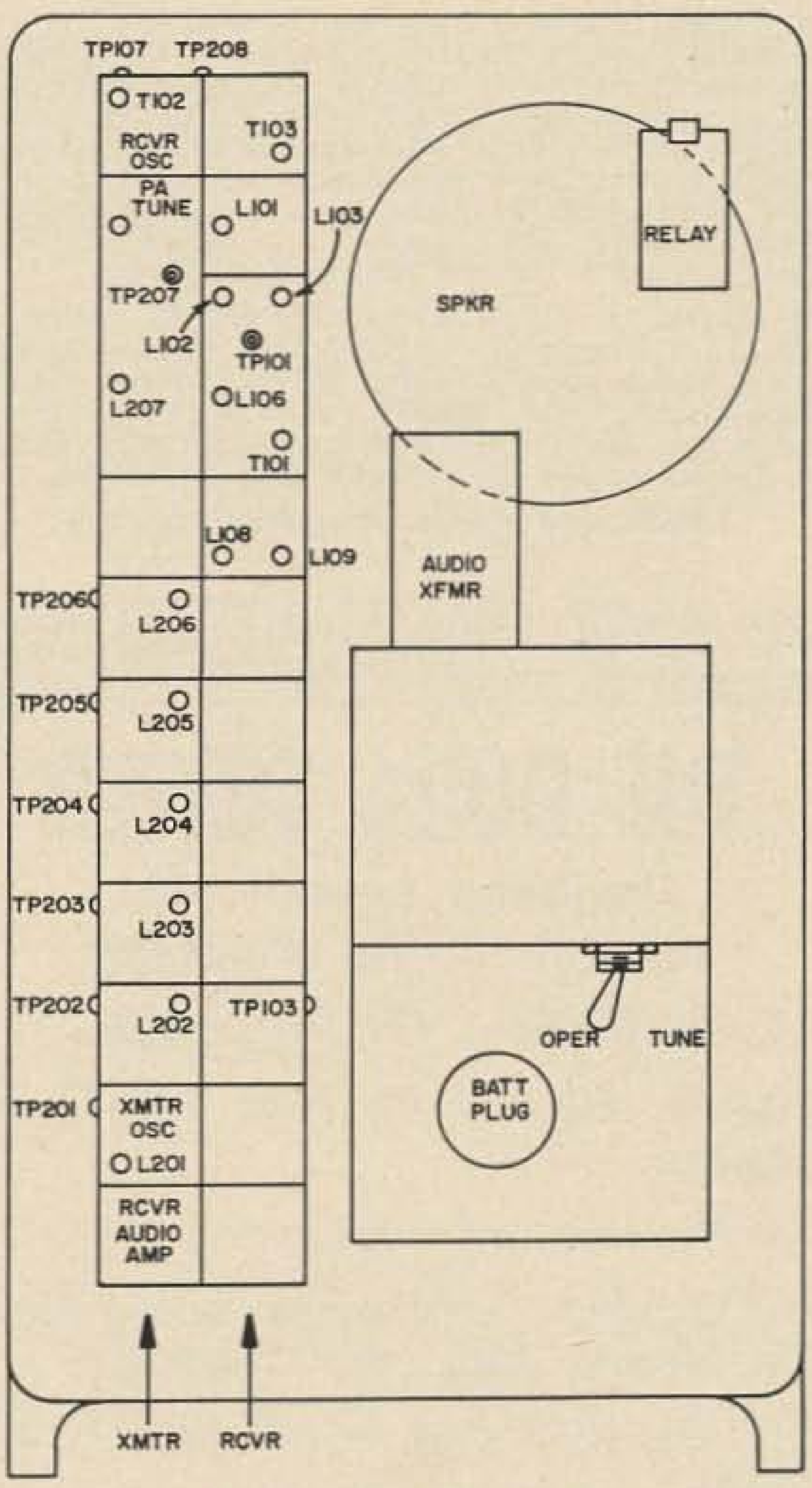
Transmitter Tune Up

1. Tune up is done with a vacuum tube-voltmeter on the lowest dc voltage scale. A 10 megohm resistor is connected in series with the negative probe with the positive connected to the chassis frame. The probe (w/resistor) is connected to test points TP201 thru TP207 as the transmitter is keyed and in that order each stage is peaked for maximum indication at its associated test point. The PWR AMPL test point (TP208) is located on the top end of the chassis frame and is peaked with an antenna attached while tuning the final stage.

Receiver Alignment

It will be assumed that the *if* amplifiers are relatively well aligned so no adjustment will be attempted on these stages. This type alignment would considerably complicate the job.

1. Install a crystal for the desired receive frequency and with the vtvm and 10 megohm resistor previously prepared for tuning the transmitter. Connect the probe to TP107 which is located on the top end of the chassis frame. Turn the set on in the HANDSET position. Adjust T102 (RCVR OSC) slug for maximum indication on the meter then continue to turn the slug counter-clockwise until approximately 0.8 of the maximum indication is obtained.
2. Connect the vtvm (with resistor connected) to TP101 and adjust T103 and T101 for maximum indication.



Tuning slug locations

3. Connect the vtvm (with resistor connected) to TP107. Adjust L109 until a small dip is noted in the reading, then turn L109 about one turn clockwise past the center of the dip.
4. Connect the vtvm to TP104 and adjust L108 and L106 for maximum indication.

At this point in the alignment a signal on the desired receive frequency is necessary, either from an accurate signal generator or a transmitter known to be on frequency. If a signal generator is used, connect it directly to the ANTENNA connector; if a transmitter is used, place it near but do *not* connect to the unit.

6. Tune (in this order) L106, L108, L106, L103, L102, and L101 for maximum indication with the vtvm connected to TP103.

This completes the receiver alignment of the unit. Again the *if* alignment is not attempted. Replace the transmitter-receiver unit in the case and the battery in the rear compartment and your unit is ready to go. The unit used here is set up on the St. Louis Repeater frequency which is 146.34 MHz transmit and 146.94 MHz receive. Don't have any grand illusions about a real powerhouse unit as the RT-209 is rated by the military at a tremendous 150 milliwatt output. This may seem extremely small, but it is more than I presently get out of a surplus battery of unknown age and I can work thru the St. Louis Repeater with it on an 18 inch whip connected to the ANTENNA connector from my basement, which is about five miles from the Repeater.

One word about the battery this unit uses. It may be rather a hard item to come by in good condition. The voltages supplied are 1½ volt, −6 volts, 45 volts, 67½ volts, and 135 volts. The military FSN is 6135-577-3340 and the nomenclature is Dry Battery type BA-358/U. The ones I have seen are manufactured by the Marathon Battery Company of Wausau, Wisconsin. The advailability of them thru non-military channels is unknown. The applicable Military Tech Manual is TO31R2-2PRC21-11. The manufacturer of all that I have seen is Motorola, Inc.

. . . KØAHD

Coiled Cords Untangle Test Leads

Conventional test leads, as supplied with test equipment are usually several feet long and have an annoying habit of getting tangled up with other things on the work bench.

A simple way of keeping your leads untangled is to use "coiled cord" for test lead wire. When not in use, this cord retracts to only a few inches and stays out of the way. Belden makes special coiled test lead wire (#8878-9). It is available either with or without test prods.

You will be pleasantly surprised at how much time you will save by using coiled cord.

D. E. Hausman VE3BUE

250 Sockets

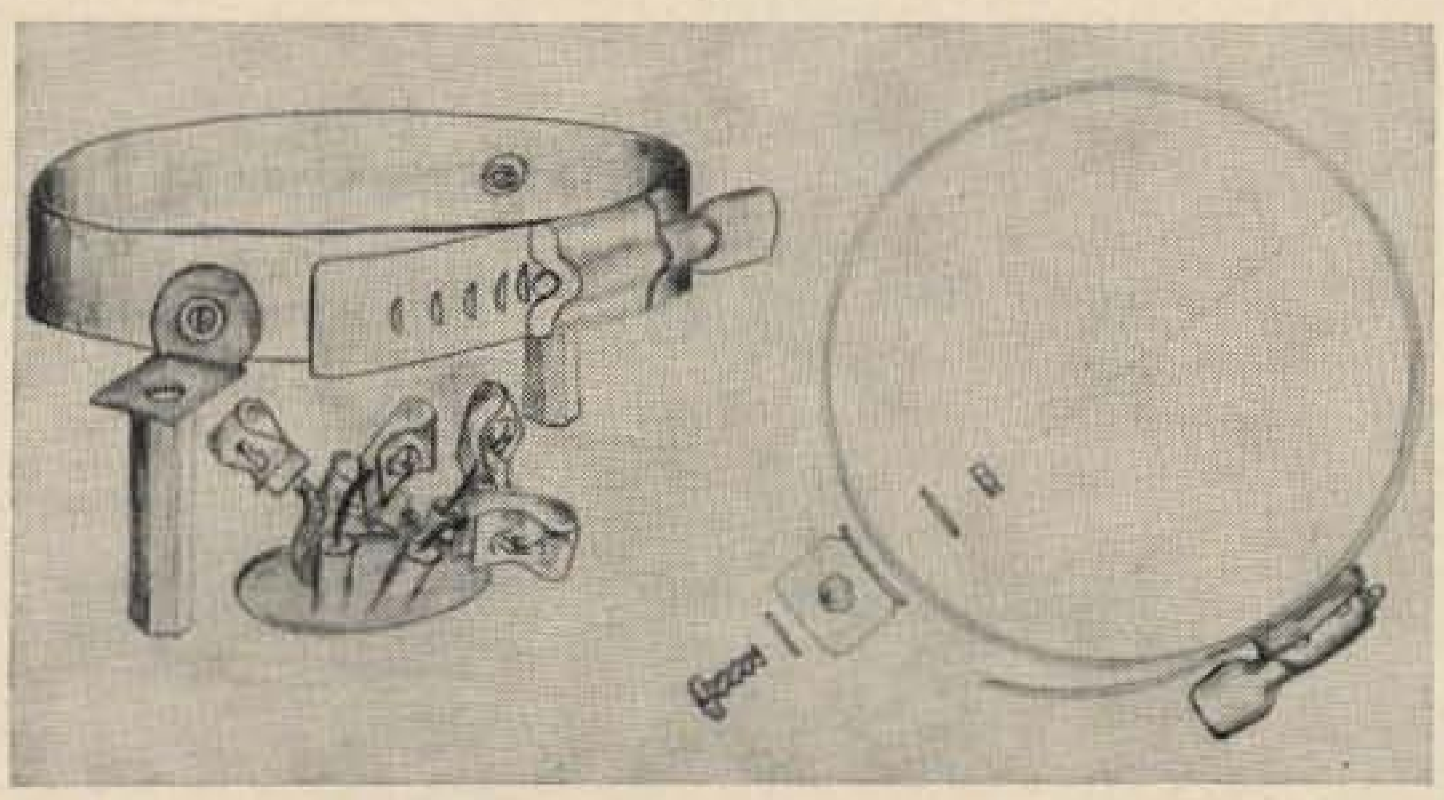
4-125, 250 and 400's can be picked up at very reasonable prices on the surplus market. Many are available through the various MARS programs. At such low cost, many fellows have put a few of these tubes away, contemplating a higher power rig, only later to lose interest after pricing their not-so-inexpensive sockets. If you're one of these individuals, take heart; this might help move that dream a step closer.

Here is a socket designed from a circular hose clamp which adjusts to the size of the tube base (about 3" in diameter). Two holes are drilled on opposite sides of the clamp and two pieces of stiff sheet metal (old tin can) fashioned as brackets. These brackets are fastened to the clamp with small screws and washers. The clamp assembly is then mounted about an inch above the chassis on metal standoffs.

Connections to the tube pins are made with Fahnstock clips soldered to the wiring going to the socket. Be sure to use insulated sleeving on the wiring passing through the chassis to the socket.

To seat the tube, first carefully attach the clips to the base pins. Dress the leads neatly and check to see that none are shorting to each other or the chassis. Then position the tube so that the small nuts on the inside of the clamp fit into two of the ventilating holes in the ring around the base. With the tightening of the thumb screw, the socket is complete. A small blower will take care of the cooling since the tube base is elevated, well exposed in the air stream, with the clamp and metal standoffs providing excellent heat sinks.

The following "socket" has been used in a six meter amplifier with a 4-250A for the past year with superb results. Total price was a rumaged junk box, although parts, if purchased, shouldn't go above a dollar fifty.

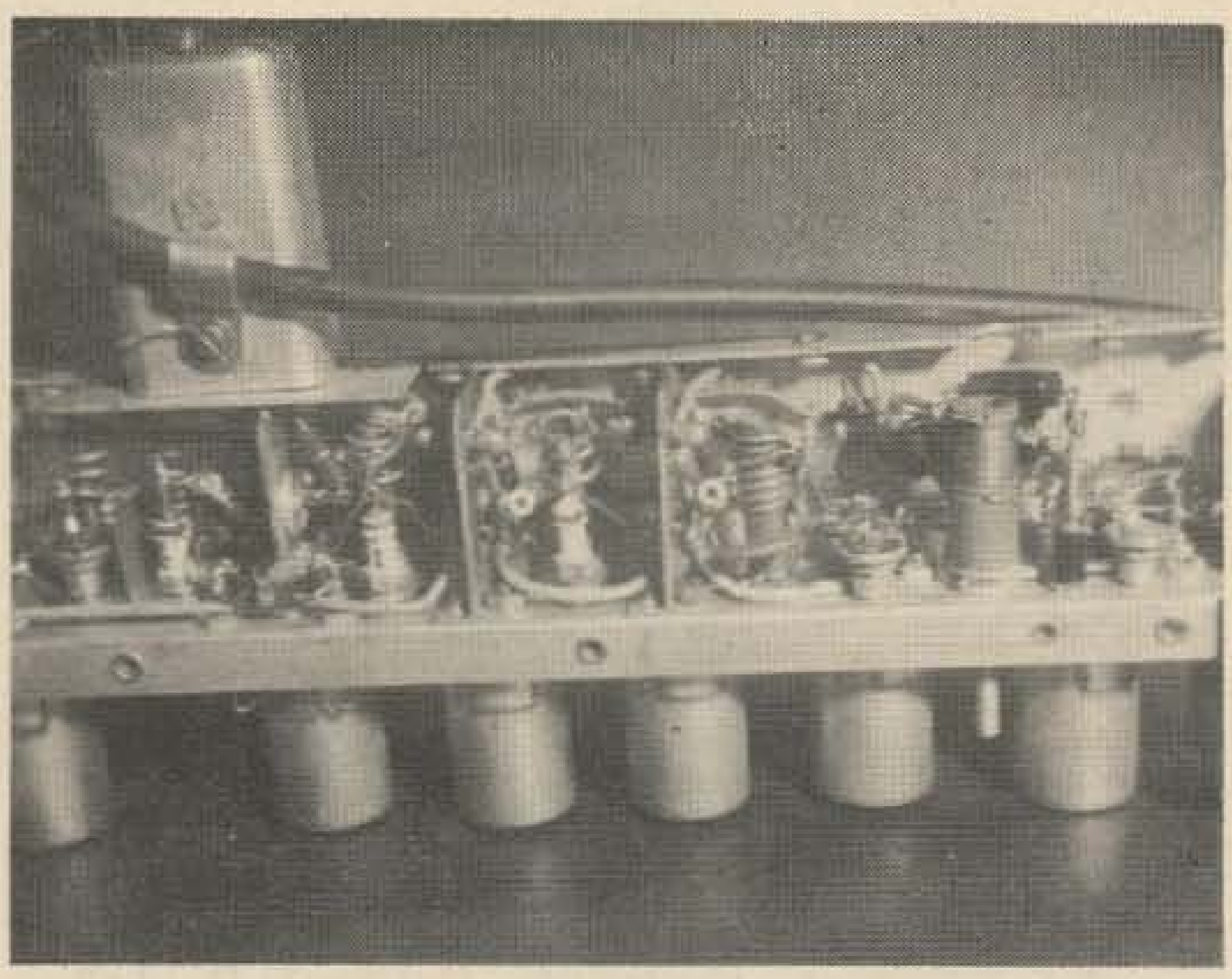


Who says high power has to be expensive?

. . . WA3AQS

Converting the ARC-1 Guard Channel for Two Meters

W. W. Davey W7CJB
329 East Kent
Missoula, Mont.



The guard channel in the ARC-1 is normally used on 121.5 MHz and in some of the older sets a frequency of 140.58 was used. These strips make an excellent two meter converter which can be made to operate into any tunable *if* system between 8.5 and 10.5 MHz.

Removing the unit

As you face the front of the ARC-1 the guard channel is a strip 11½ x 1½ inches and is on the left hand side of the unit. This strip can be easily removed by removing a few mounting screws, unsoldering 6 power connections underneath, and unsoldering the output lead from the *if* can attached to the guard channel chassis. The strip can now be pushed upward and out of the ARC-1 framework.

Testing the strip

Now is a good time to test the chassis as a converter to make sure it is working. It is very discouraging to modify some piece of gear and be unable to get it to work, only to discover that there was some defective part in it in the first place. Connect a piece of small coax on the output terminals. These are the two prongs sticking out of the *if* can at the bottom side of the chassis. This lead will go to your communication receiver antenna and ground. Facing the back or bottom of the chassis there are five feed-through condensers on the extreme right end of the chassis. This is where power must be applied. As a temporary measure three of these condensers must be grounded to make a temporary check to see if the strip is operating. The three you are going to ground normally supplied bias to the various stages. **Fig. 1** shows where to connect power into the chassis.

The unit will require 12 volts ac for the filaments and 100-150 volts dc for the plate supply at around 50 mA. If there is a 6210 kHz xtal in the socket the unit is tuned to 121.5 MHz. If there is a 7270 kHz xtal in the socket the unit is tuned to 140.58 MHz.

Most of these units are tuned to 121.5 MHz, however. If the strip is working ok it will pick up the 18th harmonic from a 6750 kHz crystal oscillator, with but a few feet of antenna on the converter. The *if* output will be 9720 kHz and can be tuned in on your communication receiver.

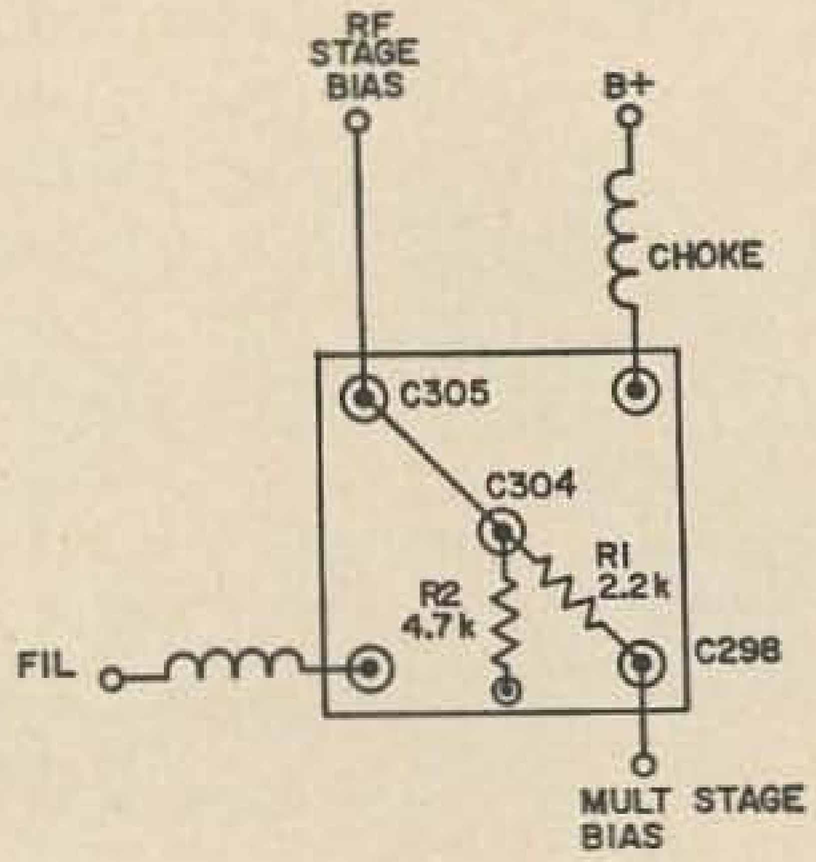


Fig. 1. Diagram of power connections to the chassis.

Procedure

If everything is working, you can now start modifying to get to 144 MHz. The oscillator chain in this strip is anything but stable since they multiplied 18 times in the second 6AK5 and then used two more 6AK5's as amplifier stages. These two 6AK5's working straight through can create a lot of havoc, so lets change this. The second 6AK5 (V126) can easily be changed so that it will tune to the 6th harmonic of the crystal, then the next stage will multiply 3 times and the last stage in the chain will be the amplifier. The oscillator chain becomes quite stable with this arrangement.

The plate coil of V126 needs to be removed. First unsolder the grid coupling condenser to V127 and the 1000 ohm plate decoupling resistor. The straps from the coil assembly to pins 5, 6 and 7 of V126 can be cut with a diagonal pliers, or unsoldered, as can the strap to pin 2 of V127. After loosening the two nuts that hold the coil assembly, the entire coil assembly can be removed from the chassis. Save these parts as you may need them for spare parts at some later date.

You are going to replace this coil assembly with a 45 MHz *if* coil from an old junk TV set or if you have no junkers around, you can buy a new Miller #6225 replacement *if* coil. Strange as it may seem these 45 MHz *if* coils will snap right into the hole in the chassis without enlarging the hole. However, prior to pressing the new coil into the hole, make the following changes. Mount a small soldering lug on the 6/40 bolt which fastens the V127 tube socket to the chassis. Now run a wire from pin 2 of V127, through the soldering lug to pin 7 of V126. This will put the necessary grounds back which were clipped off when the original coil assembly was removed. Push the 1000 ohm resistor back toward the side of the chassis and solder a wire to it—pull the wire down through pin 6 of V126, and let about an inch of wire extend from pin six. This will later be soldered to the new coil. Now then, mount the 45 MHz TV coil by pressing it into the hole in the chassis. Run a wire from pin 5 of V126 to the top terminal of the new coil and at the same time connect V127 grid coupling condenser to the top of the coil. The wire that was left hanging from pin 6 of V126 can now be connected to the bottom terminal of the TV coil. Between the bottom terminal of the TV coil, and the soldering lug, solder in a .005 ceramic condenser. These changes are shown in **Fig. 2**.

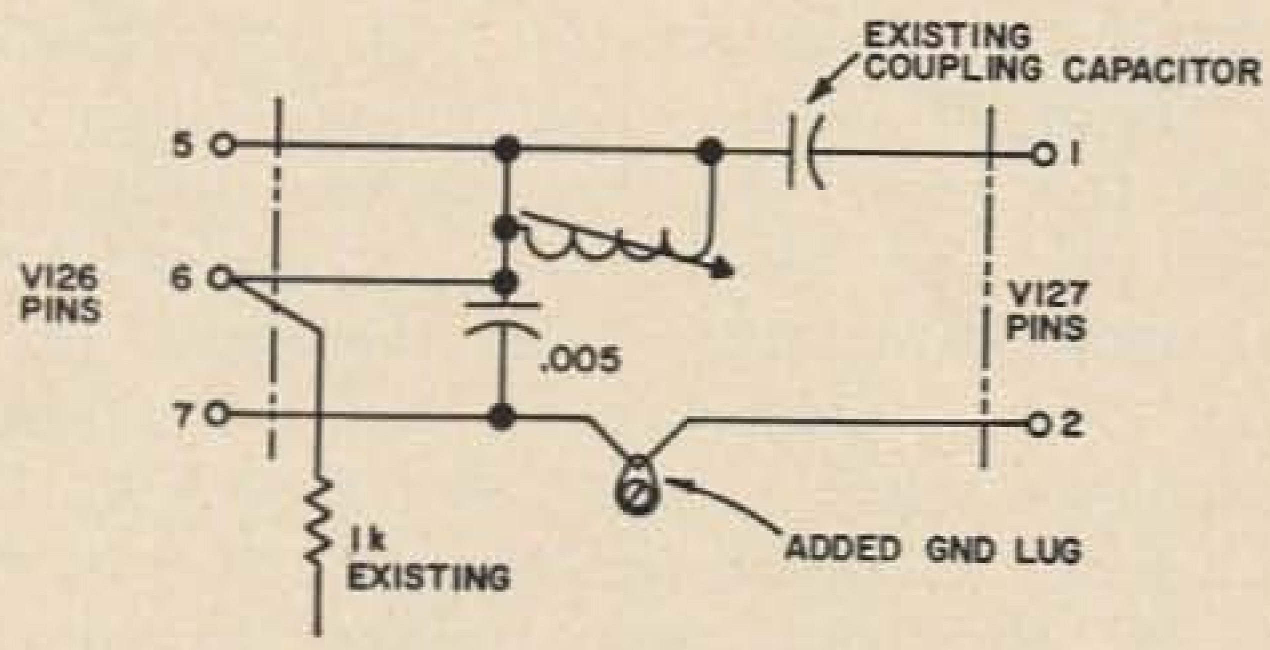


Fig. 2. Details of the modification using new *if* coil.

To get the rest of the coils down to where they will work on 144 MHz, it will be necessary to remove all of the 10 mmfd ceramics that are soldered across all of the coil assemblies. There are 6 of them. V127 plate—V128 plate—V124 grid—V124 grid—V123 plate—V123 grid, and the antenna coil. In some chassis these may be 12 mmfd. These condensers are not shown in the schematic and apparently were soldered in, depending on what frequency the guard channel was to be operated on.

Oscillator chain tune up

The crystal should be changed to a frequency of around 7450KHz to 7600KHz. Any crystal in this range will work, but the *if* output will be different. I suggest you decide approximately what 144MHz frequency you wish to listen to, then subtract 9.7 MHz from this frequency to get the output frequency of the oscillator chain. Divide the output frequency of the oscillator chain by 18 to obtain the crystal frequency. If you don't have a crystal exactly on this frequency, remember of course, that you can vary the *if* freguency between the limits of 8.5 MHz to 10.5 MHz.

We may have to resort to several tricks to get the oscillator chain tuned up. First the crystal oscillator (V-125) can be tuned by connecting a test meter on the test point right next to the crystal. Tune the crystal plate coil for maximum reading on this test point. The next stage, the coil which you have added, should be tuned roughly with a grid dipper to 45 MHz. You can then use a field strength meter coupled near the coil, or by coupling to a receiver which will tune to 45 MHz, tune for maximum S-meter reading.

The next stage, V-127, will be a little tougher. Here you need a receiver that will tune to 133 to 135MHz or a grid dip meter or field strength meter of some sort. First spread the turns on the coil until the coil is about ⅝" long. Remember, when you tune the brass slug you reduce inductance with the slug all the way in, and that you increase inductance with the slug all the way out of the coil. If you are reaching resonance with the slug all the way in, then you have too much inductance and you must spread the turns some more. If you are approaching resonance with the slug all the way out, you need to squeeze the turns together somewhat. The plate of V-128 may be tuned in the same manner. If you are at least close to resonance on these coils you can connect a VTVM across the two test points next to V-124 and tune for maximum. At this time you can touch up all the slugs previously tuned.

RF section tune up

If the oscillator chain tuning is somewhere near correct, you can feed a 144MHz signal into the front end on about a 3 or 4 foot piece of wire, and by tuning to the correct *if* output frequency on your communication receiver you will be able to use the communication receiver S meter as an indicating device. Again spread the coils until they are about ⅝" long. The antenna coil has 4 turns and should be spread to a length of ½ inch. Check each coil, one at a time, starting with the grid of the mixer and working toward the antenna. Screw the slug in or out, and squeeze or spread the coils as necessary. As you approach optimum tuning on all coils you will be able to use a few inches of wire for an antenna, and by turning on a crystal oscillator across the room, you will be able to tune all the slugs for maximum, including the slugs in the oscillator chain. NOTE—replacing the chassis cover will change the tuning somewhat.

Free bias voltage

Now, about those three feed through condensers which we grounded at the beginning. These are supposed to have about 1.5 volts of bias on them. You can use a flashlight battery for bias, or if you want something for nothing, here is how you do it.

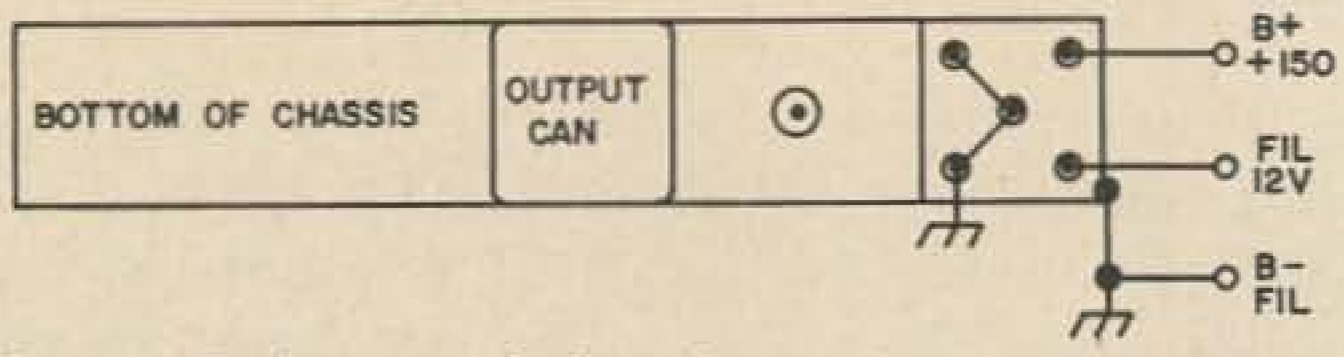


Fig. 3. End view of the chassis barrier.

Remember when you tuned the oscillator stage that you read upward of 6 to 8 volts of bias? Well—lets put it to use. Find the lower end of R-240; the 10 k resistor on the oscillator test point. Lift this resistor from the standoff type tie point and ground the resistor. The green wire which is also connected to this same tie point can now be soldered to the junction of R-240 (10 K) and R-247 (100 K) or in other words, the test point on the oscillator grid. Tracing this green wire back to the opposite end of the chassis you will find it comes to the center feed-through condenser on the barrier at the end of the chassis. There are five feed-through condensors on this barrier. Remove the three 100 K resistors and the 1500 ohm resistor located in the small compartment between the barrier and the end of the chassis. Rearrange the circuit as per **Fig. 3**. The bias voltage on the oscillator test point should be about 2.7 volts as measured with a VTVM. If it is not you can juggle the size of R2 until the desired voltage is obtained. It was found that 2.7 volts at this point gave better results than the 1.5 volts from the flashlight battery previously mentioned.

Operating Notes

The converter should be operated with 125 to 250 volts of B plus. The *if* output can should be tuned for maximum at the center of the frequency range you wish to cover. You can tune at least a 500KHz portion of the band with negligible loss of signal strength, without tuning the front end. While I have no way of actually measuring the noise figure, I did place a Nuvistor preamplifier manufactured by a well known ham supply house ahead of this converter and found that there was only about 1 dB increase in signal to noise ratio. This is hardly noticeable to the human ear. All in all I would say this is a very worthwhile 144MHz converter.

Removing the guard channel from the ARC-1 in no way affected the operation of the ARC-1 as a transceiver.

. . . W7CJB

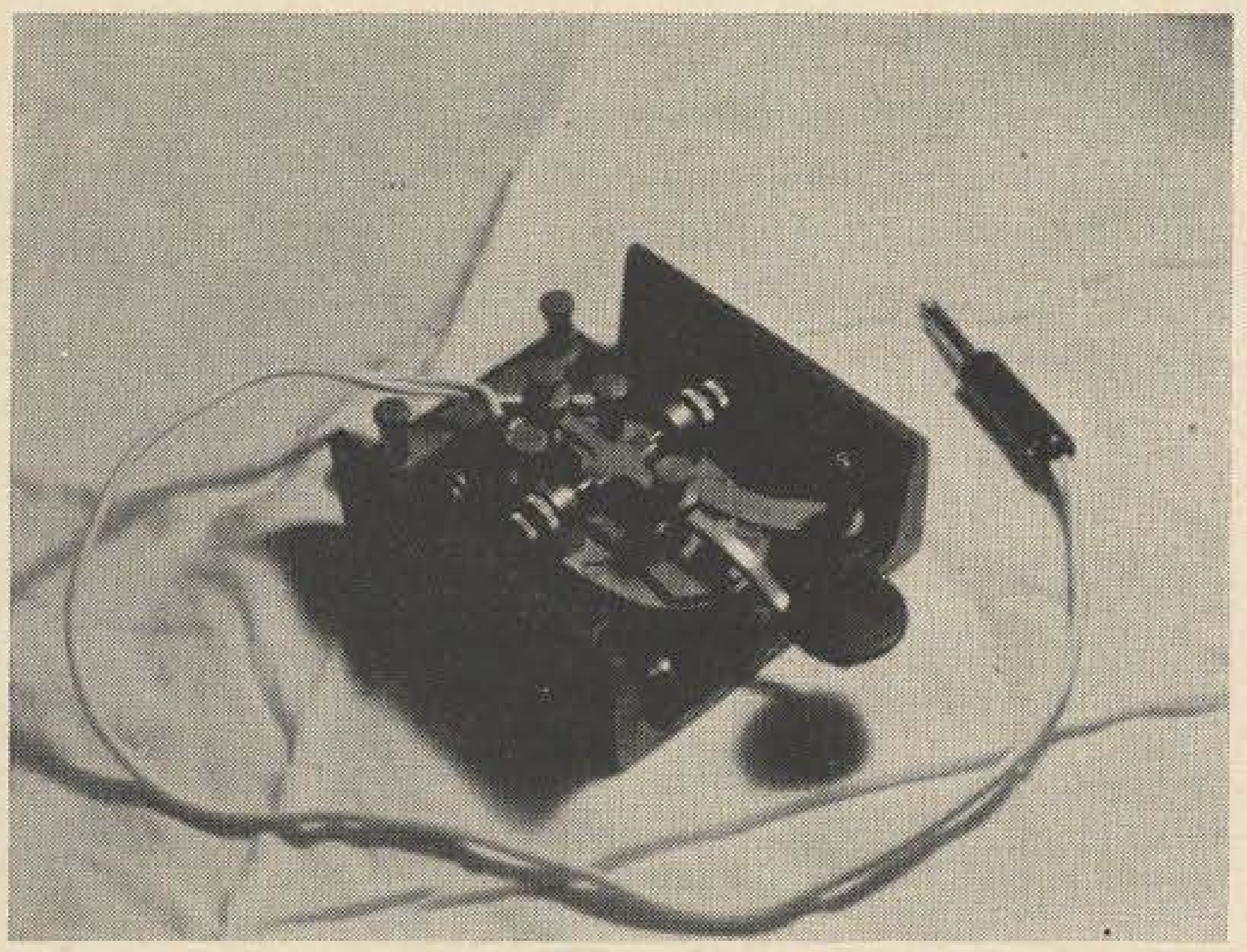
D. E. Hausman VE3BUE

Non Slip Key Base

The most annoying thing about telegraph keys, be they hand keys, bugs or paddles is their tendency to slip while being keyed. I found a cheap and easy way to make my trusty J-38 stay put. A piece of steel "U" channel, with the key bolted inside it did the trick. I got my channel from a machine shop at no cost, hence it is a bit short. Scroungers cannot be choosy! The exact size of the channel will depend on the dimensions of your key.

Although I chose to leave my base unpainted for that "rustic" look, a coat of spray paint won't hurt. To prevent the base from marring my operating table, I used some self-adhesive felt pads available at the local stationery store.

The key and base are now so heavy that it is virtually impossible for the key to take a walk around the operating table. The sides of the channel also afford a certain amount of protection from electrocution. In the J-38 at least, the shorting bar does not interfere with the side of the channel.



The non slip key base is made from a piece of scrap "U" channel. Three holes were drilled and tapped in the base for the mounting screws.

How To Use Your VOM-VTVM & Oscilloscope

Very good basic book on the use of these most common pieces of test equipment. $3.95 from Tab Books, Blue Ridge Summit, PA 17214. 190 pages.

Hybrid RTTY TU

E. C. Sherrill K6JFP
4745-49th Street,
San Diego, CA 92115

In W2NSD's RTTY Handbook, pages 47, 48 and 49, a silicon transistor RTTY converter (TU) is shown. The board is sold by Tri-Tronics Lab, in Euless, Texas, for $2.00 and works very well. The only exception is that the transistors are an industrial type, hard to find, expensive and the versatility of the unit is somewhat limited. So let's "Hybrid" the unit and give it a bit more versatility.

I bought the board, checked around and found I could replace transistors Q1, Q2, Q3 and Q4 with 2N697 silicon transistors which only cost 52 cents each. Q5 is replaced with an RCA 2N3440 which costs $2.06, and is well worth it. Don't be misled by over the air remarks on the little green keys that the 2N3440 won't take it and will burn out. Don't you believe it! I have had two of these units going for nearly two years and it hasn't happened yet.

Now, turn to page 49 in the W2NSD RTTY Handbook and check off terminal numbers 117, 113, 112 and 110. When the unit is wired do not connect to these terminal numbers; disregard them. For the power to the unit, use what it calls for: 12 volts dc, but for the loop dc to the keying transistor, the 2N3440, I used the K8DKC power supply, shown on pages 28 and 29 of the August 1965 QST, or as shown in **Fig. 1.**

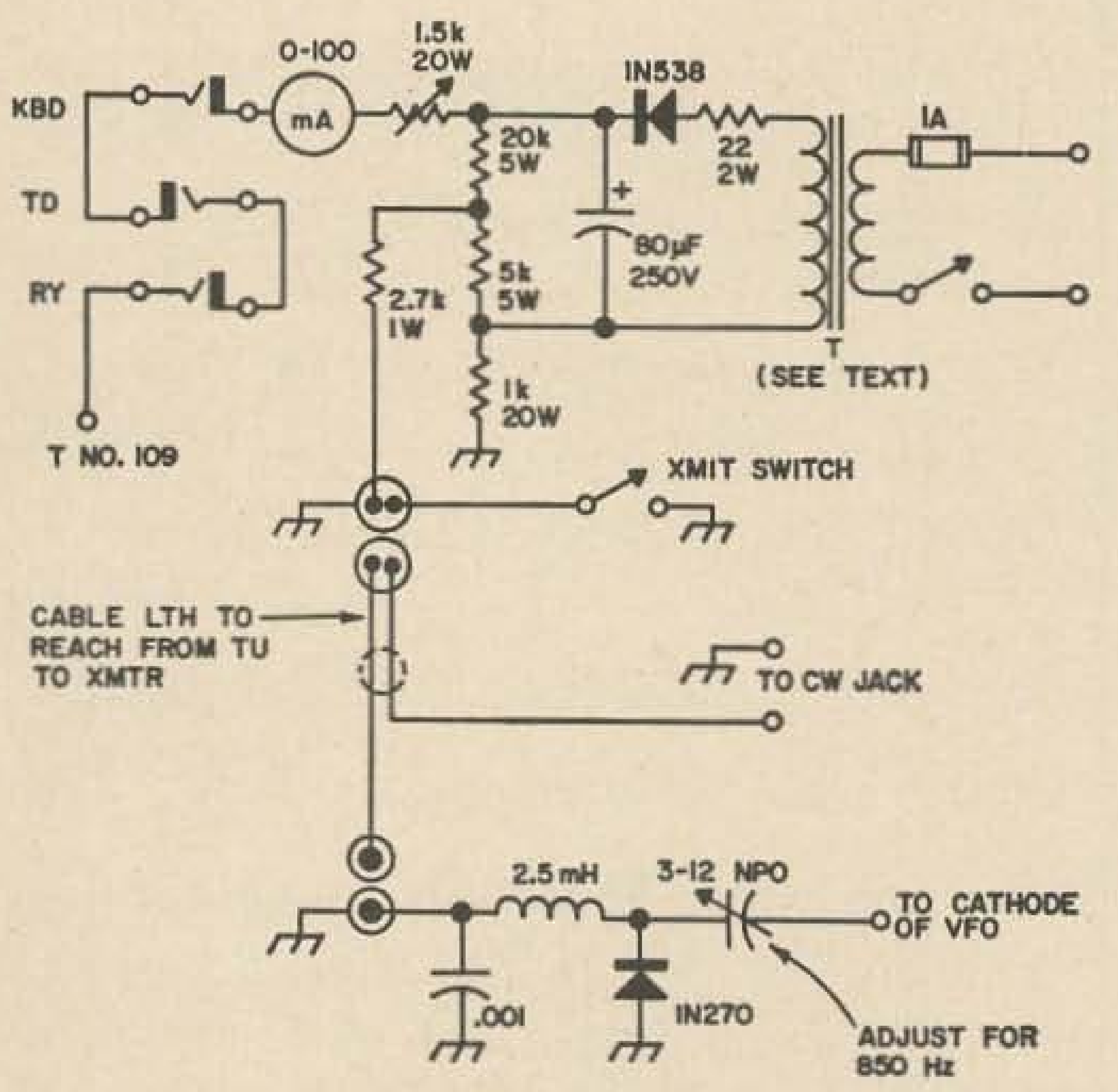


Fig. 1. "Hybrid" circuit used with Tritronics TU and K8DKC loop supply.

I used a Triad R-30 transformer for T-3. It's rated at only 50 mA, but it will give 60 without a groan. It also has a 6.3 volt ac center tapped winding at 1.5 amperes, if you need it. K8DKC used a Stancor P-8421. I have also used a Triad N-51X, an isolation transformer, rated at 130 volts dc at 300 mA. Any one of these three are ok.

Connect all parts as shown in the schematic and insulate all three keying jacks and the "B" plus from the chassis. Connect the "B" plus to terminal number 109 on the board.

Now that the terminal unit is complete and wired, plug in the transmitter distributor (TD). If you do not own a TD, use a shorted phone plug in this jack. Plug in the keyboard and the printing relay. Turn on the unit and adjust the 100,000 ohm pot connected to terminal 116, 118 and 120. Watch the 0 to 100 mA meter and stop at 60 mA. With no signal into the terminal unit tune in an RTTY station and begin to copy. If you get no copy or it is garbled, reverse the switch.

When you get tired of just copying, build an FSK board and give me a call. On page 35 of the August 1965 *QST* K8DKC shows how, or see **Fig. 1.** Use a 3 circuit mike jack and a SPST switch to FSK the transmitter and to control it in the CW position. The TD, the KBD, or the incoming signal will key the transmitter. Just how versatile can one be? The total cost is less than $20.00 for the works and it's all new. Take it from me, you won't get on any easier or with so little effort, so why not give it a try? I'll be looking for you on the green keys. All comments are welcome; a SASE please, if you have any troubles.

. . . K6JFP

Using 400 Hz Transformers

Donald Littrell W4VBH
RFD 1, Box 34
Bluff City, Tennessee

There are tons of surplus 400 Hz power transformers on the market today. Since there is not much demand for them, the price is still low. Amateurs have always sought ways to save money and still get what they need, so here is a source of untapped gold.

If you follow the principles outlined in this article, you can use high grade components in that rig of yours and still save money. Since the speech range of amateur transmitters should be restricted, the requirements for a transformer are reduced. You will find that 400 Hz power transformers are quite adequate as af output or modulation transformers.

To put one of these gems to use, you must first know a few bits of information about it. You must know its power capability and its turns ratio. Power rating is determined by multiplying the voltage and current ratings of each of the secondary is then, adding them together. This will approximately equal the primary rating. They are rated for continuous duty with high reliability, so you can push them some in amateur service. The turns ratio is easily determined from the voltage ratings. Just use the relation $\frac{E_p}{E_s} = \frac{N_p}{N_s}$ and you end up with the turns ratio. This is usually expressed as 1:1, etc. With a bit of math and a voltmeter you can put the transformers to work for you. Don't let the word math scare you. If you can multiply and divide, you can solve the math required.

I will take a typical unit and show you how to use it. The unit was built with a 125 volt primary winding tapped at 120, 115, and 110. The secondaries are rated at 5 v@ 4a and 880 v ct @ 200 mA. First, what is the power capability? 5 v @ 4 a is 20 watts and 440 v @ 200 mA is 88 w. They total 108 w. The primary must supply 108 w plus losses, so this unit would be OK at 150 watts ICAS. Now let's try the turns ratio. First the 125 v and 5 v windings: it comes out as 25:1. This is about the ratio of an audio output transformer. Then the 125 v to 880 v ratio: it is about 7:1. This is not of much use as is but I'll show later how it can be used.

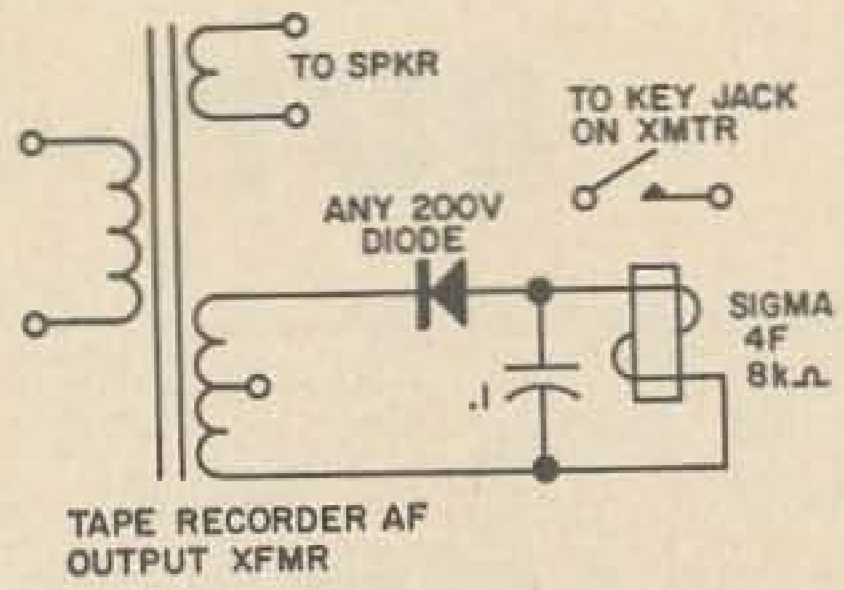


Fig. 1. Using 400 Hz surplus power transformer as an audio output transformer, complete with CW keyer for a tape recorder. Replace speaker with 8 ohm 5 watt resistor for silent operation.

Now we will see how we can use it as an af output transformer. The 5 v winding can handle 4 amps so must be made of heavy wire. If we hook a 8 ohm speaker to it, what will the load be that is reflected to the primary? Referring to the handbook we find this formula: $Z_p = Z_s N^2$. This says that the primary Z (impedance) is equal to the secondary Z times the turns ratio (N) squared. Using the 8 ohm speaker as Z_s and 25:1 as N we arrive at 5k ohms. Looking in the tube tables, we find some tubes that need a 5k ohm plate load resistance. One is the 6AQ5. It is rated at 4.5 watts. The 6BQ5 also will do and it is capable of 17 watts. This is just an example. You could use any value of speaker and find the reflected Z_p. Also, the use of the primary taps will give you ratios of 24:1, 23:1, and 22:1. This will give even wider choice of tubes. If the Z_p and Z_s are within 10% things will be fine. The high voltage winding can be used to operate a relay for automatic CW if it is the output stage of a tape recorder. Just use a silicon diode to rectify the af voltage across it and use this voltage to operate a relay such as the Sigma 4F. We are not working the transformer too hard in this use, so it should last forever.

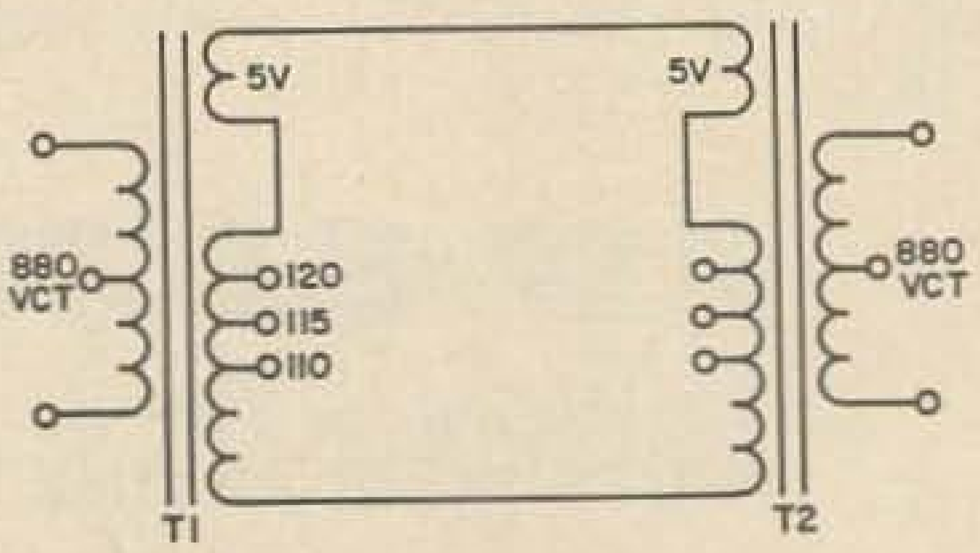


Fig. 2. Hookup for 1:1 or 2:1 ratio.

Now let's take advantage of the power capability of the transformer. If we connect two of them together as shown in **Fig. 2** we can use them as modulation transformers. To make things simpler lets look at them as one unit. The N of both units is equal to the separate N's multiplied together. The total

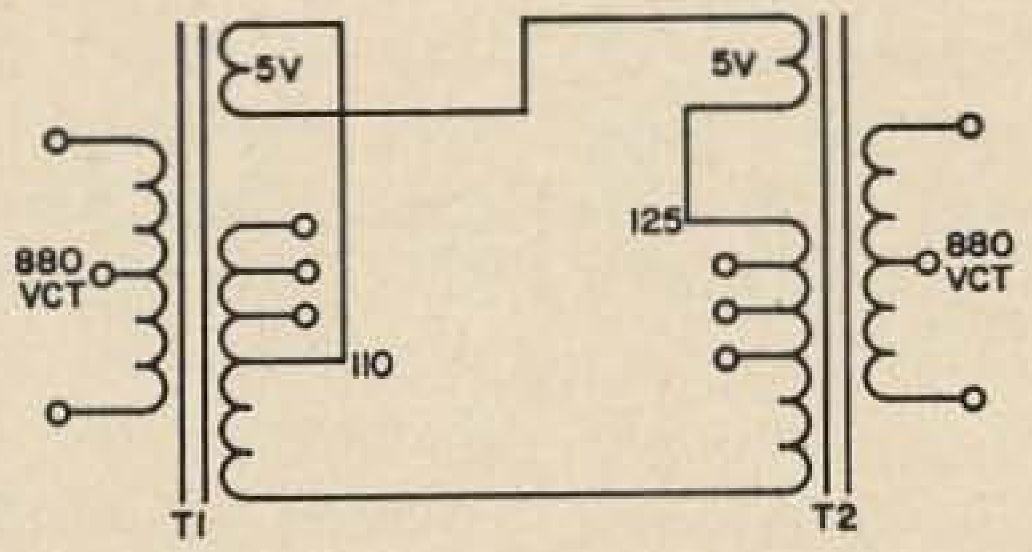


Fig. 3. Using power transformer as a modulation transformer. Ratios of 0.81:1 and 1.6:1.

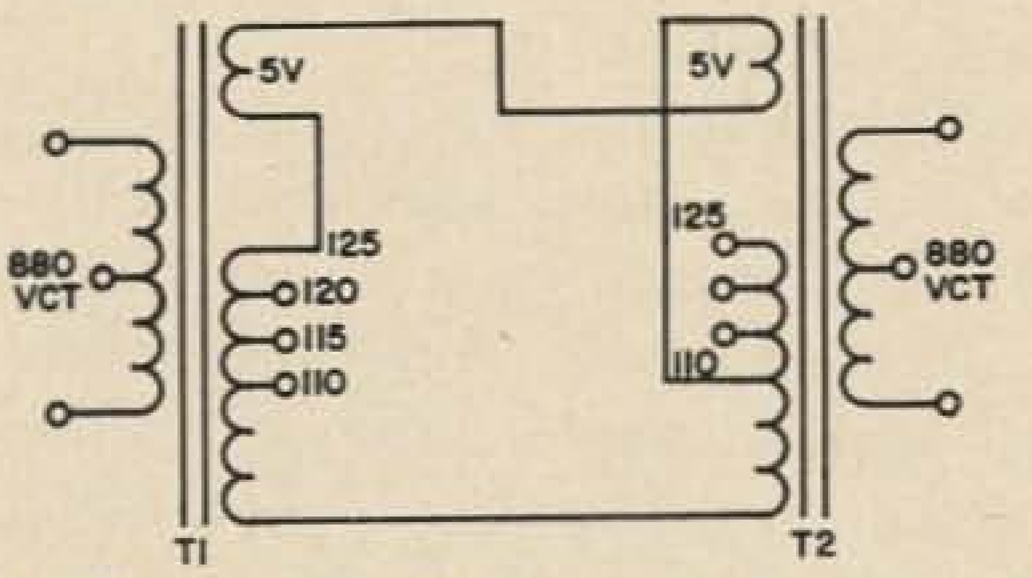


Fig. 4. 1.24:1 and 2.48:1 modulation transformer ratio arrangement.

N will be $\frac{7}{1}\times\frac{1}{7}=\frac{1}{1}$ If we choose to use half of T2's 880 v winding, the ratio is 2:1.

Fig. 3 shows how to use the primary taps and the 5 v winding to adjust the turns ratio over a wide range. Proper phasing of the 5 v winding can raise the primary to 130 v or Lower it to 105 v. The turns ratio of **Fig. 3** is: $\frac{880}{130}\times\frac{105}{880}=$ .81:1 when the entire secondary if T2 is used, or $\frac{880}{130}\times\frac{105}{440}=$ 1.6:1 if just half of it is used. **Fig. 4** shows another hook up. The ratios in this case are 1.24:1 and 2.48:1. You can see the other possibilities.

Transformer losses will be less than 10% as a rule if the resistance of the winding, as measured with an ohmmeter, is 1/20 of the working impedance. You should have good results if you don't try to get too much out of the transformers and hold the current in the secondary to a value that won't melt the windings. You should be able to modulate anything in the 1-200 watt class with ease. One final reminder: make sure the voltage rating is high enough. . . . W4VBH

A Plague in Your Panel

Robert Green W3RZD
3304 Collier Rd.
Adelphi, MD 20783

No doubt about it, there is still plenty of World War II surplus electronic gear still kicking around, and in all probability you have some of it. So, naturally, you have long ago converted it whether it needed it or not, and in the modification process there were a few holes in the panel that were no longer needed. If you are one of the new comers to this game of radio who doesn't have any WW II surplus the normal course of events will lead you to modify some commercial or homemade piece of equipment, and guess what, some of those same types of holes will no doubt show up. When they do appear, they plague us until we can cover them. Don't fret, the plague can be arrested. There is an easy way which takes very little time and effort and results in a panel with a very pleasing appearance.

Let's assume we have a panel that has a few bolt holes about 1/16" to 3/16" in size, plus some 7/16" switch holes and even a 2" hole that used to house a meter or a power plug. The first thing to do to correct the situation is to remove the panel from the chassis. Usually it can be done with little work. There were a few types of gear built with the front panel and chassis as one unit. If this is the case, you can still improve the appearance of the panel if care is taken.

If possible, take the panel to the paint store to match it with the new spray can paint you are going to use. A word of warning regarding spray can paint; when buying more than one can of the same color (and make sure it is from the same manufacturer) check the bottom of the cans and match up the "batch" numbers. Even though the paint is produced by the same company and is supposed to be the same color, one mix or batch could be of a slightly different hue. If no batch numbers are on the cans, stay away from it—try a different brand of paint.

Next, and before removing the old paint with paint remover, copy the decals or lettering on the panel, if raised metal lettering is not used.

If you have a set with the one piece chassis/panel combination, apply the remover sparingly so as not to get it into or on the components which are mounted on the chassis. Of course with this type of panel it will be necessary to remove all the parts which can be removed. A large plastic bag can sometimes be slipped over the chassis part and taped shut. After the surface paint has been removed use a drill a little larger than the hole to be plugged, and run it through the hole to remove the last of the paint. On larger holes use a knife or sandpaper wrapped around a dowel stick. If any of the holes to be patched have raised lettering which should be removed, this can be done by using a fine grit grinding wheel in a hand electric drill.

Basically, what we are going to do is plug up the holes with automobile body epoxy filler. It doesn't matter whether the panel is of aluminum or steel. Although solder could be used on the smaller holes in a steel panel it is not recommended as the flux could cause blistering in the new paint.

On the small bolt holes, use a counter-sink bit or a drill several sizes larger than the hole and form a shallow "V" or bevel, on both sides of the panel. **See Fig. 1.** If you don't have a drill large enough, use a rat-tail or half-round file to form the bevel. On the larger holes, from about ¾" up, a different approach has to be used. First bevel the hole on the front of the panel, then cut out a piece of metal, aluminum or steel, about ½" larger in size and glue this to the back of the panel, covering the hole, with epoxy resin cement and clamp it tight. The thickness of the metal depends on the size of the hole to be covered, but usually about #18 gauge (or thin chassis stock) is usable. Needless to say, this piece of metal should also be free from grease and paint. Before cementing the metal in place, drill a few small holes in it with a #28 drill. Space the holes so that the panel doesn't cover any of them when the plate is mounted. About four or five holes will do for a 2" plate. The larger the plate the more holes will have to be drilled. **(Figs. 2 and 3)**

After allowing the backing plate glue to dry overnight, lay the panel on a flat surface, face up, with waxed paper under it. It will be necessary to shim up under the waxed paper and the panel with scraps of metal the same thickness as the backing plate if one is being used. If you can do so, fasten the panel down to the flat surface by using small screws or brads through holes that *will* be used. This is to keep the panel from sliding about. Make sure that the heads of the screws or brads are below the surface of the panel.

Next mix up some of the epoxy filler. If you are working inside a well heated room us a little less of the hardener than the amount specified in the instructions on the can, otherwise the mix will "set-up" too fast. Apply the mix with a flexible bladed putty knife and work the filler into the smaller holes so that it squeezes into the back beveled area. Allow a little of the excess filler to remain on the front of the panel as it will shring slightly. If any raised lettering was ground off, cover the area with filler. In patching the larger holes which use a backing plate, allow some of the filler to feed through the holes in the plate. This will lock the filler in place.

After the filler has dried, remove the panel and again place on a flat surface, but face down. Use a sanding block and aluminum oxide paper to smooth the back of the panel. Start with #100 paper and finish with #180 paper. An aluminum panel can be given an even finer finish by using #0000 steel wool after the #180 grit paper is used. During the sanding, allow a little of the mix that worked it way through the holes in the backing plate to remain. The author found that it works best if the sanding block is at least longer in length than the largest hole, and sand the area so that the block covers the hole in each sweep over the area. Turn the panel over and repeat the same process on the front, using even more care to insure a smooth and mirror like finish.

The panel should now be washed in soap and water and given a final bath in vinegar. Wear cotton or plastic gloves when doing this to prevent body acids and oils from getting on the surface of the panel. When dry, place face down and spray first with a primer coat and then the regular paint. A final coat of clear spray is desirable. When the final back coat of paint is dry, turn the panel face up with a backing of an old rag or waxed paper to keep it from becoming scratched. If the panel has raised lettering do not apply the clear spray until the new paint has been scraped off the lettering, with a razor blade. If there is no raised lettering, apply new decals before the clear spray is used. Several times when renewing a panel as described, I found that I could not get the new spray paint to exactly match the old paint, so also resprayed the cabinet. Sometimes a two-tone effect between panel and cabinet is pleasing. As was said earlier, with a little time and effort that old piece of "junk" can be made to look quite nice. Try it. . . . W3RZD

High Voltage Battery

D. E. Hausman VE3BUE

Have you ever needed 18 or 27 volts for some experimental transistor project? No ned to build a special power supply when a few nine volt transistor radio batteries will do the job.

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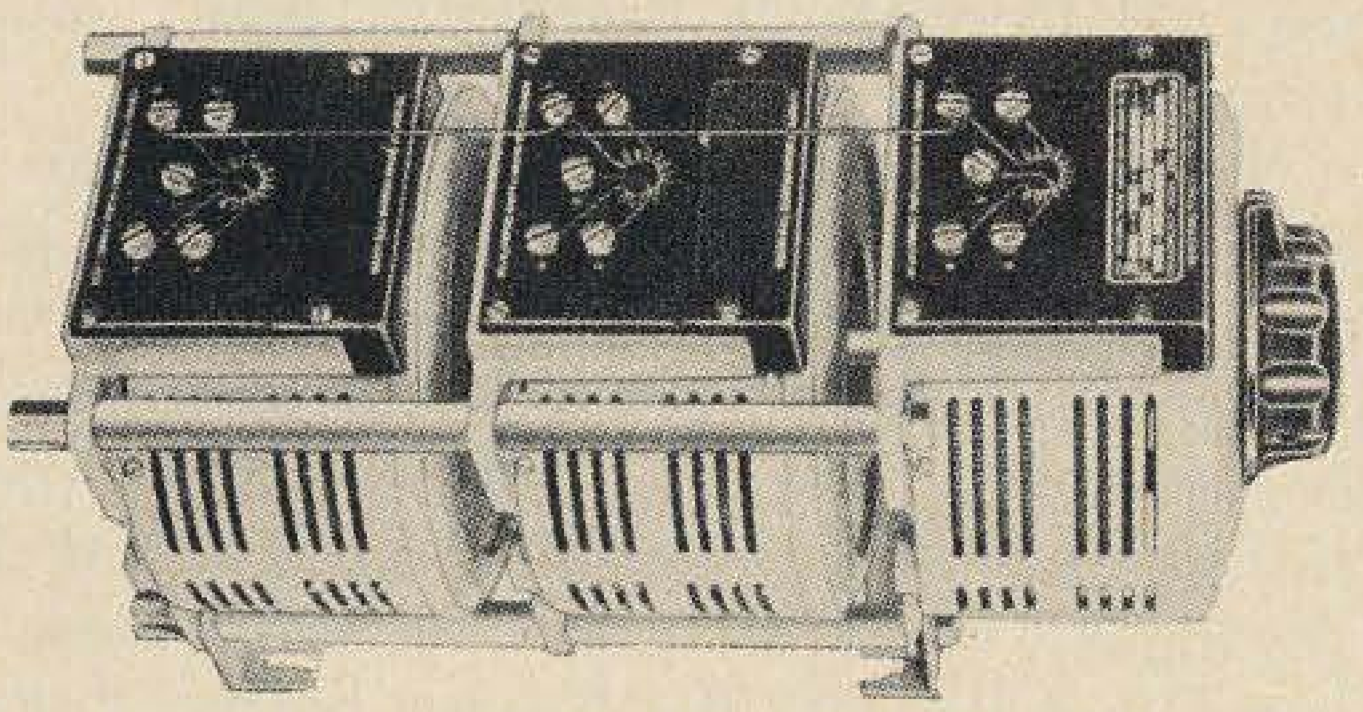

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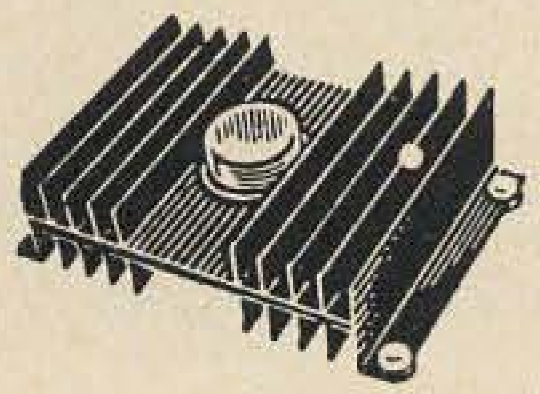

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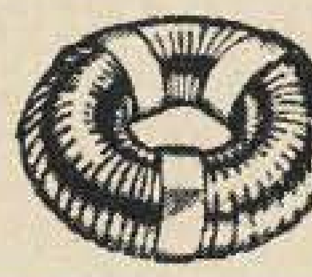

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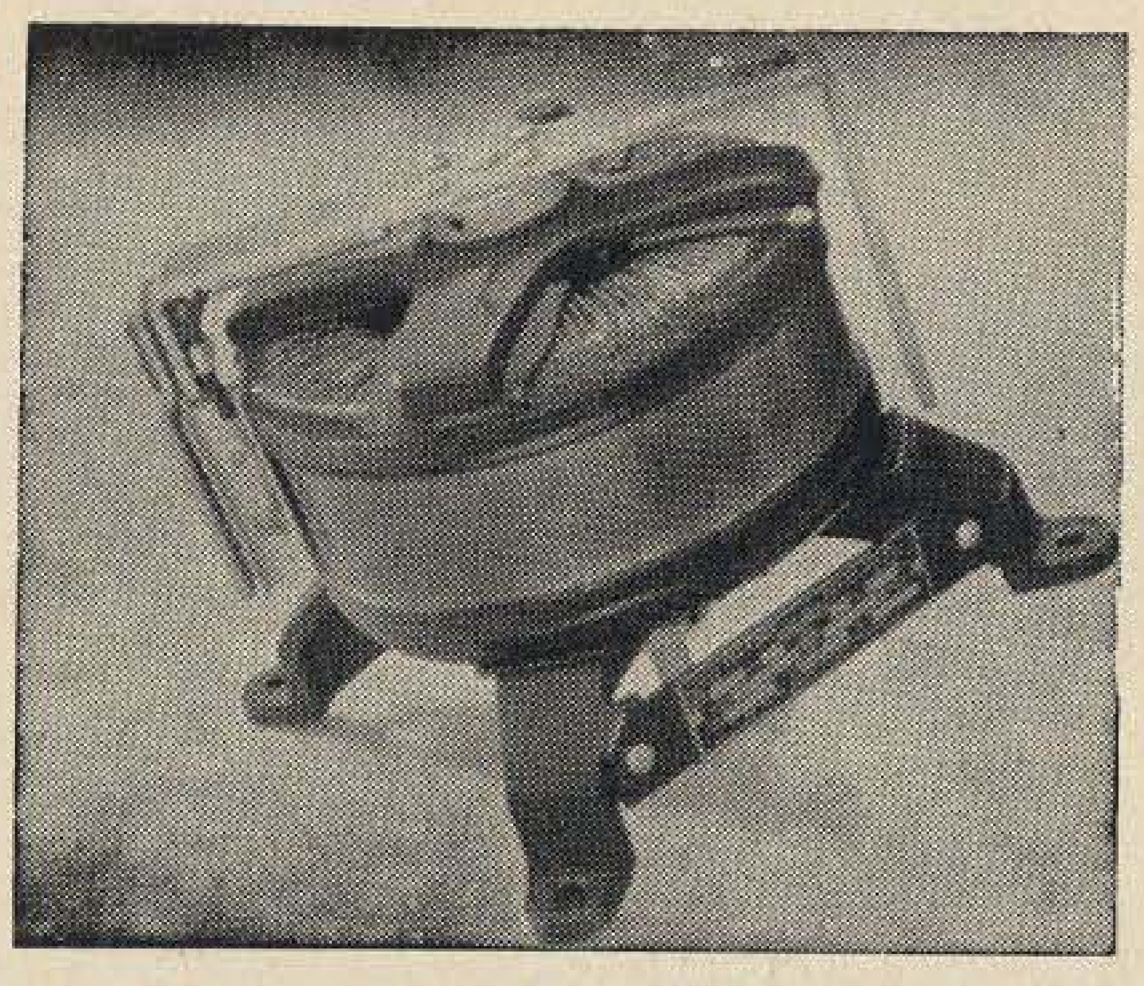

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continued from page 4

a great many amateurs feel should be reconsidered, though I'm not sure that the five words per minute requirement for the Novice and Technician licenses is really much of an obstacle.

The extension of the Novice license to five years was proposed on the basis of giving the Novice a longer time to amortize the cost of his equipment. This may indeed be a factor holding Novices back from making a heavy investment in commercial equipment and is worth consideration. I have long felt that the Novice license should be five years and renewable since the restrictions in frequencies are such that they would seem to provide adequate incentive for advancement.

The removal of the two meter phone band from the Novice seemed to me to be unnecessary. The number of Novices using this band has never been more than miniscule and it seems unfair to me to deny those few that are interested in working in the VHF bands the opportunity.

In another move, the EIA has set up an engineering committee to work on developing definitions, performance standards and methods of measurement for amateur radio equipment. They will work on bandwidth, unwanted sideband rejection, carrier suppression, distortion, power output measuring and definition, cross modulation and antenna gain. Stu Meyer of Aerotron is the chairman of the committee. They are biting off a pretty big hunk to chew.

The EIA is launching an industry-supported national advertising campaign to expand the Citizens Band market and will be using television spots, radio, magazines, newspapers and store displays. This is probably a good move to perk up that sagging market. Wouldn't it be wonderful if the EIA worked out a plan to help boost amateur radio in a similar way? Or if the ARRL made such a move?

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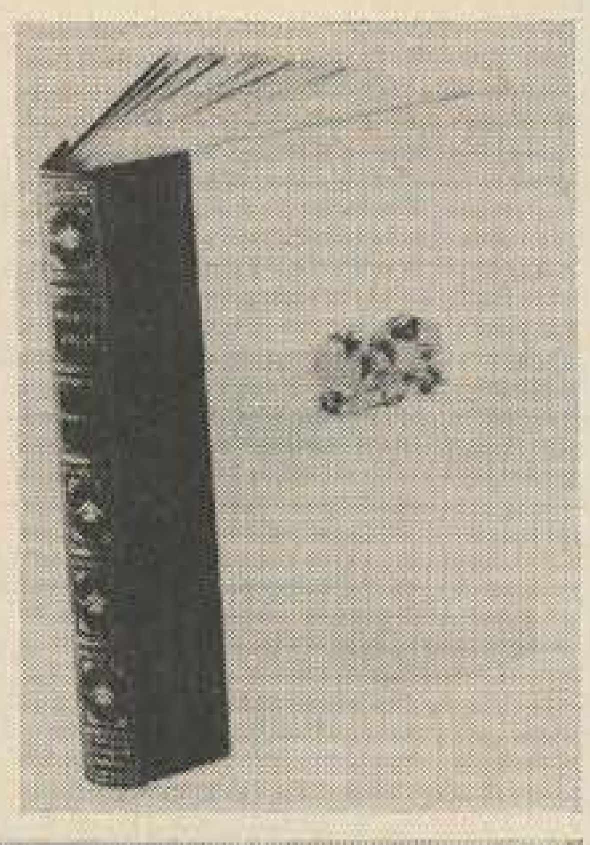

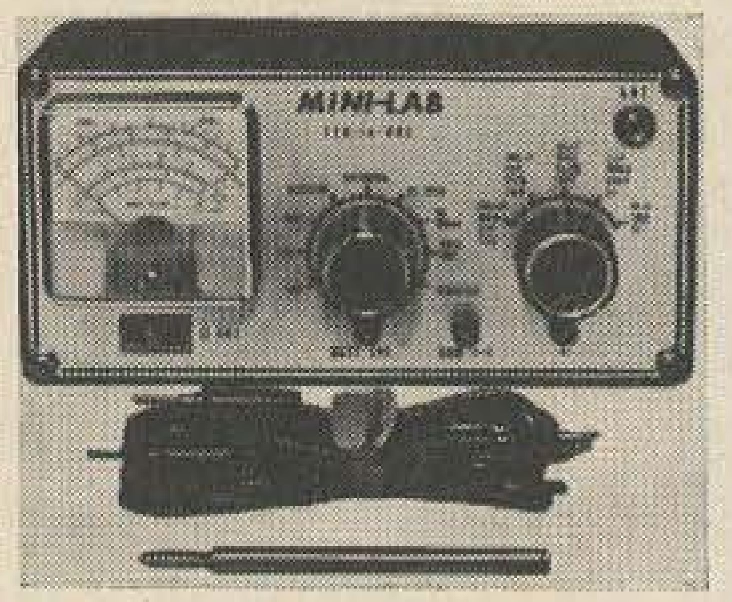

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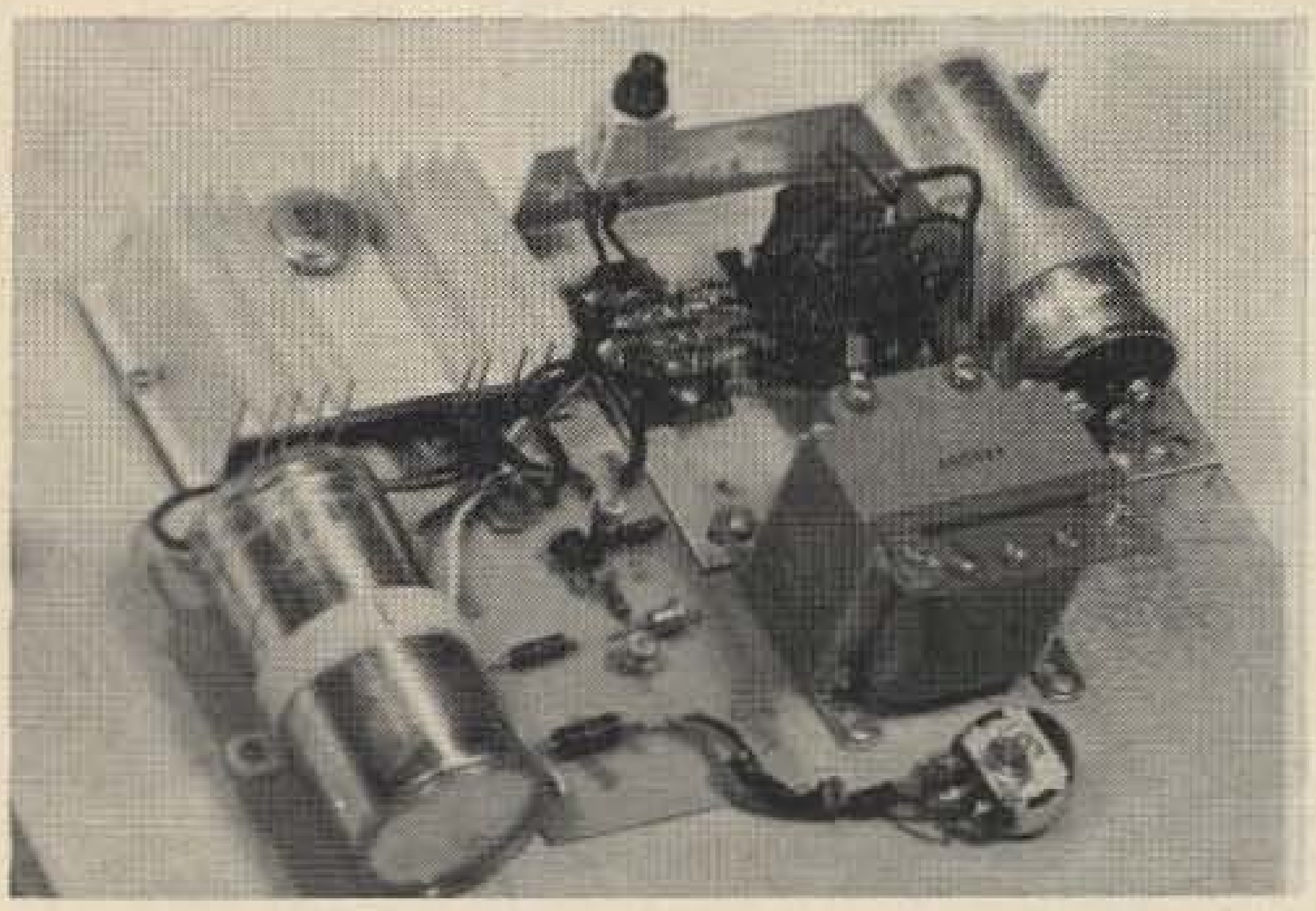
POWER SUPPLY KIT $15.00



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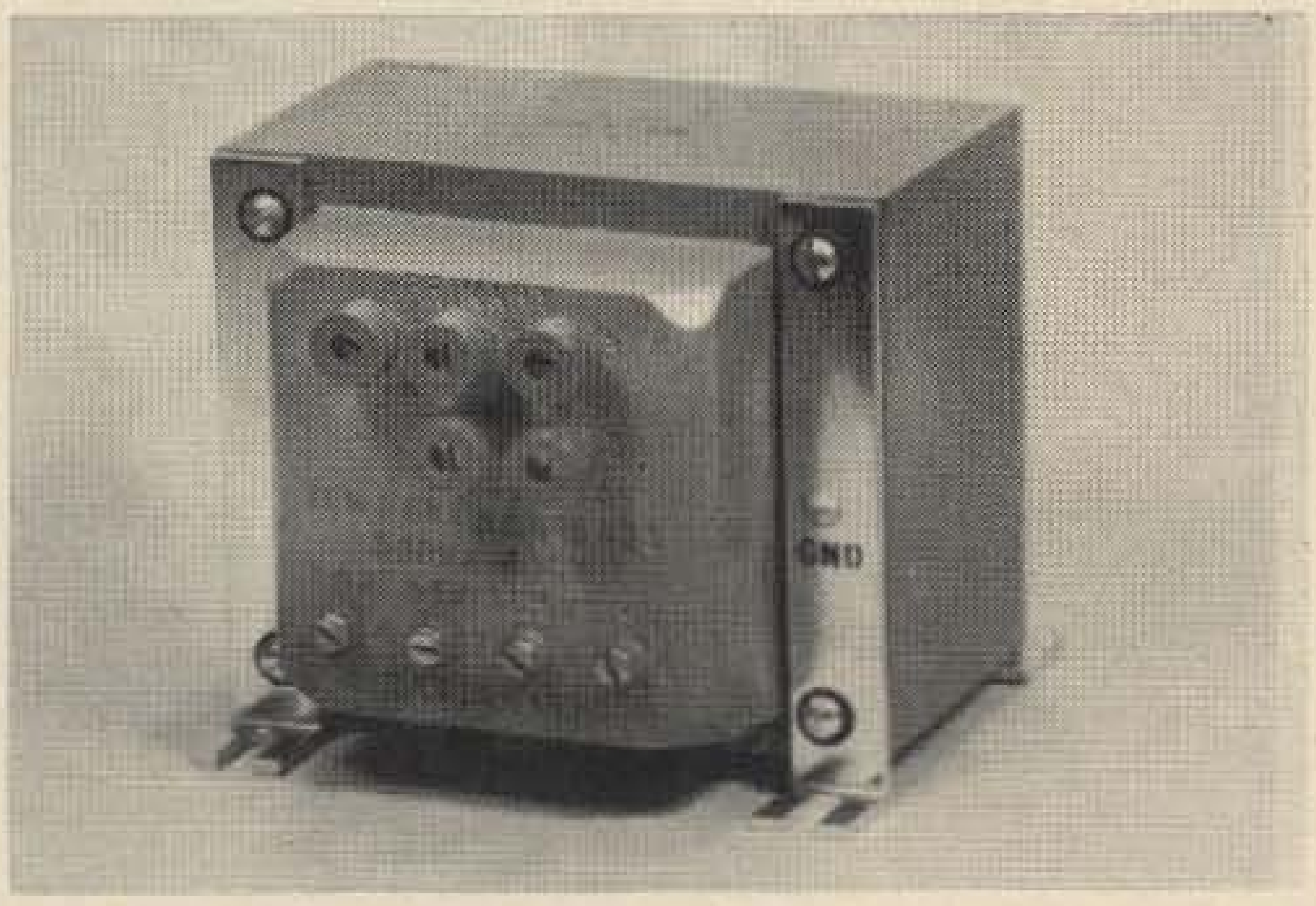

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4 4½"x[illegible]"	1.50	3.00	3.50	4.00	5.50
6 3"x4½"	1.50	3.00	3.50	4.00	5.50

General Purpose
XXXP
1 oz copper,
1 side

Pkg. Quantity	1/16"
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ELECTRONIC SPECIALS

AI

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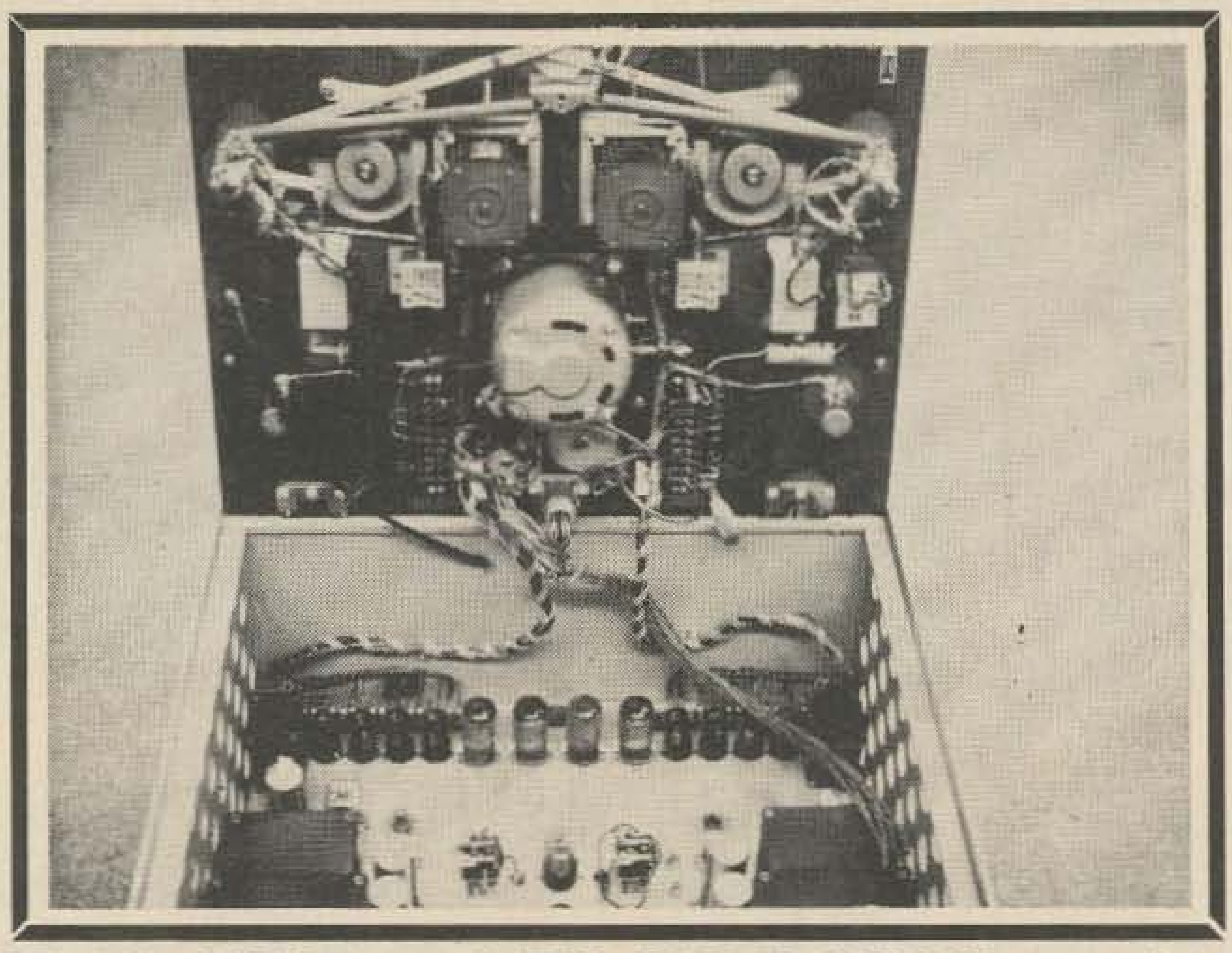

This POTTER MODEL 3232 DIGITAL MAGNETIC TAPE TRANSPORT, as used in computers, comes complete with hysteresis drive motor and basic deck parts as shown in above photo. (No recording head.) We also supply FREE schematic, instruction booklet and reprint of article which tells how to make a video tape deck for recording TV programs.

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200	1.40
300	1.75
400	2.25
500	2.60

ZENERS 1 Watt 7-33V $ .50
10 Watt 7-200V $ .75
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Avalanche mode operated transistors. This is just the item you have been looking for, a device to TRIGGER SCR's ....4/$1.00

UNIJUNCTIONS!

Similar to 2N2419. RBB of 5-7, standoff ratio of .6 and IP of 12, with data sheet.
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☐ N-CHANNEL FET'S TO-18 plastic units, low noise, low leakage, 25 volts source to gate, 50 ma gate current Gain to 9000 µmho's. $1.00

☐ SIM to 2N3429 (NPN). SI 7/8" stud, min HFE of 30, 7.5 Amps. 175 watts, VCe of 75..$1.75

☐ SILICON BILATERAL SWITCH. Replaces two SCR's by firing in either direction when breakdown voltage is exceeded. Used in light dimmers, etc. .... 2/$1.00

☐ NEON LIGHT OR NIXIE TUBE DRIVERS. An NPN, TO-18, SI Transistor. With a VCBO of 120 ....3/$1.00

☐ SIM. to 2N2875 (PNP). Silicon 20 watts with 30 MHz cut off ....$.75

☐ 500 HFe plastic transistors. NPN, TO-18, SI unit similar to 2N3565 ....4/$1.00

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PRV	3A	12A	20A	40A
100	.09	.30	.40	.75
200	.16	.50	.60	1.25
400	.20	.70	.80	1.50
600	.30	1.00	1.20	1.80
800	.40	1.25	1.50	
1000	.55	1.50	1.80	

Terms: FOB Cambridge, Mass. Send check or Money Order. Include Postage. Average Wt. per package ½ lb. No. C.O.D.'s. **Minimum Order $3.00.**

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Top Hat & Epoxy 1 AMP.

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100	.07	1000	.35
200	.09	1200	.50
400	.12	1400	.65
600	.18	1600	.80
800	.22	1800	.90

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PRV	3A	7A	20A	70A
50	.35	.45	.70	
100	.50	.65	1.00	4.00
200	.70	.95	1.30	8.00
300	.90	1.25	1.70	
400	1.20	1.60	2.10	12.00
500	1.50	2.00	2.50	
600	1.80	2.40	3.00	16.00
700	2.20	2.80		
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NEW OIL CAPACITORS

.25 MFD 12,500 V. **$3.75**
10 MFD 330 VAC .... **75¢**
4 MFD 600 VDC .... **50¢**
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1000 PIV 1 AMP

diodes Tophat or Epoxy **40¢** each **10/$3.75**

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Single turn precision Pot Lin. + — 1% 10K Ohm .... **35¢**

Crystal holder, 10 HC6U crystals in row 1"W x 3⅞" Long .... **59¢**

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#2. 18 ohm 2.7A100 watt
$1.50 per unit

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Potter & Brumfield SS relay 10MW sensitivity spdt silver contacts - 2 amps Dual coil 10,000 ohm 1 MA new **$1.75**

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M 359 .... **40¢**
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Flexible coupler 2 ¾"D for ¼" shaft .... **75¢**

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VARIACS GENERAL RADIO & OHMITE 60 cyc. Input 120v-output 0-280v 1 amp or Input 240v-output 0-280v 2 amp. Pull-outs in excellent cond. (10 lbs.) **$6.95**

INTEGRATED CIRCUITS

UL914 open gate Fairchild. This I.C. was featured in the Dec. '67' & Jan. '68' issues of RADIO-ELECTRONICS "30 Different I.C. Projects" These UL914 Fairchilds are NEW straight from the manufacturer with a reprint of R-E's article **$1.00**

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Relay Repeaters Philco CLR-6-Frequency 5925 to 7425 MC: 120 VAC 60 cys. NEW Excel. Cond. 500 lb per unit, With manual (2 units) .... **$200.00** ea.

HD #505B TACHOMETER

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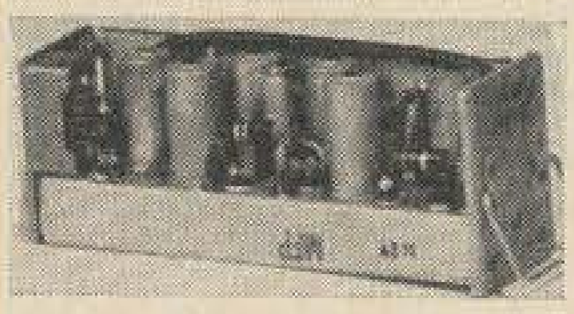
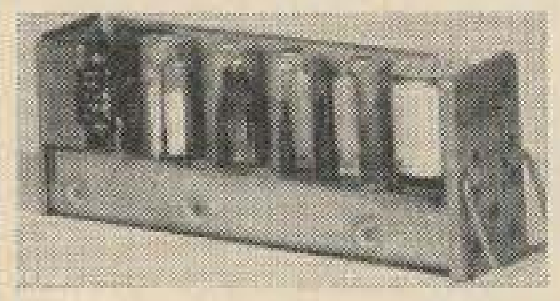
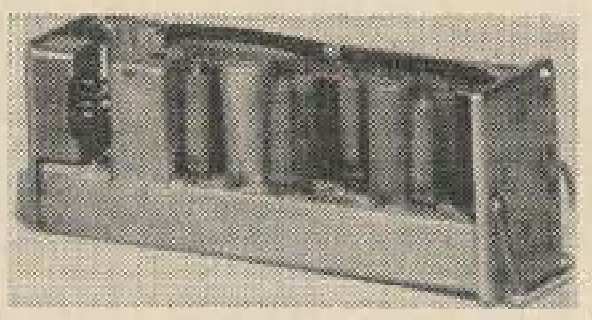


3 Tube RF Amplifier 152-174 MC 2 stages of RF amplification, 1 mixer IF output 7.5 Meg. **$2.50**

4 Tube Local Oscillator



3 tube oscillator, 1 tube B+ regulator out multiplier 152-174 Meg Uses HC6U crystal in TC oven multiplied 18 times **2.50** ea.



7 Tube 2nd IF Discriminator 455 KC IF 5 stages 2 stages limiting diode discriminator output ± 15 KC .... **$2.50** ea.

(By using the amplifier & local oscillator you have a 2 meter crystal controlled converter using your 40 meter receiver as a tunable IF. By using the discriminator, you can go FM or 6 meter & 2 meter with your present 455 KC receiver IF) SCHEMATIC INCLUDED WITH EVERY UNIT.

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1968 ARRL Handbook

The 1968 edition of the ARRL Handbook arrived the other day for review. The cover is new, a definite step ahead, I would say. The book has about the same number of pages as last year, about 700, including the advertising section. The price is still $4, reflecting the economies of a non-profit business enterprise and what is, essentially, a relatively unchanging product.

Perhaps it is unfair to review the book in terms of last years edition rather than just on its own merits. I'll try to do both.

In turning the pages of the two editions, side by side, one can see the influence of the new editor, Doug DeMaw, for semiconductors are rearing their heads in greater numbers. All of the new material is, as far as I know, out of the pages of QST. It is difficult to judge, but I would say that perhaps up to 10% of the construction projects are new this year. The influence is particularly in evidence in the VHF sections of the book, which are much more up-to-date than they have been in previous editions. This is logical, since Doug is primarily a VHF-man and By Goodman, the previous editor, was more interested in the lower bands.

The Handbook is offset printed and well done, at that. The photos, for the most part, come out beautifully . . . one of the tests of good offset work.

In all, for the $4 price, you really should get a new edition of the Handbook and keep your library up to date with a new edition each year. $4.50 in Canada, $5.50 elsewhere, $6.50 in hardcover and $7.00 foreign in hardcover.

160 Meter Expansion

Starting July first the 160 Meter boys will have cause for rejoicing. Operators in most of the states will get either more of the band to work with or more power permitted, or both. In some areas there may be as many as eight new 25 kHz segments to use. This is all due to a shifting in the Coast Guard Loran frequencies and locations. If this keeps up we may start looking for 160 Meters on our sideband transceiver bandswitches. Any of the older timers will tell you that, in the olde dayes, 160 was one of the finest ham bands we had.

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CV-253/ALR 38-1000MC Exl. Condition Late Model $150.00
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TN-3/APR-1 300-1000MC Exl. Condition 24.95
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THE ABOVE CONVERTERS CAN BE USED WITH ANY RECEIVER THAT TUNES 30MC

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T-47/ART-13 2-18 Mc transmitter Less tubes Good Condition $24.95
T-47/ART-13 with tubes Exl. Condition 49.95
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RT-18/ARC-1 transceiver 100-156 Mc Exl. Condition 39.95
ARC-3 transmitter 24 channel 100-156 Mc Exl. Condition 29.95

TELETYPE EQUIPMENT

	UNTESTED	TESTED OK
M-15KSR Page Printer with Keyboard	$135.00	$170.00
M-19ASR with table & Power Supply	200.00	275.00
M-14TD Tape Reader	50.00	75.00
M-14RO Tape Reperforator No Keyboard	50.00	75.00
M-14KSR Tape Reperforator with Keyboard	75.00	100.00

All above units have sinc. motor and will be complete and in good Physical condition as removed from service

TELETYPE CONVERTER TERMINAL UNIT

AN/FGC-1C Dual Diversity Audio RTTY Converter can be used with any type receiver. These are new and shipped in original factory crates with all spares $149.50

IP-69/ALA-2 PANADAPTER

This compact unit can be used with most Ham Receivers after conversion. Complete with conversion info and schematic. Like new condition $24.95

ARNOLD MAGNETICS TRANSISTORIZED POWER SUPPLIES

Model 838 input 12V.DC output 400V.DC @ 100MA. New $14.95
Model 834 input 6V.DC output 150V.DC @ 130MA. New $14.95
SIZE: 4½" x 3½" x 2" in enclosed metal case. These units had a retail price of $49.50

IBM REGULATED SOLID STATE BENCH POWER SUPPLY

Input 110/1/60 output 12V.DC @ 8A fixed by a Zener Diode. Almost no ripple. Like new tested OK with schematic @ ......$24.95 ea

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4-1000A by EIMAC or PENTA $95.00
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829B/3E29 ...... 8.95
803 ...... 4.95
5CP1 ...... 4.95
5BP4 ...... 4.95
3CP1 ...... 3.95

MICROPHONES & HEADSETS

HS-23 Headset 2000 ohm New ......$ 6.95
HS-33 Headset 600 ohm New 6.95
T-17D Carbon Microphone New 9.95
RS-38A Carbon Microphone with coil cord New 9.95
52AW telephone operators headset mic New 24.95

TAMAR 12V. MOBILE RF POWER AMPLIFIER

This is a very compact RF Amp. Originally mfg. for light aircraft. Frequency 118-128MC. Easily converted to 2 or 6 meters. Has built in transistorized power supply. Uses 1 ea. 6360; 1 ea. OB2, supplied with schematic. Less tubes. Special closeout price $9.95

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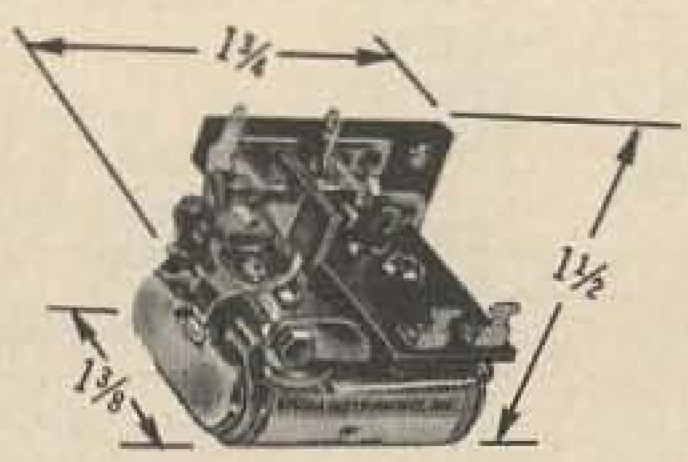


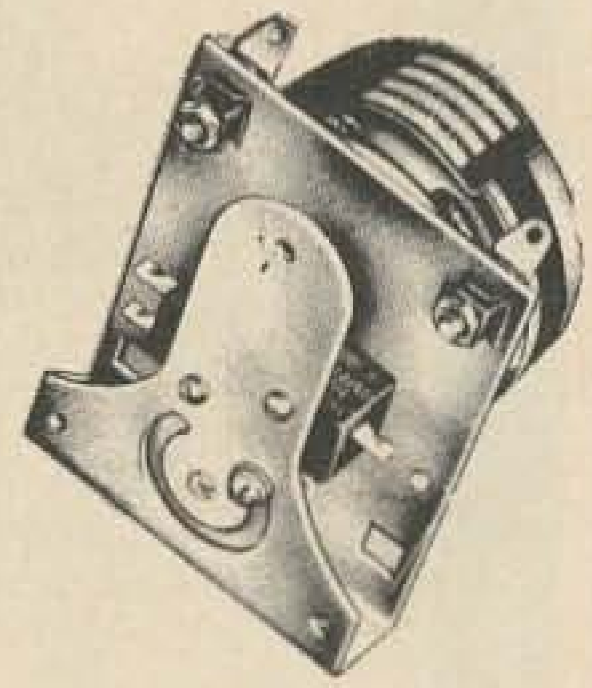

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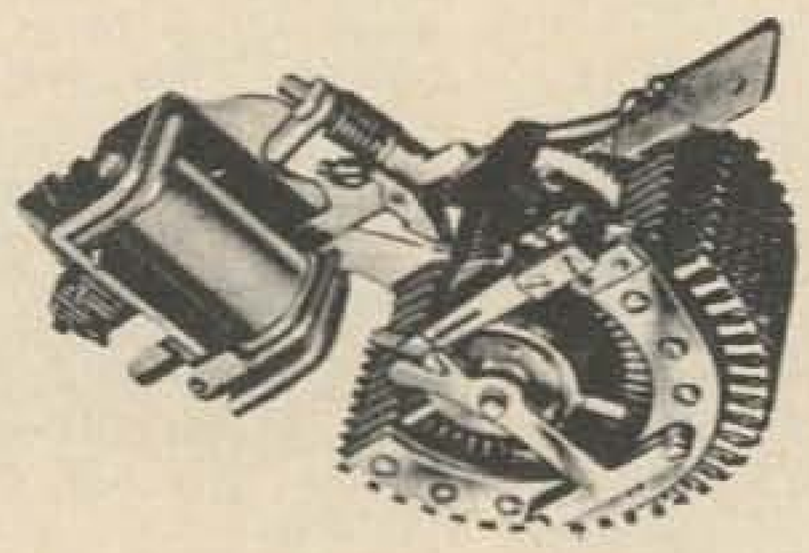
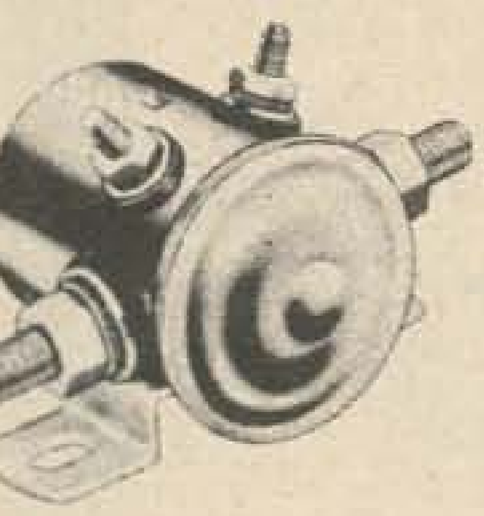
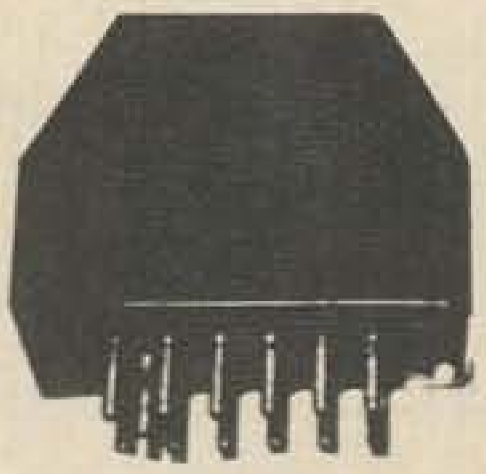



MINNEAPOLIS HONEYWELL RELAY

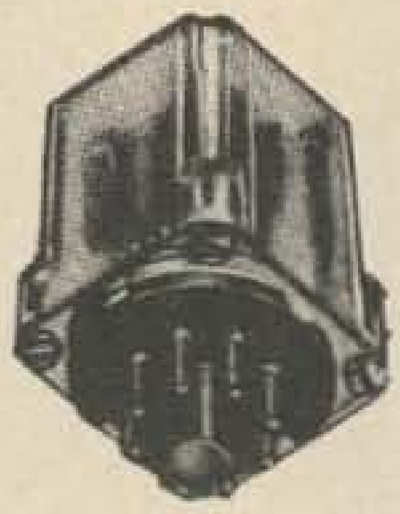
4.P.D.T. GOLD ALLOY CONTACTS
14 PIN PLUG-IN BAKELITE CASED

RELAYS

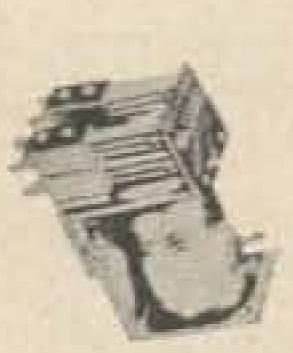



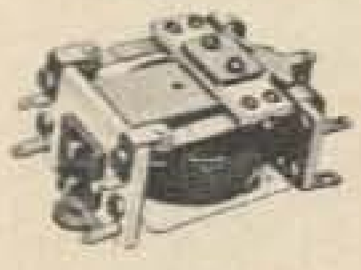
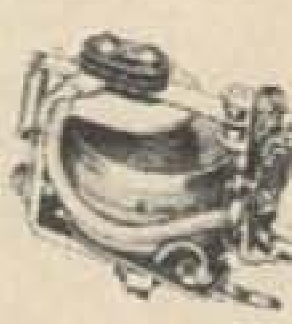

No. R-847
$2.95 ea.

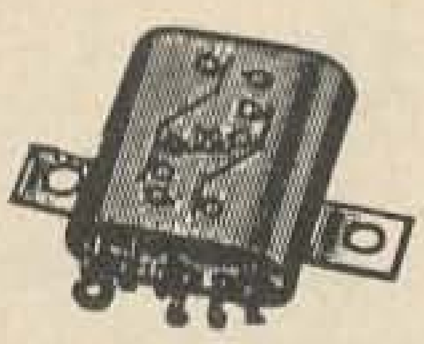
RELAYS



Top quality bakelite enclosed 14-pin plug-in relay. Contacts are of gold alloy 4.P.D.T. rated 3 amps 115 volts. Coil resistance 70 ohms, operates 10/15 VDC. Size overall 1¾" H, 2¼" L, 1-1/8" W. Supplied with 14-pin socket to match. Production quantities available. Write for 1000 prices.





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Caringella Electronics Model ACP-1 Compressor-Preamp

Available either as a kit, or completely wired and tested, the Model ACP-1 Compressor-Preamp is a valuable accessory to amateur radio and CB transmitters for providing added modulation punch and protection against overmodulation.

A low noise, high-impedance FET input stage is utilized in the five transistor, 1 diode circuit. Compression tange is 30 dB. Frequency response extends from 20 to 20,000 Hz. Input and output signal levels are completely adjustable. The unit installs easily in the microphone line. The use of printed circuit layout greatly simplifies the construction of the kit.

Further information may be obtained from Caringella Electronics, Inc., P.O. Box 327, Upland, California 91786. Price: $18.50 in kit form and $26.50 wired and tested.

Catalogs

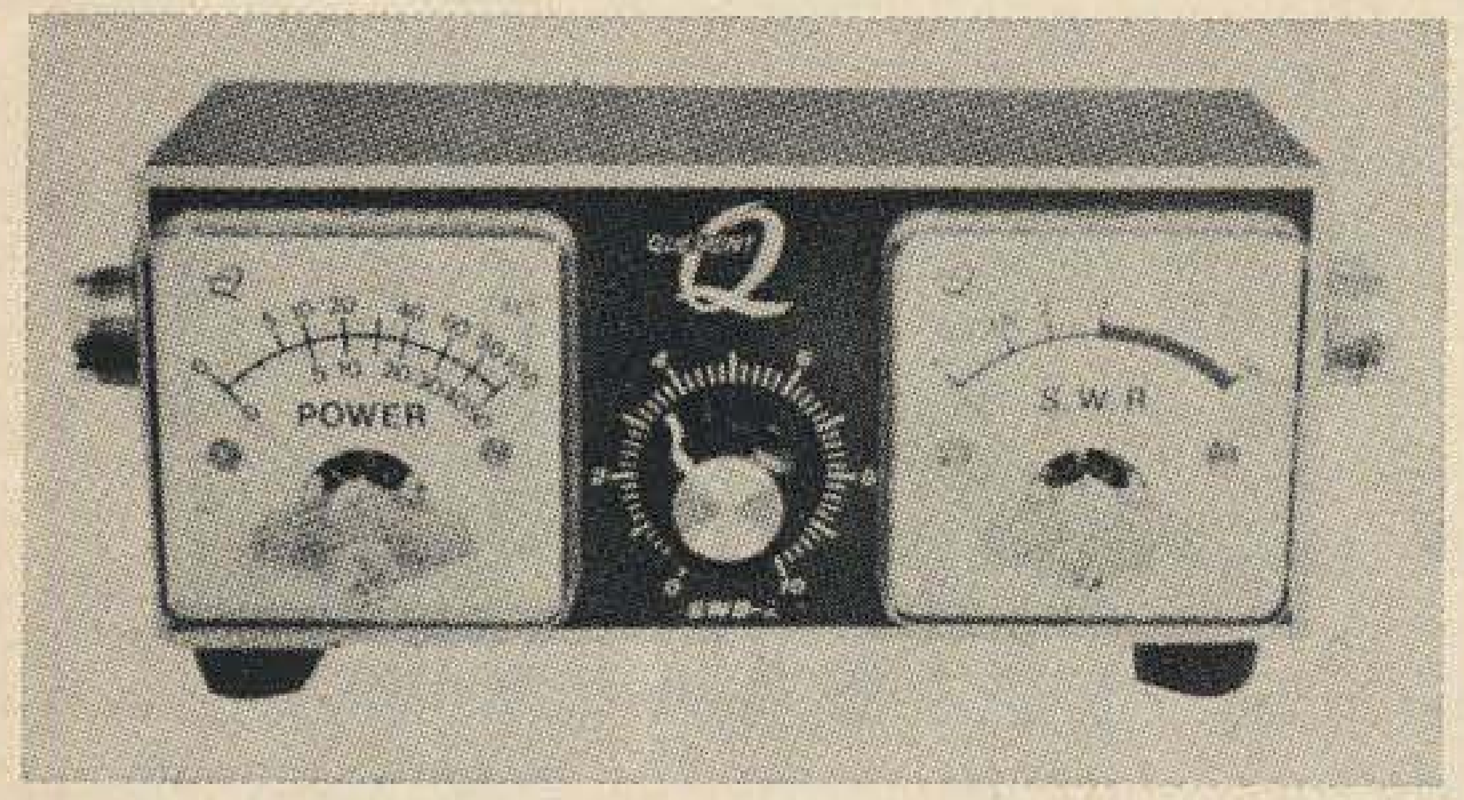
Lafayette Radio's 1968 Spring Catalog is now available free on request. This 132 page catalog contains the latest electronics and stereo hi-fi home entertainment equipment. This catalog may be obtained by writing to: Lafayette Radio Electronics Corporation, P.O. Box 10, Dept. PR, Syosset, L.I., N.Y. 11791.

Amateur Radio Antenna catalog—26 pages, is available free from Mosley Electronics, Inc. Included is a comprehensive discussion of traps, feed systems, unbalanced radiators, SWR, and other pertinent topics. Write Mosley Electronics Inc., 4610 N. Lindberg Blvd., Bridgeton, Missouri 63042.

Quement Model SWB-2 Dual Meter Standing Wave Bridge

The new Model SWB-2 is a convenient, compact, dual indicator device for use in the amateur radio station to check the operation of the antenna load to the transmitter. For VSWR measurements, this unit uses the dual bridge method of comparing simultaneously the power supplied to and reflected from the antenna system. Continuous monitoring of the transmitter output as well as continuous monitoring of the reflected power is possible by having the instrument in the transmission line at all times.

Price is $15.95 from Quement Electronics, 1000 South Bascom Avenue, San Jose, California.



The Transistor Radio Handbook

Editors and Engineers, the publishers of the famous Radio Handbook, have just released a transistor handbook that should be on your shelf. This was written by Don Stoner and Lester Earnshaw, whom you should know by now. The book was obviously written for the average amateur for it will not strain the average intellect. It starts with the usual discussion of holes and the like, and rapidly goes on to the practical applications with the basic circuits and a myriad of construction projects.

The book covers audio amplifiers, compressors, modulators, rf amplifiers, detectors, AGC circuits, oscillators, receivers, from a superregenerative detector right up through a complete superheterodyne. There are simple and complex receiver projects, converters for VHF, product detectors, crystal filters, and transmitting power amplifiers, linear amplifiers, VFO's, etc. Power supplies are covered too, in depth, with do-it-yourself examples of each type.

The book is only $5 and is available at most good parts distributors.

KAAR PH17M Transistorized transmitter for 40/80/160 Meters

This new solid state SSB, compatible AM, and CW transmitter for three band operation on fixed frequencies is now available from Kaar Electronics, Corp. Power output is 90-100 watts PEP depending on frequency and antenna used. Audio frequency response extends from 450 to 2600 Hz, and is down only 2.5 dB at 500 and 2400 Hz with respect to 1000 Hz. The transmitter can be operated on SSB with carrier suppressed 46 dB or more, or in the AM mode with carrier transmitted. Frequency tolerance is plus or minus one part per million per week. At room temperature, frequency stability is better than ±5 Hz when operating at 12.5 MHz.

The Kaar PH17M transmitter employs solid state circuitry throughout, except in the high level stages, and operates from 115 or 230 V, 50-60 Hz ac.

Full details are available from Kaar Electronics Corporation (A member of the Canadian Marconi Company Group), 1203 St. Georges Avenue West, Linden, N.J.

New Books from Sams

Bridges and Other Null Devices, by Rufus P. Turner #20564, $3.25
Understanding bridge type instruments

How to Read Schematic Diagrams, by Donald E. Herrington #20568, $2.95
Shows how easy it is to understand schematics

Test Equipment Cyclopedia, by the *PF Reporter* staff $1.95
Current information on test instruments

Transistorized Amateur Radio Projects, by Charles Caringella W6NJV #20570, $3.25
Selection of transistorized construction projects for the ham

101 *Ways to use Your Ham Test Equipment,* by Robert G. Middleton #20566, $2.95
Explore the total possibilities of your test gear

Audio Amplifier Design, by Earl J. Waters #20560, $4.25
How to design amplifiers either simple or complex

Understanding UHF Equipment, by John D. Lenk #20557, $3.25
Basic background in UHF

So You Want to be a Ham, by Robert Hertzberg W2DJJ #20607, $3.95
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3rd edition of this book with impact of incentive licensing

ABC's of Transformers and Coils, by Edward J. Bukstein, #20612, $2.25
2nd edition. Basic principles of inductance, transformer and coil construction.

Tube Substitution Handbook, by the Sams Engineering Staff #20614 $2.25
Over 10,000 direct substitution tubes listed

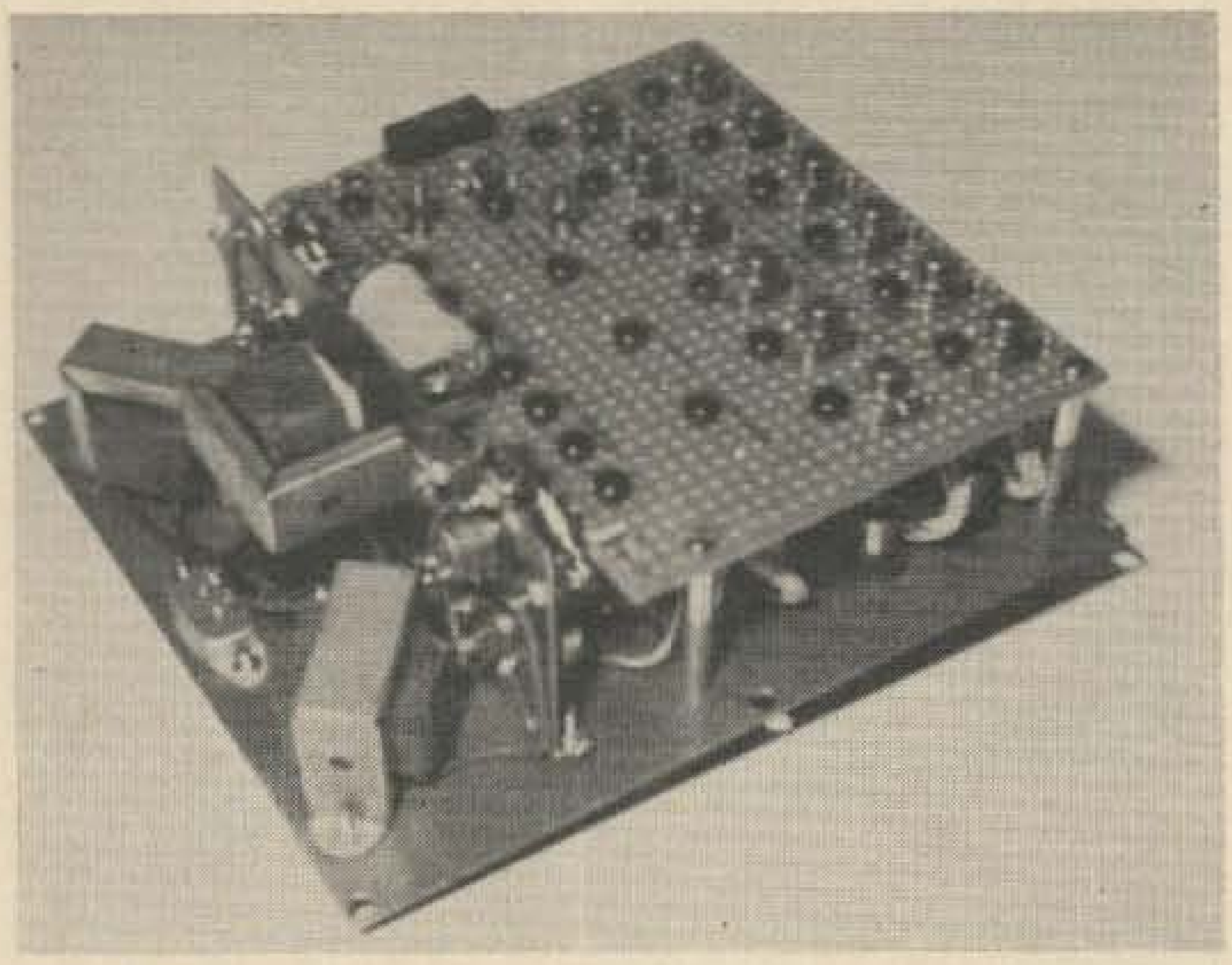
License Plate Holder

One of the nicest little low cost items to turn up recently is a license plate holder which is being marketed by Ken Walkey WB6RSP. Most of the call letter license plates are the standard 6" x 12" and they really stand out when mounted in the Walkey holders. Across the bottom in blue letters on white background it tells the world that you are a radio amateur. The holders are triple chromium plated so they will not rust. They are $3.95 a pair from Ken Walkey, Box 3446 Granada Hills, California 91344.

Electronic Circuit Design Handbook

The second edition of this Handbook has been released. The 320 page book will be of value to design engineers and amateurs who spend their days (and nights) at the workbench building. There are over 500 tried and true circuits, along with practical design data. What kind of circuits? Control, regulator, protection, filter, suppression, pulse, comparison, amplifier, oscillator, counting, alarm, timing, converter, inverter, power supply, relay, switching, and plenty of etc. $14.95 hardbound by Tab Books and available in most parts distributors.

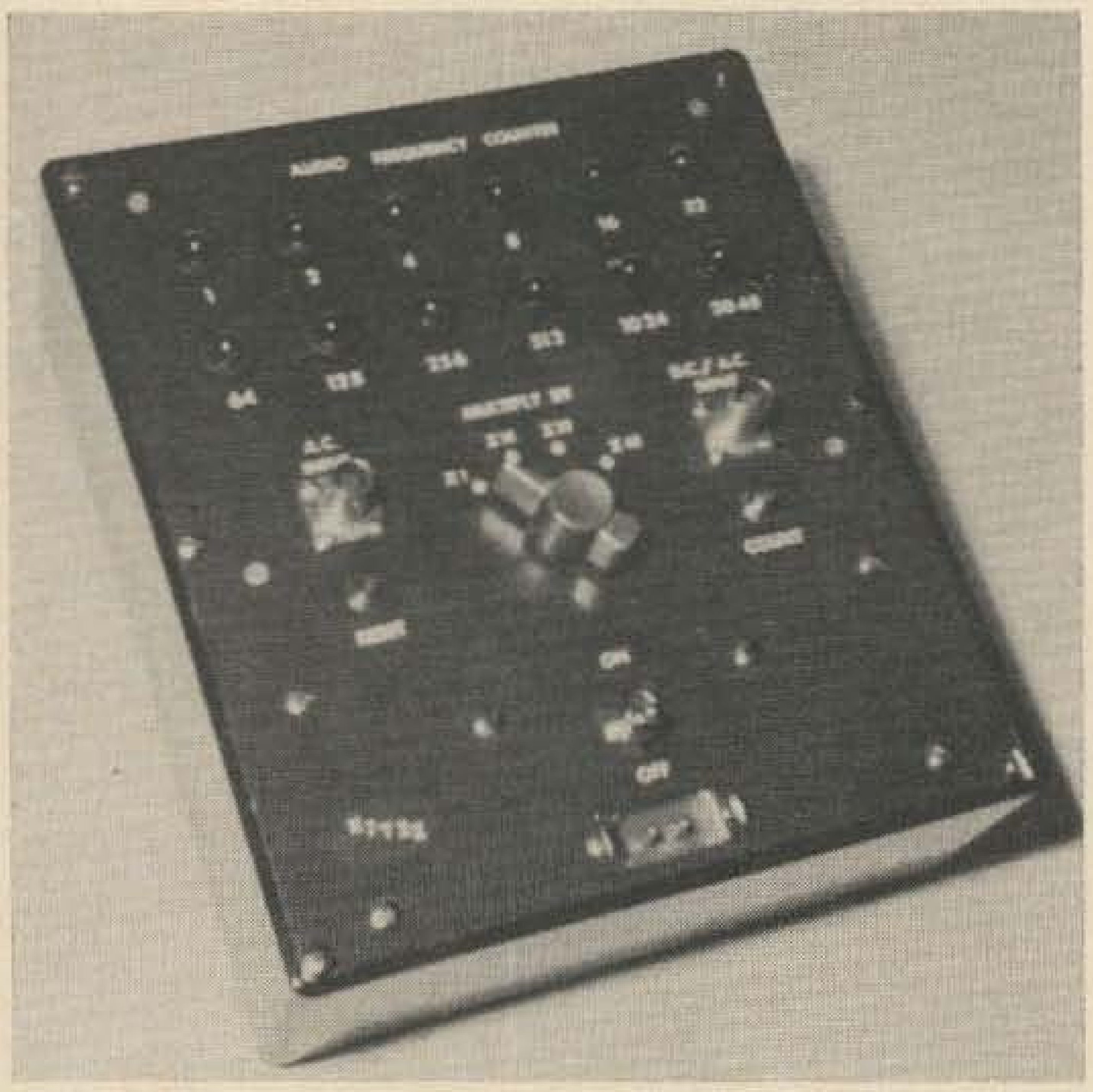
LETTERS



Dear 73,

I imagine from time to time you wonder if any of the articles you publish result in any new equipment being constructed by your readers. Well, I was most interested in the article on the Digital Frequency Meter in the November 1967 issue of 73. The author had constructed the set in three sub-assemblies which I thought was a bit unwieldly to use. So I made a bit of a change in the physical design when I built my unit. The enclosed photographs will give you some idea of how I constructed the counter. I used three low cost 6.3 volt filament transformers in lieu of the transformer called out in the article. The indicator light switches were changed from 2N1302 to 2N1306 which required the 3.9K dropping resistors to be changed to 1K to get proper bulb brilliance. I also used a 2N1304 in lieu of the 2N1605 in the input shaper circuit. No other changes to the circuit were made and the unit works just fine. Keep those fine articles coming.

Louis I. Hutton K7YZZ
Bellevue, WN. 98004



Gentlemen:

It would be helpful, when a circuit is published, to have voltages indicated by the author. This would help us to trouble-shoot if we have problems in getting the circuit to work or if difficulties develop later.

John Kopezynski K7OMS

Dear 73,

In response to the letter in the April issue from K6MVH, no one is more familiar with adjacent channel than I am. After running 750 watts on AM in a fringe area in a town of about 8000 and only one other 6 meter station around, I have had my share of TV set owner education.

I made it a practice to visit, explain, order filters for anyone that was having trouble. While I didn't put the filter on the set, I gave all the help I could so they could put them on themselves.

My article did not state that this cavity would eliminate adjacent channel interference. It did state that it should eliminate harmonics which fall in the TV channels, which is the trouble I had at one time with one particular transmitter.

These harmonics were just strong enough to cause trouble with a few next door neighbors and with the addition of the cavity they were eliminated.

As to reading his article, I read any article I can find on education of either the set owners or the ham when it comes to interference since I feel it is my responsibility to keep informed on any methods used for the prevention of interference.

Keep up the good work. I have every issue of 73 magazine ever printed. I wouldn't miss one for anything.

Don Marquardt, K9SOA

Dear Kayla & Wayne:

Having never written a "Letter to the Editor" in my life, and after reading the March '68 issue, I felt the necessity! I have taken most articles in my stride since Vol. 1, No. 1, but the one by W7CJB, entitled "Witching for Better Grounds," really threw me for a loop! Being directly, and indirectly, involved in Geology for the past 16 years, I have been periodically plagued by "those witching nuts" with the "Black Boxes," etc. In every instance the method has been kept secret with a "mysterious air" about the whole affair. This article was the first explanation of any kind presented. Not being **completely** indifferent, and willing to give anything a try—I did just that! Well, count me in—I'm a "nut" too, for the darned thing works!!!

A true skeptic must attempt to test a method, under extreme conditions, in order to discount the entire method. This I tried! On a city lot, and not looking for underground water, I figured that the plastic pipe, leading across the back lawn, to a sprinkler head should be worth a try. (Kept it to the backyard because I didn't want the neighbors to notice that I had finally "slipped a cog!") To shorten the story, IT WORKED!! (Even after I realized that the anti-syphon valve had drained the water from the plastic pipe!!!) Ultimately, I wound up in the front yard working on locating the ¾-inch galvanized waterpipe from the city water main! And again it worked, not only for me but for the XYL and YL harmonic! Then it happened! The next door neighbor shouts over—"HEY! You looking for gold??" It was earth-shattering enough to find out that the "witching" works but now the whole neighborhood was in on it—and on the first day of trials, too!

Within hours, as a result of the curiosity and tests, I became a "believer" and the neighborhood "nut!" But so long as the damage has already been inflicted, I intend to continue with the tests to determine more of the "Why," now that I know that it works!

As a result of many of the 73 articles, since 1960, I have benefitted considerably; but I don't believe that I have been more surprised than the results derived from that article. I don't have a counter-poise nor ground system to put in but the "witching" sure modified my thinking as to the possibility of it being done! (And it's no "April fool" either!!)

George Wilson WA6LNA

Dear Wayne,

Re the article in March 73 entitled Transmitter Keying with Transistors, the RCA 40264 appears to have been withdrawn. A better and cheaper substitute is the RCA 40424 or the 40425. Both have a B Vcbo = 300v, Ic max = 150 ma. The 40424 (98c) will dissipate 8 watts/250°C and the 40425 ($1.06) with attached heatsink will dissipate 3.8 watts. This transistor is also ideal for screen grid keying (differential type keying) and RTTY operation. In either case it is a good idea to connect a voltage suppressor from collector to emitter. A Sarkes Tarzian S-255 or C-871, about 65¢, should do the trick.

Ross Lunan VE2APN

Dear Wayne:

I miss your "controversial" editorials in 73, even though I didn't always agree with you. I think that the new licensing setup will work out fine, but I realize that I may be all wet.

What I really wanted to talk about was your EI column on the current DX situation. On this, I couldn't agree with you more. It would be hard to imagine anything more asinine that setting up an elaborate radio communication station, only to be prohibited from communicating, and only be allowed to swap inflated signal reports, and finally to receive a QSL made out by the local QSL manager. I like to work the G stations, because I can at least have a QSO with them, without making anybody mad at me. It sure would be nice if I could do the same with stations in other countries.

Whatever happened to the idea of having a friendly rag chew with the guy at the other end? That's what ham radio is all about, after all. It seems like a poor exchange to give up all real communication and substitute a fine print listing in magazine "honor roll."

How about starting a "DX Rag Chewer's Club" or something to give a little competition to DXCC, etc.?

Bob McGraw W2LYH

Editor 73:

Thank you so much for the first of a new series of articles starting on page 92 of the March issue of 73.

The style and manner of presentation of this material is something I have been longing to see for a long, long time. The author, or authors, of this material have struck upon a manner of presentation that has my complete endorsement. The material is presented in such a way that I get the impression the author wishes to communicate with me and pass on for my understanding the material he has to present.

Regardless of whether I happened to be interested in getting a higher grade of license or not, I would pick up and follow this material because it is presented in the manner in which I like to approach things. It makes the acquisition of this knowledge fun. The author does not seem to be afraid to attempt to use words and word pictures that take on a concrete image in the mind of the reader.

I would like to see your magazine content expand along these lines with more and varied educational articles, above and beyond what you contemplate to tie into the incentive license program.

Clayton Gordon W1HRC
P.O. Box 85
West Main St.
West Millbury, Mass.

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TRADE, NEW KW Matchbox, 250-30-3 Johnson for 2 meter gear or? Bud WAØIQA, 2045 Oswego, Aurora, Colo. 80010.

FOR SALE: Swan-400 SSB transceiver; Swan 420 VFO, complete with VOX and Mike. New units, never used. Also Eico 753 factory wired SSB transceiver with Eico 752 wired power supply, also new. Private party. Ernest E. Dutcher, Bx. 1393, Studio City, Calif. 91604.

FOR SALE: 120′ Rohn Galvanized 18″ tower, $2/foot. 160′ non-galvanized 18″ tower, $1/foot. Will sell any amount. Want mobil rig. Floyd J. Phillips, WAØJTM, 458 E. 2nd, Russell, Kans.

THE SUBURBAN RADIO CLUB of St. Louis County, Mo. will hold its 3rd Annual Hamfest on Sunday, June 30, 1968 at the Creve Coeur Memorial Park in St. Louis County. All Hams, CB'ers and their families are invited. Food available on the grounds. Advance registration $1 from KØAHD, WØMUX or WØJUY.

DISCOUNT PRICES—TIME PAYMENTS. All new equipment, factory sealed cartons, full warranty. Drake T-4XB $375, R-4B $375, L-4B $595, TR-4 $510, Galaxy V Mk. 2 $365, National NCX-200 with AC-200 power supply (Reg. $434) $369, NCL-2000 $595, SBE SB-34 $380, SB2-LA $219. New Ham-M Rotator & Indicator $99.95, TR-44 $59.95. All new equipment described above in factory sealed cartons, full warranty, immediate delivery. Time payments on any purchase. New Hy-Gain, Mosley antennas at discount prices. Write for quote on any type equipment. Reconditioned specials—Swan SW-500C $395, SW-250 $240. Time payments. Send for discount price sheet. Edwards Electronics, 1314—19th, Lubbock, Texas. 806-762-8759.

WELLS GARDNER RBL-3 VLF recvr. with 8 ft. electrostatically shielded loop antenna for 20KC. $45. K6PAK, Monrovia, Cal. 359-7255. Cannot ship.

KNOB, for Collins 75A-receiver, 6 to 1 reduction. $7 postpaid. Jules Wenglare, W6YO, 1416 7th Ave., Delano, Cal. 93215.

FOR SALE. 75A4, Serial 4190, .5, 2.1, 3.1 filters with SB610—$475; HT-37, 3 xtals full 10 mtr coverage—$250. B&W L1000A linear with input tuned ckts—$175. HX20, HR20, HP20, HP10 plus mobile mike—$250. Joseph Soroka, Jr., W3LGD. P.O. Box 8, Irwin, Pa., 15642.

CLEANING OUT! VTVM $18, Sine Wave Gen. $14, Precision E-200C $35, Capacitive discharge ignition $25, Resistance decade $10; also have magazines, books, parts, cabinets and much more. You pay shipping, postcard for list. K2EMF, John R. Yurcik, 510 Conklin Pl., Linden, N.J. 07036.

MOTOROLA 80-D 12 VDC. Very clean, no cables or head $65. DX-100 $50. Model 15 Teletype printer only $60. W. M. Richarz, 519 Davie St., Fayetteville, N.C. 28301.

WRL'S USED GEAR has trial—terms—guarantee! SR46—$99.95; Utica 650A & VFO—$99.95; TX1—$99.95; Valiant—$149.95; HA10—$189.95; SX99—$79.95; HQ100C—$109.95; 75A1—$169.95; SX140—$69.95; HR20—$79.95; NC300—$149.95; RME4300—$79.95. Low prices—hundreds more. Free "blue book" list. WRL, Box 919, Council Bluffs, Iowa 51501.

HQ-145C, EICO 720 FOR SALE. Also VFO and accessories. Used, but clean. A complete operating station. David Bantz, NYC (212) 222-2116.

THE WOOD COUNTY AMATEUR RADIO CLUB announces its 4th Annual Ham-A-Rama Sunday, July 7 at the fairgrounds, Bowling Green, Ohio. Write W8PSK, 324 South Grove St., Bowling Green, Ohio 43402 for details.

COMPLETE FIXED AND MOBILE: SBE-34 with microphone and built-in calibrator, modified for CW, with key. Deal includes Webster band spanner and mount. Less than 18 months old and not used for last 6. With all cables and instructions. $300 takes all. R. V. Palmer, 2642 Maplewood Dr., Longview, Washington 98632.

COLLINS 62S-1, serial 11744 for sale, $525; and (2) 4CX1000A's, perfect condition, $40 each. Vince Varnas, K8REG, 4329 Renwood Dr., Dayton, Ohio 45429.

TORIODS, uncased 44 of 88mH, also individually epoxy encased 8mH for standards, any 5 $1.50, 255A relay $2.10, 18B socket 70¢ all PP USA. E. W. Evans, K4OEN, 220 Mimosa Ln., Paducah, Ky. 42001.

SELL/TRADE: HB 432 KW Linear Amp/PR 4CX250M's, 432 PRK Amp/(2) 2N3478's, 144 To 432 Tripler/4CX250B, Modulator PR813's with EICO720 Driver. Desire a Comm or good HBKWLinear for 2 MTR's. Write: W9FZD, P.O. Box 13, Oakcreek, Wisc.

FOR SALE: NC-300 with speaker & converter cabinet 6M Parks conv. $150, G-76 with 12VDC supply $120, Globe 300-A $120, SCR522 with supply $30. K7UNA, Rt. 1, Box 200-B, Quincy, Washington 98848.

TEST EQUIPMENT, ETC. Large variety, including H.P. 400B $45; Simpson 260 $30; 269 $45; 388 $30, Beckman counter #7370 10cps-10mc $650; Tetronix scope plug-ins $30 to $125; BC 659 Transc. $10. Send 25¢ for large list. Palen Electronics, P.O. Box 1536, San Mateo, Calif. 94401. Phone 341-9747.

COLLINS 7SS1, 32S1, speaker and AC supply. Lot $575. Also 4-400's G.C. amp, all in good working condition. K2HDU, 7 Johnson Ave., Plattsburgh, N.Y.

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RCA CMV-3 52.525 f. m. on a. c. 2nd limiter metered guaranteed $75. 140-D high band on a.c. no case $45. Larry Davis, Amboy, Minn. 56010.

WANTED: Johnson 6N2 Thunderbolt. SALE: Heath HO-10 Monitor Scope Kit $50. Rich Flaskerud KØGEY, RFD #1, Calmar, Iowa, 52132 (319-562-3803).

THE SIX METER CLUB OF CHICAGO is having its 11th Annual Picnic and Hamfest. It will be held August 4, 1968 at the Frankfort Picnic Grove, 1 mile north of Rt. 30 on U.S. 45, Frankfort, Illinois. For further information contact Michael Corbett K9ENZ, 5215 73 Ct., Summit, Ill.

THE ASSOCIATION OF RADIO AMATEURS OF THE REPUBLIC OF MEXICO will hold it's VIII Great National Convention in the city of Laredo (across the border from Laredo, Texas) July 12, 13, and 14th. Headquarters will be at the Hotel Monte-Gar with three banquets offered by the Chamber of Commerce of Laredo, Texas, the Governor of Tamps, Mexico, and the Mayor of the city of Nuevo Laredo, Mex. Technical talks and displays, along with the usual goodies.

FOR SALE—SX-111, Eldico SSB-100 Transmitter, Heath HO-10 Monitorscope, HG-10 VFO, AM-2 SWR Bridge, NCL-2000 Linear and all sorts of homebrew equipment including 6M Exciter, 500w Amplifier, converter, etc. Send for list or call 617 453-7515. Steve Stark, WA2ENM, 77 Livingston Ave., Lowell, Mass. 01852.

THE KNIGHT RAIDERS VHF Club will hold its Second Annual Hamfest on Saturday, July 20, 1968 at Weasel Drift Picnic Grove, Garret Mt. Reservation, West Patterson, N.J. from 10 am until dark. The location is the same as last year. Manufacturers displays, swap shop, junque tables, contests, door prizes, and a good time for all will be the order of the day. Picnic tables and barbeque pits available. No tickets, no fee, it's free. Refreshments will be available. Talk in station K2DEL/2 will operate on 50.4 MC and 146.898 MC. Special certificate for contacting the talk in station available. For more details write K2DEL.

WANTED: Military, commercial, surplus, Airborne, ground, transmitters, receivers, testsets, accessories. Especially Collins. We pay freight and cash. Ritco Electronics, Box 156, Annandale, Va. Phone 703-560-5480 collect.

DUMMY LOAD 50 ohms, flat 80 through 2 meters, coax connector, power to 1 kw. Kit, $7.95, wired $11.95. pp Ham KITS, Box 175, Cranford, N.J.

LOUISVILLE HAM KENVENTION, Saturday, August 31 at the Executive Inn, featuring Dealers and Manufacturers; Technical Forums; Prizes; Contests; Fashions for the Ladies. 648 South Fourth Street 40202.

RTTY MODEL 15 and 14 TRFX with TD and power supply mounted on portable stand beautiful mint condition. Cash and carry $150.00. W3VYY, 133 Morlyn Ave., Bryn Mawr, Pa., 19010, Ph. LA 5-8849.

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RTTY GEAR FOR SALE. List issued monthly, 88 or 44 MHy torroids 5 for $1.50 postpaid. Elliott Buchanan & Associates, Inc., 1067 Mandana Blvd., Oakland, California 94610.

9th AUGUSTA HAMFEST—Sponsored by the Augusta Radio Club will be held June 16, 1968 at the Calumet Club, West River Road, Highway 104 North, Augusta, Maine. Sat. June 15, Dance and informal get-together in the evening. Sunday, 9 AM registration, 12:30 Turkey Dinner, 2:30 Hidden transmitter hunt. Displays, Net meeting rooms, fun for all. Prepaid registration $4.25. $5 at door. Send check to Phillip Young W1JTH, 47 Longwood Ave., Augusta, Maine.

SAN DIEGO AREA HOUSE with 2 BR, 1½ bath, Patio, greenhouse, lath house, garage, carport, garden, orchard, hamshack w/Hi-Gain Beam and Tri-Ex Tower. Quiet area, fenced, near transportation, shopping, schools, immediate possession $19,000. Terms. Write-wire owner W6WIE, 6920 Adams Ave., La Mesa, Calif. 92041. 714-469-5523.

VACATIONERS: Need eyeball QSO's. Stop—Use my antennas for back home QSO's. WØARW, Tentel Campground, Peyton, Colorado. Near Colorado Springs 80831.

SWAP & SHOP HAMFEST sponsored by the South Community YMCA Radio Club to be held June 9, 1968. YMCA facilities available for everyone. Lotsa food and prizes. Hamfest grounds are 8 miles south of Pittsburgh on Route 51. Look for signs or contact K3HUO, 5430 Clairton Blvd., Pittsburgh, Pa.

MOVING?

Every day we get a handful of wrappers back from the post office with either a change of address on them or a note that the subscriber has moved and left no address. The magazines are thrown out and just the wrapper returned. Please don't expect us to send you another copy if you forget to let us know about your new address. And remember that in this day of the extra rapid computer it takes six weeks to make an address change instead of the few days it used to when we worked slowly and by hand.

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