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ELECTRIC RADIO

celebrating a bygone era

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Butch Schartau, KØBS

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; Mike O'Brien, NØNLQ, Bob Sitterley, K7POF (photos) and others.

EDITOR'S COMMENTS Barry Wiseman, N6CSW/Ø

By this time next month Shirley and I will be at our new home on the side of a mountain overlooking Durango, 15 minutes from where we live now. It's been a struggle for us to put this move together and we apologize for our absence from the office.

The property we bought came without any improvements like power, telephone, water, etc. and we've had a lot of headaches but the advantages for me are enormous. Once again I will be able to get some big antennas up and run the legal power limit without fear of bothering neighbors.

The property - 40 acres- is at 8200 feet on the south slope of a mountain. I should have a clear shot in every direction but north. Besides big wire antennas for HF; long wires, V-beams, maybe another rhombic, I plan to install some long yagi's for 6 and 2 meters. I think it should be possible to work as far as Albuquerque, New Mexico (about 200 miles south), on 2 meters (probably further) on a regular basis.

I'm looking forward to operating AM on VHF. For some time I've thought that we should all be taking advantage of the 'wide-open spaces' there. In future issues we'll be doing some articles on the vintage VHF gear.

In the months ahead I'll talk more about how our new location is working out; but for now it's just wondeful to dream and contemplate how it's all going to be.

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Cover: Well known AM'er/collector, Butch Schartau, KØBS, with some of his vintage gear; a Collins 32V-2 and a 75A-1.

LETTERS

Dear ER

I read N6DM's article on the Knight 50 Watt transmitter in ER #61 with great interest, understanding, and appreciation since the Knight T-50 was my first commercial rig back in 1959-60. I always have had a special fondness for that old rig which produced hours of great fun on the bands. I even used mine with an old Globe screen modulator and had a ball on AM with about 30 watts output on 40 meters.

I recently obtained and restored another T-50 and the matching VFO to recreate my original set-up. I have really enjoyed owning this little rig and it brings back many great memories from early in my ham radio career.

One minor correction to Donald's comments. The Knight 50 Watt transmitter did, in fact, carry the Model designation T-50 and was commonly known as the T-50 by hams of the day. It may have only been called the Knight 50 Watt Transmitter in the catalog, however, the manual cover contains the familiar T-50 designation and the catalog number #83YX255.

Another interesting fact about this transmitter is its uncanny resemblance to the Johnson Adventurer. One can't help but wonder if the T-50 kit wasn't manufactured by Johnson for Allied. Any Allied or Johnson insiders out there who can answer this question?

I, too, used the ubiquitous Heath VF-1 VFO with my T-50, probably because it was cheap and readily available and could be powered from the T-50 accessory socket. The matching Knight VFO was quite a bit more expensive and not as common.

The Knight VFO was designated as the V-44 with the catalog number of #83Y725. It was a very nice unit which contained its own power supply and provided output on the 80 and 40 meter bands. I always wondered, however, why the cabinet dimensions didn't quite match and the Knight VFO cabinet was a little higher than the T-50 cabinet.

One of the most common problems and weaknesses with the T-50 is the meter and its associated switch. The cheap undamped meter movement is itself a weak point but more serious problems may result from arcing of the B+ in and around the meter and the slide switch (particularly if you attempt to plate modulate this rig). I found an easy solution to these problems was to move the plate metering to the cathode circuit. All that is necessary to accomplish this is to move the plate meter 100 ohm shunt resistors (R-6 and R-7) and associated switch leads and place them in series with the 807 cathode lead. Then place a wire lead in the B+ lead to the final in place of the shunt. That's all there is to it! This results in a slightly higher meter reading since the screen current (and grid current) is also included in cathode current, however, accuracy was never an attribute of this metering circuit anyway. A relative indication of plate current and resonance is basically all that is needed.

The Knight T-50 may not be quite as famous as some of its competitors such as the Heath DX-20 but it certainly is a great little transmitter. We nostalgia buffs can enjoy and remember just what ham radio was like in the 50's using so-called "low end" or "beginners" gear. I'm using my Knight T-50 with a home brew pp 6L6 plate modulator instead of my original screen modulator and it works like a champ on 40 meter AM!

Jack Shutt, N9GT

Antique Electronic Supply Changes Ownership

George H. and George A. Fathauer have sold Antique Electronic Supply (AES) to Joseph Campanella as of May 16, 1994. They will both remain with the company as consultants; George H. will continue to be active in the purchase of tubes, while George A. will facilitate an orderly turnover of the operations to Mr. Campanella.

Antique Electronic Supply is a unique company whose customers restore and repair antique radios, other vintage electronic equipment, ham radios, guitar amplifiers and other audio equipment. The company has a large inventory of vacuum tubes and other hard-to-find parts, supplies, and related books which satisfy the needs of their customers. They have over 3000 new tube types in stock including GE, RCA, Sylvania, Amperex and other American brands, as well as the popular Sovtek (Russian) brand. Orders are normally shipped within 24 hours by UPS. Antique's salespersons provide prompt, friendly service and can also provide technical assistance to their customers.

Antique Electronic Supply will remain at its present location of 6221 South Maple Avenue in Tempe, Arizona. The phone and fax numbers will remain the same: 602-820-5411 and 602-820-4643 respectively. There is also a toll free fax number - 800-706-6789. The catalog is available at your request. The company will continue to honor the sales policies noted in the catalog.

The Campanellas will continue Antique Electronic Supply as a family business with Greg Cravener (Joe's son-in-law) as Vice President of Technical Services and Noreen Cravener (Joe's daughter) as Vice President of Operations. Greg and Noreen are in the process of relocating their family to the Tempe, Arizona area. The present employees will continue with the company.

Mr. Campanella comments, "We look forward to continuing the tradition of supplying parts and supplies for vacuum tube equipment with an emphasis on quality and service. We welcome your suggestions as we look for ways to better serve our customers."

Mr. Campanella has been active in the electronics industry for over 40 years; almost 30 of which were with Sperry Corporation in Phoenix in various positions. During the last seven years before his retirement, he was the President of Sperry (Honeywell) Aerospace and Marine Group, headquartered in Phoenix.

Greg Cravener is a graduate engineer with over ten years experience in key engineering and computer processing positions. Noreen Cravener has over eight years experience in operations management positions, four of which were in the electronics industry.

The Fathauers founded the business in 1982 and successfully grew the company while building a strong reputation for availability and service. George H. Fathauer comments, "George A. and I would like to express our heartfelt appreciation for your support, encouragement, ideas and referrals during our 12 years with Antique electronic Supply." ER

Communication Equipment of The North Vietnamese Army and the Viet Cong

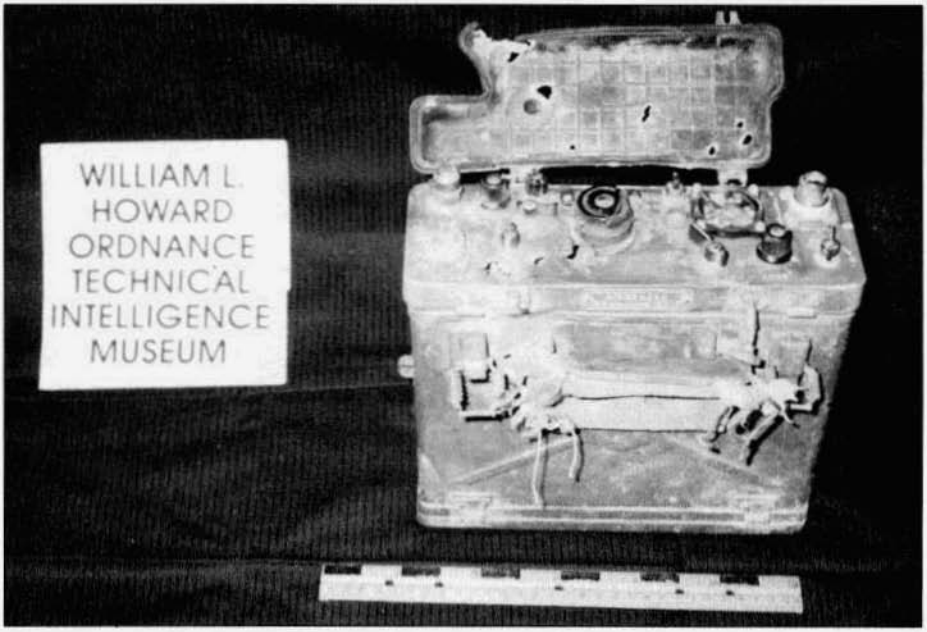
by LTC William L. Howard
219 Harborview Lane
Largo, FL 34640

In 1954 when the Geneva Agreements were signed ending the French-Indochina War, communications in both North and South Vietnam were in poor condition. Military equipment, much of it left over from WWII, was worn out. Since the French had handled both military and civilian communications their departure left the Republic of Vietnam with little equipment and no native expertise. On the other hand, North Vietnam inherited the resources of the victorious Viet Minh: experienced communicators and a battle tested military signal organization.

While the South Vietnamese laboriously rebuilt military signal units with the logistical and training support of American advisers during the late 1950's, the North Vietnamese interlaced their homeland with an austere, but comprehensive, communications network. By 1960 a powerful North Vietnamese governmental agency, the General Directorate of Posts, Telecommunications, and Broadcasting, had rehabilitated the old French wire network and installed radio-telegraph stations in every province. Encouraged by promises of aid from several Communist allies, North Vietnam then boldly embarked on an ambitious five-year modernization plan for telecommunications. The Communists intended to build a national microwave system, complete with automatic switchboards, to supplement the wire network. Automatic radio-teletype and voice radios would replace the existing radio-telegraph system, a slow, manual Morse net.

Although few of those hopes for modernization were actually fulfilled by the end of the five-year term of the plan, the optimistic outlook for North Vietnamese communications probably influenced Communist strategists meeting in Hanoi in September 1960 to consider whether the time was ripe to step up the insurgency in South Vietnam. They knew what prodigious demands such a campaign would make on North Vietnam's communicators. Reliable domestic communications to every province in North Vietnam would be essential in coordinating mobilization of the nation's resources and movement of men and material to the southern front. Since the insurgency was to be orchestrated directly from Hanoi, communicators also would have to establish extensive long-distance networks to meet the needs of both the Communist Party's political administration of an underground government in the faraway provinces of South Vietnam and the military's strategic direction of campaigns against the South Vietnamese Army. To support tactical operations within South Vietnam, the military and political cadres actually conducting the insurgency would require lightweight, easily concealed radios. Undaunted by those requirements for domestic, strategic, and tactical communications, the North Vietnamese in December 1960 announced the establishment of the National Front for the Liberation of South Vietnam.

Communist leaders tried to insist that the National Liberation Front was a popular uprising of South Vietnamese



The Type 63 manpack set was the newest item supplied by China. This set was probably intended as a replacement for the Model 71 B radio. It weighed 35 lbs., was 3 1/2" x 10" x 16" and was powered by a D-63 dry battery with taps at 3V, 27V, 90V and 178.5 Volts. It was estimated to be a 2 watt transmitter and covered 1.5 to 6 mc. Unlike the U.S. counterparts this set had a built-in key for CW operation. This set has 26 bullet holes in it.

nationalists displeased with Diem. Although the insurgents had a clandestine headquarters, called the Central Office for South Vietnam (COSVN), in a remote jungle area near the Cambodian border, doubtless Hanoi maintained direct communications with the communist bases throughout South Vietnam in addition to funneling strategic direction through the new field headquarters. Probably to relay communications from Hanoi to remote areas in the South, North Vietnamese communicators established a large communications complex at Dong Hoi about fifty miles north of the border with South Vietnam.

The oldest and most reliable strategic communications system available to the North Vietnamese was the clandestine communications-liaison network in operation since the Franco-Viet Minh War along the Ho Chi Minh Trail. As infiltration increased in the early 1960's, communications-liaison took on increasing importance. By 1964 two communications-liaison battalions were handling strategic communications and infiltration along the trail.

To communicate general information, policy, and propaganda to South Vietnam, the North Vietnamese employed voice and telegraph radio broadcasting. The Vietnam News Agency, an operating arm of North Vietnam's General Directorate of Information, managed the activities of both Radio Hanoi, the official North Vietnamese radio network, and Radio Liberation, a clandestine station located in South Vietnam near the headquarters of the Central Office for South Vietnam. Much of the

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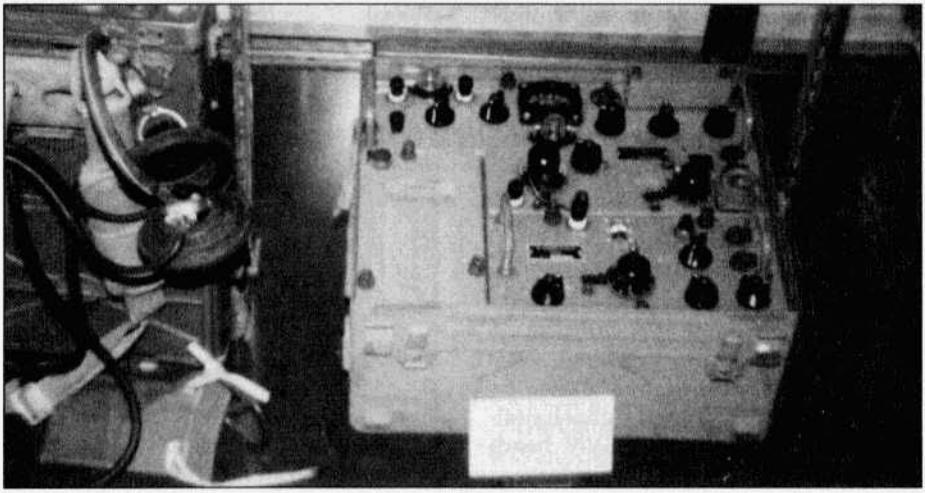
broadcast equipment had been manufactured in the United States and captured from the French. Recognizing early the importance of undermining the South Vietnamese people's confidence in and allegiance to their government, North Vietnamese propagandists began beaming specially prepared programs to South Vietnam over Radio Hanoi soon after the division of the two countries. By 1962, when the South Vietnamese domestic broadcasting network comprised only fifteen small transmitters, all less than 25 kilowatts in strength, North Vietnam had ten 100-kilowatt transmitters and several relays in Cambodia beaming Radio Hanoi's signal throughout South Vietnam.

To maintain the facade that the National Liberation Front was a legitimate revolutionary organization existing independently of North Vietnam, Radio Liberation operated an international broadcast station; that transmitter, however, was located not in South Vietnam, but at the Radio Hanoi communications complex in Me Tri, a suburb of Hanoi. As Communist propaganda assumed an increasingly important role after the beginning of the Paris peace negotiations in 1968, the Me Tri complex grew to house twenty-three transmitters beaming broadcasts throughout the world in ten languages.

Of many special communications networks established as the insurgency accelerated during the early 1960's, one operated by the North Vietnamese strategic intelligence service, called the Research Agency, was the most comprehensive and active. To manage its covert operations in South Vietnam, the Research Agency used a combination of radio broadcast, courier, and radiotelegraph.

Organized into small cells of three or four agents with cover identities and false documents, the members of the Research Agency lived a seemingly normal life in South Vietnam while covertly gathering intelligence on American and South Vietnamese military and government activities. Because the cell's communicator was the only one routinely to make contact with any member of the Communist movement outside the cell, he had to be especially careful to preserve his cover. The communicators required only a radio receiver, usually a common Japanese transistor radio, to receive missions and instructions broadcast directly from Hanoi. To avoid arousing any suspicion, a cell communicator normally left his radio in plain sight at his place of business or home and at a specified time, on an assigned frequency, listened for his instructions broadcast in Morse code and encrypted. Couriers handled outgoing communications to avoid exposing the cell communicators to radio intercept. If an agent had an urgent message to send to the Research Agency, such as news of an imminent bombing attack, the communicator brought the message to one of several clandestine transmitters hidden throughout South Vietnam for just such a use. As a result, U.S. and Allied Forces captured large numbers of transistor radios.

By the time the American air campaign against North Vietnam began, the Communists in South Vietnam, capitalizing on political and religious dissension, were well established politically and had accumulated enough military strength through infiltration and recruitment in the South to challenge major units of the South Vietnamese Army. By late 1964 the Viet Cong had an army of 34,000 full-time guerrillas and about 100,000 part-time insurgents and sympathizers, and the North Vietnamese Army was moving several regiments into the northern provinces of South Vietnam. From its jungle headquarters northwest of Saigon, the National Liberation Front controlled a territorial governmental structure comprising five military regions. Forming a



One of the most often captured radios was the Chicom Model 102E which was manpacked or mounted in vehicles. This set was a copy of the U.S. AN/GRC 9 set with a few changes.

Communist shadow of the legitimate governmental hierarchy within each region, the Viet Cong established committees down to the provincial and sometimes even the hamlet level. By mid-1964 they controlled more than half of the territory in twenty-two of South Vietnam's forty-three provinces.

Even after the size of the Viet Cong organization grew unwieldy, leaders in Hanoi were reluctant to relinquish control of the insurgency to the National Liberation Front. They continued to attempt to disguise their direct involvement in Viet Cong operations and to perpetrate the myth that the National Liberation Front was conducting a popular rebellion. To control and coordinate the activities of Viet Cong and North Vietnamese Army units operating in critical areas of the northernmost region of South Vietnam, Military Region 5, the high command established National Liberation Front headquarters there.

Because of the protean evolution of the insurgency, there was little standardization of Viet Cong signal organizations or equipment. Most signal units traced their origins to a single communicator serving as both radioman and messenger to a small Viet Minh cell during the 1950's. As the movement grew, so too did the communications organizations. In 1965 some uniformity in the organizational structure for communications began to appear: the Central Office for South Vietnam and Military Region 5 were each supported by a signal battalion, the other military regions and the infantry regiments all had organic signal companies, and provinces and battalions had signal platoons. Divisions of the North Vietnamese Army fighting in South Vietnam were supported by organic signal battalions. By late 1966 the Viet Cong and the North Vietnamese had approximately 150 combat battalions in the field under the command and control of thirty-two regimental headquarters and seven divisional headquarters. Besides the organic signal units assigned at each level, that entire force was supported by three area support signal battalions.

Dictated by the needs of the war and by available resources, command relationships, signal configurations, and

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organic equipment changed throughout the course of the conflict. Most communications units conformed to some type of tripartite organization - a battalion would have a radio company, a wire or telephone company, and a messenger company. Whatever the organization, the quality and availability of Chinese, Soviet, and captured American equipment usually dictated the actual capability of the unit. As the magnitude of the Communist military effort increased, new units assumed some missions of overburdened units. By 1972, for example, several signal battalions were supporting COSVN headquarters.

For a more thorough analysis of doctrine, training, and policy the reader should consult Chapter 16 of the book, *Military Communication, A Test For Technology*, by John Berger, from which the foregoing was extracted.

Let us now turn our attention to the tactical communication equipment used by the military forces of North Vietnam and the Viet Cong. By the mid-1960's the Chinese began to increase the amount of aid they provided the North Vietnamese. As a result the NVA was equipped almost exclusively with radios made in China and these began to move south into the Republic of Vietnam where they were eventually captured by U.S. Allied Forces.

The United States Army had several classified documents that dealt with foreign radios. The FOMCAT Foreign Material Catalogue (SECRET) and a small green book put out by USAEUR, the U.S. Army Europe, that dealt with Soviet radios. Therefore, we could not inform U.S. troops of these radios in an unclassified manner. We in Technical Intelligence did secure permission to write about them in unclassified format if the set was captured in South Vietnam. In July 1967, the only issue of the Technical Intelligence Bulletin was published by the Combined Material Exploitation Center (CMEC). CMEC also had an extensive display of captured radios and other communication equipment and was on the briefing circuit for incoming intelligence personnel.

Telephone systems were not employed on any large scale and were usually used in the higher headquarters in secure areas such as Laos and Cambodia. Occasionally this equipment was captured by U.S. and Allied Forces. The main field telephone was the Chinese Model 0743, a copy of the Soviet TAI-43, copied from the WWII German field telephone. A Chinese 10-line cordless switchboard was the most commonly encountered item. There were also Yugoslav desk telephones, Polish storage batteries as well as captured U.S. EE8 telephones.

Routine administration and logistic matters were handled by couriers who carried recording tapes from point to point. Correspondence was put on magnetic recording tape which meant that a lot of material could be transferred in a small space. The most commonly encountered recorders were the small reel-to-reel sets that came out before the cassette recorders were on the market. Most of these recorders did not have a pinch roller and the speed of the tape across the recording head depended on where in the reel the tape was, the last portion usually going slower than the first part. In addition, the drain on the batteries was very heavy and as the batteries were worn down, tape speed slowed. It did give the VC a secure means of transmitting routine communications.

Radio communication was usually reserved for operations and intelligence with intelligence having the higher priority. Operations orders could be transmitted by courier but intelligence needed a faster means of transmission. There were several different types of radios in use by the North Vietnamese and the VC.

Among the radios that were captured

The Mercury Talk is a high frequency, continuous range transceiver with a frequency range of 1.7 to 6.0 Megahertz (MHz). It was first manufactured in the People's Republic of China (PRC) in the late 1960's.

were the Type 71B Radio Transceiver, which was a manpack AM radio which weighed 45 lbs. It covered 1.9 to 7.2 MHz and was 6 1/2" x 12" x 15". Power was provided by a D71 dry battery with taps for 1.5V, 7.5V, 90V and 150V.

One of the most often captured radios was the Chicom Model 102E which was manpacked or mounted in vehicles. This set was a copy of the U.S. AN/GRC 9 set with a few changes. The transmitter took up more space and the outer carrier, a metal chest housed the transmitter, receiver and a space for the D81 dry battery. The transmitter required a 641D hand cranked generator or a 964E dynamotor. The hand-cranked generator looked just like the U.S. versions but had a built-in voltmeter, an idea first seen in WWII Japanese generators. The set was a 15 watt set with a range of 75 miles, and covered 2-12 MHz. The complete set with accessories weighed 105 lbs. The receiver and transmitter alone weighed 38 lbs. This set was being replaced by the XD6 set which had the same technical characteristics.

The Type 139 radio receiver was a manpack AM set which could be interchanged with the receiver of the 102E set. It was contained in a thin sheet metal case with a snap-on battery case and had a switch for connection to an external battery. The set weighed 10 lbs. without the batteries and was 6 1/2" x 10 1/2" x 11" and covered 2-12 MHz. Power requirements were 1.5V and 90V. This set was known to be used by the Viet Cong.

The Chinese type 7512 Radio Receiver was an AM table model receiver that was well constructed but very heavy at 90 lbs. It was designed for fixed station use and operated on 110 or 220 volts. This set covered 1.5 to 25 MHz in 5 bands. Needless to say this set required access to commercial power or a portable generator.

The Type 63 manpack set was the newest item supplied by China. This set was probably intended as a replacement for the Model 71 B radio. This set looked like a copy of the U.S. WWII Walkie-Talkie but when the RT unit was removed from its case, it looked more like an AN/PRC 10. It weighed 35 lbs., was 3 1/2" x 10" x 16" and was powered by a D-63 dry battery with taps at 3V, 27V, 90V and 178.5 volts. It was estimated to be a 2 watt transmitter and covered 1.5 to 6 MHz. Unlike the U.S. counterparts this set had a built-in key for CW operation.

The other major Chinese set that had been captured by Allied Forces was the Chinese Type 601C Radio Transmitter. This was a high power set that was table or vehicular mounted. It weighed 45 lbs. and was 20" long, 8" high and 8 1/2" deep. The power requirement was 6 volts and 500 volts from a generator or dynamotor. This set was estimated to have a range of 75 to 2000 miles, again in the 2-12 MHz range with 3 bands and 6 preset crystals. Again, it was capable

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An HRO Story

Part 1

Jim Hanlon, W8KGI
P.O. Box 581
Sandia Park, NM 87047

What was your first receiver? Certainly you remember. For those of us who started in the vacuum tube era, our first receiver was more than a little like our first love.

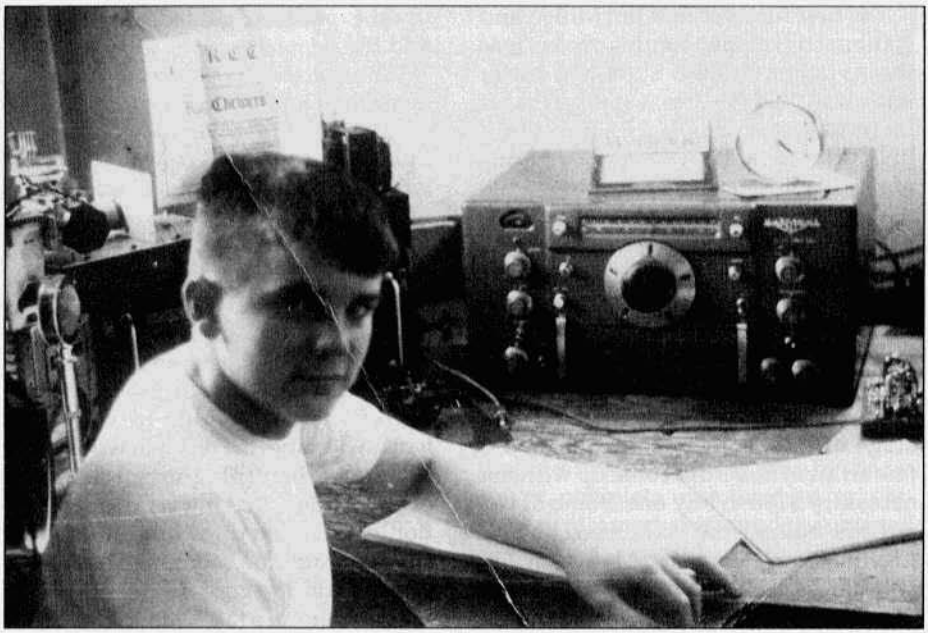
For me, it happened early in 1950. My older brother, Bob, a freshman at Saint Xavier High in Cincinnati that year, had investigated ham radio because he wanted to build a radio controlled model airplane. But radio turned out to be much more interesting than sticks, glue and paper; so by spring of 1950, Bob had built a code practice oscillator into a cigar box and had started to work his way up to the 13 wpm required for a Class B ticket (that was way back when, before the novice license). I was a sixth grader, old enough to have accumulated a small nest egg through cutting lawns and shoveling snow; so Bob enlisted me in his efforts to buy a used Hallicrafters S41G from Leo at World Radio Labs.

Now a used S41G wasn't much of a receiver. It was the Hallicrafters version of the Echophone EC-1, a step below the S38. But it was available for about $25, so it was at least within reach.

Enter Dad. Seeing his sons doing something potentially worthwhile, he decided to encourage us by offering to buy a receiver for us. Well, Bob talked that over with his buddies in the Radio Club at Saint X, and he came back asking Dad to spring, not for a used S41G, but for a brand new, top of the line HRO-50! Dad, bless his heart, gulped a little, dug down and came through for us. And it really was a good investment. Both of us got sufficiently inspired to get several Engineering degrees apiece. We both picked up FCC First Phone tickets along with our High School Diplomas and landed summer jobs as TV Engineers, where the pay was good enough to cover the majority of the year's college expenses and the hours were such that we couldn't spend much in our free time. And, of course, we both got our ham tickets. So began my love affair with the HRO.

That HRO-50 became the centerpiece of our shack. By '54 or so, it was surrounded by the world's largest 150 watt transmitter. A Bud mini-rack held most of the RF section, a "bandbox" frequency multiplier, a 6146 driver, and push-pull 809's in the final. An outboard BC457 was the VFO, and a National MB-150 was the tuner for our 134 foot center fed Zepp. The speech amp and 807's modulator were on yet another chassis. And one of those gigantic old radar power supplies held the various high voltage and bias supplies for the whole station. We broke it up around 1960. I offered and Bob accepted that I take the HRO and he take everything else. I'm afraid I got the better part of that deal. To this day, despite acquisition of "better" receivers like my 75A-3, 75A-4, NC-303, HQ-170, HQ-180 and R4B, the HRO-50 is still front and center in my station. Once I fall in love, I'm committed!

But that was only my first HRO. Around 1967, yet another one came into my life. It was during one of those maximum effort plus episodes of my life. I was teaching Electrical Engineering full time at Ohio State, and taking a full course load toward a PhD, and trying to be Husband and Father to 2 and then 3 little kids, all at the same time. Bob Higgy, W8IB, who was a lot of things to me including teacher, fraternity brother, fellow faculty member and friend, was being forced by the advancing symptoms of his Parkinson's Disease to retire early and move from the comfortable,



The HRO-50T and myself when we were both a little younger, like about 1952. My brother was and still is W4RXK. I was W4VIV and WN4VIV, back when you could hold a novice and tech at the same time.

near-campus home he had lived in since childhood to a small, one story apartment elsewhere in Columbus. One memorable day, I helped Bob dismantle and pack up his station, a Viking 500 and SX-101 combo and a considerable "junk box" collection from his 50 plus years of being a ham. When we were all done, Bob took me into the basement room that housed his coal furnace, reached under a work bench, and pulled out his old HRO. Dusting away what looked like about a quarter inch of soot, he said, "Keep this for me. I know you will appreciate it."

Wow! What Bob had given me was a rack mount HRO, serial L175, plus a rack mount coil box and power supply and a home brew speaker. It had been originally purchased by the Ohio Highway Patrol in 1936 and given to him as part of a consulting fee the next year. He had used it for many years, finally retiring it when he bought the SX-101. When I took it home, all I had to do was plug it in. It took off running despite twenty plus years of use and several years of storage under a quarter inch of coal dust. And it wasn't just a nice antique. It was and still is a top performer for ham band CW and AM operation.

So, other than my nostalgia, what made the HRO so special? How did the HRO come to be such a great receiver? For more insight on that, I will borrow from the story as told by Bill Orr, W6SAI, in his *CQ* article of May, 1975, "*The Wonderful HRO Receiver.*"

We have to go back to about 1930, when the Department of Commerce decided to develop a nation wide radio ranging and communication system. They chose General Electric to make the ground transmitters, Aircraft Radio Corporation (later to produce the ARC-5 Command Set family) to make the airborne equipment, and "the relatively obscure National Company of Malden, Massachusetts" to make the ground station receivers.

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An HRO Story from previous page

The first receiver that Jim Millen and National developed for this project was the Aviation Ground Superhet, better known as the AGS. It was state of the art for its day, featuring one RF, two IF's, a BFO, rudimentary AVC and even one of Jim Lamb's new crystal filters in the AGX model. It also used a set of three plug-in coils that were individually hand adjusted for appropriate inductance in their specific receiver by National engineers. Such was the care that could be lavished on a receiver in the bad old days of the Great Depression. The AGS came with either general coverage or ham bandspread coils, and a few affluent hams did come up with the necessary $180 to buy one. Some of the airlines bought the AGS also, but all together only somewhere between 200 and 400 of them were built. The FB7 and FBX were also designed by Millen as affordable spinoffs of the AGS technology.

At this point, let's pick up the story as Bill Orr tells it. "Some of the airlines used the AGS, but others, such as Transcontinental and Western Airlines (the predecessor for TWA and United) felt the need for a more sophisticated receiver than the AGS to replace the SW3s they were using for CW communication, and to work along with the newly-acquired Western Electric phone transmitters. The coordination job for a new receiver was turned over to Herbert Hoover, Jr., W6ZH, past president of the ARRL, who was living in Pasadena, California, working with T&WA and also teaching part time at Cal Tech. Herb contacted Jim Millen of the National Company, who had interesting ideas on the project, and the new airlines receiver concept was hurried into development.

"W6ZH set up an experimental laboratory in his garage under the direction of Howard Morgan of Western Electric. Howard and a few technicians went to work on circuit development based upon experience gained with the AGS and the demands of the airlines.

"The specifications were laid down to meet the state-of-the art. The receiver would have superior image rejection. That called for two stages of tuned RF amplification. Superior selectivity called for the new Lamb crystal filter. The read-out would be excellent, and Jim Millen had a radical new epicyclic dial design for that, readable to one part in 500! In addition, the receiver would have AVC and an S meter.

"Because the designers believed in the efficiency of plug-in coils over bandswitching, the receiver would have a new four-bank plug-in coil catacomb, each coil deck having its own calibration chart. To reduce hum, the power supply would be separate from the receiver (a design goof that was to plague the company at a later date)." (My HRO-50 was the first model to have its own, internal power supply. And Jim Millen had a few things to say about internal power supplies and plug-in coils which I'll add in later on.)

"Taken as a whole, the receiver was years ahead of its time. Viewing those days from these days, the project was one of the very first examples of system-designed equipment, an art well-known today, but unknown before World War II. Consider the state of the radio art in late 1933 and early 1934. The great majority of radio amateurs had home-made regenerative receivers or SW3's. The superhetrodyne receiver was thought useless for CW reception and was suspected of inferior performance for general shortwave work. The most affluent and sophisticated radio amateurs boasted a Hammarlund "Comet Pro" superhet, an elementary receiver without preselection, AVC or crystal filter. Since it was considered more or less a feat of great dexterity to receive anything on a shortwave superhet, the problem of interference and image signals never seemed to en-

HRO-50T, serial 0455, and speaker.

ter the picture. No standard of comparison existed with which to judge the new receiver design!" (I think Bill got a little carried away here. The National FB7 and FBX were available at that point and not all that bad as reported in ER, January, 1994. Hammarlund was offering the Comet Pro, which appears to have been similar to the FB7. Also the RME 9 made its appearance in 1933 as a bandswitching superhet with preselection, good AVC, an S-meter and a crystal filter, the direct predecessor of a line of receivers stretching through the RME 50 out to 1953. But let me not quibble with a great story.)

"Slowly, a prototype receiver took form. And what a receiver! The cost of duplicating it today would be out of the question. Special dies for punch-presses were used for the chassis and coil assembly. Castings for the dial and mechanism were designed and molds built. National company built the IF transformers, the coils, the various forms and insulators and even some minor hardware, specifically designed for the new set. The design was full of knotty problems, having no precedent, compounded by the miles separating the mechanical and electrical design teams, one on the east coast and one on the west coast!

"Finally, in early 1934, Jim Millen completed a mechanical mock-up of the receiver, complete with the new, revolutionary dial mechanism and the unusual plug-in coil assembly. Herb Hoover reported good progress on the electrical design, although problems on the electrical design still remained with AVC system and the second detector. It was decided, however, that the time was ripe to combine the mechanical and electrical systems into a working model of the new receiver.

"Using much overtime, the National Company rushed the assembly of several prototypes. The toolmakers working on the various dies and castings required a job number for their overtime slips and, as none had been assigned for the rush work, took it upon themselves to use the initials HOR, as an abbreviation for "Hell of a Rush," since that was the state of affairs for the new project thrust upon them.

"Now, known as the HOR, the new prototype was carried by Jim Millen to Pasadena for final circuit revisions and tests. The bugs were worked out and the new receiver seemed an unqualified success. By this time, however, some of the participants in the project had doubts about the name of the new receiver, at least from the social aspect, so the receiver was rechristened the HRO, the name change being made just

continued next page

An HRO Story from previous page
in time to catch the first advertisement of the receiver in the December 1934 issue of *QST*." (Actually it was the October 1934 issue where the HRO first appears.)

"The first HRO receivers met with instant acclaim. The performance was sensational, the two RF stages giving the receiver the sensitivity equal to the ears of an Iroquois Indian scouting party. Images were nonexistent, at least up to 20 meters, and stability on the general coverage ranges was equal to or better than other receivers on the market. . . .Early models of the HRO went to a number of prominent amateurs who were friends of Herb and Jim: Percy Spencer, Thorne Donnelly, Ross Hull and K.B. Warner. Another early owner of the HRO was Charlie Kolster, the Radio Inspector in the Boston office. Charlie was quite impressed with the receiver and when Jim Millen wished to replace his old 2BYP call with a first district call, Charlie confided that Jim could have W1HRO, in honor of the new receiver. Alas! The fledgling FCC goofed and instead Jim ended up with the call W1HRX!

"In spite of the call letter mixup, the HRO receiver was an instant success. The first large order came from Braniff Airways, who bought a quantity and installed them in boxes on telephone poles, every 50 miles or so along their main route. The HROs ran continuously, tuned to the 3105 kHz aircraft channel, and the outputs were patched into a special land line which could be monitored in Kansas City, Dallas, Tulsa and Oklahoma City. This scheme provided Braniff with continuous voice reception of their planes on that route. When operated in this fashion, the HRO proved to have excellent reliability and stability."

As one can see from the pages of *QST* in the middle thirties, the HRO soon became the centerpiece of many of the best amateur stations. Even W1MK, to become W1AW when Hiram Percy Maxim died, sported an HRO. The results of the Eleventh International DX Competition reported in *QST* for October, 1939, tell an interesting tale. The winning stations' transmitters, receivers and antennas are all listed. In US Winners' stations, there are 27 HRO's and one HRO-Jr, 24 RME 69's, 15 homemade superhets, 11 NC-101X's, 5 NC-81X's and SX-16's, 4 SX-17's, 3 homemade TRF/regens, and one or two of other types of receivers. Foreign Winners used 15 home-made RTF/Regens, 9 HRO's, 6 home-made superhets, 4 RME-69's, 3 NC-101X's and SW-3's and one or two of other types. It's interesting that across all categories there are only 4 Super Pro's, made since 1936, and three HQ-120's introduced in 1938. Clearly the receivers found in the most competitive amateur stations around the world in 1939 were made overwhelmingly by National, RME or the owners themselves.

The HRO was originally intended to come in at a price and performance level between the FB7 and the AGS and was offered for $233 list ($139.80 net to amateurs) with coils but less tubes, power supply and speaker in October '34 as opposed to $265 and $295 respectively for a similarly equipped AGS or AGS-Z and $62.50 and $86.50 for the FB7-A and FBX-A. By April 1937, it was being offered to hams by Henry Radio among others for $179.70 with tubes and coils or for $195.60 including power supply, in contrast to $255.70 for a Hammarlund Super Pro, $151.20 for an RME 69, and $99.50 for a Hallicrafters SX-11 Super Skyrider. Despite its relatively high price, the HRO was such an outstanding value that it became the standard of comparison for all other receivers in its day.

What made it such an excellent receiver was an optimized combination of mechanical and electrical design. The 9 tube circuit as shown features two

tuned RF amplifiers, a mixer and separate local oscillator, two IF stages with a crystal filter preceding the first, a dual diode triode for detector, AVC and first audio, an audio output, and a BFO. The power supply was in its separate "doghouse" or in a separate rack mounted unit, which kept a major source of heat and hum away from the main receiver.

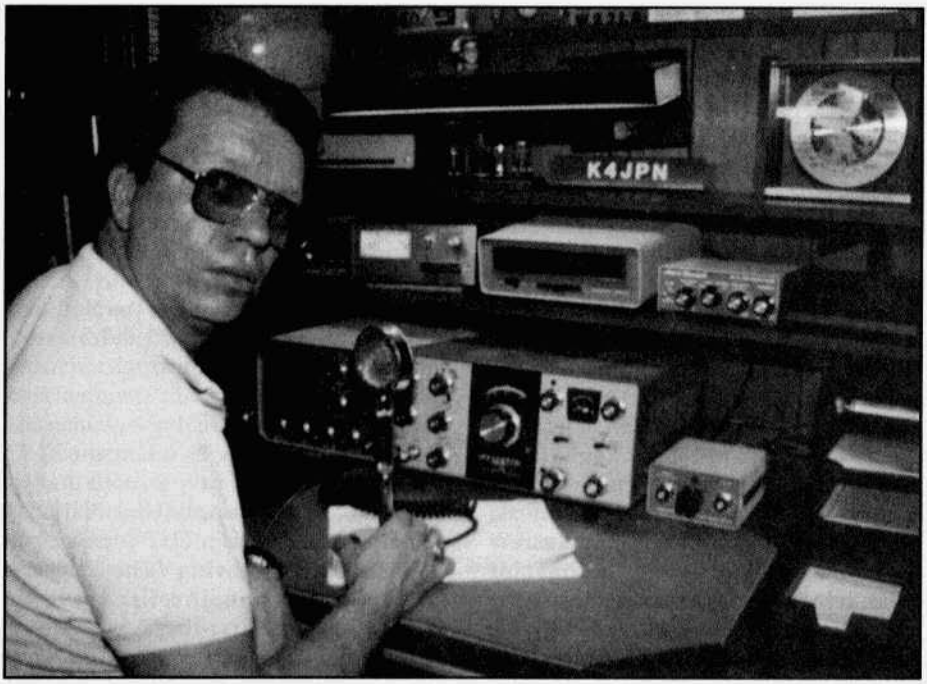
Several new design advances were made in the HRO circuit, as explained by Jim Millen and Dana Bacon in the January 1935 *QST*. The problem of tracking four tuned circuits in a superhet was solved by providing individual trimmer capacitors and an inductance adjustment on each coil. A balance between inductive and capacitive coupling was used in the RF and mixer tuned circuit assemblies to level the receiver gain across its frequency range. On the 14 to 30 MHz range in the prototype receiver, an additional grid winding self resonant just below the low frequency end of the range was used to give voltage step up and to compensate for the varying impedance of the tuned circuit. This feature is not found on my 1936 HRO. The local oscillator was "electron coupled" to the mixer screen grid, and the Hartley circuit was so designed that the oscillator input to the detector was constant over the range. The first RF stage was on the AVC bus, but it was not connected to the manual RF Gain control. This provided optimum signal to noise ratio, important for weak signal reception. The tuning range of the coil sets was limited to just over a two-to-one ratio, 1.7 to 4.0 MHz, 3.5 to 7.3 MHz, etc, providing respectable bandspread on the general coverage range and allowing, with a simple switch provided by changing a screw position on each coil unit, the amateur band, which just happened to be at the top of the range, to be spread over the entire dial. The plates of the tuning capacitors were shaped to give "straight-frequency-line tuning" on the general coverage ranges, and nearly straight line tuning on amateur bandspread.

Mechanically, the HRO is relatively light and yet quite rugged. The chassis and cabinet are welded steel. The plug-in coil drawers are held firmly in place bottom, top and back by a combination of slides, pin fasteners and upper contacts. The coil electrical connections appear directly beneath their respective tuning capacitors for maximum Q and minimum gain-killing stray inductance at high frequencies. Air dielectric trimmer/padder capacitors are an integral part of each moulded coil assembly. The tuning capacitor has two double insulated ganged units mounted on each side of the anti-backlash worm drive unit of Millen's new PW (parallel worm) drive. The worm drive unit itself is mounted on a pedestal that rises above the chassis, but the condensers do not touch the chassis at any point and the Micrometer Dial and its drive shaft do not touch the panel. This insulates the tuning mechanism from misalignment, warping or other distortion of either the chassis or panel. Parts are secured on terminal strips, wiring is laced into cables, and lots of lockwashers are used to keep screws tight. All parts are easily accessible for service, something I wish were true of my SX-28 and SP600 Super Pro. The HRO Micrometer Dial, soon to become the unofficial trademark of the National Company, provides 500 calibration marks while it rotates through ten turns with decade numbers advancing in five small windows in the dial by means of its epicyclic gearing as it is turned.

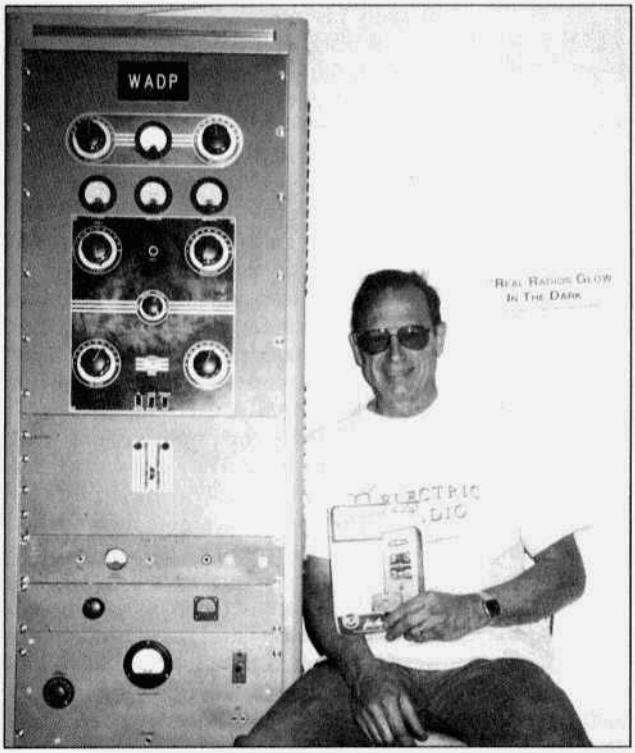
On the subject of plug-in coils and an external power supply, the National Catalog published in *QST* for October 1934 says the following: "The HRO Receivers employ plug-in coils rather than coil switching. This is because we have found that, other things being equal, much better performance is obtained with plug-in coils. The principal reason

continued on page 34

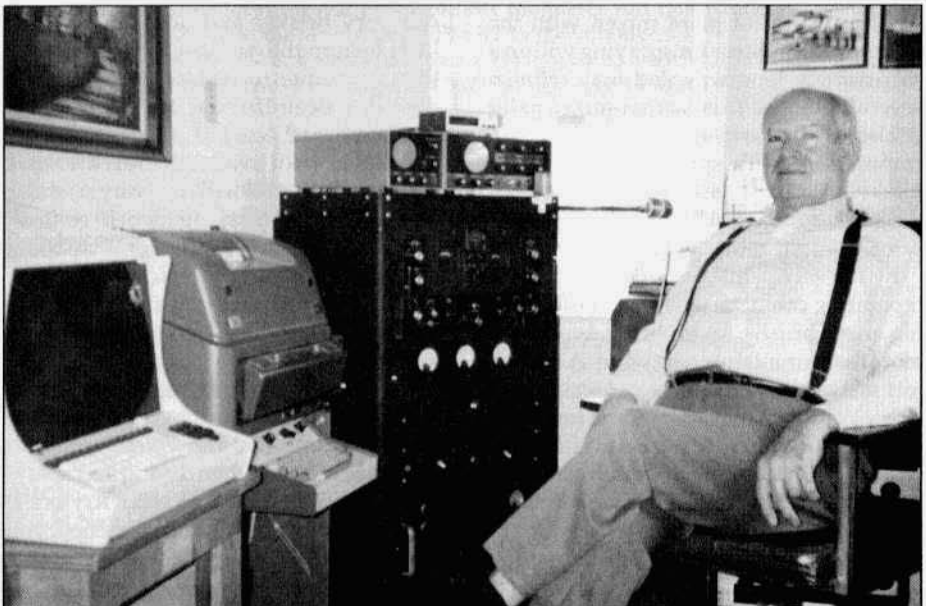
Fred Meek, N8HYR, shown with some of his vintage equipment. He is very well known on 10-meters where he is probably one of the most active AM'ers.



Steve Ray, K4JPN, with his vintage Heath station.



Tim Walker, N2GIG, with his newest acquisition, an RCA ACT-150 broadcast transmitter. He's holding the Nov., 1937 QST which contained an advertisement for the rig. "WADP" was its call when it was owned by "WSM" and used (for 30 years) on 1606 kcs. The rig puts out 150 watts, AM/CW, on 160-10 meters. When Tim gets the transmitter restored and on the air, he's promised to produce an article for ER.



Nick Oland, W3DSE, with homebuilt AM transmitter circa 1952. The rig uses an 814 in the final and 809 class B modulators. Next to the transmitter is a Teletype Model 28.

Painting Tips

by Jack Shutt, N9GT
1820 Dawn Ave.
Fort Wayne, IN 46815

One of the best sources for supplies for the restoration of vintage equipment is your local automotive paint supply store. I have found several items that may be hard to find elsewhere and items which may have disappeared from the shelves of your local electronics parts supplier.

Wrinkle finish and Hammertone paint for those old cabinets and rack panels are available, even though prices are a bit salty ($6 to $8 per can), at least you can readily find these items in these stores.

Also, if you are involved in the restoration of a particular piece of gear requiring matching of paint (Johnson maroon and gray for instance), the dealer can computer match these colors for you with great precision and the cost is really not that high for small quantities. I obtained these paints for about $12 per pint for acrylic enamel. This paint works well and is fast-drying. A pint of paint mixed with the appropriate reducer for spraying will go a surprisingly long way and may refinish several cabinets. This custom-mixed paint is also available in spray cans. You can compromise with spray cans of generic touch-up paint which is also available from the same source but for the difference in price, I would rather get an exact match.

By the way, while we are talking about repainting cabinets, why not consider using an air brush? An air brush is nothing more than a miniature spray gun. Air brush kits are available from your local hobby shop. You can get a basic model for about $15 or $20 which works beautifully for refinishing or touching up equipment cabinets. These units can be powered by small compressors, or you can purchase cans of propellent which look much like spray cans and work real well. You can also use an air tank or even a spare tire filled with air and equipped with a valve adapter as a source of air pressure. A large spray gun is really just not necessary for doing this type of work. You may, however, want the larger variety of spray gun if you are refinishing something like a six foot rack cabinet!

Auto paint supply stores usually carry a large selection of various grades of wet-dry type sandpaper which works very well for refinishing jobs (as well as for grinding crystals per KJ4KV's article in ER #59). I have also discovered an excellent use for the extremely fine grades of sandpaper. Grades 1000 through 2000 (micro fine) are available and are normally used for removing minor scratches or imperfections from auto paint finishes. They also work beautifully for removing scratches from those plastic dial windows and meter faces! Start out by carefully sanding and polishing out the scratches with say, 1000 grade. Then, switch to 2000 grade and then use toothpaste. Yes, I said toothpaste, to polish the plastic to a smooth and clear shine. The toothpaste is a very fine and mild abrasive and works great as a final polisher. It works best if you rub very briskly and actually create a little heat in the process. I recently used this technique to restore the dial window of a beautiful old NC-240D and it worked great!

Another item available from the same source, which you will find very useful is a good grade of masking tape. In contrast to the cheap stuff available at discount stores, this tape won't remove half of the finish when you remove it and is desirable when masking those two-tone paint jobs such as with Johnson gear.

And one final tip, make those equipment knobs look new by first washing them with detergent and water (scrub with a tooth brush) and then drying and spraying them with a coat of clear Krylon. If they are really grungy and scratched, you can polish them with #000 or #0000 fine steel wool before spraying them with the clear coating. This technique works great and results in a good looking long lasting restoration. 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: Wednesday nights at 8 PM PT 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: Recently started by Pat, K7YIR, this net is on 3875, Mondays and Fridays at 9:30 PT. 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.
Twenty Meter AM Net: This net on 14.286 has been in continuous operation for at least the last 20 years. It starts at 5:00 PM PT, 7 days a week and usually goes for about 2 hours. Net control is Les, K6HQL.
Arizona AM Net: Meets Sundays at 3 PM MT on 3860. 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 3875 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.
Military Radio Collectors Net: Meets Sundays at 4 PT on 3905. Net control is Tom, WA6OPE. It is not necessary to check in with military gear.
Grey Hair Net: The oldest (or one of the oldest) 160-meter AM nets. It meets on Tuesday nights on 1945 at 8 PM in the winter and 9 PM ET in the summer.
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 14.062, Saturdays at 3 PM PT. Net control is Tracy, WB6TMY.
Vintage SSB Net: Net control is Chuck, N5SWO. The group meets on 14.293 at 1 PM CT, Sunday afternoons.
Collins Users Net: The oldest of the 'users nets'. It meets on 14.263 Sunday afternoons at 2 PM CT. The net control revolves. This group also gets together for an informal ragchew on 3805 Tuesday evenings at 7 PM CT.
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.
Heath Users Net: A new net started by Marty, WB2FOU/5. Net control is shared by Fred, AA5LW. It meets on 14.275 at 4 PM CT Sundays. Check in on either AM or SSB.
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 has been meeting since 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.
NBFM Net: 3885 at 10.30 PT, Thursdays. Net control is Dennis Petrich, KØEOO.
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.
Westcoast Broadcast Equipment Net: Tuesdays on 1959 at 9 PM PT. Anybody is invited to join the group, but the emphasis will be on broadcast equipment. Moderator is Mike, W6THW.

On the Air With the ART-13/ARC

by Bill Kleronomos, KDØHG
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One of the facts of life in the vintage radio world of 1994 is the increasing scarcity of decent used AM equipment. A decent transmitter can cost several times what it might have several years ago and you won't find the tables at hamfests groaning under the weight of vintage iron much anymore. Given this state of affairs it's a real surprise to me that more ART-13's aren't being restored and put on the air.

An overview ought to mention what the ART-13 has going for it.

Tube complement: Every tube used in the rig is still inexpensive and easily available. The final, an 813 and the modulators, a pair of 811s, can be acquired more cheaply than a new pair of 6146Bs! Compare this situation to that of other military transmitters: The BC-610s compliment of tubes is getting outrageously expensive, the VT4-C/211 used in the BC-375 is highly prized by the audio fraternity and is getting scarce and very expensive.

Power capability: With the standard 1200-1300 volt plate supply, the ART-13 will crank out an honest 150 to 175 watts of genuine high level plate modulated AM. Given a bit of risk taking in the form of a higher voltage plate supply much higher outputs can be obtained. KEØMT consistently ran his at an output of near 250 watts or about 300 watts DC input using a 1700 volt supply.

Frequency coverage: Unmodified, the ART-13 will cover the top 25 kHz of 160 through part of the 17 meter WARC band and everywhere in between. From time to time I've run mine on the oddball Army MARS frequencies - only fitting for a military transmitter!

Availability and Support: ART-13s are constantly being advertised here in ER and other places. Fair Radio currently has decent surplus units available. Parts units and accessories such as the dynamotor supplies and remote control boxes are available everywhere from hamfests and other sources.

Ease of Conversion: "Conversion" is a misnomer - absolutely nothing needs to be done to get this rig running on AM mode other than routine maintenance, alignment and restoration. Just add power and play.

Other Features: Of course, the famous Collins autotune and PTO need to be mentioned first. Capable of retuning to 11 preset frequencies, you can whir and buzz your way around the ham bands in 30 seconds or less with amazing accuracy. After warmup, my rig will retune itself to within 5 to 20 cycles of a preset. Those of you intimidated by mechanical things should be reassured that the rig can be manually tuned and operated. The rig also contains an accurate crystal calibrator and sidetone oscillator for CW. Finally, the remote control box allows putting the rig into a garage, basement or other location for clandestine operations. . .

Reliability: In today's dollars, the ART-13 cost the government $60,000 or more, and they're built like it. From the famous "Kryptonite" modulation transformer to the hand machined casting, no effort was spared in design or construction. Every single part in my own rig is still in use - nothing has failed over the last 50 years, nothing is out of spec.

Caveats: A couple of minor additions should be added to the rig prior to any

serious hamming. An exhaust fan is absolutely essential in minimizing appallingly high internal temperatures. The old *CQ* conversion books recommended an automotive heater blower, in 1994 we can use a small DC powered muffin fan. As Hutchens pointed out in *ER* #7 , the thermal design of this rig is such that internal convection draws air past the VFO and low level stages first to minimize drift. Therefore, it's important to add this fan behind the PA tube/modulator compartment in the rear of the rig to draw air out, not blow air in.

Another almost essential addition is that of an external speech processor/limiter/compressor. The rig can and will overmodulate in the negative direction quite easily, generating copious amounts of splatter and buckshotting. Line level audio is required to drive the rig - an amplified D-104 will work nicely, but buy or build a compressor and use a scope to set it up correctly! Even better is the addition of some sort of audio equalization. I think in stock form the ART-13 sounds better than almost every Johnson transmitter except the Ranger and a bit of EQ makes it sound even better. Coincidentally, I think the ART-13 sounds most like the Collins 32-V series of transmitters. Not surprising considering they came out from under the same cabbage leaf.

The single most obvious glitch to the rig is the singing or talkback the modulation transformer generates especially when warm. Some sound deadening on the wall behind the rig can be a welcome addition.

Conversion Info

If I've enticed you to get on the air with this rig, let me suggest you review the Hutchens article on the ART-13 in *ER* #7, the Murphy article in *ER* #32 and the articles I previously wrote in *ER* #28, #29 and #30.

As mentioned, the word "conversion" is inaccurate - all that needs to be done is construct a power supply. The voltages required are: 27 VDC at 10 amperes to run tube heaters and autotune, 400 VDC at 225 mA for the VFO, multipliers, drivers and low level audio stages,1250 VDC at 250 mA to run the high level modulator and final.

A matching power plug for the rig must be obtained. I can only suggest sources such as Robert Downs (who advertises here in *ER*), or Fair Radio. A new plug might be purchased from sources such as Newark Electronics, but at a price, of course. Other prerequisites are a manual and stout chassis for the power supply - there's gonna be lots of iron on it! I am using a 10" deep steel chassis supported on a 10" high standard rack panel. The ART-13 weighs in at almost 70 lbs. and my supply probably weighs close to that. The supplies can follow almost any conventional design but the ones I present here follow the old LC/filter philosophy with the use of oil filled capacitors with the same grade of construction as the rest of the rig. As long as the voltages are correct with decent regulation the choice of supply design, be it full wave, FW bridge or doubler can follow the components you have available.

And as always: HIGH VOLTAGES CAN KILL! Be careful and don't leave out those bleeder resistors and covers where needed! Please!

Power Supply Circuit Description

There isn't much simpler in homebrewing than a power supply and except for the logistics of component procurement this one is no exception.

T1 and T2 are the sources of the 1250 volt and 400 volt supplies, respectively. T3 is part of the 27 volt supply. T1 and T2 are controlled by both K1, a 28 volt power relay with 20 amp contacts, and K2, a thermal time delay relay. When the main AC power switch is turned on, a predetermined amount of time must pass before the high voltage supplies can be keyed by the ART-13 to protect the tubes.

The 12.5 ohm resistor is a shunt for

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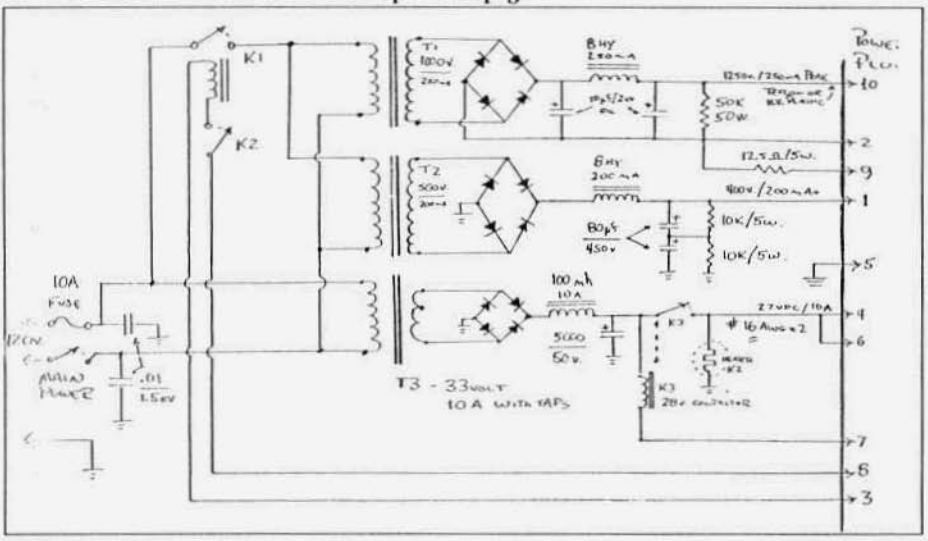

ART-13 power supply schematic.

the plate current meter in the rig. With this value of resistor the meter will read near 300 mA full scale.

When the function switch on the ART-13 is turned on, K3 is energized through pin 7 and the tube heaters and autotune motor are enabled. The "local-remote" switch must also be in "local". After the time delay, B+ can be keyed by the rig via control leads 3 and 8. In "phone", B+ is keyed by the mic, in "CW" or "MCW" B+ is always switched on.

Operation of the rig for the first time can be a bit intimidating and confusing unless you take the time to read the rig's manual and the *ER* articles previously mentioned. For example, the autotune won't operate if the function switch is in calibrate. The plate current meter reads the sum of the final and modulator plate current. To get a reading of one or the other note the difference of the readings when the rig is keyed in the phone and CW positions; the CW reading is that of the final alone. Resting current for the 811 modulators should be around 40 to 50 mA.

To tune the rig manually, the locking bars are left tight and the channel switch is turned to "manual". After the autotune stops running the rig is tuned in a conventional manner. Note that external loading capacitors in the 100 to 700 pF range are always required at the RF output terminal of the rig. I use a 560 pF transmitting mica on 160 and 80, 300 pF on 40 and a 100 pF unit on 20 and 17. Always consult the suggested tuning settings in the rig's manual; it's possible to tune the rig to a harmonic of the desired band, but I've never had a problem in this regard. Speaking of harmonics, with the use of a Drake low-pass filter, my rig is remarkably TVI-free. I would suggest shielding the power supply-to-rig cable if TVI is a problem. Adding a parasitic suppressor of conventional design to the final is also recommended.

Once your rig is up and running I strongly suggest opening it up and doing a complete alignment and a cleaning and lubricating of the autotune mechanism per the manual. If your autotune mechanism is jammed or doesn't run - DON'T RUN THE RIG! You'll burn out the motor in a remarkably short period of time.

The little rotary trimmer caps in the multiplier section are often frozen in

continued on page 38

The Antenna Null Meter - My Experience

by Steve Thomason, WB4IJN
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Background

When I read the article written by Al Roehm, W2OBJ, in the April 1994 issue of *ER*, I couldn't wait to build one. At my QTH, I use a homebrew multi-band antenna and an antenna "tuner." All of my transmitters are "hollow state" or have tube finals. The idea of being able to "tune" my antenna while keeping my finals properly dipped and loaded, not to mention the side benefit of reducing QRM, seemed too good to be true. I had to build it! After I returned from the Dayton Hamvention, I gathered up the parts and went to work.

Construction

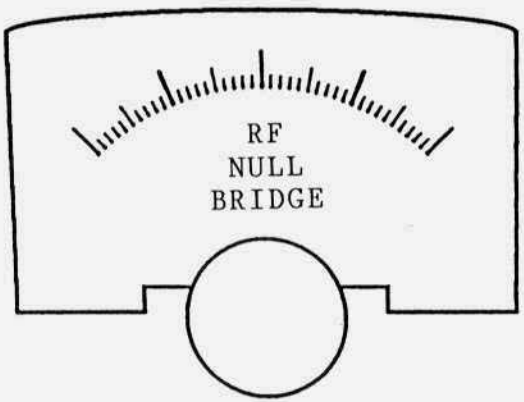
I used a Radio Shack aluminum project box (Cat. No. 270-238). I also used Radio Shack's 0-15VDC meter (Cat. No. 270-1754) which I understand has a 0-1MA movement. You do not use the resistor that they furnish with this meter. All component values except R5 were as specified by Al. I found that using a 470 ohm resistor for R5 gave me a larger meter deflection off-resonance and thereby facilitated tuning.

Operation

The Antenna Null Meter works flawlessly. I use it with power levels ranging from 100W barefoot with a set of Drake Twins, to almost legal limit from an L4B. The Radio Shack DPDT switch also handles the output from my Johnson 500 without any apparent difficulty.

I made up a new paper face plate for the meter that only has hash marks instead of the 0-15VDC scale. I mounted it with rubber cement and it looks great.

I heartily recommend the Antenna Null Meter to anyone who uses an antenna "tuner." My thanks to Al for his very informative and useful article. ER



Collins 516F-2 Power Supply Relay Mod

by Dave Ishmael, WA6VVL
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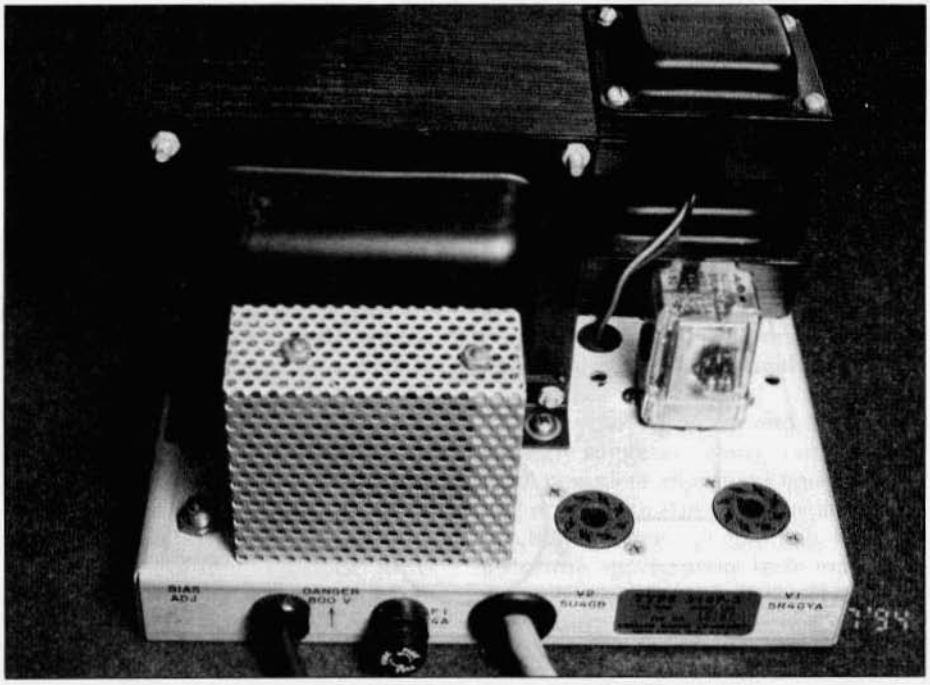
Costa Mesa, CA

While "hanging out" at Dave Kamlin, AB6XK's Wireless World in Laguna Niguel, Calif., he introduced me to a very interesting and worthwhile Collins 516F-2 power supply mod - the addition of a 120VAC relay to eliminate the high inrush currents on the 32S-? or KWM-2/2A ON/OFF switch. These inrush currents can be pretty high and can lead to the premature failure of the ON/OFF switch contacts. This mod has apparently been around for some time and will be "old news" to some *ER* readers.

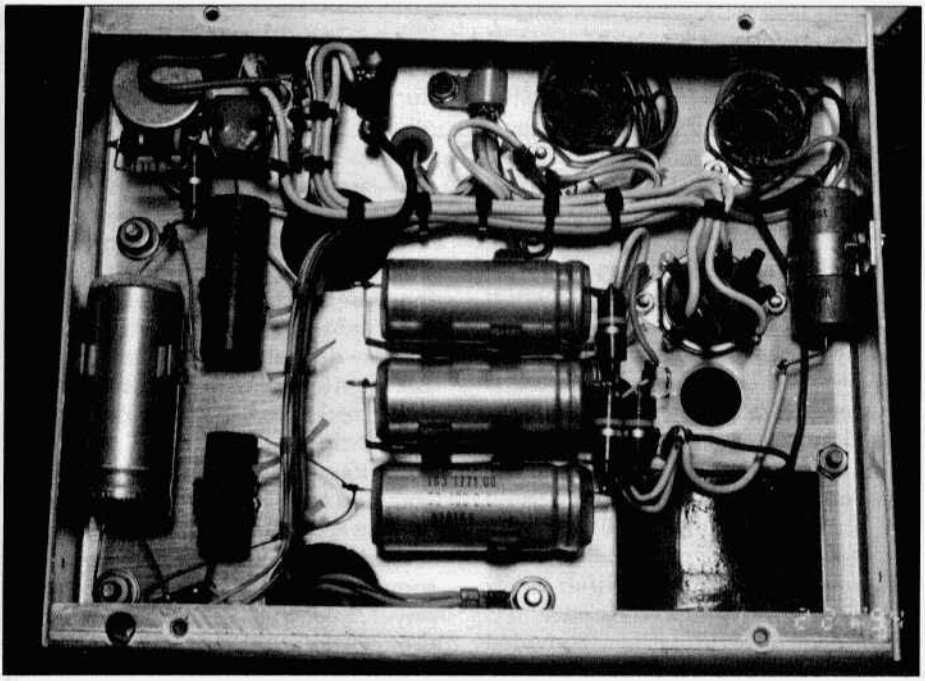
A 120VAC DPDT octal-type relay is added to T1's primary circuit. The relay's contacts switch T1's primary while the 32S-? or KWM-2/2A ON/OFF switch switches only the relay's coil current, 2.2VA. There are several sources for this relay: Potter & Brumfield, Guardian, Magnecraft, Deltrol, ... and they are available with either 5A or 10A contacts. Make sure you use the 10A relays with silver-cad contacts. The 5A silver contacts are not "weld resistant" and may stick. Most of the relays have an optional neon indicator lamp wired in parallel with the coil.

My version of this mod follows:

* Now that the unit is upside down, check the condition of the line cord and remove and replace as required. Make sure the new cord's O.D. is the same as the old or the strain relief will be too loose/tight. Leave the white lead long enough to connect to pins 7 and 8 of the added octal socket.



5 6F-2 power supply showing PB KRPPAN installed in place of L3.



Underchassis view of the 516F-2 showing the socket that has been installed for the KRP11AN relay. Note that C1 (.05 uF, 1 KV) has been relocated.

* Remove L3. Cut L3's black and red leads at the terminal strip leaving pigtails long enough to short together. Solder the pigtails together. This will parallel C5A and C5B. Save L3 as you may wish to restore the 516F-2 to its original electrical condition someday.

* Remove C1 (0.05 uFd 1KV) and set aside.

* Locate and punch a 1" or 1 1/8" hole for an octal socket that is approximately 1.7" from the side and 3.2" from the rear behind V1 & V2. This puts the socket in-line with the existing hole for L3. Using the octal socket as a guide to locate the mounting holes, drill two additional #6 holes. Be **very** careful of the wiring harness when drilling the mounting holes. Install the octal socket with the keyway toward the filter caps.

* Locate C1 against the side of the chassis close to V1 and drill a #6 hole for C1's bracket.

* Install C1 and connect across L1 (standoff near L1 & V1-pin 8).

* Wire the octal socket per the schematic. The wiring harness will have to be opened a bit to re-route the primary circuitry. Use tie-wraps to clean up the harness after the wiring has been completed.

* Using heat-shrink tubing over the eight octal socket pins is not required but is highly recommended.

* Be very careful when drilling the pilot hole for the chassis punch and the mounting holes for the octal socket and C1's bracket that **ALL** drill chips, burrs, filings, etc., are cleaned up prior to powering up the 516F-2. Voltages > 800 VDC are present and it takes but a very small aluminum sliver or burr to cause a short-circuit. You may want to remove the ventilated cover over R4-R6 and verify that this area is free of debris. Now is also the time to change/trim the bias supply's resistive divider (R8 and/or R10) to obtain the correct resting plate

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The Heathkit HW-16 Novice CW Transceiver and the HG-10B VFO

by Dale Martin, W7LOG
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The Heath HW-16 transceiver was obtained from the local ARC where it had been used as a loaner for club members in their early stages of licensing. It was declared surplus and was on its way for sale at a hamfest when purchased for the asking price of $40.

The HW-16 was designed for the Novice and General class operator with CW only on the lower 250 kHz segments of the 80, 40, and 15 meter bands. The final stage of the amplifier is adjustable from 50 to 90 watts input and is crystal controlled. Provision is provided for VFO operation. Full QSK, dual conversion, a crystal controlled front end, sensitivity of one microvolt, and 500 Hz sensitivity at 6 dB down promise an excellent CW receiver. In 1968 the price for the kit was $109.95 but by 1973 the price had dropped to $99.95.

The transceiver was to be a gift and incentive to two granddaughters to obtain their novice tickets. More on this later.

The unit worked and construction techniques were good. Some residue on the chassis indicated that the perforated cage had allowed something to create a gummy deposit over the circuit board. The mess (coffee with cream and sugar?) was water soluble and was removed with Q-tips.

On the air good signal reports were obtained but it seemed that few other hams were anywhere about. Comparison with my Drake R4B revealed that something was not right with the receiver. Even a 60 year old Hammarlund Comet Pro outperformed the HW-16. The problem was solved by accident when viewing the chassis from above with the tubes removed. The socket of the IF amplifier was missing part of the connector for the tube screen. Below the socket the lug was visibly soldered to the circuit board, but the clip holding the tube pin within the socket body was missing. Since the receiver did work

although marginally, was this defect something that existed from the very first day? Most Novices would not have equipment for comparison and it could have been this way for 25 years! Replacement of the socket produced a CW receiver comparable to the Drake.

Output into a 50 ohm load varies from 45 watts on 80 and 40 meters to 40 watts on 15 meters on high power to 30 watts on all bands on the "Novice" power.

If I had a hundred crystals for a transmitter, I would always need one more, so I obtained an exceptional Heath HG-10B VFO through the advertising section of *ER*. The combination of the HW-16 and the HG-10B makes an excellent CW station. A ten minute warmup is all that is required to minimize receiver drift, and with a maximum of ten knobs and switches, operating is a snap.

An article in October 1993 *QST* by James Chatham (W4TNF) was titled "Ham Radio on $100 a Year". His emphasis was on building gear instead of purchasing new multi-buck commercial ham equipment for the beginner. I tend to agree with him but many prospective hams have no way of achieving such a program. Yet this combination of the HW-16 and the HG-10B cost less than $100. With its simplicity and ease of operation it is a fun rig to use, and in my estimation a real buy.

Last but not least, how does one inspire someone to obtain a ham license? Today students are comfortable with computers, have wireless phones available, and in many cases are already hooked into the so called "Information Age". Objectionable voice conversations and poor operating procedures that always seem to appear when one tries to demonstrate how much fun ham radio can be is discouraging. Finally, in my case there are 300 miles of separation from a farming area with few people and lack of local hams who could help. **ER**

ARRL Membership Hits An All Time High

Newington, CT (February 16, 1994)--The American Radio Relay League has announced that its 1993 year-end membership was the highest ever, surpassing all previous records with a total of more than 170,000 members. The record high reflects all categories of membership, including voting and non-voting members.

"The growth in membership is a reflection in the growth of ham radio as a whole and also the growing number of hams who see a need for an effective national organization to look out for their interests," says Steve Mansfield, Manager of Legislative Affairs and Public Information at ARRL.

The membership total by license class shows 24.5% of members hold Extra class licenses, 28% hold Advanced, 19% hold General, 25.5% hold either Technician or Technician-plus licenses and 3% of members hold Novice licenses. The new total includes approximately 3,000 former Canadian Radio Relay League members who have been converted to ARRL membership.

The American Radio Relay League is a non-profit association for licensed Amateur Radio operators headquartered in Newington, CT. For more information about Amateur Radio and the League's activities, contact ARRL, 225 Main St., Newington, CT 06111.

A 6L6 Classic

by Niel Wiegand, WA5VLZ
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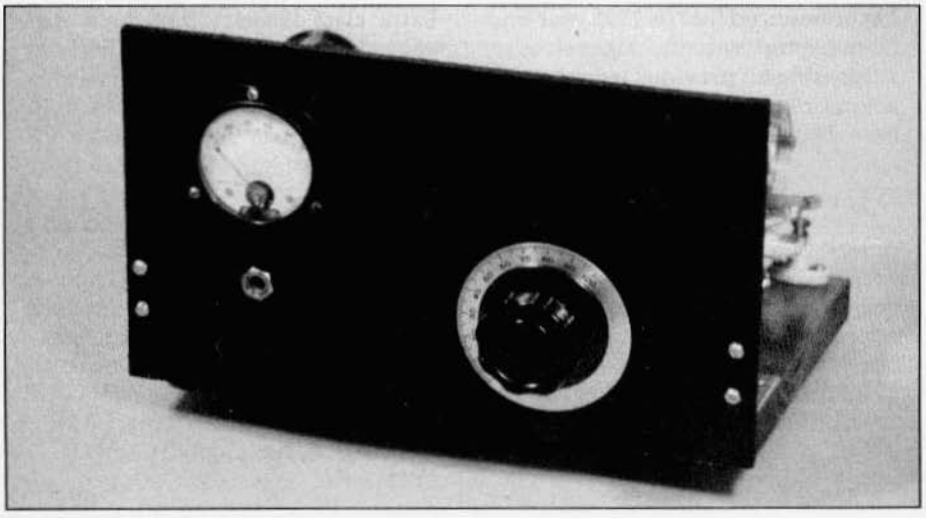
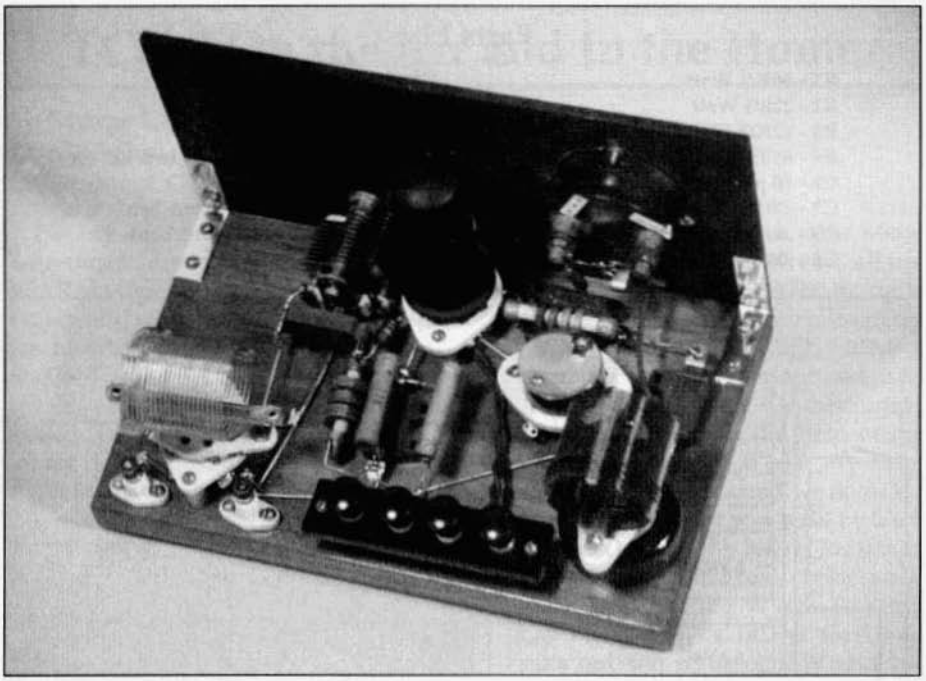
The venerable 6L6 was introduced by RCA in early 1936 as an audio power tube. The June 1936 issue of *QST* carried two articles featuring this new tube, one describing a 50 watt audio amplifier/modulator built around it and the second showing it as a high powered crystal oscillator. This second article in turn inspired a whole series of compact 6L6 transmitter designs in *QST* starting with the QSL 40 in February 1938 and ending with the QSL 25 in April 1941. The QSL Push-Pull (June 1940) ran 600 volts on the 6L6 plates and could light a 100 watt light bulb to full brilliance. The 5 watt version described in December 1939 was at the other end of the spectrum. It was a transformerless design using a voltage doubler off of the 110 volt AC line to get 220 volts B+. That particular article mentions that the operator should avoid touching the metal frame of his key. The 6L6 (and its big brother the 807) appeared in transmitter article after article for two decades.

I wanted to build a 6L6 transmitter but at the same time didn't want to melt down any of my 6L6 stock or fracture a crystal. The QSL line, while classic, was not easy on tubes or crystals. I found what I was looking for in the 1939 edition of the *Stancor Hamanual*.

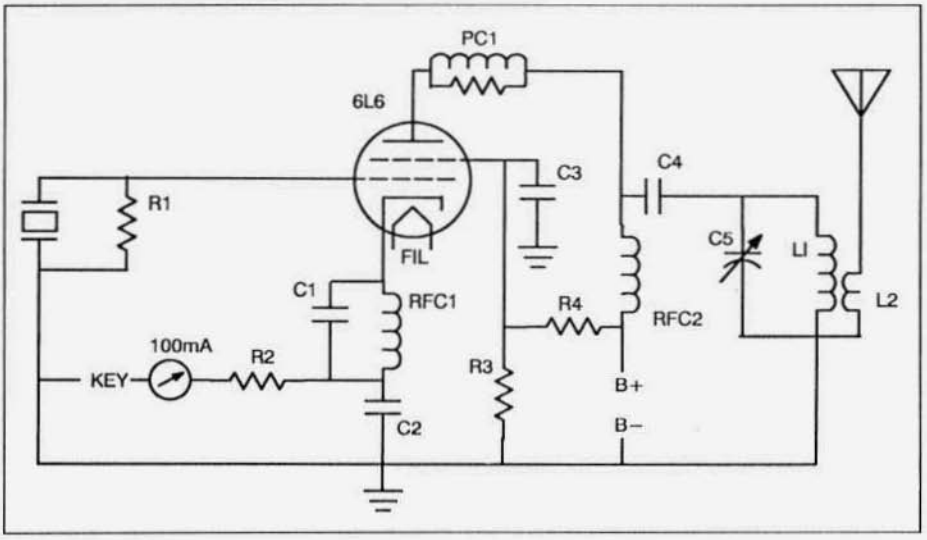
"The Stancor 25-B transmitter rig is designed specifically for the beginner. Several types of tubes may be used but the 6L6G is recommended for giving the highest power output at a conservative rating. The schematic diagram shows a regenerative type circuit using an aperiodic* coil in the cathode circuit. The 25-B will give the new licensee, or any operator for that matter, a compact experimental transmitter at a minimal cost, offering a maximum of operating enjoyment."



Front panel of the "6L6 Classic".



Rear view of the 6L6 transmitter.

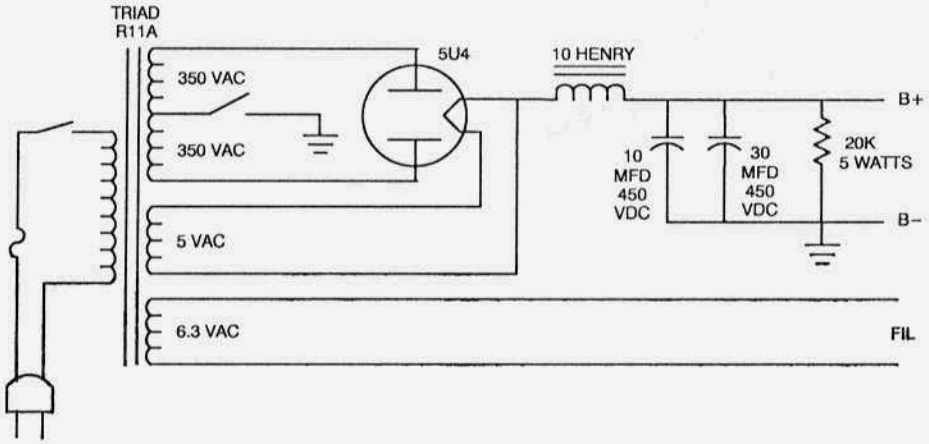


My version of the 25-B is pictured. I believe that old transmitters should be seen as well as heard so I assembled mine breadboard style. The front panel is masonite hardboard painted black. Across the back are (left to right) antenna, antenna ground, B-, B+ and the two filament connections. The final tank/antenna link (L1/L2) coil is at the left rear corner between the two antenna terminals. At the right rear I included a wooden doughnut for tank

continued next page

Parts List

R1 - 56K/1 Watt
R2 - 220/1 Watt
R3 - 12K/5 Watt
R4 - 6K/5 Watt
C1 - 50 pF Mica
C2 - .001 mFd Mica/Tubular Paper
C3 - .002 mFd Mica
C4 - .002 mFd Mica
C5 - 150 pF Variable
RFC1 - 2.5 mH/125 mA
RFC2 - 2.5 mH/125 mA
PC1 - Parasitic Choke - 8 turns #20 on 47 Ohm/1 Watt resistor.
L1 - Final tank, see text and Table 1.
L2 - Ant. link, see text and Table 1.



Power supply schematic.

Table 1 Coil Information

160 meters
Tank: 54 turns #22 enamel on 1.5" form
Link: 8 turns #22 enamel

80 meters
Tank: 35 turns #22 enamel on 1" form
Link: 7 turns #22 enamel

40 meters
Tank: 18 turns #22 enamel on 1" form
Link: 6.75 turns #22 enamel

coil storage. The crystal socket is a 5 pin tube socket. An octal socket can also be used. Wiring should be kept as short and direct as possible. I found the circuit laid out best with the 6L6 socket oriented with pins 1 and 8 closest to the front panel. I added a parasitic choke to the original Stancor design as cheap insurance and simplified the transmitter a little by using link coupling rather than pi network output. Bud OEL or B&W JEL 160, 80, or 40 meter end linked coils will work as the tank coils. Table 1 is coil information if you need to wind your own. The antenna link should be wound next to the grounded end of the tank coil. You may need to cut and try the coils a bit to get the most out of the 25-B with your antenna system.

A power supply capable of 300 to 350 VDC at 50 to 100 mA is ample for this transmitter. I chose choke input filtering to help voltage regulation.

To put the 25-B on the air just plug in a crystal and coil for your favorite band, key down and adjust the output capacitor for maximum output. A word of warning though. One attribute of this particular circuit is that it easily oscil-

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TCK-7 On the Air and In the Home

by George Cummings, K7DU
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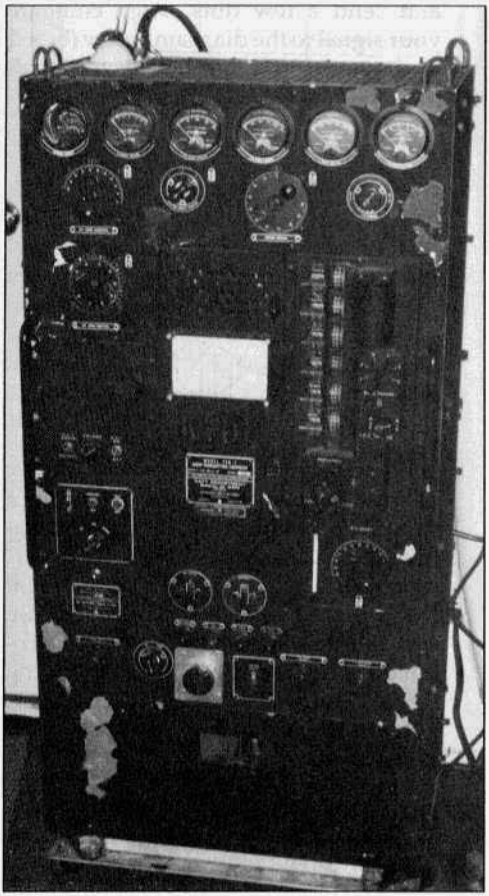
Twenty years ago I worked with a long-time ham who had collected many WWII era rigs. I helped him fix TV's and radios, and we bartered some of the rigs for my labor. That's how I came to own a TCK-7, which Tom had owned for several years but never got on the air. I traded labor on a color TV in exchange for the rig, which didn't have a modulator, and also needed a power supply.



The TCK-7

At the time we lived in a cabin about three miles from a county road, all uphill. So to move this 5 foot 280 lb. rig to my home, I took out the middle seat of my VW van and the XYL and I lifted it through the sliding side door and carefully laid it on its back for the bumpy ride up the hill. With the help of my sons we shoe-horned it into my ham-shack corner and I started work on it.

This transmitter was built by General Electric for the Navy, for use in submarines, destroyers, cruisers and other ships during WWII. The unit has parallel 813's in the final and puts out 400 watts on CW and 100 watts on phone. Grid modulation of the final provides AM. Frequency coverage is 2.0 through 18.1 MHz and incorporates direct frequency readout. The mechanical digital readout works like an auto odometer. The transmitter is gang-tuned from the VFO through the final. The 837 VFO oscillator circuit is in a temperature controlled, insulated box with heater resistors and a circulation fan, and a crystal calibrator checks the VFO readout.

The TCK was originally powered by a large motor-generator which ran on 230 DC at 10 amps. This provided voltages of 1800, 500, 115 and 12 DC plus 163 volt AC for filament transformers. Of course this generator, which weighed 345 lbs., is of no use to the average amateur. The empty area at the bottom of the rig, where the modulator used to be, provided room for a couple of power supplies (500 and 1250 volt). I found the rig will work on CW without the nega tive 115 V supply. The keying relay is

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You Can Have Click-Free Keying

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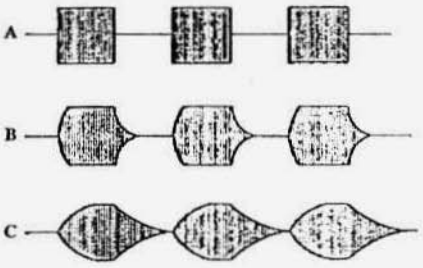
Today's transceivers produce clean, undistinguished CW signals. Using hetrodyning principals to produce the final output frequencies, they exhibit none of the frequency "pulling" that causes chirpy signals. And their keying time constants are chosen to produce well-shaped envelopes. While they may sound a bit boring, they should cause no key-click interference to stations on adjacent frequencies. However, our vintage equipment, with few exceptions, are potential "chirpers" and "clickers."

Novice transmitters, such as the Viking Adventurer, DX-20, and that ilk, all employ cathode keying of both oscillator and amplifier stages. With crystal frequency control, chirp (rapid deviations of frequency on key make and/or break) was usually not a problem. But when you added a VFO, and keyed it, the oscillator (now operating as a buffer), and the amplifier — the combination often sounded like "chirp city," especially if you powered the VFO from the transmitter's auxiliary socket.

Chirp could be minimized by keeping the VFO and buffer on and just keying the amplifier stage. But clicks are a product of the keying circuit itself, and in many cases these vintage transmitters leave a lot to be desired. The good news is there are modifications you can make to improve your keying envelope. In cathode-keyed transmitters, modifications involve adding a few components and/or using different value components. Grid-block keyed transmitters can also be modified for better CW wave shapes.

The Objective

Most of us vintage operators are intimately familiar with the RF envelope of an AM signal. We know what an undermodulated or overmodulated signal looks like on our monitorscopes. You should also become familiar with your CW envelope. Adjust your monitorscope for viewing a CW signal, and send a few dots. Then compare your signal to the diagram below (based on diagram in *The Radio Amateur's Handbook*, 1961, page243) .

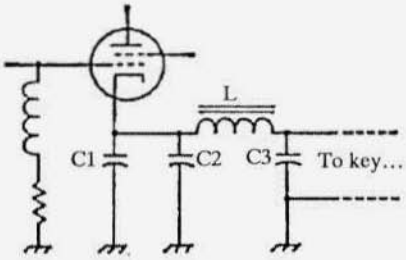


If your signal looks like A, with fast rise and fall edges, you are generating a significant amount of key-click radiation. A square wave like A, is a harmonic-rich waveform. If your signal looks like C, with very rounded rise and fall characteristics, you will produce a click-free but "mushy" sounding signal. This will cause no interference, but will be hard to copy, and annoying to listen to.

The target design objective is B. Here the rise and fall edges are softened but will still produce a non-mushy sound while generating very little key-click radiation.

"De-Clicking" A Cathode-Keyed Transmitter

Look at the keying circuit in your cathode-keyed transmitter. A Viking Adventurer, for example, keys the cathodes of the 6AG7 and 807 directly to ground, and produces an A-like pattern. Here is a modification (source: 1961 Handbook, page 244) that will give you some control of both make and break characteristics.



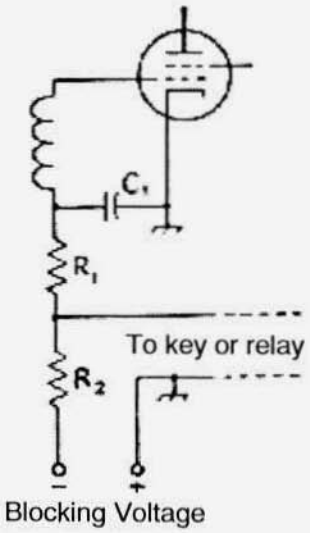
C1 is just the RF return to ground shunted by C2, a shaping capacitor. Both C1 and C3 can be 0.01 µF. C2 makes the signal softer on key up (break), and L makes the signal softer on key down (make). Values for C2 may range from 0.47 to 4.7 µF, and those for L may vary from 5 milliHenries to a few Henries. You will have to do a little experimenting to find the best combinations.

"De-Clicking" A Grid-Block Keyed Stage

A typical grid-block-keyed stage will look much like the diagram above right, (source: 1961 Handbook, page 244).

For example, in the Viking Valiant, R42 (near V11 on the schematic) corresponds to R2, and R9 (near V4 on the schematic) corresponds to R1. In the Viking Ranger, R42 (near V13 in the schematic) corresponds to R2, and R43 (near R42) corresponds to R1.

The "make" rise time can be slowed by making C1 larger (e.g. C89 in the Ranger; and C89 in the Valiant), and the "break" fall time can be slowed by making R2 larger. Again, you should ex-



periment with different values until you achieve a wave shape that's similar to B.

For transmitters with differential keying, such as the Valiant and Ranger, you may have a control potentiometer for setting the differential timing relationships. Adjust it according to your transmitter operating procedures, and check the envelope shape. If the fall time should sharpen up, try varying the adjustment potentiometer a bit. I found that R39 in the Ranger interacted a bit with the wave shaping, and adjusting it restored the desired fall-time characteristics.

Checking It Out

It is difficult to check your own station for key clicks, as the make/break spark at the key will cause clicks in your receiver. Once you are satisfied that the CW envelope wave shape looks good, make a CW contact with someone other than a local ham. Ask that person to tune above and below your signal while you send a series of dots. If he hears clicks, ask him to cut back a bit on the RF gain and check again, as you may be overloading his receiver's front

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An HRO Story from page 15

for this is the necessity for crowding coils into a small space, without well-proportioned individual shielding, when the switch is employed. This increases image frequencies and (decreases) signal-to-noise ratio, and tends to introduce dead spots. These difficulties are not insuperable, of course, and we have designed a new coil switch, as well as a new receiver employing it, which we believe represents the highest development in this type of equipment. This receiver though in many other respects similar to the HRO, is not listed in this catalog, as we consider it a Short Wave Broadcast Set, rather than preferred equipment for amateur use. Our choice of plug-in coils for the HRO Amateur Receivers is based on definite engineering experience with both types of receiver, as well as on the expressed preference of a number of amateurs. . . ."The HRO has been designed to employ an external power supply as many amateurs already possess suitable power supplies. However, an HRO Receiver with built-in power supply is also available and listed below, for those who prefer to sacrifice performance to convenience." (The HRO-S with built-in power supply was apparently never delivered commercially.)

Strangely, even though the HRO's competitors by Hammarlund, Hallicrafters, and RME all had calibrated tuning dials, the HRO continued to offer only calibration charts on the front of the coil drawers until the advent of my HRO-50 in December, 1949. It didn't seem to bother the users of the HRO, who were primarily interested in how the receiver delivered the signals.

HRO production and detailed changes are chronicled in *"The HRO Report"* by Charles P. Fisher, *AWA Review*, Volume 4, 1989. He estimated that there were 5000 to 5500 receivers made from January 1935 to mid-1938 and an additional 2500 to 3000 from then to late in 1940 or early 1941. My "L-series" HRO dates to February or March 1936, and it's of the "version 3" type as pictured in *Communications Receivers* by Raymond S. Moore.

Fisher's table of Estimated Production Dates for prewar HROs with plug-in filter crystals from that article is as follows:

Series	Dates
D,E	1/35 to 3/35
F,G	4/35 to 7/35
H	8/35 to 9/35
J	10/35 to 11/35
K	12/35/ to 1/36
L	2/36 to 3/36
M	4/36 to 5/36
N	6/36 to 7/36
P, Q, R	8/36 to 2/37
S, T, U	3/37 to 9/37
V, W, X	10/37 to 4/38
Y, Z, nnA	5/38 to 12/38
nnB to end	1/39 to early '41

You can just imagine the fun I had recently at the Spring Albuquerque swap fest when I was able to tell Dave Mallery, AB5PF, that the HRO with an L2## serial number he had just bought for all of $20 (he got there first!) had been made in February or March of 1936. I'm sure he must have thought I was the absolute King of classic amateur radio trivia.

World War II bought another surge in HRO production. Bill Orr estimates that over 10,000 HROs were put to use by various countries during the war. The British Royal Navy and the US Navy both used them. HRO copies were made in England, Australia, Germany, and according to Bill Orr in Japan.

National's (50th) Anniversary Photo Album, published in 1964, pictures a German built HRO on a test bench beside its American counterpart. The German HRO is grey instead of black, has rounded grips on its knobs instead of National's bars, and a round patch over the S-meter hole. My guess is that the Germans were short of meters during

the war. It also has a long, horizontal calibration chart on its coil drawer that showed up later on the National HRO-7 in place of the traditional pair of small charts.

The same album shows a Japanese receiver, not an HRO clone, but still featuring the National Micrometer dial. And the June, 1994 *Old Timer's Bulletin* published by the AWA has some great color photos of a Japanese HRO copy using typical HRO plug-in coils and much the same physical layout. On this receiver, however, they substituted a calibrated drum dial for the Micrometer dial. According to the description, many of those receivers were found in caves on islands in the Pacific and destroyed by the Allied forces. The same OTB also pictures several of the Australian HRO copies.

There must be hundreds of "HRO Stories" and HRO hints and kinks out there. In the next section of this article, I'll fill you in on a few of my favorites. Perhaps you HRO owners out there will be kind enough to write Barry with a few more of your own. **ER**

Part 2 next month.

TCK-7 from page 31

very noisy, so I put a key across the active contacts to the RF section and the rig works just fine. It took some creative packing to get it in that area, but it worked. The enclosed oscillator stage is immediately above the power deck, and the 837 buffer stage above that, with the final, antenna tuner and a row of six meters comprising the top deck.

Our cabin was not served by public power and our antique Kohler power plant visibly groaned when I hit the key on full power. The plant voltage dropped so radically I decided to unhook one 813 filament and run at half-power, a necessary concession for the good of the rig and family relationships.

I never have used the oscillator compartment heaters, and at room temps the oscillator is very stable. When the rig warmed up, it literally glowed. There was a line of very large pilot lights just above the power supply, which blinked and shone in red, green and amber. After transmitting for a while, especially during the winter, we joked about it being an auxiliary heat stove. This had a downside, however. Mice would occasionally invade our cabin and loved to build their nest in the buffer stage, packing their little bits and pieces around the coils. This, of course, was immediately noticeable when I hit the key and heard an arc. Then off went the rig, I opened the back, and home-sweet-home for the mice was cleaned out. Forcible eviction didn't discourage them for long, as this happened several times over a winter.

I've found the TCK very easy to service, with front access doors for the tubes and easily removed sides and back. The kids, and even the XYL, enjoyed the digital readout dials. They all moved in concert with each other with a satisfying mechanical whirring and whizzing sound. Playing with them was often entertaining. We had no TV, of course, and turning the knobs during a rainy spring day must have been a little like watching the wheels of a slot machine go around. But, of course, the TCK never learned to pay out nickels or quarters.

I've used the rig on 40 meters CW for several years and it gets good reports. I want to experiment with some voltage regulation for better keying on 30 meters, but it does a good job on 40. It's a fun rig to use, and quite unique. To date I have only worked one other TCK-7.

Right now I'm building a new home brew rig, and it's taking up my time. But as soon as it's up and running, the TCK-7 will get some more attention and see more air time. **ER**

of voice and CW. This set was probably intended for communication between a major headquarters and Hanoi.

In addition to Chinese manufactured radios, there were Soviet generators, large Polish storage batteries and a host of small transistor AM sets from all over. In mid-1968 we recaptured an AN/GRC 9, a set from the 1950's that had been supplied to the South Vietnamese as part of the MAP - Military Assistance Program. It was captured by the VC and put into service on their side.

Soviet assistance in the area of radios was minimal. In late 1967, the 1st Cavalry Division Airmobile captured a Soviet R607 naval radio. It was captured while being landed from the sea. It never actually saw service in Vietnam. This was a huge setup, designed for installation on a ship or for a fixed base station.

The only known set of North Vietnamese manufacture was the VTS-2 Radio Receiver. It was contained in a square metal box. The set was 10" x 8" x 7" and used plug-in, tube-shaped coils. There were six coils, four were stored in the top of the receiver, and two were in use. It used ten D cells for power and covered 1.9 to 12.2 MHz. The use of D cells made it very easy to purchase replacements on the local economy, a prime consideration for an army whose supply lines, better known as the Ho Chi Minh Trail, went through miles of jungle and was subject to constant bombing.

In addition to these sets, the Viet Cong used a number of "homemade" sets. The set described in the 1967 T.I.B. was a CW receiver and transmitter housed in a 50 cal. ammo can, 6" x 7" x 11" and weighed 11 lbs. without the battery. It was a 2 watt set with a range of 20 miles covering 3.8 to 6.8 MHz. It required 1 1/2 volts for tube filaments and 90 volts and 150 volts for plate supply. It had a hand wound coil. (In a previous article I described the reconstruction of a VC homemade radio in a 30 cal. ammo can. This set was not covered in the 1967 T.I.B. so I assume it was captured much later in the conflict.)

The technical intelligence bulletin was never updated or reissued during the course of U.S. involvement in Vietnam. By 1972 the CMEC was shut down and the units were returned to the United States. In 1975 D Co./519th Military Intelligence Battalion was transferred to Aberdeen Proving Ground and began to function as a technical intelligence unit. A new and updated Technical Intelligence Bulletin was issued in the late 1970's. Included in the new T.I.B. was the Mercury Talk Transceiver, examples of which were on display at the Signal Corps museum and at Aberdeen Proving Ground. It is assumed that examples of this set were recovered in Vietnam in the latter stages of the conflict.

The Mercury Talk is a high frequency, continuous range transceiver with a frequency range of 1.7 to 6.0 MHz . It was first manufactured in the People's Republic of China (PRC) in the late 1960's. The Mercury Talk incorporates independent manual tuning for the receiver and transmitter sections. This feature allows the operator to receive and transmit on separate frequencies simultaneously. The Mercury Talk may use either a whip antenna, which is connected to both the receiver and transmitter, or long wire antennas, which may be connected separately to the receiver and transmitter. Two 12 volt DC batteries are connected in series to power the radio. In addition, a 1.5 volt DC battery is used to provide illumination for the dial lights. The Mercury Talk measures 33.7 x 22.7 x 11.4 cm (13 1/4 x 9 x 4 1/2") and weighs 6.8 kg (15 pounds) with batteries.

The Mercury Talk may be operated in either the Amplitude Modulated (Voice) or Continuous Wave (Morse) mode. The radio has a power output of 2 watts and a transmitting range of 10-16 km (7-10

miles) in the voice mode or a power output of 3.5 watts and a transmitting range of over 160 km (100 miles) in the morse mode. There is no speaker incorporated in the Mercury Talk; therefore, a headset or external speaker must be used when operating this radio. The narrow frequency range of the radio makes it extremely susceptible to electronic warfare (EW).

The Mercury Talk is ruggedly constructed, easy to operate, reliable and completely transistorized. Solid state construction in the Mercury Talk reflects an advancement in the state of the art for PRC communications equipment. Compared to the U.S. Army's AN/PRC-74B, it is smaller and lighter, but it does not have the frequency range or the transmitting distance of the U.S. radio. Since the Mercury Talk is a continuous tune radio, it may be netted with U.S. AN/PRC-47 and AN/GRC-106 radios. The Mercury Talk is replacing older AM radios as part of an ongoing program to update communications equipment in the PRC Army.

These sets were for the most part dismantled so the component parts could be photographed. The remaining chassis was sent to the scrap metal yard. As a result very few of these sets survived. In the 26 years since I left Vietnam, I have only encountered one Chinese field telephone and one Type 63 backpack radio. The Type 63 that I got was missing the battery box and all the accessories. This was not too surprising as the set had 26 bullet holes and was beyond restoration!

The NVA signal intercept units made extensive use of captured AN/PRC 25 sets to monitor U.S. radio traffic. U.S. operators were very careless in their operations and very verbose. As a result, many U.S. operations were disclosed in advance to the enemy. Once advanced knowledge of a U.S. operation was known, the intercept unit would use their 102 E or XD-6 set to alert a higher headquarters and NVA troops in the area were warned and managed to escape. We bombed a lot of empty rice paddies and our infantry swept through many deserted villages as a result.

In summary, Chinese supplied radios were the backbone of NVA/VC communication. These sets were adequate for the task and while there is nothing remarkable about their circuitry or design, they are highly prized collector's items due to their scarcity. **ER**

A 6L6 Classic from page 30

lates on harmonics of the crystal frequency. You need to be sure that you have the output tuned to the right band.

The 25-B design appears to be fairly tolerant of substitutions (I made several). Mine easily runs 5-10 watts into a 50 ohm load and I've used it on 40 meters with good success.

Now I need a matching receiver. Let's see, where is that February 1941 issue of *QST*. . . . **ER**

*For those scholars in the group, the 1943 *Drake's Cyclopedia of Radio and Electronics* defines aperiodic as "Not resonant at any one frequency; untuned. An aperiodic circuit is one in which oscillations are not maintained, the resistance serving to damp out oscillatory effects.

Click-Free Keying from page 33

end. If the clicks go away with the RF gain backed off, then you are transmitting a reasonably clean signal.

What About Chirp?

Chirp makes your signal sound strange but it does not cause spurious interference. It is usually caused by "pulling" of the oscillator by following stages, or rapid changes in tube voltages during keying. With a cathode-keyed transmitter and outboard VFO, keep the VFO on the whole time you are transmitting (i.e. do not key it), and ground the oscillator/buffer's cathode during transmissions. Keying only the amplifier stage will help reduce the chirp considerably.

Other remedies include adding a buffer stage between VFO output and transmitter VFO input, and using a separate power supply for the VFO instead of "borrowing" power from the transmitter.

By getting rid of any key clicks, and keeping any chirp to a minimum, you will have a signal that really sounds distinct from the mainstream transceivers, but not because of its poor quality. **ER**

516F-2 Power Supply Mod from page 25

current for the 32S-? or KWM-2/2A. If the resting plate current is > 40 mA, the nominal bias voltage is too low, trim R8. If the resting plate current is < 40 mA, the nominal bias voltage is too high, trim R10.

This mod took me about 3 hours and cost about $1, thanks to the TRW swapmeet. I used a Potter-Brumfield KRP11AN relay. The wiring changes were very straightforward.

If you need a schematic and/or underchassis view of the 516F-2, send me a large SASE with single stamp. I will include a copy of the Potter & Brumfield data sheet. **ER**

ART-13/ARC from page 22

place. Treat 'em wrong and they'll crack or break easily. To free a frozen one I suggest holding a sharp flat blade screwdriver against one of the little metal adjusters at a right angle and tapping the handle gently with another tool. (Obvious when you're in there!)

The best advice I can give on alignment is the old adage about if it works, don't mess with it! If grid drive to the final is adequate on a given band, leave the factory (or Army) alignment alone. The ART-13 is so well designed and built that my rig was still aligned quite nicely after some 30 years of collecting dust.

Working on the autotune can (or most likely, will) be a challenge. The manuals are reasonably well written but still, some experience was required of those who used to work on the things for a living. How things work probably won't be immediately apparent but will be after a few hours of turning the gear drive by hand. Synchronizing the autotune can be an exercise in frustration at any time but usually not required unless an autotune assembly is broken or needs replacement. Working on this inspiration of Mr. Collins' is a whole lot easier if you invest in correct tools beforehand such as a set of Xcelite Bristol splined wrenches. And, no, I don't work on them in my spare time so don't ask!

All in all, once correctly set up, the ART-13 is one heck of an AM rig. There are few commercial ham rigs out there that can simultaneously match its performance and frequency coverage. You just might end up selling a few of your other rigs cluttering up the shack after a time as I did. Now, where's that B&W sideband adapter? **ER**

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FOR SALE: Ranger II - $200. Bud, (208) 466-2803 after 8 PM MDT.

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FOR SALE: Manual copies for Eico 720, 730, HQ-110, Elmac AF-68; schematic copies for Knight 50-W xmtr, Ocean Hopper rcvr. Paul Vaughn, 2317 Williamson Rd., Williamson, GA 30292.

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

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TRADE: National 697 GR-1 pwr sply, trade for 5880 AB, 5887 AB, 5897 AB, 2.5 VAC only. Also want SW-3 coils. Jim Leathem, K7BTB, Box 50355, Parks, AZ 86018. (602) 635-2117

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WANTED: Heath HX-11; Eico 730 modulator; FT-243 xtals. Chuck Barton, NZ5M, 8705 Toledo Ave., Lubbock, TX 79424. (806) 798-1452

FOR SALE: Chassis to Freshman Masterpiece radio or will trade for CW key. **WANTED:** FI-101 AC line cord filter for R-390A rcvr. Marvin C. Fortune, WA4TOJ, 2957 Gaffney Rd., Richmond, VA 23237-3551. (804) 275-1252

WANTED: B&W 5100B, 51SB-B and L-1000A in good wkg condx. Jim McCobb, K1LLU, 55 Woodcrest Rd., Baxford, MA 01921, (508) 887-8126

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WANTED: Hallicrafters SX-62 calibrated dial glass, band selector, tone and sensitivity knobs; meter for Knight 50 watt xmtr. Don Winfield, K5DUT, 6080 Anahuac Ave., Fort Worth, TX 76114. (817) 732-3976

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WANTED: Collins 312B2 console for KWM-1, 302C1 wattmeter, 310B-exciter, 75A-1 filter adapter, speech proc., NB, SM-3 mic, 32V-3; tubes - 4-400, 8122, 6LQ6 (4) matched, 810's, tubes NIB wanted only. Rick, WA1DEJ, (800) 462-2972

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FOR SALE: Viking I front panel refinishing this summer. Call or write for details. Ron Eisenbrey, KC5DFX, 115 First St., Sugar Land, TX 77478. (713) 491-7823

WANTED: RME 4300 manual, will buy or swap; looking for Heath, Eico, Knight, etc. manuals, buy or swap.Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. (908) 238-8964

TRADE: First five years of Electric Radio, 60 issues, excellent, for a Bencher or similar paddle or other old key. Richard Ferranti, WA6NCX, 254 Florence Ave., Arlington, MA 02174. (617) 646-6343

WANTED: AN/PRC-74B for MARS use. Will pay market price and shpg. Harlan, K6JFW/NNNØBDF, (408) 996-2126

WANTED

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

FOR SALE: Collins 75A-4 filters: 6 pole ceramic for high quality AM, 6 Khz - $83.50 ea.10% discount for two filters. Money back guarantee. Calif. residents please add sales tax. Vector Control Systems, 1655 No. Mountain, Ste. 104-45, Upland, CA 91786. (909) 985-6250

TRADE: FB7 w/pwr sply and 20, 40, 80 and 160M coil sets. Want SW-5 w/pwr sply and coils. Hank Bredehorst, 2440 Adrian St., Newbury Park, CA 91320.

FOR SALE: Vintage parts. Send stamp and request "Vintage Flyer". USA only. 40 years of mail order electronics. Bigelow Electronics, P.O. Box 125, Bluffton, OH 45817.

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

FOR SALE: Morrow Twins, 560AX xmtr and Falcon rcvr, exc. condx, w/manuals and all ant, pwr and mic plugs. Dusty Rhodes, W8MOW, 1324 N. Dorset Rd., Troy, OH 45373. (513) 339-1546

WANTED: Swan model 600-T xmtr, operational or junker. Need the function switch, S-6, part no. 172-103. John Elwood, WW7P, 5716 N. 34 Dr., Phoenix, AZ 85017-1911. (602) 841-1480

WANTED: Globe King 500C; 400-B; Globe Champion. Must be in exc. condx. Will pick up anywhere in New England. Marc, WC1X, (401) 842-4733, 846-6325

WANTED: Help! I have a HT-41 converted to 572B's and 3B29's. Was this a published mod or what? **FOR SALE:** Kits - Heath VL2280, 75W, 2M amp - $250; HM2141 VHF wattmeter - $90; HA201A 10W 2M amp - $50; Heath AT-1, VF1, AR2 - $300. Gary, K5JWK, 6302 Robin Forest, San Antonio, TX 78239. (210) 657-1549

WANTED: RCA AR-77 rcvr and spkr in good to exc. condx. Also want AR-88A or CR-88A. Terry, N6UR, (805) 366-2211

FOR SALE: 20,000 tubes, plus or minus, no odd voltages. PU only. Bruce Walther, W9QAH, 3000 McCulloch St., Stevens Point, WI 54481. (715) 344-9099

FOR SALE: Collins KW-1 (s/n 88) with spare plate (new) & mod xfmrs, HV pwr sply choke, extra tubes, manuals & documentation, unmodified, in superb condx - best offer. Alan, W3VL, (215) 295-5407

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

WANTED: Johnson 6N2 Thunderbolt, Thunderbolt and Desk KW; RCA Velocity or ribbon mics; Collins KWM-1 and accessories. Paul Kluwe, Box 84, Manchester, MI 48158. (313) 428-2000 (h), 998-1000 (w), FAX 428-1000

FOR SALE: CE 20A, 100V, 600L; Drake 2A/2AQ, SSR1; Gonset G50, GSB100; Hallicrafters HT-37, HT-40; Heath AT1, AR3, HW16, HG10B, TX1, RX1, SB10; Johnson Invader 2000, Pacemaker, Viking II CD; National NC-300, NC-303. Steve, WB4IJN, (803) 873-7847, x 200 (d), 821-6931 (n)

WANTED: Lake models of Vibroplex keyers like the Vibro-Keyer, Iambic, Iambic brass magnetic system and the EK-1. Charles R. Glover, 2700 Ponderosa, #137, Camarillo, CA 93010. (805) 389-1520

FOR SALE: Mica xmtg capacitors, 5000 VDC test, 2500 VDC wkg, 1-1/8"x 1-5/8", 2 mtg holes, .0005, .01, .00075, .0001 and 2500 VDC test, 1200 VDC wkg, .002 mFD, most are unused. 2500 VDC are $2 each, 1200 VDC are $1.50 each plus $2 per order shpg. James Fred, R1, Box 41, Cutler, IN 46920. (317) 268-2214

WANTED: Speaker for Collins 75A-2. David A. Clark, K5PHF, 9225 Lait Dr., El Paso, TX 79925. (915) 591-4184

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

WANTED: A Kadette radio (1932) or other set with 36-37-38-39 tubes. Ray Larson, 12241-1/2 Gorham Ave., W. Los Angeles, CA 90049-5214

ELECTRIC RADIO PARTS UNIT DIRECTORY

If you need a part for a vintage restoration send $2 and an SASE (.52 postage) for a 7 page list of parts units. If you have a parts unit, consider putting it on the list. Your dead unit can help bring others to life!

Repair & refurbishment of older tube-type amateur equipment. Fully FCC licensed; 35 years experience. Chuck Banta, N6FX, Claremont, Calif. (LA area) (909) 593-1861

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

FOR SALE or TRADE: FB7 40M "RF" preselector coil. Trade for FB7 "B" coil set or SW-3 coil sets. Hank Bredehorst, 2440 Adrian St., Newbury Park, CA 91320.

FOR SALE: Repair & restoration of all classic & vintage radio equipment, reasonable rates, prompt turn around, 25 yrs experience. Mike McKean, N3HJQ, 726 McClellan St., Philadelphia, PA 19148. (215) 336-6111

FOR SALE: Service manuals. Photocopies $5, shpg $.50 per manual. Hallicrafters, Heath, Johnson, others. SASE for list. DSM Diversified (formally Miller Radio), 909 Walnut St., Erie, PA 16502.

TRADE: Boonton Q meter 260A and book. Want to buy National audio coupler S-101 for preselector modified SW-3. Richard Bauer, K5RB, 563 Hambrick Rd., Dallas, TX 75218. (214) 348-3378

WANTED: Superior TV II tube tester or other small portable Hicock, Precision type with roll chart, working, in good condx. Charles Glover, 2700 Ponderosa, #137, Camarillo, CA 93010. (805) 389-1520

WANTED: Collins 75A-4, any serial number, any condx, garage queen OK. Abe Levy, WW3V, RFD 2, Box 230, Greenwood, DE 19950. (302) 349-5389

FOR SALE: BC-348-R, modified - $65; BC-312/342 - $85; Gonset GSB-201 amp - $225; Collins R-390A - $225; RBC, w/ps and cable - $135; BC-221- $30; TS-175U - $20; SWR bridge - $8; parting out R-388, R-390A, HA-10 amp; lotsa tubes, SASE for list. U-ship. WA7HDL, Rt. 1, Box 178-A6, Salmon, ID 83467. (208) 756-4147 after 1730 MDT.

WANTED: WW II Japanese military radio equipment of any kind; early wireless related like spark xmtrs; loose coupler rcvrs; tube type pocket/portable radios; factory made crystal sets; anything S.S. Titanic related. Takashi Doi: 1-21-4, Minamidai, Seyaku, Yokohama, Japan

WANTED: Military radios. U.S. RT-136/GRC-13, R-1444/UR; British W.S. No. 62, W.S. No. 11; Canadian W.S. No. 19, MK II; Soviet R (P) 104M. Leroy E. Sparks, W6SYC, 924 W. McFadden Ave., Santa Ana, CA 92707-1114. (714) 540-8123

FOR SALE: Collins 312B-4 - $120; DL-1 - $85; PM-2 - $90; 351E-2 - $30; 440E-1 - $25; parts, manuals, list - $1. Joe Orgnero, VE6RST, Box 32, Site 7, SS 1, Calgary, AB T2M 4N3. Canada (403) 239-0489

WANTED: Mech. filters for 75A-4 - CW (F-455J-05), SSB (F-455J-31) and AM (F-455J-60). Will consider filters for R-390A and Vector crystal filters. Rob Brownstein, NS6V, (408) 464-0505

WANTED: Dynamotor DM-28 and filter base for BC-348. John Snow, W9MHS, 4539 N. Bartlett Ave., Shorewood, WI 53211. (414) 964-0194

FOR SALE: Synchronous detector for 455 kHz IF receivers. Dramatically improves AM: Reduces fading distortion, selectable sideband cuts interference. Kit - $139, built/tested - $199. Info - $3. Steve Johnson, POB 3420, York, PA 17402-0420.

FOR SALE: GR 224 WM, 725 WM, 1611 cap brdg, 1550 octave meter; TMC TAC-1 tuner, GPR-90 rcvr, SSB adapter; Boonton 202B gen., 250A RX meter; Eldico 104 rcvr; Collins 75A-3, 75S1, 32S1 w/ps, 30L-1, w/case; Atlas 220 CS sply; CE 100V, 100V w/160M, 200V; Johnson Valiant; Drake 1A rcvr; Heath TX-1; URM 25D; 382 A/U audio gen.; ZM3 AV cap brdg. Big items PU only. Bruce Walther, W9QAH, 3000 McCulloch St., Stevens Point, WI 54481. (715) 344-9099

WANTED: National drumdial, right angle, like SW5 or Velvet Vernier, like SW3 for homebrew project. Thanks. Richard Cohen, 11802 Willow Pt. Way, Tampa, FL 33624. (813) 962-2460

FOR SALE: 1946 Weston 785 Industrial Circuit Tester, exc. condx elect. and mechanically, oak carrying case - $35; new ANB-H1 headset earpieces - $1 each. **WANTED:** Manual for Heath IO-12 scope (copy OK). Carl Gottsman, KN6AL, 3290 6th Ave., Apt. 1-E, San Diego, CA 92103. (619) 295-5611

WANTED: German WW II ex-service equipment, clandestine sets. Cash/trade. **FOR SALE:** TM11-1524 service manual SCR-584. Rag Otterstad, OZ8RO, Hosterkobvej 10, DK-3460 Birkerod, Denmark. 011-45-4281-5205

FOR SALE: New Ranger I, Valiant I and Navigator plastic dials, 160-10 meters, all freq. numbers in green, w/all holes just like original - $17.50 ppd. Bruce, W9LWW, 4003 Laurawood Ln., Franklin, TN 37064. (615) 794-9692

FOR SALE: OS8E/U oscilloscope new in orig. military sealed inner, outer boxes. Manual and cover included - $45 includes domestic UPS. John Lippincott, Box 712, Salome, AZ 85348. (602) 859-3963

FOR SALE: R-390A completely restored to new specs by Rick Mish. Looks/operates like new. Includes: ops/repair manual, 3 spare ballast tubes, all R-390A ER back issues, ant. connectors, spline wrench set. Original shock mount cabinet- very rare. Heathkit SB-620 spectrum analyzer in exc. condx set up for R-390A use, all - $975 or consider trade for Drake R8 (mid '93-'94) or JRC 535. Victor, (805) 583-4026

WANTED: Hallicrafters items - SX-28 parts rig or these parts: S-meter, steering wheel style tuning knob, the spkr terminals assembly, R-12 or R-8 spkr; manual for S-36 and knobs for HT-33 amplifier. Lee Shumway, WB8ZEY, 2820 Yankee Springs Rd., Middleville, MI 49333. phone/FAX (616) 795-3255

WANTED: 6 inch ceramic feeder spreaders, Johnson #136 or equivalent. Jim Scott, W9KV, 130 Timberline Dr., Durango, CO 81301.

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

FOR SALE: R-388 rcvr - $125; 100W HB AM/CW xmtr - $100; Model 19 teletype w/CV89 converter - $60 PU only; Drake B-line, T4XB, R4B, AC4 pwr sply spkr - $300; RME VHF 152 converter for 10, 6, and 2M - $70. **WANTED:** TBW AC pwr sply for TBW Navy xmtr; HF xmtr section for TBW; REX dynamotor plate. Steve Davis, KD2NX, 705 13th Ave., Belmar, NJ 07719. (908) 280-9760

FOR SALE: Gemtronics CB - $15; S/C #920 - $18; Victrola portable - $40; Zenith Royal 66 and Philco MT 802BKG transistors - BO. **WANTED:** J.H. Bunnell single earpiece headset, telegraph and other electricals/scientifics. J.H. Jacobs, 60 Seaview Ln., Northport, NY 11768. (516) 261-1576

FOR SALE: TMC SBC-1A/SBS-1/URA-42 SSB converter - $225; R-390A orig. service manual - $50; new, old stock mfg. tubes: Eimac 100TH - $40, 250TH - $150, 833A - $80. Shpg. additional. Joe Bunyard, 1601 Lexington St., Waco, TX 76711-1701. (817) 753-1605

FOR SALE: 1940's Raytheon audio consolette; Hammarlund Superpro XA; Hammarlund SP-400X rcvr. Charles Harper, 406 S. Mulberry St., Elizabethtown, KY 42701. (502) 769-1400 or 769-0404

FOR SALE: Restoration of vintage radios; 25 years experience. Phil Goodman, K4FXB, 217 Millbrook Farm Rd., Marietta, GA 30068. (404) 509-9493

FOR SALE: "Vibroplex Collector's Guide" - $14.95; "Introduction to Key Collecting" - $9.95. Add $2 s/h in North America. (Foreign, write.) Artifax Books, Box 88-E, Maynard, MA 01754.

TRADE: Globe King 500C in pristine condx for mint 32V-3/75A-4. **FOR SALE:** Johnson Viking Valiant - $375; Globe Scout 65A - $95. Bill, N2WXJ, (914) 356-6553

WANTED: A manual/schematic for a Beckman/Shasta WWV rcvr model 905; orig. pwr sply & cables for a Johnson SSB adapter. John Burgwyn, W4WAW, POB 7034, Rocky Mount, NC 27804. (919) 437-0851 eves.

WANTED: Drake MS-4 spkr. FOR SALE: Heath DX-35 - Best offer. Peter Harband, 5140 Gates Rd., Santa Rosa, CA 95404. (707) 537-1120

WANTED: Manuals for BC-1206B, octal tubes; Harvey-Wells AR-3A aircraft rcvr; HRO coil G, 180-430 kHz. Al Kaiser, W2ZVR, 713 Marlowe Rd., Cherry Hill, NJ 08003-1551. (609) 424-5387

FOR SALE: BC-640B complete w/full set of xtals & manual. M. Heiman, K7BDY, (602) 537-2450

WANTED: Main tuning knob for SX-101, large grey knobs with white pointers for DX-100 driver and amplifier tuning. Dave Williams, WBØZJP, 967 Hwy. P, O'Fallon, MO 63366. (314) 240-1870

WANTED: WRL-70 xmtr; HB xmtrs for display, must be museum quality; thousands of QSL cards to paper walls of Amateur display. Call Leo, (402) 392-1708, Western Heritage Museum, Omaha.

FOR SALE: Millen GDO - $75; service manual & extender kit for FT-1 - $120; 75S-1 tubesters - $75; SX-111 - $150; SR-400A Cyclone III - $250. Bill, K7VZP, (602) 942-6352

WANTED: Museum quality ham rcvr and xmtr; RCA, Shure, Astatic desk mic; dead linear (3-500); external VFO. Ed Strickland, 155 Perkins Ave., Vallejo, CA 94590.

FOR SALE: RT77A/GRC-9, TCS-13 rcvr - $85 pp; T-20, 4-5, BC-459A - $45pp; BC-696, 3-4 - $40 pp; T-21, 5-7 - $35pp; Millen R-9 - $40pp. Brown, (805) 943-2027

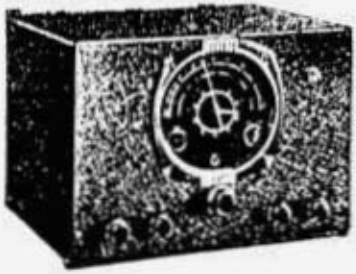
FOR SALE: AN/PRM10 military grid dip meter, tube type unit w/regulated sply and external coils, NIB. Franklin Albanese, 1610 Prince St., #6, Berkeley, CA 94703. (510) 845-2625 (eves)

WANTED: Hallicrafters S-40B main tuning dial; manual for Eddystone model 770U; manual for Gonset G-63; National radios. Ron Beaver, WB4OQL, 740 Brookdale Dr., Greer, SC 29651. (803) 879-3133

FOR SALE: Back issues of CQ, QST or trade back issues of Popular Electronics. Send list of your needs. **WANTED:** Harvey-Wells R9A - Joe please call back. Bob Nickels, 1444 S. Rotzler, Freeport, IL 61032. (815) 232-7142

WANTED: Power cable connector plug U-7/U for ART-13. M. Kobayashi, 13-5, #806, Mukouga-oka 1-chome, Bunkyo-ku, Tokyo 113, Japan

WANTED: Collins 75S-3B or 3C in mint condx; speech processor for Collins 32S-3. Bill, KO4XF, (404) 887-7567



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

WANTED: Hallicrafters S-20R and SX-71 rcvrs. Hank, W6SKC, (602) 281-1681

FOR SALE: Ranger, cosmetically fair, electrically good - $200. Pat Keogh, WB9GKZ, 3767 Fairview Rd., Greenbay, WI 54313. (414) 434-9016

WANTED: Collins 310B3 antenna coil assembly and coils; F455B08, F455C08 mech. filters; Collins spkr; DX-60B schematic. Brian Roberts, K9VKY, 3068 Evergreen Rd., Pittsburgh, PA 15237. (412) 931-4646

FOR SALE: Manuals - Drake 2B - $13; MN-75 - $7; RME 99 - $12; VHF 152A - $7; Harvey-Wells T-90 - $16; R9 - $12; TBS-50/TBS-50A - $9; B&W 5100B/51SB-B - $20; SX-100 MK II - $11; HRO-50-1, HRO-60 - $16; GPR-90/GSB-1 - $24; NC-98, HA350 - $7; NC-270 - $8; Mosley CM-1 - $9; Hammarlund HC-10 - $10; Eico 722 - $7. Copies postpaid. Dick Prester, 131 Ridge Road, West Milford, NJ 07480. (201) 728-2454

WANTED: Hallicrafters rcvr SX-115 in exc. or better condx. Cash or trade. K4GF1/7, (702) 362-8136, FAX 871-4383.

WANTED: Heath DX-60B xmtr. Must be in good operating condx. Ros Hawks, WBØGKL, 355 Animosa Dr., Durango, CO 81301. (303) 259-0785

FOR SALE: HRO-50T1, ABCDEF, AA coils, NBFM, xtal cal., spkr, rx fairly good condx - $325 or possible split; Johnson TR switch - $37; Challenger - $50; Whipload 6 - $14; Eico #322 sig. gen. - $20; Heath VF-1 - $15; HD-19 patch - $10; coax relay 110VAC - $20; AF-68 - $50; 1070 pwr sply - $45; PMR-8 - $45; DM-28 for BC-348 - $12; parting Viking I, SX-28, Shawnee, AF-67. FOB Joe, K7MKS, (206) 747-5349

FOR SALE: Collins 651S1 HF rcvr, w/manual - $850; CP-1 xtal pack - $140. Mike Palmer, K5FZ, 16707 Creeksouth, Houston, TX 77068. (713) 444-7737

FOR SALE: Swan 250C, 117XC - $250; Swan 700CX, 117XC - $350; Drake MN2000 - $180. **WANTED:** Crystals to complete CP-1. Dean, KD6LVD, (714) 643-7930

WANTED: HP freq. counter. No nixie tubes. Kurt Miska, N8WGW, (810) 641-0044 (d), (313) 663-1642 (n).

FOR SALE: Johnson T-R switch, w/instructions - $45; Collins complete keypad units for the HF/KWM-380 - $99; GR 115 VAC, 20A Variac - $50. Prices include shipping U.S. Jerry Brouwer, AB8U, (513) 429-5457.

WANTED: WW II Japanese military radio equipment of any kind; wireless sets like spark xmtrs; loose coupler rcvrs; tube type pocket/portable radios; crystal sets; toy crystal radios. Takashi Doi, 1-21-4, Minamidai, Seyaku, Yokohama, Japan

FOR SALE: TS-592A/UPM pulse gen., nearly new in orig. shpg container - $50; ZM-3A/U capacitor analyzer, nearly new in orig. shpg container - $100; Sprague Tel-Ohmike TO-6A capacitor analyzer in nearly new condx - $75; HP 412AR DC VTVM in very good condx - $45; Globe 6&2 meter VFO, unchecked - $35. Collins 180S-1 random wire antenna tuner in exc. condx - $150; military surplus whip antenna consisting of heavy duty mobile base mount and 5 each 3 foot whip sections, w/3 spare sections, all in VG condx - $75. Will negotiate. **WANTED:** Clegg 99'er. Clyde Sakir, N7IOK, 4243 E. First St., Tucson, AZ 85711. (602) 323-1120

FOR SALE: RCA CRT's - NOS 3BP1A - $15, NOS 902A - $15, used 2BP1's - $10; Jan 2" magnetic shield, as new - $10; Conar 400 xmtr - $45. **WANTED:** 9 MHz xtal for HA-5 VFO; VG/mint HA-1 keyer; matching VG/mint S-100 spkr and 2.580 MHz xtal for Hammarlund HQ-110; current meter for Heath IP-32 pwr sply; meter for Johnson Navigator. David W. Ishmael, WA6VVL, 1118 Paularino Ave., Costa Mesa, CA 92626. (714) 979-5858

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

HEATHKIT FANS: Don't mourn their passing; enjoy learning more about their past in historic pictures and personal insights from many company oldtimers in 124 page book - $9.95 pp. Heath Nostalgia, 4320 196th S.W., Suite B-111, Lynnwood, WA 98036-6754

FOR SALE: 75S-1 with Waters rejection, 500 Hz CW filter, 32S-1, 516F-2 - $500, will separate; National 697 6-volt pwr sply, unused - $75. Carter Elliott, WD4AYS, 1460 Pinedale Rd., Charlottesville, VA 22901. (804) 979-7383

FOR SALE: Tubes, tested, clean, boxed, lowest prices, good selection. Business size SASE for list. Bill McCombs, WBØWNQ, 10532 Bartlett Ct., Wichita, KS 67212-1212.

FOR SALE: Johnson Ranger I - $125; Ameco 6&2 - $60; Knight T-60 - $70; National NC-60 - $45; Heathkit mod and pwr xfmrs. **WANTED:** TMC GPR-90; Riders Perpetual trouble shooting manuals. Gary, W7FG, (918) 333-7893

WANTED: Cosmophone 35 manual/schematic (buy or rent for copying) and Cosmos equipment. Brian Harris, WA5EUK, 3521 Teakwood Lane, Plano, TX 75075. (214) 596-2914

FOR SALE: National PB-16 plugs - $.75 each; Mallory 3-gang inductor 54-216 MHz - $8. All item ppd. R.J. Eastwick, N2AWC, 224 Chestnut St., Haddonfield, NJ 08033. (609) 429-2477

WANTED: Viking Valiant cabinet. I need only the cabinet, not front panel or other parts. John, K4PCA, (706) 878-2940, call collect.

FOR SALE: HQ-170 (with working clock), clean, works purty gud - $140 + UPS. Vern, WØVV, Box 187, Lehr, ND 58460.

FOR SALE: RME DB22A; Browning MF9 freq; Globe 4B/GC rcvr $39 each. Shpg. xtra. Henry Mohr, W3NCX, 1005 W. Wyoming, Allentown, PA 18103.

FOR SALE: Collins 51S1 rcvr, official rack mount, AM & SSB mech. filters, VG condx - $450 or trade for 51J3/4; HRO-50T, good condx - $175. Shpg xtra. Pete, WB2BYQ, (201) 251-9747

WANTED: Drake R4C rcvr; (Hickok,etc) mutual conductance tube tester; Kenwood T-599 xmtr; Radio Shack DX-400; Uniden CR 2021; RCA model CRM R6A; Heath SB-610 monitor scope. Rick, K8MLV/Ø, 1802 W. 17th St., Pueblo, CO 81003. (719) 543-2459

FOR SALE: National NCX-5, w/matching pwr sply and VFO, VG condx - $275 + shpg. Jerry Buckner, WAØYSG, (417) 866-8669

FOR SALE: Repair of TV-7 tube testers w/ calibration: I will fix and then verify calibration of your TV-7 tube tester for $45 plus all shpg or return it no charge. Please no units with bad meter movements, book clips or case handles. Unit must be repairable and not a basket case. Daniel Nelson, 1025 E. Desert Lane, Phoenix, AZ 85040. (602) 243-7421

FOR SALE: PRC-47 LSB conversion - mech filter only $45. Your ampl, mod unit converted - $55. Roger Leone, K6XQ, 136 Delta Cir., Vallejo, CA 94589. (707) 552-6659

FOR SALE: 9 MHz xtal filter, bandwidth 3.2 kHz at 6 dB points, new - $45; UTC S-18 mod xfmr, new - $20. Al Bernard, POB 690098, Orlando, FL 32869-0098. (407) 351-5536

FOR SALE: National xmtr plate chokes: R152, 160M, used, exc.; R-154 80, 40, 20M, unused - $8 each ppd. Wayne, NØTE, 1212 17th Rd., N.W., New Strawn, KS 66839. (316) 364-5353

WANTED: Still looking for all of the military sets and manuals in my April & May ads. **FOR SALE:** National manuals; BC-611 parts; military radios & manuals. LSASE for lists. URM-13 - $22; DY-17A/ART-13 NOSB - $45; ART-13 plugs - $25 each; BA-38, new - $42.50. Plus UPS. Robert W. Downs, WA5CAB, 2027 Mapleton Dr., Houston, TX 77043. (713) 467-5614

FOR SALE: New 54 page illustrated catalog #8 of WW II military radio sets - $2 US, $5 foreign. Sam Hevener, W8KBF, "The Signal Corps" 3583 Everett Rd., Richfield, OH 44286-9723. (216) 659-3244

FOR SALE: Coax relays, Amphenol 30-10377, w/aux. DPST 100-W BNC, unused - $25 ea.; coax relays, Multi-Circuit FXR 323-011651-3 100-W BNC - $35 ea., used, good; treasures for antiques - many 4,5,6-pin tubes, UX226, UX245, UX171A, UX224 and many other types of the 30's, 40's - around #3 ea., NIB, checked good. All above plus UPS. Mike McDermott, WØBVA, 305 N. Keith St., Scammon, KS 66773. (316) 479-2756

WANTED: Cabinet for a 51J-4; spkr for HRO-50 or 60. **FOR SALE:** Spectrum analyzer plugins for 500 series Tektronix - IL-10, 1-36 MHz and IL-30, 900 MHz - 10.5 GHz - $125 each. Steve Scott, KI3W, (717) 626-0991

FOR SALE: Transformers, plate; fil. chokes, NOS many parts & relays, knobs, hardware, wirewound pots, etc. Call your price & needs. Joe, W6CAS, (916) 731-8261

FOR SALE: CPT-750, SSB, ISB, CW, AM - $1200. WA7HDL, (208) 756-4147 after 1730 MDT.

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FOR SALE: Wattmeters URM-120, 2-1000 MHz, to 1000 W, three couplers, meter, case, manual, 20 lbs - $120; URM-25D sig. gen. 10 kHz - 50 MHz, as-is for parts, 45 lbs - $25 each, 2 or more $20 each; Polarad 1108A 6.95-11 GHz, no output, 55 lbs - $50; HP cabinets from HP-606 type equipment, takes 19x10.5 in. panel, 13 in. deep chassis, side handles, used, 20 lbs - $25. Add shpg. Tartan Electronics, Inc., Box 36841, Tucson, AZ 85740-6841. (602) 577-1022

WANTED: Hallicrafters HT-19 transmitter. Hank, W6SKC, (602) 281-1681, FAX (602) 281-1684

FOR SALE: Heath SB-201 amp, 80 thru 10, exc. condx, new finals - $375 + shpg. Larry Howe, KBØHIB, (417) 882-1682

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FOR SALE: King 680 tube-type preselector (sold by WRL),6-80M, works, exc. - $45. Jack C. Shutt, N9GT, 1820 Dawn Ave., Ft.Wayne, IN 46815. (219) 493-3901

WANTED: Band change, tuning and beat osc knobs of Hammarlund SP-600; phasing knob for NC-183D. Thanks! Oscar Steila, Via Bardonecchia 83, 10139 Torino, Italy.

WANTED: Panoramic Radio Products P.R.1 panadapter; also wanted Johnson KW Matchbox, w/SWR meter. Jay Spivack, 325 S. Washington Ave., Kent, WA 98031. (206) 859-2680

WANTED: Heath SB-200, SB-220 carcasses; need slug from Collins S-Line PTO (70 kHz). John Hurst, KU6X, 2512 Euclid Crescent, E, Upland, CA 91784. (909) 981-6759

FOR SALE: Scott RDO rcvr, w/cabinet & 3 plug-in tuning units & RDP panadapter - $125; Hickok 6000A tube tester w/1968 chart & orig. manual - $85. All plus UPS. Ron, KC6WTG, POB 783, Santa Rosa, CA 95402. (707) 539-8319

FOR SALE: Hallicrafters SX-25 - $100; SX-43 - $90; Hammarlund HQ-100, near mint - $115. All plus shpg. John Walsh, W3GCE, 577 1st St., Whitehall, PA 18052. (215) 264-4645

Collins S-Line Gray Paint

New mix by original manufacturer. Part no. 097-6161-000 #180. $9.95 per can plus S&H. Omega Electronics, 101-D Railroad St., P.O. Box 579, Knightdale, NC 27545. (919) 266-7373

FOR SALE: Very good photo copies of manual and schematics for AT-1, VFI, DX-60A, Navigator, Viking II, CE-20A, BC-458, 1A, R4B, National 270, BC-348Q - $10 each. HQ-170 - $15. Write Craig, KB6XV, 14 Governors Ct., Sacramento, CA 95817. Call (916) 736-1133 between 6 & 9 PM PT

FOR SALE: Eldico SSB-100 - $100 PU; HW-101, spkr, pwr sply, CW - $100; SB-301, SB-600, all filters - $135; HW-101, spkr,sply, CW, exc. - $175; SB-102, SB-600, sply, exc. - $175. U-ship. Richard Lucchesi, WA2RQY, 941 N. Park Ave., N. Massapequa, NY 11758. (516) 798-1230

FOR SALE/TRADE: Transmitting/Receiving tubes, new and used. LSASE for list. I collect old and unique tubes of any type.**WANTED:** Taylor and Heintz-Kaufman types and 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

FOR SALE: Rare Western Electric model 9-B aircraft rcvr (1932). **WANTED:** NC-101X; S-35; Eddystone 740-940-1000. Nick Oland, W3DSE, 821 Kenhorst Blvd., Reading, PA 19611. (610) 378-1411

WANTED: Collins 32S3A xmtr, any condx; cosmetics important. Larry McGee, KF9E, 12728 Williams Rd., Genoa, IL 60135. (815) 784-5186

FOR SALE: New receiving tubes, special sale - all $2.75. Sales expires 10-1-94. Stock up now! SASE for list. TBE, POB 806, Lake City, MI 49651.

FOR SALE: NOS tubes. SASE for list. **WANTED:** Ranger II, PRC-77 modules; NC-300 spkr & manuals for RT-1113A/PRC-68A. Joseph Pinner, 201 Ruthwood Dr., Lafayette, LA 70503. (318) 981-7766

WANTED: Hallicrafters SR2000 and P2000 filter chokes, p/n 056-000595 & 056-000585; VOX relay p/n 021-000732 and relay socket p/n 006-001184. Dave Hawkins, (602) 286-2320.

FOR SALE: Thousands of tested tubes w/ warranty! Both xmit and Rec tubes. 15% off current prices for all orders over $25 during June and July '94 if you ask. Buy those spare tubes for your tube radio, audio, ham and electronics at about 25% of new.I have bunches of octal, older, 7 and 9-pin tubes. All tested and boxed. I give a 30 day warranty. Send wants or SASE with two stamps for list. Daniel Nelson, 1025 E. Desert Lane, Phoenix, AZ 85040. (602) 243-7421

FOR SALE: Tektronix sale - Type 564 storage scope ('92 cal. date), w/type 3A72 dual-trace, 2A63 differential, 2B67 timebase - $200; type 180A time mark generator - $30. Assorted plug-ins: 26 Tektronix, 2 HP, 2 Hickok, SASE for list. Ray, NØDMS, 10679 W. Dartmouth Ave., Lakewood, CO 80227. (303) 987-3836

FOR SALE: Collins KWM-1's (two), 516F-1, package only - $1000 shpd to lower 48. Call Mike Kennedy, 3417 W. Magill Ave., Fresno, CA 93711. (209) 435-3159

FOR SALE: Airborne SX-28, BC-1031C panadapter; Collins R-390A parts unit. Steve, KD2ED, (609) 795-9250

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Miltronixs, POB 3541
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FOR SALE: Catalog of Naval Radio Equipment, catalog SHIPS275. A 228 page publication incorporating over 100 photographs and details of Navy gear used in WW II-1944. This is a quality reprint, bound with plastic spiral. Price is $22 ppd. Also: "The High Frequency War" - A survey of German electronic development during WW II by Lt. E.S. Hessing, June 1946. 184 pages with photographs. A quality reprint, bound with plastic spiral. Price is $22 ppd. Order from: New Wireless Pioneers, Box 398, Elma, NY 14059. phone/FAX (716) 681-3186

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.

WANTED: ARC-5 rcvrs, 316, 619, Q5; BC-348; TCS xmtr (converted to 110/12 OK); HF manpack; sked for AM local QSO. WA5AAO, La Grange, TX 78945.

WANTED: SX-101A; 51J-4; Johnson Desk KW amplifier. **FOR SALE:** Drake MN-2000 - $200; (2) HT-32's (one for parts) - $125. Ben, W6FDU, (408) 374-0372

WANTED: RF xfmr T19 for HQ-170 p/n K38932-1; 60 kHz IF xfmr p/n M42005-1 for same. Steve Gajkowski, RR 2, Box 2712, Saylorsburg, PA 18353. (717) 992-6768

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FOR SALE: Radio schematics - $2.50. Also, tubes, books, Riders, extra Sams. LSASE for lists. Joseph R. Forth, WA2TRT, 321 Long Vue Acres, Wheeling, WV 26003. (304) 277-3154

WANTED: Swan 600T, 600S, 760X, accessories, anything considered. Thanks for your replies. Eric, KBØXP, 407 Eastern Ave., Stanton, IA 51573. (712) 829-2446

FOR SALE: Collins 51J3 - $225; Hammarlund SP-210SX - $225. **WANTED:** Hammarlund HQ-170, prefer VHF series; Collins 75A-3. Jim, (616) 229-4318

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WANTED: Citizens Radio Amateur Callbook (Flying Horse cover) for 1924, 1925, 1926. R. Arrowsmith, POB 166, Annandale, VA 22003. (703) 560-7161 collect

FOR SALE: Johnson KW; NC-300, w/spkr; Johnson Ranger; BC-610-I; good tubes; Federal type 58. PU only. Paul Allen, WA5PCJ, Rt. 1, Box 16, Gustine, TX 76455. (915) 885-2593

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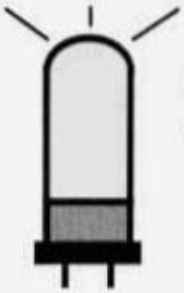

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