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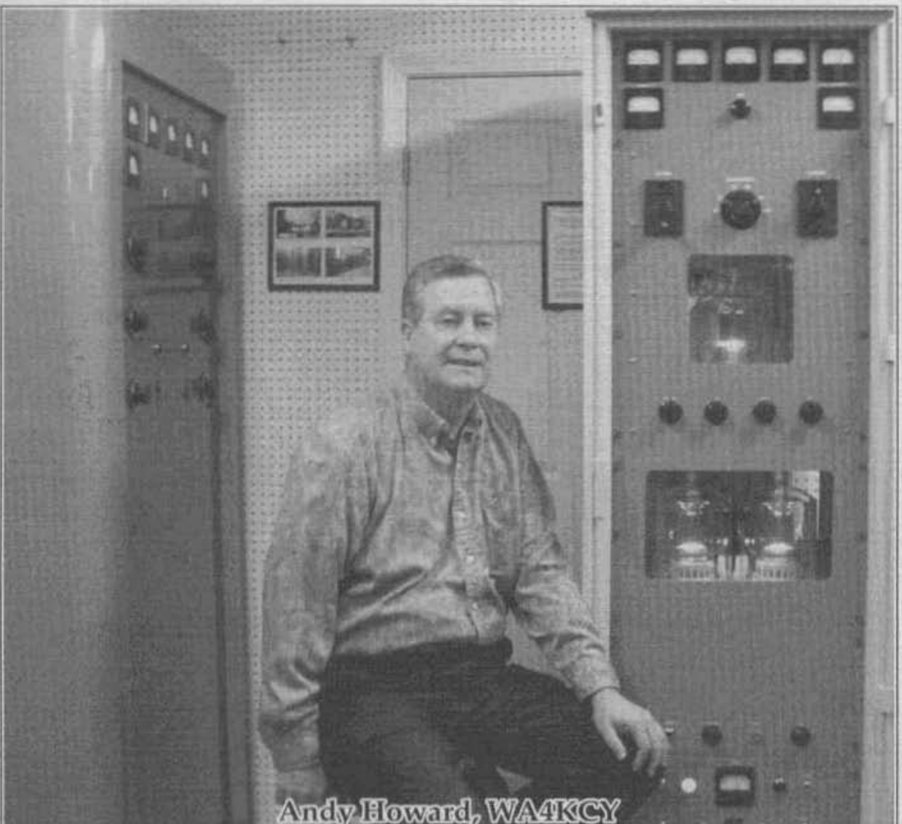
ELECTRIC RADIO

celebrating a bygone era

Number 152 January 2002



ELECTRIC RADIO

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

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

Regular contributors include:
Bill Breshears, WC3K; Bob Dennison, W2HBE; Dale Gagnon, KWlI; Bob Grinder, K7AK; Jim Hanlon, W8KGI; Brian Harris, WA5UEK; Tom Marcellino, W3BYM; Ray Osterwald, NØDMS; Chuck Teeters, W4MEW; Bruce Vaughan, NR5Q.

Editor's Comments

Bill Stewart, K6HV, Silent Key

Another old timer and radio pioneer, Bill Stewart, K6 (High Voltage) passed away recently. Bill was the kind of person everyone liked. I never met him in person but I felt I knew him very well through the many phone conversations we had over the years.

It was Bill who gave me an understanding of the history of the Collins Radio Company back when I was just starting ER and it was he who introduced me to such Collins icons as Roy Olson, Ernie Pappenfus, Gene Senti, Fred Johnson, John Foster, Warren Bruene, etc. etc.

Bill went to work for Art Collins back in 1935 and he valued this association almost above all else. In an article in ER #4 (August 1989) he described his first days at Collins. He may have been the first real sales person at Collins Radio and he contributed a lot to the company. He will be missed by many good friends.

Heavy Metal Rally

I had hoped to announce the winner (the station voted to have the best audio) of the HMR this issue but I've only received a very few votes so far. If you haven't voted yet (and you can do so if you participated or not) please do so ASAP via e-mail or by letter. I'll announce the winner next issue.

Balanced Tuners

Frank Van Zant's, KØOR, article "The Tuned Aerial" elicited a tremendous response from ER readers. It's almost as if the entire readership collectively and simultaneously concluded that the balanced tuner is the only way to go if you're using open-wire feedline. We're going to have a follow-up article next month that should be interesting too and I'm inviting those that are building balanced tuners to send in photos of their creations.

Collins 300G Article

Because of other pressing stuff I have not been able to get the promised article together. Hopefully I'll have it for next month's issue. N6CSW

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Cover: Andy Howard, WA4KCY with his new homebrew 4-1000A rig. Also shown in the photo is a Gates 250GY broadcast transmitter. See Andy's article on page 20.

Letters

"...and tuning."
Dear ER

Some of us olde buzzard buggers remember that phrase concluding long ago AM 'phone CQs. And it was taken for granted on CW, too, just not tapped out.

I would kindly suggest that today, still, the act should be applied when making glowbug CQs. Or, if you are running one of the silicone xcvrs, exercise the RIT a little. You may well find rockbound replies not exactly your zero beat.

For example, just last evening on 40 CW I answered on my 7040 rock CQs called on 7037, 7038 and 7042 without success, yet when I called CQ twice, I netted two fine QSOs on 7039 and 7042. Years ago I remember working my last WAS state 27 kcs above my transmitting frequency; it is so noted in my olde logbook.

Part of the charm of HB pebble crushers is the simplicity of xtal control, a long ago era we still try to replicate, with a friendly QSO.

Just one drop of "4 and 1" (or WD-40) on the RX tuning knob should do it nicely.

Few of us can afford today's $12 each crystals every kc from har to thar on a band, but we'd like to QSO.

Enjoy the glow.
Bill Smith, W5USM

Concerning November AGC article
Dear ER

Concerning my R-390A AGC article in the November 2001 issue, it has been pointed out to me that I did not mention what to do with the original AGC wiring between the junction of R546 and R547 and the suppressor grids of V504 and V509. The thing to do is remove the wires! The objective of the changes to V504 and V509 is to make them behave like conventional pentode RF amplifiers. I can be reached by e-mail concerning this or any other subject at Ray.Osterwald@Xcelenergy.com
Ray Osterwald, NØDMS

In regard to KØOR's article "The Tuned Aerial".
Dear ER

I wish to commend Frank Van Zant, KØOR, for his eye-opener on the timeless balanced tuner and ER, for publishing it. Noteworthy was Frank's expose' baring the corrupted use of both the G5RV antenna and balun. The photo and graphics deserve kudos as well.

Frank's mention of heating up ferrite drew my interest. Contrary to popular belief, the modern balun installed in the "balanced" input of commercially built transmatches for the amateur service is a potential source of non-linearity. Such devices are easily driven into saturation by even moderate RF power levels as they attempt to open-wire feed the popular non-resonate all band dipole.

I don't believe a power driven balun with transmatch is a satisfactory substitute for a balanced antenna tuner in matching the complex impedances presented by a single dipole intended to be operated over a wide frequency range. They are, however, excellent passive impedance matching devices and have a myriad of applications in low RF power applications. This is why KØOR's article "The Tuned Aerial" is so important to the modern amateur.

It provides rationale for using balanced tuners in lieu of balun devices and presents a "cookbook" diagram and chart that anyone can duplicate in the ham shop.

Those familiar with saturable reactors can appreciate the potential for harmonic generation in toroidal core materials used in matching networks and baluns for amateur antennas (See

continued on page 41

AMI Update - January 2002

by Dale Gagnon, KW1I, President

AMI moves into the new year with over 1350 members and a small balance in the bank. AMI Headquarters recently dropped the ball by not announcing the Thanksgiving AM Jamboree operating event in November ER. There was quite a bit of activity on the bands, but very few logs submitted. It is not too late to send in a copy of your log of AM QSOs over the Thanksgiving weekend so AMI can issue you a certificate suitable for display in your radio room.

Note on low power AM transmitter operation – On 160-20 meters amateurs using low power AM can at times be very frustrated by the lack of ability to contact, or maintain contact with stations that are coming in strong on their receivers. On the other side of the QSO many amateurs running higher power AM and/or highly effective antenna systems can be very frustrated by low power AM stations answering their CQ or checking into a roundtable with signals that can barely be copied. Often the low power AM station operator is new to AM. They hear big signals on their receiver and think they are going to be heard with the same signal strength by the station they are trying to contact.

They don't realize the other station may be running a lot more power, or that busy and noisy bands or marginal propagation often requires higher power to maintain reliable communications. I have experienced this while operating mobile. I will have several good QSOs in the late afternoon on 75 meters with stations that are of only moderate signal strength. A few hours later I am amazed that the stations with rock crushing signals can't copy me at all. It is non-intuitive, but it is true. What makes matters even worse is when AM'ers running low power make long transmissions. In roundtables or nets this can lead to tremendous dissatisfaction among the stations that cannot copy the low power station, and it gives an opportunity for other non-net stations to move in on the frequency because they think it is unoccupied.

Here are my recommendations. Stations operating low power AM on the lower HF bands should, for their own enjoyment, target most of their operating to bands and time of day when propagation is favoring two way low power communication. If a station from a long distance is called, or the low power station checks into a net, get a signal report to ensure your signal is readable before you launch into a lot of information transfer. Have your transmitter adjusted correctly to provide an optimum amount of undistorted modulation. Make transmissions short, talk deliberately, repeat important information, use phonetics and ask for reception confirmation for information that you are trying to convey. And don't be offended if the station you called or net control comes back and tells you that you aren't making it.

High power AM station operators and net control stations should give accurate signal reports to low power AM stations, including an assessment of whether it makes sense to continue. They should in a considerate way recommend short transmissions with frequent feedback on signal strength, especially if conditions are marginal.

Of course, the ultimate solution for the operator of a low power AM rig is to be working on building or acquiring a higher power transmitter and an effective antenna to use when conditions warrant!

Happy New Year from AM International. ER

To Join AMI send $2 to:
Box 1500
Merrimack, NH 03054

Marconi's Dramatic Moment on Signal Hill: A Retrospective Review

Part Two

by Robert E. Grinder, K7AK
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Part II: Marconi's frenetic, accelerated professional growth in England

On February 2, 1896, twenty-one year old Marconi arrived with his mother in London, where they were met by Marconi's cousin, thirty-year old Henry Jameson-Davis, a socially prominent young engineer and businessman. He had rented for them a quiet house in which Marconi could develop his apparatus. Marconi's wireless system as of early 1896, the one that he brought to England with him, is shown in Figure 2 (Fleming, 1919, p. 452). His transmitter was comprised of a key "K", batteries "B", induction coil or transformer "I", oscillator (spark balls) "S", aerial "K1", and ground connection "E". His transmitter was identical schematically to that of Hertz.

Marconi's receiver included an aerial "K2", ground connection "E", revised Branly/Lodge coherer "C", choking coils, relay "R", battery for relay "B1", Morse inker "M", and battery for inker "B2". The "choking coils" are in the circuit to prevent electromagnetic waves passing through the coherer, variously denoted in different sources as "electric waves," "oscillations," "impulses," and simply "waves," from wasting energy in the relay coils "R." They also prevent impulses that originate at the contacts of the relay from affecting the coherer. When oscillations change [raise] the conductivity of the coherer the circuit of battery "B1" closes to operate relay "R". When the relay closes, battery "B2" starts the tape rolling on the Morse inker, which provides a permanent record of the wireless impulses on a tape. Battery B1 also serves importantly as a benchmark for adjusting the coherer for maximum sensitivity. The plugs of the coherer tube must be set so that filings become agitated and begin to cohere at a voltage just slightly higher than that of the battery—otherwise the battery itself will pack the filings. Although relay "R" may draw less than one milliampere of current, even this tiny amount is too gross for setting the sensitivity of the coherer. Therefore, for purposes of adjustment, a galvanometer or telephone receiver, which produces an onset and offset click with each electric wave, is usually either substituted for the relay or placed in series with it (Crane, 2000; Fleming, 1919, p. 373).

Fleming (1919, p. 377), with commendable frankness, observed that "the arrangements of Marconi, though admirable, require some dexterity to manage them." For example, the tapper must be set delicately to deliver rapidly a series of blows of just the right strength to keep metal filings in the coherer constantly loose. When oscillatory sparks are transmitted via key for a short period of time, a "dot" is printed on the tape; when sparks are longer, a dash is recorded. If the tapper is too slow or too fast in restoring the coherer in respect to the sending speed of the telegraph operator, the wireless dots

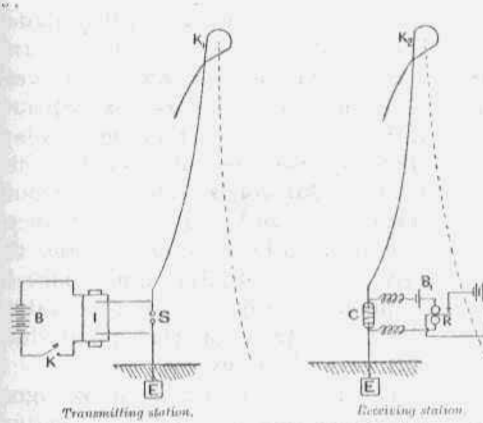

Figure 2

and dashes will be garbled, the Morse alphabetic code will be unreadable, and the message uninterpretable.

Unfortunately, during English Customs, a careless agent reduced Marconi's precious apparatus to rubble. Marconi struggled during the spring of 1896, as he turned 22 years-of-age, to reconstruct the equipment. He prepared also a preliminary description of it for submission to the London Patent Office, June 2, 1896. He followed up on March 2, 1897, with complete specifications and drawings, and on July 2, 1897, a patent was granted to him.

Marconi met in July 1896, with Mr. William Preece, Chief Engineer of telegraph and telephone networks of the English Post Office. Preece had dabbled unsuccessfully with a crude form of wireless, and he was familiar with the Branly/Lodge coherer. He was thus astounded to discover how meticulously Marconi had configured improvements empirically in his coherer to maximize its sensitivity, such as evacuating air from the glass tube and positioning its plugs to create an adjustable gap filled with a precise quantity of space and metal filings.

Perhaps Preece was even more amazed when Marconi operated his coherer. We know that Marconi's industrious manner impressed him and that he considered the demonstration to have been spectacular. Indeed, Preece offered the young man the use of his laboratory, and he served as his sponsor in arranging a series of demonstrations in 1896 and 1897 for officials and engineers of the British Postal Telegraph system. Moreover, a technician who worked in Preece's laboratory, Mr. George S. Kemp, was assigned to assist Marconi. Shortly thereafter, Kemp left Preece to work for Marconi; the association initiated a close, personal relationship that prevailed until Kemp's death in 1933.

Regrettably, neither Preece nor Marconi regarded the demonstration as having historical significance, for exactly what occurred has never been described. However, given Marconi's eagerness to obtain Preece's backing, he must have explained the characteristics of the coherer in considerable detail. Specifically, to show Preece the breadth of its capability, he would have indicated its use in: (1) receiving and recording with a Morse inker, (2) copying Morse code with a sounder, and (3) copying weak signals with a telephone receiver.

After having set up his spark gap exciter, possibly in another room, Marconi might have asked Preece to settle himself comfortably in front of the coherer. First, Marconi would have connected the coherer to the Morse inker, as shown in Figure 2. As Marconi pressed briefly the key of his exciter, Preece would have seen the inker tape register a "pip," signifying a "dot." Marconi may have said next that he would draw upon his code skill to send a message; Preece, who doubtless also knew the Morse code, could read

continued on next page

visually the message in code pips off the inker tape. Marconi surely paused to indicate to Preece that copying code with a coherer is touchy almost to the nth degree. "Why is this so?" Preece might have asked. Now, Marconi probably seized the opportunity to reveal how coherers function. The coherer, he would have said, operates as a variable resistor through three stages in each time segment between the onset of an oscillation and the packing of the filings, e.g.: (1) as an insulator-possessing extremely high resistance when metal filings are loosely packed, (2) as a detector when an electromagnetic wave causes a change in its resistance from higher to lower—as metal filings start to cling together, and finally, (3) as a low-value resistor—when the filings become so tightly packed that changes from impulses to even lower resistances are impossible.

Marconi would emphasize that the coherer works as a detector only when oscillations cause it to change the resistance of the metal filings, and therefore, the automatic tapper is a convenient accessory that keeps it from disabling itself in the form of a simple resistor. The tapper moves swiftly, he would note, because it is adjusted to keep filings loose all the time.

Second, Marconi would have substituted a Morse sounder for the Morse inker in order to show Preese another facet of the coherer. Only clicks would be heard as a message is sent. Preece would find the situation familiar, for wire telegraph operators assign meaning to double-clicks to distinguish dots and dashes. The sounder onset click is much stronger than its offset click. A telegraph operator must be skilled in distinguishing between them before a message can be understood. The time interval between the two clicks is relatively short for "dots" and the time interval between the two clicks is relatively long for dashes. Since each letter of the Morse code is comprised of a unique combination of dots and dashes, a key operator must send every element of a combination via a separate impulse, each of which produces a distinct onset and offset click on the sounder. Marconi undoubtedly would have followed the convention of telegraphers by sending in series the letter "V" (dot, dot, dot, dash) to acquaint Preese with the time values that he would be using to separate dots, dashes, and spaces.

Third, to demonstrate weak signal reception, Marconi would have omitted all accessories except that he would connect a telephone receiver and battery in series across the terminals of the coherer. He would have pointed out to Preece that a fairly strong electric wave from a spark gap transmitter is necessary for controlling even a sensitive relay, and in turn, operating accessories. Even a very weak signal, on the other hand, will produce a click-buzz-click in a telephone receiver. Preece probably began to listen intently, but he would have heard nothing—the telephone receiver would have been silent-no static, no noise, no sound-nothing—providing that electrical impulses were not brewing during a thunder and lightning storm outside. When Marconi pressed the key, Preece would have heard a strong click in the telephone receiver followed by a buzzing sound generated by the arcking of the sparks, and finally, a feeble click when the key is lifted. A minimal use of accessories is necessary, Marconi would affirm, for weak signal reception, but the coherer no longer has an automatic tapper available to keep it restored and no capability for recording messages.

Marconi would summarize his presentation for Preece by stating that the coherer is inherently delicate and must be constructed precisely for reliable reception. Since a coherer will pass only a few impulses before it needs another tap to loosen packed filings, the receiving operator must be exceedingly skillful to avoid missing part of what is sent. The task of copying weak code signals by wireless is especially tedious and fraught potentially with errors, because hand-tapping replaces the automatic tapper. Marconi could also state confidently that well-trained, traditional telegraph operators make easily the transition from wires to wireless and that many of them are eager to join him in conducting experiments.

Marconi's subsequent demonstrations for professional engineers were attaining noteworthy distances by late 1896, and they were beginning to attract media attention. To mitigate curiosity and publicize the viability of wireless, Preece arranged for a free demonstration at Toynbee Hall, at which Marconi walked around the auditorium carrying his coherer connected to a doorbell; whenever Preece pressed a telegraph key, the ensuing electric wave would activate the bell.

As word of his exploits spread, Marconi reached his 23rd year, and not surprisingly, became an intriguing, eligible bachelor. Prestigious hostesses sought him as their guest at London dinner parties. Marconi, however, regarded the elegant parties as a waste of time; he distained the small talk about wireless that guests expected of him. Speculators also approached him to sell the rights to his wireless system, but he brushed off their overtures since he was convinced more than ever that wireless was on the verge of becoming a tremendous commercial resource. He chose, therefore, to work on his apparatus by spending the winter of 1897 in semi-seclusion (Marconi, Degna, 1962).

Meanwhile, questions arose concerning the validity of his patent. Did his wireless system really qualify as a new invention? What had he contributed beyond the familiar work of others? Critics argued that his spark-gap transmitter was essentially a variation of what Hertz had conceived and his coherer incorporated features of Branly, Lodge, and Popoff. Thus, they looked upon his vaunted patent as flawed—as merely an abstract application of accomplishments not really his. Marconi and his supporters, nonetheless, believed that clearly he had perfected a doable wireless system for telegraphic communications. Thanks to his striking upgrades of the coherer, spark-gap transmitter, and aerial, Marconi had advanced prospects for wireless communications much farther than had anyone else. Awareness of the progress that he had made surely fortified his belief in himself and inspired him to redouble his effort to outshine his competition. Nevertheless, throughout his life, whenever he was proclaimed to be the inventor of wireless or radio itself, he would demure, insisting that he had invented only a workable system of wireless communications.

Hindsight reveals that Marconi's sweeping patent, purporting to cover all aspects of wireless communications, failed to protect his interests as he had hoped. It was interpreted narrowly to cover wireless mainly in respect to aspects of spark-gap transmissions and coherer receptions. Various alternative systems of wireless telegraphy were arising in Germany, in the United States, etc. for which patents were being issued. Marconi soon realized that his patent was rapidly losing its force. He recognized, 1897-1898, that successful ventures in wireless would be determined not by fiat but by whether he could best his competition in offering commercially effective and profitable wireless products.

As Marconi aimed in successive demonstrations to communicate at greater and greater distances, an

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asymptote approached. Aerial heights had practical limits and 250-500 watts of spark was about all that could be produced from batteries. Hence, Marconi focused once again on his coherer. He experimented with a Faraday induction coil in an attempt to amplify at the coherer weak signals reaching the aerial. The primary of his improvised coil consisted of a few turns of wire, one end of which was connected to the aerial and the other, to ground. The secondary of the coil, with many more turns, was connected across the coherer (Blake, 1928, pp. 108-109; Coe, 1943, p. 91). After considerable tinkering, Marconi was able to induce a stepped-up signal in the secondary coil, and thereby, enable the coherer to detect signals it had missed before. The basic design of the coil was named "jigger;" maybe because Marconi jiggled with several manifestations of it in his effort to improve it; however, sometime around 1899 the coil was named the "Billy coil," perhaps in an affectionate deference to his English nickname.

Marconi's cousin, Henry Jamison-Davis, proposed to him in April 1897, on roughly his 23rd birthday, that a company be formed to develop and market his wireless system. Marconi figured that he now needed an infusion of about $100,000 [in 1900 dollars] to support his research. Therefore, on July 20, 1897, Marconi established "The Wireless Telegraph and Signal Company Limited." The Company paid Marconi roughly $40,000 in cash, plus 60,000 shares of the 100,000 shares issued at roughly $4.80 per share (Bussey, 2000). The balance of the 40,000 shares was put on the market for public subscription. Family members in Ireland, Italy, and England purchased most of the stock. On February 23 1900, at the urging of Marconi's father, the name of the company was changed to "Marconi's Wireless Telegraph Company, Ltd" (Kreuzer & Kreuzer, 1995, p. 22).

Marconi participated in demonstrations at breathtaking pace between July 1897 and December 1899. One of them involved communicating 11-1/2 miles from a land base to an Italian Naval warship at sea, after aerials at both sites were raised to 100 feet (Coe, 1943; Krezuer & Krezuer, 1995). Another demonstration, of which Marconi was particularly proud, occurred in 1898 when he established communications between Queen Victoria on the Isle of Wight and a yacht anchored about 7-1/2 miles away, where her eldest son, the Prince of Wales, was recuperating from a leg injury. Marconi attained from the venture immense stature in the English press.

On March 27 1899, Marconi sent and received signals successfully across the English Channel. He visited Dublin, July 28 1898, to make live reports on the progress of a yacht regatta, and repeated the feat, October 16 1899, in reporting on the America Cup races for the New York Herald. The events reaped expanded international recognition for Marconi and stimulated insatiable public interest in wireless communications.

While in the United States for the races, Marconi demonstrated his wireless technology for the U. S. Navy and Army. He had communicated distances of 80 to 100 miles between land stations and ships for the British Navy, and in America, he managed to send messages 60 miles. The military services, however, were disillusioned upon learning that transmissions sent simultaneously would interfere with one another. They rejected his overtures summarily.

Marconi was brought up short by the confrontation. The U.S. military had exposed a serious problem with his untuned wireless system. His apparatus was wholly unselective, and interference was becoming a major inadequacy as transmitting and

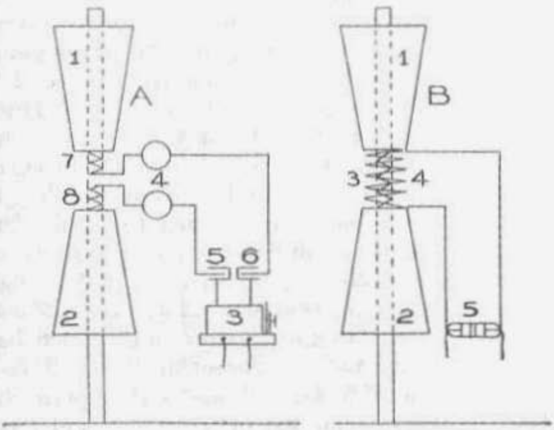

Figure 3

receiving stations proliferated. The dilemma was compounded by two complementary problems: (1) how to tune or synchronize a spark-gap transmitter and a coherer to be on the same wavelength, and (2) how to operate on different wavelengths so as to avoid interference.

Marconi attacked the problem in his usual manner. He investigated the work of others to ascertain whether a product had been invented to address them. He was heartened to learn that in 1897 Sir Oliver Lodge, of coherer fame, had invented a means of regulating or tuning the wavelengths of spark transmitters and coherers. Marconi was less thrilled to learn that Lodge had patented his technique with the title: "Improvements in syntonized telegraphy without line wires." Lodge used the term "syntony" to signify when two tuned circuits are resonate with one another. He recognized that the wavelength of a circuit is influenced by both "capacity" and "inductance," and he described a mechanism for adjusting the two factors in both transmitting and receiving circuits.

An overview of Lodge's system of syntonic tuning for a spark gap transmitter is shown on the left in Figure 3 (Thom-Collins, 1908, Part II, p. 25). Lodge developed two conical, horn-shaped radiators with a single rod or wire through each of their centers "A-1" and "A-2" to vary capacity. The cones are attached at their narrow ends, via the rods or wire, to an aerial and ground, respectively. Next, Lodge connected each terminal of the induction coil "3" in series with an adjustable Leyden jar condenser "5" and "6", also for varying capacity, and a spark ball "4" to one end of a spiral coil "7" or "8". The cones are charged by induction coil "3", and discharged through the spark gap "4". Each Leyden jar consists of metal foil sheets on the inside and outside of a glass jar. Each interposed inductance, "7" or "8", between the spark balls "4" and the cones is usually a spiral of a few turns. The spiral coils are squeezed or lengthened to vary their inductance values.

An overview of Lodge's syntonic system for the coherer is shown on the right in Figure 3. The receiver "B" is comprised of two similar capacity cones, "B-1" and "B-2." The two are connected through the primary of an induction transformer "3", whose secondary "4" is attached to each terminal of the coherer "5". As Lodge showed, transmitters and receivers so equipped may be set to operate on different wavelengths. Moreover, he also showed that they will resonate at the same wavelength when syntonized.

Marconi recognized that Lodge's system exemplified the basic principles of tuning, and he recognized, too, that a less wieldy mechanism had to be devised before it could be put to practical use. Therefore, after several months of experimenting, he introduced proudly in 1899 his version of Lodge's

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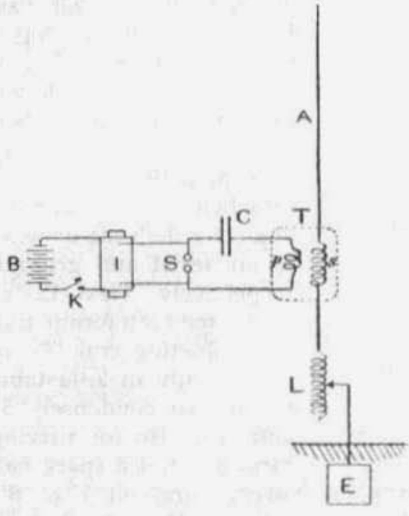

Figure 4

"syntonized" circuits. The design of his transmitting apparatus is shown in Figure 4 (Fleming, 1919, p. 464). First between one terminal of the oscillation transformer "T" and ground connection "E", he inserted adjustable induction coil "L". The secondary "s" of transformer "T" is connected between aerial "A" and "L". One side of the primary "p" of "T" is connected directly to a spark ball. The other side is connected through an adjustable Leyden jar condenser "C" to the other spark ball. The spark balls are connected to the secondary terminals of an induction coil "I". The primary of "I" is connected to a battery "B" in series with the key "K". By adjustment of variable inductance "L" inserted between the ground and the secondary circuit of the oscillation transformer and by varying the capacity of condenser "C" in the primary circuit, the two circuits may be brought into resonance with each other at different wavelengths.

Marconi's version of a system of syntonic reception with a coherer is shown in Figure 5 (Fleming, 1919, p. 465). The aerial "A", which is shown as terminated in a plate "f1", is connected to an adjustable inductance "g1", which in turn, is connected to ground "E" through the primary of an oscillation transformer "j1". The terminals of "j1" are connected by a small sliding condenser "h". The secondary of the transformer "j2" is cut in the middle, and a condenser "j3" is connected to the inner terminals. The outer terminals of the secondary of transformer "J2" are connected through two small variable inductances "g1" and "g2" to the coherer "T1" which has adjustable condenser "h1" across it. Two choking coils "C1" and "C2", respectively, are connected between "J3" and relay "R". A battery "B" is inserted between "C1" and relay "R" for operating the latter. When the variable condensers in the circuits are in resonance or syntonized with one another, the coherer can be tuned to many different wavelengths. Marconi was pleased with the degree of selectivity that he had achieved. However, Collins (Thom-Collins, 1908, Part II, p. 28) is less sanguine in his appraisal of Marconi's device, e.g.: "when syntonized to each other, selectivity may be obtained within certain limits."

On April 26 1900, Marconi filed for a patent to control syntonic tuning based upon his improvements of the Lodge technique. He argued that it would allow several stations to operate at the same time without interference. The patent was granted in 1901, and Marconi felt that he had attained commercial control of every important aspect of wireless telegraphy. Lodge claimed, however, that he held the basic patent for tuning wireless apparatus. Lawsuits ensued over a period of years until 1911, when Marconi interests purchased the Lodge patent (Coe, 1943, p. 111).

As Marconi moved forward in developing his apparatus, business grew briskly. On January 25 1899, the Marconi Company signed a lease to refurbish an abandoned silk factory and warehouse in Chelmsford in order to

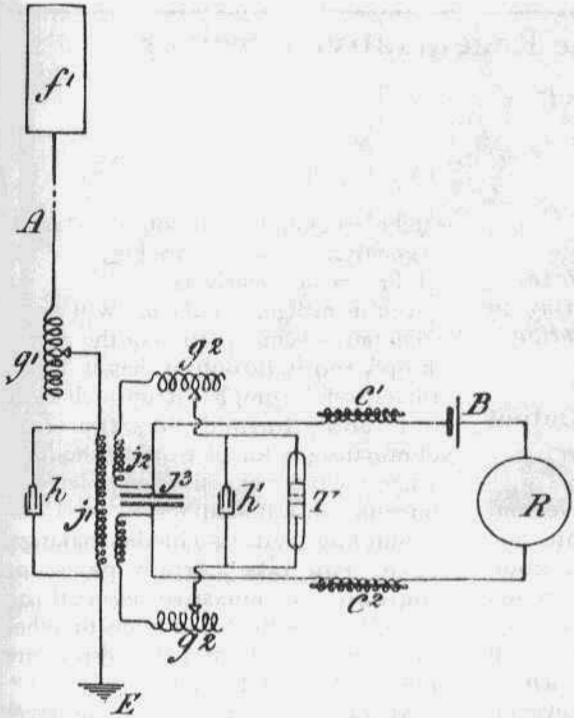

Figure 5

establish a manufacturing plant and warehouse. On July 4 1900, the British Admiralty contracted with him to install his apparatus on 26 of its ships and to build several land and lighthouse stations. Additionally, Lloyd's of London purchased his equipment to communicate with incoming ships for advance cargo reports (Jolly, 1972; Kreuzer & Kreuzer, 1995).

Marconi was only 26 years old early in 1900, and already renowned internationally. The science of wireless was progressing rapidly, however, and he was no longer alone in attempting to evolve a commercially viable system. DeForest and Fessenden, in the United States, Slaby in Germany, Popoff in Russia, and Bose in India were exerting pressure (Wellman, 1952).

Marconi aspired to create a dramatic maritime coup that would attract new customers and convince government and marine officials the world over of the superiority of his wireless system. Most of his sales had been to ships and shore stations, and he believed that he could persuade the Board members of his Company, at their meeting, in December 1900, to go along with his intentions. He told the members that he envisaged powerful land stations on both sides of the ocean; each would have sufficient range to reach the mid-Atlantic, which would ensure that vessels in the busy shipping lanes could be always in contact with one continent or the other, thus averting disasters at sea. Marconi's Board approved the project with little equivocation.

Nonetheless, conventional wisdom at the time thought it fanciful. It was assumed that the useful life of a wireless transmission extended no farther than the horizon. The meager evidence available then seemed to show that signals travel in a straight line past the horizon to be lost in space. No one was aware that long-distance wireless communications are possible because electromagnetic waves are reflected to earth from the ionsphere, a region of rarefied air above the surface of the earth that is ionized by ultraviolet rays from the sun. Marconi, nevertheless, firmly believed that his experiments suggested some phenomenon was causing his transmissions to follow the curvature of the earth, and he willingly risked the fortunes of his company, knowing that proving the pundits wrong also would boost his international stature. ER

Next month Part III

The Ultimate Regenerative Receiver

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Part 2

Warning-This article contains material that may be irritating to experienced builders. Reader caution is advised.

Power Supply & Audio Output Stage

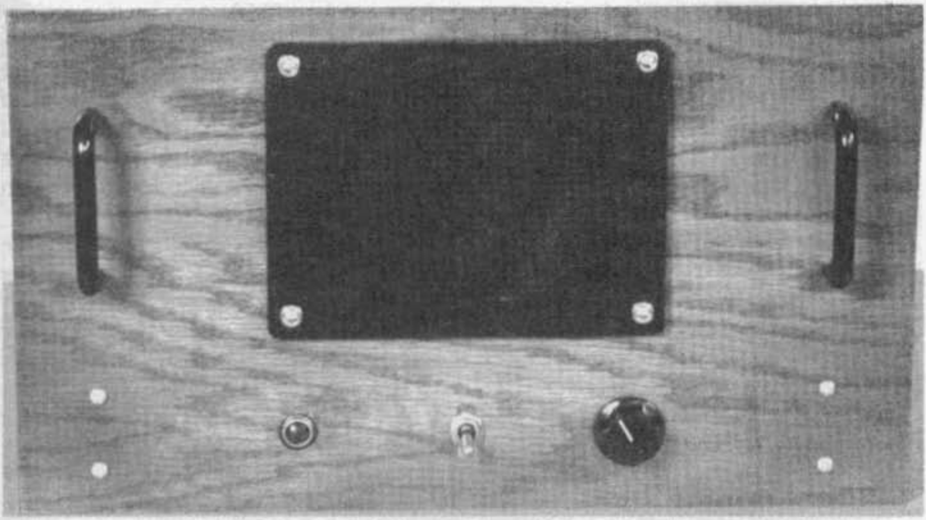
Why not build a receiver and power supply on one chassis? That's a good question. Many of my receivers are self contained, single chassis; receivers that have the power supply and speaker built as a single unit. Quite often such an arrangement works out well. However, as we all know there are certain advantages to building receivers with a separate power supply. This was the norm for manufacturers such as National Radio for many years.

Removing the power transformer, bleeder resistor, choke(s), large voltage dropping resistors, and rectifiers, from the proximity of the detector tube eliminates a lot of heat buildup, and also reduces the possibility of hum pickup. In my little 'Ultimate,' one source of heat in the radio was the audio output tube. Placing the 6V6 on the power supply chassis moves most heat generating components away from the detector. The detector tube operates with less than 16 volts on the plate, and the preamp tubes are allowed to loaf along at about 100 volts, thus generating very little heat. Therefore the detector should be quite stable. Measured frequency drift on receiver #60, the one that inspired this article, is low for a tube type receiver; less than 1 kc for the first hour of operation from a cold start. Some of my receivers are better, while others are not nearly as good.

In this article, Part Two, I will cover in detail the construction of the power supply and audio output chassis. When this chassis is complete it can be checked out and 'burned in' therefore eliminating a lot of trouble shooting when the radio chassis is completed in our third installment.

Building a radio is a lot like making a cake. You take certain parts, or ingredients, measure everything carefully, put the listed items together in a certain way, and the results are more or less predictable.

My Mother, God bless her, was never known as one of the areas better cooks. Born and raised in the early part of the twentieth century, money was always a factor in her household. Spices in her cabinet were limited to three or four of the most common such as sage, cloves, ginger, and allspice. She was notorious for requesting recipes from her friends, and then changing the recipe to something that in no way tasted like the original. If the recipe called for a cup of shredded coconut she might very well leave it out or substitute chopped peanuts. Soda was often substituted for baking powder, granulated sugar for powdered sugar, sweet milk for buttermilk, and vegetable shortening for butter. If a pie recipe called for three cups of sliced peaches she would leave out two cups and substitute starch as an extender. Remember those big, tall, tasty apply pies they used to put in bakery windows? My Mother's pies never looked like that. Her pies were about the thickness of a pancake, and the crust



Front view of power supply/amplifier. Initial cut with coping saw in speaker grill gets lost in printing. Black on black is difficult to reproduce. It actually looks very good. Black knob is the tone control.

was seldom brown—she did not like wasting time waiting for a pie crust to bake.

Once her masterpiece was removed from the oven she would sample it and say, "Everyone is always talking about what a good cook Marie is. I borrowed her recipe and I don't think it is anything to brag about."

My point is, change the receiver design any way you want. You may very well improve upon my ideas. However, please remember when you make a change you are no longer building the receiver under discussion—you are building a prototype whose quality of reception will remain unknown until you complete the set. Everything I mention from the chassis size and weight, to each individual component is the result of a lot of years experience building radio equipment. My way is certainly not the only way—it may not be the best way—but it is what works for me. If I could obtain the same results, and at the same time save weight, room, money, or time, I would certainly do so. The old timers were right—keep it simple—build it stout.

Before we get to the actual construction details I want to mention two more things I consider of prime importance. NEVER, let the thought enter your mind that you might fail—that somehow, upon completion, your receiver may not work. We are positive it is going to work—what we do not know is when, and how well.

My second suggestion is to always practice 'overkill.' Almost every time I depart from this idea I end up regretting it. For example I always use more diode capacity than necessary. Diodes are cheap, transformers are not. I once built a 100-watt transmitter, and was running my final bench test and 'burn- in.' Every thing seemed fine. I had left the transmitter on for over an hour with no apparent problems. I left the shop and went in the house to eat lunch. When I returned to the shop I found the transmitter had actually burned up. The transformer was gone. Hot tar was all over the chassis. Most of the fire had been confined to the power supply area,

continued next page

but with smoke and tar all over the entire chassis. I decided to strip the chassis clean, toss all damaged parts in the trash, and rebuild. If I had spent one dollar more I could have saved myself a lot of money and time.

In the schematic I show a conventional full wave rectifier configuration. The circuit is conventional in every respect. There is nothing new or innovative here at all. I normally use two diodes in series in each HV lead. The added cost is small and additional power rating is a comfort.

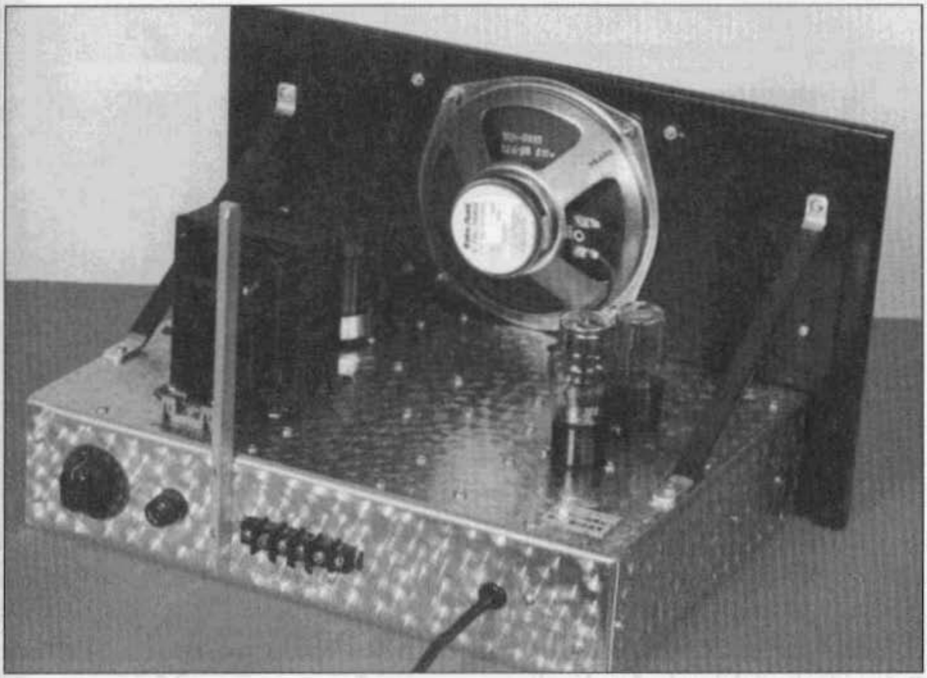
Let's begin construction. In 'Part One' I pretty well covered panel material. There is no need to back a nonmetal panel with shielding on the power supply/audio output chassis. Though different sized chassis pans may be used, you will have a much better looking finished product if you use matched chassis and panels. I prefer a chassis size of 10 X 14 X 3, and a panel size about 16 X 9—nothing critical—just make the panel large enough to accommodate your tuning dial arrangement. You can use lightweight chassis material, but the use of bracing and reinforcement under the chassis may be necessary to assure complete rigidity of all detector components, especially tuning capacitors. I have found it much easier and no more expensive to start with a .063 Byers chassis. If you buy one you will find they come cut and shaped but not drilled. They arrive in a flat pack; the top, two ends, and the two sides. All of my chassis' kits have been precisely cut and formed, and went together with no problems at all.

I have used at least a dozen chassis kits, and believe I have discovered an easy way to assemble them. First, lay out the four sides and the top. Inspect them for scratches. Mark the best long piece for the back of the chassis—the panel will cover up the front of the chassis. Now, inspect the chassis top for scratches. Mark the best side as your top. Use small scraps of masking tape and a pencil for all markings. Now, put the chassis together with a few pieces of masking tape. Duct tape is better if you have a roll available. Tape all four sides together, square with your combination square, then tape the top in place.

Three of the four corners will be fastened with two 6/32 X 3/8 machine screws, tooth washers, and a nut. To mark corners for drilling, adjust your combination square for 3/4 inch. Mark corners up from bottom and down from top. Then adjust the square and measure in from edges to a point that allows your screw to pass thru the center of the bent edges. Notice—on the front side, mark and drill holes the same on both ends. One end will be for attaching panel only—the screws are not needed to secure the chassis corner. On this corner only use one screw to secure corner and drill it midway between the top and bottom of the chassis end. This may be confusing now but once you tape the chassis together it will become quite clear. Attach top with screws about every three inches around the perimeter.

If you count the screws used in your assembly so far, you will find that you used about two-dozen screws on one chassis. To build the complete receiver you will probably use upward of 200 machine screws and nuts. As I mentioned earlier, find a wholesale nut and bolt supplier from which to buy your hardware. Last month I bought 400 outside tooth washers, 200 3/8 inch screws, 100 1/2 inch screws, and 200 nuts—all 6/32 size, from our wholesale supplier. My cost was a few cents over ten dollars. The same hardware from a well-known radio parts supplier would have cost me over $100. This is utterly ridiculous.

I find that using chassis kits is much more convenient than using a welded chassis. My little bench type drill press will not rise high enough to clear a 10



Completed power supply-audio amplifier unit. Control on the left rear of chassis is a 'hum bucker' used because my transformer did not have a center tapped filament winding. See text.

inch chassis. Using a welded chassis I have to resort to a hand drill and rattail file to drill large holes needed for fuse holders, AC line cords, SO-239 coax plugs, etc. With the chassis kit I just remove four screws and place the side or end under the drill press and use large bits or a hole saw.

I use two fuses in my power supply. More overkill. I place one fuse holder under the chassis with a 1.5-amp fuse in it. My other fuse holder is attached to the rear of the chassis and is easy to access. It has a 1-amp fuse in it. If everything operates as it should, the easy to replace fuse will 'blow' first. If something goes wrong, or someone places an oversize fuse in the rear holder, the unit is still protected by the harder to access 1.5- amp fuse.

Notice the big 'pot' on the rear of the chassis. This is a 'hum bucker' variable resistance. In this particular power supply, my power transformer does not have a center-tapped 6-volt winding. In a regenerative receiver this sets the stage for a nice bit of hum, especially on twenty meters. By placing a 30Ω-20-watt 'pot' across the 6-volt winding with the CT grounded, you have an adjustable 'hum-bucker.' I often use one even though the filament winding is center tapped. Remember we are using 1925 technology and twisting our filament supply leads. I've tried grounding one side of the filament and only using one lead—the way its been done for the past 60 years. I had to go back to the twisted filament leads to get really quiet operation. If you cannot find a 20-watt variable pot you may get by using a 10Ω-10 watt resistor from each filament lead to ground. Not ideal, but better than nothing. If you have a choice use a transformer that has a center tapped filament winding.

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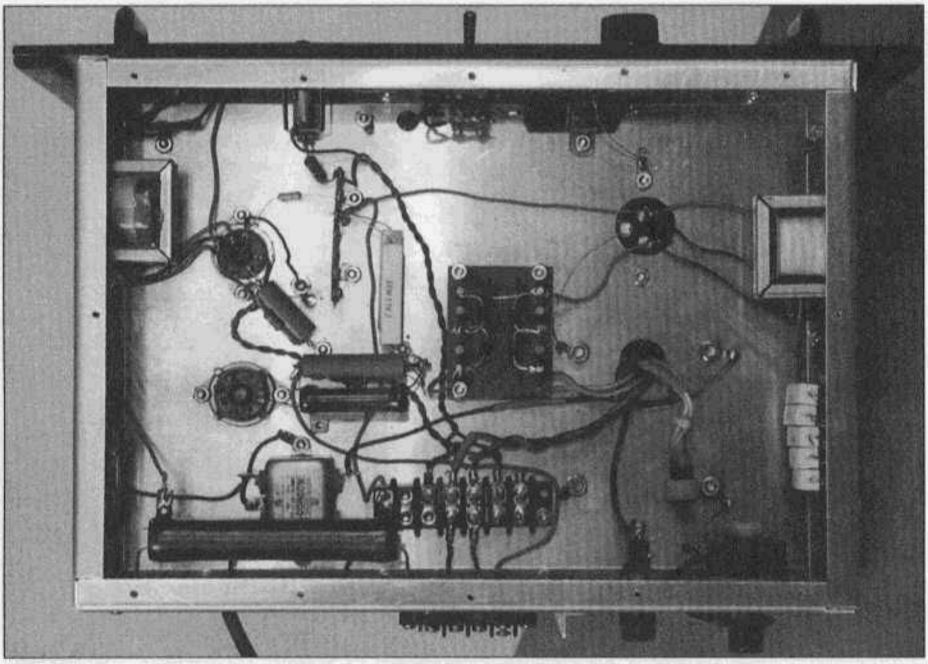

Below deck of the completed unit.

If your power transformer has a 5-volt winding use it for the pilot bulb. The old #47 pilot bulbs are too darn bright anyway. I always use a 10Ω to 15Ω resistor in my pilot bulb circuit to drop the voltage. It lowers the pilot intensity to a more comfortable level, reduces heat, and seems to make the bulbs run forever before burning out.

Let's talk about bleeders. A bleeder primarily serves two purposes; it discharges the filter capacitors quickly after the power supply is turned off, and it provides a constant load on the high voltage supply, thus tending to provide a limited amount of voltage regulation. If you go by the handbook, or by the advice of most writers, you will end up using a bleeder of 25KΩ to 35KΩ on a receiver power supply. I prefer one of a higher resistance. There are several reasons for my preference not the least of which is heat dissipation. The lower the resistance the hotter the resistor will become. As for discharging the capacitors, a 50/60KΩ resistance will discharge a capacitor within a very few seconds. You would have to be pretty agile to turn off a receiver, flip it on its back, and grab hold of a HV wire before a 60K bleeder does its job. As for the constant load/voltage regulation bit, the regulation offered is not all that great to begin with, and I normally use a VR tube for my detector-preamp stages anyway. I normally try a 50KΩ bleeder and if I feel the heat is excessive I add another 10KΩ-10 watt resistor. Even a 100KΩ bleeder will discharge the filters quickly enough.

You can make up a bleeder by wiring 5 or 6, 10KΩ-10 watt resistors in series. Mount them on whatever support you have available. I prefer terminal boards using tinned posts. I often make my own mounting boards from small squares of bakelite or a 'perf' board. If you have a nice big 30-watt bleeder in the junk box fine, use it.

You will notice that the front panel of

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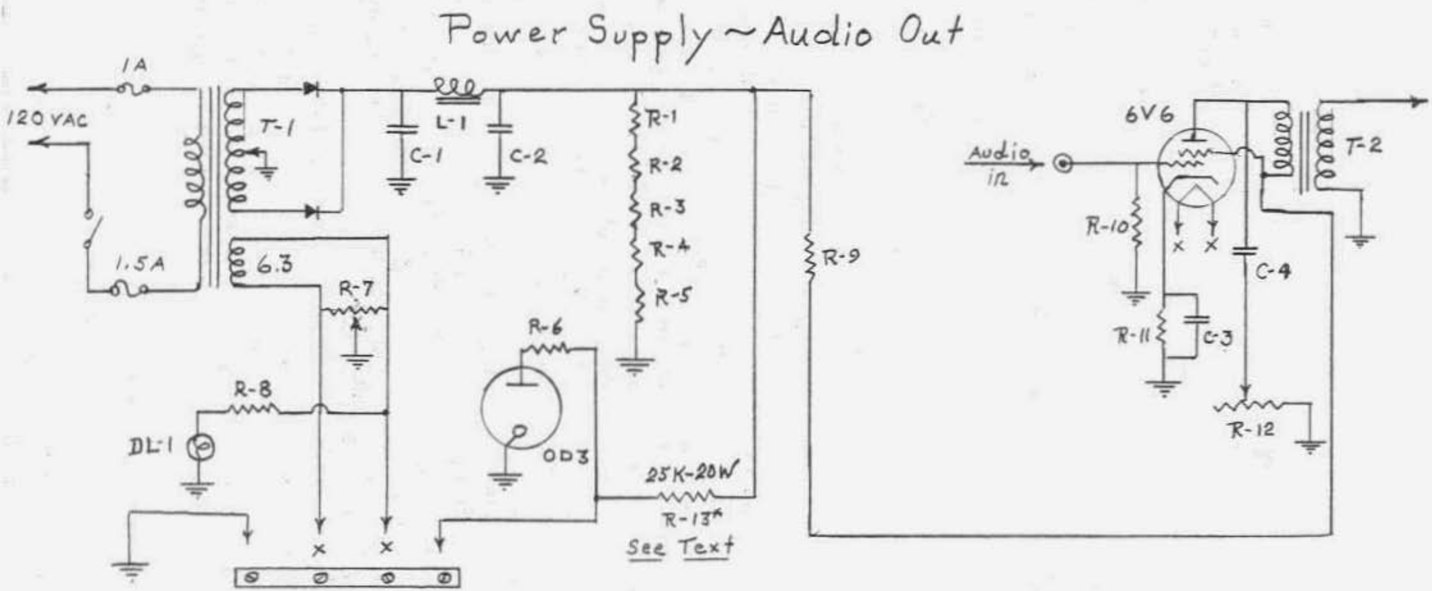

Parts List

R-1, 2, 3, 4, 5, -10 10 Watt,
R-6, 2700 Ω, 5 Watt
R-7, 30 Ω, 25 Watt
R-8, 10 Ω, 1Watt
R-9, 3KΩ, 40 Watt

R-10, 470KΩ, ½ Watt
R-11, 390 Ω, 1 Watt
R-12, 100K Linear Pot.
C-1, C-2, 50/50 mfd, 500V
C-3, 5 mfd. 200V

C-4, .1 mfd. 500 V
DL-1, #47 Pilot
T-1, Output Trans. 10K to 8Ω
T-2, Power Trans. See text
L-1, Choke. See text

2002 Winter Classic (& Homebrew) Radio Exchange

The Classic Radio Exchange ("CX") is a contest celebrating the older commercial and homebrew equipment that was the pride of our ham shacks and our bands just a few short decades ago. Our object is to encourage restoration, operation and enjoyment of this older equipment. A "Classic" radio is at least ten years old (age figured from first year of manufacture), but is NOT REQUIRED to participate in the Classic Exchange.

YOU MAY USE ANYTHING in the contest although new gear is a distinct scoring liability. You can still work the "great ones" with your new equipment!

The Classic Exchange will run from 2000 UTC February 9 to 0500 UTC February 10, 2002 (3PM EST to midnight EST Sunday). Exchange your name, RST, QTH (state US, province for Canada; country for DX), receiver and transmitter type (homebrew send final amp tube or transistor), and other interesting conversation. The same station may be worked with different equipment combinations on each band and on each mode. Nonparticipants may be worked for credit.

CW call "CQ CX;" phone call "CQ Classic Exchange."

Suggested frequencies:

CW: 3.545, 7.045, 14.045, 21.135, 28.180

Novice/Tech Plus: 3.695, 7.120, 21.135, 28.180

Phone: 3.880, 7.290, 14.280, 21.380, 28.320

7.045 and 3.545 are usually the most popular CX frequencies.

Scoring Multiply total QSL's (all bands) by total number of different receivers plus transmitters (transceivers count as both xmtr and rcvr) plus states/ provinces/countries worked on each band and mode.

Multiply that total by your CX Multiplier, the total years old of all receivers and transmitters used, three QSO's minimum per unit. For transceiver, multiply age by two. If equipment is homebrew, count it as a minimum of 25 years old unless actual construction date or date of its construction article (in the case of a "reproduction") is older.

Total QS0's all bands times RCVRs + XMTRs + states/provinces/countries (total each band and mode separately; add totals together) times CX Multiplier:

SCORE = QSO's x (Rx + Tx + QTH's) x CX Mult

Certificates and appropriate memorabilia are awarded every now and then for the highest score, the longest DX, exotic equipment, best excuses and other unusual achievements. Send logs, comments, anecdotes, pictures to: Allan Stephens N5AIT, 106 Bobolink Dr., Richmond, KY 40475. Include two first-class stamps for next CX Newsletter and mailed announcement of next CX. E-mail reports may be sent to al.stephens@.eku.edu

Al, N5AIT

VINTAGE NETS

Arizona AM Nets: Sat & Sun, 160M 1885 kHz at sunrise,75M 3855 kHz at 6 AM MST, 40M 7293 kHz 10 AM MST; 6M 50.4 MHz on Sat. at 8 PM MST; 2M 144.45 MHz, on Tue. at 7:30 PM MST.

West Coast AM Net meets Wednesdays 9PM Pacific on or about 3870kc. Net control alternates between John, W6MIT and Ken, K6CJA.

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

California Vintage SSB Net: Sunday mornings at 8 AM PST on 3860 +/-

Southeast Swap Net: Tuesday nights at 7:30 ET on 3885. Net controls are Andy, WA4KCY and Sam, KF4TXQ. This same group also has a Sunday afternoon net on 3885 at 2 PM ET.

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

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

K6HQI Memorial Twenty Meter AM Net: This net on 14.286 has been in continuous operation for at least the last 20 years. It starts at 5:00 PM PT, 7 days a week and usually goes for about 2 hours.

Colorado Morning Net: An informal group of AM'ers get together on 3875 Monday, Wednesday Friday, Saturday and Sunday mornings at 7AM MT.

DX-60 Net: This net meets on 3880 at 0800 AM, ET, Sundays. Net control is Jim, N8LUV, with alternates. This net is all about entry-level AM rigs like the Heath DX-60.

Eastcoast Military Net: It isn't necessary to check in with military gear but that is what this net is all about. Net control is Ted, W3PWW. Saturday mornings at 0500 ET on 3885 + or - QRM.

Westcoast Military Radio Collectors Net: Meets Saturday evenings at 2130 (PT) on 3980 + or - QRM. Net control is Dennis, W7QHO.

Gray Hair Net: The oldest (or one of the oldest - 44+ years) 160-meter AM nets. It meets on Tuesday nights on 1945 at 8:00 PM EST & 8:30 EDT. www.hamelectronics.com/ghn

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

Collins Collectors Association Nets: Technical and swap session each Sunday, 14.263 MHz, 2000Z, is a long-established net run by call areas. Informal ragchew nets meet on Tues nights on 3805 at 2100 Eastern and on Thur nights on 3875. West Coast 75M net that takes place on 3895 at 2000 Pacific

Collins Collector Association Monthly AM Night: The first Wed. of each month on 3885 kHz starting at 2000 CST (0200 UTC).

Drake Users Net: This group gets together on 3865 Tuesday nights at 8 PM ET. Net controls are Criss, KB8IZX; Don, W8NS; Rob, KE3EE and Huey, KD3UI.

Drake Technical Net: Sunday's on 7238 at 8PM Eastern time hosted by John, KB9AT

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

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

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

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

Southern Calif. Sunday Morning 6 Meter AM Net: 10 AM Sundays on 50.4. NC is Will, AA6DD.

Old Buzzards Net: Meets daily at 10 AM Local time on 3945. This is an informal net in the New England area . Net hosts are George, W1GAC and Paul, W1ECO.

Canadian Boatanchor Net: Meets Saturday afternoons, 3:00 PM EST on 3745.

Midwest Classic Radio Net: Sat. mornings on 3885 at 7:30AM Central time. Only AM checkins allowed. Swap/sale, hamfest info and technical help are frequent topics. NC is Rob, WA9ZTY.

Boatanchors CW Group: 3546.5, 7050, 7147, 10120, 14050. 80 on winter nights, 40 on summer nights, 30 and 20 meters daytime. Nightly "net" usually around 0200-0400 GMT. Listen for stations calling CQ BA, CQ GB.

Wireless Set No. 19 Net: Meets the second Sunday of every month on 7.175 +/- 25 kHz at 1800Z (3760 +/- 25 kHz alternate). Net control is Dave, VA3ORP.

Hallicrafters Collectors Assoc. Net: Sundays, 1730-1845 UTC on 14.293. Net control varies. Midwest net on Sat. on 7280 at 1700 UTC. Net control Jim, WB8DML. Pacific Northwest net on Sundays at 22.00 UTC on 7220. Net control is Dennis, VE7DH.

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

A 4-1000A Homebrew Transmitter

by Andrew E. Howard Sr, WA4KCY
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Introduction

What could I do to culminate forty years of building homebrew transmitters? First it would have to be the best possible work that I could do. A transmitter that would work all bands and the RF final could be used in linear service in addition to AM. It would have to use large glass tubes that were readily available and could be displayed in viewing windows. Those were what my intentions were when this project was in the planning stages.

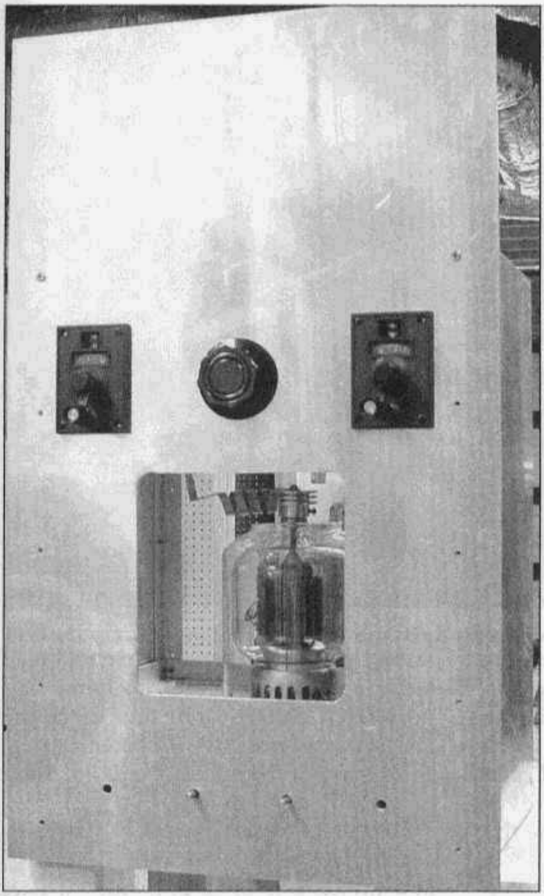
Back in 1990 while at Dayton I had a conversation with Jim Taylor, W4PNM, now a Silent Key, about building a 4-1000 transmitter for the amateur bands. Jim's question to me was "how would I go about putting a 4-1000 final on a 13X17 chassis"? Jim and I went to Dayton together for several years. He lived in Augusta, Georgia which was my hometown. We would spend many hours after meals drawing schematics and ideas on the back of table placemats. Jim was a broadcast engineer and I learned much from him. After some thought I decided that it would have to be stacked. In other words, put the tube and filament transformer on one chassis with the grid circuit, control relays, etc. under the bottom. I would then use angle brackets to put another chassis up top and leave just enough room for the 4-1000 plate cap to clear. The plate feed would go directly through the top chassis to the pi network.

Jim seemed to like this approach and after drawing up plans for the final metalwork he sent them to Ten-Tec where their expert metal workers cut all the pieces. Jim started to work on the final but became a silent key when it was mostly unfinished. About three years after Jim's death I received a call from his widow wanting to sell some of Jim's remaining equipment. I bought several pieces including the partially completed final. It remained unfinished until early in 2001. Since we could not find any documentation or schematics on what Jim had in mind to build, it would be necessary to begin anew with the wiring. I decided that it was time to finish the final and build the 4-1000 AM transmitter.

Transmitter Description

The 4-1000 transmitter uses a single tube in the final running in Class C with the additional capability of running Class AB2 for sideband linear service. It is modulated by a pair of 4-1000's running in Class AB2. Before deciding in which class to run the modulators I consulted WA1HLR, Tim Smith, the acknowledged expert on running 4-1000's in amateur service. Tim was very adamant that I build a current amplifier and run the modulator in AB2. The speech amplifier uses the tried and proven 6B4G triodes to feed the grids of the 4-1000 modulators.

The RF excitation will be provided by either a Collins 312-B or Johnson Viking Navigator exciter. I would have liked to build my own exciter and incorporate it into the transmitter but space limitations prevented this. I suppose my favorite would be the Navigator since it has two crystal positions as well as the VFO. There is a lot that can be said about a crystal for frequency control when operating a transmitter from a cold start-up.



Front of RF deck showing window for 4-1000. Holes for the 7 meters are yet to be cut.

The Cabinet

By far the most difficult part of the transmitter to find was a suitable cabinet. I needed at least 70 inches of panel space vertically with a standard 19 inch width. This was actually the last piece that I acquired. It came in the way of a gift from a good friend of mine, Allen Cutts, N4OZI. The company for which he works uses very high caliber computer cabinets made by Vero in England. I had mentioned the need to Allen upon seeing some that he had in his shack. Sure enough he found one for me. It was new but had suffered minor damage to the top in shipment. Apparently the shipper had paid the claim and the cabinet had just been pushed over in the corner and forgotten. The top is removable so straightening it was not a problem. There is also a small dent in one panel. I figured that this could go next to another rig and never been seen. The color scheme is medium gray and what I call "computer" gray or off-white. It has detachable sides that go on and off very easily and lock on with the cabinet door key. There is a back door made of metal and a front door made of smoked glass. Overall the cabinet will accommodate 19 inch panels and has room for 75 inches vertically. The depth is 28 inches. This allows for more than one chassis to be mounted on the horizontal angle brackets. I discovered that I could install the RF deck and still had room for the screen supply behind it. Metal wheels were installed to support the estimated weight of 800 pounds. I was shocked when I found this cabinet on the Vero internet site. It sold for 880 British Pounds plus shipping to the United States. Final cost was probably in the range of $1500. What would we do without good friends?

The Final

As previously mentioned I decided to incorporate the ability to use it as a linear for sideband as well as a Class C amplifier for AM. This would require a -200 volt bias supply when running AM and a -60 volt supply for Class AB2 when running sideband. It was not difficult to draw out the relay functions, a voltage divider for the bias supply, etc. The most difficult part was the grid input circuits. They are wound on

continued next page

Front of modulator chassis showing 4-1000's, filament transformers and driver transformer.

plastic pipe and coupled with coax for the links. They are tuned using the round ceramic variable caps used in the ART-13 multiplier stage. They work really well for this purpose. Front controls include a switch to change over the bias, switch the grid links, tune the grid input and a bias voltage pot. Also, included is the bandswitch and screen voltage control. The screen voltage control is a small two amp Variac that feeds the input of the final screen supply. The ability to control screen voltage lets me unload the final without the screen current rising to an unacceptable level. All knobs are Dakaware (Collins). The turn's counters are James Millen and were acquired several years ago new in the box. The meters are Westinghouse in RCA cases from a long forgotten RCA broadcast transmitter and have been on my shelf for about 10 years. There are seven meters on the final. There is a grid current, screen current, high voltage, cathode current, filament voltage and two meters to monitor each modulator tube's cathode current. As most of you know, you don't just decide one day to build a transmitter and go home and get started. It takes a long time to acquire all the parts necessary for construction. I have many friends to thank for their generosity and advice.

The pi network consists of surplus ceramic forms wound with number 10 and number 12 enamel insulated wire for 160, 80 and 40 meters. The inductor for 20, 15 and 10 meters is wound from 1/8 inch copper tubing. Tuning and loading is accomplished with vacuum variables. The plate choke is wound on a teflon form and is mounted horizontally. The pi network will cover 10 through 160 meters and is very easy to tune. The 4-1000 uses an air socket and chimney with a fan mounted in the side of the bottom chassis. As can be seen from the picture the final is completely enclosed and should be RF proof. I ran into one problem with the vacuum variables that took a unique solution. The shafts were 1/2 inch instead of the usual 1/4 inch diameter. Sometimes you get lucky. The outside diameter of the turns counter shafts

Top view of speech amplifier showing power supply on right and 6B4G triodes on left.

were a 1/2 inch as well. Since the shafts were only about 3/8 of an inch apart there was no room for a conventional coupler scheme. They are connected using 1/2 inch inside diameter clear plastic hose which is clamped onto the shafts with standard hose clamps. This works great and the flexibility of the hose allows for smooth tuning. I started with a very nice antenna change-over relay but lost the coil due to a voltage mistake on my part. I ended up putting a Leach double pole, double throw relay in a cast aluminum box. Some work with a chassis punch and drill press mounted the required three SO-239 connectors and terminal strip for the coil voltage. The contacts are wired in parallel so as to double the current capacity. The coil is 120 volts and is perfect for the purpose intended. The antenna connects to the change-over relay. One side of the relay output is connected to the final and the other to one of four SO-239 connectors on the final cabinet. There are connectors for AM input, SSB input, input from the antenna relay and receiver output when running AM.

All switching is done internally by one of three 12 volt relays.

The Power Supply

Where does one get transformers for a transmitter this size? Fortunately my good friend Tom Hand, W4WDS, is retired and winds transformers as a sideline. After discussing my needs with him he began work on all the transformers needed. The plate transformer is 240 volts input and will deliver 3500 volts DC on the low primary tap. There are taps up to 5500 volts at 2 amps. This baby will power anything one is likely to build. Rectifiers had originally intended to be 872A mercury types but there was not enough room to use them. Instead diodes are used in a half wave configuration using choke input and a single 16 mFd. 7500 volt oil filled capacitor. All wiring is done with 40,000 volt insulation high voltage wire. The bleeder consists of

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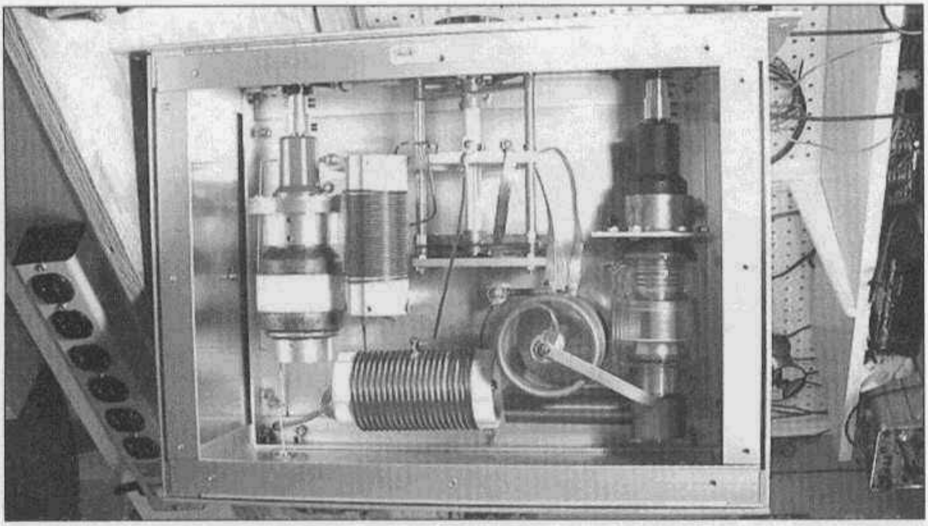


Top of RF deck showing pi network which includes band switch, vacuum variables and inductor coils.

four 100,000 ohm, 100 watt resistors in series parallel which gives 100,000 ohms at 400 watts. Most of the smaller transformers for bias supplies, screen supplies, speech amp, etc. were either donated by friends or came from my years of hoarding parts. I shudder to think of the cost of building this transmitter if all the parts had to be purchased new.

The Screen Supplies

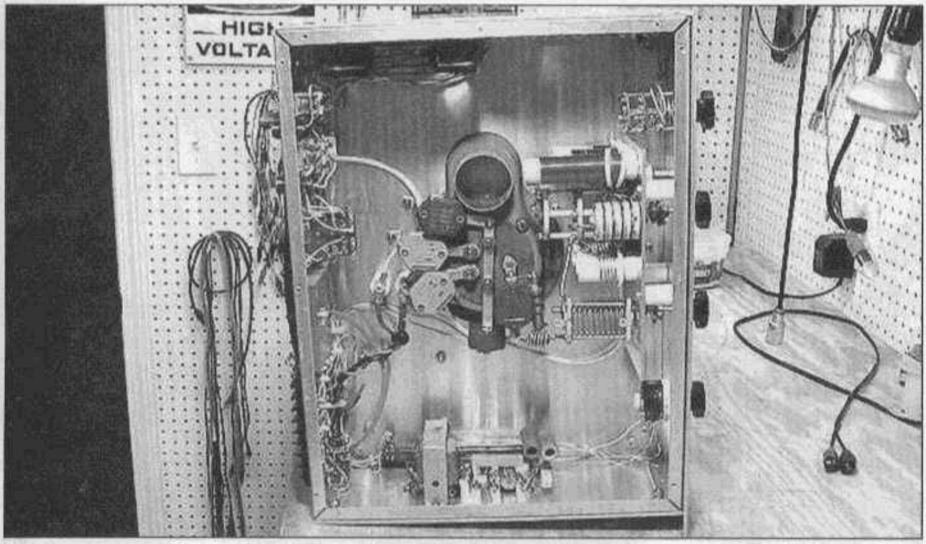
Two screen supplies are needed since 4-1000's are tetrodes. Triodes do not need screen supplies but are much harder to drive. As previously stated the Class C final uses -200 volts on the screen in Class C and -65 in Class AB2. Screen current for the final in Class C is 140 mA and 100 mA in Class AB2 for the modulator. The relatively low current needed for the screens facilitated finding suitable power transformers. Both supplies use solid state rectifiers since they will be keyed on with the high voltage supply and must furnish immediate voltage. One will be mounted behind the final and the other behind the modulator.

The Modulator

As I had great respect for Tim's knowledge about 4-1000's, I had decided to run the modulator in Class AB2 rather than AB1. In AB2 tubes draw grid current and in AB1 they do not. A speech amplifier for AB2 is a bit more complex than a simple voltage amplifier for AB1.

The modulator tubes sit on a 13 X 17 chassis using Eimac air system sockets and chimneys. The filament transformers deliver 7-1/2 volts at 30 amps although the book only calls for 21 amps on each filament. They were also custom wound by Tom Hand, W4WDS. I used two filament transformers so that each tube's cathode current could be monitored independently by one of two meters on the front panel. A bias supply for the tubes is mounted on the underside of the chassis. By connecting the input of the bias supply transformer to the 7-1/2 volt filament voltage of one of the 4-1000's the output voltage rectified and filtered will be the required -65 volts.

The driver transformer is also mounted on the modulator chassis. A BC-610 driver is used to couple the 6B4G



Underside of RF deck showing grid circuit, relays, bias supply and 12 volt supply for relay coil voltage.

plates to the grids of the 4-1000's. These are very good drivers and there are still some spares on the surplus market from World War II. The 350 volts for the plates of the 6B4G driver tubes is fed into the primary center tap of this transformer through a shielded cable that runs from the speech amplifier. Audio is also fed through shielded cables terminated with RCA plugs. The modulation transformer is a 1500 watt unit that was also wound by W4WDS. It is coupled to the modulation reactor using 4 mFd oil filled caps. This keeps DC off the secondary of the modulation transformer and improves frequency response. This is the method used in broadcast transmitters.

The Speech Amplifier

The speech amplifier had to be able to deliver approximately 6 watts to drive the grids of the 4-1000's. This meant that it would be a bit more complicated than building a voltage amplifier for a modulator running in Class AB1. Fortunately I had built such a speech amplifier for my 813 transmitter back in 1989 and was familiar with its construction. This speech amplifier was designed by Jim Taylor, W4PNM.

The microphone amplifier uses one half of a 12AX7. The plate to grid coupling of the two sections is accomplished with a .1 mFd capacitor and a 500K audio taper pot. The plate of the second 12AX7 section feeds one of the cathodes of a 6AL5 which functions as a series limiter. This is also coupled with a .1 mFd cap. The plate voltage of the 6AL5 is controlled with a 100K pot. The second cathode of the 6AL5 is coupled to an audio bandpass filter with a .1 mFd cap. The bandpass filter consists of two 3.5 Henry chokes and 5 silver micas. This effectively limits the audio frequency at 100 to 3500 cycles. The second filter is coupled to a 250K pot that acts as a modulation control. This feeds the grid of a 6C4. The plate of the 6C4 feeds the primary of a 2:1 single plate to push-pull grid interstage transformer. Each leg of the transformer secondary is fed into a 12AU7 grid. The 12AU7 plates feed another push-pull plate to push-pull grid audio transformer. The secondary of this

continued next page

View of power supply installed in cabinet. The transformer in the upper left corner is the modulation reactor.

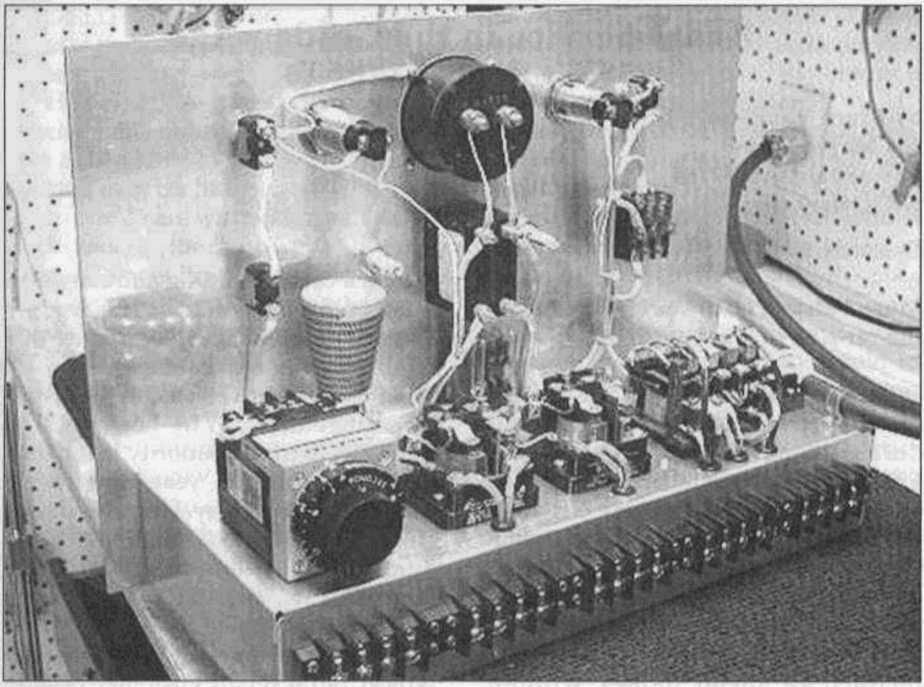
transformer feeds the grids of the 6B4G triode driver tubes. The plates of the 6B4G's drive the grids of the 4-1000's through a BC-610 driver transformer mounted on the modulator chassis. Since the driver transformer is not on the speech amp chassis it was necessary to feed the B+ for the 6B4G plates from the speech amp to the center tap of the driver transformer on the modulator chassis. This is accomplished with shielded cable terminated with RCA plugs. The 6B4G triodes are biased using a 750 ohm, 20 watt resistor.

The speech amp has a power supply that delivers 350 volts. The voltage starts at the driver tubes and is lowered though a voltage divider chain back through each tube. By the time the voltage reaches the 12AX7 it has been lowered to 90 volts. This speech amplifier also works very well to drive triode modulator tubes. There is a blank spot on the front of the amplifier for a VU meter when I find one that is suitable.

The Control Circuitry

The part of homebrew transmitters that is seldom seen drawn out in diagram form is the control circuitry. Since this circuitry varies from transmitter to transmitter few people bother to document it. The old saying about transmitter control circuitry is that one needs to decide what needs to be done and in what order. I took a somewhat different approach and drew my control circuitry in schematic form before starting the actual work.

The control circuit for the 4-1000 transmitter uses a double pole single throw relay with a 120 volt coil to turn on the low voltage. This is activated by a toggle switch on the front panel. This relay turns on an Agastat timing relay that is set for 1 second. Once this relay times out it closes another 120 volt coil relay that shorts out the BC-610 heater element resistor which is in series with the 4-1000 filaments. This step-starts the tube filaments with about 3 volts and up to 7-1/2 volts when the relay



Rear of control deck showing Agastat timing relay on left, low voltage relay, step-start relay and plate relay. The cone shaped ceramic device in rear is the step-start resistor.

closes. This is intended to protect the filaments of very expensive and increasingly hard to find tubes.

A 24 volt, 11 pin octal plug in relay is used for push-to-talk. This activates the plate relay, push to talk, exciter keying, receiver muting, antenna change-over relay. 120 volts is run through some of the contacts depending on switching needs. All screen supply voltage is taken off one leg of the secondary of the plate relay. The transmitter uses 240 volts so it is easy to just use one leg of the 240 voltage and ground. A novel approach to tuning voltage is accomplished with a 20 amp single pole double throw toggle switch with center off. When the switch is in the up position it connects one of the 240 volt legs. This allows full voltage to flow to the plate transformer. When it is in the center it is in the off position and even though the transmitter can be keyed, there will be no B+. This is very handy when tuning the exciter, adjusting grid current, etc. When the switch is in the down position it switches in the neutral leg of the 240 volts which is on the chassis. This puts 120 volts on the plate transformer and allows tune-up at half voltage.

There are 4 toggle switches on the front panel. In addition to the 2 that were previously described there is a keying toggle and a lockout toggle. There is a 20 amp breaker to turn on the operating voltage and two fuses to protect the transmitter. There are also fuses on some of the individual components. A 300 volt AC meter monitors the incoming line voltage. Two large green and red pilot lights bought from Mendelson's during the Dayton Hamvention finish out the front panel.

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Radio Service in the Golden Age
1930's through the 50's

by Bruce Vaughan, NR5Q
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Episode 8

Must Tulsy (Tulsa) sound like it's on the fer side of Ageypt (Egypt)?

The 'All American Five'* accounted for a high percentage of our repair jobs during the immediate post war years. True, the depression appeared to be over, yet it remained deeply etched in the minds of those over 20 years old. Only the young, those whose memories did not include hunger, ragged clothes, worn out shoes, and haggard parents working long hours for low pay, were inclined to spend money without carefully considering their purchase. If a five tube AC-DC radio cost $20, and a very nice 8 tube, multiband AC radio cost $75, it was obvious the $20 set would outsell the higher priced model at least 10 to 1, and it did. The attitude then was, 'will this $20 item do a reasonably good job'? It has taken many years for our attitude to change from 'make do' to today's 'is this the very best item money can buy'?

By 1940 outdoor antennas were fast becoming a thing of the past. Practically all small BC sets made after the mid-thirties used the traditional 'built-in' antenna—normally a piece of insulation board with slots cut around the perimeter and wound with cotton covered wire. Ferrite core antennas were still in the future.

When I opened my shop I hung a small outside antenna from a four-foot piece of wood wired to a vent pipe on the roof. The wire must have been 20 feet long overall and was supported only on one end. The other end fell over the back of the building and ran into a small bathroom window. This was my antenna for testing older radios that required an external antenna.

Oh, good radios existed in the period before the end of WW II—however, such radios were in the minority. Even during the depression years there were those who had money. However, it was Henry Ford who sold millions of cars during the 30's, while Dusenburg, Cord, Pierce Arrow, and other Luxury auto builders went 'belly-up.'

Let us take a moment to consider my typical radio repair customer back in the late 40's, and his state of mind when he entered my store. Said customer arrives home from work, dead tired, worried about how he can stretch a $40 pay check to cover food, clothing, school expenses, medical care, and shelter for his family of four. His wife greets him with a hug, a glass of iced tea, and several small problems—all requiring an expenditure of money. He heads for a chair on the front porch, "By the way," his wife calls over her shoulder, "our radio quit today. I was listening to 'Ma Perkins' and it just quit-all of a sudden."

This kind of news was not welcome—no radio tonight, and a trip to the repair shop tomorrow. Certainly the man is upset. More household expenses, and when the radio is repaired and back in operating condition it is going to be the same darn radio that he had yesterday. No better, hopefully no worse, the only difference is that his radio is working again and he is a few dollars poorer. The following morning he enters my shop with the dead radio under his arm.

"Good morning," I say, stepping forward to the service counter. "Got a little radio problem?"

"I hope it's little. I don't want to spend much on this radio. It's getting old and was a cheap one to start with," the sad looking man replies.

His words are wasted on me. I could tell by looking the radio was a few years old, and knew it was a simple AC-DC receiver. As for not wanting to spend much—in reality, he wanted to spend absolutely nothing. I know of no one who enjoys spending money on repair jobs. How many of us drive around hoping our transmission goes out so we can spend money getting it repaired? Not many, I assure you. I was in complete sympathy with him.

"Tell you what let's do," I said. "I'll have my bench clear about noon. Then I'll give your radio a thorough check out. Stop by or call any time after three this afternoon and I'll give you an estimate. If you decide to fix it up I can have it for you tomorrow. If you think the estimate is too high, you can pick up your set on your way home tonight. There is no charge for an estimate. Fair enough?"

I could tell the customer felt a little relief. He smiled and made a comment about the weather while I filled out a claim check.

However, I dreaded the time when the customer returned for his radio if he made a decision to go forward with repairs. He would most certainly want, and deserved, to hear his radio in operation before he paid for the repairs and left my shop, just as I would want to be sure my watch was running if I had the local jeweler clean and adjust it. And when demonstration time arrived at my shop, I knew I would be greeted by sounds of grinding, buzzing, and AC interference with only three or four of our strongest stations overriding the electrical noise. I could tell how well the set was working by listening to the noise alone—but that takes practice. There was no reason on earth why my customers should be expected to understand those conditions.

Radio reception in my radio shop was certainly nothing to demonstrate with pride. The shop was located in one of the oldest blocks of our small downtown business district. Wiring in many buildings was 'knob and tube'—poor, noisy connections were commonplace. Sheet iron roofing not only kept out rain, it provided a good RF shield for signals from our few weak AM stations. Our closest station was KUOA, a University of Arkansas station purchased by John Brown University in the early thirties. I believe at the time they were running 5 KW to a 400-foot vertical. Our next closest stations were KVOO in Tulsa, Oklahoma, and KWTO in Springfield, Missouri, both 100 miles distance. The proliferation of stations, both AM and FM, that began with the war's end was moving forward, but never the less, all stations in our area were still in the construction stage. There was a lot of talk, many expectations, and newspaper advertising, but no signals.

I tolerated this situation for a few more weeks until a local house painter made a comment that moved me to action. The customer in question was crude, uneducated, unwashed, and known to partake of spirits on a regular basis. However, the painter did have a rather nice AC operated, 6-tube receiver. When he brought it in for repairs I was pleased to be working on a nice piece of radio gear for a change. My pleasant attitude was shattered when I hooked up the set to show him how well it worked with new filters in it.

As I turned the tuning knob toward KUOA, the customer reached across the table and took the knob from my hand. He tuned in KVOO with a motion that showed this was a favorite station. "Why Hell Son," he said, "that danged

continued next page

radio ain't fixed, Tulsy (Tulsa) sounds like it's on the fer side of Ageypt (Egypt)."

My explanations about small built in loops, noisy downtown locations, and electrical interference, all fell on deaf ears. Soon, I knew I was losing the argument and might very well be losing a fight if I did not abandon my argument. I conceded, as gracefully as possible to the inebriated old-timer, and promised to re-do my 'repair' job.

Though I knew the radio was working fine and that there was nothing I could do to improve the radio, I assured the house painter he would be pleased with his radio when he picked it up the following afternoon. At the moment I had no idea how I would deliver on my promise.

I slept little that night. Sometime after four AM I got out of bed, dressed and made myself a strong pot of coffee. That was my remedy for most unsolvable problems back then—just as it is today. As I approached the end of cup number two, I started to think like a ham. The stations I needed to hear were there, I just could not hear them for the noise. If I could reduce the noise, I could hear the stations. My problem then, while not simple, was at least one that could be solved. I must somehow increase the signal to noise ratio within the confines of my shop.

Reduction of AC interference, line noise if you prefer, is one not even the power company will address without pressure far greater than I could bring to bear. I've tried for years to get help from our power company, and have yet to achieve success.

The only possible solution was to increase the signal strength present within the shop. This, I reasoned, was a distinct possibility.

When Wise Radio, my local parts distributor, opened their doors at 8:00 am, I was there. I bought 100 feet of old fashioned, stranded copper aerial wire, two glass insulators, two 250-foot spools of number 16 stranded, and a 100-foot spool of number 14 rubber covered wire.

I opened my shop, and put up a sign on the door saying I was on the roof doing antenna work—if needed, step out the back door and give me a shout. My first job was to lay out the antenna. A building east of me, a two-story building, had a redwood air conditioner water cooler on the roof. It looked substantial. I contacted the owner and explained that I needed to attach one end of my 'aerial' to his tower. Aerial sounds less massive than antenna to most people. He granted me permission with no reservations.

There was a telephone pole at one rear corner of my building. It appeared to support nothing but two telephone lines—one coming to my store and one to the store next door. Going under the premise that it is 'easier to get forgiveness than permission' I decided to anchor my antenna to the pole using a 1/4 inch hemp rope. Rope seems less irritating to telephone men than wire.

OK, now I had a rather nice sky wire. Eighty-five feet long, with my rubber covered number 14 wire soldered to one end for my lead in. Total elapsed time a little over two hours. I was in the shop, and available to customers and it was still a few minutes until 10:00 am.

I fished the leadin into the building thru the restroom building. The lead in was stapled along the floor molding from the bathroom to the workshop. I decided my demonstration table should be the checkin and checkout counter. I ended the lead in under that table.

Next, I attached an end of the rubber-covered wire to a cold water pipe and snaked it up to the same table. Now, I measured the counter top—three by eight feet, with space on one end for a very ancient cash register. Actual demo space would be about 28 inches by five feet. I cut a piece of 1/4 inch Masonite(to these dimensions, rounding off the corners. Around the edge I made inward cuts with my handsaw. Each slot was about 1/2 inch wide and cut inward about six inches. It took quite a while to cut these slots as I placed them around the entire perimeter, spaced about 8 inches between slots. When completed, it resembled the backs used on most AC-DC radios-but much larger of course.

I started winding my number 16 wire on this coil form and was surprised to find I got a full 250 foot roll on it and had room left. I soldered the wire remaining from the other roll on the end and continued winding until it was all used. I suppose there was well over 325 feet all told.

Then I screwed this coil up under the tabletop, tightly, and attached one end to the water pipe ground and the other to the antenna. I made sure all wires were well out of sight of customers... No use having to explain such things to a lot of people. As a matter of fact, if it worked the way I hoped, I intended to explain it to no one—and I did not, until this article.

Ready for the tryout I got out the 'house painters' radio and placed it on the workbench. First, I tried KVOO. It was there, but certainly not enjoyable. I tuned across the band and could identify perhaps six different stations. Now for the big moment—I moved the radio from the workbench to the checkout counter. WOW, I could not believe what was happening. KVOO sounded like they were in the next block. Noise was way, way, down compared to signals. I slowly started tuning across the BC band. Stations seldom heard at home were coming thru loud and clear—Kansas City, Pittsburgh, Coffeyville, Kansas, and on it went.

About four that afternoon the old boozer came by with a load on as usual. "Son, did you ever get my radio workin' worth a damn?" he asked.

"That's it playing right there by the cash register," I said. "Tune around the dial and tell me if it is fixed to your satisfaction."

After tuning in stations I am sure he had never heard before on the little radio he looked at me and said, "Son, you have one thing to learn. Don't try and run shoddy work by an old man like me. Do your best the first time."

That checkout counter saved me many a headache over the years though sometimes a customer would come by the shop and make a comment about how much better his radio seemed to work in my shop than it did when he got it home. ER

*All American Five. Radios using the normal AC-DC tube lineup on 12SA7, 12SK7, 12SQ7, 50L6, and 35Z5 rectifier.

WØZZS from page 42

Gene was running a Sonar 100 watt rig on AM, and I was running the HT-9. And can you believe this...on May 16, 2001 about 45 years later, I worked Gene Worth, WØAGU again on the 3875 kc AM net. That's right, you guessed it, I was using the Hallicrafters HT-9 and he was using his Sonar 100 watt transmitter.

Also, many thanks to OJ, KØOJ for getting me interested in AM again after all these years. I joined his Thanksgiving Day Bash last year using my Yaesu FT-102 and enjoyed AM so much I just kept going. I joined AMI shortly after that, #1269. ER

Clatternet: 850 shift RTTY roundtable, on 10137 kcs USB Saturday, starts 0930-1000 Pacific time.

Restoring the AN/GRC-26A Communication System

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Part Two

This series of articles deals with my attempt to restore Shelter S-69, Serial Number 212, and the communications system it houses.

Concurrent with this series of articles, I've dedicated a website:

www.arc-5.com/grc26/ to the restoration project. The website contains additional photos, correspondence from ER readers, and historical information on the GRC-26A and its family.

Part 1 (ER #150, October 2001) described how I came to acquire the AN/GRC-26A mobile communications system. I also tried to show some of the historical context for this system and how the -A version evolved. In addition, I gave a short technical summary of the system and its capabilities. I want to thank everyone who offered advice, information, and encouragement with their e-mails. Relevant sections are posted on the website (www.arc-5.com/grc26a).

Part 2 now expands on the technical details of the lesser-known pieces of equipment. But first, here is a brief progress report on the refurbishing of the shelter itself.

Shelter Restoration Progress

Once upon a time there was a woodsman who was proud of an axe that his dad had given him as a boy. "I've had this same axe for 40 years" he boasted, "it's only had three new heads and six new handles!" That's obviously the problem that restorers face when deciding how to reconcile authenticity with practicality. Part 1 concluded with the shelter stripped, ready for restoration, and me scratching my head over how to get it off its temporary trailer in order to access the bottom. With the help of Rob Flory, K2WI and his buddies Martin Rapp and Mike Rassweiler (Figure 1), we got the shelter into the desired dry-dock position. Truth be told, they did the heavy lifting. I got to slide the 4x4's in. Rob and his buddies work with a living history farm in southern New Jersey. They had recently moved a barn, so they still had some momentum going. Once up over the rails of the trailer, the underside was fully exposed. The good news is that the structure is still sound after 50 years, and does not need much work. But like the woodsman, I will have to replace some essential pieces and go even further by "improving" on the original design. The shelter now sits across 4x4's, with the bottom fully exposed and ready to repair.

The immediate task is to do the exterior repair in final preparation for a MilSpec paint job. The slight collapse in the roof, referred to in Part 1 also needs fixing. The shelter will be ready for equipment reinstallation after some work on the outside bottom, the installation of a new plywood/linoleum interior floor, and some door repairs. See the website (www.arc-5.com/grc26a) for the gory details.

I expect to have the exterior cosmetic work done before February, and the shelter trucked over to my favorite paint shop for a professional job. ER readers have offered advice on the correct color. If you have any advice, including the actual color number, please send it along. We will see if there is a consensus and then proceed with the paint job.

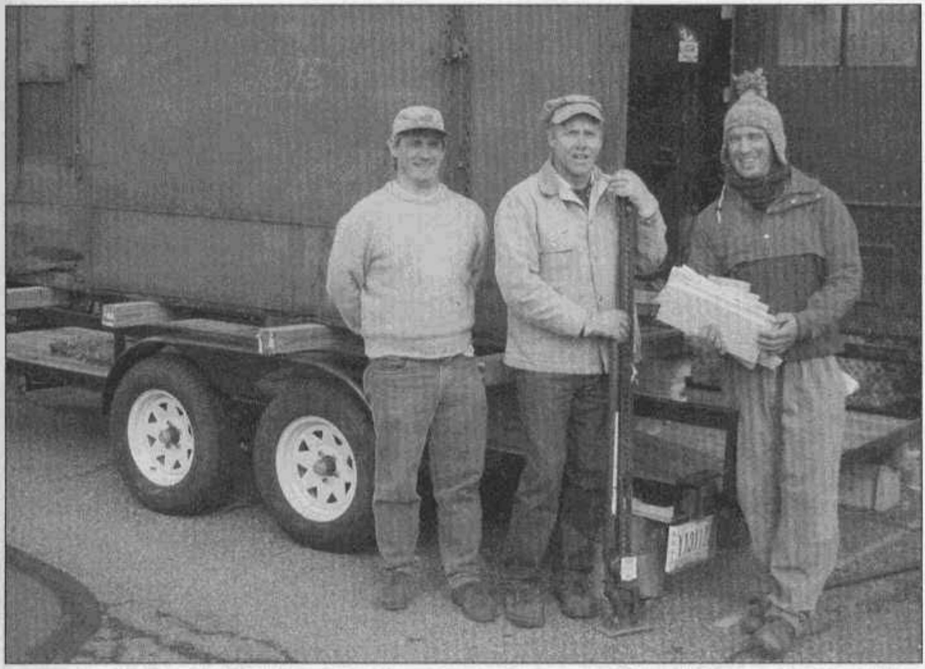

Figure 1. With the help of Rob Flory, K2WI (on the left) and his buddies Martin Rapp and Mike Rassweiler the shelter was successfully put up in drydock. This was no small task. Note the 4x4s under the shelter.

Remember, this shelter takes us squarely back to 1952. The paint inside the door (presumably not exposed to weather) is an eggshell dark olive green. The exterior of the shelter is now a flat, non-reflecting lighter olive. So much for the Home Depot part of the job. It is going to make the electronic rehab look easy.

Some Operational Details

Because the GRC-26A was designed for reliable short-range communication (100 to 200 miles or so), space diversity reception was employed when possible. The advantages of this kind of reception are best realized with widely separated antennas. The whip antennas mounted on the S-69 shelter can't do the trick, but the set was also supplied with 6 AB-155A/U masts consisting of 5 foot long sections totaling 40 feet each when fitted together. These were used to support doublet antennas when the system was deployed in fixed or semi-fixed operation. Three masts were used for frequencies up to about 4 MHz, and only two were needed for shorter antennas at higher frequencies. Therefore, assuming two masts per doublet antenna, there are enough mast sections for two receiving and one transmitting doublet. The recommended location for each doublet was 450 feet from the shelter in opposite directions, thus separating both antennas up to 900 feet.

With the luxury of this kind of antenna height and separation (and with the help of the Keuffel and Esser Type 5600 1/2 compass supplied as part of the GRC-26A) even a simple pair of dipoles can do a great job.

Thus the twin R-388 receivers should have no excuse for not capturing enough signal for the system to process reliably. Ah, but there is a problem. According to Teeters (Ref. 1), the 51J-(*), designed

continued on next page

by Collins for commercial use had a low impedance input that did not work well with the short whip on the GRC-26A. So the military modified it by converting the input to high impedance, and designating the receiver the R-388. This solved the short antenna problem, but created other ones. Read the Teeters article to learn more, and to get an insider's view of the GRC-26A's development path. I wonder how the Hi-Z input will perform when connected to a 50 ohm doublet through several hundred feet of coax.

Inasmuch as the R-388 and the BC-610 have been very well documented in the pages of Electric Radio and elsewhere, I will not dwell on them here. At the end of this article you will find a more complete bibliography than I included in Part 1 (in no particular order). Once again, I invite readers to send me more references which I will add to the website, and to Part 3. Some details of the mechanical teleprinter hardware will be included in the upcoming Part 3 of this series.

One way or another, enough signal got through the receivers for reliable voice and RTT reception. So let us turn our attention to the parts of the system that process the RTT signal. We find three pieces of equipment that most of us do not normally encounter. The units I found in my S-69 shelter are all in very good cosmetic condition. They all seem to be nicely supplied with oil capacitors, and most of the transformers are hermetically sealed, so there may not be too much to replace. Two of them qualify for true boatanchor status on the basis of weight vs. volume, and on the ratio of weight vs. useful purpose. Having said that, I must acknowledge that they do their jobs well and that heaviness itself can be a survivability advantage. The designers would surely say that they are as heavy as they need to be to get the job done. But they are heavy.

1. The CV-182 Frequency Shift Converter

The first unit of the three is the CV-182/GRC-26A Frequency Shift Converter (Figure 2). Together with its power supply the PP-712/GRC26, they weigh 140 pounds. Sensibly, they are mounted in the same cabinet (CY-1050/GRC-26) that also houses the two R-388's. The cabinet is a standard 5-foot high rack with the addition of a floor-mounted base, some shock mounts that attach to the front wall of the shelter, and slides and catch assemblies to support the equipment. These slides make the difference between a real struggle, and easy, one-person installation of the equipment. A later version of this cabinet included a fan on the empty bottom panel, and an exhaust at the top.

The manual states the Frequency Shift Converter's function: "... to convert frequency-shifted signals within the range of 440 to 510 kc (kilocycles) to polar and neutral d-c (direct current) teletypewriter or telegraph signals." Thus the signals never become audio FSK and are not demodulated from the audio output of the receiver. This leaves the audio channel of both receivers free to demodulate AM signals that can be superimposed on the RTT carrier.

2. The O-39(*)/TRA-7 Frequency Shift Exciter

The next unit is a brute that weighs in at 125 pounds (Figure 3). This would be no problem once installed, if not for its mounting position. It is placed at the end of the shelf that sits above the operating bench. The shelf is supported at the rear by the right shelter wall, and at the far left end by the front wall. However, the right end of the shelf, where this monster sits, hangs from the ceiling by a threaded rod, and has no support underneath. Thus the weight of the unit has pulled down on the ceiling, visibly deforming it.

Nonetheless, in the late nineteen

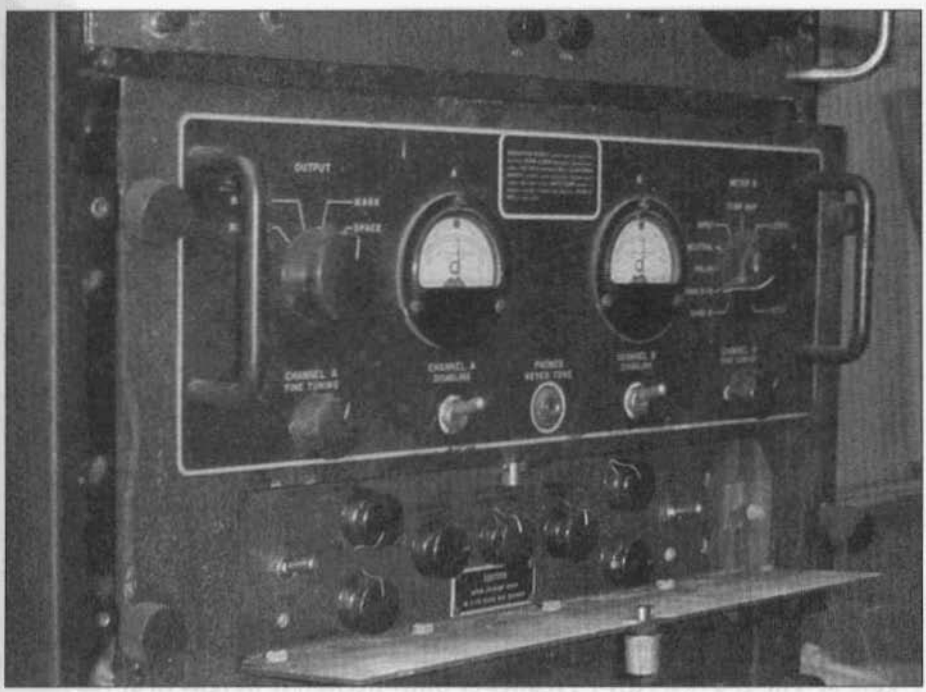

Figure 2. CV-182/GRC-26A Frequency Shift Converter. Together with its power supply (below) the PP-712/GRC26, they weigh 140 pounds.

forties if the designers among us were to develop a stable, fully shielded, oven-controlled, self powered VFO with FSK capability, including an internal offset calibrator, the O-39 is what we would come up with.

The unit is essentially a two stage VFO: a 6SJ7 oscillator and a 6AG7 buffer amplifier. The FSK function is achieved with a trimmer capacitor controlled by a 6H6. The 6SJ7 oscillator offers two ranges: 2 to 3.5, and 3.5 to 6 MHz. The buffer works straight through. Shielding inside is extensive and heavy. Tuning charts make the adjustment process easy, but are no substitute for direct calibration. How is the BC-610 fed? The O-39 has a very impressive Type N connector on the front panel. A coax lead goes from there to a less impressive 2 pin banana plug (containing a coupling capacitor) which plugs into the crystal socket of the appropriate tuning unit in the BC-610H. The tuning unit is set to "Crystal", and that's it. Thus the frequency stability of the system relies entirely on the O-39, and not at all on the BC-610. I have not yet found any data on the rated stability of the O-39. It is clear that tuning up on frequency is time consuming. It was further complicated at the higher frequencies by having to set the shift at 425 or 212.5 cycles, depending on the multiplication in the BC-610. And don't forget the required adjustment of the BC-939 antenna tuner when using the 17 foot whip. Pre-tuning and logging the settings no doubt helped. But operators must have developed their own shortcuts, which surely lead to repair calls. Chuck Strozier's recollections (which I have posted on the website) recount his having to undo the damage caused by less technical operators.

continued on next page

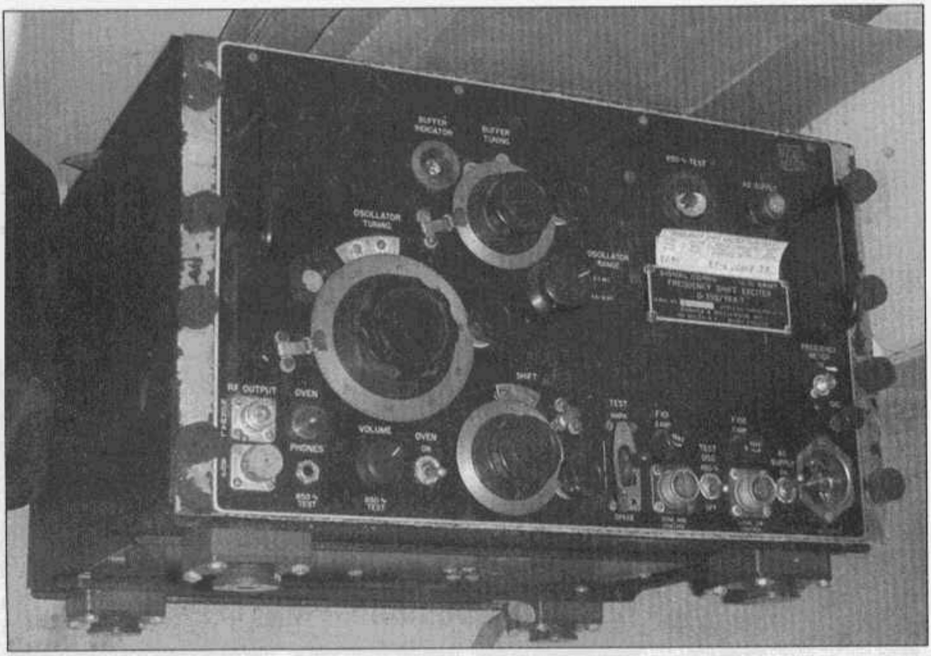

Figure 3. The O-39(*)/TRA-7 Frequency Shift Exciter. It weighs in at 125 lbs.

3. The C-808/GRC-26A Radio Teletypewriter Control

The manual describes this third unit as the "control center" of the entire system (Figure 4). It is a little smaller than the O-39 oscillator, much lighter in weight, and is mounted on the shelf above the operating bench. It is a switching center that enables the operator to assign the send and receive function to either of the two teleprinters. It also selects the function of the tape perforator: send, receive, or punch tape locally. A 1956 MWO (Modification Work Order) added a switching circuit "to prevent the RF coils in the R-388/URR Receivers from burning out during C-W break-in operation". I wonder how that problem made itself known! C-W break-in cannot have been a frequently used mode, if it took until 1956 to solve the problem. Another item that works with the C-808 Control is the AN/GRA-14 Radio Set Control. This is mounted on the wall above the operating desk. It is used to connect the GRC-26A with remote teleprinters via spiral four or twisted pair wire. Both of these units will be described more fully when we examine the RTT function of the system.

More on the Evolution

As the GRC-26 series evolved, it never really changed its mission: providing mobile and semi-fixed RTT communications, with ancillary AM and CW functions. The -B, -C, and -D models simply used updated versions of the same basic hardware. The BC-610 nomenclature changed to T-213/GRC-26, but it was still the same transmitter. Fundamental changes came later with the arrival of single sideband and the GRC-106 system. Even this later system relied for a time on RTT as an essential mode.

A chart was provided that describes the basic communications hardware from the early SCR-197 forward, and the vehicles that carried the systems. This chart omits some of the fine points,

Figure 4. The C-808/GRC-26A Radio Teletypewriter Control. The manual describes this unit as the 'Control Center' of the entire system.

including the aircraft monitoring function in the SCR-197, and the changes in teleprinters as they evolved. More information on the teletype configurations, and the functioning of the integrated system will be provided in a later article.

The Trucks

Permit me a brief digression off the subject of AM vintage radio, and onto another player in the saga. Note in the drawing on the home page of the website, and in Part 1 of this article, the shelter is shown mounted on a truck. The truck shown is the CCKW, of World War II vintage. It has the soft rounded lines consistent with auto design of the immediate prewar period, and was indeed a militarized adaptation of a civilian model by GMC. It is easily identified by the gas tank on the right hand side, and by the distinctive bullet-shaped headlights mounted on the fenders. For a better look at the CCKW carrying the SRC-399, see www.arc-5.com/grc26a/system/scr_399.htm. Over 500,000 of these trucks were manufactured through 1945, and remained in use by the Army until 1956. The CCKW was the truck that ran the famous Red Ball Express late in 1944 supplying the Allied advance into Germany after D-Day. It had a manual transmission, and a top speed of 45 MPH. From 1950 to 1955, GMC supplied the Army with its successor: the M211. The M211 was rated for a top speed of 53 MPH and had an automatic transmission. Either vehicle would have carried the AN/GRC-26A. In the mid 50's the Army started buying the Reo M35. They were called the "deuce and a half", meaning that their maximum payload over rough terrain was 5,000 pounds. Over smooth roads, the maximum was 10,000 pounds. At about 5,300 pounds (less shoring), the GRC-26(*) and the slightly lighter SCR-399 were well within this truck's capacity. The size of the S-69 shelter and it

continued on next page

predecessors, the S-55/GRC-26, and the HO-17A for the SCR-399, fit the truck bed almost exactly. Pulling the PE-95(*) generator was a piece of cake.

Next Steps

I should have the shelter painted by early February, the floor repaired, and the interior "furniture" reinstalled. I expect to spend the next few months repairing cables, and doing some preliminary checks on the electronic gear. Hopefully by the next installment, the shelter will look, what is the Army word for "shipshape"?

Keep checking the website, and keep those e-mails coming. And who knows... will the shelter find its soul-mate, and wind up where it started, on the back of a 6x6 2-1/2 ton M211 manufactured in 1952? Could be. Find out in Part 3, which I hope will be ready for the March 2002 issue of Electric Radio. Stay tuned.

Acknowledgments

I want to thank everyone who sent me e-mails with very useful advice and their experiences with the GRC-26A. A later installment in this series will feature some of them. In the meantime, thanks to Pedro, EA2IG for some .pdf files of the manual, to Chuck Strozier, and Hank, WI3U for reminiscences and to Ed, KD6EU for the operating manual through the -D version of the system.

Some Corrections

The photo on the top left side of page 6 in ER #150 is described as the left side of the interior of the GRC-26A. It is in fact the left side (facing forward) of the SCR-399.

I referred to the "SCR-299 (and its variants the -399 and -499)". This is incorrect. The SCR-399 is the successor to the -299; its variants are the -499 and -599. **ER**

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Ishmael, Rebuilding the LS-3 Speaker, ER # 73

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Mottes, R-388 IF Filter and Problems, ER # 86

MacDonald, A 6 KHz Mechanical Filter for the Collins 51J4, ER # 90

DuVall, Review of Radio News Special Signal Corps Issue, November 1942 ER # 106

Teeters, Signal Corps Radio 197, ER # 139

Willey, Plate Tank coils for the BC-610 and AC Input..., ER # 139

DuVall, The BC-312/342 Receivers, ER # 95

Gagnon, Time Capsule Found at Fair Radio Sales, ER # 146

A complete index of the entire 12 years of ER is available for viewing or downloading at the following website: http://www.qsl.net/n9oo

the power supply has only a switch, a pilot light, and a knob for the tone control. The tone control is optional. Frankly, I've never been able to attain acceptable tone control with simple circuits. I look at the ones used by Hallicrafters, Hammarlund, etc., and most are pretty much alike—a linear pot, and a capacitor in series and connected to the plate of either the output tube or sometimes the plate of a preamp. I chose to install one in my #61 and it works moderately well. It is shown on the schematic.

One note here while it is on my mind. Very few pots today have enough of a threaded shaft to pass through a piece of heavy aluminum plus a 3/16" panel. The same is true of some toggle switches, and most all panel lamps housings. Here is the way I do it.

Attach the panel to the chassis with the nuts only moderately tight. Stretch a length of 3/4" masking tape horizontally across the front of the panel with the lower edge of the tape about 1-1/4" from the bottom. Set your combination square for 1.5" and scribe a horizontal line from panel edge to panel edge. Now set the square for about four inches.

Holding the square firmly against the bottom with the rule pointing vertically, mark the center of all needed holes for controls and pilot lamps. When marking with a pencil the mark will end up being about 1/16" from your square edge due to pencil point width. Once all holes are marked, center drill through the panel and chassis with a small drill bit—I find a 1/16" or 3/32" works well. Note which holes, if any, are for a control that has threads enough to pass thru the chassis and panel. Drill those holes before removing the panel from the chassis. You may find a switch with enough threads but chances are anything else will be too short. This means that for those controls you will need to cut a much larger hole in the panel. Use a 3/4 " hole saw and cut out holes in the panel for all other controls and pilots. Work slowly, do not force the saws or bits. When all panel holes are cut, sand with a fine sandpaper until smooth inside. Now, very carefully, paint the inside edges of all holes with a black felt tip marking pen. Drill appropriate sized holes through the chassis. The 3/4" holes in the panel will allow you to tighten nuts on the various controls, phone jacks, pilot bulbs, and switches. You may reinstall the panel at this point. Do not tighten screws excessively as complete removal of the panel may be required again. I wait until the receiver is working before giving all nuts a final tightening.

Output transformers are also on the scarce list. There are plenty available at greatly inflated prices but most of us are not that desperate—yet. With a 6V6 output tube you have a moderate amount of lee-way—our object is not necessarily high fidelity, but good crisp, clear short wave reception. Any transformer with a 5KΩ to 12KΩ primary and having a 4Ω to 8Ω output will do. I have been using Hammond transformers from Antique Electronics. They have a transformer available in limited supply for about $11 that works very well.

Perhaps my biggest problem in building power supplies is the available power transformers. I normally encounter higher output voltages than I need or want. Ideally, a transformer should have a secondary voltage rating of no more than 600VAC center-tapped. One with a 500 volt secondary would be even better. Unfortunately, almost any transformer you find will have a secondary high voltage winding that delivers nearer 800VAC. There are several reasons why this problem exists. Today, our normal house voltage runs about 120 volts. I just checked mine on my Weston model 433 line voltage monitor and it is a steady 119.5- volts.

continued on next page

When many of the transformers I use were built, the normal voltage was supposed to be 110-volts. I know from experience that it was often less. A transformer originally designed to have a 800-volt, center tapped, secondary winding when using 110 volts on the primary, would today have a higher secondary voltage. If my old K & E slide rule is telling the truth the voltage would be closer to 436 volts. Today, many of us prefer solid-state rectifiers—and for good reasons. So we have rectifiers with less voltage drop than the tube rectifiers in use when the transformer was manufactured. Then, because of the high prices of chokes, most builders today use capacitor input. Up goes the voltage again. In reality we may very well end up with a secondary voltage 75 volts to 100 volts more than the transformer delivered 50 years ago in a choke input, tube rectifier, half wave, 110 volt primary voltage power supply. I know of no easy way to lower this voltage other than through the use of high wattage resistors in the 'B' plus circuit. This is not the way to good voltage regulation hence the use of VR tubes.

Another consideration; a half-century ago most good home-brew power supplies used 8 mFd filter capacitors—often the capacity was less. The power supply shown in my diagram uses two 50 mFd., capacitors. Large capacity filters were a rarity when I opened my radio repair shop in 1946. The capacitor in the power supply pictured is a 50/50, 500 volt unit available from mail order houses today for about $12. That is pretty dog-gone reasonable considering the inflation rate—about $1 in 1946 dollars. So, with rectifiers delivering a smoother output, and with added filtration, we can get by with chokes that are less than the very best choice for clean output. Use the best choke you have, but don't sweat it. Most surplus chokes will take a lot more current than this set is going to draw.

One possible source of trouble: A VR-tube is made to furnish a constant voltage source. Of course it is necessary to feed the VR tube a voltage higher than its output. In the case of an OD3 the supply voltage needs to be around 170 volts. Check your handbook for the exact voltages for whatever VR tube you choose to use. There are formulas for calculating the various voltages and resistances. I prefer to do it the easy way and use the old cut and try method. The resistances in the schematic are what works well for me. However, your components may be far different from mine and you may find it necessary to experiment with R-13.

If your VR tube has insufficient voltage it will not regulate. If the voltage is too high, you may burn out the regulator. If it is on the borderline, you will notice the VR tube lighting with its blue glow and then going out. Normally if you feed a 150 volt VR tube 20 to 25 volts more than its rated output, you will be OK.

Next month we will conclude our article with construction of the detector-audio preamp unit. Some things you might be thinking about are your tuning capacitors and dial mechanism.

A 'so-called' midget 140 pF variable capacitor, the type made by the thousands back fifty years ago, make ideal band-set capacitors. They are not easy to find but are still available if you do a little looking. I see them weekly on e-bay-usually overpriced, but available. Expect to pay about 15 bucks for one. If you find it for less, consider yourself lucky. This capacitor can be installed without a vernier drive though I strongly advise that you do so only in desperation. I have built many receivers with direct tuning and they are very difficult to set on frequency.

As many of you know, I have an affinity for the National PW dial with its 180° gearbox. These dials command rather high prices. However, for some unknown reason PW dials have been declining in price for the past year or so. It is now possible, though it may take patience, to find one for under $50. In years past I have watched in amazement as they sold in the $125 price range. If the PW is not available, or priced beyond your budget, other more affordable National vernier dials show up almost weekly on e-bay. A word of warning; all verniers are not created equal—some of the newer imported offerings are subject to slippage and are rather 'flimsy' in construction compared to National products.

Under no condition would I think of using a direct drive on the bandspread capacitor. This is in reality your main tuning capacitor and a vernier drive is a must. Use the best one you can find. The receiver will never be one bit better than the vernier tuning drive. A good tuning arrangement can make a mediocre receiver work like a real champion. ER

Letters from page 2

ARRL's "Interference From Transmitters" pp.B16-26 of Field Resources Directory 1986/87. It appears that transmatch manufacturers are using baluns with inadequate cross-sectional area to handle even moderate power levels of 375 watts of average power. Ask anyone who has attempted operating one of these marvels on 160 meters and you'll hear horror stories of overheating, shutdown, or destruction of the balun or transmatch unit.

The solution to the problems is apparent. If you are the unfortunate owner of one of these multi input impedance transmatches (as I am), you might want to experiment with core materials having a larger cross sectional area than your balun but with similar ratings and avoid the pitfalls noted above.

Better yet, home-brew a balanced tuner like KØOR.

David Olsen, W6PSS

Homebrew Transmitter from page 27

Conclusion

This has certainly been a challenging, frustrating and time consuming project. I have been working at it off and on again for about a year. There remains a couple of glitches to work out. The modulation transformer impedance is not exactly a proper match since I had originally planned to use 4-400's in the modulator. I am not satisfied with the amount of RF drive required to excite the final. These can be taken care of down the road. For now however, I have a beautiful transmitter that offers the satisfaction in knowing that it was built by my hands and in my workshop. It goes on the air easily and tunes up without any problems. I believe that building is one of the things that makes AM such a growing segment of the ham radio hobby. There was a time when hams built some of their equipment. Today's technology and lack of parts does not allow building state of the art sideband equipment. With a reasonable amount of skill, some luck in finding parts and hard work one can still create a homebrew AM transmitter that will give a sense of pride and accomplishment for years to come. By the way, to answer everyone's question about power levels these are the answers. The transmitter in Class C AM operation will unload down to 375 watts of carrier. For sideband linear service it will run the legal limit of 1500 watts peak envelope power. ER

A recent photo of Fred Pfannenschmid, WØZZS, in his vintage hamshack. The transmitter in front of him is an HT-9 he purchased used in 1956. Above the HT-9 is a Globe 65-A and an NC-173. More on the HT-9 below.

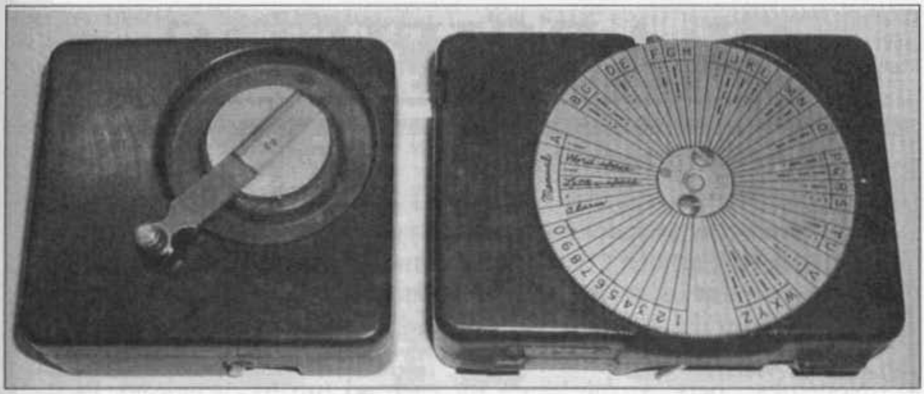
I bought the HT-9 about a year after I got my ham radio license in 1955. It had belonged to several hams in Pueblo including Don Middleton, WØNIT now SK, and my second cousin, Dr. Jeff Farabaugh former KØDCS. There were a few hams who owned it before Don and Jeff, but their identity is unknown to me. I used the HT-9 from 1956 to about the mid 60's when I bought a Heath HW-12, 75 meter transceiver.

The HT-9 transmitter uses a 6L6 oscillator, 6L6 doubler into an 814 final. The audio section uses a 6SJ7 speech amp and a 6J5 audio amp which drives 4 6L6's in push-pull parallel for modulators.

The HT-9 had been in storage in my Dad's old chicken house from 1965 until about April of 2001 when I dug it out, cleaned the rust off and did a lot of cleaning and painting. Did not paint or try to modify the front panel. Just cleaned it up and waxed it. The nomenclature was in pretty good shape. Of course, I had to replace all the filter capacitors and reworked some of the wiring where modifications had been done. The engraved sign in the middle of the front panel covers up a meter hole I cut years ago to install a meter for modulation monitoring. Also a red transmit pilot light was added by someone just to the upper right from the PA PLATE meter. To the best of my knowledge all the knobs are original except for the band switch knob in the middle. If any readers know where I can buy or otherwise acquire an original band switch knob, please e-mail me at w0zzs@juno.com. Many thanks to Keith, KØKE for donating an 814 final tube.

An interesting note... and talk about a coincidence, on August 8, 1956 I worked WØAGU, Gene Worth on 3890 kc AM in Pueblo. As noted in my log book,

continued on page 31



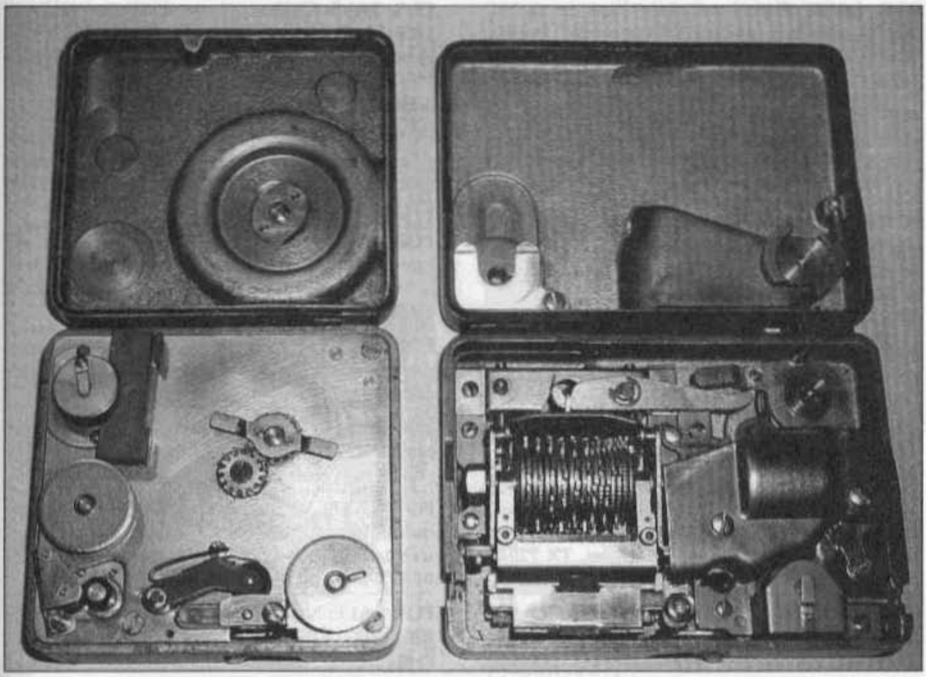
Mystery Device

A good friend of mine picked up this device recently at a hamfest and asked me what it was. I have never seen anything like it. I am guessing that it is a code burst keyer of some sort. Doesn't look to be of US manufacture, perhaps British?

What do you think this is ??? The unit on the right encodes letters and punches them into tape. The unit on the left has a windup motor and reads the holes and closes contacts to ? key a xmttr ?

Anyone know more about this?

Michael Crestohl, W1RC, 76 Ethan Allen Parkway, Unit 2, Burlington, VT 05401. mc@sover.net



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

FOR SALE: Military whip antennas, phantom A-62 antennas, 0-150 milli amp panel meters. Bruce Beckeney, 5472 Timberway Dr., Presque Isle, MI 49777. (989) 595-6483

FOR SALE: PRC 47, complete field pack; Hickok 209A VTVM; Radiotron Designers Handbook #4. Send SASE for revised list of magazines (new prices); books, radios, boat anchors, Heathkits & others; lots of test equip; kits & commercial makes; many coils, xmit caps, tubes, sockets & all types of old components. Vic Edmondson, W4MYF, 543 NE Catnip Way, Lee FL 32059. (850) 971-5580

FOR SALE: CD- Radiological Survey Meter, 2 ea, works - $150/pair; BC-611 handie talky - $250; BC-1000 w/ACC - $150; test set I-E-17 for BC-611 - $350; BC-1335 RT - $150; German Peoples Radio - $275; BC-721 handie talky - $475; BC-654, 2 ea - $250/pair. Steve Bartkowski, 4923 W 28th St., Cicero, IL 60804. (708) 863-3090

FOR SALE: (5) 814 tubes Jan, (7) 807 RCA , NIB - $10 ea; (1) 845 RCA. Dave, WØBEL (800) 500-8055.

FOR SALE: (3) Johnson Viking Messinger CB, fix up or parts. Bill Coolahan, 1450 Miami Dr., Cedar Rapids, IA 52402. (319) 393-8075

FOR TRADE: Orig manuals 75S-3B/C, KWS-1, Valiant, Adenturer, VFO122, NC98, NC183D, NCX3, SP600JX. Bernard, POB 690098, Orlando, FL 32869. ni4q@juno.com

FOR SALE: Yaesu SP-101PB phone patch-speaker, w/manual,vg condx - U$S 50; more, list $ 1.00. Joe Orgnero, VE7LBL, 1349 Leask Rd., Nanaimo BC V9X 1P8 Canada. joseph@pacificcoast.net

FOR SALE: Time delay relays for Collins 30S-1 - $22 shpd. Steve, W4IJ, POB 99, Summerville, SC 29484. (843) 871-7749

FOR SALE: NC300 - $275; HT37, needs restoring - $150; rcvr 1051, not working - $200 + shpg. George Portell, W8QBC, AZ, (480) 986-5797.

FOR SALE: Convert any wattmeter to read PEP! Perfect for AM/SSB - $19.99 ppd for complete kit! HI-RES, 8232 Woodview, Clarkston, MI 48348. (248) 391-6660, hires@rust.net

FOR SALE: Complete hardware set to connect Collins PM2 to KWM2 - $19.95 ppd. Warren Hall, KØZQD, POB 282, Ash Grove, MO 65604.

FOR SALE: Repair, upgrade, performance modification of tube communications & test equip. Accepting most military, all Collins & Drake designs, & the better efforts from others. Laboratory performance documentation on request. Work guaranteed. Chuck Felton, KDØZS, Felton Electronic Design, Box 187, Wheatland, WY 82201. (307) 322-5858, feltoned@coffey.com, www.feltondesign.com

FOR SALE: I am making aluminum plate and grid connectors for T series tubes. If interested contact Alan Price at fox75264@cs.com

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

FOR SALE: Ur old QSL card? Search by call free, buy find at $3.50 ppd. Chuck, NZ5M, CRBCS1@prodigy.net

FOR SALE/TRADE: Manuals: 75A4; NC-183D; Navigator; Apache; 75A3; Ranger; HQ-145; Adventurer; HQ100; HQ100A. Al, NI4Q, POB 690098, Orlando, FL 32869. ni4q@juno.com

FOR SALE: BC-779 Super Pro rcvr w/pwr sply & manual, working well, VGC - $225. Dave, WD4PLI, CA (818) 846-0617

FOR SALE: Signal Corps Command Set BC-442A ant relay unit, includes current meter, NIB - $40. Thorn, W7HWA, CO, (970) 259-0562, tcmays@westernet.net

FOR SALE: Multi match mod xfmrs, 60W Stancor A-3893, NIB - $100; 30W UTC S-19, NOS - $60; Terminal diagram included, ppd. Thorn, W7HWA, CO, (970) 259-0562, tcmayes@westernet.net

FOR SALE: R-390A w/covers & meters, exc - $400; nice Heath Mohawk - $300. **WANTED:** Eldico SSB-100F. Bob Braza, W1RMB, MA, (508) 222-5553.

FOR SALE: National SW5 with 6 GC Coil pairs. Needs restoration. Call for details - $250 plus UPS. Larry, K6LXT, Cerritos, CA, (562) 860-3131 ltinkler@msn.com

FOR SALE: Drake B Line R-4B, T-4XB, W/ MS-4 spkr/pwr sply. Rhett Downing, ND7O,(307) 721-3022 or nd7o@fiberpipe.net

FOR SALE: 1945 Jennings type Y Peanut, 3 mmfd 15KV fixed capacitor in uranium glass envelope, unable to ship. Come visit me in Hillside Park Sr. Apt's to see & buy. Cash & carry (cheap). Bob Ryan, 1000 S. Gilbert St. Apt 132, Hemet, CA 92543

WANTED: ARC-5 rcvrs, racks, dynamotors. Jim Hebert, 1572 Newman Ave., Lakewood, OH 44107.

WANTED: Orig Heath manuals for ham & test equip. Please state condx & price. Warren, K1BOX, POB 1051, Spruce Pine, NC 28777. (828) 688-1922

WANTED: Alignment service manual for R&S, EK-07 rcvr. Weber, 4845 W. 107th St, Oak Lawn, IL 60453

WANTED: TMC Model TAC Antenna Tuner in good condx. Al Santangelo, VE3AJM ve3ajm@sympatico.ca or (705) 277-9986

WANTED: Bendix radio rcvr RA-1B; Belguim set RST-101. George Rancourt, K1ANX, MA. (413) 527-4304 or k1anx@mindspring.com

WANTED: Connector 12 pin 9377 female ARC-5 modulator. Picture http://www.shlrc.mq.edu.au/~robinson/museum/plugs/9377.gif. Ray Robinson, VK2ILV 7, Roland Ave., Wahroonga 2076 N.S.W. Australia. (612)94898561

WANTED: Tecraft model C-3-26 10 meter xtal controlled converter. Douglas Reeves, WB6RKY, POB 278135, Sacramento, CA 95827. wb6rky@hotmail.com

WANTED: Stancor/Chicago PCC200, PCO/PS0150, RC8150; Triad A-9-J, A-10-J, A-11-J, A-12-J. FOR SALE: Books, send SASE. Richard Robinson, POB 1425, Wallingford, CT 06492. (203) 949-0871, richmix@erols.com

WANTED: RBB/RBC rcvrs, pwr splys, cables & RAK/RAL equip. Andy Miller, KD6TKX, CA, (831) 484-2389, amillertkx@aol.com

WANTED: Mics: Astatic JT 30/40; UT-48; Shure CR80/81/41; 707A; Turner VT-73; CD/BD; parts for same. Tom Ellis, Box 140093, Dallas, TX 75214. (214) 328-3225. tomsmics@flexcomp.com

WANTED: Desperate for museum display: lge AC cooled or water cooled xmtg tubes. Certain types including RCA, 898, 862, 893A or R & 5831s; other manufacturers such as Federal Telephone & Radio F 124R. Name your price. Tommy Bolack, 3901 Bloomfield Hwy, Farmingon, NM 87401. (505) 325-4275

WANTED: R-390A rcvrs, parts rigs or restorable, will restore yours at reasonable prices. Walter Wilson, KK4DF, (706) 733-8323, wewilson@knology.net, www.knology.net/~wewilson

WANTED: WWII BC-610-E series or earlier xmtr; BC-739 interphone control box. BC-652 rcvr. Steve Finelli, N3NNG, 37 Stonecroft Dr., Easton, PA 18045. (610) 252-8211, navrad@enter.net

WANTED: Electric Radio; Antique Radio Classifieds; Old Timers Bulletin. Alan Mark, POB 372, Pembroke, MA 02359

WANTED: Heath IO-3220 Dual Trace Scope. John Thuren, AA5T, TX, (281) 530-6130, jbthuren@hal-pc.org

WANTED: National Company emblems, escutcheons, logos from equipment. Also WW II rcvr's manufactured by National. Don Barsema, 1458 Byron SE, Grand Rapids, MI 49506. (616) 451-9874, dbarsema@prodigy.net

WANTED: 1950's Popular Electronics; 1961-65 Heathkit catalogs & Radio-TV Experimenter. John Curtis, WØCAR, 3146 S. Franklin St., Englewood, CO 80110. (303) 781-8027, wøcar@arrl.net

WANTED: SCR602 components, BC-1083, BC-1084 displays, any APS-4 components. Carl Bloom, CA, (714) 639-1679 or 3778111@mcimail.com

WANTED: Antique tubes. Paying $40 ea for good used type 201 tubes (not A). Buy list & new 2000-2001 catalog of collector tubes available. See www.fathauer.com. George H. Fathauer & Assoc., 688 W. First St. Ste 4, Tempe, AZ 85281. (480) 968-7686, tubes@qwest.net

WANTED: Info on Bendix 3801 Aircraft xmtr/rcvr. Have part of set. Joseph W. Long, WA2EJT, 33 N Harrison St., Johnson City, NY, 13790. (607) 798-7586, wa2ejt@hotmail.com

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

WANTED: Military survival communications equip: radios, beacons, manuals, books, historical info/photos. Daniel Cahn, 3444 Greenwood Ave., Los Angeles, CA 90066. (310) 398-7159. danielc411@aol.com

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

WANTED: RCA 140, 141, AVR5A. GE K80, K80X, K85. Any condx. James Treherne, 11909 Chapel Rd., Clifton, VA 20124. treherne@erols.com

WANTED: Seeking unbuilt Heathkits, Knightkits. Gene Peroni, POB 7164, St. Davids, PA 19087. (610) 293-2421

WANTED: Drake 1A rcvr; 399C1 Collins VFO; JRC 505 twins. K5YY, AR, (501) 756-5010. k5yy@arrl.net

WANTED: Collins 310B3, basket case OK - welcomed; & Chicago 500W CMS-2, high-level modulation xfmr; Taylor T21. Jerry, W8EGD, CO, (303) 979-2323.

WANTED: Clean Mackay 3010C & Kenwood R599D w/all filters & manual. Ric, C6ANI, POB N4106, Nassau NP, Bahamas

WANTED: National SW3, complete tube shield. State price & condition. Roger, K1TG, rwkuchera@snet.net

WANTED: Collins 70K-2 PTOs working or not; IN82A diodes; Bretting 14/14AX manual. Clark, WØBT, KS, (785) 286-2132

WANTED: National NTE. I love National. Sylvia, N1VJ, 33 Lawton Foster Rd., Hopkinton, RI 02833. (401) 377-4912

WANTED: Collins 30K1 xmtr; also need orig manuals & literature for 75A1, 32V1, 30K1. Paul Kluwe, W8ZO, POB 84, Manchester, MI 48158. (734) 428-2000

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

WANTED: BC-191 for my ART-13 (or buy $300, must work). Bill Hill, W4ZXW, 510 E. 25th Ave., Cordele, GA 31015. (229) 273-7264

WANTED: Info on xmtrs made by Clough-Brengle Co. Used by the CCC, in the mid to late 30's. Any help would be greatly appreciated. Ron Lawrence, KC4YOY, POB 3015, Matthews, NC 28106. (704) 289-1166 hm, kc4yoy@trellis.net

WANTED: Old Callbooks, especially those covering the years before 1930. Alan, W3BV, PA, (215) 795-0943 or W3BV@arrl.net

WANTED: National HRO black wrinkle spkrs, oak coil boxes, coils; Western Electric horns, spkrs, amps, mics. Barry Nadel, POB 29303, San Francisco, CA 94129. bnadel@ccnet.com

WANTED: Searching for RME CT-100 or 3R9 xmtrs and info about them. David Edsall, W1TDD, 156 Sunset Ave., Amherst, MA 01002. (413) 549-0349, dedsall@crocker.com

WANTED: New or used unmodified BC459A, BC696, T18/ARC/5, T19/ARC/5, CBY52232. Louis Lytch, K2DET, 117-33 230th St., Cambria Heights, Jamaica, NY 11411-1806. (718) 528-5065

WANTED: Manuals, manuals, manuals for radio-related equipment to buy or swap. Catalog available. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. (732) 238-8964

WANTED: Collecting military electronics including radio, radar, RDF and test, manuals & literature. William Van Lennep, POB 211, Pepperell, MA 01463. (978) 433-6031

WANTED: Postcards of old wireless stations; QSL cards showing pre-WWII ham shacks/equip. George, W2KRM, NY, (631) 360-9011, w2krm@optonline.net

WANTED: RXR-77/ARC3 + connectors & control box; C-118/ARC-3. G. Orecchia, Corso Galliera, 14/26, 16142 Genova Italy. sp0220bon@tin.it

WANTED: FT154 mounting base for BC348 HF rcvr. Gary, AG4CN, 402 Kimberly Rd., Warner Robins, GA 31088 or grandeguy@hotmail.com

WANTED: WW-2 Japanese military radio and radar of any kind. Yokohama WW-2 Japanese Military Radio Museum, Takashi Doi, 1-21-4, Minamidai, Seyaku, Yokohama 246 Japan. Fax 011-8145-301-8069, takadoi@carrot.ocn.ne.jp

WANTED: Tektronix memorabilia & promotional literature or catalogs from 1946-1980. James True, N5ARW, POB 820, Hot Springs, AR 71902. (501) 318-1844, Fx 623-8783, james.true@ibm.net

WANTED: Collins promotional literature, catalogs and manuals for the period 1933-1993. Jim Stitzinger, WA3CEX, 23800 Via Irana, Valencia, CA 91355. (661) 259-2011. FAX (661) 259-3830

WANTED: WW II military remote control rcvrs #ARW/CRW, xmtrs, dynamotors PE186 PE126, joy sticks, Gyroscopes for the GB, Azon glide bombs. Maurice Schechter, NY, (516) 294-4416 or mauricsch@cs.com

WANTED: QSL cards from old/pre WW II Ham DX countries; old regen kits. Hajime Suzuki, Nishikuniyoshi 1644-24, Ichihara-Shi, Chiba-Ken, 290-0231 Japan

WANTED: SX88; S-76; MR-2000 morse recieve option for the HAL DS 2000; KSR video Communiate Terminal. Roger Higley, W8CRK, 3507 Glenmore Ave., Cincinnati, OH 45211. (513) 451-1096

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

WANTED: Stancor 10P, parts, pieces, cabinets, anything. Chuck, W4MEW, GA, (706) 481-0238

WANTED: AC supply for BC-348. Carl, W4WML, 206 Greenfield Ave., Tullahoma, TN 37388. monin@cafes.net

WANTED: NL-9505 or NL-5853S readout tubes to repair a boat anchor. Jim Alexander, KØHIP, 1511 N. Jackson, Russellville, AR 72801. (501) 968-7270, ealexand@cswnet.com

WANTED: Fisher Radio Spacexpander (reverb), working preferred, NG also OK. Charles Graham, 4 Fieldwood Dr., Bedford Hills, NY 10507. (914) 666-4523 anytime.

WANTED: Service manuals, originals, copies for copy of HP 3330B, HP 3582A, HP 11710A. Will pay ALL exp. and more! Reinhard Wieschhoff, 7 rue du Debuche, F-78120 RambouilLet, France. Tel/Fax 0033 1 304 111 02

WANTED: Scott Special Communications rcvr. EA4JL, please call, Kurt Keller, CT. (203) 431-9740, k2112@earthlink.net

WANTED: Russian 1.5-8 MHz military transceiver, type P(R)-131. Will pay well for a good one. Leroy Sparks, W6SYC, 924 W. Mc Fadden Ave., Santa Ana, CA 92707. (714) 540-8123, leroysparks@earthlink.net

WANTED: SW3 #33A and #35 coils. I will trade my extra coils SW3 coils. Hank Bredehorst, 2440 Adrian St., Newbury Park, CA 91320. (805) 498-8907

WANTED: Long wire ants AT101, AT102, GRC-9; DY88/105; PP327GRC9; counterpoise CP12 & 13 GRC9; BC348 pwr conn PLQ102/103. KA1ZQR, 348 N. Main St., Stonington, CT 06378.

WANTED: Globe King 500 B/C; Viking Valiant I/II; Viking 500; Heathkit Mohawk. Frank, (916) 635-4994, frankdellechaie@sprintmail.com

WANTED: National SW-3 model1, version 3. Uses 32-32 30 tubes. Dean Showalter, W5PJR, 72 Buckboard Rd., Tijeras, NM 87059. (505) 286-1370

WANTED: Collins 32V & Collins 75A series; Globe Scout; National SW54. KBØW, CA, (916) 635-4994. frankdellechaie@sprintmail.com

WANTED: Hallicrafters SX88 or SX115. Larry Redmond, 413 Bedfort Dr., Duluth, GA 30096. (770) 495-7196

WANTED: HRO D coilset; Drake R7A rcvr; Collins 7553 rcvr. Jim, W8HPL, 13549 Morse Rd., Pataskala, OH 43062. (740) 927-2592

WANTED: Instruction Service manual w/ schematics for Nems-Clarke type 2801A UHF rcvr. Paolo Viappiani, Via G B Valle 7-19124 La Spezia, Italy. Fax: ++39-0187-21647, pviappiani@tin.it

WANTED: National Co., Inc nameplates, equip logos or other items w/the diamond NC on them; also WW II era tube model military rcvr covering 225-400 MHz. Don Barsema, 1458 Byron SE, Grand Rapids, MI 49506. (616) 451-9874, dbarsema@prodigy.net

WANTED: WW II German, Japanese, Italian, French equipment, tubes, manuals and parts. Bob Graham, 2105 NW 30th, Oklahoma City, OK 73112. (405) 525-3376, bglcc@aol.com

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

WANTED: I wish to correspond with owners of National FB7/FBXA/AGS coil sets. Jim, KE4DSP, 108 Bayfield Dr., Brandon, FL 33511. j.c.clifford@juno.com

WANTED: Parts for a TMC GPT-750 xmtr. I need the AM modulator deck and other parts to restore this unit. John, KF2JQ (716) 873-0524 jprusso@acsu.buffalo.edu

WANTED: Old military radar displays, scopes, antennae, receivers, manuals, etc. Even half ton items! William Donzelli, 15 MacArthur Dr., Carmel, NY 10512. (847) 225-2547, aw288@osfn.org

WANTED: RCA Models: 1X52, Ivory; 1X53, Green; 1X57, White. Cosmetically perfect for serious collection. Mike Grimes, K5MLG, 3805 Appomattox Cir., Plano, TX 75023. (972) 867-6373, grimesm@flash.net

WANTED: AN/WRR3-R1134 VLF receiver. Jack Holzer, (913) 791-5141 days

WANTED: Specifications and hookup info for Chicago Transformer CMS-1. Ronnie Hull, W5SUM, 1855 Shady Lane Dr., Shreveport, LA 71118. (318) 688-1389 or w5sum@glowbugs.com

WANTED: Westinghouse MW2 pwr sply, RF and modulator units. Separately or together. Will pay fair price. Will pick up. Gary, WA4ODY, Seabrook, TX, (281)-291-7701, myctpab@earthlink.net

FOR SALE: RCA tube manuals, RC-15, RC-20, RC-25; ARRL Handbooks, 1965, 1968, 1972 & 1978. LSASE for list. Charles Brett, 9980 Old Ranch Rd., Colorado Springs, CO 80908. (719) 495-8660, brett3729@aol.com

FOR SALE: Collins drum overlays. 75A-2, 3, 51J#. For 75A-4 & KWS-1, specify new/old - $8.50 ea. 2/$15 ppd. Correct colors. Charlie Talbott, K3ICH, 13192 Pinnacle Ln., Leesburg, VA 20176-6146. (540) 822-5643.

FOR SALE: Repro Nameplates, R-390A generic - $9; 51J-3 and 51J-4 exact replicas - $12. Tom Marcotte, N5OFF, 242 Chestnut Oak Dr., Mandeville, LA 70448. marcotte@iamerica.net

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

FOR SALE: R.L. Drake repair and reconditioning, most models including TR-7's, 35 years experience. Jeff Covelli, WA8SAJ, (440) 951-6406 after 4 PM, wa8saj@ncweb.com

FOR SALE: Heath Nostalgia, 124 pg book contains history, pictures, many stories by longtime Heath employees. (See BOOKS inside back cover.) Terry Perdue, 18617 65th Ct., NE, Kenmore, WA 98028

NOTICE: Visit HamRadioUSA.com a website dedicated to traditional ham radio & vintage radio resources. http://www.radioing.com. let's radio. W5AM

FOR SALE/TRADE: Transmitting/rcv'g tubes, new & used - 55¢ LSASE for list. I collect old & unique tubes of any type. **WANTED:** Taylor & Heintz-Kaufman types & large tubes from the old Eimac line; 152T thru 2000T for display. John H. Walker Jr., 13406 W. 128th Terr., Overland Park, KS 66213. (913) 782-6455 or johnh.walker@prodigy.net

FOR TRADE: Two good RCA 833A's for one Taylor 833A; also looking for Taylor 204A, 813, 866B. John H. Walker Jr., 13406 W. 128th Terr., Overland Park, KS 66213. (913) 782-6455 or johnh.walker@prodigy.net

FOR SALE: NOS British tubes 1930's to 1960's - send wants. David Boardman, VA2DVD, 10 Lemaistre, Sainte-Foy, Quebec G2G 1B4. (418) 877-1316, dbtubes.com

FOR SALE: Central Electronics 100V, good condx except needs some help on 10 meters. John, KØJY, 62639 Ohlm Rd., Montrose, CO 81401. (970) 249-2751

FOR SALE: WACO-5NWX telephone filters. Just plug in 1/$13.95, 2/$25, 3/$34. Money back. Cecil Palmer, 4500 Timbercrest Ln., Waco, TX 76705. (254) 799-5931, w5nwx@hotmail.com

FOR SALE: Repair! Radio repair, tube or solid state. Reasonable charges. J. Dan Rupe, W7DDF, 998 Whipple, POB 697, Grayland, WA 98547. (360) 267-4011, w7ddf@yahoo.com

FOR SALE: Books, 200+ radio titles. Great prices. SASE or email for New Revised List. Paul Washa, 4916 Three Points Blvd., Mound, MN 55364. w0tok@msn.com

FOR SALE: DX-35, DX-40 reproduction crystal doors. $11.50 shipped. Texans add 8.25% sales tax. Glen Zook, 410 Lawndale Dr., Richardson, TX 75080

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

FOR SALE: Military Radios, etc. E-mail N1UDI@ATT.NET for a List or SASE. Ronnie Parker, 1357 Bridgeport, CT 06601

WANTED: Info, instructions, schematics for Master Mobile Micro-Z-Match feed line impedance device. kebie@msn.com

WANTED: Schematics on Jackson Cap. Tester model 650A & Superior Instrument Co. VOM PB-210. K1MBI, 21 Freestone Ave., Portland, CT 06480.

WANTED: Crystals FT243 between 3513 kHz to 3525 kHz. W3MNE, 1598 Brimfield Cir., Eldersburg, MD 21784.

WANTED: Type 852 tube, must be electrically good. **FOR SALE:** QST 1944 full yr, hard bound - $22 shpd USA. Tom Berry, W5LTR, 1617 W. Highland, Chicago, IL 60660. (773-262-5360, 262-0016

WANTED: Desperately need main tuning dial for HQ-180, not the knob. Tom, NI8G, OH, (419) 499-2109

WANTED: FL-8A Radio Range filter in good condx w/lead & phone plug (PL-55). Louis L. D'Antuono, 8802 Ridge Blvd., Brooklyn, NY 11209. (718) 748-9612 after 6 pm

WANTED: Drake 2NT xmtr w/or without the 2C rcvr. Jerry Boles, N5KYE, OK, (405) 373-4727.

WANTED: 10-20 amp variac 110 VAC. Tom Mackie, W2ILA, 14 Washington St., Jamestown, RI 02835. (401) 423-0233, tom_mackie@trimble.com

Subscription Information

Rates within the US:

2nd class - $32
1st class - $42, with envelope - $46

Canada (by Airmail only) - US $48
All other countries (by Airmail only) - US $60

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Visa, Mastercard and American Express

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