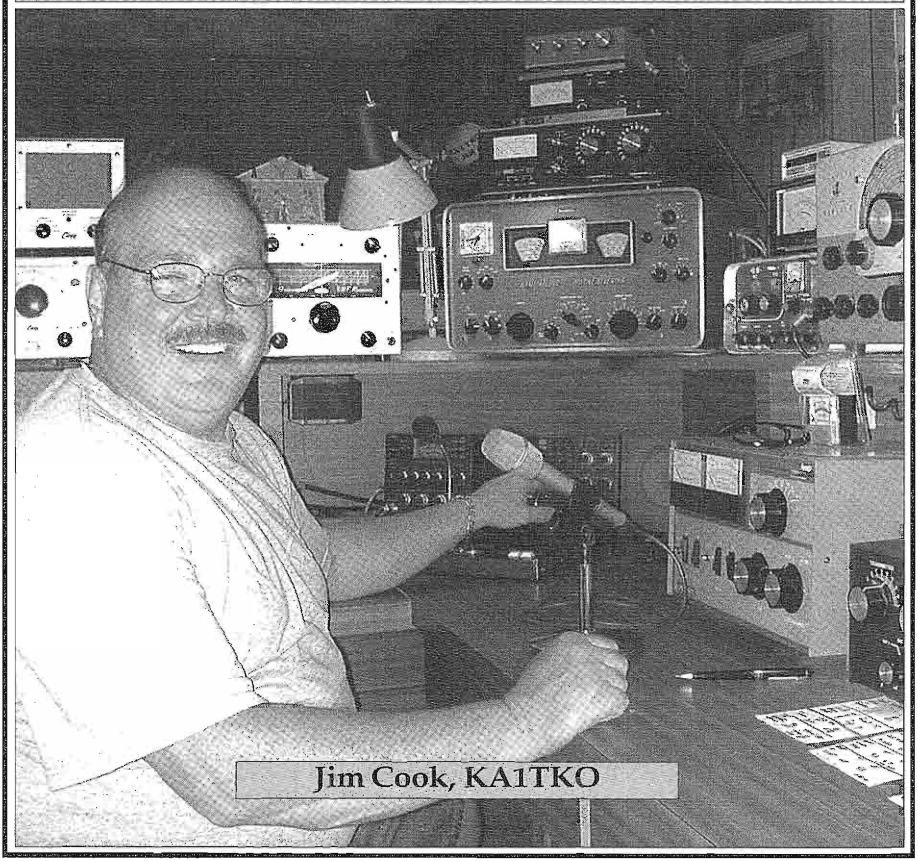
$3.85

ELECTRIC RADIO

celebrating a bygone era

Number 201 February 2006



Jim Cook, KA1TKO

ELECTRIC RADIO

Published monthly by Symbolic Publishing Company
PO Box 242, Bailey, Colorado 80421-0242
Periodicals postage paid at Cortez, CO
Printed by Southwest Printing Inc., Cortez, CO
USPS no. 004-611
ISSN 1048-3020

Postmaster send address changes to:
Electric Radio
PO Box 242
Bailey, CO 80421-0242

Editor
Ray Osterwald, NØDMS

Editor Emeritus
Barry R. Wiseman, N6CSW

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, e-mail, or call.

Regular contributors include:
Chuck Teeters (W4MEW), Jim Hanlon (W8KGI), Tom Marcellino (W3BYM), Bruce Vaughan (NR5Q), Bob Grinder (K7AK), Bill Feldman (N6PY), Dave Gordon-Smith (G3UUR), Dale Gagnon (KW1I), Brian Harris (WA5UEK), John Hruza (KBØOKU), Hal Guretzky (K6DPZ)

Editor's Comments

FCC Notice of Proposed Rulemaking

The following paragraph comes from a public statement released last month on ARRL's web site:

"NEWINGTON, CT, Jan 9, 2006—The FCC is inviting public comments on the ARRL's Petition for Rule Making that asks the Commission to regulate the amateur bands by necessary bandwidth rather than by mode. The petition recommends what the ARRL calls "a shift in regulatory philosophy" to encourage and enable development and refinement of digital techniques and advanced technologies. It has been designated as RM-11306, and comments are due by Monday, February 6."

I know that this proposal has caused some consternation among AM operators. I have the full text of the original proposal that was released by ARRL on August 10, 2005, and I also have a copy of the NPRM document RM-11306 the FCC recently released. Although the comment period will have passed by the time this issue of Electric Radio is released, I can find nothing in either document that poses a future threat to traditional AM operations, except at 6 and 2 meters.

Quoting from the FCC's docket file copy dated November 14, 2005:

"... the National Association for Amateur Radio, also known as the American Radio Relay League, Incorporated (ARRL), by counsel and pursuant to Section 1.401 of the Commission's Rules, 47 C.F.R. 51.401, hereby respectfully requests that the Commission issue at an early date a Notice of Proposed Rule Making, proposing changes requested herein in the rules governing the Amateur Radio Service...

III. Bandwidth Segmentation by Regulation...

...14. There are certain incumbent Amateur operations ***that should be allowed to continue,*** though they may not comply with the above-referenced bandwidth limitations. Principal among these is ***double-sideband AM,*** which has a significant

[Continued on page 17]

TABLE OF CONTENTS

Cover: Jim Cook (KA1TKO)is on the air from Winchester, MA, near Boston. Jim uses a Johnson Valiant, and also has a Ranger 2 driving a Henry 2K amplifier. His receivers are an HQ-180, R-390A and HRO-50. Jim is in the process of carefully rebuilding a Globe King 500. (Photo courtesy Dan Brown, W1DAN)

The 1946 Zenith Mechanical Filter

By Chuck Teeters, W4MEW
110 Red Bud Lane
Martinez, GA 30907
Cteet70@aol.com

There was a race to get radio receivers to the pent-up civilian market after the end of WWII. The first major player to get into the postwar broadcast receiver field was RCA, who got their "Transitione" series back in production in November 1945. Most amateur radio manufactures initial postwar offerings were similar, new production runs of old prewar designs, such as the Hallicrafters SX-28A and the National HRO-5. Other Ham set builders offered advertisements promising radical new sets, which were never ready for production, such as the Cardwell 54, and the Millen 501, and never did get into production.

One of the big players in the postwar radio market was Commander (retired) Eugene McDonald's Zenith Radio Company. The Zenith name was taken from the Ham call "9ZN," of Karl Hassel and Ralph Mathews, who were the technical brains, and partners of McDonald. While Commander McDonald was not a Ham, he tied Zenith into various amateur activities in the late twenties and thirties, building short wave communications

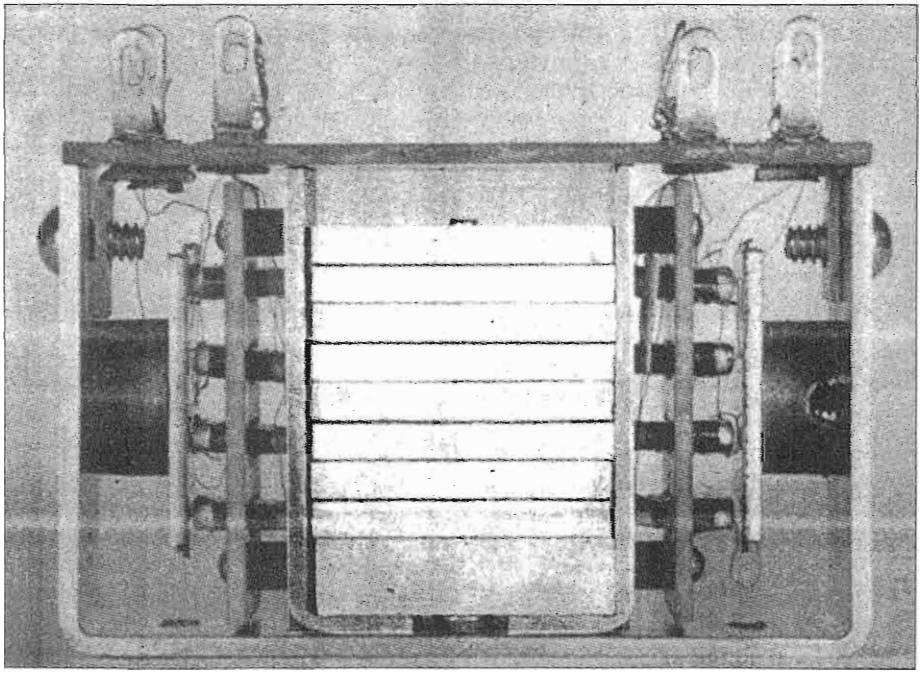


Figure 1: In an experimental receiver, four differing bandwidth Zenith mechanical filters were assembled in a single structure. Any one filter was selected by a four-position switch, thus the merits of different bandwidths could thus be determined. The size was about 2 1/2 by 4 by 2 inches.

equipment for polar expeditions, and experimental radio sets for the US Navy, all of which paraded the Zenith name in front of the radio buying public.

Because of the few pre-WWII broadcast stations in smaller communities, the better home receivers had short wave bands to provide worldwide news and entertainment for the suburban and rural listeners. Zenith was one of the leaders in multiband home receivers and also produced a really good short wave battery powered portable, the "TransOceanic." Commander McDonald wanted to keep Zenith an industry leader in the post-WWII years, so Zenith engineers were looking over the technical progress made in WWII, as many of the new developments in tubes, components, and circuits could be incorporated into their postwar receivers.

One area that Zenith investigated was mechanical resonance at low radio frequencies. The development of sonar (underwater sound detection and locating) had led to great leaps in ultrasound technology. The driving force behind this development was the submarine warfare in the Atlantic and Pacific during WWII. Past attempts to use mechanical resonance at radio frequencies had been blocked by lack of an electromechanical converter, or transducer, which had to be used to connect electrical circuits to mechanical circuits. However, WWII sonar research had developed both piezoelectric and magnetostrictive transducers working at frequencies up to 500 kHz.

The lead engineer at Zenith, Robert Adler, had done sonar research and was familiar with the analogy of using mechanical elements in electrical networks. The use of mass substituted for inductance and springs for capacitance was well known to Adler. Warren Mason at Bell Telephone Labs had demonstrated mechanical filters working at low audio frequencies using mass and springs. He published books on the subject, Electromechanical Transducers and Wave Filters, Van Nostrand Co. 1942. While WWII sonar technology had overcome the transducer frequency limitations, operation of a mechanical filter at radio frequencies presented other problems. The masses and springs would become inconveniently small. Adler saw a way around this problem however. He knew that when inductors and capacitors became too small at microwave frequencies, you switched lumped circuits into transmission lines with distributed constants. Adler knew that a 455-kHz wave in steel has a wavelength less than 1 inch, so a mechanical filter for a 455 kHz IF could employ microwave technology and use transmission lines, since they would be well under 1" in length.

Adler developed the mechanical equivalence of half wave (1/2") and quarter wave (1/4") line networks, first on paper and then in the lab. The rules and formulas he developed allowed for design and construction of 455-kHz mechanical filters. His first designs used circular resonant stainless steel elements, 0.01 inch thick, connected together by parallel steel wires 0.006 inch in diameter. He demonstrated that the more elements in a filter, the better the skirt selectivity. With 6 elements he was getting a 2.2: 1 shape factor. He also demonstrated that changing the ratio of the diameter of the coupling wires to the element thickness could provide pass bands from 4 kHz to 14 kHz.

The specifications on Adler's first limited production mechanical filter, with six elements, for AM broadcast use, were 8-kHz bandwidth at 6-db down, and 18 kHz at 60-db down, pass band ripple under 2 db, insertion loss of 8 db, and the

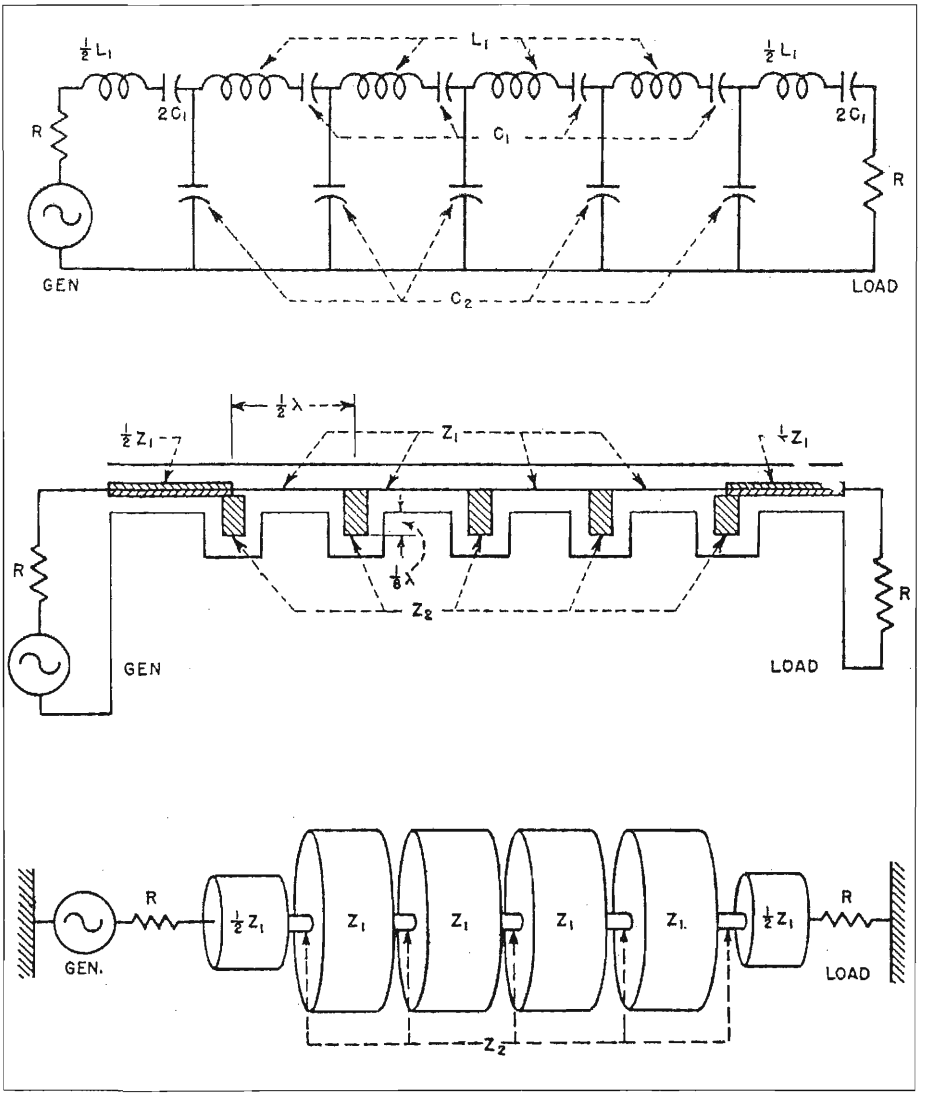
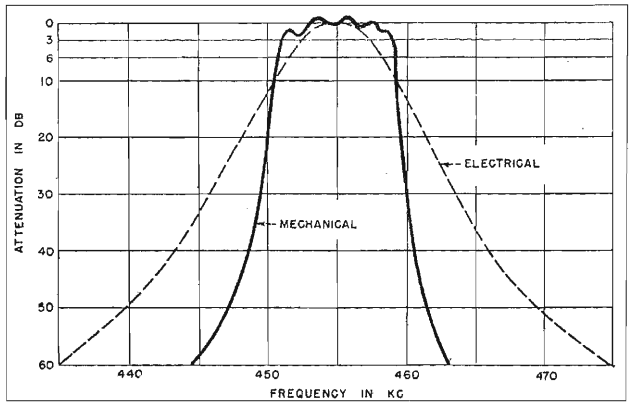


Figure 2: Electromechanical filter is developed from the consideration of electrical filters.

termination was high impedance using matching transformers. The filter was less than 2 cubic inches, and weighed less than 2 ounces. He also pointed out that the essential parts were stainless steel, easily manufactured by punching and spot welding with no adjustments or tuning necessary.

Zenith built a run of broadcast receivers with the limited production filter to test user response. It was suspected that the set might be hard to tune, but listeners using the set had no trouble. The most distinctive feature of the set was its selectivity, its ability to listen to New York stations, WNBC and WOR in Chi-

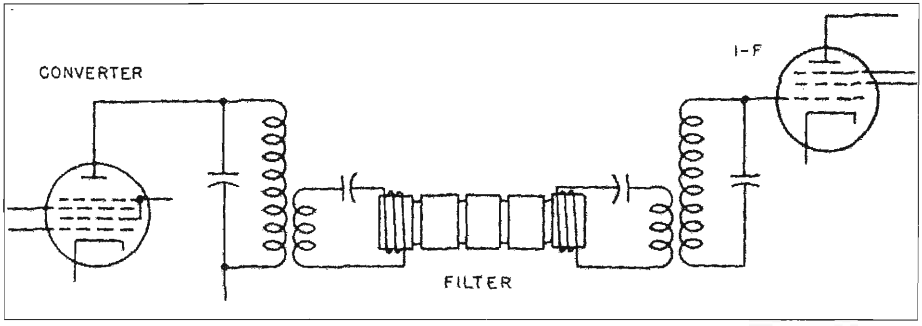
cago; even though there were 50-kW Chicago stations only 10 kHz from the New York station's frequencies. A few receivers were built with a 4-kHz filter to test the user's ability to tune out one sideband, eliminating selective fading. Listeners found it worked, and was easy to tune, however the results were not as spectacular as the selectivity tests. Carrier fading was still a problem while listening to only one sideband.



Above: A comparison of electrical and electromechanical filter bandpass characteristics.

From an amateur standpoint, the most interesting filter Adler built was a four-stack of filters in one case with elements for 4, 6, 8, and 10-kHz bandwidths, see **Figure 1**. The filters were terminated at 100 ohms impedance for ease of switching receiver bandwidths. He was convinced that a switchable filter of this type would be of paramount importance for communications receivers. He sent several of the multi-section filters to Fort Monmouth for Signal Corps evaluation and possible military use.

While Adler's mechanical filters did exactly what they were supposed to do at a very low cost, improving receiver selectivity with almost a 2:1 shape factor, preventing adjacent channel interference, and allowing one sideband to be tuned out to reduce selective fading, postwar technology was bypassing the old prewar AM/SW broadcast receiver market. The 1947 Atlantic City ITU radio conference allowed the FCC to open up hundreds of new Class II and IV AM broadcast allocations. The result was a multitude of new AM broadcast stations coming on the air in every small town and hamlet, so the need for home broadcast sets to receive short wave was vanishing. The home market for short wave was also being eliminated by the rapid expansion of radio station networks. They also settled



The electromechanical filter is most effective if used between the converter and the first IF amplifier.

the FM broadcast band question. The pre-WWII FM broadcast band of 42 to 50 MHz was still in use as well as the new postwar FM broadcast band of 88 to 108 MHz. The FCC cutoff the 42 to 50 MHz FM stations to open up TV channel one. The FCC also opened up hundreds of new 88 to 108 MHz FM broadcast allocations. The public had been holding back on purchasing high-fidelity, static-free FM radios because of the band uncertainty. With the band problem settled, and the new stations, the buying-public shift from AM/SW to AM/FM in home radios for static-free high-fidelity reception started in earnest.

As the consumer markets that Zenith had developed the mechanical filter for, high-fidelity, interference-free AM-broadcast reception, and fade-resistant short wave reception were disappearing from the home receiver market, the big money in sales was changing rapidly from radio to television. Zenith was forced to change its research and development direction from radio to TV to stay alive in a very completive market. Further progress in the mechanical filter market was side lined for big-screen TV, remote control tuning (using wire with Zeniths in those days), and what Commander McDonald thought would be the Zenith big money maker, "Phonovision."

Zenith Phonovision was a method of sending scrambled TV signals on a regular TV channel and unscrambling it with a signal sent over a phone line, for a fee of course.

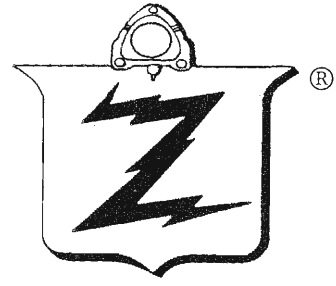
A suggestion from Robert Adler, that the mechanical filter had a good potential for amateur radio sales, was turned down by McDonald as the limited market was not worth investing time and money in. However, it was Commander McDonald's fixation with Phonovision that proved to be the waste of time and money. Both the FCC and the public turned it down. TV reception would remain free, at least until cable TV came along many years later.

So, Collins didn't invent the mechanical filter, but they proved, seven years later, that the mechanical filter did fit into the rapidly expanding amateur SSB market. So, score one for Art Collins and zero for Commander McDonald. But, let's give a half-point to Robert Adler for his articles in Electronics, Broadcasting, and Radio News about the Zenith mechanical IF filters. The April 1947 Electronics article by Adler gave engineers the construction details as well as the mathematical calculations necessary to build mechanical filters. The Broadcasting article gave filter performance details to receiver builders and broadcasters. The Radio News article was aimed at acquainting technicians and experimenters with mechanical IF filters. Adler's articles put mechanical filters into the realm of public property and allowed free and unlimited use. No valid patent could be obtained on mechanical filters since they had been described in public trade publications. As the famous QST author and inventor, Larsen E. Rapp, WIOU, would have said, "In Hock Veritas Art."

Reference:

Robert Adler, Compact Electromechanical Filter, Electronics, April 1947.

ER



Martha's Breadboard Deluxe

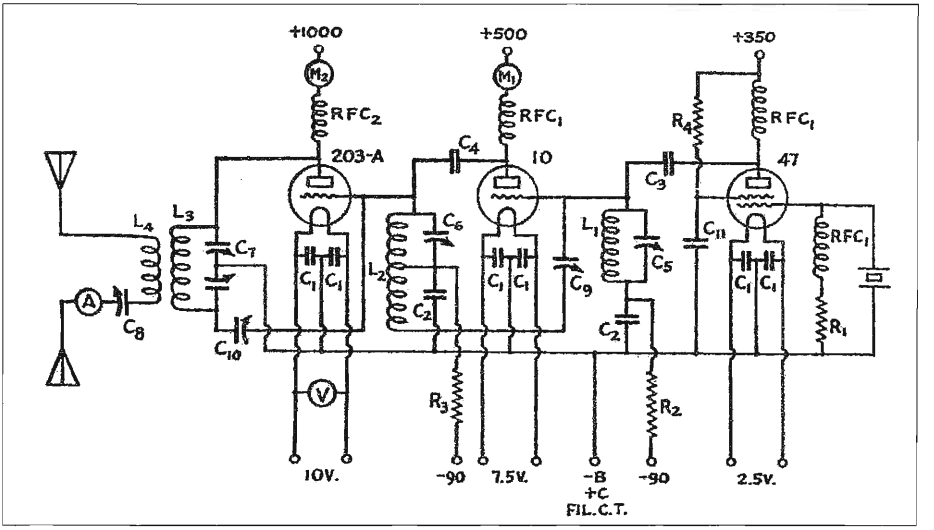
A Modern Version of Homebrewing in the Mid-1930s.

By Gary Halverson, K6GLH
503 Jessica Ct.
Mokelumne Hill, CA 95245
ghal@ix.netcom.com

Introduction

Our ancestor hams of the '30s sure had their share of challenges. Learning the rapidly evolving new radio technology was a challenge in itself and so was getting a license. One of the FCC requirements in getting a ham license was demonstrating a working knowledge of electronics by drawing from memory a complete schematic of a 3-tube transmitter that included a crystal oscillator, buffer amplifier, and final amplifier. Then explain how it all worked. Ham radio was not for wimps back then, and the best way to gain this knowledge was to actually build the transmitter the FCC test was based on.

The Great Depression sparked some creative thinking by resourceful hams. For example, the standard kitchen breadboard was a readily available and inexpensive platform on which transmitters could be quickly constructed. Modifications and refinements could be effected quickly since the "architecture" of a formal chassis didn't get in the way. Starting over was no big deal when screwups



Schematic of the 3-tube transmitter from the 1935 ARRL Handbook.

occurred. The breadboard was also friendly to incremental changes, or even major design changes along the way. One could start with a single crystal oscillator, then add stages until the money ran out, or the goal was met.

I'm not an electronics engineer, so for me, this was going to be the same kind of learn-as-you-go experience as the typical Ham may have had in the mid-thirties. In other words, a modern "re-enactment" of the 1935 homebrewing experience.

Construction

The original 3-tube, 3-band breadboard design first appeared in the 1934 ARRL Handbook. It used a 47 crystal oscillator driving a 10 buffer, which in turn drove a 203 final. The oscillator was designed to use a 75 or 80-meter crystal which would either operate straight-through, or be doubled in the buffer stage for operation on 40. Doubling again in the final amplifier provided operation on 20 meters. By the time the 1935 edition of the Handbook was published, the design had evolved to an elegant breadboard unit sitting on a wooden apron adorned with four Jewel meters. This was the version for me.

To truly get into the spirit of a project like this, I thought it would be appropriate to build the rig in the kitchen. The light was better there, it was comfortable, and there just wasn't any room left in the garage. Besides, back in the thirties, the kitchen was the creative focal point of family. Having a meal on the kitchen table, with the fragrance of fresh oven-baked bread mingling with pot roast still wafting in the air, and listening to the old radio shows on a Philco Model 90 cathedral radio, was about as good as it could get. The Happiness Boys, Little Orphan Annie, Amos 'n Andy, Jack Armstrong, and the Lone Ranger all captured the imaginations and hearts of the country with imagery far more colorful than the movies. And so in that spirit, my kitchen table was usually so cluttered with Handbooks, components, and tools during this project, that making room to eat a meal there was sometimes a delightful challenge.

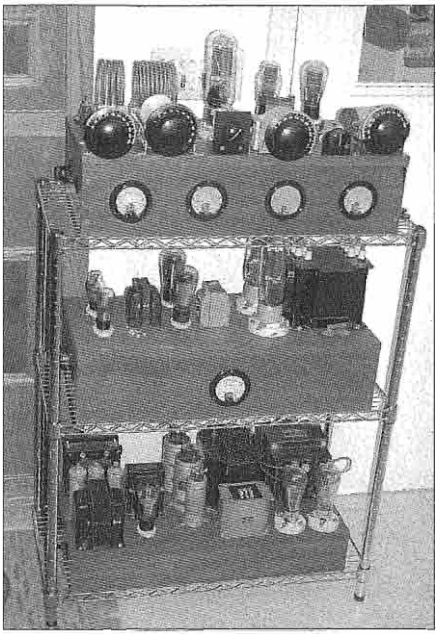
The project started by junkbox diving for the required parts. Rounding up the variable capacitors, tube sockets, and old radio dials was fairly easy. The Cardinal

On the kitchen counter, work progresses on the power supply.

Rule was that all the parts be appropriate to the vintage of the transmitter—no modern parts anywhere just because they were convenient. It would be like forging an antique. But, the bigger challenge was the hardware. A quart-jar assortment of old slot-head woodscrews found at a garage sale came in handy, but I quickly ran out of the smaller sizes (no cheating with Phillips-head screws). It turned out that the local Ace Hardware store had the best selection of the old-style screws at the best prices when all else fails.

Wood was the big shocker. I wanted a furniture look, but the cost of mahogany blew me away. A hardwood was required, but oak or mahogany was just too expensive. 1 X 12s worked for the breadboard deck, and 1 X 4s for the apron. A good compromise was poplar stained with Varathane's Red Mahogany No. 251. Two coats on the poplar gave the desired look. After sufficient drying time, a clear satin spray-on sealer was applied. It's ironic that by the time the project was completed, nearly $200 had been spent for wood and screws and nothing for all the electronic components. (I'm not going to tell you about the new $550 compound sliding miter saw with laser guide and the $500 table saw needed to complete the project.)

The original plan was to construct three identical wooden chassis that would stack vertically in a wooden shelf frame. A wiring bundle would run vertically down the backside middle of the each deck providing the interconnect wiring. On the bottom would be the power supply, the middle the modulator, and on top the RF deck based on weight. Small casters on the shelf frame were installed to provide mobility. But to start the project, I used a Martha Stewart wire frame Baker's rack to hold the wooden chassis until the details of a more appropriate frame were



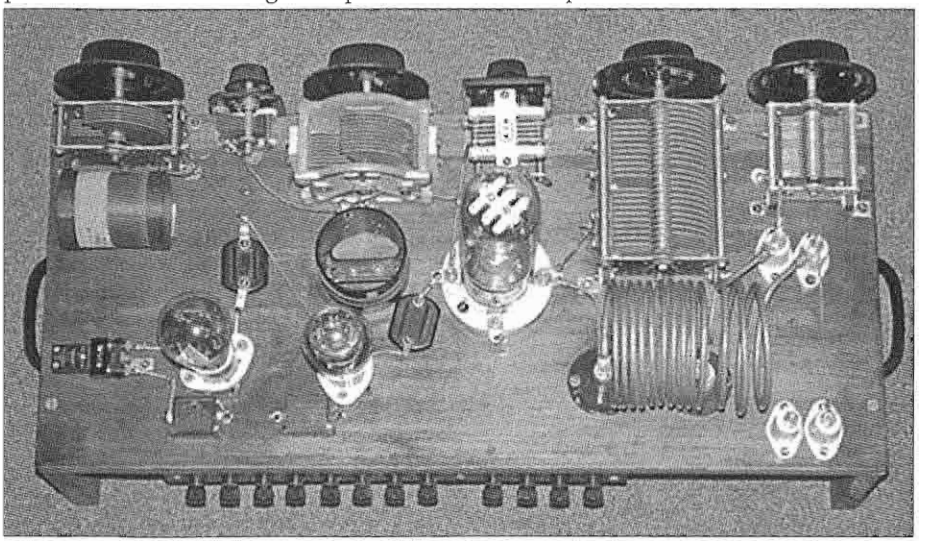
Martha on the baker's rack.

worked out. Now the project had a name— "Martha".

Cleaning component contacts with steel wool was necessary. Decades of oxidation and grime made soldering impossible without cleaning. Each part was thoroughly cleaned in the kitchen sink, inspected and tested, then placed on the breadboard and moved around to determine the best layout before drilling any guide holes for the woodscrews that secured the components to the board. This was pretty much a design-as-you-go experience based on what specific components were available—like cooking from scratch.

Finding enough cloth-covered wire was a problem—they didn't have plastic covered wire in 1935. Some old junker radio chassis from the 1930s provided much of the wire, but scrounging was still necessary. Vintage solder lugs were yet another problem. Several old lugs were salvaged off the leads of old components in the junkbox. In all, it took more time to find the correct (and working) vintage parts than it did to construct the transmitter.

The under-chassis wiring was shaped and held in place by small black tie-wraps. During this time period, it was common practice to make splices within the wiring harness and then slip some spaghetti tubing over the splice. This was also true of connections to components, such as power transformers and chokes.



Here is a top view of the exciter unit.

When the wiring was completed, waxed lacing cord was added and the tie-wraps cut away.

Construction went quickly. Once the approximate component positions were found, mounting the parts was easy. Working with wood is a joy compared to aluminum or steel.

Testing and Rework

While the high-voltage circuits on the power supply had previously been tested, the first "geriatric infant mortality" failure occurred when the RF deck was connected. One of the round can-type, 2-microfarad, 2-kilovolt filter caps shorted causing a spectacular fireworks display in the 866 mercury-vapor rectifiers. My friend Dick was amazed to see brilliant blue sparks shooting inside the rectifier bulbs with an intensity similar to the sparks flying off metal on a grinding wheel. It later turned out to be too much for the NOS Collins 866A which apparently was weakened by this event and protested with constant arc-overs.

In keeping with the situation during the Depression, the frugal approach to the low voltage supply was taken by deriving the 300 volts required for the oscillator from a tapped voltage divider power resistor across the 500-volt supply. Well, it didn't work out, so it was necessary to build a dedicated 300-volt supply for the oscillator—another 'expensive' power transformer which had to be located on the modulator deck because there wasn't any more room left on the power supply deck.

The only tweak necessary on the RF section was removing a few turns of wire from the oscillator tank circuit in order to get the variable capacitor plates in the zone. Everything else on the RF deck was a breeze.

The task of neutralization was smartly executed by my very capable friend, Dick Benson, W1QG. He opted for the use of a 60-MHz, dual-channel scope instead of a loop of wire and a #47 pilot lamp which made the job easy and fun (I looked the other way of course while he neutralized each stage in succession).

Dick, W1QG, keying down Martha with 90 Watts into the light bulb.

In the first on-air tests, a 3.885 crystal was installed, a dummy load connected, and each stage tuned up. In listening to the carrier there seemed to be a lot of hum on signal. It turned out to be inadequate filtering on all three DC voltages: the 300 V, the 500 V, and the 1250 V supplies.

Back in the thirties, it was common practice to use both a swinging choke and a smoothing choke in the filter circuits, as high-value capacitors were not available. These chokes were usually sold in sets, and Martha was cooked up with leftovers—about three chokes short of a full-course power supply. Additional filter capacitors were added and the hum disappeared leaving a clean carrier. Time to move on to the modulator.

Next month, I'll have the modulator, final amplifier, on-air results, and the conclusion.

ER

The AM Broadcast Transmitter Log

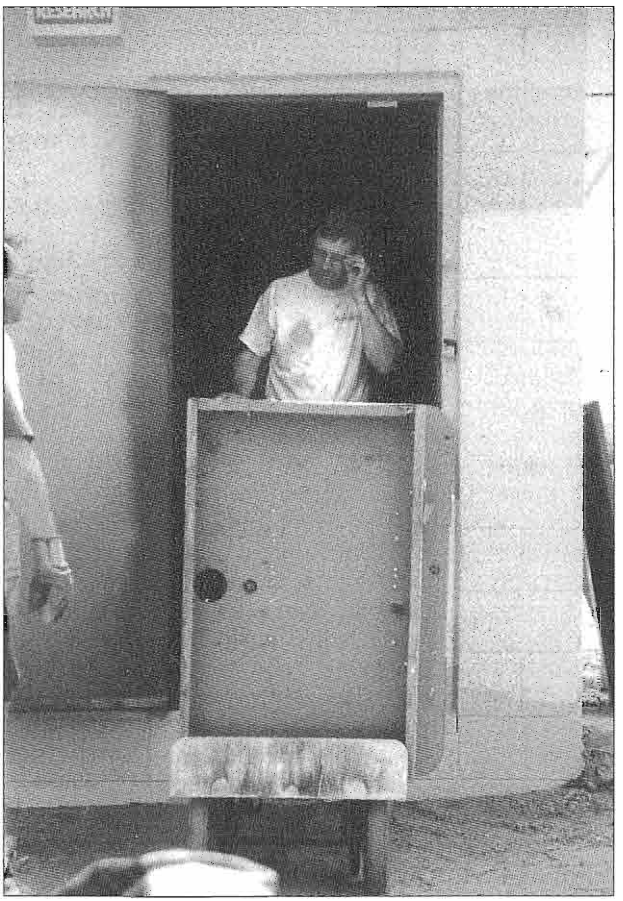
Part 8, Transportation and Installation Tips

By David Kuraner, K2DK
2526 Little River Rd.
Haymarket, VA 20169
k2dk@comcast.net

This issue will discuss some odds and ends of broadcast transmitter transportation, installation, and lots of tips to use in dealing with these rigs.

Moving the Box

When trying to move a box weighing 800 pounds, or more, the typical U-Haul type refrigerator hand truck will not do. If you can get it down to 600 pounds or less you stand a chance with U-Haul® or similar equipment. If you just need to move the rig along a level cement or similar floor, iron pipes rolling underneath will do just fine. Three or four one-inch diameter pipes, about 36 inches long, should do nicely. You can investigate heavy duty dollies and hand trucks, but be prepared for some heavy prices. Many people have just bit the bullet and paid professional movers.



Bob Henry and myself looking at the Collins 20V stuck in the doorway of the transmitter building.

Some rigs can be transported with the heavy iron still mounted inside, although this is not recommended. Surely you can lighten the load by several hundred pounds if they are removed, as well as anything else of significant weight easily removable. Before disconnecting anything, take plenty of pictures. All too often, problems with the rig can be a result of your miswiring. Even if you don't remove anything, ALWAYS check the HV wiring to insure no shorts, bad insulation or miswiring on reassembly.

Dudley Parkin (W5DUD) passes along some photos of damaged feed-thru insulators in his 20Vs in **Figure 1**. He claims to have never found a Collins 20V that didn't have this problem. I must have been very lucky as mine came from a very dry environment in the desert of New Mexico.

You should plan on us-

Figure 1: Charred feedthrough insulators from a Collins 20V transmitter, caused initially by rust developing on the metal. (Photo courtesy W5DUD)

ing at least three people for the job. At some point, you will need to get the box into your pickup truck, minivan or box van. You will most likely have to lift it and it's not worth getting hurt. I had no problems transporting an 1150-pound 20V 2000 miles across the country in a minivan as well the 800-pound Bauer. (Although, there were some interesting moments getting it out of the transmitter building and again loading it into the minivan.) An open trailer is also an option. Unless you are getting something super heavy, these vehicles will do.

Getting the rig though doors can be a real challenge. The typical residential room door opening is 80 inches high by 29 inches wide. Measure those openings and all diagonal measurements of the box before you start so you don't have an "Oh *&$!" experience.

The Final Position

Before you even try to get it off the vehicle and into the house, basement, garage, or wherever, mount heavy industrial casters on the bottom if it will not interfere with getting it through the doors. Use the heaviest-duty style caster you can find. I attempted to use what proved to be underrated wheels with predicable results. Many people will make a dolly from heavy plywood and mount that to the bottom of the box. In one case, I chose to remove the heavy base of the Bauer, mount the wheels to the box and reinforce the remaining metal sides. I had a height issue and this resolved it. Just give thought to how you want to accomplish this since you will invariably need to move the box again at some point. And be aware that those wheels can increase the height by 5 or 6 inches.

Now, if you wish to mount it in a wall with access to the rear on the other side, you may not want it on wheels. This is the way it would be installed at a broadcast transmitter plant. Also give some thought to ventilation issues. You don't want to completely wall it up. But you don't need volumes of air for amateur use under Intermittent Commercial and Amateur Service (ICAS) conditions. I keep my rigs in a large closet specifically built for them. I was prepared for an exhaust fan but just the natural openings and movement of the air proved quite adequate. Be sure

there is room in the back for servicing. Be sure to ground the rig!

Alternate Method of Pre-tuning the Output Network—John Staples, W6BM

The first article in this series passed along a simple way to adjust the PI network without applying plate voltage. In the August 1994 ER, issue #64, John Staples provides the following technique as he describes the restoration of a 1938 Collins 20K-1 kilowatt rig:

"...The initial adjustment of the final amplifier plate circuit was carried out with an easy and powerful technique, with the power off. If, for example, the final tubes require a 2000-ohm load, a signal generator is connected through a 2000-ohm, non-inductive resistor and a 50-ohm dummy load is connected to the output of the PI-L network. A dual-channel scope displays the RF voltage on each side of the resistor. (The internal impedance of the signal generator is not critical, and capacitive coupling by the scope probes is small compared to the circuit capacitance.) The tuning and loading controls are adjusted so that the voltage on the plate side of the resistor is one-half of that on the generator side with the two voltages in phase. (Swing the generator frequency to insure that you are on resonance.) These settings will be close to the final settings determined during the hot tune-up."

John did a beautiful job of restoring this transmitter. Looking at the before and after pictures clearly shows a tremendous amount of effort on this project.

Power Reduction for Initial Tune-up Chuck Teeters, W4MEW

Chuck Teeters, in November 2001, ER #150, passed along an interesting method of temporary power reduction should your rig not have the power reduction feature. It would appear to be usable for that monster homebrew on initial power up as well:

"If there is no cut back, connect a 1200-1500 watt, 115-volt heater or hair dryer in series with the HV transformer primary. Put the power to the monster and hopefully you can tune the final for some output. The plate voltage meter should have a reading of half or less than normal. When you are happy with everything remove the electric heater and go for it."

A related idea is to use a 100-watt light bulb just in case there is a short with 120-volt equipment. I prefer to use a fused Variac instead for 120 volts. I have also heard of people using Variacs on the HV primary for power reduction or simply running the 240-VAC primary on 120 volts. 120 volts on the primary is my preferred method and it should result in 250 watts from a 1-kW box.

Cleaning the Box

All too often, electronic equipment is stored in a less than friendly environment which promotes mold, rodent habitation and some insects unknown to the scientific community. I was very fortunate in that one of my boxes was in a dry environment and the other super clean and well cared for. If you are faced with a massive clean up with mold and rodent droppings, be prepared for some rather drastic measures. According to Dr. Anna Marie, the resident expert on the Weather Channel, mold may not be a health hazard. Whether you accept that or not, you can bet that rodent droppings are!

Mike Dorrough (KO6NM) in April 2001, ER #143, goes into detail on this subject. He suggests applying Formula 409® liberally and letting it soak in for a few minutes. Then rinse with a sharp fast spray. I have seen pictures of transmitters being blasted with garden hoses and then let to dry in the sun. Mike nixes the "dry in the sun" part in favor of "the biggest, meanest fans you can find on the interior." If you are going to do this, protect those components that would other wise be damaged by water. Meters, unsealed transformers, and even labels, as Mike suggests, need to be protected.

Now, if you have big iron that needs to be dried internally, Larry Will (W3LW) passes along a method of drying things out in the September 2003, ER #172. Small

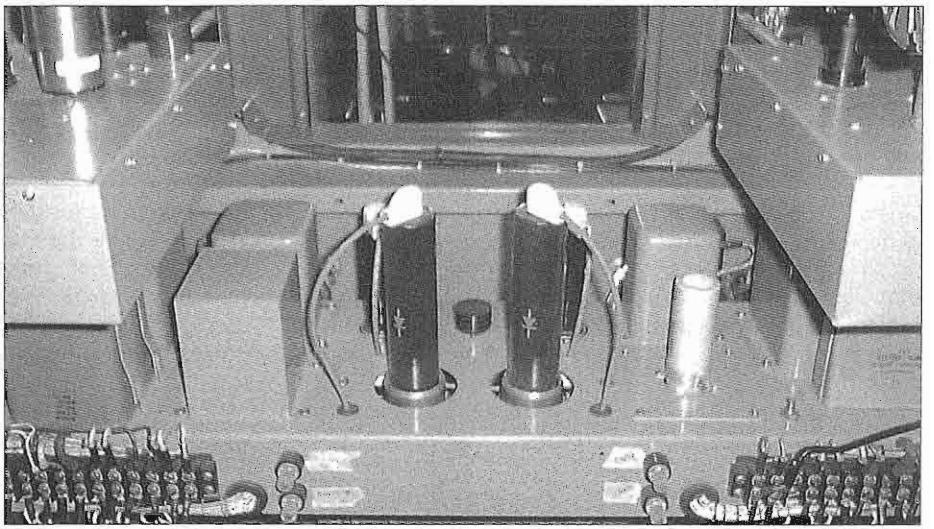


Figure 2: Rear interior view of the Collins 20V with the solid state replacement rectifiers in the center of the photo. While more efficient and reliable, they negate a lot of the warmth and esthetics of the original transmitter. (Photo courtesy W5DUD)

transformers can be baked in a kitchen oven at 140 degrees for five hours. For the big modulation reactor, here is what he did:

"...I fashioned a home made oven using a thermostatically controlled single burner hotplate and a hood made from an old hot water heater jacket. ..... An oven thermometer allowed me to set the oven temperature to 140 degrees F and after 25 hours of 'baking,' the leakage was cured."

Larry goes on to say how he dipped all transformers in transformer vanish to reseal the windings. For those of you converting the RCA BTA-1R1 or similar series transmitters, this article and his more recent article in the April 2005, ER #191, is must reading.

Potpourri of Tips

If the RF ammeter failed, the FCC permitted stations running these vintage broadcast rigs to calculate power output from the input parameters. It was assumed that 70-percent efficiency was the norm. Roughly 1400 watts DC input would yield 1-kW out.

Many of us have never had equipment with mercury rectifiers. Those licensed over fifty years ago may know or barely remember this fact. When the tube is first used or unused for lengthy periods, the tube should be lit without power supplied for at least 20 minutes. This insures that all the mercury is vaporized and ready for action. These rectifiers were common in 1940s equipment and were used in broadcast equipment until many were replaced by solid state rectifier stacks. The replacements are the same size and roughly the same shape as the original mercury tubes. If your rig has mercury rectifiers, you are treated to the warm soothing glow of that blue light. Consider yourself blessed and treat those guys well.

Sometimes in restoring a BC rig, the modulator goes into oscillation and indicates heavy plate current. Most likely the negative feedback resistor chain is damaged, miswired or for some reason not providing the proper negative out of phase feedback. The negative feedback, of course, is used to improve the overall

audio distortion and response of the transmitter. For amateur service voice transmission, the improvement is hardly, if at all, noticed. The feedback circuit can be disconnected with no impact whatever and hopefully your problem just disappears.

The 833A tube socket, typically found in the Gates, BC-1 series as well as other transmitters, needs some special attention. The filament sockets must be free to move laterally. Do not tighten them to the mounting bar. You run the risk of cracking the seals and adios 833A.

The red color on the 4-400A modulator tubes' plate is normal. It shows on a portion of the anode and really makes one wonder. Not to worry!

Now, here's a great idea for adjusting you audio EQ by yourself to suit YOUR taste. Buy the Behringer DSP-100 Shark processor and use the delay function. With the audio delayed up to 2.5 seconds, you can do a typical "testing one, two, three," and then have it immediately play back to you without feedback at normal receive volume into a speaker. This way you hear what others hear and not the altered version influenced by the bones in you head.

Just in case you are concerned with massive amounts of RF frying the receiver front end, here is a simple and cheap insurance policy. Place a grain-of-wheat bulb in series with the receiver input to act as a fuse. If RF does get in, the bulb takes the hit and goes out in a blaze of glory sacrificing itself to save the receiver's front end. The bulb can be wired internally or externally. Radio Shack part number 272-1092, called a "microlamp," is perfect.

And, one last thing to include at this writing is the issue of blower noise and air circulation. Let's remember that this transmitter is no longer subject to 24/7 constant-on duty, so the cooling requirements are much less demanding. ICAS ratings are all you need for cooling the box. So, if you have the blower that can wake up the dead with its noise, consider reducing its voltage from 240 to 120. You should be able to live with that noise and the box should be able to live on the reduced air pressure. There are several possible ways to accomplish this if switched 120 VAC is not available within the box itself. They include the use of a dropping resistor or rewiring the fan between one leg of the 240 input and chassis/electrical ground to derive the 120 voltage. I rewired my Bauer transmitter and the noise went from a tornado to a cat's purring.

One caveat—well, really there are two. Many transmitters have an air pressure switch which shuts everything down with the loss of air pressure. It may have to be bypassed, although I found that this was not necessary. The other thing is that you may not get enough air flow with certain designs. Fans and blowers pressurizing the entire box are likely candidates for reduced air flow. Anything going directly at or into a pressurized compartment is another story and probably should be left alone.

Teething Pains Revisited

In the September 2005 issue, ER #196, I described several things that could go wrong with any BC conversion. With all that I described, still occasionally my transmitter would overload and knock itself off the air. On one occasion I just happened to be looking at it and suddenly one the modulator tubes started to glow red. It was clearly loosing grid bias. The culprit appeared to be dirty sockets contacts. The grid connection broke, sending the plate current into orbit. Clean the socket connections with Caig DeOxit® or similar contact cleaner and a small brush. And, just to drive home the point that this box produces lots of RF power, I discovered that my coax to the 80-meter dipole was charred.

If you have something to pass along, please let us know. Also, I have referenced many back issues of ER. All of those back issues are still available. If you desire more information than presented here, the original source is still available.

73, Dave, K2DK *ER*

following in the Amateur community. The proposed rules accommodate continued DSB-AM operation in the high-frequency bands without additional restriction, as is the case now. Again, this is based on the principle that accommodation of new technologies should not be at the expense of currently used operating modes...

18. [The existing table]...would be replaced with a table segmenting bands by bandwidth, with the new paragraph (e) including some consequential renumbering of 97.305. The bandwidths 200 Hz, 500 Hz, 2.8 kHz, 3.5 kHz, **9 kHz**, 16 kHz and 100 kHz appear in the proposed Appendix. ...

...9 kHz: Though the necessary bandwidth of a DSB AM emission is often stated as 6KOOA3E, [6 kHz] ***ARRL recommends 9 kHz in order to leave no doubt that transmitters now in use for DSB AM emissions can continue to be operated.***

VI. Conclusions

...There are emission types that are in use today which do not necessarily fall neatly into a sub-band division by maximum bandwidth, such as DSB AM, but those emissions can continue to be accommodated for those who wish to use them, without detracting from the use of the bands by others and without diverging substantially from the paradigmatic change suggested herein."

To ARRL's credit, the language in the proposal specifically mentions exempting AM operations in three separate places.

Finally, the last part of the proposed rule change has a table showing the existing amateur radio frequency allocations by band, the maximum bandwidth per band, and a column of standards that refer to the proposed FCC Part 97.307(f) rule change. At the bottom of the table, there is a footnote exemption:

"(1) The 3 kHz maximum bandwidth does not apply to double-sideband amplitude-modulated phone A3E emissions which are limited to —26 dB bandwidths of 9 kHz."

This exemption applies to the following HF band segments:

160 Meters: entire band
75 Meters: 3.725-4.00 MHz
40 Meters: 7.125-7.30 MHz
20 Meters: 14.15-14.35 MHz
15 Meters: 21.00-21.08 MHz
10 Meters: 21.20-21.45 MHz, 24.93-24.99 MHz, 28.3-28.5 MHz, and 28.5-29.0 MHz

The table makes no mention of exemptions for AM operations on either 6 or 2 meters, so there will be a potential problem for those who are operating AM on those bands. We can talk about the need for yet more federal regulation of modes and bandwidths—a separate issue—but as far as AM operations on the traditional HF bands are concerned I see no threat at this time. The proposal seems to be aimed at mandating bandwidth for developing digital technologies and the related need to sell new equipment. Operators of converted broadcast transmitters may be required to limit their occupied bandwidth to 9 kc at -26dB, but that is the only necessary change at HF that I can see at this time.

West Coast AMI Bash with Bob Heil in Concert

Sunday, February 26, 2006, 3:00 PM, Bob Heil (K9EID) will be performing for AMI members at the Trinity Church, 3902 Kenwood Dr., Spring Valley, CA, near San Diego. Bob's performance is hosted by the Theater Organ Society of San Diego, and he will be playing a vintage Whurlitzer pipe organ that recently underwent a $200,000 restoration. Bob has been playing organ for many years, and was a student of Stan Kann, the house organist at the 5,000 seat St. Louis Fox theater, where he substituted for Kann from 1956 to 1961. In St. Louis, Bob was introduced to the Whurlitzer Jesse Crawford Special and learned how to tune and voice this wonderful 1929 pipe organ. Please contact Charlie Porter, KG6PRO, (AMI #1498), at 619-286-9979 or kg6pro@cox.net for more information.

73, Ray, NØDMS

Milestones in the History of Amateur Radio

The 1MO—French 8AB Two-Way Transatlantic Contact

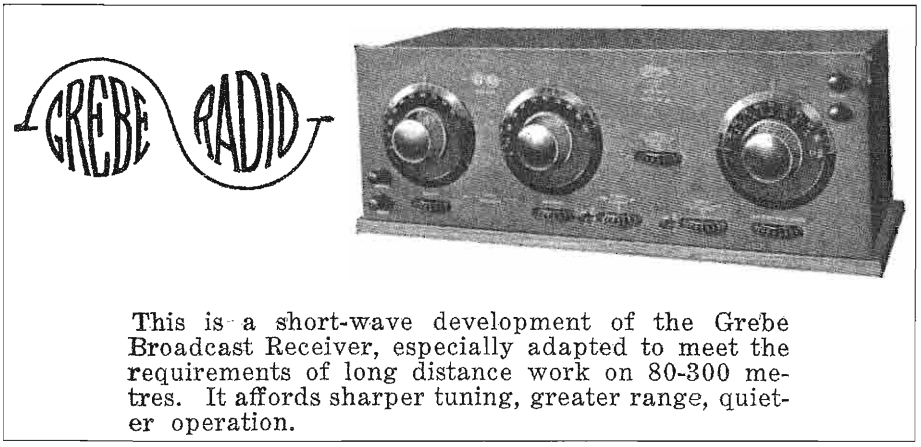
November 27, 1923

By Robert E. Grinder, K7AK
7735 N. Ironwood Dr.
Paradise Valley, AZ 85253

Fred Schnell, 1MO, West Hartford, Connecticut, worked Leon Deloy, 8AB, Nice, France, during the night of November 27, 1923. The Atlantic Ocean had been bridged by two-way amateur contact for the first time. Both men had met years earlier, during WWI, and ever since they had aspired to work each other.

Amateurs on each side of the Atlantic had for years vied with one another for the distinction of being, on the one hand, among the first to be heard on the other side, and on the other hand, to be first to establish a two-way contact. Given a background of assiduous planning, Schnell and Warner touted the fourth transatlantic listening tests on 200 meters—scheduled to start late December, 1923, and to be succeeded on January 11, 1924, by a "free-for-all" period—as the most propitious circumstances ever for making two-way transatlantic contacts.

Amateurs and radio engineers generally believed in 1923, as they had for 20 years, that transmissions on longer wavelengths increased the effectiveness of long-distance communications. Many amateurs were disappointed, therefore, when the government assigned the favored, longer wavelengths to commercial and military services and dispatched amateurs to 200 meters. Amateurs who were experimenting with vacuum-tube apparatus were becoming aware that the new refinements would function satisfactorily in the 100 meter range, but the technological advantages piqued little interest in the shorter wavelengths, which were thought to be useless. The amateur community in late 1923 was blind-sided by its fixation on longer wavelengths and its misconception that its wavelength at 200 meters was really too short rather than too long for DX transmissions. Even after military research demonstrated the



This is a short-wave development of the Grebe Broadcast Receiver, especially adapted to meet the requirements of long distance work on 80-300 metres. It affords sharper tuning, greater range, quieter operation.

Figure 1: From QST, November 1923, Volume 7, p. 4.

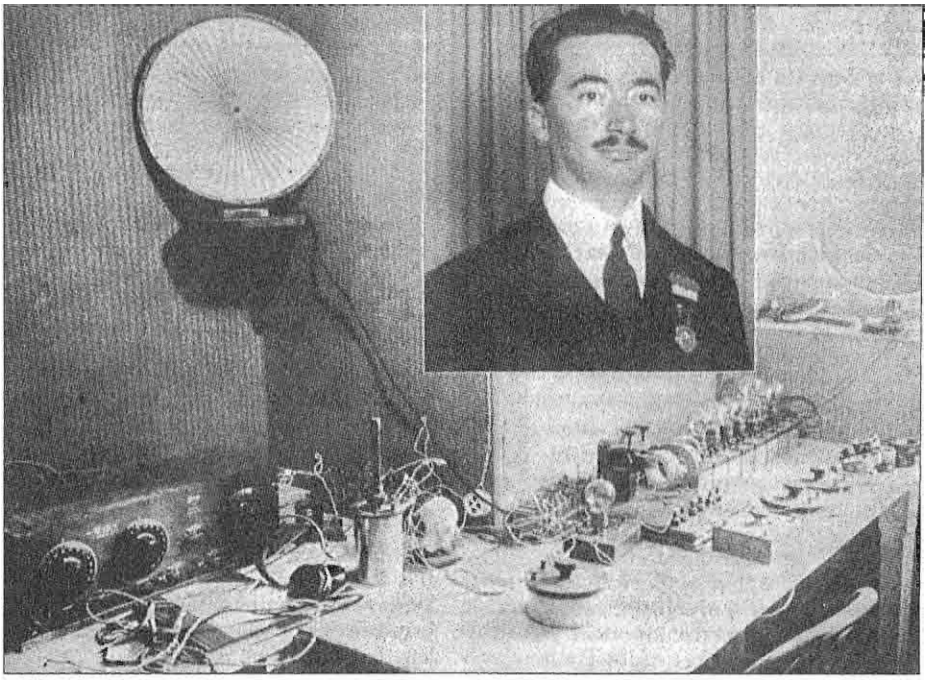


Figure 2, above: Leon Deloy, French 8AB, and his receiving apparatus. From "Radio Broadcast," 1924, March, Vol. 4, p. 423.

efficacy of shortwaves for long-range work, "the inertia of mass sentiment could not be overcome" (DeSoto, (1936, p. 97).

How, then, did 1MO and French 8AB achieve one of the more dramatic milestones in the history of amateur radio? A great deal of the credit must be attributed to Leon Deloy, 8AB, for possessing the acumen to plan the happening carefully, to utilize the finest receiving equipment available, and most importantly, to choose to operate, more or less on faith, near 100 rather than

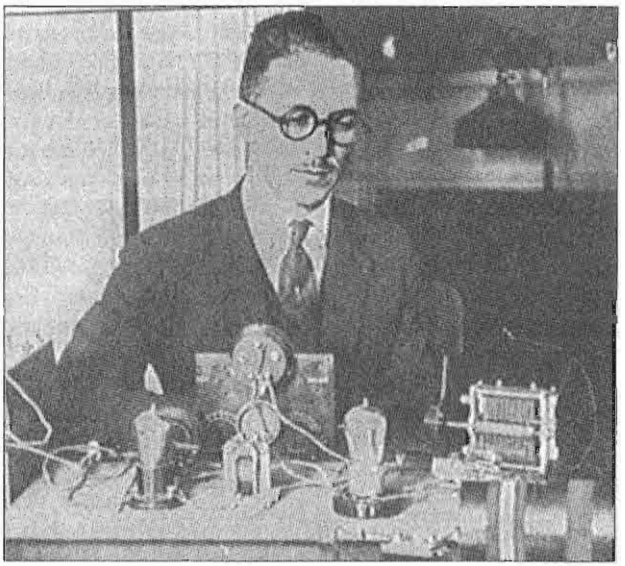


Figure 3, left: Fred Schnell, 1MO, and the homemade receiver with which he copied French 8AB. From "Radio Broadcast," 1924, March, Vol 4, p. 422.

200 meters—and risk thereby the possibility of continued failure should sporadic reports of successful long-range transmissions on 100 meters prove ultimately to be mere freaks of nature.

Leon Deloy, 8AB, "lived, thought, acted and worked with one objective—to work across the Atlantic" (DeSoto, 1936, p. 86). During the third transatlantic test, December, 1922, he was one of three European stations heard in the United States, and in January, 1923, a scheduled attempt to make two-way transatlantic contact with an American amateur almost succeeded. During the summer of 1923, Deloy visited leading American amateur stations prior to the second ARRL national convention in Chicago. His avowed purpose was to learn techniques for improving his equipment. He consulted particularly with John L. Reinartz, 1QP-1XAM, one of the foremost theoreticians of amateur equipment in the United States; however, he elected in his final analysis to purchase a state-of-the-art Grebe CR-13, the first shortwave receiver created commercially for amateur operators.

The performance characteristics of the CR-13 thrilled Deloy when a representative of the Alfred H.Grebe & Company demonstrated it for him at the ARRL convention. Alfred H. Grebe, a twenty-eight year old radio engineer had attained unparalleled breadth in the radio sciences as a commercial telegrapher, receiver designer, and radio manufacturer. The CR-13 was Grebe's 13th receiver in a line that started with the CR-1 in 1919 (Grinder, 1996). Grebe recognized early the promise of shortwave operation, and he manufactured the CR-13 to tune from 80 to 300 meters. Advertisements of the CR-13 indicate that Grebe strived to attain goals shared later by Bill Halligan, Lloyd Hammarlund, James Millen, and other manufacturers of amateur receivers. For example, he proclaimed that the CR-13 possessed beat-oscillator stability, sharp selectivity, and unsurpassed sensitivity. Further, in a declaration that was unprecedented at the time, he asserted that the CR-13 was also capable of locating instantly the wavelength of a desired station ("Advertisement," 1923).

Deloy rebuilt his transmitter and integrated the CR-13 (see **Figure 1**) into his station following his return home to Nice, France (see **Figure 2**). When his station was assembled, and he was ready to attempt a transatlantic contact, he cabled Schnell to inform him that he would transmit on 100 meters from 9pm until 10pm EST, starting November 25. His schedule was relayed swiftly to other American amateurs, and those whose receivers could tune to 100 meters listened for 8AB along with Schnell. 1MO heard 8AB while the latter transmitted "ARRL" for an hour and sent a secret cipher group, "GSJTP" [for the purpose of positive identification] (Warner, 1924). After Deloy was informed via cable that his signal had been nearly solid copy on the 25th, he sent a message to 1MO on the 26th in which he stated that he would call again the next night (November 27th), and this time, he would listen for a reply. Meanwhile, Schnell obtained special permission from Supervisor Kolster in Boston to operate officially on 100 meters (see **Figure 3**). Deloy came on the air at exactly 9:30pm. He sent steadily until 10:30pm; he then indicated that he was standing by to listen for a call from 1MO. Deloy responded to Schnell's call immediately, and at that moment, their transatlantic contact became a historical first.

Schnell and Deloy exchanged messages until John Reinartz, 1QP-1XAM, who had obtained permission also to operate around 100 meters, broke in and called 8AB. Deloy heard him and asked him to stand by, but when Schnell missed a few words of one of Deloy's transmissions, Reinartz indicated that he had solidly copied Deloy. After Reinartz and Deloy

exchanged pleasantries for several minutes, 1MO and 8AB again connected. Suddenly, however, Deloy abruptly developed transmitter trouble and signed off. Deloy's signal had been audible on loudspeakers at both 1MO and 1XAM. Deloy, for his part, reported that 1MO and 1XAM were easy to copy "a foot from fones'" on the Grebe CR-13 (Warner, 1924, p. 10). Reinartz and Schnell had built their receivers; all three men used comparable half-kilowatt transmitters of Reinartz' design.

The following evening, November 28, static and noise disrupted reception on 100 meters, which enabled 1MO and 8AB to exchange only calls. On the 29th, 1XAM again worked 8AB for a few moments. Apparently, 8AB's signal was barely readable underneath that of KDKA's rebroadcast on 103 meters of a concert destined for Western affiliates [see Installment 7, ER #176, pp. 40-41, for discussion of the phenomenon of rebroadcasting]. Deloy could be heard on Reinarz' receiver only when KDKA was not modulating the rebroadcast signal.

Robert M. Morris (1994), 2CQZ-W2LV, was among the dozens of amateurs who listened to the 1MO and 1XAM exchanges with 8AB. Morris found that getting his equipment to work around 100 meters was akin to struggling in a no-man's-land, but once he managed to copy 1MO, he found it possible to tune his apparatus for 8AB. He said that he listened to the three stations for five or six nights. Finally, he said, on December 3, 1923, perhaps when the thrill of the achievement has dissipated somewhat, Deloy decided to determine whether he could contact anyone else in the United States. When Deloy made his intentions known, Morris gave him a long call—illegally, for he did not have permission to transmit on 100 meters—on a low-power, vacuum-tube transmitter. To Morris' "everlasting amazement," 8AB responded. Morris (1994) believes that he had made the first transatlantic contact from the second Radio District and that he had become the third American to contact 8AB.

The primary reason for the success of the first two-way transatlantic contact "was the short wave [100 meters] that made the accomplishment possible" (Warner, 1924, p. 10). According to DeSoto (1936, p. 97), a spectacular example was required to displace the prevailing "mass inertia" regarding the viability of short wavelengths. "That example was found in the historic transatlantic work on the part of Deloy, Reinartz, and Schnell on November 26, 27, and 28, 1923."

We owe thanks to Deloy, Reinartz, and Schnell for hastening the migration of amateurs to the shortwave regions of the radio spectrum. They were the first amateurs to show convincingly that 100 meters, which had heretofore been regarded as even more useless than 200 meters represented in fact a mother lode of opportunity for DX communications (Orr, 1988).

References:

Advertisement QST, 1923, November.
DeSoto, C. B. (1936). Two Hundred Meters and Down: The Story of Amateur Radio. West Hartford, CT: The American Radio Relay League.
Grinder, R. E. (1996, August). Alfred H. Grebe: First Manufacturer of Amateur Short Wave Receivers. Electric Radio, #88, 4-9, 38-39.
Morris, R. M. (1994, May). 1923—A Great Year in Amateur Radio. The Old Timer's Bulletin, 35, #2, 14-15.
Orr, W. I. The Year Was 1923. Ham Radio, 21, 88-91, January 1988.
Warner, K. B. Transatlantic Amateur Communication Accomplished! QST, January 1924, 7, 9-12.

ER

Amplitude Modulation Using Ring Modulators

By John Robert Burger, WB6VMI
jrb@csun.edu

Introduction

Ring modulators have long been used commercially to drive linear amplifiers. For example, Technical Materiel Corporation of Mamaroneck, New York produced the sideband exciter Model CBE-1 (otherwise known as the O-714/UR) for use with the TMC GPT10K. A ring modulator is a balanced bridge of semiconductor diodes as presented below. This article discusses a modification that applies to the given commercial exciters; the modification removes narrow sideband and carrier filters from the circuit to achieve quality AM. The author has converted not only the CBE-1 but also the Swan 500 and the T-4X by Drake—this unit can cover 160 meters. Details of the conversions are given at http://www.ecs.csun.edu/~jrb/am/. These, and similar equipment, can be made useful again if their owners are willing to embark on an interesting and rewarding conversion project.

Converting old sideband rigs requires rewiring of exciter circuits, great fun for a radio amateur. There are absolutely no changes to the front panels, and no physical changes to the chassis. A micro-mini AM/SSB switch may be installed in existing openings in the cabinet. The result is high quality double sideband with carrier, in other words, AM. When all is done correctly, the specifications on the resulting AM equal or exceed those of any other AM exciter.

Audio response in the author's ring modulator is flat typically from about 90 Hz to 10 kHz, with a gentle roll off below 90 Hz. What counts most, especially to a male voice, is response below 300 Hz. Invariably, commercial transmitters of the day cut off sharply below 300 Hz, therefore removing the essential power and push of male speech. As a result, amateurs on sideband rigs sound alike. This makes it difficult to identify or differentiate speakers by voice sounds, for example, when several are talking at once without saying who they are. Lacking lows also camouflages messages in which tone and emotion count. Most important to AM amateurs, however, is the increased pleasure of hearing a friend as he or she really sounds, as opposed to having annoying staccato words punching the air, and a thin sound. I have found that when audio cuts sharply below 300 Hz, no amount of equalization can restore it, contrary to recent marketing pitches for sideband transceivers.

Responses above 3000 kHz are also important, because the human ear is sensitive to high-pitched sounds, even if they are soft. Modern transceivers favor the use of sharp filters to pass the 300-2700 Hz audio range, partly since this is said to be communications audio, and partly because it is easier to design systems for this range.

Another benefit of AM is "quieting." This means that the carrier activates the AGC of the receiver to suppress background noise. Unlike SSB, in which receiver noise continually punches through between words, full quieting is possible with AM. When this happens, you can hear a pin drop as though you were in a sound proof studio. Under quieting, your receiver hum is usually the only thing you might notice, but only if the other person stops talking, and if you turn up the volume. Low-level hum is expected and pleasurable in a radio, but it must be unobtrusive. Transmitter noise, if it exceeds receiver hum, would be noticed. Many receivers do not respond to 60 Hz;

so more likely harmonics of 120 Hz from the power supply would be heard.

With a ring modulator, 60 Hz, 120 Hz, and associated harmonics can easily appear on the carrier. These come mainly from very small, unwanted signals induced into the audio input to the ring modulator. Good shielding can eliminate such harmonics, although good shielded audio cables are usually installed already. Another approach is to eliminate 60 Hz and 120 Hz by extra power supply filtering. When this is accomplished, peak-to-peak noise can be made to be less than a modulation level of 1% and is not noticed with normal voice modulation.

A side benefit of converting an old unit is that with the flick of a switch, SSB can be available for that occasional swap net listing. Ultimately, SSB is a good way to transmit data using PSK31 or RTTY for amateur radio. Units such as the Swan and the Drake have many features for CW keying, VOX, spotting, multi-band operation and various tuning aids. It is a

volts for good performance with about one hundred millivolts of audio and double that for RF output. There must be a few stages of tuned amplification prior to transmitting to an antenna, the purpose being to filter RF harmonics (integer multiples of the input RF frequency).

What is fairly obvious is that this is a balanced modulator as long as Rb is centered and Cp equals Cr. If Cf in conjunction with Cn, at the top of the circuit can successfully bypass all of the RF, then carrier output is zero. To see this, consider the signal from X to Y across the output at Ck. When the RF input is positive, diode 1 conducts to ground, providing a certain diode potential at X while diode 3 in series with Cn + Cf provides an equal potential at Y. The voltage across Ck is the difference of these two equal potentials, and is therefore zero. A similar situation occurs when the RF input goes negative, causing diodes 2 and 4 to conduct, and ideally there is no output

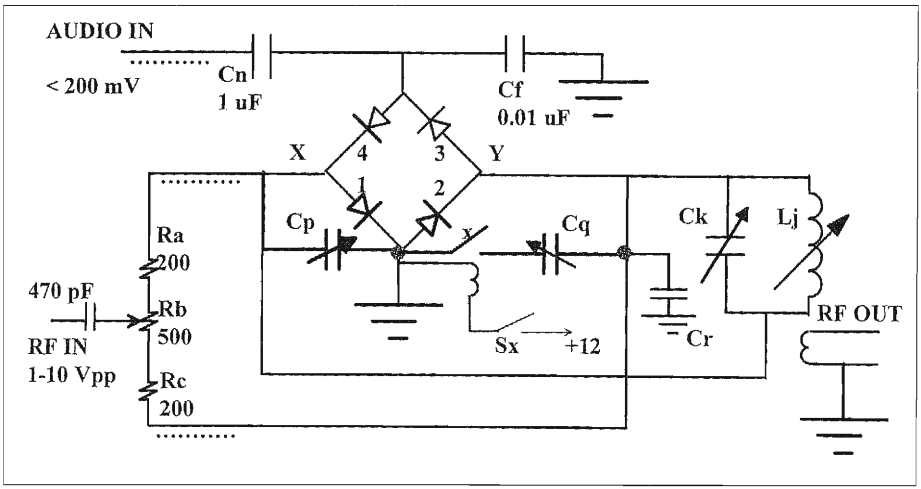


Figure 1: The ring modulator as envisioned by WB6VMI.

really a pleasure to use older equipment.

The Ring Modulator

In **Figure 1**, RF enters on the left, as does the audio. Modulated RF exits on the right. The RF input should be several

carrier.

Because of a small amount of RF across the combination of Cn and Cf, the diode bridge is not exactly balanced. Phase shifting mechanisms are complex, but very

	Cp	Cq	Cr	Cn+Cf
T4X	1-8 pF	0.25-1.5 pF	≈ 1 pF	0.47+0.005 uF
500	20-200 pF	20-200 pF	≈ 50 pF	1 + 0.01 uF
CBE-1	100-550 pF	Not Used	360 pF	0.01 uF

Table 1: Comparison of parameters of the Drake T-4X, Swan 500, and CBE-1.

real, so the bridge can be exactly balanced to zero output at the frequency of the RF input by using Rb and Cp.

The application of audio with a positive peak affects the resistance and capacitance of diodes 4 and 1. For both positive and negative RF voltage the bridge is no longer balanced, resulting in outputs. Outputs are not at the carrier frequency, but are sideband frequencies because of mixing in the diodes. A similar mixing occurs for negative audio voltage.

To achieve AM, the bridge can be unbalanced slightly using Rb, for example, by adjusting Rb clockwise slightly. This will permit relatively more signal to diodes 2 and 3; giving them a lower voltage drop compared to diodes 1 and 4, and consequently, carrier output. When this is done, the bridge no longer balanced for zero output. Consequently 100% downward modulation is impossible until the capacitance Cp is re-adjusted, after which it works great.

Assume that Rb has been increased clockwise slightly, and that this resulted in Cp having been increased slightly for perfect 100% modulation. To regain a zero carrier output for SSB service, the author offers a minor invention, the closing of switch Sx to close a miniature relay that inserts Cq. This novel trimmer has the virtue that it can re-balance the diodes for zero carrier output at the RF frequency.

Ring modulator theory easily translates into practice for a wide variety of layouts. In particular, the diodes do not need to be exactly matched because the adjustments Rb, Cp and Cq can compensate in most situations. The author always uses germanium diodes because they are inexpensive, available, and work better with only a few volts of RF. Sideband units usually use a quartz crystal oscillator for the RF, so changing frequency is usually not an issue. Adjustments are set at a nominal output power level, giving reasonable performance above and below nominal power as controlled by Rb.

Reducing Theory to Practice

Parameters used in the author's TMC CBE-1, his Drake T4X and also his Swan 500 are summarized in **Table 1**.

Adding Cq to the T4X is optional, since without it the suppressed carrier's power is still very low; Cr represents stray capacitance. Cp, Cq, Cn and Cf were added in the Swan while Cr is stray capacitance in the cable that feeds the RF to the ring. Cn sets the low frequency response, but cannot be too large, because it causes a time constant before the transmitter is ready for good modulation, as noticed in the Swan. Conversion details for the Drake and Swan are available for study at http://www.ecs.csun.edu/~jrb/am/ The CBE-1 design is superior, but not convenient for Swans or Drakes. The audio is applied with a transformer, allowing a balanced AF input (**Figure 2**). Cn is not used, and the size of Cf is not an issue since any drops across it are canceled at the output. The ring modulator is balanced, and stays that way since carrier is added later in the signal chain. This reduces the need for Cq, although it is still useful to have Cq to adjust the carrier in SSB mode. Keeping the bridge balanced reduces hum pickup. A balanced bridge is also less sensitive to temperature in-

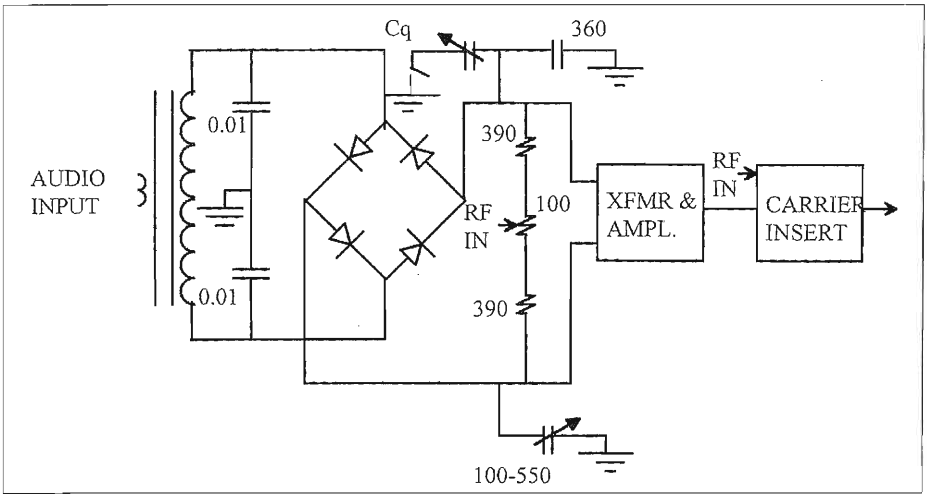


Figure 2: The CBE-1 modulator.

creases. A drawback of the above ring modulator is that diode heating during a transmission can cause a slight increase in RF power. This is not noticeable on the receiving end.

The CBE-1 is a superior design, but not as practical for use in amateur transmitters. The audio transformer is too large and heavy, and has limited low frequency response. Inserting the carrier later in the signal chain is a good idea, but correct implementation requires extra amplifiers the author's instrumentation, performance is summarized in **Table 2**.

Note that –6 dB means that the voltage amplitudes are reduced to nearly 50 % of their midband ranges.

The original AM capabilities of these exciters continue to be available, but are not as good. For examples, the T4X uses a controlled carrier system that works quite well. It uses screen-grid modulation that tends to distort audio waveforms at higher levels of modulation. The

Table 2. WB6VMI Performance

	Nominal Power Output Watts	AM Audio Range -6 dB	60 Hz Modulation	SSB Audio Range –6 dB
T4X	20 W	90 Hz-10 kHz	<0.5 %	600 Hz-2.6 kHz (NOT FLAT)
500	20 W	90 Hz-10 kHz	< 0.5 %	300 Hz-3 kHz
TMC CBE-1	10 mW	150 Hz-10kHz	≈ 2 %	150 Hz-10 kHz

for which there is little room. Never the less, future work will focus on such improvements.

Details about the Drake T4X and also the Swan 500 appear at http://www.ecs.csun.edu/~jrb/am/. Based on Swan uses filters to generate single sideband AM, therefore limiting the audio frequency range to 300 Hz to 3 kHz. Near 100% modulation single sideband AM gives extra distortions to the audio, although it probably cannot be heard. The

Table 3. Tube Dissipations @ 20 Watts RF Out

	Plate Voltage	Plate Current	Plate Power Input	Power Each Tube	Rated Power*
6JB6A x 2/DRAKE	685 V	≈80 mA	54.8 W	17.4	17.5
6HF5 x 2/SWAN	860 V	≈85 mA	73.1W	26.6	28

*General Electric Recommended Design Maximum; No Cooling Fan

above ring modulator avoids these issues.

Power Tubes Considerations

Horizontal amplifier tubes have a 'design maximum' power dissipation rating that an AM operator should know about, since carriers are on for long periods of time. AM exciters need about 10 or 20 Watts RF output in order to drive a typical grounded grid amplifier. Of course, the peaks of amplitude modulation must not be clipped because of inadequate loading. With this in mind, while viewing an Oscillograph of the transmitted waveform, loading must be slowly increased from its minimum setting so that maximum RF goes to the antenna while minimum DC current goes to the tubes. Power dissipated by each tube can be calculated as Plate Power Input minus RF Power Output, all divided by two (two tubes). It is clear in **Table 3** that these tubes are going to be near their design maximum (where they are supposed to operate) based on plate ammeter readings and the author's antenna power meter.

With the final dipped, the operator's manual for the Drake suggests a maximum continuous current of 200 mA, while the Swan manual suggests a similar value. Up to a point, increased plate current provides more RF power, and only a slight change in power that the tubes must dissipate. Just the same, the author is glad that values in **Table 3** are well below the 200 mA value. Quiescent current to the finals can make a difference and should be set as recommended. If maximum RF out occurs at a setting different from plate current minimum, it is a sign that neutralization or load impedance is imperfect. We emphasize that the final plate current should be minimized while operating; it is not recommended that you tune for maximum RF output with a horizontal amplifier tube. A silent fan directed at the finals cage is an easy way to increase available power dissipation, and therefore the life expectancy of the tubes.

Conclusion

This article offers an innovation, a switch for either double sideband full carrier AM or suppressed carrier SSB. Audio range for the AM is typically 90 Hz to 10 kHz. 60 Hz harmonic modulation is below 1%. When a commercial transmitter is converted to include AM, extra enjoyment results. The main fun, however, is the conversion itself. The cost for parts is low, although time is required. With patience, your old sideband unit can become a wonderful AM exciter for your power amplifier. Such exciters exceed the performance of commercial amateur exciters sold to date in audio quality. Conversions as above have proven to work well with the Swan 500 and the Drake T4X, using the Henry 2K4 operating class AB, and the TMC GPT 10K operating class A.

ER

Mechanical and Electrical Considerations for the R-390A

By Ben Robson
Quebec, Canada

The ER community is rich in knowledge and experience; I'm aware that for every nugget of advice that's printed, ten times as many ER people have knowledge, good ideas and hard won experience to share, but don't through inertia or time constraints.

All my useful information for the R-390A has come from past ER issues and the absolutely essential technical manuals TM-390A and the desirable daddy TM-390. TM-390 is my alias for the TM-11-5820-357-35, 9 March 1962, and TM-390A is my alias for the TM-11-5820-358-35, 8 December, 1961.

Information from other sources has been disappointing or simply not trustworthy. An editor is a very important person. Unfortunately, the Internet has blown away editors.

I am aware that I evaluate and work on the R-390A as a technician and treat it like the fine instrument it is. My viewpoint is different from a Ham operator and/or a collector.

My Trials and Tribulations with the R-390A and some General Comments

• Diodes: I only use the 26Z5W rectifier tubes. I considered using two silicon diodes, one voltage dropping power resistor and a B+ power-on, time-delay relay. I rejected it because "Keep It Simple" is my lifetime guide. Read ER number 34, page 27.

• Powering up: After measuring 19-ohms of contact resistance on a R-390A on/off microswitch and successfully repairing it (I swapped with the unused contact), I never use the R-390A on/off switch. I always use an external powerbar switch (expendable) and Variac to fire it up.

• Trimmers: Most RF module trimmers are at B+ level (216 volt dc). Use a rigid, insulated blade to adjust the trimmers. Today's tuning tools are too flexible and their blades will twist and distort before the trimmer moves.

• Slug adjustment: I use a short, high-quality, number 9 Torx driver to adjust the slugs rather than a long Bristo driver.

Because some of the steel friction clips chew the brass thread, I put a single drop of fine oil onto my slug thread. Hey, my R-390A is on a desktop, not being pounded by the seas!

• Potentiometers: I needed to replace all potentiometers with new military grade ones. I could not locate a 500-k pot with a SPDT switch. I used the original SPDT switch by fitting it onto a cheap 500-k log pot. I don't know if the noise limiter pot should be linear or log. Two of these potentiometers were way out of specification, 1.2 Meg and 2.0 Meg, and one had a carbon track that had flaked off.

• Lubricants: All of the gear/cam bearings are of the sintered, phosphor-bronze kind. This means that you only lubricate them with *LOW* viscosity oil, e.g., fine sewing machine oil. I use Labelle number 108 synthetic oil[1] exclusively for light duty applications. Using grease on sintered phosphor-bronze bearings simply clogs the bearing pores, a real no-no. There is also a narrow sintered phosphor bronze bearing embedded in the front-panel KC and MC bushings. Therefore, use only light oil on the KC and MC shafts.

Don't use oil or grease on the gear teeth, it attracts dust. Ray Osterwald's use of moly powder on gear teeth sounds

promising. Read ER number 197, page 39. With no lubricant on any of my gear teeth, my KC knob rotates smoothly, i.e., with the PTO disconnected the torque required is 7 inch-ounce. How sweet it is!

I do put Labelle number 106 synthetic grease[1] with teflon on the MC index cam rim and the intermittant bandswitch gear. Read ER number 25, page 25.

The other front-panel solid bushings for the antenna, bandwidth and BFO shafts could have a dab of grease. I use light oil.

• Bearing crack: Sintered phosphor-bronze bearings can crack. Because of a cracked MC shaft bearing on the gear-front-plate, I tried to replace the entire gear-front-plate, but it didn't fit because I was fitting a Teledyne plate to a Stewart Warner body. Instead, I squeezed out the MC shaft bearing with my machine vice and a short slug and then press-fitted it with the machine vice into the Stewart Warner gear-front-plate. Success, lucky me.

Sheet Metal Construction and Obstructions

Belatedly, I discovered a small but critical difference in the sheet metal shape of the IF module between Stewart Warner and EAC modules.

On the EAC, the rear right-hand mounting flange corner (near the green captive mounting screw and module connector) is knife sharp and squared. Whereas, on the Stewart Warner, it is a rounded corner with smooth edges. Alarmingly, the sharp corner pinched, and potentially cut, the vertical wiring harness in the corner of the mainframe. Just swapping the EAC IF module in and out becomes a hazardous procedure.

The solution on the EAC is straightforward. I trimmed the corner at 45 degrees with a tinsnip. Then, I rounded the edges with a small mill file and got instant peace of mind.

Woes with the Bandwidth Switch Index

Components of the bandwidth switch assembly are: a long through-wafer switch shaft, a rigid coupling, and a six-position index.

Proper assembly would be one each coupling set-screw at a right angle, that would lock the flat of the long shaft and the flat of the index. The other two set screws tighten the half round of the shaft and index respectively.

Caution: Keep the coupling away from the index spring plate! As you rotate the shaft, the spring plate bends towards the coupling. The index tab, going through the small hole in front of the IF module, secures the angular position of the index.

You've done it right, but guess what, your wafer switch contacts don't meet head on. The angular index position is off by several degrees.

So what did a Steward Warner or EAC assembler do? They tightened the coupling screws skewed on the flats and half rounds after the index was in position! It was like having a flat on a rotary switch and deliberately tightening your knob away from the flat. Contractors were only paid to follow the specifications, not to try and improve things.

First, look to see if three wafer switches track properly through all six positions. If they do not, use a small, flat, needle-nose file and file a small slot in the small hole to be able to rotate the whole assembly such that the wafer switch contacts meet head on.

Woes with the Crystal Oscillator Module

• Frozen alignment screw (T401): Remove the shield can. Put one drop of light oil on the slug thread. Heat the external thread nut with your chisel tip iron and be ready with the other hand to turn the slug with a screwdriver that fits well. The heated nut will expand before the slug thread.

• Trimmers: I had one loose trimmer where the micamold capacitor was somewhat diagonally wedged between both

trimmer lugs. The forked clip was barely retaining the trimmer groove. I repositioned the capacitor.

• Drum decal: Due to age you may find hairline cracks or worse on the drum decal.

Caution: cleaning the drum decal may wipe it right off. To avoid this possibility, first, gently dab clear nail polish on the cracks. Wait to dry, then apply a layer of clear nail polish around the drum decal for a more permanent protection.

• Switch tracking: Verify that both wafer contacts on the 32-position wafer switches are tracking. If not, loosen the four corner-wafer mounting screws; there is sufficient leeway to bring the contact into alignment; then retighten.

• Iron clip: The long aluminium shaft is grounded by an iron clip made by a punch die. Punch-die manufactured pieces have a rounded edge on one side and the other side is sharp.

Here I digress: I always look at and flip punched pieces, where appropriate, to avoid the sharper edge coming in contact with a surface! Consider the slugracks. The long shaft is held by two clips. In fact, there quite a few clips used in the receiver. Always install them with the smooth edge towards the rubbed surface.

This is also true for circlips. Some of the clips may be scraping; flip them over. For example, take apart the differential. (By the way, I love the heft of my smooth turning differential.) Remove the three Phillips-head screws with star lockwashers. Pull the two parts apart. This clip was bent the wrong way so that the sharp edge was scraping on the soft alloy shaft. I corrected this by polishing away the sharp edges and ensured that the surface contact of the clip was parallel to the shaft.

There are so many quality and assembly-control issues with these receivers. It's tiresome for a guy who is a perfectionist, but who never quite reaches the top of the mountain. I know it's not possible, since I am not perfect myself.

• Minimize backlash error: The long gear train driving the 32-position crystal selector switch has no anti-backlash gearing. TM-390A does not consider backlash and only checks for switch contact.

To minimize the backlash, remove the RF module gear train with attached crystal oscillator module from the mainframe. Observe the contact backlash as you select a MC setting, from high to low and low to high. Loosen the gear clamp. Split the backlash error such that you maximize the switch contact surface before you retighten the gear clamp.

RF Module RF and IF Transformers

Although TM-390A has resistance charts, they are NOT accurate and are therefore misleading.

The coils of the Z216, T201, T202 and T203 columns are wound with Litz wire[2], i.e. very fine, individually laquered copper wires. All are green cotton-covered wire except for 3 coils.

One of my Z202 coils had 4.2 ohms resistance instead of the 2.4 ohms I expected. This higher resistance lowers the designed resonance Q and thus impairs performance. It occurred to me that the Litz wire connection might be at fault.

Always mindful that a visual inspection can only catch a subset of potential problems, I gathered together all my Litz wire coils for extensive visual inspection and resistance measurements. Did I ever open a can of worms.

To determine a nominal value for each group of coils, first I tabled all the four group's coil resistance. Then, I glanced over the values in a group, minus the test lead resistance. Any value greater than the majority I excluded from consideration. Out of a total of four sets (48 transformers) eight coils were rejected. This was a whopping 17 percent of the total, and importantly, one or more from each group. Having taken apart the high-resistance T202 coil, I know the Litz wire

The resistance range I accepted is as follows:	
group T201	3.40 .. 3.79 Ohms
group T202	2.28 .. 2.48 Ohms
group T203	1.45 .. 1.62 Ohms
group Z216	2.37 .. 2.63 Ohms

Table 1: Range of acceptable resistances.

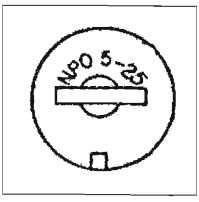
in the R-390A has six strands. A quick calculation of six times my nominal value, divided by five, quantifies the effect of one less strand. One strand resistance is six times my nominal value. In fact, on one coil a strand was visibly not connected.

The resistance range I accepted is as follows in **Table 1**.

One anomaly: I have one Z216 set with visibly thicker beige colored cotton covered Litz wire. The resistance measured was 1.44, 1.46 and 1.49 ohms. Perhaps they have more than six strands. I am not about to find out. Higher Q, thus narrower bandwidth for the Z216 group should be all right. Since I have spare transformers, I am not trying to repair Litz wire defects. In any case I could not work with such fine wire and resolder all strands in situs.

Ceramic Trimmer Distribution

There are 64 ceramic trimmers to be adjusted in an R-390A. The drawing to the left shows the relationship between the center adjustment slot and the notch in the rim of the trimmer. Note that maximum capacitance is the opposite side of the forked clip on the rear of the part.



Assuming your receiver is aligned and working, look over all your trimmer's physical settings. Trimmers set at full-minimum or full-maximum capacity DO NOT indicate a true alignment peak, so track down what might be wrong in that particular circuit. The sentences that follow describe how to tell when all the trimmers are set for maximum capacity.

The RF module has 30 ceramic trimmers. Maximum capacitance occurs when, looking down from the top of the RF deck, all of the notches are to the right.

In the variable-IF section, maximum capacitance occurs when the notch points to the rear, as viewed from above.

The crystal oscillator module has 24 ceramic trimmers. Here, maximum capacitance is reached with the notch is to the front of the chassis, view from above.

The IF subchassis module has 10 ceramic trimmers. Maximum capacitance for the BFO neutralization trimmer is when, as viewed head-on from the left side panel, the notch points to the front panel. (Note that not all IF subchassis modules have all 8 trimmers for the mechanical filters.) Looking down at the top side of the filters, maximum capacity is when the notches in the 4 trimmers all point to the center. Viewed from the trimmer access holes in the side of the IF module, maximum capacitance of the trimmers is when the notches point to the rear of the chassis.

Ceramic Trimmer Construction

The 64 trimmers have different capacitance ranges and some are NPO and others are N750. Each trimmer has the following component parts, some of

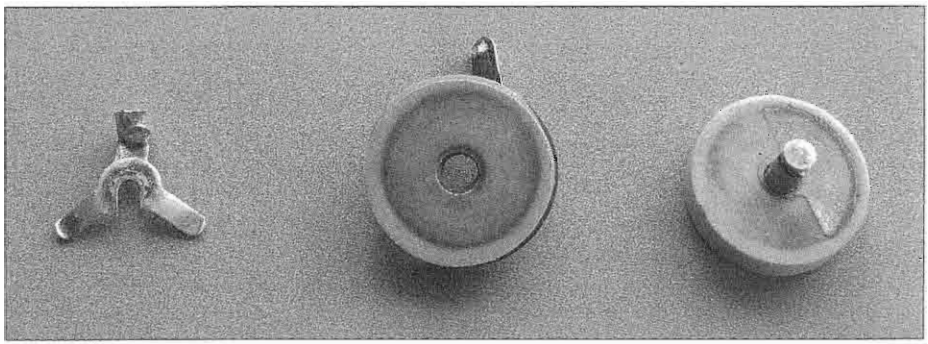


Figure 1: A disassembled ceramic trimmer (a variable capacitor) that is similar to the trimmers in the R-390A. On the left is the forked contact clip, part "F." Center, the thin silvered disk "D" with a center hole and one protruding contact, just visable on the top, attached to the bottom of the piece. Right, the ceramic disc with center stud "A" and the semi-circular plated rotor section that is grounded through the center stud and its contact with clip "A."

which are shown in **Figure 1**:

A = center stud with groove.

B = slotted labeled ceramic wafer with silver deposit and plated- through hole. (Deposit area depends on capacitance range). Note that A is integral with B. A/B must be conductive, i.e., no ohms.

C = thin wafer disk with center hole with one side having a silver deposit. (Deposit area depends on capacitance range). *Extreme caution*: They are very fragile and brittle. I broke several.

D = thin flexible disk with center hole and oval cutout. Both sides of D have a friction surface.

E = dual contact prodruding through D cutout to make contact with C silver deposit.

F = forked contact-2 clip with dimple, holds captive A/B, C and D.

G = mounting area with center hole for A and two small holes for E and F.

Problems with Ceramic Trimmers

Here is what I found can go wrong with these trimmers:

- A does not make contact with the B deposit or is loose. Not repairable by me.
- "A" fell out of "B" on two trimmers. Not repairable by me.
- C is frozen with B so that they rotate together. This causes erratic capacitance because it looses contact with E.
- D is in the wrong position.
- F is not completely trapping the "A" groove.
- "F" dimple is not in "G" small hole (potential short with metal frame).

Over 20 percent of the trimmers were frozen and would not move, so I had to take them apart for cleaning. Trimmer disassembly can be done without any unsoldering. With a five inch, fine tipped long nose plier, unclip the forked contact by lifting the dimple and wiggling it away from groove A. Then lift and remove AB, possibly with frozen part C. Flood the trimmer assembly with ethanol.

Caution: C is guaranteed to crack if dry lifted from A/B or D. To prevent C from cracking, lift D and C using a hobby razor blade as a wedge from G. When separated from G, carefully peel D from C.

Clean all surfaces from A to G with ethanol, then pat dry the flexible disk D. Reassemble in reverse order.

Antenna Relay

Have you been bothered by the fact that when in the CAL, BREAK IN or STANDBY mode the antenna inputs are shorted to ground?

If you use a high level signal connected to the antenna input and you select CAL, your signal equipment might not appreciate a short to ground. This is one detail too many to remember for me, and what I wanted was a simple antenna input disconnect system.

I have one antenna input module with two relay coils each wired in parallel and one with one relay coil, so here is my solution for the single relay antenna input module:

All you require is a 3/4 inch by 1-3/4 inch piece of insulating tape, e.g., Scotch Magic Tape®.

Remove the antenna input module, keeping track of where the two short and two long Philips head screws with split lock washers belong. Unsolder the two relay coil wires. Observe the two little insulated pins being pushed when manually activating the relay. During disassembly and reassembly, hold the module such that these two pins are held by gravity down toward the relay coil. Remove the six small slotted screws. Gently pry the coverplate off, straight out, then sideways (bending the neon lamp wire). Observe that the three contacts would move to case ground upon relay activation. Place your piece of Scotch tape on the case ground surface and smooth it down with a toothpick.

During reassembly, remember to hold the module so that gravity holds the insulated pins down.

Verify that all three mini-BNC and corresponding antenna inputs have zero resistance, but upon manual relay activation each are an open circuit. Resolder the two coil wires and reinstall the antenna input module.

A much simpler solution for the dual relay antenna input module follows:

On the rear panel remove the four same length Philips head screws with lock washers. (You might not need to unsolder the relay coil connection.) Remove the four each small Philips head screws with lock washers from the two side plates. The contact cavity is now exposed. Maneuver a small sliver of Scotch Magic Tape® on the case ground surface. Verify proper operation per the paragraph above, then reinstall. That's it. Now you have one less potential pitfall to keep track of.

Cleaning Small Parts

In my early R-390A days, I built a motor driven tumbler out of a Meccano/Erector set. The container was a lidded tin can. This worked fine, but it was too noisy and I had no coarse sawdust available. It's now parted.

I now use a short glass jar with lid. Load the jar with your parts to cover the bottom. Squirt a little 3-In-One oil over the parts. Put the lid on, rattle and shake the parts so that they roll over each other. The more the better. I shake it intermittently over a of couple days.

Periodically wipe off the dirty residue on the walls of the jar with facial tissue. Add a squirt of fresh oil. You may need to do this several times. Keep shaking. Your screws, nuts, washers, springs and slug plates will appreciate it. When satisfied, dump the lot onto several layers of facial tissue and another layer on top. With the palm of your hand, do a rolling motion. The tissue will absorb most of the oil and residue. I use a glass container so I can watch the progress of the cleaning. I did once shatter a glass jar because I was too vigorous.

Synthetic Steelwool

I have always avoided the use of steelwool. It's messy, uncontrollable and the metal debris can too easily contaminate me and the working environment.

Relatively recently I discovered Glit® Finishfast synthetic steelwool[3], which I find great for cleaning and scouring. It's available in #2 and #000 grades, and is sold in packages of two 6"x 9" pads. For example, my mainframe sidepanels were ideal candidates for using a Glit® #2 pad. First, use a 6-inch fine flat mill file to smooth all nicks around the panel edges.

For a working surface, I use an old terry cloth towel spread out next to a sink full of clean water. Soak one of these pads in the water. Then push the pad hard with long sweeping strokes back and forth. Just like steelwool, it does leave scouring marks, so be mindful of the pattern you're creating. Rinse your pad in the sink and repeat until you are satisfied with the results. As necessary, drain and refill the sink with clean water. It's a slow but rewarding process.

I also redid my front panels, which had been finished with #600 wet sandpaper, with the Glit® #000 product. What a pleasure! I obtained a satin finish which is far less reflective (hardly any fresnel lens effect).

Front Panel Scratch Protection

To protect my front panel satin finish from my finger nails while manipulating the KC or MC change knobs, I used a plastic disk from a video tape cassette as a shield. Find a cassette with clear plastic reels where the reel has only small cut-outs close to the center and the disk is only fastened by thermoplastic rivets and NOT additional solvent (glue). (This design was hard to find). Use your finest close cutting side cutter and snip off the plastic rivet heads. Use a narrow blade Xacto knife and cut the rivet residue flush with the clear plastic disk. Resolutely but gently pry off the round clear disk. Use a half inch tapered reamer and carefully enlarge the center hole for your grommet. Gently insert the grommet. Remove your KC or MC knob.

Push the shield grommet and rotate it onto the shaft, put the knob back on. Pull and rotate the shield towards the rear of the knob. The rubber grommet should not touch the frontpanel bushing (would add friction). I used a rubber grommet with chassis hole 7/16, grommet hole 5/16, from Antique Electronic Supply, part number P-G717.

Injection Molded Knobs

Try as you might, the knobs are always mounted crooked and therefore wobble upon rotation. This makes a great receiver look and feel cheap. The 1/4 inch shaft hole has a groove opposite the set screw. This is crazy. This groove plus the necessary chamfer of the shaft hole cause the knob fit to be crooked. I tried putting a special brass sleeve in the shaft hole to greatly reduce the play but this sleeve did not work on all of my knobs. Some knobs remain a sore point.

To make the sleeve, clean out the shaft hole with a 6.5 mm twist drill (or better yet, use a "G" drill). From a hobby store, get a sheet of 0.005-inch shim brass. With a pair of scissors, cut a piece 28/64 by 51/64 for a large knob or 26/64 by 51/64 for a small knob. Shape the sleeve by bending it around a pot shaft with the fold on the outside. Insert the sleeve in the shaft hole such that the open edge is in the groove. Knob holes and shafts have a tolerance so if one is too tight, try another match. (On the flat shafts this sleeve is probably not reusable.) Sorry guys and gals that's the best I can come up with, pouring epoxy or machine shop work are not an option for me.

Crystal Oscillator Module T401 Alignment

TM-390A omits the alignment procedure for T401. TM-390 page 94 includes the procedure. (R-390 T402 = R-390A T401.)

Preset the receiver controls to TM-390A paragraph 36. Connect your negative reading high input impedance analogue voltmeter to the diode load. Set the MC counter to 31 Mc. Turn the function switch to CAL, calibrate say at 500 kc then BFO off.

Screw the slug of T401 out until only one peak reading on your voltmeter is obtained, while turning the trimmer capacitor 31 throughout its entire range. Set the trimmer capacitor slightly away from the position of peak reading, adjust the slug of T401 for peak indication. (You are peaking for the 2nd harmonic of the

17 Mc crystal, i.e., 34 Mc.) Adjust all other 23 trimmers as per the TM-390A procedure, paragraph 74, page 114. Of course, a digital counter and/or an oscilloscope is much preferred.

Balance the Antenna Input

TM-390A omits the procedure to balance the antenna input, but the following procedure appears in TM-390 on page 98. Precondition: your receiver is aligned and working.

Connect two 68-ohm resistors in series and connect the free ends to the balanced 125-ohm antenna input terminals. Connect the output lead of the signal generator to the junction of these resistors. Be sure that the ground lead of the signal generator is connected to the receiver chassis.

Tune the receiver [to the frequency listed below] and then tune the signal generator to this frequency for peak receiver output diode load. Adjust the trimmer capacitor closest to the front panel of the transformer listed below for MINIMUM output. During the alignment procedure, change the setting of the signal generator attenuator to increase the output indication to approximately negative 5 volts at the diode load.

Adjust the balance trimmers in the order shown in **Table 2**.

My goal is having a R-390A that performs better than a brand new one. While I spent some time on externals, I found scope and real satisfaction in realizing my concept of the designers' intention. I have some way to go. It's the journey that is important for me. I'll be sad when it's all over.

Acknowledgements

Without the patient help from my XYL you would not be reading this. Thank you Lise.

I owe a big thank you to ER for inspiring me late in my life.

P.S., without me knowing exactly what I wanted and Fair Radio's cooperation as my supplier, I would not have two R-390As which meet my mechanical standards or the necessary spare modules for parts. Thank you all for your good service.

References:

[1]LaBelle Lubricants have been the preferred choice of model railroaders for over 35 years. LaBelle Lubricants are formulated from the finest raw materials

[Counter reading]	Transformer (front trimmer)
00 950	T201
01 900	T202
03 600	T203
07 500	T204
13 500	T205
31 500	T206

Table 2: Counter readings vs. trimmer locations.

available and are specifically designed for miniature motors and tiny gears. Many of the LaBelle Lubricants recommended for model railroaders are exactly the same as used by NASA in the space program; Ford Motor Corp; Chrysler Corp; Singer/Fredon & Wurlitzer. LaBelle Lubricants were some of the very first in the USA to include micro-powered lubricates mixed directly into the lubricant.

Labelle lubricants are available in most hobby shops, or directly from distributors such as:
Wm. K. Walthers, Inc.
1-800-487-2467 or 1-414-527-0770, 8AM-5PM CST, Monday - Friday.
Internet: www.walthers.com

[2]Litz wire and iron cores were commonly used to produce coils with Q values of 100, or more. Litz wire with a large number of strands was useful in obtaining maximum Q.

The use of Litz wire began because the high frequency AC field of a coil produced eddy currents in the metal of the wire, which were then superimposed upon the desired flow of current. The first effect was for the current to concentrate at the outside surface of the conductor, leaving the interior relatively idle. In a coil where there were numbers of adjacent turns carrying current, each had a further influence upon its neighbor.

In turns near the center of a coil, the current concentrated on the surface of each turn where it was in contact with the form, i.e., at the minimum diameter. In turns at either end of a coil, the maximum current density occured near the minimum diameter of the conductor, but was displaced away from the center of the coil.

Thus, most of the conductor was going to waste. Multi-strand, or "Litz" wires, were developed to meet this difficulty. "Litz" is a shortened version of Litzendraht, a German word meaning "stranded wire." For use in shortwave coils, several strands of number 44 AWG copper wire were woven together, each being of a small cross section and were completely insulated by an enamel and silk covering from its neighbors. 5, 7, 9, and 15 strands were common. Owing to the weaving of the strands, each wire carried a nearly similar share of the total current, which was then forced to flow through a larger effective cross section of copper. The former tendency towards concentration at one side of a solid conductor was decreased, and the copper losses were correspondingly reduced.

Litz wire was most effective at frequencies between 300 kc and 3 Mc. Outside of this range, comparable results were usually possible with round wire of solid section, because at low frequencies the "skin effect" steadily disappeared, while at high frequencies it was large, even in the fine strands forming the Litz wire, and was augmented by the use of strands having increased diameter.

At the lower frequencies (up to about 1 or 2 Mc) Litz wire was advantageous for obtaining high Q values, but anything greater than about Q = 120 required some care in the transformer construction, and the size of can selected materially affected the value obtainable.

(Editor's note: Compiled from the Radiotron Designer's Handbook, 4th Edition, 1953.)

[3]One possible U.S. distributor of Gilt Finshfast products is:
New England Maintenance Depot
125 Frank B. Murray St.
Springfield, MA 01103
800-942-2473

ER

Ham Radio's Twins

The Knight Kit R-100A and T-150

By Harold Smith, W4PQW
1435 Bush St.
Pensacola, FL 32534

In my collection of twin radios, I am the proud owner of the Knight R-100A receiver and the T-150 transmitter. These units came out in 1962 and were sold in kit form by Allied Radio of Chicago, IL. They sold for about $100 each—about a week's pay for a working guy at that time.

A lot of new Hams with limited budgets were able to put these together and get on the air and enjoy Ham radio. Plus, it gave a great sense of accomplishment in being able to assemble these units, turn them on, tune them up and start having QSOs. There were designed to work 80 through 10 meters using AM and CW modes.

When you look at the inside working of these sets, it is obvious that quite a bit of sound engineering went into the design of them. They were designed to be simple, reliable, and stable with good performing circuits and components. They are very attractive in appearance, having two-tone panels with gray cabinets and matching black knobs with metal inserts.

R-100A Receiver Features

My Knight R-100A is a nice working, friendly receiver that you can "fall in love with." It is basically a 540 kHz to 30 MHz general coverage set with a bandspread on the 80, 40, 20, 15, and 10-meter Ham bands. Printed circuit boards were used in the RF, IF, and audio stages—the early years of printed circuit boards. It has a built-in Q-multiplier, variable selectivity, delayed AVC, and an automatic noise limiter. The "S" meter and crystal calibrator were optional.

The R-100A has a built-in 120 VAC power supply and requires an external speaker. The tube line-up is a 6BZ6 RF amplifier, 6BH8 oscillator/mixer, 6AZ8 1st IF, 6AZ8 2nd IF, 6BC7 detector, delayed AVC and noise limiter, 6AZ8 1st audio, 1/2-6AW8 power amplifier. The other 1/2-6AW8 is the BFO. In addition, it has a 12AX7 "Q" multiplier, and an 0B2 voltage regulator for the VFO. The rectifier is a 6x4. This is a good tube lineup for a simple receiver.

The Knight R-100A Receiver

Of course, there's plenty of room for improvements; some modifications that would certainly add to the performance would be "double conversion" and a good "IF filter," and perhaps a product detector. There is plenty of space at the top and bottom of the

Allied Radio advertised the Knight-Kit T-150 kit transmitter in many Ham magazines, such as the one above that appeared in the May 1963 QST.

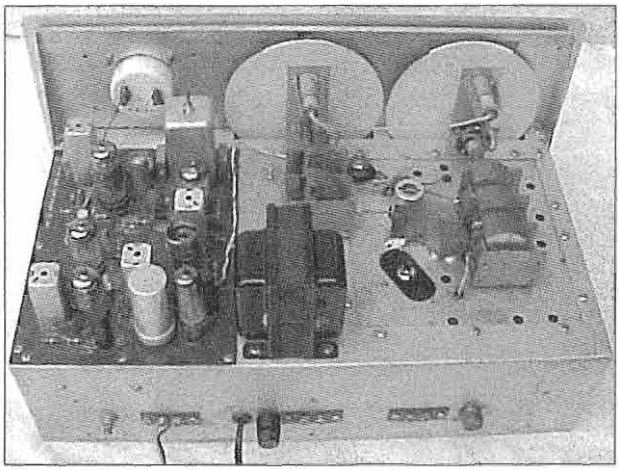
chassis. It is not at all crowded.

When the R-100A came out about 1962, this was also about the time that Hammarlund brought out the HQ-100, Hallicrafters had the SX-110, and National's entry was the NC-125. All of them sold for about $200.00. The Knight R-100A sold for about half of those prices, but with about the same specifications. The R-100A came in kit form.

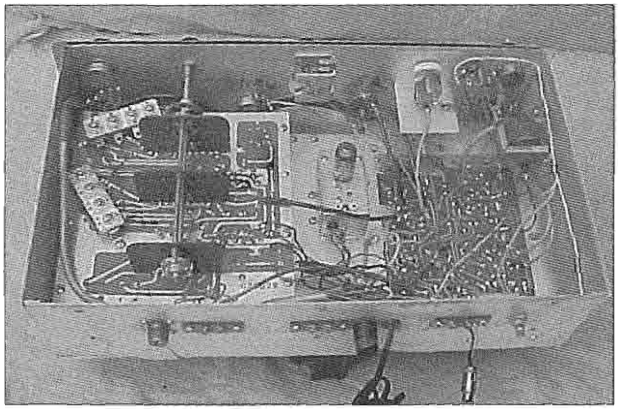
T-150 Transmitter Features

The transmitter also is very basic in design. It works 80, 40, 20, 15, 10, and 6 meters in the AM and CW modes. Power output is 90 watts on 80 through 15 meters, 55 watts on 10 meters, and 40 watts on 6 meters.

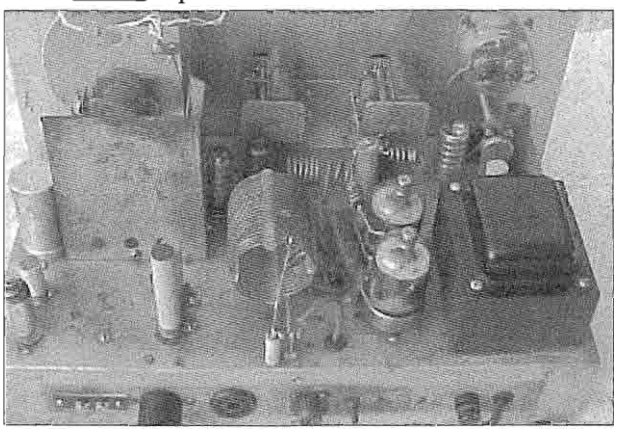
The T-150 tube line-up is: 12BY7 VFO, 6CL6 crystal oscillator, 7189 buffer/multiplier, 12AX7 speech amplifier, 6DR7 modulator, and an 0A2 as a voltage regulator. There are two 6146s in the RF output "PA," and it has a PI-network output. There are large and easy to read



Above: The R-100A receiver is shown above with the cabinet removed.



Above, bottom view of the R-100A receiver chassis. Note the printed circuit boards on the right and left sides. Below, top view of the T-150 transmitter chassis.

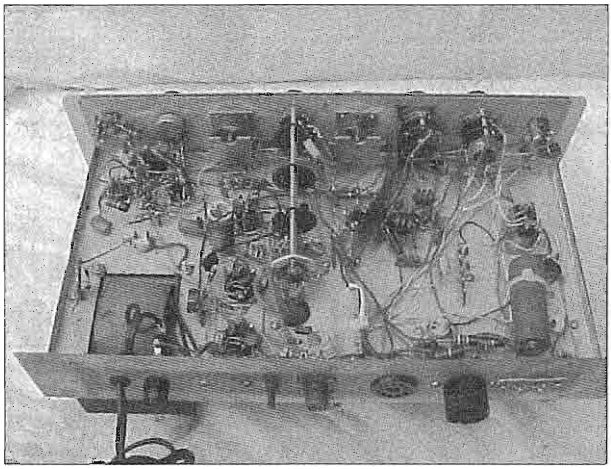


panel meters that show buffer grid, final grid, final plate, and relative output power. "VFO" or "XTAL" can be selected on the front panel, and there is a built-in 120 VAC power supply.

The most unique feature of the T-150 is the screen modulation system. This is a low cost, simple system of AM modulation where the 6146 power amplifier tube's screen grids are acting as a driver at the audio rate, or in other words, the screens derive their operating voltage from the single 6DR7 modulator tube. Actually, the PA screen voltage reaches a level of approximately 150V.

The secret to getting a high percentage of modulation (about 90%) with fairly low distortion at voice frequencies is by driving the screens from a low impedance source. In this case, it is driven from the cathode circuit of the 6DR7 modulator tube, a low impedance point.

In the 50s and 60s, a lot of manufacturers, and some Hams, worked with several schemes to perfect screen-modulation techniques. Most of those resulted in questionable performance and excessive distortion. Needless to say, screen modulation developed a "not so good" reputation.



Above: Bottom view of the T-150 transmitter chassis.

The modulation system used here is obviously well designed and matched up right. As a result, this transmitter, when properly loaded and tuned, sounds really good. It sounds like any other AM modulation and looks good on a monitor scope. I don't believe people listening can tell that it's not regular plate modulation.

If you decide to operate the T-150 you will want to install "push to talk." Note: I don't consider "push to talk" a modification; I consider it a necessity, right? My PTT modification is shown below in **Figure 1**.

To sum up this review, I am impressed with the design and construction of this equipment. I am amazed at the ease of operation and the good signal reports I receive on AM.

For a person that wants to break into the fast-growing field of AM with a nice, matched receiver and transmitter at a modest cost, this could be it. I recommend it.

ER

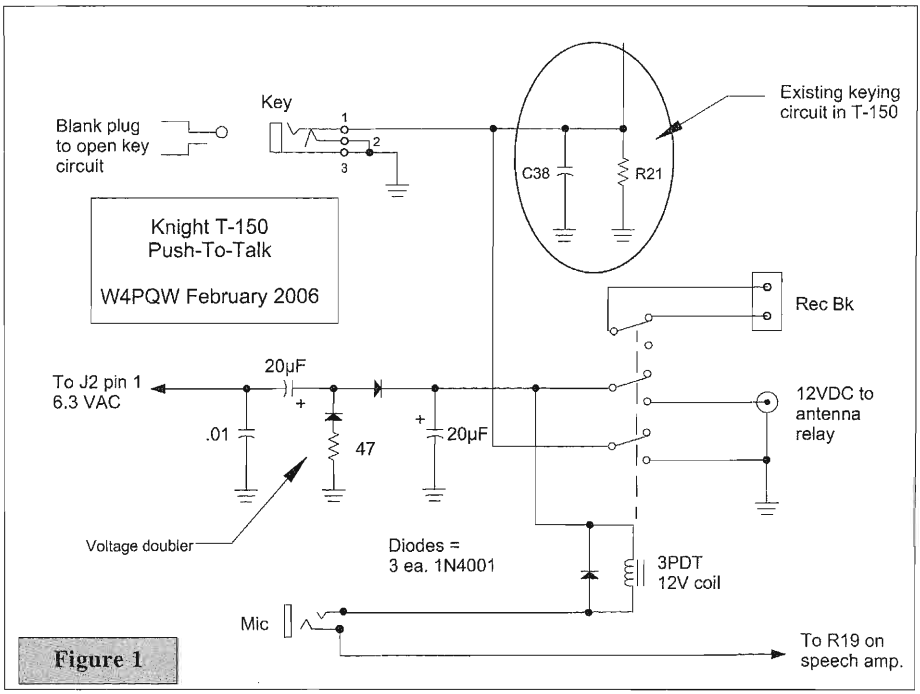


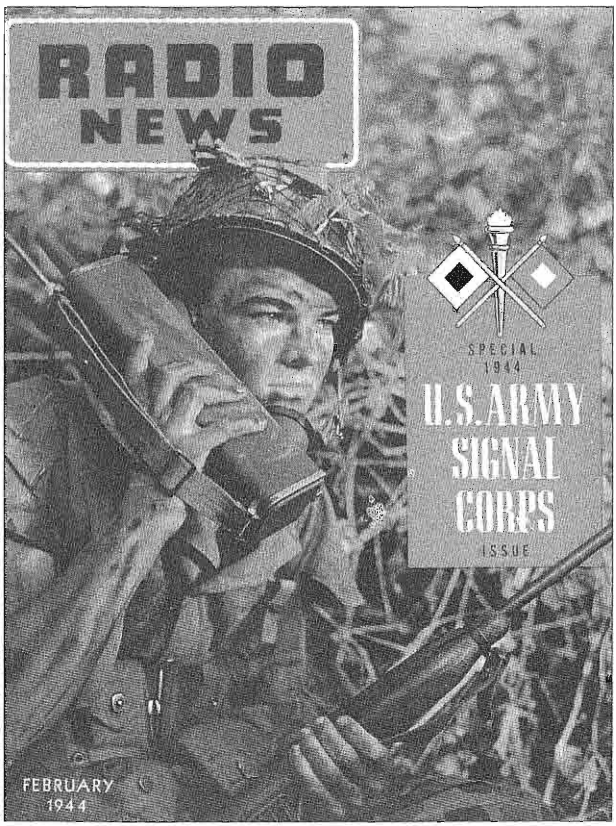
Figure 1

BC-611s, Motorola, and Patton

By Jim Riff, K7SC
9411 E. Happy Valley Rd.
Scottsdale, AZ 85255
K7sc@arrl.net

During my career at Motorola, I was fortunate enough to have been able to be involved with many aspects of the company, and in that way I was able to assist in setting up a corporate museum. The Galvin Museum (now closed to the public) is a historical and current portrayal of the developments of the company. Located in Schaumburg, Illinois, this 300,000 sq. foot building contains displays and the archives of the company back to 1928. When doing research for several exhibits I stumbled upon some data on the BC-611s that Motorola developed and produced during WWII.

Prior to the invasion of Italy, an urgent visit late one Friday afternoon by the U.S. Signal Corps. to the engineering offices of Motorola, then located at 4545 Augusta Blvd. in Chicago, had an unusual outcome. The request was for 500 BC-611 walkie-talkies on a rush basis. At first, the request was refused by the sales department, as the current Motorola factory was at full wartime capacity. A few moments later Mr. Paul Galvin, the president of Motorola, received an urgent phone call from an "unnamed government office." Mr. Galvin then replied to the Signal Corp officer that his company was now at the disposal of the U.S. Army, and that anything they needed Motorola would supply. This was no simple request, as the BC-611s must be on frequency, 7,050 kc, and ready to ship in two days. Since Motorola was capable of cutting their own crystals and had excellent support from their many Chicago based suppliers, a gallant attempt began. Managers, cooks, payroll staff, etc. were pressed into service picking up and delivering parts from suppliers from all over Chicago. Assembly was spread onto cafeteria tables and office desks all over the building.



Left: Figure 1

Under the direction of John Mitchell, chief engineer of military products,

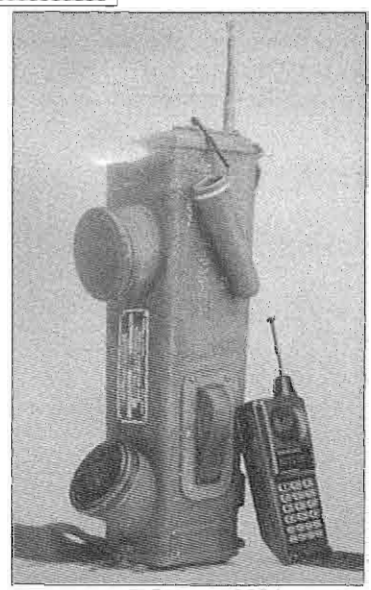
troops direct communication with Patton's armored vehicles for the invasion of Italy (**Figure 1**). Because of these efforts and several others, Motorola was issued the Army-Navy "E" award flag that flew proudly in their lobby all during the war (**Figure 2**).

The story does not end there, as several BC-611s were then used in company advertising to symbolize the relationship of that first portable with their then emerging cell phone business (**Figure 3**). Several BC-611s are on display in the Motorola museum including one emotional example containing a rather large bullet hole that completely penetrated the case; allegedly the unit still functioned.

Above left: Figure 2
Below: Figure 3, captioned "Like Father, Like Son"

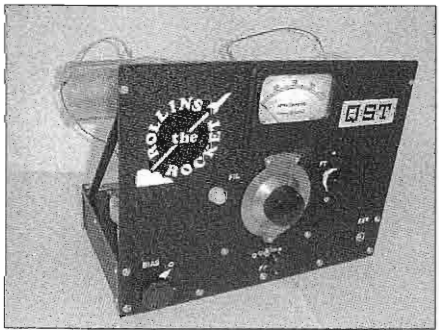
all plant personnel were asked to work the weekend, including engineers, production line staff, office staff, and managers. Dinner and lunch were provided to all shifts on premises, and all hands were pressed into service assembling radios. Late Sunday evening, two Army trucks left the Motorola docks loaded with 500 BC-611s and all of their support accessories. Arriving at Chicagoland Airport (now Midway Airport), they loaded the radios onto a waiting B-24 heavy bomber. According to records released after the war, the B-24 lifted off at 2200h and refueled in Miami, then on to Brazil, and then across the Atlantic to Morocco.

These radios were then issued to 3rd Army personal under the command of General George Patton, giving the ground



PHOTOS

Here is W4PQW's shack as it looked in 1953. ER author Harold Smith, at that time, was using a Globe King transmitter, a Meissner signal shifter, a military surplus crystal calibrator, a National NC-240D, a RME VHF 152A converter, and a National HRO receiver.



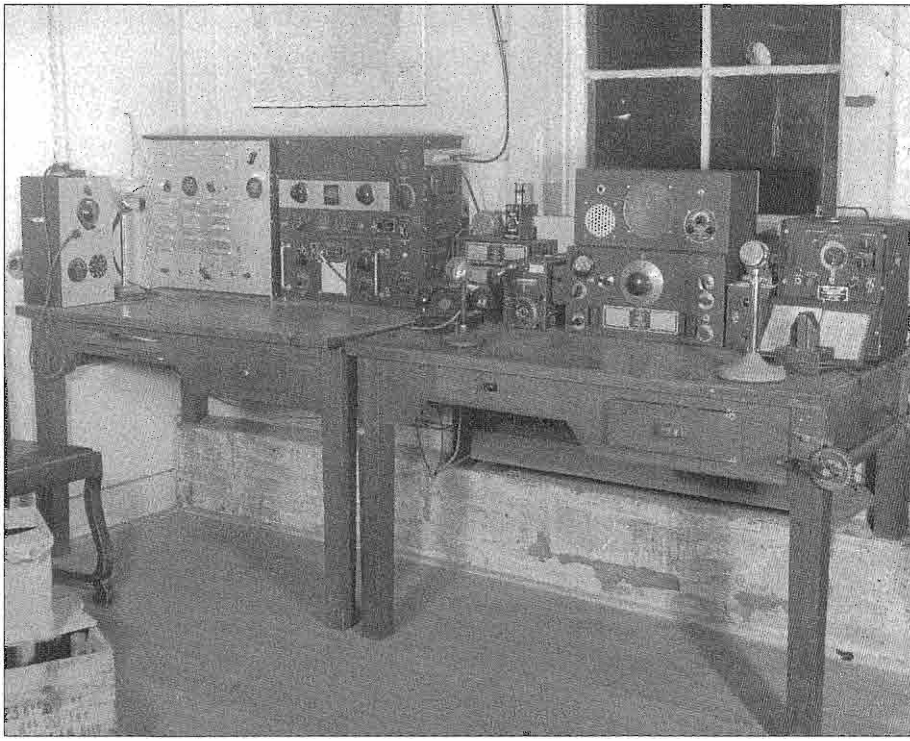
(We will have more about the "Rollins Rocket" in a future issue of ER...ed)

Left: Ed Swynar (VE3CUI) built this rig and named it the "Rollins Rocket," "...in honor of John Rollins (W1FPZ), the tireless fellow who annually compiles the results of the annual A.W.A. '1929 Bruce Kelley Memorial QSO Party.' John seems to be the perennial SOLE user of the Colpitts oscillator in this event...his stalwart and unwavering dedication to the design caused me to ponder the advantages of the Colpitts over the near-universal Hartley. John's enthusiasm — and a handful of old (near-spent!) 211 & 203A triodes that I had here — were all the inspiration that I needed to 'roll my own' version of the Colpitts."

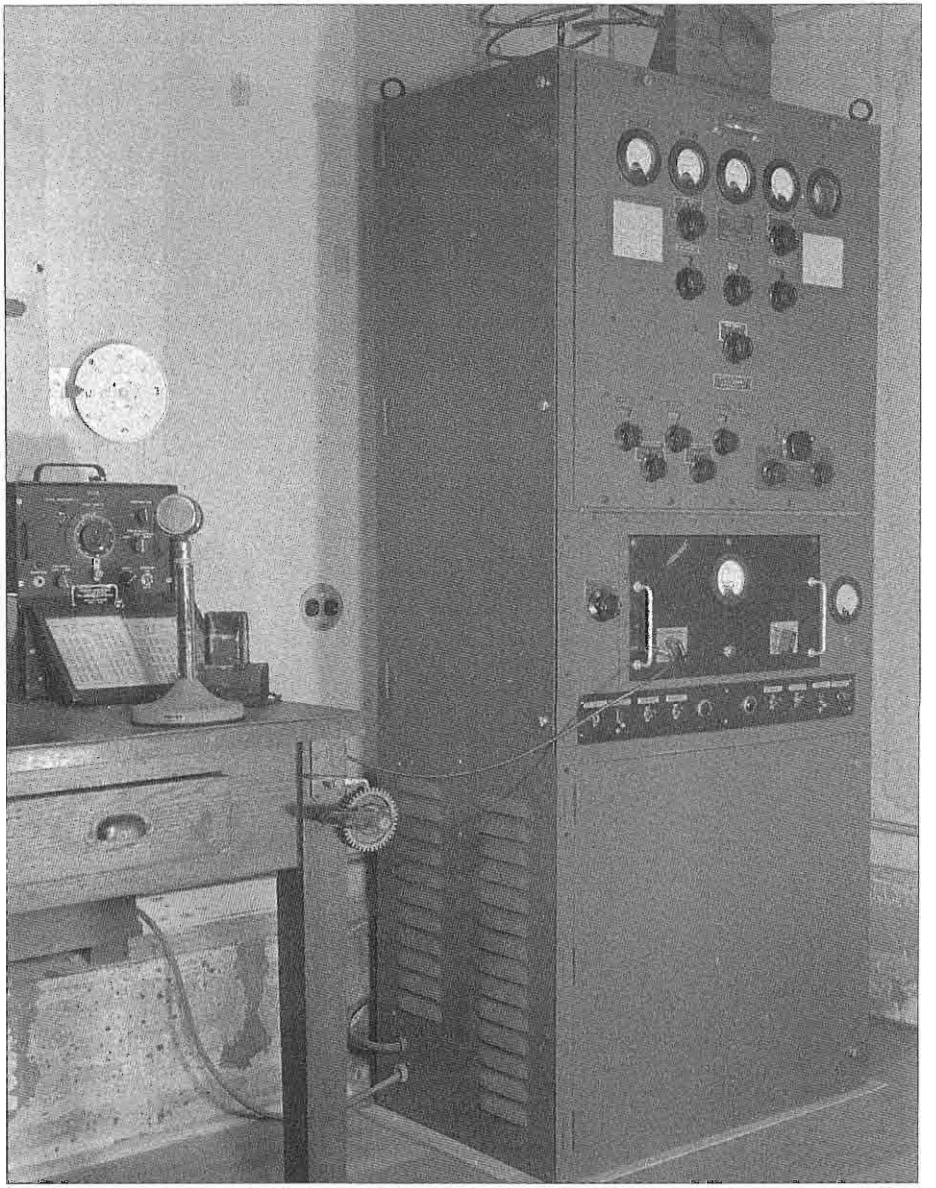
Above: Robert Evans (WW9W) is an active AM operator located in Punta Gorda, Florida. Robert's excellent station consists of a Hallicrafters BC-610E, two Collins 32V-2 transmitters, a 75A-1 and a 75A-2. The Collins equipment was restored by Howard Mills at the W3HM Radio Lab, in Harpers Ferry, WV.

Below: Received at ER from one of those two old rascals, Towers and Duncan.

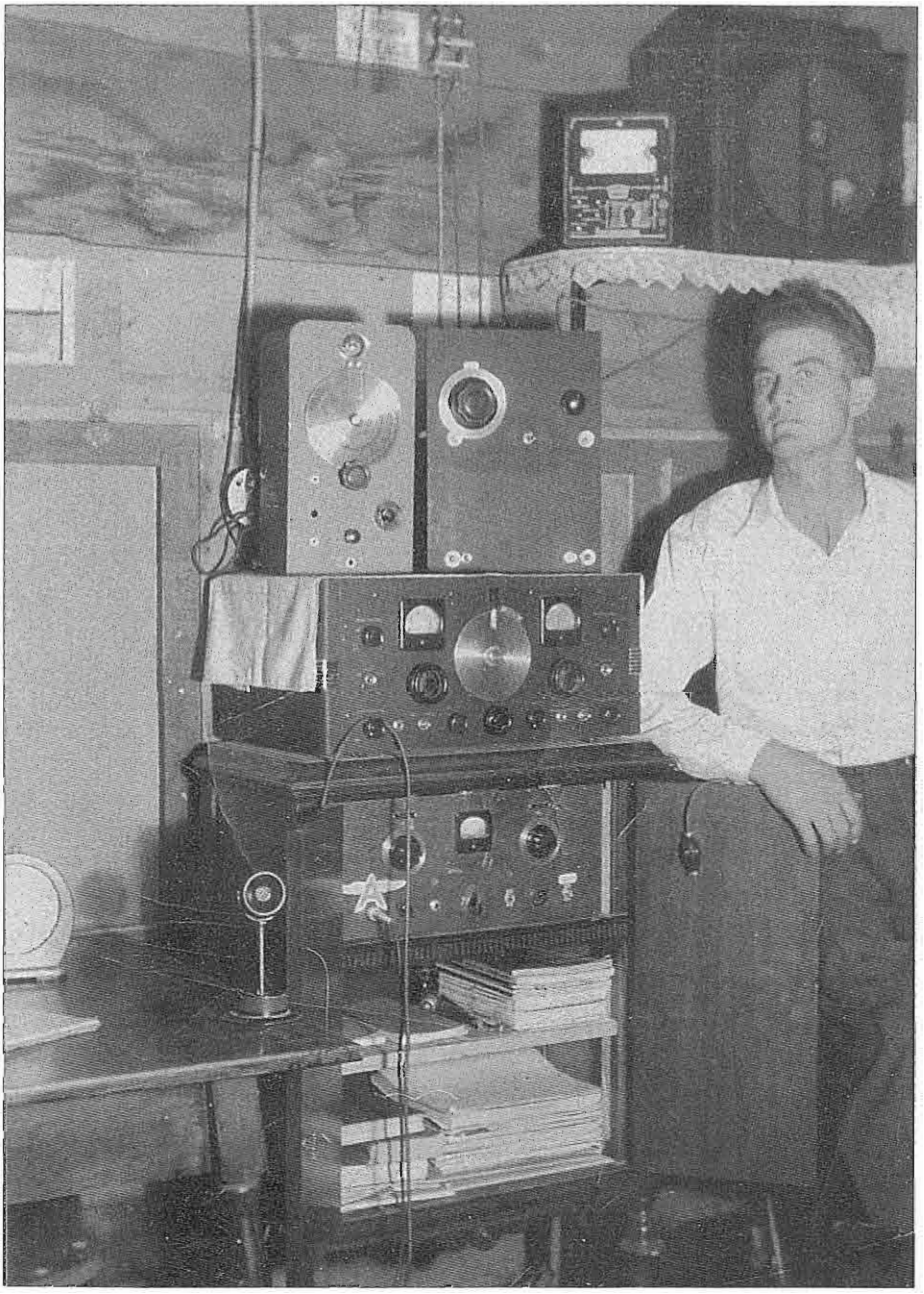
W5JCO, New Orleans, 1949



The photos and text on this and the facing page are presented through the courtesy of Dan Brown (W1DAN). As Dan has described these historic photos, "...These two photos of Mick DeBen's (W5CJO) basement shack in New Orleans were taken in 1949. Now a SK, Mick started my interest in AM and my longtime love of the National HRO receiver. When I obtained my General license as KA5DNH in the early 1980s, I would chat with him and W5EDY on ten meters AM on Sundays. Mick would use a BC221 as a VFO into a BC375 transmitter that used four type 211 tubes in a MOPA configuration. His other transmitter that he used on 80m CW and AM was a TBY with homebrew 811 modulator built into the receiver compartment. His receiver was an HRO-M that he built a power supply for, changed the glass tubes out to metal ones, and replaced the wax paper caps with ceramic caps. He converted an AN/ARN7 direction finding compass receiver to a Q5-er. Mick stuck a piece of the compass antenna wire into the last IF of the HRO, where the AN/ARN7 would be tuned to 455kc to provide a tighter IF with more gain. This receiver setup is at another ham's QTH near New Orleans and works to this day."

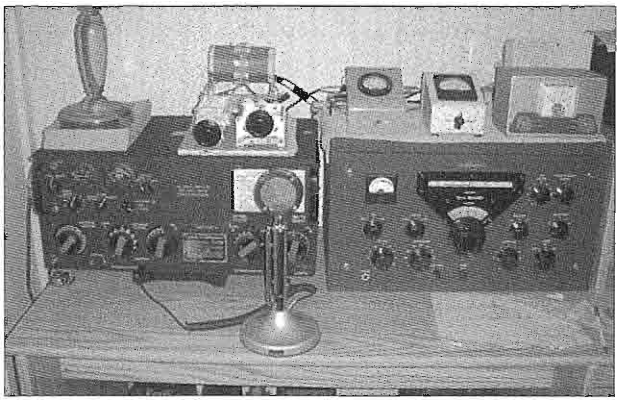


Above: Another view of Mick DeBen's New Orleans shack shows his big TBY Navy transmitter. The homebrew modulator is in the second panel from the bottom, where the receiver would have been. Notice the four steel lifting lugs at the top of the transmitter!



Above: Sylvan Smith (W7IFJ) at his station sometime after 1936. The two pieces of equipment on top of the Hallicrafters Super Skyrider are test equipment. Under the SX-17 is a homebrew transmitter built by W7IFJ. Sylvan is 91 and still active, but not on the air. (Photo courtesy Cliff Appel, W7CGA)

A group of Midwest Hams got together last August 15 for a eye-ball QSO at the Lake Pepin, Wisconsin, home of Butch Schartau (KØBS/9). They call themselves "Widebanders" and all are vintage AM and military radio fans. A In the group photo above are rear, standing, left-to-right: Duke (W9GDW), Ed (KØBKA), John (K9XH), Jim (W9ADJ), Robert (WØVMC, a.k.a. WØ-Voice Modulated Carrier, or if it's Christmas time, WØ-Very Merry Christmas), George (WB5WUX), Butch (KØBS), Front, kneeling, left-to-right are Mike (WØWG), Joe (KB9R), Marlin (WJ9Y). Also attending but not shown in the picture was Skip (K7YOO). (Photo and story courtesy of Mike Warren, WØWG)



Here is Butch's summer operating position at Pepin, WI. He uses an ART-13 WWII aircraft transmitter with a homebrew antenna tuner and wattmeter, and a 75A-4 does the receiving duties. On the shelf below the desk is a homebrew power supply for the ART-13.

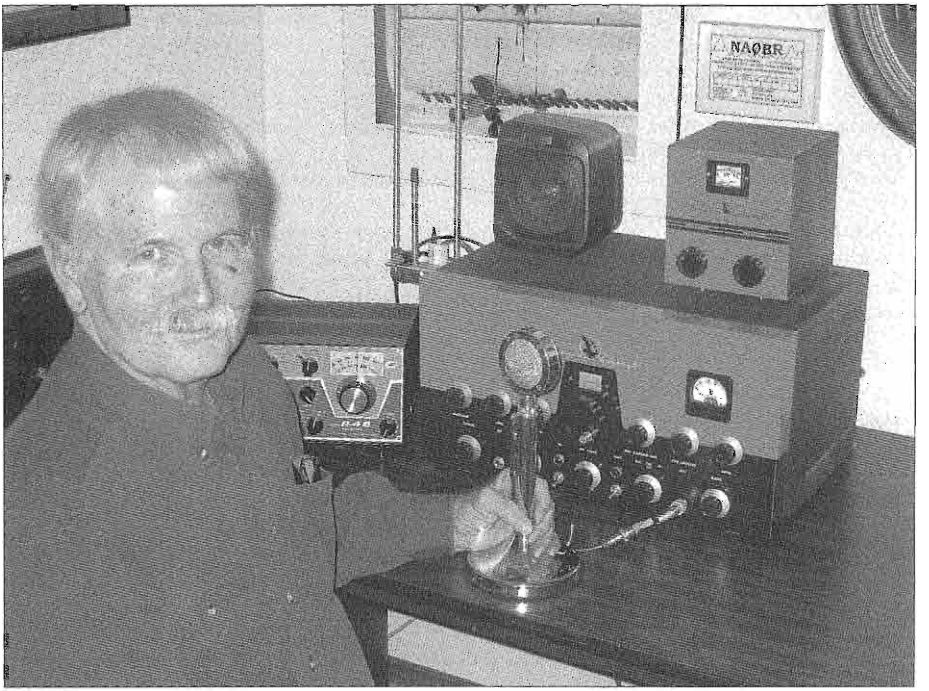
Above: On September 17th, 2005, Joe (W3GMS) and Martha (N3QBE) Fell, of East Fallowfield, PA, hosted the 2nd "AM Radio Bash" at the W3GMS studios. As Joe described it, "During the event, we had our guest studio in full swing, which gave us 3 extra talk positions. During the session W3GMS was active on both 80 and 40 meters. An outside grill kept all well fed during the event. From left to right are: Stan, (W3YGC), Fran (W3SCC), Joe (W3GMS), Gary (W1GHW), Bert (WA3JYU), Bill (W3DUQ), Joe (N3IBX) and Al (KZ3AB)."

Below, left: Fran (W3SCC) was running the board while guest operators KZ3AB, N3IBX and WA3JYU occupied the guest operating seats.

Above right: George Rancort (K1ANX) attended the Hosstrader's Hamfest in the fall of 2005 and found a lot of great vintage amateur and military radio equipment for sale, such as the load in the pickup shown here. The equipment looks like it is in great condition and could be put to use right away.

Below, right: Bruce Reed (NAØBR) is Colorado's newest AMer, operating from the high plains at Byers, due east of Denver. Here he is shown with his Johnson Viking and VFO 122, restored by Mike Sell, KØCOM. Bruce has been active on 3875 kc during the Colorado morning AM net. (photo courtesy Mike Sell, KØCOM)


150·YRZ


NAQBR

VINTAGE NETS

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.

BFO CW Net: Tuesdays, 7PM local ET, 3693 kc. QSX WY3D in Southern NJ. Vintage gear welcome!

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: Tech./swap sessions every Sun. on 14.263 Mc @ 2000Z. Informal ragchew nets meet Tue. evening on 3805 kc @ 2100 Eastern time, and Thu. on 3875 kc. West Coast 75M net is on 3895 kc 2000 Pacific time. **10M AM net starts 1800Z on 29.05 Mc Sundays, QSX op 1700Z. CCA Monthly AM Night:** First Wed. of each month, 3880 kc starting @ 2000 CST, or 0200 UTC. All AM stations are welcome.

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, 3885 kc +/- QRM. QSX op W3PWW, Ted. It isn't necessary to check in with military gear, but that is what this net is all about.

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. @ 9PM 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: Sat. mornings, 7143 kc, 10:00 Eastern time. 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 is 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's Group Sun. @4PM CT, 14.250 Mc. QSX op Dean (WA9AZK). Technical Net is Sat, 7235 kc, 1900Z. QSX op is 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), Bill (N6PY) & 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. every month on 7270 kc (+/- 25 Kc) @ 1800Z. Alternate frequency 3760 kc, +/- 25 kc. QSX op is Dave (VA3ORP).

CLASSIFIEDS

Advertising Information

Subscribers receive 1 free 20-word ad per month. **Extra words are 20 cents.** Here is how to count the words in your ad: "For Sale" or "Wanted" and your contact information counts as 7 words. Hyphenated words count as 2 words. **Please count the words in your ad as described above, and if you are over 20 words, send payment for the extra words at .20 each.** Note: Not all readers use e-mail, so it is a good idea to include phone numbers. Non-subscribers: $3.00 minimum for each ad up to 20 words. Each additional word is 25 cents. E-mail ads are fine.

Please call or write for display rates.

VINTAGE EQUIPMENT ONLY!

ER
PO Box 242
Bailey, Colorado 80421-0242

Telephone: 720-924-0171
FAX (call first): 303-838-3665
Ray@ERmag.com

Deadline for the March 2006 issue: Saturday, February 25

SERVICE FOR SALE: Repair and restoration on all vintage equipment; over 50 years of experience. Barney Wooters, W5KSO, 8303 E. Mansfield Ave., Denver, CO 80237. 303-770-5314

MANUALS FOR SALE: Military Radio manuals, orig. & reprints. List for address label & $1. For specific requests, feel free to write or (best) email. Robert Downs, 2027 Mapleton Dr., Houston, TX 77043, wa5cab@cs.com

FOR SALE: Elmac AF67, PMR7, M1070 power supply, hand mic, Dowkey relay, electrically restored, manuals $275.Victor Gregowski 8350 Smiths Creek Road, Wales,Mi 48027 vjgreg@bignet.net, 810-367-2087

FOR SALE: Regency M-51A rcvr, 30 to 50 Mc. Telrad 18A freq standard, same as Hallicrafters ET-7. Philco 70 chassis. **WANTED:** Singer MF-5 SPA-100 system. Dean Soderling, 6725 Portland, Richfield, MN 55423, 612-869-9264

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

FOR SALE: Globe Champion.Hallicrafters S36A, and very nice Heathkit Apache/Mohawk. All very clean to mint with audio and power supply mods. Frank KBØW/6, fdellechaie@sbcglobal.net or 916-635-4442

FOR SALE: Tektronix model 7633 scope with plug-ins and cart, $500. Hallicrafters model BR-40 receiver, $125. Bill Garbutt, 2665 E. 5th St., Casper, WY 82609, 1-307-235-4799

FOR SALE: Tektronix service note copy: Troubleshooting Two-Way Radios w/ spectrum analyzer. 28 pages, $25. Ross Wollrab, 229 N. Oakcrest Ave, Decatur, IL, 62522. 217-428-7385. rewollrab@aol.com

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: Radio transmitter BC-458A, Signal Corps, US Army, SN-20120, Western Electric, for parts. RCA aircraft receiver model AVR, 7HLN SN-2947, M15950L, for parts. Guided Radio model A126 amplifier. Kay-Lab decade amp model 102A, gain X100-X1000-X10000. Good transformer: Freed Co MS900020-1, primary hi-pot test 1500v, taps 1-2-3-4 105v-115v-125v. Sec hi-pot test 2500v taps 5-6 6.3V-2A max working voltage 1000V, max altitude 100000ft. Transformer: Burrougas corp. DRA TF1RX 01JB 46997, primary 105-115-125V, 60 cps, sec 1216V-2A, 12.6V 2A CT. Gordon Shimmel, POB 101, Hannawa Falls, NY 13647, 315-265-4638

FOR SALE: Craig eight track stereo recorder, model H-260, complete, clean, good working condition $350. Bogen amplifier model BT-35A, series A-46, complete, clean, $150. Stromberg Carlson amplifier model SAV22, 22 watts output, clean, complete, $200. All about prices include shipping. Albert B. Casolari Jr., 1812 Albany, Springfield, IL 62702, 217-544-2187

FOR SALE: Johnson turns counter dial, NOS, $60. National ACN or SCN dials, NOS, $45. Richard Prester, 131 Ridge Road, West Milford, NJ 07480. 973-728-2454 rprester@warwick.net.

FOR SALE: Heath HR20 & HX20 with manual & power sply $75. Heath SB614 scope with manual, clean, $100. Heath station console with manual $100, clean. Heath SB400 w/manual, clean, gone thru by former factory technician, clean, $225. Heath Marauder transmitter, nice, $150. Heath Shawnee, $35. Hallicrafters model SX11 with matching speaker, clean, $125. John Kistler, KC8DEY, 60803 CR 9, Newcomerstown, OH 43832. 740-498-6193

FOR SALE: Knight microphone KN-4550 (Allied Radio Chicago) similar EV-672 cardioid synamic, 150 ohm or hi-z, circa 1960, polished chrome, no scratches, with cable, no stand. $60. Bob, KD9GI@MSN.COM 815-332-9520

FOR SALE: Military whip antennas, radio receiving set AN/GRR5 $150. Bruce Beckeney, 5472 Timberway, Presque Isle, MI 49777, 989-595-6483

FOR SALE: Hallicrafters "TO" keyer $65. Harvey Wells T-90 transmitter plus p.s. $150. Hallicrafters TW-2000 (transoceanic) $100. DX-60 $60. VF1 VFO $40. Richard Cohen, 813-962-2460

FOR SALE: Heathkit DX60B with BFO. Galaxy 5, station control ***WANTED:*** Super Pro dust covers. Bill Coolahan, 1450 Miami Drive NE, Cedar Rapids, IA 52402. 1-319-393-8075

FOR SALE: Part of 30-year Collins collection including 30K-1, A-line and S-line items, etc. Call or email for details. **WANTED:** Westinghouse "MX" meters, 7.5VCT 5A filament transformer. Gary, K6GLH, 209-286-0931 (CA) or ghal@ix.netcom.com

---

FOR SALE OR TRADE: Complete QST 1915 to now, $6000, price and shipping negotiable. K8CCV, 330-427-2303

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

TUBES FOR SALE: Radio club stock reduction. Tubes from 2A3 to 5692. SASE for price list. E.F. Hayes, WØJFN, 3109 N. Douglas Ave, Loveland CO 80538

FOR SALE: QSTs most years 1930s onward. Most one dollar, state desired subjects, months, years. Charles Graham, W1HFI, 4 Fieldwood Dr, Bedfore Hills, NY 10507 914-666-4253

FOR SALE: Hickok volt/ohm meter M-470A w/leads $35. Midland CB M-77-888 40 ch. w/mic $25. Realistic microphone amplifier (carnaval) $40. Lafayette code osillator M 99-25603 $10.. Bernie Samek, 113 Old Palmer RD. Brimfield, MA. 01010 413-245-7174, bernies@samnet.net

---

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

---

FOR SALE: DRAKE TR-7/TR-7A/R-7/R-7A Service kit. Includes 13 Extender Boards and Digital Jumper Card. $63.85 includes postage. See http://pweb.amerion.com/~w7avk, Bob, W7AVK, 807 Westshore J28, Moses Lake, WA 98837, w7avk@arrl.net, 509-766-7277.

SERVICE FOR SALE: Let's get that old radio of yours working again! Antique Radio Repair - All Makes- Also Transistor Radio Repair. Tom Senne, N5KCL, 937-865-5213

http://tomsradiorepair.bizland.com

ALPHA AMP PARTS FOR SALE: 8877's, chassis, meters, pwr xfr, and more.Bob, WØYVA. Call or email; robert@isquare.com 703-450-7049.

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

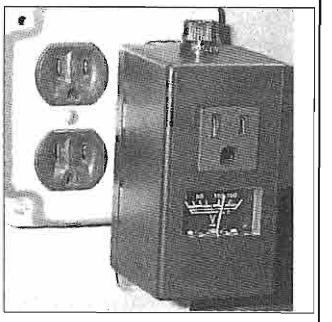
---

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
***NEW! 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. Both models come with a full money-back guarantee.



Model AB1-M

Electric Radio Store
720-924-0171

BUY/SALE/TRADE: Manuals: EICO, National, Knight, Johnson, Hallicrafters, Collins, Heathkit, Hammarlund, Drake, WRL, others. NI4Q, POB 690098, Orlando FL 32869, 407-351-5536, ni4q@juno.com

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

FOR SALE: FT243 CRYSTALS: 3500, 3505, 3515, 3520, 3546, 3548, 3558, 3645, 3686, 3702, 3805, 3825, 3830, 3837, 3855, 3875, 3880, 3885, 3890, 3983, 5355, 5360, 7000, 7025, 7030, 7035, 7037, 7040, 7044, 7045, 7047, 7050, 7060, 7125, 7146, 8025, 8400, 10106, 10116, 10120, 12500, 14060, 14286kHz. See: http://www.af4k.com/crystals.htm or call Brian, AF4K, at 407-323-4178

HALLICRAFTERS SERVICE MANUALS: Ham, SWL, CB, Consumer, Military. Need your model number. Write or email. Ardco Electronics, PO Box 24, Palos Park IL, 60464, WA9GOB@aol.com, 708-361-9012 www.Ardcoelectronics.com

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

HALLICRAFTERS PARTS: Hallicrafters SX101/101A reproduction main tuning knob. Includes silver inlay and set screws. $35.00 Mike Langston KL7CD, 1933 Diamond Ridge Drive, Carrollton, Texas 75010, mlangston@hcpriceco.com 972-392-5336

JOHNSON PARTS: EFJ replacement parts: Valiant tie bolts-4 for $18.50. Ranger tie bolts-3 for $17. 80-2CM mic connector (also for Heath/Collins/others) $10 All ppd. Contact Cal Eustaquio, N6KYR/8, 823 W. Shiawasee St, Lansing, MI 48915, catman351@yahoo.com

DRAKE SERVICE FOR SALE: R.L. Drake repair and reconditioning, most models including TR-7's, 35 years experience. Jeff Covelli, WA8SAJ, 440-951-6406 AFTER 4 PM, 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

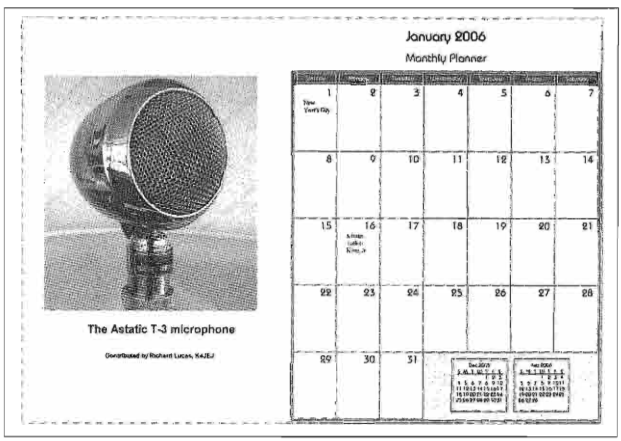
FOR SALE: Obsolete Triplett parts. Send part number and description for possible quote. USA only. Also several tons of transformers, switches, other material that's Triplett surplus. Bigelow Electronics, POB 125, Bluffton, OH 45817-0125

Mil-Spec Communications
R-390, R-390A, R-388 & Other Military Receivers
Sales - Service -Manuals - Parts
Box 633, Englewood, FL 34295-0633
Please call us at: 941-474-6818
FAX: 941-474-7874
milspec39Ø@aol.com
"Since 1985"

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

TUBES FOR SALE: Tested good globe 201A and 226 $14, 227 $10 and others. Slightly weak 226, 227, 245, 280 guaranteed to work in early radios ½ regular price. Write or e-mail: tubes@qwest.net for a new price list or see www.fathauer.com. George H. Fathauer & Assoc., 123 N. Centennial Way, Ste. 105, Mesa, AZ 85201. 480-968-7686 or toll free 877-307-1414

WANTED: National NC-183DTS speaker, NFM-83-50 adaptor and SOJ-3 Selectojet. Contact Ric at C6ANI@arrl.net



The 2006 Electric Radio wall calendar is now available from the ER Bookstore. 12 full color photos of vintage equipment and shacks! $11.95 postpaid! See p. 63 for order information.

SERVICE FOR SALE: Vintage Radio Service. We repair radios, record changers, radios home, auto, tube & transistors. 1930-1980. Ken Hubbard, KA9WRN, POB 792, Beloit, WI 53512. 608-362-1896

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

SERVICE FOR SALE: Authorized repairs and sales of all types of amateur radio, communications, and test equipment. Please 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

SERVICE FOR SALE: Repair, Restore, Sales of antique, vintage tube radios. John Hartman, NM1H, www.radioattic.com/nm1h

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: 160m FT243 CRYSTALS: 1885, 1900, 1915, 1925, 1930, 1945, 1970, 1977, 1985 kHz. See: http://www.af4k.com/crystals.htm or call Brian, AF4K, at 407-323-4178

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

BOOK FOR SALE: Heath Nostalgia, 124 page book contains history, pictures, many stories by longtime Heath employees. (See ER Bookstore) Terry Perdue, 18617 65th Ct., NE, Kenmore, WA 98028

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

PLEASE VISIT: RadioWorld-Online. Come to see our ham gear, parts, and more. Carl Blomstran, PO Box 890473, Houston TX. 281-660-4571.

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

PARTS FOR SALE: Parts, tubes, books, ECT. Send two stamp SASE or email letourneau@wiktel.com for list. Wayne LeTourneau, POB 62, Wannaska, MN 56761

PARTS FOR SALE: Complete hardware set to connect Collins PM2 to KWM2 - $19.95 ppd. Warren Hall, KØZQD, POB 282, Ash Grove, MO 65604-0282.

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

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

FOR SALE: Two plate making computers. Miso mex multinex master. Best offer. Pickup only. Also two motors for same. Hank, 570-654-2347

WANTED: Holtzer-Cabot AN/PSM-2-A Megger in good condition, Mike, VE7MMH, at mike46@shaw.ca

WANTED: BC-458 or T21/ARC5 parts set. Pete Hamersma, WB2JWU, PO Box 467, Holderness, NH 03245, pehamers@worldpath.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: Parts to fix up Trans-Oceanic radios. I need a plastic front panel for a H500. A cabinet would be great if you have one. Need a plastic wavemagnet cover for a 600 series. Need mounting parts for the main carrying handle for the 600. The G500, H500, and all 600 series handles will interchange. Kevin Rutsky, R.D. #1, Box 155, Pittsfield, PA 16340. 814-489-3193

WANTED: Gonset 3201 Power Sply/ Modulator for the G77 Tx and either an R45/ARR7 or R595/ARR7AX. Working or repairable + good cosmetics preferred. Brian Cauthery, VE3DFC, Caledon, Ontario Canada. 519-927-5858

WANTED: SX115, HT32B, HT33B and SP600JX21A. Also cabinet for 51J4 and SX73. Ward Rehkopf, 16173 Indian Valley St., Schoolcraft, MI 49087 269-679-3435. radiohound2@yahoo.com

---

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: Navy WW2 shipboard receivers and transmitters. Need equipment, manuals and general operating information. Receivers of the type RAK, RAL, RBA, RBB, RBC, RLS etc, Transmitters of the type TBA, TBK & TBM (with modulators), TDE TBS etc. Equipment is for the restoration of Radio facilities aboard the USS Alabama (BB-60), now part of the Battleship Memorial Park, Mobile, Alabama. I was a Radio Technician aboard the Alabama in WW2 and would like to hear from other WW2 RTs and Radio Operators concerning radio operating and maintenance procedures aboard other Navy WW2 ships. Please call Stan Bryn, AC5TW, at 1-800-984-9814 week days between 0800-1100 MST. Or email intor@zianet.com.

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: Schematic and info on a USN loop ALR 25, 10kc to 30 Mc, made by Electro-Metrics, NY. KB6BKN@Juno.com

WANTED: Collins 310B-3, basket case OK, 70E-8A PTO per 1948. Chicago CMS-2, pair of Taylor T-21. Jerry, W8GED, CO, 303-979-2323.

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

WANTED: Tektronix **Type 570** curve tracer, any condition. Ron, AA2QQ, 718-824-6922

WANTED: Manual/schematic for Pearce-Simpson Marine Radio "Catalina". J.R. Linden, K7PUR, PO Box 4927, Cave Creek, AZ 85327 480-502-6396, jrlinden@usa.net

WANTED: CONAR Tuned Signal Tracer, mfg for National Radio Institute students. Also radio correspondence courses by National Radio Institute of Washington, DC. George Reese, 380 9th St., Tracy, MN 56175, 507-629-6091

WANTED: Heath SB104, SB102, SB301, SB303, HG108. Hallicrafters SR series transceiver 150-2000. BC348, T195, R392 and others. Jimmy Weaver, KB5WLB, 870-238-8328

WANTED: INTECH COM 6000 Service Manuals: COM3648, COM1000, COM1005 HF SSB Marine radio. Wes, K5APL, 870-773-7424 k5apl@cableone.net

WANTED: Harvey Radio Labs Tri-Tet Exciter or FT-30 Transmitter. $1000 reward! Robert Enemark, W1EC, PO Box 1607, Duxbury, MA 02331, 781-585-6233

WANTED: Any TMC Equipment or Manuals, what have you? Will buy or trade. Brent Bailey, 109 Belcourt Dr.,Greenwood, S.C. 29649, 864- 227-6292 brentw@emeraldis.com

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

WANTED: Bias and filament transformer from HT33 A or B amplifier. John, W8JKS, 740-998-4518

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

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 30th, Oklahoma City, OK 73112. 405-525-3376, bglcc@aol.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.

The Hats Are Back!

By popular request, we are offering another run of the popular Electric Radio 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 caps will hold up for a long time.

$19.95, including priority shipping.

ER Store
PO Box 242
Bailey, CO 80421
720-924-0171
Or on-line: www.ermag.com

WANTED: Looking for a National NTX or NTE transmitter/exciter for use in my vintage hamshack. Any condition, even basket cases or parts, considered. Will pick up in New England, or arrange shipping if outside of area. Paying any reasonable price, and most unreasonable ones! Please email with details or photos, all considered and most likely bought! Thanks! Bruce, W1UJR, 207-882-9969 or w1ujr@arrl.net

WANTED: Schematic and related info on Halowatt TR5 broadcast rcvr made mid-1920s in Portland, OR. Fern Rivard, VE7GZ , PO Box 457, Cranbrook, BC V1C4H9 Canada crc@cyberlink.bc.ca

WANTED: Collins 312A1 speaker, National SW5, Eldico R104 and T102, QSL cards from 1920's, 9CXX or W9CXX. Scott Freeberg, WA9WFA, 327 Wildwood Avenue, Saint Paul MN 55110. 651-653-2054 wa9wfa@qsl.net

WANTED: Commercial or kit-built 1930s and 40s transmitters. Doc, K7SO, 505-920-5528 or doc@cybermesa.com

WANTED: Hallicrafters SX115, SX88, Collins 75A-1, AM broadcast transmitter in New England area, Heath DX100B. Will pay good price for good equipment. w1txjohn@aol.com, 802-775-7632 Eves.

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: Sonar CB transceiver model J23 mobile set. 23-channel, tube-type CB radios, also 23-channel mobile sets. Ed, WA7DAX, 1649 E. Stratford Ave., Salt Lake City, UT 84106. 801-484-5853

WANTED: TCS & TBY Navy radios. Ken Kolthoff, K8AXH, PO Box 215, Craig, MO 64437. Work #913-577-8422.

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

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: WWII Navy GP-7 transmitter in any condition, with or without tuning units or tubes, etc. Ted Bracco, WØNZW, braccot@hotmail.com A.C. 717-857-6404 X306

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: 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: KWS-1 RF section in any condition, or a complete KWS-1 for TLC restoration. Also HT33, prefer operating unit. Gary, K2PVC, 917-359-8826 gschonwald@earthlink.net

The Collins DVD Repair Library

THE COLLINS AND HAMMARLUND VIDEOS NOW AVAILABLE ON DVD!

Now you can work on your classic equipment with the help of these world famous videos but in digital format on your computer or DVD player! All the prices are the same as the VHS video tapes, except for the 75S-3/32S-3 DVD. It is $89.95 as it is now a full 4 hours long and includes the removal and rebuild of the 70K-2 PTO!

With these references on DVD, viewers will benefit from the latest technology in the world of video. You can instantly access whatever part of the video you want without having to fast forward or rewind! There are no more worries about "wearing out" a particular portion of a video tape by viewing it over and over again! Head and tape wear during slow motion and freeze frame are no longer concerns.

Collins KWM-2 ..... 4 hours, $89.95
Collins 75S-3 and 32S-3..... 2 hours, $89.95
Collins 30L-1 .....1 hour, $39.95
Collins 30S-1..... 1 hour, $39.95
Collins KWS-1..... 2 hours, $39.95
Collins 75A-4..... 2 hours, $89.95
Collins R-390A.....7 hours, $109.95
Collins R-390A Addendum.....2 hours, $49.95
Hammarlund SP-600JX.....4 hours, $89.95

Shipping within the US: $5.95 each for the first two DVDs, additional titles are shipped free.

NOTICE:

We Are Closing Out The Collins Video Tapes. The Remaining Titles Are Available As Priced Below, While Supplies Last:

Collins 30S-1: $27.97
Collins KWS-1: $27.97
Hammarlund SP-600JX: $62.97
Closed-out tapes are shipped free.

ER BOOKSTORE, PO BOX 242, BAILEY COLORADO, 80421-0242
720-924-0171

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

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

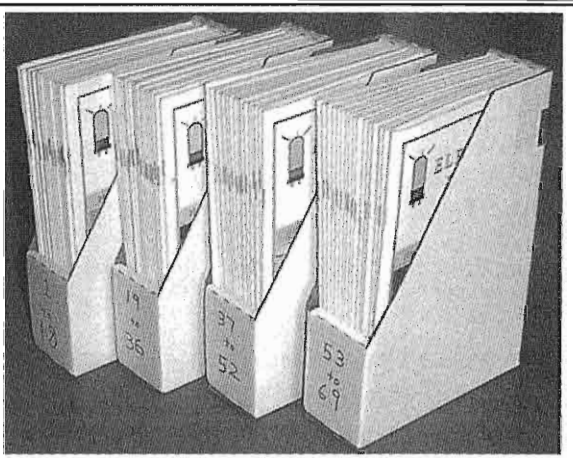
WANTED: Hammarlund ED-4 transmitter. Any condition or information. Bob Mattson, W2AMI 16 Carly Drive Highland NY 12528. 895-691-6247

WANTED: Circuit for the "Mitey-Mite" transmitter-receiver. Harold Schaffner, W2GMX, 519 Perine St., Elmira, NY 14904.

WANTED: Scott Special Communications rcvr. EA4JL, please call Kurt Keller, CT, 203-431-9740, **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: PYE, Fairchild, Syncron, Langevin. Richard P. Robinson, PO Box 291666, LA CA 90029 323-839-7293 richmix@erols.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: SCR-602 components, BC-1083, BC-1084 displays, and APS-4 components. Carl Bloom, 714-639-1679

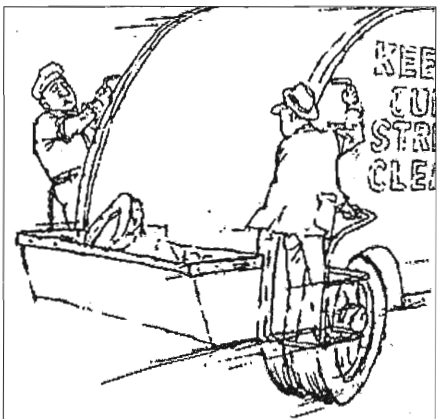
WANTED: Western Electric horns, speakers, amps, and mics. Barry Nadel, POB 29303, San Francisco, CA 94129 museumofsound@earthlink.net

WANTED: Wirewound power resistors with slider, 25000 to 50000 ohms. Various wattages, higher preferred. Louis L. D'Antuono, WA2CBZ, 8802-Ridge Blvd., Bklyn, NY 11209. 718-748-9612 AFTER 6 PM Eastern Time.

WANTED: TOP DOLLAR PAID: for BC-610i Tuning Units & Coil Units. Also want xtals for AM portions of 75, 40, 20. Rick Brashear (K5IZ) rickbras@airmail.net 214-742-1800

NOTICE: Expert HRO-500 alignment done with modern test equipment (HP, TEK, etc.) 650-529-9180 www.nortrex.net or nortrex@bigplanet.com

Don't forget to say you "Saw It In Electric Radio" when contacting advertisers! It helps Electric Radio and it helps the advertiser.



Of course, there are some days when none of those radios turn up, Mr. Claypool.

Electric Radio Coffee Mugs!

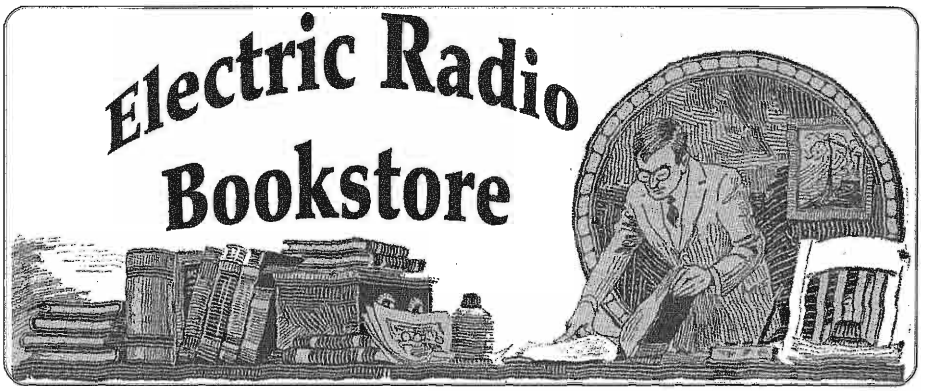
A new item in the Electric Radio Store is this nice 15-oz white ceramic mug with the ER logo in 3 colors and a maroon-red handle and rim. This large mug is perfect for those long roundtable QSOs and holds a lot of coffee!

$13.99, including priority shipping within the US.

ER Store
PO Box 242
Bailey, CO 80421
720-924-0171
Or on-line: www.ermag.com

Electric Radio T-Shirts

The front displays the logo from the cover of ER (the tube logo, Electric Radio, and "celebrating a bygone era"). The back has "Real Radios Glow in the Dark" (used with the permission of Classic Radio). The T-shirts are 100% cotton and come in Small, Large, X-Large, XX-Large. The color is slightly lighter than the cover of ER. $15.50 delivered, $16.50 for XXL.



— BACK ISSUES —

All Electric Radio back issues are either from the original press run or are lithographic reprints from the original negatives. Shipping prices are for delivery by media mail within the USA. Overseas, please inquire for shipping quotes.

- Single issues: **$3.85** postpaid
- 1-year sets (or any 12 issues) **$38.00 per year + $2.00 S&H**
- **Special deal on any four years (or any 48 issues): $100.00 + $4.00 S&H**
- Buy **the entire run** of Electric Radio from #1 for **$375.00 + $8.00 S&H,** at least a 50% discount over single issues.
- For a postpaid 29-page **printed back issue index**, please send $2. Foreign orders please inquire for shipping rates.

— COMPENDIUMS —

All the Collins compendiums are packaged in nice 3-ring binders

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**

Communications Receivers, The Vacuum Tube Era: 1932-1981: This is the classic136 page volume that has much invaluable information about vintage receivers in one handy volume. By Raymond S. Moore, 4th edition ---------- **$19.95-10% = $17.95**

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

NEW! **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

SPECIAL DEAL! Heath Nostalgia *and* Heathkit, The Early Years CD both by Terry Perdue ---------- $27.00

Heathkit, The Early Years CD: By Terry Perdue, high quality scans of documentation from Heath publications, plus a voice recording of Gene Fiebich. ----------$18.95 - 10% = $17.05

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

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, by Raymond S. Moore, 144 pages. ---------- $21.95-10% = $19.75

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

Understanding, Building, and Using Baluns: by Jerry Sevick, W2FMI. This is W2FMI's updated version of his classic book that gives detailed information about many commonly-used baluns in amateur radio. ---------- $19.95 - 10% = $17.95

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

Zenith, The Glory Years, 1936 to 1945, Illustrated Catalog and Database: A companion volume to "The Glory Years," this one has 151 pages of reproduced Zenith advertising and full serial number, chassis number, and production data that has never before been available in one reference manual, or to the public. 151 pages by Cones, Bryant, and Blankenship. ---------- $29.95 - 10% = $26.95

Ordering Information:

U.S. Orders: Please add $4.50 shipping for one book and $1.00 for each additional book, ***five or more books are shipped free!*** Checks and money orders by US mail are fine. Overseas and Canadian Orders: Please inquire for shipping quotes.

Electric Radio Bookstore, 720-924-0171
or on the Internet at www.ERmag.com

Subscription Information

Published Monthly

Rates within the US:

1st Class Rate: $42 (mailed in envelope)

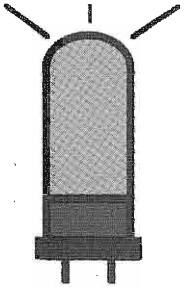
Periodicals Rate: $32

Rates outside the US, by airmail only:

Canada : US $48

All other countries: US $60

Electric Radio
PO Box 242
Bailey, Colorado 80421-0242
720-924-0171
Office Hours: 9:00 AM to 5:00 PM MT, Monday to Saturday
Subscriptions and renewals may now be purchased online at WWW.ERMAG.COM
Visa, Mastercard and American Express
FAX: 303-838-3665
email: Ray@ERmag.com or 1editor2@indra.com
The Electric Radio mailing date is posted monthly at www.ermag.com



Electric Radio
PO Box 242
Bailey CO
80421-0242

PERIODICAL

TO:

Postmaster: Return entire magazine for address changes, do not destroy.