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ELECTRIC RADIO

celebrating a bygone era

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ELECTRIC RADIO

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

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

Electric Radio Solicits Material

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

EDITOR'S COMMENTS Barry Wiseman, N6CSW/Ø

Recently, I had a call from a ham who told me the following story about his experience in this 'economic downturn' or recession. Although it's not totally dissimilar to what we're getting from the media every day, I think it's worth passing along.

He had lost his job and after six months of searching for another one (with no success) he reached a point where he had to sell his amateur gear to put food on his table. His gear was all the latest, high-priced Japanese stuff.

Shortly after he had sold all his gear, he found another job but because of the debt he had accumulated he said he could not justify buying another station like the one he had had. Instead, he bought an old "boat anchor" with the hope that it would at least get him back on the air. I won't tell you exactly what he bought for fear of giving his identity away, but it was late '50's, all tubes, it was not working and he got it for less than a $100.

Although he isn't much of a technician, with a little help from some older, more experienced ham friends he got the rig on the air. He enjoys using his 'new' rig more than any rig he has ever had. It has none of the bells and whistles he had become accustomed to, but he's finding that he doesn't miss them at all. As an added bonus he says, "I've discovered vintage radio and all the great people involved in it and I'm having more fun now than I've ever had".

Maybe there's a moral to this story; however difficult times may get and however little money we have for ham radio, we can still get a vintage rig on the air and enjoy the hobby. We should not despair.

I wish everyone a Merry Christmas and a Happy New Year. On to #33.

TABLE OF CONTENTS

Cover: We celebrate our third Christmas with another great cover by Bob Beasley, K6BJH.

Reflections Down the Feedline

by Fred Huntley, W6RNC
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Today, the communications and electronics industries are clamoring for more frequency allocations - HF, VHF, UHF, etc. Meanwhile, the spectrum between 15 and 600 kcs. is very sparsely occupied. Perhaps the amateur community should take a look at this part of the spectrum and try to figure out how to make use of it.

There is usable frequency all the way down to zero! Our planet earth oscillates at 7.83 cycles per second. The human body resonates at between 7 to 9 cycles. With anger, that rises to 18 or 19 cps. and with depression, falls to 5 or 6 cps.

Until recent years, the U.S. Navy had the Omega navigational system on 9.75 kcs. The early days of wireless started out on the long waves and major activity there continued through the 1950's. NAA/Arlington, VA was on 120 kcs., POZ Nauen, Germany on 25 kcs., YN/Lyons, France on 20 kcs., GBY/Glace Bay, Nova Scotia on 40 kcs., IDO/Rome, Italy on 27.5 kcs., etc.

The first SSB phone transmission was inaugurated in 1923 by A.T. & T. Co. over a transatlantic circuit on 55 kcs. This service continued after the advent of HF, as an emergency backup link.

In the latter part of the 1960's, there was still NSS/Annapolis, Md. on 15.5 kcs., GBR/Rugby, England on 16 kcs., NBA/Balboa, C.Z. on 18 kcs., NPG/San Francisco on 19 kcs., NPM/Pearl Harbor on 20 kcs., GBZ/Wales, U.K. on 19.6 kcs. Also on were FUB/Paris, France, NKL/Jim Creek, Wash., etc.

The Alexander Alternator, built by G.E. Co. put out 50 KW on 17 kcs. and some of these units were used in communications through the 1930's.

The frequencies between 190 and 400 kcs. contained marine radio beacons, aeronautical range stations - some of which also gave local WX reports in voice.

Invariably, the lower the frequency, the higher the transmitter power that was required. With 25 to 100 KW or more, very reliable long distance communications were maintained. But this involved huge transmitter and antenna installations - plus a lot of electric power consumption.

The 400 to 500 kcs. MF band was used for ship to shore radiotelegraph, as was a segment of long waves to a lesser extent. In 1940, while aboard ship off Cristobal, Panama Canal Zone, at night I passed traffic to WBF/Hingham, Mass. with strong, clear signals - both ways on 143 kcs.

There are still a few radio stations on today between 15 and 500 kcs., but they are all government or military high power RTTY etc. automatic transmissions.

In a couple of years, international telecommunications regulations will change all shipboard communications to UHF satellite radio. So, the radio operator and his telegraph key will soon become a thing of the past.

For ten years, radio amateurs and others (no license required) have had FCC authorization to operate on a frequency around 190 kcs. with a restriction of 1 watt power and a maximum transmitting antenna length of 50 ft.

Until a few years ago, there used to be a West Coast group of hams on 160 meter phone, who were low frequency enthusiasts. They called themselves "Lowfers". Their discussion centered on "DX" activities with one watters and experimental receiving antennas on 190 kcs.

In the early days of amateur radio, ham activity started out on what now is the higher portion of the AM broadcast band. Maybe its time to go back to our roots and re-investigate the lower frequencies. •

Christmas, 1913

by Jan Perkins, N6AW
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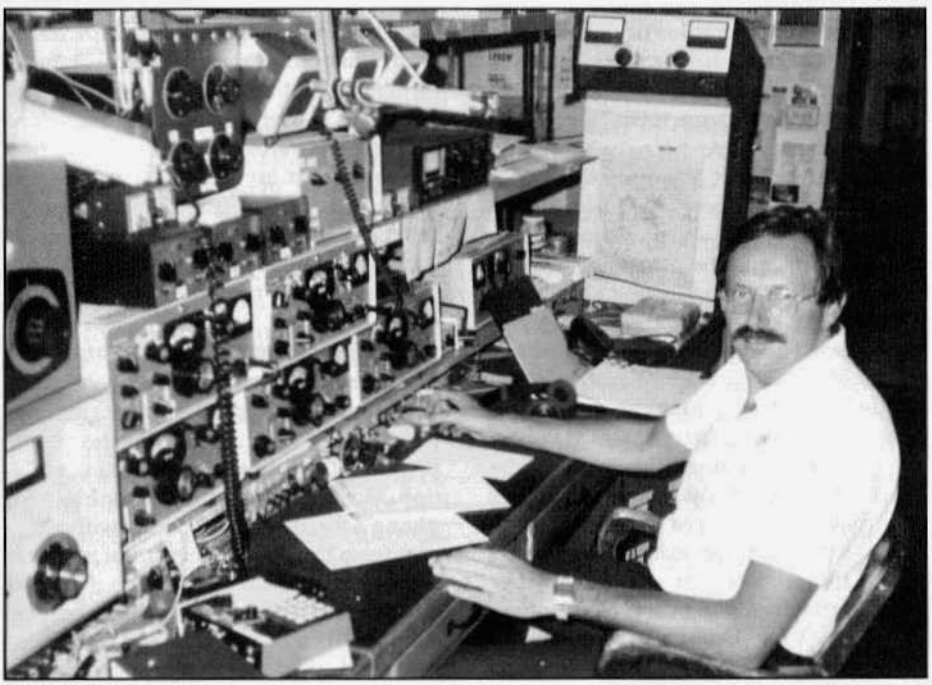
Don Wallace sat at his wireless station and meticulously adjusted the cat-whisker and slide tuner of his crystal set. It was homemade, as was virtually all components of his station and those of most other wireless experimenters. The tuner consisted of over 200 turns of number 22 wire wound on a Quaker Oats box. One end connected to a wire that went out the window, up to the roof of the barn, and was strung to the palm trees out in front of the house and down Linden Avenue another two blocks. The other end went to a water pipe for ground. The sliding contact was wired to a cat-whisker and piece of Galena crystal, and the headset.

He listened carefully and there it was; the throaty buzz of JC calling him. Don had recognized the signal immediately. Due to the construction methods, each of the dozen or so stations on the air in the Los Angeles Basin had a characteristic sound. Don answered with his own self-assigned call, WV, and the transformer groaned as the spark gap arced across with a firecracker-like pop. The smell of ozone soon began to permeate the room, which was a corner of the barn that was partitioned off.

The transmitter was a fixed spark gap with zinc electrodes connected to a hand-

continued on page 28



Jan Perkins, N6AW in his hamshack. Jan is the author of the book, "W6AM, Amateur Radio's Pioneer".

"A Not Noticeably Drifty VFO"

by Walt Hutchens, KJ4KV
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Part 1

Theory, Results, and Causes of Drift

It began with Editor Barry Wiseman's remark in the August, 1991 issue that except for Collins sets, most vintage ham gear is 'noticeably drifty on CW'. Dave Ishmael, WA6VVL, picked up the point in a letter published the following month and preceded to do many hours of drift testing on various ham (and one or two military) sets of the period. He shared some of his results with me; they seemed to confirm Barry's remark, with some sets drifting several kcs (on 40 meters) before settling down.

Readers of the 'In Uniform' series recall that most military radios of the 1930's to 50's drift a kc or so during warm-up. Was this the practical limit for simple tunable oscillators with vacuum tubes? Or could a better job be done? And if so, what would it take? I decided it was time to build a 'Not Noticeably Drifty' VFO as a subassembly for a small home brew transmitter which had been in the planning stage for a couple of years.

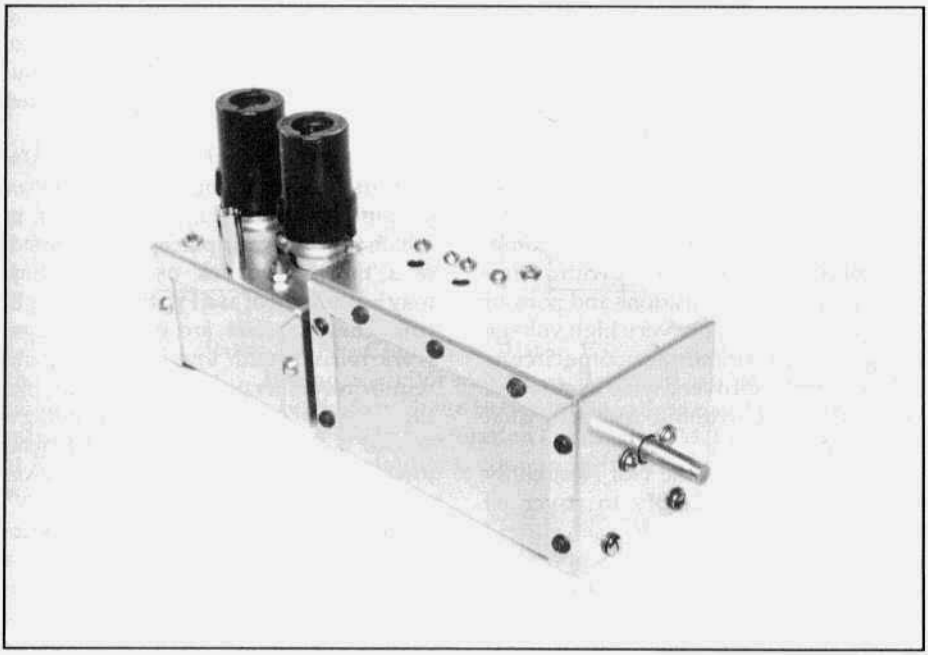
I don't have a machine shop and certainly wasn't going to spend much money on the job; but with those restrictions I decided to produce the most stable VFO possible. In the first part of this two-part article we'll cover some theory, describe the results of the project, and talk about how they apply both to building a VFO and to improving an existing one. Next month the second part will dig further into the practicalities of the Not Noticeably Drifty VFO. Though we will refer to VFO's throughout the discussion, the same considerations apply to other tunable oscillators such as receiver local oscillators.

What Does 'Stable' Mean?

The best modern radios phase lock a tunable oscillator to a precision crystal oscillator. These VFO's can be set to a specific frequency and deliver that frequency with an error of less than one cycle per megacycle indefinitely. They are both 'accurate' and 'stable' in any sense of those words. Most ham operation, however, doesn't require the ability to set an exact frequency on the dial — either we call CQ on 'about' 3885 kcs or we zero beat another station's signal. We do want to stay on frequency without retuning for at least the length of an average QSO, say an hour or so. If we are using AM, 'on frequency' could be as much as 500 cps, while for SSB or CW (perhaps with a very narrow filter) we want something closer to 50 cps. Moreover, since our gear isn't left on 24 hours a day and operating hours are limited, quick warm-up is useful. These considerations set the goals for the Not Noticeably Drifty VFO as a warm-up time of one minute and drift as much less than 50 cps/hour as practical. In addition, the VFO was to be part of a Real Radio, so it had to Glow In the Dark — no transistors would be allowed.

Stable Oscillator Fundamentals

All oscillator circuits work the same way: part of the output from an amplifier is fed back to the input with the proper phase and amplitude to maintain oscillation. Most commonly this is done by supplying a parallel tuned circuit with a current from the plate of a vacuum tube and taking part of the voltage across the tuned circuit as the signal for the grid of the tube. At resonance the current and voltage in the tuned circuit are in phase so (with the right connections) the phase shift is 180 degrees.



The Not Noticeably Drifty VFO. The unit covers about 3500-4000 kcs; studs at top front and posts on top rear are for mounting. After one minute, the unit drifts about 20 cps in the next four minutes. Drift thereafter is usually less than 10 cps per hour and 100 cps per 24 hours.

Disturbances (such as a change in the value of a part) anywhere in the oscillator circuit cause changes in the phase of the signal at that point. To maintain the correct overall phase relationship the frequency has to change until the change in tuned circuit phase shift cancels out that caused by the disturbance. The rate at which the phase shift in a tuned circuit varies as the frequency changes is proportional to its 'Q'.

An oscillator will be stable if it has (1) only small disturbances; (2) a high-Q tuned circuit so that little frequency shift is required to correct for a disturbance of a given size; and (3) a stable tuned circuit.

Quartz crystal oscillators easily achieve drift rates (one measure of stability) of a few cycles per hour because typical HF crystals have Q's well in the thousands and the modern ones are quite stable against reasonable changes of temperature. If the crystal is in good condition, is not exposed to excessive heat from the equipment in which it is used, and is not asked to produce so much power that it drifts from internal heating, it isn't necessary to pay much attention to stability of other parts in the circuit. Conventional HF L-C circuits, however, rarely achieve Q's above 200 or so and thus cannot so easily correct for problems elsewhere. In addition the parts from which they are built are only stable as a result of specific design and construction features. For these reasons building a stable L-C oscillator requires attention to details.

Choosing An Oscillator Circuit

There is no magic circuit which will make it easy to build a stable VFO. Some circuits offer more isolation between the tube and the tank circuit and thus make it easier to get good behavior during early warm-up; but once the tube properties

continued next page

stabilize (about four minutes) the circuit has little effect. But since quick warm-up was one of the goals and tube properties do have some effect on long term stability, I spent some time looking at different oscillator circuits.

The choice of a circuit also depends on how the oscillator will be used. If it will be bandswitched (bad for stability, but sometimes necessary) then a circuit with a minimum number of connections and none of them at points of either very high voltage or high current is important. Some circuits will not work well over a wide bandwidth or won't do so without use of a dual section capacitor.

I decided to build the Not Noticeably Drifty VFO subassembly to cover 80 meters; when it is built into a set, either I will multiply the output frequency to the desired band or change the frequency range and heterodyne up or down as necessary. These choices eliminate the need for bandswitching and set the frequency range at a reasonable 3500-4000 kcs.

Yet another design choice is the oscillator power level: higher power means fewer stages, and less heat from tubes but lower power means less heating of oscillator tank parts by circulating RF currents. I decided I wanted a well buffered 1-2 volts peak-to-peak at a low impedance: this is enough to drive a small mixer stage directly and the low impedance means that shielded cable can be used without worrying about the length.

Oscillator Circuits

The simplest circuits use a single tube with the cathode tapped onto the tuned circuit, the plate coupled to one end and the grid to the other.

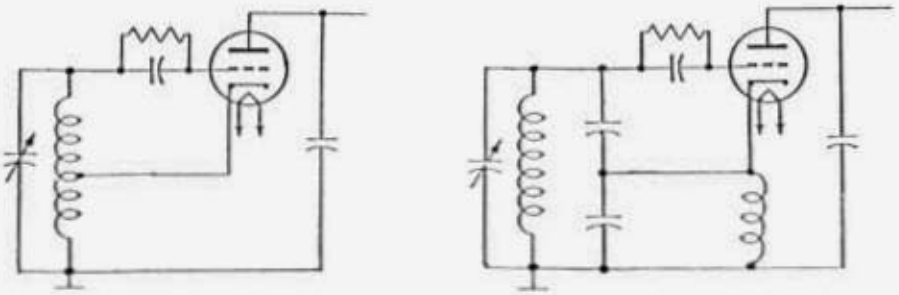
These circuits are grouped mainly according to whether the coil or capacitor is tapped. A circuit with a tapped coil is called a Hartley oscillator, one in which the capacitor is tapped is called a Colpitts. Variations produce other members of the Hartley or Colpitts families. Some of the possibilities are placing the RF ground on a different electrode, connecting the plate and/or grid to additional taps or placing additional reactances in series or parallel with these elements to reduce the coupling between the tube and the tuned circuit.

Most conventional radios of the '40's-'60's use either unmodified Hartley or Colpitts circuits, a Hartley variation in which the cathode is placed at RF ground, or a 'tickler feedback' oscillator, which may be thought of as a Hartley with a split coil. These circuits are easy to design, work reliably with low gain tubes, and require few other parts. Hams usually like the Colpitts because it avoids winding a tapped coil, while commercial sets tend toward the Hartley, because it has fewer parts and thus costs less.

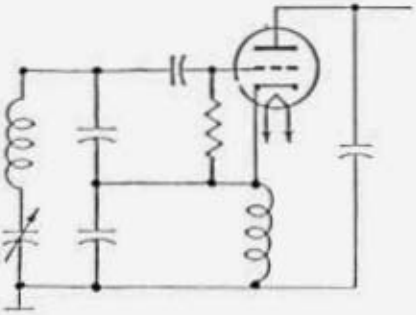
The simplest 'high stability' circuits use a high gain tube such as the 6AU6 and a circuit which trades the extra gain for better isolation between the tube and tank circuit. The 'Clapp' circuit was popular with hams in the 1960's; it is a Colpitts circuit modified by placing the tuning capacitor in series with the tank coil. The tank coil must be made larger for resonance and the voltage divider capacitors are greatly increased over those of the usual Colpitts circuit — to perhaps 1000 mmf each for 80 meters. These capacitors shunt the tube interelectrode capacitances (typically around 5 mmf) so the latter have much less effect.

The bad news, however, is that the junction between the coil and tuning capacitor is a very high impedance point so any change in the surroundings or movement of the coil or capacitor will have serious effects. This is also a high voltage point and the tuning capacitor (usually shunted by a fixed capacitor in practical circuits) must be able to 'take it'. The relatively large inductance is another problem. Because of these factors, I decided not to use the Clapp circuit.

The Vackar oscillator was also popular in the 1960's, though more in Europe than in this country. In this circuit, the Colpitts is modified by grounding the cathode and



Left - Hartley oscillator, Right - Colpitts oscillator. With the plate at RF ground as shown, a single section tuning capacitor may be used; output can be taken from the cathode. A disadvantage is the RF voltage between the cathode and filament which may lead to increased drift and hum modulation - generally FM. Placing the cathode at RF ground usually requires a double section capacitor if a wide tuning range is wanted.



Clapp oscillator. The distinctive feature is the use of a tuning capacitor in series with the coil across the voltage divider caps.

shunting the grid part of the voltage divider by a second divider (the 300 mmf and 2700 mmf caps in the figure) to decouple the tube. The effective tuning capacitance is about that which is usual for the operating frequency so extra inductance isn't needed and there are no points of very high impedance. Since there seemed to be no important disadvantages, I decided to try the Vackar circuit.

The Oscillator And Buffer Tubes

Warm up drift comes from heat generated in the set; heat coming from close to the tuned circuit is the worst and often comes from the VFO tube or tubes. Since the VFO should operate at a fraction of a watt of plate/screen power to minimize heating of the tube structure and other circuit parts, the filament will be the biggest heat producer and a low power filament is desirable. Interelectrode capacitances are unstable so a tube with small ones is best and we need high gain in order to use the Vackar (or any other stable) circuit.

The 6AU6 was popular with hams and commercial builders of ham gear and it meets most of the criteria; it has, however, a 1.9 watt filament. A better choice is the 6AK5, with a 1.1 watt (6.3 volt .175 amp) filament, among the smallest interelectrode capacitances (4 mmf and 2.2 mmf for the plate and grid respectively to everything else) and a 5000 micromho transconductance. (Transconductance in micromhos is the gain of a tube stated as the number of microamps change in the plate current for a one volt change of grid voltage).

The 6AK5 was developed during WW II for UHF radar service; while there are later tubes with higher gain, I couldn't find one which equaled its other characteristics and the 6AK5 has the additional advantage of being cheap and widely available at flea markets. Since most of the considerations in choosing an oscillator tube also apply to the buffer stage, I decided to use the 6AK5 here too.

continued next page

Results

My first attempt at a Not Noticeably Drifty VFO used the basic Vackar circuit. It worked, but there was more than 200 cps warm-up drift. After some head-scratching, I realized that the RF choke used to feed the plate voltage is a reactance in parallel with part of the tank and the drift I was seeing was due to changes in its properties. There was much less drift when I replaced the choke with a 15k resistor and increased the plate voltage to compensate — but connecting a resistor where there was a high RF voltage lowered the effective Q of the tank circuit. When I tapped the coil to feed plate voltage near the point of minimum RF voltage, the Q came back up, the drift was still low, and I was able to reduce the plate voltage (and input power) considerably.

With this change, warm-up was about 100 cps, long term drift about 10 cps/hr with no compensation, and the Q of the tuned circuit was plenty high. However, the drift pattern was irregular and I could not trace this to any one part because there were so many of them!

Hummm... Perhaps the Vackar circuit did have an important disadvantage, namely, all those capacitors. If I changed from the Vackar circuit to its Hartley equivalent, there would several fewer tank circuit parts... and all I would have to do was wind a coil with three taps.

Making the coil was just as much fun as I expected — but the thing worked, drifting only about 80 cps during warm-up and less than ten cps/hour thereafter. With only one critical fixed capacitor, the Mk II circuit (given in the second part of this article) was free of strange drift patterns, making accurate temperature compensation relatively easy. And because of where I placed the taps, the tank circuit Q was even higher, giving better resistance to disturbances.

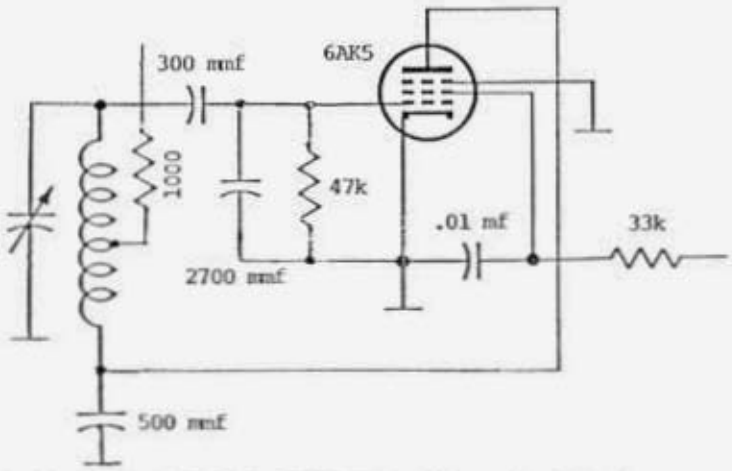
With temperature compensation the Mk II circuit beat the design goals by a mile. I'll use this circuit in my planned homebrew rig. The coil is a nuisance — and because of the complicated design you might have to try more than once to get it right. But the better performance coming from the smaller number of parts more than repays for the trouble in my opinion. If I did not want to wind the tapped coil, I would use the modified Vackar circuit.

What Causes Drift?

Warm up drift has many causes. Here, from the experience of building the Not Noticeably Drifty VFO and staring at the insides of a few dozen more or less drifty military radios, are the main ones.

The drift amounts are for 80 meters and assume normal good construction methods, a low power VFO tube such as a 6AU6, and no bad parts. Testing must be done with the set operating right side up and nothing blocking the air flow.

Cause	Amount
Heat source in or below VFO (Oscillator tube or large resistor)	1 - several kcs
Tuning cap aluminum plates and/or single bearing construction (Even worse if wide tuning range)	1 - several kcs
Drifty oscillator tube (tube is good on tube tester)	0 - several kcs
VFO parts spread around, not enclosed	500 cps - 2 kcs
Coil high temp coefficient (Applies to most coils not designed for low temperature coefficient)	100 cps - 1kc
Tuned circuit fixed caps not NPO (silver, mica etc. -- can be much more if poor quality)	100 cps - 500 cps
Standard rather than high stability oscillator circuit	100 cps - 200 cps



Circuit of the Not Noticeably Drifty VFO Mk I with modified Vackar circuit. In the basic circuit, the coil tap and 1000 ohm resistor are not used and high voltage is supplied through an RF choke connected to the plate. The value of the tuning capacitor and description of the coil will be given in the second part of this article.

Most existing VFO's will have more than one of these conditions. Although most sources of drift cause a downward frequency change, there are often one or two which go the other way, causing things to not be as bad as they might be. Uniform heating of the VFO from the set in which it is used acts as a multiplier on the 'parts' drift sources, so reducing overall heating is almost always useful. Temperature compensation reduces drift from uniform heating but only by 50 to 95%; the higher percentages usually apply to the VFO's with the least drift before compensation.

In building a VFO from scratch, the table can serve as a guide to what not to do; if all these problems are avoided you will have under 100 cps warm-up drift.

With an existing VFO, one would prefer to avoid major surgery. Moving concentrated heat sources such as large resistors, increasing ventilation, and adding heat shields is always a good idea and may give considerable improvement without much work. For example, my NCX-5 transceiver drifted about 50 cps in 10 minutes; though this was within the specs, it was annoying for SSB. After moving three large resistors and adding a small fan to take heat away from a hot spot, the drift fell to about 25 cps per hour.

Always try a couple of different oscillator tubes; some makes may be better than others but even different tubes of the same make will differ. If the VFO was built from a kit, study the construction manual to be sure it was done by the instructions. In particular be sure that the parts are of the right type and placed exactly where the manufacturer intended. Drift of almost any factory or kit VFO can be cut by half or more by careful temperature compensation.

VFO's without heating problems (and which have no bad parts or obvious design problems such as an aluminum tuning capacitor) are harder to improve because the drift is likely to have many sources. In most cases a complete replacement (or replacement of everything but the tuning capacitor if it is of good quality) would be the most practical approach.

Next month we will look at details of the Not Noticeably Drifty VFO, including mechanical design and construction, winding the coil and selecting the other parts. For now, let's just say that there were a few surprises... •

THE FIRST FIFTY YEARS OF SIDEBAND

by Jim Musgrove, K5BZH
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Part Two

I'm sure that a lot of the pioneers had folks in and out of their houses regularly. Trish Taglairino, Tony Vitale's daughter, told me they had visitors from all over. Her mother was very accustomed to this and could expect out of town visitors at least once per month. They were only 32 miles away from New York City. She said that the family would know that Tony had done something great again when there would be another parade of hams to the basement. When Tony Vitale, W2EWL, told me later about his recruitment into sideband, I could visualize what Trish was talking about. Tony witnessed a demonstration that Bob Ehrlich, W2NJR, did at a club meeting on a Friday night in November of 1950. Another ham told Tony that he could get him crystals for the filter by Monday. Tony had the rig operating that Wednesday night. Saturday about 30 guys showed up and Tony had to send out for beer.

There was a list of the active 75 meter sideband operators which was referred to as the "Grandpappy List". The vast majority of the 75 meter sideband operators were identified in this list. Grandpappy's name was Bob McCague and his call was W3KPP. Actually four people were credited with compiling the list. They were Wes Schum, W9DYV; Dick Long, W3ASW; Hoagy Hoagland, W2SHN; and Grandpappy, W3KPP. Grandpappy was one of the few pioneers that was not one of the technical types. He was a banker by profession.

It was reported in By Goodman's sideband column in the November 1950 "QST" that the list contained 50 U.S. and Canadian sidebanders. The March 1951 sideband column reported that the sixth "Grandpappy Roster" contained 75 calls. In May 1951, the sideband column reported that the seventh issue of the "W3KPP Roster" contained 101 U.S. and Canadian stations. The January 1952 column reports 145 stations on the "W3KPP List." It now contained 35 states. The following January, it was reported that the "W3KPP Roster" had 237 U.S. stations from 37 states and Hawaii plus 17 Canadian stations.

Thanks to Ed Sommerfield, W2FJT, I have a copy of the February 1953 issue of the "Grandpappy List". It contains 309 continental U.S. calls, 1 Hawaiian call, and 18 Canadian calls.

It is interesting to review the names and calls on the "Grandpappy List". For example, Art Collins, WØCXX, was one of those listed. Collins had an early interest in sideband. It is reported that when 40 meters was opened to phone operation, the first sideband contact was between Art Collins and Bill Rust, W2UNJ.

Activity seemed to exist in pockets. The W2 area had the largest number of sidebanders. The W9 area also had lots of activity. The W1, W3, W4, W6, and W8 call areas had a fair amount of activity. The W5 call area was low on the totem pole with the W7 and WØ call areas not having much activity either. This is reflected in the "Grandpappy List". It should be noted though that the fellows that put this list together were from the New England region and their interest was the upper end of 75 meters. I discovered that some of the Texas operators were not included on that list. Leonard Meyer, W5EBM; Garth Johnson, W5DDJ; Jess Williams, W5ETL; and several others that aren't on the 1953 "Grandpappy List", operated a little above 3802 kilohertz.

Wes Schum, W9DYV founder of Central Electronics speaking at a hamfest in Fremont, Nebraska in 1957. The rig is a CE 200V. Photo provided by Harry Snyder, WØRN.

Material on sideband is another interesting topic. Virtually nothing was in the hands of the average amateur radio operator prior to 1948. The guys employed by the phone company had some data. The Amateur Radio Relay League was pursuing articles on single sideband in 1948. Scanning the 1948 and 1949 "QST's", one can find a fair amount of material on sideband. "QST" published a regular column entitled "On the Air with Single Sideband" that started in the middle of 1948 and continued for about 5 years."CQ" also published articles on this new mode of emission."CQ" initiated their "SSB" column by Bob Adams, K2DW, in the June 1956 issue. Another publication that was famous for sideband data was the "GE Ham News".

The 1949 "Radio Handbook" by Editors and Engineers had a simplified SSB rig. The ARRL "Radio Amateur's Handbook" started including sideband information in the early fifties. It was 1954 that the ARRL took a collection of the choice articles from earlier "QST's" and published "Single Sideband for the Radio Amateur". This book went through several revisions. "CQ" published "Single Sideband Techniques" by Jack Brown, W3SHY, in 1954. Later they published the "New Sideband Handbook" by Don Stoner, W6TNS.

The evolution in equipment is interesting to track. A lot of folks had an impact on this. A fellow from Rice University that was employed as an engineer at General Electric, named Don Norgaard, W2KUJ, designed a phasing exciter called the "SSB-Jr". A construction article was published in the November-December 1950 "GE Ham News". This rig used 3 tubes and generated sideband using the phasing tech-

continued next page

nique. Norgaard's design would be copied by many. Later the commercial manufacturers revised it and mass produced sideband exciters. For example, the Central Electronics "10A" was based on this design.

Central Electronics, headed by Wes Schum, W9DYV, introduced the 10A by advertisement. Actually it was available several months earlier than this ad. The 10A was a 10 watt exciter that generated the sideband signal at 9 megahertz and heterodyned it to the ham bands. It could be purchased as a kit or wired & tested. A few months later, a big brother, the 20A, was introduced. It ran 20 watts and had a few more "bells and whistles". Central Electronics then upgraded the 10A to include some of the refinements of the 20A. The new rig was designated as the 10B.

Central Electronics had such an impact as an early manufacturer of single sideband equipment that some of their history needs to be reviewed.

Wes Schum was licensed as a teenager in 1939. His early interest in sideband was due to the heterodynes caused by conventional AM. Schum made his first sideband transmitter in 1948. The crystal filter was assembled from surplus crystals out of tank transmitters. He later built one of the "SSB-Jr's" that was designed by Don Norgaard. Wes then came up with the idea of generating the sideband signal on a fixed frequency and heterodyning it to the operating frequency. This led to the famous 10A.

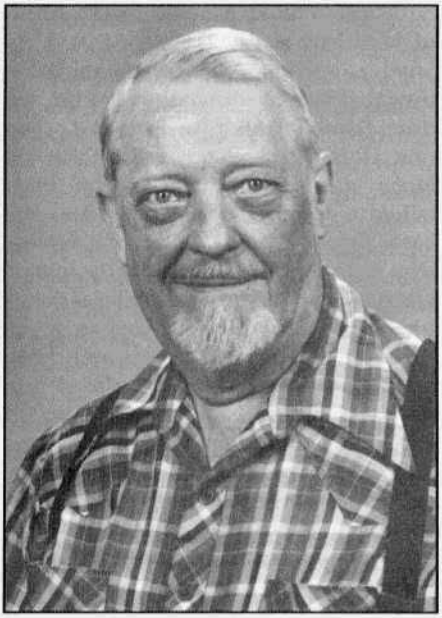
When the 10A was introduced, the company was located in Wes Schum's basement and garage on Giddens Street in Chicago. Schum even rented some of the neighbor's garages to store materials. Most of the early 10A's were sold as kits. The production personnel for the wired models were located all over the Chicago area. Various people or groups worked on a contract basis to wire the kit models. I understand that the majority of the contract people were DeVry students. The wired kits would then be tested in the Schum basement.

Schum later rented the place on Belmont Avenue. This brought about a tough period for a few months. Dealers took 30 to 90 days to pay the bills. Previously the orders came directly from customers with money orders or checks. Another problem was that when the business was at the basement and garage, the overhead costs were very low. They did recover from the cash flow problem though.

Wes Schum tells about Art Collins, WØCXX, calling him and asking for a 10A exciter. Wes told him that they had a tremendous backlog of the wired models at the time and that he could send a kit much quicker. He asked if Art had anyone at Collins Radio that could wire it. Of course he did. Well, as the story goes, the Collins folks wired the kit without paying much attention to the instruction manual. They couldn't make it work. After several days, someone decided that it might be a good idea to read the manual. Upon doing that, it was learned that the problem they had was simply not inserting a crystal of the proper frequency required with the heterodyning scheme to result in sideband output on the hamband.

Wes Schum later learned that this particular unit was for Art Collins's personal use. Collins had noted that one of the sidebanders who was using a Central Electronics exciter and driving an amplifier with a pair of 811's could walk all over his KW1. This sparked his interest. Schum stated that later Art Collins called again needing 3 more units for company research equipment. He told Schum that this time he wanted wired models.

Wes Schum said that he believes the Central Electronics 10A exciter was the first manufactured transmitter to use the heterodyning process. Central Electronics later marketed a deluxe broadbanded single sideband transmitter which was designed by Joe Batchelor, W4EGK. Joe commented that very few engineers get to design their dream transmitter and then get to see them produced. He definitely did that with the Central Electronics 100V.



Joe Batchelor, W4EGK, designer of the Central Electronics 100V.

Eldico advertised their SSB-Jr in the September 1952 issue of "QST". This was another revision of the W2KUJ phasing exciter. Apparently not many of these were sold. This transmitter was reviewed in the January 1953 "New Apparatus" column in "QST". The review stated that it contained 7 tubes and had an output of 5 watts. It was complete with the power supply.

Elenco, headed by Paul Wright, W9OHM, was another company that entered the field of sideband exciters with a SSB-75. Theirs was a filter rig. It was first advertised in the March 1953 "QST". As with the Central Electronics exciter, it was available somewhat earlier than the first "QST" ad. Lakeshore followed suit with another phasing SSB exciter, the "Phasemaster". The time was arriving when the big guns would be making their entry into single sideband.

The Central Electronics exciter became the common means of getting on single sideband. Small linear amplifiers using a single 811A or single 4-65A started becoming common.

By the middle fifties, hams had discovered that the easy way to build a linear was to use the grounded grid configuration. Norman McLaughlin, W6GEG, was one of the west coast hams that published several grounded grid articles. Many tubes were available on the surplus market at very reasonable prices. The 837 was one that could be bought for about a dollar. They were capable of a lot more power than indicated by the specification sheets. Thanks to W6GEG and others, the standard homebrew amplifier of the middle to late fifties seemed to be a single 837 driving two to four 837's in grounded grid.

Another tube that was popular in the hamshack of the fifties was the 1625. It would have made a good candidate for a grounded grid amplifier if the beam forming plates weren't tied to the cathode. Hams soon discovered that some brands of the 1625 could be modified by taking the base off and moving the lead to the beam forming plates to another pin location. The base then had to be reassembled and glued. Later, hams realized that they could easily saw part of the side from the base and perform the required modification. There was at least one commercial amplifier, the P&H LA400, that used the modified 1625's.

One of the favorite small linears used up to four 6AG7's in a grounded grid configuration with plate voltages in the order of 600 to 750 volts. This was an inexpensive and quick way to get to the hundred watt level.

The first selectable sideband receiver to be marketed was the Hallicrafters SX-96. Apparently someone at Hallicrafters realized that the S-76 had an excellent IF amplifier with close to the ideal passband characteristics for sideband. Hallicrafters made a few minor changes which included a selectable crystal controlled conversion oscillator to select sidebands. The front panel was changed drastically, as Hallicrafters loved to do, with model changes. Behind the front panel, it was hard to tell the difference between the S-

continued next page

76 and SX-96. The SX-96 advertisement first appeared in the December 1954 "QST".

Collins Radio had been running technical articles about sideband for advertisements in the late 1954 and early 1955 magazines. In March of 1955, the Collins 75A-4 appeared in the advertisements along with the new Collins KWS-1 transmitter. They also advertised a 32W-1 exciter which was basically a KWS-1 without the final amplifier and high voltage power supply. As an interesting note, the Collins advertisement in the 1955 ARRL "Radio Amateur's Handbook" listed the KWS-1 as a 30L-1.

Art Collins, WØCXX, worked at convincing General Curtis Lemay, KØGRL, that the Air Force should adopt sideband. In 1956, a Strategic Air Command C-97 was flown over a good part of the world with a 75A-4 and KWS-1 on board. Art Collins was one of the operators. General "Butch" Griswold, KØDWC, was another operator. MARS frequencies were the ones primarily utilized and the callsigns AFØCXX and AAFØDWC were used. Amateur frequencies were also used and, of course, the amateur callsigns were WØCXX and KØDWC. The sideband gear performed very well. General Lemay frequently communicated with the aircraft from his fixed station. Lemay still wasn't totally convinced. He wanted to fly the polar regions. This mission was also very successful. The Air Force flew at least three SSB missions in 1956. These experiments also brought about improvements at some of the Air Force's amateur radio club stations which were enjoyed by many service men.

In October of 1956 a KW SSB transmitter and a sideband receiver were installed on President Eisenhower's special railroad car using the White House call of W3WTE. Interestingly enough, the first contact was with General Lemay, KØGRL. The second contact was with General Griswold, KØDWC. It wasn't much longer until the Air Force owned new single sideband equipment. Lemay and Griswold were both active sideband operators. I have encountered many stories about both of them. My favorite is the one that Harry Snyder, WØRN, tells. It was about the time that he met both of them for the first time. Some of the guys from the group that Harry rubbed elbows with at the Northeast Nebraska Radio Club often talked to some of the hams at the Air Force base. One of them was Curt and another was Butch. Both independently invited Harry's bunch to a club meeting at the air base. Harry and crew decided to go, so they got together in one car and drove over there. The base had a closed gate policy and upon arriving, the guard needed to know who they were seeing and what the nature of their business was. Harry said that he rolled the window down and explained to the guard that they had been invited to a radio club meeting. He didn't know the last names as they only knew these guys as Curt and Butch from radio contacts. The guard got a little excited at this point and made a phone call. About this time, Harry is beginning to realize just who Curt might be. In short order, a car complete with flashing lights appeared. They were escorted to the hobby shop. General Griswold came out to see what the excitement was. Griswold made the comment, "Oh, it's those damn guards, they've gone ape again." Harry said that he was personally embarrassed at this time and explained to Butch that no one realized just who KØDWC and KØGRL actually were and that consequently they weren't dressed properly for the occasion. Griswold told him something like, "Bull, come on in." The first person they met inside was General Lemay, the Commanding General of SAC. Everyone had a great time.

I'm told that the Collins KWM-1 was designed with government funding. Supposedly Collins developed the KWM-1 at an old brick warehouse in Ottumwa, Iowa, rather than at Cedar Rapids, to maintain security of the work. Art Collins did not want information leaked to his competitors. It was rumored that one of them had offered $5000 for a set of drawings.

Sideband was becoming more popular in the ham bands and the feuds between conventional amplitude modulation operators and single sideband operators were beginning to get good and started as the sidewinders began to utilize more of the spectrum. The commercial manufacturers were also having problems. For one thing, they now had two phone markets, conventional amplitude modulation and single sideband. They weren't too compatible. On top of that, some of the manufacturers had problems with their engineering staff resenting sideband. Some of the engineers just couldn't be convinced to design sideband equipment. A few of these guys even changed companies as a result.

Barker & Williamson and Heath were among those that offered sideband adapters. Some operators wanted to retain the ability to use AM phone with high level modulation and be able to use single sideband. The Heath adapter was designated as the SB-10. I recall hearing many of the Heath SSB adapters being used on the air. I also noted that many hams referred to it on the air as the SOB-10.

Some companies started offering their higher power AM transmitters with the ability to use the finals in a linear mode if sideband operation were desired. The Globe King 500 is an example of one of these. E.F. Johnson offered the Desk Kilowatt which would run the legal limit on AM phone or single sideband. It had a pair of 4-400A's in the final and was modulated by 810's. The basic idea was that it could be driven with a sideband exciter and the AM modulators could be driven with a speech amplifier. They offered an exciter, the Pacemaker, at a later date which didn't make the list of favored sideband transmitters.

A lot of folks were still homebrewing exciters even into the early sixties. Some of this was done to keep expenses down. I really think that most homebrewing was done due to the fact that a lot of hams of that era simply enjoyed building equipment as much or more than operating. There's a different feeling about using a transmitter or receiver that is home constructed. Today's newcomers probably have no idea as to the amount of homebrewing that took place in the fifties and sixties. It was a widespread practice even among the novices. The novice license was created in 1951 and the majority of the novice transmitters in the early fifties were homemade.

Homebrewing was well established within the sideband group. Sometimes two or three friends would decide to build the same unit. Joe Galeski, W4IMP, told me that he and two of his friends in Johannesburg, ZS6ATA and ZS6ARQ, built the "Sideband Package" simultaneously. They held weekly schedules on the air to discuss such things as parts placement and voltage measurements at particular nodes. Most of the old timers seem to feel a little sad that this practice has changed so drastically. A few are even bitter about it. One fellow commented that today's hams are such damn wimps that they couldn't even begin to unscrew the self tapping screws in their "rice boxes".

Six Rexford, W2TBZ, said it best with, "Early sidebanders were scroungers and dump pickers of the first water. No piece of surplus equipment or abandoned radio was safe. Every capacitor, choke, coil, tube, IF can, or crystal was pressed into service. It was a grand and glorious age and I shed a bitter tear that it will never happen again". •

Part 3 will appear next month.

PBS Documentary On Radio Pioneers

Ken Burns, who made the "Civil War" documentary, has now produced "Empire of the Air: The Men Who Made Radio", a two hour documentary on radio pioneers David Sarnoff, Lee De Forest and Edwin Armstrong. It is based on a book by Tom Lewis. It will air on PBS sometime in January. N6CSW/Ø

Hoss Traders Fall Flea Market

by George Maier, KU1R
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It was the kind of Friday that all New Englanders look forward to in the fall; clear blue sky, mid-seventies, beautiful foliage everywhere; in short, a great day to be going for a ride. Shortly after picking up my son, Alex, (age nine, and studying for a novice) at the end of his grammar school day, we were on our way out of Sudbury on US 20, the Boston Post Road, to where it joins up with Rt 128; Massachusetts' Electronics Highway. From there we headed due east to pick up I-93 northbound for the final leg into southern New Hampshire.

Despite threats of less than perfect weekend weather, the fall tourist traffic on Rt 128 and especially I-93 was slow to miserable. For once, we didn't care; to begin with, we were taking our new four wheel drive vehicle on its first real trip; next, we were going to pitch a tent and camp out over Friday night, for the first time; and finally, we could listen to the friendly chatter on the K1MNS repeater (25/85) in Derry, NH, which attracts many of the mobiles on approach to Deerefield.

The Hoss Traders flea markets have, for 19 years now, been held at the Deerefield Fair Ground in the town of Deerefield, New Hampshire. It's about 10 miles ENE of Manchester, on route 42, north of route 101, which is the main road between I-95 along the coast, and I-93, the gateway to White Mountain region. The flea market was an outgrowth of an on-the-air swap net that still meets weekly at 4:00 pm Eastern time every Sunday around 3942 Khz. The first few Hoss Traders flea markets were held in Seabrook, NH, at a camp ground close to the beach. I had the pleasure of attending one of the first Seabrook events in the mid-seventies with my old pal Jack, K1SMM, who now lives in Orlando, and is still collecting hollow state radios.

One of the best known facets of the Hoss Traders' events is the Sound Trailer that houses the PA system used to make general announcements, and of course call the winning numbers for the door prizes. Bob Tiffany, W1GWU, has been one of the official voices of Deerefield almost since the beginning. He tells an interesting story about the evolvement of the sound system from one speaker on a building at Seabrook, to several speakers at a central location, to what it is today; multiple horns scattered throughout the facility, fed by over 1000 feet of interconnecting wire. Announcements can be clearly heard almost anywhere in the fairgrounds. One of the more memorable ones from this event was ..."It's 6:00 a.m. everyone, time to rise and shine, have some breakfast and start selling".

The fairground itself has quite a history. The Deerefield Fair has been in existence for over 100 years, and is held each year around the first of October. It greatly resembles many of the larger county fairs that are held around the country during the early fall season. In the spring and summer other annual events like home shows, and equestrian shows also take place here.

Attendance for the October Hoss Traders session was in excess of 5000; the 1991 spring session (May 4th) was over 7000. After expenses, the money collected at the gate as entrance fees is donated to the Shriners' Burn Center. The total donations raised by the Hoss Traders flea market activity for 1991 was well into the tens-of-thousands of dollars, which should make every attendee burst with pride; the gate profits help to support a very worthwhile lifesaving organization, and, a good time is had by all.

The ever growing popularity of the event has caused Friday arrivals to increase to the point that the gate fee had to be increased four time the normal amount to gain entrance to the fairgrounds before 4:00 p.m. on Friday. This was necessary to cover the added costs of allowing earlier access; the fairground is run kind of like a hotel, additional time on site cost simply costs more.

All in all, Friday night was really fun. Many of the sellers were already set up, giving ample time to scout around and find some early bird bargains. The pace was relaxed, the atmosphere was friendly and the food stands were open for business. Many of the nicer vintage items disappeared early; a Viking 500, and super clean 75A-1 among them.

The next morning it was cloudy, but still warm. By 7:00 a.m., a steady stream of cars had started to arrive. As I made the rounds in daylight, I took note of some of the classics that were found to be for sale:

HRO	75A-1 (2)	75A-4
SX-100	B&W 5100	NC-300 (2)
G-66	Ranger	G-76 (3)
SX-43	Howard 430	Valiant (2)
BC-312	S-40B	S-40A
KWS-1	BC-654 (2)	HQ-129X
TBS-50	DX-35	CE-200V

As always, there were substantial amounts of more current gear, new equipment vendors, parts vendors, computer hardware and software and some super test equipment bargains. My personal find for the day was a McMurdo Silver 904 capacitor checker; I've always wanted something with his name on it. My son Alex, found a few IBM MS-DOS games and a new Nintendo cartridge that made his weekend.

HRO enthusiast, Mike Tannenbaum, K2BN, mentioned that some of the folks that had recently bought items from the bankruptcy asset sale of the National Radio Company (successor to the National

continued on page 29

Ben, KA1YKG, and his dad Chris, AJ1G, operating a BC-654 field set on 3885 Khz into an 8' loaded whip with radials on the ground.

Collecting/Repair/Restoration...Tips

Modern Solder

Having trouble soldering corroded terminals and wires, tired of over heated components, melted insulation and burned fingers? Switch from the old standby rosin core solder, e.g. Kester #44 or "other pure rosin solders" to a more modern solder with a non-corrosive activated rosin core. One of the best is Kester #88 available from any good electronic distributor.

The difference is amazing, I can easily solder copper wire that is black with oxide and oxidized tinned terminal lugs. Also, the flux does not leave any corrosive residue. Do not buy an activated organic (non-rosin) flux, the residue may be conductive and on a long term basis potentially corrosive.

Muffin Fan Cooling For The 75A-4

Having just acquired a Collins 75A-4, I noticed that it showed signs of excessive heat, e.g. brittle insulation on the output and power transformer leads, melted wax etc. After running the receiver for several hours in an 80 degree ambient temperature (not too uncommon when you have a shack full of older vacuum tube equipment) it was apparent that the natural convection cooling was not as good as it could be.

Not wanting to punch additional holes in the cabinet or modify it in any way, I discovered that a 3 1/8" square Rotron Sprite muffin fan (a hamfest special) fits perfectly in the space between the power transformer and the RF shield box. The leads can be run through one of the ventilation slots in the back panel. With the fan blowing forward the internal temperature dropped from quite hot to barely warm. The A-4 is now more stable,the tube life extended and the overall reliability improved with no permanent changes to this great old receiver.

Restorating Crackle Finish

The next time you have an older piece of equipment with a grubby looking crackle finish forget about trying to use oils, furniture wax, shoe polish or extract of batwings to restore the original finish.

The very best product to use is Turtle Wax Clearguard. It is similar to Armorall but works much better. Apply a liberal amount, let stand over-night and buff with a soft cloth. It is not necessary to do any pre-cleaning, the Clearguard will remove most dirt and grime.

Only one caution, avoid contact with any material that has a natural rubber component. Regardless of what the label says, it will attack and soften most rubbers.

Fragile Filaments In Some Eimac Tubes

During my years of working around amateur and commercial transmitters, there is one very important caution regarding Eimac 35T - 450T tubes. This whole series has extremely fragile filaments. I've seen them open when the tubes were stored in an unheated area during 0 degree weather, being pulled from their sockets and barely knocked against a heat shield and even when carefully wrapped with padding and shipped in a good transmitting tube container.

The reason for this is that the thoriated tungsten filament in this series of tubes is a self-supporting helix with several sharp bends. As the tubes get older and especially if they have considerable hours on them, the filaments seem to become more prone to breakage. Be very careful in buying them at a hamfest. Always look for signs of broken filament wire down around the base seal.

Editor's Note:

All the tips this month were provided by Roger Faulstick, KD4AS.

AM FREQUENCIES

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

From the Editor:

10 Meter Contest Results

Last month I reported the preliminary results of the 10 meter contest. Here are the final results: Ron Cole, N6OMW, was the first place finisher with 100 points; Steve Berkule, NW2F was second with 28 points and Howard Hannon, KD8DX was third with 24.

20 Meter Contest....

The 20 meter contest got off to a great start. At 8:00 p.m. local I heard considerable activity on and around 14.286, our 20 meter net frequency. Then within minutes propogation started to deteriorate. By 10:00 local the band was dead. Dan Bolle, N9JBF, summed up his experience this way:

"After working around the basement Saturday afternoon until 8:00 p.m. and listening to all the people getting ready for the contest it was a big disappointment to come down at 10:00 and find the band had shut down.

"We [Southeastern Wisconsin hams] hung in there as a group until about 12:15; then some of the guys went to bed and some went to other bands. I lasted until about 3:00 before I fell asleep. I didn't wake up until a half hour after the contest ended. Maybe next time the band and I will hold up all night."

We'll have another 'Allnighter' later this winter. **N6CSW/Ø**

160 Meter Contest on Saturday, Dec. 28

Last year we had a 160 meter contest on this same date . Conditions were terrible due to storm activity across almost the whole country. Let's hope for better conditions this year. The rules are the same - one point for each contact and the exchange of information must be on AM. I would also like to see the equipment used listed on the logs submitted. The contest will start at 6:00 p.m. California time and 9:00 Eastern. It will end at sunrise the following morning.

Despite the bad conditions last year, there was a tremendous turn-out and the scores were fairly high; Bill, WA8LXJ, came in first with 70 points, Gary, W7FG, scored 69 for second place and Bill, W8VYZ was third with 60 points. If conditions are just average this year, the scores should be considerably higher.

Vintage Sideband Net

A couple of issues back I talked about the possibility of organizing a net for those interested in vintage SSB. Since then I have received a lot of letters and calls indicating to me that there is considerable interest in a net of this sort.

Twenty meters is the band that most people would prefer. I think we should pick a frequency in the General portion of the band and a day of the week (how would Friday be ?) and get started in the New Year. **continued on page 29**

A Hollow State Refresher

by Bill Kleronomos, KDØHG
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"Will the tubes in my AR-88 last longer if I leave it on all the time?" "How come the plate current in my Ranger drifts up after I've been on the air a while?"

To understand the answers to these and other like questions we need to revisit basic electron tube theory, and, perhaps toss aside some commonly held misconceptions of what's going on inside those shiny glass bottles containing that lovely red glow.

THE KEY IS THE CATHODE

The cathode of any electron tube is the single most important structure with regards to life and performance and will be the focus of this article. Let's begin by looking at the subject from a historical context.

The cathode most commonly used in the earliest days of the vacuum tube was made of pure tungsten wire, the same material of which light bulbs are made. This type of material has several major drawback in this application- it gets fragile with use so life is limited, and the efficiency as an electron emitter is poor- it takes many watts of heater power per milliamp of electron emission. Pure tungsten filaments are only used today in very high power water cooled broadcast tubes where the severe operating conditions would destroy other types of material.

It was discovered that filaments made of tungsten alloyed with a small amount of thorium oxide had much greater emission than those of the pure metal, and this type of filament is known as the thoriated-tungsten emitter. These operate at a bright yellow heat and are used in virtually all transmitting tubes above the 100 watt or so level such as the 813, 4-65, 4-1000, 100-TH, 3-500z, etc. The efficiency of this type of filament is considerably greater than the pure tungsten type and since it does not operate at white heat the life is considerably greater.

The thoriated-tungsten cathode has an interesting manufacturing process. A tungsten wire containing about 1% thorium oxide as an impurity is "carburized" by heating it in a low pressure atmosphere of a hydrocarbon gas such as propane. Then the tube envelope is pumped out and the filament is heated to a bright white temperature for a minute or two. The temperature is then reduced to a yellow white heat for 10 to 30 minutes or so. This process, called "flashing", causes the thorium oxide present on the surface of the cathode to be reduced to a one molecule thick layer of pure metallic thorium because of the reaction with the carbon in the propane. This single molecule layer of thorium enables this type of filament to operate many times more efficiently than a pure tungsten one operated at the same temperature.

There are two factors in the operation of a thoriated-tungsten filament that are important to the amateur or broadcaster. The first is that this type of cathode wears out, or deteriorates at about the same rate, whether or not plate current is present. The RCA Transmitting tube manual, HB-3, contains specific information as how to maximize life of this type of tube. Table I, courtesy of RCA, shows recommended standby operating conditions for different types of tubes to maximize life. The second important item about thoriated filaments is that they can be permanently damaged by a heavy overload which overcomes the space charge and strips the cathode of its layer of thorium molecules. More on the importance of this space charge later. It is possible to sometimes reactivate a damaged or worn filament of this type by duplicating part of the original manufacturing process. "Flash" the

filament at 2 times rated voltage for 20 to 60 seconds, then immediately reduce the voltage to 120% of nominal for an hour or two. A bench lashup using a socket, transformer and variac works well. If you try this, remember- the tube will get VERY hot during this procedure!

As a note, RCA claims that most thoriated-tungsten types of transmitting tubes should have a useful life of at least 5000 hours when operated within CCS ratings.

The most common and efficient type of cathode is the oxide coated indirectly heated type used on modern receiving and lower powered transmitting tubes. The first large scale commercial use of this cathode was on the RCA type 27, introduced in May, 1927. This type of cathode generally consists of a nickel cylinder containing a heater coated overall with a mixture of barium, strontium and thorium compounds. Capable of enormous emission per watt of heater power used, this type of cathode operates at a temperature of somewhat less than 800 C, or at a dull red color. Under normal circumstances, the oxide coated cathode can last upwards of tens of thousands of hours; one run at low plate currents with a generous sized cathode will have a life measured in decades-many of us have lifted the lid on a 1920s or 30s receiver only to find the original tubes to still be in good working order! So, one should ask, why don't the tubes in my rig last more than a year of operation, if that?

To understand some of the things that can cause premature demise to a tube we need to take another look at what really goes on inside that bottle and perhaps toss aside a few long held misconceptions.

The time honored explanation for the electron flow within a tube is, "The electrons go from the cathode to the plate (and screen)". Wrong! This explanation is an over-simplification, and as such is erroneous as is often the case. The electrons do NOT leap off the cathode and zip off to the plate!

Here is a more precise- and correct- explanation of the electron flow. Assume a tube with only heater voltage applied. Electrons boil off the cathode in large numbers and, having nowhere else to go and no motivation to do so, form a cloud around the cathode surface. This cloud is called the space charge, or virtual cathode. When plate voltage is applied, the current flow within a tube is from this space charge to the plate. This virtual cathode acts much like a reservoir of water that supplies the tube's varying current requirements and is replenished at a constant rate by the cathode itself.

The space charge has other effects within the tube. All tubes contain an imperfect vacuum and residual molecules of gasses are present. The high energy electrons present during the operation of a tube bombard the gas molecules and create positive ions. While electrons have little mass, positive ions which consist of atomic nuclei (protons and neutrons) are very heavy on an atomic level. Having a positive charge they are attracted back to the cathode in the opposite direction of normal current flow at a high rate of speed. When they impact the cathode they have a heating effect and they cause a chemical reaction that "poisons" or eventually ruins the cathode emitting coating. This is one of the reasons the oxide coated cathode is not used in large transmitting tubes that operate at higher voltages. The high energy ions present due to residual gasses would destroy an oxide cathode. However, at lower plate voltages with a space charge present, most of these positive ions are safely neutralized by picking up free electrons from the cloud before they have a chance to impact the cathode and cause damage.

Armed with this knowledge, let's go over the nasty stuff that happens within a tube when, equipment is first turned on. Plate voltage first appears on the plate, either because of a instant-on solid state power supply, or because the 5Y3/5U4/5R4 type of rectifier heats up faster than an

continued next page

indirectly heated cathode type. No space charge is present within the tube yet. On a microscopic level, a smooth appearing cathode appears as rugged as a mountain range, full of peaks and valleys and other imperfections. As it slowly heats, the high points being both closer to the anode charge and acting as a point discharge source have their available electrons ripped out of the coating material. This causes voltage gradients throughout the cathode material; the high points, missing their electrons have a positive charge compared to the rest of the cathode and arcing occurs throughout the cathode material. This arcing continues until the cathode is warm enough to establish a space charge around itself. And without a space charge for protection, the positive ions created by the initial plate current flow bombard the cathode material as discussed above.

This double whammy occurs each time the equipment the tube is used in is turned on, and each time some of the cathode coating is destroyed. After a year or two, a tube designed to last many thousands of hours is prematurely low on emission and must be replaced.

It is for this reason that tubes in equipment that is infrequently turned off seem to last forever.

Filament voltage is also crucial to the longevity of a vacuum tube as most of us have heard- but why?

Low voltage reduces the emission of the cathode and a tube when operating at rated plate current will have its space charge depleted with all the attendant effects just described. The only time lowered heater voltage is acceptable is with the use of certain transmitting tubes in a standby condition or when the plate current used is substantially reduced in all other types. However, the most common abuse of the heater voltage rating seems to be overvoltage. Most older equipment seems to be rated for 110 to 117 VAC operation but the standard for today's line voltage is 120 volts, +1- 3%. Line voltages of 122 to 124 volts are relatively common. This means a 5% or better overvoltage condition on a rig's filaments is not an uncommon occurrence.

The scenario for what happens within a tube with prolonged heater overvoltage is different than what's been previously described. At first, the performance of the tube is excellent- small transmitting tubes may be able to be run at higher than normal plate currents and as hams, we will frequently do so. The overheating of the cathode coating causes some of it to slowly evaporate from the cathode's surface and it will condense on the closest cooler surface- the control grid. Eventually, the control grid gets a nice coating of highly efficient electron emission material. When the tube is run hard, the internal heat within heats the grid sufficiently to cause it to liberate electrons which are attracted to the plate (or screen). This leaves a net positive charge on the grid (referred to as "reverse grid current") which increases the plate current even more, which heats up the tube internally even more and we have plate current runaway if the grid resistor is of large value. This is one reason that a maximum grid resistance is specified in tube data sheets. The effect is magnified even more if the tube is slightly gassy to start with, and overheating will liberate even more gas.

This effect of thermal runaway is not uncommon in amateur transmitters. I have had it occur several times in my Johnson Ranger and in sideband rigs where the plate current in standby or an idle condition drifts noticeably upward after a prolonged transmission. When this happens regularly, the tube is essentially ruined. The prevention of this condition includes maintaining the tube filament voltage at a proper level, not using excessive grid current and only loading the tube up to the manufacturer's specified plate current. Where a tube has a reduced rating for plate modulated AM use, it's easy to load up to the maximum CW rating. Don't- if you want that tube to last!

Tubes aren't cheap anymore. The common types of small transmitting and audio output tubes are escalating in price, and those made overseas seem to be of nowhere the quality of the old stock GE, Sylvania and RCAs we've been using. It's of real benefit to take a few precautions to extend tube life where desired or practical. Armed with the knowledge of how a cathode operates, we can have a plan of action.

First, take the time to measure the filament voltage in a piece of older equipment with an accurate meter such as a DVM. If it is too high, consider using a small variac on the AC line to bring everything into specs. Many military receivers have multiple transformer primary taps that go up to 125 volts. Use them where available- they were put here for a reason! To reduce cathode stripping by early application of plate voltage consider replacing a 5Y3/5U4 type of directly heated rectifier with an indirectly heated type such as a 5V4/5Z4/5AT4/5AR4 where socket wiring and compatible ratings permit. This type of rectifier warms up much more slowly, at a comparable rate to other tubes. As a bonus, many of these rectifiers have a very low internal voltage drop thereby reducing heat. If you tend to leave a receiver on all the time as many of us do, this change is not as important.

For the ultimate in tube life, consider adding an Amperite or modern equivalent time delay relay to the center tap of a power transformer's high voltage secondary. Waiting 30 seconds to a minute before applying high voltage to tubes is almost as good as leaving the unit on all the time. This suggestion will have varying degrees of benefit; receivers using a low plate voltage such as the Collins S-Line won't have the ion bombardment and cathode arcing problems to the extent those having plate voltages in the 250 volt + range will. Many Hallicrafters receivers are wired to disable plate voltage when the "standby" switch is operated. Consider warming such receivers up in standby mode then switching the unit to "receive" after warmed up

By understanding what's happening in those glass bottles and by using some care one can largely eliminate the #1 slam made against hollow state equipment- "it is not reliable- the tubes always need changing". My 1936 Phico broadcast set with its original tubes seems to say that's not true- if some TLC and common sense is used. ●

RCA

RECOMMENDED STANDBY CONDITIONS FOR TRANSMITTING TUBES

TUBE TYPE BY KIND OF CATHODE *Filament or Heater-Cathode*	RECOMMENDED PERCENTAGE OF NORMAL OPERATING FILAMENT OR HEATER VOLTAGE FOR STANDBY PERIODS AS FOLLOWS:			
	Under 15 Minutes	15 Min. to 2 Hours	2 Hours to 12 Hours	Over 12 Hours
Pure-Tungsten Filaments:				
Large Tubes— Such as 889R-A, 5562, 9C21	80	80	80	Off
Thoriated-Tungsten Filaments:				
Small and Medium Tubes— Such as 813, 833-A, 5762	80	Off	Off	Off
Large Tubes— Such as 5771, 5671, 5770	80	80	Off	Off
Oxide-Coated Filaments:				
Vacuum Tubes— Such as 5618, 2E26	80	Off	Off	Off
Mercury-Vapor Tubes— Such as 816, 866-A, 857-B	100	100	100	Off
Gas Tubes— Such as 3B25	100	Off	Off	Off
Oxide-Coated Heater-Cathode:				
Vacuum Tubes— Such as 5763, 807, 829-B	100	80	Off	Off
Mercury-Vapor Tubes Such as 5550, 5563	100	100	100	Off

FEB. 1, 1950 TUBE DEPARTMENT RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY RECOMM. STAND-BY CONDITIONS

Adding 160 Meter Coverage To The ART-13

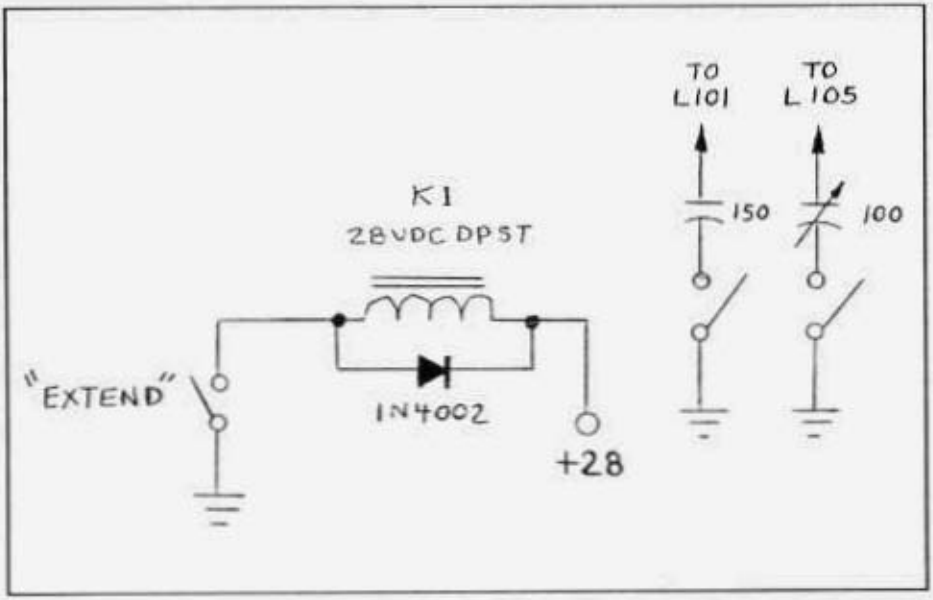
by Mike Murphy, WB2UID
38 N. Reading St.
Hooksett, NH 03104

The series on the ART-13 by Bill Kleronomos, KDØHG, has been great. The tips and problem solving approach to this rig will surely push some people into finally firing one up! For many years these rigs have been a rarity on the bands but now I'm starting to hear them.

I got mine at Deerfield 4 years ago for $35 (less tubes) and had nothing but fun getting it operational. The dummy L.F. oscillator panel area is a natural for containing all kinds of homogenizing add-ons without destroying the rig. I ended up with time delay, grid blocked keying and shaping filters, audio feedback and fan controls all in this area.

Bill mentioned extending the range of the ART-13 to cover more of 160 M. I ran into the same grid drive problem at frequencies below 1950 khz. Determined to cover the entire 160 M band with full grid drive, I ended up padding the vfo and the first multiplier tank via a remotely switched DPDT relay. My ART-13B, designated COL-52286/T-41, is different in that it already has an 'extend' switch on the front panel. This switch was originally used to extend the L.F. coverage in much the same way I wanted to extend the 2.0 Mhz band. This switch now controls the 24V relay located in the multiplier cavity that performs the padding function.

This conversion extends the 2 Mhz band position to cover the full 160 M range with full grid drive. The basic circuit is a DPDT relay that adds padding capacitance to both the oscillator tank and the first multiplier tank. An extend switch can be mounted somewhere on the front panel or on the Dummy LF oscillator panel. •



LETTERS

Dear ER

I just returned from two weeks in Tahiti. I brought along a Sony 2010 for monitoring. I heard nothing on 14.286 and only weak heterodynes on the 10 meter band. The 11 meter band was full of strong AM signals mostly from Texas and Louisiana. Looks like AM kilowatts are not dead after all.

Art Rideout, WA6IPD

Dear ER

Some of your recent articles have been outstanding! In particular was Andy Howard's/WA4KCY "A Desktop 500 Watter Using 4-125A Tetrodes", an absolutely gorgeous job of homebrewing. Also, Ray Osterwald's/NØDMS "The Collins Linear PTO" answered a lot of questions I have had about these PTOs. Walt Hutchen's/KJ4KV "The BC-348 Receiver" was worth waiting for - I had no idea the design of this receiver dated to 1934! I am not always interested in all the articles but I still manage to read Electric Radio cover to cover and its the only magazine that I subscribe to that I do! And naturally your CLASSIFIEDS are worth their "weight in gold".

David Ishmael, WA6VVL

THAT'S OLD NED--- HE WAS ISSUED THAT CALL BEFORE RADIO WAS INVENTED!

Dear ER

Just writing to ask if you would consider publishing some calling frequencies for the vintage CW gang. I sure have been running into a lot of them lately. The AM calling frequencies seem to be very well recognized so maybe with luck so will the CW.

I recommend these easy to remember frequencies:

80 meters	3.560 Mcs
40 meters	7.060 Mcs
20 meters	14.060 Mcs
15 meters	21.060 Mcs
10 meters	28.060 Mcs

By the way, I have been using the CW filter (Part Number 455A4-CW1) from Vector Control Systems in my 75A-4 and it works very well. The selectivity is very sharp and it sounds just like the 75A-1 or 75A-2 with the crystal filter set at position 3. What was a real surprise to me is that both the selectivity and phasing controls in the filter can are easily accessible so anyone can adjust the filter characteristics to their taste. I highly recommend it!

Dave Mills, AJ7O

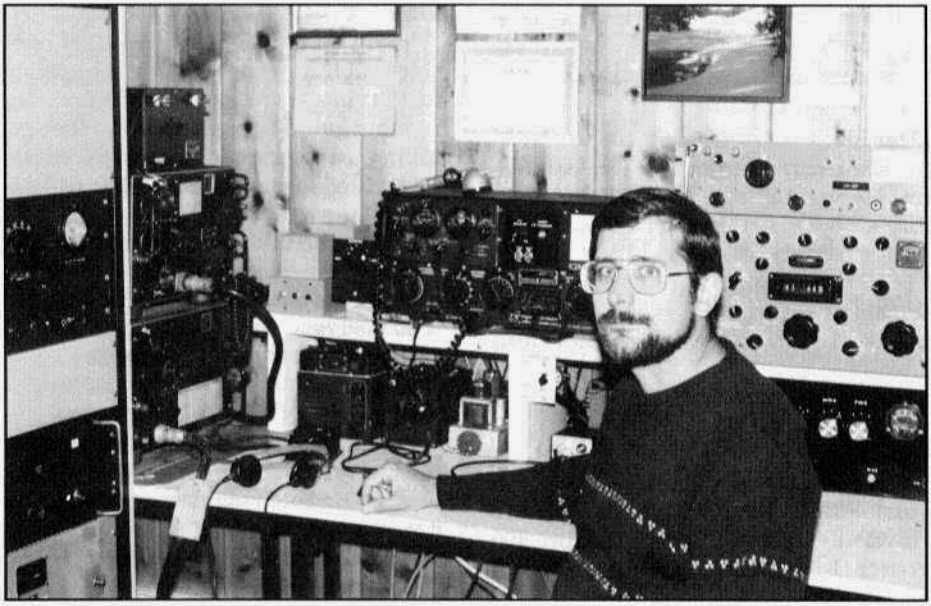
Dear ER

I checked into the vintage CW net for the first time and really enjoyed hearing those great old rigs again on my new (to me) 75A-2. They all sounded great and unique unlike the modern generic solid state transceivers of today.

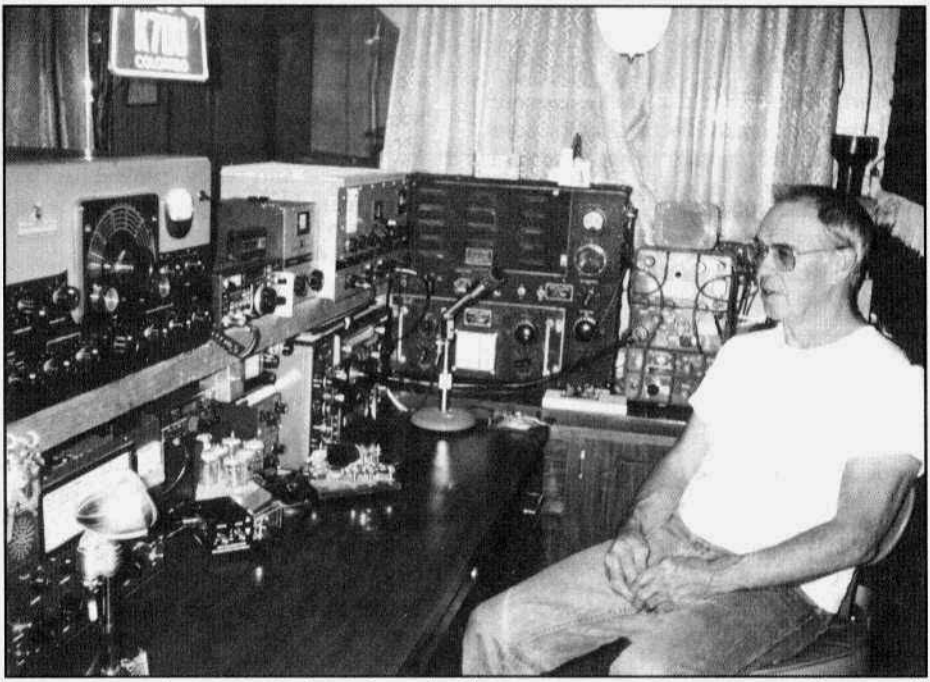
I use my old rigs all the time (I have no modern solid state units in use anymore) and I'd like to QSO vintage stations at times other than "net" time only.

Since 7137 is the CW net frequency on Saturday nights, how about you CW vintage ops getting on this frequency plus or minus 5 kcs at all other times during the week. Let's make 7132 to 7142 a vintage CW station hang-out, OK? Just call "CQ vintage" or listen for me calling "CQ vintage".

John Seginski, N7NV



Mike Murphy, WB2IUD, shown with his vintage gear which appears to be mostly military surplus. See his article on page 24 that describes extending the 160 M coverage of the ART-13.



George Cummings, K7DU, in his hamshack. He operates AM on 160, 75 and 10 as well as CW on these as well as other bands. Mostly he uses a Viking I/HRO-60 for AM and a Pacemaker/HB rcvr for CW.

Bill Owen, KFØIE, says most of his activity is on ten meters. One of the transmitters he uses is the Stancor ST-203 that's located on the shelf above the Ranger.

Another photo from the Butler, PA hamfest. From left to right Ed, KO3L; Mark, SWL; Greg, K3EWZ and Russ,WB3FAU

Last issue we erred on the caption of the group photo at the Butler hamfest. We omitted the names of those in the front row. They are from left to right: Dale, WB8WOJ; Tony, N3HFB; Tony, WA3GKX and Steve, WA3JJT

Christmas, 1913 from page 3
wound transformer. The operating wavelength of 250 meters was determined by the output inductor and the size of the antenna. The transformer was keyed directly from the 110 VAC 50-cycle power line. A key was made from pieces of brass, as was the antenna change-over knife switch. They chatted for a while and Don had to sign off. His transformer was getting hot and starting to smell. It was made of stovepipe, waxed paper, and several thousand turns of #22 copper wire. Periodically he had to rewind it.

John Cook lived just three blocks away from Don. They had built receivers and learned the code together four years earlier. While on a visit to his uncle's the next year Don acquired the pieces of stove pipe to build a transformer. By late 1910 he was on the air as WV. As there was no licensing authority yet, Don was free to choose his callsign. Most wireless experimenters selected their initials; as Don was particularly impressed with Western Union, he borrowed their's.

John Cook was still in the process of accumulating enough pieces of stove-pipe for a transformer of his own. In the meantime he borrowed one of the four spark coils out of his father's Model T Ford when he wanted to transmit. Driven by some aging batteries it imparted only a limited amount of energy to the antenna, but he had been heard six miles away at the United Wireless station in San Pedro, PI. He had to be sure to re-install the spark coil in the Ford when he finished for the night. One time he had forgotten to return it.In the morning his father had been hand-cranking the car for some time and then discovered the car wouldn't start because one of the spark coils was connected to an antenna instead of the ignition system. His father had raised the roof.

The early spark transmitters such as Don's that keyed directly from the line had a peculiar characteristic that came to be known as kickback. Occasionally when the key was pressed the cycle of AC energizing the transformer was the reverse cycle of the previous dot. There would be a tremendous bang, much louder than the typical arcing sound of the gap, and a large pulse of AC would be forced back up the line. When that happened in your house, or the one next door, or down the block, a light bulb would become very bright and sometimes explode in its socket. Naturally, this created a certain amount of apprehension among the neighbors.

When tuned in on a crystal set Don's signal sounded like a 50-cycle buzz, similar to ignition noise in modern AM receivers. This was due to the 50-cycle line frequency. Depending upon the shape of the zinc electrodes, flat or filed to a point, a coarse or sharp characteristic was added to the note. The arc could be untuned, or have a tuning coil that was loosely or tightly coupled to the antenna, causing the signal to fade fast or slowly fade away. Each of these combinations gave the signal a distinctive characteristic. In this manner even when there would be dozens of transmitters on the air in an area, the sound of each was usually unique.

Don's station had initially been in a corner of his bedroom until one evening three years earlier when he had finished building his transmitter. The first time that he pressed the key the sound of the arc in the enclosed space was similar to a firecracker exploding. Everyone in the house had come running. His wireless station was permanently exiled to the barn. Nearly meeting a similar fate himself Don was on good behavior for some time after that.

Don was just 15 years old in the fall of 1913. His father was the manager of the First Exchange Bank in Long Beach, and could be considered well-to-do. William Wallace felt that in order for his children to appreciate the value of a dollar they had to earn their spending money. Every last item in Don's station was home-built, right down to the hot-wire ammeter. He had accumulated the money to purchase the wire and various materials by doing odd jobs.

The crystal set in his station was a bit short of the current state of the art. Although Armstrong's oscillating detector circuit utilizing a de Forest spherical audion was still over a year away from being presented to the IRE, the loose coupler was proving superior to the single-slide tuner. Commercially made loose couplers by Bunnell cost over 15 dollars. Don had started construction of one from a diagram in Modern Electrics. However, there was lots of room for improvement in his transmitter. Even though he could work stations up to 30 miles away, a fixed spark-gap transmitter had limitations. It imparted a low note which was hard to copy, and was not very efficient.

Howard Seefred, recently assigned 6EA by the Department of Commerce, lived in Los Angeles and had a rotary spark-gap transmitter. It had a higher note and was a pleasure to copy. It consisted of an AC motor that had insulated contacts that rotated past a fixed contact. The high voltage momentarily arced across as the contacts rotated past the fixed point. The rate of contacts rotating past each other determined the pitch of the signal.

Don yearned to have a rotary spark-gap, but the price was enormous; 30 dollars. It was just not practical to build a transmitter of this nature without access to a machine shop. He calculated that he would have to save all of his money from odd jobs for another two years to be able to afford one.

In the weeks before Christmas Don made some toys for his little brother and sister, now 4 and 6 years old. A train with several cars and wheels that moved was fashioned from wood. His brother would be delighted with it. The dollhouse for his sister took longer. It required a lot of detail work. Now that the football season was over he had ample spare time to do a nice job.

On Christmas morning, he was awakened by the smaller children racing downstairs. He enjoyed watching them open their presents and play with their toys. His presents were the usual; school clothes and shoes; plus a football.

After all of the commotion had settled down, his father went out to the barn to wash their car. Don went along to give him a hand. As they were opening the doors he noticed his dad had a little smile, and then he saw it; next to the car was an orange crate sized box with a big red ribbon around it. At sunset that day a new transmitter with its own unique high-pitched sound announced itself to the wireless experimenters in the Long Beach area. ●

Hoss Traders Flea Market **from page 17**

Company) had been around the fairgrounds early Friday, and had sold all of the goodies that they brought along. Mike wound up with some very nice restoration stock that I'm sure will show up in some of his future projects.

As a final note, the weather held up well for all of Saturday amidst ever deepening clouds, but went seriously downhill the next day. Timing is everything !!!

The spring 1992 Hoss Traders Flea Market (usually the first weekend in May) will be a unique event; it will mark 20 years at Deerefield, and there will be some very special goings on. As plans become firm they will be forwarded to ER so all that wish to participate can do so. It's certain to be exciting ... so when you see me there, be sure to say hello !!! ●

Vintage SSB Net **from page 19**

About a month ago I got my Central Electronics 20A up and running and have really enjoyed the experience. I'm not saying that I would rather operate SSB than AM but that vintage SSB can be fun too; particularly when you get on the air with others who are interested in vintage gear.

I'd still like to have more input on the Vintage SSB net before I announce times and frequencies etc. Please call or write with your ideas. **N6CSW/Ø**

CLASSIFIEDS

Advertising Information

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

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

VINTAGE EQUIPMENT ONLY

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

DEADLINE FOR THE JAN. ISSUE: JAN. 3

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

FOR SALE: Complete 160-10 meter AM station - AF-67 xmtr, Pierson KE-93 rcvr, Elmac M-1070 AC/DC supply, all manuals - $100; HQ-140X - $80; HQ-110 w/spkr - $90; HQ-129X - $65; 10 M Johnson Messenger - $30; Sonar PS-23 CB - $35. Pat, WB9GKZ, (414) 434-9016

FOR SALE: Parts by mail since 1954. Vintage parts available. Send stamp and request "Vintage Flyer". USA only. Bigelow Electronics, Box 125, Bluffton, OH 45817

FOR SALE: Hallicrafters SX-43, S-40B, S-84, S-86, NC-125 - $30 ea; TV-7d/v tube tester - $60; URM-25D sig. gen. w/access. - $70; Heath Q-multiplier QF-1 - $10; GD-125 - $20; regen. rcvr GR-81 - $45; Super SCAF filter - $75; National TMC-1000 2 section 100 MMF 3000 volt variable, NIB - $20; Hammarlund PS-135-C crystal calib., NIB - $25; factory cabinet for SP-210 - $30. **WANTED:** Pre-war and WW II HRO's, any cond., also coils and access. John Orahood, N5SPQ, 5819 Miller Valley, Houston, TX 77066. (713) 440-5598

FOR SALE: Miscellaneous odds and ends, antique radios and parts. LSASE for list. Hidyne Research, POB 3342, Williamsport, PA 17701. (717) 326-2148

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

WANTED: Old receivers, SX-73, SP600JX, AR-88, BC-342, BC-348, ST Tube Type HRO and etc. Masahiro Nada 6-9-3 Fujiwaradai-Kitamachi Kita Kobe 651-13 Japan. FAX 011-81-78-981-3261

WANTED: Technical Material Corp. rcvrs - GPR-90, GPR-91, GPR-92; SBC-2, CSB SSB adapters; VOX-5 diversity combiner. Also original manuals, cabinets and spkrs for same. Ron, KC6WTC, POB 783, Santa Rosa, CA 95402. (707) 539-8319

FOR SALE: Collins KWM-2/516F2 w/e - $475; National NC-57 - $40; Hallicrafters S38D - $30. **WANTED:** Info on AN/PRC-47 (power connections, etc). Jack, WA2IWJ, (201) 927-7784

CLASSIFIEDS

FOR SALE: Collins KWM-2A, RE, w/516f-2 ps and 312B-5 console, very nice, w/manuals - $950 for the package. Charlie, KD4AJ, (404) 396-0276

FOR SALE: Apache xmtr. WANTED: Meter for Heath AT-1; SB-640 remote LMO; info on nixe tubes, where to find, etc. Marty Drift, WB2FOU/5, 108 Hickory Lane, Hickory Creek, TX 76205. (817) 497-6023

WANTED: Coils E and F for HRO-60. Don, W7KCK, (503) 289-2326

FOR SALE: Still have some left - military, antiques, tubes, parts, rcvrs, xmtrs, etc. What do you need? Cdr. Glenn W. Ritchey, USN Ret., W7SAB, 219 Naval Ave., Bremerton, WA 98310. (206) 373-9631

WANTED: Breting 6, 40 and 49 and Patterson PR-16. Dan Mason, 1325 N. Lima St., Burbank, CA 91505. (818) 848-9474

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

FOR SALE: Hallicrafters S36A, S37 VHF rcvrs in cabinets, nice cosmetic shape and working - $150 each; Hammarlund BC-1269, 145-600 Mcs - $100. Allan Douglas, Box 225, Pocasset, MA 02559.

WANTED: For NC-303: good NTS-2 spkr and XCV-303 crystal/WWV calibrator. J. Dennis Bohrofen, KØRAV, 2472 X Ave., Grimes, IA 50111.

FOR SALE: Drake R-4C, AM filter, spkr and manual - $250 firm. Levy, 8 Waterloo Dr., Morris Plains, NJ 07950. (201) 285-0233

FOR SALE: 300 rigs, SASE for list; vintage manuals. Mike Horvat, POB 73, Stayton, OR 97383.

WANTED: Model 3201 modulator/ps for Gonset G-77A xmtr. John Lewis, WB9NWO, 3526 N. Elmcroft Ter., Peoria, IL 61604. (309) 685-5865

WANTED: Equipment built by James Millen Mfg., transmitters, tuners, vfos, test equipment or parts. Also wanted: Looking for information on James Millen; photos, newspaper articles, letters, anecdotes and facts. For future article on this influential engineer. Henry Rogers, WA7YBS, POB 501, Minden, NV 89423. (702) 267-2725

WANTED: HRO-60 coils type G,H, J, AA, AB. Cash/trade. Barry Nadel, Box 29303, San Francisco, CA 94129. (415) 346-3825

WANTED: My 75A-4 tuning knob was smashed in shpg, need replacement; also want Collins 30-K. Joel Thurtell, K8PSV, 11803 Priscilla Lane, Plymouth, MI 48170. (313) 453-8303

WANTED: AM crystal filter FL-3; Heathkit p/n 404-201 for Heathkit SB-300 rcvr. Dean Cole, W7JUC, 480 Dale Dr., McKinney, TX 75069. (214) 548-2366

FOR SALE: Viking 500, needs some work, prefer PU - BO; Johnson SSB adaptor - $125. Plus shpg. **WANTED:** HRO-500.Gene Peroni, KA6NNR, POB 58003, Philadelphia, PA 19102. (215) 665-6182

WANTED: Heathkit HP-23 ps in good wrkg cond. Gary Elliott, NO5H, POB 295, Epps, LA 71237. (318) 926-3343

FOR SALE: Hallicrafters SX-42 main dial and bezel - $10 each; brand new BC-221-AJ freq. meter w/AC supply and manuals - $60; Hallicrafters rcvr model CRX-102 - $22.50; E.F. Johnson Personel CB Messenger, xlnt - $25; Collins 51J-2 rcvr manual, original - $20. Ward Becht, 625 Tufts Ave., Burbank, CA 91504. (818) 842-3444

WANTED: BC-222; BC-322; complete TBYand TBX; FT-250 mount; RT-524 manual; AN-75A antenna. Dallas Watson, 5900 N. Braeswood, #109, Houston, TX 77074.

FOR SALE: Tube Hi-Fi; antique headphones; RV-13 aircraft rcvr; NC-183; SX-42; R-42 spkr; test equip. SASE for list. Ed Richardson, WI5D, 1040 Cleveland, Stephenville, TX 76401. (817) 968-3365

CLASSIFIEDS

WANTED: Wireless Set No. 19 equipment circa WW II. Also looking for information and anecdotes. Chris Bissaillion, VE3CBK, 1324 Old Carp Rd., RR #1, Kanata, Ontario, Canada, K2K 1X7

WANTED: McElroy Mac Key bugs. Looking for model with cast lettering on base,and also sheet-steel "Junior" model. Tom French, W1IMQ, 120 Great Rd., Maynard, MA 01754. (508) 897-2226

FOR SALE: Heathkit SB 303 w/AM and CW filters, SB 401, excell. - $350; 2 Collins mech. filters PN 526-9427-00 - $40 each; S-Line xtals for ranges 4.0, 14.8, 28.2, 28.5 - $5 each. U pay shpg. Gary Elliott. NO5H, POB 295, Epps, LA 71237. (318) 926-3343

WANTED: Frequency tuning knob for the BC-455 command set rcvr; manual for the Johnson Viking I xmtr. Jerry, AB8U, 3041 Rising Springs Ct., Bellbrook, OH 45305.

FOR SALE: GC rcvrs Lafayette HA-600 and HE-30, excell. - $55 each plus shpg. Henry Mohr, W3NCX, 1005 Wyoming St., Allentown, PA 18103.

WANTED: RME DB20 or DB22 preselector in good operating condition. Roland Matson, K1OKO, RFD #1, Box 2943, Kennebunk, ME 04043.

FOR SALE: Hammarlund SP-600 JX-17, no cabinet - $125; Clegg 99er - $55; Hallicrafters T.O. keyer - $35; I-177B tube tester - $35. All in good condition, w/manuals. U-ship. Bill, KFØIE, (612) 722-9125

FOR SALE: Lavoie spect. analyzer LM-18, 10-44000 Mhz - $250; Riders manuals 7-13 - $175; URM-25F - $95. Clyde Sakir, N7IOK, 4243 E. First St., Tucson, AZ 85711. (602) 323-1120

WANTED: Pre-war FCC Amateur License Application form, blank or otherwise. James T. Schliestett, W4IMQ, POB 93, Cedartown, GA 30125. (404) 748-5968

FOR SALE: (3) V70Ds - $125. **WANTED:** 1938 ARRL "How to Become Amateur...". Parker, W1YG, 87 Cove Rd., Lyme, CT 06371.

WANTED: Radar equipment; need parts for SCR-584; 5J26 magnetrons. Also collect early TV cameras. Allan Weiner, 14 Prospect Dr., Yonkers, NY 10705. (914) 423-6638

WANTED: WW II military sets, racks, etc. Finders fee paid on non-owned sets purchased. Sam Hevener, "The Signal Corps", W8KBF, 3583 Everett Rd., Richfield, OH 44286. (216) 659-3244

WANTED: KW-1, SC101, SC301, 75A-4, NC-101X, HRO-500, NCL-2000, NCX-1000, NC-400, 150A, 150B, 40B, 30W, 32A, 32B, 30DX, 30DXB, 20B, 42B, 300B, 202A, 202B. Collector. Rick, (617) 233-1414, collect.

FOR SALE: Johnson Viking Mobile - $70; 75A-4 dial drum - $35. **WANTED:** SB 401 xmtr; HQ-180 or HQ-180A. Dan Radcliffe, KF9BP, 8201 Plainview Pkwy, Sussex, WI 53089. (414) 255-9165

FOR SALE: BC-342, mint - $150; BC-348, excell. - $100; HQ-129X, excell. - $50; S-36, good - $25. Al Sziriski, AI4U, 6251 Fox Hunt Trail, Orlando, FL 32808. (407) 222-0007 days, 298-3493 eves

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WANTED: Heathkit HG-10 vfo; manual for Heathkit DX-35 xmtr. Roy Barnett, 5552 12th Ave., South Birmingham, AL 35222. (205) 591-6321

FOR SALE: Leader LPM-885, 1 KW HF SWR/WM, LPM-8805 WM/dummy load, 1.8-500 Mhz - $50 each plus UPS. Jim, WØJJL, 2207 Madison Ave., Norfolk, NE 68401. (402) 371-3477

WANTED: Novice xmtrs/rcvrs - Walter Ashe, Philmore, Meisner, WRL, Ameco; schematic for DX-40 & VF-1; vfo for Knight T-60. Larry Howe, 1333 S. Airwood, Springfield, MO 65804. (417) 882-1682

CLASSIFIEDS

FOR SALE: NC-300, good cond. - $100; Viking Challenger, good - $70; Drake R4C, very good - $220; Viking I, very good - $150. Cliff Fleury, AI7Y, 64174 Tumalo Rim Dr., Bend, OR 97701. (503) 382-9162

WANTED: Mint 75A-4, high SN. Top cash. Also 75S-3C and 51S-1. Joe Kramer, K3ES, (412) 621-3977

FOR SALE: Globe Champ 300 w/manual; TBS-50A w/vfo; HF 10-20 converter; DX-35. **WANTED:** 3-1000Z. Gene, W7MXM, (208) 522-5854

Electric Radio Back Issues

"The First Year" (#1-#12) - $30, "The Second Year" (#13 - #24) - $30. Individual copies - $3. All prices include First Class delivery in the U.S. and Canada. Foreign orders please enquire.

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

WANTED: McIntosh and Electro-Voice amplifiers and accessories for my collection! Marcus Frisch, WA9IXP, Box 28803, Greenfield, WI 53220-0803. (414) 545-5237

FOR SALE: 51J4, 651S1, R390A, HRO-500, GPR-90, MS R9 SSB converter. Much more, SASE for list. Joe Overmyer, 1212 Main St., Evanston, IL 60202. (312) 663-0150

WANTED: Mobile ham radio equip. made by Palco Engineering Co., Frankfurt, Indiana. It may be marked Carmel, IN. I have some photos and drawings but want some actual equip. James Fred, R1, Cutler, IN 46920. (317) 268-2214

WANTED: BC-455; pre 1940 BC-191 and tuning units; pre 1940 aircraft radios; WW II APT xmtrs and other ECM equipment. James Treherne, 11909 Chapel Rd., Clifton, VA 22024. (703) 830-6272

CLASSIFIEDS

FOR SALE: Over 150 military manuals of the 1940's and early 1950's. Large SASE w/$.52 postage for list. August J. Link, 2215 Faraday Ave., Suite A, Carlsbad, CA 92008. (619) 438-4420 days.

FOR SALE: Ham Radio (many ARRL Handbooks) and Radar/Microwave. Book lists now available. Send $.29 stamp for each. Rainy Day Books, POB 775, Fitzwilliam, NH 03447. (603) 585-3448

WANTED: Collins KW-1, KWS-1, KWM-1, R389, R390a, 75A-4 with 3 filters; Hallicrafters SX-115. F.H. Werry, DJ3OE, Saturnweg 18, D-4056 Schwalmtal, Germany. phone: 01149-2163-20528, FAX: 20552. 24 hrs., will call back.

WANTED: Military Radios and Electronics Systems, collections and accessories: dynamotors, DF loops, control boxes, etc. Any vintage or nationality. Charles DiCecca, KA1GON, 501 Mystic Valley Pkwy, Medford, MA 02155. (617) 396-9354

WANTED: Vibrokeyer. Marcus Frisch, WA9IXP, Box 28803, Greenfield, WI 53220-0803.

WANTED: Hammarlund Super-Pro, SP-200 or BC-779 basket case for parts, need S-meter and coil/capacitor assemblies for 1.5-5 Mhz band. Jack Shutt, N9GT, 1820 Dawn Ave., Ft. Wayne, IN 46815. (219) 493-3901

FOR SALE: ART-13; BC-224C; BC-312N; T-67/ARC-3; Wilcox 807A; RME 4300; Mosley CM-1; Gonset G-63; NC-300 w/spkr; R4C/T4XC/AC-4; Collins 312B4, 312B5, 30L1, 30S1, 32S1, 75S1, 75A-2, 75A-4, KWS-1 and parts. Ron Follmar, K5GIT, 1409 W. Willis, Alvin, TX 77511.

FOR SALE: New RK-4D22 tubes - $23; used 3CX100A5 tubes - $5. **WANTED:** Vintage Motorola police motorcycle equipment. Geoff Fors, WB6NVH, POB 342, Monterey, CA 93942

FOR SALE or TRADE: F455J05 (500 Hz filter for 75A-4). Trade for F455J60 or sell - $100. **WANTED:** Clean, reasonable, Collins 51S1 and new 6550 tubes. Ron, (209) 255-1177

WANTED: Very old or unusual Hallicrafters equipment, entire 1934 "H" and "Z" line of Silver Marshal, parts, memorabilia and manuals. Chuck Dachis, "The Hallicrafter Collector", WD5EOG, 4500 Russell Drive, Austin, TX 78745.

WANTED: Multi-Elmac ATR-4 or other mint Multi-Elmac equipment. Lea, KN4JW, 310 So. Park Dr., Spartanburg, SC 29302. (803) 582-8237

FOR SALE: Restorable rcvrs: SP-210 (1939), S-36A and NC-156; BC-610 parts; 19" racks; very clean Johnson KW , T-Bolt and KW Matchbox; misc gear and parts; vintage mags, Handbooks, etc; military surplus. SASE for list. Rick, K8MLV/Ø, (719) 543-2459

FOR SALE: Radiomarine Navy rcvr model AR-8511 w/ps and manual, excell. cond. - $100. Al Hart, 12236 Magnolia Blvd., N. Hollywood, CA 91607. (818) 762-6842

WANTED: Restoring #29 Collins 30K-1, need RF/amplifier parts, also 75TH tube (s). Can you help me. David Knepper, W3BJZ, Box 34, Sidman, PA 15955. (814) 487-7468

WANTED: Late unmodified 75A-4; Viking Navigator; Speed-X bug; HQ-180 manual, xerox ok; manual, schematic or expertise on BC-191; SX-32 parts source; 600 ohm spkr; universal audio output xfmr; electro-dynamic spkr with 1300 ohm field coil. Brian Roberts, K9VKY, 3068 Evergreen Rd., Pittsburgh, PA 15237. (412) 931-4646

FOR SALE or TRADE: R390A w/cabinet; HRO-W , w/ps and coils; NC-300, w/spkr; Knight T-150; Collins 75A4 vernier knob. All with manuals and reasonable prices. **WANTED:** Mech. filters for 51J4 (500 kc I.F.); Meisner Signal Drifter; panoramic adapter; 4CX250B tubes; Collins noise blanker. Roger Faulstick, KD4AS, 210 Mariah Ct., Merritt Island, FL 32953. (407) 453-3312

FOR SALE: Johnson Desk KW and Ranger I - $1400. **WANTED:** Manual for Johnson Pacemaker, copy ok. Bill Jenkins, WA5MWJ, 11916 Donahoe Bend, Fort Smith, AR 72916. (501) 646-3859

CLASSIFIEDS

FOR SALE: Our triple output Crystal Calibrator runs off rectified filament voltage or 9V battery. Kit or built. Visa/MC accepted. Call or write for our latest six page parts and kits flyer. Large SASE appreciated. Steve, NW2F, Two Fox Electrix, POB 721, Pawling, NY 12564. (914) 855-1829

WANTED: Military electronic items, including Radar, RDF, communications and odd or unusual items; APS-10; APS-13; loop for DAG. William Van Lennep, POB 211, Pepperell, MA 01463. (508) 433-6031

FOR SALE: Ranger I, working, clean - $125; two Ranger I's for spare parts - $30 each. Joel, WB2SLH, 180 Sequams La Ctr., W. Islip, NY 11795. (516) 587-7945

WANTED: National HRO-500; Collins 51S-1, 65S-1, 32S-3A, S-Line access.; 51J4; Hallicrafters SX-88. Charlie, K5UPX, 18003 Vintage Wood Ln., Spring, TX 77379. (713) 333-6769, 320-0317

FOR SALE: Hallicrafters S-38B - $40; HT-37 w/manual - $150; BC-221 freq. meters, w/built in ps - $40; 805s - $20; 713s - $14 each. **WANTED:** Unique wire tuner. Levy, 538 McCarty, Apt. 407, San Antonio, TX 78216. (512) 366-3289

WANTED: All items found in WW II Martin B-26 bomber's forward radio position: chair; wall lamp; clock; vent; oxygen; SCR-274N radios; brackets; controls; dynamotors. I am building a display from pictures and diagrams. SASE for information/want list. Greg Greenwood, WB6FZH, Box 1325, Weaverville, CA 96093. (916) 623-4520

FOR SALE or TRADE: Military TV-10 transverter (ARC-12), mint - $100; TS-505D/U multimeter - $40; PP-39A/TRC-2 vibrator ps - $40; 100 NOS 6GH8A tubes - $25. Jay Myers, 1010 Graybar Lane, Nashville, TN 37204. (615) 297-5886

FOR SALE: KWS-1 manual only, orig. not a reprint, great cond. w/orig. warranty card still attached - BO; will trade two R-388 Collins rcvrs for one 75A-4 in mint cond. Greg Pace, WA4SQR, POB 102, Norcross, GA 30091. (404) 447-9345 office, days

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WANTED: Johnson Viking II w/vfo; Ranger II; Johnson 500; Heath Apache; Heath Warrior; power xfmr for Hallicrafters HT-37 or HT-32; black cast front sub panel for HT-32 (or non-working HT-32); Hallicrafters HT-4; National NC-303. Todd Zelasko, KA8CEF, 9401 Grand Div., Cleveland, OH 44125. (216) 883-5134

CLASSIFIEDS

WANTED: Spkr for 75A, 75A-1, 75A-2, 75A-3 or rcvr w/spkr; 310 series exciter; Ranger I; Drake IA; GSB-100. Greg Greenwood, WB6FZH, Box 1325, Weaverville, CA 96093. (916) 623-4520

FOR SALE: 3 inch rack milliammeters ,RF ammeters and 5 inch Bud meter panel. Also Bud sectional rack; BC-221 freq. meter. Bill Riley, W7EXB, 863 W. 38th, Eugene, OR 97405. (503) 345-2169

FOR SALE: Older test equipment manuals: HP, Tektronix, GR, etc. SASE with needs. No list. S.T. Carter, II, W4NHC, POB 033177, Indialantic, FL 32903-0177

WANTED: Johnson Ranger II in excell. cond.; directional coupler for Johnson Matchbox; low voltage xfmr for Collins 32V xmtr; Collins 75A-1 rcvr and/or matching spkr; 4D32 and 6082 tubes. Ron, KC6WTG, POB 783, Santa Rosa, CA 95402. (707) 539-8319

FOR SALE: AAF airborne radio equip. handbook, "repro" - $25; other military TM/TO repros, some orig; control box C-87/ART-13, NOS - $27.50; MP-48, reconditioned - $97.50; VRC-12 parts. Robert Downs, WA5CAB, 2027 Mapleton, Houston, TX 77043. (713) 467-5614

WANTED: Copy of manual or schematic for H. W. T-90 Bandmaster. Will reimburse any expenses. John, WB5OAU, 7605 Roberts, NE, Albuquerque, NM 87109.

FOR SALE: Eldico SSB-100A; Heath DX-40 and vfo; SSB adapter; Johnson Viking I; Invader 2000; old instructographs; Knight T-60; Meissner Exciters; National XCU-27 & 109; package - (1) SW-5 and (4 1/2) SW-3s, power & coils - $1100; (4) FB-7s and FBXAs, power & coils - $1100; Subraco mobile; Swan 250C; WRLs, AC & DC power supplies; Galaxy III; military Collins R-224/ARC 21. SASE for list. Tom Raymond, W5JM, 2320 S. "O" St., Fort Smith, AR 72901. (501) 783-8848

WANTED: Stancor PC-8401 or PC-8418 xfmr; also TU-1 or TU-1/B tuning unit for BC-191. Howard Kraus, K2UD, 372 Callodine Ave., Amherst, NY 14226. (716) 838-2406

WANTED: Boat-anchors, particularly old xmtrs. Will pick up at your QTH, call or write soon. Eastcoast to Westcoast and back to Eastcoast trip w/van & trailer begins Dec. 28. Parker, W1YG, 87 Cove Rd., Lyme, CT 06371. (203) 434-7783

ELECTRIC RADIO PARTS UNIT DIRECTORY

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

CLASSIFIEDS

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

WANTED: National HRO or RAS series rcvr w/coils, spkr, ps, rack or table mount, complete or partial sets/coils considered. Greg Greenwood, WB6FZH, Box 1325, Weaverville, CA 96093. (916) 623-4520

FOR SALE: Working, mil. HRO-Jr., 190 Kcs - 30 Mhz, w/ps, spkr and complete coil set - $125; Tapetone 6 meter converter w/reg. ps; National 6/2 meter vfo, NIB; 4-1000 tube, almost new; mint Johnson equip. and more. See ad in last ER. Rick, K8MLV/Ø, (719) 543-2459

WANTED: Johnson 10 watt audio amp; Eico 751 AC ps; Johnson power reducer; Johnson swamping attenuator (both models); Johnson Signal Sentry; Johnson low pass filter; Johnson T-R switch; Johnson xtal calibrator; Johnson phone patch; Johnson Whipload 6; Johnson Keys (standard and semi); Heath Shawnee; Johnson 275 watt Matchbox. Mack Fairley, AB4ZF, 506 Tallyrand Ave., Monroe, NC 28112-5788. (704) 283-5146

WANTED: Modulation unit for Westinghouse MW-2 xmtr. Would also like to locate power supply and xfmr for same. Gary Musgrave, WA4ODY, 1428 'I' St., N.W., Washington, DC 20009. (202) 483-3932

FOR SALE: BC-645 xcvr w/access. and manual; Command rcvrs 1.5-3 Mhz; Command xmtrs 7-9.1 Mhz. Good condition.Frank Tamilio, WA1VNR, (617) 641-2055.

WANTED: Gonset 220 Communicator; HT-46; SX-146; Swan 140; MB-80/A; Heath Pawnee; Drake DSR-2; Lafayette HA-410; HA-1200; Regency XR2A. Herman Cone, WB4DBB, 305 Foxwood Dr., Goode, VA 24556. (703) 586-5643

WANTED: Variable inductor for National NC-125, National part # SA: 4873. Gary Kabrick, WA7WOQ, POB 34, Amado, AZ 85645.

WANTED: Collins 75A-4 tuning knob; KWM-2 metal trim ring. Mimi, (213) 379-6052

FOR SALE: Transmitting/Receiving tubes, new and used. Some 304TL, 35T, 203A, 811A, 833A. LSASE for list. I also collect old and unique tubes of any type. Looking for Taylor and Heintz-Kaufman types. Maybe you have something to trade? **WANTED:** Large tubes and sockets from the old Eimac line; 450T through 2000T for display. John H. Walker Jr., 16112 W. 125th St., Olathe, KS 66062. (913) 782-6455

FOR SALE: Several Hallicrafters S-38, ABCD's, very good, may need alignment - $50 each. Includes manual and shpg (48 states); Collins mech. filter F455a2 for KWM-2 - $60; 40 ARRL Handbooks, 1943 to date; plus other books - SASE for list. Parting BC-610 and B&W 5100. **WANTED:** Pre-1940 ARRL Handbooks for my collection. Bob Schafer, WA7IHN, POB 442, Aumsville, OR 97235. (503) 749-1149

WANTED: I'll pay copy and mail costs for a good photocopy of the RCA AR-77 patents and tube location label. Craig Zitterich, 1725 Oak Hill, Corinth, TX 76205.

FOR SALE: 813s, unused - $16, used - $8; 4E27A/5-125B unused - $15, sockets - $4. **WANTED:** R-388; Siltronix (Swan) 1011 manual. B. Kipping, KE7KK, 6712 Lake Dr., Grand Forks, ND 58201. (701) 772-6531

FOR SALE: Hallicrafters equipment: HT-32B - $175; HT-37 - $90; HT-37 - $75; HT-37 - $45; HT-41 - $125; HT-40 - $40; HT-46 - $70; HT-44 - $75; SX-115 - $250; SX-101A - $110; SX-111 - $75; SX-111 - $50; SX-146 - $70; SX-71 - $20; SX-117 - $95; S-36 - $20; Skybuddy - $50; HA-5 - $35; HA-1 - $30; HA-8 "Splatter Guard" - $25; HA-10 - $20; HA-2 transverter - $75; R-48 spkr - $15; R-47 - $20. G. Hawrysko, K2AWA, (718) 224-2448

WANTED: Hallicrafters SM-40 S-meter; any matching spkrs, SX-110, SX-122 etc; Gonset Comm 111 2 meter rig. Bill Colligan, N1DJR, 35 Quail Run, Hamstead, NH 03841. (603) 329-7879

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

CLASSIFIEDS

WANTED: Hammarlund transmitting condensers and National Type 'S' dials with metal skirts and bakelite knobs. Roland Matson, K1OKO, RFD 1, Box 2943, Kennebunk, ME 04043. (207) 985-3751

FOR SALE: APR-4 w/CV253 tuning unit (38-1000 Mhz) - $60; URM-25D signal generator w/ access. - $50; TCS rcvr - $50. **WANTED:** R441/SSR-13; R440/SSR-12; Collins built R389, R390A, R392. Tom Brent, Box 1552, Sumas, WA 98295. (604) 826-4051

FOR SALE: Globe HG-303 & V-10 vfo; Eico 720 & vfo - $25 each; Taylor TZ-40 - $5 each; 809s - $3 each. Plus shpg. More tubes, SASE for list. Richard Lucchesi, WA2RQY, 941 N. Park Ave., North Massapequa, L.I., NY 11758. (516) 798-1230

FOR SALE: National NC-2-40D rcvr, excellent cond., w/matching spkr and manual - $325. Charles Stinger, W8GFA, 404 Ross Ave., Hamilton, OH 45013. (513) 867-0079

BOOKS, MAGAZINES WANTED: Modern Electrics, Experimenter, Science Invention, Radio News, Radio Retailing, Radiocraft, M.I.T. Radiation Laboratory Books, **OTHER TECHNICAL BOOKS, MAGAZINES**, also **CRYSTAL SETS, MICROPHONES**. State lot price for resale. Delton Lee Johnson, WB6MNY, 14 McKevett Heights, Santa Paula, CA 93060. (805) 525-8955, evenings

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WANTED: More of that great military radio gear - R-1051 'parts' set, freq. standard module for GRC-106 xcvr, MAY, MAW, URC-11, URC-68, other interesting stuff. Walt, KJ4KV, 3125 N. Military Rd., Arlington, VA 22207.

WANTED: HRO-60T; NC-400; spkr/coils/calibrator for HRO-50T1; preselector for 51S1 (55G1); Drake RV-4C remote vfo; MS-4 spkr; spkr for 75A4 (270C3); manual for SPR-4. Carter Elliott, 1460 Pinedale Rd., Charlottesville, VA 22901. (804) 979-7383 (h), 980-7698 (w)

FOR SALE: Setchell-Carlson 613B audio amplifier, uses P-P 6V6s, 110 VAC or 6 VDC powered, excell. cond. - $50; ZM-30u impedance b ridge w/manual - $35. Ron, KC6WTG, POB 783, Santa Rosa, CA 95402. (707) 539-8319

WANTED: Johnson Viking 500. Will pick up within 300 miles of Chicago. Jim Jorgensen, K9RJ, 1709 Oxnard, Downers Grove, IL 60516. (708) 852-4704

ELECTRON TUBES: All types - microwave, transmitting, receiving, obsolete, military--Large inventory. **Daily Electronics Corp.**, POB 5029, Compton, CA 90224. (213) 774-1255; (800) 346-6667

CLASSIFIEDS

FOR SALE: Eddystone 770R rcvr - $50; BC-1031A panadaptor (455 khz) - $50; more, list - S.50. J. Orgnero, VE6RST, Box 32, Site 7, SS 1, Calgary, AB, T2M 4N3. Canada (403) 239-0489

FOR SALE: Johnson T/R switch (#250-39) - $45 including UPS shipping. Steve Sauer, WA9ASZ, R 3, Box 413, Bloomfield, IN 47424. (812) 863-2088 eves. after 6:00 EST.

WANTED: Manual/schematic for Knight RF sweep generator, model KG-652. Henry Brown, W6DJX, 4141 W. L-2, Lancaster, CA 93536.

WANTED: Clean Ranger at a reasonable price; TM 11-274 (GRC-19); TM 11-858 (R392); schematic for Scott SLR-F (it's for sale/trade!) Tom Mackie, WB2ILA, 93 Baker Rd., Portsmouth, RI 02871. (401) 683-1420

WANTED: Knight Ocean Hopper w/case and plug-in coils; Heath MT-1 Cheyenne xmtr; Heath VF-1 vfo and Central Electronics 458 vfo. All in good to mint condition. Manual for Hallicrafters S-107; both dial scales for Hallicrafters SX-24; info on SSB adaptor for 75A-2 that plugs into FM socket. David Ishmael, WA6VVL, 1118 Paularino Ave., Costa Mesa, CA 92626. (714) 979-5858

WANTED: Receivers: Squires Sanders SS-1R; 51S-1; ARR 15; R-388/388A; G1 33. Mitsugu Shigaki, JA6IBX, Jozan Kamidai Machi 2825-2, Kumamoto, Japan 860.

WANTED: 75A-4/KWS-1, Collins emblem; 75A-4 spkr or any 75A series spkr; T-195 vfo. Dean Gagnon, KK1K, (802) 878-8293

TRADE: Two UTC S-18 modulation xfmrs (new, in original boxes) for an S-19 (or equivalent). Al Bernard, NI4Q, POB 690098, Orlando, FL 32869-0098. (407) 351-5536

FOR SALE: SB-200 - $350; SB-600, 610, 620, 630 - $200; DX-60B, HR10B, HG10B - $150. John Rozanski, WB1CVP, 26088 Kay Ave., Hayward, CA 94545. (510) 785-7240

FOR SALE: DX-100 - $125; NCL-2000 - $375. Both in mint condition. Chuck Graves, 641 N. Oak Grove Ave., Springfield, MO 65802. (417) 863-7415

FOR SALE: Technical manuals TM 11-800 BC-191A-E - $12; TM 11-620 SCR-608-A, B & -628-A (BC-683/684) - $15; TM 11-601 SCR-808-A & -828-A (BC-923/924) - $20; TM-11-284 AN/GRC-3 to 8 - $6; TM 11-5039 AM-65/GRC - $4; TM 11-5036 PP-109 & 112/GR - $4; TM 11-289 RT-66, 67, 68/GRC - $8; TM 11-5038 AN/GRA-6 - $5; GRC special, previous 5 manuals for - $22; TM 11-296 AN/PRC-6 - $6; TM 11-612 AN/PRC 8,9 & 10 - $10; TM 11-295 AN/GRR-5 - $10; TM 11-291 AN/VRC-13, 14, & 15 - $15. Excellent condition,quantity available. Shpg included on orders over $10. Sase for list of over 100 manuals. August J. Link, 2215 Faraday Ave., Suite A, Carlsbad, CA 92008. (619) 438-4420 days Mon. Sat.

CLASSIFIEDS

WANTED: Collins cabinets for 32V-3 and 51J-4; need service manuals for 32V-3, 51J-4, KWS-1, 75A-3 and 75A-4; need manuals for Radiophone Model 44 Bandscanner and U.S. Navy RB V-2/BC-1031 panadaptors. Roy, N5QQM, 1336 Sherwood Forest Blvd., Baton Rouge, LA 70815-5330.

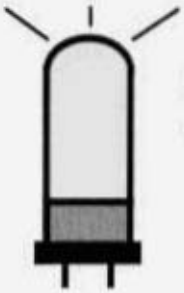
FOR SALE: Collins 75A-4, fine W3HM overhaul, cascade filters - $500; Heath monobanders - HW-32A, works/looks great - $85, HW-32, very good - $75; SB-600 spkr/ps - $55; HP-23A - $45; HW-22, as is - $45; WRL 84 Duobander, mint, w/ps - $95; Hallicrafters HA-1 'TO' keyer - $75. **WANTED:** Heath Warrior or Conset linear. Joel Thurtell, K8PSV, 11803 Priscilla, Plymouth, MI 48170. (313) 453-8303.

FOR SALE: Heathkit HP-10 mobile ps - $40; Collins "The First 50 Years", new - $25; 3" military scope, WW II - $15; Atwater Kent model 30 - $90; RME pre-selector - $15; Heathkit TC-2 tube tester - $20; 1954 ARRL Handbook - $13. **WANTED:** ARRL Handbooks 1934, 1935; pre 1936 QSTs; KWM-2A. Mark Hovda, NØJWI, Box 10091, Cedar Rapids, IA 52410. (319) 364-4048 7-9 pm CST.

FOR SALE: 52 QSTs, 1930, 1932, 1933, 1934, 1935; 9 Radio News, 1929; 1936 ARRL Handbook; 5 CQs, 1947; Bencher, NYE, Signal Corps keys - $140 plus UPS. Tom Waters, 3703 Bonview Ave., Baltimore, MD 21213. (410) 488-5356.

WANTED: Hallicrafters HT-45 linear. Must be excell./near mint. I'll pay top dollar. Wen Turner, AD7Z, POB 451, Cal-Nev-Ari, NV 89039.

FOR SALE: Hallicrafters SR-75; Ameco AC-1 xmtr; Heath AC-1 antenna coupler. Offers. Mark Michel, W9OP, 339 Naymut St., Menasha, WI 54952.



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145 CR 123
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TO: