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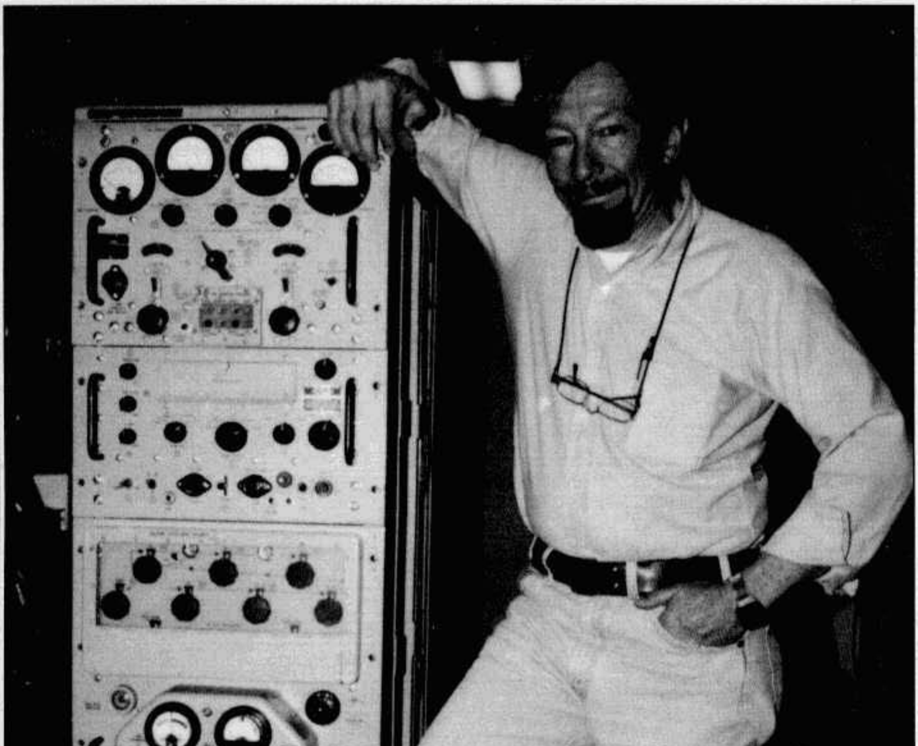
ELECTRIC RADIO

celebrating a bygone era

Number 94 February 1997



Dennis DuVall, WA3YXN

ELECTRIC RADIO

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Electric Radio is published primarily for those who appreciate vintage gear and those who are interested in the history of radio. It is hoped that the magazine will provide inspiration and encouragement to collectors, restorers and builders.

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

Regular contributors include:

Walt Hutchens, KJ4KV; Bill Kleronomos, KDØHG; Ray Osterwald, NØDMS; John Staples, W6BM; Dave Ishmael, WA6VVL; Jim Hanlon, W8KGI; Chuck Penson, WA7ZZE; Jim Musgrove, K5BZH; Dennis Petrich, KØEOO; Bob Dennison, W2HBE; Dale Gagnon, KW1I; Rob Brownstein, NS6V; Dick Houston, WØPK; Andy Howard, WA4KCY; Skip Green, K7YOO; George Maier, KU1R; Albert Roehm, W2OBJ; Steve Thomason, WB4IJN; Don Meadows, N6DM; Bob Sitterley, K7POF (photos) and others.

EDITOR'S COMMENTS

Lew McCoy, W1ICP, makes his first appearance in Electric Radio in this issue. I couldn't be more delighted and I'm sure most ER readers welcome his presence as well. We've all grown up reading his articles in QST and CQ and he's been a source of inspiration for us all. These days Lew still writes for CQ where he's Technical Editor and he's active in QCWA - he's Chairman of the Finance Committee now; he just recently completed his term as President. When he volunteered to write for ER I suggested that a monthly column called "Looking Back" where he would reminisce about his past, might be interesting to ER readers. He thought so too, so we've started it in this issue.

I'm also pleased to have an article in this issue by well-known Collins engineer, Warren Bruene, W5OLY. His article, "Designing the Collins 30K" will be remembered by ER readers for some time to come. This is a great article on a great transmitter.

This year's Electric Radio 160 Meter AM Contest/Jamboree was not as successful as it has been in past years. Most participants who sent in logs remarked on the awful conditions. Before next year I'm going to try to work out the details of having the contest run over a longer period of time. The winners this year are as follows: First place - David Smith, N2KSZ, 56 contacts, 32 with AMI numbers, total of 88 points; Second place - Dennis DuVall, WA3YXN, 51 contacts, 32 with AMI numbers, total of 83 points; Third place - Laurence Szendrei, NE1S, 23 contacts, 16 with AMI numbers, total of 39 points. Congratulations to the winners and thanks to all those who participated; particularly to all those who sent in logs. N6CSW

TABLE OF CONTENTS

Cover: Dennis DuVall, WA3YXN, with a rare old Navy transmitter from the '50's, the SRT-14. This transmitter, which Dennis has restored and put on-the-air, weighs 400 lbs, has a single 4-400 in the final (plate moduled by a pair of 807s), has a power output of 100 watts and operates between 300 kcs and 26 Mcs. Dennis will have an article on this rig in a future issue of ER. ***Photo by KW1I.***

Looking Back

by Lew McCoy, W1ICP
1500 Idaho St.
Silver City, NM 88061

When Barry asked me if I would consider doing a column in ER about some of my history in amateur radio--I more than agreed.

To me, it is fun to reminisce and in my case, and in Amateur Radio, certainly a heckuva lot has happened. What better place to talk about history than in Electric Radio.

Although I am 80 years old, and I wasn't licensed until the end of WW2, I actually operated spark. How's that?!! Spark went out in the very early 20s and I was only a few years old so how could that be. Well actually, I operated spark in 1920 when I was 4 years old and then much later--better explain both occasions.

My dad got interested in building radios--both transmitters and receivers back just at the end of World War One. I was only four years old and it was my earliest clear memory--but if it happened to you--I know any of your readers would have been in the same boat. My dad had built a rotary gap spark transmitter and one day he had sat me on his lap, and had me press the key as the wheel roared around. Frankly, it scared hell out of me and implanted a clear memory of that occasion.

Then, many years later, when I was working at ARRL Headquarters, Roland Bourne, who had been the chief engineer for Hiram Percy Maxim, had rebuilt the original 1AW rotary gap transmitter. This transmitter is (or was) displayed in the lobby of W1AW Newington, Connecticut. When Roland finished refurbishing the unit, we (I) tested it to see if it would produce TVI in the neighborhood. I didn't work anybody with the spark rig except possibly some of the neighbors. On another occasion, at the Antique Wireless Association--I keyed a much larger spark transmitter--so I can truthfully say I operated spark.

My mother was a tough little Irisher and she saw no use for radio whatsoever and nagged my dad to give it up. Of course to keep peace, he did--I know it changed his life appreciably. One of my proudest moments was years later when he was dying of cancer. I was setup to give a TVI demonstration, my first such lecture, and it was scheduled in Chicago, at the athletic club. My dad happened to be in Chicago so I brought him along. As happens in Chicago a snow storm hit the town that day (and I breathed a sigh of relief because I figured there wouldn't be many hams attending the talk because of that weather). Boy! Was I wrong. That hall was packed, remember, this was my first talk on TVI, and I was really nervous--in fact--panicky! I really don't remember what I said that night except the audience applauded and actually cheered on occasion. Some of the readers will remember Harry Harrison, W9LLX, of Motorola and Chicago. He was one of the invited engineers who was sitting on the podium. When I finished, I went over and sat down next to Harry and whispered to him "Harry--How in hell did I do?" Harry replied that I had done an absolutely marvelous job. Gosh it was a relief to hear that! The bottom line is that my dad was there and got to hear me--I know he was very proud.

In future columns, I will talk about those TVI days, my time at ARRL, and so on. I remember how scared we all were that Amateur Radio was going to come to an end.

I say "future columns" Do you readers want to hear more?--let Barry know. Vy 73. Lew, W1ICP

Letters

Dear ER

I wish to thank Mr. Al Brogdon for his kind comments (ER No. 92) in reference to my article on The Radio VT Fuze. Yes, it was APL who coordinated the American VT fuze development. After the initial design, development, production and testing, they handled the work of letting contracts to and conducting liaison with the more than one-hundred companies who either made component parts for or assembled the various sizes and types of VT fuzes. All of this and much more is covered in extraordinarily complete detail in Ralph Baldwin's book, 'The Deadly Fuze' - see Reference 8 in my article. Since Al worked at APL, I'm sure he would enjoy this book. Incidentally, his photo of the Mark 45 fuze is better than the one in Baldwin's book because the cutaway section shows the oscillator coil and the antenna cap.

Bob Dennison, W2HBE

Dear ER

Val M. Johnson's story, "What's In A Call?", was very similar to mine. [ER #93]

I received my novice license (KN5ONE) the day before Christmas in 1957. What a Christmas present! I got on with a Heath AT-1, AC-1 and Hallicrafters S-38B. Shortly thereafter I received my Conditional license (K5ONE) and a plate modulated DX-40 (that could be the subject of a great article) and an S-40B. In 1966 I took a day off work, drove to El Paso, Texas about 120 miles away and I passed my General. When I received the license, it was issued as W5PTQ. What!!! I wrote the FCC and asked about my K5ONE so they re-issued it still as a Conditional. I decided not to confuse them any more so I had two call signs listed at two addresses! I just let the boat rock until 1978 when the FCC was asking all that had two call signs to turn one in (never believe the FCC). Being the law abiding citizen that I am, I sent both licenses to the FCC and asked to keep the K5ONE. Of course they issued me W5PTQ. I complained vehemently (I jumped up and down in one spot) and every time I renewed, I asked for my old K5ONE, but to no avail. When I took the Extra exam in 1985, I requested a new call sign ... you guessed it, K5ONE.... you guessed it again ... the FCC then issued me NV5D. Things kept getting worser and worser but there wasn't anything I could do about it. People suggested I write to my senator, my representative, Barry Goldwater, the president, the president's dog, etc., etc. Nothing worked.

When I heard of the Vanity Callsign Program in late 1994, I was ecstatic. They kept putting off the date while I waited semi-patiently for a year and a half. Finally, they listed May, 30, 1996 as the first gate. On May 28 I sent a 2-day USPS mailing to the address given. One week later I was listed in the FCC data base as K-5-O-N-E and received the hard copy a week later. WOW!!! Finally after all these years I can work CW again (K5ONE really swings on CW). With all of my other call signs on CW I signed K5ONE half the time anyway because it was so natural.

That, also, is what is in a call sign. I can't tell you how much I am enjoying my new call sign. Half the people still recognized me as K5ONE, the other half got used to K5ONE - very fast. Sorry about writing "K5ONE" so much but I am enjoying doing it.

Wayne Blanton, K5ONE, (Formerly KN5ONE, W5PTQ, NV5D, KG6AQY, XE2AGZ, VP1FB, V3FB, V31AB, etc.)

continued on page 15

Designing the Collins 30K

by Warren B. Bruene, W5OLY
7805 Chattington Dr.
Dallas, TX 75248-5307

Forward

The 30K-1, Serial No. 1, was delivered around February 1, 1947 so this article really commemerates the 50th anniversary of this transmitter coming into being.

This February is also an anniversary for me as I got my ham license in February, 1935. My first call was W9TTK. It later became WØTTK and after I moved to Dallas in 1964, it became W5OLY.

I started with Collins in Nov. 1939 and retired from Collins Rockwell in 1984. I continued at Electrospace Systems until 1990 which is a span of over 50 years of full employment in the business.

Collins Radio received a telegram when WWII ended to stop all military production - which was everything. New products were needed. Along with products for other markets, Collins decided to develop three new products for Amateur Radio. These were the 75A receiver, the 30K 375/500 watt ph-CW transmitter and the tabletop 32V transmitter. All were to provide VFO operation using one of the new accurately calibrated and stable permeability tuned oscillators (PTO) developed by Ted Hunter, WØNTI. The design of the 30K and the companion 310A VFO exciter was assigned to me. This was the first complete transmitter for which I was to be the design engineer. For the past few years I had been responsible for the RF versions of the Navy TDH 3 KW Autotune HF transmitters. They used a pair of Eimac 750TL's in the final and a pair of 450TH's in the class B modulator. An 813 was used in the RF driver stage.

Final RF Amplifier Tube Choice For The 30K

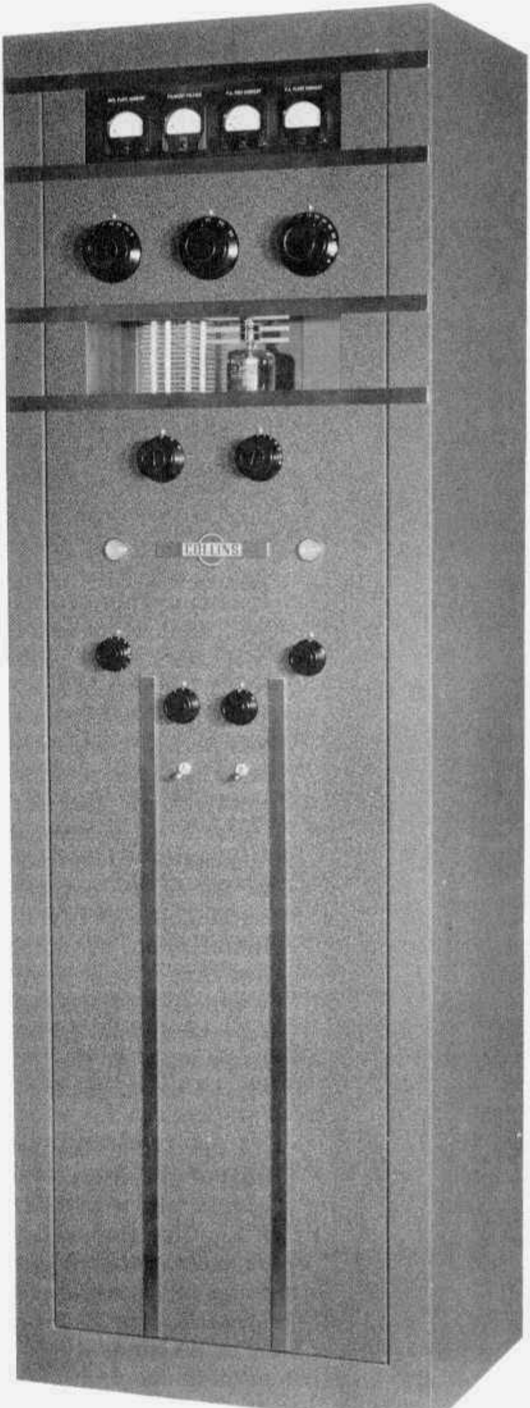
Eimac had recently introduced the 4-125A tetrode which was called a modern replacement for that old workhorse, the 813. We had offered our ideas to Eimac on what features we would like in such a tube. It is compact with shorter internal leads and lower internal capacitances. The data sheet indicated that neutralization probably would not be necessary below 30 MHz. And that cherry red glow of the tantalum plate gives the operator sort of an unexplainable thrill. Furthermore, it added confidence that the circuit was operating as intended because you could "see" that the plate dissipation was correct. You could even resonate the final by tuning for the dullest glow.

A pair of 75T's was a compatible choice for the class B modulator using the same HV DC power supply with a pair of 866A mercury vapor rectifier tubes.

Note: In 1952 the list price of a 4-125A was $30.50, the 75TH's were $13.25 each and the 866A's were $1.95 each.

Features And Objectives

In late August '45 I prepared a list of 23 design features and objectives. It included such things as using a common HV power supply for both the final and the modulator, limit power to the ratings of a pair of 866 mercury vapor rectifier tubes, a smartly styled cabinet, cover 80 through 10 meter bands, speech clipping but should sound good on the air, band switching, inductive RF output coupling, matching to 75-ohm coax or 72-ohm twin lead line and also to



The Collins 30K

tuned Zepp feeders, antenna switch on band switch, push-to-talk, time delay, and blocked grid or suppressor keying for a clean CW signal with no clicks or backwave. By September 10th I had drawn a schematic for a proposed design of the exciter and transmitter and also a drawing for the front panel of the exciter.

Initial Concept For The 310A Exciter

The initial concept was to control the transmitter remotely from the tabletop exciter positioned next to the receiver. The operator would manually set the band-switch on the transmitter and turn ON filament power. Plate power was to be remotely controlled by a switch on the exciter. Grid and plate tuning would be remotely controlled using motors operated by a "raise/lower" switch on the exciter. The speech amplifier would be located in the exciter and an "electric-eye" would be provided to monitor the modulation level. After some thought and consultation with others, it was decided that this much remote control wasn't worth the cost. Eliminating remote tuning just meant that the transmitter should be located within reach of the operator. The audio amplifier was moved to the transmitter and located on the modulator chassis. The electric-eye modulation monitor was eliminated as was a keying monitor and speaker. These changes and simplifications allowed a substantial cost saving.

I was told that Art Collins

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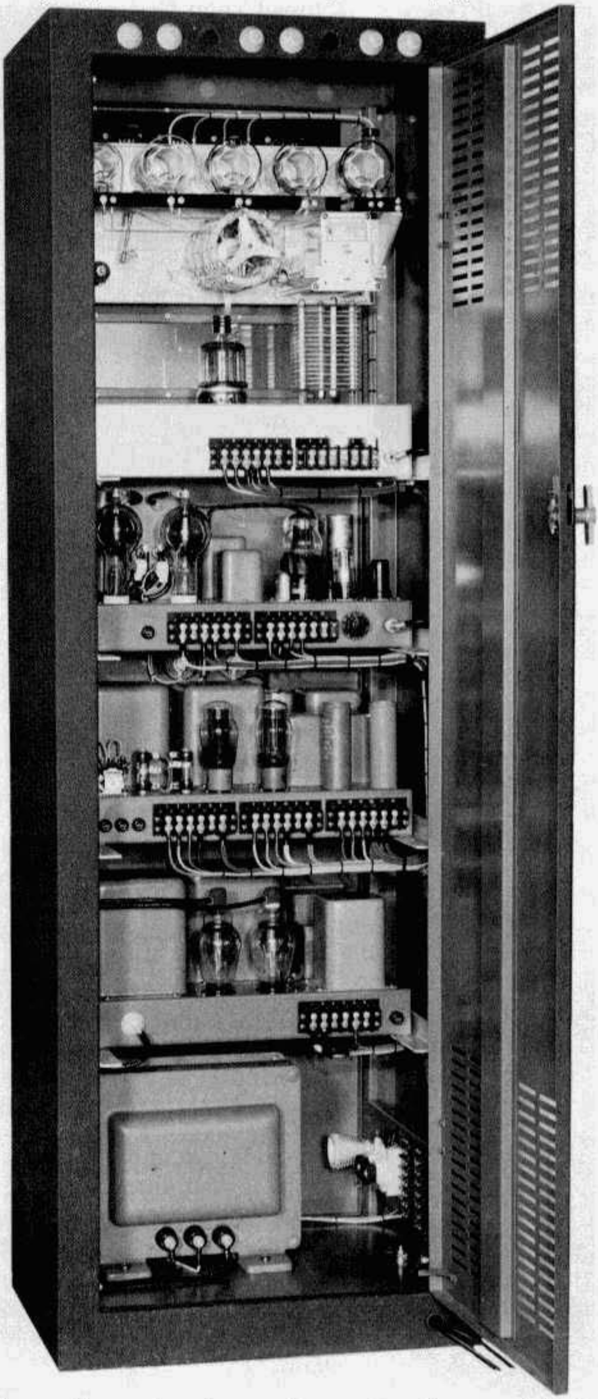
Designing the Collins 30K from previous page



Rear view, showing unit construction and link coupled RF output.

wanted a mixer type exciter but I wasn't told why. I just assumed that it was to achieve frequency accuracy comparable with the 75A receiver which used a crystal oscillator for the first injection, a variable IF, and a PTO for the second injection. It was several years before it finally dawned on me that he must have had SSB in the back of his mind.

My first schematic had a 1.000 MHz crystal oscillator followed by a harmonic generator and triple-tuned selective filters to select the desired harmonic. This was mixed with the output of a 2-3 MHz PTO and amplified by two tuned stages. It was soon realized that the selectivity requirements were quite severe (and expensive) and that some "birdies" were present - such as the 4th harmonic of the crystal frequency on the top edge of the 80 meter band. A simpler and lower cost system was needed. The cost of a separate crystal for each band (like in the 75A) wasn't too appealing either.

I devised a scheme of mixing a 6.0 MHz crystal output with a 1.5-2 MHz PTO. This generated a very accurate and stable frequency covering 7.0-7.5 MHz. The 20, 15, and 10 meter bands would be covered by multiplying this by 2, 3, or 4 respec-

The Collins 310A exciter

tively. The 80 meter band would be covered by tripling the PTO output to get 3.0-4.5 MHz of which only 3.5-4.0 MHz was used. The buffer/amplifier, following the crystal oscillator, and the amplifier stage following the mixer were keyed for CW. It produced very clean keying with no chirp and no backwave.

A production type model was built and put on the air with the 30K. It performed beautifully and I was proud of the relatively simple design, but Art declared it "neither fish nor fowl" meaning it was neither a completely mixer nor a completely multiplier type of exciter. I was then authorized to use the 70E-8 PTO which was being designed into the 32V transmitter for an all multiplier type exciter.

Direct Reading Carrier Frequency Indicator

One objective was a direct reading frequency indicator to take advantage of the frequency accuracy of the PTO. I wanted to provide an analog feel of where you were in the band as well as the ability to read the frequency to an accuracy of 1 KHz. The result was the slide-rule dial calibrated to indicate the frequency to a 100 kHz segment (10 kHz on 80 meters). Only the scale for the band in use was illuminated. The 70E-8 covered 1600-2000 kHz with 16 turns of the shaft. Therefore, one turn of the dial covered 50 kHz on the 80 meter band, 100 kHz on the 40 meter band, 200 kHz on the 20 meter band, 300 kHz on the 15 meter band and 400 kHz on the 10 meter band. This required a separate circular scale for each band. A red pointer with a white indicator mark was moved up and down by the band switch to correctly position the KHz indicator in front of the correct circular scale.

Exciter Tube Lineup

The tube lineup in the 310A was a 6SJ7 in the PTO, 6AG7 isolation amplifier, 6AG7 frequency doubler, 807 frequency multiplier, 807 frequency doubler, two VR105 voltage regulators for the PTO, a 6XGT rectifier for the bias supply and a 5R4GY for the 500 VDC supply. The outputs of the last three stages were bandswitched and tuned with variable capacitors - all ganged to the PTO. The output circuit of the last 807 was link coupled to the 73-ohm

continued next page

Designing the Collins 30K from previous page

coax output. The nominal power output was 10 watts.

There were several modifications to the 310A which were identified by "dash" numbers up through -3. The 500 VDC power supply was deleted in the 310A-2 and the 500V of plate power was obtained from the 30K. Additions in the 310A-3 were a multimeter, a side-tone oscillator, grid block keying, and an adjustable RF drive control (to the 30K).

The 4-125A Operating Conditions For Phone

The operating conditions chosen for phone were close to those shown on the Eimac data sheet for a DC plate voltage of 2500 volts. The DC screen voltage listed was 350 volts with 210 volts peak audio modulation when the plate was modulated 100%. 100% screen modulation isn't needed because the plate current rises approximately as the 3/2 power of screen voltage.

The screen was made self protecting (from excessive dissipation) by dropping the voltage from 500 VDC to approximately 350 VDC through a 5000 ohm resister. The maximum possible screen dissipation (with no modulation) would occur with the screen at 250 volts drawing 50 mA which is 12.5 watts (when unmodulated). The maximum rated screen dissipation is 20 watts. The 5000 ohm screen dropping resistor provided 500 VDC to 350 VDC with 30 mA of screen current. The screen dropping resistor also makes the screen somewhat self-regulating for variations in RF drive voltage. If the drive is high, there will be more screen current so the screen voltage will drop a little. If the drive is a little low, the screen voltage will rise a little. Also the dropping resistor allows for some self screen modulation. Thus the screen voltage dropping resistor performs several useful functions, it protects the tube and makes the circuit more tolerant of variations in RF drive and also for differences between tubes.

The DC grid voltage is derived from a fixed DC bias voltage plus an additional amount obtained from a grid bias resistor. The fixed part needs to be high enough to keep the plate current cut off in Key-Up when there is no RF drive. The fixed bias voltage required is determined principally by the DC screen voltage which rises to 500 VDC when there is no drive. The characteristic curves for the 4-125A show that the tube would be just barely cut off with -80 volts bias at 350 VDC screen voltage. Cutoff bias with 500V on the screen would be -80*(500/350)^3/2 or -137V. A -145 VDC bias supply is provided for this purpose (this same bias supply provides an adjustable bias for the modulator tubes).

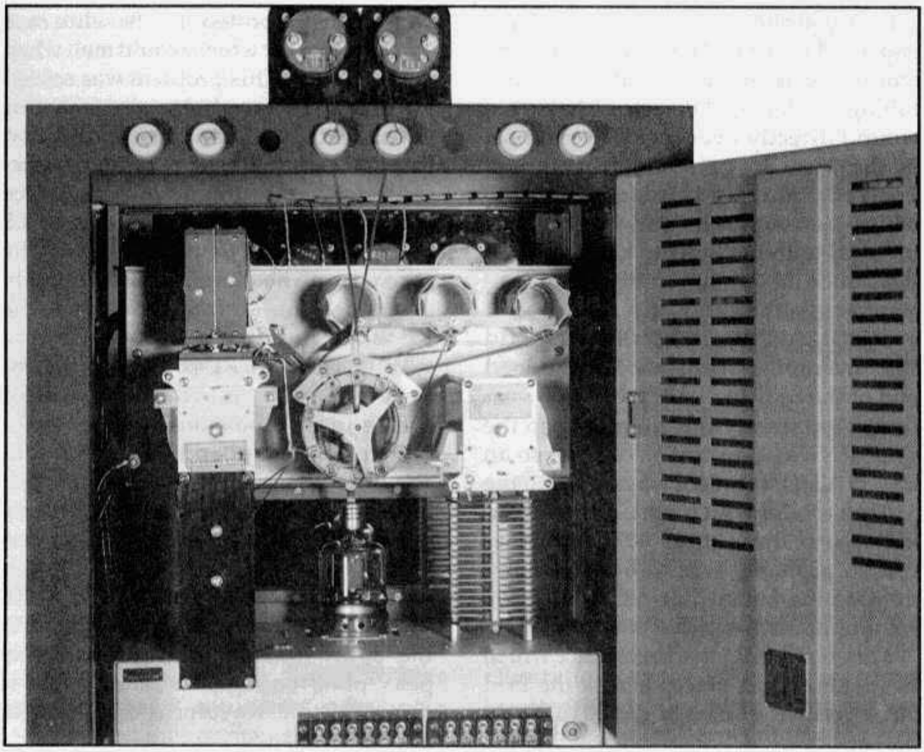
Note: The DC bias voltage is not regulated. If the AC power line voltage varies, a corresponding DC screen voltage variation will result. An unregulated bias supply produces a compensating change in the DC bias voltage.

A 5000 ohm grid leak resistor was provided for the additional bias. The 30K-1 instruction book states that the DC grid current should be 12 to 15 mA. This produces a total DC grid voltage in the range of -205 to -220 VDC.

An object of the design was to provide enough self regulation of the screen and bias voltages so that no changes would be required when adjusting the loading from 150 to 200 mA DC plate current for phone and CW respectively. It appears that when loaded for phone, there will be more than 30 mA of screen current which will drop the DC screen voltage a little below 350 VDC. When loaded for CW, the screen current will be less than 30 mA resulting in a DC screen voltage a little higher than 350 VDC. Changing the plate loading causes the DC grid current to vary some also.

RF Grid Circuit Design

All of the Collins transmitters which I had worked on used direct coupling between RF stages, but I had used link coupling in my home brew ham trans-



Rear view of the 30K1 showing the variable link coupled RF output network.

mitters. Therefore, I started with link coupled coils at both ends of the transmission line between the 310A output and the 4-125A grid circuit. I had trouble getting and maintaining the desired coupling across each ham band (especially 10 meters), and this started my "real" education on the effects of SWR on a coax transmission line. The link coupled circuits which I had used previously were only a foot or so apart, therefore the impedance of such a short length of line made little difference. It makes a lot of difference when the length is 20 feet or so, however.

Directional wattmeters didn't exist yet but the Jones MicroMatch came out about that time. It was designed for measuring SWR on high impedance open wire lines. It wasn't suitable for low power in a coax line. Therefore, I built an SWR meter using the Jones circuit but modified for the 73 ohm coax I was using and for 10 watts of power. It took quite a bit of experimenting before I understood and believed what it was telling me. The matter was complicated by the fact that a variation in coupling across a ham band varied the grid drive and this in turn varied the RF load resistance at the end of the coax. I found it necessary to use direct coupling in the 4-125A grid circuit. I used a tap on the grid tank coils for the 80 and 40 meter bands and a pi circuit on the other bands. The main reason for using the pi circuits was to avoid the need for positioning the tap at a fractional turn.

Apparently there was still quite a bit of SWR on the coax, which caused drive to change with different lengths of coax. This was minimized by designing all couplings to work with a 23.5 ft. length of coax.

continued next page

Link coupling was kept in the 310A end of the coax. The link coils were wound using bus wire with insulating tubing slipped over the wire. They were wound directly over the 807 tank coils in the 310A to get enough coupling. Their position could be varied a little to adjust the coupling. I added resistance in series with the links to keep the load resistance on the 807 driver more constant across the bands. (In retrospect it probably would have been better to add the "swamping" resistance at the load end of the coax to minimize SWR variation). Apparently this did not keep the grid drive as constant as desired so an EXCITATION control was added to the 310A-3 model which varied the screen voltage to the output 807. A further reason probably was to better accommodate the somewhat different drive requirements for phone and CW.

The effective RF load resistance which the 4-125A grid places across the grid circuit is on the order of 15,000 to 20,000 ohms.

The Plate RF Tank Circuit

The RF plate load resistance for the 4-125A is relatively high, being over 6000 ohms for CW and 7000 ohms for Phone. Shunt feed would present a severe RF plate choke problem in such a high impedance circuit, therefore series plate feed was chosen. The RF voltage across the plate choke is then only the voltage drop across the bypass capacitor from the bottom end of the plate tank coil to ground. This allows a commercial RF choke to be used. Isolation to the RF output circuit was achieved by link coupling which just requires sufficient spacing between the tank coil and the link. The tuning knob for the plate tuning capacitor was isolated by an insulating flexible coupler.

The HV bypass capacitor must be located near the 4-125A where it receives a lot of radiated heat. High voltage mica capacitors were available but they were made using several lower voltage sections connected in series-parallel. These sections were potted in a Bakelite case using wax or tar which would melt when it got too hot. This problem was solved by using an air dielectric capacitor which we could manufacture. We found that the circuit would operate satisfactorily with only 150 pF of capacitance which has 300 ohms of reactance at 3.5 MHz. This could be mounted near the tube with no heat problem. (I originally developed this air capacitor idea in the 3 kw TDH HF transmitters during WWII). The peak RF voltage across this bypass capacitor is about 60 volts at 3.5 MHz and is proportionally lower on the higher frequency bands. The peak voltage on phone will be nearly twice that high but this is no problem for the commercial RF choke selected. The 2nd harmonic voltage across the capacitor is only about 15 volts peak on CW at 3.5 MHz. This is very small compared to the approximately 2150 fundamental peak plate voltage, therefore there is very little RF waveform distortion to impair efficiency.

A two section plate tuning capacitor was used to reduce the minimum tank circuit capacitance on the higher bands. One section varied from 13-34.5 pF and the other 20-57 pF. The larger section was paralleled with the other only on the 80 meter band.

The Antenna Coupling Circuit

Initially, in the interest of simplification, it was planned to just feed 75 ohm coax or 72 ohm 1 KW twinlead. This was a simple means of feeding dipole antennas. It was thought that putting up a dipole for each band to be used might be preferable to complex tuned antenna coupling circuits. Therefore, the antenna coupling link was just approximately series resonated with a fixed capacitor. Thus the only adjustment was the amount of coupling from the link to the plate tank coil. A separate plate tank coil was provided for each band with its own coupling link. The links were all mounted on an insulating shaft

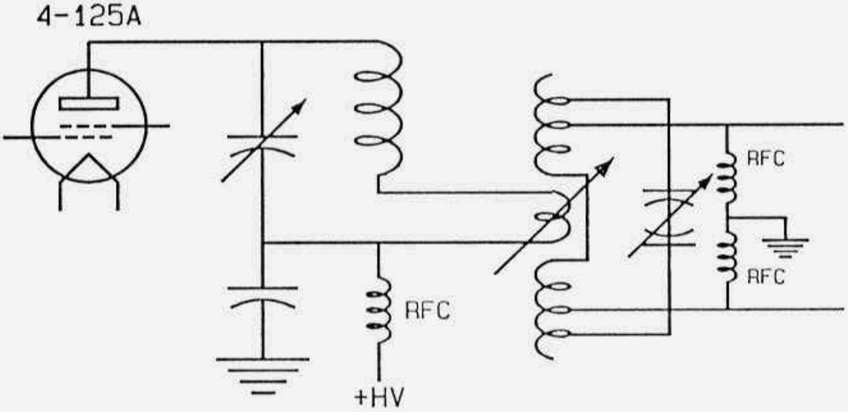


Figure 1. 30K-1 output network

so that the links could be rotated closer to and further from the bottom end of their respective tank coils. It was thought that if resonant feeders or a high impedance transmission line were used the user could build a simple resonant circuit placed on top of the 30K cabinet. It would be link coupled to the plate tank with the variable coupling link in the transmitter. It was soon found, however, that hams wanted an antenna tuning circuit built into the transmitter. Art Collins suggested the circuit which was then designed into the transmitter in January, 1947.

This coupling circuit for the 30K-1 is shown in Figure 1. It took two plug-in antenna tuning coils to cover all bands. One covered the 80 and 40 meter bands and the other covered the 20, 15 and 10 meter bands. There was a swinging link in the center of the antenna coil and this link was in series with the plate tank coil. The antenna coils could be jumpered for either a series or a parallel tuned circuit or for either a parallel or single ended configuration. Usually the parallel configuration was used since most hams were using open wire feeders.

It was found that the bandwidth was greatly increased in the parallel configuration. As the 310A frequency was shifted, the tuning error of the antenna circuit tended to cancel the tuning error in the plate circuit. Large segments of any band could be covered without retuning - a very attractive feature. Other factors which affect this broadbanding are the resonant Q of the antenna and the transmission line length. Most of us didn't understand just how this all tied together back then. Now, this knowledge is in hand but it is rarely used to advantage.

Three pairs of antenna terminals were provided near the top rear side of the 30K cabinet. Two switch sections on the bandswitch were provided which could be jumpered to provide automatic antenna switching when changing bands. Two RF ammeters which could be used to read antenna feeder current were mounted on top of the cabinet .

Equations For Link Coupling

The coefficient of coupling, k, to a link at the middle of a coil is approximately 35%. When just off the end of the coil, it is about 20%. The Q of a parallel

continued next page

resonant circuit is the ratio of the equivalent resistance across the circuit divided by the reactance of the capacitance across it.

$$Q = R/X_C$$

Maximum power is coupled into a link when the inductive reactance of the link is equal (in magnitude) to the load resistance across the link, such as 72 ohms. The Q of the tank circuit must be quite high to get adequate coupling to an untuned link. It takes a Q of 50 when k=20% to an optimum link, or a Q of 16 when k=35%.

The k required when two resonant circuits are inductively coupled together is much less. In the above case, just resonating the previously optimum link drops the minimum Q of the plate circuit in half. The required k between two resonant circuits with Q's of Q_1 and Q_2 is:

$$k = (1/ (Q_1Q_2)\text{^}1/2$$

When only part of the inductance of one circuit is inductively coupled to the other, the k required is increased in inverse proportion to the fraction which is inductively coupled.

This is explained in detail in my article "How to Design RF Coupled Circuits" in *Electronics*, May 1952. It also appears in Chapter 18 Radio Transmitters in the 5th Edition of Henny's Radio Engineering Handbook, McGraw Hill, 1959.

The Class B Modulator

The 75TH tubes were chosen for the modulator because they were the right size and could be operated at a DC plate voltage of 2500 - the same as used in the final. The 75TH has a mu of only 20 so it requires a bias voltage of approximately -105 volts DC for the recommended 45 mA modulator idling plate current. The instruction book lists 175 mA plate current for 100% modulation.

We worked with the modulation transformer manufacturer to find a reasonable compromise between tube operating conditions and transformer design limitations. This is a very high impedance circuit therefore capacitances within the transformer greatly affect the high frequency response. We asked for flat response to 4000 Hz and then a rapid drop. The plate-to-plate primary impedance of the final design was 32,000 ohms. Each tube sees a load of one fourth of that or 8000 ohms at the crest of the audio wave. The peak plate voltage swing is 1730 volts at 100% modulation. The peak power output required from the modulator tubes is equal to the DC power input to the final in the carrier, for no modulation condition, which is 375 watts. The modulator tube peak plate current is therefore:

$$i_p = 375/1730 = 0.217\text{A or } 217\text{ mA}$$

The modulator tubes do not draw grid current until approximately the 70% modulation level. It rises to approximately 20 mA instantaneous peak at 100% modulation. This places a non-linear load on the 6B4G Class A driver tube which causes the audio distortion to rise from 2% at 70% modulation to 8% at 100% modulation. No attempt was made to reduce this because it just acts as a little "soft" speech clipping which is more of an advantage than a disadvantage.

Audio Amplifier And Speech Clipper

The microphone input was designed for high impedance mics such as Turner's crystal and dynamic mics. It was coupled to the grid of a 6SJ7 through an RF filter.

From the beginning I had planned to include some means of minimizing overmodulation splatter. Articles on splatter suppressors and on speech clipping were starting to appear. A moderate amount of speech clipping, such as 6 to 10 dB, greatly increases sideband power without excessive distortion. A clipped signal will sound louder in the receiver because the receiver AGC operates from carrier level - not sideband power. We decided to include a speech clipper followed by another gain control to set the clipping level to just below 100% modulation. Thus we could have the advantage of speech clipping plus the avoidance of overmodulation splatter.

The speech clipper used a 6H6 twin diode to clip both the positive and negative peaks. It was followed by a low-pass filter with a 4000 Hz cutoff frequency. The clipper was preceded by one section of a 6SN7 dual triode and followed by the other section. A potentiometer between the 6SN7 and the grid of the 6B4G driver tube designated as the "clipper control" was used to set the clipped output level to a little under 100% modulation. The audio gain control at the input of the first section of the 6SN7 sets the level into the clipper for the desired amount of clipping. Of course, the gain setting depends upon how loud the operator speaks into the mic also.

Art Collins and Roy Olson listened to the 30K over the air at a Olson's residence to assure that it functioned correctly and sounded OK.

I remember building a clipping level monitor into the engineering model using a small cathode ray tube. The audio input to the clipper was applied to the horizontal input and the output of the clipper fed the vertical input. This produced a sloping line at low audio levels where there was no clipping, but continued in a horizontal line in the clipping region. It was interesting to watch but was not seriously considered for production.

High Voltage DC Power Supply

The high voltage DC power supply was rated for 2500 VDC and 300 mA. It employed a conventional single-phase full-wave circuit using a pair of 866A mercury vapor rectifier tubes. A two-section DC filter was used using a 12 Hy filter choke and a 2 mFd filter capacitor in each. In addition, the input choke was tuned to 120 Hz with a 0.10 mFd capacitor. At that time it was common practice to use a swinging choke in the first section whose inductance varied from 25 Hy, with just bleeder current load, down to 5 Hy at full load current. Collins engineers had been using the tuned choke idea for several years because it reduced hum better and had better transient response to a varying load such as the keyed final.

With an untuned input choke, there is a minimum "critical" inductance required to prevent the power supply from starting to act like a capacitor input filter. When this happens, it causes the no-load voltage to rise resulting in poorer regulation.

The maximum load resistance is just that of the bleeder resistance (100,000 ohms) when the final is keyed OFF. The value of critical inductance in a single-phase full-wave rectifier circuit is:

$$L_C = R/1130 = 100,000/1130 = 88 \text{ Hy}$$

Instead of an 88 Hy choke we tuned the 12 Hy input choke to 120 Hz to achieve the same result and with a much shorter transient time-constant. The choke is rated for 12 Hy at full load current of 300 mA. The inductance of this choke is approximately 18 Hy when passing just the bleeder current of 25 mA. Therefore it takes a capacitor of only 0.1 mFd to tune it to 120 Hz using 60 Hz primary power. (It must be tuned to 100 Hz when using 50 Hz primary power which requires an 0.15 mFd capacitor). The best value can be found experimentally by measuring the DC output voltage using different values of tuning capacitance. The best value produces the lowest DC output voltage.

The transient voltage across the choke may be up to double the DC output voltage. That is one reason why this

continued next page

Designing the Collins 30K from previous page

capacitor has a DC voltage rating of 5000 volts. The second reason is that there is a high value of 120 Hz current circulating in the resonant circuit. This creates a significant amount of heating. It has been our experience that a paper dielectric filter capacitor with a DC voltage rating of twice the DC power supply output voltage is sufficient. Plastic film capacitors available now heat less.

Tuning Resistor

There is a LV-TUNE-OP control on the 30K-1. In the LV position, only the low voltage and bias supplies are energized. In the TUNE position the HV power supply is energized but with a 660 watt conical heater element connected in series with the 115 VAC primary winding. This reduces the 2500 volts so the 4-125A will not overheat before the operator can resonate it. Once resonated, the switch is turned to the OP, operate position, which shorts the tune resistor.

LV Power Supply

A single 500 VDC power supply provides all of the low voltage DC power requirements including the 4-125A screen, the audio amplifiers and the later versions of the 310A exciter. It uses a 5R4GY rectifier tube.

Bias Supply

The -145 VDC bias supply furnishes the fixed bias for the 4-125A and an adjustable voltage of approximately -105 VDC for the 75TH modulator tubes. It also provides -60 VDC for bias voltages in the 310A-2/3 and a DC voltage to energize the HV power supply relay. A 5R4GY rectifier tube is used.

Cabinet And Mechanical Layout

It was standard practice at Collins to unitize the cabinet layout by circuit function. This was done so that new transmitter models could be created by redesigning only one or two units. Each unit was usually built on a standard width chassis and mounted one above another in a steel cabinet. I chose a chassis width of 17 inches which was the standard width of chassis used in rack-and-panel construction. The chassis would be supported on rails screwed to the sides of the cabinet. A cabinet height of 66-1/2 inches was chosen so that the meters would be at eye level to an operator standing in front of the transmitter. The welded steel cabinet was designed for simplicity and strength. The St. James wrinkle paint was the standard paint used for most Collins equipment at that time. It was a pleasing greenish-gray neutral color which would be less objectionable to XYLs than black.

Ample space was provided around the chassis for convection air currents to remove heat. Slots in the rear door provided air entry and a 7 x 11 inch cutout in the roof allowed hot air to exit. A metal plate was mounted 1 inch below the roof to keep fingers out, to collect dust and to contain stray RF better.

Note: This transmitter generated no TVI when originally designed because there was no TV!

The meters had to be mounted behind a glass panel because they were located at high voltage points in the circuit. Another glass window was provided so the operator could see the color of the 4-125A plate. This gives the operator confidence that everything is operating OK. Trim strips were used to add some style and provide a family resemblance to the pre-WWII 30J transmitters. The controls were located near the circuits they controlled and/or to provide symmetry. Large pilot lights were chosen just for looks.

Testing And Development

A lab technician, Ken Everhardt, WØEIT, was assigned to the project to assemble and wire the equipment and assist with testing and development. Some of the changes made during development were discussed above. I had wanted to include a time-delay to prevent energizing the 2500 VDC power

continued on page 39

Letters from page 3

Dear ER

I greatly enjoyed Ken Greenberg's "Memories of Allied Radio" in the January 1997 issue of ER. I too grew up with the "bible" always close at hand.

However, Ken's article suggests the greatest electronic catalog is no longer with us. In fact, the Allied Electronics, Inc. (An Avnet Company) catalog is very much alive and well. I've been ordering from it for several recent years and found very important things for my, shall we say, older radios.

Tube sockets, octal and 11 pin plugs and covers, high voltage transformers and filter chokes, and even a microphone connector for my Johnson Viking. Yes tubes, though a bit expensive, are there. And, of course, all the high voltage caps you can imagine. The only things I found wanting are air variable caps.

So, my pitch is, ER readers need to know the Allied catalog is available, their inventory exceptional, and their service excellent in 1997.

Allied Electronics, Inc. 1-800-433-5700.

Charles D. Barton NZ5M

Editor's Note: Up until receiving the above letter I was under the impression that the old Allied Radio Company had no connection whatsoever to Allied Electronics. I guess I was wrong. Mostly out of curiousity, I called their 800 number and requested their latest catalog. I had not seen one for several years and was surprised to see that it has grown to over 1000 pages. And it does indeed contain a lot of stuff that vintage restorers/repairers need. I suggest it as another good parts source.

Dear ER

A footnote to my article Recompensating Old Oscillators to Minimize Drift (ER Oct. 96, pg. 9) suggested a ceramic trimmer capacitor for temperature compensation. Unfortunately, this type of trimmer gives small 200 Hz wavers, and is poor for CW. I've located a stable capacitor manufactured by XICON Passive Components, namely the Class 1 Ceramic Disc (CD series). In particular the SL code (approximately N330, or -330 ppm/C) is available off-the-shelf from Mouser. I've used the CD 1000S5-022K in my Valiant's 7 MHz VFO with good results (this is a 22 pF, 1 kV, N330 +500,-500 capacitor). The temperature coefficients can vary 500 ppm/C, so it might be wise to obtain several in case one does not have adequate negative coefficient.. If this does not make you happy, then check with XICOM Passive Components, telephone (800) 628-0544, about those temperature coefficients that are available by special order.

Robert Burger, WB6VMI

Dear ER

I want to express my support for the December 1996 article by Carl, WB1EYE, on the 5 watt "cake pan" transmitter. In view of the letters of complaint I have seen in QST regarding authors that sell their project, I wanted to counter the same type of letter that you might receive as ER editor. In my humble opinion, ER cannot just be a magazine which has articles about commercially built tube type equipment. I think it is a great idea to have articles that encourage building using tube type equipment. In these days when some (including myself) may not have the time to hunt around for parts, I welcome the ability to buy a complete kit of parts (or even the finished product) from the author of the article. If someone thinks that the kit price is too high, then they can go buy the parts elsewhere. Just don't deny everyone the ability to make that choice by not publishing the article.

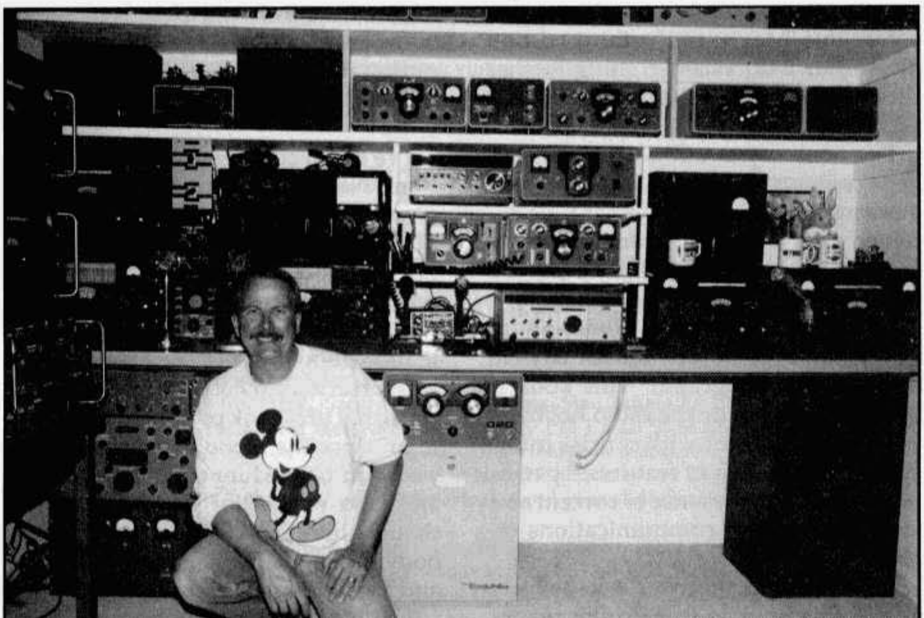
I will look forward to other articles that encourage building, especially the ones that Carl alluded to in his article (the N2ZAB tube type receiver; a screen modulated AM transmitter).

Dick Bean, K1HC

Koji Mitoshi, JL1HID, in his hamshack. Some of the gear in the photo includes an R-725, a Valiant, a HF-380 and a KWM-380.

At the Mason-Dixon hamfest, fall 1996. Ted Young, W3PWW (left); Mike Oxenreider, WB3CTC (center) and Walt Hutchens, KJ4KV. The rig Ted is holding is one of Walt's latest homebrew creations; quite possibly the subject of a future ER article. ***Photo by WA3YXN.***

Well-known AM'er Art Rideout, WA6IPD, in his newly renovated hamshack. His favorite transmitter, the BC-610, is on the right side of the photo.



Mike Student, W7MS, in his mostly-Collins hamshack. Some of the gear shown includes an R-390 (with a TMC CR-591A SSB converter on top of it), just to his right; a 30S-1 amplifier to his left and a KWS-1 in the extreme right of the photo. Other familiar faces in the photo include the ART-13, 75A-4, etc, etc, etc.

Book Review

"Shortwave Receivers Past and Present" by Fred Osterman, N8EKU, published by Universal Radio Research, Reynoldsburg, Ohio. Second edition, first printing, 1997, softcover, 8-1/2x11 inches, 351 pages, B&W photos, $19.95.

Reviewed by Barry Wiseman, N6CSW

This is another book that I can wholeheartedly recommend to the readers of Electric Radio. It is a big book - 350 pages, 8-1/2 by 11 inches - with excellent photos (mostly pulled from advertisement brochures) with extensive information on all our beloved boatanchor communications receivers and also on the solid state stuff that came later.

The one deficiency in the book is that it starts its chronicle in 1945. Most of us are also interested in receivers that came before this. Maybe in the third edition the author will consider going further back to fully satisfy us vintage enthusiasts.

The book starts out with a several-page contents section in large bold type that makes finding a company or receiver very easy. The companies are listed alphabetically followed by the receivers listed chronologically.

Following the contents comes an introduction section. The author says in the opening paragraph, "This book is designed to provide the radio hobbyist or receiver collector with concise information on the value, features, specifications and performance of current and former shortwave communications receivers."

Further along he says, "A key objective of this book is to help the reader make an informed choice when purchasing a used shortwave receiver. The following questions are addressed:

* When was the radio introduced?
* What did it sell for when new?
* What is the current market value for the radio in used condition?
* Where was the radio made?
* What frequencies does it cover?
* What modes does it receive?
* What is the frequency display...analog or digital?
* If a digital display, what is its resolution
* What voltages (or batteries) are required?
* Where can I find a review of the radio?
* What accessories were made for it?
* How was the receiver performance rated when new
* What is the used value rating of the receiver.

This book is designed to answer these questions and more."

With one half a page devoted to each receiver the book succeeds in doing all that the author suggests.

The author is the owner of Universal Radio Research, the publisher of the book, and also Universal Radio, Inc. the radio related supply company (mostly mail order) that most of us are familiar with.

I've had a couple of phone conversations with Fred regarding the book and gleaned some interesting information. The First edition of Shortwave Receivers Past and Present - which I haven't seen, nor was I ever aware of it - was written as a result of requests for information about buying used receivers by Universal Radio customers. The interest in that first book prompted Osterman to produce the second edition.

I would give him an 'A' for accuracy and also an 'A' for completeness although there are some minor errors (nobody will ever get it completely right) and some minor omissions.

The book is available from the Electric Radio bookstore. For ordering information see page 56. **ER**

VINTAGE NETS

Westcoast AM Net: Meets informally, nightly on 3870 at 9:30 PT. Wednesday at 9:00 PM PT they have their formal AM net which includes a swap session. Net control rotates.

California Early Bird Net: Saturday mornings at 8 AM PST on 3870.

California Vintage SSB Net: Sunday mornings at 8 AM PST on 3835

Southeast Swap Net: Tuesday nights at 7:30 ET on 3885. Net control is Andy, WA4KCY. This same group also has a Sunday afternoon net on 3885 at 2 PM ET.

Eastern AM Swap Net: Thursday evenings on 3885 at 7:30 ET. This net is for the exchange of AM related equipment only.

Northwest AM Net: AM activity daily 3 PM - 5 PM on 3875. This same group meets on 6 meters (50.4) Sundays and Wednesdays at 8:00 PT and on 2 meters (144.4) Tuesdays and Thursdays at 8:00 PT. The formal AM net and swap session is on 3875, Sundays at 3 PM.

K6HQI Memorial Twenty Meter AM Net: This net on 14.286 has been in continuous operation for at least the last 20 years. It starts at 3:00 PM PT, 7 days a week and usually goes for about 2 hours. Net control varies with propagation.

Arizona AM Net: Meets Sundays at 3 PM MT on 3855. On 6 meters (50.4) this group meets at 8 PM MT Saturdays.

Colorado Morning Net: An informal group of AM'ers get together on 3806 Monday, Wednesday and Friday mornings at 7AM MT.

DX-60 Net: This net meets on 7290 at 2 PM ET, Sundays. Net control is Jim, N8LUV. This net is all about entry-level AM rigs like the Heath DX-60.

Military Net: It isn't necessary to check in with military gear but that is what this net is all about. Net control is usually Walt, KJ4KV, but sometimes it rotates to other ops. It starts at 5 AM ET Saturday mornings on 3885.

Westcoast Military Radio Collectors Net: Meets Sunday mornings at 0930 local on 3975 + or - QRM, except the 1st Sunday of the month when the net meets at 2130 local. Net control is Tom, WA6OPE.

Grey Hair Net: The oldest (or one of the oldest) 160-meter AM nets. It meets on Tuesday nights on 1945 at 8:30 PM EST & EDST.

Vintage CW Net: For CW ops who enjoy using vintage equipment. This is not a traffic net; speed is not important. The net meets on 3537, Sundays at 7 PM Mountain. Net control is Tracy, WB6TMY.

Vintage SSB Net: Net control is Andy, WBØSNF. The Net meets on 14.293 at 1900Z Sunday and is followed by the New Heathkit Net at about 2030Z on the same frequency. Net control is Don, WB6LRG.

Collins Collectors Association Nets: Technical and swap session each Sunday, 14.263 MHz, 2000Z, is a long-established net run by call areas. Informal ragchew nets meet at 0100Z Tuesday nights on 3805 and on Thursday nights on 3875.

Drake Users Net: Another relatively new net. This group gets together on 3865 Saturday nights at 8 PM ET. Net controls are Criss, KB8IZX; Don, WZ8O; Rob, KE3EE and Huey, KD3UI.

Swan Users Net: This group meets on 14.250 Sunday afternoons at 4 PM CT. The net control is usually Dean, WA9AZK.

Nostalgia/Hi-Fi Net: Meets on Fridays at 7 PM PT on 1930. This net was started in 1978.

K1JCL 6-Meter AM Repeater: Located in Connecticut it operates on 50.4 in and 50.5 out.

JA AM Net: 14.190 at 0100 UTC, Saturdays and Sundays. Stan Tajima, JA1DNQ is net control.

Fort Wayne Area 6-Meter AM Net: Meets nightly at 7 PM ET on 50.58 MHz. This net has been meeting since the late '50's. Most members are using vintage or homebrew gear.

Southern California Sunday Night 6 Meter AM Net: 8 PM Sundays on 50.4. Net controls are Dan, KV6I and Scott, K6PYP. Informal, supports restoring old gear and using it on the air. Loan gear available for those wanting to join in.

Westcoast 40-Meter Sunday Net: Net control varies. The group meets on 7160 starting at 4PM PT.

Collins Swap and Shop Net: Meets every Tuesday at 8PM EST on 3955. Net control is Ed, WA3AMJ.

Old Buzzards Net: Meets daily at 10 AM Local time on 1945. This is an informal net in the New England area .

Canadian Boatanchor Net: Meets Saturday afternoons, 3:00 PM EST on 3745. For hams who enjoy using AM, restoring and operating

Nets that are underlined are new or have changed times or frequency since the last issue.

The ITT Mackay Marine 3010-C Communications Receiver

by Ray Osterwald, NØDMS
P.O. Box 582
Pine, Colorado 80470

"If you get a chance to listen to one, take it, even if it means crawling a few miles through snowdrifts or over a hot desert!" This is how By Goodman described his overall impression of a new Mackay 3010-B when he reviewed it for the "Recent Equipment" column in the April 1967 issue of QST. He also said that most hams thought they probably had the most sophisticated communications receivers available because of competition, high prices, and crowded bands. He hoped it wouldn't be too much of a shock to learn that such was not the case!

The present day Mackay Communications is a very old company, with a rich history going way back before the turn of the 20th Century.

The company that eventually became the Mackay Radio and Telegraph Company was formed in September 1883 by John W. Mackay (1831-1902) and his partner, James Gordon Bennett Jr.

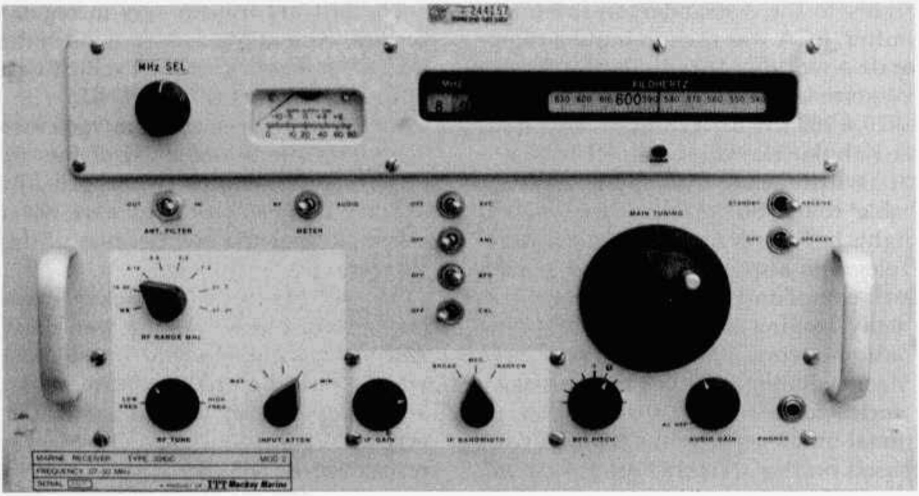
John Mackay immigrated to the United Stated with his parents from Ireland in 1840, when he was 9 years old. In 1851, when he was 20, Mackay went west to California. Like so many thousands of others, he hoped to try his luck as a miner in the gold fields. Although having little formal education, he apparently was a man of integrity who quickly earned people's respect.

Eventually leaving California for Nevada, by 1867 he had become a partner in the fabulously rich Comstock Silver Mine in Virginia City and was a multi-millionaire who was still in his thirties. During this period, one of the hobbies he developed was reading Morse messages by ear. He would sit for hours in the Western Union telegraph office at Virginia City and listen to the sounders rattle on, carrying messages full of information from the gold and silver investors who were constantly communicating to their home offices in San Francisco or New York City. There is no doubt this "hobby" aided his investment activities, and it also introduced him to the communications industry as it existed in those pre-wireless days on the western frontier.

Mackay married into Virginia City society, and became one of the first transatlantic "commuters" when he moved to Paris, France at the insistence of his wife. After this move, Mackay had to run his business from overseas via the transatlantic cable telegraph services, and he gradually became fed up with the seventy five cent per word rate charged by Western Union. Those rates are what drove John Mackay into partnership with Mr. Bennett.

They incorporated as the Commercial Cable Company, and their first sea cable was "landed" July 1884 between Waterville, Ireland and Canso, Nova Scotia. The route was soon extended across the English Channel and into Paris, France.

In that same year, 1884, John Mackay invested one million dollars of his own money for a controlling interest in the Postal Telegraph Company. Postal was the company Mackay used to deliver the actual messages carried over the sea cables. Without a delivery agent, the cable would be useless and he would have been unable to compete with Western Union. There was a joke in the industry at the time which said that it was useless to compete with John Mackay. If he needed something, he could just dig up more silver and buy it!



Front panel of the 3010C. The sticker (top center) indicates that this receiver was once owned by the Goddard Space Flight Center.

The Postal Telegraph Company owned several patents previously acquired from Elisha Gray which described a method of sending multiple circuits on a special wire pair. In some ways, Gray's "harmonic telegraph" was an early line multiplexer. These patent rights kept Mackay out of legal trouble with the Bell system patents. Postal also used a patented line conductor having a steel core with a copper covering, which was invented by Chester Snow. I doubt that there are many modern day hams which at some point in their amateur career haven't wrestled with this wire, which is now sold under the trade name "Copperweld"! The Postal Telegraph Company eventually operated many thousands of miles of wire, had two routes to the Pacific Coast, and an exclusive contract with the Canadian Pacific Railway.

Clarence H. Mackay (1874-1938) took over the business after his father passed on in 1902. In 1903, Clarence Mackay began a major system expansion when he invested 12 million dollars and spanned the Pacific Ocean with cable. This completed an ambitious 6,000 mile span from San Francisco to Japan, and gave Mackay introductory experience in maritime communications.

By 1928, Mackay had over 74,000 miles of cable and their advertising bragged that "the sun never sets on the Mackay system". During this period, Mackay also acquired what remained of the old Federal Telegraph System, which was a very strategic move that allowed them to enter the radio business, and is indirectly responsible for the 3010 receiver entering production some 34 years later.

In 1909, Federal Telegraph obtained patent rights to the Danish Poulsen arc transmitter. Federal used those rights to build a modern, automatic-keyed Morse radio system routed through 10 large American cities. It was soon expanded worldwide, and their international services used some of the most powerful arc transmitters ever built, at 1000 KW.

Clarence Mackay got into the wireless business as the result of competition, much as his father had done some 30 years earlier when he went into the cable business. In October 1919, General Electric formed RCA in order to keep Marconi from acquiring patent

continued next page

Mackay Marine 3010C from previous page
rights to the Alexanderson arc transmitter. RCA was then to build and operate a worldwide radio network with Western Union as its delivery agent. In 1920, a 200 KW RCA station went on-air at Kahuku Hawaii, in direct competition with Mackay's' Commercial Pacific cable route. So, Mackay used patent rights he had received from the Federal Telegraph acquisition to build and install competing arc transmitters, eventually leading to his own worldwide radio network. By the late 1920s, both Mackay Radio and RCA had extensive worldwide HF networks using directional antennas. These networks were based on the Marconi "beam system", first released in 1924. As technology changed, Mackay was quick to change to tube transmitters, seeing the obvious advantages. In May 1928, the Mackay system was merged with IT&T.

The first wireless transmitter in the USA which would consistently span the Atlantic was located near Sayville, Long Island. It was raided and taken over by the US Navy in 1915 after the War Department discovered that German agents were using it to transmit illegal war messages. In February 1928, Sayville was leased to Mackay Radio which operated it through 1936 as part of the Atlantic Network. Initially, Mackay added 30 KW arc and 10 KW tube transmitters, and had them on-air by May 1929. In 1935 Mackay needed more space for point-to-point HF antennas, and returned Sayville to the Navy after purchasing property near Brentwood, Long Island.

WSL at Amagansett, New York was another of Mackay's' Atlantic coastal stations.

In 1933, Mackay established domestic automatic-keyed radiotelegraph service, directly competing with traditional wired services. Morse speeds up to 200 WPM were possible. This continued until all the radio services (excepting broadcast) were shut down in 1942.

The last arc transmitters in regular service were at Mackay stations in the domestic network on the Pacific Coast of California, just before WWII.

In 1943 Postal Telegraph merged with Western Union, and most of the old Postal cable system was scrapped. The Mackay domestic services were never resumed after the war because of this merger.

As a corporation, Mackay made many contributions to the war effort, and specialized in radio installations which could be dropped into an area and set up quickly. Most all of the Liberty ships were equipped with Mackay transmitters.

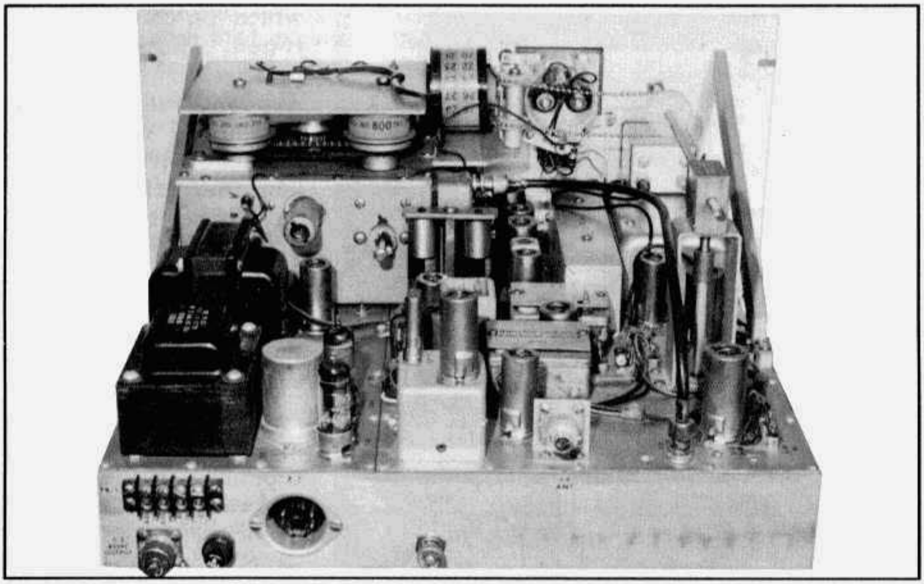
As soon as France and North Africa were liberated from Germany, Mackay engineers were on the scene, and within weeks had reestablished high speed links to London and New York.

In 1956 Globe Wireless merged with Mackay Radio. Globe Wireless had been formed in January 1930 by Heintz & Kaufman from their Dollar Radio holdings. Dollar was an old-time steamship and cable company. Globe received Dollar's 17 HF frequencies; a very valuable commodity which was then passed on to Mackay. On the staff at Globe Wireless was Dr. Frank Terman of Stanford University, the father of California's Silicon Valley, and the author of the famous Radio Engineering textbook.

In 1960, Mackay Radio became part of the ITT organization, which leads us to recent history and the year 1967, when the Marine Division at Mackay Radio decided to offer their 3010B receiver to the amateur radio market.

Mackay 3010 Receiver Design

Unfortunately, very little is known about the production history of the Mackay 3010 receivers. All that I will be able to describe in this article is what I learned from a borrowed evaluation receiver (Editor Barry Wiseman's 3010C) and manuals. I hope this will be



Rear view of the 3010C

enough to do the receiver justice, as it is extremely unusual in design and in performance.

The 3010 was designed by Mackay's Chief Radio Engineer, Mr. Alan Finkel. My 3010 schematic is dated May 2 1962, so I'm assuming production started early that year. (Also, its RF amplifier tube was introduced in late 1961.) I'm guessing that the 3010B was introduced in late '62 because the "B" manual is dated January 1963. There are seven component revision dates on the 3010 schematic, the last one being May 27, 1965.

The only difference between the two models is the dial tape. Originally, they used a 16 mm photographic film 90 inches long, calibrated in 2 kHz steps. The film dial proved to be brittle and unreliable, and the "B" model switched to a fiberglass composition tape to perform the same function. The tape colors were changed from red and green to yellow and green.

The manual I have for the 3010-C is dated December 1971. The 3010-C Model 2 I obtained for evaluation has tubes with August 1970 date codes, so the "C" model must have been introduced some time after late 1969. (I've been unofficially told that it was introduced in 1970). The only difference in the "C" model is a crystal-controlled upper and lower sideband BFO option, and a front end option which protected against static discharge using biased zener diodes.

The manual mentions that the 3010 was designed to be used with Mackay Radio units MRU-14B, MRU-19B/20B, MRU-21/22. MRU-23, MRU-27, or MRU-29/30. I have no idea what these were. Any further information from readers would be greatly appreciated, and will be written up for ER.

Sitting down in front of the 3010-C, the first thing I notice is the attractive two-tone grey-beige paint scheme which sets off the other controls without harsh contrasts. The knobs are black plastic, and the illuminated S-meter has dual scales. The top scale is in red lettering, and is accurately calibrated in dBm at 600 ohms. The lower scale is black and reads signal strength directly in decibels. The RF calibration marks are accurate within 2 dB except at the

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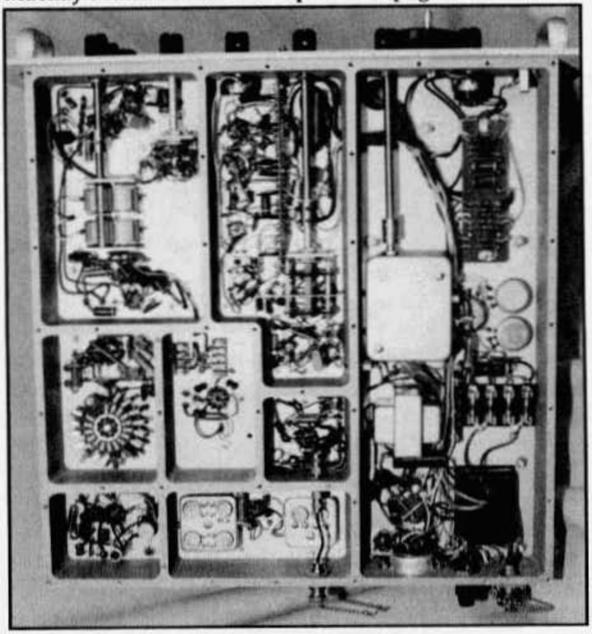
Mackay Marine 3010C from previous page



Underchassis view

which 1K chunk is being tuned. There is an RF preselector, which uses a 7-step bandswitch and a 2 section tuning condenser to tune a Pi-network in the RF amplifier grid circuit. A front-panel toggle switch (marked "Antenna Filter") cuts in a high-pass filter and is used to reject the broadcast band when in port. This filter is really nice to have built in for operating on 160 or 80 meters. The manual mentions that other filters could be special ordered to reject any other desired frequencies. There is a front panel step attenuator which provides 10 dB per section. One attenuator position is "off".

high end where the levels are compressed.

After a brief warm up of a few minutes, the receiver becomes stable and ready to work. Gentle pounding on the front panel and the bench top produces only a very slight wobble in a beat note, and it settles right back to where it was originally tuned. From a cold start, the 3010 is resettable to less than 50 Hertz. All of the oscillators are free-running, nothing is phase-locked. There is a small amount of backlash in the tuning mechanism, but this would probably go away if the entire tuning system were disassembled, cleaned, and lubricated.

This receiver is one of the few tube type models around which uses those newfangled "Hertzs" on the dial panel. There is a MHz window, which changes in increments of 2 Mhz as the "MHz Select" control is rotated. The Kilohertz window is calibrated 0 to 2000, for a two MHz span. The operator need only match the colors between the "MHz" and "Kilohertz" windows to figure out

In keeping with modern receiver design using low plate voltages, the 3010 power supply delivers 145 volts B+ at less than 1% ripple. This is due in part to a capacitor input filter and an 8 Henry choke which is physically larger than the power transformer. There is also regulated 108 volts for the oscillators.

As W1DX pointed out in 1967, the ship's radio operator was paid to get the message through. Everyone on board depends on Sparky's abilities and on the equipment for their safety. To a skilled radioman who understands the functions of the controls, the 3010 gives complete control over signal to noise ratio. Yet, there is an elegant simplicity to it, which leaves knob twisting to a minimum. For example, there are no passband tuning, rejection notch or tone controls, and the AGC time constant is fixed. There is no noise blanker, just a fixed audio limiter. The limiter clips at a low level and causes audio distortion.

This is a high-performance communications receiver which maintains an 80 dB image rejection ratio throughout its 70 Khz to 30 Mhz tuning range. It doesn't use complicated, expensive, and delicate slug racks or multiple gang-tuned stages. There is no tedious alignment procedure, although some of the factory passband alignments require a sweep generator. There is a big reserve of sensitivity, which is a necessity if the ship's antenna should ice up and blow down in a gale.

A ship's receiver must be sturdy and easily repaired when at sea. The 3010 fills this requirement, with room to spare. The main chassis is an aluminum casting with 5/16 inch sidewalls, milled to accept top and bottom cover plates. The casting is drilled and tapped for 44 bottom cover screws. The front panel side braces are milled castings, also 5/16 inch. There is a two-piece top cover on the chassis, but it's "only" 3/16 inch! The front panel is 1/4 inch hard aluminum, and the VFO casting is bolted to the front panel and to the main chassis casting for maximum possible mechanical stability. Each electrical stage is built into its own compartment. The electronic components which are mounted inside the compartments are neatly laid out, all the leads are dressed, and everything is easily accessible with ordinary hand tools including the simple two-deck bandswitch. All of the components are standard electronic parts with ample safety ratings made by big name-brand manufacturers. All 16 power leads enter each compartment via feedthru and bypass caps. Voltage leads into the oscillator compartments have series inductors in addition to the other components. Some of the signal leads are coaxial, with gold-plated bulkhead fittings mounted on the sidewalls. This is a receiver I could live with!

Looking at the block diagram (figure 1), the 3010 is a triple-conversion design with a final IF of 455 Khz so that Collins mechanical filters could be used as options. My evaluation receiver is fitted with 2.1 Khz and 500 Hz filters.

Looking on down the signal chain, a few big surprises start to show up. This receiver uses the "modern" up-converting heterodyne conversion scheme, which means that the IF is higher in frequency than any of the tuning ranges. This places images and some IMD products outside of the IF passbands where they can't be detected. The first IF has a fixed-tuned 37 to 39 Mhz response, and the first LO drive comes from a switched crystal oscillator running from 39 to 67 Mhz.

The second LO chain mixes a 3 to 5 Mhz VFO signal with a fixed crystal oscillator at 47.94 MHz to get to the second IF of 5.940 Mhz. The second LO has a passband of 43 to 45 Mhz, also up-converting and out of the tuning ranges. The second IF uses a high-selectivity crystal lattice filter with a 6 Khz passband, made by Blackhawk Networks, as the coupling element. In the wide selectivity position, this filter provides the main selectivity.

The third mixer uses drive from a fixed crystal oscillator at 5.485 Mhz to produce the final IF of 455 Khz. It's interesting to note that the second and third IF frequencies are not in a maritime band, but are part of the aeronautical mobile services band. This greatly reduces the possibility of interference.

Part of every plate load in the signal chain is some sort of low pass or bandpass filter, which attenuates harmonics and images to the low levels required in a receiver of this caliber.

Since there is so little activity on the maritime HF bands nowadays, I did a lot of tuning around using a gain antenna during one of last fall's band-crunching DX contests. This receiver has extremely high dynamic range. At no time did I ever notice it ever failing to dig some weak, fluttery signal out between the megawatt contest wheels. There was a little bit of cross-modulation noticeable, but this went away when I cut in some attenuation and tried different front-end tubes.

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Mackay Marine 3010C from previous page

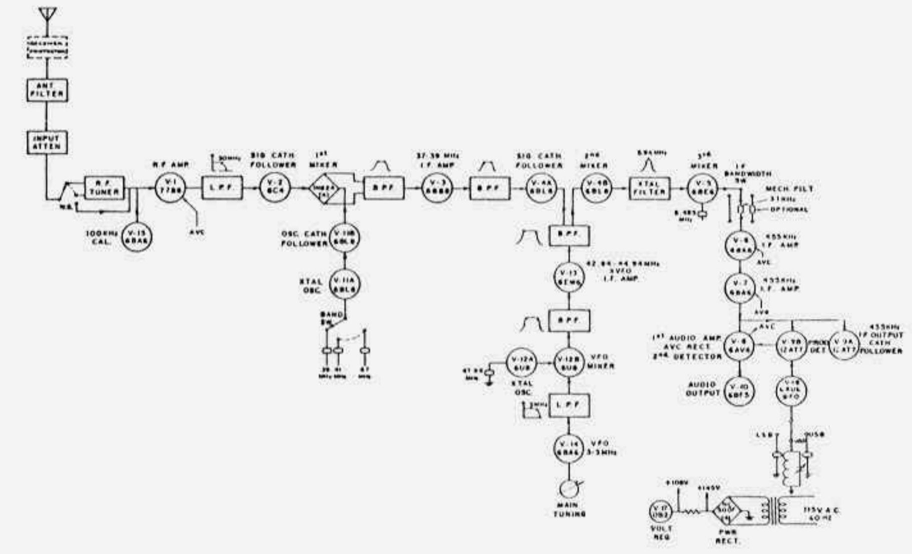

Figure 1. 3010C block diagram (with SSB BFO)

I guess I'll go back on what I said before about performance measurements. Please be advised that these measurements, while accurate within a few dB, were made with good quality older test equipment. Due to variations in test equipment and the operator's experience, individual measurements may vary from what I've provided.

After a fresh tune-up, the 3010 shows a two-tone, 3rd-order dynamic range of 108 dB, measured at 20 Khz signal spacing and -15 dBm signal levels. (For number collectors, this is an intercept point around +23 dB. Try that with yer YeaKenCom). Its blocking dynamic range (single-tone) is 90 dB. This was measured with the attenuators off. The dynamic range number increases as each attenuator section is switched on. If 10 dB is selected, the third-order product decreases by 30 dB (3 X 10). The blocking dynamic range increases by 20 dB. In the "max" attenuation position range, the third-order dynamic range would be over 220 dB.

How can this be? Did I miss something here? This is a 27 year old tube-type receiver with an AGC controlled sharp-cutoff RF pentode in the front end!

The secret to this unusual performance is found in the first mixer, the tube used at the RF amplifier, and in very careful circuit design.

Believe it or not, the first mixer is a single-balanced diode ring (figures 2 and 3). I've been told this was the first time this type of high-performance mixer was used in a commercial design. (Does anybody know if this is true?) The low-impedance drive requirements of the diode ring are met by V2, the signal cathode follower, and by V11b, the oscillator cathode follower. Both of the followers also provide stage isolation. Output balance is provided by R22, which to some degree cancels the oscillator fundamental in the low-impedance tickler winding of the first IF bandpass filter. This method of achieving balance in the diode ring is not as good as what is used in modern double-balanced designs. Today, 50 ohm broadband ferrite transformers with controlled characteristics are used on the LO and IF ports, and the IF output is

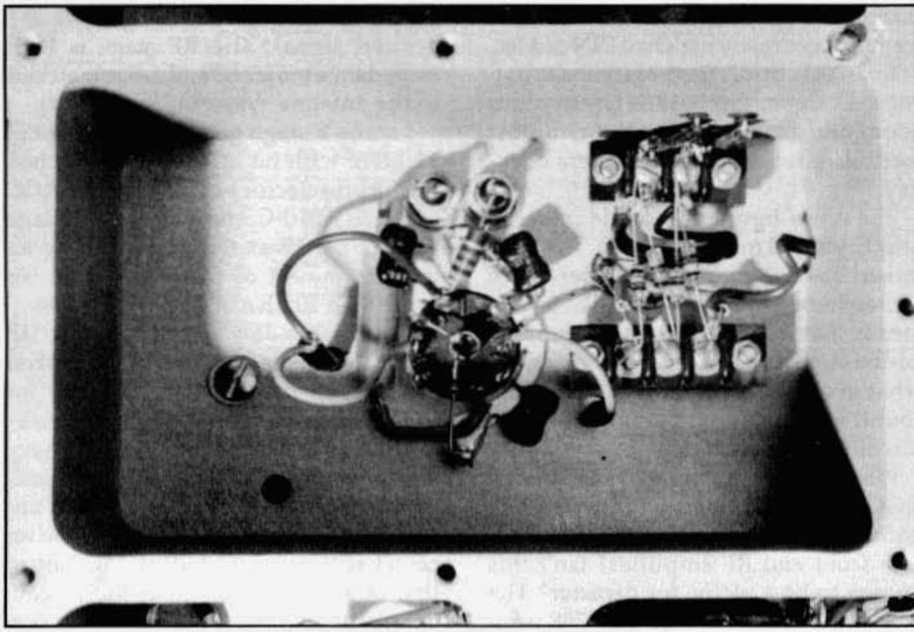

Figure 2. 1st mixer and 1st IF amp stage

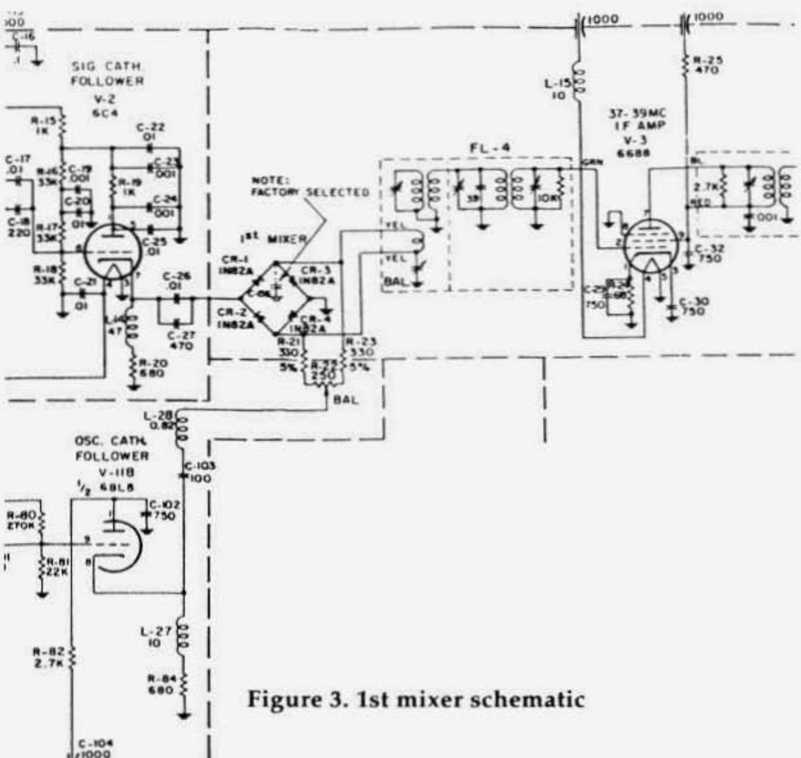

Figure 3. 1st mixer schematic

continued next page

Mackay Marine 3010C from previous page
taken from a tap on the RF port's transformer. Accurately matched PIN diodes, unavailable in '62, further increase balance. Even so, the 3010 is pretty darn good, and for sure "better" than most medium-priced plastic receivers of today.

The noise figure of a diode mixer is roughly equal to its loss in dB. The 3010 mixer has an estimated noise figure somewhere around 6 or 7 dB, which means that insignificant mixer noise is added to a tuned signal. This stage is what gives the receiver its clean, quiet sound in spite of its crummy 6BF5 audio output stage.

Who in their right mind would use an AGC-controlled sharp-cutoff pentode with extremely high transconductance as a front end RF amplifier? Isn't this known to be a recipe for disaster? The fact of the matter is that the 7788 is no ordinary tube.

In the early 1960s, Amperex Electronics in Hicksville NY was the center for high-performance tube design. If the 7788 is any indication, there is no telling what the industry might have produced had research lasted a few more years. Introduced in November 1961, the 7788 was designed for broadband carrier amplifiers. To be effective in this service, it had to be highly resistant to production of intermod products and blocking, and boy is it! Maybe it has Kryptonite grid wires and a Dilithium plate or something, I don't know. Its real design secrets have apparently been lost to time.

I breadboarded a 7788 broadband RF amplifier with a resistive plate load for test purposes, as I could never find data sheets on it. In this simple configuration, I got a voltage gain of 54 dB and a blocking dynamic range of 80 dB at 14 MHz. With the plate and screen current ratio used in the 3010, the 7788 has an equivalent noise resistance of about 100 ohms. This means only a very small amount of noise over what is generated in the antenna resistance is added to a desired signal. The RF stage is both impedance matched and noise matched to the antenna system (see figure 4).

I made a stage gain measurement at 14 MHz with no attenuators switched in, the preselector peaked, and the AGC off. The 3010-C showed an RF stage gain of 66 dB at the plate. This is an insane amount of front end gain. No more than 10 dB of RF gain is necessary to establish a low noise figure at HF with the mixer used in this receiver. The only reason I can see to design for this much gain is that maybe the low-frequency antennas in use were very small in terms of wavelength and therefore were inefficient. With a good antenna, it is necessary to operate the receiver with at least 10 dB attenuation in line at all times and with the IF gain control at about 12:00 if excessive noise and distortion are to be avoided.

How much sensitivity is really necessary in an HF receiver? Does a low noise figure have any other advantages besides high sensitivity?

Classic receiver theory says that there is a certain amount of thermally-generated noise which is always present due to the voltage drop across antenna resistance. This noise voltage acts like a broadband signal, and although it is at a relatively low level, there is no reason to make receiver sensitivity any higher, the idea being that weaker signals would be masked by the stronger noise voltage.

I won't present the equations behind this idea. Readers are referred later to the excellent article by Dr. Rohde for the fine details. The math is pretty straightforward, and anyone using a hand held calculator can work it out. The noise voltage developed across a 50 ohm antenna turns out to equal .31 microvolts (uV), or -117 dBm, at a bandwidth of 2.4 KHz. Therefore, if -117 dBm is the weakest readable signal, the receiver noise floor, by convention,

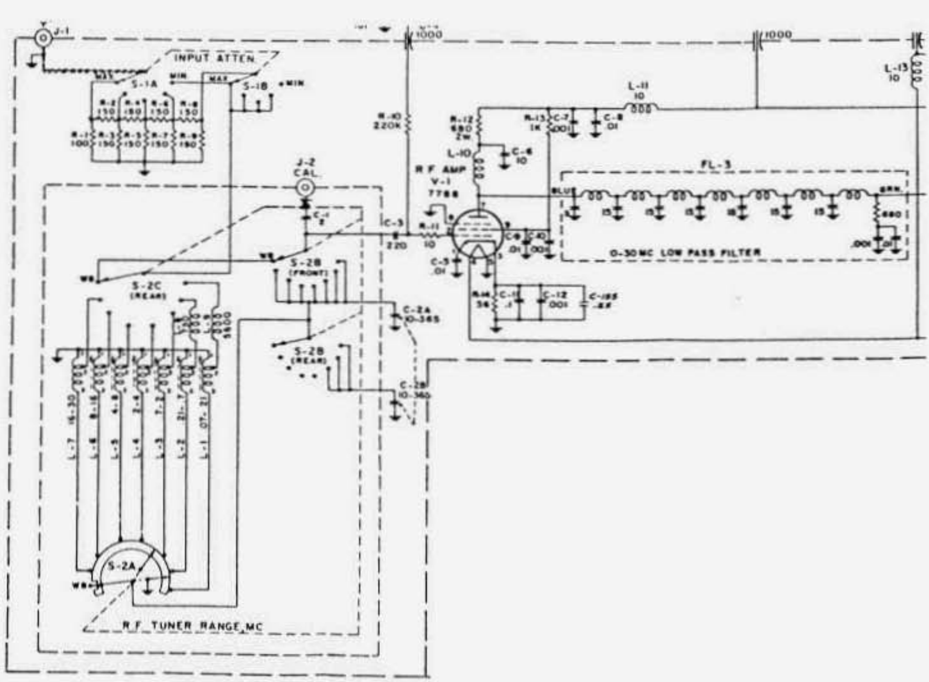

Figure 4. RF amplfier schematic

would be 6 dB lower at .016 uV, or -123 dBm. We're told there is no reason to design for a noise floor below -123 dBm.

To test this assumption, I measured the MDS (minimum discernible signal) of my 75A-4. This was through a commercial-quality directional coupler with 40 dB directivity. The test port was open. Then, I again measured the MDS with a vertical antenna at the test port. The difference between the two measurements gives the amount of noise voltage present. It turns out that the noise voltage developed is nearly exactly what the equation predicted. I repeated this test every 30 days for nearly a year. The amount of noise across the antenna is very nearly the same, summer or winter, day and night, and it varies by no more than 2 dB, which could be my error amount.

My personal opinion is that HF receivers with low noise figures seem to sound and perform "better" than ones with higher noise figures. I can't prove it, but a reduction in performance, or an increase in distortion, could be caused by amplifier noise adding to the receiver's total distortion number. A possible cause might be reciprocal mixing between the amplifier noise components and local oscillator sidebands.

The improvement in performance seen by a quiet HF front end seems to be similar to what is gained by a certain type of FM receiver alignment using SINAD. Hope I'm not preaching to the choir here, but SINAD is an FM receiver sensitivity measurement which uses a log ratio of signal, noise and distortion to noise and distortion. Interestingly, the Mackay manual specifies the 3010 sensitivity numbers as an input voltage required to produce a 6 dB signal to noise over noise ratio.

The first IF amplifier deserves some mention. It is another Amperex hot-rod tube, the 6688. This was similar in design

continued on page 40

A 1927 TNT Oscillator

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In early 1996, I wrote about my 1927 Hartley oscillator using the low-cost and readily available type 27 tube. My hope was that this simple transmitter would encourage more participation in the Antique Wireless Association's (AWA) 1929 QSO Party. In Part 1 of my article (1) I said that the beginner should avoid using the TNT circuit because it usually gives a bad note, often has a tendency to drift and almost always has a pronounced chirp. My Hartley worked well and even though it put out only three watts, I worked 27 stations in eleven states in the 1995 contest. (2) While pondering what to do in the 1996 contest, it occurred to me I should ignore my own advice and build a TNT oscillator! There are several good reasons for the TNT:

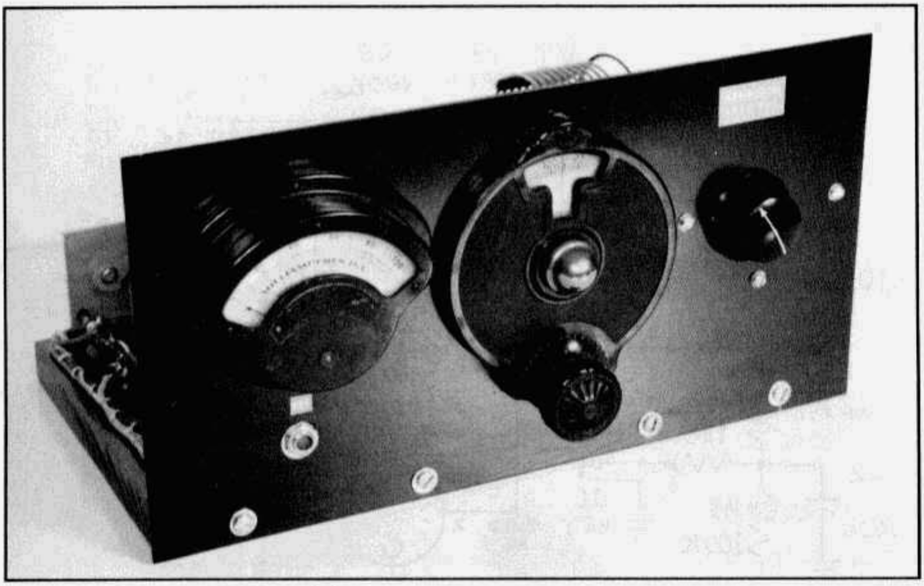
1. The circuit is simple and easily built.
2. There is only one tuning control and no other adjustments are required.
3. It is an 'old-time' circuit.
4. In a contest, it is quicker and easier to send TNT than HARTLEY or COLPITTS.
5. A TNT signal will exhibit some chirp which makes it easier to copy through the QRM.
6. The other contestants are usually "turned on" by the excitement of wanting to work a station that sounds like something out of the 1920s. It should help me score more contacts.

The '27 TNT

The circuit diagram of the '27 TNT is shown in Figure 1. As in my previous design, I chose the tank circuit values to give a bandspread of 1 kHz/dial division. Thus when the dial is set at 80, the frequency is 3580 and when the dial is set to 90, the frequency is 3590. The tuning condenser, C6, is a Cardwell MR-105-BS which was modified by removing all but one of the rotor plates. This called for adding one regular washer plus one .024" washer in front of the rotor plate and then four washers to compensate for the plates removed. Thus modified, the ΔC from zero to full mesh is 17.5 pF. The tank inductance then required to give a tuning range 3500-3600 kHz is 6.47 uH. Most of the old-time self-excited oscillators used 1/4" copper tubing tank coils. But the tank current in this TNT is only about one ampere so I used B&W 3905 coil stock. This inductor material is wound with #12 wire, is 2.5 inches in diameter and has 6 turns per inch. I used 10 turns which gave an inductance of 6.2 uH. After the oscillator was completed, I found that I needed a little more inductance to get the desired 1 kHz/Div so I cemented a piece of ferrite inside the coil. The band-set condenser, C7, is a broadcast type variable chosen because it had a built-in planetary reduction giving a smooth vernier touch when adjusting the frequency calibration. The output link, L3, consists of two turns of #16E wire about 2.4 inches in diameter. The output terminals, J3 and J4, are ordinary Fahnestock clips.

The plate current indicator is a Weston model 267 fan-type meter chosen mainly for its old-time appearance. It happened to have a 0-100 mA scale but a 0-50 mA meter would also fill the bill.

The amount of chirp can be modified somewhat by changing the value of C1. Minimum value should not be less than about 150 pF. I used 300 pF to get a bit more chirp.



Front .... The 1927 TNT oscillator

The Power Supply

Blocked-grid keying is used just as in last year's Hartley but the power supply circuit was modified to give about 7 volts more bias so as to completely cut-off plate current during key-up condition. The modified power supply circuit is shown in Figure 2. The filter condenser was changed from 33 uF to 4 uF to add a bit more old-time spice to the signal. As in the previous Hartley rig, S3, labeled Remote Control, allows the B+ to be turned off by a remote SEND-RECEIVE switch. At my station, this switch also turns the receiver B+ On or Off and connects the antenna to either the receiver or the transmitter. A photo of the power supply was shown in Part 2 of the Hartley oscillator article. (2)

GRID COIL

The grid coil used in TNT oscillators has always been a mystery. So far as I know, no one has ever given a formula or procedure for finding the required inductance. So during my breadboard development, I put in a slug-tuned coil and adjusted it for best results - maximum power output consistent with good stability and minimum chirp. I found that 105 uH was best. You can't have a slug-tuned coil in a 1927 rig so I made a solenoid consisting of 71 turns of #28E on a piece of fiber tubing one inch in diameter. This coil is 1.12 inches long and fell short of the desired inductance so I cemented a small ferrite slug inside the coil to bring the inductance up to 105 uH. The final coil was given several coats of Krylon to keep moisture out.

Construction

The baseboard is made of poplar and measures 12 x 7 x .75 inches. After all the screw holes were drilled, it was stained with Red Devil #44 English Walnut oil wood stain. This was followed by two coats of Minwax clear semi-gloss polyurethane. The front panel is 12-1/4 x 6.5 x .071 aluminum. After the holes were drilled, it was given three coats of Sherman-Williams #00343 yellow primer for aluminum. This was followed by several coats of Nybco 1750 semi-gloss black enamel.

An aluminum plate at the back holds

continued on page 33

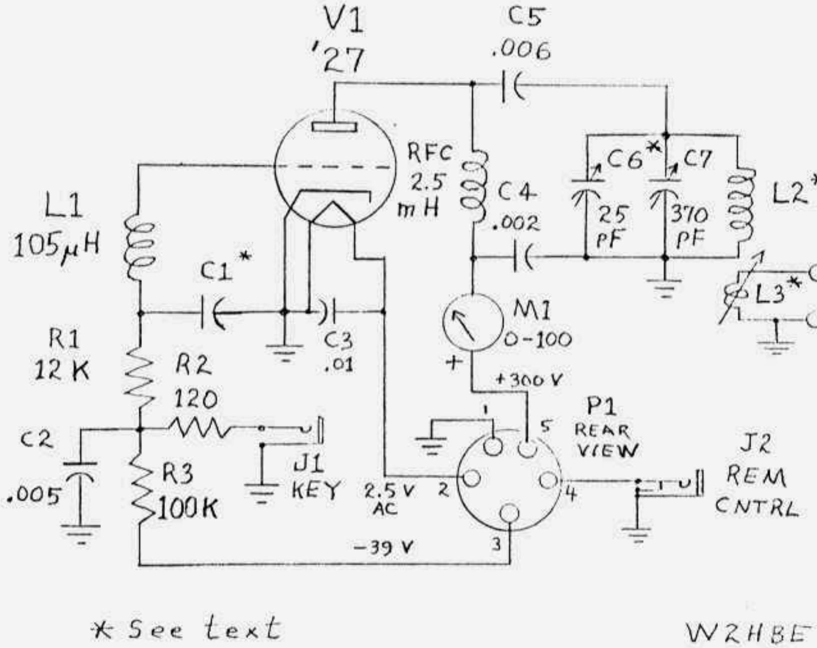
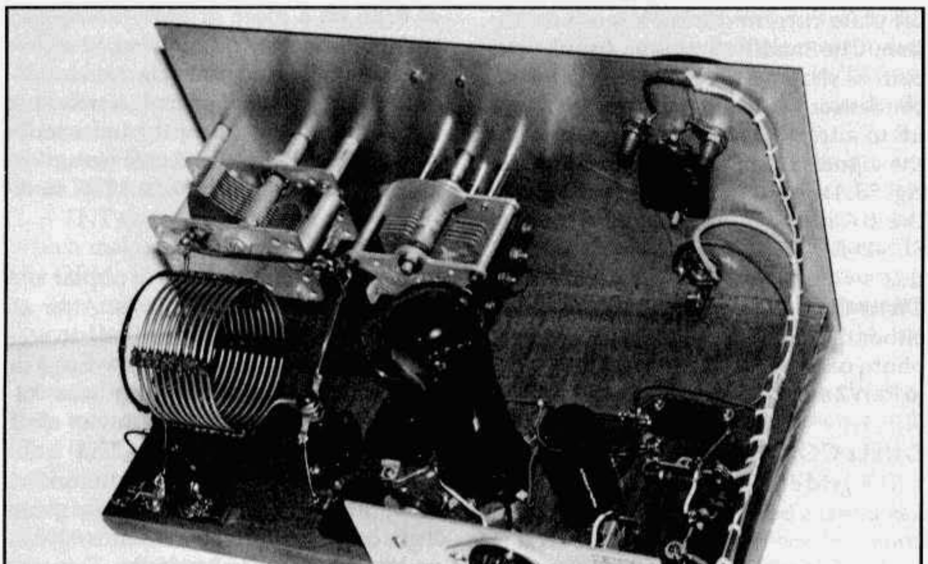


Figure 1. Wiring diagram of the 1927 TNT oscillator



Rear ...... Rear view of the TNT

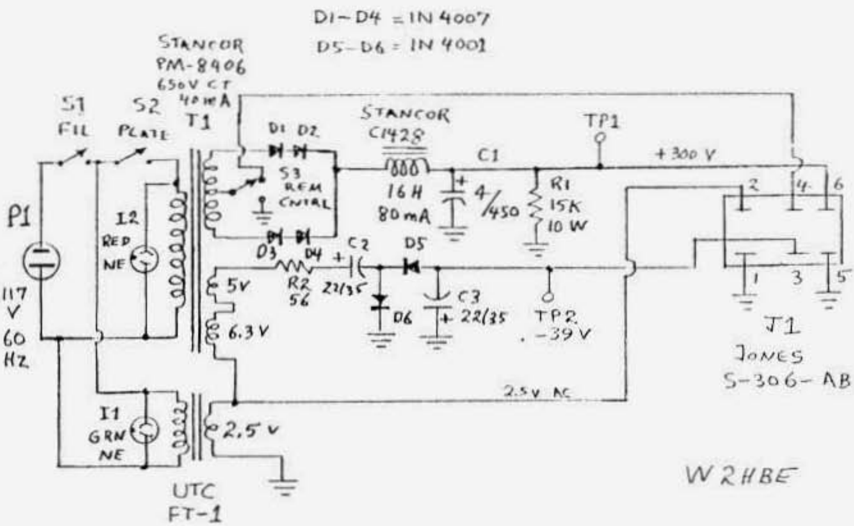


Figure 2. Power supply for the 1927 TNT oscillator

J2, P1 and RFC1. This plate measures 5.5 x 2.75 x .071 inches and is left unfinished except for fine sanding. It is held to the baseboard by three #6 one-inch RH wood screws. RF wiring was done with .07 square bus. Power wiring was done with #20 lacquered cotton braid stranded wire (AES SW-704 etc.).

Several of the components used are not genuine 1927 parts but the rules of the AWA 1929 QSO Party state that a replica transmitter may use some new parts as long as the circuit and the tube are of the correct vintage (pre-1930). (3) If it weren't for this rule, very few 'legal' QSO's would take place in this QSO Party which is really meant to be a fun time for both the old-timers and the young fellows who feel cheated because they came on the scene too late to enjoy using those wonderful old-time rigs. I didn't get my 'ticket' until 1936 and by then everyone was using crystal control. So the 1920 QSO Party gives me a fine excuse to chirp and buzz and have lots of fun. I'm sure you will enjoy it just as much as I do.

Final Comments

I found the completed rig to work exactly the same as the breadboard. I'm not always so lucky. The bandspread was not quite 1 kHz/Div so I needed a little bit more inductance. I took the easy way out and cemented a piece of ferrite inside L2. The output link, L3' must be rather close to L2 (about 1/4 spacing) for maximum power out.

With 300 volts on the plate, no-load plate current is 16 mA. I normally increase coupling until power out is three watts and plate current is 28 mA. Efficiency runs about 37%. Plate voltage falls to about 290 volts, key down.

Contest Results

The 1996 O.T. QSO Party ran on two successive weekends in December 1996 in hopes that at least one weekend would enjoy good conditions. The first Saturday night yielded three QSO,s - heavy rains and static conspired to dampen our fun. The second Saturday night was better - four QSO's! This time we had to contend with the regular Saturday night traffic nets and a multi-

continued on page 39

Real Audio for the R-390A Revisited

by Bill Kleronomos, KDØHG
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Lyons, CO 80540

It's certainly been gratifying over the last few years to note how many people have seized tools and soldering iron and made a great receiver even better by upgrading the audio section according to my original ER article in issue number 42 October, '92. As I noted previously, the RF design of the R-390A is second to none and will never be duplicated, but the audio sections were deliberately designed to deliver only a restricted-bandwidth signal at a level of perhaps a half watt. Not only that, but a close examination of the original Collins designed audio chain reveals that feedback has been added to the amplifiers in a deliberate attempt to further restrict dynamic range. I can only make educated guesses as to why the receiver was designed in this manner, but it suffices to say that while the original audio section was adequate for CW, RTTY and local monitoring purposes through a typical military "tin-box" speaker or communications headphones, it certainly isn't up to the task where quality, wide-range audio is desired with the use of today's limited efficiency high fidelity mini-speakers. And if anyone's noticed, today's speakers are usually 4 to 8 ohms- not 600!

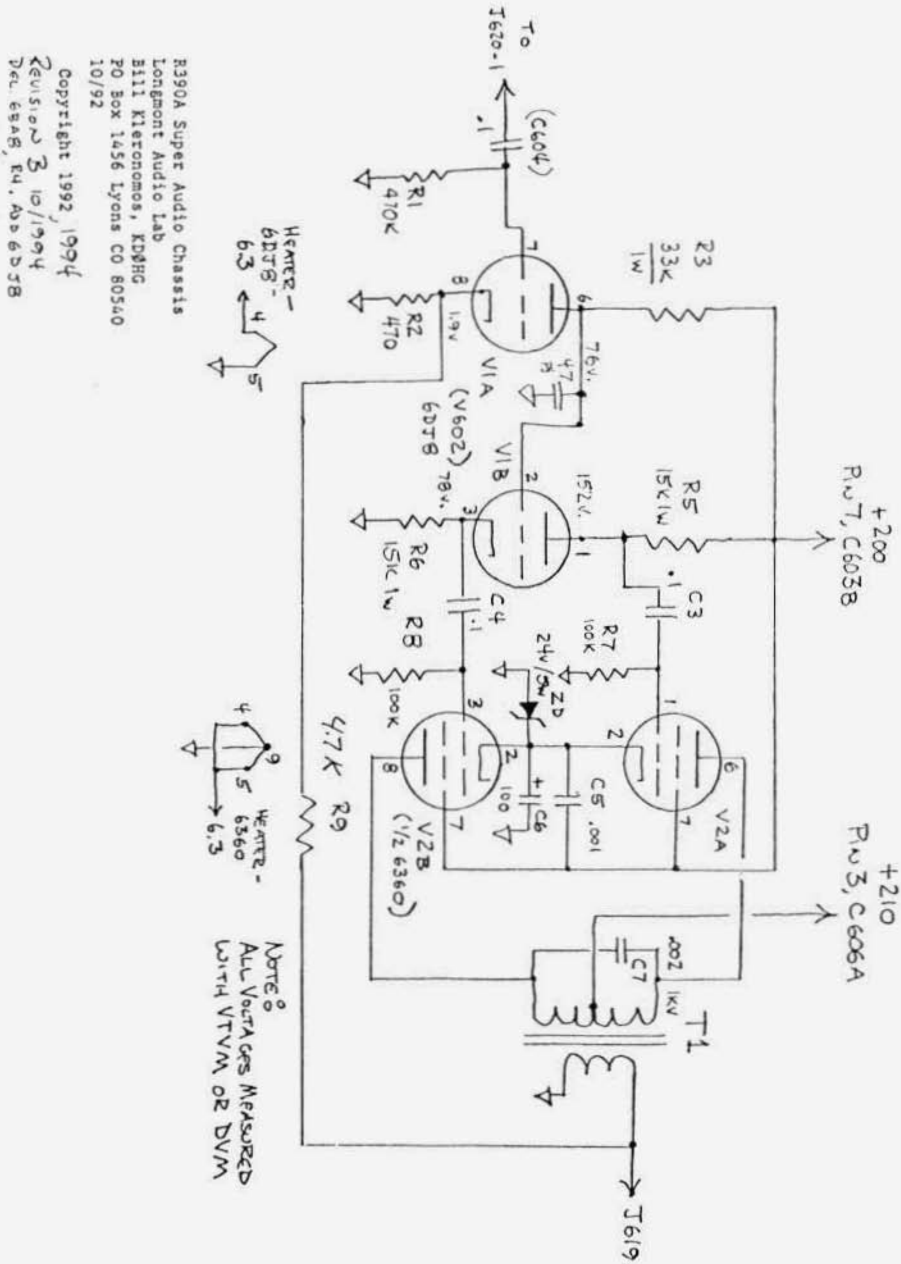
Having modified a number of audio chassis for individuals over the last couple of years, I've gone up the learning curve regarding my original design. With a number of my originally modified chassis having been used for several years, sometimes on 365 x 24 duty, it can be said the circuit is as bulletproof as the rest of the receiver - the tubes and components are run so conservatively that no failures have been reported to me. The tubes in my own receiver still check at 100% in my tester. About two years ago I made some minor revisions to the design in response to a minor annoyance and in an effort to achieve an even better sound.

The annoyance I'm referring to is that the sound quality of the original design was to some extent dependent on the brand of 6BA8 tube used. While the sound with any tube used was always pretty good, nevertheless I felt the circuit should perform in a more consistent manner from unit to unit. I ran a number of 6BA8 tubes through exten-

continued on page 36

Parts List

R1 470K, 1/2W
R2 470,1/2W
R3 33K, 1W
R5, R6 15K, 1W
R7, R8 100K, 1/2W
R9 4.7K, 1/2W
Cl (C6O4) .1 uF metal film, 100V
C2 33 to 47 pF, 300 volt
C3, C4 .1 uF 250 volt
C5 .001 uF 1 KV ceramic
C6 100 uF, 25 to 30 volt electrolytic
C7 .002 uF, 500 volt metal film
T1 8000 ohm to 8 ohm PP output transformer, @ 8 watts. Antique Electronic Supply #PT-291 suggested.
VI 6DJ8 or 6922
V2 6360
ZD 24 volt, 5 watt zener diode


R390A Super Audio Chassis
Longmont Audio Lab
Bill Kleronomos, KD0HG
PO Box 1456 Lyons CO 80540
10/92
Copyright 1992, 1994
Revision 3 10/1994
Del 6BA8, E4. Add 6DJ8
To J620-1
(C604)
.1
R1 470K
R3 33K 1W
R2 470
1.9V
76V.
47
V1A
(V602)
6DJ8
V1B
78V.
152V.
R5 15K 1W
+200 Pin 7, C603B
R6 15K 1W
C4 .1
C3 .1
R7 100K
24V
ZD
R8 100K
4.7K
R9
V2A
V2B
(1/2 6360)
C5 .001
C6 100
+210 Pin 3, C606A
C7 .002 1KV
T1
J619-9
Heater - 6DJ8 - 6.3
Heater - 6360
6.3
Note: All voltages measured with VTVM or DVM

Real Audio for the R-390A from page 34

sive tests, but I could never attribute any one tube characteristic to a particular sonic quality, and frankly, to this date I'm still baffled! My resolution of this problem was to go back to the drawing board and replace the 6BA8 with the audiophile-friendly 6DJ8 or 6922 dual triode. This change makes the sound of the chassis much more consistent and with the added benefit of what I perceive as a smoother sound, probably due to the well-regarded sonic signature of a triode as compared to a pentode.

Revising one of the chassis using the 6BA8 is relatively easy, requiring the removal of the unneeded screen dropping resistor and bypass capacitor. The stabilization capacitor at the grid of the former 6BA8 will need to be connected from grid to ground instead of from grid to plate as it was, and pin 9 of the socket, the internal shield of the 6DJ8, will need to be grounded. The plate and cathode pin-out of the 6DJ8's second section (1 & 3) is the opposite of the original 6BA8's triode section, so the wires will need to be swapped. The stabilization capacitor I referred to may be any value from 33 pF to 47 pF, mica or ceramic, but don't leave it out - the 6DJ8 can be one hot VHF amplifier/oscillator so don't give it an excuse to fly.

R3, the plate resistor for the first amplifier stage needs to be changed from its former 100 K to 33 K, 1 watt, and R2, the cathode resistor needs to be changed from 820 ohms to 470 ohms, 1/2 watt. R1, the grid resistor for the first triode section may be up to 470 K in value - you can leave the factory-original 470 K in place that was connected from ground to pin 7 of V602 (or V1, the new 6DJ8). Finally, there was a typo error in the original ER article - note that the cathode bypass capacitor of the 6360 output stage is supposed to be 100 uF, 25 or 30 volts and not the 10 uF originally specified (and corrected the following issue). With parts on hand, this whole revision of the original design should only take an hour or two.

Due to the overall negative feedback loop, the original article's cautions about the polarity of the output transformer are still valid. If the circuit oscillates, squeals, or makes funny noises on turn-on, reverse the winding of either the primary or secondary of the output transformer. Sometimes there won't be an oscillation but instead the audio may be "peaky" sounding, distorted, or excessively loud where just cracking the volume control may blow you out of the room with audio. Reversing a winding of the transformer will cure the problem. In any case, try the connection both ways and choose the winding polarity of the OPT that results in the least, or smallest audio output for a given setting of the volume control.

The brand of 6DJ8 used isn't critical - you may use the mil-spec 6922 version if it suits you. I've personally been very pleased with the sound quality of the economy-priced Russian 6DJ8s sold by AES and others to the audio industry. They seem to be durable; I've been using one in my own receiver for a year and a half with no problem. I've also discovered there is a British military spec equivalent to the 6360 output tube with the part number CV2798. I've used them as available and they work well; it may be easier to find and less expensive than the 6360 in some parts of the world.

As was the original, this revised version of my modified R-390A audio chassis is perhaps the single most worthwhile change one can make to a great receiver - I urge reviewing the original ER article before proceeding with this project for the first time. Happy listening! ER

R-388 US Military Contract List

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A few years ago, I bought my first R-390A from Rev. Joe Pinner, KC5IJD. Being a mechanical engineer by trade, I was impressed by its complexity, performance, and robust construction. About that same time, an article ran in Electric Radio about the history of the R-390A. Within that article was a list of contracts and numbers produced. I became interested in the history of the radio, so I began a most informal poll asking users for their contract and serial numbers in an attempt to verify the R-390A contract information.

It didn't take long to realize that there were many holes and inaccuracies in the R-390A data best known to that date.

Along the research trail, I ran into Wally Chambers, K5OP, and Les Locklear. They were keeping rig data as well, so we all pooled our slips of paper and bar napkin notes to come up with the most accurate R-390A list compiled to date. The results of this research have recently been contributed to Electric Radio by Les Locklear.

A natural offshoot of the R-390A research activity was contract data on other radios, and I began keeping information on most of the classic Collins receiver designs. I will report out on these different radios in future issues of Electric Radio, but in this issue, we will cover the R-388.

Many readers of these pages already know that the R-388 is the military version of the Collins 51J-3. This radio covers .500 Mcs to 30.5 Mcs in thirty bands of 1000 Kcs each, AM and CW. These radios were very popular in industrial and military installations. They were also available to amateurs and SWL's, but like most quality gear of the period, it was expensive for amateurs. This is a comparison of R-388 specifications compared to the better known R-390A.

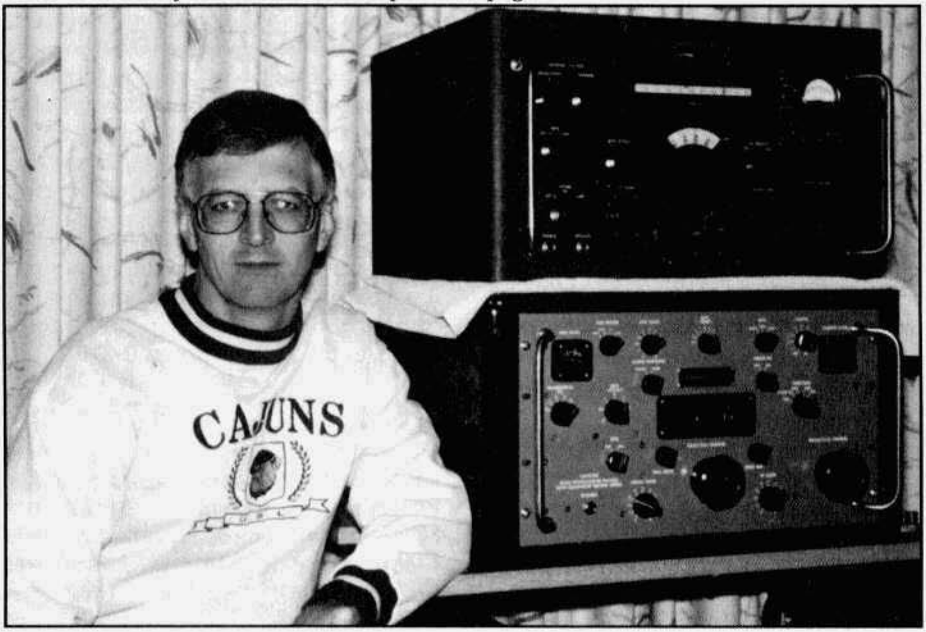
	R-388	R-390A
Freq Coverage	0.5-30.5 Mcs	0.5-32.0 Mcs
Dial	analog	mech/digital
Fixed IF	500 Kcs	455 Kcs
Filters	tuned circuit	mechanical
Weight	43 lbs	75 lbs
No of tubes	18	25
PTO	70E-15	70H-12/others
PTO Range	2.0-3.0Mc	2.455-3.455Mc
Audio	1.5W, 4/600Ω	.5W, 600Ω
Power Req'd	85W	220W
No. of Ovens	None	Three
CW audio filter	No	Yes
Construction	single frame	modular
Tuning torque (in/lbs)	0.4	1.0
US Mil ordered, approx	10,600	54,000

In operation, the user will find that the R-388 is easier to tune. The operation of the tuning knob is very smooth, however there is no significant flywheel effect as found on a Hammarlund SP-600. An average R-390A, on the other hand, requires a more deliberate twist of the tuning knob to overcome the friction of all the works, and is less attractive as a band surfer. From an overall performance standpoint, the R-390A is hard to beat.

Shown below is the US military contract information that I have to date (this article will likely scare up more). Naturally, this doesn't include any production for civilian use, or numbers for military orders for US allies.

The high serial numbers shown indicate the highest number contributed to

continued next page



The author with his two of his favorite receivers: R-388, top; R-390A, bottom.

me by an owner, so it can be inferred that at least that many were made under each contract. A high s.n. of "0" means that from various pieces of documentation this is a known contract, but no examples surfaced in my survey.

Compiling an R-388 contract list is like counting stars; there is a finite number out there, but each time you count, the number gets higher. It would appear that Uncle Sam placed many orders of small numbers. Interestingly enough, the R-388 orders go out well beyond the dates of availability of the new R-390 and R-390A. Perhaps this was for reasons of economy or ease of use.

According to the information available, all R-388's were made by Collins.

Not shown in the list below is a contract for R-388A's (same radio, but with mechanical filters, equivalent to the Collins 51J-4), NObsr-69046. I don't have any serial number data for this contract, however civilian serial numbers as high as 7000 have been contributed. There were likely some radios made for government agencies other than the military.

Future installments will cover the R-389, R-390, R-391, R-392, and R-725.

Any info on these rigs contributed now would make the future installments all the more complete. **ER**

R-388 US Military Contract List

NObsr-49132 (AN/URR-23A) 91
NObsr-52527 (AN/URR-23A) 180
19624-PHILA-50 976
1908-PHILA-51 355
3096-PHILA-51 8
3131-PHILA-51 919
3155-PH-51 1379
3164-PH-51 153
3167-PHILA-51 491
3357-PHILA-52 1672
3362-PHILA-52 109
3469-PHILA-52 20
3470-PHILA-52 1449
25635-PHILA-53-36 2193
25067-PH-54-55 363
21318-PH-56 88
30951-PH-56 0
30951-PHILA-57 0
37003-PC-62 171
Total of high serial numbers 10617

Designing the Collins 30K from page 14

supply before the 866A mercury vapor rectifiers had time to warm up. I tried a scheme of connecting the filament of a 12H6 twin diode in series with the bleeder of the bias supply and operating a relay from current passed by the diodes. The 5R4GY bias rectifier had to warm up before the 12H6 started to warm up which gave a 22 second delay. It would also provide protection from bias supply failure. The use of the 12H6 for extra delay was discarded to save cost, most of which was due to the need for a 300 mA bias supply instead of 75 mA. This deletion reduced the delay to approximately 5 seconds which meant that the operator had to be the "30 sec. timer".

The Boonton Q-Meter was a very important RF test instrument. We could use it to measure coil inductance and Q, capacitance, and coefficient of coupling between coils. A neon bulb on the end of an insulating rod was also very helpful. We used it to search out parasitic circuits. HF caused a pink glow, a LF parasite caused a yellow glow and a violet glow indicated a VHF parasitic oscillation. We could follow the resonant circuit path by moving the bulb along the circuit path where the color was strongest.

Models 30K-2, 3, 4, and 5

These were all intended for commercial service. There were some users who wanted to be able to communicate between different locations independently of the telephone system. One example was the Corps of Engineers who controlled the water flow through dams. All they needed was a day and a night frequency. These transmitters were crystal controlled with two sets of tuned circuits. Relays were used to switch the tuned circuits from one frequency to the other. They used single-ended pi-networks for the RF output networks. As I remember, most of the differences between models were related to methods of remote operation.

Concluding Remarks

It was fun working on the development of this transmitter. The Company allowed us quite a bit of freedom to use ingenuity in our designs. Most of the engineers at Collins were hams and they frequently stopped by to see how it was coming. I had lots of free advice. My office mate was Lou Couillard who was developing the 75A receiver at the same time. A color photograph of the 30K in the laboratory appeared on the cover of the November issue of *RADIO NEWS*. Clyde Hendrix, WØHBG, came to Cedar Rapids to personally take delivery of serials No. 1 of the 75A and the 30K with the 310A exciter. Years earlier he had purchased a Collins 30FXB when the company was just getting started. **ER**

A 1927 TNT Oscillator from page 33

tude of RTTY signals. My final score showed 30 valid exchanges and two QSO's with fellows who were simply curious. I think the chirpy, raspy TNT signal was a success. Several people commented on it - N2EZ said it was the lousiest signal on the band! Hooray! Halfway through the contest, I loosened the antenna coupling slightly, dropping the output to 2.5 watts. This seemed to steady the signal a bit. I feel that the project was a complete success except for one thing - I didn't receive a single OO (official observer) notice! Maybe next year I'll short out the filter choke! **ER**

References

1. ER #82, Feb. 1996
2. ER #83, March 1996
3. Old-Timer's Bulletin, Antique Wireless Ass'n, Dec. 1987

Mackay Marine 3010C from page 29

to the 7788, but is much smaller, uses only one frame grid, and has "only" 18,000 uMhos of transconductance. Its job is to preserve the noise figure of the front end and compensate for the insertion loss of the first mixer and the 1st IF filter. This tube was also used in broadband amplifiers and is equally resistant to IMD. I recently obtained a few of them military surplus from Fair Radio, and they have a 1985 date code and the boxes were bar coded. My tax dollars at work!

A unique method was used to inject the second LO at the second mixer. A cathode follower couples the second variable local oscillator to the secondary "hot" end of a broadband transformer. The first IF is coupled to the primary, and the cold end of the secondary is the coupling to the second mixer grid circuit. This was called "series" injection, and provides super isolation between all of these stages.

There is no gain between the second and third mixers, only a crystal bandpass filter. Up until the input to the third mixer, the low noise figure of the front end has been preserved. The third mixer is a conventional self-excited 6BE6 crystal converter which is followed by the mechanical filters. Two stages of conventional AGC-controlled IF amplification follow the filters, using the familiar 6BA6.

A very simple and conventional AGC detector is used, which develops bias across the load of a 6AV6 diode. This is similar to AGC circuits in hundreds of different communications receivers, but the time constants are chosen just right to produce nearly ideal attack and release characteristics. Audio rises less than 8 dB for a 60 dB change in RF input.

The product detector is equally simple. It uses half of a 12AT7, and injects BFO voltage at the cathode. Mixing is in the plate circuit. The B+ to this stage is heavily decoupled, as it should be.

I don't like the audio output stage. The 6BF5 was listed for renewal purposes only in my 1960 RCA handbook, and I can't figure out why the 3010 uses it. Maybe they had some left over from another project and wanted to save on production costs. Whatever the reason was, the audio amplifier goes into distortion at low input levels, and has a restricted range which makes it tiring to listen to for long periods. Too bad they didn't get someone from National to do the audio on this rig. After all, we don't want Sparks getting too grouchy!

This pretty much wraps up my observations of the Mackay 3010C. I'll have to start looking around for one, now that I know a little more about them. Maybe an ad in the 'ol ER is a place to start?? **ER**

References

This article was prepared with material gathered from the following sources:

Wireless Communication In The United States, Thorn L. Mayes, The New England Wireless and Steam Museum, 1986

The Telegraph, Lewis Coe, McFarland and Company, 1993 (This book is great, and I highly recommend it.)

Wireless Radio: A Brief History, Lewis Coe, McFarland and Company, 1996

Operating and Maintenance Instructions: Receiver Type 3010-B, Mackay Radio and Telegraph Co., Marine Division, January 1963

Marine Receiver 3010C Mod 2 With SSB BFO, ITT Mackay Marine, December 1971

QST, ARRL, April 1967

Effects of Noise in Receiving Systems, Rohde (DJ2LR), Ham Radio Magazine, November 1977

Electronics, McGraw Hill, November 10 1961

Personal correspondence, N6CSW and Sandy Blaize, W5TVW

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FOR SALE: R-390A/URR Orig.1961 Maintenance Manual TM11-5820-35,189 Pgs.,$28 incl.dom Priority Mail. Aben POBox 4118 Jersey City,NJ 07304 Avidov@juno.com

FOR SALE: Heath SB-220 amp, good condx, no mods,orig. manual - $390. John, (518) 272-3631.

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FOR SALE: Gates 500T broadcast xmtr, works great on 160M - $700. Steve, KA9QLF, Jacksonville, IL, (217)243-3920, swenger@fgi.net

FOR SALE: Western Electric 451A-1, 250 watt broadcast xmtr, PU only in NE CT - asking $600. Fran, KA1DD, MA, (508) 464-5500.

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Lee, W9VTC, (847) 439-4700 (d), 726-1660 (n)

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WANTED: Still collecting early WW II radar equip. & manuals, what have you. Allan H. Weiner, 97 High St., Kennebunk, ME 04043. (207) 985-7547

WANTED: QST, CQ, Radio Craft & Radio News magazines, 30s, 40s, 50s. Advise price + shpg. Beni Fernandez, KP4DN, 1674 Atlas St., Summit Hills, PR 00920.

WANTED: Good R-389, R-390A and SP600JX. Mitsugu Shigaki/ 2825-2, Jozan Kamidai Machi Kumamoto.860, Japan. FAX :JAPAN (0)96-329-4601, fle83163@pcvan.or.jp

WANTED: Info on military entertainment radios, photographs, manuals, personal histories on use, or any set you may have to sell. Henry Engstrom, KD6KWH, POB 5846, Santa Rosa, CA 95402. (707) 544-5179

WANTED: Collins - Amateur catalogs, sales literature, manuals, promotional items & Signals. Richard Coyne, POB 2000-200, Mission Viejo, CA 92690.

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WANTED: Mics. EV605, 638, 641; Astatic T-3; Shure 707A, 520, 545, 533VC; Turner CX/BX, CD/BD, VT-73. Will buy not working. Tom Ellis, Box 140093, Dallas, TX 75214. (214) 328-3225. Fax 328-4217. 74053.3164@Compuserve.com

WANTED: Meter movement for Heathkit tube tester Model IT-17; Collins CC-2 and CC-3 Suitcases. Chuck, N7UVZ, NV, (702) 882-9141 after 1800 PTZ

WANTED: BC-312 dynamotor, SCR-193 accessories (cables, canvas covers, junction boxes, CH-60 case, etc.) or documentation to recreate them. Chris Bowne, AJ1G, 3 Carnot Ct., Pawcatuck, CT 06379. radiobwn@riconnect.com

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WANTED: Atlas 210X & parts for Atlas xcvrs in any condx. Matt, KD8ZB, MI, (616) 429-2334, 6-9 PM EST.

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WANTED: Tektronix memorabilia & promotional literature or catalogs from 1946-1980. James True, N5ARW, POB 13280, Maumelle, AR 72113. (501) 851-8783, FAX 851-8784.

WANTED: Heath xtal sets; early ham & shortwave equip., literature, accessories, broken or parts units; any Heath amateur gear. WA5THJ, Rt 9 Box 163, Alvin, TX 77511. (713) 331-2956

WANTED: Fair to good condx. E.F. Johnson Valiant I or II . Will pay above average price. J. Costello, WA5HSI, LA, (504) 889-2424.

WANTED: Vintage AM equipment for personal use, must be collector quality or mint. Prefer Collins, will consider others. Bob Tapper, K1YJK, Box 61538, Denver, CO 80206. (303) 740-2272, FAX 777-6491

WANTED: Yeasu YC-601 digital display for my mint FT-101E. Must be restorable to a 9. Will pay top dollar for a good one. Randy Best, WA7CPA, AZ, (602) 266-2256

WANTED: Heath gear, unassembled kits, catalogs and manuals. Bill Robbins, 5339 Chickadee Drive, Kalamazoo, MI 49009. (616) 375-7978. billrobb@net-link.net,

WANTED: Mil HDBK 161. **FOR SALE:** NOS 4CX250B - $45; 841 - $15; 8233 - $25. Joseph Pinner, 201 Ruthwood Dr., Lafayette, LA 70503. (318) 981-7766, kc5ijd@net-connect.net.

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WANTED: RBB-2 schematic, alignment instructions or manual, copies OK. Henry Rogers WA7YBS, POB 511, Virginia City, NV 89440. (702) 847-9047

FOR SALE: T-Shirts w/Johnson Viking logo - $15, state size. Viking Radio Amateur Radio Society, POB 3, Waseca, MN 56093.

FOR SALE: Used technical books - radio, electronics, math, military, magazines, etc. List: $1 (stamps OK). Softwave,2 Dept. ER, 1515 Sashabaw, Ortonville, MI 48462

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FOR SALE: Drake 1A - $275; Collins 32V2 - $475; Collins 310B - $250; Clegg Zeus - $200. PU only. **WANTED:** SX-88; RME-9. Steve, K6PFW, CA, (909) 985-1062.

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FOR SALE: 35 Johnson 4 inch ceramic ladderline insulators - $2 ea plus shpg. Dennis Baker, KE0QM 15113 S Blackfoot Dr., Olathe, KS 66062. (913)782-9092, wbfim@sound.net.

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FOR SALE: Heath CW xcvrs, HW-7 - $80; HW-99 - $250. + shpg. Steve Whited, 3637 W. 71st St., Indianapolis, IN 46268. (317) 298-9967

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FOR SALE: RCA AR-88; R388; 18051. Joe, K2QPR, FL, (407) 220-7362

FOR SALE: The tubes you need, NIB. Send SASE for new list T, PL-68 for Collins, Amphenol plugs, sockets, socket extenders, high-voltage ceramic capacitors, Teletype repair parts. Typetronics, Box 8873, Ft. Lauderdale, FL 33310-8873. (954) 583-1340, Fax 583-0777. Fred Schmidt, N4TT

FOR SALE: Collector piece, near mint Allied Knight T-150 w/near mint instruction manual, securely shipped anywhere, double boxed - $320 or BO. Robert, CA, (415) 367-1660 any time or (818 330-8913

FOR SALE: Hallicrafters SX115, very clean, complete, untested - $350 + shpg. Paul Adams, 11 Lake Rd. E, West Yarmouth, MA 02673. (508) 790-2780

FOR SALE/TRADE: Ameco TX-86; Heathkit Seneca VHF-1, DX-60, HW-16, HG-10, VF-1; Johnson Ranger, Challenger, SASE. Sam Timberlake, POB 161, Dadeville, AL 36853. (205) 825-7305. stimber@worldnet.att.net

FOR SALE: 75A-4 MHz drum decals, 20.5 or 20.8 MHz (you specify), buff color, install instructions - $8.50 ppd. W3HM, Rt 3 Box 712, Harpers ferry, WV 25425

FOR SALE: Negative cycle loading circuit, instructions - $2; Protect modulation transformer, extend positive peaks. WB8BEM, 410 Robinhood Dr., Florence, Al 35630.

FOR SALE: Collins 51J series drum overlay - $10 ea, specify which. Ron Hankins, KK4PK, 555 Seminole Woods Blvd., Geneva, FL 32732. (407) 349-9150

FOR SALE: The Bighorn Museum of Amateur Radio has been selected by the family of the late Hank Adams, WØAEE to liquidate his estate. Please send a #10 SASE with 2 units of postage for a rather large list. P.O. Box DX, Genoa, CO 80818. kopv@juno.com

FOR SALE: Antique radio, amateur radio + electronics related books, 200 titles, good prices & service. Paul Washa, WØTOK, 4916 Three Points Blvd., Mound, MN 55364-1245. (612) 472-3389

FOR TRADE: Heath HP-14 DC sply for HA-14 mobile linear amplifier w/orig manual & cables, exc condx. Trade for exc Eimac 3-1000Z for my BTI amplifier. Fran, KA1DD, MA, (508) 464-5500.

FOR SALE: Books, some on very early radio, some technical, some Amateur Radio. Send SASE for list. Fenton Wood, 109 Shoreline Dr., Star Harbor, Malakoff, TX. 75148 (903) 489-0204

FOR SALE: Repair! Radio repair, tube or solid state, reasonable rates. Jim Rupe, AB7DR, Western Amateur Radio Repair Co., (WARRC), 998 Whipple, Grayland, WA 98547-0697. (360) 267-4011

FOR SALE: Vintage tubes, (833A, VT4C, etc.); assorted radio/wireless telegraph books & magzines, 1880-1935. SASE list. Jan Perkins, 524 Bonita Canyon Way, Brea, CA 92621.

FOR SALE: National 300 rcvr, good condx, works very good - $200 + shpg. Bob, W7ZSB, UT, (801) 943-7721

FOR SALE: RME 69 cabinet, exc - $50; collector quality S-line - $1100. **WANTED:** Collins 312B5, 399C1 VFO. K5YY, AR, (501) 756-5010 eves only.

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FOR SALE: Attn Swan collectors, nice clean 500C w/117XC, VX2, 410C VFO w/22B adptr. Includes orig manual & factory brochure - $325 + shpg. Clint, K7LCT, MT, (406) 248-8687.

FOR SALE: R-388 - $255; SX-28, internal mods, no holes - $145; AF-67 - $95; TMC VOX-(1?) VFO - $145. U-ship. WA7HDL, ID, (208) 756-4147 after 0030Z.

WANTED: Link Radio paperwork, 500C manuals, catalogs, ads, copy OK; 2210 xcvr. Larry, W6WUH, Box 1139, Occidental, CA, 95465. (707) 874-1000

WANTED: Very early Hallicrafters and Hallicrafters/Silver Marshall equipment including Skyriders with entire front panel dull aluminum color, S-30 radio compass, S-33 Skytrainer, S-35 panadaptor, wood console speakers - R-8 & R-12, HT-2, HT-3, BC-939 antenna tuner, parts, advertising signs, paper memorabilia of Hallicrafters. Also want RCA model AVR-11 airport tower receiver. Chuck Dachis, WD5EOG, "The Hallicrafters Collector", 4500 Russell Dr., Austin, TX 78745. (512) 443-5027

WANTED: Info on the old Allied Radio in Chicago. I'm researching the company for an article in ER. Need anectodes, stories, history, etc. Kurt H. Miska, N8WGW, 3488 Wagner Woods Ct., Ann Arbor, MI 48103. (810) 641-0044 wk. FAX (810) 641-1718. khm@tir.com

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

WANTED: Collins 312B-2 console & CV591A SSB adapter. Butch, KØBS, 5361 St. Mary Dr., Rochester, MN 55901. (507) 288-0044

WANTED: DX-20; a January 1963 QST mag; Alpha 76PA w/o tubes. Ron, GA, (770) 664-6931.

WANTED: Kleinschmidt teleprinter models: 311, 321, (AN/FGC-40, AN/GGC-16, AN/UGC-39...) Tom Kleinschmidt, 506 N. Maple St., Prospect Hts., IL 60070-1321. (847) 255-8128

WANTED: GPR 90, 91, 92; Hallicrafters SX-88; Eddystone rcvr's. James B. Geer, 1013 Overhill, Bedford, TX 76022-7206. (817) 540-4331

WANTED: Military radios: Canadian WS #29 (CDN) A set; eastern European RM-31 set. Leroy Sparks, W6SYC, 924 W. McFadden Ave., Santa Ana, CA 92707-1114. (714) 540-8123

WANTED: Mics by Altec, Neumann, AKG, WE, Sony, any vintage; tube compressors/limiters; will trade my rare NOS tubes for mics. Mike States, Box 81485, Fairbanks, AK 99708. (907) 456-3419 ph/fx

WANTED: Old tube amps & xfmr's by Western Electric, UTC, Acro, Peerless, Thordarson; Jensen, JBL, EV, Altec, WE spkr's. Mike Somers, 2432 W. Frago, Chicago, IL 60645. (312) 338-0153

WANTED: For my 40s/50s HRO RX, black wrinkle desk spkr and S meter (RX w/good meter considered) Thanks. Greg Greenwood, WB6FZH, Box 1325, Weaverville, CA 96093. (707) 523-9122 msg#

FOR SALE: Collins repair: FCC Licensed Technician, we repair the Collins Gray Line i.e. S-Line, KWM-2/2A etc. & other select models. Merle, W1GZS, FL, (352) 568-1676

FOR SALE: New list -hundreds of manuals, schematics and service information. Send 2-stamp LSASE. David Crowell, KA1EDP, 40 Briarwood Rd., North Scituate, RI 02857-2805. (401) 934-1845

FREE: Send for my free illustrated meter list. **WANTED:** Meter literature & brochures. Chris Cross, Box 94, McConnell, IL 61050.

FOR TRADE: Two good RCA 833A's for one Taylor 833A. John H. Walker Jr., 16112 W. 125th St., Olathe, KS 66062. (913) 782-6455. johnh.walker@alliedsignal.com

FOR SALE: Globe Sidebander DSB 100, fair, rare - $550; SBE 33 - $100 trade. Swan 350/ps, rare - $360; Yaesu FT101 - $225; Heath DX 60B/HG10B, nice - $225; Clegg 99, fair - $80. All+ shpg. Jim, W7DDF, 998 Whipple, Grayland, WA 98547. (360) 267-4011

FOR SALE: R1051, 1051B, 2-30 MHz decade tuned military rcvr rack mount, highly stabel AM/FSK/CW/USB/CSB/LSB, 115V - $250, tested guaranteed, + shpg. Tony Snider, VA, (757) 721-7129.

FOR SALE/TRADE: Xmt'g/rcv'g tubes, new & used - 55¢; LSASE for list. Many thousands added lately. I collect old & unique tubes of any type. **WANTED:** Taylor & Heintz-Kaufman types & large tubes from the old Eimac line; 152T through 2000T for display. John H. Walker Jr., 16112 W. 125th St., Olathe, KS 66062. (913) 782-6455. johnh.walker@alliedsignal.com

FOR SALE: Xmtrs: BC 610H, ready on 160M - $475; TN 339/GR ant. turner for 610 or T368 - $165; BC 610E, ready on 40M w/VFO WW II army vet - $525; BC 610C, ready on 75M w/VFO - $500; Elmac AF67 all band w/ps - $150; home brew 813 rig w/6ft. rack all band VFO - $275; Hammarlund HX500 SB exciter NBFM - $175; rcvrs: Drake mod. 2B multiplier w/mod. 2BQ - $150; Collins 75A2 - $295; Hammarlund SP600 rack mount - $225; National HRO 60T 9 coil units - $425; BC 312N w/matching spkr - $170; BC 342 - $150; BC 312N - $150; BC 224F n/w - $45; BC 348R - $45; 3-BC 221 freq. mt. - $25 each; I-CKB - $25; Super Pro WWII AM/rec - $125; RCA Radioal 2 rec, yr 1923 mod. AR800 - $395; Atwater Kent rec. mod.32 - $135; Atwater K. rec. mod.60 - $100. PU only. Bill Jenkins, W9WHL, Rt.11, Box 88, Bedford, IN 47421. (812) 275-2098 EST after 5:30 PM

FOR SALE: SP-600JX - $130; Zenith Transoceanics H-500 - $100; Royal 1000D. Carter Elliott, WD4AYS, 1460 Pinedale Rd. Charlottesville, VA 22901. (804) 979-7383. celliott14@aol.com

WANTED: TMC GPR-92 HF Rcvr. Hank, W6SKC. (602) 281-1681 FAX: 281-1684

WANTED: Clean Johnson Rangers, Valiants, Invaders, Five Hundreds, 6N2 Thunderbolt; SSB adapters, top dollar for clean gear. Gene, AA5JR, AZ, (520) 646-0370, eves

WANTED: 2 Collins Rack Mounts for KWM-2A. Cory/N2AQS/AFA4TZ, 1000 E. 14th St./178, Plano TX 75074-6249, 972-751-7535 (24 hrs).

WANTED: SP400, RME, EH Scott rcvrs, only in very good condition. EA4JL, contact in the States, Kurt Keller, CT (203) 431-6850

WANTED: BC-611 &/or spare parts. Andy, WA4KCY, 105 Sweet Bay Ln., Carrollton, GA 30116. (770) 832-0202. wa4kcy@usa.net

WANTED: Heathkit AK-5 spkr for RX-1 Mohawk; Hallicrafters R42 spkr for SX-42; National spkr for NC109; manual for HP203A function gen; manual for HP8556A LF section (plug-in for HP140T). Reasonable prices please. Bob Smith, KC4WJO, 14779 Kogan Dr., Woodbridge, VA 22193-3314

WANTED: Mics: Shure CR80, 510, 705, 707, 520, 545; EV 905, 605, 638, 641; Astatic JT-30/40, Hi/dual-Z. Tom Ellis, Box 140093, Dallas, TX 75214. (214) 328-3225, Fax 328-4217, 74053.3164@compuserve.com

WANTED: Collins 75A4, 75A3, Heath Mohawk & National NC-400 rcvrs; manual for 75A2 (6BE6 mixer type). Jeff Wilder, W8XQ, 2730 Mckinley, Kalamazoo, MI 49004. (616) 381-4133

WANTED: Huge Navy equipment: shipboard & shore radio, radar, & sonar, mint thru junkers. William Donzelli, 304 S. Chester Ave., Park Ridge, IL 60068. (847) 825-2630, integrat@ust.com

WANTED: Military electronics, RDF, radar, communications, test, manuals, literature, etc. What have you got? William Van Lennep, POB 211, Pepperell, MA 01463. (508) 433-6031

WANTED: Watkins-Johnson or Communications Electronics Inc. info, catalogs, manuals or equipment. Terry O'Laughlin, WB9GVB, P.O. Box 3461, Madison, WI, 53704-0461, 608-244-3135

WANTED: Reward paid for National SW-4, has 4 tubes but only one set of coils. Robert Enemark, W1EC, POB 1607, Duxbury, MA 02331. (617) 934-5043

WANTED: Globe King 500, A, B or C xmtrs, any conds., reasonably priced. Terry Collins, KB9ALP, 18 N. Tomahawk Ave., Tomahawk, WI 54487. (715) 453-3707 d, 453-4633 eves

WANTED: In pristine condx.: Collins 32V3, 75A1, 30S1, 270G-1, 32S3A (RE), 310B3, 30K1, mech filter adapters, 55G1, SP-600X, cabinet, TV-7 tube checker & 75A-4. Lee, W9VTC, IL, (847) 439-4700 d, 726-1660 eves.

WANTED: Hallicrafters RCA CR-88A or AR-88. Gene Peroni, KA6NNR, Box 58003, Philadelphia, PA 19102. (215) 665-6182 dys.

WANTED: Aircraft or airport radios, xmtrs, pre WWII, flight gear from all eras. James Treherne, 11909 Chapel Rd., Clifton, Va. 20124 703-830-6272.

WANTED: NIB KWM-2A, stored as backup and never used. Cory/N2AQS/AFA4TZ, 972-751-7535 (24hrs)

WANTED: Coil sets for Globe Champion 175A for 160 & 10 meters; HFD-30X (2) capacitors. Don Hilliard, WØPW, 8630 Nighthawk Rd., Neosho, MO 64850. (417) 451-5892

WANTED: Ranger I, will pay top dollar for Ranger I in 100% working conds. Paint can be average. No modifications. Push to talk or not OK. Want old model keying circuit. Fuses in plug will be 3 amp and 5 amp. I want this Ranger to drive my Johnson Desk for my personal use. I am a radio ham, not a dealer or rebuilder, enough said. If you have one of these suckers call Bob, WA6ICL, , CA, (818) 362-7404, leave message, I will get right back to you same day

WANTED: Info/history on WW2 TCS Radio System for article. Any help appreciated. Thanks. Greg Greenwood, WB6FZH, Box 1325, Weaverville, CA 96093. (707) 523-9122 msg#

WANTED: Collins mechanical filter #F455FA60 and obsolete I.C. #MFC 6020 or ECG761 to fix xtal cal on Swan SS-200A HF xcvr. Dennis, WAØWAB, KS, (316) 225-3736

WANTED: WRL-70 xmtr; HB xmtrs for display, must be museum quality; thousands of QSL cards to paper walls of Amateur display. Call Leo, (619) 321-1138

WANTED: Manuals, manuals, manuals for radio-related equipment to buy or swap. Catalog available. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. (908) 238-8964

WANTED: Orig. tube-type CB radio operating/owners manuals; also tube-type CB radios. Walter Ryan, 7114 Geyser Ave., Reseda, CA 91335. (818) 344-8735

WANTED: Knight equip, all types; ham, shortwave, CB test, etc. Thank you. Walter, CA, (818) 297-7249.

WANTED: National sets MB-29 & 30; LC-3; SW-58C; SW-34 & HFC. Cash or trades. Robert Enemark, W1EC, POB 1607, Duxbury, MA 02331.

WANTED: Vector tube extenders. Roger Higley, W8CRK, OH, (513) 481-5885 (w), 451-1096 (h)

WANTED: Collins KWM-2A labeled on chassis Collins Radio Co. of Japan; early KWM-2 serial # below 100. Bill, KD4AF, NC, (910) 699-8699.

WANTED: Collins parts, meter from 75A2/3/4-51J4; kilocycle dial for 75S/32S series knobs; filters 800, 1.5, 4, 6 kc for 75A3/4; 75A1, 75S3/B/C rcvr. Have for trade 30S1 RF deck only. Bruce, N9KGR, WI, (414) 693-3247.

WANTED: Drake 2C rcvr. Jerry Boles, 14857 Redbud Ln., Piedmont, OK 73078. (405) 373-2228

WANTED: Any coil set for HRO50 except B. **FOR SALE:** Radiotron handbook V4 - BO. R.F. Haworth, W2PUA, 112 Tilford Rd., Somerdale, NJ 08083. (609) 783-4175

WANTED: Swan WM200A VHF & WM3000 HF wattmeters in wrkg condx; a pair of new 8950 tubes. Craig, WA9HRN, 1308 Kristin Dr., Libertyville, IL 60048. (847) 367-1599

WANTED: 1941 Amateur Radio Call Book. John, W8VBQ, OH, (513) 831-3195.

WANTED: Heath SSB-110. The six meter SSB rig. James Chase, K9YXR, 4370 N. 700 W, Angola, IN 46703. Fax (219) 833-1587

WANTED: Condenser, carbon and other early broadcast microphones; cash or trade. James Steele, Box 620, Kingsland, GA 31548. (912) 729-2242

WANTED: To buy any Lunch Box & related items. Arthur Fritz, N3SFE, 104 2nd St., Montgomery, PA 17752. (717) 547-2674

WANTED: WW II Japanese military radio of any kind; pre-war Japanese QSL cards. Takashi Doi, 1-21-4 Minamidai, Seyaku, Yokohama, Japan. FAX: 011-8145-301-8069

WANTED: WW II Japanese xmtrs & rcvrs (parts, plug-in coils) for restoration & ER articles. Ken Lakin, KD6B, 63140 Britta St., Ste. C106, Bend, OR 97701. (541) 923-1013. klakin@aol.com

WANTED: Hammarlund Comet Pro, AVC model; Comet Pro coils, parts & parts sets; Hallicrafters SX-11 dial plate; Millen 90801 exciter. Dean Showalter, WA6PJR, 72 Buckboard Rd., Tijeras, NM 87059. (505) 286-1370

WANTED: Navy xmtr's: TCA, TCE, TLX, TBW 800 cycle pwr sply; TBM modulator CAY-50065. Steve Finelli, N3NNG, 37 Stonecroft Dr., Easton, PA 18045. (610) 252-8211

WANTED: One and two tube receivers (regenerative), kits or homemade. Bob Mattson, KC2LK. 10 Jane Wood Road, Highland, NY. 12528-2607. (914) 691-6247, rmattson@freemark.com

WANTED: Help: Can anyone put me in touch with someone who can test 8122 tubes for output? Craig Pitcher, WA9HRN, 1308 Kristin Dr., Libertyville, IL 60048. (847) 367-1599, call collect. cpitcher@cahners.com

WANTED: Manual for DSI Instruments, Inc. model 5500 frequency counter. Gary Payne, 5251 N. Fresno #202, Fresno, CA 93710.

WANTED: SRR-11, 12 or 13 BFO plug-in assembly or coil. Earl, K6GPB, POB 255, Rio Dell, CA 95562. (707) 764-3141. earlwilson@delphi.com

WANTED: Still looking for Swan 160, other Swan stuff any condx. Eric, KBØXP, Box 98, Stanton, IA 51573. (712) 829-2446

WANTED: 6900, 845, EL34 tubes, Dynaco, Eico, Fisher, Marantz, etc.; Western Electric tube audio amps. Robert, IL, (815) 229-1344

FOR SALE: Just released: Send 2-stamp LSASE for latest Olde Tyme Radio Co. Flyer 196A. Olde Tyme Radio Company, 2445 Lyttonsville Rd., Ste 317, Silver Spring, MD 20910.

FOR SALE: CQ 1950 - $12; multimeter USM-223, exc condx w/all leads & adapters - $25. Patrick Marineau, K9HF, 6300 Kingsway Dr., St. Louis, MO 63123.

FOR SALE: Bridge rect trans 5V 10A, 5V 5A, 5V 5A for 866s, new GE NOS - $35. Joe, W6CAS, CA, (916) 731-8261.

FOR SALE: Hallicrafters SX-11, SX-15, SX-18, S-19R, S-20, S20R, S-38 thru 38E, S-40A, S-42, S-43, SX-71, S-94, S-95, SX-101A, S-108, S-111, S-120, HT-41; EC-1, EC-1A, DB-20, EK-2, GW-22, IM-13. Tom Lucht, 9317 Jaynes, Omaha, NE 68134. (402) 342-5630 (d), 571-0688 (n)

FOR SALE: (2) PRC-77, includes antenna, handset & rechargeable battery - $200 ea + shpg. Carl Banfield, W2YH, 24 Fox Hill Dr., Franklin, NJ 07416. (201) 827-7441

FOR SALE: Johnson Valiant w/manual, good shape - $175; Heath Seneca, good shape - $125. PU only or I will drive reasonable distance. Mike Sawyer, KC4SLK, RR1, Box 177, Danville, PA 17821. (717) 275-9621

FOR SALE: Used 807 tubes, tested OK, guaranteed - $5ea + $3 priority mail. James Schliestett, W4IMQ, POB 93, Cedartown, GA 30125. (770) 748-5968

FOR SALE: Mercury 2000 mutual conductance tube tester, Sencore SM152 sweep/marker gen - $25 ea. Bill, KE7KK, 6712 Lake Dr., Grand Forks, ND 58201. (701) 772-6531

FOR SALE: Two 6 meter xcvrs w/D104 mics & manuals; Swan 250 + Clegg Venus - $300 ea. I ship. N3SFE, PA, (717) 547-2674.

FOR SALE: Tube list, new & used, wide variety audio, ham. Recently expanded. SASE 52¢. Bill McCombs, WB0WNQ, 10532 Bartlett Ct., Wichita, KS 67212-1212.

FOR SALE: RCA SSB-1, 60 watt base station used by US Border Patrol until 1971, w/orig manual but no cabinet - $100 + shpg (125 lbs), or PU. Dave Parker, WB9WHG, POB 307, Iron Ridge, WI 53035. (414) 625-3919

FOR SALE: Johnson SSB adapter w/ps, cables & manual - $300; Heath HW-18 & HP-23B - $50; Collins 32S-3 WE - $400; SX-101 Mark 3 - $200; 9 pin octal type plugs, new - $8 ppd; S-line TR relays, new - $45. John, AE4EN, NC, (910) 686-4236.

FOR SALE: BC-610 TX (latest I model) complete w/the following equip: remote speech amp w/patch cord, antenna tuner, 160 meter tank coil, 2 spare 250TH output tubes, rare stock shock mount base w/HD casters. Will sell w/or w/out pwr sply deck; Atwater Kent antique horn type spkr; 2 ea 250TH pwr tubes. **WANTED:** B&W T-368 TX pwr sply deck; B&W T-368 exciter; 1 to 4 4-125A pwr tubes. Joe, WE5I, AR, (501) 257-2839.

FOR SALE: Hallicrafters HT-9, restorable - $225; Apache - $225; Viking II w/122 VFO - $225. Robert Braza, N1PRS, 23 Harvard St., Pawtucket, RI 02860. (401) 723-1603

FOR SALE: TG34 keyer w/6 tapes, good condx. - $100 + shpg; 9-inch SASE for list, more stuff. Rich, K9RLF, 1140 S. Taylor, Oak Park, IL 60304. (708) 383-4579

FOR SALE: Collins 75A-1 - $495; Hunter Bandit 2000C - $450; Drake TR4/AC4 - $295. Ron, K1BW, MA, (413) 538-7861.

FOR SALE: Clegg 99'r - $80; RME 152A - $50; Trio2200 - $75; UPC wire tuner - $125; Gem antennas. Ron, K6LLQ, CA, (510) 682-2838 or CBA.

FOR SALE: Vintage equipment manuals starting at - $5; Hallicrafters, Johnson, WRL, others. SASE for list. DSM Diversified, 909 Walnut St., Erie, PA 16502.

FOR SALE: Collins repair. I specialize in S-line equipment. Reasonable, & work guaranteed. Steve, N6HK, Box 1136, Goleta, CA 93116. (805) 967-7466

FOR SALE: TS100AP radar test scope; Heath marine DF/rcvr DM337 - $45; wavemeters, General Radio 247W & 566A - $40 ea. Van Field, W2OQI, 17 Inwood Rd., Center Moriches, NY 11934. (516) 878-1591

FOR SALE: (5) 5 pin acrylic coil forms 1-3/8" dia x 2-1/2 high - $2.50 ea. Joseph R. Forth, 321 Long Vue Acres, Wheeling, WV 26003. Phone/Fax (304) 277-3154, schematic1@aol.com

FOR SALE: 75A-3, clean, no cabinet - $350, U-shp. Marcus, WI, (414) 297-9310.

FOR SALE: 1925 Grebe Synchrophase 5 tube TRF radio w/tubes, works, good shape - $200. PU only. Pat Stewart, W7GVC, 1404 Ruth Ave., Walla Walla, WA 99362-3558. (509) 525-1699

FOR SALE: NC109 - $135; S-76 - $235; NC-300 - $195; Allied SX190 - $165; Sommerkaup FR100B - $225; RME70 w/spkr - $250; Adventurer - $135; Twoer - $40. Free list. Richard Prester, 131 Ridge Rd., West Milford, NJ 07480. (201) 728-2454

FOR SALE: Hammarlund matched pair: HX-500, FSK, AM, FM, CW, SSB, 80 thru 10, 100W; HQ-180 matching spkr, manuals, good to exc. Will not separate - $525. Mel, WØMLT, CO, (970) 249-1544.

FOR SALE: National CRO - $80; VFO-62 - $40; AC-200 ps - $45; NC-183 - $75. LSASE for book list. Wayne Childress, KF4MNL, Rt 1, Box 200A, Altavista, VA 24517. (804) 369-4072

FOR SALE: Millen dip meter 90651 - $65; military automatic HF antenna tuner type CU2351, unused, mint - $600; Tadiran TER-100 military terminal, mint - $200; coaxial dynamics directional wattmeter, 19 inch panel mounted - $100; Creed 444 teleprinter, like new, orig box & manual - $250; British Clansman radio headset/boom mic, new - $100; various Racal communicaitons tube rcvr & xmtr equip from England, call for details. Nigel, K4UCD, GA, (770) 922-8546 (h), 414-0550 (w)

FOR SALE: New orig. PJ-068 mic plugs for Collins S-line/KWM-2A/HF-380 shp'd in USA - $8 ea. Clint Hancock, KD6H, 6567 Ashfield Ct., San Jose, CA 95120-4502.

FOR SALE: KWM-2 fan bracket - $15 ppd. Dave Ishmael, WA6VVL, 2222 Sycamore Ave., Tustin, CA 92780. (714) 573-0901

FOR SALE: Collins 30J3, circa 1939. As is or will parts out. No RF deck. Carleton Rand, W1PZI, 85 Black Hall Rd., Epsom, NH 03234. (603) 736-9695

FOR SALE: Heath sig gen SG-8 - $30. **WANTED:** Viking I or II junkers. Collin Collier, N4TUA, GA, (912) 988-1276.

FOR SALE: Collins 312B4, W/E, exc - $125; NC173, spkr, manual, very nice - $200; Viking Ranger I, beautiful, manual copy - $300; DX40, exc, manual - $80; HW101 w/SB650 digital freq display (rare), SB600, HP23B, all manuals, very exc - $325; Tempo I, AC sply/spkr, manual copy - $75. **WANTED:** GPR 90. I trade. Dick Dixon, W7QZO, 16032 Lost Coyote Ln., Mitchell, OR 97750. (541) 462-3078

FOR SALE: Seven Johnson Hi-Q inductor coils, NOS, 160-40-20M - $25 lot; Shure 545 mic, NIB - $50. Dave, W1DWZ, MA, (508) 378-3619.

FOR SALE: NC300 - $200 + shpg. **WANTED:** RRB or RBC & pwr sply. John, NM1H, 11 Woodhenge Cir., Londonderry, NH 03053. (603) 437-2819

FOR SALE: All NIB: RC-404/TR cable reels - $15; National HX-100 sockets - $7.50; 4D32s - $29; 3E29, 6082WB, 5U4GB - $5; 9-pin miniature tube shields - 20¢. Lowell Thomas, K6KC, POB 15026, Fresno, CA 93702. (209) 227-1605

FOR SALE: Kenwood TL922A 80-10 HF amp - $1250; (3) Gonsets: 913 6 mtr amp, 4CX250B - $300; Gonset Communicator II, 2 mtrs - $85; Gonset Communicator 4, 2 mtrs - $100. **WANTED:** Johnson Adventurer front panel. John, WA9LWJ, WI, (715) 457-2506.

FOR SALE: NOS 2E24 tubes. **WANTED:** Pre-1929 QST magazines; vintage mobile rcvr. Eddy Swynar, VE3CUI, 3773 Concession Rd. 3, RR8, Newcastle, ONT L1B 1L9. Canada.

FOR SALE: GPR-90 - BO over $225; S-38A - $30; R46B - $45; Trimm headphones - $5; GR 1214A audio osc - $15; 30 pF 15 kv vaccumn variable - $25; Galaxy xtal calibrator - $20; Johnson Roller coil 24-306-1 - $35; National MB-40 - $40. Joe Sloss, K7MKS, WA, (206) 747-5349 after Feb. 19th.

FOR SALE: Heath AT-1, w/orig assembly manual, missing 2 knobs - $95; National VFO-62 w/copy of manual - $35; MFJ versa tuner II model MFJ 941D - $60 + shpg. Tom Murray, 3177 Latta Rd., #409, Rochester, NY 14612. (716) 723-1672

FOR SALE: Variable AC sply 120V in 0-130V out at 10A metered tested - $65 + shpg. Tony Snider, VA, (757) 721-7129.

WANTED: BC191 or BC375; dymtr ps for R-45/ ARR7; manuals for TA-12, R-105A. Greg Richardson, WA8JPC, POB 405, Gallipolis Ferry, WV 25515.

WANTED: EF Johnson Ranger II, must be VG - exc condx; Hammarlund XC-100P xtal calibrator; 1945 issues of CQ Magazine. Brian, IL, (800) 225-0256, X 14733.

WANTED: Squires-Sanders SS-1R, SS-1T, SS-1V, SS-1S, see my web page tulsa.oklahoma.net/ ~wd5jfr. Hank, WD5JFR, OK, (800) 364-4265

WANTED: Cabinet &/or parts rig for Globe Champion; good/bad meter for S-line, need housing; 6083/AX-9909 tube; A coil & spkr for HRO-60. John Poland, AE4EN, POB 1028, Hampstead, NC 28443. (910) 686-4236

WANTED: EF Johnson Hamalogs & Viking ham catalogs 1948-1968; Ranger I or Valiant I. Bruce Hering, 41120 State Hwy 13, Waseca, MN 56093-4217. (507) 835-5619

WANTED: Manual or copy of schematic etc, on Hughes/Mitchell VFO, dial showing calibrations for 40, 20 & 10 meters. John Micsak, W2PRR, 1549 Shoecraft Rd., Penfield, NY 14526-9707.

WANTED: DM-24 dynamotor; R25/ARC-5 1.5-3.0 mc rcvr. Pete Hamersma, WB2JWU, 87 Philip Ave., Elmwood Park, NJ 07407.

WANTED: Someone to refinish the front panel & cabinet of my Ranger. Doug Knoll, KA9IQA, 1400 4th Circle NE, Waseca, MN 56093. (507) 835-8821

WANTED: Tektronix RM-503 scope in any condx. Fran, KA1DD, MA, (508) 464-5500.

WANTED: IERC tube shields. John Richardson, KBØUPL, 1163 Highland Pl., Dubuque, IA 52001. (319) 556-5504

WANTED: Johnson TR switch; Swan 700CX; 410 VFO; VX-1 & VX-2 units; Johnson 122 VFO. Ron, 10701 W. 54th St., Shawnee, KS 66203. (913) 268-5973, arongv@aol.com

FOR SALE: Classic gear - SASE for list. **WANTED:** Vintage rigs. The Radio Finder, Joel Thurtell, 11803 Priscilla, Plymouth, MI 48170. Tel/Fax (313) 454-1890

FOR SALE: Copies: Hard to find schematics for radios, also kit radios 1922-1950; manuals: test equip. ham gear. Contact me for prices, availability. Duane Ballew, KB7QZK, 6813 152nd St. Ct., NW, Gig Harbor, WA 98332. (206) 851-4505

FOR SALE: Hallicrafters hand-fone, never issued, 1970 AM, 1/2 watt out, 27 to 50 MHz - $50 ppd. Richard Lucchesi, WA2RQY, 941 N. Park Ave., N. Massapequa, NY 11758. (516) 798-1230

FOR SALE: Convert any wattmeter to read PEP! Perfect for AM/SSB - $19.99 ppd for complete kit! HI-RES, 8232 Woodview, Clarkston, MI 48348. (810) 391-6660, hires@rust.net

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FOR SALE: RIT for KWM-2 and S-Line. No modifications for KWM-2. $59.95 tested/42.95 for kit. SASE for details and order info. John Webb, W1ETC, Box 747, Amherst, NH 03031.

FOR SALE: National NCX-5/ps - $225; Hallicrafters SX-111 - $135; Heath SB-303 - $145; DX-60 - $65; tubes: 6JB6 - $10; 807 -$5 ea. Bob Needleman, K3AC, 395 Meadowbrook Rd., North Wales, PA 19454. (215) 661-9283.

WANTED: Collins 75S-2 rcvr. Wes, K5APL, TX, (903) 838-0569. k5apl@sdinknet.com

WANTED: Drake spkr MS-7; xtal BW filters for R-7. Need 0.5, 1.8, 4.0 kHz. John, Alaska, (907) 337-9157

WANTED: SR-400; Johnson TR switch; HT-37; Knight P-2 SWR/pwr meter; WRL V10 info. Ron, WØOIZ, KS, (913) 268-5973. arongv@aol.com

WANTED: Cash for Collins SM-1, 2, 3; 312A-1, 2; 55G-1;62S-1;399C-1;51S-1;302C-3;KWM-1;KWM-380; also buy estates. Leo, KJ6HI, CA, ph/fax (310) 670-6969.

WANTED: Junker HT-44 for parts. Bob Struk, 1726 Kinglet Ct., Sunnyvale, CA 94087. (408) 991-3747

WANTED: Manual schematic TMC HF rcvr, model GPR 110S. Harry Weber, 4845 W. 107th St., Oak Lawn, IL 60453-5252.

WANTED: Heath VF-1 VFO & WRL Globe Scout 680A. Paul, K8JJC, MI, (616) 891-2190, Call collect.

WANTED: Pwr sply & telegraph key for TBY-8 to complete set. Bob Forte, K2RGM, POB 160, Lake Luzerne, NY 12846. (518) 696-2400

WANTED: Hallicrafters HT-1, HT-9, HT-31, S-T, SX-11, SX-17, SX-25; Howard rcvrs; Harvey xmtrs. Ken Seymour, KA7OSM, 9115 SW 176th Ave., Beaverton, OR 97007. (503) 306-7439 24 hrs. ken.seymour@attws.com

WANTED: Filters for Collins 75A-4; 500, 2.1, 6. Mike, K4KUZ, FL, (954) 583-4026.

WANTED: Restorable Johnson Thunderbolt linear. Victor Gregowski, WD8DWR, MI, (810) 367-2087.

WANTED: Temple (brand) luggage type portable radio; BC-348; White radio logs; 1930-1950 Popular Mechanics magazines. Harry L. McCall, KB4CSY, 9135 Glade Valley Rd., Ennice, NC 28623-9641. (910) 657-8248

WANTED: IL6, 50A1 tubes; socket savers; Butternut HF-2V; straight key leg strap (CW mobile); 1950-1972 bound QST or old binders; clean Volksempfanger. Marcus Frisch, WA9IXP, Box 28803, Greenfield, WI 53228-0803. (414) 297-9310

WANTED: AT1 meter & meter switch; DX20 tuning knobs; any gray Heath knobs. Larry Myers, W3MNE, 1598 Brimfield Cir., Eldersburg, MD 21784.

FOR SALE: All electronic repairs welcomed. Specializing in ham gear, qualified. Stocking Collins, Heath, etc. Tiki Electronics, 1564-62 Front St., Cuyahoga Falls, OH 44221. (330) 922-8454.

FOR SALE: PRC47 LSB/USB kit - $40; new machined coax antenna panel - $9. All restorable. Jay Craswell, WB0VNE, 321 West 4th St., Jordan, MN 55352-1313. (612) 492-3913

FOR SALE: Fiberglass rods, 5/8" dia., 13" long, UV resistant, good standoff insulators, twinlead spreaders, ten ppd - $10. Ron, K5YNR, NM, (505) 327-5646.

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

FOR SALE: Vintage Radio Kit. Complete kits available for low pwr & QRP CW. Write or call for complete list of kits and components available. Want a "fun project?" Build the CPCW-5 Cake Pan xmtr. The CPCW-5 is a two tube xmtr built on a 9x9 inch cake pan that you have to see and hear to believe!!!! Article on the CPCW-5 was in Nov. ER. Contact us at: Vintage Radio Kit, 427 N. Main St., Sharon, MA 02067. (617) 784-0847, Mon thru Thurs 9:00 AM to 4:00 PM EST.

FOR SALE: Hammarlund HQ-180C - $270; Heath HW-16 - $60; exc SB-230 amplifier - $330; Gonset 2M Communicator - $50; Conar 400 xmtr, exc - $60; Central Electronics 20A - $60. SASE for list. All with manual + shpg. Larry Wright, N4QY, 170 Heritage Ln., Salisbury, NC 28147. (704) 633-3881.

FOR SALE: Mine detector AN/PRS-3; rcvr 454B; xmtr 457A; rcvr Super Pro w/ps. W5WBA, NM, (505) 831-2646.

FOR SALE: URM-127 audio generator 0-10 MHz, 0-10 volts, p-p, 5 lbs in water tight case - $25 tested + shpg. Tony Snider, VA, (757) 721-7129.

FOR SALE: 51J4 in cabinet with 3 filters and spkr - $900; Johnson power attenuator - $50; TR switch - $50; xtal calibrator - $20. Wen, NV, (702) 297-1156

FOR SALE: QSTs 1950 to present - $6 per yr. + shpg. Robert Milligan, KI4MB, 6608 N. 18th St., Arlington, VA 22205-1802. (703) 533-0650

FOR SALE: ARC-5s; Viking 2s; parts, more. 2-stamp SASE or $1 for list. Jim Miccolis, N2EY, 126 Summit Ave., Upper Darby, PA 19082. (610) 352-5247

FOR SALE: Unbuilt Heath GD600 photoelectric light switch, complete in orig box - $25; DX60B works well - $75. John Nauman, W9CN, 420 Patrick Ave., Merritt Island, FL 32953. (407) 452-7904

FOR SALE: TU-5B tuning unit for BC-191, exc condx - $75; HQ-180 - $350; BC-221 w/pwr sply - $50. Bill Swiger, KB8IJC, WV, (304) 842-4635

FOR SALE: Send for the K7FF mailorder list of parts/equip, two first-class stamps & mailing label. Spring antenna projects: new military antenna strain insulators, brown porcelain, round, 3/4" x 4" - $1.50; standard & copper-clad steel antenna wire, center insulators, porcelain egg insulators, stainless steels whips, for VHF/UHF antennas, snap-on toroids, ground rods, coax, stainless steel guy cable sets, etc., etc. (send for list). Derek, K7FF, 5191 Rimwood Dr., Fair Oaks, CA 95628. Fax/phone (916) 965-4904.

FOR SALE: Radio & electronics related books, 160 titles, call or write for list. Paul Washa, W0TOK, 4916 Three Points Blvd., Mound, MN 55364-1245. (612) 472-3389

FOR SALE: Surplus Conversion HBook, vol 1,2 - $30 pair; Radio HBook 8, 10, 11 edition - $25 ea; telegraph set TG-5 - $75. Gary, MN, (612) 496-3794

WANTED: S-meter & two knobs for Hallicrafters SX-16; ER magazine 1-60. Ron Reaver, WB4OQL, 740 Brookdale Dr., Greer, SC 29651. (864) 879-3133

WANTED: 160 meter coil strip for Meisner EX Signal Shifter; also clean unit or junker. Hank, W2IQ, 635 Chestnut Grove Rd., Dandridge, TN 37725. (423) 397-9796

WANTED: Manual or schematic for Galaxy remote VFO, model RV-1. Al Kaiser, W3LEQ, 713 Marlowe Rd., Cherry Hill, NJ 08003-1551. (609) 424-5387

WANTED: 1954, 1955 WRL, Walter Ashe, BA, Radio Shack catalogs; June 1945 Radio News. Al Bernard, POB 690098, Orlando, FL 32869-0098. (407) 351-5536

WANTED: Military entertainment radios, (morale rcvrs), manuals, info. Any country. Henry, KD6KWH, POB 5846, Santa Rosa, CA 95402. (707) 544-5179

WANTED: Dow-key relays to go with two boat anchors; Johnson TR switch; Swan 700 CX & VX-1 & VX-2 VOX units. Ron, 10701 W. 54th St., Shawnee, KS 66203. (913) 268-5973. arongv@aol.com

WANTED: Johnson TR switch & Dow-key relays for my old rigs; Swan WM-2000 or WM-2000A SWR meter; Swan VX-1 & VX-2 VOX units. Ron, 10701 W. 54th St., Shawnee, KS 66203. (913) 268-5973. arongv@aol.com

WANTED: (2) National NC-150 or NC-500 or equiv. neutralizing condensers. James Schliestett, W4IMQ, POB 93, Cedartown, GA 30125. (770) 748-5968

WANTED: Hammarlund HC-10; Heath HO-10; cabinets for R390A & R388/51J; DX100. Dave, W3NP, WV, (304) 298-4596.

WANTED: S-76 Hallicrafters in working or reparable condx. Joe Frank, W1SOV, 8 Bay Crest Dr., S. Burlington, VT 05403. (802) 862-1816.

WANTED: Manual or schematic, copy fine, for GATES BC1-F, also modulation xfmr for same or any that will match pair 833A to pair 833A. Fred Pomnenke, WD5BPP, 10981 F.M.20, Kingsbury, TX 78638. (210) 639-4437, after 7PM or lve messg.

FOR SALE: Power designs 0-50V at 0-1.5A metered bench top sply small w/handle, 5 lbs - $50 + shpg. Tony Snider, VA, (757) 721-7129.

FOR SALE: Resistor substitution box .1 to 100 meg in .1 steps at 2 watts, in case - $20 + shpg. Tony Snider, VA, (757) 721-7129.

FOR SALE: SP600 JX-26 parts unit, no knobs, meter, glass or case, all else complete but rough - $70 + shpg. Tony Snider, VA, (757) 721-7129.

FOR SALE: CNA46161 IRBL-2 15 kc - 600 kc, rough but restorable - $50 + shpg. Tony Snider, VA, (757) 721-7129.

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