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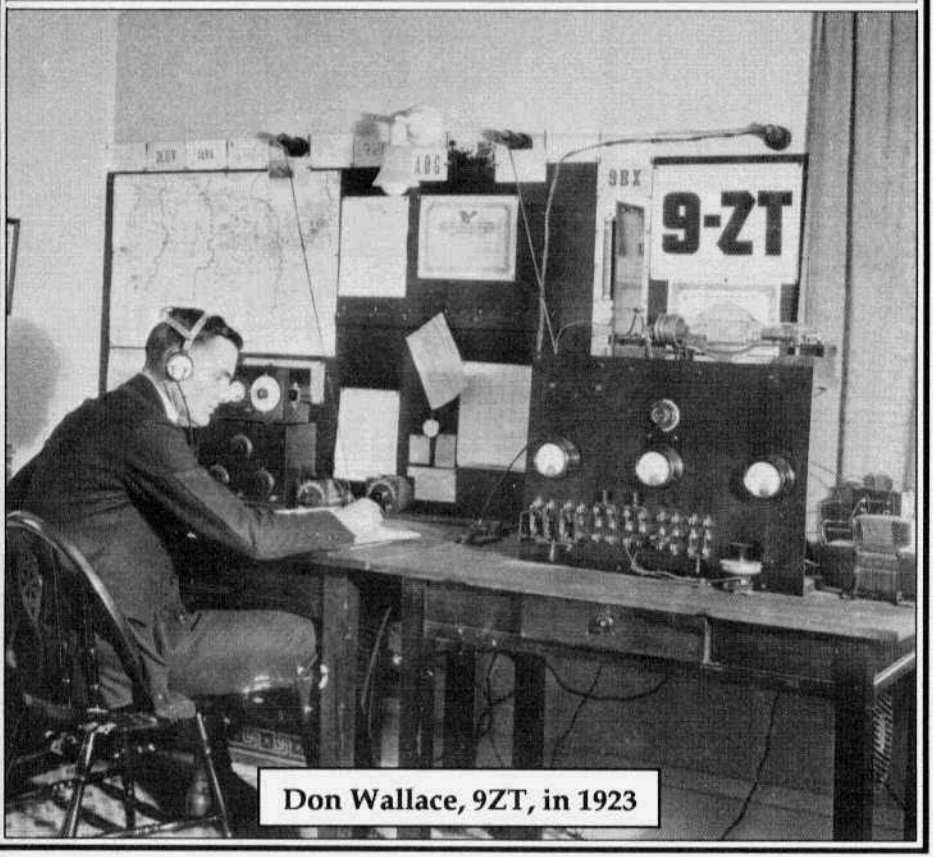
ELECTRIC RADIO

celebrating a bygone era

Number 30 October 1991



Don Wallace, 9ZT, in 1923

ELECTRIC RADIO

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WALT HUTCHENS,KJ4KV.....ELECTRIC RADIO IN UNIFORM
FRED HUNTLEY,W6RNC.....REFLECTIONS DOWN THE FEED-LINE
BILL KLERONOMOS, KDØHG.....VINTAGE PRODUCT REVIEWS
DALE GAGNON, KW1I..... AM REGULATION UPDATES

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

Electric Radio Solicits Material

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

EDITOR'S COMMENTS Barry Wiseman, N6CSW/Ø

Back in the April issue, #24, we ran a short article about a missionary group in Honduras that was operating a Johnson Viking II as a broadcast transmitter. Recently I talked again with J.R. Powell, M.D. in West Point, Mississippi, one of the leaders of the group.

The transmitter was flown down to Honduras in January and put on the air. It was operated three hours every evening, 7 days a week, 75 to 100 watts out on 4.910 Mcs. Until recently it operated flawlessly. Dr. Powell said it had good audio; "The music sounded great". He also said that the main 'operator' of the station was a "totally inexperienced" Miskito indian.

About a month ago, the audio driver transformer, failed - a common occurrence with Viking II's - but they had a spare and were back on the air within hours. Just the other day it quit again but this time they have been unable to find the problem. Their plans are to fly it out to the U.S. for repairs.

Dr. Powell asked me if I could locate another Viking II as a backup and I was able to do that with very little difficulty. Mike Palmer, K5FZ, had one which he has since shipped to Mississippi. Mr. Powell says it operates just fine. They should be in great shape, having an operational spare, when they put the station back on the air again in November.

It occurred to me that this old equipment we operate is pretty good stuff. How many modern-day solid state amateur transmitters would stand-up to what the Viking II has been through - and it's 40 years old!

When the station gets back on the air I'll have another report. On to #31...

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Cover: Don Wallace in 1923. Jan Perkins, N6AW, has written a wonderful book about Don's life. A review of the book is on page 13.

Reflections Down the Feedline

by Fred Huntley, W6RNC
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Before the days of permeability tuned oscillators (PTO's) and phase locked loops (PLL's), some CW radio signals had a lot more personality. There used to be a lot more chirps, drift, jumps, clicks, backwave, ripple, etc. In AM phone too, broadness, muffled audio, splatter and buckshot used to be a more common occurrence.

Somehow, at least in my opinion, a chirpy CW signal isn't all that bad - they are quaint to listen to. One can conjure pictures of what's going on at the transmitter end - is his plate voltage sagging because of low batteries, poor AC supply regulation, or gross overload? Whatever the cause, it doesn't do too much harm - except if the CW speed went over 20 wpm, it would be a mess to copy.

In the 1930's, QST magazine had an occasional humorous spoof article written by one Larson P. Rapp (a fictitious name). I remember one time when he mentioned chirps - the 'down chirp' and the 'up chirp'.

The common CW chirp (down chirp) decreases in frequency when the voltage sags in the power supply. On the other hand, an up-chirp increases in frequency when the power supply voltage increases under load.

So, I suspect that the anonymous, leg pulling writer, Larson E. Rapp, must have been familiar with ship radio transmitters, because I have never heard an up chirp CW signal on the ham bands.

In the 1930's, one of the best shipboard transmitters was the RCA ET-3626, which had a bunch of 211 tubes that put out 1 KW on low frequency. This transmitter had a big keying relay that was louder than a telegraph sounder and made a perfect keying monitor. When the key was down, the relay contacts connected more turns in the field winding of the large Westinghouse HV DC motor generator. So, in this model of transmitter, the plate voltage actually increased under load and produced a slight 'up chirp' in the keyed CW signal.

It was easy to tell that a ship had the ET-3626 transmitter because nothing else sounded like it. Many United Fruit Co. ships and also Grace Line passenger ships had this transmitter with its peculiar and pleasant to listen to 'up chirp' radio signal.

In earlier days, many high-power hams used to enhance their CW signals by using a resonant filter in the HV power supply. This let through some 120 cycle ripple and gave a distinctive sound to the CW note. Of course, by the book, such practice was frowned upon, but it sounded nice over the air and helped punch through the QRM.

Frequency drift was also a lot more common, way back when. Transmitter frequency jumps also happened once in a while, but mostly, jumps occurred when using a regenerative receiver. Some of these sets were real sensitive and a person's heavy walking across the floor could shift the receiver's frequency. This also applied to the earlier cat-whisker detectors, except in that case, you lost everything.

Key clicks don't have much redeeming value, but on the other hand, too soft of a CW wave shape is objectionable too. It seems to me that W1AW errs on the side of caution, and could stand a little hardening up of their keying. The ideal is to make the wave front as hard as possible, without causing clicks. At higher CW speeds, rounded front edge signals are harder to copy.

With AM phone there is less latitude for messing around with the signal. Usually, when the audio is not right, things sound really bad and cause havoc. Compared with older times, todays AM has a lot less raunchy signals on the air and also there are a lot more excellent ones. So, keep up the good work and keep pumping plate modulated watts into the ether. ●

TUBE TYPE DESIGNATION SYSTEMS

Exceptions prove the rules in numbering radio tubes

Reprinted from G-E Ham News, November-December, 1953

If, as the saying goes, "an exception proves the rule," then the rules governing the designation of radio tubes by numbers and letters are exceptionally well-proven.

For electronic tube numbers are like French verbs, more exceptions than rules. However, believe it or not there is a system—several of them, in fact—and on occasion it helps to know what the various numbers and number-letter combinations mean.

Three standard systems now are recognized and used by most tube manufacturers. These are: (1) a receiving type system, (2) a cathode-ray system, and (3) an industrial and transmitting type system. These have been established as standard by a joint committee of two associations of manufacturers—the Radio Electronics and Television Manufacturers Association (RETMA) and the National Electrical Manufacturers Association (NEMA).

Unfortunately, many tube types predate the system now being used, and as a result we have several hundred cases in currently used tubes where the numbers do not follow the aforementioned systems. Also, some manufacturers still use numbering systems of their own instead of conforming to the voluntary standards set up by the joint committee mentioned above.

A brief review of the current numbering systems and some of those used in the past may help amateurs who when they browse through a tube manual, get the feeling they are wandering about in an unexplored jungle.

RECEIVING TUBE TYPES

Back in the 1920's, each manufacturer numbered or otherwise named his tubes as he saw fit and things very soon got very messy. The replacement problem was headed toward becoming unsurmountable, and so in 1933 the industry adopted the first voluntary standard numbering system which although it has been since modified several times—still is used today for receiving tubes. This system calls for a number, letter and another number. An example is our old friend, the 6L6.

The first number symbol determines the filament voltage within a certain range, to wit:

Rated Filament or Heater Voltage	Symbol
Zero	0
In excess of 0 and up to and including 1.6	1
In excess of 1.6 and up to and including 2.6	2
In excess of 2.6 and up to and including 3.6	3
In excess of 3.6 and up to and includin 4.6	4
In excess of n-0.4 and up to and including n+0.6 where n is any integer	n

The letter or letters in the middle are merely serial designations with two letters being used when manufacturers run out of single letters. Today the letters I, O and P are never used—and also, double combinations such as "AA" are never used.

The final symbol in this system consists of one or more digits which indicate the number of useful elements for which terminals are provided. This includes separate internal shield and shell connections. A few spot checks with the standard base diagrams (which are used in the ARRL Handbook and G.E.'s tube manuals) will show how this final symbol works out.

Often a suffix is used in this receiving type system. These, and their meanings, are: G—glass with octal base; GT— same except with a 1 and 1/8-inch diameter tubular bulb (known as T-9 size); M—metal-coated glass with octal base; X—low-loss base; Y— intermediate-loss base; and W— military type tube. A second suffix which may be A, B or C and so on—means a superseding version of the same

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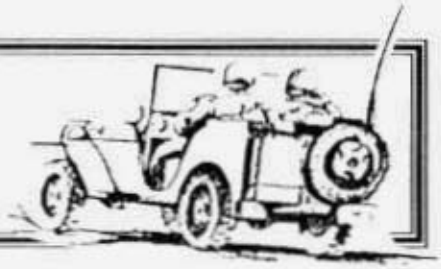
ELECTRIC RADIO IN UNIFORM



by Walt Hutchens, KJ4KV
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"The BC-669 Transmitter-Receiver"

We have visited a couple of U.S. Army 'one man' radios and also one which is only a bit larger -- the BC-474. This month we turn to a larger set, intended for communication over substantial distances from scouting cars and small headquarters units. The BC-669, the radio of SCR-543, might be thought of as a 'little brother' to the well-known BC-610, and in fact they have a historical connection -- but that is getting ahead of our story.

Overview

The BC-669 is the major component of SCR-543. It is an AM voice transmitter and receiver in one assembly. It is 21" x 18" x 14" (H x W x D) and weighs 89 pounds not counting the power supply, wooden case in which it was normally used and accessories. The AC power supply weighs another 69 pounds, and the associated PE-108 AC generator used to provide primary power, 265 pounds. As used in a vehicle (including everything but the spare parts chest), the set weighs about 750 pounds.

The receiver is a superheterodyne with a panel mounted loudspeaker. The transmitter a MO-PA unit with a rated output of 45 watts on AM; there is no provision for CW. Push to talk operation is provided using a handset or a suitable carbon mic and headphones or speaker. The transmitter and receiver are crystal controlled on six pre-tuned channels from 1.7 to 4.5 Mcs. The receiver covers the range in two bands and may also be continuously tuned.

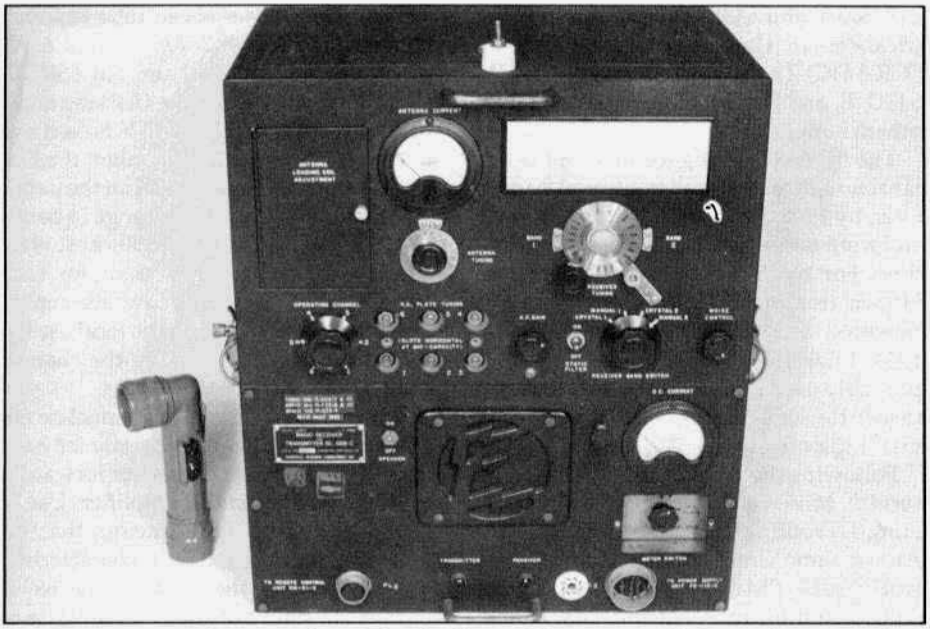
Models through the BC-669C require a remote control box for operation; later models (BC-669D, E, and F) do not.

With the associated PE-110 power supply, the BC-669 operates from 115 VAC 550 watts. The PE-108 generator can be started and stopped from the radio's remote control box. A vibrapack mounted on the PE-110 allows operation of the receiver from a 12 volt DC source when the generator is not running; the change over to AC power is automatic when it is available.

The entire SCR-543 (including the PE-108) was carried in a 1/2 ton truck or 3/4 ton scout car. The BC-669, control box, antenna and power supply were mounted in or on the vehicle. The PE-108, covered by a wooden slat case, was carried behind the radio. To transmit, the vehicle was stopped and the generator taken out and started.

History

The BC-669 cannot be understood without knowing something of where our Army was in the late 1930's. Field radios had been used in WW-I. The sets of that time, however, were spark sets and large oscillators; true portables were crystal radios with buzzers for transmitters. By the mid-1930's, progress had brought MO-PA transmitters with regenerative receivers (operators learned to select a 'good' 864 tube for the regenerative detector); these were portable on the back of a mule and had ranges of a few miles. Although the superhet receiver and crystal controlled transmitters had been around for a



The BC-669 transmitter-receiver. The final amplifier tune up holes and meter switch access would normally be covered by plates. Hinged door at upper left allows adjusting taps on the series loading coil; the tank coil taps are reached through a hinged lid on top of the set. The feed-through insulator at top center is the antenna connection.Hallicrafters sets have an 'h' in the speaker bezel.

few years, such equipment was not in Army field use.

The combat arms -- armor, artillery, infantry, etc. -- were independent to an extent which is hard to imagine today, developing not only their own tactics and weapons, but struggling with the Signal Corps for the power to develop their own radio equipment. The Signal Corps, however, had the upper hand and throughout the 1930's, equipment reaching field use was thoroughly tested and never less than ten years out of date.

Then Hitler smashed Europe and the U.S. began to re-arm. By 1941, the Signal Corps stranglehold on radio procurement began to be broken -- first by the Army Air Corps (which purchased the Navy's excellent ATA/ARA command sets as SCR-274N) and then by other combat arms. With England already at war and military procurement backlogs growing fast, from-scratch development of radio equipment was practical in only critical cases such as radar and hand-held portables. Calls went out for sets already in production for civilian applications which could be quickly adapted for Army use.

Most readers probably know that the BC-610 -- at 400 watts output, the largest Army field radio -- began life as the Hallicrafters HT-4, a mid-1930's ham/commercial set. To fill a requirement for harbor and small vessel radios, the Army bought the Hallicrafters HT-12 marine radio as the BC-441 (of SCR-281). Then, probably in 1942, the HT-12 was adapted by Hallicrafters for Army field use, becoming the BC-669 of SCR-543.

The set was to be used for semi-mobile applications by field and antiaircraft artillery, probably at the battalion and regimental level -- division and higher levels would have had the BC-610. The 'early model' BC-699, with black wrinkle paint, was bought first from Hallicrafters (SCR-

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543, 543A, and 543B) and then from Electrical Research Laboratories Inc. ("ERLA", SCR-543C). There was a later model, (SCR-543D, E, and F) with olive drab paint and other changes.

The BC-669 isn't rugged or water resistant enough to be a good field radio. Moreover, by 1943, FM radios – SCR-608/628, etc. were taking over as artillery field radios. For mobile applications requiring HF sets (for longer range) the dynamotor powered SCR-506 became available in 1944. Like the BC-610, the BC-669 was probably used more as a transportable set than in the semi-mobile scouting and command roles for which it was bought.

Following the war, the BC-669 stayed in service. Mine was given 'MFP' (Moisture Fungus Proofing) treatment in May, 1952. At the same time, several maintenance work orders ('MWO') were done, apparently including one replacing the wartime paper capacitors with modern plastic cased units.

I have seen two '669s with MARS markings; by about 1960 it was widely available in the surplus market. Hams didn't use the set much, probably because of its size, weight and lack of a transmitter VFO. I can't estimate total production but a guess would be 20,000.

Design

Mechanically, the BC-669 consists of a modulator chassis which includes the speaker and metering circuits and a receiver/transmitter chassis holding everything else. The receiver/transmitter mounts on top of the modulator deck by means of four latches.

The AC power supply is on a separate chassis and contains a 300 volt AC supply for the receiver, a 540 volt supply for the transmitter, and the receiver vibrapack.

The set itself is drip proof; when mounted in wooden cases for vehicular use it is splashproof if the covers are closed. The speaker cone does not appear to be specially treated for water resistance, it is not blast-proof, and there's no way to cover or seal it.

The receiver is a seven tube superhet consisting of a 6SK7 RF stage, a 6SA7 mixer, a 6J5 local oscillator, one 6SK7 IF stage (385 kcs), a 6SK7 first AF amp and a 6K6 audio output tube. A 6H6 is used as a detector and shunt noise limiter; the limiter is controlled by a switch on the panel.

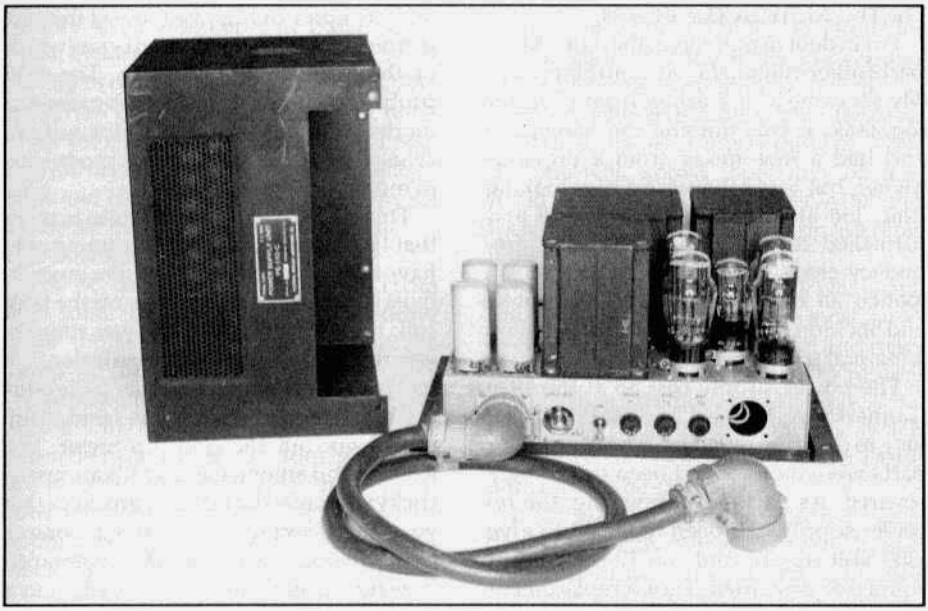
The receiver covers the range in bands 1700-2700 and 2700-4500 kcs. The bandswitch has two positions for each band, one providing continuous tuning and the other connecting the local oscillator to a crystal selected by the channel switch.

The AVC system is conventional except that the AVC voltage is not only fed back to the RF and mixer stages but forward – to the 6SK7 first audio amplifier. Use of forward-feeding AVC means that (in theory) a perfectly flat AVC characteristic can be obtained; the circuit in the '669 is claimed to hold output to an increase of only 1.5 db for in increase of signal strength from 100 to 100,000 microvolts.

Another unusual feature in the receiver is a tuned circuit peaked at about 1000 cps which is switched in when the noise limiter is 'ON'; in the presence of very heavy noise this circuit improves intelligibility of 'communications quality' voice signals.

The transmitter consists of a 6L6 Pierce (grid to plate) crystal oscillator driving parallel 807's. The modulator is a 12J5 mic amplifier driving four 6L6's in push-pull parallel; judging from the idling plate current the modulators operate class AB1. Though it may seem strange to use a modulator drawing 190 Ma of resting current, a more 'efficient' circuit would have meant large changes in the plate supply load and thus considerable changes in output voltage.

The use of high level plate modulation, particularly with more-than-ample power, is unique among Army sets and is matched in the early wartime period only by the Navy's ART-13. Because the ART-13 uses a dynamotor (with inherently good voltage regulation) for plate supply, the designers did not need to use the modulator



The PE-110C 115 volt power supply with cover off. The missing connector at the right is for the cable to the PE-108 gasoline powered generator. Two of the four filter capacitors are unconnected spares.

tubes as a bleeder; operating them in class 'B' allowed considerably greater efficiency than in the BC-669.

The plate tank and loading arrangements are unlike any I've seen in a military radio. One side of the plate tank coil is spanned by six bars each carrying a sliding contact; each bar is connected to a contact on one section of the channel switch. Another switch section selects a screwdriver adjusted tuning capacitor. When you set the channel, the part of the tank below the chosen tap is connected in parallel with the adjustable cap and a fixed capacitor as the plate tank circuit.

On the other side of the plate coil, six more rods with sliding contacts provide an adjustable antenna tap which is selected by the channel switch. A separate series loading coil also has sliding contacts connected to the switch. Aircraft and mobile sets often are designed to operate only with very short (capacitive) antennas. A fixed capacitor in parallel with a variable cap in series with the antenna lead lets you use the BC-669 with a resonant antenna.

Tuning up the transmitter on a new channel consists of inserting a crystal in the socket and setting the position of each of the three sliding contacts and the adjustable tank and antenna tuning capacitors for plate resonance and proper loading. When returning to a previously tuned channel, you reset the antenna loading cap for maximum antenna current and set the receiver to the right band and channel frequency; if operating the receiver with crystal control you just tune for maximum noise near the channel frequency.

The AC power supply consists of a full wave rectifier developing about 300 volts at 90 Ma for the receiver; the same transformer delivers 12.6 VAC for the filaments of both receiver and transmitter. A separate transformer feeds four 5Z3's in a full wave bridge circuit to provide 540 volts at 350-440 Ma for the transmitter; the primary of this transformer is energized when the transmitter is keyed.

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On The Air With The BC-669

I'm in debt to more than the usual number of other military fanatics on this project. My set came as a 'freebee' from collector Joe Zsak; it was missing the nameplate and had a few 'mods' from a previous owner, but was otherwise a nice looking unit. Joe also loaned a nameplate and furnished copies of the front panel frequency chart; Robert Downs, WA5CAB, loaned an original power supply cable; and Sheldon Wheaton, KC0CW, supplied a manual to copy.

The power supply cost $5 at the 1990 Gaithersburg hamfest and it didn't take long to discover why; though all the major parts were there, it had been extensively rewired. As part of the rewiring, the receiver supply had been reversed to give -300 volt output and the 12-pin output connector discarded. I got a replacement connector from Robert Downs; it took about a day to install it, undo the wiring changes, and install a three-prong twist-lock receptacle for the line cord.

I made one other 'safety' change: in the original supply there is no bleeder resistor on the transmitter high voltage supply and as a result, the oil-filled filter caps could hold a lethal charge for days or weeks if power is applied without a load connected. I added a 270k 2 watt bleeder across each capacitor.

The 8 mfd receiver supply filter caps – minimal in any case – seemed to have lost something (perhaps 'capacity'?) after nearly 50 years of duty; the first sound from the receiver was a loud hum which didn't change with the setting of the volume control. I was able to open the cans and replace the insides with 40 mfd units. The receiver then worked correctly; even the calibration was nearly perfect.

The transmitter had been 'converted' for ham use; backing out the wiring changes and hooking up the power receptacle properly took a few hours. Though there was no big problem, an assortment of dirty switch and relay contacts, tube failures (ever see a screen to cathode short?) and 'cockpit troubles' swallowed the next couple of days. We will not discuss which of these took the most time. The final problem was the electrolytic bypass cap on the carbon mic supply which had decreased in value, causing the modulator to 'motorboat'.

This is one of the hardest sets to tune up that I have used. The PA plate tuning caps have only a narrow range so you must do most tune up with the slider on the tank coil; there's no chart to tell you roughly where it belongs. At 3885 kcs so little of the coil is in use that the setting is quite critical. When I first tried, I couldn't find a 'dip' until I got out the grid dip meter. The loading and antenna series coils are just as tricky; because the settings are so coarse you must select the best setting (of one or two) which falls within the allowable range of plate currents rather than loading to a specified value.

When the BC-669 was adapted from the HT-12, the upper end of its frequency range was extended from 2700 kcs to 4500 kcs. It appears that this was done without changing the plate tank; you just short out more of the coil. This is the reason tuning is critical on 80 meters; on 160, moving a slider one turn is a smaller percentage change.

Each of the sliding contacts must be adjusted by sticking your hand down inside the top of the set; though there is no easily-touched high voltage, there's a nasty RF burn waiting if you don't unkey the transmitter first.

I used the set for the first time on the Old Military Radio Net (Saturdays, 0500 ET, near 3885 kcs) and it got good audio reports from Chris, AJ1G, and George, N2GBY. On the scope, the modulation is unusually full for a military set; in fact this is the first set I've tested to be capable of 100% modulation with a T-17 carbon microphone. The receiver is quite sensitive; a 12" clip lead is plenty of antenna to bring in the 77-meter evening AM action. The forward-feeding AVC works as advertised, making all signals sound about

equally loud whether 'full quieting' or down in the noise. Without a BFO, there's no way to copy SSB and the lack of a VFO makes the '669 somewhat inflexible, but it is fine for use on the 'AM channels'. I plan to grind crystals for other AM frequencies on 80 and 160 meters and will have my set on the air through the Winter season.

Conclusions

The BC-669 is a civilian marine radio with some 'basic training' and a poorly fitted uniform. Nonetheless, there are things we can learn from this set.

Marine radios are used to communicate among ships and smaller craft and between them and shore facilities, generally at moderate ranges. Since trained operators aren't available, they are intended for 'appliance operator' use -- perhaps the first radios to be so designed. Reducing operator frequency changes to setting a channel switch and tuning the receiver for the most noise must have seemed 'a natural' for the Army of 1941-42.

The good idea, however, was scuttled by the Army's inability to realize that the war it was preparing for would look like the one already raging in Europe -- violent, fast moving, and fought in all weather -- rather than a good weather 'shoot' at the artillery range. The days of the commander riding (or driving) to the top of a hill to 'get the picture' while his staff set up the radio to allow him to give orders were already gone.

Because of its inadequate weather resistance, great weight and almost laughable concept -- two or three men dismount and haul the generator out of the rear of the truck when you want to transmit -- I doubt that the '669 had any significant use as a scout/command car set. More likely, it found an indoor job; perhaps as a headquarters set backing up the BC-610 at division and higher levels and as the main radio for smaller units. In this line of work, it was probably satisfactory.

The labeling of the controls is intended to be easy for non-technical people to understand: "STATIC FILTER" for the noise limiter/filter, and "NOISE CONTROL" for the RF gain control. The first of these is incomplete; the second is worse, for the operator who knows only what the label says may make a serious mistake while the one who knows more may be confused. It should be called "RF GAIN" and then marked, "Set for maximum tolerable noise".

Like many others of the early war years, the manual is a jumble. Unlike most, however, there is some really useful and practical information: "It is easier to replace wafers, than to remove the whole switch... Gently ease the switch shaft thru the switch centers (these switch centers are easily damaged so be careful)."

Even allowing for the different standards of the time (three prong AC power connectors didn't start to show up until the 50's), the BC-669 has an unusually long list of safety hazards. In addition to the lack of bleeders in the HV supply and the chance to pay for more than an average day's sins with an RF burn while reaching in to tune up, the AC line connection is made by a cable with male plugs on both ends; if you connect to the wall outlet first, you have a hot plug on the other end.

Separate connectors are provided on the PE-110 AC supply for cables to the PE-108 generator or a wall outlet if available. They are in parallel, and nothing prevents you connecting both at once with results which are sure to be exciting.

It is hard to accept the difficulty our armed forces had in recognizing what the coming war would be like. But all the services had the problem to some degree and it is visible in most radios of the late 1930's to 1942 period; Hallicrafters and the BC-669's designers can't be blamed for the set's poor weatherproofing and strange concept. A radio with the number of safety hazards found in this set, however, is rare, and for these, the BC-669 gets a 'Turkey With Trimmings' award. ●

Synchronous Detectors

by John Staples, W6BM
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Have you ever noticed that using the BFO sometimes helps pull weak AM signals out of the noise? Selective fading can also be reduced. These and other reception problems can be helped by using a synchronous detector.

Synchronous detectors (SD) are not new: the basic idea is to use a product detector to receive AM with the BFO locked to the incoming signal. As product detectors and phase lock loops are not normally used by AM'ers, I will outline their characteristics below.

AM Signals

But first, let's look at what constitutes an AM signal. I'll skip the math and use a visual representation to describe the components of the signal. In your transmitter, the modulator controls the instantaneous carrier level by the voice waveform. On an oscilloscope you can observe the carrier amplitude varying from zero to about twice the unmodulated carrier voltage. The spectral analysis of an AM signal shows it to be an unmodulated carrier and two sidebands, each spaced away from the carrier by the modulation frequency, as shown in Figure 1.

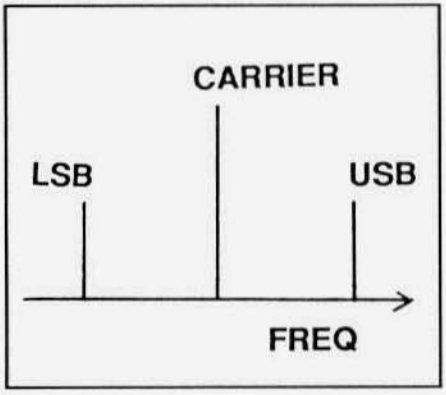


Figure 1

The carrier and sidebands can be represented as vectors, whose length represents the amplitude and whose direction the phase of the signal. Conventional double sideband AM consists of a carrier and two sidebands, each sideband one-half the carrier amplitude for 100% single-frequency sine-wave modulation. Our vector diagram rotates around once each period of the carrier frequency, which we will ignore so we will see the carrier as a stationary vector pointing straight up.

Each sideband for sinusoidal modulation is spaced away from the carrier by the modulation frequency, one above, and one below the carrier frequency. The two sideband vectors are rotating, one clockwise at the modulation frequency, the other counterclockwise. Figure 2 shows the vector sum of the carrier and the two sidebands at four points along the modulation waveform. Adding these vectors up, we see that the total signal amplitude varies from zero to twice the carrier amplitude at the rate of the modulating frequency. Notice that the phase of the vector sum, the dashed line, stays stationary and the amplitude varies.

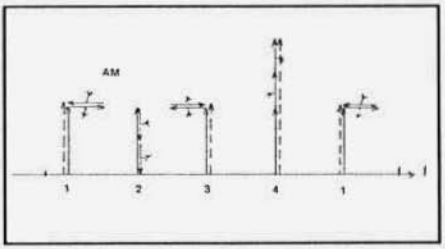


Figure 2

Many of the old phasing rigs, such as the Central Electronics 20A could provide both AM and phase modulation (closely related to FM) by adding carrier either in-phase or quadrature-phase (+or-90 degrees) with the double sideband signal produced by one of the balanced modulators. Figure 3 shows how a crude phase modulation signal is generated by adding a carrier

generated with a 90 degree phase shift to two sidebands. (The drawings are rotated by 90 degrees.) Note that the phase of the resultant vector sum varies back and forth, and that the amplitude remains almost constant. Demodulating this signal with an envelope detector would produce only a small and distorted audio signal. (True FM has many sidebands and the overall signal amplitude is constant.) In an analogous way, demodulating an AM signal with a local regenerated carrier inserted in quadrature (+90 degrees) will not recover the audio.

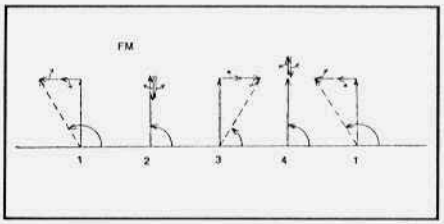


Figure 3

Selective Fading

Figure 4a shows a carrier 67% modulated by a sine wave. A diode detector recovers the modulation by rectifying the signal; the audio follows the modulation envelope.

Selective fading is caused by multipath propagation which produces selective interference (comb filtering) that can sharply reduce the amplitude of one particular frequency of the received signal. If one sideband fades, the detected audio level is reduced. But if the carrier itself fades, severe distortion can result. In Figure 4b, the sideband levels remain constant but the carrier level has faded to two-thirds the level in Figure 4a. The signal now appears to be 100% modulated, and a diode detector will still give an undistorted signal. However, as the carrier is further attenuated, as in Figure 4c, the envelope now takes on an entirely different character.

Now the envelope shows strong second and higher harmonic components of the modulating signal. In Figure 4d the carrier has been eliminated by selected fading, and the audio is severely distorted. The audio information is still there, and a synchronous detector can detect the original audio without distortion.

continued next page

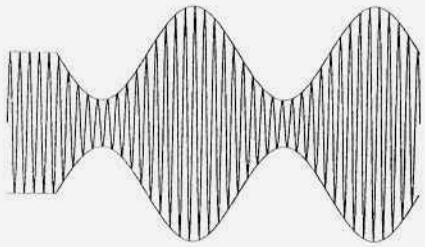


Figure 4a

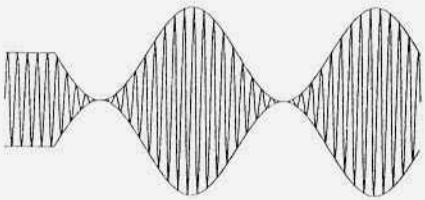


Figure 4b

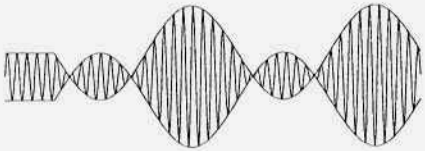


Figure 4c

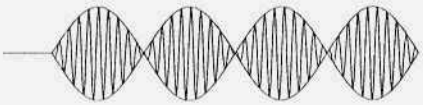


Figure 4d

Product Detectors

Synchronous detectors make use of product detectors, which we know from our earlier single-sideband days (before we rediscovered AM). A product detector is nothing more than a mixer, heterodyning signals down to the audio range. The product detector electronically performs a vector multiplication of the signal and the BFO. The sign of the output signal represents the phase between the two input signals and the output amplitude is the product of the two input amplitudes.

Phase-Locked Loops

In a phase-locked loop (PLL), shown in Figure 5, the output of the product detector is used to lock the BFO to the incoming signal frequency. The input and BFO signals mix in the doubly-balanced multiplier (MUL). The difference is low pass filtered (LPF) and controls the BFO frequency. The PLL can sense a weak carrier buried in noise, and lock a clean local oscillator to it. In a sense, it can be thought of as a narrow band selective filter.

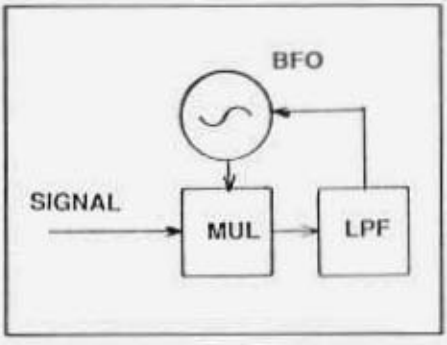


Figure 5

As the BFO is moved closer to the incoming carrier the PLL will suddenly lock on: the capture range is the lock frequency difference approaching from above and below the signal. Once locked, the carrier (or BFO) frequency can now be moved over a substantially wider range before lock is lost: this is known as the lock range. Filter constants that give a wider capture range are more susceptible to noise accidentally unlocking or modulating the BFO. Different signal-to-noise conditions will require different low-pass filter characteristics. As with any feedback circuit the stability of the PLL while locked, depends on the gain and phase characteristics of the loop.

PLL's make excellent FM detectors. The correction voltage is directly proportional to the signal frequency (for a linear voltage controlled oscillator) and provides the audio output.

Synchronous Detectors

Now we can put all the pieces together. The PLL circuit will lock the BFO on to the input signal carrier. The low pass filter characteristics in the PLL have been chosen to reject the AM sidebands but to allow a sufficient capture range for easy tuning. The modulation is recovered in a second product detector. Figure 6 shows the synchronous detector circuit.

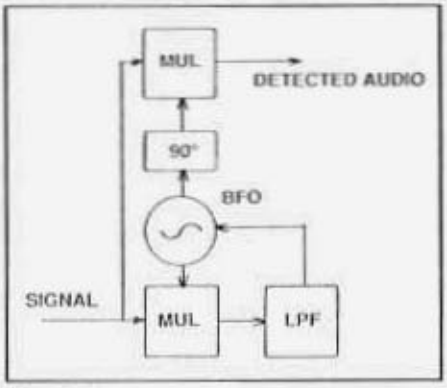


Figure 6

Why is there a 90 degree phase shift circuit before the audio product detector? The 90 degree phase shift between the two inputs of the locking product detector produces zero error voltage (if the BFO free-runs exactly on frequency). By shifting the carrier phase by 90 degrees to the audio product detector, the d.c. output is proportional to the signal amplitude in phase with the BFO input. The two product detectors produce output voltages which are proportional to the in-phase (the audio) and quadrature-phase (in this case the phase difference, which indicates deviation from phase lock) components of the input signal.

If the carrier is attenuated due to selective fading, as long as there is enough to maintain lock (it doesn't take much), the locally generated BFO will remain locked to the carrier and the demodulation will be undistorted.

Other Characteristics

AM generated by SSB transmitters often sounds poor. Often the sideband exceeds the carrier level and the signal sounds distorted. The synchronous detector cleans up such signals by inserting the proper carrier.

A diode demodulates random noise just as well as audio on a carrier. An AM signal has two sidebands in a definite phase relationship to each other. This redundancy is used by the synchronous detector to increase the signal-to-noise ratio. The random phase of noise will both phase and amplitude modulate the carrier. The quadrature phase component will be demodulated by a diode detector but not by the synchronous detector. Under ideal conditions (weak signal, white noise, 100% sinusoidal modulation) the synchronous detector can give up to a 3 db better signal-to-noise ratio than a diode detector.

Diode detectors can be somewhat nonlinear: their rectification characteristic may be curved, distorting the audio. The good linearity of synchronous detectors produces fine audio.

The synchronous detector is versatile: it can function as an AM as well as a FM detector. If the BFO is of high quality, the frequency lock feedback loop can be opened and the product detector used to demodulate SSB signals.

A different form of synchronous detector has been described in Don Stoner's, W6TNS, "*New Sideband Handbook*". This type works for DSB signals even if no carrier is present. It consists of two SSB detectors, one for each sideband, with a phase detector comparing the two audio outputs and locking the BFO. This detector would also work for AM, but is considerably more complex than the one described here.

Practical Circuits

In future articles, Bill Kleronomos, KD0HG, and I will describe practical circuits using synchronous detectors. The approaches are very different: Bill uses a crystal-controlled local oscillator and amplitude-controlled BFO injection. I use a low phase noise discrete component BFO, a digital four-phase generator and two doubly balanced modulators. •

Book Review

Don C. Wallace, W6AM, Amateur Radio's Pioneer
by Jan D. Perkins, N6AW

Don Wallace went on the air in 1911 at the age of 13 and was on the air almost daily until his death in 1985 at the age of 86. Throughout his life Don was always described as 'enthusiastic'. Whatever he did in radio - most notably DXing and antenna building - he did to the best of his abilities and with all his energy.

In 1945 he purchased the 105-acre Press Wireless (a news gathering agency) receiving site on top of Palos Verdes Peninsula, near the town of Rolling Hills in southern California. This was to be his main operating location for the rest of his life. With a array of rhombics -45 miles of wire supported on 140' poles- and with a KW on each band he had the dominant signal on the amateur bands.

Jan Perkins, N6AW, who was a close friend and associate of Don's-and himself a notable contester and DX'er-has produced a first class book. It's well organized, well written and might be the best amateur radio book I've ever read. It's more than just a chronicle of Don Wallace's life, it's also a history of amateur radio.

The book is a deluxe hardcover, 8 1/2" by 11", 288 pages, and profusely illustrated with photo's. It's $29.95 plus $3 shipping and handling from the ER Bookstore. **N6CSW/Ø**

The Collins Linear PTO, Part one

by Ray W. Osterwald, NØDMS
10679 West Dartmouth Ave.
Lakewood, CO 80227

During the course of radio history, a few developments have come along which have proven to be significant advancements in the state of the art. Probably the first major development was the discovery of the crystal detector which, in the days of "mechanical" radio, gave the spark operators great new sensitivity and operating range. The primitive coherer and electrolytic detectors then in use would, if used in the modern environment, likely be totally desensed by a full-tilt electric mixer! Along came Dr. Fleming and his electric vacuum valve, which spelled the end of wireless as it was known, but gave birth to electric radio. This progression continued, and we are all pretty much familiar with what was to follow.

In the 1930s and 1940s, Arthur Collins guided his company with a belief that radio equipment should be built on a foundation of solid engineering principles derived from scientific research. As the company grew, he hired the best team of researchers and engineers he could afford, and deliberately set out to push discovery in the radio field to its limit. His ultimate achievements with the Apollo communications project are testimony to the success of his approach.

During the post-war era, I feel that three Collins developments, the stable, linear PTO, the mechanical filter and the crystal-controlled first conversion oscillator, were the most significant developments in radio since the DeForest Audion. Available for the first time was relatively high-speed data transmission, practical single-sideband radio telephony and an H.F. receiver as accurate and stable as a laboratory frequency standard, which a person could have at home. The contribution these techniques gave to national defense are probably incalculable.

As mentioned in a previous issue of Electric Radio, a Collins engineer named Ted Hunter invented linear permeability tuning just before World War II, and the design was probably first used by Roy Olson, WA6THD, in his ART-13 master oscillator. In a relatively simple concept, linearity was achieved by matching the permeability of a powdered-iron tuning core to a variable-pitch coil, so that as the tuning core moved within the coil, a linear rate-of-inductance-change was achieved. What was really amazing is that Collins was able to mass-produce thousands of these wonderful precision oscillators. Most Collins receivers of the period used the scheme not only in the VFO, but also in the front-end coils.

The purpose of this article then, is to give a little of the history and manufacture of Collins PTOs, and to present maintenance information so that use of this fine equipment may continue well into the next century– in spite of the so-called digital revolution!

PTO DEVELOPMENT AND MANUFACTURE

The design and manufacture of a new PTO at the Collins plant was a painstaking chore, which began back in a corner of the engineering lab. Here, an engineer would develop a new variable-pitch coil by winding, by hand, maybe 2 1/2 turns of a certain wire size at 7 turns per inch, and then the next 2 1/2 turns would be wound at 8 turns per inch, or whatever his calculations showed to be close to the desired tuning range. Then, the new coil would be run in an oscillator. If the frequency deviation from linearity went a certain way, he would add or subtract turns, or change the pitch slightly until linear tracking was achieved over the desired tuning range. Typically,

he might have to make fifty of these coils to find exactly the right one. Once the data on the coil was known, a steel cam was cut which would automatically move the wire guide on a coil winding machine, thus enabling precision coils to be mass-produced.

The new cam was then taken into the coil winding department, where there were about fifty coil winding machines set up. These machines were commercial products modified by the Collins machinists. In this department, the actual work was done by women with years of specialized experience. The winding machine guides would follow the cams and wind the new variable-pitch coil onto a custom-ground, hardened steel mandrel. Then, in a process developed exclusively by Collins, the coil form was applied to the coil wire while the wire was still attached to the mandrel!

This unique process used a molding compound produced in the Research Department, and it contained ground-up quartz so that it was quite stable from a temperature standpoint. Also, the turns stayed where they were put. After the form was molded, and the compound had cooled, the mandrel was pushed out and re-used. Because of the lack of any molding material between the wire of the coil and the tuning slug, the oscillator would have excellent temperature and long-term stability.

The precision of the windings had to be pretty good, as there was no compensation available after the molding process was finished. The winding precision depended entirely on the accuracy of the steel cams on the winding machines.

This molding material may be seen in some early PTOs with the cover removed as a covering on the outside of the coil.

The special tuning slugs were developed by the Collins designers working very closely with chemists at the Aladin Company, which at the time was in the powdered iron business. Once the engineer had a mix with the right combination of powdered iron, iron particle size, and binder, the mix formula was "frozen" and wasn't allowed to change. The resulting mix produced a tuning slug which had the proper initial permeability for the coil inductance and oscillator tuning range. The slug had a hollow core, and a hardened steel lead screw ran down thru it. Flanges were attached to the core so that rotation of the rigs' tuning mechanism caused the lead screw to run the slug in and out of the variable-pitch coil, thus tuning the oscillator. Usually the lead screw ran in precision ball bearing races at each end.

Attached to the end of the tuning slug was a spring-loaded cam follower. The follower rode on a series of oval steel compensating washers, which had slots in them, and a threaded clamp screw ran the length of the washers. Between each cam was a steel spacer. The cam followers, riding over these washers, changed the rotational position of the tuning slug ever so slightly, which changed the oscillator tank inductance. Thus, tuning could be compensated and made linear over its entire range.

After the tuning slug, the variable-pitch coil, cam stack and follower had been assembled to the machined aluminum PTO frame, the tank capacitors were soldered in, and the unit was temperature cycled in a regulated oven. The main frequency-determining component in the PTO is the sealed ceramic tank capacitor, its composition specified and selected by Collins, and usually 300 to 500 uuF. During the temperature run, the drift was graphed, and the appropriate compensation capacitors were added. During a production run however, not all of the PTOs were temperature cycled, but were only spot checked. The content of the material used in the components was held so constant that 100% checking was not necessary. They would generally make about a thousand at a time.

After all of the PTO components were assembled, final calibration was performed in a test fixture. The oscillator tubes were plugged in, power applied, and after warm-up, the dial calibration procedure was performed. The fixed end-point adjustment was made, so that the oscillator covered the desired tuning range in exactly the number

continued next page

The Collins Linear PTO from previous page
of specified turns. Then, linearity was adjusted. The tuning slug lead screw was moved one whole turn, and the technician would loosen the clamp screw running the length of the cam stack. The cam stack washers would be tapped one way or the other until a calibration point would zero beat against a crystal standard. When all of the calibration points were finished, the cam stack screw was tightened up and the threads sealed.

The final production step was to seal the assembly against moisture. In the 70E-8 PTO, used in the 32V series transmitters and 310 series exciters, there was a tube of silica gel screwed into the body of the PTO. In later equipment, sacks of silica gel were taped to the PTO frame rails, inside the cover. The silica was supposed to absorb any moisture taken into the PTO can during heat-up and cool-down cycling. The final sealing step was simply a coat of Glyptol around a rubber O-ring. This method of sealing was a topic of controversy among the engineers, as they did not all agree with this method of sealing a PTO.

In an interesting side-story, the Collins engineers discovered that when aircraft engines at the Cedar Rapids airport were to be mothballed, the mechanics would remove the sparkplugs, and screw in a container of silica gel in their place. Engineering got a bunch of these containers, and began screwing them into the 70E-8 PTOs for moisture protection! They are still there today, and can be re-newed and used over and over again.

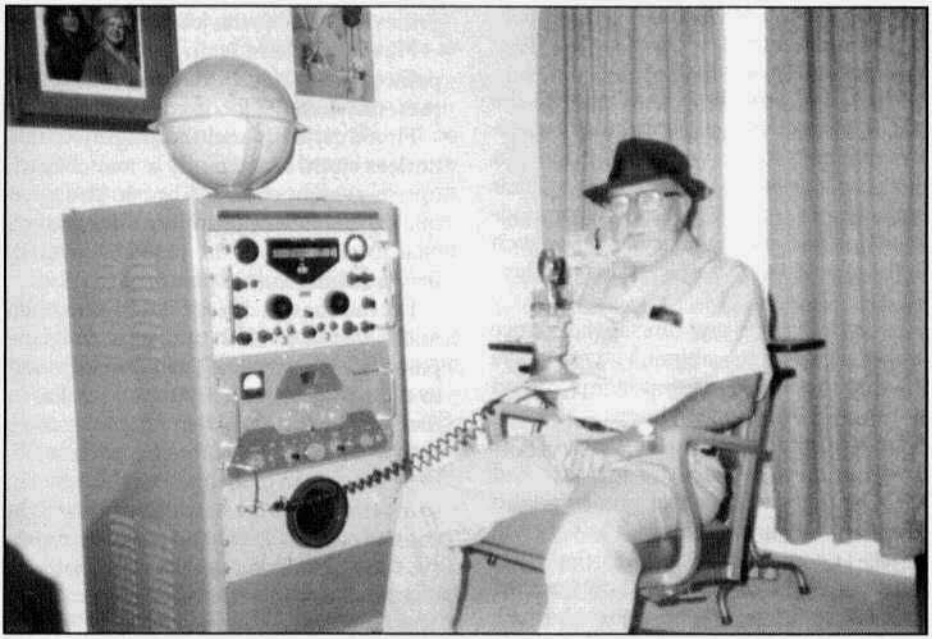
The first production Collins ham receiver, the 75A-1, used the 70E-7A PTO. The 75A-1 was designed by Roy Olson, under the personal direction of Mr. Collins. The 32V series transmitters and 310-series exciters were the first of the transmitters with the PTOs. They used the 70E-8. Also involved with 70E-8 production was Eugene Senti, who added mechanical filters to the 75A-3, and who was Project Engineer on the 75A-4. Mr. Senti is a fine gentleman, who contributed much of the background information for this article.

The following chart lists various equipment and the specific PTOs used in them:

PTO Type	Equipment Type	Total Turns	Tuning Range
70E-1	ARC-2	10	1.0 - 1.5 Mcs
70E-7A	75A-1	10	2.0 - 3.0 Mcs
70E-8	32V, 310B	16	1.6 - 2.0 Mcs
70E-12	75A-2, 75A-3	10	1.955 - 2.955 Mcs
70E-14	KW-1	16	1.6 - 2.5 Mcs
70E-15	51J	10	2.0 - 3.0 Mcs
70E-23	KWS-1	10	2.75 - 3.75 Mcs
70E-24	75A-4	10	1.955 - 2.955 Mcs
70H-1	R-389	51	469.0 - 980.0 Kcs
70H-2	R-390	10	2.455 - 3.455 Mcs
70H-12	R-390A	10	2.455 - 3.455 Mcs
70K-1	KWM-1	1	3.455 - 3.545 Mcs
70K-2	KWM-2, 75S-1, 75S-3/3A	2	2.5 - 2.7 Mcs

Next month, this article will continue, but with specific information about doing your own maintenance and restoration of these fine pieces of vintage equipment. •

Warren Dittmer, K2LXW, one of the most active AM'ers on ten meters. Any time the band is open Warren will be there. He always has a strong signal out here in Colorado and he always sounds good.



Martin Heiman, K7BDY, operating one of his AM stations. Another very active AM'er, Martin operates all bands from 160 thru 2 meters. On 160 he operates a modified broadcast transmitter.

Collecting/Repair/Restoration...Tips

Power Microphones

The amplified D-104 microphone may inadvertently bias the first audio state in many transmitters incorrectly, resulting in poor audio performance. Some transmitters, such as the Viking Ranger, don't have a d.c. blocking capacitor in the grid circuit of the first audio stage. The output coupling capacitor in the amplified D-104 is an electrolytic which if leaky will change the operating point of the first stage. The cure is to add a d.c. blocking capacitor between the microphone connector and the d.c. ground return resistor in the transmitter. A 0.01 - 0.05 microfarad capacitor would be fine for a grid resitor in the 0.5-1.0 megohm range. The coupling capacitor in the mike itself is a high capacitance electrolytic, which should be replaced by a similar unit if you intend to drive 600 ohm audio processing equipment.

John Staples, W6BM

Authentic Capacitors

Most of us are all too familiar with the pile of defunct wax-paper tubular capacitors that goes along with restoration of a 1940's vintage receiver or transmitter. Their replacement is usually made with modern axial-lead plastic or mylar types such as those sold by Antique Electronic Supply.

Even though no one can see them once the set is back in its cabinet, I have always felt that the modern components ruined an otherwise authentic chassis.

Now, instead of discarding the old wax capacitors, I place one lead in a vise and heat the body with a heat gun (the kind used for heat shrink tubing). The wax will soften and melt quickly, and the outer cardboard tube can be pulled off from the core. Since the modern capacitors are much smaller than their vintage counterparts, they will fit inside the cardboard tube with lots of room to spare. The tube is then filled back up with the melted wax. With the old, dirty wax melted off, most old wax capacitors will look almost new again. With the "re-cored" paper capacitor reinstalled, the set remains historically correct. This process only works with those capacitors having a separate outer cardboard tube, and won't work with those having cheaper construction or paper labels.

Geoff Fors, WB6NVH

From G-E Ham News

Refinishing Panels

Rack and panel transmitters are good looking when new, but the black or gray crackle finish eventually gets dull and shabby in appearance. It is generally difficult to completely repaint a panel and still maintain the crackle appearance, unless a professional does the job.

However, there is an easy way to repaint panels. The crackle finish will still be present when the job is complete.

First dust the panel thoroughly with a lintless cloth. Next, apply a coat of black (or gray) enamel with a brush. Use good quality enamel. Apply only a thick enough coat to ensure that the panel is covered. Brush off any excess paint.

Let the enamel dry for 10 minutes, then make a wad of cloth and wipe over the panel in long sweeps. Turn the cloth wad to a clean portion before each stroke, so that you continue to remove the enamel. After all excess enamel has been removed, procure a clean cloth and rub the panel in short circular strokes, applying only light pressures. This gives the panel its finish. (A sponge will not work well.) Finally let the panel dry in a dust-free room.

W1GVY

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.

Vintage CW Net.. News

Tracy Reese, WB6TMY, reports that the number of check-ins is increasing each week. Last week there were twelve.

When we go off Daylight Saving Time the group plans to move to the novice portion of the 40 meter band. The frequency will be 7.137 Mcs. Tracy is hoping that this frequency will work out better than the crowded 20 meter band and also give the novices a chance to participate. The net will still be on Saturday nights at 6 p.m. California time, 9 p.m. Eastern.

In a recent conversation, Tracy mentioned a couple of things that should be noted. First of all, the net does not operate ' high-speed' CW - about 10 to 15 wpm mostly. Also, it is not necessary that you stay with the net the whole evening. If you would like to just check-in and check-out that would be fine.

I think that one of the more interesting things about the "Vintage CW Net" is the variety of equipment that is being used - everything from a Globe Chief to a KWS-1 - and each rig seems to have a distinctive sound.

If you haven't checked in with the net I urge you to do so. I think it will be a very unique experience. Until we go off DST the net will be on 14.062 (plus or minus) at 6 p.m. California time, 9 p.m. Eastern. Net controls are Tracy, WB6TMY and Ray, NØDMS. **N6CSW/Ø**

Ten Meter Contest.... Oct. 26-27

I've had a number of letters and calls recently suggesting that we have another 'contest' on ten meters. I've picked the week-end of Oct. 26 - 27 for the event. The rules are 'loose', as they have been for past contests.

The contest will start at 12:01 a.m. on Saturday Oct. 26 and continue until 12 p.m. on Sunday Oct. 27. The times are local times, whereever you might be located. There will be 1 point for every contact; no extra points for DX. Both stations must be operating AM for the contact to be good. Logs should be forwarded in to ER as soon as possible.

Next issue I'll announce another context; maybe we'll have one every couple of months through the winter. I'd welcome ideas and input on future contests.

In the last 10 meter contest, held last November, John Barcroft, WA6ZJC, came in first with 120 points, Bill Kipping, KE7KK, came in second with 68 points and Marty Drift, WB2FOU/5 came in third with 53 points. If the band stays in the shape it is in at the moment the scores may be higher this contest.

It's been suggested that later this season, and almost certainly next year, that the MUF may not extend up to 29.0 Mcs. I wonder if we should start thinking about another 'AM window' lower down the band? **N6CSW/Ø**

Restoration Of The Central Electronics 100V

by Dennis Petrich, KØEOO
6419 Berwickshire Way
San Jose, CA 95120

My story starts out like many of yours have. As I read the pages of ER I see where many of us had the same beginnings. My mind would soar and travel the world as I listened to a friends short-wave set (Zenith Transoceanic) when I was 12 years old. Later on I heard a local ham on my crystal set and I became excited about talking to other parts of the world myself. Some time later I passed the novice test and my parents surprised me with the Knight T-50 transmitter for Christmas that same year (I already had a Knight Space Spanner receiver.). The novice ticket came two months later.

I got my Novice in '59 as KN7LDV in Henderson, Nev. Later we moved to Minnesota where I received the KØ call. I couldn't afford to buy much equipment so for the first 20 years I built all of my equipment. Barry has asked me for some photos and a description for another article.

I first saw the CE 100V one winter's night in Minnesota (burr). I was with a friend to visit the home of a ham who had just got the 100V new. Well to say the least, my mouth hit the floor as he showed us the advanced features (I was using the Knight T-50 and Eico 730 modulator at the time). I never forgot that night. I was about 16 years old and I have been secretly in love with the rig ever since.

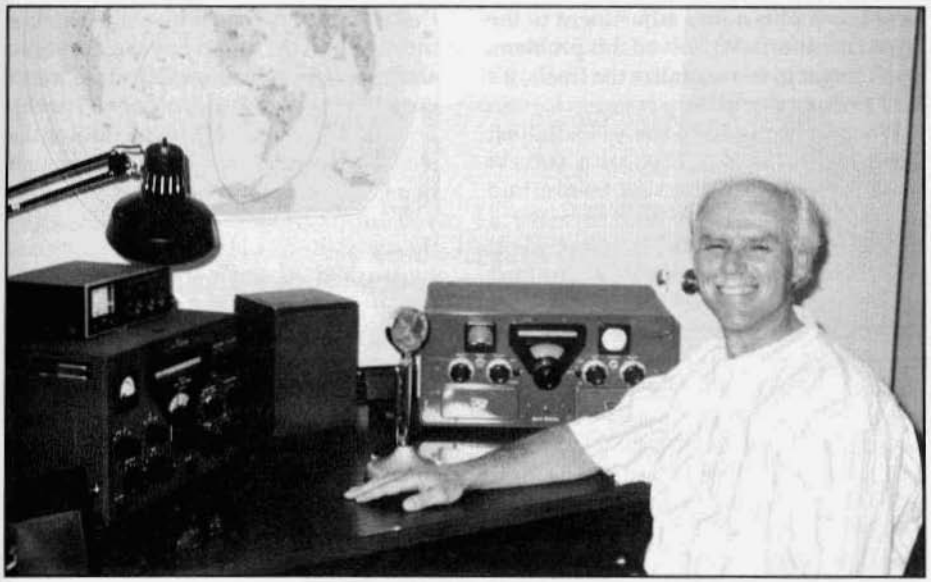
Some of the features of the 100V that I like the most and which made it a rig ahead of it's time are:

All the modes of operation, CW, PM, SSB, AM and more.
The fine audio section with the limiter indicator and bandpass filter.
The antenna mismatch indicator and alarm.
The monitor oscilloscope to assure linear operation.
The patented broad band RF section for NO tuning.
The super stable and smooth VFO.
The excellent VOX.
The ease of use, even for a guy who has been using a Signal One CX7A.
The sharp look of the rig and the knowledge that it is rugged.
The dial and meter face have a warm glow to them.

The 100V represents a rig between the AM days and the filter SSB transceiver days. The days when the bottom 20 kcs of 40 meters (then 7200 to 7220) was the strong hold of the new SSB'er and where DSB was often heard and where there were no heterodynes. Back then the talk was about the gain that SSB had over AM, as many of you remember. It was a changeover period that made and lost fortunes for some companies. CE lost as did many others but that doesn't mean they didn't produce high quality rigs. I guess that is why I like ER magazine and why I wrote this article. Now on with the restoration.

I acquired this 100V at a swap meet here in the valley several months ago. The following is a description of what I had to do to restore this fine vintage transmitter. I will go through the restoration in brief giving you only the important details.

I first took the 100V apart and used soap/water and rubbing alcohol to remove the 30 years of dirt. You can remove all the tubes, fans and the coils unplug. That includes the final coils on the underside. You can also remove the five modules.They are the audio limiter, audio filter, diode and capacitor modules and the PS-2 phase shifter module. Remove all of these and clean them separately. It took me two days to clean the rig before I did any other work. This rig is very modular making it very easy to work on; another advanced feature.



The author with his 100V on the right and 75A-4 receiver on the left.

Next replace all of the electrolytic capacitors in the power supply. This is quite easy to do. Next, and as important, you must replace all of the small white 'Chemtronic' capacitors. most of them are in the audio sections. They are 6 mfd and every one was open! The audio limiter section had several as well. There is a 100 mfd one across the screen overload relay in the final cage, don't miss it.

It goes without saying I tested all of the tubes and replaced the weak or gassy ones. By the way while you are in the audio limiter module replace the two 1.4 volt mercury batteries. They supply a threshold level for the clipper circuit. I replaced mine with two small 'N' type batteries but mercury cells would also be ok. I had to solder wire to the battery terminals because the holders were gone and there isn't room in the box for another holder. Make sure the limiter tube is good, this circuit will not work properly unless everything is ok.

Check and re-dress all wires under the chassis looking for burnt resistors and capacitors. Look for other mods that may have been done in the past by a non-expert and clean them up if necessary. I like to remove all black tape and replace it with tie wraps when I can. Also put a drop of 30 weight oil on the front and rear bearings of the fans. If they are still noisy replace them. In my 100V the 2AP1 CRT was very weak; I replaced it.

At this point you should be able to turn the rig on and check some of the sections out. Before you start restoring the 100V make sure you have a good manual with schematic. I went through the manual front to back and checked out each section and adjusted it to spec.

One word of caution. The final '6550' tubes checked ok in a tube checker and put out good power but one of them was either gassy or had a parasitic oscillation. The symptom was that the plate current on the 'watt' meter position would creep up slowly as I operated AM, CW and SSB. And even after the tubes were in cutoff there was a lingering reading on the meter that would slowly go to zero. While this was happening I saw one of the plates with a red glowing spot. I swapped the tubes around and the problem followed the tube. All of the suppressors were ok.

continued next page

Restoration of the CE 100V from previous page
New tubes plus a bias adjustment to the finals I mention later, solved this problem. Don't forget to re-neutralize the finals; it's easy to do in the 100V.

When I got my 100V the VFO dial felt like it had rocks in it! If yours is velvety smooth then skip this section. I was afraid I was not going to be able to make it smooth,thereby ruining all of this work. Well, finally one weekend after I couldn't ignore it any more, I tackled the VFO dial. The following is the procedure I recommend.

Remove the dial knob, and the three screws holding the planetary reduction mechanism in place, clean any grease off with a rag making sure you don't lose any of the ball bearings. Using white lithium grease put just a few dabs on the removed shaft, between it and the tubular housing that has all the holes in it for the ball bearings. The grease will hold the ball bearings in place during reassembly. Put some grease on the outside of the ball bearings and reassemble the reduction drive. Make sure you don't tighten the three screws. They are to be adjusted later when the main screw drive is lubricated.

Next you must remove the VFO from the unit. To do this requires removing the front panel. Yes, that's right the front panel! It's easier than I thought. Remove all the knobs and screws holding the panel on and unsolder the wires going to the two indicator lamps. Do not remove the four screws holding the VFO to the panel, the VFO dial is pressed on as best I can tell. That is why removing the panel is necessary. Next remove the CKT assembly (just four screws) and the ball chain that turns the dial drum from the band switch. At this point the panel comes right off. The VFO will be out in the open and easy to work on.

Next remove the 'U' shaped VFO housing which covers the worm drive. Do not remove the end housing that covers the VFO electronics itself. Find the screw drive and where it goes into the gear ball bearing housing (toward the front panel). At that end there is a small wire clip that goes into a hole in the round housing the screw shaft goes into, you must look close, it isn't easy to see but is comes off easy. The clip holds a plug from turning that rides on the shaft. Unscrew the plug out of the round housing and down the shaft far enough so you can get grease into the hole vacated by the plug. Each time you squirt lithium grease onto the screw shaft turn the main dial knob to move the shaft and grease into the ball bearing housing. Do this several times to get as much grease as you can into the housing. Next pack grease - as much grease as you can - around the shaft one last time and screw the plug back into the round housing. Grease will squirt out through small holes and around the screw shaft, that's ok. Wipe off the excess grease and put the small wire clip back in place to hold the plug. This plug keeps a small reservoir of grease in place around the shaft. My dial freed up immediately when I started to grease it; hope yours does also. Please call me at home if you have any questions with this VFO greasing procedure; without pictures it isn't easy to explain. To finish up, put the 'U' shaped housing back in place and reverse the disassembly procedure.

When that is done, adjust the three screws on the dial drive for just enough tension so that the VFO shaft will turn the VFO easily. If everything went well the VFO will be very easy to turn, it should be velvety smooth with no trace of roughness. If you didn't notice, the VFO has a dual speed dial, both should be easy to turn. This completes the VFO lubrication procedure.

I did not have to calibrate the 21 small screws used to calibrate the VFO every 50 Kcs. There is a procedure in the manual to follow if you need to. This is another great feature of the 100V VFO. I understand that Collins VFO's did not have this feature.

If you want, as I did, you can remove the back cover on the VFO itself. Curiosity got the best of me, but I paid for my look. There is a sponge rubber material about .5

The CE 100V has a very handsome and well laid-out front panel. The CRT is an unusual feature.

inches thick lining the housing. The material fell apart when I touched it so I was forced to remove and clean the housing and glue holding the material with alcohol. I then replaced the insulation with a synthetic fiber stuffing material used in couches for padding. I took a small amount and just formed it around the inside of the housing. The insulation is used to even out the temperature changes and reduce air currents during warm up, so it is important.

One area I should highlight are the capacitors in the plug-in capacitor module. When I first put my rig on the air on SSB I only had 28 dB of SSB suppression. The rig should have over 50 dB! I was unsuccessful using a scope and audio generator to improve the suppression. The problem was two of the 6 mfd capacitors in the module were very leaky. I replaced them all with new hand matched 6 mfd capacitors. Now my suppression is over 50 dB and the audio reports I get are fabulous to say the least. When I am on the air almost everyone comments on the audio; how clean and easy it is to copy. It's kind of the AM of SSB rigs if you know what I mean.

In the preparation of this article Barry gave me Joe Bachelors phone number to call for assistance. Joe (W4EGK) was one of the original designers of the 100V and many other products. I called and he was very helpful. He told me the story behind the "line" position on the meter switch. It seems that Joe had one of CE's early 100Vs at a field day and there was a problem with the line voltage that was causing havoc with all of the rigs. No one had a meter so Joe vowed he would solve the problem by putting the "line" position on his 100V.

He also helped me understand the difference between the 100V and the 200V. It seems that when Zenith bought out CE in the early '60's they wanted to reduce the cost of the 200V to increase the profits. To do so they went from a modular chassis design for easy servicing, to one single chassis design. This would eliminate all of the interconnects and some extra metal thereby reducing the costs. They did add solid state rectifiers and a final amplifier bias adjustment that the 100V's did not

continued next page

Top view from the front.

have. Joe said the rectifier change was a good one to make; it reduced the heat in the cabinet by about 25 watts.

Well, after I heard that, I decided to replace the two 6AU4's and the 5U4GB with solid state rectifiers. The bias supply already has a selenium rectifier in it which I replaced with a silicon unit. I built my own replacements into some old octal tube bases.

The original HV plate voltage for the 6550's was 675 and 600 volts respectively, about 25 volts higher than before. The power supplies are of the choke input type so a series dropping resistor is not necessary. The 350 volt supply ran at 340 volts and went to 360 volts at full load with the new rectifiers and 380 in standby and 400 volts at turn on.

When I first turned on the rig before the tubes warmed up the voltage went to 400 volts causing the OA2 VR tube to light with a bright flash and pop! Because of this and the higher operating voltages, I changed the 3K series load resistor located in the final chassis near the screen protection relay to 3.5K. The change allows the VR tube to operate at about 60 ma. worse case and to 71 ma. at turn on. Before, it ran at about 63 ma. Best of all the flash and pop went away.

Next, I added the final grid bias adjustment that Joe mentioned. Before I made the rectifier modifications the final idling plate power was 70 watts - high by 20 watts. When I made the rectifier modification the idling power went up to 90 watts! Not good; to run the rig I would need to change the bias. Normally the bias should be at -39 volts. Well it really was at -36 volts.

The circuit I added gave me the ability

to adjust the bias from -36 volts to -51 volts without loading down the existing circuit and would slow down the RC time constant of the input circuit just a bit. Not enough to change it's keying characteristics.

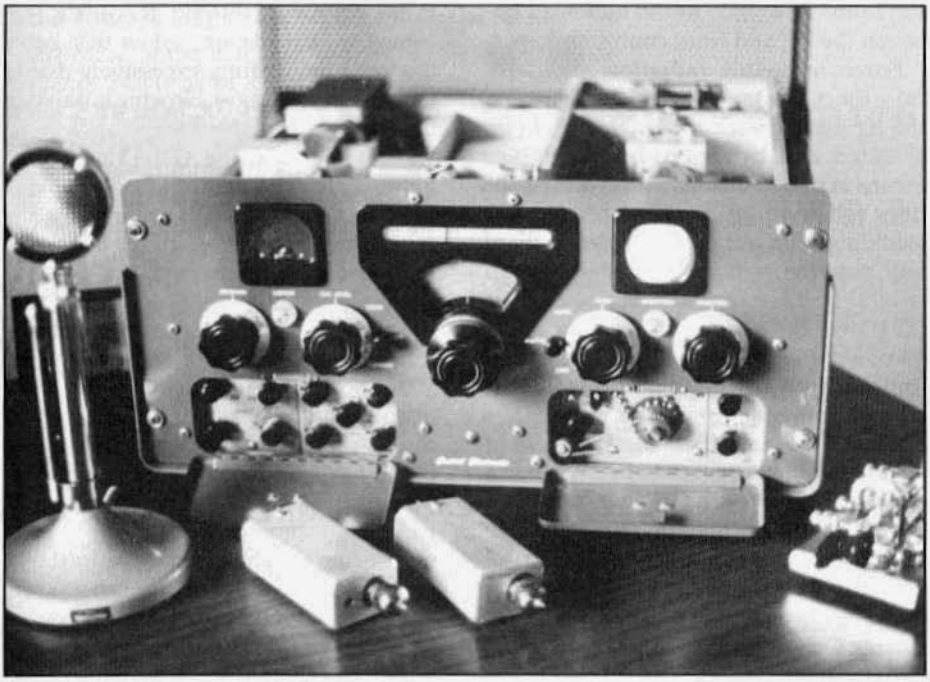
With the bias adjustment I was able to bring the final plate idling power down to 50 watts easily. The bias was at -44 volts with the tubes at 50 watts. I mounted the adjusting pot in the same place as on later 100V's; on the side of the driver chassis across from the driver plug-in coil facing out.

CQ and QST magazines were kind enough to send me reprints of old articles on the 100V/200V. I was surprised that there was only two articles after all of these years; one is for key clicks and the other is to add 160 meters to the 100V. The later article does not use Joe's patented broad band coil design. Only Joe can do that I guess.

When I repaint the cabinet the restoration of my Central Electronics 100V will be complete.It is a very fine rig and I plan to use it for a long time. Joe Batchelor at CE did a great job in the design of this transmitter. As far as I am concerned todays new rigs are not all that much better for a whole lot more money.

I have worked about 20 countries and many locals on SSB and CW (some AM as well) and have enjoyed using it and my 75A-4 a great deal. It's fun running a vintage 50's station! It's almost as much fun as running a completely homebrew station. I hope to hear your 100V/200V on the air in the future; it would be fun to compare notes. •

Editor's Note: Dennis and I had a very long QSO on 40 meters recently. His 100V really does sound great. One thing we discussed was a possible "Vintage SSB Net". Anyone else interested?



100V with cabinet removed and front panel doors opened revealing controls for VOX,carrier balance, etc. The two modules in front of the transmitter are the audio limiter and the audio bandpass filter.

Improve And Maintain That ART-13

by Bill Kleronomos, KDØHG
POB 1456
Lyons, CO 80540

TVI Suppression

There is a benefit in both suppressing high order harmonics and preventing their escape. The most obvious place to start is by adding a parasitic suppressor to the plate circuit of the 813. I noted a noticeable decrease in crud on my own TV on channels 2 and 4 by performing this mod. Make a suppressor by winding 5 or 6 turns of tinned wire around the body of a 47 ohm 2 watt carbon resistor. There is no need to dispose of the stock spring type plate lead when installing this suppressor. I installed mine by replacing the #14 wire between the plate connection at the top of L 108 and relay K105. The resistor sits in the 3/4" hole in the bulkhead between the PA and front compartments.

Some harmonic radiation emanates from the control and power cable between the rig and power supply. This could be shielded and bypassed, but a simpler means exists. Radio Shack and other vendors sell snap on ferrite cores for RFI shielding. The rectangular holes in these will pass the power cable. Merely snap several of these ferrite toroid cores over the power cable as it exits from the ART-13 power plug. They will provide a high impedance to any common mode RF that tries escaping the rig via this route.

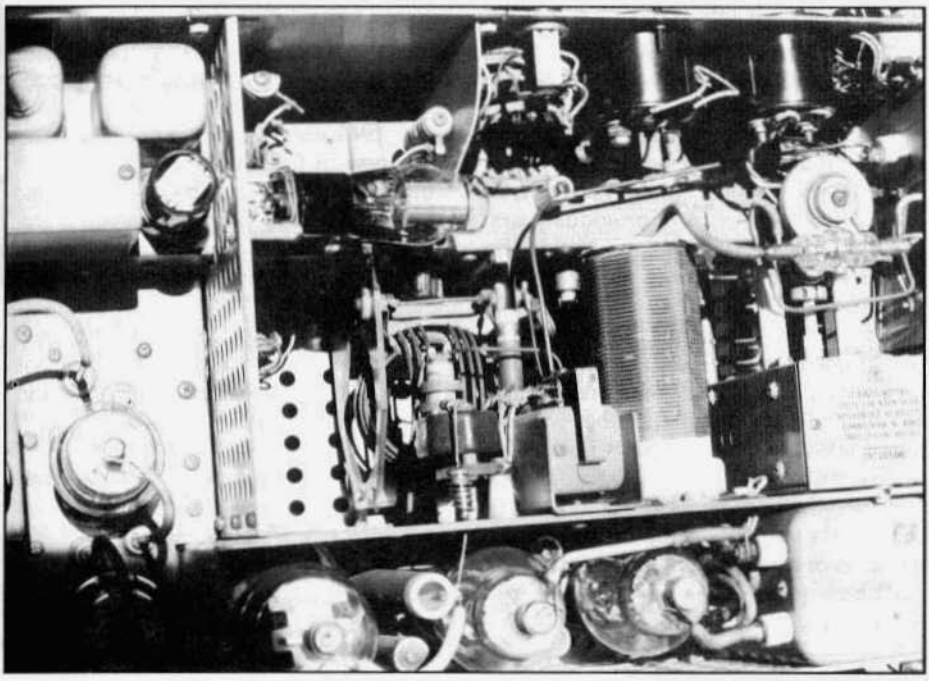
Class C RF amplifiers are 'dirty', so to speak, so don't forget the obvious - use a high quality low pass TVI filter in the rig's output lead. An antenna tuner is also highly recommended instead of an all band dipole in the interest of not radiating spurious signals.

Other Operational Notes

An external shunt capacitor is always required from the antenna port to ground for the rig to load properly. I found a 560 pf transmitting mica ideal for 160, 80 and 40 while a 100 pf works great on 30, 20 and 17 meters.

The ART-13 is capable of output far in excess of the nominal 100 watt rating and modulating that RF a good solid 100%. Jeff, KEØMT, is obtaining close to 300 watts out on his on 160 and 80 with about 1700 plate volts. I am not as brave; at 1300 volts mine makes about 175 to 200 watts out on all bands except 20 where the output is around 100 watts. It is imperative to use some form of auxiliary cooling of the final and modulators; I recommend bolting a muffin fan to the outside of the PA compartment right behind the 813 and orient it to draw air out of the rig; not to blow air in. As Walt Hutchens pointed out in his review of this rig, there is a "designed in" balance of airflow that keeps the vfo from drifting excessively due to temperature changes. Blowing hot air into the rig will upset this flow.

As I mentioned, the ART-13 is no audio lightweight. The pair of 811s are able to fully modulate the 813 at virtually any power level. The screen of the 813 is also independently modulated, and this set-up has inherently low distortion. Due to the ratios in the modulation transformer, it is not possible to modulate much over 100% positive, but you can very easily over-modulate in the negative direction causing all sorts of splatter and distortion. Some form of audio compression, clipping or peak limiting is almost essential! KEØMT, a broadcast engineer, is presently using a sophisticated broadcast type processor on his ART-13 that can produce equalized asymmetrical audio processing in a multi-channel basis, and let me tell all of you out there that I have never heard such sweet audio out of any amateur rig of any type!



Looking into the top of the ART-13 from the rear.

According to the manuals, the overall frequency response of a stock rig is flat within 2 dB from 300 Hz to 4 Khz and within 7 dB from 100 Hz to 7 Khz. You can change a few components in the speech amp stages to flatten the response out beyond these figures, but who needs flat audio out beyond 10 Khz as I was able to obtain during experiments? The military specification for audio distortion is a maximum of 7 % at full power. I don't think there are many amateur AM rigs out there that will beat this figure. I measured the distortion of my rig as slightly less than 6%, with no changes to the speech amp.

Although thousands of these fine rigs have been parted out or scrapped over the years, there still seems to be a good number around. I realize that military surplus is not everyone's cup of tea, but there are few amateur rigs of this quality in the 'medium power' range, and as such, the ART-13 deserves serious consideration as an AM or CW rig. •

References:

Army manual T.O. 12R2-2ART13-2 (Fair Radio Sales)

Navy manual 16-30ART13-501

Surplus Radio Conversion Manual Volume II (From CQ Magazine)

Conversion Notes on Collins ART-13 by Sam Appleton, K5MKI (no date available)

The AN/ART-13 by KJ4KV, ER #7

FSK for the ART-13, QST, May 1964

Converting the ART-13, CQ, November 1946

Editor's Note:

In upcoming issures we'll have more on this fine transmitter. Areas to be covered include modifying it for SSB and RTTY operation. Bill and I would welcome any input from readers regarding their experiences with repairing/modifying or operating this military classic.

Tube Type Designation Systems from page 3
type which, according to the rules of the game, can be plugged into the same socket and should give as good or better performance.

That is the currently-accepted receiving tube type designation system. But there are many exceptions. Numbers like 41, 80 and 12A carry over from previous years. We find another type of exception in the so called "loctal" tubes whose designations all begin with a "7"—such as the 7C5. Obviously this plan does not conform to the filament voltage code above. Other exceptions have come about because the original purpose of certain tubes was not for "receiving." That is, some tubes often are used now for receiving purposes but were originally designed, and numbered, in accordance with some other system. Samples of this type of exception are the 9002 and quite a few tubes in the 5500 series.

CATHODE-RAY TUBES

Being the baby of the family, the cathode-ray tube had a system slapped on it before it was hardly dry behind the filaments. As it now stands, this system calls for a number symbol which tells the maximum diameter or diagonal of the face in inches, a letter which is merely a serial assignment and a letter-number symbol which designates the type of phosphor used. For example, the 16RP4 has a diagonal of 16 inches and P4 phosphor coating inside the face. However, there are a few exceptions like the 905, 908, 1803 and so on.

TRANSMITTING TUBES

Under the inglorious heading of "tubes and devices exclusive of receiving and cathode-ray tubes" amateurs will find their favorite transmitting "bottles" labeled with various and sundry letters and numbers which mean little, if anything.

The numbering of transmitting tubes was not standardized until 1942. Thus many tubes still being manufactured carry numbers and/or letters originally assigned under systems started by different manufacturers. For instance, the famous 807 and its brothers and sisters in the 800-series are carry-overs from private pre-war numbering systems. So are tubes in the 200- and 400-series.

In 1942, a standard number-letter-number system for transmitting and special purpose tubes was adopted—a plan which lasted only four years. However, a great many tubes still popular with hams were assigned numbers under this system. Samples are the "Lighthouse" series like the 2C40 et al, the 4D32, 2E26 and others. Under this system, the first number symbol was assigned to indicate power rating of the heater or filament as follows:

Filament or Heater Power	Symbol
Zero	1
In excess of 0 watts and up to and including 10 watts	2
In excess of 10 watts and up to and including 20 watts	3
In excess of 20 watts and up to and including 50 watts	4
In excess of 50 watts and up to and including 100 watts	5
In excess of 100 watts and up to and including 200 watts	6
In excess of 200 watts and up to and including 500 watts	7
In excess of 500 watts and up to and including 1000 watts	8
In excess of 1000 watts	9

Next, a letter symbol indicated the structure and/or function of the device in accordance with the following schedule:

Type	Symbol
Monode	A
Diode	B
Triode	C
Tetrode	D
Pentode	E
Hexode	F
Heptode	G
Octode	H
Vacuum capacitors	L
Crystal diodes and rectifiers	N
Photo-emissive devises, etc.	P
Mercury types	R
Vacuum contactor-type switches	S

Finally, a number symbol constituted an aerial designation and these serial numbers started with 21 to avoid conflict with the receiving type designations.

In 1946 this system was scrapped in favor of a pure numerical serial system starting with 5500—the system which is in effect today. Thus, many of the newer tubes used by amateurs are appearing with numbers in the 5500's and 6000's. Of course, as this "5500 system", as it is often called -- officially includes special purpose devices, hams will find a great many industrial tubes mixed in with the newer transmitting types of interest in ham operations.

Neither of the two systems outlined nor any of the private numbering systems was made retroactive. Thus some tubes now bear complex numbers relating to more than one system. This gets a little bulky but does tell the story. Witness the GL-4D21/4-125A. Here the "GL" denotes a General Electric Company tube and the "4D21" and the "4-125A" explain how the tube has been listed under two different numbering systems.

GERMANIUM PRODUCTS

Under the long-hair title "solid state devices" we find one very old friend of the amateur—the crystal diode and one very new friend, the transistor. While at this writing the numbering system for such devices has not been officially promulgated by the joint designation committee of RETMA and NEMA, there is a system in use—a system which stems from the 1912-1946 transmitting tube system outlined above.

When crystal diodes began to be numbered—such as 1N51 et al—the first symbol (the number "1") was in accordance with the 1942-1946 code and indicated zero power filament or heater. The second symbol, the "N", indicated a crystal device. The last number was merely a serial designation.

Then the transistor came along and began to carry numbers beginning with "2N--." (G.E junction-type transistors, for instance, are designated 2N43, 2N44 and 2N45.)

Some manufacturers now want to code "solid state devices" by a system which in effect would pick up the pieces of several broken-down systems. They feel that it should go like this: The first number symbol would indicate the number of elements minus one—thus a 1N51 is a diode, a 2N45 a triode and so on; the "N" would indicate a "solid state device"; and the last number would be a serial designation. However, such a coding system has not been officially adopted.

As long as this is a free country, no manufacturer ever will be bound to adhere to a standard tube numbering system. He can call his tubes anything he likes.

However, most manufacturers today do their best to ease the replacement problem by going along with the decisions of the majority on a voluntary basis.

This question sometimes arises: Just who decides precisely what number shall be assigned to a particular tube type under any of the currently-effective designation systems?

The answer is that RETMA registers all tubes upon request of manufacturers, assigning the next open number in the system in question.

Now on the basis of the above rules and exceptions, could you make up your mind whether or not to use, say, an 862A in your next rig? Chances are you can't--and the chances are, further, that you won't bother to try when you find out that although this bottle has a 200-gallon input rating (and should run cool on the ham bands), it lists at $1322.00. •

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WANTED: Technical Material Corp. rcvrs - GPR-90, GPR-91, GPR-92; SBC-2, GSB 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

CLASSIFIEDS

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WANTED: Tektronix 3L10 and 3L20 spectrum analyzer modules for 560 series mainframes. Price and condition to Bob Booker, KØNT, 2120 S. Brownell, Joplin, MO 64804.

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WANTED: HA-700 Lafayette rcvr dial with numbers intact. Will buy complete rcvr if necessary. John McDonald, W6SDM, 24 Glenbrook, Camarillo, CA 93010. (805) 484-1307

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WANTED: Echophone EC1-A rcvr in good shape. Also 15 meter dial strip for HRO-60. Vance Lockenour, W9CNL, RR-15, Box 932, Bedford, IN 47421. (812) 275-4836

FOR SALE: Johnson 10 meter Messenger AM xcvr - $50; Johnson Mobile xmtr w/vfo, restorable - $50; 6N2 vfo - $20. WANTED: Ribbon mike. Pat, WB9GKZ, 3767 Fairview Rd., Green Bay, WI 54313. (414) 434-9016

WANTED: SP-400, whole or parts. Howard Hartzell, R.D.2, Box 505 Mifflinburg, PA 17844.

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FOR SALE: Drake C-4 console with R-4C, T4XB, ps and manuals - make offer. **WANTED:** 351 R rack mounts for 75S-3 series of equip. Roger, W8CRK, 2741 Werkridge, Cincinnati, OH 45248. (513) 451-1096

WANTED: Collector needs HRO', esp. older models; also need info on accessories for RCA AR-8714C D.F. rcvr. John Orahood, N5SPQ, 5819 Miller Valley, Houston, TX 77066. (713) 440-5598

WANTED: Riders Vol. 3 & 5 and above 20; F/712/frr-60(V) audio bandpass filter from DDR/5 rcvr by TMC; BC 939; manual for SX-42; antenna trim knob for SX-28. Gary Reiss, WAØJRM, Rt 1, Box 141, Wilcox, NE 68982. (308) 263-3231

WANTED: Dual HV/LV power xfmr for Globe King 500 (A, B, C, or ?) modulator ps. W2JBI, 69 Judith Rd., Little Silver, NJ 07739. (908) 741-4918

FOR SALE: For BC-610: 7 plate tank coils with swinging link - $140. Victor Gregowski, WD8DWR, 3635 Orvall Dr., Port Huron, MI 48060. (313) 385-9479

CLASSIFIEDS

WANTED: Wireless Set No. 19 equipment circa WW II. Also looking for information and anecdotes. Chris Basaillion, 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: Radio, electronic, military, avionics equipment, parts, manuals, books, magazines, list - $.50. **WANTED:** Collins manuals, catalogs, brochures. J. Orgnero, VE6RST, Box 32, Site 7, SS 1, Calgary, AB T2M 4N3 Canada. (403) 239-0489

WANTED: Complete set of update sheets for Precision 920 tube tester. F.M. Evans, KØAM, 641 Countryside Circle, Hudson, WI 54016.

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

WANTED: Radar equipment, need parts for SCR-584, units or complete systems. Allan Weiner, 14 Prospect Dr., Yonkers, NY 10705. (914) 423-6638

FOR SALE: Connectors, parts, TM's or TM Repro's for most military radios before 1955. DY-17A/ART-13A NOS8 - $45. **WANTED:** SCR-506 parts; Antenna mounts MP-37, MP-47, MP-48, MP-50, MP-57; Dynamotors DM-41, DM-43, DY-31/ARC-2, DY-96/VRC; cables; chests; other parts for SCR-399/499. Robert Downs, WA5CAB, 2027 Mapleton, Houston, TX 77043. (713) 467-5614

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

FOR SALE: FM signal generator AN/URM-103, 18-80 Mhz, 8 xtal controlled IF outputs, beautifully constructed mil. spec. equipment - $89 ea.; AM signal generator AN/URM-25F, 10 khz - 50 Mhz - $75 ea.; giant size mil. spec. discone antenna AS-3886, 6' diameter disc elements, 9' long elements, 'N' connector, heavy duty, UPS shippable - $99 ea. All items plus UPS. Joe Bunyard, 1601 Lexington St., Waco, TX 76711-1701. (817) 753-1605

WANTED: Original meter and cabinet from RCA AR-88/CR-88; RCA 44BX microphone; Western Electric 247A and 350B tubes. Sam Thompson, W6HDU, 1031 San Antonio Ave., Alameda, CA 94501. (415) 521-1429

WANTED: Navy tube tester TV-7/U; xcvr SCR-522 w/xtals; schematic and test procedures for GC Electronics Co. Test Pattern Generator model 36-610; Precision Electronic tube and transistor checker, model 10-60. Stephen Kalista, WB2LKN, HC 1, Box 137, Jim Thorpe, PA 18229. (717) 325-4120

CLASSIFIEDS

FOR SALE: Interphone amplifier AN/ATC-2 with data book and dynamotor, less tubes - $20, with tubes - $30, plus $5 shpg; Hy-gain co-axial switch, 3 inputs to one switch selected output - $5 plus $2 shpg; Heathkit SW rcvr, model AR-1 in gray fabricated covered wood cabinet, 550 kcs to 30 Mcs - $25 plus $5 shpg; HP AC VTVM, model 400D - $25 plus $5 shpg; police alarm radio, 'as is' - $15 plus $3 shpg; dash mount 'CB' spkr w/cord and plus - $3 plus $2 shpg; Telrad xtal controlled freq. standard - $25 plus $5 shpg. James Fred, R1, Cutler, IN 46920. (317) 268-2214

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: Leeds and Northrup standards resistors,etc.; Thomas 1 ohm, cat. 4210,NBS "ROSA" 4200 series esp. 100 ohm, 4221, 4222, .1, .01 ohm. Any other L&N equipment in gray metal enclosures. Thanks. Buddy Herring, 1310 Andover Rd., Charlotte, NC 28211. (704) 366-6600 eves.

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: Viking 6N2 w/vfo - $75; Drake R4C noise blanker - $85; 75A4 solid state mixer tubes - $25 each; Drake C4 console, complete - $200; ultra-modulation adapter, model UM4B, as seen in AM Press Exchange #94 - $50. **WANTED:** HRO-50 coils. Bill Thissell, K7VZP, 3333 W. Sunnyside Ave., Phoenix, AZ 85021. (602) 942-6352

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.

FOR SALE or Trade: Altec Lansing compression amp., 0 - 30 dB compression; B&W sideband adaptor; tubes and misc. equipment. **WANTED:** KWM-2; SR-150 or? Russ Hunt, W9HZD, 14 Siros, Laguna Niguel, CA 92677. (714) 363-8119

WANTED: Military Radios and Electronics. Systems, collections and accessories: dynamotors, DF loops, control boxes, etc. Any vintage or nationality. Charles DiCecca, KA1CON, 501 Mystic Valley Pkwy, Medford, MA 02155. (617) 396-9354

WANTED: Manuals/schematics/conversion information, 160m/40m plug-in tuning units and 801-803-843 tubes for US Navy GP-7 xmtr. Also HQ-140XA and US Navy TBX-8 manuals, xeroxes ok. Mark Starin, KB1KJ, 457 Varney St., Manchester, NH 03102. (603) 625-1165

FOR SALE: HT4-B, some rust but restorable; T368C. No shipping. **WANTED:** Johnson 500 ; Thunderbolt and mint R390A. I.D. Byars, W4KKO, (615) 668-8451

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

FOR SALE: DX-100 - $100; HQ-170 w/spkr, mint - $250. **WANTED:** NCX-3 manual. Chuck, NYØK, (307) 334-2720

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: Speaker for Collins 75A1, 75A2 or 75A1 or 75A2 with speaker; 310 series exciter; D-104 mic. Greg, WB6FZH, Box 1325, Weaverville, CA 96093. (916) 623-4520

FOR SALE: Many vintage Collins, Johnson, Hammarlund radios, plus tubes, parts, etc. SASE for Fall List. **WANTED:** Buncll sideswiper. Parker, W1YG, 87 Cove Rd., Lyme, CT 06371.

FOR SALE or TRADE: BC-610F w/coils and tuning units, 160-10 meters; AR-88 w/cabinet and meter, orig. cond.; BC-348Q; HT-32; Drake 2B w/2BQ; Viking II w/vfo; KW amp in 6'rack. All in excell. wrking cond. Call anytime. Joe Perratto, K2QPR, 1341 SW Evergreen Ln., Palm City, FL 34990. (407) 220-2189

WANTED GP-1 Navy xmtr and accessories; tech manual for BC-348 JNA rcvr; QST, CQ magazines 1942 - 1945; CQ Surplus Schematic Handbook; CQ Anthology, volumes 1 and 2. Alan Mark, POB 372, Pembroke, MA 02359

FADING EXPERIMENTS between your 2D "Square Diagonal" or 3D "Space Dimension" antenna, and mine, or others, may prove near elimination of short term fading compared to "1D" doublets, yagis, verticals, etc.(impossible to test on SSB!) George Bonadio, W2WLR, 373 East Ave., Watertown, NY 13601-3829. (315) 782-6664, (800)724-7460

WANTED: Johnson Desk KW xmtr or other Johnson xmtrs. Pay cash or trade. Will pick up. Len Crispino, (518) 638-8199

WANTED: Power supply for Atwater Kent model 40. Steven Kalista, HC-1, Box 137, Jim Thorpe, PA 18229. (717) 325-4120

FOR SALE: Very mint 75S-3, 32S-3, 516F-2 - $950. Frank, KC4SRT, Rt 4, Box 224, Sylvania, GA 30467. (912) 857-3307 Nights, 764-8138 days

CLASSIFIEDS

FOR SALE: High voltage capacitors. Check out our growing inventory of new Doorknobs, Mica Transmitting Caps, Tubular Film, Orange Drops, Discs, Silver Mica. Plus many hard to find NOS and surplus parts. Just in: FT-243 crystals. Visa/MC. Call or write for our latest 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

WANTED: Hallicrafters SR-400A Cyclone III (later model from 1971) in excellent condition w/manuals. Will consider earlier SR-400s or SR-2000 (if finals ok). Mark, WB9QZB, 5356 N. Glenwood Ave., Chicago, IL 60640. (312) 275-6867

WANTED: HRO-60; NC-400; coils for HRO-50T1; speakers for NC-303 (NTS-2), HRO-50T1, NC-183D (NC-183DTS), 75A4 (270C3); original manuals for HRO-60, HRO-50T1. Carter Elliott, 1460 Pinedale Rd., Charlottesville, VA 22901. (804) 979-7383 H, 980-7698 W

WANTED: Johnson Viking II, Ranger II and 500; Heath Apache; power xfmr for Heath SB-610 Analyzer; power xfmr for Hallicrafters HT-37/HT-32; black cast front sub-panel for HT-32. Todd Zelasko, KA8CEF, 9401 Grand Div., Cleveland, OH 44125. (216) 883-5134

WANTED: Disabled veteran wants a scanner. It can be base or handheld. Can pay only shipping. John Eary, (606) 329-2833

FOR SALE: Professional reprint of 3 ft. by 5 ft. factory diagram of Collins KW-1 - $18 ppd. Tom Berry, K9ZVE, 1617 W. Highland, Chicago, IL 60660. (312) 262-5360

WANTED: Help in getting a beautiful Viking 500 on the air. Name your price for your extra set of 3 interconnecting cables or for making a set for me. Or sell me the correct materials and I'll make the cables. (I have instructions but they don't make much sense without being able to see the materials.) Or advise who you know that might be able to assist in this project. I also need a complete schematic. All help and information is greatly appreciated. This unit is mint and belongs on the air. Steve Sauer, WA9ASZ, Rt 3, Box 413, Bloomfield, IN 47424. (812) 863-2088 evenings after 6 EST

CLASSIFIEDS

WANTED: Spy radios. Buying military radios beginning with "SS"; (example SST-1,)! Also M-209 cipher machines! Trade items available! Keith Melton, POB 5755, Bossier City, LA 71171. (318) 747-9616

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.

FOR SALE: 30S1; 30L1; KWM2A; 51J4; xtal sets; PM-2; 180S1 and dipoles. **WANTED:** KW-1; KWS-1; SC101; SRA-22; National HRO-500; anything Rockwell. Richard Galardi, 9 Walden Pond Cir., Saugus, MA 01906.

WANTED: Manuals or copies for Morrow 5BR and 3BR-5 converters; Clegg FM-27B. Geoff Fors, WB6NVH, POB 342, Monterey, CA 93942-0342

WANTED: Mint Astro 103 or 200 or ?. Cliff, W4RML, 16514 Arabian Way, Montverde, FL 34756. (407) 469-3534

WANTED: National NCX-5 parts set or just a case and some knobs. Also manual or one to copy. Walt, KJ4KV, 3123 N. Military Rd., Arlington, VA 22207

FOR SALE: NC-270 in excell. cond. electrically and cosmetically, w/orig. manual and matching NTS-3 spkr - $125 plus shpg. Steve Sauer, WA9ASZ, Rt 3, Box 413, Bloomfield, IN 47424. (812) 863-2088 evenings after 6 EST

FOR SALE: Please send SASE for 5 page list of vintage gear for sale; xerox's available for over 200 vintage manuals - 10 cents per page. Mike Horvat, 112 E. Burnett, Stayton, OR 97383.

FOR SALE: Nice Drake TR4C w/RV4C remote vfo, spkr, AC4 ps and manuals - $300 u ship. **WANTED:** Heath Mohawk rcvr, good to excell. cond; TR coax switches; 115 relay coils; two front screws for Apache xmtr. George Carroll, 301 New Jersey Ave., National Park, NJ 08063. (609) 848-6699

WANTED: Speaker or speaker cabinet for HQ-160; anything Hammarlund. Charles Graham, K6KDZ, 20335 Casa Loma Rd., Grass Valley, CA 95945. (916) 273-6847

WANTED: Collins 32V-3 xmtr. Fenton Wood, 109 Shoreline Dr., S.H., Malakoff, TX 75148.

FOR SALE: Collins 3253, 7563B, 516F2, W/E, good cond. - $500; 312B4 R/E , good cond.- $100; Drake L75 amp, excellent cond. - $700. Paul, W5NTQ, (713) 776-0440 eves.

ER Parts Unit Directory

At this point the directory has 180 units in it. If you need a part for a vintage restoration send $1 and an SASE 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

516F-2 Power Supply Upgrade Kit

An upgrade kit is now available from VISTA to add relay switching on/off control and solid state rectifiers to the Collins 516F-2 Power Supply. This kit provides the following performance and reliability advantages:

* Extends life of KWM-2/2A or 32S-3/3A ON/OFF switch by eliminating the high current inductive load switching.
* Eliminates primary current in the loop-thru wiring, lowering the source impedance to provide better output voltage regulation and improved 6.3 VAC filament voltage.
*Prepares the power supply for solid state rectifier units to replace the 5U4 and 5R4 tubes as endorsed by Collins 1-76 Service Info Letter. The solid state rectifiers reduce the electrical load on the power transformer and significantly reduce the dissipated heat generated with tube operation. A 200 ohm, 25 watt resistor is added to simulate the plate resistance of the 5U4 tube, allowing a solid state rectifier to produce the correct output voltage while saving 15 watts of filament power.
*The kit is installed without drilling holes or making any mechanical modifications.
*The relay bracket and resistor are pre-wired with color coded wire to simplify the installation.

The price for the VISTA Upgrade Kit is $49.95 plus $3 for shipping/handling. The price for the pair of 5U4/SS and 5R4/SS solid state rectifier replacements is $29.95 plus $3 s/h. If the kit and the rectifiers are purchased together, the price is $74.95 plus $5 s/h. Ohio residents must add 6% sales tax. Please mail check or money order to:

VISTA

VISTA TECHNOLOGY INCORPORATED
3041 Rising Springs Ct.
Bellbrook, Ohio 45305
(513) 426-6700

FOR SALE: Johnson Thunderbolt - $395; original AR-88 manual - $15. **WANTED:** Millen 90281; MD-7 modulator; NC-303 rcvr. Richard Smith, KF6EA, 1122 Via La Cuesta, Escondido, CA 92029. (619) 739-1835

FOR SALE: R-388 - $250; 32V-2 - $300; 75A-1 - $175; TR4-CW, w/RV-4C, AC-4/MS-4 - $525; TR4-C w/AC-4/MS-4 - $300; GAP DX-VI - $199. Joe Thurtell, K8PSV, 11803 Priscilla, Plymouth, MI 48170. (313) 453-8303

FOR SALE: Homebrew KW xmtr, 250TH finals, 810 modulators, VM-5 mod. xfmr - $450. **WANTED:** 5514 tubes. Mike, KE9FK, (303) 431-9278

WANTED: I.D. plate for Collins R-388 rcvr and spkr for same. Nick Mentavlos, 8331 Bar Harbor Lane, Charlotte, NC 28210. (704) 556-7188

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

FOR SALE: 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

WANTED: (2) 8122 tubes and sockets for Hallicrafters Hurricane restoration; Radio Boys Books; 1950's Allied catalogs. Jeff Garrett, KEØMT, (303) 455-5658

WANTED: Bandspread coils or coil forms for National SW-3, AC model. Leland Smith, W5KL, HCR-31, Box 147, Jasper, AR 72641. (501) 428-5967

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

CLASSIFIEDS

FOR SALE: Johnson vfo, factory wired Viking II with 12AU7 keyer, Hallicrafters SX-100 w/spker, manuals - $300 PU only. John Maver, W6MQK, 1049 N. Holliston Ave., Pasadena, CA 91104. (818) 798-9345

FOR TRADE: National FB7-A and/or SW-3. **WANTED:** Pre-WW II xmtr; Johnson, National ham gear and accessories; Speed-X keys. Niel Wiegand, WA5VLZ, 911 North Bend Dr., Austin, TX 78758. (512) 837-2492

WANTED: Manual and schematic for radio amplifier AM-8C/TRA-1 (uses 2 HK257B/4E27 RF amp tubes and 3 OD3 voltage regulators). John Lellelid, Box B, Colman, SD 57017. (605) 534-3744

WANTED: Signal-One CX-7 for parts, non working. Dan Ramsey, K6PJY, 2726 Roosevelt Ln., Antioch, CA 94509

FOR SALE: Pierson KE-93 w/AC and 6 &12 DC supplies - $125 plus shpg. W6LHH, 561 Atherton, Novato, CA 94945. (415) 892-2643

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: Manuals for SSIR rcvr/panadapter; also manual for HRO-60. Will pay for copy costs etc. Tom Arnold, N4VHC, 2007 E. Powhaton Ave., Tampa, FL 33610. (813) 237-0317

FOR SALE: Heath HW-8 - offer or trade. **WANTED:** Any tube type CB gear; spkrs for 2B, NC-300, HQ-170. Bill Kipping, KE7KK, 6712 Lake Dr., Grand Forks, ND 58201. (701) 772-6531

WANTED: Copy of "World's Equiv. Tubes" by Bran. Gary Cain, 1775 Grand, #302, St. Paul, MN 55105. (612) 698-4851

WANTED: National NHU VHF rcvr for cash or trade my nice SW-4. Robert Enemark, W1EC, Box 1607, Duxbury, MA 02331. (617) 934-5043

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

NEW 75A4 FILTERS

AM filters with optimized response to eliminate the ringing and distortion caused by the steep skirted mechanical filters. Make your A4 sound like an A1, A2, HRO, etc.

Three models:

455A4-4 khz

Gives a smooth slightly narrower nose than the 6 kc Collins, ideal for crowded band conditions. Non-ringing design. Filter BW = 4 khz @ -6 dB, 16 khz @ -60 dB.

455A4-6 khz

Best for general AM use. Much smoother sounding than the 6 khz Collins. Filter BW = 6 khz @ -6 dB, 16 khz @ -60 dB.

455A4-9 khz

Great sounding audio when QRM is not a problem. Filter BW = 9 khz @ -6 dB, 21 khz @ -60 dB.

Note that above bandwidths are for the filters alone. Nose BW reduced slightly and -60 dB improved considerably when installed in receiver.

New design optimized for best tradeoff between skirt selectivity insertion loss (within 3dB of mechanical filter) and smooth audio quality. Exclusive circuit neutralizes input to output leakage capacitance.

Also available is a CW filter, model 455A4-CW1 to give similar response to the crystal filter in a 75A1 or A2. Single crystal backed up by a ceramic filter. Less insertion loss than 500 Hz Collins.

Prices: (money back guarantee)

455A4-4 khz, 455A4-6 khz, 455A4-9 khz — $83.50 ppd.

455A4-CW1 — $88 ppd.

(10% discount for 2 or more filters)

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(714) 985-6250

Direct plug-in, no modifications necessary!

WANTED: Collins 75A-3, 51J4 or 75A-4; universal audio output xfmr; SX-32 parts source; lighted meter for HRO-5. Brian Roberts, K9VKY, 3068 Evergreen Rd., Pittsburgh, PA 15237. (412) 931-4646

WANTED: Johnson gear: power divider, attenuator,power reducer, 275 watt Matchbox with or without directional coupler and indicator,10 watt audio amplifier; Heathkit SB 110A; 866A tubes. Mack Fairley, AB4ZF, 506 Tallyrand Ave., Monroe, NC 28112. (704) 283-5146

WANTED: Original military manual TM11-858 (R-392). Also need copy of schematic/manual for Scott SLR-F Navy rcvr. Tom Mackie, WB2ILA, Rd #2, Harbor View Rd., Oyster Bay, NY 11771. (516) 624-2178

FOR SALE: Control Box C-87/ART-13, NOSB - $27.50, two for $47.50, plus $2.50 UPS; ART-13 manual repros: Maintainance - $45, Operation - $22.50. State transmitter model. Antenna mount M-48, used - $97.50; VRC-12 parts. Robert Downs, WA5CAB, 2027 Mapleton, Houston, TX 77043. (713) 467-5614

CLASSIFIEDS

FOR SALE: Collins KWS-1, 75A-4, SC-101 station controller - $1600. Manuals for everything. All equipment in very nice condition. Bill Harrower, WA0U, Rt 1, Box 47, Ulman, MO 65083. (314) 369-2781

FOR SALE: AN/WRR2; TBX; TBY; BC-683B; RBB; CH2; OCT; TDQ. Trade for W.E. tubes, Hi Flamps. V. Vogt, 3305W 43rd ST. #247, Renton, WA 98055. (206) 251-5420 EX. 247

FOR SALE: Exceptional HQ-170, prof. reconditioned, excell, w/manual -$140; Johnson 275 watt Matchbox, good cond., orig. manual - $75. Bob Lemanek, 14565 Garfield, Allen Park, MI 48101. (313) 928-6658 after 6.

FOR SALE: Complete HRO RAS-3 w/6 sets of coils, spkr and power supply, good cond. Charles Stinger, W8GFA, 404 Ross Ave., Hamilton, OH 45013.

FOR SALE: After being burglarized 5 times, I still have some left. What do you need? Cdr. Glenn W. Ritchey, USN Ret., W7SAB, 219 Naval Ave., Bremerton, WA 98310. (206) 373-9631

The K8MLV/Ø Sale Continues; many items left. See Sept. ER, last page. Many xfmrs, chokes, chassis, etc **FREE**. Bring truck or pay shipping or this will go to the dump. Rick, K8MLV/Ø, (719) 543-2459

FOR SALE: R4B, T4XB w/power supply; Eldico SSB-100A; Heathkit DX-40 w/vfo; SSB adaptor; Johnson Viking I and II and others; old Instructograph; Knight T-60 xmtr; Meisner Exciters; National HRO-50 coils AA and AB, xtal calibrators XCU -27 and -109; Swan 240 and 250C; WRL Galaxy III w/AC and DC supplies; military Collins R-224-ARC-21. For complete list send SASE. Tom Raymond, W5JM, 2320 S. "O" St., Fort Smith, AR 72901. (501) 783-8848

WANTED: Information on Eddystone receivers, history of the company, list of their products, etc. Also information from someone who has used Eddystones commercially or in an amateur radio station. Also would like a manual for a model 770R MK II. Barry Wiseman, N6CSW/Ø, POB 57, Hesperus, CO 81326.

WANTED: Schematic or manual for Eldico SSB 1000 amplifier. Xerox ok. Thomas Berry, K9ZVE, 1617 W. Highland, Chicago, IL 60660. (312) 262-5360

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A directory of vintage parts unit rigs available to subscribers for $1 and a LSASE. Presently there are 170 units in the directory and it's growing daily. The list of units is by manufacturer in alphabetical order followed by the owners address and telephone number. If you have a parts unit please let us put it on the list.

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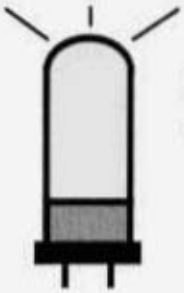

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