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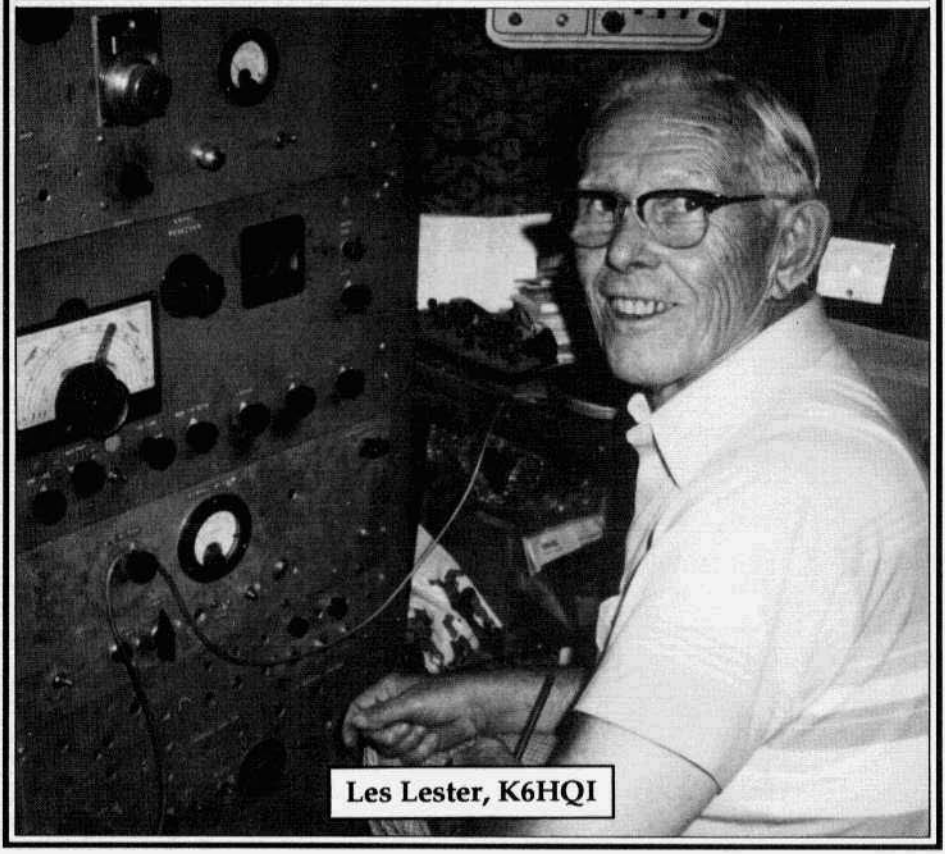
ELECTRIC RADIO

celebrating a bygone era

Number 51 July 1993



Les Lester, K6HQI

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FRED HUNTLEY,W6RNC.....REFLECTIONS DOWN THE FEED-LINE
BILL KLERONOMOS, KDØHG.....VINTAGE PRODUCT REVIEWS
DALE GAGNON, KW1I..... AM REGULATION UPDATES

Electric Radio is published for amateur radio operators and others who appreciate the older tube type equipment. It is hoped that the magazine will stimulate the collecting of, and interest in, this type of equipment.The magazine will provide information regarding the modification,repair and building of equipment. We will also work to-wards a greater understanding of amplitude modulation and the problems this mode faces.

Electric Radio Solicits Material

We are constantly searching for good material for the magazine. We want articles on almost anything that pertains to the older amateur equipment or AM operation. From time to time we will also have articles and stories relevant to the CW operator and the SWL. Good photo's of ham shacks, home-brew equipment and AM operators (preferably in front of their equipment) are always needed. We also welcome suggestions for stories or information on unusual equipment. For additional information please write us or give us a call.

EDITOR'S COMMENTS Barry Wiseman, N6CSW/Ø

In the May issue we printed a letter from a subscriber who was less than happy with the way his issues of ER were arriving through the mail. I mentioned that I was exploring the idea of putting the magazine in envelopes. I asked for comments.

From the comments I received - a considerable number - I've concluded that for 98% per cent of our subscribers no change is necessary. However, I do think that at some point in the future we will offer the option of an envelope at extra charge for those fewsubscribers who are having bad luck with the postal service.

ER Parts Unit Directory Update: The parts directory continues to be a popular service for all of us who restore, repair or build. We have around 260 units on the list but we all wish we had more. So once again I'm asking everyone to consider putting any parts units you might have on the list. As I've said before, "Your dead unit can live on by bringing another one to life" (or something like that). And I'd also like to hear from people with units on the list when they sell the entire unit or when there's nothing left to sell from it. From time to time I hear that when people call someone with a unit on the list they're told it's been sold or there's nothing left of it. The parts unit directory is worthwhile. As time goes on it's going to only become more and more worthwhile and perhaps absolutely vital to our hobby. Please consider adding your parts units to the directory.

From Dale Gagnon, KW1I's report on page 3 it's apparent that many AM'ers have not as yet joined AMI. I urge everyone to become members. To a large extent it will be the strength of this new organization that protects our operating priveleges. Please send in your $2 ASAP.

TABLE OF CONTENTS

Cover: Les Lester, K6HQI, best known for his long service as net control on the nightly 20-meter (14.286) AM net. His station is completely homebrew, right down to his monoband yagi. This photo was taken by Peter Brown, KH6IRT, on a recent visit to Les's shack.

Tube Manufacturing Ends in the Western Hemisphere

by Barry Wiseman, N6CSW/Ø

From a letter I received recently from David Allen Parker, KD4EUK:

" I thought you might be interested in the enclosed newspaper article regarding the last tube manufacturing facility here in the U.S. to be shut down.

" I think it's a bloody shame. You might pass this info on to all the AM'ers and maybe we can have a moment of silence in memory of the vacuum tube era. I have had two aunts work at the plant in Owensboro in the past; one worked there when it was Ken-Rad and the other worked there when it was General Electric.

"I don't know which to do first, sit down and cry or go out on a hill somewhere and scream and cuss until I'm blue in the face.

"Well I'll say 73 for now as I wipe the tears from my eyes. I would go on and on but I've got to go look for a high hill right now."

73, David, KD4EUK

The following information is taken from the June 13, 1993 edition of the newspaper "*Wall Street Week*". The story was written by Stewart Jennison of the "*Messenger-Inquirer*".

"The last general purpose glass receiver tube to be built in the Western Hemisphere of the planet earth will be assembled Thursday [June 10] in Owensboro, Kentucky.

"Since 1922, millions of the so-called radio tubes have been built in Owensboro by a succession of three companies - Ken-Rad, General Electric and MPD.

"Before the transistor and other solid-state devices rendered them nearly obsolete, the tubes found their way into millions of radio and television receivers sold the world over.

"For Owensboro, the tubes had a more important contribution - jobs - more than any other one company has produced here.

"In 1966, as the advent of the color TV gave the receiver tube one last major market to fill, employment at GE in Owensboro peaked at 6,600.

"Today, it takes every manufacturer in Daviess County to produce 6,300 jobs.

"Although product diversifications have helped MPD keep employment at about 500, only 16 workers have been needed in recent months to complete production runs for buyers who've been given one last chance to make an order, according to Byron Clark, MPD's vice president of manufacturing.

"The last buyer is Richardson Electronics, a Chicago-based supply house that will keep a supply of the hot and bulky (by transistor standards) tubes in stock.

"The tubes are still in demand by musicians and audiophiles, who prefer the "warm" sound that tubes contribute to amplifiers.

"Since RCA and Philips quit making glass tubes in the United States, MPD has been the last producer on the continent. Some are still being produced in eastern Europe, China and the former Soviet Union.

"The end of tube production in Owensboro has been delayed several years longer than predicted. The last production run didn't come until last week.

"Glass torches used to seal the glass vacuum tubes will be fired up one last time during an open house scheduled from 4 to 5 p.m. Thursday.

"MPD is inviting retirees from Ken-Rad and GE to take a last look at the equipment and see one last tube made for posterity."

And so it goes... **ER**

****AMI News****

by Dale Gagnon, KW1I
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Bow, NH 03304

AM International Needs Members Now

As of your reading this report AMI has approximately 150 members. There is a more less steady flow of 10 membership letters per week. Unfortunately, to actually impress ARRL Division Directors, FCC staffers, manufacturers, etc. we need to show more strength. The work of AMI cannot be accomplished without AM'ers getting behind AMI. Since a good portion of subscribers of Electric Radio and virtually all of the subscribers of The AM/Press Exchange are AM enthusiasts and even this number does not represent all of the AM'ers, we know that there are plenty of potential AMI members. Don't wait any longer, sign up now. The best thing we can do to preserve our AM privileges is to take a visible stand together. AM International membership gives you that opportunity. (Make sure you get your certificate before AMI Discovery Weekend - see below).

Stan Tajima, JA1DNQ, AMI Director for Japan

Stan's offer to be the contact person for AMI in Japan was accepted. He will disseminate AMI information and will encourage JA to US AM activity.

AMI Discovery Weekend

Mark your calendars for September 12-13. Starting Saturday morning and running through Sunday evening, participate in an all band AM operating event to discover where AMI members are and to help the general amateur population discover what AMI is all about. AM enthusiasts will log contacts with other amateurs, exchanging signal report and AMI region. If the contact is an AMI member, log their certificate number as well. AMI is interested in discovering AM operating patterns, so a copy of your AMI Discovery Weekend log (include frequency information) is important. Please send a copy to AMI Headquarters, Box 1500, Merrimack, New Hampshire 03054-1500. Highlights of the event will be published. It is not necessary to be an AMI member to participate.

AMI Nets

Don't wait to have someone contact you and ask you to run an AMI net. Pick an uncontested time and frequency, announce a net and call for check-ins. Use information in your AMI brochure to create a net preamble. Invite amateurs who have not previously operated their rigs on AM to try it out. An important factor in a successful net is being able to count on the net actually taking place at its scheduled time. Make a commitment to running the net and arrange for net control back ups when you cannot get on the air. Let your AMI Regional Director know about your net, net schedule, net control operators, number of check-ins, etc. Some topics for discussion on the net: Welcome and technical advice for new AM operators, homebrew project update, antenna comparisons, audio checks, new equipment acquisition, flea market reports, upcoming operating events, magazine articles of interest, AMI membership, etc. Gently enforce an "old buzzard" transmission ban so that everyone gets a chance to transmit once in while. Good luck!

Regional News

Rocky Mountain - Bill, KDØHG, has sent a letter to AM'ers that he is acquainted with to get things moving in this region. If you haven't received a copy, get in touch with Bill. Bill had several suggestions on how AMI could help AM equipment stay on the air, from parts banks and technical help to preventing the junking of AM equipment from estates.

continued on page 32

T-8040 -- A Homebrew 80 And 40 Meter Transmitter

by Walt Hutchens, KJ4KV
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Part One

Barry Wiseman's request in the October 1992 issue for interesting vintage homebrew projects lead me to build an 8-tube receiver for 80 and 40-meter roundtable use but as I neared the end of that project (R-8040, described in ER for March and April, 1993), a chilling thought seized me: didn't I also have to build the companion transmitter? Anyone who would ask the question wouldn't wonder long about the answer. With a sigh, I sketched out a few ideas; this article (with Part Two which will appear next month) describes the resulting set.

Designing A Transmitter

As with the receiver project, I found nothing in the handbooks I wanted to copy. Lower powered transmitters in the Radio Amateur's Handbooks of the late 50's to late 60's are mostly one-and-two tube sets for Novice use, that is, easy to build, rather bulky CW-only sets with separate power supplies. More complex designs were mostly just that, with few real enhancements. About the best of the lot is 'A Five Band Fifty Watter', a 12BY7-6DQ6 unit with a built-in supply appearing in the 1969 handbook.

About the only compact transmitting equipment is SSB transceivers. Typical units are 'A Mechanical Filter Sideband Exciter' (1967) and 'A 50-Watt PEP Transceiver for 75 Meters' (1969); perhaps by the late 60's the assumption that anyone building a complete transmitter for General Class use wanted an SSB rig was correct.

As was the case for receivers, my Radio Society of Great Britain Radio Communications Handbook, 5th Edition, offered much more interesting gear, with three designs in the 10-20 watt class but likely not hard to scale up to 50 watts. But again, these were transformer-operated sets with the wrong features for this application.

Just as for the R-8040, I began the design with a list of 'wants'. The transmitter (T-8040 because of the bands it would cover) was to:

1. Match the R-8040 in shape and size and be likewise self-contained and transformerless. It seemed reasonable to assume that the amount of power practical with a 6" x 9" panel and 7" x 7" chassis could be generated with series filament tubes and a voltage tripler plate supply.

2. Be designed mainly for AM at about 50 watts of carrier but also able to operate CW. This amount of power should be possible using a pair of medium size TV sweep tubes (total rated plate dissipation 34 watts) as finals.

3. Cover 3800-4000 kcs and 7100-7300 kcs, which ranges contain all the popular 80 and 40 meter AM frequencies.

4. Operate either on crystal control or from an exciter output from the receiver.

5. Be capable of over 90% modulation and include circuitry to prevent overmodulation.

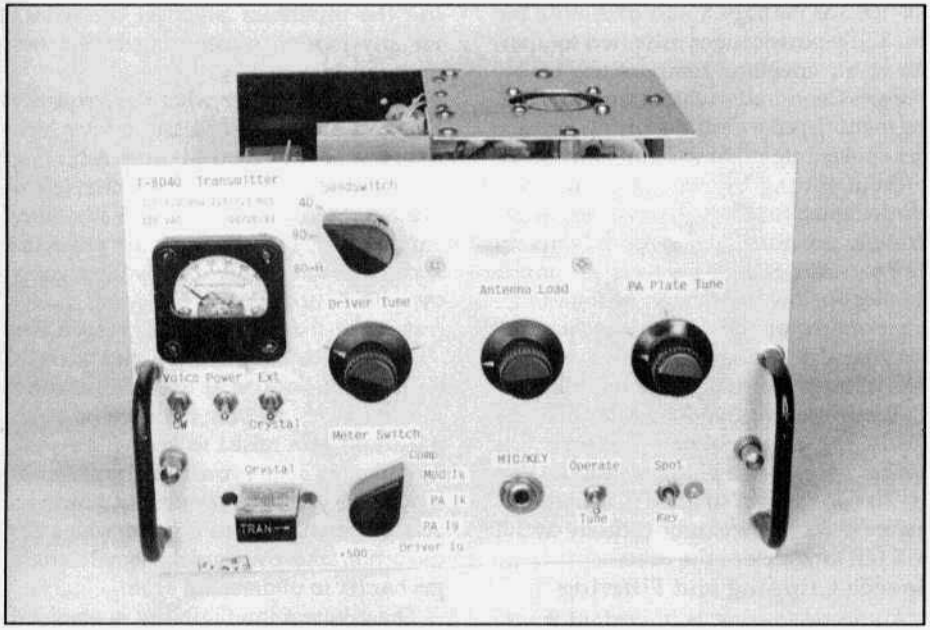
6. Include speech clipping and filtering to improve 'talk power'.

7. Use conservatively rated parts and have adequate cooling to allow extended operation without overheating. The final should be protected against loss of drive.

8. Have metering of enough currents and voltages to make adjustment and basic troubleshooting straightforward.

9. Have a minimum number of controls.

10. So far as possible avoid the use of rare or expensive parts and use a minimum number of tube types.



The T-8040 Transmitter. The labels shown are temporary ones stuck on the unfinished panel with rubber cement for testing and photos; a photo showing the final paint job (matching the R-8040) will appear in Part Two. The '80' bandswitch position connects the usual shunt cap to allow loading antennas near 50 ohms with a reasonable size variable; the '80-H' position leaves the shunt cap off for use on higher impedance antennas. The 'Comp' meter position indicates reduction of the clipping level to prevent overmodulation. 'Tune' reduces power input for tune up. 'Spot' turns on only the crystal oscillator.

The T-8040 Design Overview

The transmitter which evolved is a nine-tube set; counting the dual triodes, equivalent to 13 tubes. The RF section consists of a 12AT7 serving as a crystal oscillator and buffer, a 10GK6 driver and a pair of 22JF6 sweep tubes in parallel as the final. The driver grid and plate are ganged and tune 3800 to 7300 kcs in a single band. A bandswitched pi network matches antennas from about 40 ohms up.

The audio section consists of a 12AT7 two-stage microphone amplifier, a series clipper using silicon diodes, a 12AT7 phase inverter, a 5687 driver and a pair of 22JF6's operating zero-bias Class 'B' as modulators. A 240 to 120 VAC 40 watt autotransformer and a filter choke taken from a junk TV set are used as 'iron' in a modified Heising circuit. Feedback from the modulated high voltage increases the clipping depth when necessary to prevent overmodulation.

The use of receiving tubes and parts may suggest 'low power' or even 'wimpy'. While the 75 watt carrier which the set actually delivers is not 'high power' even by today's standards, it is a solid 75 watts and the T-8040 will do it for an hour at a time without discomfort. Thanks to effective speech clipping and filtering, this amount of power will get through about as well as a legal-limit set running in 'high fi' mode.

'Wimpy' is to a great extent in the eye of the builder (we have all heard discussions of whether an 833A is an adequate ham final tube or whether you really need

continued next page

ER in Uniform from previous page
a 4-1000 or perhaps a pair of them!), but the 22JF6 power tubes are rated to operate at an envelope temperature of 240 degrees Centigrade, which is right around the melting point of solder; in this set they run cool enough that you can touch them without getting burned. The filter caps are designed for 85 degrees C; they aren't likely to get much above room temperature in the T-8040. There are no power resistors below the chassis: both of them are mounted on the top plate where they are cooled by a 1-9/16" fan which also takes care of the finals and modulators.

A self-resetting overload relay protects the final against tune-up mistakes such as not having a crystal plugged in and if that doesn't do the job, small low-wattage resistors in each power tube cathode circuit will fail long before the tube.

Speech Clipping and Filtering

Audio processing is important if you want the most from a low powered set; as we noted when discussing the ARC-39, processing for AM has two main parts.

First, nearly all the information which helps recognize words is in the frequencies between about 300 and 3000 cps; frequencies outside this range make your voice 'sound like you' but they do little to help another station understand what you're saying. You cannot even just leave those extra frequencies in for free; since voice peaks are the result of all the frequencies adding up, a wider range of frequencies means higher peaks, which will require reducing the gain to prevent going over 100% modulation. Thus a wider audio range always means less sideband power for the frequencies which help the other station understand your words.

There are two other factors to think about in choosing the bandwidth for a ham AM set: one is that band conditions on the lower HF bands so rarely allow other stations to copy you on a broad receiver that frequencies above 3 kcs are essentially wasted in any case, and the other is that since hams are required to use the minimum practical bandwidth for any mode, transmitting higher frequencies is illegal.

Second, no matter what the frequency range, ordinary speech has a very high ratio of peak to average power. Adjusting for 100% modulation on peaks means a low average modulation level and low sideband power. By cutting off the peaks the audio gain can be increased without going over 100% modulation. This raises the average sideband power so the signal is louder and easier to understand when there is noise but it does so at the price of some distortion. As clipping is increased (with the audio gain raised to keep 100% peak modulation) at first your signal just sounds louder. As you cut more deeply, however, you eventually get to a point where the distortion takes over and the signal starts to get harder to understand again.

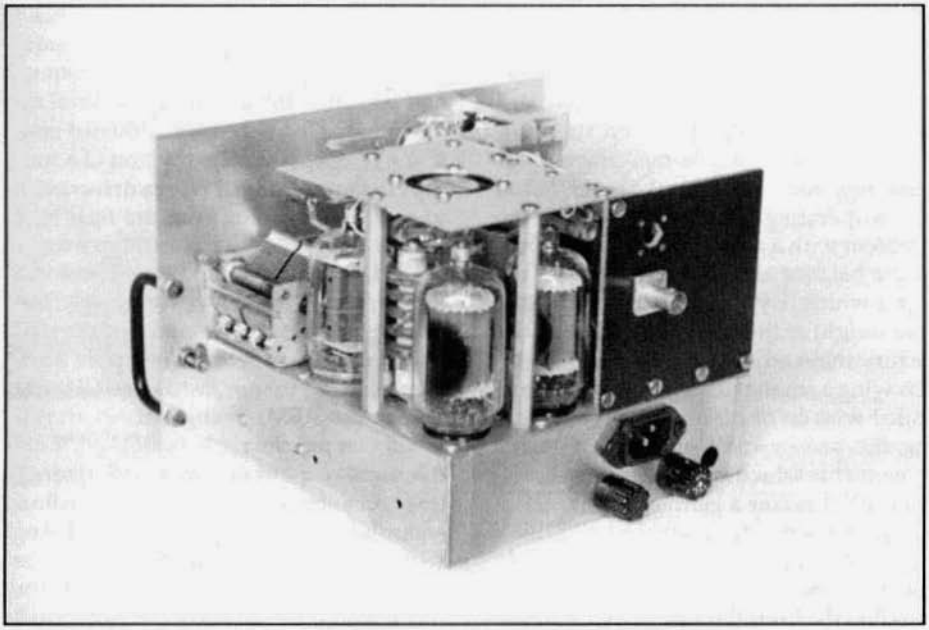
The greatest intelligibility is obtained at about 20 dB of clipping; that is, when the top 90% of the voice waveform is cut off and the remaining signal amplified to produce full modulation. At this clipping level your signal will get through as well as an unclipped signal of about three times the power.

The usual scheme for a transmitter using speech clipping and filtering is:

1. Use a high-pass filter to remove speech frequencies below about 300 cps. Part of this filtering can be done by selecting a microphone which has little response outside the wanted range, that is, a mic designed for 'communications' work.

2. Amplify and clip the resulting signal. Since the overall audio gain may be up to 20 dB higher than for a transmitter without speech clipping, great care must be taken to minimize noise picked up by the microphone and hum and noise in the low-level audio stages.

3. Filter the clipper output to remove frequencies above 3000 cps. Not only does this reduce unwanted frequencies in the original speech but it takes care of the harmonics produced by the clipping process.



Right rear quarter of the T-8040. The BNC connector on the rear goes to the antenna; the hole above it is for the antenna connection to the receiver. The two tubes at the rear are the modulators; the finals are directly forward of them on the chassis. The PA plate choke and speech amp and driver tubes are between the modulators and final. The Radio Shack 273-244A fan in the top plate blows upward. Visible next to panel are the PA plate tuning cap, final tank, and top edge of the bandswitch and keying relay.

4. Amplify the clipped and filtered speech enough to fully modulate the transmitter. The stages after the clipper must have low frequency response well below the lowest frequency they will amplify to reduce phase shift, which would turn the flat tops of the clipped signal into 'sawteeth', forcing reduced gain and a lower average modulation percentage.

More complex systems of processing have been used for AM, for example the voice frequency range is sometimes divided into several bands which are processed separately and then combined. Yet another approach is to treat the voice signal as a modulated waveform, demodulate it, process the 'modulation 'and 'carrier' separately and then recombine them. Neither of these became popular, probably because they're much more complicated and don't give you that much more than the simple approach.

A well designed communications voice transmitter using standard speech clipping and filtering does not 'sound bad'. In fact, 10 dB or so of clipping is almost undetectable, although the transmitter will get through like one of about twice the power. At 20 dB, your voice will not sound exactly like you but it will be clear and not unpleasant.

On The Air With The T-8040

One of the interesting things about any homebrew project is the problems the builder found after he started testing.

The panel meter is a fleamarket item and slightly less than perfect. In fact, its sensitivity was less than half what it should have been and it had a tendency to stick. I opened it up with a very bad feeling but the problem turned out to be simple: the outer turns of one of the hair-

continued next page

ER in Uniform from previous page
springs were looped over the inner ones, perhaps as a result of being dropped.

Like many military meters the movement was badly balanced so it gave different readings depending on the position of the set. Since homebrew rigs (at least my homebrew rigs) spend many hours operating upside down, I fixed the problem with a dab of glue on the appropriate balance arm. Epoxy is best as the types which dry by solvent evaporation lose weight as the solvent departs. At the factory these adjustments were made by screwing a small balance weight made of coiled wire on or off of the arm but lacking the proper tools and with a meter movements which are sometimes over 50 years old I prefer a gentler technique.

One of the first four new-in-box 22JF6's I plugged in had a solid heater-cathode short which -- because the filaments operate directly from the line -- took out the protective cathode resistor. The overload relay had not yet been connected or it too would have been a casualty. As a result of this experience, I rearranged the final cathode circuit and added a zener diode to protect the relay.

The answer to the obvious question is that my TV-7 military tester doesn't have a Novar adapter or test information for this tube; and yes, I didn't have the sense to do an ohmmeter check. Later, however, I found that an ohmmeter check isn't always enough. While selecting a balanced pair of tubes, a Sylvania 22JF6 which was okay on the ohmmeter developed the same short about ten seconds after it was turned on, taking out that protective resistor for a second time. There doesn't seem to be a good answer to this unless you have a tester which will handle this type tube; in any case the kit of essential spares should include extra cathode resistors and a tested pair of final amp tubes.

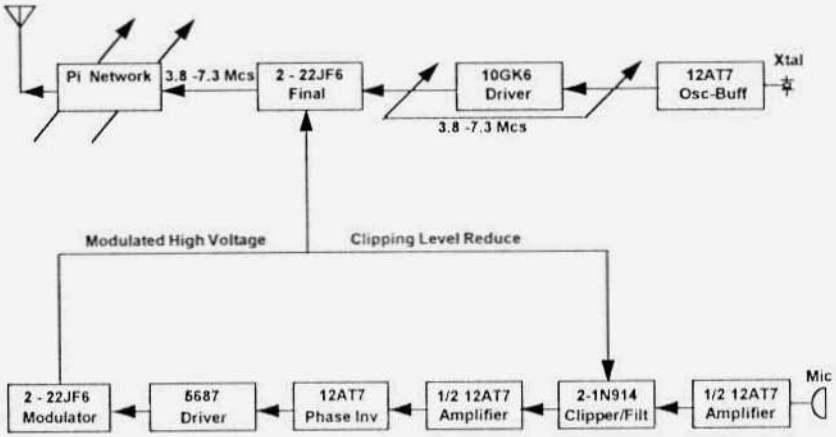
Crystal-controlled transmitters are stable, right? Even so, getting real stability from the T-8040 turned out to be the toughest of the early problems. Since I wanted the crystal oscillator to operate at a very low level (to avoid crystal heating and to match the intended low level exciter output from the receiver) I had used a 12AT7 operating at a fraction of a watt input as an oscillator. With a driver stage to provide isolation from the final (and increase the power) what could go wrong?

Well, let us count the ways. There was a little ripple in the PA power supply; this had been left to be cleaned up later and was not itself a problem. The ripple, however, showed up not just as a 60 CPS AM hum, but as FM, giving a nasty warble when you put the receiver BFO on. Since the oscillator supply was well filtered, this had to be coming back from the final -- but how? The PA plate voltage swing with modulation would be far greater than the ripple, so the FM would likely be much worse; the problem had to be fixed.

A bit of head scratching later, it was clear that modulated RF from the final was getting back to the oscillator. Since a class 'C' amplifier does not operate with exactly 180 degrees phase shift from input to output, mixing a bit of final RF with the oscillator signal shifted the phase slightly -- but an oscillator must operate with exactly zero phase shift around the loop from output to input and back. To accomplish this, any phase change in the loop causes the oscillator frequency to change so that the tank circuit produces a correcting phase shift. Add in some off-phase amplitude modulated RF, and presto -- you have FM.

RF coming back from the final had to be neutralized, right? The set was stable, but I carefully neutralized both the final and driver anyway. The FM got better -- but it didn't go away.

More head scratching and some reading. Hummm. . . I had found on the R-8040 that because the common B- is isolated from the chassis (it is connected right to the 120 VAC line, so it had better be!) it has to be decoupled just like B+



T-8040 Transmitter Block Diagram

when low level stages are involved. Sure enough, adding a 50 uH choke and bypass to chassis (RF) ground in the oscillator B- eliminated the FM. I wonder what is the maximum number of times in one life that one has to learn the same lesson before it sticks?

Once the RF section was working I trimmed the tank coil so the set would load to about 75 watts output: at this level the tubes are operating at about their handbook ratings. Since those ratings assume continuous service inside a closed-up cheap TV set, the finals should last a long time. I imagine you could get over 100 watts output but longer tube life and greater reliability seemed more worthwhile than an extra small fraction of an S-unit.

Next month we'll look at the technical details of the design (including the schematic) and come to some conclusions about small line-operated transmitters.

Oops! (And Thank You)

Arrrgghhhhh! (Sound of gnashing teeth). My thanks to William Shibler Sr., W3QII, for pointing out the repeated error occurring at the top left of page 6 of the R-8040 article in the April issue of ER. The paragraph beginning at 'The Detector' (which was intended to be printed as a footnote) refers to the mu of a tube as if it were the same as the Gm. Wrong – Gm stands for transconductance, which was what I was talking about. Mu may be thought of as the voltage gain from grid to plate on a load of infinite impedance; in effect it is the highest voltage gain you can get from a given tube.

Dedicated military radio readers may cross out 'mu' in all three places in the paragraph and write 'transconductance' in the margin. Use blue black ink and a fountain pen or steel nib; be sure to initial the change.

My thanks also to the many readers who wrote with comments on this project and to the ten (so far) who sent $6 for the notes and enlarged drawings. The notes actually ran just over 30 pages, rather than 'more than 20' as promised. I hope at least a couple of the fellows will build this set (or use parts of it in their own designs) as I am having a lot of fun with it and I am sure it can be improved. As I write this I

continued on page 34

Good Audio

Part Three

by John Staples, W6BM
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Commercial Audio and Monitoring Gear

Used broadcast and audio production gear is making it to the surplus market and is readily adaptable to the ham shack. Mixer amplifiers, equalizers and compressors (limiters) may be obtained at reasonable cost. All this equipment operates at low impedance, with an audio level of typically 0 to 30 dBm (1 milliwatt to 1 watt) into a 600 ohm balanced load. You can't connect an unamplified high-impedance crystal microphone to the input of one of these low-impedance mike mixers.

Mixers typically provide several inputs, which can be configured for low-level, low-impedance microphones by using plug-in preamplifier modules, or for high-level sources by omitting the preamp. The amplified D-104 drives the high-level inputs on these mixers well, as well as most consumer audio sources.

The mixer may be followed by equalizers and limiter amplifers. The gain of the limiters is generally quite high, and they may be driven by audio sources operating down to perhaps -30 dBm, which includes the amplified D-104.

Off-the-air modulation monitors are available, such as the popular General Radio 1931 (A,B), the Western Electric 26W and the Gates M-5693. These units require about 1 watt of r.f. from the transmitter, which may be taken off the feedline through a small wide-space variable capacitor. These monitors indicate carrier shift during modulation, and average and peak modulation percentage. They have a 600-ohm audio monitor output which can drive headphones.

Tape Recorders

A cassette tape recorder is a useful addition to the station. I use one to play back the Ham Radio Newsline report after the Wednesday night AM swap and to play back air checks. I record roundtable participants with a wide selectivity setting, and the listener can verify the playback fidelity by comparing it with direct reception of the same signals. Nothing works as well, or as diplomatically, in pointing out audio problems than letting the offender hear himself, comparing his to the other signals in the roundtable.

(The Newsline program is recorded off the phone line through a transformer audio coupler with the phone in the mute mode, preventing room audio from being recorded. I use a monitor amplifier and speaker, switchable among many sources in the audio chain, including an off-the-air monitor, to check the recording and the playback. The mike mixer permits audio inserts for station identification during the Newsline playback.)

Broadcast Transmitters

Broadcast AM radio is in financial trouble, and stations are folding or unloading their old vacuum-tube transmitters in favor of no-maintance, efficient solid-state equipment. The old transmitters are being bought up by the ham community, and are fun to restore back to life, usually on 160 meters, but 75 meter operation is possible with many of these old transmitters.

The power efficiency of AM broadcast transmitters has increased remarkably over the years. Older transmitters usually ran about 20 to 25% efficiency, a.c. line input to r.f. output. Today's pulse-width-modulated solid-state transmitters are running up to 86% efficient, a remarkable improvement. Their excellent reli-

ability has been welcomed, as broadcasters are no longer able to keep maintenance personnel at the transmitter sites.

Commercial AM transmitters in the 250 to 1000-watt power range are significantly larger than ham transmitters of the same power rating. They can be remotely controlled and placed in the garage, but since they are also pretty to look at, many hams are accommodating them right in the shack (*QST*, February 1993).

These transmitters are crystal-controlled, but can be driven by small VFO-exciters such as the Johnson Navigator. Their external drive power requirement is usually more than can be delivered by standard outboard VFO units. The audio input level required is typically 10 milliwatts (10 dBm) into 600 ohms.

These transmitters use tubes familiar to hams: 4-250's, 4-400's, 810's or 813's. The 833-A was popular in the 1 kW transmitters. The rectifiers are usually 866-A's in the smaller units and 872's in the larger ones. The later vacuum-tube transmitters use higher gain pentodes or beam power tubes in all the r.f. and audio stages to reduce the number of stages.

Some of these transmitters require three-phase primary power, which reduces the rectifier and filter component sizes, but is a headache for the ham. The power transformer may need replacement and the ripple filter may need to be upgraded.

Some transmitters such as the Western Electrics, use low-level modulation and Doherty final amplifiers, which are more efficient than the usual linear amplifier, but are difficult to change frequency once they are tuned. Others, such as some of the RCA's, employ neutralization circuits that are frequency-sensitive. These transmitters might as well be kept crystal-controlled on one frequency. Other transmitters, such as Collins or Gates, use circuits more familiar to hams and are perhaps the easiest to convert to ham frequencies.

Receiving

The receiver plays an obvious role in determining audio signal quality. Each receiver seems to have its own "sound", some better than others. The receiver need not have a fancy push-pull audio output stage: some of the best receivers I've heard have a simple single-ended audio stage. The sound of a receiver depends on the front-end design, the i.f. bandwidth, the detector, and the audio amplifier design.

Poor receiver front ends are subject to overload and cross-modulation by nearby strong signals, which increase the noise background. An input attenuator may help, but most vacuum-tube receivers have quite good front-end characteristics. Phase noise in the h.f. oscillator in the old vacuum-tube receivers (which produces hissy sidebands) is almost always low, but it can be quite high in the early solid-state receivers, and is almost guaranteed to be so in early synthesized solid-state units. High local oscillator phase noise will heterodyne a wide spectrum of signals into the i.f. channel, producing unwelcome background noise.

The i.f. bandwidth characteristic is important in determining the sound of a receiver. A narrow i.f. strip chops off the sidebands and remove the highs. Mechanical filters, with their sharp skirts, produce a sharp audio cutoff, which is perceived as a ringing at that frequency. However, 15 kHz wide mechanical filters, if the peak-to-valley ripple amplitude is below 3-4 dB, can sound excellent, as the cutoff is beyond the transmitted audio spectrum, yet adjacent signal selectivity is still adequate.

The last i.f. stage of the Hammarlund SP-600 tends to overload on strong signals, but an easy modification cures that problem. Replace the last i.f. tube with a 6AH6, and connect a 10k resistor from the junction of R56 and R57 to ground to change the bias.

Selective (distortion) fading can be reduced by the use of a synchronous detector which also provides a low-distortion

continued next page

Good Audio from previous page
demodulation of the signal (Staples, ER#30,34). Frequently, just turning on the BFO and zero-beating the signal can help reduce selective fading distortion.

The frequency response of the audio system may be widened by increasing the value of the coupling and bypass capacitors and decreasing the value of the shunt capacitors, except that of the detector load capacitor. Negative feedback may be included around the last audio stages. The 75A-4, usually not considered a superior AM receiver, when provided with a 15 khz mechanical filter and an additional audio feedback circuit in addition to the two that already exist (W9FGJ, priv. comm.), is a fine sounding receiver.

Fig 9

Among the best sounding receivers I have heard are the AR-88, SX-73, R-390 and many of the middle-range receivers that have a fairly wide i.f. bandwidth. Receivers to avoid are those with low final i.f. frequencies and receivers with narrow mechanical filters. The HRO-50T and HRO-60's have a rather narrow i.f., which gives them a somewhat bassy sound, but their excellent skirt selectivity and gentler i.f. selectivity roll-off draws many fans.

A good speaker, not one of those little, inefficient so-called hi-fi bookshelf speakers, but a nice, big 10 or 12 inch speaker in a decent cabinet helps. Place the speaker up against the wall, or preferably in the corner, to develop the bass response. Squirt your volume controls with cleaner (or WD-40) to get rid of the scratchiness.

I keep a dozen or so receivers available for different conditions and moods at my primary operating position. I have provided each receiver with a standard connector carrying the antenna, speaker and break-in connections, so I can easily move receivers to other operating positions, or down to the basement shop for service. My station controller allows all these receivers to be selected by a rotary switch. Two speakers are available, selected by another switch on the station controller.

Improving Your Own Signal

So, what can you do to improve your audio? You can start by ensuring that your microphone is in good condition and by monitoring your own signal. Then, with a little bravery, you might try some modifications to the transmitter. You may later want to include external audio processing equipment so you can play broadcast station.

You can't go wrong with an amplified D-104 fitted with a new crystal element. The response of this mike is ideal for AM operation and, with a good transmitter, nothing more needs to be done. It has a natural sound without any obvious resonances or peaks, and the low-impedance output can drive any type of audio equipment. Some transmitters, such as the Collins 32V series, have a rather low-gain audio channel and benefit from the higher output. Others, such as the Johnson Ranger, have lots of gain and work well with an unamplified microphone, although the value of the first stage grid resistor may be increased to 2 or 3 megohms for a better sounding bottom end.

Used D-104's frequently have marginal crystal elements with low output or poor frequency response. New elements are available for $19 and are well worth the cost. I have not had any experience with ceramic replacement elements.

Build an audio monitor (Staples, ER#36). You can make one with a silicon diode, a pair of headphones and a couple of feet of antenna wire.

Talk a member of your roundtable into installing a tape playback facility so you can compare your audio to the others in the group. This is much better than vague aural reports, sometimes overdiplomatic, about your audio quality.

If you have a transmitter known to have deficient audio, such as the Johnson Valiant, modify it. The modified Valiant is one of the best-sounding rigs on the air. Some rigs can be improved by widening the audio frequency response, but if the driver and modulation transformers are inadequate, this may not result in the improvement you expected. The Collins rigs have good iron and a modified KW-1, less the clipper, low-pass filter and splatter choke, sounds excellent. Just as nice is the Johnson Desk Kilowatt with a Ranger as the driver.

Watch your modulation level carefully. A 'scope with a trapezoid presentation is the best, but an envelope display is also effective. Overmodulation seems to be more common than undermodulation, and is less obvious to the casual listener. Some rigs don't have enough audio power to fully modulate the rig, and a 'scope can point this out. You may have insufficient r.f. drive or weak tubes in the modulator or final.

R.F. feedback to the audio system or VFO can cause audio problems. Check your mike cable and connector for good ground to the transmitter, and if feedback persists, put a small r.f. bypass right before the first audio amplifier stage. R.F. feedback into the VFO compartment can cause unwanted frequency modulation of the signal. The VFO compartment of the Johnson Ranger/Valiant/500-family of transmitters occasionally loosens up, which can cause FM, particularly on 160 and 40 meters where the VFO operates straight through at the output frequency. Tighten the screws of the VFO compartment.

Experiment with an equalizer. It doesn't need to be fancy, but you will need an amplified microphone to drive it. Be sure that r.f. does not get into the equalizer, particularly if it's solid-state. Don't overdo it -- start with small changes and get opinions from the rest of your roundtable as you adjust it.

Summary

In this article, I've discussed issues affecting audio quality from the microphone to the loudspeaker. Good audio is not hi-fi audio: it is a low distortion audio with a frequency response optimized for ham-band AM communications.

We AM'ers are reviving an older operating mode with vintage equipment, but in a different operating environment, where talk power is less important now than a clean-sounding signal. These old transmitters can use some help in redefining their original communications intent. Feel free to experiment with this old equipment and make it exceed its original specifications. The rebirth of AM has attracted lots of new listeners, many of whom have become hams and joined us. Good audio is one of the natural attractions of AM operation, and I hope I have helped you improve the sound of your own station. **ER**

Biographical info:

Ham since 1956
Extra Class since 1958
Previous calls: K9CPZ, W6RGS, 7J1AFX
First Phone Commercial license since 1958
5 years BC experience, early 60's
PhD in nuclear physics
Active on 160 and 75 West Coast groups
Primary rig: homebrew 813
Contributed several ER articles
Collecting antiquarian radio equipment for 25 years

Editor's Note: Next month we'll print some of the letters we've received in response to John's article.

Armed Forces Day at Fort Burnside

by Dale Gagnon, KW1I
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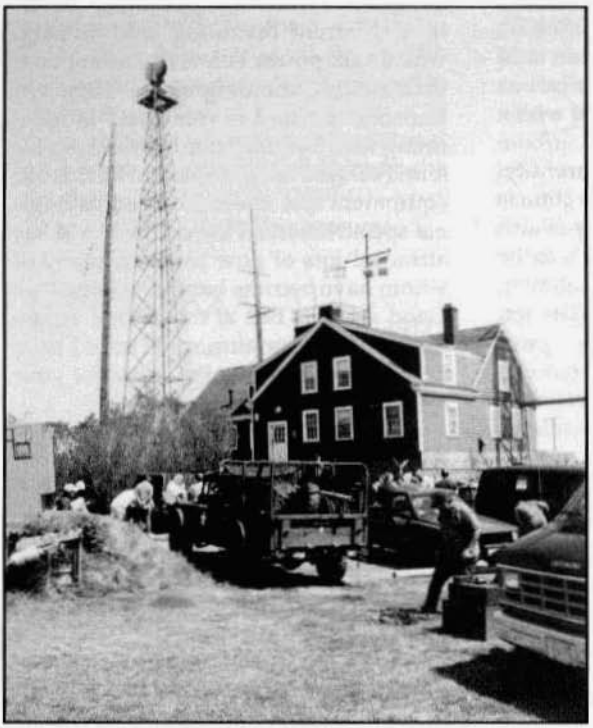
Photos by Charlie Dicecca, KA1GON



Fort Burnside, a World War II vintage military base, is situated on the southern tip of an island at the mouth of Naragansett Bay near Newport, Rhode Island. Most of the fort is gone, but a couple of gun batteries and a house-like structure still remain. This concrete bunker disguised as a summer home was the harbor entrance control point during the war. Later in the 50's radar towers were added. From the lookout platform on the house water stretches in an arc over 300 degrees. Today this is the home of Brown Beezer, WA1NZR. Brown is the caretaker of this facility for the town of Jamestown, RI. He has turned this fabulous setting into a military radio paradise as well, with many classic and modern military radios. He also is a military vehicle collector and boasts a wrecker, jeep, several trucks and an ambulance. All in working order!

Upon learning of the Military Radio Contest Brown invited military radio enthusiasts to come to his QTH on Armed Forces Day, May 15 to enjoy a day of equipment operation and appreciation.

My brother, KK1K and I arrived late Friday night and were not able to muster ourselves to join Brown on the Old Military Radio Net (3885kHz at 0900z. Shortly after the net closed we did get up and reported to the radio room. Most of the activity during the day was on 75 and 40 meters. AJ1G, WB2ILA, K1DT, KA1GON, KA6?? (all the way from California) and a number of other local radio enthusiasts dropped in to enjoy this classic setting and operating event. Brown had prepared a briefing room complete with desks and chairs, air raid warden helmet, WWII posters and other authentic relics. Radios operated during the event were ART-13/ARR-7, GRC-9, GRC-46, PRC74, PRC104, TSC-15, TRC-136, GRC-142, TRC-75, T368/R390, SCR-284 and ARC-5 equipment.

Brown's QTH has no problem with antenna support. There are 50 and 100 ft towers adjacent to the house and also

continued on page 33

Brown Beezer, WA1NZR, with a Number 19, MK II set.

Other participants in the Armed Forces Day meet were Chris, AJ1G, Charlie, KA1GON and Dean, KK1K.

Notes On the 6AG7/6L6

by Dave Ishmael, WA6VVL
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I have built and/or breadboarded several 6AG7/6L6 80/40-M transmitters during the last year and have not been particularly pleased with their output power. Even though I was very happy with my rebuilt Heath AT-1 (ER#50), its output power was still relatively low - 8-10W - not much better than the 5W output from my single-tube 6AG7 80/40M QRP rig that uses a much smaller power supply and is one third its size.

One of the spare AT-1 "parts units" left over from the AT-1 rebuild had a missing power transformer so I finished stripping the power supply components off the chassis and made a 6AG7/6L6 test bed out of it. I connected this stripped AT-1 to a Heath IP-17 power supply so I could easily vary the 6AG7/6L6 plate voltages as I ran the various tests. A second Heath IP-32 power supply was used for dual-voltage tests.

One of the most popular configurations of the 6AG7/6L6 is using the 6AG7 as a crystal oscillator with an untuned (RFC) plate. The AT-1 uses this configuration on the 80M band. Heath was apparently concerned about parasitic oscillations and the lack of neutralization when running the 6L6 "straight-through" on 80M so they left the 6AG7 plate/6L6 grid untuned. The 6L6 is operated as a doubler on 40-10M, so traditional LC tuning is used instead of the 90uH RFC. Measuring the 6L6 grid drive voltages and output power on the 80M vs 40M band in the AT-1 is a convenient way to evaluate the untuned vs tuned drive configuration.

The following table summarizes the differences in VP-P grid drive voltages in the AT-1. 6AG7 plate voltage = 6L6 plate voltage = VDC. The 80M band uses an untuned 1mH RFC and the 40M band uses a tuned LC network. The DC input power to the 6L6 averaged about 76mA @ 385V or about 30W. The 6L6 dipped to 50mA on both 80/40M but maximum output did not occur at the dip on either band.

	untuned RFC 80M		tuned LC 40M	
VDC	6AG7 VP-P	Power Out W	6AG7 VP-P	Power Out W
385	86	7.5	460	9.0
350	76	6.0	430	7.0
300	63	4.2	345	5.0
250	50	3.0	280	3.2
200	38	1.9	200	2.0
150	27	0.9	150	1.0

Notes:

1. The 6AG7's output was measured at its plate, pin 8, key-down. The voltage at the 6L6's grid is a bit less.
2. The output power was measured with a Kenwood AT-230 on the 20W range.
3. A 50-ohm dummy load was used.

I tested a number of chokes in the range of 500uH - 2.5mH in the plate of the 6AG7. They all performed about the same. A National R-33 100uH choke increased the drive to the 6L6 about 40% but did not increase the output power (for reasons that will be explained later).

Lewis McCoy/W1ICP pointed out in his January, 1953, QST article "A Novice 35-

watter" (1955/56 ARRL handbook) that the 6AG7's plate RFC must be broadly resonant at 5MHz to provide sufficient drive to the 6L6 on 80/40M. He recommended a Millen 34300 100uH RFC. I (mistakenly) assumed that not using this RFC was the reason for the relatively low 5W output from my first 6AG7/6L6 xmtr (ER#43) - it wasn't.

My tests indicate that the drive available from a 6AG7 in an untuned configuration will NOT drive the 6L6 into class C operation - it's not even close. The AT-1 operates the 6AG7/6L6 at 400-V key-down, which maximizes the 6AG7's output - about 86-VP-P. At AT-1 plate voltages of 400-V and class C operating angles of 120-140 degrees, the required grid drive is 234-308-VP-P.

The indicated grid drive on the AT-1 and similarly metered grid circuits does not measure the tube's actual grid current - it measures the relative drive voltage across the grid-leak resistor. The current through the grid-leak resistor bears little relationship to the actual grid current. The majority of the current through the grid leak occurs during the negative portion of the grid voltage waveform when no 6L6 grid current flows. Even though class C operating angles are 120-140 degrees, positive grid current occurs during only 43-45 degrees at AT-1 plate voltages of 400-V using the 6L6.

If the waveform of the grid voltage is sinusoidal (e.g., from a tuned LC tank), the following formula may be used to calculate the required class C VP-P grid voltage:

$$\text{VP-P grid drive} = \frac{\text{max positive grid voltage} - (\text{grid cutoff voltage})}{1 - \sin((180^\circ - \text{desired operating angle})/2)} \times 2$$

An example using the measurements from the AT-1:

$$\text{VP-P grid drive} = \frac{(12\text{V} - (-65\text{V})) \times 2}{1 - \sin((180^\circ - 120^\circ)/2)} = \frac{77\text{V} \times 2}{1 - \sin(30^\circ)} = 308\text{VP-P}$$

Another very revealing test is output power vs 6AG7 plate voltage (untuned/RFC) vs 6L6 plate voltage using dual power supplies. Varying the 6AG7's plate voltage is a convenient method of varying the drive to the 6L6 as the 6L6's plate voltage is changed.

		6L6 Plate Voltage					
		150V	200V	250V	300V	350V	385V
6AG7	150V (27VPP)	0.7W	1.3W	1.4W	1.4W	1.4W	1.4W
	200V (38VPP)	0.8W	1.6W	2.3W	2.7W	2.7W	2.9W
	250V (50VPP)	0.9W	1.6W	2.4W	3.4W	4.4W	4.6W
	300V (63VPP)	0.9W	1.6W	2.4W	3.6W	4.8W	5.8W
	350V (76VPP)	0.9W	1.6W	2.4W	3.8W	5.1W	6.0W

Notes:

1. Because the output changes were relatively small, the output voltage was measured and output power calculated.

Referring to the table above a few conclusions can be drawn:

* In designs where the 6AG7 and 6L6 are run from different plate voltages, the grid drive can be way too low. In fact, with 6AG7 plate voltages <300-V and 6L6 plate voltages >350-V, the 6L6 will not even be driven into cutoff, let alone class C!!!

continued on page 32

The 'QRST' System

by Albert A. Roehm, W2OBJ
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Every so often, comments on the merits of the RST system appear in our various ham publications. They deal mainly with whether the "T" portion of the RST report should be dropped or retained. As I recall, this system was suggested by Arthur M. Braaten, W2BSR, who became a SK in 1990. These discussions always remind me of my old QRST System.

About thirty years ago there was a renewed concern throughout the amateur community over the accuracy (or inaccuracy) of S-meter circuits, signal reports and calibration standards. To overcome the difficulty of trying to provide accurately measured signal strengths, I thought a set of differential readings would be more useful. By letting the "Q" represent the S-meter reading for the quiescent (no signal) condition, the procedure automatically compensates for such variables as location, type of antenna system, operating mode, receiver gain, noise reduction due to the bandwidth in use, splatter, and other local receiving conditions.

Here is how the system works. . . . a typical RST 579 with an S3 noise level would be reported as QRST 3579. This tells the other operator that the signal is a comfortable four S-units above the noise. Alternatively, an 8599 report means the received signal is only one S-unit above the background noise. Note that in the first example an S7 signal is "arm-chair copy" while the S9 signal in the latter case is approaching borderline copy.

Perhaps the time has come to rethink old practices. A signal of less than T9 quality is so unusual it deserves to be highlighted and discussed separately during the QSO. Therefore, dropping the "T" from ROUTINE REPORTS might easily be rationalized. But, what about the "R" report? Can everyone imagine the difference between an RS 39 and RS 49 report? Probably not! Unless you're working some weak DX or a domestic QRP station, the readability report is invariably R5. Wouldn't a QS report be more meaningful? I think so.

From a practical viewpoint the simpler QS system could be used for most routine phone and CW reports, especially where a readability of R5 could be assumed. When copying a marginal signal, i.e. close to or in the noise, then a QRS report would be more appropriate. On those rare occasions where a less than T9 signal is encountered, the full QRST report would be a courtesy to alert the operator of impending trouble.

Here is a chance for the AM (and CW) readers of ER to improve the value of their signal reports. Perhaps the proposed changes could be easily tested by incorporating them into the rules of some contests. Your comments will be appreciated. **ER**

HOW OLD IS THIS RADIO ?? IT MUST BE BEFORE MY TIME !

AM FREQUENCIES

2 Meters - 144.4, calling freq., activity in most cities; **6 meters** - 50.4 calling freq. **10 meters** - 29.0-29.2 operating window; **12 meters** - 24.985 calling freq.; **15 meters** - 21.400 - 21.450; **17 meters** - 18.150 calling freq.; **20 meters** - 14.286 for the nightly net starting at 5:00 CA time; **40 meters** - 7160, 7195, 7290 are the main freqs. Westcoast AM'ers net every Sunday afternoon, 4:00 PM on 7160; **80 meters** - 3870, 3880 and 3885 are the main freqs. Westcoast swap net Wednesdays nights, 9:00 PM on 3870. AM Swap net Thursday nights, 7:30 PM on 3885; **160 meters** - Gray Hair net every Tuesday at 8:00 PM EST on 1945. Mostly sporadic summertime activity, but during the winter signals can be heard anywhere on this band.

The Vintage CW Net

The vintage CW net, started by Tracy Reese, WB6TMY, continues to attract the vintage collector/restorer who prefers to work CW. The net, which now meets on Saturdays at 3 PM Pacific on 14.062, invites everyone to check in, even if they are not operating vintage equipment. Tracy says that all a check-in needs is an interest in vintage equipment.

In a recent letter Tracy suggested that I regularly publish the vintage CW and SSB frequencies like I do the AM frequencies. I think that his suggestion is a good one and next month I'll start doing that. The reason I haven't been doing this all along is that when I started ER there were not any vintage CW or SSB nets in existance. Times are changing.

Consider checking into the Vintage CW Net; it's an enjoyable experience.

Tracy Reese, WB6TMY, net control

Heathkit Users Net to Start in October

Marty Drift, WB2FOU/5, has advised us that he will be starting a Heathkit Users Net in October on 20 meters. He invites anyone with comments or ideas to contact him. His address is 108 Hickory Ln., Hickory Creek, TX 76205, or he can be reached by phone at (817) 497-6023

The Drake 2B Receiver

by Peter Doherty, W1UO
316 Sunnybrook Rd.
Raleigh, NC 27610

There is a haunting sound from my novice days I'll never forget. After just joining my first radio club, I had gone to visit one of the older members. It was late afternoon, sunspots were hot and 15 meters was jumping. He tuned around the CW band, wading through a sea of signals which my novice ears just couldn't unjumble. He stopped tuning and flipped the bandwidth switch on his receiver to 500 cycles. The barrage of signals was now reduced to just a few. He then rotated the passband tuning control until one signal seemed to stand alone amongst the rest. Then the magic. He flipped the switch on the Q multiplier to the 'peak' position. He turned up the Q balance until the speaker just about broke into oscillation. Then he rotated the peaking control. Suddenly, this weak signal that had been buried under all the others popped into the foreground with an eerie sound. Rare DX. Worked him, then another and another. I was hooked. I had to have one of these receivers. But the year was 1969 and where was a 15 year old going to find all the money necessary to buy this great receiver?

Well years have passed, and the price of a used model hasn't changed much. But now I've got a little more money. That is what's great about Electric Radios – we can all afford them now. So when I was at Dayton two years ago, I finally bought my first dream receiver, the Drake 2B.

Early Drake Receivers

The first Drake receiver, the Model 1A, was introduced around 1958. It covered all the ham bands from 80 through 10 meters. It had a product detector, which makes it fine for SSB and CW reception but not the best for AM. It had a single selectivity of 2.5 kc and a tunable passband control. The list price was $299. There is a good description of this receiver in an ad in the May 1959 *CQ* magazine. The next Drake receiver was the Model 2A, introduced in an ad in the December 1959 issue of *QST*. While it maintained the same basic receiver path as the 1A, many updates were added. The first RF amp was turned into a tunable preselector. A diode detector was added to allow AM reception. The passband tuning module now had two selectivities to choose from, 4.8 and 2.4 kc. Five auxiliary crystal positions added to the flexibility of available frequency coverage. The AVC had a slow or fast decay. Many of the receiver functions now appeared on slide switches on the front panel. The basic receiver listed for $269.95. The speaker cost $12.95. At first, the Q-multiplier option was a separate box but later it was incorporated into the speaker cabinet. It listed for $34.95.

The Model 2B

Drake came out with the Model 2B in April, 1961. It is a refinement of the 2A design. Unless you look closely, you might mistake the two receivers. The 2B had an improved fast AVC release so that the receiver could be used successfully in full break-in CW. The passband tuner was completely redesigned and now had three selectivities. Work was done on improving the RF preselector. The receiver retailed for $279.95. The matching Q-multiplier/speaker cost $39.95 and the 2AC calibrator another $16.95.

The Drake 2B is a very simple but sophisticated receiver. It is a triple conver-

The Drake 2B receiver with the 2-BQ Q-multiplier.

sion superheterodyne, using a crystal controlled high frequency oscillator, variable capacitor tuned VFO and a final I.F. at a frequency of 50 kc, which allows the use of steep-sided L-C filters for the bandpass circuitry. Done correctly, L-C filters can have very good skirt selectivity and I find the sound much more pleasing than that of crystal filters. It has three available bandwidths of 0.5, 2.1 and 3.6 kc, which are a fine selection for CW, SSB and AM reception. The receiver uses true passband tuning, where the actual passband frequencies of the filter are changed, and not the modern method of sliding the oscillators beneath a fixed passband filter.

Besides the normal diode detector, it has real product detector which does a great job on both CW and SSB. The detectors coupled with a very effective AVC system produce a receiver with very nice audio. It also utilizes tuned RF stages in the front end which helps to peak the band of interest while reducing images from other frequencies.

The standard receiver is set up to receive the 80, 40, 20, 15 and part of the 10 meter bands. There are two crystal positions for covering the remaining 10 meter band as well as five more auxiliary positions. They could be used for covering the WARC bands, but in my case I dedicated them to various shortwave bands.

There are two accessories which really complete the receiver. One is the 2-AC crystal calibrator, which plugs into the receiver itself. This produces a marker every 100 kc for dial calibration. The other is the matching 2-BQ Q multiplier/speaker. The Q multiplier can be used in the peak mode in which the passband of the receiver can be narrowed to as little as 100 cycles. In the notch mode, it can eliminate a strong heterodyne in the receiver passband. I would not consider buying a receiver without the Q multiplier.

Restoration

My Dayton purchase turned out to work when I first plugged it in. It needed the usual cleaning of tube sockets and controls. Luckily, Drake used only four paper type capacitors and these were quickly replaced (C29, 43, 52, 69). The cathode bypass electrolytic capacitor in the final audio stage was also replaced (C78). I

continued next page

noticed a definite improvement in the audio quality after changing these capacitors. After a few days, the filter capacitor (C70) opened up, producing a very loud hum. This turned out to be more of a problem since it was a four section can capacitor (100-100-10-10 mFd) with small dimensions. The local TV shop had one of the same physical size with two sections of 100 mFd. I used this with two small 10 mFd tubular electrolytics discreetly tucked under the chassis to complete the repair. I then put in a new set of tubes and aligned it. The results were truly rewarding. The only odd tube in the receiver is a 8BN8 and I would keep an eye out for a spare at the next flea market. All the other tubes are quite common and easy to obtain.

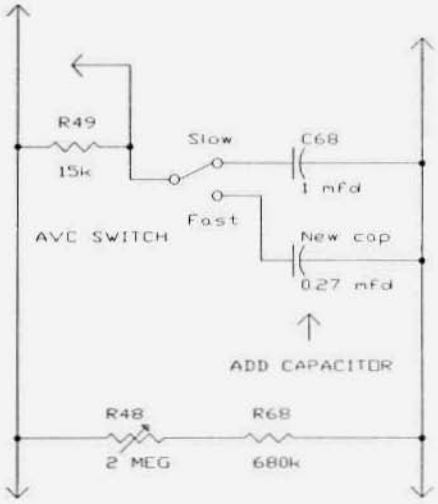


FIGURE 1

Modifications

I made several small modifications to the receiver (all totally reversible, of course!) which I feel enhance the performance. The first is the AVC release time constants. The receiver has a very quick release time constant in the fast position. This would be useful for running full break-in CW, but since I don't operate this mode I decided to adjust the time constant to something more suitable. I accomplished this by installing a 0.27 mFd capacitor across the unused switch contact on the AVC switch. See Figure 1. I mounted a two-terminal solder lug strip under an existing screw on the rear panel of the chassis and ran a wire up to the switch on the front panel. In my stock, I happened to have the same type of wire used in the receiver, which makes for a very invisible modification. While I was at it, I also replaced the AVC slow capacitor with a new one (C68).

The other two mods concern the frequencies available with the auxiliary band switch. Position A is meant to cover 4 to 5 mc. Pretty useless. I would much rather cover the 49 meter shortwave broadcast band (5.9 to 6.5 mc). This was easily accomplished by removing two jumpers from the bandswitch. See Figure 2. These jumpers remove shunting capacitors from the RF amp tuning circuit and allow the preselector to tune the required range. A 10.0 mc crystal did the trick. An added benefit of this Band A modification is that by tuning the preselector to an image, reception of the 22 meter shortwave band (13.5 to 14.0 mc) is also possible.

Bands B, C and D were dedicated to the 31, 25 and 19 meter shortwave broadcast bands (9.5 to 10.0, 11.5 to 12.0 and 15.0 to 15.5 mc), using crystals of 13.5, 15.5 and 11.5 mc respectively. No modifications were necessary. Band E was dedicated to the 16 meter shortwave band (17.5 to 18.0 mc) and to accomplish this, it was necessary to solder a 75 mmFd capacitor across L11, which is the resonating coil for the crystal oscillator. See Figure 3. A crystal of 14.0 mc is used here.

I purchased most of the crystals at various flea markets. Each one worked correctly. Obviously, the crystal oscillator is not too fussy. Those that I could not find, I ordered from JAN Crystals. They are a good source of inexpensive crystals.

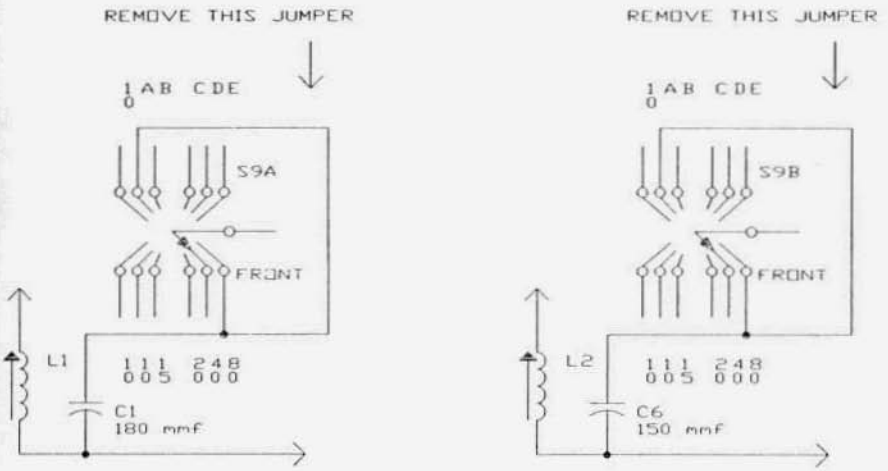


FIGURE 2

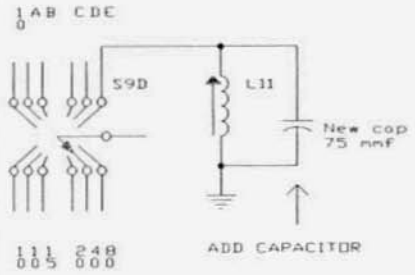


FIGURE 3

Conclusion

The receiver has performed flawlessly over the past two years. I've spent many hours of enjoyable listening, especially on the shortwave broadcast bands. But the biggest thrill is to zero in on a weak CW signal, narrow the bandwidth to 500 cycles and rock the passband control. Then flip the Q multiplier into the peak mode, crank up the balance and peak the signal. The sound of the rare DX rising out of the velvet background is definitely one of the high points in radio reception technology. **ER**

Colorado AM'ers at a recent hamfest. From left to right: George, K7DU; Art, WØIWV; Hank, WØAEE; Rick, K8MLV/Ø; Phil, NØCFF; 'OJ', KØOJ

Jim, K6JAD, with his latest acquisition, a Hallicrafters DD-1.

Gerald Meyer, KB4VR, in his Miami hamshack.

Tom Marcellino, W3BYM, with his vintage station. On the left a Viking II sits on a Hallicrafters SX-101A. The transmitter on the right is a Collins 32V-1. The mic in front of it is an Electrovoice 911. The mic with the Viking II is an Astatic JT-30.

LETTERS

Dear ER

Enclosed is a copy of a letter I wrote to the widow of Don Scott, WA4UGR. As you've probably heard, Don died of a heart attack while at work in early June.

As is so true in our hobby, I made a good friend with someone I never met. We were trying to fix that by meeting in the mountains. I think what shocked me the most was that Don was more my age.

But it also underlines for me what makes AM so attractive. QSOs that add up to something, continuing conversations from day to day, discussions of family and projects that never happened for me on SSB and not very often on CW.

What I enjoyed most about Don was his low-keyed sense of humor and his ability to make nice radios out of nothing. I'd love to see his shack! When my low voltage transformer blew on the Viking II, he told me that he'd had the same problem. He found another transformer, mounted it on a board, and ran the wires inside the case! His amplifier was totally homebrew, in a constant state of flux, and always sounded good. Don laid to rest the nasty rumor that a Japanese rig wouldn't work well on AM. The sound he got from a 101EE was remarkable.

Don Scott wasn't one of the "heavy hitters" of AM. He didn't design or invent commercial rigs nor write scholarly articles on restoration or design. He was one of us. A man who loved his hobby and the people in it, a man who took what he had on hand and made it sound good. Most of all, he would give you the shirt off his back. I received several "care packages" from Don since I returned to AM, those wonderful little boxes with that missing tube or hard-to-find capacitor.

Too many times we forget that there are people behind the radios, microphones and the keys. Don Scott was one of them.
Haney Howell, NO2N/4

Haney's letter to Mrs. Scott
Dear Mrs Scott,

I am one of Don's ham radio friends. We talked each morning before he went to work, and these chats were the high point of my day. He was always friendly, supportive and someone who obviously enjoyed his hobby and his family.

We discussed meeting later this summer during his trip to the Smoky Mountains. I live nearby and this seemed to be a good chance to finally put a face with someone I knew well from the radio. I'm truly sorry we never had a chance to meet.

Don and I chatted the morning before his death. I was headed for the Boone area and we discussed places where we could meet if his trip worked out. I called him each morning the next week, and was getting ready to call on the telephone when I heard the news. What a shock!

I'm certain you've been told this recently by other friends, but I want to tell you again. Don represented to me what is good about our hobby. A man willing to help, a person who shared. We talked about all the rebuilds on the amplifier, the adventure of buying your new car, and how he hoped Tim would eventually want to operate more often.

I've been an amateur for more than 35 years, and reached a point where it was becoming uninteresting. On a lark, I put an old AM transmitter on the air, and the first person who helped me was Don. I've enjoyed every minute of my AM time, and working on the old equipment is what I really want from the hobby. Don did much to make me understand that.

Just know that others share your loss, even those of us who only knew Don as a voice and a caring person. While a hobby, radio seems to cut through to other levels. I can't think of any other pursuit where I'd be moved to write a letter like this.

Just know that thousands of ham radio operators will miss him as well. Truly, he was much more than a voice in the night.
Haney Howell, NO2N/4

Dear ER

I want to tell you a little about the recent hamfest known as the Breeze-Shooters, a Pittsburgh based club. The hamfest is held in Butler, PA. It is very popular in the AM vintage radio circle. Much older equipment is found here. I, myself, purchased four receivers - two RME 45's - an SX-101 - and a National NC-100. The expensive one of the bunch was the SX-101 at $75! Probably the buy of the day was the purchase by Dave, N3IQE, a Collins 75A2 at $120! Dave Cramer, WB3ETN, purchased a Hallicrafters HT-9 for $100. Steve, WA3JJT, got a Harvey-Wells TBS-50D for $25.

Other AM'ers seen in Butler on June 5 were: KO3L, Ed N3GWE - Ed; WA3GKX, Tony; N3BRY, Denny; N2BAU, Kenny; N3HFB, Cherrytree Tony; WA3RRS, Konrad; WA3UCR, Bill; W3VZW, Frank; K3USC, Brian; W8VYZ, Ashtabula Bill; also young Bill (call unknown); WD2AFJ, Ray; N3LQJ, Mark; KA3KYF, Ralph; KD3ZJ, Jason.

Several of us AM'ers got together and provided fresh grilled lunch, in the form of hot dogs and burgers and 807s.

This event is one of the best in the Northeast. This can be attested by anyone coming any distance. They come back the following year.

There are others I've forgotten to mention. Suffice to say, it's the people that make the event.

Russ Dworakowski, WB3FAU

Dear ER

I've enjoyed the magazine from the first issue. Have met many new friends through the ads and a lot of fellas have sure helped me out in acquiring interesting tubes for the collection here. The number of tubes has passed 7000 now. Some are dupes and some are variations of a single type but there are still thousands of different types in all of that. Last count I had 77 Xerox copy paper boxes full plus a six-foot display case. These are just the small ones. The larger ones occupy separate niches around the garage and basement!! Almost ready to begin building a new house where I'll have room to set up the "Midwest Vacuum Tube Museum" if everything works out OK and XYL doesn't restrict my space!

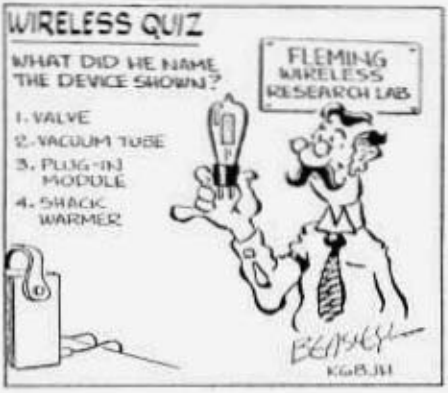
John H. Walker Jr.

Dear ER

Thanks for a fine publication. I particularly enjoy the restoration and minor modifications articles appearing in the magazine. The writters do an excellent job. A couple of weeks ago I picked up a very nice NC-300. Remembering I'd seen a modification in Electric Radio, I searched and found it in the Sept.'92 issue. The article was written by KØEOO/6. The NC-300 worked OK but there was room for improvement. Rolling up my sleeves I dug in. Now the NC-300 is one of the best in my small arsenal. Extremely stable, it has a superb AVC system and I tune the bands with it as much as the 'A4.

I'm mainly interested in vintage SSB and appreciate my 'new' NC-300. Thank you Dennis and again thanks to Electric Radio.

Ron, AD6V



A Premier Quality Homebrew Stereo Amplifier

The Rebirth of the Classic Williamson

Part Two

by Bill Kleronomos, KDØHG
P.O. Box 1456
Lyons, CO 80540

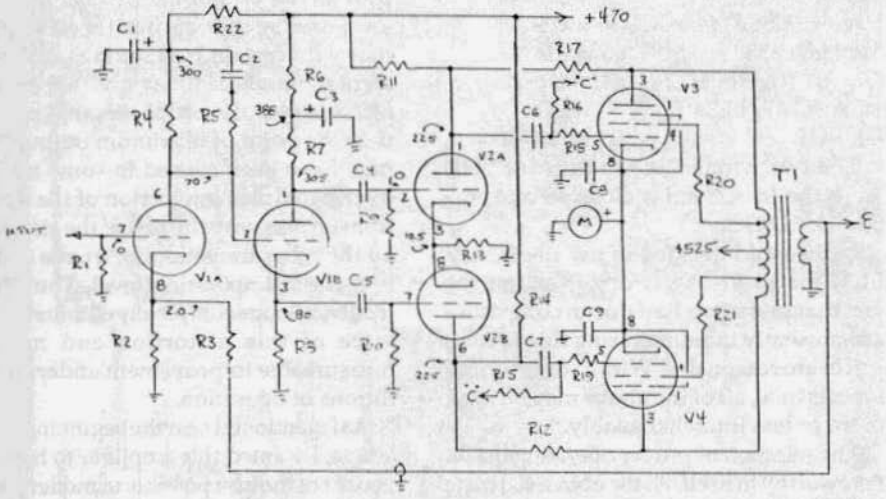
Circuit Design

This is an area where I utilized both my own observations and published articles on the Williamson from the '50's. My process was to breadboard parts of the circuit and make measurements regarding behavior at different signal levels. Notes on each circuit revision were kept in a notebook for reference and comparison. The test equipment I used was an Eico 378 audio generator (a better performer than my old HP 200CD), an HP 331 distortion analyzer and a Tektronix 547 scope with 1A2 dual-trace preamp.

Over the years, some criticisms and modifications of the basic Williamson design have been published. The most interesting article I found was one that appeared in Audio Engineering of August, 1952. [Note: This magazine was the renamed Radio magazine of an earlier era; it still exists and is now called Audio]. The author of the 1952 article suggests a number of improvements that I took into consideration in my own prototype. The first changes involved replacing the original 6SN7 preamp and driver tubes with some better performers in terms of hum, noise and output voltage capability. That's not to say there's anything wrong with the original 6SN7 design; we're talking refinements here. I spent a number of evenings looking at tube data sheets and my own selections were the use of the 6DJ8/6922 as a preamp/phase splitter and the use of a 12BH7 as the push-pull driver stage. My logic behind use of the 6DJ8 was that it's a low noise tube, originally designed as a VHF amplifier/mixer. Its other advantages are that is uses a rigid frame grid construction, which would tend to minimize microphonics, and it doesn't have as high an amplification factor as the more commonly used 12AY7, hence more bias voltage can be used, allowing the tube to handle larger input signals before running into grid current. The 12BH7 was chosen for its low plate resistance, high plate voltage rating, easy availability and once again, low amplification factor and subsequent ability to handle large signal voltages. In most class A voltage amplifiers, the total harmonic distortion is directly proportional to the output voltage being delivered as a percentage of maximum output capability. In other words, big output voltage capability=lower distortion. On my bench, the 6DJ8-12BH7 combination was able to deliver over 250 volts peak to peak output voltage at less than 3% THD+noise. Since the maximum peak output voltage it would ever need to deliver would be on the order of 45 volts, we're talking one heck of a good driver. I measured the THD at about .35% at 45 volts P-P output on the bench.

Other notes on the preamp/driver stages. According to my Amperex tube handbook, both triode sections of the 6DJ8 do not have the same heater-to-cathode voltage rating. Section 2 (pins 1-2-3) has the greater rating. This is apparently due to its original design for use in cascade VHF amplifiers. With regard to the 12BH7, I plotted a loadline and selected a nominal value of 950 ohms for a cathode resistor as the schematic shows. It is, however, possible to make a noticeable reduction in the complete amplifier's THD by reducing this resistor to a value of around 750 ohms.

The downside to doing this is that certain brands of tubes get slightly unstable and create a small ringing type of oscillation evident on portions of low frequency (20 HZ or so) waveforms. Plate dissipation is also increased. I mention this as a



Schematic of the amplifier, one channel shown.

Parts List - Williamson Amp (one channel)

C1, C3 - 10 uF/400-V electrolytic
C2 - 820 uf/300-V mica or polystyrene
C4, C5 - .01 uF/500-V or better Vitamin Q or polypropylene, matched to 1% or better.
C6, C7 - .25 uF/500-V or better Vitamin Q or polypropylene, matched to 1% or better.
C8, C9 - .1 uF/100-V tubular

Note: All resistors are metal film or metal oxide film unless otherwise noted. All resistors of like values are matched to within .5% using a DVM.
R1- 47K, 1/2-W
R2 - 470, 1/2-W
R3 - 3.92K (for 8 ohm), 2.4K (for 4 ohm), value is 1200 divided by the output impedance (feedback resistor).
R4 - 47K, 3-W
R5 - 4.7K, 1/2-W
R6-R8 - 22K, 2-W
R9-R10 - 220K, 1/2-W
R11,12,14,17 - 100K, 3-W
R13 - 950, 1/2-W
R15,16 - 100K, 1/2-W
R18,19 - 4.7K, 1/2-W
R20,21 - 1K, 2-W
R22 - 33K, 3-W

M - 300 mA DC panel meter
T1 - output transformer, screen taps at 40-50%
V1 - 6DT8/6922
V2 - 12BH7A
V3 - 6CA7/EL34, 6550 or 6L6GC

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point of interest; the complete amplifier has such low distortion that one would never hear the improvement such tweaking will make.

The selection of output tubes was an interesting project in itself. Many types were tested in my breadboard circuit with a number of different plate voltages. As I have a couple of pre-school toddlers around the house, tubes with plate caps were tested but never seriously considered. There were two bottom line issues involved in the decision making process, those of performance and availability (price!). Under identical conditions of 450 plate volts, and using manufacturer's recommended bias, I measured the output power generated at the visual onset of clipping as viewed on the scope.

continued next page

Homebrew Amplier from previous page

Sylvania 5881,	50 watts
Sovtek (USSR) 6L6GC	36 watts
Sylvania 6550	66 watts
GE 1614 (metal 6L6)	41 watts
RCA 6CA7/EL34	50 watts
GE 8417	68 watts

The two winners in the battle of THD were the 6CA7 and a close second, the Sovtek 6L6GC.

In the end I decided to use the 6CA7/EL34 for its great performance and the fact that perhaps a half dozen companies are presently manufacturing this tube so prices are reasonable. With a socket wired for this tube, all of the above may be used more or less interchangeably.

The selection of proper operating bias is noteworthy in itself. At the above 450 plate volts, the 6CA7s produce the overall lowest distortion at an idle current of about 110 mA per pair. My finished amplifier, on the other hand, has a plate voltage of near 530 volts. At this higher plate voltage, the best overall bias level as tested for THD was around 70 mA. An attempt to use anything over 100 mA surprisingly caused higher distortion, and the tubes were running awfully warm near their maximum rated dissipation ratings. Idle current on the higher side made for lower THD at lower levels; conversely, lower idling plate current made for lower distortion at maximum output. A current near 50 mA caused a profound dip in THD at full output but an increase at the 5 to 10 watt level. In general, it seems, idle current should be inversely proportional to applied plate voltage, approaching a little over 100 mA if plate voltage is much less than 500.

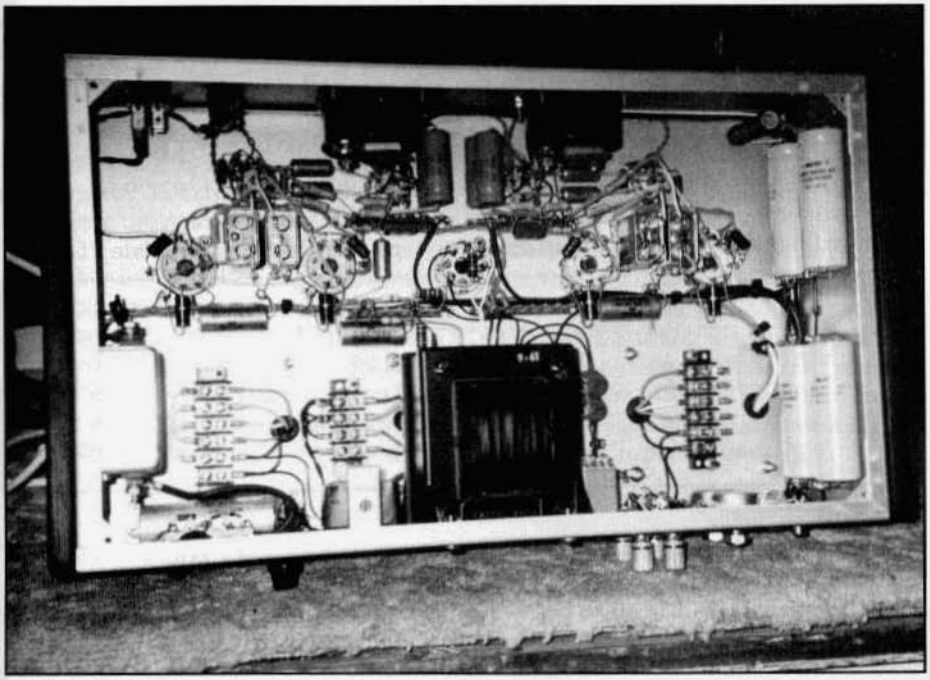
A final note on bias - if one adds a 10 to 22 ohm, 2 watt resistor in series with the common cathode connection and ground of the 6CA7s, a measurable decrease in distortion can be observed with some types and brands of tubes. Once again, probably never audible but observeable on test equipment.

I made another minor change to the original Williamson design that I haven't seen published elsewhere. R12 and R17 provide an additional inverse feedback loop around the output tubes. I found that with certain bias settings, and with certain brands of tubes, a visual amount of crossover distortion became evident near the point of maximum output. This may have been caused in some manner by the complex interaction of the output transformer with the rest of the circuit, or by the tubes transitioning from a class A to a class B operating level. The added feedback loops completely eliminated any trace of this distortion and made a measureable improvement under all conditions of operation.

As I mentioned near the beginning of this article, I wanted this amplifier to have the benefit of the best possible in modern components (within reason... I've seen custom hand rolled silver foil capacitors go for more than $1,000-each). All resistors other than the bleeders are metal film or metal oxide types. These resistors are reasonably priced from sources such as Digi-Key in Minnesota, and they have superb specifications in areas such as stability, temperature drift, overload capability and voltage coefficient. They are available in ratings up to three watts. Bear in mind that under-chassis temperatures on a piece of equipment such as this can get outrageous; it's perhaps best to operate resistors with a large power derating factor - use ones two or three times larger than actually needed. The wattage ratings shown in the parts list reflect this conservative design philosophy.

As this is a push-pull amplifier, balance is important. I purchased twice as many resistors as called for and matched pairs of like value with the use of a DVM. The real crucial ones are R 7, 8, 11, 12, 14 and 17, but try to match all of them if possible.

Capacitors are another subject area one could write an entire article on. There are objective and subjective reasons to use different types or not to; I chose to go with the prevailing opinions in the audio press on types. The coupling capacitors in the signal path are Sprague "Vitamin Q" types, which



Underside of the chassis.

most hams with any self respect should have available in their junk boxes or in odds and ends of military surplus chassis. These capacitors are held in high esteem by the homebrew audio fraternity which feels that, in general, paper/oil capacitors integrate musical waveforms in a sonically superior way. Don't ask me how! I can also recommend the use of polyprypelene dielectric types which I have found offer superior performance in sample and hold circuits due to the characteristics of the dielectric, and should likewise offer a low distortion signal path. At the bottom of both my list and those of the hollow state audio fraternity come the mylar dielectric types, although to be honest, I probably couldn't tell that they were being used under blind test conditions. One thing I'll say about the Vitamin Q and similar paper/oil hermetically sealed types: I've never seen one fail, even in WW II era radio equipment. Just ensure that capacitors, especially paper types, are run at a substantial voltage derating factor for longest life under torrid conditions as well as for minimizing internally generated noise.

Again, for longest life, I'd recommend sealed can types for the power supply filters and bypasses, but they are rather large. I ended up using Mallory TCG computer grade electrolytics for these applications.

Miscellaneous Construction Notes

Williamson and others have cautioned builders of amplifiers to widely separate power transformers and filter chokes from the output transformers to minimize hum coupling. I chose not to do so; the spacing between transformer end bells is nearly an inch, and the residual hum present in the complete amplifier is extremely low. All internal wiring is mil spec surplus silver plated copper with teflon insulation - not for any alleged sonic reasons, but because it's not damaged when hit with a hot soldering iron. All heater wiring was twisted up in an electric drill to cancel hum effects and installed before any other parts were wired in so it could lie next to the chassis.

continued on page 34

Notes On the 6AG7/6L6 from page 17

* There is a minimum level of grid drive required to obtain maximum output from the 6L6 at a given level of 6L6 plate voltage. That minimum level will NOT drive the 6L6 class C and is approximately:

VP-P grid drive = positive grid voltage - (grid cutoff voltage)

* A good "rule of thumb" when using a 6AG7 with an untuned/RFC plate to drive a 6L6 is to use the same plate voltage for both tubes. In this respect, the AT-1 "got it right".

I tested the 6L6's grid cutoff and screen voltage as a function of its plate VDC:

Plate VDC	Grid Cutoff Voltage	Screen Voltage
385	-65	264
350	-59	239
300	-50	212
250	-42	181
200	-33	148
150	-25	113

Notes:

1. I defined cutoff as when the 6L6's plate current measured 1 mA.
2. The 6L6 screen resistor was a 22k connected to the 6L6's plate VDC.

At this point, I was starting to get the feeling that the 6L6 left a lot to be desired in the RF amplifier department. Heath's 2nd generation AT-1, the DX-20, uses a 6DQ6A in the final. With the exception of the 6DQ6's plate cap, the basing is the same as the 6L6. I substituted a 6DQ6B for the 6L6 in the AT-1 test bed and connected its plate using the DX-20's parasitic choke to pin 3 of the octal socket. The output power on 40M was now 16W!! The plate current was also way up, about 130mA. What a difference!! There was also a 15% increase in the grid drive available using the 6DQ6B.

I'm not sure that the AT-1's power xfmr would handle the additional plate current but swapping tubes sure put the 6L6's performance in perspective. The "venerable" 6L6 is OK for building that 6AG7/6L6 classic, but it is probably not the best choice if you are interested in maximizing the output power for a given set of components.

Although these tests were done using an AT-1, they are consistent with the results I have obtained from other 6AG7/6L6 designs. With the exception of the AT-1's fixed-linked-coupled output, the rest of the design is classic 6AG7/6L6. Output powers using a pi-net will be slightly higher, but the relationships between plate voltages and grid drive should be similar.

For additional reading, try Lewis McCoy/W1ICP's "More Power with the AT-1, Simple Modifications for Greater Output" in the October, 1955, QST, pgs.36-39, 130. I wouldn't classify the mods as simple but the article covers a lot of ground. W1ICP recommends changing the 6L6 to a 6BQ6. **ER**

AMI News from page 3

Northwest - Pat, K7YIR, sent a matrix of operating frequencies and times for Northwest AM activity. Frequencies span 160-2 meters! Pat mentions in his letter that he has added a Clegg Zeus for 6 and 2 meters and now he has high level AM on 160-2. VHF AM'ers from other regions may want to correspond with Pat to look for those 6 meter openings. **ER**

Armed Forces Day at Fort Burnside from page 15

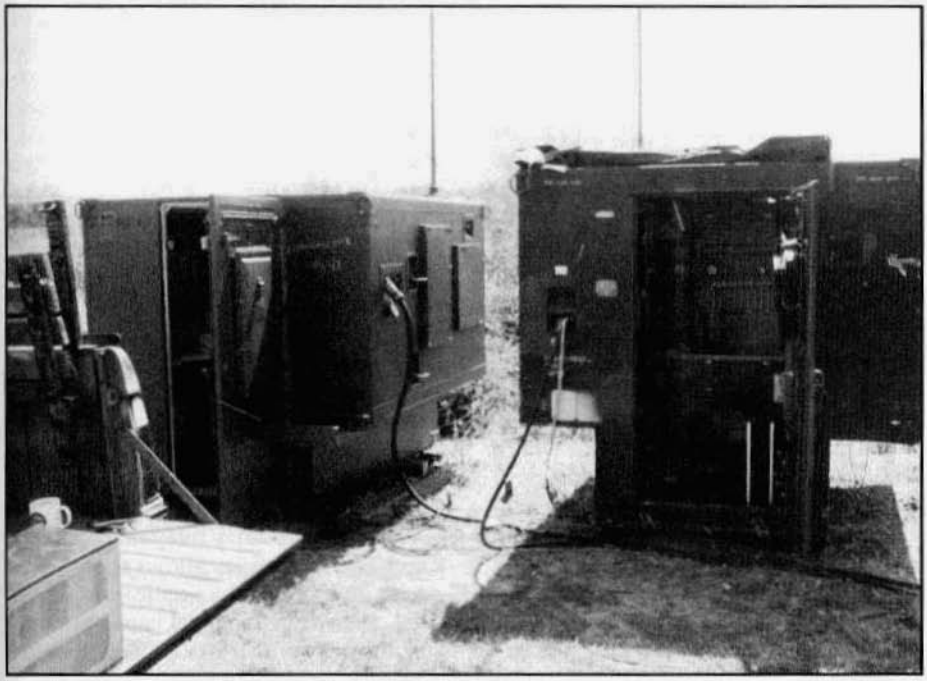
several tall telephone poll antenna supports. Contacts were made on CW, AM, SSB and RRTY. Several Armed Forces stations were contacted.

Much time was also taken up with troubleshooting and maintenance. Even expensive military radios give some problems when they haven't been used in a while!

Probably the most interesting radios were the equipment enclosures designed to sit on the back of a vehicle and to serve as communications centers in a battlefield setting. Brown has several of these staged in a semi-circle just outside the house. They are complete with power supplies, transmitters, antenna couplers, teletype, switching, documentation, antenna mounts and whip antennas. A trailer mounted 3 phase 115-V 400 Hz generator was purring most of the day to keep the enclosures running.

Armed Forces Day at Fort Burnside was declared to be a success and we will be back again next year.

Note: I did not receive written reports from other stations operating the Military Radio Contest, but did talk to several on the air. I would like to hear from participating stations and military radio enthusiasts form other parts of the country on how to make next year's event bigger and better, drop me a line. **ER**



Unit on the left is a TRC136 and unit on the right is a TSC15, Both are Collins manufacture and run about 1000 watts PEP.

T-8040 Transmitter from page 9

am listening to Field Day on it; this is the best receiver I've used for severe QRM conditions.

Homebrew plans for the future include combining the R-8040 and T-8040 in a plywood cabinet to make a complete portable AM station for vacation use. Even with space for an antenna, phones, mic, flashlight, line cord, logbook, etc., the whole thing would only be about 16" x 9-1/2" x 8" (H x W x D) and less than 15 pounds.

After that, at Editor Wiseman's suggestion, I may look at a transceiver using battery operated tubes on a single chassis for real portable operation. We are talking of something at the 2 to 10 watt power output level, able to operate from 9 volt and flashlight batteries and go in a corner of your hamfest tote bag. This might combine versions of the R-8040 and T-8040 to give you a very low power general use portable or it might be further simplified by crystal control of both TX and RX.

(Sound of teeth again). I don't know why I listen to him.

Finally, with some changes, you could build a receiver along the lines of the R-8040 but covering all bands -- indeed, it might even be a general coverage unit. This set wouldn't be a lot more work to build than the R-8040 and in the hamband-only version would cost about the same since special order filter crystals would be eliminated. I hope someone else tackles this first (those constructors for whom serial no. 2 of a design is too tame, will find more info in the R-8040 note package) but if not, I probably won't be able to resist. ER

Homebrew Amp from page 31

For superior high frequency and transient response it's important to minimize the capacitance of signal paths to ground. For example, C6 and C7 are physically large can type capacitors that needed additional support beyond that of the lead wires. (They're .25 uF 1000-volt Sprague 'Chlorinols'.) I measured their capacitance from terminals to can and came up with near 100 pf, so they were epoxied to a piece of perfboard which in turn was glued to the chassis. This expedient reduced their terminal to chassis capacitance to less than 15 pF.

Surplus ceramic tube sockets were used throughout - because they look nice! Tube shields were unnecessary as evidenced by the low residual hum specs.

As is common practice, the 6.3 volt heater line is elevated to a DC voltage of about 45 via a divider from the main B+ line to minimize hum. C5, the heater signal bypass capacitor, is very important in keeping hum and noise down. Don't leave it out.

A surplus EMI filter is used at the AC line input to keep out high frequency line noise as well as to provide some degree of protection to the power supply from voltage spikes. C1-C4, across the rectifiers, are present to prevent a clicking type of transient that has been reported as audible in amplifiers using a choke input filter, as this one does. Reportedly, this transient-generated noise is created as the rectifiers switch on and off during the AC cycle, and can be generated by tube type rectifiers as well as the silicon variety.

An Amperite delay relay that operates a second, heftier relay allows the tubes to warm up prior to the application of B+. As a protective feature, I chose to use a surplus relay with a 90 VDC coil that will only operate and enable the main B+ if bias voltage is present. No bias, no B+. As it should be. ER

Part three next month.

CLASSIFIEDS

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DEADLINE FOR THE August ISSUE: August 3

FOR SALE: Repair and restoration on all vintage equipment; 35 years experience. Barney Wooters,W5KSO, 8303 E. Mansfield Ave., Denver, CO 80237. (303) 770-5314

FOR SALE: R1051B rcvr, s/n 5507, ex. condx - $495; Racal RA 6790, 500 kHz - 30 MHz, AM, FM, SSB, CW rcvr, still manufactured today, mint - $1600. U-Ship. Bob, WB2ZOF, (315) 468-2691 eves

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WANTED: Anyone have schematic & alignment instructions for Clegg 99'er, 6-meter AM xcvr? Would appreciate copy, or contact me to arrange purchase. Wayne Arnett, AI7C, 2699 Mazatlan Dr., Grand Junction, CO 81506.

FOR SALE: Motorola FM TRU-5V mobile unit (FM), w/mic, control box and instruction book - $30. shpg paid. Bill Riley, 863 W. 38th Ave., Eugene, OR 97405.

FOR SALE: Johnson Viking 500, good wrkg condx, spare tubes - $700. Jeff Main, N9INW, (414) 962-6383

WANTED: Heath DX-35; front panel for DX-100; Collins 62S-1, 75S-3C. Dave, WA3HSC, (703) 941-7377 (d), (301) 868-0557 (n)

FOR SALE: Motorola R-390, operates weakly - $95; (2) identical two-tone test units (Panoramic Electric model TTG-2) - $25 each or both for $45; Johnson Kilowatt Matchbox (has meter) - $195; Hallicrafters S19-R Sky Buddy, VG - $120; BK Precision model 1590 scope, two channel, 100 MHz, probes, mint - $750; military sweep scope model TS-452D and manual, self contained scope, absolutely mint- $125. All plus shpg. Glen Fritz, N4WDX, 14711 War Admiral, San Antonio, TX 78248. (210) 493-8707

FOR SALE: Collins S-Line aluminum knob inlays: small (exciter/PA tuning) - $1; 30L-1 - $2; spinner/plain (main tuning) - $3. Charlie, K3ICH, 13192 Pinnacle Lane, Leesburg, VA 22075. (703) 822-5643

FOR SALE: New list of 1000's of tubes! Includes new, used, antique, collectible, Majestic and Western Electric types. Send SASE to Jim Cross, 2817 Parklawn Dr., Dayton, OH 45440-1538. (513) 298-5827

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FOR SALE: Used technical books - radio, electronics, math, military, magazines, etc. $1 for large list. (stamps ok). Softwave, Dept. ER, 1515 Sashabaw, Ortonville, MI 48462

FOR SALE: Heathkit SB-101/102, HD-10 keyer, SP-600 spkr, HP-23 AC sply, HDP-21A mic, all exc., package deal, share shpg - asking $350. Dave, WA3HSC, (703) 941-7377 (d), (301) 868-0557 (n)

FOR SALE: HQ-160, mint, w/spare tubes, manual and original box - $130. No shpg, local vicinity pick up. Bud Gross, WØBYG, 11040 70th St., S., Cottage Grove, MN 55016. (612) 459-3233

WANTED: Top and bottom covers and original cabinet for R-390A; data on Cetron UXCVII triodes; manual for HP 606B. Clark Hatch, WØBT, 2546 SE Peck Rd., Topeka, KS 66605. (913) 235-2721

FOR SALE: Collector quality Heathkit SB-104A, SB-604 spkr/sply, SB-644A vfo, SB-634 station console, all manuals, mint - $500; (2) Heathkit HW-101, stuff - call; Collins R-391, exc., pick-up - $275; Hammarlund HQ-110 - $65; National NCL-2000, pick up - $400; Drake TR-6, MS-4, AC-4, N/B, exc. - $400. U-ship. Richard Lucchesi, WA2RQY, 941 N. Park Ave., N. Massapequa, NY 11758. (516) 798-1230

FOR SALE: Hallicrafters model SX-42, completely restored, carefully realigned on all bands, exc. appearance, w/o spkr, w/manual, 8 ohm output - $220 plus UPS. Ted, W6NPB, 2157 Braemar Rd., Oakland, CA 94602. (510) 531-7042, FAX 531-7072

FOR SALE: Classic amateur and all Lafayette radio manuals. Will match or beat any published price. List available. Satisfaction guaranteed. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. (908) 238-8964

FOR TRADE: Johnson S5B adaptor, matching pwr sply and original manual for nice Valiant II. Sam, N4VIB, Rt 3, Box 3469, Chatsworth, GA 30705. (706) 695-5658

FOR SALE: New reprint "Tubes and Circuits" by Wholesale Radio Laboratories, circa 1942-43 - $8 ppd. James Fred, R1, Box 41, Cutler, IN 46920.

WANTED: SC-101; SC-301; KW-1; 30K-1 thru 5; 302C1; 75A thru 75A-4 rcvrs and spkrs, any condx. Purchase entire estates, pick up 48 states and top $ paid. Rick, (800) 462-2972

FOR SALE: BC-455B rcvr - $20; C-87/ART-13, new - $13; Measurements 111B crystal calibrator - $35. **WANTED:** Drum type mechanical digital clock. U. Joe Orgnero, VE6RST, Box 32, Site 7, SS 1, Calgary, AB, T2M 4N3, Canada. (403) 239-0489

FOR SALE: Tube types 35T - $70; 304TL - $130; 572B - $100; 100TH - $40 and others. Ed Belleci, 2310 SE 113th, Portland, OR 97216. Phone/FAX (503) 281-4734

FOR SALE: Military radios - ART-13,T-195, R-392,ARC-5, all new; TBX xcvr, BC-348Q w/ dynamotor, no mods & mint; ART-13 shocks and all acces.; also BC-456's; Collins R-390A, mint, all covers, orig. cabinet, all filters, perfect. WA1DEJ. (617) 233-1414 late eves.

FOR SALE: R-390A service: Module repair and alignment to complete remanufacture, new front panels, knob sets, VFO calibration, new filter capacitors, tubes, squelch modification, 20 years expert service, 2-week turnaround, very reasonable, any condition accepted. Rick Mish, (419) 726-2249

WANTED: Parts, assistance to reconstruct Stromberg Carlson 160L Acoustical Labyrinth! France is not on the moon, will pay all expenses. Reinhard Wieschhoff, 7, rue du Debuche, F78120 Rambouillet, France.

FOR SALE: Electronics suite from U.S. aircraft carrier. MF-UHF rcvrs, xmtrs, radars, PPI displays, RTTY cnvters, terminals. Much more.Bob Mantell, W6VQT, 3135 N. Ellington Dr., Los Angeles, CA 90068. (213) 851-2786

FOR SALE: R-390A EAC (1967) s/n 51xx, complete, near mint; G133F (military airborne 51S1) LTV s/n 101xx, near mint. Mike Nowlen, WB4UKB, 12911 New Parkland Dr., Herndon, VA 22071. (703) 481-9614

WANTED: Depot manuals for R-390 and R-390A rcvrs, repros OK; manual for Heath SB-301 rcvr. Geoff Fors, WB6NVH, POB 342, Monterey, CA 93942. (408) 373-7636

WANTED: A speech amp to drive a pair of 811's; Johnson 122 vfo; 160 meter xtal 1.950-1995. Donald Spreeman, 542 E. 20th St., Kaukauna, WI 54130-3344. (414) 766-1175

TRADE: James Millen's (W1HRX) personal QCWA pin, for 1934 model Mac-Key (brass plate, 54xx s/n). Tom French, W1IMQ, "the McElroy collector", 120 Great Road, Maynard, MA 01754. (508) 897-2226

FOR SALE: Collins main tuning knobs for 75A etc.; main tuning knob for HRO etc.; 1940's and'30's magazine call "Radio", good shape. Marty, (817) 497-6023

FOR SALE: National NCX-500 xcvr, w/AC 500 sply - $185. **WANTED:** National NTS-3 spkr, XCU-400 calibrator; Globe King 500. Bill, KE7KK, 6712 Lake Dr., Grand Forks, ND 58201. (701) 772-6531

WANTED: Early Hallicrafters - any condx. Also SX-88,Blue Racer, JT-30 and Breting #9. Tom Lucht, 9317 Jaynes, Omaha, NE 68134. (402) 571-0688

ELECTRON TUBES FREE 1993 Catalog, over 2,000 types in stock. **Electron Tube Enterprises,** Box 311, Essex, VT 05451. (802) 879-0611, FAX (802) 879-7764

FOR SALE: Radio tubes; repair and restoration of all vintage amateur and commercial radios, 25 years experience. Herbert Stark, 321 N. Thompson St., Hemet, CA 92543. (714) 658-3444

WANTED: Collins literature, manuals, catalogs, SM2, SM3, MM2 mic's, TD1, 647T dipole ant, 35C low pass filter, 55G1. Rick Coyne, KD6CPE, POB 2000-200, Mission Viejo, CA 92692. (714) 855-4689

FOR SALE: New RCA 802 tubes - $3; type 1616 - $2; type 2E26 - $1.50; type 673 (same as 575A except base) - $10. Write for special pricing on other tube types. Antique Electronic Supply. See ad inside back cover.

WANTED: For a Globe King 350/400 circa 1949 - manual (I have basic diagrams), pwr sply chassis (or a 3"H x 17"W x 12"D bare chassis). Charles J. Graham, K6KDZ, 20333 Casa Loma Rd., Grass Valley, CA 95945. (916) 273-6847

WANTED: 51J4 top dust cover and mech. filters F500B-14, F500B-31; General Radio Company catalogs, mauals and old "Experimenter" magazines. John Tiedeck, WA2SDE, 212 Grandview Rd., Media, PA 19063. (215) 566-8049

FOR SALE: NC-300 w/ER mod for SSB - $250; rare Drake RR-1 (commercial grade SRR-4); Kenwood 599 D twins - $475. Excellent to mint. James B. Geer, WB5LXZ, 604 King Dr., Bedford, TX 76022-7124. (817) 268-1985

WANTED: Espionage equipment. Historian purchases spy radios, code and cipher machines and any equipment, devises or manuals pertaining to the world's intelligence organizations. Keith Melton, Box 5755, Bossier City, LA 71171. (318) 747-9616

FOR SALE: Heath Nostalgia - 124 page paperback covers Heath history in pictures and stories. $9.95 postpaid (plus tax in WA). Heath Nostalgia, 4320 - 196th SW., Suite B-111, Lynnwood, WA 98036.

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Shipping charges additional.

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WANTED: Very early Hallicrafters and Hallicrafters/Silver Marshall equipment including Skyriders with entire front panel dull aluminum color, S-30 radio compass, S-33 Skytrainer, S-35 panadaptor, wood console speakers - R-8 & R-12, HT-2, HT-3, BC-939 antenna tuner, parts, advertising signs, paper memorabilia of Hallicrafters. Also want RCA model AVR-11 airport tower receiver. Chuck Dachis, WD5EOC, "The Hallicrafters Collector", 4500 Russell Dr., Austin, TX 78745. (512) 443-5027

FOR SALE: Hallicrafters SX-99, works fine, cabinet good - $100 plus shpg; National NC-300 hamband rcvr, works fine, very good condx, with manual - $125 plus shpg. Fred Clinger, WA8KJJ, 417 Beechwood Dr., Galion, OH 44833. (419) 468-6117 after 6 PM

Electric Radio Back Issues

All back issues are available at $30 per year or $3 for individual copies. This price includes delivery in the U.S. and Canada. Foreign orders please enquire.

WANTED: Johnson accessories, code keys, SWR bridge, station monitor, etc. Even good clean rigs. Bob Kemp, POB 470, Lake City, MN 55041. (612) 345-5345 days

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FOR SALE: Hammarlund HQ-180C, w/ matching S-200 spkr, original manual, spare tubes, exc. condx - $250. Dan, KF9BP, (414) 255-9165

WANTED: Feb. 1944 Radio News, "Signal Corps Issue". Will pay $20 each. Also Fair Radio and John Meshna catalogs, '50's-'60's Sam Hevener, "The Signal Corps" 3583 Everett Rd., Richfield, OH 44286-9723. (216) 659-3244 before 8:30 EDT

FOR SALE: Johnson Viking Valiant, nice - $200 PU only; Instructograph - $40. WANTED: Millen 5-inch rack-mounted scope. Jim Jorgensen, K9RJ, 1709 Oxnard, Downers Grove, IL 60516. (708) 852-4704

WANTED: Heath SB-620. Will pay $100 for a nice one. Scott Johnson, 11027 S. Bannocks, Phoenix, AZ 85044. (602) 496-0763

FOR SALE: Swan Mark I, 2000 PEP linear, exc., pick-up - $450; Galaxy V, Mark II, no pwr sply - $95. George Maier, KU1R, 64 Shadow Oak Dr., Sudbury, MA 01776. (508) 443-7083

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FOR SALE: Collins kHz dials for 75A-1, 75A-2, 75A-3, 32V-1, 32V-2, 32V-3, KW-1, KWS-1 - $30 per dial or $35 exchange. Butch, KØBS, (507) 288-0044

FOR SALE: SB-220, extensive overhaul 3/93 including new tubes - $575; HW-32A, 20-M rig, AC and DC splies, mic - $135; Radio Shack DX-160, spkr - $125. Lane, (505) 678-6401

WANTED: Crystal mic for Heathkit DX-60. David L. Muse, KD4FEB, 5401 Sumac Circle, Fayetteville, NC 28304.

FOR SALE: 1 KW isolation xfmr, 120, 240 or 440-V, new - $50; 1.5 KW isolation xfmr, 120, 208, 240 or 440-V - $90; ceramic tube sockets for 807-1625, 42-83, 6146, 53 & 7-pin min. type - $2 each; breadboard octal sockets - $2.50. Joe, W6CAS, (916) 731-8261

FOR SALE: First user friendly circuit on early BC-348's. Send $2 + (2) 29 cent stamps. Ray Larson, 12241-1/2 Gorham Ave., W. Los Angeles, CA 90049-5214.

FOR SALE: Drake R4A rcvr, with I.B. unit, mint condx - $125 shpd in 48. Cliff, W3LVC, 6904 Montgomery Rd., Elkridge, MD 21227. (410) 796-1070

FOR SALE: Rockwell-Collins 637T-1 adjustable dipole HF antenna, 2-30 MHz, phosphor-bronze wire rope, complete w/plastic rope, coax and manual, new in orig. sealed plastic and unopened box - $225, limited quantity. Jim Stitzinger, WA3CEX, 23800 Via Irana, Valencia, CA 91355. (805) 259-2011

FOR SALE: Oscilloscopes - USM-281A/HP180A - $200; USM-281A, military overhauled, like new - $300; USM-281C/TEK 7603N - $395. Signal generators - HP606A, lab quality H.F. generator, exc. - $200; HP608D/TS-510AU - $89; URM-25F - $89; HP233 - $39; HP202H - $200. Frequency counters - HP5245M, new color mainframe, Hi-stab, T-base, exc. - $200; HP 5255A 12.4 Ggig plug-in, HO-6 option - $150; HP 5326A W/DMM - $125; USM-207 - $150; HP 100E frequency standard, mint - $125. Receiver - LTV G-175C, exc. - $175; LTV G-186B 500 kc IF spectrum display unit for G-133/515I, exc. - $250. Tube testers - TV-2B/U, exc. - $200; TV-7D/U - $60. Miscellaneous - Watkins-Johnson TDM-102 telephone demodulator, exc. - $150; large military weather balloons - $10; AT-197GR discone antenna, exc. - $75; new HP 410B probes - $25; new military, soundproof headphones/microphone combo - $50; large sola isolation trans./line conditioner, as new - $80; nuvistors #7587 checked good - $5; Ballatine #300 AC voltmeter, w/access. and case - $25; Empire AT-106-S1 precision step attenuator, 3 decades, 100 dB, 4 Gigs - $125. Meters - HP 400L, w/manual - $49; HP 415B - $15; HP 430C - $15. Shpg additional. Joe Bunyard, 1601 Lexington St., Waco, TX 76711-1701. (817) 753-1605

FOR SALE: Military tubes - 3/VT63, 2/VT62, 2/VT249. Removed from new-unused BC-223AX. Offers. Bob Bakinowski, 1524 Saint Tropaz, Tucson, AZ 85713. (602) 624-8029

FOR SALE: Heath HX-11 - $40, GR-54 - $35. Both work. John Nauman, W9CN, 420 Patrick Ave., Merritt Island, FL 32953. (407) 452-7904

WANTED: Intelligence museum wants German, Japanese, Italian, Russian and Chinese communication equipment and any British or U.S. spy radios. LTC William Howard, 219 Harborview Lane, Largo, FL 34640. (813) 585-7756

WANTED: McIntosh and Thordarson amplifiers; poor to junk Collins 75A-2, 3 and 51J series rcvrs; poor to junk Hallicrafters louvered spkr. Serious sellers only! Marcus Frisch, WA9IXP, Box 28803, Greenfield, WI 53228-0803. (414) 545-5237 (24 hrs) collect

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TRADE: My RAS-5, w/manual, complete & perfect for your GPR-90 in similar condx. A. Bruno, 24 Butternut Dr., New City, NY 10956. (914) 354-8899

FOR SALE: HRO-50T1; Tempo One xcvr; left-handed Vibroplex bug; Yaesu FT-101, FR-101. John File, POB 566, Tolono, IL 61880.

WANTED/FOR SALE: Vintage tube CB's. Send card or call with models you have for sale. LSASE for list. Steve White, WB5UGT, Box 1086, Clute, TX 77531-3814. (800) 374-6477 (9008) leave message.

WANTED: International Crystal STP-50, STP-10 diagrams and information needed to put silent key K5MUH's 1958 6-meter AM station back on the air. Michael, Box 226841, Dallas, TX 75222.

Photofacts and Parts for Collectors
Electrolytics, high voltage capacitors, power resistors, plugs, switches and more. Free catalog. **A.G. Tannenbaum, WA2BTB, P.O.Box 110, East Rockaway, NY 11518. (516) 887-0057, FAX 599-6523**

WANTED: Feet for the National NC-200 rcvr and spkr; pwr xfmr for the National NC-100A rcvr. James T. Schliestett, W4IMQ, POB 93, Cedartown, GA 30125. FAX/phone (404) 748-5968

FOR SALE: Information on Altec-436C compressor, schematic, parts list & hookups - $4 postpaid USA. Russ Hunt, W9HZD, 820 Lill St., Barrington, IL 60010.

WANTED: A set of Bristo spline keys used on Collins equipment, ART-13, R-392, etc. Also want a SW-4A and MS-4. Dave Williams, WBØZJP, 967 Hwy P, O'Fallon, MO 63366. (314) 272-1870

FOR SALE: Dentron 160-10L amp, w/872 tubes - $495; Bird 43, w/3 elements - $210; Valiant II, factory wired - $395. Bud, (208) 466-2803 after 8 PM MDT

WANTED: Receivers - NC-190, RME-84. Kindly state condx and price. Elmer P. Renstrom, RR 1, 1598 Maple St., Crete, IL 60417

BOOKS FROM ER

The First Fifty Years: A History of the Collins Radio Company and the Collins Divisions of Rockwell International $49.95

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Electric Radio, P.O. Box 57, Hesperus, CO 81326

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Collins promotional literature, catalogs and manuals for the period 1933-1983. Jim Stitzinger, WA3CEX, 23800 Via Irana, Valencia, CA 91355. (805) 259-2011. FAX (805) 259-3830

FOR SALE: Collins 75A-4 filters: 6 pole ceramic for high quality AM. 3 bandwidths available: 4, 6, or 9 Khz - $83.50 ea.; single pole CW crystal filters - $88 ea. 10% discount for two filters. Money back guarantee. Calif. residents please add sales tax. Vector Control Systems, 1655 No. Mountain, Ste. 104-45, Upland, CA 91786. (714) 985-6250

FOR SALE: Drake 2NT - $100; Hallicrafters HT-37 - $150; Heathkit DX-35 - $85; SX-101 - $150; DX-60, w/HG10 - $125; DX-100 - $175. Cliff Fleury, 64174 Tumalo Rim Dr., Bend, OR 97701. (503) 382-9162

FOR SALE or TRADE: HQ-129X; Hallicrafters S-36A (military BC-787-B), S-38, SR33A; Viking Messenger 6-channel tube mobile CB; NOS Eimac 4X150A, 4X150G - $15; .05, 600-V/1500-V caps - 4/$1; 24 - 115-V inverters, regulated, vibrator type - $30. All plus shpg. Trade any for battery and crystal sets of 1920's. Michael Crain, RR 1, Box 472, Harveys Lake, PA 18618-9782. (717) 639-2794

FOR SALE: National NCX-1000 new& used; NCL 2000 linear, mint; HRO-500's new & used, panels, meters & chassis's; KWS-1, mint; Henry 2K console, new; Swan 700CX xcvr, ps, spkr, phone patch & console, exc.; Hallicrafters SR 2000 xcvr, ps & vfo, 2 KW rig, exc.; S-40B rcvr; Knight R100 rcvr; Galaxy GT 550 xcvr, vfo & ps, new; Drake C4 station console, complete & mint; HRO-600, exc.; Heath HG10B vfo, HR10B rcvr, DX-60B, looks new, (Pkge only); HM-9, NIB, kit; Astro 200 xcvr, mint. WA1DEJ, (617) 233-1414

FOR SALE: Vintage parts. Send stamp and request "Vintage Flyer". USA only. Copies of some obsolete Readrite/Triplett equipment manuals. Bigelow Electronics, P.O. Box 125, Bluffton, OH 45817.

FOR SALE/TRADE/WANTED: Vintage tube CB's, all makes/models available; old radio books. LSASE for lists (specify). Charles Zafonte, RFD #1, Box 75, Fort Kent, ME 04743. (207) 834-6273 eves.

FOR SALE: Transmitting/Receiving tubes, new and used. LSASE for list. I also collect old and unique tubes of any type. Looking for Taylor and Heintz-Kaufman types and large tubes and sockets from the old Eimac line; 250T through 2000T for display. Maybe you have something to trade? John H. Walker Jr., 16112 W. 125th St., Olathe, KS 66062. (913) 782-6455

FOR SALE: Collins 30K-1 xmtr, w/310B-1 exciter - $3800; R-390A rcvr - $300; Regco 5500 rcvr, 20 Mcs - 1 Gig - $1800. Jim Stitzinger, WA3CEX, (805) 259-2011

WANTED: Johnson gear, all models, any condition. Also parts and literature. Please state condition and shipped price. Wen Turner, AD7Z, Box 451ER, Cal-Nev-Ari, NV 89039.

WANTED: Collector seeking mint, orig, or restored 75A-4, HQ-170 rcvrs, DX-60 xmtr. Not looking for junkers or parts sources. Offer top dollar for the right rig. Dan, WB4GRA/6, Visalia, Calif., (209) 734-0597

WANTED: Collins 270G-3 or 312A-1 spkr; escutcheon for 75A-4 and Electro-Voice model 419 stand. David A. Clark, K5PHF, 9225 Lait Dr., El Paso, TX 79925. (915) 591-4184

WANTED: Hallicrafters S53A, S107, S108, S40B, S85; National NC-57B, NC-98, NC-105, NC-88, NC-121. Beni Fernandez, KP4DN, 1674 Atlas St., Summit Hills, PR 00920. (809) 792-0102

FOR SALE: Johnson Viking #122 vfo, w/orig. brochure booklet, very clean - $55; Stancor A-3801 35-W audio output xfmrs, 6.6K pri., clean - $40/pr; Fisher tube rcvr audio output xfmrs (2) and pwr xfmrs - $30 for all 3. Offers considered on all items. Plus shpg. Franklin Albanese, 1610 Prince St., #7, Berkeley, CA 94703.

ELECTRIC RADIO PARTS UNIT DIRECTORY

If you need a part for a vintage restoration send $2 and an SASE (.52 postage) for a 6 page list of parts units. If you have a parts unit, consider putting it on the list. Your dead unit can help bring others to life!

FOR SALE: Millen 90651 grid dip meter, exc. condx, w/new tube, all standard coils and fitted case - $60 includes UPS. Terry Perdue, 23225 Woods Creek Rd., Snohomish, WA 98290. (206) 568-4403

FOR SALE: Repair & refurbishment of older tube-type amateur equipment. Fully FCC licensed; 35 years experience. Chuck Banta, N6FX, Claremont, Calif. (LA area) (714) 593-1861

FOR SALE: Fine Tunings's Proceedings, four books: 1988, 1989, 1991, 1992-93. All four - $25 postpaid. Ken Greenberg, 4858 Lee, Skokie, IL 60077. (708) 679-8641

FOR SALE: KW107 Supermatch, combination antenna tuner, SWR-pwr meter, dummy load. Made in England by KW Electronics, mid-'60's, exc. - $150. KØOCC, Atlanta, (404) 396-1312

FOR SALE: Narrow bandwidth (600 Hz) mech. filters for CW reception with Collins 51J-type rcvrs - $45 each. Limited supply. Joel Thurtell, 11803 Priscilla, Plymouth, MI 48170. (313) 453-8303

FOR SALE: Have you received your 1993 catalog of coil forms, literature, tubes and other radio parts? If not send $2 to Antique Radio Labs, R1, Box 41, Cutler, IN 46920 for your copy.

FOR SALE: R9A rcvr, T-90 xmtr, APS-90 pwr sply, TBS-50A, w/pwr sply. All Harvey-Wells. W7MXM, (208) 522-5854

WANTED: Hallicrafters DD1 Skyrider diversity, only in very good condx. Jose Cangas, EA4JL. Contact in the states Kurt Keller, (203) 431-6850 *

FOR SALE: Collins 32S3 xmtr, WE, fine condx electrically and mechanically - $300; two S-Line rack panels - $75 each. Mike Palmer, K5FZ, 16707 Creeksouth, Houston, TX 77068. (713) 444-7737

WANTED: SX-62A aluminum front dial cover; 7" working TV; SX-133. Steve Sauer, WA9ASZ, R3, Box 413, Bloomfield, IN 47424. (812) 863-2088 eves after 7 PM EST

WANTED: 62S-1 Collins converter. Edward J. White, WA3BZT, 809 Seymour Rd., Bear, DE 19701-1121.

FOR SALE: Two Lafayette 6-meter xcvrs HE-45B, both - $50 plus shpg; Heathkit SB-401 and SB-303, both - $200 plus shpg. Jerry Meyer, KB4VR, 415 NW 96 St., Miami, FL 33150. (305) 751-3611

WANTED: All types of military electronics, especially RDF and radar items, manuals too. Also need URD2 antenna. William Van Lennep, POB 211 Pepperell, MA 01463. (508) 433-6031

WANTED: Lysco 40-meter mobile xmtr that used 3-6AQ5's. Also need schematic for "Transcon 10" xmtr/converter. Steve Miller, WA3JJT, 909 Walnut St., Erie, PA 16502. (814) 454-8990

WANTED: Xcvr SCR-522 plus xtals and all accessories; Nixie tubes (Burroughs) for Heath digital voltmeter model 1202. Steve Kalista, WB2LKN, 9 Maple Dr., Jim Thorpe, PA 18229. (717) 325-4120

FOR SALE: VG/mint Heath HR-20 rcvr - $70; HG-10B vfo - $40. **WANTED:** 1957 Allied catalog and complete AT-1 manual. **TRADE:** My homebrew model FRK 10 MHz rubidium frequency standard for your mint SX-100. PU only. David Ishmael, WA6VVL, 1118 Paularino Ave., Costa Mesa, CA 92626. (714) 979-5858

WANTED: FB7 (or ACS) coils or coil parts. Help rejuvenate a senior citizen (radio, not me). Thanks! Jim Hanlon, W8KGI, POB 581, Sandia Park, NM 87047. (505) 281-0814

TRADE: Good/excellent R390A for 51J4. 75A-3/A4 also considered. Ed Cole, WBØSUT, 6060 4 Mile Canyon Dr., Boulder, CO 80302. (303) 444-7296 *

FOR SALE: R-390A original manual, Dept. of Army, Jan. 1956 - $50. Paul, (202) 363-8593

FOR SALE: Heath AR-3; Collins 75A-4; KWM-1; KWM-2A; 32S3; 75S3B; Belmont 6D111 Mac Key; connectors for KWS-1. Joel Levine, WB2BMH, 67 Derby Ave., Greenlawn, NY 11740.

FOR SALE: TN339/GR (BC-939A) roller inductor tuner, gov't recon'd - $125; GRC-9 xcvr, w/DY-88, LS-7, T-17, cables, manual - $125. Jerry, WB3BDM, 1813 Rocky Glen Dr., Frederick, MD 21702. (301) 696-1934

Dovetron NB-1 Noise Blanker

The Dovetron NB-1 noise blanker is a small solid-state device that plugs directly into J22, J23 and J24, which are located on the top of a Collins KWM2/2A HF transceiver. The NB-1 may also be installed in all versions of the Collins 75S(*) receiver.

In addition to noise pulse blanking and random noise suppression, the level of the received signal may be amplified 15 dB or attenuated more than 20 dB. Specs upon request.

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FOR SALE: Small quantity of Bud 5-pin and B&W BVL, 1500 series and 3400 series coils and bases; also some B&W coils from 10 KW amplifier AN/MRC-2 (look like giant BC-610 coils) and extra BC-610 coils and tuning units (none for 160 meters). LSASE for list. Robert W. Downs, WA5CAB, 2027 Mapleton Dr., Houston, TX 77043-2410.

WANTED: Visitors and tubes by museum. Old and odd amateur or commercial tubes, foreign and domestic purchased, traded or donations welcome. All correspondence answered. K6DIA, Ye Olde Transmitting Tube Museum, POB 97, Crescent City, CA 95531. (707) 464-6470

FOR SALE: Drake R4A, exc. - $180; Collins 32S-3, 516F2 - $450; 75S3B, 3 filters - $500. U-ship. Gary Elliott, NO5H, 808 Clarice St., Delhi, LA 71232. (318) 878-8032

FOR SALE: T-150 xmtr - $75. **WANTED:** National SW-54; ARC-5 xmtrs & rcvrs for 40 meters; Hallicrafters S-53A rcvr. Bob Braeger, WA6KER, 6634 Navel Ct., Riverside, CA 92506. (909) 682-5084

FOR SALE: Collins meatball lapel pin - $5.95 + .75 S&H. George Pugsley, W6ZZ, 1362 Via Rancho Pkwy., Escondido, CA 92029.

FOR SALE: RIT for KWM-2 and S-Line. No modifications for KWM-2; 75S- needs one wire - $59.95. SASE for info. John Webb, W1ETC, Box 747, Amherst, NH 03031.

WANTED: S-Line R/E 32S3A, 75S3C, 312B-5 & 516F-2 set; 75A-4 S/N 5000, R/E KWM-2A, w/516F-2; REAL HF-380 or HF-8020/851S-1 or 851S-2. Mimi Kobayashi, 2212 Rockefeller Ln., Redondo Beach, CA 90278. (310) 379-6052

FOR SALE: RME 84 - $145; HW-101, w/pwr sply - $160; Harvey-Wells TS50, w/pwr sply - $100; Hallicrafters FPM-300 MK II - $300; Globe Scout 90 - $60; Hallicrafters HA-2, w/pwr sply - $100; Johnson 6N2 - $100; Harris commercial amplifier RF-103A, w/remotely tuned antenna coupler, 3-1000 tube - $2900; Wilcox T-158 - $500; Collins 51S1 - $900; HB 4-1000 amplifier, w/pwr sply - $500; National NCL-2000 - $450; T-368 antenna tuner - $150; Ham M rotor - $125; Tri X 500 - $175; Collins station KWM-2A (RE), 30L-1 (WE), 312B5 (WE), 2 ea PS - $1700; Gates HFL-1000 amplifier - $1500; rare Collins 51J4 (HP gray, engraved lettering) - $600; Collins KWM-380 - $2500. U-ship. Howard, W3HM, Rt 3, Box 712, Harpers Ferry, WV 25425. (703) 318-1074 X 320 (d), (304) 876-6483 (after 7 PM)

WANTED: Repairable or parts units tube-type SSB/CW gear, accessories or power supplies-Heath, Drake, etc. Byron Tatum, WA5THJ, 1920 Maxwell, Alvin, TX 77511. (713) 331-2854

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WANTED: Copy of manual for Measurements model 59 grid dip meter. Terry Perdue, 23225 Woods Creek Rd., Snohomish, WA 98290. (206) 568-4403

FOR SALE: Heathkit amateur radio repair by RTO Electronics, 4166 Maple St., Berrien Springs, MI 49103. (616) 473-3201

FOR SALE: 23-channel CB radios. All solid-state radios, guaranteed in good working condx - $25 + shpg. Burl, (214) 736-2397

WANTED: Manuals for R-390, R-390A and WRR2; ID plate for 51J4; URM 26 series signal generator. Ward Rehkopf, K8FD, 116 Fairway Dr., Belmond, IA 50421. (515) 444-4396

WANTED: Matching spkr for Hammarlund PRO-310 rcvr. Also literature, reviews and/or info on this rcvr. Michael J. Scanlan, WAØEPW/6, 5601 W. 79th St., Los Angeles, CA 90045. (310) 645-5511 after 6 PM PDT

FOR SALE: Put a class knob on your classic Collins 75A-4. 'Jupiter Superknobs' are solid brass, six times heavier than fragile plastic original vernier knob - $149 + $5 shpg 48. Joel Thurtell, 11803 Priscilla, Plymouth, MI 48170. (313) 453-8303

WANTED: Pre WW II radio magazines, books, photos of stations, QSL cards, broadcast and ham collections bought. C. MacNeill Book Dealer, WA8ZNX, 3165 12 Mile, Berkley, MI 48072. (313) 543-1177 days

FOR SALE: Walkie-talkies - BC-611 military, brand new, F units; parts; chassis's; batteries & repairs. WA1DEJ, (617) 233-1414 late eves.

FOR SALE: Globe 500C, good condx - $700; E.H. Scott RCH rcvr in exc. condx - $250; DX-20, good - $35; Heath HW-17, good - $35; Subraco (1950 classic) 10-mtr mobile xmtr, exc. condx - $25; BC-794 Superpro, complete, physically good, poor working, with great, orig. AC ps - $35; Gonset III, 2-mtr, CD yellow, good condx - $35; Hallicrafters S77 rcvr, very good - $45; SW-54, very good - $48. Pete, WB2BYQ, (201) 818-4311

WANTED: WW II Japanese military radio equipment, literature and pictures. Takashi doi, 1-21-4 Minamidai Seyaku Yokohama, Japan

FOR SALE: Used panel meters, round, square, 2-3 inches, various ranges - $3; roller coils - $10; variable vacuum capacitors - $20. Franklin S.H. Young, KH6CDO, 2816 Poelua St., Honolulu, HI 96826. (808) 988-7474

WANTED: Nems-Clarke VHF rcvrs & related literature; REL FM BC tuners; misc FM BC rcvrs. Joe, N4WQC, Box 19302, Alexandria, VA 22320. (703) 256-2468 phone/FAX

FOR SALE: T-368 w/manuals, power cord and connectors. The rig is complete, very clean and was given a thorough gov't overhaul before being mothballed - $600 PU only. Ed Hart, W4EOU, 1711-A Linda Ln., Normal, IL 61761. (309) 454-4375

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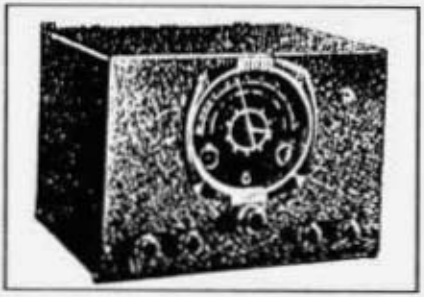

WANTED: Any condition, Hallicrafters Sky Master and EP-132 as shown. Also want SX-46, S-48 and S-49. Chuck Dachis, 'The Hallicrafter Collector', 4500 Russell Dr., Austin, Texas 78745. (512) 443-5027

FOR SALE: Zenith 4K035 farm radio - $60; Watterson 527 - $50; Mitchel Bed Lamp - $50; Philco 46-250 - $40; Motorola 5X11U - $50; Emerson Big Portable - $50; Philco 40-130 - $60; GE 408 - $30; Detrola 579 - $40; Zenith 5S319 - $95; Bendix 847D - $75; RCA 6BX63 - $45; Federal R/P 101 - $50. S&H extra. Poloroids $1 each plus SASE. Bud Santoro, 3715 Bower Rd., Roanoke, VA 24018. (703) 774-9153

WANTED: Schematic/manual for Tecraft model T-20/220 or any Tecraft VHF AM rig. Jim Musgrove, K5BZH, 400B Swanee, Austin, TX 78752. (512) 459-5564

FOR SALE: RCA model AVR-20-A1, 12-V aircraft rcvr, 2.3-6.5 MHz, phone or CW, NIB - $50; Conset 3-30 MHz converter - $25; Conset Tri-band converter - $25; SCR-522 xmtr, rcvr, complete manual - $125; orig. complete Airforce SCR-274N instruction manual (TO-08-10-50) - $45. Thorn Mayes, W7HWA, (303) 259-0562

FOR SALE or TRADE: SX-62 and NC-190. **WANTED:** Hallicrafters SX-28A, SX10/11/12/17. Jim Dillon, 201 Seward, Juneau, AK 99801. (907) 586-3223, 10-6 PDT

WANTED: SC-101; SC-301; KW-1; 30K-1 thru 5; 302C1; 75A thru 75A-4 rcvrs and spkrs, any condx. Purchase entire estates, Pick up 48 state and top $ paid. Rick, (800) 462-2972

WANTED: Radio News 2-1944 (special Signal Corps Issue), complete. Will pay $35 for clean one, $50 for a new one! Gene, KD4YIZ, (800) 619-0900, (800) 872-9680 Tnx!

FOR SALE: Hallicrafters S-38C; WE ground magneto; keys, flameproof, J-37, 38, 45, etc. 8 page list of etc. items - $1 plus SASE. J.H. Jacobs, 60 Seaview Terrace, Northport, NY 11768. (516) 261-1576

WANTED: RCA AVR-5A tombstone, AR-1496D battery set, BC-AA-191 xmtr; pre-1940 aircraft, airport radios. James Treherne, 11909 Chapel Rd., Clifton, VA 22024. (703) 830-6272

FOR SALE: Hallicrafters HT-44 xmtr, w/AC sply, manual - $125, offer/trade. Mike, WA7NPA, POB 208, Washougal, WA 98671. (206) 837-3560

FOR SALE: SX-101A - $85; 75A-4, mint, will sell or trade for NC-303. Chuck Graves, (417) 863-7415

WANTED: National SRR VHF Super-regen (looks like small SW-3); National HRO Sr. S-meter (dead or alive). Niel Wiegand, WA5VLZ, 12105 Mustang Chase, Austin, TX 78727. (512) 219-8548

FOR SALE: Collins spinner knob for 75A etc; Swan remote vfo; Heath audio amp AA-100; manual for Heath sig. gen. IG-42. **WANTED:** Manual for Heath HO-13 scope, copy OK; manual for Heath XC-2 converter. **TRADE:** 75A-4 lid for KWS-1 lid. Marty, (817) 497-6023

FOR SALE: BC-348Q, exc. condx, works good - $100. Al Szriski, AI4U, 6251 Fox Hunt Tr., Orlando, FL 32808. (407) 222-0007 (d), 298-3493 (n)

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FOR SALE: Hard to get units, parts, tubes, technical information SASE. Cdr. Glenn W. Ritchey, USN Ret., W7SAB, 219 Naval Ave., Bremerton, WA 98310. (206) 373-9631

FOR SALE: NC-300, w/matching spkr - $135; Viking II, 122 vfo - $100; Valiant (W6BM audio mods) - $170. Shpg xtra. Bill Code, KB9IY, 1540 Kaywood Ln., Glenview, IL 60025. (708) 998-0974

FOR SALE: G-50 - $44.50; Collins 180-S tuner - $175; S-38C - $29; AF-68, w/#1070 AC-DC ps - $89; TBS-50 - $49.50; DX-100 - $85; type "A" Velvet Vernier - $10; Type "BM" - $10; PMR-6A, w/DC ps - $45; NIB 7027A tubes - $10; NIB 6B4 - $10; Ameco Conelrad rcvr - $10. Joe Sloss, K7MKS, (206) 747-5349

WANTED: Collins 32V-3 junker. Fenton Wood, KB5VQ, 109 Shoreline Dr., SH, Malakoff, TX 75148

WANTED: Vacuum relay for CU-32/ART-13A. I broke this relay while trying to repair all the shipping damage done to this otherwise beautiful piece. Please, all sellers of this great old gear, please use a professional packer. An old box and some crumpled newspaper doesn't cut it. Our treasures are becoming too rare to sacrifice to our modern day carriers. Thanks. John Coward, POB 276, 8970 Glen Arbor Rd., Ben Lomand, CA 95005. (408) 336-3414

FOR SALE: HQ-145, near mint - $175. **WANTED:** Radio Shack DX-400; Uniden CR 2021; RME 4350; TMC GPR-90/92; RCA model CRM R6A; SX-101 MK II. Rick, K8MLV/Ø, 1802 W. 17th St., Pueblo, CO 81003. (719) 543-2459

FOR SALE: ARC-38 xcvr, w/control head and two dynamotors, also 618-S1 and 618S-1 MC xcvrs with control head, manuals included. All in good shape - $250 for all. Pick up only. **WANTED:** Manual for Motorola PT-400 handi-talkie. Ronald Reu, WBØLXV, Rt 1, Box 334, Winfield, MO 63389. (314) 668-6518

WANTED: TM 11-851 for Hammarlund SP-600JX rcvrs. L.A. Locklear, 1122 36th St., Gulfport, MS 39501. (601) 864-8384

FOR SALE: Lafayette Explor-Air and Knight Space Spanner, both are in mint condx with cases and manuals. Dusty Rhodes, W8MOW, 1324 N. Dorset Rd., Troy, OH 45373. (513) 339-1546

WANTED: 1 complete phasing knob for a National NC-183 rcvr. J.A. Thomas, 1130 Pleasant View Lane, Colorado Springs, CO 80921-2234. (719) 841-4564

FOR SALE: R-390A with all IF, RF & mixer conversions by NØDMS from ER #24-25-26 plus KDØHG super audio conversion from ER #42 - $375. Pick up only. John Kelley, W7KKN, Lacey, WA (206) 438-5080

WANTED: Instruction manuals, circuit description, diagrams, anything on Raytheon 456 Khz notch filter, 441-848-000 and Collins signal control filter, part no. 528-0237-005 and RF-IF module 541-9325-005 George Rancourt, White Load Rd., Southampton, MA 01073.

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WANTED: Radio historian and former editor of Ham Radio Magazine is researching and preserving pre-1958 amateur QSL card and log books. Don't let our records be lost! Gladly pay all shipping and packing. Douglas Stivison, NR1A, 45 Norman Rd., Upper Montclair, NJ 07043. (201) 509-0585

WANTED: BC-474, Command set, Hallicrafters S-72, ARRL Handbook pre-1960. Dong-Hyun Cho, Biology Dept., Kang Won Natl. Univ., Chun Chon, 200-701, Korea

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FOR SALE: Desk KW; Viking Valiant ; SX-101 and Johnson 500. Paul, WA5PCJ, Rt 1, Box 16, Gustine, TX 76455. (915) 885-2593 between 8 and 9 PM CDST

WANTED: Johnson 122 vfo in good operating condx; manual (copy OK) for Hallicrafters SX-28. Gary Elliott, K7OX, 6229 E. Joan De Arc, Scottsdale, AZ 85254. (602) 948-4772

WANTED: Drake T4XB and R4B orig. service manuals in VG condx, no copies. Bill, WA2TDR, (201) 744-3164

FOR SALE: Collins 312B-4, WE, EC - $150 firm, with money back guarantee. Jerry, AB8U, (513) 429-5457

WANTED: Tube audio amplifiers: Western Electric, RCA, Heathkit, Fisher, Dyanco, etc., any condx, literature, parts. Need Heath W5M. Mike Nowlen, WB4UKB, 12911 New Parkland Dr., Herndon, VA 22071. (703) 481-9614

FOR SALE: Collins mechanical filter F455-D31, new in box - $50; Boonton/HP-260 Q-meter, w/manual & 12 Q/inductor standards - $250; Chicago Transformer 115-V primary/2330-0-2330-V @ 775 VA secondary, new in orig. crate - $50; 3 new 833A tubes - $50 each; 4 new 100TH tubes in box - $25 each; Jennings vacuum variable 250 pF @ 20 KV - $50. Ron, KC6WTG, (707) 539-8319 noon to 9 PM Pacific time.

WANTED: Hallicrafters HT-46 xmtr. Cash or trade for AM gear. Bob Mattson, KC2LK, 10 Janewood Rd., Highland, NY 12528. (914) 691-6247 after 7 PM

WANTED: Audio xfmr for SP-600 JX26. Mr. Curtis, (219) 884-4127

WANTED: Lists, indexes or directories of WW II Navy tech. manuals or equipment. Ray, W6RIC, (805) 985-6048

WANTED: Unbuilt kits by Heath, Johnson and Knight. Gene Peroni, POB 58003, Philadelphia, PA 19102. (215) 665-6182 days

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FOR SALE: Tektronix RM 503 oscilloscope manuals, originals - $20 ppd. Also other Tektronix manuals. Alton Bowman, 4172 East Ave., Canandaigua, NY 14424.

WANTED: WW II German equipment and tubes, manuals and other parts. Bob Graham, 2105 N.W. 30th, Oklahoma City, OK 73112. (405) 525-3376

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WANTED: Sartori solid-state tubes for Drake R-4C/T-4XC. Bill Gross, WB6WCW, 106 Verona Ave., Goleta, CA 93117. (805) 968-4227

WANTED: Tech manuals for PRC-66 and PRC-36. Joseph Pinner, 201 Ruthwood Dr., Lafayette, LA 70503. (318) 981-7766

FOR SALE: Repair! All makes and models, homebrew, maximum labor per unit - $96. Dan Rupe, W7HBF, Telo Technology, 1302 S. Uplands, Camano, WA 98292. (206) 387-3558

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FOR SALE: Collins 51J4, 3 filters, VG - $475; Collins R-648/ARR-41, orig. VG - $175; Collins R-392, good - $145; R-390, R-390A for sale, repair service. **WANTED:** Nice SB-301, HP-23 supplies, mil. surplus KWM-2's for repair. WA5TIH, 1920 Maxwell, Alvin, TX 77511. (713) 331-2854

FOR TRADE: Hammarlund PRO-310, exc. condx for military rcvr. **WANTED:** Info or schematic on Collins 51N-2 rcvr. John Richardsons, 1163 Highland Pl., Dubuque, IA 52001. (319) 556-5504

FOR SALE: SX-24, works - $95 OBO; CDE TRA-4 rotor/control w/cable - $20; Swan 500 w/117 XC supply, cables, book, clean vintage SSB - $225 OBO; Viking II cabinet - $20; R-392 PTO - $10; Heath HA-10 amplifier, rough - $75 OBO; Westinghouse 861 tube - $25; 27 uH high power roller inductor, w/counter - $35. U-ship. WA7HDL, (208) 756-4147

WANTED: Military Radios. RT-136/GRC-13, MAY-1 and manuals for same. Also want Russian military sets, R-114, R-113, R-108. Leroy E. Sparks, W6SYC, 924 W. McFadden Ave., Santa Ana, CA 92707. (714) 540-8123

WANTED: Collins 51J4 rcvr, w/case, spkr & manual. Barry Nadel, Box 29303, San Francisco, CA 94129. (415) 346-3825, FAX 346-0468

FOR SALE: Class B audio driver xfmr for Viking II and DX-100 - $12.95; replacement audio driver xfrm for Ranger - $8; 600-V orangedrops, most values - $.40-$1.95; 600-V Sprague electrolytics, 20 and & 10 mFd, axial leads - $9.95 & $8.95; 2.5 mH RF chokes, 160 mA - $3.65; vintage 2000 ohm headphones - $17.95; NOS polished ceramic ant. end insulators - $2.95, center insulators with rope hole - $5.95; single-section variable caps, 365 pF, U.S. made - $7.95. Antique Audio. Write or call for our free 1993 catalog. See our display ad on page 36.

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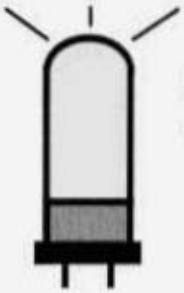

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