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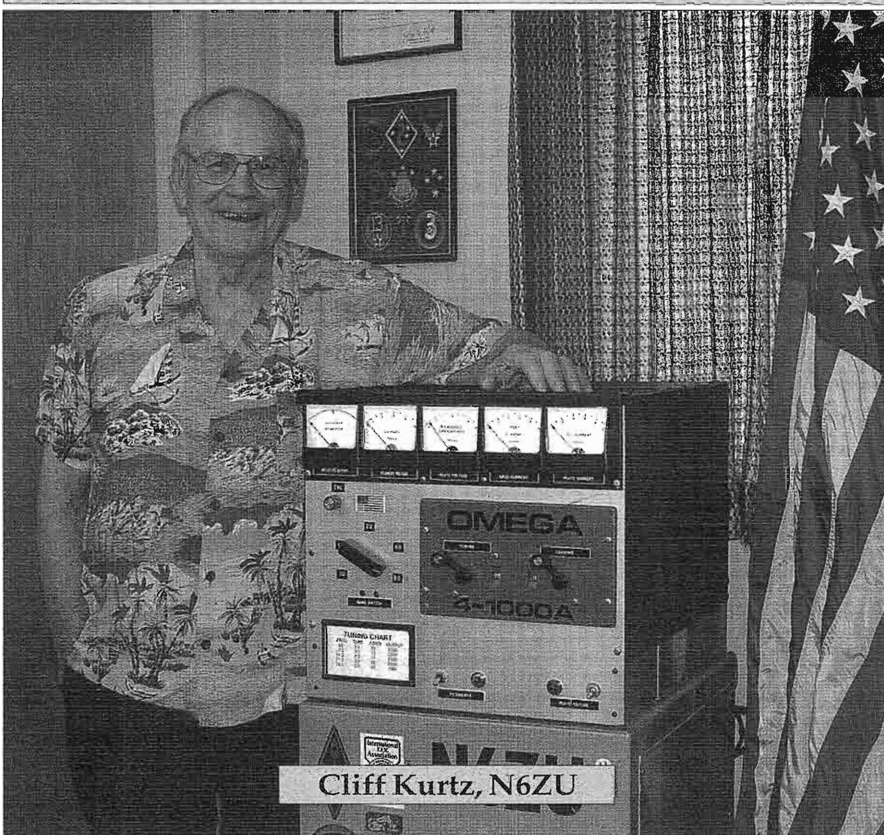
ELECTRIC RADIO

celebrating a bygone era

Number 218 July 2007



Cliff Kurtz, N6ZU

ELECTRIC RADIO

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Electric Radio is all about the restoration, maintenance, and continued use of vintage radio equipment. Founded in May of 1989 by Barry Wiseman (N6CSW), the magazine continues publication for those who appreciate the value of operating vintage equipment and the rich history of radio. It is hoped that the magazine will provide inspiration and encouragement to collectors, restorers and builders. It is dedicated to the generations of radio amateurs, experimenters, and engineers who have preceded us, without whom many features of life, now taken for granted, would not be possible.

We depend on our readers to supply material for ER. Our primary interest is in articles that pertain to vintage equipment and operating with a primary emphasis on AM, but articles on CW, SSB, and shortwave listening are also needed. Photos of hams in their radio shacks are always appreciated. We invite those interested in writing for ER to write, email, or call.

Regular contributors include:
Chuck Teeters (W4MEW), Jim Hanlon (W8KGI), Tom Marcellino (W3BYM), Gary Halverson (K6GLH), David Kuraner (K2DK), Bruce Vaughan (NR5Q), Bob Grinder (K7AK), Larry Will (W3LW), Dave Gordon-Smith (G3UUR), Dale Gagnon (KW1I)

Editor's Comments

The First Ever "Honor Your Elmer" Contest

As I mentioned last month, this is a new contest that is starting right now. It's time to step up and declare your respect for the man who held your hand and taught you what you needed to know to pass your test—your ham radio daddy—in the Electric Radio "Honor Your Elmer" contest! We've got Mother's Day and Father's Day every year, but what about our Elmers? These guys deserve some recognition and respect too!

Electric Radio is proud to sponsor the first ever (that we know of) contest to honor the Elmer that helped you into our avocation, ham radio. The object is to tell your story and share it with the world. What better way to say "thanks" to the man who helped you become the ham you are today?

The contest rules are simple – we don't need no stinkin' rules! Just tell the story. 2000 words would be great, but the story is what's important. We'll publish the Elmer stories we receive on the ER web site (space is limited in the magazine) for the next 6 months. At the end of the year, readers can vote for the winning story, and the winner's story will be printed in Electric Radio.

There will be at least three prize categories, with a first-place grand prize. Details will be announced next month, and they will be nice prizes that are worth winning. The real reward is the honor and recognition you will bring to your Elmer. It's a win-win for everybody.

So, sit down at that keyboard and take a walk back down memory lane back to your experience with your first receiver, the first QSOs you ever heard, learning the code, meeting your Elmer, and all the great experiences he shared with you along the way to earning your license and getting on the air with your first rig.

(Continued on pg. 34)

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Cover: Cliff Kurtz (N6ZU) is standing next to his amplifier "Omega," a pair of 4-1000s, Cliff's 200th homebrew amplifier. The flag in the picture has actually flown over the nation's capital in Washington DC. The service patches in the picture behind Cliff were acquired during Cliff's WWII duty as described in the "Radioman Scout Kurtz Reporting for Duty" stories. Cliff's amplifier article begins on page 11 (Photo Courtesy of Gary Halverson, K6GLH).

The 1938 National Transmitters
Part 1, The National NTE Exciter

By Jim Hanlon, W8KGI
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I enjoy writing articles for Electric Radio. They allow me to combine my technical side as an electrical engineer with my experiences as a radio ham for 55 years and with the joy of spinning a good yarn—how much better can it get than that? Every once in a while, things come together just right for a really good story about some ham radio gear. This time it was the confluence of my acquiring a National NTX-30 transmitter and its companion NSM modulator, my friend Doc (K7SO) getting an NTE exciter, and then our finding out about Mort Jones (W6KLG) with his very special NC-600 transmitter that provided the basis for an article, or perhaps a series depending upon how our esteemed editor wants to handle it, on these closely-related pieces of transmitting equipment that came out of the late James Millen era at National.

We all know that National in the mid 1930s, with Jim Millen as their engineering-guiding light, was at the forefront of communications receiver development and manufacture. From their little SW-3, which packed so much value into a small box with a small price, to their marvelous HRO and NC-100 families, so well designed both electrically and mechanically, National receivers were recognized throughout the world as among the very best. But, Jim Millen was no slouch as a transmitter designer either, as his W1HRX rig, shown in QST for December 1936, attests[1]. That rig, along with his personal HRO, is in the AWA museum today and is still making an appearance on 75 meters for the AWA AM-QSO party. So, it wasn't a great surprise that, in 1938, when the Great Depression was waning and at least some hams had enough spare cash to consider investing in a commercially-made transmitter to go with their store-bought receiver, National came out with a line of transmitting equipment as well.

I am aware of several different transmitting components that National offered. Their primary unit was the NTE, a desktop exciter that featured a 6L6 crystal oscillator and three, broad-banded 6L6 multiplier stages with 5 watts RF output either on 75, 20, 10 and 5 meters for phone men or on 80, 40, 20 and 10 meters for the all-around ops, depending upon the model chosen. The NTE also contained a speech amplifier and modulator driver section with 10 watts of audio output and, of course, its own power supply.

The NTE, which by itself was intended to be a desktop exciter to be combined with higher powered RF and audio amplifiers, quickly evolved into the NTX-30, a stand-alone transmitter with 30-plus watts output. National omitted the NTE's audio amplifier, and in its place installed an RF final amplifier using a pair of parallel 6L6Gs. As a companion, they also offered the NSM, perhaps standing for National Speech Modulator, which went beyond the speech amp in the NTX to incorporate a very neat and effective compression circuit, and which also developed more than enough power to 100% modulate the NTX-30.

Yet another member of the family was the NSA speech amplifier, apparently more like a stand-alone version of the 10-watt audio driver also built into the NTE.

And then, of course, there was the top-of-the-line NC-600 transmitter, which combined an NTE exciter with a

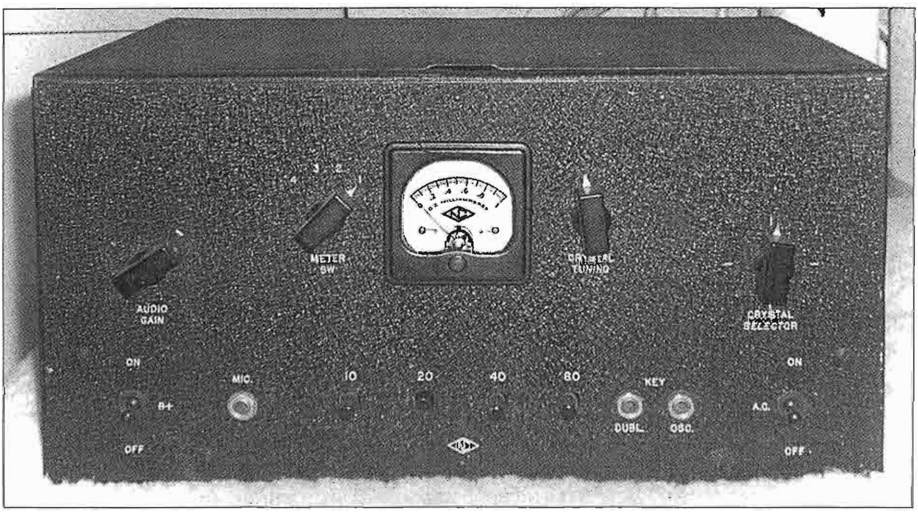
35T buffer and a pair of 100THs in the RF chain, a pair of 203Zs in the modulator, and all of the necessary power supplies.

Part 1, The National NTE

We are very fortunate that Jim Millen and his engineering crew at National documented many of their development projects in QST articles and in the National one-page technical discussion ads found in every QST for many years. Millen himself wrote about the NTE in "New Approach to Amateur Transmitter Design," published in QST for March 1938. As he explains, "The r.f. exciter in a transmitter can have high 'survival value' if it is properly designed. Final stages, buffers, and modulators may come and go (and they usually do, in most amateur stations), but the exciter, like the receiver, should be designed carefully and built as a long-time investment. Such an exciter should be capable of operating at any predetermined frequency in the amateur bands, and the operation of selecting a frequency should be rapid and convenient. If these specifications are completely filled, such a unit can become part of the permanent equipment of the shack to the same extent that a good receiver does."

Millen's NTE, probably standing for "National Transmitter Exciter," combines an RF exciter with an output of five watts, or more, with an audio "preamplifier" delivering 10 watts. The RF exciter is bandswitched and covers four bands. The version in his QST article covers 80, 20, 10, and 5 meters, popular phone bands in 1938. This would become the NTE-A in National's transmitting equipment lineup. Another version, the NTE-B, covers 80, 40, 20 and 10 meters. This later version was also advertised as an RF exciter only, without the audio stages, and is known as the NTE-C. And, to round out the possibilities, Mort Jones recently sent me pictures of his NTE, which is the five-meter version, and it does not have the audio stages, so at least one of these was also made. The "A" and "B" sold for $129, the "C" for $93.

The electrical layout of the NTE is shown in the schematic of **Figure 1,** page 4. This is, by the way, the schematic for the production model taken from the



This is a front view of Doc's National NTE-B exciter and speech amplifier. Across the top are the clearly-marked control knobs. Across the bottom are the B+ switch, microphone jack, bandswitch push buttons, doubler and oscillator key jacks, and the AC power switch.

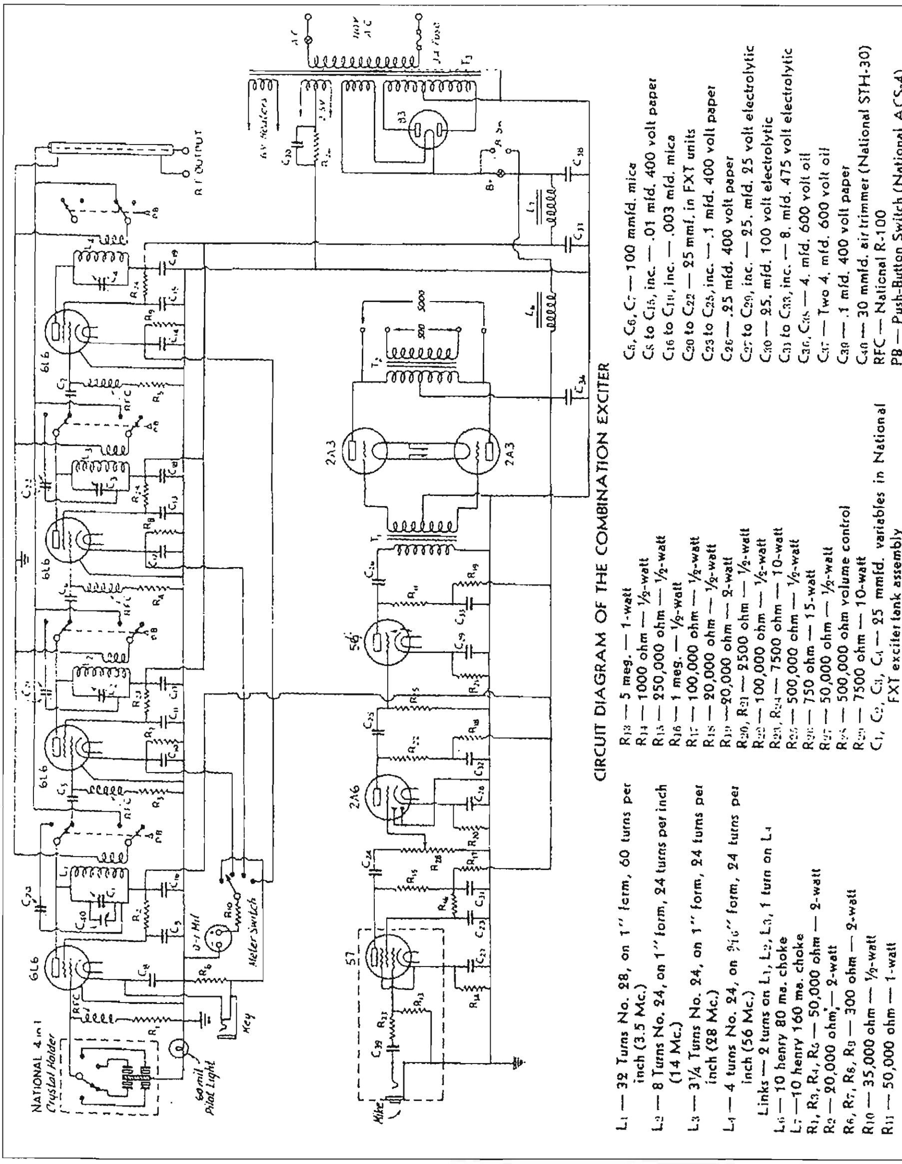
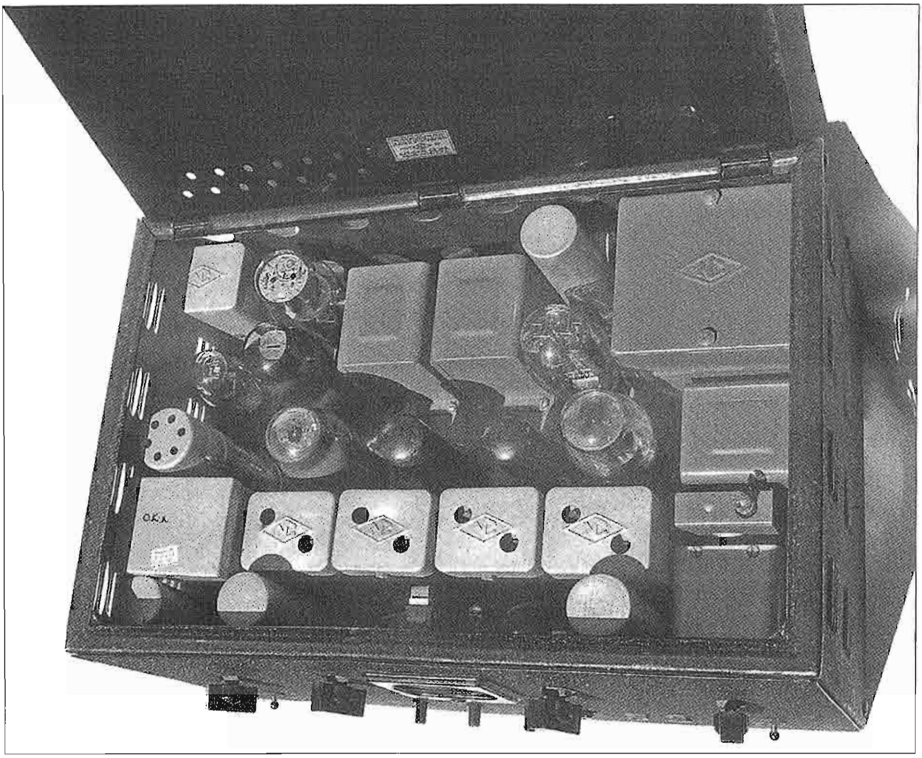


Figure 1: Schematic Diagram of the National NTE Exciter

manual for The 600-watt transmitter, and it differs in a few subtle details from the schematic printed in the QST article for the development model. The RF lineup starts with a 6L6 running as an 80-meter crystal oscillator in the "tetrode" circuit. Note that there are four crystals that can be switch selected from the front panel.

Also shown on this schematic is C_{40}, a second panel-mounted tuning capacitor on the oscillator tank circuit, in parallel with C_1, the capacitor mounted in the National FXT exciter tank assembly associated with the oscillator. "This control also permits securing the best adjustment for any particular crystal and

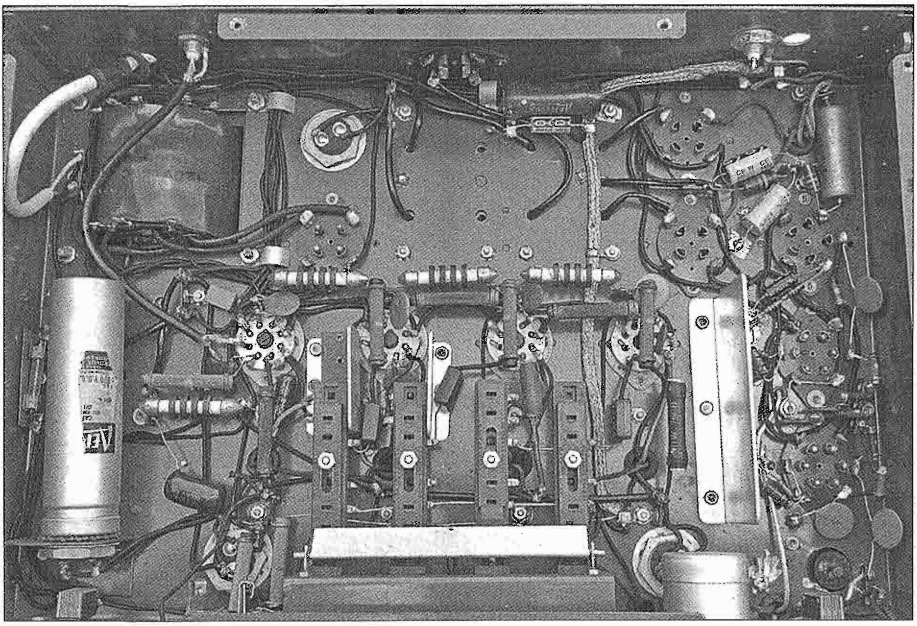


This is a top view of the NTE-B, showing the four 6L6s just behind the square, IF-transformer-like, FXT exciter-tank circuit cans, with the oscillator on the right. The audio section is on the left, with the pair of 2A3s in the rear. The 83 rectifier is behind the 6L6 oscillator.

for best keying conditions when using the outfit on c.w."

The 80-meter output of the oscillator is either capacitor coupled to the grid of the second 6L6, in the development model and the NTE-A, or is a quadrupler stage to 20 meters, or is link coupled to the RF-output terminals. When the 80-meter link-output option is selected, an additional trimmer capacitor, C_{20}, is connected across the oscillator tank to compensate for the input capacitance of the multiplier stage, which has been disconnected. There are two more 6L6 doubler stages that generate output on 10 and 5 meters, respectively. The plate tank circuits of the first and second multipliers are similar to that of the oscillator in that they are either capacitor coupled to the next stage in line or link coupled to the RF output terminals depending upon the setting of the bandswitch. Compensating trimmer capacitors, C_{21} and C_{22}, are also switched in when the outputs of the first and second multiplier stages are connected to the RF output, rather than to the next stage in line. The multiplier-tank circuits are broad band enough to require no retuning once they are set for the center of the band. Cathode bias is provided for the oscillator and for each of the multiplier stages, so that when excitation is removed from any of the stages they will not overheat.

In the development model, the oscillator was keyed in its cathode and one side of the key jack was grounded. In the production model, shown in the sche-



This bottom view of the NTE-B clearly shows Jack Ivers' 4-section, push-button switch, the National type ACS-4.

matic, oscillator cathode keying is also indicated, but the key is connected between the 6L6 cathode and the cathode resistor. This allows the meter to be switched across the oscillator cathode resistor as well as the multiplier cathode resistors to monitor each stage's cathode current, while also keeping one side of the meter grounded. But, it also results in both sides of the key being hot to ground, and that is inconvenient for folks like me who have a keying circuit common to several transmitters with one side grounded (I wound up using a keying relay in my NTX-30.).

Millen explains his development of this circuit layout as follows. "One of the fundamental problems in exciter design is that of maintaining uniform output on different bands. As a matter of fact, it is usually desirable so to arrange the circuits that output increases with frequency, since the larger tubes to which the exciter is connected ordinarily will require increasing driver power. With tubes of the high-mu triode type (53s, etc.) it is possible to maintain nearly constant output but the desired increase is not available, particularly at 14 and 28 megacycles. The 6L6s, on the other hand, have the ideal characteristic of requiring extremely low excitation for full output, and it is possible to quadruple with practically no loss in power and to obtain an actual increase when doubling except at 56 Mc. The line-up of the 'phone-band model will, therefore, do everything that is asked of it, its output being essentially the same at 3.5 and 14 Mc., with a definite increase at 28 and 56 Mc. The output is sufficient to drive all of the common pentodes and beam tubes used in amateur work, as well as the low and medium-power triodes. Large triodes will require additional power, but since the driving tubes would require high voltage, it seemed more logical to locate it near the final rather than to attempt to incorporate it in the exciter."

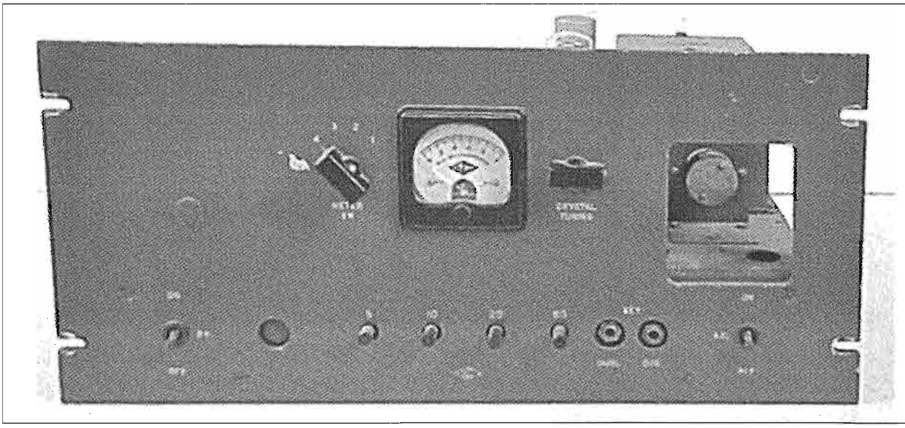
The audio amplifier schematic is also shown in **Figure 1**. The pair of 2A3s in the output will deliver 10 watts in push-pull, Class-AB1 service, when run with cathode bias as shown. They can produce 15 watts when run with fixed bias, so it is interesting that Millen did not choose to go for the extra power output that they might have afforded him. Millen's colleague at National, Dana Bacon (W1BZR), described the choice of 2A3s in his QST article[2] on the design of a speech amplifier that turned out to be the National NSA as follows, "Since most of the screen-grid tubes and pentodes are quite fussy as regards load impedance and since their plate impedances are high, making the Class-B coupling transformer quite critical in design, the obvious choice is low-impedance triodes, such as the 2A3s."

For the NTE's low-level audio stages, Millen chose the older, non-octal line of tubes with 2.5-volt filaments, again, an interesting selection. In the development model he used the equivalent, non-octal tubes with 6.3-volt filaments. If he had been working with tubes available from the National stockroom, he certainly would have had access to the newer octals, a 6J7 for the preamp and 6C5s for the next two stages, since they were being used in the NC-100 at that time. But, in the end the National engineers had a preference for 2.5-volt filament tubes for low-level audio stages at that point in time because they produced less hum than many of their 6.3-volt counterparts, and the early HROs were delivered with 2.5-volt tubes for just that reason. In any event, Millen's audio lineup provided plenty of gain for a crystal microphone, requiring only 5-millivolts input at the grid of the 57 for full audio output. (My old ARRL Handbook lists the typical output of a crystal mike as 40 millivolts.) Note also that the schematic shows shielding around the first audio stage, including the tube. Millen explains, "The treatment of the circuit elements associated with the 57 tube requires special care; all by-pass condensers and resistors must be grounded at the correct point (found experimentally) on the chassis and all elements, including the cathode resistor and by-pass condenser, must be mounted in a tightly fitting metal shield. Even the grounding of this shield is rather fussy, and it should preferably be isolated from the front panel." Also note that each audio stage plate circuit is filtered separately, by R_{17}-C_{31} in the first stage, by R_{18}-C_{32} in the second stage, and by R_{19}-C_{33} in the third stage. ...this filtering must be effective in eliminating R.F. as well as in preventing audio feed-back."

The power supply is relatively straightforward, outside of being "husky" enough to source the total current required by both the RF and AF sections of the NTE. The rectifier tube is a mercury vapor 83 that can put out 250 milliamperes. The filter capacitors, C36, C37 and C38, are oil-filled units. Millen explains, "Oil condensers are used, rather than electrolytics, as the operating voltage is of a value that is slightly in excess of what may be safely used when complete freedom from breakdown or failures is desired, especially after long periods of inactivity." It is also interesting that the B+ switch is in the HV line rather than in the transformer center-tap line. Putting it in the center tap would have been a better choice from the standpoint of voltage-to-ground on the switch electrodes.

Millen describes the physical and mechanical development of the NTE as follows: "For some time it has been our feeling that it would be a perfectly swell thing if we could have some kind of gadget containing a solution to all of the headaches normally encountered in the construction of a transmitter. The bulk of the so-called headaches are pretty well confined to the speech amplifier and the exciter, consequently if these two could be combined once and for all in one compact cabinet, along with all the necessary power supplies, switches, and accessories, the construction or reconstruction of the rest of the transmitter would be just plain fun.

"With this in mind, we took a chassis, cabinet and other parts normally used to

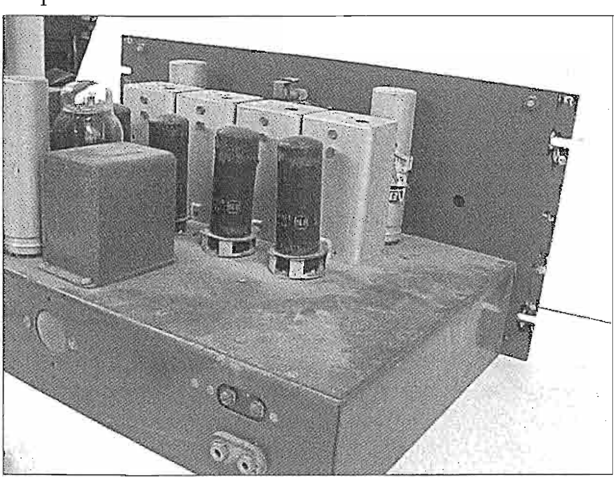


Mort Jones' NTE-C is the model that covers 80, 20, 10, and 5 meters and is without the audio amplifier. Note also the omission of the audio gain control above the B+ switch.

make an NC-100 receiver, and tried to build such a device. While from a circuit point of view the results were reasonably satisfactory, the unit was somewhat of a monstrosity mechanically. Certainly it seemed foolish to shift a large catacomb back and forth for band changing when most of the compartments were empty and the contacts therein were used simply for switching purposes.

"About this time we became very much intrigued by a type of switch used in the telephones now furnished with the Western Electric automatic exchanges. One of our engineering associates, W1HSV (Jack Ivers), designed a very compact switch using the same principles, which would do everything that the shifting catacomb did, and do it much more quickly and conveniently. Around this switch developed the circuit and mechanical arrangement which is the subject of the present discussion, and which is illustrated in the accompanying diagram and photographs. ..."

Ads for the NTE started appearing in QST in April 1938, one month after Millen's design article, and ran until February 1940. Across this time frame there are several variations on the theme. The development model used 6L6Gs in the RF stages, which changed to metal 6L6s in the production units. The box holding the crystals went through several changes. In the development version, it was mounted on the chassis with a flexible shaft running from its top to the panel control, which either switched four indi-



The rear view of the NTE-C shows a blank position where the audio amplifier has been omitted.

vidual crystals or drove the holder on a National "Vari-gap" variable-frequency crystal holder. In Doc's NTE, presumably an early-production version, the crystal box is mounted securely to the back of the front panel. To get to the interior of the box to change crystals (One-inch square quartz plates, I think.) one has to remove the panel, hardly a convenient process! In later versions, the crystal box plugs in through the panel, much like a single section of an HRO coil drawer. One only has to unplug the box and remove four screws to gain access to the box interior for changing crystals. Doc's NTE, and the one shown in the QST ad for February 1940, have an additional key jack marked "DUBL." In Doc's rig, that key jack is in the cathode of the first doubler stage to 40 meters, and as with the oscillator key jack, both sides of it are hot to ground.

I have not yet worked on an NTE, but I do have its close relative, the NTX-30, on the air. So, I can offer some suggestions about what you may run into if you go to work on your own NTE. First off, anyone who has read some of my articles in ER knows that I am not the kind of person who will strip out all of the capacitors and resistors and replace them just for safety's sake. But in this case, all of the paper capacitors in my NTX measured shorted or highly leaky, so I would recommend that, at the very least, you test all of the paper capacitors in your NTE. I replaced them with 1000-volt rated, metallized-polyester film capacitors that I obtained from Mouser; and they are working very well. Disc ceramics would also be fine for the RF circuits, but I would not use ceramics for coupling capacitors in the audio stages. Also, take a careful look at your filter capacitors. Mine measured leaky and were getting warm under power, so I replaced them with electrolytics. I used two 450-volt electrolytics in series with a 220-k, 1-watt resistor across each capacitor to equalize the voltage drop. Do not increase the size of the input filter capacitor, C_{38}, beyond its original value of 4 mfd (use two, 8-mfd units in series), or the B+ voltage will go higher than it should. You can safely increase the size of the following filter capacitors if you wish and perhaps reduce the hum level a little more.

Watch the value of cathode current in each stage. The 6L6 rated plate dissipation is only 21 watts, and with 5-watts output that means you should limit the power input of an "active" stage to 26 watts. With a plate-to-cathode voltage of 350, 26 watts corresponds to a plate current of 74 mA, and a cathode current of perhaps 17 mA more than that, taking screen and control grid currents into account. An "inactive" doubler should be limited to a plate current of 60 mA. The 40-meter doubler in my NTX was running close to 100 mA cathode current, and the metal tube's outside shell wasn't quite glowing red but it was getting very hot! I wound up juggling the cathode resistor on the doubler until I had an acceptable level of current. In my case, I added 1000 ohms in series with the existing 300-ohm resistor and the cathode current dropped to 57 mA. You should also check the screen-to-cathode voltage; it should be in the range of 250 to 300 volts. You might also be more comfortable using 6L6GCs, with their higher 30-watt maximum plate dissipation. And, if you don't plan on using your NTE on all bands, you could leave out the doubler tubes for the higher bands and lessen the load on the power transformer.

Bill Fizette reported to me that he was having a problem with arcing in the 83 rectifiers in his NTX. Bill switched to 5Z3s in his rig, a high-vacuum, plug-in replacement. I just substituted silicon diodes for the rectifiers in my rig. A couple of 1-amp, 1000-volt 1N4007s in series for each of the two diodes in the 83 are doing very nicely, and they are available from Mouser for only five cents apiece.

So, if you've found an NTE and you've refurbished it to operating condition, now what do you do with it? Well obviously it would make a very nice exciter for a higher-powered RF amplifier and its accompanying modulator, just as Jim Millen intended. You could drive the sox off a pair of 807s or 6146s or a single 813 with the 5+ watts RF output, and a pair of 811As in Class B need only 4.4 watts of audio drive to generate 340-watts output. But, even if you don't have, or care to build, one of these classic RF final and modulator pairs, you can still have fun with your NTE. By itself, "barefoot," the NTE should do as well as any of the modern QRP rigs. With my 1941 Meissner Signal Shifter, which also has a 6L6 doubler in its output stage and is comparable in power output to the NTE, I worked from my New Mexico QTH to Idaho, California, and Georgia on 20 meters in the last Classic Exchange, and in earlier CX events I've worked to Arizona and Wisconsin on 80, and Michigan, California, Arizona and New York on 40. If you could find one of the early grounded-cathode SSB linear amplifiers like the Central Electronics 600L or the P&H LA-400, which were designed to work with the low output of the early 10 or 20 watt SSB exciters like the CE-10B and 20A, you could get a real boost in output. Even a grounded-grid linear like the Heath SB-200 would give you a power gain of 8 or so, making the 5+ watts of the NTE into something around 50 watts, which would certainly get out as well as any of the single 6146-size transmitters. So, get your new prize on the air, either barefoot or with an amplifier, and you'll be amazed at how much fun you can have with it.

Next time, in Part 2 of this series, we'll go on to look at the transmitter version of Jim Millen's exciter, my NTX-30. An article on it will be in ER as soon as I can find the time to write some more and as soon as our "Hon Ed" can find the space to print it. So, stay tuned.

Footnotes:

1. "Amateur Radio Stations W1HRX, Middleton, MA," QST, ARRL, December 1936, pp 41-43

2. Dana H. Bacon, W1BZR, "Some Practical Aspects of Speech Amplifier Design," ARRL, QST, April 1938, page 12 and ff.

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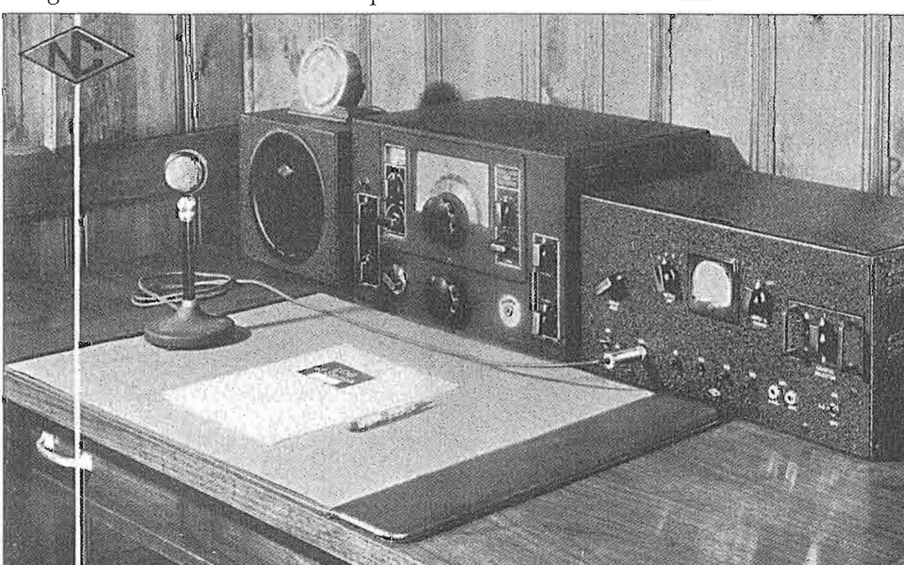

National Ad From November 1939 QST (Scan courtesy K4OAH and K5MO)

The Absolutely Final Final:
40 Years of Linear Amplifier Building Tips from a Prolific Builder, Part 1

By: Cliff Kurtz, N6ZU
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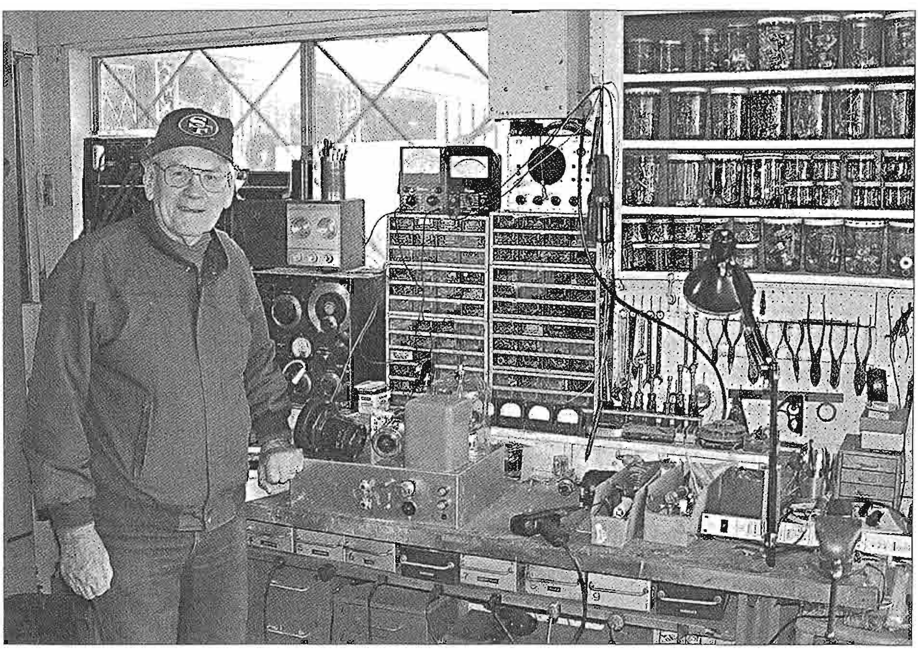
Introduction

Cliff Kurtz (N6ZU) has built 265 custom linear amplifiers over the past 40 years. That's a lot of amplifiers for one guy to build. Cliff's amps have ranged from 813s to "2X4s," that is, a pair of 4-1000s. Most of his amplifiers were built for hams on the West Coast who wanted a custom-built, ham-band amplifier that was simply not commercially available. His amplifiers stretch from Guam to New York. Over about 44 years of building amps, Cliff came to favor the 4-1000A in a grounded grid configuration due to its simplicity and ease of operation. However, in 2005, at age 84, Cliff decided to hang up his soldering gun and concentrate on working DX instead.

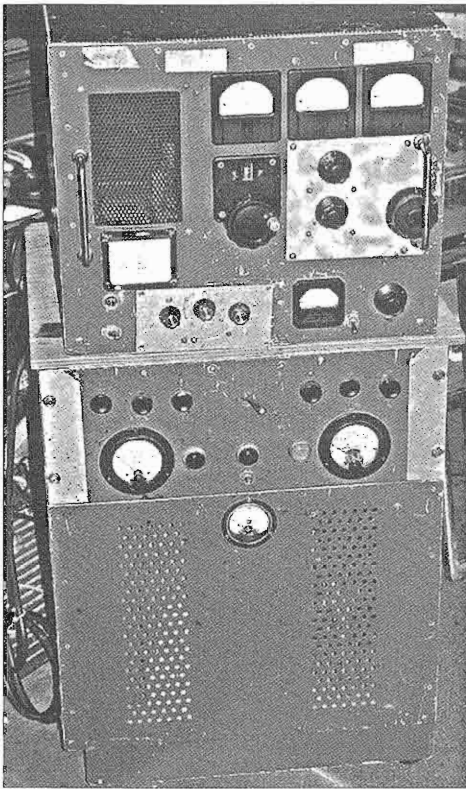
In early January of this year, Van (KL7NN), a local ham, pulled into K6GLH's driveway with his pickup truck pulling a huge trailer. On the trailer was an old homebrew 4-1000A linear amplifier, which he presented to Gary as a gift. The amplifier was unloaded from the trailer and moved into the garage.

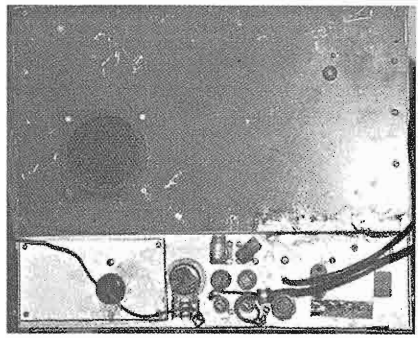
Van said that he had acquired the amplifier at an estate sale and had taken it to the local swap meet but nobody was interested because it had been so severely "modified" by the original owner.

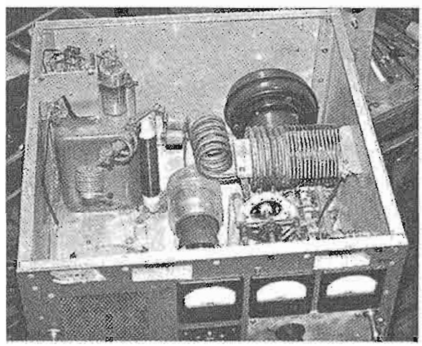
Besides being covered with decades of dirt, it was clearly the victim of several



Cliff Kurtz (N6ZU) in His Well-Equipped Garage Shop "expeditious improvements" inflicted by the owner. Van also mentioned that while he was at the swap meet a guy came up to him and said, "I built that amplifier." That would be the hero of our story, Cliff







Left: Amplifier on power supply
Top: Rear panel of amplifier
Bottom: Looking into amplifier

The N6ZU 4-1000A Amplifier that was Presented to Gary, K6GLH, as a Gift by KL7NN

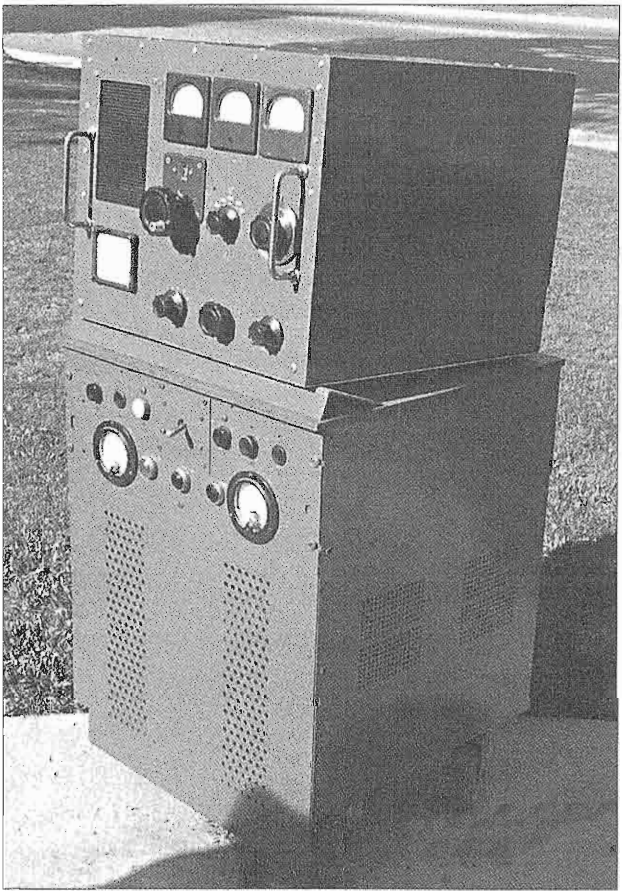
Kurtz. Van also mentioned how saddened Cliff was to see what had become of his once-beautiful amplifier.

A Victim of Severe Abuse

While Gary had known of Cliff for many years as a regular at the local swap meets, he had never really gotten to know him until late last year at an "AM get-together" at Gary's house the night before a local swap meet. As everybody sat around the spaghetti-fueled "round table," Cliff's charismatic personality was a highlight of that evening. His sharp intellect and quick wit, great sense of humor, and about four normal lifetimes worth of great stories to tell, kept everyone well entertained that delightful evening.

When Cliff learned that Gary had acquired one of his forlorn "children," he volunteered to help put it right again. So, arrangements were made to bring the amplifier to Cliff's home in Stockton, California, where he could assess the damage and formulate a rescue plan. It turns out that this was one of his earlier amplifiers, built about 25 years ago. He looked it up in his log book, but at that time he wasn't dating the projects. He did have a photo of it.

It didn't take Cliff long to declare the amplifier and power supply a total disaster. The only solution was a ground-up



Gary's amplifier is shown when it was new, as originally built by Cliff.

violations in amplifier design that the previous owner had made in his "improvements." He contrasted these violations with the correct, tried-and-true engineering practices which he explained clearly and in lay terms. And that's when this project also became a story to share with the next generation of amplifier builders.

Getting Started

Cliff started the project by tearing down the old amplifier chassis. All components were removed from the chassis and evaluated for their usefulness in the next incarnation. Many parts didn't make the cut. For example;

• The B & W FC-30 filament choke was put in the reject pile due to its frequency sensitivity and marginal current-handling aspects.

• The old plate choke was checked with a grid dipper and found to be resonant on 15 meters.

• The bandswitch was almost impossible to turn, and didn't look all that robust.

• The loading air variable had some bent plates, didn't have enough capacity, and was contaminated with a lot of debris on the plates.

• A couple of meters could have had more appropriate ranges.

• The tuned input circuit was a mess and needed to be retuned for each band selected.

Why these items were changed from the original construction will most likely remain a mystery forever. The salvaged

rebuild. Since this possibility had been discussed on the air over the course of several evenings, Gary had anticipated this conclusion and brought along several select items from the junkbox that might be useful in the resurrection. The chassis was riddled with random holes, the front panel had two huge rectangular holes cut into it, and the back panel was equally abused, but the owner tried to make amends by plugging all the holes with a silicone bathtub caulking to maintain the air seal. Fortunately, a new-old-stock aluminum chassis was available.

As the rescue project got underway, Cliff began to talk about several of the parts were then inspected and cleaned, lubricated and repainted as necessary. The superfluous junk removed from the old amplifier was enough to fill a swap meet table.

Cliff pointed out that it's important to check the resonant frequency of the plate choke to be used. The existing choke had been changed from the original in favor of what the owner must have thought to be a more robust choke. The problem was, however, that it resonated in the 15-meter band. Cliff established this with a simple test with a grid dipper. He simply shorted the leads of the choke, held the grid dipper near it, and looked for the dip. Obviously, a dip in one of the HF ham bands is not what you want.

The vacuum-variable capacitor had a maximum capacity of 350 pf, and for 3.5-MHz operation, the charts called for 275 pf, so this was a keeper. Its stiff operation was resolved with a few drops of oil.

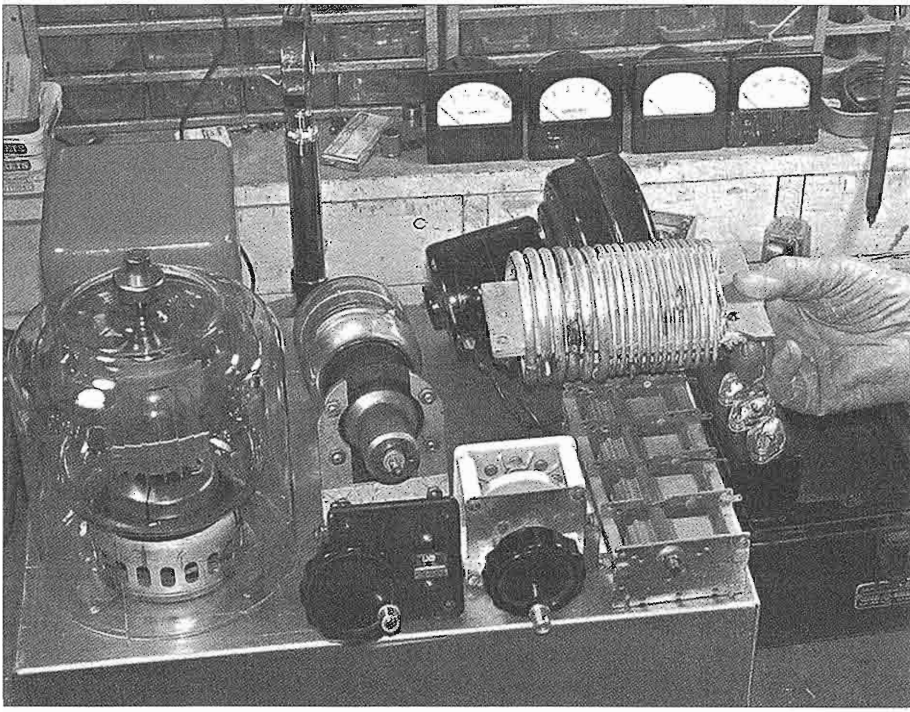
The old loading capacitor, however, wasn't up to the job. Its capacitance fell short and the original owner had to add fixed-value mica transmitting capacitors and a switch to achieve the right loading. This meant another butchering of the front panel. Here again, why didn't he just leave things alone?

The filament transformer was cleaned up and repainted. The blower was checked, and while rated at 3050 RPM, it ran smoothly. It was cleaned and lubricated.

Tank-Circuit Considerations

Another important point that Cliff

Checking the Plate Choke for Resonance with the Trusty Millen Grid Dipper


Cliff starts construction by laying out the components on the chassis.

made was to determine if the final tank coil was the appropriate for the tube load impedance, based on operating plate voltage and current. The wrong inductor can mean wasted energy and melted or distorted coils. At first glance, he thought the existing tank coil had overheated due to a mismatch to the tube. This would have caused the tube to run hot and the tank coil to dissipate a lot of heat.

Cliff got out the amplifier PI network tank-circuit chart in the back of an old Bill Orr Editors and Engineer's Radio Handbook. He calculated the plate load impedance by dividing the operating voltage, in this case 4800V, by roughly two times the plate current, or 1.5A for about 3200 ohms. The chart showed the tank coil inductance for this load impedance as 17 microhenries. The measured inductance was about 18.5 µH, so we were in good shape. The blackened appearance of the coil turned out to be simple silver oxidation, which cleaned right up with some silver polish.

With the final evaluation and selection of the major components, Cliff was ready to make a preliminary layout on a new chassis.

Laying Out the Components on the Chassis

Cliff started with the tube and filament transformer. Because he's fond of a tube viewing window, the tube had to be located near the front of the chassis. The filament transformer was mounted directly behind the tube, allowing a straightforward connection of the filament choke between the transformer and socket. From the tube, the RF flows to the right. First the plate choke, the tank tuning capacitor, bandswitch, and finally to the loading capacitor. The tank coil will be mounted to the right wall of the amplifier allowing the shortest possible leads to the bandswitch. The blower is located in the rear right-hand corner with the squirrel cage opening facing the right side for air intake. The air is directing down into the bottom of the chassis, pressurizing it. A sealing plate on the bottom of the chassis forces the air to exhaust through the tube socket, tube base, and out through the top of the chimney.

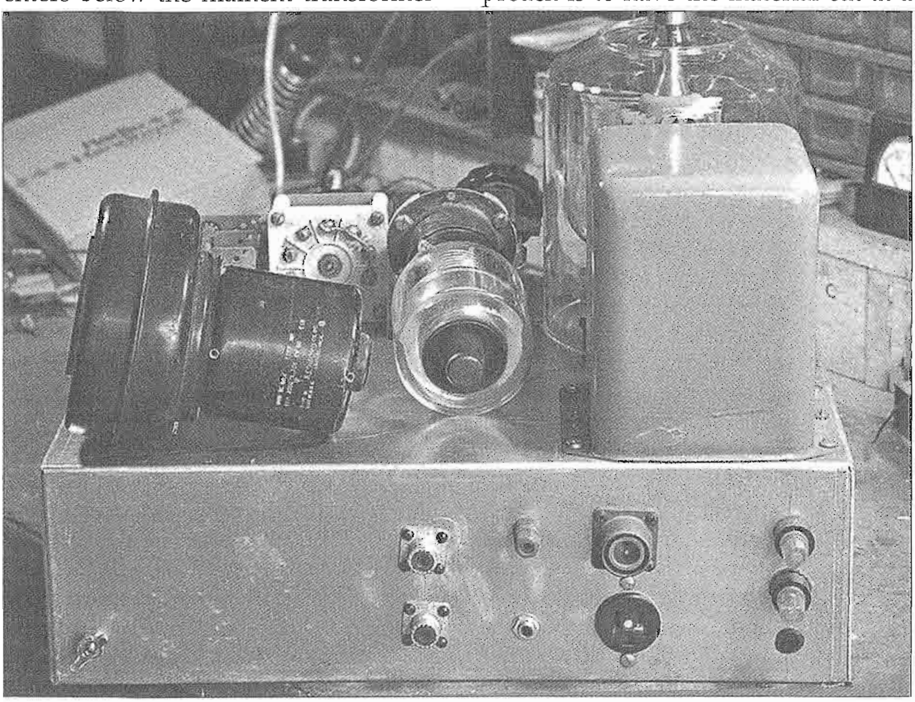
Tube cooling is very important because Class-B operation means the tube is conducting heavily while operating near the most linear part of its load curve. With an idle current of 100 mA at 5000V, that's 500 watts of heat going into your hamshack for the duration of your key down time. It also means that there must be an adequate airflow over the tube envelope and seals to prevent thermal hotspots that could lead to a fracture in the metal-to-glass bonds.

Layout of the chassis rear apron is equally straightforward. AC line input enters below the filament transformer and passes through two line fuses. Only two control switches are used on the front panel, a "Filament ON" switch and a "Plate" switch. The plate-supply power is routed through a chassis-mounted connector to the left of the fuses. Directly above this connector is the high-voltage connector.

To the left of the high-voltage connector is the B– terminal. Cliff prefers to have a 50-ohm wirewound resistor shunted by back-to-back, 2-amp diodes between the chassis and HV supply return (see schematic diagram).

The Rear-Chassis Layout

The material selected for the "skins" of the amplifier was black anodized aluminum. Cliff was able to find some sheets of this material at an industrial materials supply house in Sacramento called "Blue Collar Supply." While the table saw with a metal cutting blade can be used to cut large pieces of aluminum, a better approach is to have the material cut at a



Rear-chassis component layout is important!

shop that has the equipment for doing this professionally. Blue Collar Supply offered to shear the anodized aluminum for a nominal charge of $1 per cut. This saved a great deal of time and the cuts were perfect.

Front-Panel Layout

The next step was to lay out the front panel. The major component layout on topside of the chassis dictated the placement of the several items right off the bat. For example, the tube-viewing port, the vacuum-tuning capacitor knob, the bandswitch, the loading capacitor, and the meters were all pretty much established. It was just a matter of making precise measurements to "tune-in" the symmetry.

The layout of the lower portion of the front panel needed to track the top portion to maintain symmetry. From the picture below, you can see that the meters, knobs, switches and indicators all are aligned vertically and have the same horizontal spacing. The tube viewing window is located to present the best view of the entire plate structure of the 4-1000A. The perforated aluminum, shown in the picture, was eventually replaced with a finer mesh-brass screen and a Lucite plate to allow a cleaner view of the tube's plate structure.

Metering

The essential meters for a 4-1000A grounded grid amplifier are the Grid, Plate, HV, and optionally, Relative Output if the layout permits, which was not the case in the Final Final.

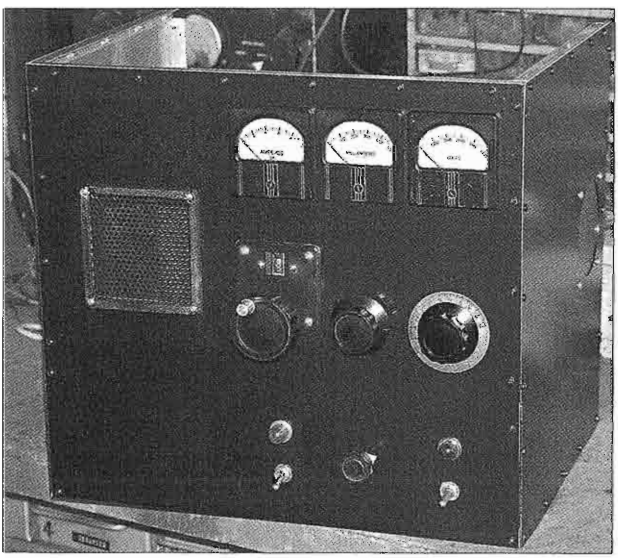
Meter quality is very important. Older meters are sometimes more reliable and higher quality than some of the more modern meters. They can also be obtained at substantially lower prices than newer meters.

Recommended meter values for the single 4-1000 amplifier are;

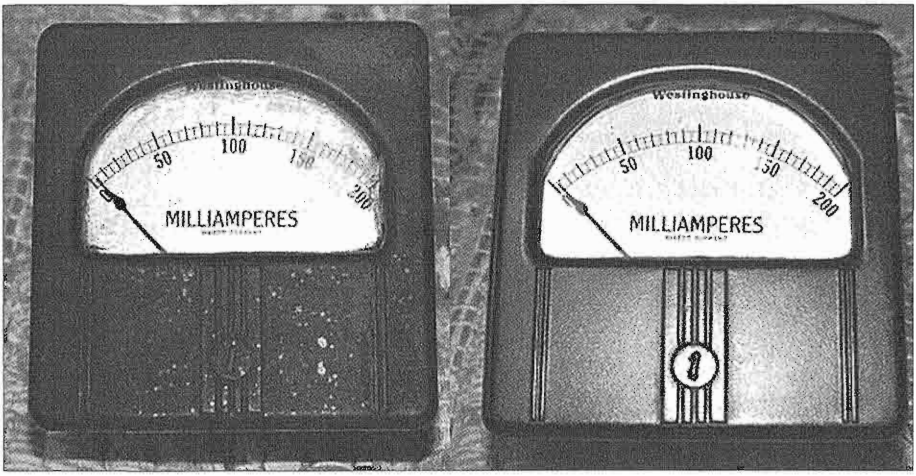
- Grid: 0-500 mA
- Plate: 0-1 A
- Relative Output/HV: 0-1 mA

Finding theses values in matching meters can be a challenge. Scanning the swap tables for the right values in matching meter styles can take an entire season to round up a suitable set. But, it's important to the final appearance of the amplifier that they all be matched in the same manufacturer and style. You may want to obtain extra meters using the same case, in the event one of the required meters has a cracked glass, chipped or cracked case, or damaged mounting hardware. Cases can easily be swapped with the same style meter.

Cleaning the meters is the next step. Start with soap and water on a dampened rag, being careful not let any water run into the meter should the glass be separated from the case. Use a toothpick to loosen any debris in the ribbing and the zero-adjustment



The Completed Front Panel



Before-and-After Meter Cleaning

slot. Clean the meter as well as possible and dry with a paper towel. Next, use an automotive rubbing compound on a paper towel to cut through layers of nicotine, grease, and any other material on the meter case. You'll be surprised at the amount of dirt that will come off.

After cleaning with the rubbing compound, dry the meter and apply a coat of automotive car wax. Use a Q-Tip® to get the wax into the ribbing. Dry and buff to a shine with a soft rag. When you're done, the meter should look like new.

It's also a good idea to check the inside of the meter for any loose material that might have gotten into the movement. There are usually three small screws at 120-degree angles from each other around the back of the meter that secure the movement to the case. Remove these screws and carefully extract the meter from the case. Once the meter has been removed, gently blow out any loose debris inside the case and check that the glass seal to the case is intact. If not, repair as necessary, clean, and then reassemble.

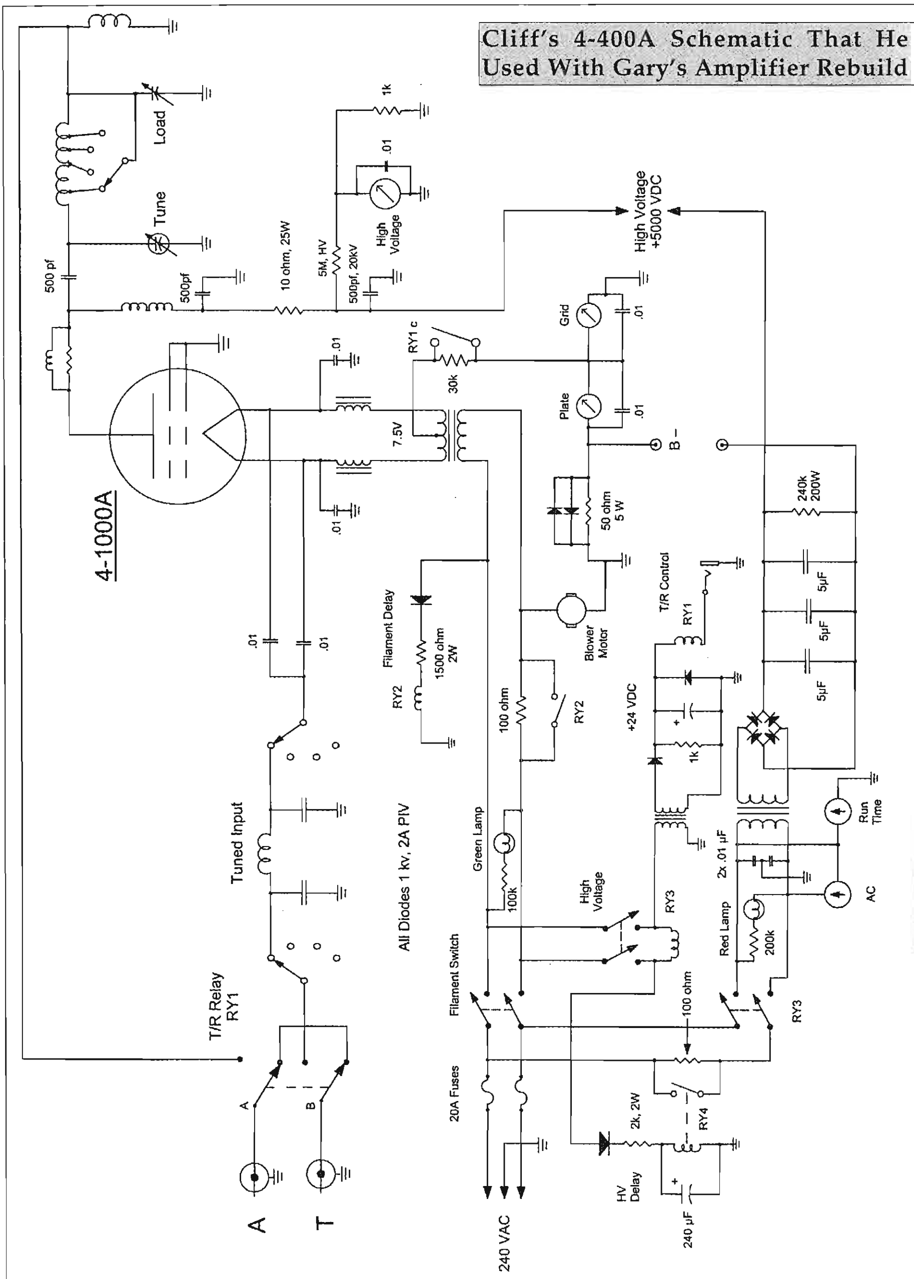
Blemishes on the meter scale can also be cleaned once the meter is out of the case. Be careful, however, not to touch the meter pointer or blow on it, as it is quite delicate and can be damaged while exposed. Use a damp Q-Tip® to clean the scale. Don't rub too hard, and if the stain or blemish doesn't come off easily, you might be better off to just leave it alone and move on. It's also a good idea to clean the back side of the glass while the meter is out. Frequently, a cloudy film buildup occurs on the backside of the glass and cleaning it restores a crisp, sharp scale appearance.

AC-Line Safety

Safety needs to be integrated into the design from the very start. Amplifiers of this power level should be operated only on 230-VAC-primary circuits due to the current draw. Working with 230 VAC requires that industry conventions and codes be strictly followed. Refer to Ray Osterwald's sidebar on safety for AC and the power line color codes for 230V and 120V at the end of this article, next month in Part 2.

High-Voltage Safety

You don't get a second chance when operating an amplifier with 5000 volts on the plate. Also, some special considerations are in order. For example, an accidental short of the plate connector to the chassis would cause significant damage to the conductive material at the point of



Cliff's 4-400A Schematic That He Used With Gary's Amplifier Rebuild

contact before the fuses would blow and the energy in the filter capacitors was dissipated. For this reason, a low-value resistor between the high voltage return line and the chassis is recommended. A 50-ohm, 25-watt resistor works well as a "shock absorber" in the event of accidental HV contact with the chassis.

Tuned-Input Circuit

The ground-grid amplifier requires a tuned input circuit to keep the exciter happy, minimize the distortion of the input waveform as a result of grid current loading by the 4-1000, and to minimize intermod products produced by the amplifier.[1] Cliff's technique is to mount a tuned-LC circuit for each band on an aluminum "L" plate directly behind the input band switch on the underside of the chassis. Placing the circuit in a shielded box is usually unnecessary.

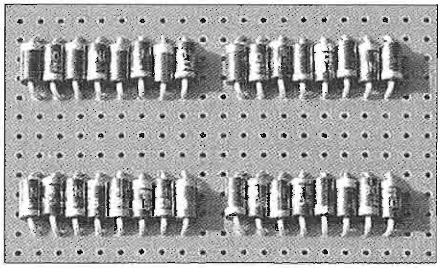
The inductors are mounted so that the threaded tuning screws face the rear of the amplifier. This enables the coil for each band to be tuned easily. Silver-mica capacitors are used to resonate the coils.

Tube Biasing in Operate and Standby

The grounded-grid amplifier using the 4-1000 operates in Class B.[2] During standby, no bias supply is required on the cathode (filament), as bias voltage is derived through a resistor on the center tap of the filament transformer secondary winding to ground, biasing the tube well into cutoff. During transmit, this resistor is shorted out, placing the cathode at ground.

The High-Voltage Power Supply Soft Start

Today's high voltage supplies differ from those used back in the thirties through the sixties in that they don't use filter chokes, just larger-value filter capacitors. This is primarily due to improvements in capacitor manufacturing materials and methods over the years. While this simplifies power supply construction, it also means that some start-up current limiting circuitry is required to protect the diode rectifiers from working into a very low impedance load while the capacitor charges. The usual approach is to place a resistor in series with the plate transformer primary, then short it out with a relay after a time delay. Cliff uses a simple RC circuit to establish the delay time, about 3 to 5 seconds.



Typical String of Diodes Mounted on a Circuit Board

Diode Strings

The need for equalizing resistors and capacitors is urban legend, according to Cliff. He says that back in the early days of diode production, the characteristics of each individual diode varied quite a bit, and it was necessary to use equalizing capacitors and resistors. But, as the manufacturing processes improved, consistency became much more uniform, rendering equalizing resistors and capacitors irrelevant. Cliff said that he's not used them for years and never had a single problem with the diode strings. The diodes of today are typically better quality than the equalizing components, and cheaper too. Another point is the number of diodes to use in a leg of the bridge rectifier. Cliff said he takes the voltage of the transformer secondary, multiplies it by 1.4 to get the DC voltage, and then triples that number for safety. This figure is typically around 16 kV. Then, you divide the peak reverse voltage rating of the diodes to be used into 16 kV for the number of diodes to use in the leg.

[Editor's Note: References will appear at the end of Part 2. Next month, the N6ZU "Final-Final" story continues with Part 2, having construction techniques, tools, initial power-up checks, checking for parasitics, amplifier Q&A, and a large section on electrical safety and the National Electric Code.]

ER

Vintage Linear Amplifiers, Part 1

By David Kuraner, K2DK
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Haymarket, Virginia 20169

We have talked about audio and modulator requirements with various modifications in prior ER articles. Class-AB or Class-B operating vacuum tubes do not know or care whether it's amplifying audio or RF. Many of the same issues apply to RF linears as well as audio amplifiers.

There have been countless articles in every ham publication over more than five decades describing how to build someone's pet design. ER has described a few commercial amplifiers having unique circuits, and homebrew (HB) construction and modifications. Many fine designs have been created and published since the linear amplifier became popular around 1955 with the emergence of SSB.

ER has not run many pieces on commercially made ham linears. An article exalting the Heathkit SB-200, for instance, has never appeared even though this is the most popular commercial vintage linear ever (A recent ER article, April 2007, #215, by Victor Gregowski, WD8DWR, described the proper tuning of the SB-200 input circuit.). The SB-200 was manufactured from 1964 through 1978 and sold for $200. It later appeared as the SB-201 from 1978 through 1983 at $449.94 (For the greater price you lost 10-meter coverage due to the rules aimed at preventing a ham linear amplifier from being used on Citizens Band frequencies.). The SB-200 circuit is simply a duplication of many HB construction articles. This, and similar, commercial equipment is just as popular and useful today as when it was first built (A recent QST article, January 2007, discussed re-

Pictured above are linear amplifiers, a Heath HA-14 "KW Compact" on top and the familiar SB-200 on the bottom.

furbishing vintage linears.).

A second version of the SB-200 was produced as a mobile amplifier. Called the "KW Compact", HA-14, it contained the same grounded-grid triode 572Bs as the SB-200/201. The unit sold for $99, starting in 1965. This was one year after the SB-200 was marketed. It lasted for 3 years and is now quite rare. At that price, you received the RF deck only. A mobile-or-fixed power supply was also available.

Many newcomers to our ranks are not familiar with this technology. And, we old timers can use a refresher and perhaps actually learn a few new things. There was, after all, quite a bit of design effort that went into these devices. Also, those of us who have big broadcast transmitters might like to employ these boxes on other modes or be faced with the dilemma of a bad modulator section. In the later case, perhaps your only economic alternative is to use it as a linear amplifier. All the basic parts are there. They just have to be slightly modified to do the job.

As tube technology advanced, we went from glass bottles to external anodes and the ceramic base. Many ceramic-based, external-anode types contained beryllium oxide. When breathed as a dust, this compound is a deadly poison and disposal of these tubes becomes an environmental issue. I once had to replace a 4CX1000 in a Collins HF-80 amplifier. The old tube became a paper weight on my desk because management was afraid to toss it.

With vacuum-tube RF linears, the choices are triode vs. tetrode/pentode, internal vs. external anode, and grid driven vs. grounded grid. You then add into the equation plate dissipation, impedance matching of both input and output, plate choke resonance, biasing, control issues, and the "little" problem of getting rid of heat. It's not as simple as one would have thought. This series is going to explore these issues and describe some of the more popular commercial and published HB vintage designs. For those with broadcast (BC) rigs, it will become quite evident what needs to be done to turn the box into a robust linear. This will not be a step-by-step or typical construction article "a la" ARRL. It is a long-overdue discussion of amateur and commercial designs, should you wish to roll your own, modify an existing commercial device, or reuse parts from a broadcast rig without totally rebuilding the BC box.

The Grounded-Grid Triode

The most common circuit found in early commercial and HB construction articles employs a pair or quad of 811As, or 572Bs in parallel. Even some modern equipment, such as the Ameritron AL-811H, employs these devices. The 811A has a plate dissipation of 65 or 85 watts and a maximum voltage rating of 1500 or 1700 volts, depending on which data reference is used (Orr vs. ARRL). It's very big brother, the 572B, is rated 160 watts and 2750 volts. The 572B can be thought of as the equivalent of a pair of 811As and has been substituted in HB equipment originally designed for 811As. The commercial devices employing quad 811As were often redesigned using paired 572Bs at the same power level. The new models simply replaced the older model in the manufactuer's offering. As an aside, the filament requirements for either tube are identical, 6.3 VAC at 4-amps-per tube.

Commercial examples can be found in the Heathkit line of linears. The Warrior HA-10 ($229.95, 1961-65) employed quad 811As. Its replacement for the approximate same power level was the SB-200 ($200). On the HB side, an early construction article by Ernest A. Coons (W1JLN/FOE) used two 811As for 500-watts PEP. It can be found in ARRL handbooks and their SSB publication published around 1960. Quad 811As were used by Floyd K. Peck (K6SNO) at the 1000-watt-PEP level. An almost identical circuit is found in the Gonset

101 linear amplifier and the Gonset 201 series. The later Dentron Clipperton L uses quad 572B in a very robust design. And, even Collins used 811As for their 30L-1 linear mate to the KWM-2.

These tubes are known as "zero bias" and do not require bias voltage on the grid. Bias of around 100-volts negative is often applied to reduce or cut off idling current when in the standby mode. (This is the same idling current as found with modulator tubes.) As the popularity of zero-biased and grounded-grid circuits increased, the 3-400 (400 watts plate dissipation at 3000 volts), and later, the 3-500 series tubes (500 watts plate dissipation at 4000 volts), were specifically developed for this application. The Heathkit SB-220/221($369.95/599.95, 1964-1978-1983) employed a pair for 2000-watts PEP. This tube is still used with recent or current production models such as the QRO HF-2000 and Ameritron AL-80B. The bottom line is that this vacuum-tube technology hasn't changed in over 50 years and is still going strong today in modern designs.

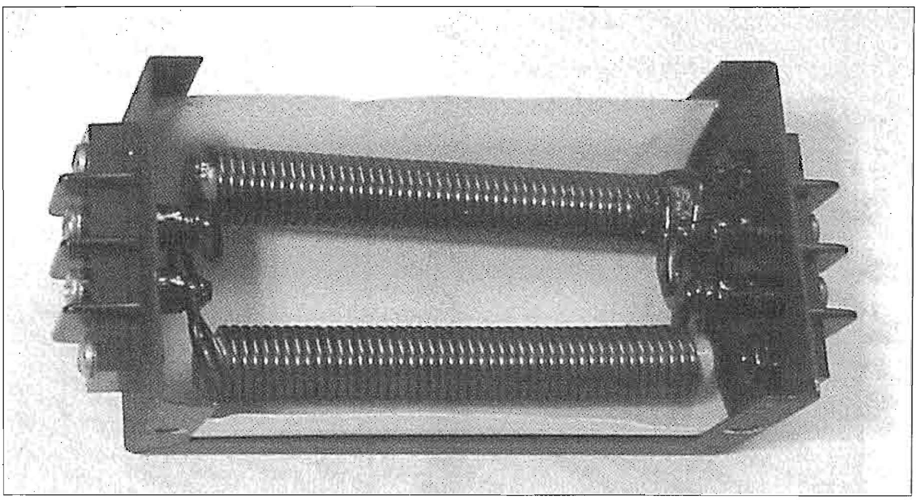
Before leaving the subject, it must be noted that amplifier power levels prior to the FCC rule change were DC-input levels to the plates of the tube and not the output power specified today.

The Grounded-Grid Linear

A perfect example of this circuit is one I developed over 25 years ago based on the paired 811A/572B configuration. See **Figure 1**, page 24. This amplifier used parts and the chassis from a Viking II. This basic circuit would apply to a broadcast transmitter modification as well. We will have more on BC rigs later.

Some of the circuit designations are from the original Viking schematic. It developed over 400-watts CW with about 80-watts input and well over 600-watts-PEP output (At the time of measurement, I did not own a peak-reading meter.). The Viking's PI-output network was used, as well as the plate transformer. The full-wave bridge rectifier produced 1600 volts.

A filament transformer was added, and the filament choke is a B&W FC-15. This is a commercial bifilar RF choke designed to handle 15 amps of filament current. They also made a 30-amp model. Both are very difficult to find. Amidon Associates, according to their Internet material, still makes a 10-amp kit to produce this type of choke. They also claim to be able



Built into a box, here is a homebrew filament choke made from Amidon ferrite rods, which are supplied in their kit.

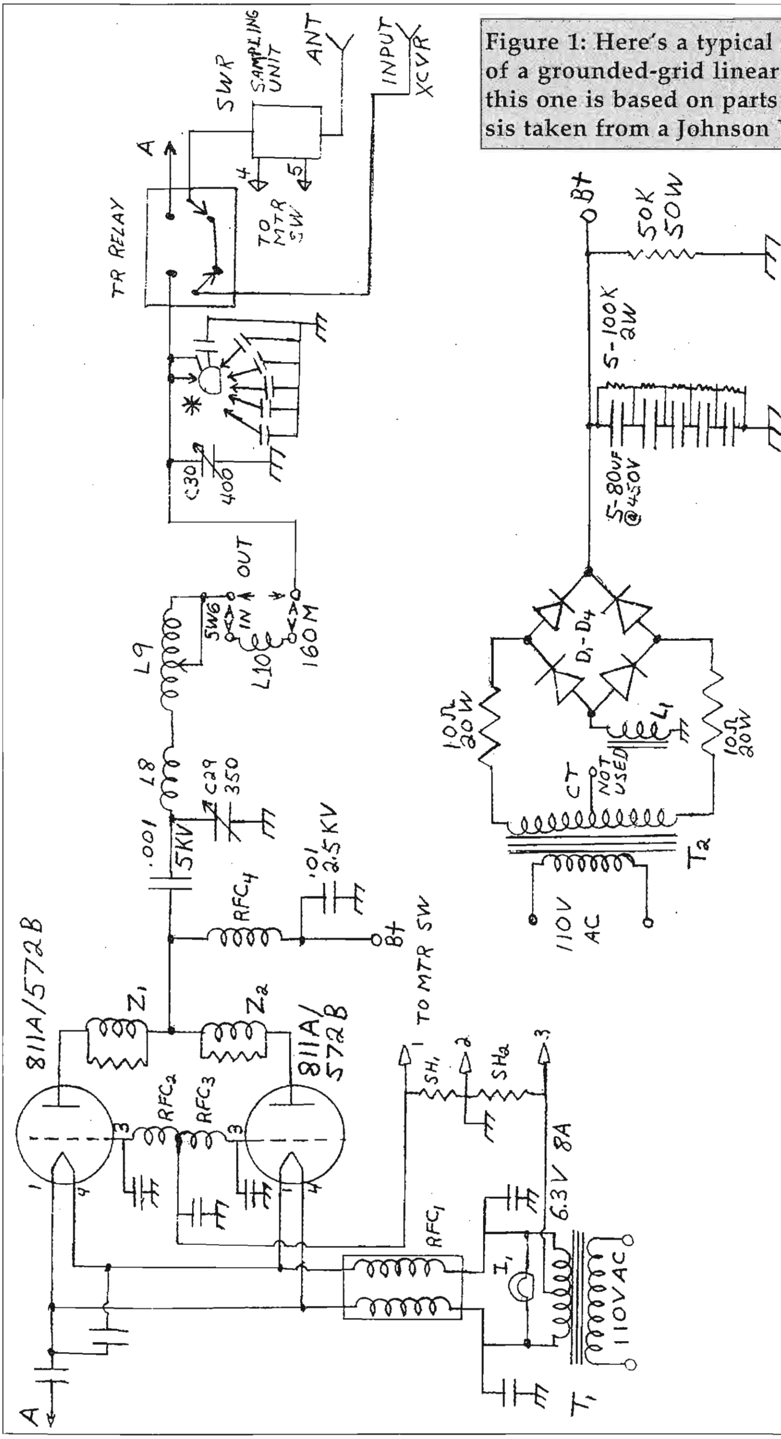


Figure 1: Here's a typical schematic of a grounded-grid linear amp, and this one is based on parts and chassis taken from a Johnson Viking I.

to provide kits for higher amperages. Any ARRL handbook can provide instructions on its construction. It is quite simple to do if you obtain the correct ferrite rod, which is also available from Amidon.

This is an untuned input circuit, also known as a broadband input. We will have more on the input circuit later. It can affect the linearity just as with the driver circuit of an audio amplifier. The input to a grounded-grid linear almost never presents a 50-ohm load. When using a modern transceiver, you almost invariably must use an external matching circuit, such as a simple antenna tuner, to get full output from the exciter.

The shunt resistors, SH1 and SH2, permit the original meter to monitor the tube's grid (input) and plate current. The SB-200 shows a grid current range on its meter. Some manufacturers ignore grid current while others clearly warn you not to exceed a certain value. For the 811A/572B, over all the years I've used them, it appears to be a non-issue. Most HB and commercial designs also monitor power output, which is the primary tuning indicator.

This is the basic circuit which all the grounded-grid amplifiers are based on. Often, tetrodes such as the 4-400 or 4-1000 are triode connected in grounded-grid configuration. The screen grid is simply grounded, and the tube automatically becomes a zero-biased device. The 813 pentode is another popular tube seen mostly in HB designs. The third grid is normally grounded. When multigrid tubes are triode connected, consideration has to be given to the control-grid dissipation rating. The proper division of the input signal between the grid and screen is about a 5-to-1 ratio, but very difficult to implement, so it is simply ignored in amateur designs. One of the illustrations in the audio series showed triode-connected 807s. The screen grid was feed directly while the

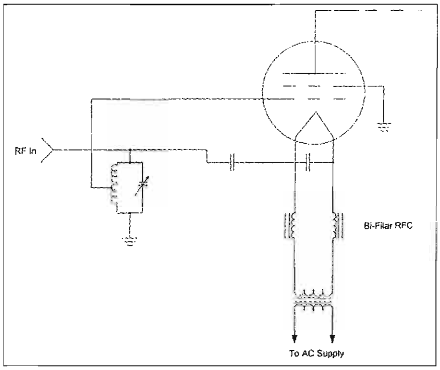


Figure 2: This illustrates a tapped input circuit that achieves a 5:1 ratio between the screen-and-control grids.

control grid had a 20,000-ohm resistor in series with the input signal in an attempt to achieve this ratio. See ER# 215, April 2007, page 13. **Figure 2** illustrates the additional complexity with the grounded-grid input circuit (Readers are referred to the <u>Radio Handbook</u>, 23rd ed., pages 15-15, fig. 14, for information regarding suggested component values for all the input circuits discussed within this series.).

This circuit is an excellent amplifier for a typical 100-watt-PEP SSB transceiver. About 80% of the excitation power also appears in the output. Additional benefits include its stability. Normally, no neutralization is required on HF. The circuit can not get any simpler. However, for AM your carrier input must never exceed ¼ of the rated SSB-PEP output. Typical operation with a modern 100-watt class transceiver would be 10-to-25 watts carrier input for 100-to-250 watts out. This permits the linear to develop the AM sideband peaks without causing distortion. In SSB circles, this distortion is called "flat topping."

Another serious source of distortion comes from not disabling the ALC circuit, which drives modern transceivers into ALC action with AM modulation. In recent months, many more people have been experimenting with their AM mode button on modern gear since the open-

Table of Most Popular Vintage Linear Amplifiers Using Glass Envelope Tubes

Manufacturer	Model	Year(s)	Cost	Description/Notes
Barker & Williamson	LPA-1	1959-64	$269	375w triode 813
Collins	30L-1	1961-75	$349/495	(4) 811A
Drake	L-4	1966-67	$695	(2) 3-400Z
Gonset	GSB101	1958-61	$439	(4) 811A
	GSB201	1961-68		(4) 811A
	GSB201 mkII, III, IV	1968/69/70	no data	(4) 572B
Hallicrafters	HT-31	1955-56	$395	(2) 811A
	HT33/A/B	1957-58/60/63	$775-995	PL-172A
	HT-45	1963-65	$299	3-400Z
Hammarlund	HXL-1	1963-67	$395	(2) 572A *
Heathkit	Warrior, HA-10	1961-64	$229	(4) 811A
	KW Kompact, HA-14	1965-67	$99	(2) 572B RF deck only
	Chippewa, KL-1	1960	$399	(2) 4-400A
	SB-200	1963-75	$200/299	(2) 572B
	SB-201	1978-83	$449	(2) 572B 80-15 meters
	SB-220	1970-75	$349/449	(2) 3-500Z
	SB-221	1978-83	$599	(2) 3-500Z 80-15 meters
Swan	Mark-1	1965-66	$499	(2) 3-400z

Table 1: Popular Vintage Linear Amplifiers, Including Models Made Prior to 1980. (The Clipperton L Post-1980.) All Zero-biased Devices Assumed to be Class B Grounded-grid. Others Assumed to be Class-AB1 Grid-Driven. All Assume 80-to-10 Meter Coverage Unless Otherwise Noted. (*572A as Indicated by Reference Data.)

ing of the expanded phone bands. They may need guidance with these adjustment issues.

Of course, other linears can be driven much harder with higher input and resulting output power. The down side of the linear in AM service is the inefficiency and great heat generated as a result. Tubes with high plate dissipation are normally used and operated very conservatively. One example of a 1930s broadcast transmitter used 600 watts total plate dissipation in the final linear stage to develop 250 watts output.

As was previously mentioned, tubes such as the 4-400 become zero-bias devices when both control and screen grids are grounded. Life is easy since the grid bias and screen grid voltages are not used. With the external-anode devices, such as the 4CX series, the proper grid voltages must be maintained while the RF signal is placed at ground potential via bypass capacitors. This disadvantage is paid back with increased gain. The box can be much more compact with this type of small RF device but heat then becomes a big issue.

Next month, we discuss input circuits and RF feedback. *ER*

The Wilcox CW3 and F3 Receivers

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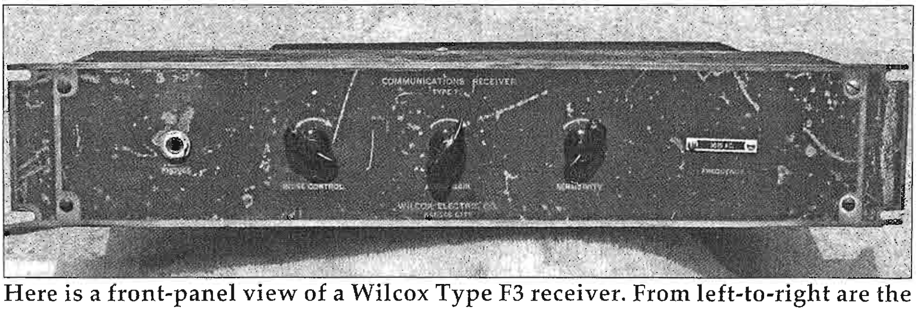
The arrival of the 2007 Fair Radio Electronic Surplus catalog interrupted my planned activities several weeks ago. I've been a surplus hound since WWII when the War Assets Administration, and the RFC, were distributors of war surplus. I still find the Fair Radio catalog great reading as old WWII stuff keeps showing up. The 2007 issue has SCR-522s for sale. They were the mainstay of 2 meters from 1946 through about 1950. The 522 is a 10-watt, crystal-controlled AM transmitter and a receiver, easily changed over to be tunable, and put lots of hams on 2 meters, including me, as W8JWK.

While the SCR-522 is definitely not one, there are some WWII-surplus units that I have acquired the second time around. I have three SCR-274N command set transmitters, one each for 75, 40 and 10 meters, with the MD-7 AM modulator. I use the 50-watt transmitters on 3885, and 7295 to work local, and the one modified for 29-MHz operation on sporadic E.

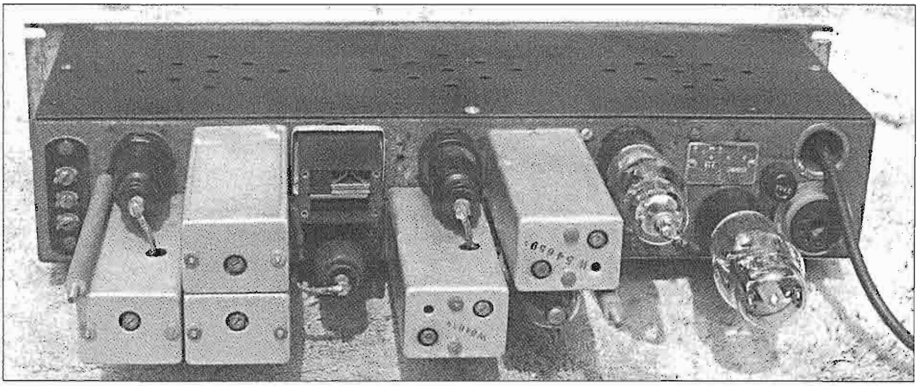
At the Anderson, South Carolina, swap fest I saw a Wilcox rack-mount, fixed-tuned, AC-operated HF receiver like the surplus one that I had bought in 1947 from Niagara Radio on Greenwich Street in NYC for $29. While I never actually did any thing with it, I always had some grand plans to put it to use. What I eventually did with it I have no idea. A close inspection of the Wilcox rust box at Anderson showed it was an F-3 model, an AM-voice receiver with squelch, not my CW-3 version. Marty–AA4RM–was the owner of the Wilcox, and when I recognized it he said, "if you know anything about it take it home," so I did. This would be my chance to finally put my past plans, what ever they might have been, for the Wilcox into being.

Wilcox fixed-tuned HF receivers got their start as Eastern Air Lines ground-station receivers due to Eastern president Eddie Rickenbacker's wife. Her cousin ran Wilcox, and while Capt. Eddie liked Bendix radios, he threw some business to Wilcox. In the thirties, aircraft transmitted AM on frequencies between 3 and 3.5 MHz, or 6 and 6.5 MHz. The standard air-to-ground channels for communications with the CAA, predecessor of the FAA, were 3105 or 6210 kHz. CAA ground stations replied on navigational frequencies between 200 and 400 kHz. With the exception of Newark, New Jersey, all airport control towers transmitted on 278 kHz.

Small aircraft needed only a low-frequency receiver and a 3105-kHz



Here is a front-panel view of a Wilcox Type F3 receiver. From left-to-right are the headphone jack, Noise Control (squelch), Audio Gain, and Sensitivity (RF gain).

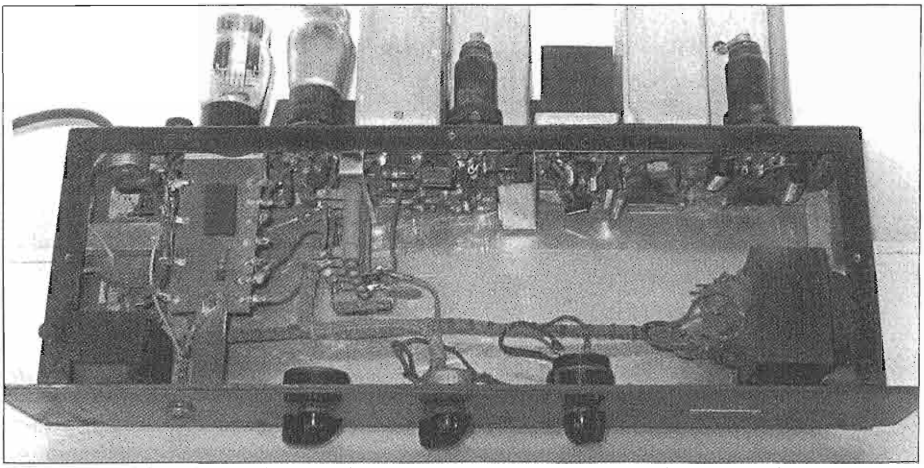


This is the rear view of the Wilcox F3 with the tube cover removed. The RF-tuning cans are on the left, along with the 6K7 RF amplifier, then the crystal and the 6K8 oscillator/mixer. Next is the 6K7 IF amplifier and the two IF transformers. Last on the right is the partially-hidden 6F7 detector, the 6C8 audio, and a type 80 rectifier. The socket is for remote control.

transmitter. Airlines needed company communications in addition to CAA communications, so in addition to the LF receiver, which was frequently a direction finder with a loop antenna, they had a multichannel HF transmitter and receiver. Two of the channels were 3105 and 6210 for talking to the CAA, while the rest were company simplex frequencies. For example, the Delta in-range company frequency in the Atlanta area was 3015 kHz. The 3-MHz frequencies were used in the daytime and the 6 MHz at night. If you followed the Amelia Earhart disappearance, you know that the Coast Guard was listening for KHAQQ, her call sign, on 3105 and 6210, when she disappeared over the Pacific.

The Wilcox F3 was apparently a good receiver at a better price than ground receivers made by RCA, Collins, Western Electric, Bendix, and others, so other Airlines started using the F3. It has an excellent squelch, which is unusual in an AM receiver, and was set up for remote operation over a single telephone line. With WWII on the horizon, the U.S. Army Air Corps started buying them for ground-station and control-tower receivers. In 1941, the Signal Corps asked Wilcox to build a CW version. This was the CW-3 model, which looked identical to the F3, but had a BFO in place of the squelch. In 1942, the Signal Corps asked Wilcox to modify the 3-to-6.5 MHz frequency range of the CW3 to 1.9-to-16.5 MHz by use of plug-in coils for Army point-to-point, long-distance CW and TTY circuits. In the Wilcox receivers, the oscillator frequency, and consequently the received frequency, was controlled by a plug-in, 3-prong AR-4 crystal, so drift was no problem as in many other HF receivers of the time. The Wilcox was a cheap, small, 3-inch, rack-mounted unit that supplemented the Hammarlund Super Pros, National HROs, and Hallicrafters SX-28s. The Wilcox survived until the end of WWII, even though it was replaced by the fixed-crystal tuned Press Wireless AN/FRR-3 for CW and TTY service.

The Wilcox F3 I got from Marty had been stored in a very damp location for many years, however, it was complete except for the bottom cover, and appeared to be unmodified. It still had the original tubes and crystal. A check with the grid-dip meter showed it was tuned to the Delta 3015-kHz frequency, which matched the metal label on the front panel and a 2560-kHz crystal (3015 minus



This top-side view shows the very compact, yet easily-accessible dishpan construction style that was used by Wilcox.

455 kHz), which took right off when I applied external filament and plate voltage to the 6K8 oscillator/mixer. The B plus was a dead short to ground, so the rest of the receiver was dead. With four new filter caps, a new fuse holder and line cord installed, and some deoxidizing and cleaning, the F3 produced tube-operating voltages, but nothing was heard at the headphones jack. The tubes were removed, the pins cleaned, and the tube sockets were cleaned. A tube check showed the 6C8G audio amplifier and squelch gate had one triode section intermittent. Resoldering the tube pins eliminated the problem. The same thing showed up in the 6F7G grid-leak detector and AGC rectifier/amplifier. I was able to correct it the same way.

A voltage check showed everything was close to what I consider normal, however, the receiver was producing only a small bit of noise with 500 µV into the antenna terminals. I put a ¼-volt audio signal on the detector grid, trying to isolate the trouble. Nothing showed up in the phones at the output. Moving the audio signal to the detector plate produced good output. I measured the detector plate and found 11 volts. Grid-leak detectors use a very high value plate-load resistor, but 11 volts was too low. The .01 audio-coupling cap on the plate of the detector measured 0.6 Meg. This was not enough leakage to bother the following audio grid, but was enough to pull the detector plate voltage down to where it would not work. If Wilcox had used a diode detector the leaky cap would not have bothered anything, but they wanted the audio gain of a grid-leak detector to eliminate the need for an additional audio-amplifier tube.

Now, with the audio coupling cap replaced, a few microvolts on the balanced antenna terminals produced a strong audio signal in the headset. With the receiver working, a touch-up alignment showed sensitivity to be better than 5 µV, not bad for one 6K7 RF stage. Selectivity was 9 kHz at 6-db down, again, not bad for one 6K7 455-kHz IF stage. The one stage of audio produced good headphone output. The second half of the 6F7G was the AVC amplifier and kept the audio output within reasonable limits. The squelch, labeled "Noise Control," would release on a 25-µV signal. Now, it was time to clean up the rusted chassis and covers. After the rust was buffed off and a black repaint job made, the Wilcox looked halfway presentable. I decided not to do the front panel as it was readable even though it was scratched up.

Now that the Wilcox was working, I was back to where I was in 1947: What to do with it? A crystal-controlled, fixed-tuned AM receiver had more possibilities in 1947 than in 2007. My first-and-only thought was 3885 kHz, the local AM frequency. A check of my crystal stock turned up a 4330-kHz rock, which, with high side injection, would put the Wilcox on 3875. I could grind the crystal up 10 kHz, or tune the IF down 10 kHz to 445 kHz to get it on 3885. I elected to do the latter, as most IF cans will move at least 10 kHz. In 1950, we used surplus crystals to make SSB filters and moved IF cans around to match the crystals. The IF tuned to 445 kHz with no trouble. The RF and mixer stage tuned up on 3885 kHz just fine. It took about 6 µV to kill the background noise on 3885.

The Southeast AM radio group meets on Tuesday nights, so that was my chance to see how the Wilcox F-3 would perform. Sam (KF4TXQ) was running the W4AMI net, so with the F-3 on the bench beside my ARC-5 transmitter I checked in. There were about 40-50 AM stations on 3885 kHz from DX-40s to KW-1s. The Wilcox performed flawlessly on every station. All were Q5 and ran from S3 to S9++. The receiver really surprised me at how well it handled the different signal strengths and was wide enough to make all sound good. There were a few stations several states away that needed help with the squelch, but other wise it was sit back and enjoy the net. The 1938 six-tube, including the 80 rectifier, receiver could hold its own against any Collins, Hallicrafters or Hammarlund on 3885 kHz. As that famous QST author Larsen E. Rapp, WIOU, would have said "Accolades Wilcox, Caveat Emptor the others."

ER

The CW-3 receiver was advertised infrequently in the years following WWII, such as the one above from the January 1948, QST.

A 1937 US Coast Guard Motor Lifeboat Radiotelephone

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I must admit, I am a sucker for the rare and the odd—aren't all of us ER readers? I ran across a radio that is, to me, quite odd and perhaps rare. The transmitter-receiver shown in **Figure 1**, Model R-104/T-104, was manufactured in 1937 by the Radiomarine Corporation of America for use in U. S. Coast Guard motor lifeboats. Members of the Coast Guard use the term "motor lifeboat" to describe a small motor-rescue boat. I assume that the Coast Guard procured the set in relatively small quantities, as the serial numbers are 13 and 17, respectively, for the transmitter and receiver in Figure 1. I presume, too, that depression-era funding for the Coast Guard was not exactly generous.

Quality was certainly not compromised in the construction of the transmitter-receiver. Figure 1 indicates that the transmitter (T-104) is mounted above the receiver (R-104) in a splash-proof aluminum enclosure, with a front cover that can be dogged down to prevent exposure to the elements. An operator on the boat was able to remotely control basic functions of the equipment—power on/off, frequency of channels, and volume—while it was fully enclosed. The remote control connector is a typical, gigantic, multi-pin, Navy–type connector.

The two units are designed to operate from a nominal 12-VDC electrical system. Two dynamotors are placed at the

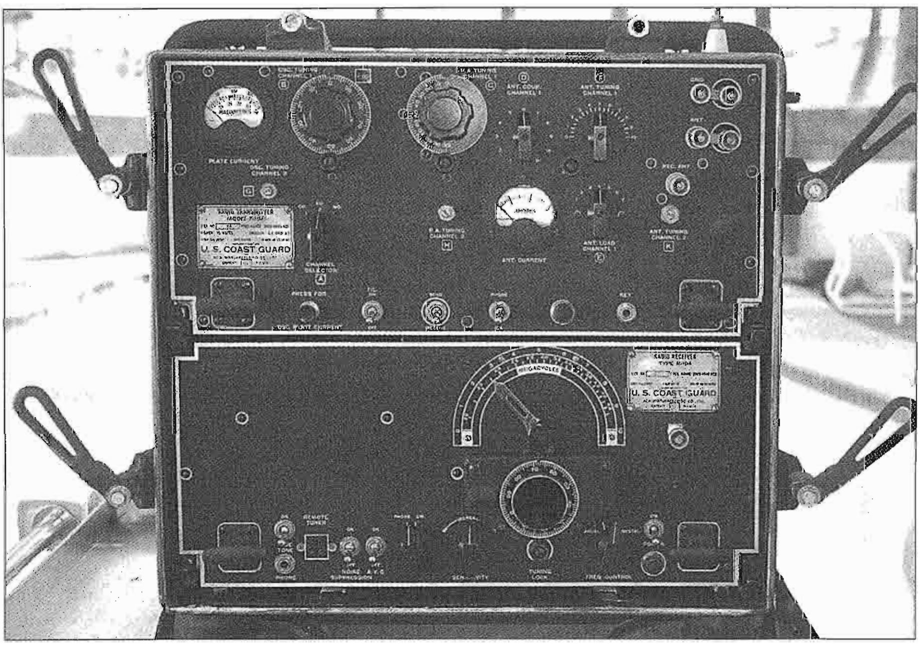

Figure 1: View of the US Coast Guard R-104/T-104 Set with the Front Cover Removed

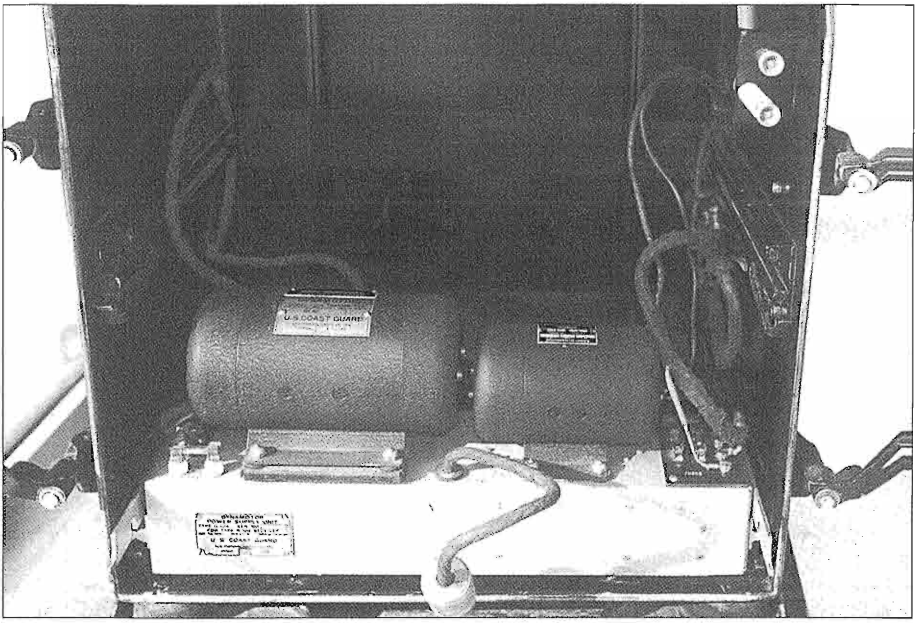

Figure 2: Rear view behind the receiver chassis, showing the dynamotor power supplies.

bottom rear of the enclosure, behind the receiver chassis (see **Figure 2**). The larger of the two dynamotors provides 450 VDC for the transmitter. The smaller dynamotor provides 220 VDC for the receiver. A DC power cable exits the rear of the enclosure through a watertight gland.

The architecture of the T-104/R-104 is somewhat reminiscent of the Collins TCS. The transmitter (see **Figure 3**), whose mode of operation is AM only, uses one 807 final, which is modulated by two 807s, whereas the TCS had two 1625s in its final, but only one was used for AM operation. The transmitter provides for crystal control on two independent channels; further, the second channel can also be tuned using an internal VFO. The first channel-tuning adjustments are behind the front panel, and it is obvious that they are not designed to be manipulated while in service. I assume that the first channel is set on 2182 kHz or some other common hailing frequency. Controls for the second channel are operated from the front panel, thus permitting rapid frequency changes. The speech amplifier appears to have a relatively flexible input circuit that will accommodate a variety of microphone impedances and levels.

The receiver (**Figure 4**) contains eight typical 1930's five, six, and seven-pin tubes. It can be either crystal controlled on two channels or tuned continuously in one band that covers 2.0 to 4.5 MHz. A location is provided on the front panel for what appears to be a remote motor-driven tuning control. It is operated through the four-pin Jones plug, which is on the left side of the receiver panel.

The radio came to me in excellent shape, but dusty and dirty. After a day or two of removing hardened mineral oil from the bottom of the case, I was ready to perform an electrical assessment. In all cases where I find a historical piece like this that has been "improved," my first step is to remove any and all obvious "improvements." Fortunately, I encountered only a handset someone had

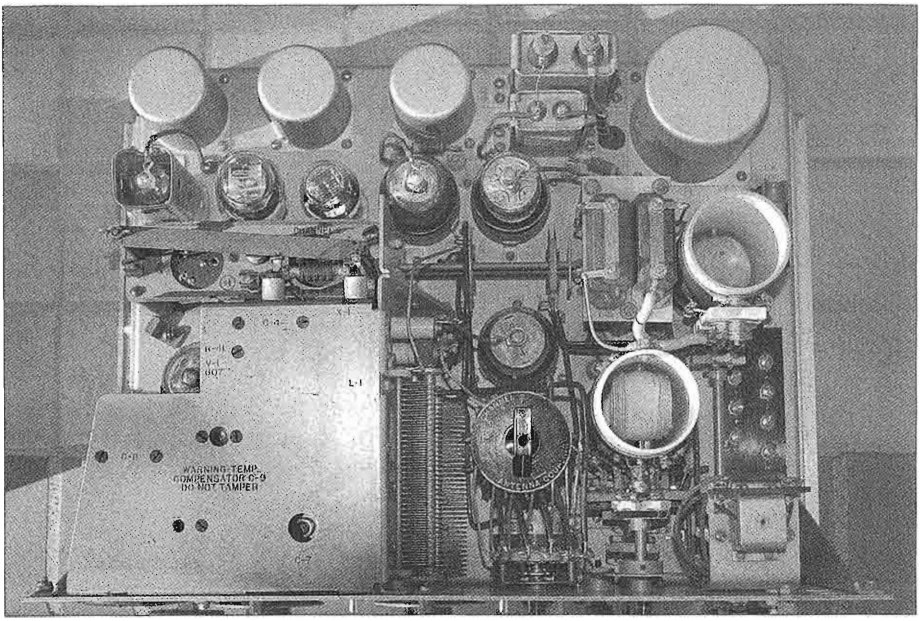

Figure 3: This is a top view of the transmitter chassis. Note the internal tune and load controls for channel 1 in the lower center of the photo.

cobbled hastily to the front of the set and some creative DC-input wiring using 12-AWG, solid THW wire. After the abominations were removed, I found that I did not need to plug any holes or touch up the paint.

I removed both dynamotors, and I cleaned and reinstalled them. A receiver audio-output transformer was leaking mineral oil, and I repaired it by re-sweating the case seal with a large-caliber iron. After a good general clean up,

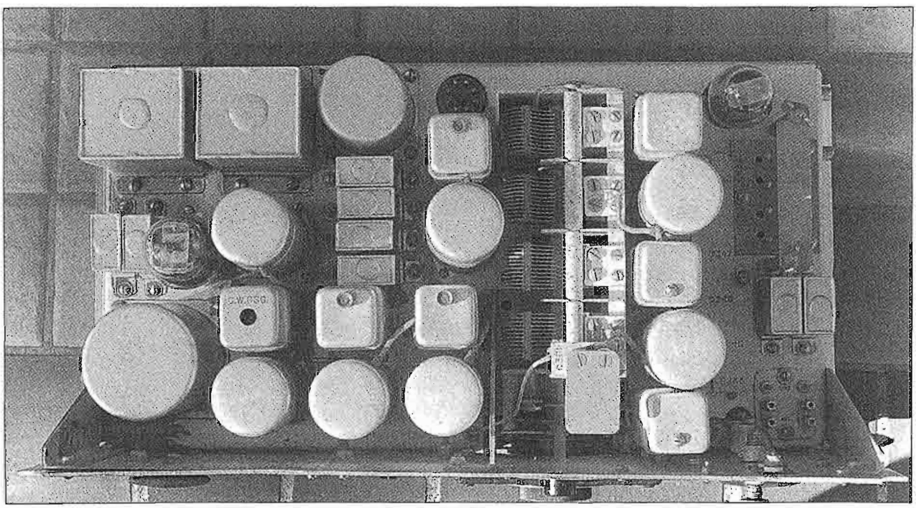

Figure 4: Top View of the Receiver Chassis

redressing wires, and checking all the tubes on a TV-7D, I was ready to check both transmitter and receiver for signs of life.

I applied 13 VDC from a large regulated supply and flipped on the receiver power switch. The dynamotor spun up and was nearly inaudible! The receiver came to life, and I checked the dial calibration at both ends of the band. It was within about 2.5 kHz at 4.5 MHz. I was able to copy clearly a modulated 1-kHz tone at 2 µV. Not bad! I measured the band width at about 12 kHz, which I suppose was about par and completely adequate for the application.

Since I had no crystals for the transmitter, I put the MO to the test immediately. I decided to use channel two, because the tuning controls were accessible on the panel, and I was less likely to meet mean Mr. Electron and his energetic friends while tuning up. I plugged in a Telex 66T microphone and keyed the transmitter; the result was nothing but a click. I cleaned the dynamotor power relay (and all the other relays as well) and tried again. I was met this time with an instant 20 watts into my phantom antenna and Bird Termaline. (I use an old ARC phantom antenna simulator that was made to simulate 15′ or 30′ whips.) After some quick touch up, the power peaked at about 25 watts. I coupled the output loosely to my HP 8561 spectrum analyzer and discovered that a 3.855-MHz signal drifted up by about two kHz over a period of thirty seconds; after that it was relatively stable. I whistled up the modulator and encountered severe flat-topping. I switched to a RS-38 microphone; now I had about 90% modulation. All in all, quite a nice signal!

I acquired recently a few of RMCA crystal holders from the era, and have fitted 75-meter, HC-6/U crystals within them. I look forward to placing this rig on the air in the near future. I will probably mount it in my old International Scout, which has a sturdy 14/28-volt, 200-amp, three-belt alternator. I intend to load the transmitter into the 11′ whip on the Scout, since it appears designed to drive such an antenna.

I would very much like to communicate with any individual who has any further information on this radio; even better yet, has technical information such as a manual or schematic. I would also like to know more about the original application of this set. Was it used in other craft—perhaps harbor tugs? Was it perhaps more common than I think it was? I find it incredible that I could get this seventy-year-old rig on the air so easily with absolutely no parts replacement. It is certainly a testament to the quality that RMCA lavished on it.

ER

(Comments from pg 1)

Write it up and send your Word document to Ray@ERmag.com. Typewritten sheets are fine, but please, no handwritten sheets. Here is a short example from Gary, K6GLH: "My Elmer was Doug, WA9AXN (now KB9LV), whom I met in 1963 when I was 14, growing up in cow country, Wisconsin. Doug gave me my novice test, answered an endless stream of questions, and took me to radio club meetings and the ham stores in Minneapolis. He was the best Elmer a kid could have and I owe him a tremendous debt of gratitude for a great career and the ham friends I now have."

K6HQI 20-Meter Memorial Net Alive and Well!

From Tim, N5DWV, comes word that the 20-meter AM 14.286 K6HQI Memorial Net is alive and well. Conditions have been very poor on the 20-meter band, but recently band conditions have greatly improved. A lot of the stations are getting on the air between 4:00 PM and 5:00 PM PT, 7:00 PM CT, and 8:00 PM ET. Stations like W8VYZ and VE4BX, who helped K6HQI (SK) anchor this net for 20 years are getting back on frequency. So, change the tank coils, switch to your 20-meter antenna, retune your rigs, and join us on 20 meters! ER

Building the 1956 Science and Mechanics Sun-Powered Radio

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My favorite magazine when I was a teenager in the late '50s and early '60s and discovering "radio" was Radio-TV Experimenter. This magazine was published by the Science and Mechanics Publishing Company and was crammed with all types of construction projects that varied from the simplest 1-tube or 1-transistor radios to building a 7" oscilloscope from a discarded TV set to a 10-tube, 21-Mc receiver/transmitter to a 5-tube CB transceiver, to a 5-tube Hi-Fi amplifier. Each magazine contained (say) 35-50 "make-it-yourself projects" per volume. A small collection of Radio-TV Experimenter offered a cornucopia of ideas and exposed me to huge segments of electronics. In addition, there was White's Radio Log, which was a directory of AM-FM-TV stations that I used as my family moved back and forth between the East and West coasts. Does anybody remember KOMA in Oklahoma City, Oklahoma? [Ed.–You bet, "Ricky the K" and Larry Neal!]

As a teenager, there was one project in Radio-TV Experimenter that I dreamed about building for years, the "Sun-Powered Radio." This 1-transistor, sun-powered radio was first featured in the June 1956 issue of "Science and Mechanics." Using a single CK722 and powered by four International Rectifier B2M photocell sun batteries, it was built into a 3-9/16" x 4-15/16" x 1-1/4" hinged-plastic case. I was just totally captivated by this project but was never able to build it. I was probably 12 or 13 years old when I first saw the sun-powered radio in Radio-TV Experimenter. I have thought about this project off and on my entire adult life – I have never forgotten it.

Fast-forward to March 2001 when much to my surprise, I discovered that Dave Minchella (KE2GE) not only was familiar with that article, but had several dozen Vactec P/N 158312 solar cells that could be used as a substitute for the International Rectifier B2M photocell sun batteries. After exchanging a few (dozen) emails, I traded Dave his solar cells for one of my reproduction Ocean Hopper front panels. My luck held as I found the June '56 issue of Science and Mechanics and the '57 Radio-TV Experimenter #4 on eBay. I had waited long enough – it was now time to build that sun-powered radio!

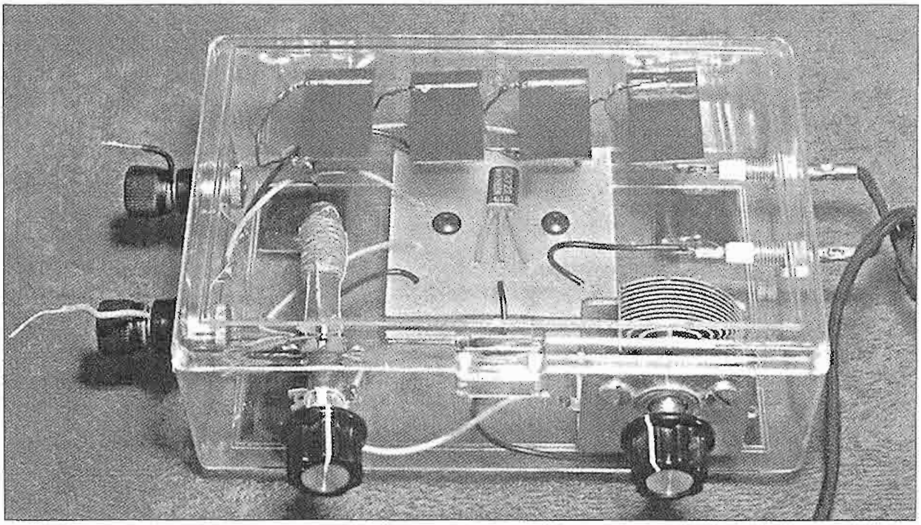
What I ended up building was a close copy of the original. The following are comments on the design and construction of my sun-powered radio:

- I graded the Vactec solar cells and then selected four of them for the highest output voltage using a 40-watt incandescent bulb as a light source. The four series-connected cells selected produced 1.2 VDC. I then hot-glued small right-angle brackets (similar to Keystone P/N's 612, 621, or 634) on the bottom of the solar cells to mimic the B2M mounting configuration.
- The clear-plastic hinged case I found was a tad larger at 5-1/4" x 3-3/4" x 2" than the original. I scotch-taped drill templates to the outside of the case and used a very sharp scribe and a small pilot drill to locate the holes. I then went up in small steps until the #4 and #6 hole sizes were reached. The holes for the tip jacks, loopstick, and clearance hole for the main tuning capacitor's shaft were *very carefully* and *slowly* enlarged with a T-handle reamer.
- I located a NOS J.W. Miller tapped Vari-loopstick P/N 2002 on eBay.
- The tuning capacitor is a single-section 365 µµfd similar to the P/N CV-235 from Antique Electronic Supply.
- I was lucky enough to find an original Raytheon "iridescent blue" CK722 PNP germanium transistor with a 618 (1956) date-code that worked pretty well.

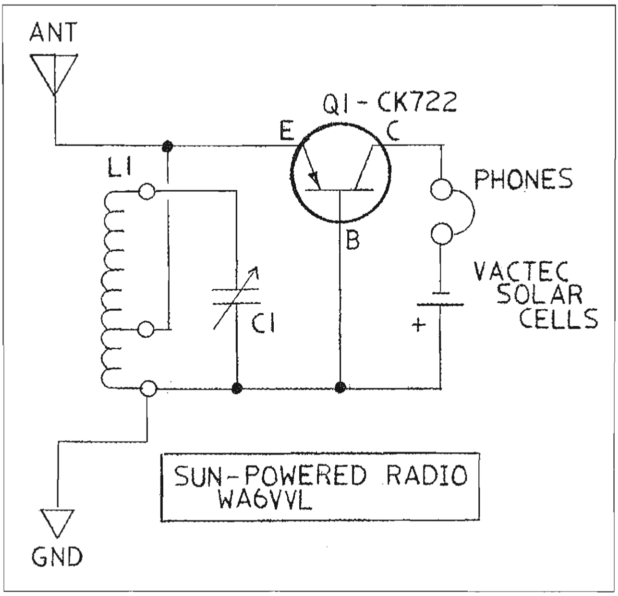
A vintage blue Raytheon CK722 transistor was found in the original box.

- I breadboarded the original circuit, but decided to use the circuit that Allied Radio used in their Knight Kit 1-transistor Radio, circa '56 (Allied P/N 83 Y 765). The Allied circuit is extremely simple and works every bit as well as the original. Also, the original uses a non-tapped loopstick. Using the tapped loopstick significantly improves the selectivity of the radio – something I would have been clueless about had I built it in '56.
- I decided to fabricate a small printed circuit board to mount the CK722 and serve as an interconnect for the wiring.
- I chose to use a vintage pair of binding posts for the antenna and ground that I salvaged from a Doerle "Globe Circler" 2-tube regenerative radio that was built in the '30s.
- The headphone jacks are white insulated tip jacks similar to HH Smith P/N 1506-101, Johnson P/N 105-0251-001, or Keystone P/N 6024.
- The hex knob for the main tuning capacitor fits a ¼" shaft and is Radio Shack P/N 274-415 (pkg of 4). The hex knob for the loopstick fits a 1/8" shaft and came from my "junk box".
- The rubber feet are self-adhesive.
- The #6 solder terminals are similar to Keystone P/N 7332.

So, was it worth waiting 45 years to build this radio? Although the performance leaves a lot to be desired (but similar to Knight's 1-transistor radio),



The 1956 sun-powered broadcast-band radio was built into an acrylic enclosure, following the component original layout.



Complete Schematic of the Sun-Powered Radio

building this radio was a *very* satisfying experience. I'm not sure why these memories are so powerful after all those years and after so many construction projects, but there's a certain sense of "closure" now that I've built it.

Send me a large SASE or email me and I will send you a copy of the original article from the Jun. '56 Science and Mechanics.

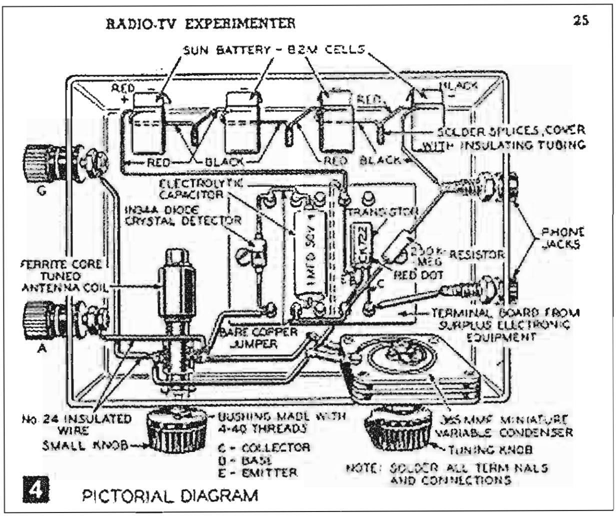
Selected References:

1. Harold P. Strand, "Sun-Powered RADIO (How to Put the Sun to Work)," Craft Print Project No. 248, Science and Mechanics, June, 1956, pgs. 162-166.

2. Harold P. Strand, "Sun-Powered Radio (How to Put the Sun to Work)," Craft Print Project No. 248, Radio-TV Experimenter, #4, 1957, pgs. 23-26..

3. Donald L. Stoner, W6TNS, "Selenium Photocell & Sun Battery Handbook," International Rectifier Corporation, Cat. No. B2M, 24 pgs.

4. "Midget 10-Cell Solar Battery Powers Two-Transistor Radio A T.R.F. receiver (with improved selectivity) that can run on the sun)," Radio-TV Experi-

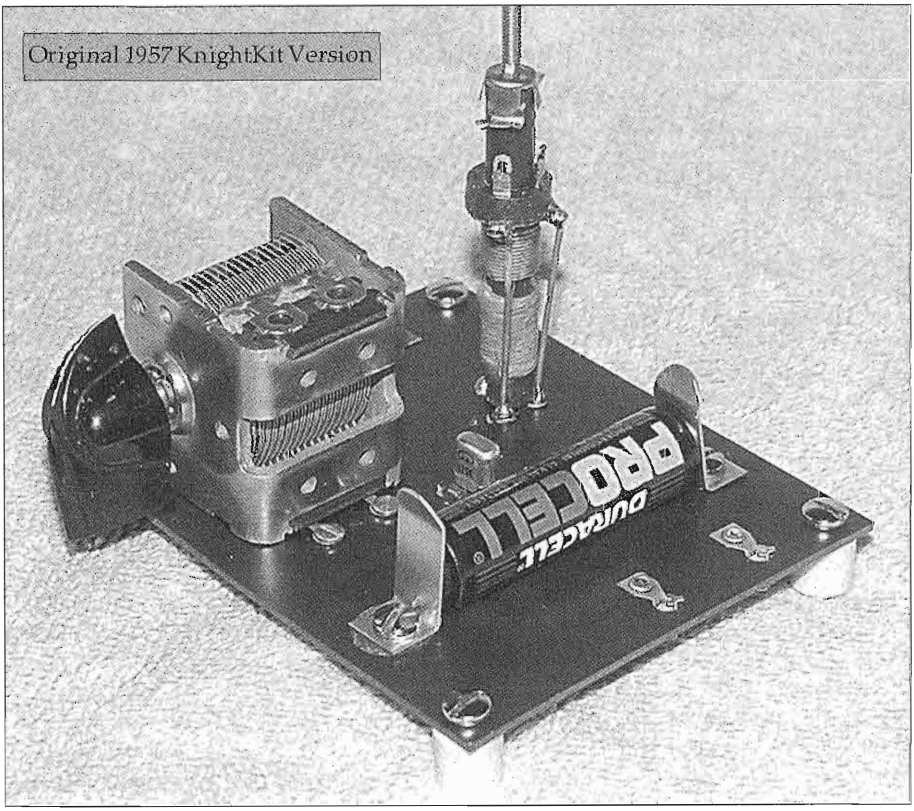


menter No. 551, 1958, pgs. 123-126.

5. Knight-Kit Transistor Radio Kit, P/N 83 Y 765, Allied Radio Catalog, 1957, No. 160, pg. 208.

6. "Raytheon Transistor Applications – More than 50 Practical Circuits using Raytheon CK722 Transistors," a compilation of CK722 construction articles including the Raytheon data sheet for the CK722 (and others), no editor listed and undated.

7. For those with Internet access, visit http://www.ck722museum.com The CK722 Classic Germanium Transistor Website and Museum hosted by Jack Ward. "The Story of the CK722", a 120-page book by Jack Ward, is available in either hard copy or 2 CDs. *ER*



Original 1957 KnightKit Version

Electric Radio Yearly Index: July 2006 to June 2007
Issues 206 to 217

Compiled by Don Buska, N9OO

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Hamfests/Conventions

Military

Miscellaneous - General

Miscellaneous - Technical

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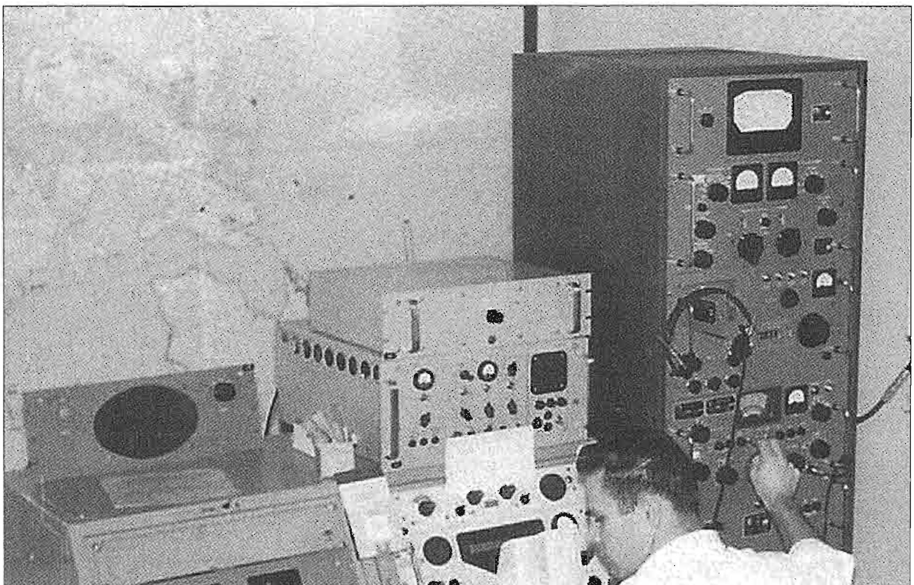
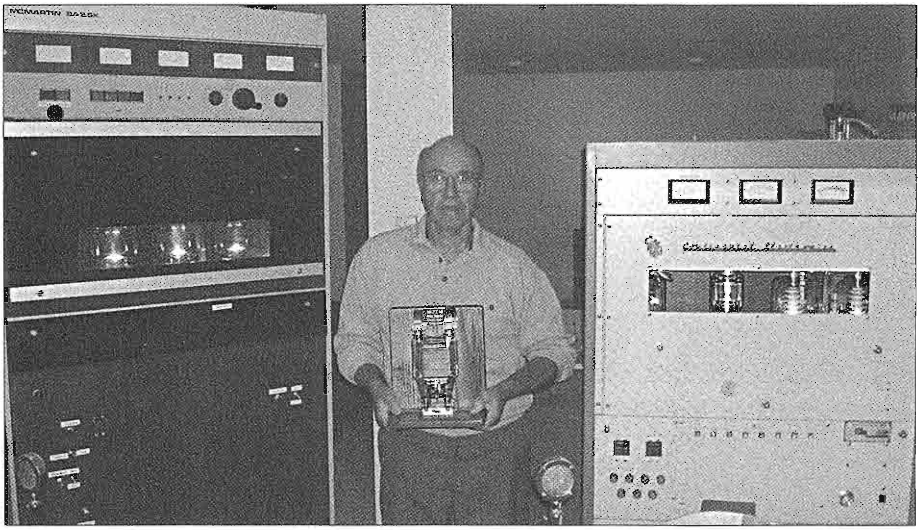


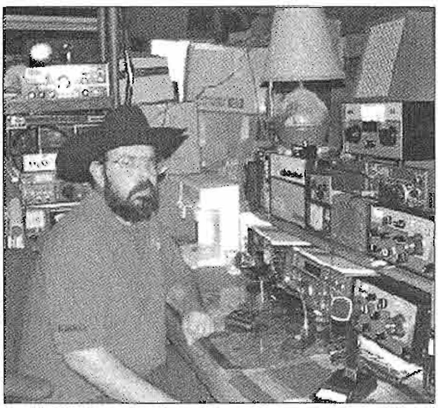
Operator, Date and Location Unknown, But What a Great Station! (photo courtesy Tyler Stampfli, KAØKA)

PHOTOS

Editor's Note: "Thank You" to everyone who has recently sent in photos, and please keep them coming so I can run the Photo column on a regular basis!

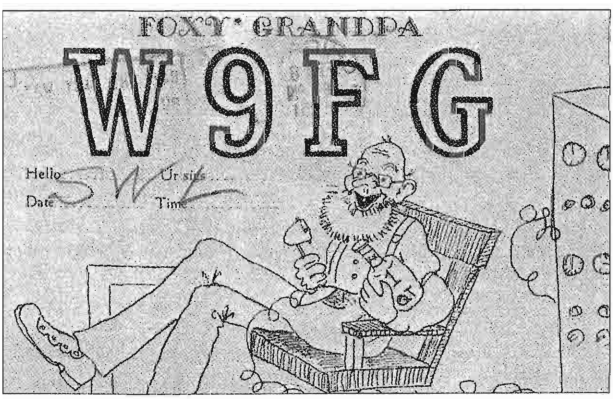


Bob Raide (W2ZM) was the winner of the 2006 Electric Radio Heavy Metal Rally. Bob is holding the trophy that was donated by Gary Halverson (K6GLH) for the event, a mounted 833A. Bob is standing by two of his glowing, converted broadcast transmitters. On the left is his McMartin, and to the right is a Continental.

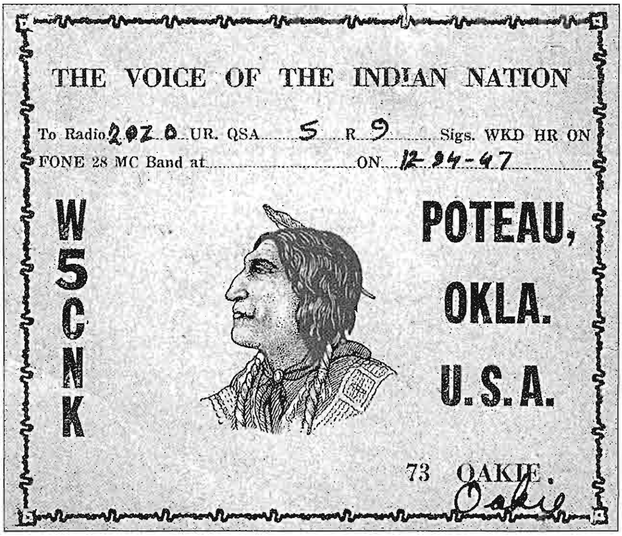


Right: Richard Zolla (N6NKN) is on the air from Costa Mesa, Californina. Rich has an interest in a lot of vintage equipment, including Collins, Hammarlund, Drake, Swan, and others. He's shown in his shack earlier this year.

Above: In the 1950 photo above, George Cummings (K7DU) was licensed as W9AZR at Cary, Illinois and was operating his home brew rig, a Millen exciter, 6L6 to an 807. His receiver was an NC-173. He is shown using a Vibroplex Champion, which he still uses today. K7DU was a regular fist on the Vintage CW 20-Meter Net, back in the early 1990s, hosted by Tracy, WB6TMY. George is on the air frequently from Hanna, Wyoming with one of his favorite transmitters, the Collins AN/ART-13. Listen for him on 40 CW.



Left: Carl Stengel (W6JEO) sent in the W9FG QSL to the left. W9FG's shack photo from 1949 was in the March 2007 issue of ER. Carl mentioned receiving W9FG's card in 1951 while he was a SWL with his trusty Hallicrafters S-38, which he still has. Later, after Carl was licensed, he worked W9FG on 160 phone in 1953, and his receiver was an SX-25, so that part of the caption in ER 214 is correct. However, part of the caption has an error. It was pointed out that W9FG had a "coffee grinder" antenna rotator, which is an error. It was actually an antenna relay and ammeter.



Left: Rich Estes (K8LRY) sent in the classic QSL card shown that he found in a pile of old papers and books. Oakie, W5CNK, was confirming a 10-meter phone QSO with W2QZO in Schenectady, NY, that took place on Christmas Eve of 1947.

Above: Steve Belcher (W1TAV) put together his vintage shack from memories of his Dad's shack and those of other hams that used to visit with him back in the 1960s. On the left side may be seen a Hallicrafters HT-40, National VFO, HQ-170A, Heath HR-10 and a 301 scope. In the center is a DX-100. On the right side are a HQ-160, DX-60 and the HB-10 VFO. Steve mentions that he's been a ham for 31 years as WA1ZUF, and recently got his Dad's call asigned to him, W1TAV. Steve is active, 75 & 160 AM phone, from East Bridgewater, Massachusetts.

Above: Joe Prewitt (WØTUT) was licensed as WNØTUT in 1954, and is between QSOs in his ham shack located in Hayden, Colorado, which is Northeast of Grand Junction, Colorado. Joe mentioned that he started out as an SWL with the family's Philco, and one night he heard a W7 ham in Sundance, Wyoming, about 150 miles away, and decided to get his Novice ticket. When he got it, he was active in the Colorado Slow Speed CW net, and went on to work some DX with the aid of his friends, such as W9NZZ. His equipment above, in 1954, was a Heath AT-1 transmitter and a Hallicrafters S-38C receiver.

Left: Here is Joe in his 2007 station located in Panama City, Florida. On his desk are two Collins 651S-1 receivers, a 312B-4 control console, and a custom Heath power meter. On top of the rack is a Collins KWM-2, and racked up below it is a MacKay Marine 3020A receiver and a Collins 32S-3 transmitter.

VINTAGE NETS

AM Carrier Net: Sunday mornings, 8:30AM local Eastern time, 3835 kc. QSX W2DAP. Friendly format.

Arizona AM Nets: Sat & Sun: 160M 1885 kc @ sunrise. 75M 3855 kc @ 6 AM MST. 40M 7293 kc 10 AM MST. 6M 50.4 Mc Sat 8PM MST. Tuesday: 2M 144.45 7:30 PM MST.

Boatanchors CW Group: QNI "CQ BA or CQ GB" 3546.5, 7050, 7147, 10120, 14050 kc. Check 80M winter nights, 40 summer nights, 20 and 30 meters day. Informal nightly net about 0200-0400Z.

California Early Bird Net: Sat. mornings @ 8 AM PST on 3870 kc.

California Vintage SSB Net: Sun. mornings @ 8AM PST on 3860 +/-

Colorado Morning Net: Informal AMers on 3875 kc daily @ 6:00 to 6:15 AM, MT. QSX KØOJ

Canadian Boatanchor Net: Daily 3725 kc (+/-) @ 8:00 PM ET. Hosts are AL (VE3AJM) and Ken (VE3MAW)

Collins Collectors Association (CCA) Nets: Sunday, 14.263 Mc @ 2000Z. Informal ragchew net Tue. evening, 3805 kc @ 2100 ET, Thu. 3875 kc. West Coast 75M net, 3895 kc 2000 PT. 10M AM net 1800Z, 29.05 Mc Sunday, QSX 1700Z. CCA First Wednesday AM Night each month, 3880 kc starting @ 2000 CST, or 0200 UTC.

Drake Technical Net: Meets Sun. on 7238 kc, 2000Z. Hosted by John (KB9AT), Jeff (WA8SAJ), and Mark (WBØIQK).

Drake Users Net: Check 3865 kc, Tue. nights @ 8 PM ET. QSX Gary (KG4D), Don (W8NS), and Dan (WA4SDE)

DX-60 Net: Meets on 3880 Kc @ 0800 AM, ET on Sun. QSX op is Mike (N8ECR), with alternates. The net is all about classic entry-level AM rigs like the Heath DX-60.

Eastern AM Swap Net: Thu. evenings on 3885 kc @ 7:30 PM ET. Net is for exchange of AM related equipment only.

Eastcoast Military Net: Sat. mornings starting 0500, 3885 kc +/- QRM. QSX Ted, W3PWW. It isn't necessary to check in with military gear, but that is what this net is all about. Late checkins are welcome.

Florida AM Group: A large group meeting every Sunday, 7:30AM ET, 3875 kc and pre-net checkin 7:00AM ET, 3675 kc. QSX Maury, N4GUI. Also, Florida vintage SSB net "AFLAC" meets Wed., 3910 kc, 9PM ET. QSX Warren, W1GUD.

Fort Wayne Area 6-Meter AM net: Meets nightly @ 7 PM ET on 50.58 Mc. Another long-time net, meeting since the late '50s. Most members use vintage or homebrew gear.

Gulf Coast Mullet Society: Thu. @ 6PM CT, 3885 kc, QSX control op W4GCN in Pensacola.

Gray Hair Net: One of the oldest nets, @44+ years ,160 meter AM Tue. evening 1945 kc @8:00 PM EST and 8:30 EDT. Also check www.hamelectronics.com/ghn

Heathkit Net: Sun. on 14.293 Mc 2030Z right after the Vintage SSB net. QSX op W6LRG, Don.

K1JCL 6-meter AM repeater: Operates 50.4 Mc in, 50.4 Mc out. Repeater QTH is Connecticut.

K6HQI Memorial 20 Meter Net: Flagship AM net 14.286 Mc daily for 25+ years. Check 5:00 PM Pacific Time.

Lake Erie Boatanchor CW Net: Saturday morning, 1 PM ET, 7094 kc QSX op Steve (WA3JJT) or Ron (W8KYD).

Midwest Classic Radio Net: Sat. morning 3885 kc @ 7:30 AM, CT. Only AM checkins. Swap/sale, hamfest info, tech. help are frequent topics. QSX op is Rob (WA9ZTY).

Mighty Elmac Net: Wed. nights @8PM ET (not the first Wed., reserved for CCA AM Net), 3880 +5 kc. Closes for a few summer months. QSX op N8ECR.

MOKAM AM'ers: 1500Z Mon. thru Fri. on 3885 kc. A ragchew net open to all interested in old equipment.

Northwest AM Net: AM daily 3870 kc 3PM-5PM winter, 5-7 PM summer, local. 6M @50.4 Mc. Sun., Wed. @8:00 PM. 2M Tues. and Thurs. @ 8:00 PM on 144.4 Mc.

Nostalgia/Hi-Fi Net: Started in 1978, this net meets Fri. @7 PM PT, 1930 kc.

Old Buzzards Net: Daily @10 AM ET, 3945 kc in the New England area. QSX op George (W1GAC) and Paul (W1ECO).

Southeast AM Radio Club: Tue. evening swap, 3885 @7:30 ET/6:30 CT. QSX op Andy (WA4KCY), Sam (KF4TXQ), Wayne (WB4WB). SAMRC also for Sun. Morning Coffee Club Net, 3885 @ 7:30 ET, 6:30 CT.

Southern Calif. Sun. Morning 6 Meter AM Net: 10 AM on 50.4 Mc. QSX op is Will (AA6DD).

Swan Nets: User Net Sunday 2200z winter 14.250Mc ±QRM. QSX op rotates Jim (WA5BDR), Jay (WB6MWL), Norm (W7RXG), Bill (W4WHW). Tech Nets: Wednesday 2300z 14.251Mhz / Saturday 1900z 7235 kc QSX op Stu (K4BOV)

Texoma Trader's Net: Sat. morning 8:00AM CT 3890 kc, AM & vintage equip. swap net.

Vintage SSB Net: Sun. 1900Z-2000Z 14.293 & 0300Z Wed. QSX op Lynn (K5LYN) and Andy (WBØSNF)

West Coast AMI Net: 3870 kc, Wed. 8PM Pacific Time (winter). Net control rotates between Brian (NI6Q), Skip (K6LGL), Don (W6BCN), or Vic (KF6RIP)

Westcoast Military Radio Collectors Net: Meets Sat. @ 2130 Pacific Time on 3980 kc +/- QRM. QSX W7QHO.

Wireless Set No. 19 Net: Meets second Sun., monthly, 7270 kc (+/- 25 Kc) @ 1800Z. Alternate 3760 kc, +/- 25 kc. QSX Dave (VA3ORP).

CLASSIFIEDS

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SERVICE FOR SALE: JOHNSON "TURBO" RANGER, Valiant, Viking 500, Viking II, includes panel and cabinet refinish. Hammarlund 180(A), National 300, 303, R390(A). http://w4pnt.8k.com Patty & Dee's Marina: 534 W. Main St. Waynesboro, VA. 22980 w4pnt@highspeedlink.net 540-249-3161 Cell: 540-480-7179

FOR SALE: BC348R with parts unit, no dyno, $50. RBM-4 receiver with AC power supply, $50. Contact Mike VE7MMH at: mike46@shaw.ca or 604-988-0112

FOR TRADE: Johnson Invader 2000 upgrade package. Convert your Invader 200 to a 2000; best trade offer. Urei 1693 broadcast mixing console; also best trade offer. Gary, K6GLH@volcano.net or 209-286-0931

FOR SALE: Ameco model PT tuneable preamp, 1.8 to 54 Mc, 5 band w/AC distribution panel. $19 + shpg. H. Mohr, 1005 W. Wyoming St., Allentown, PA 18103-3131

FOR SALE: NOS tubes: 1 VT-4C & 1 203A/503A same as VT. I'll take $125 for both. I ship. John Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

FOR SALE: National NC-100AS $150. Hammarlund S-100 speaker $20. Globe Chief 90A $75. Richard Cohen, 813-962-2460

FOR SALE: Ten Tec Omni 6, factory updated to Omni 6 Plus, all filters, w/pwr sply, $1,200 + shpg. Please call Earl, 603-434-8326


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FOR SALE: Heathkit DX-100 parts: Plate transformer, $40. Filter choke, $35. George Stevens, WØATA, POB 704, Longmont, CO 80502 303-776-9036, vintage1@prodigy.net

FOR SALE: Racal RA-6778C receivers with DVD of manual. Pickup only, no shipping facilities. Bill Ford, VE3CK, 23 George St. N., Smiths Falls, ONT, Canada K7A 1Y3. 613-284-0700

FOR SALE: Johnson Ranger I, totally restored to turbo specs, complete cosmetic restoration, plug & play, ready to go. $1,250 + shipping. Valiant II, turbo, complete restoration as above, $1,650 + shipping. Dee Almquist, W4PNT, 540-480-7199, 57 Chris's Cir, Crimora, VA 24431

FOR SALE: GR 1932A distortion/noise meter and manual, $170. GR 1142A frequency meter and manual, $75. Lodge: The Ether of Space, $45. The Telephone Book, $15. Ross Wollrab, 228 N. Oakcrest Ave, Decatur, IL 62522-1810, 217-428-7385, REWollrab@aol.com

FOR SALE: Heathkit 2-meter Transceiver the "Twoer" Model HW-30 exc cond with manual, $65. John Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

FOR SALE: Cushcraft R-7 Antenna 10; 12, 15, 17, 20, 30, 40 meters very good cond, $100, I ship. John Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

FOR SALE: Telegraph Sounder 20 ohms. Pony relay 20 ohms, both in very good cond $75 for both. John Snow 1910 Remington Ct., Andover, KS 67002 316-733-1856

FOR SALE: RCA Photophone multi-tester model KR-13, make offer. W7SC, 3932 Mesa View Ln., Boise, ID 83706

FOR SALE: Make offers on 4CX1000, NOS, good filament. Two 21' 150 Mc Motorola/PD antennas, UPS shippable. W5JBV, mtkhamm@yahoo.com 850-747-3262

FOR SALE: Cushcraft A-4S beam $150, Motorola CentraCom rack-mount consoles $100, both items pick-up only. WANTED: Hallicrafters S-36/RBK-series VHF receiver. Steve Davis KD2NX, 71 Oak Street, Keansburg, NJ 07734, 732-495-8275, kd2nx66@yahoo.com

FOR SALE: Swan 350, $70. Triplett signal generator, $20. Simpson 260, $20. 6LQ6 tubes, $15. HP-606A, $45. Carter Elliott, 1460 Pinedale Rd, Charlottesville, VA 22901, 434 979 7383, celliott14@earthlink.net

FOR SALE: Collins 30L-1, RE, late, works great, average condx $600. 32S-3, RE, rough, $495, works super. 75S-3B, winged, nuvistor mods, BFO control out (T-10), very sensitive, $400. 312B-4, RE, $200. SM-3, $200. SM-2, Heil cartridge, $200. FREE Kenwood TS-930S if you have no working radio–call. Items guaranteed, prices FOB Houston. Don, K5AAD, 713-942-9747

FOR SALE: Collins 51J4. BC223A, PE94A. BC624A. BC1206. Gonset 66B. Two homebrew transmitters. Bill Coolahan, 1450 Miami Dr. NE, Cedar Rapids, IA 52402. 1-319-393-8075

FOR SALE: New Collins handles for transmitters 32V, KWS-1, KW-1. Replace those beat up and gouged front panel handles on your Collins A-line gear! Handles are finished in high gloss epoxy. Uses existing screws. $20 each. Include $37.50 per pair for priority mail shipping. Please order via EMAIL: w3hm@frontiernet.net or by phone, 304-876-6483, or by regular mail with money order to: W3HM Radio Labs, 570 Acorn Circle, Harpers Ferry, WV 25425

FOR SALE: Heathkit Impedance Bridge Model IB-2 with copy of manual, $45. Mike Grimes, 5306 Creekside Ct. Plano, TX, 75094. 972-898-7251, K5MLG@verizon.net.

FOR SALE: New, universal power supply for Elmac, Gonset, Harvey Wells, others. SASE for brochure. Harold Smith, W4PQW, 1435 Bush St., Pensacola, Fl. 32534 850-476 8107 w4pqw@cox.net

FOR SALE: 50 year collection of radios and parts, PU local in W. NY Buffalo area. Rudy, W2ZIA, 716-937-9279

FOR SALE/TRADE: Manuals: EICO, Knight-Kit, Lafayette, Multi-Elmac, Collins, Morrow, Gonset, Harvey-Wells, Ameco, Millen. Al, NI4Q, POB 690098, Orlando, FL 32869 407-351-5536 ni4q@juno.com

FOR SALE: Ham, CB, and test equipment, all older tube-type gear. Send for list. Ed, WA7DAX, 1649 E. Stratford Ave., Salt Lake City, UT 84106. 801-484-5853

SERVICE FOR SALE: Quality repair of your vintage radios. Work is guaranteed. Check website for info: www.westonelectronics.com Jim Weston, K4COD, PO Box 294, Concord, GA 30206, 770-884-3202

FOR SALE: Hammarlund clock reproductions, 12 hour (easier to read) or 24 hour, specify, $35 each, shipped. Rob Hummel, WA9ZTY, 202 Midvale Dr, Marshall WI, 53559-9616

FOR SALE: QSTs, Cheap! Attn Mobile Operators: 100A alternator, 14.5 VDC in, 12V out, with 120V 10A pwr sply. Also 3 phase 2200V 1 kw transformer. $100 for all + shpg. 350uF 330V capacitors .50 ea. Rudy, W2ZIA, 716-937-9279.

FOR SALE Sprague Orange Drop capacitors New/NOS. Many values/ voltages. 50% off retail. Mix or match values. eMail for complete list. gg136@aol.com

FOR SALE: KWM-2 CDs. All original material, not a copy of the manual. High resolution color pictures which will really help locate parts, plus much more. For more information visit my web page at http://www.heavymetalradios.com/ or E-Mail me at boatanchors@comcast.net, DW Holtman, WB7SSN

FOR SALE: Technical Books & CDs. Harold Kinley (WA4GIB), 204 Tanglewylde Dr., Spartanburg, SC 29301 www.radiotechnologies.net

FOR SALE: Chinese Army type 65 hand crank generators for 102E radio sets. Ken, KD6B, kd6b@bendbroadband.com 541-923-1013, POB 310, Redmond, OR 97756

FOR SALE: "Unique Radio Parts", LLC. www.wa9tgt.com (Replacement parts for "Drake" radio equipment)

FOR SALE: Atwater-Kent dual speed tuner repair kit. Complete details at www.adamsradio.com Adams Manufacturing CO., POB 1005, Lincoln Park, MI 48146

FOR SALE: Galena crystals and/or parts to make your own crystal radio. Also have radio tubes. Len Gardner, 458 Two Mile Creek Rd, Tonawanda, NY 14150, radiolen@att.net

FOR SALE: Telephone Filters, suppress >1MHz interference, plug in, 1/$7, 2/$11, 3/$14, 4/$16.75, shipped U.S. Brian Harris WA5UEK 3521 Teakwood Lane, Plano TX 75075 brian.k.harris@philips.com 214-763-5977

FOR SALE: Military whip antennas NOS, $40. WANTED: R-392 receiver. Bruce Beckeney, 5472 Timberway, Presque Isle, MI 49777, 989-595-6483

DRAKE PARTS FOR SALE: New spun inlays for the B Line or TR4 main knob. $6. Also sell new pointer knobs. Alan, KC9YS, 630-879-1132 after 7pm.

FOR SALE: Naval Receivers RAK, RAL, RAO, RBA, RBB, RBC, RBL, RBM. Some checked, pwr splys available. $75-$450 depending on condx. Many other types. Carl Bloom, carl.bloom@prodigy.net 714-639-1679

QSLs FOR SALE: Your old QSL card? Search by call free, buy find at $3.50 ppd. Chuck, NZ5M, nz5m@arrl.net

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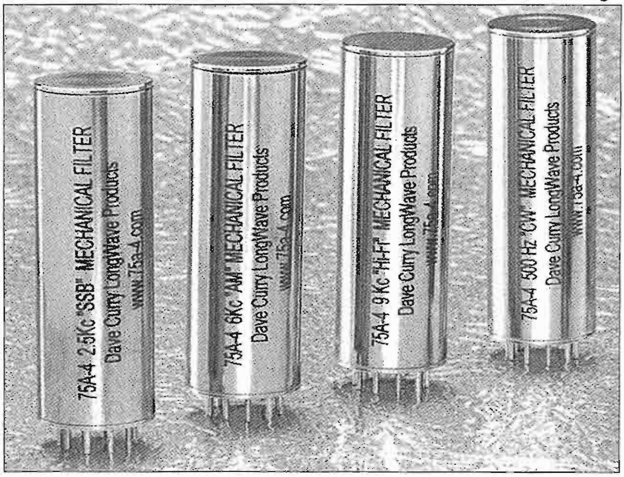
FOR SALE: DRAKE TR-7/TR-7A/R-7/R-7A service kit. Includes 13 extender boards and digital jumper card. $64.60 includes postage. See http://pweb.amerion.com/~w7avk, Bob, W7AVK, 807 Westshore J28, Moses Lake, WA 98837, w7avk@arrl.net 509-766-7277.

FOR SALE/TRADE: Transmitting/Receiving tubes, new and used. LSASE or email for list. WANTED: Taylor 204A, 211, TR40M and Eimac 500T. John H. Walker Jr., 13406 W. 128th Terr., Overland Park, KS. 66213. PH: 913-782-6455, Email: jwalker83@kc.rr.com

DRAKE OWNERS: New Sylvania 6JB6, same date code, tubes for sale. Price: $23 ea. Call Dick at 207-490-5870

FOR SALE: FT243 Crystals: 1000, 1822, 1880, 1942.5, 3530, 3535, 3540, 3545, 3550, 3625, 3675, 3735, 3800, 3825, 3870, 4325, 4335, 4340, 7040, 7050, 7123, 7140, 7143, 8400, 10106, 28238, 28258, 28571 kHz more. 100kHz, 455kHz HC51U wire leads. Some FT171B, HC6U Crystals. Contact af4k@hotmail.com or send SASE to Brian Carling, AF4K, 117 Sterling Pine Street, Sanford, FL 32773 or call 407-323-4178 http://www.af4k.com/crystals.htm

The Collins Filter Family



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DRAKE INFO FOR SALE: Drake C-Line Service Information. Hi-Res Color photos of boards and chassis with parts identified. CD also includes Hi-Res scans of R-4C and T-4XC manuals, various version schematics and more. Garey Barrell, k4oah@mindspring.com 4126 Howell Ferry Rd, Duluth, GA 30096. 404-641-2717

DRAKE SERVICE FOR SALE: R.L. Drake repair and reconditioning, most models including TR-7's, 35 years experience. Jeff Covelli, WA8SAJ, Telephone 440-951-6406 or email: wa8saj@ncweb.com

FOR SALE: QRP transmitter kits. Step-by-step instructions. Wood model, up to 5 watts 40/80M $15. "Tunatin" one watt 40M $10. You furnish crystal and power. Robert Larson, 1325 Ridgeway, Medford, OR 97504 w7lng@arrl.net

SERVICE FOR SALE: Repair, upgrade, performance modification of tube comm. & test equip. Accepting most military, all Collins & Drake, & better efforts from others. Laboratory performance documentation on request. Work guaranteed. Chuck Felton, KDØZS, Felton Electronic Design, 1115 S. Greeley Hwy, Cheyenne, WY 82007. 307-634-5858 feltondesign@yahoo.com

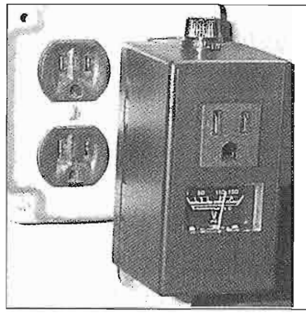
FOR SALE: Radio parts and hardware. Some are 60 years young! Free flyer, USA only. Bigelow Electronics, POB 125, Bluffton, OH 45817-0125

ZIM ELECTRONICS INRUSH CURRENT LIMITERS

Inrush Current Limiters are now available from the Electric Radio Store or on-line! These inrush limiters were reviewed in the September 2004 issue of Electric Radio and are available in three versions:

Model AB-1M, (With Voltmeter) $34.95
Model AB-300M, 300 watts (2.5 amps x 120 VAC) with meter $39.95
Model AB-1 (With Pilot Light) $29.95
Shipping, each limiter $5.45

(4 or more limiters are shipped free for US orders. Overseas customers please ask for shipping quotes.)
The Inrush Limiter provides a gentle, slow startup for your valuable vintage radio equipment. They also reduce the line voltage closer to original design values due to the voltage drop across the limiter element. AB-1 and AB-1M are 150W. All models come with a full money-back guarantee.



Model AB1-M

Electric Radio Store
720-924-0171

BOOKS FOR SALE: Lots of old radio & related books. Please contact Eugene Rippen, WB6SZS, www.muchstuff.com

FOR SALE: Tubes tested good globe 200A $8.50, 201A $14, 226 $8, 227 $9. Write or e-mail: tubes@qwest.net for price lists or see www.fathauer.com. Slightly weak tubes guaranteed to work in early radios 1/2 regular price. George H. Fathauer & Assoc., 123 N. Centennial Way, Ste. 105, Mesa, AZ 85201. 480-968-7686 or toll free 877-307-1414

SERVICE FOR SALE: Repair of tube and solid state 1930 to 1975 radio equipment, auto, shortwave and older amateur gear. Please contact Ken Hubbard, KA9WRN, at 608-362-1896 or write Vintage Radio Service, POB 792, Beloit, WI 53512-0792.

SERVICE FOR SALE: Authorized repairs and sales of all types of amateur radio, communications, and test equipment. Call Land Air Communications, 718-847-3090. Visit our web site: www.landaircom.com. We have over 3,000 items in inventory and carry all types of communications parts.

BOOKS FOR SALE: Radio books, magazines, catalogs, manuals (copies), radios, hi-fi, parts. Send 2 stamp, LSASE. David Crowell, KA1EDP, 40 Briarwood Rd., North Scituate, RI 02857. ka1edp@juno.com

JOHNSON PARTS: New Ranger 1, Valiant 1, & Navigator plastic dials, freq numbers in green, with all the holes just like orig.-$17.50 ppd. Bruce Kryder, W4LWW, 277 Mallory Station Dr., Ste. 109, Franklin, TN 37067. b.kpvt@provisiontools.com

FOR SALE: FT243 CRYSTALS: 1885, 1915, 1925, 1945, 1985, 3870, 3875, 3880, 3885, 3890, 7143, 7280, 7285, 7290, 7293 kHz, more. Contact af4k@hotmail.com or send SASE to Brian Carling, AF4K, 117 Sterling Pine Street, Sanford, FL 32773 or call 407-323-4178 http://www.af4k.com/crystals.htm

ACCESSORIES FOR SALE: KWM2/S-line metal logo pins. Meatball or winged. Excellent replica of the original. Put one on your hat, badge, or replace a missing logo on your panel, $6.25 shipped. W6ZZ, 1362 Via Rancho Pkwy, Escondido, CA 92029. 760-747-8710, w6zz@cox.net

FOR SALE: Vintage electronics at Alameda Antique Mall, 9837 Alameda Genoa in Houston. Visit www.RadioWorld-OnLine.com Carl Blomstran, POB 890473, Houston, TX 77289

ACCESSORIES FOR SALE: Spun Aluminum Knob Inlays for most Boatanchors. Collins Dial Drum Overlays. Dakaware Knobs. Charlie Talbott, 13192 Pinnacle Lane, Leesburg VA 20176-6146. 540-822-5643, k3ich@arrl.net

PLANS FOR SALE: Build your own "Midget" bug replication by KØYQX, ca 1918, featured by K4TWJ in CQ Magazine, May '98. 10 detailed blueprints. FAX: 507-345-8626 or mobeng@hickorytech.net

NOTICE: Visit Radioing.com, dedicated to traditional ham radio & vintage radio resources. Let's Radio! Charlie, W5AM. www.radioing.com.

ACCESSORY FOR SALE: RIT for Collins KWM-2/2A; No modifications needed. $79.95 SASE for details. John Webb, W1ETC, Box 747, Amherst NH 03031 w1etc@adelphia.net

PARTS FOR SALE: Aluminum heat dissipating plate and grid connectors for all 3, 4 and T series Eimac tubes including 3-500Z, 4-1000, 304T's and others. Alan Price, fixer7526@wmconnect.com

TREASURES FROM THE CLOSET! Go to www.cjpworld.com/micromart to find some unique items many hams would lust for! Gus, WA, 360-699-0038 gus@wa-net.com

SERVICE FOR SALE: I build hot-rod receivers: R-390A, SP-600, R-388/51J. NC-183D and transmitters: Valiant, DX-100, T-4X-A-B, HT-32, AF-67. 51J-4 filter replacements, R390A Hi-fi AM $245.00 ea. Chuck Felton, KDØZS, Wyoming, 307-634-5858, feltondesign@yahoo.com

WANTED: General Radio 716-C capacitance bridge in very good condition. Ross Wollrab, 228 N. Oakcrest Ave, Decatur, IL 62522-1810, 217-428-7385, REWollrab@aol.com

WANTED: Info/manual CU-1280/FRD (Sylvania). R. Sitz, 5210 14th St. W. #57, Bradenton, FL 34207

WANTED: Manual for radio direction finder BC-973B, part of radio set SCR-503B. Allan Lurie, W9KCB, 605 E. Armstrong Ave, Peoria, IL 61603 309-682-1674

WANTED: National NC-101X receiver with magic eye tube. Must be very good condition or better. Any unreasonable price paid. Bruce, W1UJR, 207-443-2140 or w1ujr@arrl.net

WANTED: 4 Military Vertical Base Insulator Assemblies. Insulator is orangy color with short aluminum pipes on each end. Stamped MX-384/GRA-4. I will pay for boxing and shipping. State price to amhouston@hal-pc.org or 281-530-6130. John Thuren, AA5T, 7143 Siena Vista Dr. Houston, TX. 77083

WANTED: Left and right side ribbed metal trim strips for Hallicrafters S-20R receiver. Ken Hodge, 5330 N. Nashua Circle, Parker, CO 80134, 303-284-5581

WANTED: AF-67 transmitter with nice cabinet, need not work, can be basket case. John Snow, 1910 Remington Ct, Andover, KS 67002, 316-733-1856

WANTED: Eimac 3-400Z SK-416 chimney. Dave Ishmael, WA6VVL, 2222 Sycamore Ave., Tustin, CA, 92780 714-573-0901 daveishmael@cox.net

WANTED: QSL cards from Antarctic scientific, military and expedition stations. Also, any old magazine articles relating to ham radio activities in Antarctica. Harry Schools, K3HS, 2511 S. 20th St. #3, Philadelphia, PA 19145

WANTED: For Heath HW22A single-bander: cabinet, gimbal bracket & hardware, mic clip, final shield. David, KM6RI, 408-243-9326, varns@att.net

WANTED: Old QSL card of mine. KN8GID or K8GID. Will pay reasonable fee. Buck, WØRST, bfetters@aol.com or 636-226-6159

WANTED: Used HF receivers of all types in very good to extra good condition. Jim, 43 Burnham St., Apt A2, Belmont, MA 02478

WANTED: Antique radio parts. National RF90 choke. About 1 inch in diameter and fits into grid leak clips. HF impedance #10, looks like a grid leak, is marked #10 HF impedance. Pilot #130 RF choke, has two knurled nuts. United Laboratories (or other?) 200 ohm rheostat, Bakelite, about 1-3/4" diameter. I will be happy to pay an unreasonable price for any or all. Dean Showalter, W5PJR, 72 Buckboard Rd., Tijeras, NM 87059 505-286-1370

WANTED: Collins Service Bulletins for 651S-1 HF Receiver. Contact mmoss@mindspring.com

WANTED: National AN/FRR-24 receiver components and info. See http://www.virhistory.com/ham/frr24.htm Nick, KD4CPL, nick@3rdtech.com 919-929-4342 (NC)

WANTED: Someone with a collection of Short Wave Craft, Radio Craft from the 1930s to collaborate on a series of articles on a substantial collection of original items form that time period. Please call Chuck, WØIUH, 320-277-3242

The Caps Are Back!

By popular request, we are offering another run of the popular Electric Radio baseball caps. These new caps are a nice 5-panel all-cotton style with an adjustable rear headband and a 3-inch front brim. The background color is light tan, and the ER logo is embroidered in 3 colors, not printed. These hats will hold up for a long time.

$19.95, including priority shipping.

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Or on-line: www.ermag.com

WANTED: James Millen plug in oscillator coils for Millen 90881 linear amplifier, Millen parts #s 43011, 43015, 43021, 43041 and 43081. Gary K2PVC; gschonwald @earthlink.net 917-359-8826

WANTED: Technical Materiel Corp (TMC) power supplies PS4 (low voltage and bias) and PS5 (high voltage) for the TMC PAL 1K kilowatt linear amplifier, also known as the RFD or RFA. Gary K2PVC; gschonwald@earthlink.net 917-359-8826

WANTED: Squires-Sanders SS-1R and SS-1V. Bob, WØYVA. 703 450 7049; robert@isquare.com

WANTED: Hallicrafters HT33 with salvageable power supply. The RF section is not required to be useable, need a power supply to contribute to one that is. Gary Schonwald K2PVC. gschonwald@earthlink.net phone: 917-359-8826

WANTED: Technical Materiel Corp rack mounted antenna tuner and RF /SWR meters to be used with the 350-watt or 1000-watt TMC linear amplifiers. Will consider other TMC transmitting equipment and accessories for collection and on-air use. Gary Schonwald K2PVC. gschonwald@earthlink.net phone: 917-359-8826

WANTED: Meter movement for Western Electric transconductance tube tester KS-15750. Walter Hughes, WB4FPD, 6 Academy Ct., Berryville, VA 22611 540-955-2635

WANTED: Vacuum Tubes: 279A, 212E, 249B, 258B, 271A, 242A, C120, C100A, 804, RK20, CK70, GL805, C201, ZB-120, 802. Components for rebuilding Collins 30J RF output deck, including Cardwell or equivalent dual section variable 440 pF and 240 pF capacitors. Components for Collins 12H /12N speech input console, including preamplifiers and program amplifiers. Rod, W5CZ, 303-324-2725, rodperala@aol.com

WANTED: Will buy SP-600 and some other Hammarlund equipment, working, not, or incomplete. Al, W8UT, anchor@ec.rr.com 252-636-0837

WANTED: Pearce-Simpson manual/ schematics for VHF marine radio, model "Catalina", JR Linden, K7PUR, PO Box 4927, Cave Creek, AZ 85327, jrlinden@usa.net

WANTED: Clean National Select-O-Ject, NC-183DTS and Heath VX-1. Contact Ric at c6ani@arrl.net.

WANTED: ITT-Mackay Marine 3010-C Receiver, late S/N, complete and in good or VG conditions, with original box and manual. The item has to be shipped to a friend in Ohio (not outside U.S.). Send your offer to Paolo Viappiani, Via Valle 7, 19124 La Spezia, Italy, or pviappiani@tin.it

WANTED: Early QSL cards from my Grandfather, Hal Smith (SK). His calls were KH6KA, K6YJR, K6OQE. Gladly reimburse postage plus modest finder's fee! Phil Wilson, 1355 Big Otter Dr, Blue Ridge, VA 24064 k6cra@arrl.net

WANTED: National NTE-30 Transmitter. Any condition, any price! I love National. Sylvia Thompson, n1vj@hotmail.com 33 Lawton Foster Rd., Hopkinton, RI 02833. 401-377-4912.

WANTED: One of my "KN8GCC" QSLs from the mid-1950s. Tom Root, 1508 Henry Court, Flushing, MI 48433, wb8uuj@arrl.net 810-659-5404.

WANTED: Any TMC equipment or manuals, what have you? Will buy or trade. Brent Bailey,109 Belcourt Dr., Greenwood, SC.29649, 864-227-6292, brentw2@earthlink.net

WANTED: Seeking unbuilt Heathkits, Knight kits. Gene Peroni, POB 7164, St. Davids, PA 19087. 215-806-2005

PRESS WIRELESS, NY: Photos, information wanted on Hicksville, Baldwin, Little Neck, Centereach, Northville facilities. George Flanagan, 42 Cygnet Dr., Smithtown, NY 11787 w2krm@optonline.net 631-360-9011

WANTED: Postcards of old wireless stations; QSL cards showing pre-WWII ham shacks/equip. George, W2KRM, NY, 631-360-9011, w2krm@optonline.net

WANTED: Top prices paid for globe shape radio tubes, new or used. Send for buy list or send your list for offers. Write or e-mail: tubes@qwest.net. See www.fathauer.com or send for catalog of tubes for sale. George H. Fathauer & Assoc., 123 N. Centennial Way, Ste 105, Mesa AZ 85201. 480-968-7686, Call toll free 877-307-1414

WANTED: Manuals, manuals, and manuals for radio-related equipment to buy or swap. Catalog available. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. 732-238-8964

WANTED: Searching for RME CT-100 or 3R9 xmtrs and info about them. David Edsall, W1TDD, 156 Sunset Ave., Amherst, MA 01002. 413-549-0349, dedsall@crocker.com

WANTED: WW II German, Japanese, Italian, French equipment, tubes, manuals and parts. Bob Graham, 2105 NW 3Oth, Oklahoma City, OK 73112. 405-525-3376, bglcc@aol.com

WANTED: QSL card from W9QLY, Frank (Mac) Maruna, from 1956 or before. WILL PAY TOP DOLLAR. Don Barsema, KC8WBM, 1458 Byron SE, Grand Rapids, MI 49506, 616-451-9874

WANTED: Top dollar paid for WWII radios, PRC-1, PRC-5, AR-11, SSTR-1, SSTR-5, British B2, need pts for PRS-1 mine detector. Steve Bartkowski, 708-863-3090

WANTED: TCS & TBY Navy radios. Ken Kolthoff, K8AXH, PO Box 215, Craig, MO 64437. 913-634-3863.

WANTED: ARC-5 rcvrs, racks, dynamotors. Jim Hebert, 900 N. San Marcos Dr. Lot 77, Apache Junction, AZ 85220

WANTED: Front panel for Kenwood VFO-230. KH7TU, Ken Thomas, PO Box 4003, Lihue, HI, 96766, 808-647-0645, captdale2@hotmail.com

WANTED: Harvey-Wells Odds-'N-Ends: Speakers, phones, mikes, manuals, supplies, prototypes, military, aircraft. Kelley, W8GFG, 219-365-4730, 9010 Marquette St., St. John, IN 46373

WANTED: Collins R-389 LF receivers, parts, documentation, anecdotes, antidotes. W5OR Don Reaves, PO Box 241455, Little Rock AR, 72223 501-868-1287, w5or@militaryradio.com or www.r-389.com

WANTED: Incarcerated ham seeks correspondence. w/others on mil (R-390's &backpacks) & tube radios. Also copies of postwar-90's surplus catalogs, backpack specs & photos. W.K. Smith, 44684-083, FCI Cumberland Unit A-1, POB 1000, Cumberland, MD 21501.

WANTED: Receivers. Telefunken E1800, Rohde Schwarz, EK-56/4, NC-400, Racal 3712, Hallicrafters SX 88, Collins HF8054A, Collins 851S-1. Manual for Racal R2174B(P)URR 310-812-0188(w) alan.royce@ngc.com

I NEED INFO!: Radiomarine T-408/URT-12/USCG/1955. Sam, KF4TXQ, PO Box 161. Dadeville, AL 36853-0161 stimber@lakemartin.net 256-825-7305

WANTED: Scott Special Communications rcvr. EA4JL, please call Kurt Keller, CT, 203-431-6850, kkeller1@comcast.net

WANTED: SCR-602 components, BC-1083, BC-1084 displays, and APS-4 components. Carl Bloom, 714-639-1679

WANTED: Western Electric horns, speakers, amps, and mics. Barry Nadel, POB 29303, San Francisco, CA 94129 museumofsound@earthlink.net

WANTED: Tektronix memorabilia & promotional literature or catalogs from 1946-1980. James True, N5ARW, POB 820, Hot Springs, AR 71902. 501-318-1844, Fax 623-8783 www.boatanchor.com

WANTED: Collins promotional literature, catalogs and manuals for the period 1933-1993. Jim Stitzinger, WA3CEX, 23800 Via Irana, Valencia, CA 91355. 661-259-2011. FAX: 661-259-3830 jstitz@pacbell.net

WANTED: Westinghouse SSB Transmitters MW-3 (Exciter, Amplifier, Power Supply). Also, MW-2 (AM). Will pickup anywhere. Gary, WA4ODY, Seabrook, TX 77586, 281-291-7701 myctpab@earthlink.net

DONATIONS WANTED: Southern Appalachian Radio Museum, Asheville, NC, where others can view your radio treasures. For general information or donations call Clinton Gorman, Curator, 828-299-1276

WANTED: Need test set I-135 "G" or "F" will trade WWII I-135 "E" or will purchase, also have BC-611 to trade. Steve Bartkowski, 1-708-430-5080, 7702 Austin Ave, Burkank, IL 60459

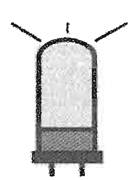
WANTED: BA-37 and BA-38 batteries for BC-611 walkie-talkie. Any condition except leaking. Louis L. D'Antuono, WA2CBZ, 8802-Ridge Blvd., Bklyn, NY 11209. 718-748-9612 AFTER 6 PM Eastern Time.

WANTED: R390, R390A and R392 receivers dead or alive or parts/ assemblies. Any condition considered. Will pickup if you have enough items. Glenn, WA4AOS, 864-684-2956

WANTED: Mint, complete or parts sets. Hammarlund SP-600 JX-28 version, has nomenclature tag R-620, doesn't have name engraved on panel like others, 1937 RCA ACR-111, RCA CR-88B version, RCA AR-8516, TMC CV-1758 SSB converter, and DEI Defense Electronics TR-711 telemetry receivers and modules. Will send custom shipping carton for easy transaction/shipment. Dan Gutowski AB8VM P.O. Box 142 Dexter, MI 48130 734-718-7450. dg16ms26@msn.com

WANTED: Electric Radio Tuning Meter as shown in many back issues of ER. Also need a10 Amp Variac, anyone have one for sale? Joel, W7EPA 928 231 3674 or W7EPA@ARRL.net

FOR SALE: Early Heath OL-1 oscilloscope, $25. EICO 667 tube & transistor tester, $250 or best offer. Vern, 770-307-1459



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A new item in the Electric Radio Store is this nice 15-oz white ceramic mug with the ER logo in 3 colors and a maroon-red handle and rim. This large mug is perfect for those long roundtable QSOs and holds a lot of coffee!

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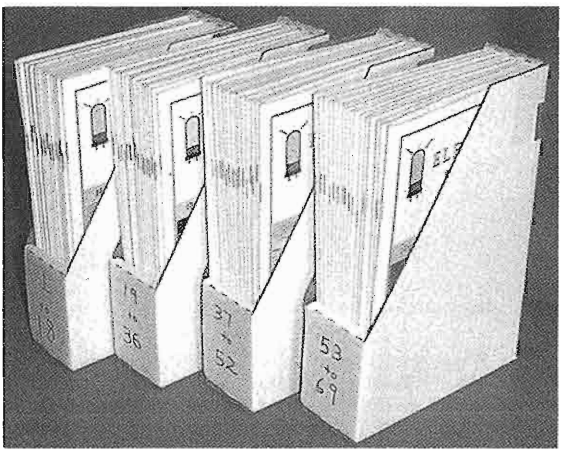

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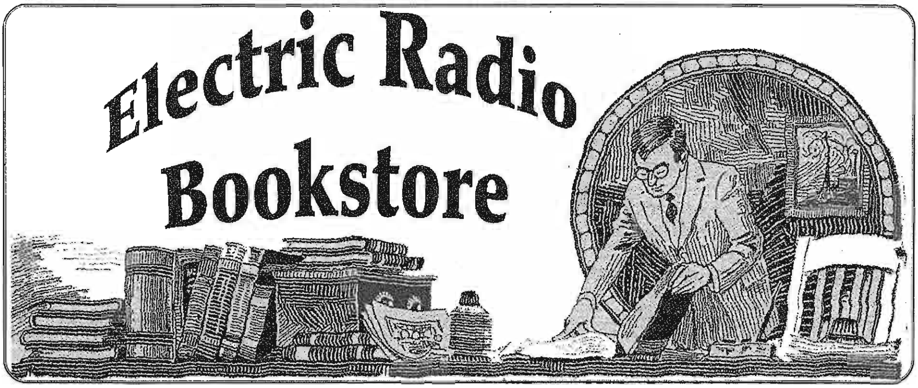

— ELECTRIC RADIO BACK ISSUES —

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Collins 75A-4 Modification Compendium: All the factory modification bulletins from Collins Radio Co., and all the articles printed in CQ, Ham Radio, QST and ER over the last 45 years, now 92 pages, $20.00 plus $5.00 S&H.

Collins S-Line, KWM-1, KWM-2, KWM-2A Service Modification Compendium: 260 pages, $45.00 plus $6.00 S&H.

Collins KWS-1, 32V series, and 75A series (A1 thru A-3): 43 pages, $15.00 plus $5.00 S&H

— BOOKS —

A. Atwater Kent, The Man, the Manufacturer and His Radios: This 108 page paperbound book describes Atwater Kent's biography, and his rise from a saleman and inventor of electrical equipment to become one of America's foremost radio manufacturers and a household name. There are historic photographs and diagrams on nearly every page, and color plates with vintage AK advertising, by Ralph Williams and John P. Wolkonowic. -- **$25.95 - 10% = $23.35**

A Pictorial History of Collins Amateur Radio Products: Jay Miller's (KK5IM) classic volume describes the amateur radio products produced by the Collins Radio Company. It has high-quality historic photographs on nearly every page, and the text is backed up by Miller's personal research. ---------- **$39.95 - 10% = $35.95**

A Family Affair, The R.L. Drake Story: The complete story of the R.L. Drake story, as told by John Loughmiller, KB9AT. 273 pages all about the history of the company, product descriptions, technical repair tips, and great shack photos make a must-have volume for Drake users and collectors. ---------- **29.95-10% = $26.95**

Arthur Collins, Radio Wizard: 394 pages by Ben Stearns tell Arthur Collins biography from his early years until retirement. Stearns is a professional journalist and was employed by Collins from 1962 to 1977. Many historic photographs and stories from former employees. ---------- **$18.95-10% = $17.05**

Collector's Guide to Antique Radios, by John Slusser. The 6th edition in 320 pages with hundreds of photos and descriptions of long-gone companies and products from 1920 to 1950. ----------**$24.70 - 10% = $22.45**

Crystal Clear: Crystal Sets, Crystal Detectors and Crystals: A 282 page guide to crystal sets and related US-made equipment from 1920 to 1955, by Maurice Siever---**$29.95 - 10% = $26.95**

Early Development of Radio in Canada: 154 pages of Canadian radio history by Robert Murray, excellent illustrations on nearly every page covering the early wireless days and the start of radio broadcasting and manufacturing! ----------**$26.95 - 10% = $24.25**

Heathkit, A Guide to Amateur Radio Products: This is the new revised second edition including some 30 additional products, a tube chart, sales data, a separate ER article index, a completely new introduction, and a new section devoted to Heath's CB equipment. The book is 75 pages larger than the original. By Chuck Penson, WA7ZZW--$29.95-10% = **$26.95**

Heath Nostalgia: Written by Terry Perdue, K8TP, an ex-Heath employee, this 124-page book is a great history of Heath and the Heathkits that we all remember. ------- **$14.95-10% = $13.45**

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Hiram Percy Maxim: Published by Electric Radio, this is the complete biography of HPM, the famous founder of ARRL, by Alice Clink Schumacher, 216 pages. ----- **$19.95-10% = $17.95**

Miller's Collecting Science and Technology: 160 pages of high-quality color photographs from museum collections make this hardback volume an excellent introduction to this new collecting field. Written by Lindsay Sterling -- **$29.95-10% = $26.95**

The Collector's Vacuum Tube Handbook: This is a 205 page book that is full of unique, hard-to-find information on tube types that were released before 1934. Includes history and good photos. --$25.95-10% = **$23.35**

Radio-Craft: 50 Years of Radio by Gernsback: This is a high-quality 656-page reprint of the March 1938 edition of Radio-Craft magazine and is about the first 50 years of radio, and contains hundreds of vintage advertisements. -------------------------------------- **$15.95-10% = $14.35**

NEW! **Radiola: The Golden Age of RCA:** is a beautiful new hardback book that is all about the golden age of RCA, 1919 to 1929. Written by Eric Wenaas, this book, with 700 color photographs, tells the story of RCA in the early years. It is the product of years of intensive research into RCA and all of the subsidiary RCA companies. An excellent reference, it is now available for **$65 - 10% = 58.95 + $6** shipping from the ER Bookstore!

Radios by Hallicrafters : High-Quality photos, descriptions, approximate values, and short histories of nearly everything made by Hallicrafters. By Chuck Dachis -- **$29.95-10% = $26.95**

Radio Tubes and Boxes of the 1920s by Fathauer: If you appreciate the rare and colorful vacuum tubes and advertising art from the early days of radio, then this great 104-page book will be very interesting and informative. -- **$26.95-10% = $24.95**

The All-American Five Radio: Although this book is about classic American 5-tube broadcast receivers, it also contains a wealth of accurate information on vacuum tube receivers, proper trouble-shooting, and alignment and is recommended for experienced repairmen and novices alike. 92 pages by Richard McWhorter --- **$21.95 - 10% = $19.75**

Transmitters, Exciters & Power Amplifiers: This is the companion volume to Moore's communication receiver book, 144 pages. ---------------------------------- **$23.16-10% = $20.85**

Tube Lore: The best vacuum tube reference book in publication! All types of information is included, such as tube date code information and production history. 173 pages by Ludwell Sibley ---$16.95-10% = **$15.25**

Tube Testers and Classic Electronic Test Gear:Written by Alan Douglas, a retired engineer, the book is packed full of valuable information about test equipment 166 pages. ---$29.95-10% = **$23.35**

Vintage Anthology, Revised Edition: by Dave Ishmael, WA6VVL, is a revised and updated version of Dave's popular book. 209 pages of great information especially valuable to radio builders. ---$21.95 - 10% = **$19.75**

Zenith, The Glory Years, 1936 to 1945: 244 high-quality pages all about classic Zenith radios. Hundreds of high-quality color photos, and history from the Zenith company archives, never before available. If you like beautiful Zenith consoles, you will like this book! by Cones, Bryant, and Blakenship --- **$34.95 - 10% = $31.45**

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