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ELECTRIC RADIO

celebrating a bygone era

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Guglielmo Marconi

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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, KW1I; Bob Grinder, K7AK; Jim Hanlon, W8KGI; Brian Harris, WA5UEK; Tom Marcellino, W3BYM; Ray Osterwald, NØDMS; Chuck Teeters, W4MEW; Bruce Vaughan, NR5Q.

Editor's Comments

160 Meter Events, December 23rd and 29th

Two events this month on 160 meters that should be noted: December 23 there is the 2nd Annual AMI 160M Heavy Metal Jamboree and December 29 is the 8th (or 9th) Annual ER/N2KSZ Memorial Jamboree. The Jamborees get started early in the evening and carry on until the following morning. For those of you who are not normally active on 160, these events are an opportunity to try out the band and get to know some of the regular ops there.

Colorado Morning Group Thanksgiving Day Jamboree

OJ, KØOJ, the events organizer, told me that when he got on frequency (3876) at 6 AM the jamboree was already underway which indicates the level of interest out in the west. During the day there were 36 checkins.

Collins 300G Progress Report

I'm very proud to announce that my 300G is on the air and performing well. All of the major problems have been resolved and I'm just having a ball operating the transmitter on 160. I'm still learning about the transmitter but should be able to present some kind of report next issue.

Updates to Parts Directory and Vintage Nets List

Now would be a good time to make sure that the Parts Directory and the Vintage Nets are up to date. I'd like to ask everyone that has a unit on the Parts Directory to make sure their listing is accurate. If you've moved or no longer have the parts set please let me know. And also all those that check into the Vintage Nets— have a look at the listings on page 19 and let me know if there's any misinformation there. Happy Holidays to all from Shirley and me. N6CSW

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Cover: Guglielmo Marconi at the time of his experiments in England. While touring the U. S., Marconi arrived in 1933 at the Chicago World's Fair, "A Century of Progress." He went forthwith to amateur station, W9USA, which featured a KW transmitter. The awed young operators apologized for its home-built appearance, saying that radio amateurs had built it. Marconi replied that he understood, since he was an amateur himself. (See the W9USA transmitter in QST, 1933, December, p. 31).

Press Wireless 2.5 Transmitter

by Chuck Teeters, W4MEW
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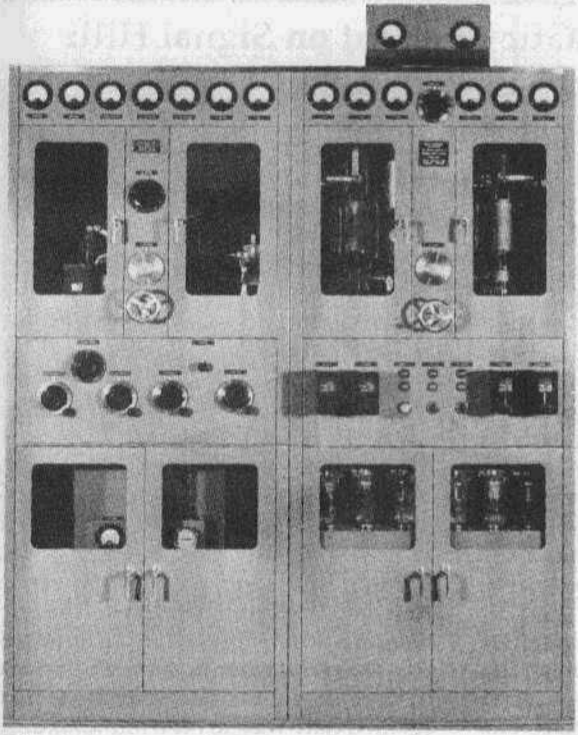
Unless you were born in the twenties or earlier, it is hard to imagine the days before underseas multichannel telephone cables, and communications satellites. The War Department was dependent upon high frequency CW at the start of World War II. Overseas messages were sent by Morse over commercial cables or international code via short wave radio. There were several overseas telephone circuits using LF and HF SSB operated by AT&T, but none were used by the Army. The hub of Army and Air Corps communications was radio station WAR, at Fort Meyer, VA at the present site of the Pentagon, operated by the Signal Corps Communications Service Division.

Fixed station Army transmitters were 400 to 1000 watt 4 to 23 MHz CW units made by WECo, Federal and GE/RCA. Receivers were Hammarlund Super Pros, with a few National and Wilcox mixed in. When the buildup for World War II started the Signal Corps went to the manufactures to get receivers and bigger transmitters. The company that offered an immediate response was the Press Wireless Company of Hicksville, NY.

Press Wireless was an old time communications company that, as their name suggested, provided worldwide communications for newspaper groups. They had been unhappy with the equipment offerings available and had started their own manufacturing division in 1937 to build transmitters and receivers. With their experience as an operating company the equipment Press Wireless designed and were building, was optimized for reliable long distance CW communications circuits. Simple, reliable, using readily available parts, easy to maintain 4 to 26 MHz transmitters and receivers designed for 24 hour, 7 days a week and mostly unattended operation, it was just what the army was looking for.

The first radio the Army bought from Press Wireless was their model 981 - 2.5 transmitter. The PW 2.5 was a 2-1/2 KW output 2 to 23 MHz air cooled CW transmitter. The first one was delivered to WAR for testing. It was love at first sight for the Army fixed station officers and enlisted men. The PW 2.5 was big and rugged and exactly what they would have built if they had time to do it themselves. There wasn't a part in it that they didn't recognize. The Bud Radio cabinets held Cardwell, Hammarlund, and National caps. EF Johnson tube sockets were holding Amperex and RCA tubes. The meters were Weston, and the control knobs and dials were Millen. The term battleship or brick outhouse would best describe the construction. Even with the massive construction, every part was accessible and easy to change.

The transmitter was crystal controlled with a 6J5 oscillator followed by an 807 buffer, with three frequency multipliers using Amperex HF100s which could be switched in or out depending upon the output frequency. A push pull driver with HF300s preceded the push pull output stage which used Amperex ZB3200s. The output tank was set up to feed a 600 ohm open wire line, which was the commonly used transmitter feed line in those days. The transmitter operated from 220 volt three phase power. A half horsepower blower cooled the final tubes and moved air through out the entire transmitter. The buffer was electronically keyed by a pair of 2A3s. The ZB3200s operated at 3900 volts with 1.8 amp plate current. The output was always in excess of the rated power, and was normally over



The PW 2.5 is a 2-1/2 KW output, 2 to 23 MHz air cooled CW transmitter.

three and a half kilowatts. The rectifiers were three pairs of 866s, a pair of 872s and six 972s in a three phase full wave circuit.

The transmitter was in two 6' 6" high cabinets sitting on a 3' by 5'6" base. All the wiring came in through the base except the RF output which came off the top of the right cabinet which housed the power amplifier and 3900 volt power supply. The oscillator, buffer, keyer, multipliers and driver were in the left cabinet, along with their power supplies. In case of PA trouble, the 750 watt output of the driver was available from the top of the left cabinet. The front and back doors opened on both cabinets for QSYs and maintenance. QSYs were by switches and tuning caps, except for the driver and final. These tuned circuits used long rods running along the outside of the coils, and copper or ceramic spacers were inserted to select the proper sections of the coils. The rod ends were tightened up to bring the spacers in contact with the lugs on the coils. A good transmitter man, MOS 649, could shut down, retune and bring the 2.5 back up on a new frequency in one and a half minutes.

The Army was happy with the PW 2.5 so they bought 24 more. It was the most used big transmitter the Army had in WW II. With the good results of the 2.5 the Army bought 12 PW-15s, a 15 kilowatt air cooled, and 10 PW-40s, a 40 kilowatt water cooled, transmitters from Press Wireless for the longer paths such as Washington to Ethiopia, and San Francisco to Australia. The Army then bought the Press Wireless PW-DDR receiver which picked up AN/FRR-3 nomenclature. This was a 5 channel fixed tuned diversity receiver that could be remotely controlled. In 1942 PW started working with Western Electric to convert CW equipment to 850 hertz shift radioteletype. The PW-FS-12 frequency shift exciter became the 0-5/FR and a WECo teletype tone converter D-152609 became the AN/FGC-1. In 1943 when the Army started using WECo SSB transmitters and receivers, the PW-15S and PW-40S were adapted for linear amplifier service.

The PW-15s and PW-40s survived until replaced by Collins 15 and 40 KW units in 1953, but the 2.5s were pulled out of service soon after the war and by 1949 were gone. The PW receiver AN/FRR-3 was replaced by the AN/FRR-38 (R-390) in 1952, and the 0-5/FR frequency shift exciter was replaced by the 0-5B/FR built by Hallicrafters in

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

Part One

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One hundred years ago, Guglielmo Marconi (1874-1937), while situated atop Signal Hill, St. John's, Newfoundland, reported the reception of transatlantic wireless signals sent from Poldhu Point, Cornwall, on the Southern coast of England. The signals consisted solely of three brief clicks, representing the letter "S" of the Morse code, sent over and over again during the afternoon of December 12, 1901.

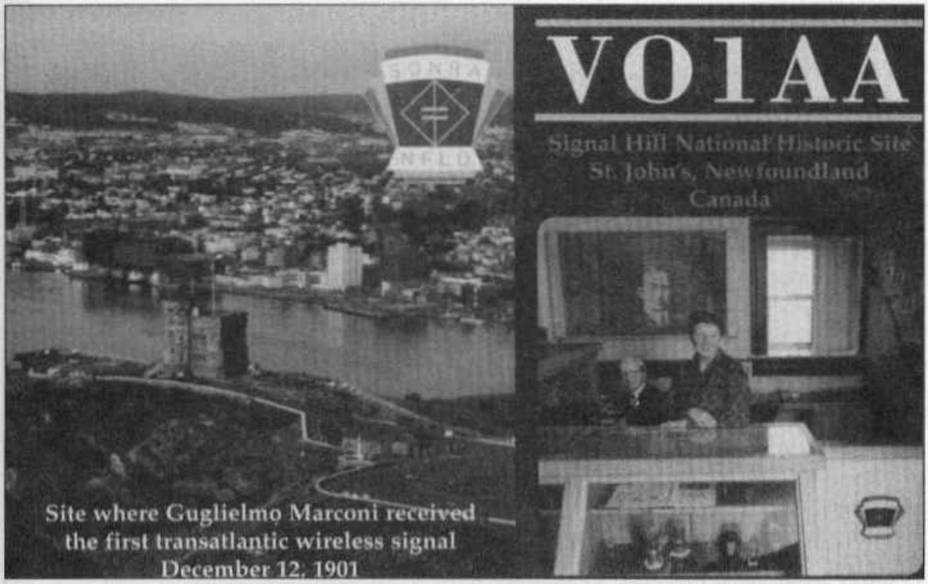
Marconi had conducted recently wireless transmissions across the English Channel and from coastal stations to nearby ships at sea. His efforts attracted considerable publicity and alerted entrepreneurs to the commercial potential of wireless. The transatlantic performance, however, heralded an illimitable leap into the future. The long-distance wireless transmission of electromagnetic waves represented an unforeseen dimension of physics-an extension of reality that illustrious scientists of the day, like Thomas Alva Edison, thought impossible. The worldwide reaction to the event was predictably one of incredulity and astonishment. Perhaps a comparable intensity of awe and excitement was attained subsequently when astronauts first walked on the surface of the moon; perhaps it will not be attained again until a spaceship carries humans to another planet.

I became a radio amateur as radio technology flowered around mid-century. Marconi's stunning 1901 exploit featured prominently in the folklore then current. My interest in it languished subconsciously for years thereafter, since the apparatus that he used—coherer receiver, 15-25 kilowatt spark transmitter, and ad hoc antenna designs—had little meaningful connection to the vacuum tube era in which I was participating.

A few years ago, my interest was revived when a trip to England provided opportunity for a visit to Poldhu point. I stood on the forlorn site where a radio shack once housed his spark transmitter, which in 1901 had been far and away the most powerful transmitter ever constructed. The site was on a promontory over 100 hundred feet above the Atlantic shoreline, which offered a view of the horizon that seemed half-way to Newfoundland.

My inquisitiveness thus kindled, I was motivated during August 2001, to visit St. John's, Newfoundland. The Province was in the midst of commemorating the one-hundredth anniversary of Marconi's transatlantic test. Children were being encouraged to fly kites, in symbolic replay of a Herculean aspect of the event (see Part III, below). Distinguished spokespersons were making speeches, less about Marconi's historical tests than visionary pronouncements about the next stages in wireless communications. Importantly, the curators of exhibits at Colonial Building, St. John's, where legislators once held their congresses, arranged cooperatively with the staff of Marconi plc, Chelmsford, England, to bring to Newfoundland for a temporary exhibit the original equipment that Marconi had used on Signal Hill.

A few weeks after he returned from St. John's, Marconi stored in boxes at



VO1AA—QSL card of the Society of Newfoundland Radio Amateurs (SONRA), whose members operate a commemorative (SSB) amateur station on Signal Hill.

Chelmsford the coherer and its accessories, which someone covered much later with cloth sheets. The diligence and persuasiveness of the curators paid dividends, because for one hundred years, successive generations of Marconi personnel in charge of the priceless heirlooms had chosen to prohibit historians, scientists, and citizens from examining them.

The artifacts brought to the Colonial Building were displayed in rectangular glass cabinets set on pedestals for viewing easily from several perspectives. The docents whom I met were justifiably proud that this was the first exhibit of the receiving equipment that Marconi had used on Signal Hill. The fact that it has been boxed and hidden from scrutiny explains why it has been described speculatively in the literature only with sketches and drawings-journalists and biographers had been denied access to pictures of the actual items. Since the artifacts were now were on public display and accessible for everyone to view free of charge, the gracious docents permitted me to photograph them through the glass of the cabinets. To assist me, they removed glare by turning off spotlights and closing curtains to exclude sunlight.

Initially, I intended this paper to be primarily one in which I shared with readers of Electric Radio my photographs of Marconi's receiving apparatus (see Part III, below). My intent was to augment the perspective provided already by the sketches and drawings. However, as I reviewed the circumstances associated with Marconi's formative years and his transatlantic tests, I encountered details that unfolded less lucidly than I anticipated. Therefore, I decided to present the pictures in the context of a discussion of both Marconi's emergence as a wireless engineer through 1901 and the incremental development of his apparatus. I describe transmitter evolvement from Hertz, Marconi, and Fleming and receiver evolvement through Varley, Hertz, Branly, Lodge, Popoff, Marconi, and Solari. I have

continued on next page

divided my commentary into four parts: (I) Marconi's formative years; (II) Marconi's frenetic, accelerated professional growth in England; (III) Marconi's dramatic moment at Signal Hill; and briefly, (IV) Marconi's stature in history.

Part I: Marconi's formative years

Marconi's childhood in Bologna, Italy, was cushioned by prosperity. His father oversaw huge family farms and banking interests. His mother was a heiress from a wealthy Scotch-Irish family, who were whiskey distillers in Dublin. She grew up living in a castle and had come to study music at the Conservatory in Bologna, where she met and married his father. Marconi's boyhood residence was his father's four-story mansion, Villa Grifone, surrounded by acres of vineyards.

Marconi did not attend school with other children. He was tutored starting at age five until he was 14 years old. Reading books, especially about electricity, became his favorite pastime between five and ten years of age. Since the relatively severe winters in Bologna were distasteful to his mother, the family and tutor moved usually for a few months to warmer, seaside climates, like Florence or Leghorn. In Leghorn, when he was 13, he befriended an elderly former telegraph operator who was losing his sight. Marconi read to him, and in turn, the older man taught the boy the Morse code. Marconi's acquisition of code skills, at a youthful age, indicates an early interest in telegraphic communication. My belief is that the occasion was one of his more critical formative experiences. A few years later, when he began seriously to demonstrate wireless systems, skill with the Morse code facilitated his gaining knowledge hands-on as he operated equipment himself.

When Marconi was 14 years old, his parents enrolled him in a Florence Institute, where his favorite classes were in physics and chemistry. Marconi loathed the school, partly because years of solitary tutoring failed to prepare him for the rough and tumble activities of his peers. However, Marconi developed a life-long friendship with an older boy, Luigi Solari, who later assisted him in countless experiments, and notably, provided the coherer that Marconi used on Signal Hill to listen for transatlantic signals from Poldhu.

Marconi attended the Leghorn Technical Institute at age 15. His mother obtained this time the services of a teacher who provided for him private lessons in physics. The breadth of his knowledge expanded rapidly. He began to subscribe to physics journals, and he used volumes at the Institute to complement the relatively good collection of technical books in the library at the family estate. He was attracted especially to discussions of experiments. On one occasion, Marconi demonstrated Benjamin Franklin's proposition that static electricity could be drawn from a cloud in the midst of an electrical storm; he connected a bell to a zinc spear placed on the roof of the villa, leading it to ring when a thunder storm materialized.

Given the studious, young lad's intense involvement in physics, his mother arranged for him, at nineteen-years-of-age, to discuss his interests with a family friend, Augusto Righi, distinguished professor of physics at the University of Bologna. Righi appreciated Marconi's curiosity and dedication, and without requiring him to register as a student, he allowed him to borrow his books, attend his lectures, and perform experiments in his laboratory. Marconi spent endless hours pouring over books and conducting experiments; in the process he developed, as most good technicians do, a sophisticated, intuitive capacity in understanding how to make things work while not understanding the theoretical bases for why they worked.

Whereas most of the adolescents in

Monument erected in honor of Marconi at Poldu Point. The plaque reads as follows: "To commemorate the pioneer work done by Guglielmo Marconi and his research experts and radio engineers at the Poldu wireless station between 1900 and 1933. The Marconi Company presented this historic land to the National Trust. Some six acres of cliff land were given in 1937 and forty four acres behind the cliffs on which stood the station and masts were given in 1960."

Bologna were expected to work to augment allowances, and perhaps aid their families, Marconi's family resources afforded him the luxury of being a self-educated student, unfettered by financial constraints. Throughout his formative years, his mother had taught him English and inspired him to concentrate, to learn, and to follow his inclinations, wherever they might lead him. She encouraged him to elevate his dreams and aspirations to higher and higher planes; thus, he became literally a "son of destiny;" he acquired an exalted sense of self-confidence, and as an adult, consecutively more lofty visions led him to address seemingly unattainable goals. Simultaneously, his father neither interfered with his son's solitary activities nor discouraged him. However, his father exerted as much influence as his mother upon his character; via subtle discussions, he imbued his son with an acute awareness of entrepreneurial corollaries-to be certain that his every undertaking represented a sound, profitable investment.

In the summer of 1894, during his twentieth year, his mother sent Marconi in the company of an older brother, to the Italian Alps for a vacation. She hoped that his gregarious brother would introduce him to outdoor sports and evening festivities, thus tempering his reclusion. The stratagem failed. One day, while in the Alps, Marconi read an obituary of Heinrich Hertz who had died prematurely that year at only 37 years of age. The article described how, six years earlier, in 1888, Hertz had demonstrated empirically the principle that "electric waves" could be

continued next page

propagated through space.

Hertz drew upon a substantial variety of precedents. For example, a Dutch mathematician, Christian Huygens suggested in 1678 that all space in the universe is filled by an invisible medium, which he regarded as ether, and he hypothesized that it accounted for the propagation of light. [Physicists today regard the concept of ether as superfluous.] Almost two centuries later, in 1832, the British genius, Michael Faraday, who contributed extensively to the science of electricity, supported Huygens' theory. Faraday stated that he believed that some form of vibration propagates both light and electromagnetic waves through the atmosphere. Faraday also offered a laboratory demonstration of the "induction coil;" that is, if a low-voltage is delivered to a coil of a few turns wound around a cylinder, a much higher voltage is produced at the ends of a second coil of many turns, when it is wound over the first coil. Consequently, should the ends of the second coil be brought close together, a relatively large spark will ensue. Following Faraday, a British mathematician, James Clerk Maxwell, developed in 1867 a precise, comprehensive mathematical formulation in which he postulated that both light and electromagnetic waves travel similarly through space at a speed of 186,000 miles per second.

Hertz set out to design a laboratory experiment that would both create and detect electromagnetic waves. His primary objective was to demonstrate that the waves travel through space. In developing parameters for his apparatus, he incorporated serendipitously what were to become the three essential components of a wireless system—transmitter, aerial(s), and receiver. Figure 1 illustrates Hertz' system. [Thom-Collins, 1908, Part II, p. 5). The sending mechanism "A", or "exciter," as he named it, is comprised of "1" a key, "2" a battery, and "3" an induction coil. The high tension terminals are connected to an "oscillator," which is formed by two brass spheres, "a" and "a." Each is supported by a vertical brass rod "c" and attached by a horizontal brass rod to a square brass plate, respectively, "b" and "b," which create an aerial. The spark-gap is shown at "d." The receiver "B," or "resonator," is derived simply from a loop of wire, with its ends affixed with tiny balls, which are brought close together. Hertz hypothesized that when the exciter generates a high-voltage current, a spark will leap from one oscillator ball to the other; electric waves will then be emitted, and via wireless, a small spark will jump across the open ends of the resonator.

Hertz' confirmation of Maxwell's theory was widely disseminated throughout the scientific world. Excited physicists replicated it easily. The primitiveness of his detector, however, narrowed for a time his extraordinary demonstration to the status of a mere novelty. The wire ring that Hertz used as a detector required too much energy from his oscillator to affect it more than a few feet away.

Physicists were initially pessimistic about whether the detector could be improved. However, an English railroad technician, S. A. Varley, in the 1860s, sought to protect telegraph lines from lightning, and in discovering by trial and error the mechanism he needed, he produced inadvertently the first wireless detector. Varley packed a block of wood loosely with carbon and tin filings, tied one end of the filings to a telegraph wire and the other end to ground. He found that the loose filings were highly resistant to the passage of electricity, so that when the block was in the circuit, the wire was insulated from ground; however, the filings adhered in the presence of lightning, and in this low-resistance condition, conducted the lightning to ground. After the lightning passed, the

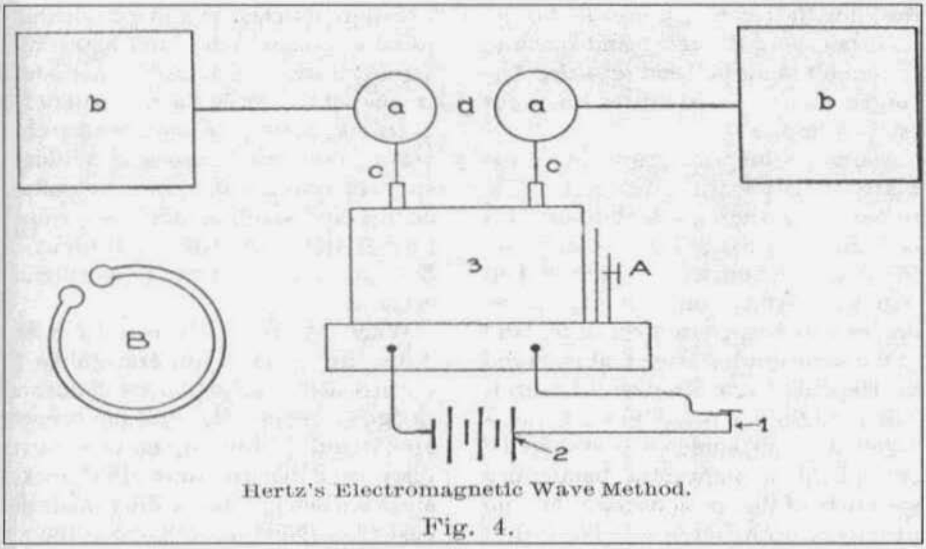


Figure 1: Hertz's electromagnetic wave apparatus

filings returned to their loose state and again insulated the telegraph wire from ground.

Varley had solved a substantial problem, and post-Hertz physicists were relieved when they recognized that he had created the first relatively effective wireless detector, for only in the presence of an electromagnetic wave—lightning being comparable to a man-made spark—would the device conduct current. Professor Edouard Branly, a French physicist was first to convert Varley's wooden device into a wireless receiver. In 1890, he filled a thin glass or ebonite tube, a few inches long, with iron filings with which he detected waves from a Hertzian oscillator at about 65 feet. Branly used an adjustable copper plug at each end of the tube. He found, with tension against the loose filings from the plugs, that reception of an electromagnetic wave caused the filings to adhere, that is, change from relatively higher to lower resistance, and thereby, conduct current, which he registered on a galvanometer in series with a battery across the plugs. Furthermore, Branly found that he could loosen the filings again instantaneously by tapping the glass tube with the end of a pencil.

Four years later, Sir Oliver Lodge, professor of physics at Liverpool, succeeded in 1894 in detecting Hertzian waves several hundred feet with the Branly receiver. He fitted the tube with a clock mechanism to jar the particles loose automatically. Lodge called the device a "coherer" in that wireless waves caused the filings to cohere. In 1895, about the time Marconi's interest in wireless flourished, Alexander Popoff, a Russian physicist made significant improvements in the Lodge coherer while endeavoring to develop a warning device for lightning storms. Popoff was first to use an aerial and ground system, a technique that Nikola Tesla in 1883 had described in published lectures (Cheney, 1981, p. 69). He also incorporated a "decoherer tapper" that was controlled directly by the wireless impulses. When the latter lowered [changed] the resistance of the coherer, conduction closed the circuit of a battery operated-relay, which in turn, activated a bell and a clock-driven recorder. The bell striker tapped the coherer leading

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the filings to decohere [raise resistance], thus releasing the relay and opening the circuit to the bell and recorder. The contrivance was now in readiness for another impulse.

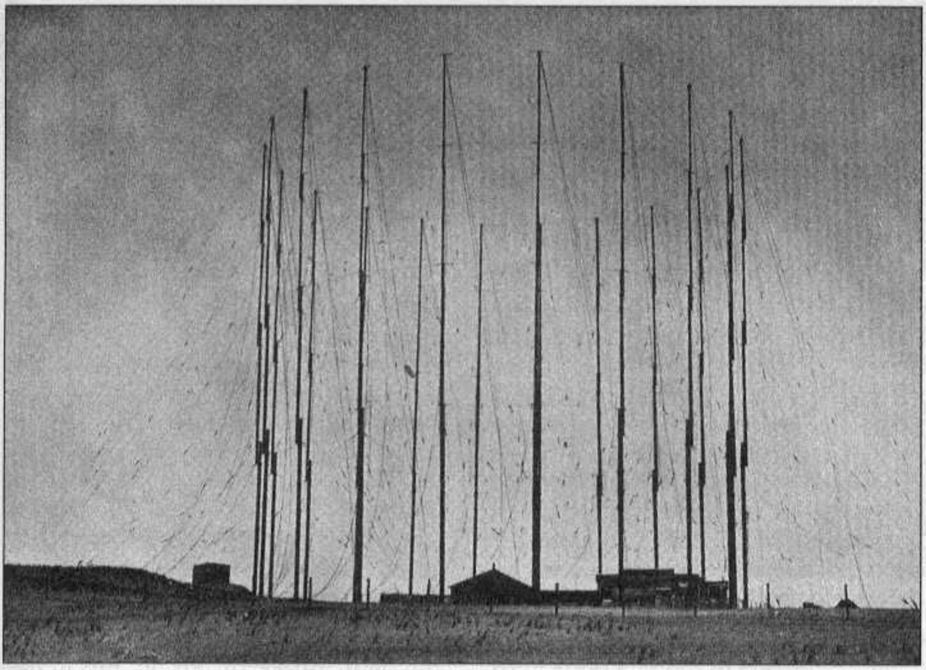
Marconi's biographers assume that Marconi first learned of Hertz' epic research when he read his obituary. This is logically possible, but barely so. Marconi's mentor, Professor Righi had published articles on Hertzian waves; one of which appeared coincidentally in the same journal issue that included the Hertz obituary (Kreuzer & Kreuzer, 1995). Righi regarded wireless as a noteworthy phenomenon, but shared a belief held by many other laboratory scientists of that period that it had no practical significance. Given that Professor Righi was actively researching Hertzian waves, and that Marconi was under his direct tutelage, it is virtually inconceivable that the widely read young man had not before learned something of Hertz' wireless experiment, and the subsequent efforts of Branly and Lodge to improve Hertz' primitive detector.

Perhaps during the ensuing six years between Hertz' demonstration of wireless and his death, Marconi encountered only isolated commentary about the advent of wireless. Since Righi regarded the phenomenon as inconsequential, an impressionable Marconi may have dismissed it cursorily, too. However, when fragmented insights merged into a sweeping vision after he read Hertz' obituary, Marconi's intuition persuaded him that telegraph messages could be sent and received over great distances—once the deficiencies in Hertz' wireless apparatus were remedied. Vast benefits to humankind and enormous commercial gain might then be realized. Messages sent by wireless would be less expensive per word than those sent across telegraph lines; costly submarine cables would become superfluous; maritime wireless would permit ships to be in contact with land bases, and significantly, save lives by facilitating rescues at sea. From the moment of his percepts, Marconi's modus operandi was that of a man possessed! Within a span of only seven years, relentless energy and single-mindedness would propel the unregistered student in Bologna from obscurity to worldwide acclaim.

When Marconi returned from the Alps, he worked indefatigably to reconstruct Hertz' exciter-oscillator and Lodge's coherer. He took the coherer apart and following endless tests discovered that a mixture of 95% nickel and 5% silver, ground to dust, made the best filler. Next, he exhausted the air from the tube and found that a vacuum improved both its sensitivity and reliability. Following a few months of tinkering, he connected across it a Morse sounder and battery in series, placed the coherer about 200 feet from his oscillator and asked his father to listen for a series of clicks. Marconi assured him that with further improvements, messages in Morse code could sent commercially over long distances. He acquired his first investor when his father advanced funds to purchase supplies for additional experiments.

Marconi was thankful for his father's support, because he was convinced that by intensifying his research he would eventually perfect a commercially viable communications system; however, he worried that someone would surpass him. Years later, he is reputed to have said: "My chief trouble was that the idea was so elementary, so simple in logic that it seemed difficult to believe no one else had thought of putting it into practice" (Jolly, 1972, p. 23; Tarrant, 2001, pp. 21-22).

Marconi's concerns were unfounded, truth-be-told, because he was unacquainted with the academic world in which his competition functioned.



Circle of masts erected at Poldu and Cape Cod, respectively, for the transatlantic experiment.

Academic scientists prefer to advance theorems and principles rather than indulge in uncertain applications. They work tediously in university laboratories, on a single issue at a time usually, to be certain that the explanations they set forth are accurate and replicable. They are trained traditionally to draw conclusions conservatively; they are neither expected nor encouraged to think in terms of humanitarian and commercial implications. They are disinclined to ponder either impulsively or speculatively. Moreover they must often fulfill other tasks associated with teaching and administration, and they may have limited financial resources for research. For example, both Branly and Lodge, respectively, were on the cusp of creating wireless systems. However Branly said reflectively in 1927: My difficulties have always been tremendous. I have never been well off... " (Coe, 1943, p. 26). Lodge also reported in 1923: "I was too busy with teaching to take up telegraphic or any other development. Nor had I the foresight to perceive what has turned out to be, its extraordinary importance to the Navy, the merchant service, and, indeed, land and war service, too" (Hawks, 1927, p. 242).

Marconi, in contrast, had spent his adolescence training himself to be a resourceful, skillful, applied technician in physics. His strengths were in taking the products of other and improving upon them. He was unconstrained by laboratory regimen and free to pursue promising ideas, trust his own judgment, and persist against daunting odds. He was guided by grand-scale visualizations, and from them, derived inspiration to strive for long-range goals. Importantly, Marconi's family and their entrepreneurial and investor connections guaranteed access to money virtually whenever he needed it. Nonetheless, Marconi was anything but

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The Ultimate Regenerative Receiver

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Part 1

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

I call this radio my 'Ultimate Regenerative Receiver' because it is the best receiver I've built. I'm sure there are better 'regens' out there—perhaps many readers of this article have better—but as far as my home built receivers go, this one is the 'ultimate.' It's taken me long enough—59 previous attempts to be exact—but I've finally built one that exceeds my expectations. My intention is to fully explain the construction of my radio in such detail that even those who have never built a radio before can duplicate my results.

How good is the radio? It worked so well when I first powered it up that I simply did not believe it. In a side by side listening test between the 'regen' and my Drake R4-B, I copied more stations on the 'regen' on 20 meter CW, than I could copy on my Drake. Obviously, I reasoned, the Drake was defective. I then checked the Drake against my Corsair, it seemed to be working normally. Again, I tried the regenerative radio against my Drake R4-B with the same results. I knew it was impossible for a detector-amp regenerative radio to equal the results of a Drake, so I tried it against my Corsair II with amazing results. The Corsair had the edge here and there, but the operation of the sets was so close to equal that I began to doubt my sanity. "Surely, this is the early stages of senility," I thought.

Next, I tried the "Ultimate' against my old and trusted Kenwood TS-930. Unbelievable!

Now, totally frustrated, I wrote an e-mail to the Editor of ER, and to Dave Ishmael, WA6VVL, a writer for ER. Dave is an Engineer, and an accomplished radio builder. I explained my dilemma. In a side by side listening test, using the same antenna, the 'regen' held its own, and sometimes surpassed three very good commercial receivers. Please understand, I'm talking signal reception, not single signal reception. We all know 'regens' do not have a lot of modern goodies like AVC, crystal filters, digital readout, etc. My tests were basic—how many stations could I read on CW between 14,000 and 14,050. How did DX on the 'regen' compare to the same DX station received on my commercial receivers. I also ran a very subjective test—which receiver sounded more pleasing to the ear. No filters were used on the commercial sets. Sure, sometimes it was necessary to kick in the filter between my ears when listening to both the 'regen' and my commercial receivers. Tuning on the 'regen' is good and sharp, but as expected is less sharp than the superhets. Actually in my tests conducted in mid-afternoon, and later about 9:00 PM, the difference in sharpness was not a problem.

The results of my tests contradicted all logic, common sense, and past experience. The radio was working better than it should. Both Barry and Dave were kind, but somehow I have the feeling that they, like me, question the results of my tests.

This is the 60th regen that the author has built. He calls it his "Ultimate Regen".

I am presently building #61 & #62 as duplicates of #60 to assure that the results of this little receiver are repeatable. If you're reading this, then the two sets worked as expected.

Why have I built so many radios? Why have I concentrated all my efforts on old, obsolete, regenerative radio circuits? Why do all my sets look like something out of the 20' and 30's? Please allow me to explain.

When I retired I began building all the ham gear I longed to build when I was young, but could not do so because of a shortage of both time and money. At age 63 I found myself with a lot of time, and a large junk box of parts accumulated since the mid 30's. Let me explain. Five years later, I found myself with six home built KW rigs, several '100-watt class' transmitters, and a desk full of other assorted radios, antenna tuners, SWR bridges, audio filters, speakers, and accessories. As I searched for my next building project I read some articles on regenerative receivers that aroused my curiosity. In my youth I'd built 'regens,' sometimes called 'bloopers', but none of my early sets were good enough to encourage me to build more of the same.

Now, with forty years experience as a radio repairman, I finally built a regenerative receiver that showed promise. It hummed on twenty, squealed and whistled on forty, tuning was critical, and regeneration was rough. However, I was amazed at being able to listen to DX on a mere handful of parts thrown together in a few hours time. I began work immediately on another receiver using roughly the same circuit, correcting obvious faults found in the previous work. It worked better. I built a third, then a fourth. More often than not, my last radio seemed to work a little better than the previous set. If, after a reasonable time spent trouble shooting, the set did not work better than its predecessors, it was junked for parts. Perhaps if I kept building receivers, I would eventually get it right. I might even come up with a simple receiver good enough for serious ham communications. Before we go any further, if you are a SSB operator you

continued next page

may be wasting valuable time. While I listen to SSB all the time on my 'regens' I would not want to try to operate a SSB station using nothing but a homebrew regenerative radio—that would be an exercise in futility.

I readily admit I am partial—years of building simple receivers have made me 'soft' on regenerative receivers. I maintain that CW sounds better on a good detector-amp 'regen' than it does on most expensive modern day transceivers. Notice, I said 'sounds better.' No one would argue they are more selective, quieter, or that AVC, DSP, and digital readout are not a good thing, however in the hands of a skilled operator a simple 'regen' will give your new transceiver a run for the money, often pulling in stations better than the modern radio. CW signals on a well built regenerative have a unique sound- a quality I love and I'm sure you will too.

When I arise each morning I face northeast (toward Malden, Massachusetts) and bow three times. The National Radio Company serves as my inspiration. James Millen stuck with a simple three-tube radio that evolved into the SW-3. Take a look at the diagram of a National 1-10. I know of no radio circuit more basic. Yet, I've read that to duplicate the results of the 1-10 is very difficult. I am told that National Engineers, using the same basic circuit, built many different sets before they hit upon the proper mechanical arrangement that made the 1-10 work so very well. And we must mention the HRO, a classic from the day it was introduced. The HRO remained the 'flagship' of the National Company for over 25 years-and used plug-in coils long after band switching was standard on other manufacturers cheapest offerings. Millen's secret was in the mechanical construction more than in esoteric electrical circuits.

Numerous versions of the HRO, the NC-1-10, NC-100 and 101X, and others National sets I'm sure, used the famous PW dial. As a matter of fact, many builders today refer to the PW dial as the HRO dial. Take a PW dial apart—two moving parts, held together by two small coil springs. Few things are as simple-or more practical. Combined with a simple graph the PW dial enables accuracy in frequency readout very near to perfection. I use PW's on my homebuilt receivers when I can afford them. Introduced in the mid-30's the dial is unmatched today. It is simply the best. They are so valued by builders that they often fetch prices beyond my pocketbook. Only last week I saw one go for $85 on e-bay. It is not unusual for a PW to bring well over $100.

To better understand my obsession with regenerative receivers we should first take a look at the advantages, as well as the disadvantages of Edward Howard Armstrong's great invention. After all, it was the discovery of regeneration that made the vacuum tube a useful tool of communication.

Advantages of the regenerative receiver:

1. Its simplicity and ease of construction and 'regens' use very few parts.
2. Regenerative receivers offer excellent sensitivity.
3. Good audio quality when properly built and adjusted.

Disadvantages of the regenerative receiver:

1. Poor selectivity. Selectivity can be improved by adding an RF stage, but are the results worth the effort?
2. Temperamental tuning.
3. Hand capacity. Signal changes when we touch a control on the front panel..
4. Unstable—Signal drifts.
5. Signal 'pulls' as the detector tries to follow a strong signal as you tune across the band.
6. Microphonic detector. Tapping the table, or even playing the set loudly will often trigger 'feedback' or micro-

phonics.
7. Strong signals play havoc with reception. This is especially noticeable on contest weekends.
8. 'Dead Spots'
9. Need to adjust regeneration as you tune across the band.
10. Frequency readout is difficult.
11. Rough regeneration-squealing, howling, squawking, etc.

Is that all? Just eleven disadvantages? No, there are others but I have hit upon the main ones.

It appears obvious then that a 'regen's' disadvantages far outnumber its advantages.

Is it possible that some of the disadvantages of regenerative receivers can be partially or wholly eliminated by changes in our method of construction? The answer I believe is yes, it is quite possible. Mechanical construction is equally as important as the electrical circuits. I feel that the set featured in this article bears this out.

I have written several articles for ER describing my building efforts. If you recall most were general in nature and did not stress such things as precise component values-or even the circuits used. Receiver #60 is so good that I have decided to detail every phase of its construction.

This receiver, if built with any degree of care, will absolutely amaze you and it does it with a circuit so simple and easy to construct that you should easily complete it in less than 40 hours. And what can you expect for your efforts? You should end up with a receiver that pulls in DX with ease, and with ear shattering volume, has good frequency stability, (less than 1 KC for the first hour from a COLD start) readout accurate enough for serious ham radio operation. The receiver has regeneration that's unbelievably smooth, good sensitivity and selectivity is all one could expect from a regenerative receiver with no RF stage. On the Sweepstakes weekend recently I had no problem copying over fifty different stations on the CW portion of 20 meters with one pass up the band.

Before we get into the actual construction of this receiver let me explain a little of my philosophy of the regenerative radio. I have tried many different detectors, many different tubes, and many different circuits. In my opinion, adding a tuned RF stage to the simple detector results in better selectivity and perhaps more sensitivity. It also requires more parts, more shielding, more building expertise, more coil winding, more money, more time, and a helluva lot more chances for the receiver to operate at a level less than you expected. It can be the beginning of an exercise in hair pulling, nail biting, foot stomping frustration that only a tranquilizer the size of a vanilla wafer can curb. If we still lived in the age of Allied Radio when any needed part was available for immediate shipment, then my opinion might be far different. However, as you well know, parts are not easy to find today.

In a TRF receiver shielding is of the utmost importance and today you will have a difficult time buying off-the-shelf shielding materials. You better be skilled in metal work before getting involved with a TRF receiver.

Description of the Receiver

The receiver is built in two pieces. One piece contains the power supply, audio output circuit, speaker, and VR tube.

The second part contains the detector, two stages of audio amplification, and the frequency marker. Both units are built on identical size and weight chassis—10 X 14 X 3, .063 aluminum. They are available from K3IWK for around $20 each.

The circuit uses a 6C4 regenerative detector, 6SQ7 first audio, 6SQ7 second audio, 6V6 audio output, OD3 voltage

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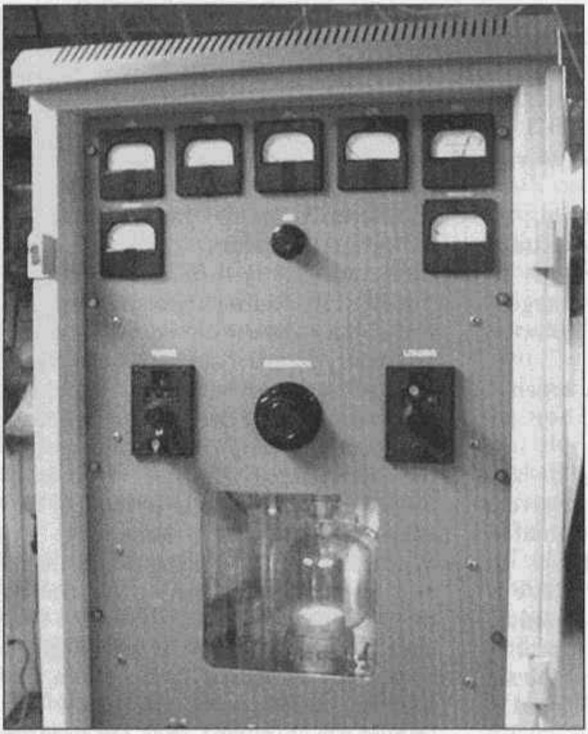
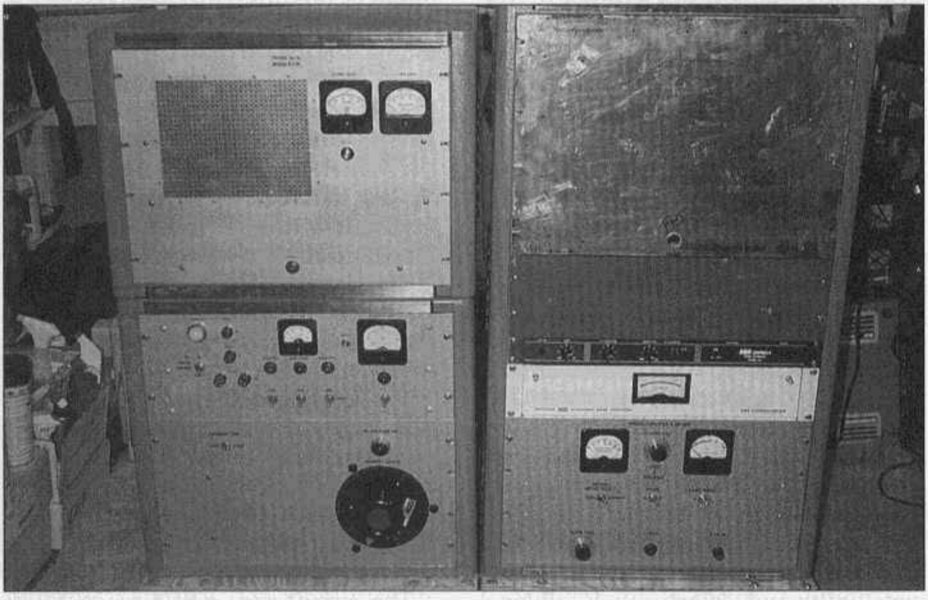
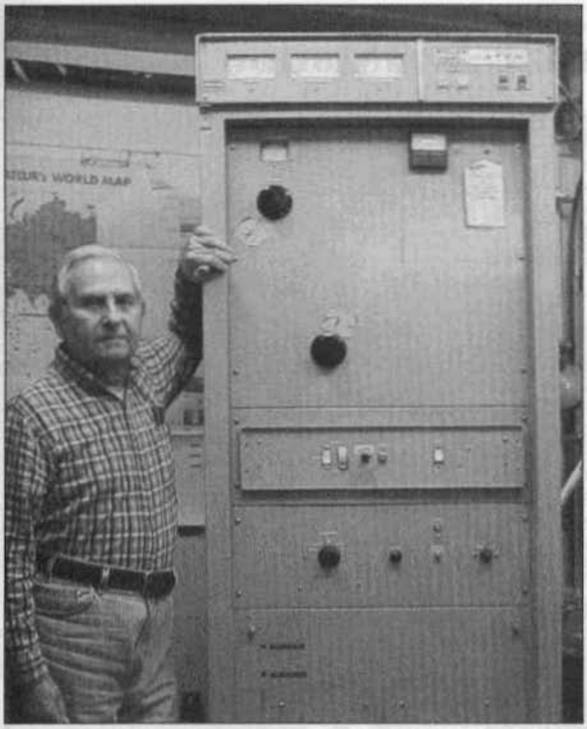


Andy Howard's, WA4KCY, partially completed 4-1000 transmitter. Sometime in the new year Andy will be producing a series of articles on the design and construction of this rig.



This is a photo of Tom Marcellino's, W3BYM partially completed 813 rig. This will also be the subject of a series of articles in the new year. Tom says he's been working on this rig about 3 months, 4-5 hours a day.



In response to the two articles W7GMQ produced on the Gates Vanguard II broadcast transmitter (Oct. & Nov. 2001) Ozzie, W6ICM sent in this photo of his rack model Vanguard II. And by the way, Ozzie would like to sell this transmitter which is located in Fort Jones, Calif. The price is $400. For info contact Ozzie at w6icm@sisqtel.net

Doug Smith, WB4TFQ, in his Kentucky hamshack. He along with WAØFBQ and WAØBUT will be running the 18th Annual Christmas Eve Santa Claus Watch on 1975. The net starts at 6:30 PM and runs until about midnight.

A Classic AM Station

This photo was taken of me in my shack back in January, 1947. The rig consisted of a pair of United Electronics 812Hs modulated by the classic 811s. The receiver was a brand new HQ-129X. I replaced the original outboard exciter with a Millen exciter which you can see in the rack. I had this wonderful sounding transmitter until September, 1950, when I was recalled to active duty. I elected to stay in the service until my retirement in 1967. I had some interesting assignments and a lot of hands on activity with the boatanchors in the Army, Navy and Air Force—but that's another story. By the way, I got my license in April, 1941, five centuries ago!
Mike Ruggiero, W2NVR

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.

<u>**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</u>

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

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.

<u>**Hallicrafters Collectors Assoc. Net:**</u> 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.

<u>**Nets that are underlined are new or have changed times or frequency since the last issue.**</u>

How to Repair a Transmitter

by Jim Hanlon, W8KGI
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Part Five

Little Lessons Some of my Rigs have Taught Me

On one occasion I found that my HT-20 would work well on all bands up through 15 meters, but there was absolutely no grid drive to the final on 10 meters. I was puzzled, because the HT-20 uses the same bandswitch positions to cover both 15 and 10 meters. It turned out to be the fault of the 6L6 driver tube. It put out RF up to about 24 MHz, and above that frequency it just fell flat. That particular 6L6 is now happily amplifying audio frequencies in my Globe King's modulator. This is the only instance in which I've seen a tube drop off so abruptly as a function of frequency. So keep this in mind as a rare but possible failure mechanism.

Remember that tube transmitters often run hot. When you choose a place to put your transmitter, make sure that there is adequate clearance around the sides, back and top for proper ventilation. Also, give your VFO some warm-up time before you depend on it to be stable. You'll have to get to know your individual unit to gauge how much. My DX-100 is ready to roll after about 5 minutes. My Valiant is still moving after a couple of hours.

If you don't have an oscilloscope, there is another simple gadget you can use to help trouble shoot audio stages. Just put a 0.1 microfarad, 600 volt capacitor in series with a pair of high impedance (2000 ohm and up) earphones, ground one side of the phones, and use the free capacitor lead as a probe to listen to the audio on the grids and plates of your audio amplifier. Be careful of high voltage when you are probing. I hold on to the insulated body of the capacitor and stay well clear of the free lead. You can identify distorted audio with your ears by using the microprocessor between them pretty well. Just watch out for the initial "pop" when you touch the capacitor lead to a different DC voltage level, and be sure to discharge the capacitor by shorting across it when you are through.

If your CW signal chirps, there are a few things to try that may help. Try letting the oscillator run continuously and just key a later stage. Check the voltage to the oscillator plate and screen grid. If they are changing considerably as the rig is keyed, consider regulating at least the screen grid voltage. A simple voltage regulator tube (VR-150, OA3, etc.) circuit as shown in your ARRL Handbook, power supply section will do the trick. Bypass the oscillator filament leads to ground at the tube socket with 0.01 microfarad disc ceramic capacitors, and bypass the other RF chain tube filaments to ground as well. If possible, run the oscillator on a subharmonic of the output frequency, since feedback from later stages on the oscillator frequency can "pull" the oscillator and cause chirp.

I wound up cracking a ceramic wafer in the oscillator section of the bandswitch in my Viking Valiant. To my great relief, I was able to glue the pieces back together with a small amount of quick setting epoxy. That was about 15 years ago, and the Valiant is still running well.

I was looking for the source of a persistent keying click in my Hallicrafters HT-18, when I noticed via my oscilloscope that there seemed to be a high frequency, "parasitic" oscillation on the leading edge of the keyed waveform. I was able to suppress this oscillation by putting a choke consisting of several turns of wire wound around a 1 watt resistor in series with the 6L6 output amplifier's plate lead. My inspiration for this fix included my Elmac AF-67 and AF-68 and also my Command Set transmitters, all of which use a similar choke. You can find examples of this kind of choke on several of the ARRL Handbook transmitters that use a 6146, 807, 1625, 6DQ6 or similar tube in the output stage. In the 1965 Handbook that I'm looking at right now there are four of them, consisting of between 5 and 10 turns of wire sized between #20 and #16, all wound around a 1 watt resistor, 1/4 inch in diameter, with resistance between 22 and 100 ohms.

Speaking of those two Elmacs, they both were originally designed with a 22.5-volt bias battery for their 6L6/5881 modulators. Replacement batteries were quite expensive, so I just put a 22.5 volt Zener diode (actually several lower voltage Zeners in series in the AF-68) in series with the modulator cathodes. The diode provides the necessary bias and never needs to be replaced.

My AF-67 at one point suffered a burned-out meter thanks to my turning the meter function switch with B+ on the rig. I don't do that any more, even though the manual says I should be able to do it. After I had replaced the switch wafer that had developed a short to ground, my next job was to fix the meter. The guts of a meter were a common, two-inch, 1 milliamp movement made by Simpson. I was able to find a regular, two-inch Simpson 1 milliamp meter at the local electronic surplus store, and I just did a transplant of its movement into my burned-out meter's front case. I also put the dial scale from the original Elmac meter onto the new movement as I was making the swap. Now to look at it you would never know that anything had ever gone wrong with the meter on my AF-67.

The first Command Set transmitter that I bought, around 1952, was a $2.95, "As-is, removed from aircraft" BC-457 from Columbia, the Gem of the Surplus. When it arrived, it was somewhat the worse for wear. The top cover and the front panel were both bashed in, the ceramic form for the antenna loading coil fell out in chards, and only one tube, a National Union 1625, was unbroken. It also appeared to have been soaked in salt water. Having already paid my money and nothing else to lose, I hammered out the dents in the panel and cover, washed out the salt residue with the garden hose, baked the water out in my mother's oven (one afternoon while she had gone to the beauty shop), plugged in the original 1625 and three other new tubes (at the additional cost of $1), and applied power. The BC-457 immediately came to life and served for many years as the main, 80-meter VFO for the W4VIV/W4RXK station. Command Sets are tough!

I now have a CBY52209, Navy equivalent of the BC-457, 4 to 5.3 Mc., and a BC-459, 7 to 9 Mc., on 80 and 40 meters respectively. I use that regulated, General Radio power supply I mentioned earlier for the oscillator plate and final screen, and a Harvey Wells TBS-50 supply for the 1625 plate voltage. The 80 meter Command Set has always keyed wonderfully without a hint of chirp or click. But the BC-459 chirped merrily from the outset and was quite resistant to change. Bypassing the final amplifier filaments to ground with a 0.01 mFd ceramic capacitor right at the tube socket in an attempt to keep final amplifier RF from getting back to the oscillator via the filament lead helped a little bit. The loading adjustment also makes a lot of difference in how the note sounds. The most effective thing so far has beeh wrapping several turns of the power cable through a circular ferrite core. That appears to have

continued next page

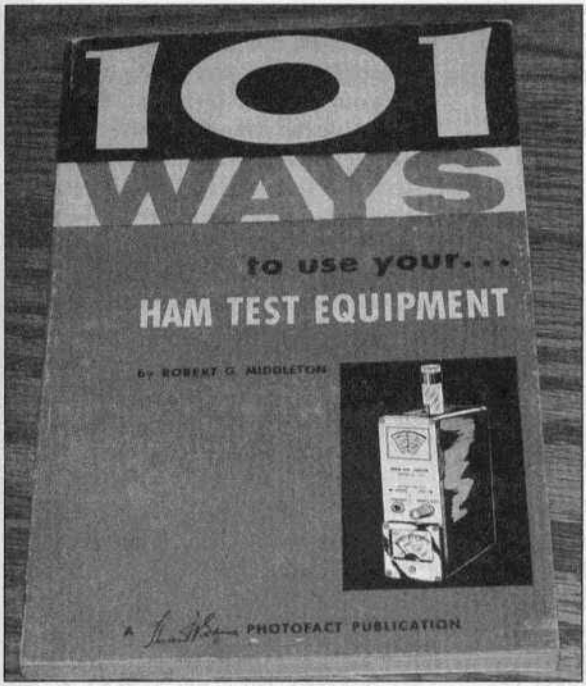
"choked off" a lot of the RF being picked up on the power cable and kept it from entering the transmitter. I still have a distinctive note on 40, but at least it's not so bad that I don't mind putting it on the air. It just makes me stand out among all of those perfect notes from the Yaecomwood rigs.

My Millen 90800 has a meter that is switched between the 6L6 crystal oscillator plate and the 807 amplifier plate. Normal tune-up procedure is to dip the oscillator plate, hope the 807 has proper grid drive, and dip the amplifier plate. The 90800 also uses an external, 45-volt battery for grid bias on the 807 stage. I now monitor the 807 drive (control grid current) with a 5 milliamp meter in series with the bias battery. And I've found that five, nine-volt transistor radio batteries in series make a good bias battery and are a lot cheaper than one 45 volt battery.

The final amplifier pi-match tank circuit in my Harvey Wells TBS-50 Bandmaster is coupled to the 807 plate through a DC blocking capacitor, but there is no DC path to ground in the pi-match itself. Most rigs that use a pi-match in this fashion have a radio frequency choke connected across the loading capacitor that provides that DC ground path. The result on the Bandmaster is that the antenna output terminal can charge up to a substantial fraction of the B+ voltage on the 807 plate! To keep that from happening, I keep a 33K ohm resistor connected from the antenna terminal to chassis ground. Also, the pi-match loading capacitor is not large enough to match a 50-ohm load on 80 meters. To help it out, I shunt several additional fixed capacitors across it from the antenna output jack to ground, about 50 to 200 pF worth.

You may decide to replace the vacuum tube rectifiers in your rig with solid state diodes. As I mentioned when talking about my Valiant, you can directly replace mercury vapor rectifiers like the 866A with solid state diodes. The peak inverse voltage across the diode will be about 2.83 times the power transformer secondary RMS voltage from center tap to ground. As a precaution against power line spikes, I'd advise using diodes rated for at least four times the RMS voltage. Make sure the diode has an ample current rating as well. If you are replacing high vacuum rectifiers, I'll offer the same advice that was in my receiver article.

"Some folks think it is a good idea to replace the rectifier tube with solid state diodes. After all, that tube gets awfully hot and heat makes the receiver drift and accelerates the aging on all of its parts. While this is true, the heat developed by the rectifier is largely because there is a substantial B+ voltage drop across it, perhaps 50 volts, that will almost completely disappear if you replace it with silicon diodes. The result will be higher B+ voltage on every circuit that may do even more mischief than the rectifier tube's heat. If you absolutely must use silicon diodes, put a resistor in series with them, between their common junction and the input to the first filter capacitor, to drop the B+ down to its originally intended value. A good starting resistor to use would be 50 ohms, 2 watts for a 5Y3, 5Z4, 5W4, or 80; 100 ohms, 5 watts for a 5V4; and 170 ohms, 10 watts for a 5U4. (Thanks to John Sehring WBØEQ from the Boatanchor Reflector for finding these recommendations in a 'Cordover SS Modules Inc paper,' vintage early 60's.) My Meissner EX Signal Shifter has a turret inside for bandswitching the coils. The turret has brass studs that make contact to copper alloy springs as it turns around. The metal on both sides of the contact eventually acquires a surface coat of oxide and sulfide. I can tell when it's gone too far, because the VFO starts to chirp. When that happens I clean the contacts with some DeOxit and a gentle scrubbing with a fine grade of steel wool.



as well as a giant collection of military and industrial surplus. Their catalog is a great read. I use both AES and Fair regularly and I've always been happy with them.

The following list of parts sources was contributed to the Boatanchor Reflector last February by Ed Sieb, VA3ES. As of this writing all of the listed sites do work, and they look like some pretty good tips.

Here's a place to start your search:

http://www.thebizlink.com/am/resou.htm#parts This is a list of good parts sources. Some of those links don't work, so here are a few others that do work:

Ed. The book shown above was published in 1960. I've found that this book and books similar to it are very helpful when using vintage test gear.

Where to Find Parts

I really can't do anything better on this subject than I said in my receiver repair article published recently in ER. Just to be complete, I will repeat it here if Barry has the room.

When my friends find out that I keep two dozen old radio transmitters and receivers working and on the air, they always ask me if it isn't hard to find parts for them. Well it really isn't much of a problem so far if you just know where to look. Antique Electronic Supply (AES), whose catalog you will find at http://www.tubesandmore.com/on the internet offers a complete selection of tubes, resistors, capacitors, transformers and a lot of other things. Fair Radio Sales, with an internet catalog at http://www.fairradio.com/, has a lot of tubes and other spare parts available

Paints, and restoration parts:

ALO Restoration: (Bought former R&R Parts): http://www2.southwind.net/~n0alo/

Cardwell Condenser: THE Main National, Johnson, Hammarlund parts source; Coils, capacitors, etc. http://www.cardwellcondenser.com/

Daburn Electronics. Must be seen to be believed! Has everything a BA enthusiast might want. Ceramic parts, Porcelain stuff, insulators, hardware, etc. etc. etc. EXCELLENT! http://www.daburn.com/~daburn/

RF Parts Co. — transmitting parts: capacitors, coils, tubes Good Source. http://www.rfparts.com/

Murphy's Surplus — Another good source of "stuff": http://www.maxpages.com/murphyjunk

SBE Electronics - these people make the Orange Drop(r) capacitors!! http://www.sbelectronics.com/

Hammond Corp. Transformers, Cabinets Has a line of "Classic" transformers

continued next page

http://www.hammondmfg.com/index.htm

Surplus Sales of Nebraska: All kinds of serious parts. Good source.

http://www.surplussales.com/

William Ford Surplus.

Always an excellent source for both surplus (rigs, etc) and parts. http://www.falls.igs.net/~testequipment/

C & H Sales Inc. Not specifically electronic parts, but is a general surplus dealer. Good catalog, always has some unusual, but useful items. Good source for mechanical parts, hardware, tools, etc.

http://www.aaaim.com/CandH/index.htm

Another good source of parts, as I mentioned earlier, is the ER Parts Unit Directory. You will it listed at the bottom of the "Electric Radio Store" page in the back of this issue of ER.

Finding Modification Articles

Hams being what we are, there are many articles in the literature about how to make a particular transmitter "better." You may or may not want to make a lot of changes in your rig, but it would sure help to know where to find modification articles about it. Chuck Penson has published an excellent list of review and modification articles for every amateur radio related Heathkit in the back of his book, "Heathkit, A Guide to the Amateur Radio Products." There have been some very good articles published in ER, especially about improving the audio characteristics of AM transmitters. You can find those articles by looking in the ER Index available on the web at http://www.qsl.net/n9oo. An excellent reason for belonging to the ARRL is their Members Only, QST/QEX Index Search. I just plugged "DX-100" into their search engine and got 22 hits back, ranging from "Keying the DX-100" published in August, 1977 to "The Heath DX-100 Transmitter (Recent Equipment)" published in December, 1955.

Once you have found a reference, there is then the job of tracking down the article. Barry can be convinced to sell you a back issue of ER for a reasonable fee. Many technical libraries in Universities have collections of QST. Check out the catalog computer at the main library and it will direct you to the Engineering or Physics library where they are to be found. If you have a few dollars to burn and you want to get a very enjoyable reference, buy one or more of the ARRL's CD's containing past years of QST. Also, you may be able to get a copy of a particular article from one of the "Anchorites" on the Boatanchors Reflector.

Where to find help

I said this in my receiver repair article, and it bears repeating. Outside of finding a local "Elmer" to help you restore your transmitter, the next best thing I can recommend is the bunch of very good people who hang out at the Boatanchors reflector on the Internet. The accumulated wisdom in that group is fantastic. You can join the group by contacting Jack Hill, W4KH, at listown@nanniandjack.com.

Conclusion

There is nothing like the thrill of making a contact with a transmitter that you are on personal, very familiar terms with. If you built it or restored it to working condition, it becomes an extension of your own personality. I built my own two-stage novice rig when I was still in the 8th grade, so I know it doesn't take any special talent, just the courage and audacity to roll up your sleeves and give it a try. I hope that this article has encouraged you to get involved with an old transmitter and to return it to active service on the ham bands.

I'd also like to pass a tip of the Hanlon hat along to John MacAulay, WQ8U, a good ham friend since 1953, for reading proof on this article, suggesting some needed improvements, and catching at least some of the mistakes. ER

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

by Bruce Vaughan, NR5Q
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Episode 7

Lull Before the Storm

Those earning their living repairing and selling radios in the immediate postwar era experienced a period quite unlike any other in the history of radio. One milestone was the passing of the 'console'. Before that sad day, Sunday, December 7, 1941, a nice, large 'floor model,' radio was considered a necessary appurtenance in most middle and upper income households. It seems in retrospect that when the first bomb fell on Pearl Harbor the console radio became a casualty. I have been trying to recall selling a 'floor model' radio during my 40 years in business and cannot remember even one—other than used prewar radios. Radio-phonographs, even before the advent of the LP record were available from almost all radio manufacturers and sold moderately well.

As a Magnavox dealer I sold almost as many radio-phonographs as TV sets—but console radios only, none at all. Not a lot of really good 'table model' radios, excluding communications receivers, were available—most of our radio sales were 5 or 6 tube AC-DC receivers in plastic cabinets. The audio quality on most small receivers was really terrible. One notable exception was Philco. I cannot remember the model number but in 1948/49 I sold several very good 'table model' Philcos. They were about the size of a HQ-140 and weighed as much as most 'boat-anchors.' I remember the set had several SW bands and good audio. My wholesale cost of this Philco was $78—a real bargain. I suspect this model was designed to go in a 'floor model' cabinet, but Philco changed their plans when console sales plummeted.

The early postwar years were filled with anticipation. Everyone in the business knew the dream of TV would soon become a reality. Many radio service shops changed the name of their business to reflect this change. Our country was filled with 'Radio and TV' shops manned by technicians who had never seen a TV picture or a TV receiver.

Most buyers were waiting for TV, reluctant to invest in a radio-phonograph. The general attitude in the late 40's was that one item of electronics was all a family needed or could afford. The fact remains that radio-phonograph sales actually increased **after** TV became a reality. Given the picture quality, and programming available in those early years, the miracle is that TV managed to ever get off the ground at all.

Customers were not alone in their long wait for TV—manufacturers were waiting also. Everyone knew TV was coming-the big question was when? After all, radio publications and newspapers had been proclaiming for years that TV was just "around the corner." Meanwhile, radio manufacturers tried to keep their factories humming by producing a myriad of items, some of which were totally impractical.

One such item was the "Mail-a-Voice." This was one of the first magnetic recorders, other than the 'wire

continued next page

recorder' to hit the retail market. It resembled an inexpensive child's record player. A paper-like, iron coated disc about the size of a phonograph record was placed on the turntable spindle. Then a plastic retaining disc was placed over the magnetically coated paper disc to hold it in place. The plastic disc had grooves, not as closely spaced as those on a 78-RPM record, for the pickup arm stylus to 'ride' in. The pickup arm supported a magnetic head. The grooves were only a means of moving the magnetic head across the paper disc with uniform spiral spacing.

The idea was that you could record a letter, fold the disc, and fit it into a standard envelope for mailing. I never sold a single 'Mail-a-Voice.' The ones I stocked were either traded for something else of no value, or given away as 'prizes.'

My introduction to TV came unexpectedly. One morning in 1948, I picked up a Sunday edition of the *Arkansas Gazette* at my favorite newsstand. Later, while reading the paper, I came across a small news item that interested me greatly. A radio repairman from Altus, Arkansas had actually picked up a TV picture. To the best of my knowledge, his was the first TV receiver in the state. I knew I had to go to Altus, see that TV, and talk to the owner.

As you might surmise from the name, Altus is located among some of the higher mountains in Arkansas—a very good TV location. I drove to his shop in the little village the following day. Mr. Carter, the radio shop owner, was only too happy to talk television with someone. We got in his service truck and went up, and I do mean UP to his house. He lived on a mountain top north of town. His set was one of the early 'mirror in the lid' TV's. Of course we could see nothing but snow on it while I was there. I found out that the closest station was probably St. Louis or Dallas; he had never picked up a picture from either one. The station he had received was Boston. It came in briefly, he said, on two separate occasions. The good news was that a TV station would soon be in operation in Oklahoma City, about 200 miles distance. He hoped, he said, that when the Oklahoma City station, WKY, came on the air, his reception might improve. Projections were that the station would be in operation before fall of '49. He also told me that a friend of his, a radio repairman in Hartman, Arkansas, had recently purchased a television receiver. That was all I needed to hear. I might not be number one or number two, but by golly I could be number three.

I drove back home by way of Wise Radio in Fort Smith. Yes, they had a television set for sale. It had arrived only the week before and was their very first TV. The counterman told me there was nothing they could do with it, as there were no TV stations within range. It was a Hallicrafters with a 7-inch screen and sold for only $179.95. I bought the set, and ordered a fifty foot tower, and a Yagi cut to channel 4, that of the new station in Oklahoma City. Though Elmo Wise had not sold a TV before I bought the Hallicrafters, he was enthusiastic. He told me that a station would be operating from Tulsa, Oklahoma sometime before Christmas of 1949. He thought the call letters would be KOTV.

I could not wait to unbox the TV set when I got home—my wife was less enthusiastic. Of course without an antenna I could not hope to see a picture. I connected it to my ten meter, 4 element Yagi, and got nothing but snow, though at the time we referred to it as interference.

While waiting for the tower and antenna to arrive, I tried a number of home built antennas-a dipole, a simple Yagi, and even a long wire. The results were nil on everything. During this interval I had a phone call from a good friend and ex-employee who had moved back to his home town of Paris, Texas, and opened a radio service shop there. Lewis told me he had a 100-foot tower, with a Vee DX on top aimed toward Dallas. He said he often received a picture, sometimes plain enough to enjoy an entire program. He suggested that Mary and I pay he and his wife Janice a visit the following weekend and see his TV installation. Then, Lewis continued, when my tower and antenna arrived, he and Janice would pay us a visit, and he would help raise my antenna. It sounded great to me, and Mary thought it a good idea.

We left for Paris, Texas early Saturday morning. We drove some distance before stopping for breakfast near Fort Smith. By noon, we were very close to Paris and decided to stop for lunch, and timed our arrival for early afternoon. It was about 2:00 pm when we pulled off the two-lane highway and parked in front of 'Bill Ingram's Garage.'

Bill Ingram, father of Lewis, owned a large lot near the downtown area of Paris. He had been in the automobile repair and tune-up business since Model T Ford days. Bill allowed Lewis to build his shop, and a home on a south corner of his lot. The TV was located in the garage area to allow a larger number of viewers to see this new miracle.

I was surprised there were so many cars parked in front of the garage, especially when there was a 'CLOSED' sign in the window. Mary and I tried the front door. It was unlocked. In the back of the room at least 25 people were watching a football game on the 10-inch screen. Some were sitting on boxes, some on auto tires, some on the grease-covered wood boxes, and a few even had chairs. I don't know exactly what I was expecting but I tried to hide my disappointment from Lewis. He rushed forward to greet us and began a long description of the antenna, the TV, the trouble they had raising the home built 100' tower, etc.

My first impression was negative—I disliked the blue cast to the screen. Somehow, I imagined that the picture would appear black and white. I could best describe the color as a fluorescent blue, more closely related to an oscilloscope green than to a pure white. I found that I could tolerate snow, fading, loss of vertical hold, and all the problems that plagued TV in those days-but the blue screen was not acceptable. If this was TV, I decided it had a way to go. Fortunately, his TV is the only one I ever saw that had that blue cast. All this occurred over a half century ago, but I believe the TV in use was a Garod.

When my tower arrived, I placed a call to Lewis. That weekend we raised my antenna in the middle of the backyard. I aimed my Yagi at Oklahoma City and waited, and waited. When the station first came on the air, June 6, 1949, it only broadcast from 6:00 pm until 10:00 pm, four hours a night. Their power was very low with antenna to match. The first two evenings we received absolutely no signal at all. Lewis and Janice were leaving for home on Wednesday morning. Tuesday evening the four of us planned on going to see a movie at a new theatre that had recently opened in an adjoining town.

After dinner while the others were getting ready to go see the movie, I turned the TV set on and received the shock of my life. I suppose we had a temperature inversion, sunspots, or some such phenomena that evening. Whatever it was, I had a picture like I was to see only on rare occasions during the coming weeks. The picture looked like a glossy photograph and with sound yet.

Remember, dear readers, this was before satellites, video recorders, and color. Everything you saw on TV was either live or from a movie. I remember one outstandingly bad program that

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The Tuned Aerial

the feeding and tuning of wire for the reception and transmission of wireless waves

by Frank Van Zant, KOØR (Kilowatt out Zero return)
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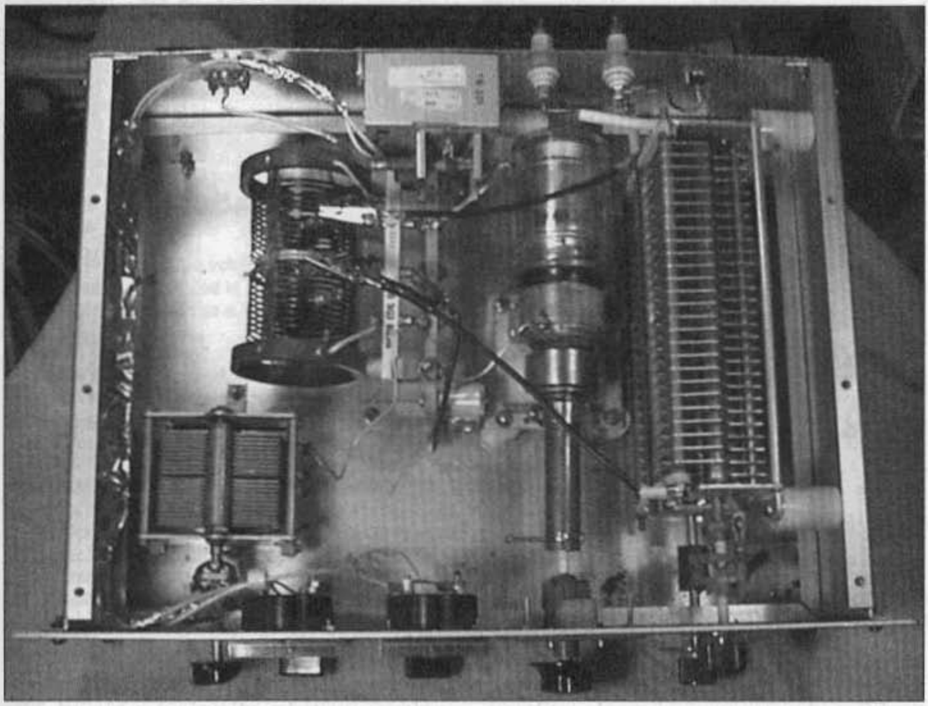
In Amateur Radio, one of the greatest subjects for discussion and experimentation is the antenna. How to get power into it, out of it, and do so in the least expensive and most efficient way has been the topic of endless discussions among Amateur operators since the invention of the "Wireless". As we review the technical literature for the last hundred and some odd years, it is evident that there has been quite an evolution in understanding and quantifying the basics of what makes a "good" antenna. The literature also reveals a good deal of misunderstanding.

A look at the earliest antennas in photos and design literature from the first part of the century, shows that the more copper that was put in the air the better. Those antennas were built in various forms of birdcages, cones, pyramids, etc. The greatest possible mass of metal was the desired objective for pickup of the long wavelengths involved in those days. By the 1920's and 1930's, a more scientific approach was evident as the mechanics of equating physical dimensions to electrical dimensions and properties was better understood and put into practice. This occurred because the short waves had proven their usefulness and antenna dimensions had dramatically shrunk as a result. Thus, for the Amateur radio enthusiast, who could ill afford acres of towers and tons of copper, and for the military who needed portability, there evolved simple antenna designs sized for specific frequencies at these shorter wavelengths. The two antenna types that stood out in that era were the simple quarter wave vertical (or longwire) and the dipole. Since coaxial cable was not common or generally available to the average Amateur prior to World War II, open wire feedline was commonly home-brewed and used. With the open wire feedline, one had to use a balanced antenna tuner.

In the 1930's, the two main methods of feeding an antenna were tuned feeders (open wire feedline) and non-resonant feeders consisting of "twisted pair" insulated wires that exhibited a nominal impedance of 70 ohms. Common household AC "Zipcord" usually had a nominal impedance of 70 ohms. So, with a half wave dipole, you could put twisted pair or zipcord feedline at the center and be somewhere in the ball park for matching the antenna to the feedline on the one single band for which the antenna was cut. But, that was a single band antenna. Most Amateurs wanted to work more than one band. Therefore the "tuned feeder" open wire feedline was used with a flattop cut as long as possible for the city lot in question and fed in the center. With a judicious choice of flattop length plus open wire feedline length, all bands from 160 through ten meters could be accommodated. The method of tuning the feedline plus the flattop then became important. A glance at the Antennas chapter of The Radio Amateur's Handbook for 1939, page 317, shows Table II which provides a range of flattop plus open wire feedline lengths versus type of tuning required for coverage from 160 through 10

Front panel view of the author's balanced tuner.



Under-chassis view.

meters. Table II is reproduced here as Fig.1.

It is evident from Fig. 1 that, if you live on a city lot with enough room for a full sized 80 meter dipole and 67 feet worth of open wire feedline, you could work all bands from 160 through 10 if you have an appropriate antenna tuner with balanced output (and I don't mean one with a ferrite balun—more about that later). Before proceeding with a description of this type of system, lets

continued next page

Fig. 1

TABLE II FROM THE 1939 ARRL HANDBOOK

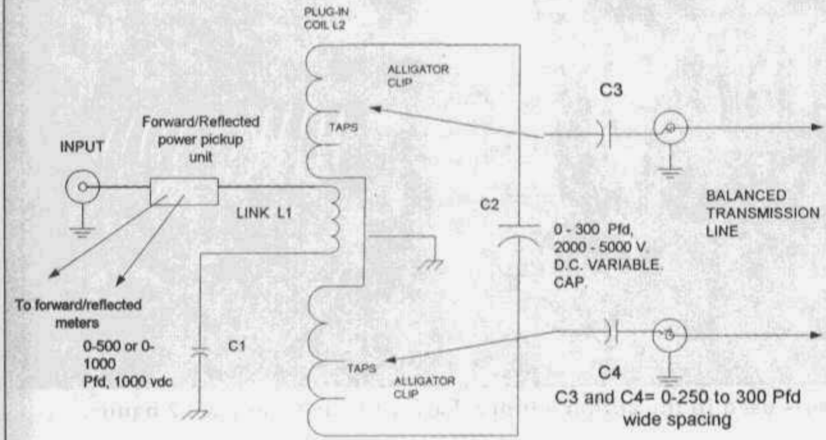
Antenna Length (Ft.)	Feeder Length (Ft.)	Band	Type of Tuning
137	68	1.75*Mc.	Series
		3.5 Mc.	Parallel
		7.0 Mc.	Parallel
		14.0	Parallel
		28.0	Parallel
100	38	3.5 Mc.	Parallel
		7.0 Mc.	Series
		14.0 Mc.	Series
		28.0 Mc	Series or Parallel
67.5	34	3.5 Mc.	Series
		7.0 Mc.	Parallel
		14.0 Mc.	Parallel
		28.0 Mc.	Parallel
50	43	7.0 Mc.	Parallel
		14.0 Mc.	Parallel
		28.0 Mc.	Parallel
33	51	7.0 Mc.	Parallel
		14.0 Mc.	Parallel
		28.0 Mc.	Parallel
33	31	7.0 Mc.	Parallel
		14.0 Mc.	Series
		28.0 Mc.	Parallel
		* 1939 Bandedge	

first have a short discussion of some of the other current multiband antenna systems.

Several different types of simple multiband antenna systems have been developed since World War II. Prominent among these are the trap dipole, the off center fed Windom, and the G5RV to name a few. There are antennas that combine similar approaches in a vertical antenna arrangement which usually requires ground radials, etc. The foregoing, to list but a few, are all compromise antennas and are not truly efficient in the pure sense of the word, particularly where multi-banding is concerned. The most misused of all these is the G5RV whose inventor intended it to be used only on 20 meters and only as a directional antenna. Any antenna that has traps, ferrite baluns, coaxial cable matching sections, etc is a lossy antenna and at best only really covers one to

Fig. 2 ANTENNA TUNER FOR BALANCED FEEDLINE

KOØR



- C1 can be a low voltage variable capacitor. A possible source is a broadcast variable with two or three sections tied in parallel.
- C2 was chosen as a single stator variable due to availability and cost factors. A vacuum variable was used.
- L2 can be wound over a 2" diameter PVC pipe as one continuous coil with a center tap which will be grounded. Number 12 or 14 gauge house wire (sears) can be used. L1, the link, can be wound over L2, equally spacing it on either side of L2's center tap point. It should be spaced from L2 with strips of lucite or circuit board.
- Taps can be small copper flat blade alligator clips available from Radio Shack. The clips should be soldered to the coil wire without shorting between the turns of L2.
- The tuner can be used as an unbalanced output tuner by merely connecting a coax feedline to one or the other of the output connectors.
- Coils vary in diameter from 2.5 to 3.5 inches in diameter and are space wound. Wire gauge is 16 at 160 thru 80 meters, 14 at 80 thru 40 meters, 12 at 40 thru 20 meters, and 10 at 20 thru 10 meters. The 160/80 meter coil is 3.5 inches diameter, 13 turns in each section, spacewound over 1.25 inches per section. The link is 5 turns. The 80/40 coil is 2.5 inches in diameter, 11 turns in each section space wound over 1.75 inches per section. The link is 3 turns. The 40/20 coil is 3.5 inches in diameter, 5 turns per section space wound over 1.25 inches per section. The link is 3 turns. 20 thru 10 meter coil is 3 turns per section wound over 1.25 inches per section. The link is two turns.
- Overall end to end inductance of each coil is: 160/80 = 42 uHy; 80/40 = 15.5 uHy; 40/20 = 5.25 uHy; and 20/10 = 1.35 uHy.

three bands with any semblance of efficiency—if that. Baluns only perform their design duty of balanced to unbalanced and impedance transformation when there is already a very low SWR on the path. Virtually none of the popular multiband antennas operate with a low SWR at more than a few frequencies and therefore require the use of an antenna tuner most

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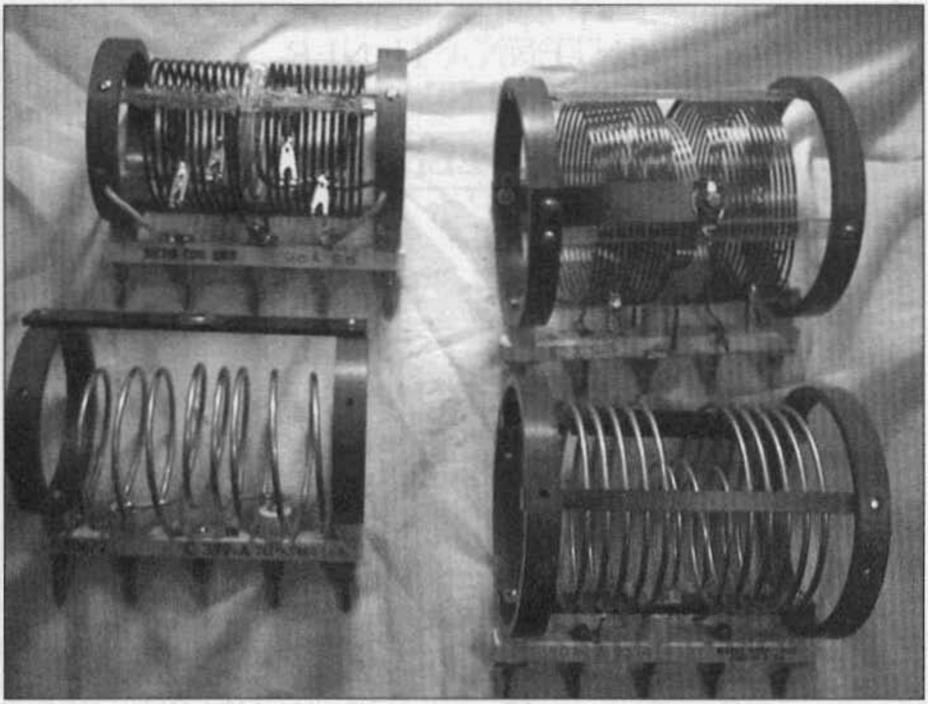

Plugin coils used in the author's tuner. Each coil covers at least 2 bands.

of the time anyway. A high SWR on a feedline has a serious impact on a 4:1 ferrite balun if it is used in an antenna tuner. Losses! Feel it warm up.

To overcome all these deficiencies, the old fashioned flat-top with open wire feedline and a **real** balanced antenna tuner is hereby advocated. Let's enumerate the advantages: (1) Compared to coax cable there are no (or absolutely minimal) losses in an open-wire feedline, even with SWR's of 10:1; (2) Operation on any frequency between the lowest and highest design frequency. This only requires having the right coil in the antenna tuner; (3) The versatility of wide range impedance matching; (4) A truly wide range of operation even for seriously shortened flat-tops; (5) ability to use it as a flat-top stretched between two masts/supports or as an inverted-V with one center support. In other words, forget about pruning and tweaking the flattop or feedline for lowest SWR. This is all done "automatically" with the balanced antenna tuner when you adjust the taps and series/parallel tuning capacitors for resonance and correct impedance match. And finally (6) As opposed to the ubiquitous T-tuner, the balanced tuner with a parallel tuned tank circuit suppresses harmonics. It is a narrow bandpass filter. The commonly configured T-tuner is a high pass filter which zips those harmonics right out to the world.

Let us now rediscover the old-time tuned doublet. For starters, open wire feedline can be home brewed using 3/8 x 3 inch plastic dowel rods, paraffin boiled wood dowel rods, or fiberglass bicycle flag rods cut to 3-inch lengths and drilled to tightly pass No. 14 gauge radio shack antenna wire. Alternatively, the wire can be 14 gauge insulated house wire available at most hardware stores. Spreaders can be glued in place with silicon cement. Or, open wire feedline of excellent quality can be purchased ready made from a prominent advertiser in Electric Radio. Unlike the coax fed single or multiband antennas, you do not have to worry about the impedance of the open wire feedline. You really don't need to know. But, if you need to know, its probably between 450 and 600 ohms or thereabouts. I have a prejudice against the "open" wire feedline that looks like overblown TV ribbon with holes in the dielectric. More losses there.

The rest of the project is a little more ambitious. That involves the construction of a home brew, balanced, multiband antenna tuner. The greatest challenge here is to collect and/or improvise all the parts. The geometry and layout of parts is not critical and is driven by the size and type of parts collected or made from scratch. These tuners have been made by mounting the coils and capacitors on a piece of plywood at one extreme, ranging to the more common aluminum chassis and panel method of construction. This article will illustrate the one built by the author in a fairly compact aluminum enclosure, using plug-in coils (which could also be home brewed) and having provision for measuring relative forward and reflected RF power.

First let's examine the circuit diagram of such a tuner. Figure 2 illustrates the circuit of a tuner that can utilize a single tuning capacitor across the plug-in coil and two series tuning capacitors between the coil taps and each side of the feedline. For high power operation the coils should be wound with #14 to #10 wire depending on band of interest and power level. The coil taps are made with small copper clips soldered onto the coil wire. Connection with the series variable capacitors on each side of the feedline are made with short insulated wire leads and alligator clips to the coil taps. The series feedline capacitors must be insulated from ground. Taps close to the grounded center of the coil are low impedance points and taps further out toward the ends of the coil are higher impedance points. Keep everything symmetrical here. It is to be noted that the combination of the one parallel vacuum variable with the series feedline variable capacitors provide for both series and parallel tuning. With the series capacitors fully meshed, you in effect have a parallel tuned balanced tank circuit with impedance matching taps. With the series capacitors partially meshed, you are then series tuning the feedline. The selection of the tap points and settings for the series and parallel tuning capacitors and the series link tuning capacitor is done by experimentation with your particular antenna and feedline. The combination provides a wide range of resonating and impedance matching. Obviously, the goal is to adjust everything until zero reflected power and maximum forward power is achieved. This is easier done than said. Once the variables are set with your antenna, the settings should be closely repeatable in the future (assuming the antenna doesn't blow down). A tuning chart should be made for future reference.

Capacitor(s) spacing should be consistent with the power level. The main parallel tuning capacitor used in the author's unit is a vacuum variable of 0 to 300 pFd capacity and 5 KV breakdown voltage. The series feedline capacitors are MFJ 0-250 pFd units with wide spacing. The series link tuning variable capacitor can be a 500 pFd unit with 500 to 1000 volt spacing. The RF forward and reverse power pickup unit is one purchased from Fair Radio for a bargain price. The meters are salvaged 0-1 mA meters. The particular coils used in the author's unit are surplus BC-610 type tank coils purchased and collected over the years. Some were damaged or had links missing and had to be restored.

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Lake Erie Boatanchors Group Get Together

by Jeff Covelli, WA8SAJ
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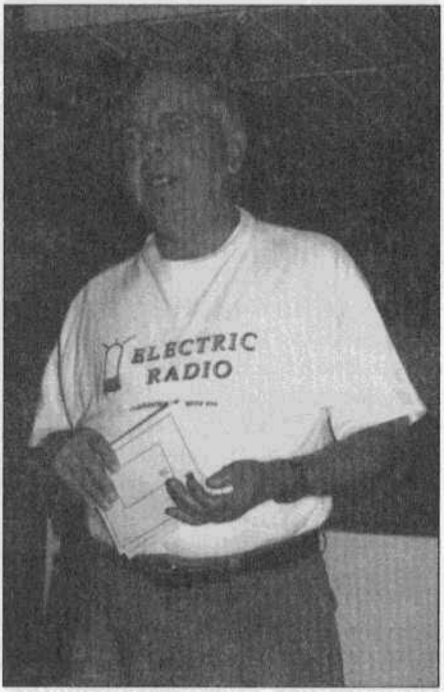
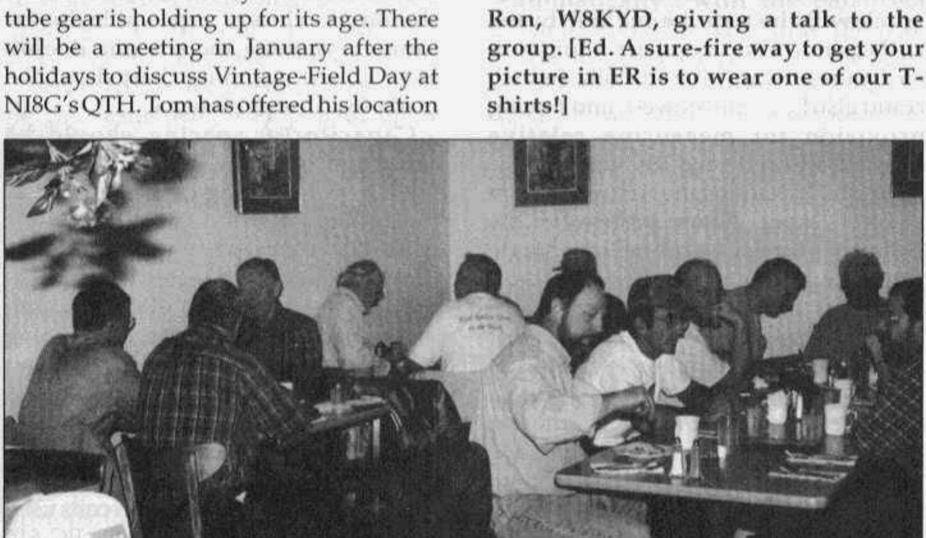
The Lake Erie Boatanchors Group had another informal get-together at the Colonial Eatery in Parma, Ohio on Saturday November 3, 2001. 16 out of about 40 that were invited showed up. Many had to come from other surrounding states. We certainly filled the meeting area, and had a great late breakfast. Here are the calls and names of the folks that showed up: AA8TV, Ed; K8DBN, Bill; K8GJW, John; K8GVH, John; K8TV, Ken; KB8MTZ, Al; KC8LTD, Barney; KC8QGJ, Tom; KF8IS, Tom; NI8G, Tom; W8KYD, Ron; W9MDX/8, Larry; WA8SAJ, Jeff; WB3FAU, Russ; WB8ZEJ, Bill and WD8BIL, Bud.

We all had a great time getting together and discussing all the old gear, comparing what is out there today and how the old tube gear is holding up for its age. There will be a meeting in January after the holidays to discuss Vintage-Field Day at NI8G's QTH. Tom has offered his location



Ron, W8KYD, giving a talk to the group. [Ed. A sure-fire way to get your picture in ER is to wear one of our T-shirts!]



We had a great breakfast with many pots of coffee.

The Lake Erie Boatanchor Group, top row, left to right: Al, KB8MTZ; Ken, K8TV; Russ, WB3FAU; Bud,WB8BIL; Tom, NI8G; Tom, KC8QGJ; Bill, WB2EJ; Ed, AA8TV; Ron, W8KYD and John, K8GVH. Front: Bruce, KF8IS; Jeff, WA8SAJ; Bill, K8DBN; Larry, W9MDX/8; Barney, KC8LTD. *Photo by Barb, KC8LTD's XYL.*

Russ, WB3FAU brought his newly acquired Hammarlund SP-400 to show the group.

for the event and this year we all might get going on this one.

Tom, NI8G also showed us his new HF mobile installation and Russ, WB3FAU had a newly acquired Hammarlund SP-400 Super-Pro to show off . The group is a loosely knit one, with no formal club type of stuff, only a common bond of old gear, AM and some vintage SSB.

Ron, W8KYD and Bill, K8DBN have been instrumental in getting this thing rolling along, and the increased interest in the older gear has helped get more folks coming to the informal get-togethers. Some of the folks have been SWL's and listening to the AM activity has sparked an interest in them getting their ham tickets.

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Ultimate Regen from page 15
regulator, and a 6SK7 marker oscillator. I am not a purist, I prefer solid-state rectifiers to tubes.

A few features of the radio are:
Shock mounted detector.
*Link coupled antenna.
Crystal marker for accurate calibration.
Precise adjustment of detector voltage.
Voltage regulation.
A two step attenuator in the antenna circuit for use on contest weekends.
Power supply and audio output on separate chassis from detector.

Pre-Construction Considerations

A word about coil forms. There are small manufacturers today who still supply plug-in coil forms. Most are of good quality. If you prefer to buy rather than build, manufactured forms will save you a little time. However, with my home built 'link antenna coupler' almost all available forms are a trifle short. I therefore prefer to 'roll my own.

For years I've been making my own forms from 1.25 inch PVC. I bought a 10 foot length of the tubing last week for 88 cents. I prefer coils a little taller than those offered by the trade today so I usually cut the PVC into 3.5 inch lengths. Lets see... If I cut the tubing into four inch lengths I'll get 30 forms for 88 cents. That is about 3 cents a form. Now I must add $1 per form for a base. If you have some old tubes you are home free. But even when I must buy a base I end up with $1.03 per base... Oh yes, I better add a dime to that for epoxy adhesive. Anyway, I end up with less than a buck and a quarter per form. Compare this with the five to eight dollars asked by sellers today...

"But," you say, "I'll never use thirty coil forms." Well, you may be right of course. However, if you only use six forms and throw the rest of the PVC away, you end up with a superior (In my opinion) coil form and save a whopping $30 to $40. That much money will buy you a nice, bright, new chassis from K3IWK, plus two or three tubes for your receiver.

Building today is not cheap. By carefully watching your money you can still build a receiver like the one in this article for about $250. If you have access to e-bay, a few local hamfests, and a well stocked junk box then the cost will be less.

I am often approached by someone wanting to buy one of my surplus 'regens'. Surplus homebuilt receivers are akin to surplus children. They are your creation and should, and do, mean more to you than anyone else. You may have too many kids, but which ones do you wish to dispose of. Secondly, I build my receivers 'stout' and spare little cost on parts. I think the proper term is 'overkill.' I dislike running any parts near their maximum rating. I also have a fondness for National PW dials and gear boxes for my tuning control. It is not unusual for me to end up with well over the $250 price mentioned earlier. If I priced a receiver for the exact amount I have in it there are many who would feel it was overpriced. If I calculate the actual cost of a receiver, and then charge my time out at $11 bucks an hour (this is what kids get today for stocking grocery store shelves) then I would have to ask somewhere between $500 and $700 for a simple regenerative receiver. Even this figure is conservative for some on my efforts.

So, like any hobby, building radios is not a way to save money, and certainly not a way to make money. It is a hobby, a most gratifying hobby, and nothing more. I can think of no hobby that delivers more pleasure for the dollar.

Let's discuss radio panels. Panels are a matter of choice, assuming they are sufficiently rigid. A piece of lightweight aluminum for the panel is in my opinion unacceptable. If you have access to some 1/8" aluminum stock, great! I am uncomfortable with anything less.

I have found that panels made from 3/16" plywood, backed with thin aluminum works very well. The same is true for any of the hardboard stocks such as Masonite. Antique Electronics carry a black panel material that is similar to Bakelite in appearance. It is available in 8 x 24 inch sheets for about $14 per sheet. It takes two sheets to build this receiver. If you go this route, by the time you figure in packing and shipping charges, you are going to have well over $80 in the chassis and panels alone. This is why I opt for the plywood panels on most of my receivers. At home supply stores I can buy nice oak or birch plywood in 24 X 24 sheets for $4.45. A large sheet of thin aluminum stock suitable for shielding, and panel backing, will cost about $20 at the same store.

I finish my plywood panels a number of different ways—my favorite is to let the beauty of the wood come through. First sand the panel with very fine sandpaper. Then apply one or more coats of stain. I like to mix my own stains. I prefer a mixture of dark walnut and dark oak stain. This gives my oak panels a real 1920's look. This look can be enhanced enormously by the use of Mohawk Ultra Classic Toner. I use the 'Perfect Brown' color. This toner is easy to use and gives your panels a 'classic radio' look with gradual shading becoming much darker in the corners and along the outer edges of the panel. It is available from Antique Electronics.

Walnut and Birch plywood also look great when painted. I have finished panels in black, gray, and silver 'Hammartone.' If a painted panel suits you, you will save money. It is a lot cheaper to buy one can of black satin spray paint for four bucks than to buy stain, toner, clear varnish, and tack rags. Of course if you go for the stained panels you will have a lot of stuff left over to harden in the can before you toss it in the trash. Stained panels are reasonable in price only if you are doing several square feet of wood.

When you buy the plywood for the panels don't forget to pick up a 6 foot length of 1/2 inch aluminum strap. You will use over half of this making panel braces. It is of prime importance that you build a 'regen' rock solid. Why? The detector is tunable. Movement of anything in the detector circuit from the end of your long wire antenna tied to a tree in the backyard, to the grid of your first audio tube, will shift the frequency if it exhibits movement. Don't worry too much about the antenna movement, it is not as critical as some would have you believe. Do be concerned about anything on the detector chassis. A very slight movement of the panel will result in problems, including making CW signals sound 'chirpy'.

Radio construction can be divided into three parts—the mechanical construction, the circuit and wiring, and the cosmetics of the radio. Actually, a good radio builder pays attention to all three but you can save money on the cosmetics and end up with a radio every bit as good as one that costs you quite a lot more.

In future issues of ER I intend to explore all aspects of building this receiver. Our next installment will cover such things as the power supply unit, and layout the receiver chassis. Schematics and parts lists will also be included so that you may start gathering up all the necessary items to complete your receiver. **ER**

The RCAF Mystery Radio

by Doran Platt, K3HVG
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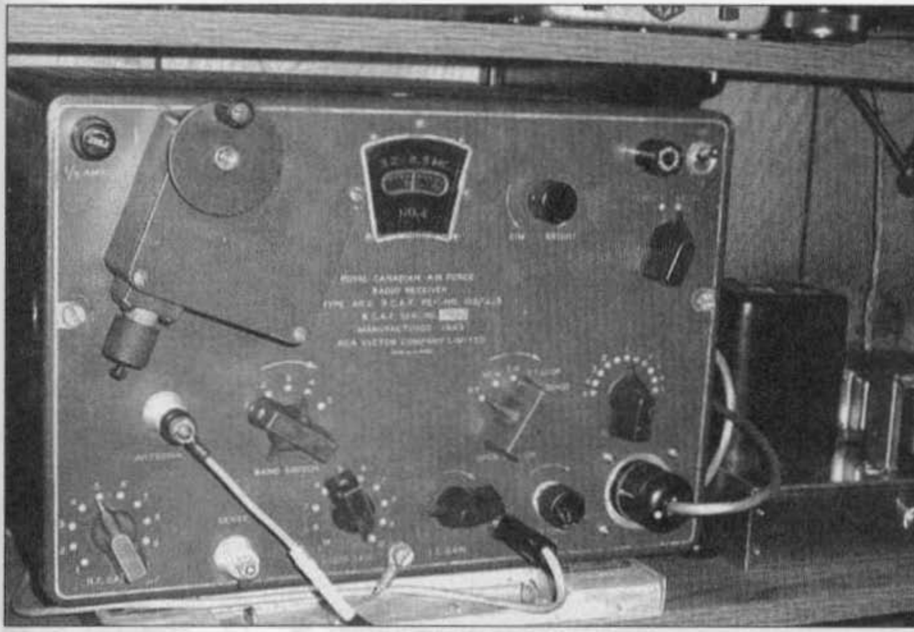
Monrovia, MD 21770
jeepp@erols.com

In 1958, just prior to my becoming a licensed radio amateur, I received a unique gift from a neighbor. The gentleman, a military member of the Canadian Embassy in Washington, presented me with an HF receiver he had had for some time. The radio was without nomenclature, but the neighbor informed me that it was an RCAF radio of WW II vintage and that it was of the type of receiver installed in heavy transport and bomber aircraft. The receiver had been converted to the extent that it had a 110 volt power supply installed and the front panel overlay had been replaced. The new panel had been decorated much like the skin of the "Spirit of St. Louis" aircraft. There was a nice, external, P.P. 6V6 audio amplifier included with the radio. I used this radio on and off for about 4 years. It disappeared during some obscure trade I must have made prior to entering the Air Force in 1961. I had been looking for another one of these receivers for the past 35 years.

In early 1999, I saw a receiver on E-bay that looked strangely familiar. It looked like the old RCAF radio I used to have, but it certainly was not identical. I decided to bid on it, anyway, and eventually won. The rest of the story is that this receiver is an RCAF model A.R.2, RCAF Stores Reference No. 10D/1275. The A.R.2 receiver operates from 12 volts DC; its counterpart, the A.R.6, operates from 24 volts. These receivers were manufactured by RCA-Canada for the RCAF and were installed in heavier aircraft. One of the Canadian radio museums has confirmed this point. Per the manual, these receivers were used with the RCAF A.T.1 and A.T.7 transmitters. It turns out that the radio I received as a gift in 1958 was indeed an A.R.2 or 6. The difference, obvious now, was that my old receiver had the modified front panel with metal tags for labels and the tuning gearbox had been rotated to make it appear in line with the panel. Take a look at the front panel picture and you'll see what I mean. My collection has now gone full circle on this particular item.

The design of A.R.2 receiver is fairly standard for the period. It's a 7-tube superhet that uses 1940's vintage octal tubes. The lineup consists of 6SK7/6K8/6SK7/6J5/6SQ7 and 2 6K6's for the audio. It appears to be, more or less, a typical, WW II-era, military receiver and, arguably, the Canadian equivalent to the BC-348 in that it tunes from 140-400 kHz and .48-21.0 MHz. Unlike the BC-348, though, the A.R.2 receiver has provisions for tuning via either the front-panel gearbox or a remote teleflex cable. The band and function switches are set up to operate locally or by remotely-controlled motors in the receiver. The receiver has two audio amplifiers; one stage for receive audio and the other for sidetone and intercom. The audio output impedance is 2000 ohms at about 500 mw. The receiver has antenna connections both a longwire and a direction-finding loop. The B+ voltage is 165 volts DC at about 90 mA and filament current (at 12 volts) is 2.3 amps. Both the B-minus and filament circuits float above ground. The floating B-minus, and filament voltages are bypassed to chassis ground, at various



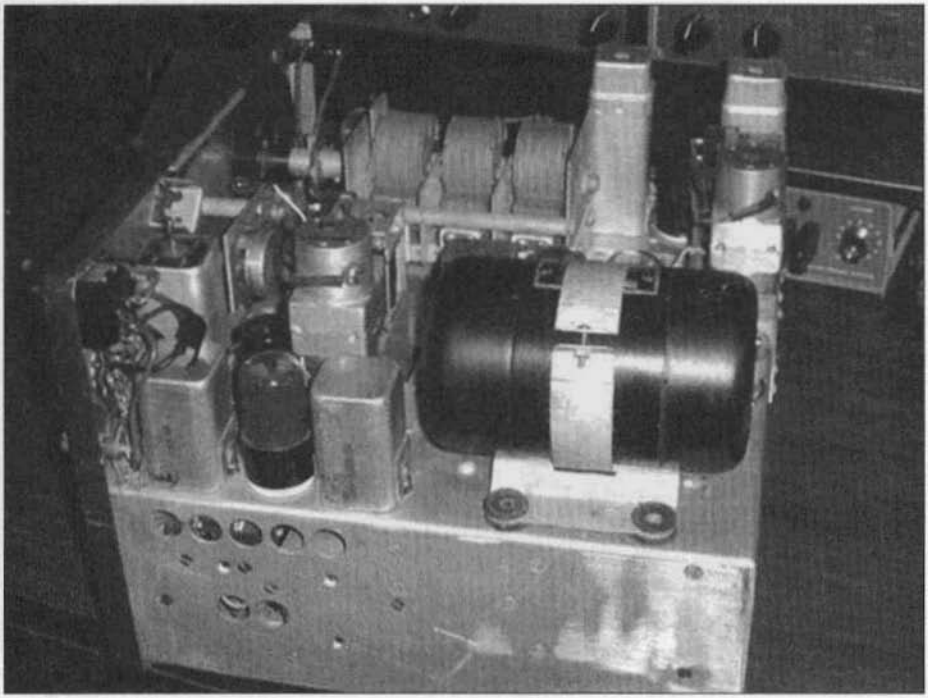
The A.R.2 receiver was manufactured by RCA-Canada for the RCAF (Royal Canadian Air Force).

points on the chassis. The manual alludes that this design aided in noise reduction in an aircraft environment. It may well be that this design was also used because it appears that one could install the radio in either a positive or negative ground power system. I know the Brits used positive ground in many installations, so perhaps RCAF did, too.

To get the receiver on the air, I first powered it up with 12 volts DC. Once operation was confirmed, the receiver aligned, and a few capacitors changes out, I moved to build an outboard power supply and audio amplifier. Using an outboard supply precluded the necessity to butcher the radio and will enable me to restore it to near original condition later, if desired.

Power and audio connection to the receiver was made via the available front panel power and remote control connector. I did, though, have to commit the cardinal sin of replacing the unique connector with and octal socket (I kept the connector, just in case I ever find its mate!). To simplify design, I chassis-grounded the B-minus and one side of the filaments. Unlike the BC-348, grounding the A.R.2 B-minus has no effect. The filament wiring design is very convenient in that the conversion from 12 to 24 volts is accomplished via jumpers on a terminal board. Inasmuch as there are numerous capacitors associated with the filament circuit and in consideration of the internal DC motors and relays, etc. I elected to run the AC filament current directly to the filament terminal board. In this way I was able to isolate the filament circuit from other LV DC distribution. In the future, if I decide to re-configure operation using the dynamotor, all I need do is reconnect the distribution bus to the terminal board. There are two fuses in the radio. One, B+, is on the front panel, the other fuse, the primary DC input, is inside, hidden away on top of the chassis. The chassis of the A.R.2 is quite

continued on next page



A view of the A.R.2 with the cabinet removed.

deep and it's a bit difficult, in some areas, to get at components and tube sockets to make necessary repairs.

Sensitivity and bandwidth, during operation, appear to be on par with the BC-348. The A.R.2 does not, however, have a crystal filter. The reduction gear drive for the tuning mechanism provides a excellent bandspread but the dial itself is not quite as directly readable as the BC-348. The audio output of this military receiver is a typical 2000 Ohms. Although, a speaker, such as an LS-7 (marginally with an LS-3), can be directly driven, I found that an auxiliary amplifier was required for several reasons. First, the audio output inherently low. Using a speaker directly, one must keep the audio gain control at or near maximum. Secondly, I find that the BFO injection in this radio appears to be set at a very low level. While acceptable for CW reception, it is insufficient for SSB. One has to reduce the RF gain such that there is little or no audio output left. The additional of an audio amplifier improves this situation. I do intend to see if I can increase the BFO coupling, just a bit, to improve operation.

The technical manual I received with the receiver was only about 80% complete but did include a schematic (albeit its condition was akin to the Dead Sea Scrolls). By piecing it together and making magnified copies and then re-drawing certain areas, I've been able to resurrect a pretty decent schematic, capable of mastering copies. If anyone needs tech data from the manual, has a complete book, or has an A.R.2 or 6, I'd like to hear from them. The plan, now, is to mate the A.R.2 with a TA12 transmitter I recently purchased. This may make a credible pair to put on the air. Finally, my continuing thanks to Mr. John Orobko, Canadian Diplomatic Service... wherever you are. ER

Radio Service from page 27

evening, 'The Smoking Room.' For longer than anyone liked, an elderly gentleman, smoking a pipe, delivered a bunch of down-home philosophy and humor. I suppose the best way to describe the program is as a bad imitation of Will Rogers. After the 'Smoking Room' we watched a movie of a symphony orchestra as they 'fiddled' away for one hour.

Program material made little difference. We waited anxiously every evening for the TV station to 'sign on.' Sometimes during the day we left the set on with nothing but a test pattern to see.

Very soon after Oklahoma City came on the air, KOTV in Tulsa, Oklahoma began operation on a nightly schedule. Tulsa, only 100 miles away, came in much better even with their small 16KW transmitter, and a roof-mounted antenna. The roof was on the 'Phil tower,' the tallest building in Tulsa at the time. If I remember correctly, the antenna was some 350 feet above ground. Today, the Philtower is lost amid a cluster of much taller high-rise office buildings. At last, we could depend upon some sort of picture almost every evening. It seems TV at long last was finally coming around that long predicted 'corner.' ER

Marconi from page 11

a mannequin shaped by external forces; during his formative years he developed a strong will to succeed, attained a sound knowledge-base in physics, acquired an astute understanding of applied technology, and significantly, as a consequence of his family background, learned social graces that enabled him to interact with ease in the company of persons at all levels of society-kings, queens, eminent scientists, lowly laborers, etc.

Since no one on the horizon appeared poised to dash his dream, Marconi toiled vigorously in 1894-1895 to improve his apparatus. After making changes incrementally to the coherer, he began a step-by-step reconstruction of Hertz' oscillator. First, he substituted relatively large metal plates for the ones Hertz had attached to the spark balls, and found that the distance a signal could be sent increased. He then fastened one plate on top of a tall pole and buried the other in the ground-following Tesla and Popoff's concept of a basic aerial and ground. As the pole went higher and higher, signals could be sent farther and farther. He added also an aerial and ground to the coherer and again circumstances improved. Marconi's somewhat imprecise observations led him to work from the assumption that "the energy of electromagnetic waves did not diminish in intensity when the distance was increased if the length of the aerial wires were increased as the square [root] of the distance, that is, by doubling the height of the wires the waves would be transmitted four times the distance, the initial energy remaining the same" (Thom-Collins, 1908, Part II, p. 13).

The day arrived, late in 1895, when Marconi was regularly transmitting a few miles to his coherer. Although his apparatus was still rudimentary, he decided to ask the Italian government to fund a program of comprehensive research. The Italian officials denied his request, but suggested, given the potential of wireless in ship-to-shore communications, that he offer his system to authorities in England, where maritime activities are much greater than in Italy. Marconi's mother seconded the idea, began preparations for the two of them to move immediately to London, and wrote to friends and relatives in Ireland and England to announce their coming. ER

Ed. Part 2 next month.

The Tuned Aerial from page 33

These can often be found at Hamfests and Fair Radio has had them off and on over the years.

The plug-in coils can also be home brewed using Lexan bar stock, PVC pipe forms, banana plugs, appropriate wire, and banana jacks. Some skill and dexterity will be required for this. However, if you have only one or two bands of interest, one coil on a PVC form is all that's necessary. With judicious choice of inductance and taps, one coil can cover two bands. The tuner, as constructed here, handles maximum power on 160 through 20 meters. We very seldom use it on 17, 15 or 10 and when we do, it is usually barefoot with 100 watts which is more than adequate for those bands. There has never been any problem with breakdown, arcing or heating in SSB and CW service at any time.

With this antenna and tuner configuration, you can be assured that your RF is 99.9% being radiated into space and not being used to heat up coax, ferrite cores or trap coils and condensers.

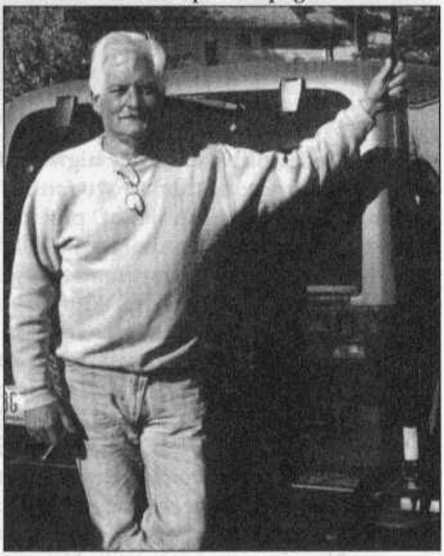
A future article will discuss a multiband tank circuit tuner that is primarily used for single band coax fed antennas. There is no bandswitching (or very little in order to cover 160) and no plug-in coils involved for full coverage from 80 through 10. A quick turn on three different knobs and you are fully tuned and matched. In the meantime, good luck with your tuned "Aerial" and high efficiency balanced tuner. ER

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

Press Wireless from page 3

1952. The Press Wireless Company never regained their prewar prominence and disappeared in the early fifties. The remnants of PW became Northern Radio, part of which evolved into the Technical Material Corporation. The Army went full circle in the sixties when they bought TMC 15 and 40 KW transmitters to supplement the Collins transmitters. However TMC receivers never came up to expectations and the Army went with National Radio for the new AN/FRR-59. Press Wireless however will remain in the memory of all who used them because of their rugged dependability and in the case of the 2.5, as a true example of what a 2550 lb. boat anchor should be. ER

Boatanchors Group from page 35



Tom, NI8G with his mobile setup.

The AM activity in the greater Lake Erie area has been good. Every Sunday on 3880 at 8:00 AM, there are about a dozen or so that check into the "DX-60 net" and during the week there is always some AM activity on 75 or 40 meters. ER

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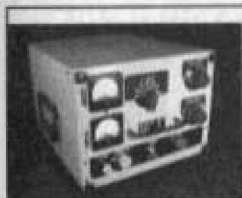

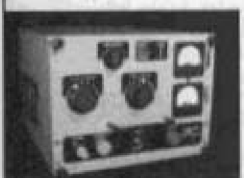

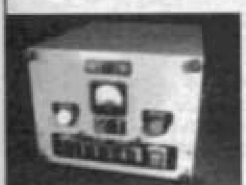

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WANTED: Heath Gear, unassembled kits, catalogs and manuals. Bill Robbins, 5339 Chickadee Dr., Kalamazoo, MI 49009. (616) 375-7978, billrobb@net-link.net

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

WANTED: Back issues of QRP or RADIO AGE magazines. Gary Fender, W5UUO, 450 Cunningham Rd., Celina, TN, 38551. (931) 243-5323, gdfender@multipro.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: Plastic meter cover for B&K 707 tube tester 3/8"x4"x4-11/16". Allan Lurie, W9KCB, 605 E. Armstrong Ave., Peoria, IL 61603. (309) 682-1674

WANTED: Hallicrafters rcvr S40 or S40A. Jerry, N5KYE, OK, (405) 373-4727.

WANTED: Tubes: Any quantity, clean, unused, small or lge. Please send list of types, quantities. **FOR SALE:** Tubes - send SASE for list AE; teletype parts. Fred Schmidt, N4TT, Typetronics, POB 8873, Ft. Lauderdale, FL 33310. (954) 583-0777, FX: 583-1340

WANTED: BC342 nameplate; phone jack covers; AF gain/RF gain control; Heath capacitor tester; CT-1 manual. Louis D'Antuono, 8802 Ridge Blvd., Brooklyn, NY 11209. (718) 748-9612

FOR SALE: 51J-4 filter replacements, direct plugin—6.0 kc Collins mech. filter, 3.3 xtal lattice, 2.3 kc xtal latice ,500 cycle xtal latice - $215 each; R-390A 16 kHz flat phase filter, for Hi-Fi AM - $245. Chuck Felton, KDØZS, WY, (307) 322-5858, feltoned@coffey.com, www.feltondesign.com

FOR SALE: New Release. For details send 2-stamp LSASE to: Olde Tyme Radio Co, 2445 Lyttonsville Rd. Ste 317, Silver Spring, MD 20910

FOR SALE: Military and commercial communications items: http://www.maxpages.com/murphyjunk. Murphy's Surplus, 401 N. Johnson Ave., El Cajon, CA 92020. (619) 444-7717

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: Hallicrafter rcvrs S-85 w/manual, VG - $85; S-40 w/manual, GC - $60; RME 4350 rcvr w/ manual, VGC - $160; + shpg. **WANTED:** Hallicrafter rcvr parts; S-meter for SX-96, 99 or 100; IF xfmrs 16650 kc from SX-130, 133, 122, 111, 140 or 117. Will buy basket case rcvr if has needed parts. Burt Ostby, KC8FBR, MI, (989) 736-8020. kc8fbr@kwcom.net

FOR SALE: MFJ-941D, 300W antenna tuner, has SWR meter, exc - $40 +shpg. Henry Mohr, 1005 Wyoming, Allentown, PA 18103

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: T-368-C military xmtr w/manual, exc cosmetic & working condx, spares available including exciter unit - $1200; TCS matching serial number TX & RX w/some accessory gear & manual - $250 (with some spares); R392 in exc condx - $200; Eldico SSB 100F - $400; SSB 1000F - $700; both w/ spares. All gear PU only northeast TX or Houston. Tom Smith, N5AMA, 13034 Elmington Dr., Cypress, TX 77429. (713) 417-5959, cell (281) 376-3436 hm

FOR SALE: Realistic Mod DX 302 @10 w/ant - $80. Bernie Samek, 113 Old Palmer Rd., Brimfield, MA 01010. (413) 245-7174, fx 245-0441

FOR SALE: Heath HA-14 mobil amp, no p/s. **WANTED:** Globe Champion 300 or 300A. Cliff, WA9SUE, WI, (608) 625-4527 after 6 PM

FOR SALE: AF-67 w/pwr sply; HTX-100. Jim Barton, WØKNJ, POB 417, Burke, SD 57523. (605) 775-2044

FOR SALE: Radio Society of Great Britain Handbook, 4th Ed., exc condx - Free. Shpg contiguous USA - $22. John, W2PRR, jandjm130@juno.com

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 fixr7526@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: R390A, S/N 4617, EAC manufacturer, 1968, clean ,operates on all bands, all filters - $450 PU only; EICO 720, good condx - $75; 730 modulator, factory wired, VG - $100. Bob Zimmer, NV1X, 205 Brigham Hill Rd., Milton, VT 05468. (802) 879-7235, zimmerb@biotek.com

FOR SALE: WWII FM Vehicular Radio Set, BC-924TX, BC-603 & BC-683 RX's and FT-237 mounting rack. Includes 12V dynamotors and extra RX. Good condx - $300/BO, PU only. Steve Davis, KD2NX, 11 Vineyard Ave., Middletown, NJ 07748. (732) 495-3241, kd2nx@worldnet.att.net

FOR SALE: Boonton model 190A Q meter, 20 to 260 MHz, exc condx w/manual - $175 + S/H. L. Gardner, 458 Two Mile Creek Rd., Tonawanda, NY 14150. radiolen@aol.com

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: Globe King 500/A/B/C xmtr. Will pick up anywhere near Chicago. Jim Jorgensen, K9RJ, 1709 Oxnard, Downers Grove, IL 60516. (630) 852-4704. JandRJor@interaccess.com

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

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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: 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: IM-28 Heathkit VTVM meter. Part number 407-75, (6",200ua movement) or some one to repair my meter. I would be willing to purchase the complete IM-28 VTVM if the price was right and it was in working condx. Gary E. Mayfield, WAØEAF, 103 South Jackson, Marquette, KS. 67464. (785) 546-2369

WANTED: National RAS or HRO-Junior rcv w/tuning boxes etc. Ted Bracco, WØNZW, 203 East Main St., POB 730, Teutopolis, IL 62467. (217) 857-6404, X 306, braccot@hotmail.com

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

WANTED: TBW MF chassis , need junker for parts to finish restoration. Rob, robv@uriacc.uri.edu or call (401) 874-2063

WANTED: S-line spinner knob; 75A4 reduction knob; S-line cabinet. **FOR SALE:** S-line rack mount. JeRB, K8WPI, (616) 226-8873, JeRB@view2earth.com

WANTED: 3.1 KHz mech filter(or substitute) for Collins S-Line, 455 kHz center freq. Have NIB 2.1 kHz filter for trade, part/all. Bill, KDØHG 970-532-0603, klerosb@earthlink.net

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: 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: Copy of Yaesu FR50B rcvr & FL50B xmtr manuals in English & early '70s. Gary Wagner, K3OMI, 11124 Oak Hollow Rd., Knoxville, TN 37932. (865) 690-4217

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, K2DFT, 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: HRO-5 "silver front" G Coil 180-430 Kc. Also PP-327 AC power supply for GRC-9. Tony, k4kyo@arrl.net or (703) 522-1568

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

WANTED: Help! need chart for connecting Merit A-3106 Universal modulation xfmr. Will gladly compensate. Joe Walden, 317 White St., Norman, OK 73069. (405) 321-4717, whiskeyjoe2000@yahoo.net

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 mauriesch@ics.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: Old Army Navy radar equipment, any condx, any size. Bigger is better! William Donzelli, 15 MacArthur Dr., Carmel, NY 10512. (845) 225-2547, aw288@osfn.org

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: Super Pro seperate pwr sply w/80 & IV tube. Bill Coolahan, 1450 Miami Dr. NE, Cedar Rapids, IA 52402. (319) 393-8075

WANTED: Tuning knobs & cabinet for Grebe CR-9. Fred Schmidt, N4TT, POB 8873, Ft. Lauderdale, FL 33310.

WANTED: HRO D coilset; Drake R7A rcvr; Collins 75S3 rcvr. Jim, W8HPL, 13549 Morse Rd., Pataskala, OH 43062. (740) 927-2592

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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: Power Supply, Multi-Elmac M1070 or PS-2V. Norm, W1CIX, (508) 583-8349

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: 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: Manual for Ray Jefferson model 4105 marine rcvr, 1964. Harold, W4YWH, KY, (859) 441-9595, anytime

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: Heath HA-10 & KL-1 (KS-1). Dallas Mrasak, KA9NJV, 2349 E. Converse, Springfield, IL 62702. (217) 523-4023

WANTED: Buffer & output coil set for a Heath DX 40 xmtr. Cliff Fleury, AI7Y, POB 1233, Goldendale, WA 98620. (509) 493-8203

WANTED: S-line spinner knob; 75A4 reduction knob; S-line cabinet. **FOR SALE:** S-line rack mount. JeRB, K8WPI, (616) 226-8873, jerb@view2earth.com

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

Don't forget the 2nd Annual AMI 160M Heavy Metal Rally on the evening of December 23 and the 8 (or 9th) Annual ER/N2KSZ Memorial 160M Jamboree on December 29.

FOR SALE: RCA tube manuals, RC-15, RC-20, RC-25; ARRL Handbooks, 1965, 1968, 1972 & 1978. LSASE for list. Charles Brett, 5980 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

FOR SALE: Johnson & Hammarlund panels, cabs refinished. Done in same finish as new cars. Ranger-1, II (price, call), Valiant-1, HQ-180 (series), $250. + shpg. Visa/MC/AMX. Dee, W4PNT, VA, (540) 249-3161, cell (540) 471-7023 or w4pnt@vaix.net for jpg's

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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: 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: Military Radios, etc. E-mail N1UD@ATT.NET for a List or SASE. Ronnie Parker, 1357 Bridgeport, CT 06601

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: 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: BC-1000 p/s, canvas,2 handsets, battery box & BC-11 radios. Steve Bartkowski, 4923 W 28th St., Cicero, IL 60804. (708) 863-3090

FOR SALE: B&K model 700 Dynaquick tubechecker - $75 plus shpg. Larry Steeno, K9LWI, 1838 Bluespruce Ct., Green Bay, WI 54311. (920) 468-5149, Lsteeno@milwpc.com

FOR SALE: Misc equipment, parts (connectors, meters, relays, etc), manuals. List $1. Joe Orgnero VE7LBI, 1349 Leask Rd., Nanaimo BC V9X 1P8 Canada

FOR SALE: WRL AT-3 Antenna Tuner - $35; Heath QF-1 Q-multipler - $30; Drake WV-4 Wattmeter - $95. Richard Prester, 131 Ridge Rd., West Milford, NJ 07480. (973) 728-2454. rprester@warwick.net

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