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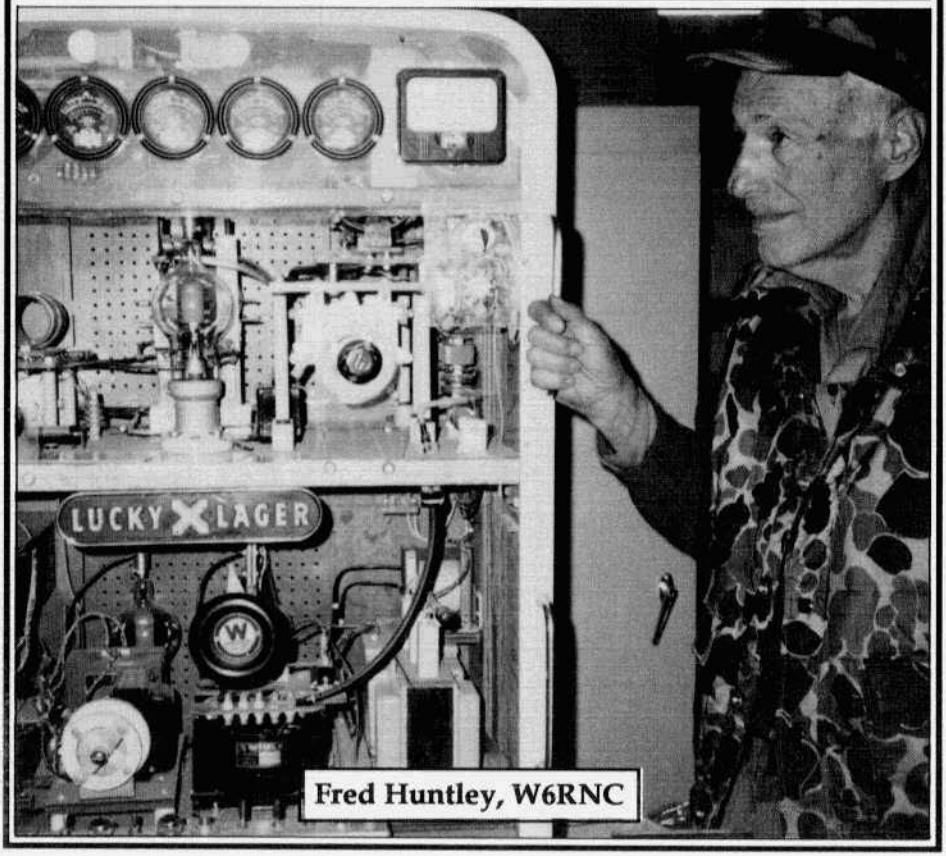
ELECTRIC RADIO

celebrating a bygone era

Number 40 August 1992



Fred Huntley, W6RNC

ELECTRIC RADIO

published monthly by Barry R. Wiseman, N6CSW/Ø

at 4 Aspen Place, Durango, CO 81301

Second Class postage paid at Durango, CO. and additional offices

Authorization no. 004611

ISSN 1048-3020

Postmaster send address changes to: Electric Radio
Box 57
Hesperus, CO 81326

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WALT HUTCHENS,KJ4KV.....ELECTRIC RADIO IN UNIFORM
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

Bill Halligan passed away last month. I think we should pause and consider how this man through his company, "Hallicrafters", enriched all our lives. He had something for all of us, from an S-38 for the novices just starting out, to really elaborate, top-of-the-line gear like the SX-88. He also had transmitters from a very basic unit like the HT-6 - low power and low priced - to the HT-4, which was one of the first high-powered, deluxe ham transmitters. That unit was so well designed it went on to war as the BC-610. Although Hallicrafters was also the people that worked there, it was Bill Halligan's genius that created and guided the company. He will be long remembered.

We attended the Fort Tuttill hamfest at Flagstaff, Arizona, over the weekend of July 24-25. Although the WX was awful - it rained a lot - it was a very enjoyable event. It was great to meet some of the AM'ers that I've known only over the air and of course it's always fun to go shopping at the swapfest.

Fort Tuttill is one of the bigger hamfests in the west and what I saw there is probably representative of what's happening all over the country. The first thing I noticed was the absence of good AM gear. Apparently there were a couple of Rangers, and a couple of 75A-3s, but they were gone by the time I got there. I did see one very mint Valiant , a couple of nice R-390As and a couple of Hammarlund receivers but that was about it. There was also a noticeable lack of parts and tubes. Talking with the other AM'ers confirmed my observations. Maybe we're seeing the end of the good times as far as the availability of vintage gear is concerned. All of the AM'ers there got together for a group photo. Next month we should have that and maybe a full report on the event.

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Cover: Fred Huntley, W6RNC, with his 'Kelvinator Kilowatt'. Fred described this transmitter in his "Reflections Down the Feedline" column in ER #6.

Reflections Down the Feedline

by Fred Huntley, W6RNC
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AM On The North Atlantic

In 1947, I got a job as a 3rd operator onboard the SS America/WEDI–the largest U.S. ocean liner (26,000 tons).

The radio staff of WEDI consisted of a Chief Operator, a 1st Assistant, two 2nd operators, and three 3rd operators. The radio room was located on the top deck, behind the navigating bridge and the Captain's quarters.

There were 2 CW and one AM phone operating positions--each of which used a RCA AR-88 receiver. To the rear of the operator's chairs, were three floor standing transmitters made by RMCA. The two CW transmitters were relay controlled dual channel sets--each with a pair of 4-125A's in the final.

I cannot recall what was inside the phone transmitter cabinet. All I remember is that it was right in back of the operator's chair and put out plenty of heat, which made that job environment uncomfortably warm. All the operators had to wear officers uniforms, with coats on most of the time.

The rich and famous passengers, as well as the others aboard ship, would place their ship to shore phone calls and the radio operators job was to make the circuit to the shore station and monitor the elapsed time for each call--in conjunction with land-based overseas operators.

It was interesting to listen to most of the personal conversations, including big business deals and the activities of high society.

In order to ensure over-the-air privacy, we had a Western Electric speech scrambler, which inverted the audio frequencies. Highs were made into lows, and lows were made into highs. It also acted as an unscrambler.

After a good radio telephone circuit was established, the shore radio operator would say: "Go to privacy". Most of the time, they called it Condition "A", and I would switch in the speech scrambler.

The shipboard operator could plug headphones into either the input or output of the scrambler. After a while, I became able to read words and phrases of the scrambled speech in my head, and made it a sort of game to see how much of the scrambled conversation I could decipher.

When WW II was declared, the U.S. Navy had taken over the SS America and all the commercial radio equipment was removed from the ship at the Newport News, Va., shipyard.

A year or so after I got off the job on the SS America, I met a Mackay/ITT marine radio service man in Norfolk, Va., who told me that when the Navy had all the original radio equipment removed from the SS America, he bought the Western Electric speech scrambler from the shipyard for $25.00.

After the war, the SS America was reconverted to its peacetime equipment and furnishings, and this fellow told me that he sold this same Western Electric speech scrambler back to the shipyard for $500.00, and they re-installed it in its old original position.

So, that's the story of one piece of AM radio equipment that was used on the high seas. ER

Bill Halligan SK

William J. Halligan -- just plain "Bill" to thousands of hams worldwide who enjoyed QSOs with him, often while using gear built by his Hallicrafters Co. – is dead at the age of 93.

Halligan died July 14 in a Miami Beach hospital. He had lived the past two decades in Bal Harbour, Fla., where, until his health failed in recent years, he was active on the ham bands as W4AK.

Halligan founded Hallicrafters in Chicago in 1933. Over the next half-century the company became one of the most prolific producers ever of communication receivers, transmitters, amplifiers and other electronic equipment.

Halligan was a manufacturing and marketing pioneer in the radio industry. He incorporated new components as soon as they became available and introduced improved rigs at a dizzying pace. His varied product lineup featured models priced for almost every pocketbook. He put a premium on packaging as well as performance, and the stylish appearance of Hallicrafters gear made it easier for many hams to convince their XYLs to allow radio gear into the home.

In a "statement of policy" published in 1936, Halligan explained: "The Hallicrafters organization was founded in the belief that there was room for improvement in the design of amateur radio equipment, and a definite need for an adjustment in price levels. We felt that good management and skillful engineering might make this possible." In noting that Hallicrafters had, indeed, quickly become the largest American manufacturer of communications receivers, Halligan observed: "We have attained this position by sticking closely to our original aims: maintaining a progressive atti-

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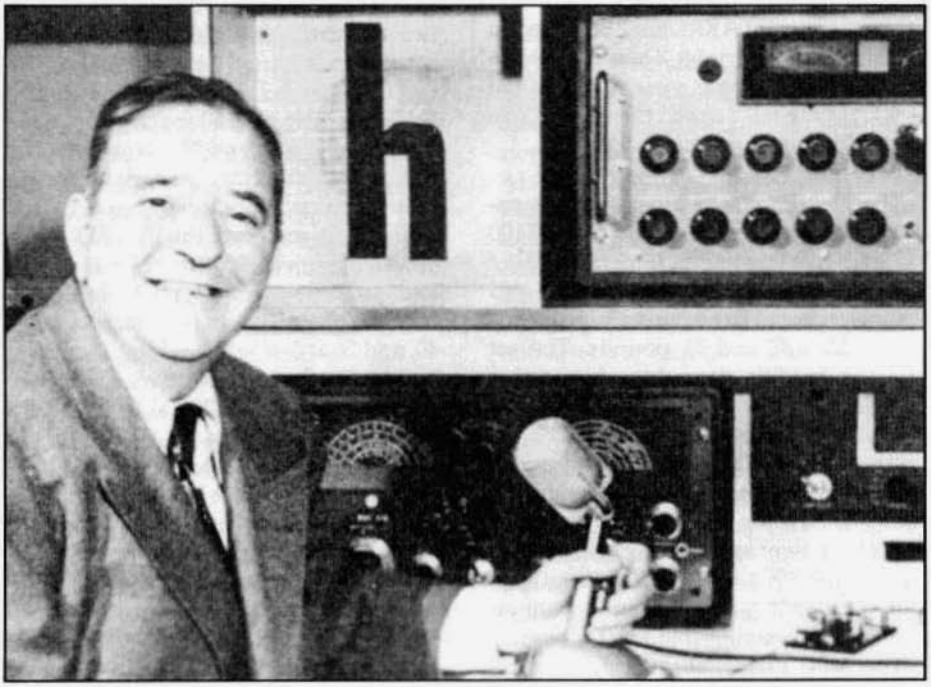

Bill Halligan in 1954 with SX-88 receiver and HT-20 transmitter.

The World Radio Labs Duo-Bander II Transceiver

by Walt Hutchens, KJ4KV
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Arlington, VA 22207

(After having been given the required lecture on Conduct Ashore and seeing the Hygiene film, Walt has been detailed to Shore Leave for the month of August. The In Uniform column will return next month.)

Big hamfests do things to me... by the time I've been racing from table to table for a few hours, everything becomes a blur. Gosh that's a cute little rig... with an extra hole drilled in the panel it can't be very expensive. But what's that 'WRL' logo on the panel? I thought World Radio Labs only did AM rigs, like the Globe King.

I had been thinking about getting a lightweight ham set for hotel room use on a planned auto trip; this one was easier to lift than a current ARRL handbook and at $25, the price was right. "Does the spider-web (a white tangle visible inside the case) go with it?" I asked the seller. "You twisted his arm", said his wife.

Overview

The Duo-Bander is an amateur transceiver covering 3800 to 4000 kcs and 7100 to 7300 kcs in two bands. It measures 5-1/2" x 11-1/4" x 10-1/4" (H x W x D) and weighs 9 pounds; the power supply is 5-1/2" x 5" x 6" and 14 pounds. The set operates on LSB voice only and is rated at 400 watts PEP input (around 250 watts PEP output) at the maximum rated plate voltage of 900. With the 'Duo-Power 300' supply (plate voltage about 700 volts) the rating is 300 watts PEP input. At least four different power supplies were made; the Duo-Power 300 supply available with the Duo-Bander II can be operated from either the 115 VAC line or a 13 VDC source.

The set is designed for use with a 50 ohm antenna. There are only seven panel controls: ON/OFF-VOLUME, CARRIER NULL, MIC GAIN, the bandswitch, transmitter TUNE, METER SENSITIVITY, and frequency. There's a panel mounted loudspeaker. A panel jack takes a crystal push-to-talk mic such as the Shure 355C.

There's a S-meter which reads RF antenna voltage on transmit. A slide switch on the rear apron switches the meter to read PA cathode current. Also on the back are a pot for the PA bias, a RCA-type jack for control of a linear amplifier, and a SO-239 antenna connector.

The two speed knob drives the dial at either 12:1 or 2:1 reduction; the back lighted dial is directly calibrated in 2 kc increments. The set uses 9 tubes and 7 transistors.

History

The Duo-Bander is indeed a product of Leo Meyerson's World Radio Labs. According to ads in QST, the original model, the Duo-Bander 84, was introduced in February 1966 at $160 for the wired and tested set alone or $283 as a complete station including AC power supply, dipole antenna, microphone and cables. Competing sets were the Eico 753 three-band transceiver ($270 for the transceiver and power supply as kits), the Heath HW-12, 22, and 32 (single band sets for 80, 40, and 20 at $160 each as kits), the Heath SB-100 five-band transceiver kit at $400 and the National NCX-5 at $685. For the ham with Cadillac tastes (and wallet to match) the KWM-2 sold for around $1000. Transistors were just beginning to show up in ham designs and the Duo-Bander's limited use of them was typical.

The Duo-Bander II arrived in July 1969 with what appear to be only small changes. The price was now $170 for the set alone or $300 with Duo-Power 300 115 VAC/13 VDC supply. Technology in

The WRL Duo-Bander II. Headphone jack at the right was installed in a hole drilled by the previous owner.

other ham sets, however, had advanced considerably since 1966. National's NCX-1000 and SBE's SB-34 were both fully transistorized except in the power stages. With a price of $1750 the Signal One CX-7 marked a new 'top of the line' including a digital frequency readout. And a company called Yaesu was selling the FTdx-400, a five band set with many new features, for only $600; within months they would bring out the FTdx-560 with even better performance for $460.

The times were prosperous -- hardly the best market for an 'economy class' product and especially an obsolescent one. Perhaps it isn't surprising that the Duo-Bander II had a very short life: the last ad appeared only three months after its introduction. Later WRL ads featured the Galaxy GT-550 five-band transceiver and FM-210 2-meter FM set made by another of Leo Meyerson's companies, so the Duo-Bander II was probably the last set to carry the WRL logo.

Design

One way to understand the Duo-Bander is to list things it doesn't have: AM or CW operation, RIT, a RF gain control, provision for matching anything but 50 ohms, ALC, a calibrator, a lighted meter, even a headphone jack... This is truly a 'no frills' design.

Control of costs begins with the block diagram. On transmit, a 5.55 Mcs crystal oscillator drives a balanced modulator and after a crystal filter selects the lower sideband, a 12BA6 IF stage (shared with the receiver) brings the signal up to a usable level. A 6EJ7 mixer either adds or subtracts the 1.55 to 1.75 Mcs VFO signal; the sum gives 7.1 to 7.3 Mcs and the difference 4.0 to 3.8 Mcs. This 'band imaging' approach requires only one mixer but makes the set tune in opposite directions on the two bands.

The restricted frequency range allows using two pairs of overcoupled fix-tuned circuits rather than ganged tunable cir-

continued next page

WRL Duo-Bander from previous page
cuits to select the right band. It also avoids spurious responses -- if the set could tune that far, the second harmonic of the VFO would fall at 3.7 Mcs and the fourth at 7.4 Mcs and at both frequencies the third harmonic would be equal to the IF frequency.

A 12BY7 (designed for TV video output service) acts as a driver for a pair of 6LB6 sweep tubes. Instead of the typical pi network using two variable caps the Duo-Bander uses a fixed capacitor on the antenna end of the tank. Tune up consists of adjusting the plate tuning cap for maximum RF voltage on the antenna so matching anything but a 50-ohm antenna requires an external tuner.

On receive the signal flow reverses, with the 12BY7 acting as a RF amplifier and a 6HG8 mixer switched on to drive two 12BA6 5.55 Mcs IF stages. A 6GX6 product detector feeds the pentode half of a 6JV8 used as an audio power tube. The triode section of the 6GX6 is the 5.55 Mcs crystal oscillator for both receive and transmit.

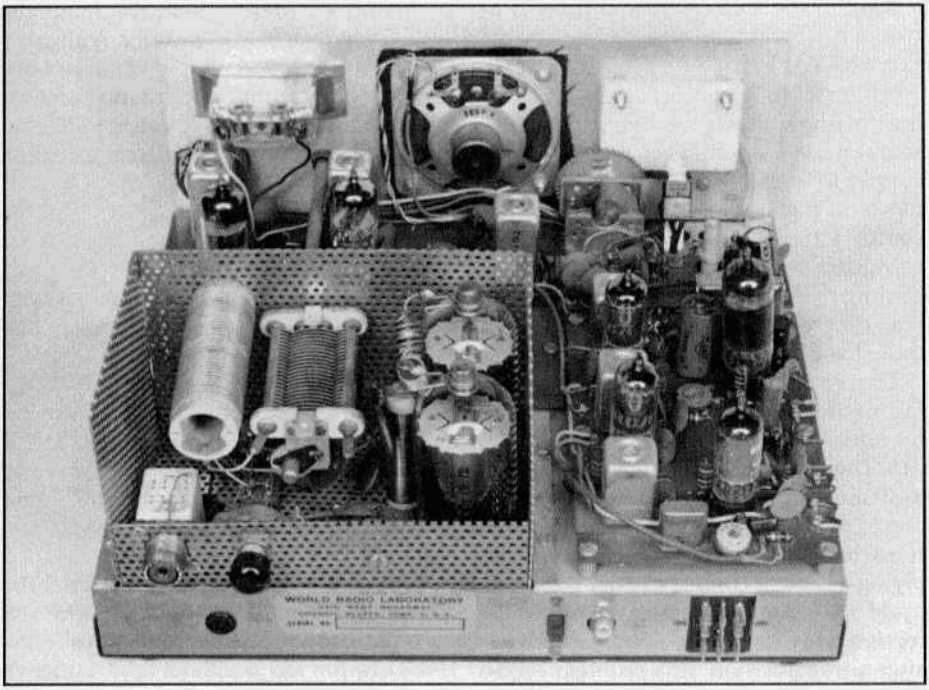
AVC is developed from the detector audio output and amplified by a 2N2926 (NPN silicon) transistor. The triode half of the 6JV8 is used on the usual bridge circuit to drive the S-meter. Other 2N2926's serve as balanced modulators, a two-stage speech amplifier, and in the VFO and buffer. It is hard to see how the job could have been done with fewer parts; this economy was helped by the use of dual-section and very high gain TV tubes in several sockets.

While there's no waste in the Duo-Bander, few low-cost improvements have been left out, either. The use of amplified AVC (as good as that on any vintage set I've used) is one example. Another is the use of voltage dividers rather than just series dropping resistors to furnish the IF stage screen voltages; this prevents the screen voltage from going up as the AVC reduces the current and thus gives much better AVC action on strong signals. Still another is the audio amplifier which uses negative feedback from the speaker winding of the output transformer back to the cathode to give exceptionally flat and clean response; this set has the clearest audio of any I have used, although the loudspeaker is a typical 3" 'el cheapo' unit.

You might think that the use of a TV video output tube as a receiver RF stage is a compromise but, in fact, it is a plus: the only job of a RF amplifier is to raise the signal from the antenna above the level of the mixer noise. On 80 and 40 meters, that's not hard because the atmospheric noise on these bands is so great that only a strong signal can be heard. At the same time, the typical ham antenna may deliver unwanted signals of several volts from nearby stations; if the RF stage is overloaded, both distortion and spurious signals will be the result. The 12BY7 has enough gain, and (since it is capable of several watts of output) it also has far better dynamic range than more common RF amplifiers.

The Duo-Bander uses many standard cost control measures -- wide spacing of tubes and careful layout rather than tube shields, a VFO dial made from an off the shelf reduction drive and gears with a couple of pieces of screen printed plastic, and a low-cost panel meter. But there are a couple of clever touches as well. The PA is neutralized not by the standard air dielectric trimmer, but with a fixed ceramic disk capacitor; this may be the reason the manual says the final tubes must be replaced only with tubes of the same (GE) make.

The bandswitch isn't a rotary switch but three slide switches operated by a plastic rod from the panel knob: 'PUSH 40', 'PULL 80'. With a tiny aluminum-plate variable cap and coils that look like something out of a 5-tube broadcast set, the VFO might be expected to drift a few kcs during warm-up. In fact it is so well located and cooled (and operates at such a low frequency) that drift is tolerable, even without temperature compensation.



Inside the Duo-Bander II. With 700 to 900 volts on the 6LB6 plate caps, working on this set would be safer if the PA compartment had its own cover.

The mechanical design is 'more of the same'. A lightweight steel chassis holds three phenolic circuit boards and the final amplifier unit. The circuit boards carry the VFO/speech amp; the IF, receiver audio, and crystal oscillator/detector stages; and the RF amp/driver circuits. The final amplifier unit is an open perforated metal box holding the PA tubes, tank circuit, and transmit/receive relay.

The panel is a flat .090" aluminum plate and the case is made of light sheetmetal top and bottom 'U' sections held to the chassis sides with sheetmetal screws. There are no trim pieces or bezels; the WRL logo is screen printed on the panel like the other markings.

The small number of tubes, open layout, and extensive use of perforated and slotted sheetmetal make this one of the coolest operating vacuum tube rigs I've seen. With so few tubes and most of the parts on circuit boards, the chassis is uncrowded and the wiring (high quality vinyl and mostly laced in cables) is unusually neat.

The 'Duo-Power 300' power supply has a feature I had never seen before. The line cord connects through a 12 pin 'Jones' connector. Removing the cord lets you plug another assembly on to the back of the supply. This unit is a shallow box holding a heat sink with a pair of switching transistors; inside is an oscillator circuit to convert 13 VDC to a 13 V AC square wave at 400 cps. It connects through another set of pins on the Jones plug to a center tapped winding on the power transformer in the main part of the supply. Jumpers on the line cord and oscillator assembly Jones plugs configure the supply appropriately: with the line cord the ON-OFF switch controls the 120 VAC line and the filaments are connected to a winding on the transformer but when running from 13 VDC the switch operates

continued next page

WRL Duo-Bander from previous page
a relay in the 13 VDC line and the filaments run from that source.

On The Air With The Duo-BanderII

After a thorough vacuuming and brushing out (the spider had moved on, but the web was a mess), looking inside the power supply for signs of meltdown and making ohm meter checks for high voltage shorts, I turned the switch -- and was rewarded by the sound of SSB signals coming from the speaker. It wasn't quite that simple, of course, but when is anything ever that simple?

The receiver sometimes lost AVC causing blasting and distortion; this was cured by replacing a leaky RF stage coupling cap. The set usually died when switched to 40 meters because of a poor contact on one of the slide switches. Realigning the rod which operates the switches and applying a dose of contact cleaner fixed the problem. A dirty contact on the transmit-receive relay sometimes left the set dead after a transmission; this problem eventually disappeared.

Even after careful alignment, receiver sensitivity was low, with only very strong signals reaching S9. I had already checked the tubes, now I started on the resistors. Perhaps because the set runs so cool, one after another they were either within tolerance or very close -- oops!

The exception was the receiver mixer screen resistor -- marked 47k, looked fine, but measured 430k. With this replaced, sensitivity meets the spec of 100 microvolts giving S9 and you can still hear the signal generator as its output drops below 0.1 microvolt.

The dial calibration is somewhat off on 40 meters. This is because the frequency of the 5.55 Mcs crystal oscillator is set to put the carrier at the right place on the sideband filter passband and on my set this is a few hundred cps lower than 5.55 Mcs. The VFO is adjusted to read correctly on the 80 meter band but there is no separate adjustment for 40 meters. The manual says the resulting error is 'only nominal'; on my set it is about 1 kc.

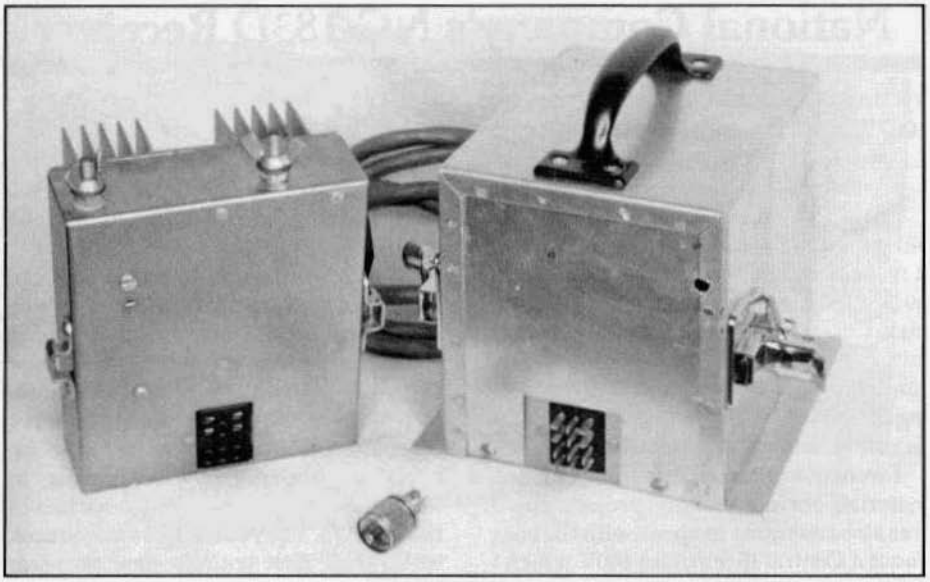
With drift of -730 cps in 50 minutes the VFO was in or at least near the 'noticeably drifty' category. A couple of hours work with temperature compensating caps reduced this to about -70 cps, eliminating the need to retune during an extended QSO.

As usual the final problem was the nastiest. Transmit audio reports were poor -- very poor. I first tried looking at signals on a 'scope', but there was so much stray RF pickup that the results could not be interpreted. Then I hit on using a battery operated receiver with piece of coax as a probe to listen to the signal at various places in the set. Sure enough, the signal was okay at the balanced modulator and through the IF, but very sick after being mixed up or down to the channel frequency.

Ahha! The VFO signal had substantial 60 cps hum and (at some frequencies) a burbling sound on transmit. The collector voltage for the oscillator and buffer is taken from a poorly filtered halfwave rectifier supply used to operate the relay. This voltage is regulated by what is shown on the diagram as a zener diode but is actually a diode-connected transistor of the same type as the others in the set. This 'zener' not only did not have a low enough dynamic resistance to remove the remaining hum, but was affected by RF picked up on transmit; installing a real zener diode fixed the burble and greatly reduced the hum.

A no-name crystal mic had come with the set but it turned out to contain a dead cartridge. A junk pair of military headphones provided a dynamic cartridge and a Radio Shack midget transformer brought the voltage up to the right level. In the Army they'd call this a 'field expedient'...

I had not planned to operate mobile on the trip, but when I found that the 13 VDC side of the Duo-Power supply was okay, was there any choice? A piece of plywood with holes for the feet anchored the set on the right front seat and the power supply



Duo-Power 300 supply. For 13 VDC use the Jones plug on the supply mates with the transistor switch assembly at left; draw catches on the sides make a solid assembly. The aluminum cover on the supply itself was homebrewed by the former owner, perhaps to replace a steel cover which would have screamed like a banshee on 13 VDC. The handle on top was my addition: at 14 pounds the unit feels like a lead brick.

went on the floor. I had a center-loaded Radio Shack CB antenna; a couple of pieces of PVC pipe became 80 and 40 meter loading coils. I clamped the mount to the rear bar of the rooftop luggage rack, ran pieces of nylon twine from the loading coil to the forward corners of the rack as guys, and -- Presto! -- a no-holes mobile antenna. It isn't the best ever -- the 'Q' of the coils is fairly low, the antenna is only about 5' long and I made no attempt to get a good match to the Duo-Bander's 50-ohm output -- but I have no trouble making contacts on either band.

The set is tuned by inserting a carrier, tuning for max antenna RF voltage, setting the meter sensitivity for a full-scale reading, nulling out the carrier and then adjusting the audio for 1/3 of full scale on peaks. A trial run with the mobile convinced me of the obvious: one can't watch a meter to control the speech level. Three diodes, two resistors, two capacitors and two hours later my Duo-Bander had a simple ALC circuit. The circuit is the usual one which rectifies the negative swings which occur when the PA draws grid current and applies this bias to the 12BA6 transmit IF stage. I now run the mic gain slightly higher than the formerly correct setting and let the ALC control the drive.

Conclusions

The Duo-Bander definitely has its faults. The manual looks amateurish with a hand drawn (and often unreadable) parts layout, typewritten text and Ozalid schematic -- not at all what I expected from a company like WRL. The writing is only adequate -- the right coverage and easy to read but poorly edited, thin on theory and unclear in a couple of critical places such as the alignment instructions.

The use of transistors as zener diodes seems to me to have been a mistake. The dial calibration markings are irregular in a few places.

The inexpensive planetary dial drive has slight backlash; at 40 to 50 kcs/revo-

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National Company's NC-183D Receiver

by Ray Osterwald, NØDMS
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Lakewood, CO 80227

One block from where I work is the oldest radio-electronics store in Denver. It is located in a vintage two-story brick building which dates back at least to 1900. Inside, one is likely to find nearly anything in radio from the last fifty years, complete with the original dirt, providing the owner will let you look, and that he can remember where to look.

I went over there one day with a list of materials for a company project, and I was also intending to speak with the boss about a Central Electronics 100V which I knew that he had in the basement. We came to terms on the 100V. While we were talking, I noticed another 1950's-era unit sitting on a shelf in a dimly lit corner, covered with so much dirt and grime I couldn't tell what it was. He referred to it as the "National", and when he realized that I might be interested in it, he included it as a package deal. Later on, outside in the sunlight, I brushed aside the accumulation of grit and saw the classic National emblem on the upper left corner of the cabinet, and "NC-183D" on the upper right. It had the remains of civil defense decals on the front panel, and there was a faded tag indicating that it had once been in a police auction. The victim of some rough handling, there were dents, long rusty scratches in the cabinet, and the crystal phasing shaft was broken off. Another blow had smashed the BFO tuning condenser.

As I loaded it into my truck and drove off, I got pretty angry thinking about how it had been treated over the years by its former owners, who had probably bought into the "newer is better" attitude. I promised myself I would restore it "some day". Later, upon closer examination of the receiver, I realized that it was extremely well built, so "some day" turned out to be "right away".

The NC-183D was introduced to the radio world in April of 1952. It enjoyed a fairly long production run, lasting until 1958, when it was discontinued in favor of the NC-303, National's new, deluxe, SSB receiver. NC-183D production was a direct result of a series of events at National beginning five years earlier, in March of 1947, with the introduction of the NC-173. The NC-173 was introduced to be their first entirely new post-war receiver, and they were justifiably proud of it. In 1947, the radio manufacturing industry was just beginning to recover from WW II. During the war, no new commercial designs were being developed, and material for civilian projects was not available. In 1946 and early 1947, National did the best they could with updated pre-war designs, while launching research and design efforts as quickly as possible. This program led to the NC-173, and similar commercial designs.

The '183D would surely have been introduced prior to 1952, if it had not been for increasing world tensions and uncertainties at the start of the "cold war". This climate caused President Truman to endorse the Defense Production Act of 1950. Under this act, the Department of Commerce set up the National Production Authority. In turn, the Authority came out with the Controlled Materials Plan (CMP). As spelled out in the CMP, the basic raw materials so necessary in the production of radio equipment (steel, copper, aluminum, and all of their alloys) were controlled, and diverted on a priority basis to the production of defense materials. The remainder was going to less essential areas, such as amateur ra-

National Company's NC-183D. Bob Hohertz, W5PYT, (Ozona Bob) calls this receiver "a band switching HRO".

dio, but manufacturers were required to apply quarterly for their allotments of basic material. They had to justify everything, and state the purpose for which the material was to be used. It was tough enough to keep up with the technical changes in receiver design and to produce a competitive product for a limited market, without having to guess on raw material amounts for designs not yet in production. This fact is evident by scanning the literature of the day. In the spring of '52, four major manufacturers were advertising receivers: Hallicrafters (13 models), National (six models), Collins (one model), and Hammarlund (one model). Of these receivers, only three (SX-73, NC-183D, and 75A-2) were really new designs, and all of them were rather expensive. Morrow and Gonset had small lines of inexpensive mobile converters, and RME had two pre-war receiver designs available on a limited basis. Due to these CMP material restrictions, for a small period ending in June 1951, amateur radio receiver production was actually suspended at National.

NC-173, National's First Post-War Design

The NC-173 was designed by National engineer Ray Caulk. With a price of $189.00, it was lower than the HRO-5A1 ($274.35) and the NC-2-40D ($241.44). The other models in the National line that year were the NC-1-10A ($67.50), and the NC-46 ($107.40). The NC-173, as mentioned above, was intended to be an entirely new, post-war design. Actually, it was a somewhat better receiver than its more expensive brothers, which were copies of late 1930's designs. The cabinet was given smooth, glossy sides, in contrast to classic black wrinkle finishes. Semi circular dials, and light grey coloring added to the modern appeal.

The principal technical advantages with the NC-173 are seen in tube design and circuit application. Its electrical layout is mostly conventional: a single RF amplifier, a mixer which uses a separate oscillator, two stages of intermediate amplification, a BFO, a noise limiter, and single-ended audio.

It used a 6SG7 as a single-stage RF

continued next page

National Company's NC-183D from previous page

amplifier/preselect, and a 6SA7 as a first converter. The 6SC7 was an unusually good choice for a front-end tube in 1946. Being newly-designed, it was a remote-cutoff pentode with very low inter-electrode capacitance, and an equivalent noise resistance (ENR) of just 3200 ohms in class-A service. This was an extremely quiet tube to use for a RF amp, providing a reasonable noise figure in the 15 and 10-meter bands. With more than enough gain to override the mixer noise, it was a DX'ers delight. (The 6SA7 mixer has an ENR of about 30,000 ohms.) It had good overload protection due to a linear AGC response, requiring nearly 15 volts of bias to cut it off. Its performance falls off above 20 Mcs., and performance at 6 meters is not as good. This is probably the reason its use as a front-end tube was discontinued in later models.

A voltage-regulated local oscillator was used, and the shielded crystal filter was placed just after the 1st converter, as it should be, to avoid filter overload. There were two IF stages, again using low-noise 6SG7s.

Advanced techniques applied from war research began with the tuned circuits in the IF. National used high-capacitance (high-C) transformers to reduce stray coupling, which sharpened up the close-in skirt selectivity, and the high-C design minimized transformer alignment shifts and mixer "pulling" with AGC action. Also, with a high-C design, alignment is less affected when tubes are replaced. These transformers have less gain than is usual, but the quiet, high-gain 6SA7 amplifiers more than make up for it. Both of the oscillators were very stable. There was amplified AGC, formerly available only in very expensive receivers. The BFO energy was injected down-stream of the AGC amplifier and AGC detector so that the presence of BFO voltage supposedly would not increase the AGC line bias, and also that AGC and the signal meter may be used on CW and RTTY (another luxury). The S-meter was well calibrated, and did not require frequent readjustment.

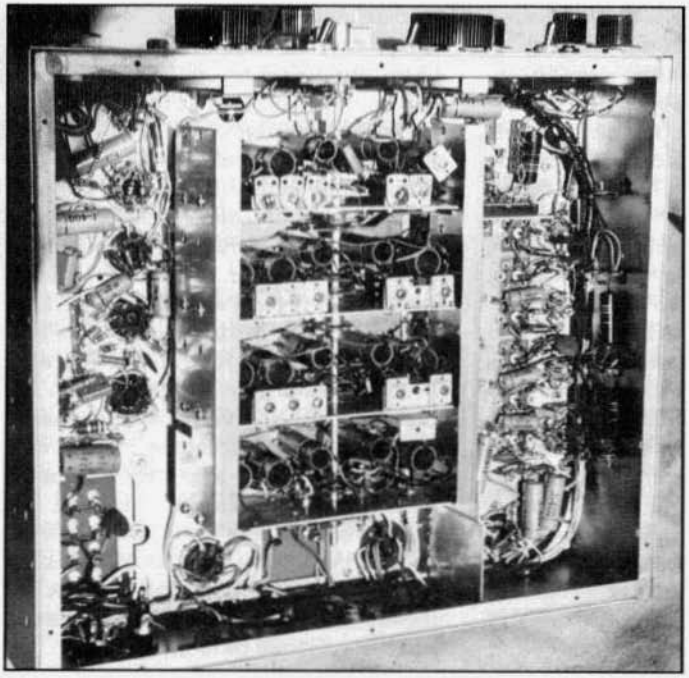
The noise limiter was unique for 1946. A second 6H6 diode half was used to prevent short, high-amplitude transients, generated by the limiter's clipping action, from charging up the audio coupling condenser, which would have otherwise modulated audio signals at the rate of the noise impulse. This charging action will turn a typical noise limiter back into a noise generator. A well known, very high priced receiver from Iowa suffers from this problem!

National gave the '173 single-ended audio, which was unfortunate. They simply were trying to hold the costs of production down. In my opinion, next to some 1930's Scott and Zenith receivers, National has the best sounding audio around. Good audio is important, even in a communications receiver. Long stretches listening on the air with a high-distortion, low-dynamic range audio section is very tiring, as your brain is continually forced to compensate for the distortion.

Introduction Of The NC-183

Research efforts at National continued. Harry Paul (W1PMS) took the NC-173's framework and redesigned it, and it became the NC-183. It was available by December 1947, and it retained the NC-173's cabinet style with light grey coloring. Production of the NC-173 was not discontinued, however. They continued to offer it as an alternative, at about $90.00 below the NC-183. Production of the NC-173 continued intermittently until October 1951.

The NC-183 was different in that Mr. Paul added an additional RF stage, which was intended to reduce image response problems with the 3-to-1 tuning range the NC-173 offered. The crystal filter was essentially the same design, except for the balanced input transformer and the output filter loading coil. Both of them got additional shielding. The limiter circuit is essentially the same, amplified AGC



Underside of the '183 chassis

was retained, and fortunately the separate LO stage was retained. The low-noise 6SG7's remained, at both RF and IF. Major changes were incorporated into the audio. Low-distortion push-pull audio was introduced, using beam-power 6V6s, at an undistorted 8-watt power level. This circuitry is virtually identical to the HRO-50 audio. The tuning condenser, built in-house at National (as were most other components in the series), was redesigned and strengthened to improve stability. The new design incorporated a bi-metal temperature compensator strip in the oscillator section to reduce long-term drift and warm-up time. The custom-cut gear train used entirely spring-loaded gears to eliminate backlash, and a 5-to-3 ratio was provided for vernier action on both main tuning and bandspread. Unfortunately, dial slippage is a recurring problem with these receivers, and overshadows the nice gearing mechanism. There is a ground strap in the front of every condenser section to reduce RF resistance and mechanical noise. All four sections are shielded from one another, and the construction is very sturdy, with thick-wall sections. Ball bearings are used at the front section, and an adjustable thrust bearing at the rear. The last plate in each section is serrated, to allow for the time-honored method of bending a section of a condenser plate to adjust each section's capacity. (This method actually dates from the early thirties, when single-knob superhets were everyone's goal.) The plate shape in each condenser section closely approaches a straight-line frequency response. This was the main method used to come close to their advertised 1% calibration accuracy specification.

The Double-Conversion NC-183

Rapid changes in tube design, component construction, and market strategy led to Harry Paul redesigning the NC-183 in mid-to-late 1951. The first step came with the discontinuance of the venerable NC-173 in October 1951, after 4- 1/2 years of intermittent production. Then, in April of 1952, National announced an "all-new" receiver, the NC-183D. It is likely that the "D" in the model designation indicates that it had become double conversion.

The most visible change with the NC-183D model was the main tuning and bandspread dials, which were changed to an easy-to-read, edge-lit Lucite style. The calibration numbers are easily visible

continued next page

ND-183D from previous page
against a black background, but do not glare. The "S" meter is mounted in a beautiful chromed case, with the scale illuminated in colors that match the tuning dials. The layout of the operating controls and cabinet size are identical with the NC-183.

Electrically, there were many changes. The front end was completely redone, using 2 6BA6's for RF amps, 6BE6's for 1st and second mixers, and 3 6BA6 IF amplifiers. Both of the mixers are self-excited (no separate oscillator stage), as will be discussed later. When used above 4.3 Mcs., the first IF is 1720 kcs, and the second is 455 kcs. Below 4.3 Mcs., it is a single-conversion receiver. In the 455 kcs. IF, 5 double-tuned transformers are used, and in the 1st IF there are 2 double-tuned circuits. When used above 4.3 Mcs. in double-conversion, there are altogether 16 tuned circuits before detection. All of them are slug-tuned so that the Q and shape of the combined IF response is superior to those of many receivers of similar design. The tuning gang condenser was further strengthened, and additional vibration protection was used. Temperature compensation was built into the plate design, and warm-up drift and long-term drift are hardly noticeable. Miniature tubes were used up until the first audio stage, and push-pull 6V6s were retained.

When changing over from single to double conversion, an unusual eccentric, cam-follower, and reach-rod arrangement is used to throw a multiple-pole slide switch which is mounted near the 1st converter tube socket. Driven off of the bandswitch shaft, this mechanical arrangement bypasses the first mixer below 4.3 Mcs. when in singleconversion.

NC-183D Construction

The NC-183D I described purchasing above had never obviously been worked on. This left the chassis in good enough condition to make some observations about its original construction. The most obvious detail of its construction is that the chassis is large, roomy and the parts are well laid out, which makes the schematic easy to follow. There is enough extra room that repair on any area, including the bandswitch, is easy. Most all of the RF components (coils, variable condensers, transformers, etc.) are of National manufacture. My chassis was built with entirely Sangamo capacitors, none of which were defective, including the power supply filter. IRC carbon and film resistors were used throughout, and all of the tubes were made by Raytheon. Several were very weak, so I think they were probably the original supplier. Every solder joint was individually inspected in production, and if accepted, marked with red lacquer. Where a tie strip is mounted with a screw instead of a rivet, a star washer is used both above and below the chassis. Yet, they choose to use lossy bakelite tube sockets throughout. All of the tube numbers, and other information, are silk-screened onto the chassis.

The tuning dials are solidly mounted to circular copper plates, and the plates are driven from below via pinch rollers. This is quite a contrast to other manufacturers who choose to drive the plastic dial directly. Be sure when cleaning the dials not to let any fluid run down between the dials and backing plate, as it might cause permanent damage to the lettering. Cast flywheels are used on the main tuning and bandspread shafts, but the panel knobs are much too light. A heavier knob would have given a much more positive tuning feel. The flywheel support brackets have elongated mounting holes, so that the brackets may be moved forward or backward to adjust for smooth tuning action.

The 4-section tuning condenser is built as well as one from a frequency meter, with a straight-line frequency characteristic. There are ball bearings at each end of the tuning shaft, large double rotor wipers in every section, and Steatite insulators supporting the stators. The antenna trimmer uses a grounded tuning shaft, and yet it is coupled to the trimmer con-

denser in the antenna section with an insulated coupling.

The bandswitch is 9-section, with the oscillator section made from ceramic. The others are bakelite. The individual compartments are large and roomy, and the switch sections are easy to get to, with enough room to unsolder a wire lying between a top contact and the chassis.

Performance

In spite of the NC-183D's attention to constructional detail, there are some trade-offs which seriously limit its usefulness as a communications receiver. There are also several areas which perform very well. Through the courtesy of Mike O'Brien (NØNLQ), I have some original NC-183D test data from National Company. It indicates sensitivity (MCW and CW), image rejection ratio, and noise figure over the tuning range of the receiver. It shows a 10 dB S/N ratio of between 1.0 to 1.9 uV (microvolts), except in the 20-meter band, where it is much worse, at 2.6 uV. While this doesn't sound like much difference, on a log scale, that's 7.5 dBv! The 2.6 uV figure relates to an MDS (minimum discernable signal, 3 dB above the receiver noise floor) of .8 uV. My receiver had all the weak tubes replaced with NOS (and aged) Raytheon tubes and a full prescription alignment. I could get no better than a MDS of 3.2 uV at 14.100 Mcs. As 3.2uV corresponds to a 10 dB S/N ratio of 10.1 uV, the receiver is obviously of questionable value for weak signal work. On the 40-meter band, the sensitivity is somewhat better (?), at 4.9 uV. Also, BFO voltage does get onto the AGC line, enough to charge the AGC line and register on the carrier meter.

Blocking and 2-tone IMD testing revealed yet more bad news. The single-tone blocking dynamic range measured a disappointing 56 dB. This is the in-band dynamic protection. The out-of-band, or 3rd order 2-tone dynamic range is 48 dB, hardly a competitive figure. In all fairness, the standard test is made with AGC off and RF gain cranked full on. If one is willing to ride the RF gain and leave AGC on, the receiver will perform fairly well as a general coverage unit, or for stateside AM. AGC response does hold output constant within 3.5 dB as indicated in the specifications.

The 6-meter band is essentially useless. The self-excited mixers generate so much harmonic response (birdies) that valid signals can't be found. The antenna trimmer "tunes" these responses, pulling the mixers enough to shift the birdies around in-band. This problem also shows up on the 10-meter band, but to a lesser amount. Mixer "pulling" is caused by changes in circuit loading "downstream" of the mixer stage reflecting back to vary the mixer plate load, which changes the mixer injection frequency. Pulling is unusually bad in self-excited (no separate oscillator stage) mixers, and one does not expect to see their use as high as 6 meters. However, regardless of where the receiver is tuned, every control on the front panel pulls a mixer somewhat, including the audio gain! In addition, if turned to a steady signal with the BFO, pushing on the front panel causes a 50-100 cycle change in the beat note, but I don't think they meant to include a built-in code practice oscillator.

Significant alignment problems exist as well. In conventional superhet design, the tuning condenser is produced so that all sections are as nearly alike as possible. Then, as we all know, tracking is adjusted on the low end of a band with a series padding condenser, and a parallel trimmer for the high end. In really nice designs, there is a mid-frequency cross-over adjustment provided by slug tuning the inductance. In the NC-183D, and the others in the family, there is only a single parallel trimmer for the high ends (except for the broadcast band). These trimmers are "economy" models, very touchy in alignment. They have much more capacity per degree of change than is necessary. What is really worse than this is the low-frequency adjustment, which consists

continued next page

NC-183 from previous page
of reaching inside the coil forms, and bending a coupling loop "as necessary" to bring in the tracking on the low ends of every band. In my receiver, I spent the better part of an entire Saturday trying to get the thing to track properly, and never really did. As a result, sensitivity over any one of the bands varies by 10 to 20 dB, except on the broadcast band, where tracking can be adjusted at three points. On the "D" band, moving the wire too far makes the receiver break into oscillation. These coupling loops are long pieces of enameled copper wire. As soon as the temperature or humidity changes, there goes your superhet tracking and your Saturday! If you find it necessary to attempt this "alignment", I suggest getting a couple sizes of plastic crochet hooks, as they are the best method I could find to snare the wires long enough try a change. The only way I can see to meet factory specifications for sensitivity and dial calibration would be to completely rebuild the front end, hand selecting all new components with an RLC bridge, and then temperature cycling them.

I do like several circuit features. The IF alignment was performed without any problems, and sweeping the IF with a Tektronix tracking generator after completion showed that IF response meets all of the specifications regarding shape factor. Heterodynes in the shortwave broadcast bands can be completely eliminated with proper use of the crystal phasing control, and single-signal CW reception is possible if one is patient. This performance is due to the good design of the crystal filter unit. In any single-crystal filter of the period, the frequency where minimum attenuation through the filter occurs is where the crystal is a series resonant circuit element. Conversely, maximum attenuation occurs when the crystal is a parallel resonant element. A variable condenser is typically placed in parallel with the crystal, and its adjustment controls the frequencies which are passed or rejected, by neutralizing the crystal's capacitance. Bandwidth is usually controlled by changing the resistive load on the crystal, which changes its loaded Q. However, when this is done, the gain through the filter is different for every bandwidth setting. What National did to improve the standard design was to switch-select fixed capacitance in series with the crystal to control series-mode resonance. This approach controls bandwidth very effectively without changing stage gain.

It is a very stable receiver, and it tunes smoothly. It is resettable to WWV within about 500 cps, and warm-up drift does not exceed 250 cps. Long-term drift is not noticeable. (These figures may be higher in the winter, however). The logging scales are entirely adequate for broadcast dx'ing, and the indirect dial lighting is great, and very attractive.

The National NC-183D could have been a very high quality receiver, with only a few simple changes. With its high image rejection ratio, three stages of IF, and push-pull audio, it would have been a dream come true in the 1930's. In spite of its technical shortcomings, I still like it. It's not a bad broadcast receiver, and shortwave listeners should find it entirely adequate. It deserves an honored place on the shelf of receiver history, as National Company struggled to compete in the difficult post WW II economy. **ER**

Radio Tube and Box Display

by Mike Palmer, K5FZ
16707 Creeksouth
Houston, TX 77068

One day while searching in my collection of new and used tubes I had acquired from years of hamfests, it occurred to me that there was just an incredible variety of shapes and sizes represented. Some of them were quite unusual and possibly rare. Having so many of them, I saw that I could pull one of each size and shape and not make a dent in my tube inventory.

In no time I had sorted 52 physically different tubes and 38 boxes from different manufacturers or of a different design! I was amazed that there were so many different brands that were not familiar; like Standard, Quick-Check, ITT, Heintz and Kaufman, Marshall, Arcturus, Rad-Tel, Calverton. More common are names like CBS, RCA, Cetron, Raytheon, Amperex, Philco, Sylvania, Motorola and Realistic.

Construction:

A general layout of the tubes was determined so each tube would provide clearance for the tubes nearby. Each hole was marked with a felt-tipped pen. Three sizes of holes accommodated all the tubes. Hole size was determined by letting the pins slip into the hole. The lip of the tube base rests on the 3/16 inch clear plastic surface. Tubes were secured with clear silicone glue. This allowed the base and pins to be visible. The 2 plastic sheets were supported by metal spacers above a 4-foot hardwood board. Height above the board is such that no pins touch the board. Screw heads were countersunk and the wood was stained and varnished. The tube boxes are supported by a short plastic wall and silicone glue holds them in place.

This was a fun project constructed by Mike, WA5MCL, John, W8CAE, and myself while Mike and John were visiting me last year. ER

Collecting/Repair/Restoration ...Tips

Dri - Transfer Lettering

Nothing does as much to dress up home-made equipment as the use of modern dri-transfer lettering. Letters and complete radio-related word set are available for use on transmitters, receivers, hi-fi audio equipment, test gear, etc. Very small letters and numerals are available for marking frequencies on dials. Letter sets come in both black and white.

Dri-transfer letters (DTL) are much easier to use than the old decals that they replace. No water is used thus eliminating the old problem of their sliding around on the panel during application. And, best of all, there is no reflective plastic substrate to give away the secret that it's not a professional silk-screen job.

Application of Dri-Transfer Letters (DTL).

1. Place the painted panel to be lettered on a desk or table and hold it in place with masking tape.

2. Stretch a string across the panel as a guide to where the word or label is to be positioned. Secure string with tape.

3. Place the DTL sheet on panel with desired word in chosen position.

4. While holding the DTL sheet so it can't move, rub a soft pencil (I found a green coloring pencil works well) back and forth across every letter of the word. Carefully lift one end of the DTL sheet to see if all the letters transferred to the panel. If not, lower the sheet and rub the areas that didn't transfer. With practice you will succeed on the first try.

5. Place the DTL protective backing sheet over the word just transferred. Using the convex side of your fingernail, rub against the backing sheet to press the word firmly into contact with the panel. This insures good adhesion.

6. When all lettering is in place, spray the panel with a clear acrylic spray such as Krylon. Do this in four or five steps. The first two or three coats must be very light to avoid lifting the letters or words. The final coat should show even coating of the panel.

7. If you do not wish to spray the entire panel, cover each individual word with clear fingernail polish. I use Super Shine, Shiny Top Coat by Sally Hansen.

Removal of Dri-Transfer Lettering.

After you've used your equipment for a while, you will think of some changes or improvements and it will be necessary to remove one or more DTL words so you can add new ones. This is not as difficult as you may think, although I recommend experimenting on an old panel first.

1. Use a small Q-Tip (small piece of cotton wrapped around the end of a wooden tooth-pick) and lacquer thinner. Apply to the DTL and work in small sweeping motions until all of it is lifted and removed. This will soften the underlying paint and mar its appearance but this can be kept to a minimum if you use only a small amount of lacquer thinner and confine your efforts to the smallest area necessary.

2. When the lacquer thinner has evaporated, carefully smooth the area with No. 600 emery paper.

3. Retouch the damaged area with paint of the same color using a very small model maker's brush. When the paint is nearly dry, it can be smoothed by pressing a sheet of teflon-coated paper against it - I use the backing sheet on which Avery or Dennison removable labels are supplied.

4. When the paint is dry, apply the new DTL as outlined above.

5. The DTL can be protected by applying a thin coat of nail polish as outlined above.

Where to Get DTL Stock.

Antique Electric Supply in Tempe, Ariz., carries dri-transfer letters in both black and white suitable for most home-made equipment. See their ad in this issue and send for their catalog. Most large art stores carry sheets of alphabets and numerals. My favorite is a brand called Geotype by Geographics, Inc.

Bob Dennison, W2HBE

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 SPAM net starting at 5:00 CA time; **40 meters** - 7160, 7195, 7290 are the main freqs. Westcoast SPAM net every Sunday afternoon ,4:00 PM on 7160; **80 meters** - 3870, 3880 and 3885 are the main freqs. Westcoast SPAM 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 summer-time activity but during the winter signals can be heard anywhere on this band.

From the Editor:

The Fall and Winter Operating Season

Now is the time to be getting ready for the fall/winter operating season. All our antenna work should be done now while the weather is nice and operating conditions keep us off the air. If we have shack renovations or repairs to our main rigs we should also be doing that now.

I think we're going to have a good fall and winter. Our numbers have increased dramatically and after such a bad summer (my observations are that conditions have been terrible) we're all going to spend as much time as possible operating our stations.

15 meters is going to be interesting. As ten goes dead (it's almost there) 15 is going to be it's replacement. I'm hoping we can get some serious AM activity going on this band. I've been listening on 15 - mostly above 21.400 - and I've heard some AM activity but nothing up to the level that I expected this summer. Of course, as I've said, conditions - noise/propogation- have been awful. Next month we should see conditions improve and the level of activity start to increase.

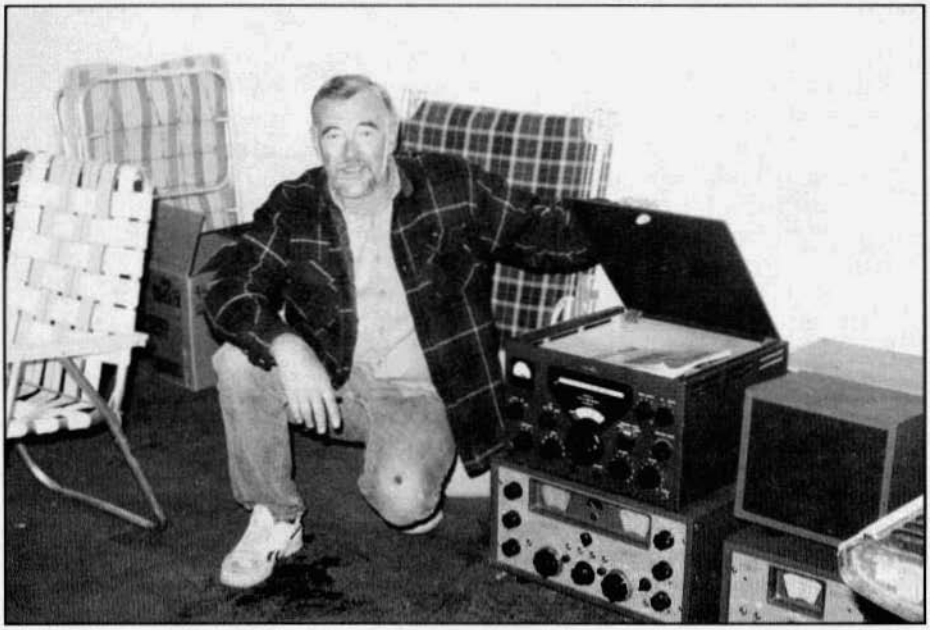
20 meters is still my favorite band but with Les, K6HQI, (net control on 14.286) on the road, the level of activity there has dropped off as well; look for it to increase when Les gets back on with his 833A's.

I wish there were more 40-meter activity out here in the West. We did have our 40-meter Saturday night 'bashes' for a couple of years but we've never had the all-day, most-of-the-night activity that's the norm on the east coast. Maybe we have to promote more 40-meter activity out here.

75 just never seems to expand much off of the standard 'channels' - 3870, 3880 and 3885. For a while, a couple of years ago, we had some Colorado activity around 3850. Maybe we should start operating more down there.

The last band to consider is 160. I think we're going to be have more AM activity down there this year than any year in the history of amateur radio. One reason that I say this, is that there is a large number of broadcast transmitters being restored; and 160 is their band. I know of at least ten broadcast transmitters that are in the process of being restored/renovated for 160-meter operation. I'm sure there are more. I think this is very exciting.

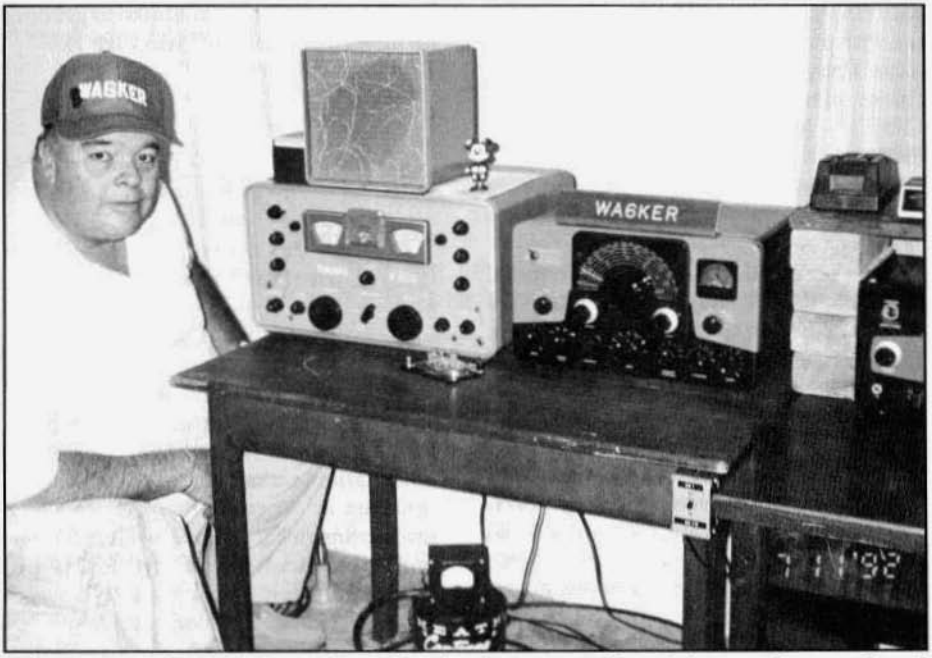
We still have a couple of months untill fall and then a couple of months until the real good conditions of winter. I can't wait! **N6CSW/Ø**



Dick Wagner, KB2EGG, with some of the gear he acquired at the most recent Deerfield, NH, ham swapfest.

Tom French, W1IMQ, at Deerfield, selling his books on Vibroplex products. Note his 'Vintage' car in the background.

Lance Johnson, K1MET, with his vintage gear. He uses the Valiant II and 75A-4 on 160 meters and the 32V-3 and 75A-3 on 80-10.



Bob Braeger, WA6KER, with a classic vintage station; Johnson Ranger I and Hammarlund HQ-160.

LETTERS

Dear ER

Yes! Teletype is still alive and florishing amongst a dedicated few in the U.S.! There is a small group of collectors of the "greasy widgets" who keep in touch on an irregular basis and we keep UPS busy carrying our treasures between us.

I have been an avid Teletype fan for 32 of my 33 years as a Ham. I was only 13 when I got my first Model 26, with the help of Bryon, W2JTP, who happened to live in my town. I was fortunate to land a job with New York Telephone Company in the early 1970's as a Teletype repairman and I literally "died and went to Heaven". Unfortunately, TTY was on the way out by the late 70's and the big thing was "data". I personally helped a lot of local hams get on RTTY, mostly through fixing machines and building T.U.'s. It was a lot of fun.

Since then, I have been collecting the castoffs. As you mentioned, no one wants the stuff anymore so it's easy to get nowadays. I have a collection of about 25 machines, many of which are the 28 line (the Cadillac). I also have 26's, 32's, 33's, and even a Model 38. My good friend Bill, W4NZY, in Louisville, KY, has quite a collection as well. We constantly swap parts and such.

I've also begun collecting the terminal units that nobody wants. It's not unusual to pick up a HAL ST-5 for $10! I also have a full 6-foot rack of military RTTY gear, with the required R-390A receiver.

I have wanted to advertise for RTTY gear in the ER ads, but hesitated that I would be spoiling the intent of the magazine. Now that you've opened the floodgates, I won't be so timid. Of course, I also have the requisite S-Line, Ranger, etc., that qualifies me to belong to your fraternity!

I'll be watching to see if you unearth any more closet Teletypers. Will write again soon to update you on where some of the more famous RTTY'ers have gone.
Jack Hart, WA2HWJ

Dear ER

I read your article on vintage RTTY and I too would like to see a renewed interest. I bought my model 15 and terminal unit from Byron Kretzman, K2JTP, when he and I both worked together in the early '60's. The Twin City TU was his original one. I changed the auto start relay and added a mark hold feature.

I remember when I got my receiver going and was tuning the range finder in November of '63. I was listening to UPI which made good copy. The bell started ringing and before my eyes was the first report that President Kennedy was shot in Dallas! A week later my transmitter was in operation and I had a great time for many years until they went to 170 cycle shift. I bought a transistor TU out of Florida but my HRO-50 and 32V-3 are not stable on 170 cycles.

If enough interest could be found back on 850 cycle shift I would like to get back on again with the old Twin City TU.
Bud Gross, WØBYG

Dear ER

In view of the articles on broadcast transmitters, I have a little story to relate about my experiences with a Collins 20V-1.

In 1956 I was managing KFML-FM, in Denver, when the owner and I decided to add AM. We bought a new 20V-1 and I installed it and put it on the air. Everything was going fine until the thunderstorm part of the fall of 1956.

The transmitter started to go off the air for no apparent reason. Then we lost the modulation transformer, which Collins replaced at no cost to us. After several more transmitter failures we lost the second modulation transformer. This had Collins confused, so they sent us a new 5-KW modulation transformer. This solved the transformer problem, but now the arcovers started jumping four-inch porcelain

insulators in the final cage. In that particular model of Collins, they ran the bias supply on the final cage components and the B+ was shunt fed to the plate of the final tubes. They said they ran the bias voltage to the final tank so that any arcs would trip a relay in the bias supply and would momentarily remove the final plate voltage from the final to kill the arc. This made sense to me, but we continued to have outages from plate overload on arcs.

I asked Collins to set up a test transmitter in the lab to see if they could achieve the results we were having. They did, and a couple of days later they called and told me about a little relay on the front inset panel. They said for me to place a short between two of the leaves on that relay. They said that an over zealous ENGINEER had decided they should also open up the cathode circuit of the final whenever arc caused plate voltage removal to kill the arc.

To make a long story short, they had not checked the relay to be sure the plate voltage was removed before the cathode circuit was interrupted. As it turned out, the cathode of the final was opened without removing the plate voltage on the final, thus creating an infinite impedance for the plate circuit through the secondary of the modulation transformer, which caused horrendous voltages to be generated in the final tank assembly and explained why it was jumping 4-inch porcelain insulators and anything else it was exposed to....

We never had a single case of trouble with that transmitter thereafter. As far as I know, that jumper is still across the relay contacts on that 20V-1.

Art Robinson, WØIWV

Dear ER:

I just received a letter from Robert Bennett, a subscriber in Las Cruces, N. Mex. He sent me a letter correcting some errors in the R-390A series article that appeared in the the 4/91 issue of ER.

Mr. Bennett says, in part..."the CV-1982 is not a dual diversity converter, it uses only the output from a single receiver. It does use automatic frequency correction and has provisions for subcarrier reception. However, to use these features, the transmitted SSB signal has to be in a special format, that is, it must contain an out-of-band transmitted carrier reference. The purpose of the AFC and subcarrier is to drive a secure voice (crypto) devise. For normal SSB reception, the two features should be turned off via switches on the front panel. As far as I can determine, the CV-1982 is unique to the AN/TSC-26. The TSC-26 is not a space terminal, as you state. The TSC-26 is a communications central used by Special Forces....to provide communications to their agents deployed in hostile territory. The TSC-26 supports several modes of communications in the HF band. The most important is high speed burst Morse, the unit also provides secure TTY and secure/non-secure SSB voice..."

I sure wish I could have gotten this corrected information when I was looking for it.

Ray Osterwald, NØDMS

Dear ER

Shortly after the June issue of Electric Radio came out showing the telephone filter I have been using, I received a letter from Ed, N3GWE, with a copy of an article that Bill Orr, W6SAI, wrote for CQ Magazine, April 1991, showing the filter in greater detail. I certainly want to give credit where credit is due! One thing he mentions that I was unaware of is that greater attenuation can be gained by keeping the .0047 caps at least 2 inches apart.

Even though my filters have had the caps less than 2 inches apart, they have worked wonderfully!! He mentions that at a distance of 5/8 inch, the filter attenuation drops about 10 db.

Steve Miller, WA3JJT

Lee Faber, W7EH...Radio Pioneer

by Barry Wiseman, N6CSW/Ø
4 Aspen Place
Durango, CO 81301

Part Four

Lee continues:

"Within days of the Pearl Harbor incident, I received a telegram from the War Production Board telling me that I had to supply them with a list of all the raw quartz, semifinished products and finished products I had on hand. This kind of scared me because I didn't think anyone in the government even knew I was in the business of making crystals. At that time it was just a sideline for me. And then a few days later Motorola sent a man out - his name was Elmer Wavering - to try to persuade me to get into crystal manufacturing in a big way. They needed thousands and thousands of crystals.

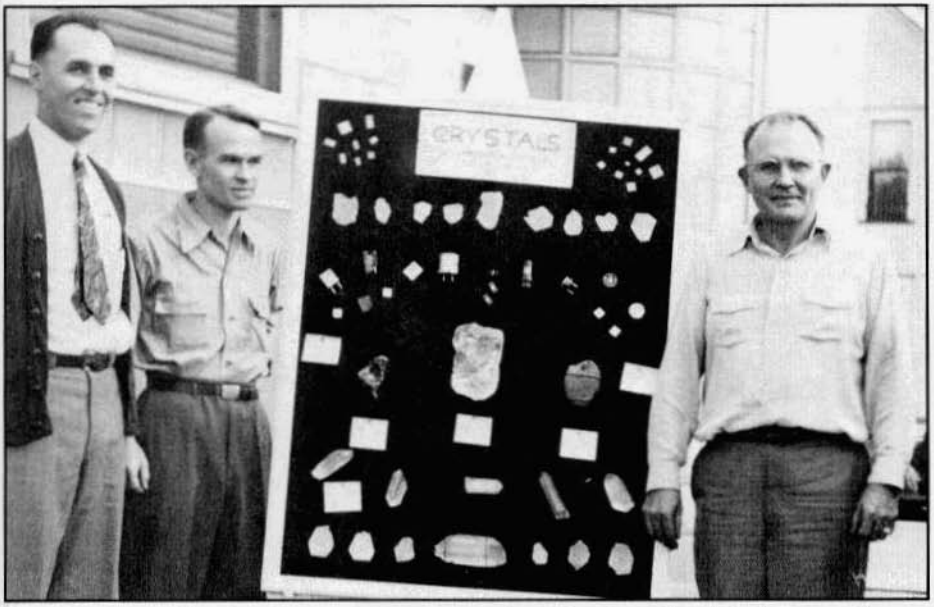
"Then I got another telegram from the War Production Board. They told me to come to Washington. When I got up there they said that they wanted me to go to work for Bendix Corporation in Baltimore in their crystal department that they were setting up for war production. I had a home and a family and I didn't want to move to Baltimore so after thinking about it a bit I said, "I'll go home and expand the crystal business that I have now". The man I was talking to at the War Production Board thought that would be all right, "But did I have the money to get started?" I replied that I didn't have much money and he said, "I'll give you a line of credit for $250,000." I just about fell out of my chair; I'd never heard anyone ever talk about that much money. In a way it scared me; at that time I was making about $125 a month. I went back to Sandwich without talking any more about the $250,000.

"I was really in a dilemma. On the one hand I wanted to get involved - and probably would have to get involved - in some aspect of crystal production for the war effort, but I also didn't want to take a chance on losing what I had. I had a good job with the power company; by now I had been with them nearly 20 years and was a supervisor over about 5 or 6 towns. I was making $125 a month and could look forward to a pension. I'd been through the depression and had a deep appreciation for security. And I also had to consider my family. Up to this point, I had provided them with a comfortable life and I wanted to continue doing so.

"When I got back to Sandwich, I went to see a friend of mine, James Knights; he was about my age and also a ham (9HMZ). He operated an electrical repair business. He fixed radios, automotive electrics and rebuilt batteries and that sort of thing. I told Jim what I was up against and asked him if I could start up my crystal business in the back of his shop. He said that I could, so he and I built a little room in one corner about 12 by 12 and I hauled in my equipment and started making crystals.

"As the business started to grow Jim started helping me. I was getting a little apprehensive about the power company finding out about my business so I asked Jim if we could put everything in his name. I'd just be helping him out; that would be the appearance of it at least. So that's the way the James Knights Company got started. Jim was an honest, hard working and reliable man.

"We didn't form a formal partnership until we had been working together for several months, and then it was only on the advise of our friends. One friend, who was the postmaster and also an accountant, advised us to set up an accounting system because he said the government



James Knights, Maurice Druesne (an engineer) and Lee in 1944. This photograph was taken in front of the James Knights' factory. The display contains crystals in various forms, from raw quartz to slabs to the finished product.

was going to require it. Another friend, who was a lawyer, advised us to set up a partnership or corporation. Neither Jim or I really knew anything about business at that time. Then we were advised to get some capital together to get the company going, so we both mortgaged the equity in our homes and came up with $4000 each. You might say that the James Knights Company started with that $8000. We never did take any of the credit offered to us by the War Production Board.

"We stayed in Jim's original building about a year. It was a tumble-down sort of building but we had a local contractor come in and kind of shore it up. When we outgrew that building we bought a much larger one across the street. We kept Jim's building as a machine shop. We were building most of our own machines - jigs, grinding tables, and special equipment - at that time. There was no other alternative. Later we bought a lot of machines and equipment from the Atlas Corporation. They started adapting things like press drills for lapping machines and table saws to accommodate diamond wheels that we used to wafer mother quartz, etc. I think their main business was making tools and home workshop stuff for Sears.

"Our philosophy was always to do the best job that we could. We worked hard and put everything we had into the business. Jim and I both had ideas about how to make crystals better and more efficiently and we worked hard developing new products. But we also had some very sharp people working for us. I think we had around 10 engineers with us most of the time - some good, some bad. Most of them were just very smart, practical people; very, very few of them had formal educations in engineering. Most of them were also hams. I was always eager to hire hams because they came with a knowledge of what we were doing. One of the most important engineers we had was Robert Berge. He just died about 3 years ago. He was also a good friend of mine. Another good engineer was William Cotteu.

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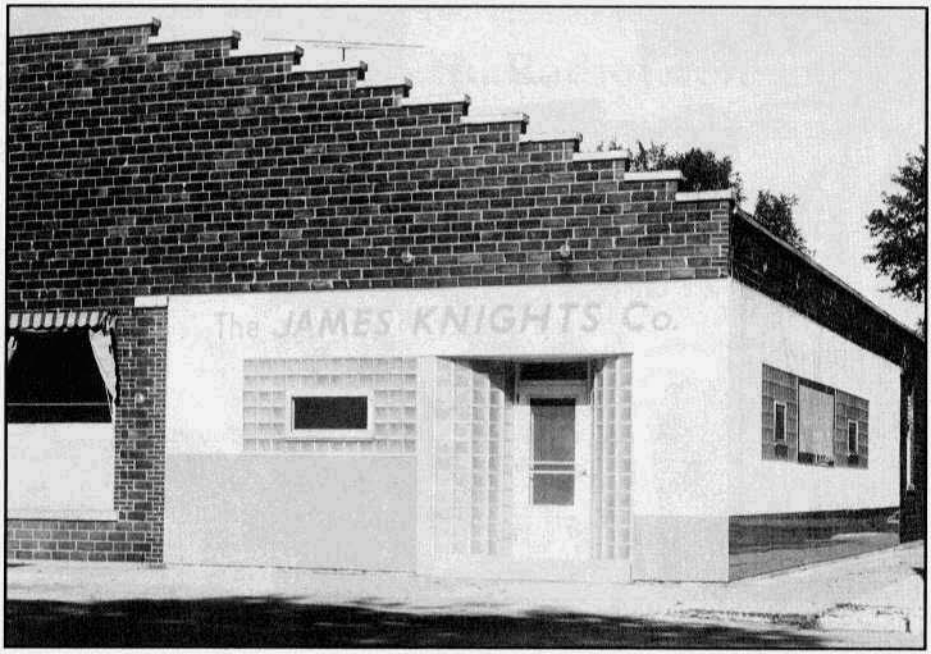


The James Knights Co., Sandwich, Illinois

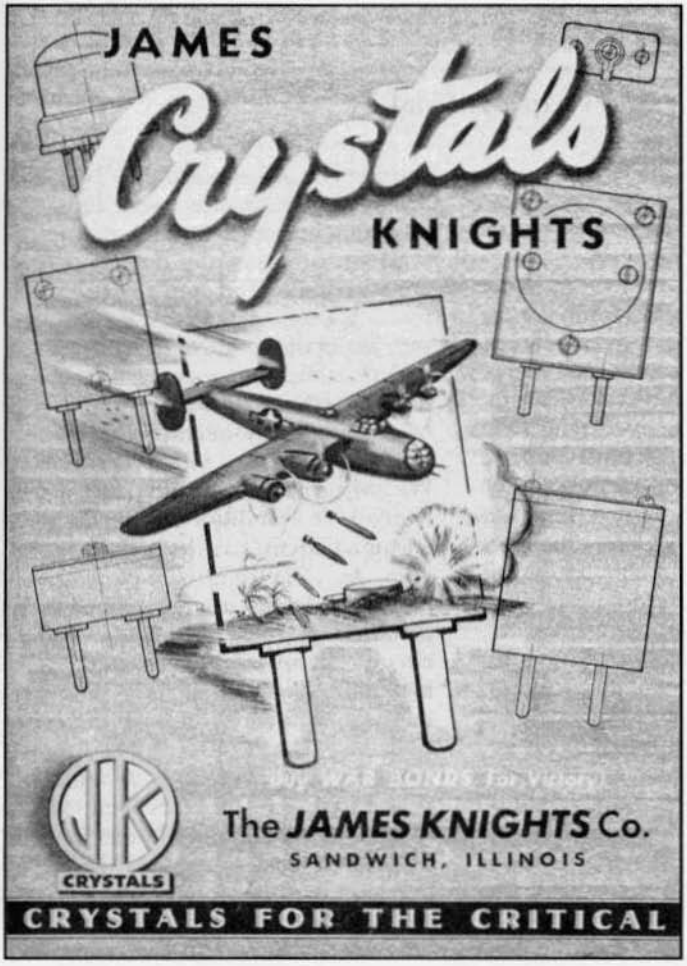
"Then the money began to roll in. We were getting big prices for our crystals. We went from about ten or twelve employees at the beginning to around 300 at the peak, just before War's end. We were the largest employer in Sandwich, of course.

"The crystal business was very, very profitable. Selling to the government during the war was almost like a license to print money. There were some companies that maximized their profits by being less than honorable. For instance the government had set an upper limit of $500,000 gross sales that a company could achieve before their contract had to be renegotiated. Most of the crystal companies stayed below that amount because the profits were enormous to begin with and they thought that they could do a half a million worth of business and come out at the end with a lot more money than by doing a million dollars worth of business and letting the government renegotiate their contract down to a point where maybe they'd make 10 or 12 per cent profit. The year we were renegotiated they allowed us only 12-1/2 per cent.

"Another angle some of the companies played was running up their expenses because under the renegotiation regulations their profits were based on their cost. I guess I should have hired 25 janitors but I wasn't sharp enough to know that. I never hired any more people than I really needed. And our people were very, very productive. Where other companies had a lot of young people that had not developed good work habits, we had mostly older people who knew how to work.

"Another thing that we did that wasn't very profitable during the war was to get involved in very specialized crystals. The real money makers were the simple crystals like FT-243s and that sort of thing. But in retrospect I think the experience we gained in developing and manufacturing 'high-tech' products during the war really helped us survive after the war.

"When the war ended we just closed the plant. We didn't have orders to fill



and there was nothing else we could do. Jim and I stayed on of course and some of our key employees. The total number ,including Jim and me, was probably about 15.

"Although we were not broke, the James Knights Company was deeply in debt, most of our profits had gone to improving our plant. And at the end of the war the government reviewed our contracts and we had to repay them something on the order of a million dollars. We had to borrow most of that. Things were pretty tough immediately after the war. I remember that we could not pay our bills to our suppliers and so on. I called up all the companies that we owed money to and reassured them that they would get their money, that eventually all our bills would be paid. I paid them all something on what we owed them every month. All my creditors, most of them suppliers, went along with me very willingly.

"If it weren't for the war I suppose I would have carried on making crystals part time and would never have gotten into it in a very big way. At the end of the war, there were some 70 large and small companies in the crystal business. Shortly after the armistice there were only 5 and I'm very proud that the James Knights company was one of those. The challenge now was to survive in the business without the lucrative government contracts.

"I might mention that now that the war was over, I was back on the air and it was just great. Ham radio was always - and still is - a very important part of my life." ER

Part Five next month

Tuning Broadcast Transmitters

Whaddya mean - don't dip the final ?

by Dick Houston, WØPK
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Durango, CO 81301

Some of you who are adapting older broadcast transmitters to ham use may run across some mystifying instructions about tuning up. You may read something like "adjust the plate tuning control to obtain minimum plate current, then turn the control clockwise until the plate current increases 60 milliamperes", or maybe "adjust the plate tuning control to obtain minimum plate current then observe the remote antenna circuit meter or the line current meter and adjust the plate tuning for maximum output current".

What's going on? Don't you always dip the final (or other stage) plate current to minimum? Well... as the old BC engineer might have said, it depends! We'll get back to what it depends on and why, but first - why haven't most hams heard of this difference in tuning procedure?

There are two reasons:

The difference becomes greater as the Q of the output tank circuit gets lower. A Q of 12 is usually specified as the best compromise among the various factors for the RF bandwidth required for good voice transmission - up to maybe 3500 hertz. To obtain the required bandwidth for broadcast use (FCC requires good response for AM up to 7500 hertz and most high-quality transmitters do a little better) a Q of 4 to 6 was common. So the average ham transmitter would be much less likely to show the difference we're talking about.

The main reason, however, is that the difference exists only if the coil in the tank circuit is adjusted, and not the capacitor. Most, if not all, ham transmitters use a variable capacitor to tune the output stage. Because of the lower frequencies and the resultant larger capacitors involved, most broadcast transmitters were turned by adjusting the coil in the tank circuit. This was typically done by moving a metal vane of some kind into the coil, or by rotating a contactor so that it spiraled its way along the inside of the coil.

Back to the tuning -- even if maybe we don't "dip the final", we certainly tune the output circuit to resonance. What we mean by resonance is the villain in our story. We are accustomed to thinking of resonance as the condition in which a parallel-tuned circuit has the highest impedance. As a matter of fact, parallel resonance is more accurately defined as the condition in which the impedance of the circuit is purely resistive, even if it is not maximum. For best efficiency and symmetrical bandwidth around the center frequency, the pure resistance circuit is what we want. Let's look at what's involved. We'll assume a 50-ohm coaxial cable load, although a really old transmitter may have been designed for higher-impedance open-wire line. The principle is the same in any case.

Earlier transmitters used a parallel-tuned output tank circuit with the load either tapped across the lower end of the coil or link coupled to the coil, as shown in Figure 1 (note that in this and all following diagrams, only the RF paths are shown, with any DC isolation such as coupling capacitors omitted for simplicity). Either way puts the load resistance into the inductive branch of the tuned circuit. Later transmitters used a pi-network output tank as shown in Figure 2, which shows how the pi net is very similar to the circuit in Figure 1, with the load resistance still in only the inductive branch of the equivalent tuned circuit. The pi output capacitor is relatively large and mainly controls loading, and the input capacitor connected to

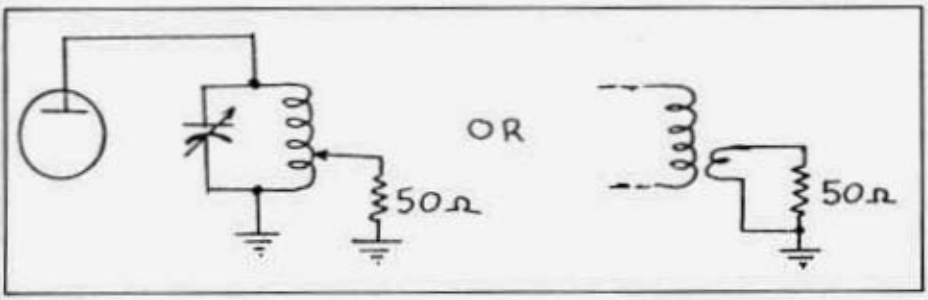

Figure 1

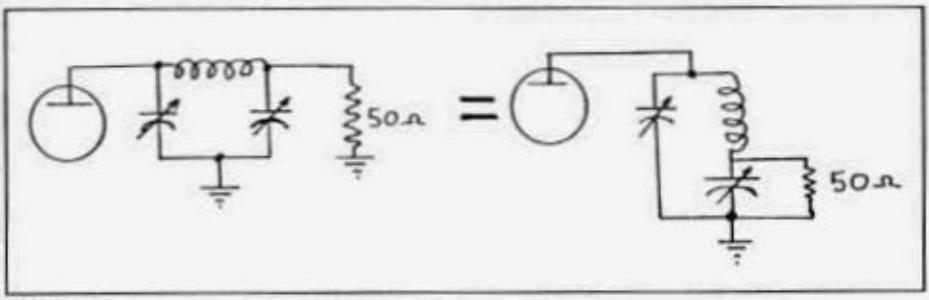

Figure 2

the plate is adjusted for tuning. The point is that in any standard configuration the tuning capacitor can be considered as pure capacitance and the load resistance appears in the inductive part of the tank circuit. Notice what this is saying: if you adjust the tuning capacitor, you are not affecting the resistive load in the tank circuit; but if you adjust the coil you are varying not only the inductance, but also the effective value of the resistive load in the circuit! That's where our difference comes from.

If you're the mathematical type, you can easily set up a formula for the parallel impedance of the tank circuit, with the resistive load in the inductive branch. Then you can solve for zero reactance and also differentiate and solve for the maximum impedance. But you don't have to be a math whiz to see the effects if we use a graphical approach, so that's what we'll do.

First, let's look at Figure 3, which shows the currents that flow in a parallel circuit with no resistance. We'll assume that the

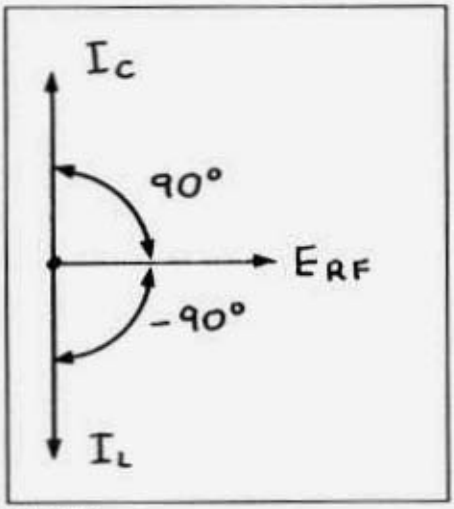

Figure 3

RF voltage across the circuit is constant over the small tuning range involved, which is close enough to demonstrate the effects. With a certain RF voltage across the circuit, RF currents will flow through both the coil and the capacitor. The current through the capacitor will lead the applied voltage by a phase angle of 90

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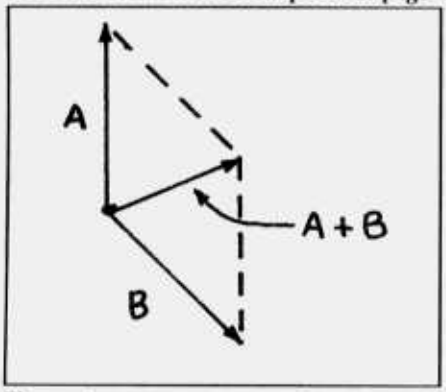

Figure 4

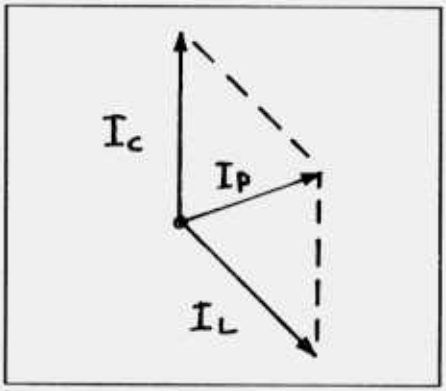

Figure 5

degrees and the current through the coil will lag by the same amount, as shown in Figure 3. If the capacitive reactance equals the inductive reactance, the currents will be equal (by Ohm's law). Since there is a 180 degrees phase between the two currents, the resulting RF current into the tank circuit will be zero, which says that the circuit's impedance will be infinite. This is, of course, a hypothetical case, since there is always some resistance (loss) in a real-life circuit.

Now let's put the load resistance into the inductor side of the circuit and see what happens. In our diagrams we'll assume that the RF voltage is horizontal to the right, but we won't show it to avoid cluttering up the diagrams. Before we go any further, however, let's review how simple addition is done on vector diagrams with two vectors starting from a common point. Figure 4 shows vector A pointing straight up and vector B pointing down and to the right. To add the two, we draw a line parallel to each one and then draw a third line from the point of origin to where the two new lines meet. This third line represents the sum of the original two -- it's that simple.

Now we are ready to draw the diagrams for our tank circuit. Note that the vectors that we have drawn represent RF currents. However, the DC plate current in a class-C amplifier is the sum of all of the short pulses of plate current at the RF frequency. So we can say that whatever resulting RF current we determine can also represent the value of DC current, at least so far as its relative values are concerned. The purists among us may object, but let's label the vector sum of the two RF currents as the DC plate current we measure with a meter - OK?

We're nearly there, so hang on! Figure 5 is like Figure 3, except that now we have included some resistance in the inductive branch so that the current in the coil is at an angle of less than 90 degrees with respect to the input RF voltage (which you will remember is aimed straight to the right, although we agreed to leave it off the diagrams). The resulting current through the parallel tank circuit is not zero, as in Figure 3, but is represented by the sum vector labelled Ip. This is the RF current flowing into the parallel circuit from the plate, but as we agreed, it also represents the DC plate current.

Now we get down to the "nitty-gritty" of our investigation. Figure 6 is like Figure 5, except that it shows the currents for three values of capacitance (the larger the capacitor the greater the RF current). The point labelled C can be seen to produce the minimum plate current, which also points directly to the right, indicating zero reactance. If we increase the capacitance to the value marked C+, or reduce it to the value marked C-, note that the vector gets longer, meaning a higher plate

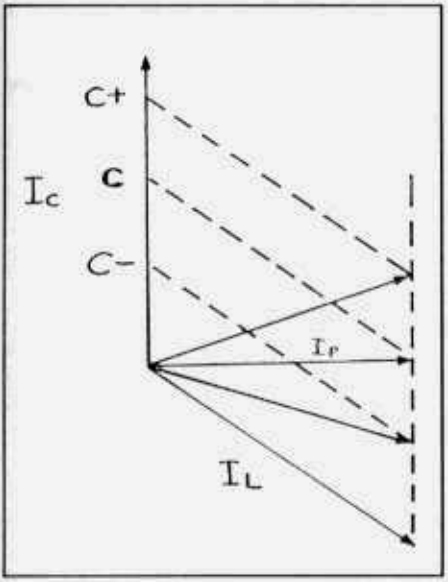

Figure 6

current, and also departs from the direct right, indicating that the tube load is not purely resistive. That's what we said would happen if we tuned the capacitor - remember?

Now look at Figure 7. It's the same as Figure 5, except that this time we've shown three values of the inductance L (the higher the value of L the lower the current). The value marked L+ is chosen to produce the shortest resultant vector, which is the dip in the plate current. But note that the vector is pointed partially upward, so the circuit is not purely resistive. Increasing the inductance to the point L++ further increases the plate current and the phase, so that's no good.

But look what happens when we decrease the inductance to the value marked L. The vector representing the plate current increases, meaning higher plate current, but it now points directly to the right, meaning pure resistance. Further decreasing L increases the plate current and the phase angle, so we obviously don't want to do that.

So there you have it - the answer to the odd tuning instructions we mentioned at

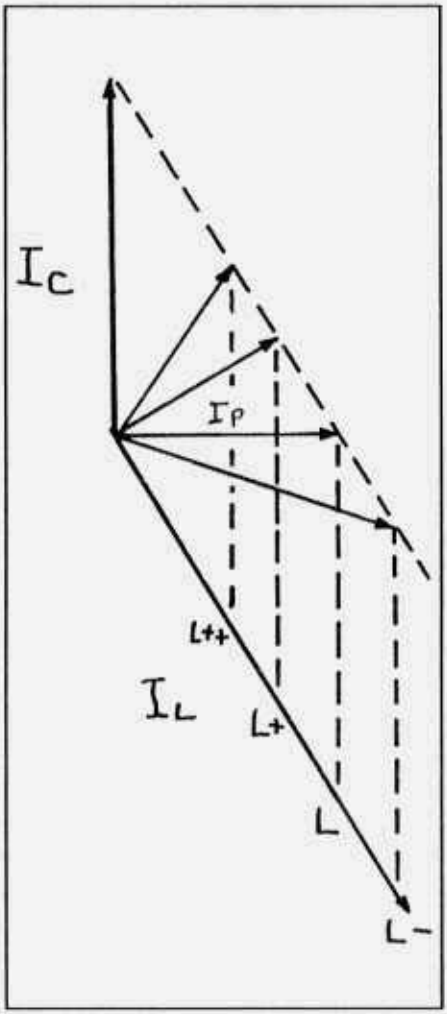

Figure 7

the start. When you adjust the coil for minimum plate current (plate dip), you have located point L+. Now to get actual resonance - zero reactance - you adjust the coil in the right direction (lower inductance) to reach the point L. If the instruction book says to increase the plate current a certain number of milliamperes or a certain percentage, that just means that the manufacturer has determined the amount off dip that will give you the zero reactance condition.

I rest my case! **ER**

5-Position T/R Relay Controller

by David Ishmael, WA6VVL
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Costa Mesa, CA 92626

Now that I have collected a fine stable of vintage receivers, I was going to buy a 5-position (or so) antenna switch so that I could use them. When I connected my 75A-2 and DX-40 for my first AM QSO last year, I realized that a simple antenna switch was not going to cut it!

As a result of that (brief) experience I designed and built the 5-position T/R relay controller. Even though I used my 'junk' box and bought most of the parts at swapmeets, I still managed to spend $60 on this project!

Here are some of the features of my controller:

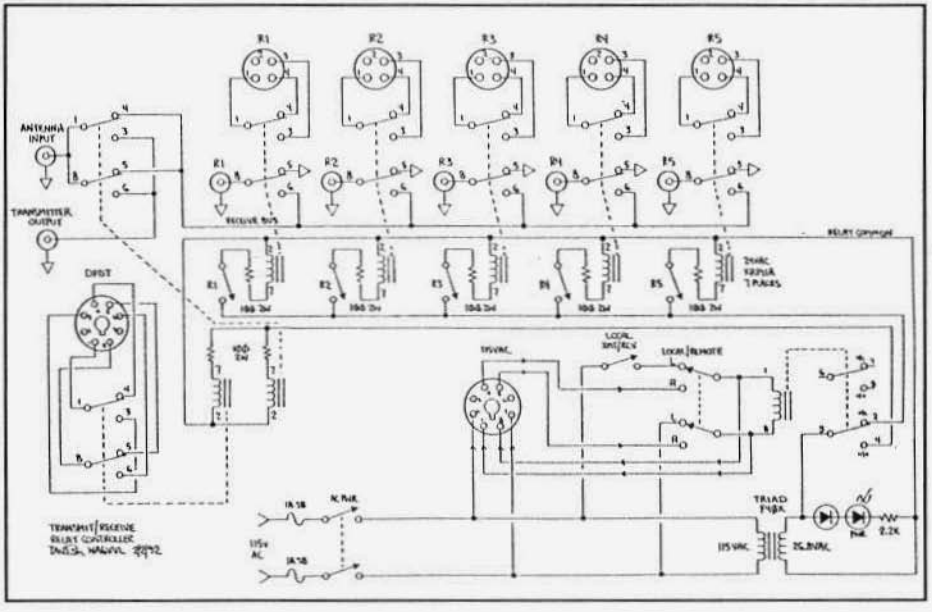
* 5 positions with individually isolated SPDT rcvr muting contacts and BNC-type connectors for the antenna.

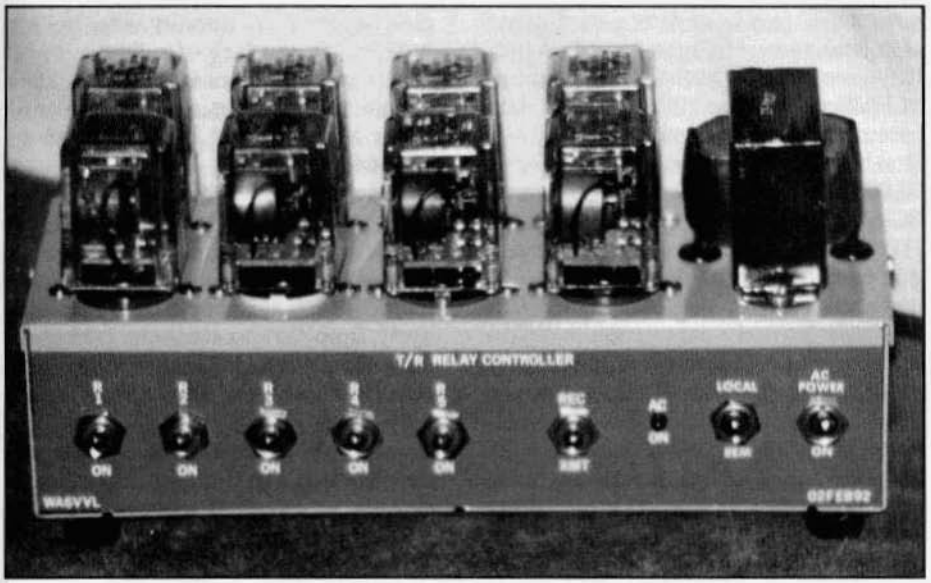
* A separate set of DPDT contacts for external control applications.

* Built-in XMTR switching for my DX-20/DX-40. I haven't tried to switch the Viking I with it (I use the external T/R relay).

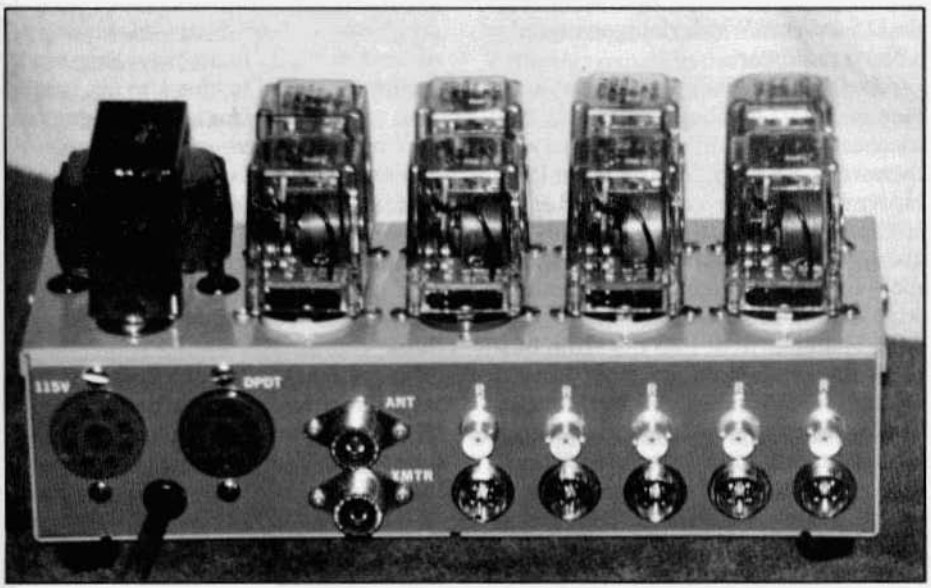
* Local/Remote operation. I used a 115 VAC relay for the main T/R relay. 115 VAC from the controller can control an external T/R coaxial relay. In the local mode, the front panel REC/XMT switch controls the controller. In the remote mode, 115 VAC from my DX-40, Viking I or remotely mounted T/R switch controls the controller.

Homebrewing is alive and well! I can now switch antennas among a 75A-4, Drake 2-B, HQ-170C SP-600 and a Kenwood R-1000. **ER**





Front View of T/R Relay Controller



Rear View

Bill Halligan SK from page 3
tude that is reflected in every Hallicrafters receiver, by constant research and ready acceptance of new and sound developments in radio science."

In later years, Halligan remarked publicly several times that he was most proud of Hallicrafters' contribution to military communications, especially during WW II when the company produced some 50,000 SX-28 receivers, several thousand BC-610 transmitters (an outgrowth of the HT-4 ham rig) and other shortwave gear that provided vital links for U.S. and Allied armed forces.

It was an early association with the military that first interested Halligan in radio. Barely into his teens, the young Bostonian heard a huge spark-gap transmitter at a nearby Navy shore station bleeding into his crystal broadcast receiving set. His fascination led him to learn Morse code, and in 1914 he earned his first amateur call, 1AEH.

By 1916 Halligan had a commercial ticket and soon thereafter, just out of high school, he was hired by the Marconi Co. as a shipboard wireless operator. When the U.S. entered WW I, Halligan served as a Navy radioman.

After the war, Halligan obtained a new ham call, 1UL, and began studies in electrical engineering at Tufts University and then won an appointment to West Point. However, before earning a degree, Halligan left school to pursue his two great loves: his sweetheart Katie, and radio. He married Katie and, after a brief stint writing radio columns for newspapers, Halligan went into the radio business, first as a parts importer's representative and then as a retailer. He called his Boston store The Radio Shack; it was the seed which grew into the retail radio empire known by that name today, although Halligan's association ended after a few years.

In the late 1920's Halligan moved to Chicago, then a hotbed of radio manufacturing activity. He worked successfully for a while as a representative for component makers, but dreamed of seeing his own name on high-quality sets. When he launched the Hallicrafters Co., his financial backing was shaky and he was hobbled by the lack of a license to use basic circuits patented by RCA. These problems led to business alliances with Silver-Marshall and Echophone to get production rolling.

Despite the Depression, Hallicrafters soon was turning a profit, thanks to the nation's appetite for newfangled radios and Halligan's aggressive marketing. Bob Samuelson, lured personally by Halligan away from Collins Radio in 1938 to design a line of transmitters for Hallicrafters, recalls: "There were many days when Bill didn't come in 'til noon because he'd been out in the bars on Rush Street with customers the night before. And he treated suppliers really well, too, so we usually got first crack at new components as they were developed."

Halligan's ongoing activity on the ham bands, as W9WZE and later W9AC, made him a challenging boss because he regularly gave the latest Hallicrafters rigs thorough workouts on the air. "He knew what the radios ought to do," says Samuelson, noting that Hallicrafters in its heyday was a great place for a creative engineer to work. "Bill attracted good people. He knew everybody in the plant by name. He had a helluva sense of humor. He could be tough -- he could chew us out one guy at a time, or as a group. But he was fair, and he created a great work atmosphere. We all felt tremendous loyalty toward him."

Fritz Franke, who followed Samuelson as Hallicrafters' chief engineer in the mid-1940's and remained Halligan's top aide into the 1960's, agrees that Halligan was a demanding boss but also a funloving fellow. "He had a good sense of humor, and he expected other people around him to have one, too," says Franke, now 84 and living in a Chicago suburb. "He did a lot of things that were new and good for business. I worked for him for 30 years

and was very close to him in the last years of Hallicrafters, and he was always surprising me with ideas. I had my own business when he asked me to go with him, and I was making a little money at it, too – but I never was sorry that I went to work for Bill."

During WW II, Hallicrafters operated 14 plants in and around Chicago, employing thousands of workers to keep up with military production orders. Part of Halligan's remarkable success in dealing with the Signal Corps and winning Army contracts could be traced back to the two years he spent at West Point in the early 1920's and the fact that some of his former cadet classmates had become key procurement officers.

With the return of world peace, Hallicrafters engineers resumed development of ham gear. But Halligan also was eyeing the consumer market. The company began producing TV sets, hi-fi tuners, clock-radios, etc., aimed at living rooms and bedrooms rather then ham shacks. In a 1945 interview published in Radio-Craft magazine, Halligan explained his view of an expanding electronics marketplace: "It is the nature of the industry, the very nature of the subject, to be imaginative, to be unlimited and uninhabited, to take a chance, to say 'Maybe it can be done...' and then proceed to do it."

Halligan was forced to reassess his enthusiasm in the 1950's when Hallicrafters found itself losing out amid the cut-throat competition of the consumer market. He decided to return the company to its roots and concentrate on serving hams, the military and other serious shortwave communications customers, including those in the emerging aerospace industry. A 1953 Chicago Tribune article said of Halligan: "Because of his prominence in the industry, he is sometimes referred to as 'Wireless Willie' or 'Radio's Number One Ham.'"

In the mid-1950s, Halligan struck a short-lived deal to sell Hallicrafters. He soon regained control of the company and continued at the helm for another 10 years. Hallicrafters was sold to Northrop Corp. in 1966. The company stumbled along for almost another decade. Then the once-proud Hallicrafters name became mired in a confusing series of transactions, and finally disappeared from the marketplace altogether in the early 1980s.

In keeping with his founding philosophy, Halligan's legacy includes a number of innovations that debuted commercially in Hallicrafters ham gear: first communications receiver to employ metal tubes and iron-core IF transformers (SX-9 in 1936), first dual-diversity receiver (DD-1 in 1937), first SSB receiver (SX-88 in 1954) and first selectable-sideband receiver (SX-96 in 1955), the calibrated S-meter, automatic noise-limiter, tee-notch filter, digital electronic keyer, etc. Under Halligan's leadership, Hallicrafters also led early development of compact, transistorized transceivers with its startlingly farsighted FPM-200 in the late 1950s – only to be overtaken by other manufacturers who perfected and mass-produced similar units in the 1960s.

In all, Hallicrafters marketed well over 100 different models of ham-oriented receivers, some three dozen transmitters and amplifiers and a score of transceivers. Many of the rigs remain in use today or are being rediscovered and restored. Collectively, they earned William J. Halligan a special spot in the hearts of vintage shortwave communications gear enthusiasts everywhere.

Halligan is survived by two sons, William Jr. and Jack; 10 grandchildren and 12 great-grandchildren. **ER**

Mike O'Brien, NØNLQ

REFERENCES: "He Makes What We Hams Use," QST, February, 1954; "The Hallicrafters Story" by William I. Orr, Ham Radio, November, 1979, "Interview with William J. Halligan" by Theodore J. Cohen, CQ, August, 1984; Communications Receivers by Raymond S. Moore; The Hallicrafters Story by Max De Henseler; The Hallicrafters Company by Chuck Dachis; The Chicago Tribune and The Chicago Sun-Times, July 23, 1992.

WRL Duo-Bander from page 9

lution it takes a steady hand to tune in a SSB signal. I think most hams would have been willing to pay for a headphone jack but there should have been a hole for one on the rear of the chassis in any case.

Two low cost improvements should have been provided. ALC would have allowed replacing the front panel mic gain control (and knob) with a 25 cent screwdriver adjust PC board unit with savings which would just about have paid for the other parts. The result would have been a nice new feature and even simpler operation. Approximate temperature compensation of the VFO would have required only replacing an NPO ceramic with the same value having an N080 characteristic: could this have cost even a nickel?

These shortcomings, however, are a mixture of the tolerable and the compromises unavoidable in a no frills design -- mentioning them is hardly more than whining. Look at the important things: the receiver sounds great and is plenty selective and sensitive; on transmit there's ample power for a set in this class and you get good audio reports. The features I really want -- an 'S' meter, loudspeaker and first rate AVC -- are provided. The set is light, compact, sturdy and reasonably attractive. With so few controls it's a cinch to operate -- a big advantage in a mobile installation.

Overall, the WRL Duo- Bander II is a fine piece of work. Though its technology was outdated, a quality two band home/mobile rig and power supply for $300 was an unbeatable value. Considering the problems of receiver design with the transistors of the 60's, I'd be more confident of working a 'weak one' with the Duo-Bander than with an up-to-date set of the time.

I can't help wondering if today's Yaesu, Icom and Ten-Tec world offers anything to equal the Duo-Bander. With our economy in a funk, the market for a solid no-frills design at a rock bottom price might be a lot better today than it was in 1969. **ER**

SE Station To Commemorate Anniversary Of The Invention Of Regenerative Receiver

The Will County Amateur Radio League (WCARL) of Illinois has organized a special event station to commemorate the 80th anniversary of the invention of the regenerative receiver by Edwin Howard Armstrong. The station will be operating on 7.138 plus or minus QRM from 1200Z, Sunday, Sept. 6 to 1700Z, Sept. 13. The first five people who make contact with WCARL's regenerative receiver station (W9OFR/RR) will be awarded the book, "The Legacies of Edwin Howard Armstrong"; all others will receive a certificate.

Frank W. Rasmusson, KA9VPH, will be operating the station using a homebrew regenerative receiver. Others in the club will be operating other stations on SSB and CW as part of the special event using the call W9OFR/SE/SSB/CW. The SSB frequencies are 28.400, 14.255, 7.200 and 3.900 Mhz (plus or minus QRM). The CW frequencies are 14.055, 7.060 and 3.690 (plus or minus QRM). Certificates will be sent to all contacts. The QSL manager for the event is Lawrence G. Wolfe, N9MWV, 1205 Agnes Ave., Joliet, IL 60435. **ER**

CLASSIFIEDS

Advertising Information

Subscribers receive 1 free - 25 word- ad per month. **Extra words are .15.** Here's how to count the words in your ad: the heading - For Sale, Wanted, etc count as **1 word**. Your name, call, address and telephone number count as **6 words**. Hyphenated words count as **2 words. Please count the words in your ad and if you're over 25 words send payment for the extra words.**

Non-subscribers: $3 minimum for each ad (up to 20 words). Each additional word is .20. **Please call or write for display rates.**

VINTAGE EQUIPMENT ONLY

ER
P.O. Box 57
Hesperus, CO 81326 **Phone/FAX 303-247-4935**

DEADLINE FOR THE SEPT. ISSUE: SEPT. 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: Military tech manual listings, largest stock in the world, over 50k - $5 refundable with first order. SASE for inquiries. Lee Frank, POB 10776, Harrisburg, PA 17105-0776.

WANTED: Original US military radio technical manuals, vintage 1942-1960. Glanzmann, Impasse 22Bis Ave.,Gros-Malhon, 35000, Rennes, France.

FOR SALE: National NC-173 rcvr, w/matching spkr - $150; Johnson Viking II X-meter - $150; Johnson mic - $30; Johnson low-pass filter - $25. Ray Murray, WA2UJU, 585 North Star, East Aurora, NY 14052. (716) 652-8178

WANTED: E.F. Johnson SWR coupler 250-37 and TR switch 250-39. Also looking for a chrome vibroplex bug. Jeff, W7ID, (208) 323-9267

WANTED: GE YRS-1 SSB adaptor and Millen 60456 IF xfmr. Joe Reda, KC6TXU, 380 Dunster Dr., Campbell, CA 95008. (408) 374-7645

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: Hallicrafters HT-18, good cond. - BO. **WANTED:** Radiotron Designer's Handbook by RCA. Steve Miller, WA3JJT, 909 Walnut St., Erie, PA 16502. (814) 454-5285 (w), 454-8990 (h)

WANTED: Hytron HY6L6GX or Taylor T-21 tubes. Have cash and parts to trade. Bob Mattson, KC2LK, 10 Jane Wood Rd., Highland, NY 12528. (914) 691-6247

FOR SALE: WRL Globe Chief 90A, CW/AM xmtr, w/schematic, very clean - $75; Heath HR-10B hamband rcvr, w/manual, like new - $75; Johnson Viking Matchbox, 275 watt, very nice - $75. Chick Dressell, W3BPZ, 1039 N. 21st St., Allentown, PA 18104. (215) 437-1608

WANTED: Any bug with sheet-metal base and frame. Also early Mac-Key with brass nameplate. Tom French, W1IMQ, "The McElroy Collector", 120 Great Road, Maynard, MA 01754. (508) 897-2226

CLASSIFIEDS

FOR SALE: SX-101 and HT-37 - $185 for pair; Hickock Cardomatic 123R tube tester - $45; National NC-98 GC rcvr - $100; Knight R-100-A rcvr, w/spkr - $55; TV2-B/U tester - $45; Eico model 753 xmtr, less ps - $50. **WANTED:** Swan 1011, model 508 external vfo, model 14A DC converter, VX2 VOX; Siltronix 1011, FD 1011A counter; other Siltronix accessories. Larry Cozzi, Rt 1, Box 60, Solon Springs, WI 54873. (715) 378-2845

FOR SALE: Used technical books - radio, electronics, military, test equipment, catalogs, etc. List- $1 (stamps ok). Softwave, Dept. ER, 1515 Sashabaw, Ortonville, MI 48462

FOR SALE: National NCX-5 w/NCX-A ps/spkr, VX-501 external vfo and manual - $250 plus shpg. Mark Waldman, WB2JNW, 12 Hidden Meadow, Penfield, NY 14526. (716) 377-3843 eves 6-10 PM EDT

WANTED: HRO-60 coils type G/J/AA/AB and pre-1950 ARRL Handbooks. B. Nadel, Box 29303, San Francisco, CA 94129. (415) 346-3825

FOR SALE: Hallicrafters HT-32B, near mint cond., w/orig. manual - $200 pick up; Drake C4 station control - $125. Dan Radcliffe, KF9BP, 8201 Plainview Pkwy, Sussex, WI 53089. (414) 255-9165

FOR SALE: R-390A meters - $30 per pair; other parts available. Pat Keogh, WB9GKZ, (414) 434-9016

FOR SALE: Lafayette radio operating and service manuals, schematics etc. If I don't have it,they never printed it. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. (908) 238-8964

WANTED: Old books; magazines; Handbooks; White's Radio Log; first callbooks; old writings on early radio; issues of "Radio Magazine"; De Forest stock certificates; pictures of De Forest, Armstrong and Marconi. Call, write or FAX. Please do not throw them away. I pay shpg. Call, write or fax. Donald R. Boland, N1FYX, 28 Faulkner St., Malden, MA 02148. (617) 324-5362, FAX 322-8412

WANTED: Need osc. and final plate coils for Hallicrafters HT-6. If you won't part with yours I would appreciate construction data so I can restore this classic. Also need a junker unit. Thanks. R. Haworth, W2PUA, 112 Tilford Rd., Somerdale, NJ 08083. (609) 783-4175

FOR SALE: Johnson Valiant, broadcast quality audio, spotless like new, no scratch condition - $350. Will consider trade for equal condition SX-115, SX-117. Don, K9TWO, Indianapolis, IN 46237. (317) 788-4337 or 241-1010 (w)

FOR SALE: National NC-300 - $150; XCU-300 xtal cal. - $25; HQ-129X, w/manual - $95; GSB-100 - $150; DX-60 - $65; 75A-3 Mcs dial - $35. Bill Jenkins, WA5MWJ, 11916 Donahoe Bend, Fort Smith, AR 72916. (501) 646-3859

CLASSIFIEDS

WANTED: Manual for HP600B; 3TF7 tubes; meters for R390A; TEK 465 or 475 scope, must be in very good cond. Clark Hatch, WØBT, 2546 SE Peck Rd., Topeka, KS 66605. (913) 235-2721

WANTED: Buy and sell all types of electron tubes. Harold Bramstedt, C&N Electronics, 6104 Egg Lake Rd., Hugo, MN 55038. (800) 421-9397, (612) 429-9397, FAX (612)-429-0292

FOR SALE: Johnson Matchbox, 275 watt w/ meter and coupler - $90; Johnson Speedex bug model 114-520 - $25; Lafayette HA-460 6-meter xcvr - $25; (2) Taylor TZ-40's - $20 for both; Heath HD-19, hybrid patch, - $20; Heath HW-16 CW xcvr, xtals and book - $50. All plus shpg. Richard Lucchesi, WA2RQY, 941 N. Park Ave., N. Massapequa, NY 11758. (516) 798-1230

FOR SALE: SAMS for hams. Photofacts of vintage ham gear. We also buy used SAMS. A.G. Tannenbaum, WA2BTB, POB 110, East Rockaway, NY 11518. (516) 887-0057

WANTED: Ampex PR-2230 Instrumentation Magnetic Tape Recorder/Reproducer. Complete or parts units. Prefer machine for 1" tape with 1-7/8 to 120 IPS tape speed but may take 15/16 to 60 IPS and/or 1/2" tape. Condition or presence of heads or signal processing electronics not important. Premium price paid for NOS machine. These units were used in many military hospitals and may turn up in areas around them. **FOR SALE:** Dynamotor DY-17/ART-13, PE-94-C - $45; Control Box C-87/ART-13 - $27.50. All NOSB. Also **WANTED:** Mounts FT-185, FT-253, Dynamotors DM-41, DM-43, DY-96/VRC, DY-142/VRC, PE-103, PE-135; Tube 307A/VT-225; Generators GN-45, GN-57; Cord CD-501; Vibrators VS-3, VB-5, 500C. Robert W. Downs, WA5CAB, 2027 Mapleton, Houston, TX 77043. (713) 467-5614

FOR SALE: Harvey-Wells TBS-50 - $50; Johnson Ranger, as-is - $75; National NC-57 - $45; Heath Two'er - $25; Collins 75S-1, as-is - $150. Jack, WA2HWJ, (201) 927-7784

Prater's Mill Swapfest: Saturday, Sept. 12, just north of Dalton, Ga. Don't miss this one. Last year there was a big turn out of AM'ers.

ELECTRON TUBES FREE 1992 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: Western Electric AM xmtr, audio equipment, mics, loudspkrs, catalogs, etc. Ron Steinberg, K9IKZ, (800) 279-8324 (w), (708) 773-3583 (h) or FAX (708) 773-0822

WANTED: Ranger I or II, must be in working cond. and w/manual. Al Gross, W8PAL, 12219 N. 112 Lane, Youngtown, AZ 85363. (602) 933-3499 or 814-6387

FOR SALE: ARR-41, w/dynamotor and copy of manual - $175; Drake UV-3 VHF/UHF tri-band FM xcvr, w/manual and all access. - $500 OBO. Steve Davis, KD2NX, 705 13th Ave., Belmar, NJ 07719. (908) 280-9760

WANTED: Excellent National NC-303 and spkr. Jim Geer, WB5LXZ, 604 King Dr., Bedford, TX 76022. (817) 268-1985

WANTED: Manual for Lysco 600S. Will reimburse all expences. Marc Kulbacki, BE3GIX, 2434 Alexandra Ave, Windsor, Ont. N9E 2J3. Canada (519) 969-5620

FOR SALE: Drake R-4B w/manual and PS-4 - $450; SPR-4 w/manual - $200. Levy, 8 Waterloo, Morris Plains, NJ 07950.

FOR SALE: Hallicrafters WR-400, good, plays - $40; Dyna Quik model 550 tube tester chart and book - $7.50 shpg. included. Ed Turner, KB8MPR, 730 East Martin St., East Palestine, OH 44413.

FOR SALE: R-390A; tubes - 837s, 836s, 816s and 4-125As. **WANTED:** NCX-5 and 51J4. Russ Hunt, W9HZD, 2242-C Via Puerta, Laguna Hills, CA 92653. (714) 859-6428

CLASSIFIEDS

WANTED: Globe King series; homebrew 1500 W tube tx; broadcast tx's; two-buttons mic. Donald R. Boland, N1FYX, 28 Faulkner St., Malden, MA 02148. (617) 324-5362, FAX 322-8412

FOR SALE: CS-137 crystal carrying case (1945) includes 40 FT-243 type xtals, holds 120 xtals, excell.; J-47 key (1951), mint; BC-348 switchbox (1944) excell.; T-17 carbon mic, coiled cord, PL-68, good; National Radio Institute Basic Electronics Course (1976), 9 volumes, 8-1/2 x 11 format, mint. Best offer on each. Bob Lemanek, K8HVG, 14565 Garfield, Allen Park, MI 48101-2115

FOR SALE: AF-67 - $35; Drake 34PNB - $85; Johnson 6N2 converter - $25; 803 tubes NIB - $10; T-177 tube tester - $45; Silver #904 cap-res bridge - $35; B&W 550A coax switch NIB - $15; BC-AR-430 xmtr w/NIB coils - $50; BC-AR-408 ant. relay - $10; BD-AR-93 dynamotor unit - $45; PE-103 in original wood crate - $95; FT-161 mount - $5; FT-100 mount - $10; BC-357 rcvr NIB - $15. Joe Sloss, K7MKS, (206) 747-5349

WANTED: ARRL Handbooks - 1st, 5th, 6th, 8th, 16th editions. **FOR SALE:** ARRL Handbooks, 1927 to date; many other books, LSASE for list; Hallicrafters S-38A-B-C-D-E's - $50shpg included; KWM-2 filter F455A2.1. Parting: BC-610, B&W 5100 & SSB, HT-40, S-40, S-38's, NC-33. Bob Schafer, WA7IHN, POB442, Aumsville, OR 97325. (503) 749-1149 eves.

FOR SALE: Hammarlund HQ-170 - $150; Gates M5700 program amplifier and M5702 power supply - $50; BW RF clipper for Heath SB series - $50; Drake T-4XC and AC-4 - $240. **WANTED:** HRO-60 coils. Jim Jorgensen, K9RJ, 1709 Oxnard, Downers Grove, IL 60516. (708) 852-4704

CLASSIFIEDS

Western Heritage Museum Omaha, Nebraska
"a magnificent home for your equipment"

Leo Meyerson, WØGFQ, (founder of WRL) in concert with QCWA, needs donations of gear and related materials for the amateur radio exhibit at Western Heritage Museum in Omaha, Nebr.

This permanent display is the only one of its kind in the country and is something that all hams can be proud of. We expect 50,000 visitors annually.

Your tax deductible donation will be permanently noted on a plaque that will be prominently displayed.

For more information contact Leo at (402) 392-1708 , May-Nov., (619) 321-1138, Nov.-May.

FOR SALE: URC-32 linear plate supplies, 2000 V@750 mA and a 600 V screen supply, Collins, excell. cond. - $175 each, plus shpg. Jack Strater, WB7EOB, 17234 NE 16th Pl., Bellevue, WA 98008. (206) 747-5354

WANTED: National HRO-7 coils "E" (900 kc to 2050 kc) and "F" (480 kc to 960 kc) for my personal rcvr; manual for National HRO-STA1 rcvr, will pay fair price plus shpg; Heath HG-10B vfo in excell. cond. Chick Dressell, W3BPZ, 1039 N. 21st, Allentown, PA 18104. (215) 437-1608

WANTED: Books on the history of the General Radio Company. Also want early wireless items and old radio books. Frank R. White, KBØTC, POB 3283, Olathe, KS 66063.

FOR SALE or TRADE: Hallicrafters: SX-117, HT-44, PS-150, HT-32A, S20R, Heath DX-100. Ray, 4521 Whitfield Ln., St. Louis, MO 63134-3821. (314) 428-1963

FOR SALE: Collins 233D xmtr, 20-20 Mhz, 450 TLs mod. by 450 TLs, w/manual - $2000 OBO, PU only. **FREE:** RTTY equipment, machines and accessories, PU only. Vern Dawson, K6RRC, (916) 451-2324 (Sacramento area).

WANTED: Clean, unaltered and operational Collins 310B-1, RME-69, RME-99, w/manuals. Martin O. Piepenburg, W9OLD, RR 1, Box 56B, Monterey, IN 46960. (219) 542-2591

FOR SALE: R-441A/SRR-13 (as described in ER#27) - $100; E.H. Scott Allwave 12 w/cabinet, all coils, spare tubes - $500, PU only. John Atwood, WA1ICI, POB 59102, San Jose, CA 95159. (408) 985-2768

WANTED: E.F. Johnson milliammeter; Electrovoice 664 mic; Help lowering sidetone/frequency offset on KWM2; Collins vernier dial. Brian Roberts, K9VKY, 3068 Evergreen Rd., Pittsburgh, PA 15237. (412) 931-4646

FOR SALE: Central Electronics 20A - $20; BC-459A - $15; BC-696A - $15; 6336A tubes, used - $10 each. All items plus shpg. Mike, N8CLZ, 4505 Sobieski, Detroit, MI 48212. (313) 891-5229

FOR TRADE: Willing to trade HRO coils A, B, C, or D to obtain E, F, or G coils. Dennis Gibbs, 3863 Beech Down Dr., Chantilly, VA 22021. (703) 631-8539

WANTED: Mount (PP-3702/ARC-102) or connector for 618-T3, C-3940/ARC-94 control box and connector. Steve Rohrer, KA4RSZ, 303 Melrose Ave., Decatur, GA 30030. (404) 378-1366

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

CLASSIFIEDS

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

FOR SALE: Collins model TDO autotune xmtr, 2-18 Mhz but will also cover 160 meters, 813's modulated by 805's. Mark, AF1Z, (508) 548-7265

FOR SALE: RAL-7 rcvr, .3-24 Mcs, working, w/manual - $50. PU only. **WANTED:** The ant. plug-in module for SRR-11/FRR-21; manual for the AN/UGC-74A(V)3 field teletype. Nick Oliviero, 14150 Oro Grande St., Sylmar, CA 91342. (818) 367-5000

FOR SALE: Elmac AF-67 (beautiful) - $85; Globe Scout 680A & 755A vfo (gorgeous), both work FB - $125. Manuals for all. **WANTED:** Modulation xfmr for Ranger I. Bernie Doermann, WA6HDY, (805) 481-6558

WANTED: Mint or near mint SX-115; SX-101A; SX-100; HT-32B; HT-37; Drake 2C; Johnson 122 vfo; Knight R-100; Mosely CM-1. All must be mint or near mint. Mike, KC8CU (207) 525-4421

FOR SALE: New Collins parts: 30L-1 blower motors - $35; 51S-1 PTO osc., 70K-7, P/N 522-2918-000 - $200; silver plated 30S-1 tank coils - $7. Dennis Brothers, WAØCBK, HC 84, Box 1, Potter, NE 69156. (308) 879-4552

WANTED: Lafayette or WRL Q-multiplier; WRL CW-7 xmtr; Ameco ps for my TX-86 xmtr. Gary Wagner, K3OMI, 11124 Oak Hollow Rd., Knoxville, TN 37932. (615) 690-4217 M-F days

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FOR SALE: Heathkit SA-2060A deluxe antenna tuner, still in kit - $250; Heathkit HA-10 Warrior linear amplifier - $250; SX-25 - $75; RME VHF-152A - $15; BC-459A - $15; Tektronix 545 with 1A2 - $55; new tubes - 4-125A/4D21 - $65, 4X150A - $45, 4CX250F - $45, 35T - $50, 6080 - $6, 27 - $3.50, 30 - $4, 42 - $11, 2A3 - $22; used, good tubes - 813 - $14; 807 - $4; 45 - $14; 2A3 - $12. Lots more tubes - write. **WANTED:** Schematic for Johnson Viking Challenger, or will sell as-is - $50. G. Stevens, WØATA, POB 704, Longmont, CO 80502-0704. (303) 776-9036

FOR SALE: Ratheon 4D32 tubes, new/unused, for Collins 32V xmtrs - $79 shpd. Tom Smith, N5AMA, 13034 Elmington Dr., Cypress, TX 77429-2062

CLASSIFIEDS

WANTED

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: 325-1 - $300; B&W 5100 w/SSB adaptor - $275; DX-60 - $65. **WANTED:** Ameco AC-1. Cliff Fleury, AI7Y, 64174 Tumalo Rim Dr., Bend, OR 97701. (503) 382-9162

WANTED: Cabinet for 32V-3; Millen 37001 connectors. Lloyd Cabral, AA6T, POB 970, Aptos, CA 95001. (408) 722-4349

FOR SALE: AN/PDR-27F radiation detector w/all access. - $45; RT-556/APX-46 IFF radar - $40; more, list - $.75 (coins). **WANTED:** Collins literature. J. Orgnero, VE6RST, Box 32, Site 7, SS 1, Calgary, AB T2M 4N3. Canada (403) 239-0489

WANTED: Shure 51 or 55 microphone. Terry Knapp, KC7ZD, 1937 Valley Dr., Las Vegas, NV 89108.

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

WANTED: "Broadcast News"(RCA), "Pick Ups" (W.E.), other broadcast literature and catalogs of the '30's - '50's. Sam Thompson, W6HDU, 1031 San Antonio Ave., Alameda, CA 94501. (510) 521-1429

WANTED: SW xtals for Drake R-4B; books on hollow-state radio design/servicing. Alan Johnson, N4LUS, 6001 Goldsboro Rd., Bethesda, MD. (301) 229-7069

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: Original or photocopy of Heath DX-35 manual. Will pay postage and copy costs. Pete Hamersma, WB2JWU, 87 Philip Ave., Elmwood Park, NJ 07407.

FOR SALE: Collins 75A-3, very clean, works fine - $250; Henry 2K console linear, very clean - $695, PU only. Jack Elvis, K6EVY, (714) 969-1147

WANTED: Heath 5-tube superhet, FM-AM broadcast radio w/manual. Richard Allen, 361 E. Pinehurst, CA 90631. (310) 694-5027 eves.

FOR SALE: BC-610F, price reduced. Chuck Graves, KØRFQ, 641 N. Oak Grove, Springfield, MO 65802. (417) 863-7415

TRADE: Collins 310C-1 and/or HRO-500 for quality AM xmtr. John, WB5OAU, (505) 821-4239 or callbook adr.

WANTED: I will trade a BC-222, a TBY and a No. 19 Mk II for a BC-191. Ted Bracco, Quincy College, 1800 College Ave., Quincy, IL 62301. (314) 228-5213

FOR SALE: Johnson Valient II, factory wired - $395; SP-600JX-17, orig. cabinet - $350; Collins 390A w/cabinet, perfect & clean - $350. Bud, W7TYG, (208) 466-2803, after 8:00 PM MDT

FOR SALE: Transmitting/Receiving tubes, new and used. LSASE for list. 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

ELECTRIC RADIO PARTS UNIT DIRECTORY

At this point the directory has over 200 units in it. If you need a part for a vintage restoration send $2 and an SASE (.52 postage) for the list. If you have a parts unit, consider putting it on the list. Your dead unit can help bring others to life!

CLASSIFIEDS

WANTED: Machine shop work. Knobs shafts bushings, etc. made to your sample or drawing. Reasonable. Jim Dill, Box 5044, Greeley, CO 80631. (303) 353-8561 evenings.

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

WANTED: Pre-WW II HRO rcvrs and Collins xmtrs such as 45A, 32C, etc. Bob, KD9B, 1025 North Vine St., West Lafayette, IN 47906. (317) 743-4053

FOR SALE: Want to share hard to get radio equipment, parts, tubes, etc. Cdr. Glenn W. Richey, USN Ret., W7SAB, 219 Naval Ave., Bremerton, WA 98310. (206) 373-9631

FOR SALE: KWT-6/URC-32 manuals, truck load of related spares - $600; Valiant; R-390A; 51J4; HX-500; SX-99; CE-20A; 32S1 p/s; 75S1. **WANTED:** F 500 Z4 LSB filter. McDermott, WØBVA, Box 121, Scammon, KS 66773. (316) 479-2756

WANTED: Ranger II or similar AM xmtr in original condition. Write conditions. Stan Tajima, KD2HB/JA1DNQ, c/o Shinagawa, 21555 Sterling Dr., El Toro, CA 92630.

FOR SALE: 75A-4 w/spkr and 3 filters, SN 5484; 30S-1, new final and new spare; Johnson Ranger; Globe Champion 300; TBS-50 w/ps and vfo; TBS-50 w/ps; BTI linear w/spare final; RME 4350 rcvr w/spkr. All very clean. W7MXM, (208) 522-5854

WANTED: Tuning units for ATD WW II xmtr; control box for ATD; also R-1444/UR rcvr. Leroy E. Sparks, W6SYC, 924 W. McFadden Ave., Santa Ana, CA 92707. (714) 540-8123

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

FOR SALE: Eico 950B capacitance/resistor bridge, very nice - $25 + $5 shpg; Heathkit VT-1 vibrator tester - $20 + $5 shpg; Century in-circuit condenser tester - $20 + $4 shpg; United TV Labs VOM, as is, - $10 + $4 shpg; restored Solar CB cap/res bridge - $30 + $5 shpg; many rebuilt and new audio xfmrs - $10 to $15 plus $3 per order shpg, list available for SASE. **WANTED:** Clinton or Universal battery radios in any condition. James Fred, R 1, Box 41, Cutler, IN 46920. (317) 268-2214

WANTED: Hallicrafters SX-42 and SX-101A. Must be mint to near mint condition; main tuning or bandspread tuning knob for SX-100. John B. Keil, 4618 Norwalk St., Union City, CA 94587. (510) 471-4838

FOR SALE: National NCX-3 w/ps, spkr, manual; McMurdo Silver wavemeter w/coils; manuals - HQ-129X, SX-71. **WANTED:** Collins 75A-1; calibrator for 75A2/3; Hallicrafters SX-42 manual. Carter Elliott, WD4AYS, 1460 Pinedale Rd., Charlottesville, VA 22901. (804) 980-7698 (d) 979-7383 (n)

Please remember to count the words in your ad. If you are over 25 words, please send 15 cents for each extra word.

CLASSIFIEDS

WANTED: Hallicrafters SX-73 and SX-88 in near mint or excellent cond. I will pay premium Doe-Ray-Me for these rcvrs. And I'll pick up within 250 miles of my QTH. Bob Bell, 89 Ridgehill Dr., Toronto, Ont. M6C 2J7. Canada (416) 783-3288

FOR SALE: R-390, operational - $200; HP 606A - $175; HP 330D - $40; URM-25F - $85; URM-25J, recond., like new - $120; USM-207 counter, 600 Mhz - $150; HP 5243L - $50; HP 5245M - $150; HP 212A - $75; HP 214A - $75; HP 416A - $50; HP 416B - $65; TS-382 - $40; HP 233 - $40; Lge military weather balloons - $10; giant mil. discone antenna, 28 Mhz up - $100; lge roller inductor - $35; AN/PSM-13 battery test sets - $10; scrapping mil. spec. tube type test gear, no lists, write wants; used/tested pull-out tubes, no lists, write wants; some R-390A parts, write wants; antique heavy brass terminal posts - $1 ea.; heavy duty, 4-gang, air variable capacitors - $12.50 ea.; Hickok 752 tube tester, mint, like new w/accessories - $125. U ship all. Joe Bunyard, 1601 Lexington, Waco, TX 76711-1701. (817) 753-1605

FOR SALE or TRADE: Hallicrafters S38E, SX-100, HT-20; Bud W78; National NBS1, NC-173R, NC-2-40C; Gonset G-63; CEMM2; Jackson 648 tube tester; Eico 753/WSS vfo; Atlas 180; BC-969, 1.5 kcs - 150 kcs; Heath VF-1; Collins 455 kcs 526-9365-031. Will be at Greys Lake. Bruce Walther, W9QAH, (715) 344-9099

FOR SALE: Complete electronics suite from decommisioned U.S. Navy aircraft carrier. 1960's vintage equipment. Collins URC32A (500 W HF xcvr); Westinghouse WRT-1s and 2s (1 KW multimode xmtr); Collins R390A rcvrs; Magnavox WRR3A rcvrs; radar sets; ant. couplers; teletypes etc. Call for details. Bob Mantell, W6VQT, 3135 N. Ellington Dr., Los Angeles, CA 90068. (213) 851-2786

FOR SALE: 4-65A w/socket - $20; 4-250 socket - $9; 4-250s, used - $25; 4X250Bs, new - $30; 4X150As - $30; 807s - $3; 6Y6s - $2.50; 866s w/ socket - $9; 810 sockets - $10; Eimac RX-21A rectifiers - $17; Collins 500 mA, meter, 2-1/8" - $10; Simpson multi-scale - $10; others - call; 5 V, 14.5 amp fil. xfmr - $15; 5V, 20 amp - $20; isolation xfmr, 1-1/2 KVA - $60; WE autoformer 90-230V, 8 taps - $45; R-175A choke - $12; coax relay, 28V DC coil - $15; Electro-Voice 630 mic, new - $65; Jennings Vac Var. 9 to 302 - $75; B&W 850 - $85; mica Sangamos, 2500 volt, variety. Large quantity of HV caps and other parts for builders. Call. Joe, W6CAS, (916) 731-8261

CLASSIFIEDS

WANTED: A few 'missing pieces' of that great old military gear: DM-43 or Dy-96 dynamotor (24 volts, for BC-653 xmtr); CRR-21748 dynamotor for the ATD; MAR xcvr complete or just good case and covers; CRC-7 emergency xcvr; tuning units range 'D' and 'F' for the GP-7; GRC-106 freq. standard module; CAY-20084 rectifier/modululator for Navy model TBW xmtr; set of xtals for the PRT-4 and PRR-9; URC-68, PRC-90 and PRC-63 survival xcvrs; MAY xcvr; junker R-442/VRC rcvr or just a good front panel for one; BC-923 rcvr; 61851 xcvr; accessories for URC-87(V) (Southcom SC-130 'Patrolfone') xcvr - battery box, whip antenna; dynamotor DM-21 for BC-312 rcvr; manual for CPRC-26(Canadian) xcvr; ARC-33 aircraft xcvr; dynamotor for RAX rcvr (this has 3 pins that stick out on the bottom. Whew. Thanks for taking the trouble to read all this. Walt Hutchens, KJ4KV, 3123 N. Military Rd., Arlington, VA 22207. (703) 524-9794

FOR SALE: Military R-1051 B HF rcvr, fully operational, w/docs - $495. Ken McArtney, N2BAU, 194 Royal Parkway W., Williamsville, NY 14221. (716) 634-9533

WANTED: ARC-5 equipment, R-24 rcvr, MT-5 and MT-70 mounting bases, C-27 control box. James Owens, NWØO, 1363 Tipperary St., Boulder, CO 80303. (303) 673-9019

FOR SALE or TRADE: SX-24, good for parts. WANTED: SX-25, SX-28 and a HRO. Vin Tese, WA2UXO, 430 W. 34th St., #12E, NYC, NY 10001. (212) 563-5021

TRADE: Nice Kennedy 110 for Harvey Radio Labs xmtr FT-30, see "Flick-o-Switch" page 257 or Big Cash Paid. Robert Enemark, Box 1607, Duxbury, MA 02331. (617) 934-5043

FOR SALE: Multi-output Fluke 407 lab grade power supply. Very handy for troubleshooting tube equipment. Has regulated 0-555 volt/300 mA, 0-25 volt bias and two 6.3V/5A outputs - $60. UPSable. Joe Bucher, KF9EU, Rt 2, Box 321, Bloomfield, IN 47424. (812) 384-3362

WANTED: Globe V-10 (VFO). Write or call with your price. Blaine Puterbaugh, WB8SSO, 8732 Secor Rd., Lambertville, MI 48144. (313) 847-3367

Transformers
For Vintage Equipment
We rebuild transformers for all equipment. Please call for information. Max Kunz, Top Tech Inc., 10811 Fairbanks, North Houston Rd., Houston, TX 77086. (713) 440-9909

WANTED: 6L6GX or HY6L6GTX tubes. Have cash, manuals and parts to trade. Bob Mattson, KC2LK, 10 Jane Wood Rd., Highland, NY 12528. (914) 691-6247

FOR SALE: Collins 32V-3, GC - $300; Boonton 91DA RF-Voltmeter, GC - $95; Clegg Intercepter, needs work - BO; Johnson KW Matchbox w/ directional coupler, GC - $150; Collins R-388, GC - $150; 2 tower base insulators, unused - BO; 17 sections of 55G Rohn tower including tapered base section - $BO; HP 200CD audio gen., GC - $40; Bird 6154 Termaline wattmeter, need oil seal, works OK otherwise - BO; HP 5245L freq. counter w/5254B and 5253B plug-ins, plug-ins need repair, w/manuals - BO; Thordarson plate xfmr, 7000 VCT @ 750 mA, w/(2) 750 mA chokes, all non oil - BO; Collins VHF VOR xmtr - BO; R-390, needs work - BO; (3) 6 ft. rack cabinets - BO; (3) 5 ft. modular racks - BO; HP 606A RF gen. w/manual - $100; HP 608D and URM 25 RF gen. - BO. Bill Harrower, Rt 1, Box 47, Ulman, MO 65047. (314) 369-2781 eves & wknds

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WANTED: Manual, photo copy or any other information for a Nems-Clark model 200-2 panoramic adaptor. Bill Springer, K5CGR, 923 Nelda, Houston, TX 77088.

WANTED: Connectors, control box and modulator for Bendix TA-12 series xmtr; connectors, tuning shaft, shock mount and control box for Bendix RA-10 DA rcvr. **FOR SALE or TRADE:** (2) BC AN-229 TRF aircraft navigation rcvrs w/dual 201-399 kcs, 4150-7700 kcs coil units and partial manual. Sam Kelly, 12811 Owen St., Garden Grove, CA 92645. (714) 893-2092

WANTED: Knight-Kit rcvrs or xmtrs, esp. Span Masters and R100A. **FOR SALE or TRADE:** Instructograph and Hallicrafters S94. John Vercellino, WB9OVV, 6921 Springside Ave., Downers Grove, IL 60516-3114. (708) 964-3020

FOR SALE: Racal RA117E high-freq. communications rcvr, w/RA218 ISB/SSB adapter, all tube, on diecast chassis, 19" rack mounting, in good cond. - $600 (I pay shpg). **WANTED:** Racal radio equipment, including factory-made 19"rack and table-top cabinets. Nigel, KC4TLV, (404) 949-1097 (H), 994-3900 (W)

WANTED: Teletronics LA-2A compressor/limiter; National HRO. Vin Tese, WA2UXO, 430 W. 34th St., #12-E, NYC 10001. (212) 563-5021

WANTED: R-5 or R-5A ARN-7 radio compass rcvr and accessories. Mark Meltzer, 582 Valley St., San Francisco, CA 94131. (415) 826-3889

FOR SALE: (7) Simpson "300" series meters; (4) B&W xmtr coils; (20) Trumbell porc. knife switches; (10) 200 W resistors; (4) Stancor fil. xfmrs; (7) xmtr var. caps; (2) headphones; (6) panel meters; Hi-V fixed caps; various diodes and more. All - $240 plus UPS. Tom Waters, 3703 Bonview Ave., Baltimore, MD 21213. (410) 488-5356

WANTED: An antenna relay plug (P4) for a Valiant. Doug Beard, KFØVF, 604 7th St., N., Springville, IA 52336. (319) 854-6312

FOR SALE: VFOs: National 6N2 w/manual, Globe 6-2. Both internal pwr and excellent - $35 each, shpg xtra. Henry Mohr, 1005 Wyoming St., Allentown, PA 18103. (215) 435-3276

WANTED: Communications rcvrs - TMC GPR-90/92; I.T.T. Mackay Marine 3010-B; Recal 6117; Eddystone. Ron, KC6WTG, POB 783, Santa Rosa, CA 95402. (707) 539-8319

WANTED: Units or modules - PRC-47, PRC-74 esp. PA, 618T, KWT-6, ARR-41, R-1051B. Byron, WA5THJ, 1920 Maxwell, Alvin, TX 77511. (713) 331-2854

WANTED: Clean Drake equipment - 2B, 2C, R-4B, T-4XB, acc for any of these. Byron, WA5THJ, 1920 Maxwell, Alvin, TX 77511. (713) 331-2854

FOR SALE: KW-1 prototype - BO; 4D32 - $35; 30L-1 - $550; (2) R-392s, w/spkrs - $150 each; Drake 2C, w/2CQ, xtal cal. and NB - $175; DX-60B - $50; Eimac 4-1000 metal socket - $40; PM-2 - $100. Mike Palmer, K5FZ, 16707 Creeksouth, Houston, TX 77068. (713) 444-7737

WANTED: Mint WRL 755 vfo, w/book; also Globe King 500C. Doug Gordon, K6PUN, 2215-A Faraday Ave., Carlsbad, CA 92008. (619) 438-4420 days M-F

FOR SALE: Johnson Valiant, (2) Viking II xmtrs, Invader 2000 xmtr, Mobile vfo, 122 vfo; Swan 350 xcvr, (3) 117 x ps's, 500 xcvr, 510X ant. tuner, 175; Hallicrafters S-47 rcvr, (needs wk), SX-71 (rcvr) (needs wk), SX-42 rcvr, w/spkr, HT-37 xmtr, SX-111 rcvr, S-40 rcvr, (needs wk), Super Skyrider rcvr, (for parts); Drake TR-3 xcvr, w/spkr & ps, 2B rcvr, (2) RV3 remote vfos, TR4C xmtr, w/ps; Hammarlund HQ-129X rcvr, HQ-110 rcvr; Galaxy V xcvr, w/ps, spkr & manual; Heathkit HG-10 vfo, HW-32 xcvr, w/ps, 717 rcvr, HW-100 xcvr (parts); SBE-36 xcvr w/ps; WRL Globe Chief xmtr, Globe King 400 xmtr, with mod. and ps, Globe Chief 90A xmtr; National NC-300 rcvr (needs wk); Collins 32V-1 xmtr; BC-610 I xmtr; BC-614 speech amp; BC-939 ant. tuner; Bandmaster Z-Matcher; R-390 rcvr; Precision Electronics audio amp; Hickock tube tester (like new); Army surplus RTTY controller; HP 650A test osc.; Paco C-20 Res/Cap bridge; Triplett 650 VTVM; Shure 444 mic; shelves and boxes of old and current TV/radio tubes, NIB. Plus much, much more. Will ship those items within UPS limits, all else will be PU only. From the estate of Frank Wilson, W5KUO/Ø. For more information contact Russell B. Smith, W6ONK/Ø, POB 1954, Montrose, CO 81402-1954. (303) 249-5881

FREE: Teletype Model 19. Pick up only. Bill Albrant, K7JYE, 101 Acron Circle, Brea, CA 92621. (714) 529-7181

FOR SALE: Hammarlund SP-600JX-17, like new, w/manual - $350; SP-600JX-21, like new, w/manual - $1000. Plus shpg. Jack Dubbs, 44 Monk, Security, CO 80911. (719) 392-2043

WANTED: Manual or manual to copy for SB-33. Walt Hutchen, KJ4KV, 3123 N. Military Rd., Arlington, VA 22207. (703) 524-9794

WANTED: Collins 30FX, 30J-1, 30K-5 xmtrs; SC-101 console; 75A-3 rcvr. Gary, KE6MS, (310) 696-0177

FOR SALE or TRADE: B&K Model 1077B Television Analyst, exc. cond., w/manual and all cables. **WANTED:** Manual for B&W 500, Dyna-Quick tube tester. Barry, N6CSW/Ø, 4 Aspen Pl., Durango, CO 81301. (303) 247-4935

WANTED: Will pay $25 for your SX-62A front panel escutchen, in exc. cond.; SX-133 and also Knight-Kit table radios. Steve Saurer, WA9ASZ, Rt 3, Box 413, Bloomfield, IN 47424. (812) 863-2088

FOR SALE: Military portable radar PPS-4, complete set w/tripod - $500. **WANTED:** Early radar equipment, television cameras, pre-war oscilloscopes, CRTs and early electron microscopes. Allen Weiner, 14 Prospect Dr., Yonkers, NY 10705. (914) 423-6638

WANTED: ARRL Handbook editions #1, 4, 5, 6; CQ magazine for 1945 '46; manual for Navy GP-7 & ATD. Sheldon Wheaton, KCØCW, 14708 Murray Ln., Olathe, KS 66062.

WANTED: Hammarlund HQ-180A, HC-10, SB-10. John Berenyi, 2708 E Kays Creek Dr., Layton, UT 84040-7612. (801) 544-1905

WANTED: Someone who has parts and is willing to restore a MacKey for reasonable price. (missing dot paddle, some hardware, 1 weight etc.). Tom Schlechte, (813) 687-3721 after 5 EST

WANTED: Will pay top dollar for the following items: HT-5 speech amplifier, for the HT-4B xmtr; original HT-4B manual; HT-4B/BC-610 tuning unit TU-61 and C-454 coil unit, both for 1.5 to 2.0 Mhz; HT-4 air padder. Also need coils and plug assemblies for ART-13. Please call Barrie, KF7VA at (406) 549-1921 (eves and wknds), 728-7637 (wkdys). Write 125 Ben Hogan Dr., Missoula, MT 59803.

FOR SALE: Another "ultimate boatanchor", a Meissner 150B xmtr, w/type 02433 Meissner exciter unit, all coils 1.5-12.5 Mcs and manuals. In good wkg cond. - $150, PU only. Bob DeRosa, WA2VMO, 91 Robinson Ave., Statton Island, NY 10312. (718) 984-4170

FOR SALE: Working antique Hickok RF-AF generator - $65. **WANTED:** Sylvania 6JB6 tubes and working Ranger, preferably Ranger II. Rick, K8MLV/Ø, 1802 W. 17th St., Pueblo, CO 81003. (719) 543-2459

FOR SALE: Ameco TX-62 xmtr, good cond. - $35. **WANTED:** Squire-Sanders SS-1R spkr; information on SS-1T xmtr. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872-1818

FOR SALE: Collins 75S1, 32S1, 312B4, 516F2, all in nice cond., w/cables and manuals - $500; Heathkit SB-200 linear amp., new, never operated, w/manual - $350. Dick Houston, WØPK, 159 Sortais Rd., Durango, CO 81301. (303) 247-9159

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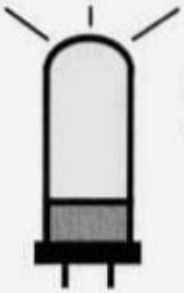

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