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ELECTRIC RADIO

celebrating a bygone era

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Andy Allain, KCØJTL

ELECTRIC RADIO

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

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

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

Editor's Comments

Our Condolences to Radio Pioneer, Leo Meyerson, WØGFQ

Recently Leo's wife Helen passed away. She was Leo's partner and supported him in everything that he did. They were married for 69 years. We're all sad for Leo and send him our deepest, heartfelt condolences.

Vintage Field Day, June 8/9, 2002

Back in 1997 when we decided to sponsor and promote Vintage Field Day we thought the event would become more popular than it has. Despite the fact that interest in the ARRL sponsored Field Day has declined, we thought there was a special appeal to a vintage field day where challenges still exist in operating gear from the field. We thought that even though we're all getting older (and the gear isn't getting any lighter) we'd have no shortage of enthusiastic participants.

This year the 2nd weekend in June is the 8th and 9th; we won't have the conflict with Father's day that we've had in the past. We're hoping that this will help get more people into the field. We're also hoping that by starting to talk about VFD now we'll stir up interest and get everyone thinking about how they can get involved.

One idea that I've had is to devote an entire issue to articles/reports on the activities of VFD. Could this increase the interest in the event? Should we create categories, i.e. single op, multi-op, multi-bands, etc. and then make it something of a contest? What about prizes?

I'd like to ask everyone for their ideas on how we can better organize and promote VFD. Please let me know what you think. N6CSW

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Cover: Andy Allain, KCØJTL in his great-looking Heathkit equipped hamshack. Although he's only 17 years old he's been operating vintage gear for over two years. It's great to see someone as young as Andy involved in our hobby. ***Photo by Mike Sanders, KØAZ.***

The Missing 1934 Single-Sideband Report

by Chuck Teeters, W4MEW
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In 1934 Jim Lamb, W1AL, the technical editor of *QST* prepared a report on the feasibility of single sideband carrierless phone transmission on amateur frequencies for the ARRL Board of Directors. Lamb received board permission to present the report in a series of articles in *QST*. The first article "Background for Single-Side-Band Phone" was published in the October 1935 issue. The article, on page 33 and 34, did not appear in the table of contents on page 3 of the issue, nor does it appear in any of the *QST* indexes. The article ends very abruptly in the middle of an explanation of carrier phase requirements. There were never any follow up articles, no explanations, no editorial comments from K. B. Warner, W1EH, editor of *QST* and League secretary, about the SSB article. There were never any references to the article. It was as if the report never existed.

Unless you went through early QSTs, and came across the two pages, the existence of the report would remain unknown. All ARRL history in *QST* and in the book "Fifty Years of ARRL" omit any reference to the Lamb SSB report. All SSB histories refer to articles in "*R9*" magazine by Robert Moore, W6DEI, and sometimes the commercial work by Hank Yanel, W2SN, at the AT&T New Jersey transmitter site in "*Proceedings of the IRE*". Checking with Steve Ford, the current editor of *QST*, confirmed that there was no follow up in *QST* and that the ARRL had no record of the Jim Lamb 1934 SSB report. Again it was as if the report never existed.

QST devoted considerable space, 13 years later, to SSB in the January 1948 issue. K.B. Warner, still *QST* editor in 1948, introducing the advantages of SSB, used the term "carrierless single-sideband" twice in his two page editorial. In the same issue By Goodman, W1DX, assistant technical editor, in his article explaining SSB used the same term. Carrierless single-side-band was the way Jim Lamb described SSB in 1935. All other references in these two articles and all others used single sideband suppressed carrier or SSSC to describe SSB. Again no reference to the Lamb report or where the carrierless term came from.

Jim Lamb, the *QST* technical editor in the early thirties was about the brightest light there ever was on the *QST* staff. Lamb had developed the single signal crystal filter in 1932 that became the standard in all communications receivers until replaced by Collins' mechanical and various crystal lattice filters in the fifties. Collins kept the Lamb crystal filter in the 75A-2 and 75A-3 receivers even after they added mechanical filters. Lamb received no compensation from receiver manufactures using his crystal filter circuit. In 1937 Lamb developed a noise silencer. This circuit was superior to the existing Dickert limiter as Lambs silencer took the noise pulse out where the Dickert limited the noise pulse amplitude. The noise limiters we have today in our solid state SSB transceivers use the same principles as expounded by Lamb in 1937.

Lamb took an unannounced leave of absence in the middle of October 1938, after a meeting with David Oram, chief engineer of Hammarlund. Lamb disappeared from *QST* and his leave of absence status ended in April 1939. There was no explanation of his sudden departure from the *QST* staff. Lamb patented his noise silencer in April 1939. It was first used in the Hallicrafters SX-28 Super Skyrider the next year. The next vacuum tube receiver to use the noise silencer was the Pierson KP-81, which was a great receiver combining the best of a Hammarlund Super Pro with the best of a National HRO. With the advent of solid state receivers the Lamb silencer showed up in everything. This also happened to be about the time the patent expired.

K.B. Warner was hired by the ARRL in 1919 in the dual capacity as editor of *QST* and league secretary when they bought *QST* from C.D. Tuska. Warner remained in that position until his death in September 1948. He was replaced by Arthur Budlong, W1BUD, who had been assistant secretary prior to Warners death. K.B. Warner had a very influential position, being a voting member of the board and directing *QST*. He established the policy that *QST* was amateur radio only, no broadcasting, and no short wave listeners. Published articles were the property of the magazine and he considered publication in *QST* a sufficient reward for authors. According to Warner, writers of *QST* articles were writing for the good of amateur radio, not money. He required a careful screening of advertising for honesty in performance claims. He charged his technical editor with the responsibility of verifying advertising statements. Warner also insisted he check the technical accuracy of all published articles.

It becomes easy to surmise what happened between Warner and Lamb in 1938. With Warners belief that publication was a sufficient reward, and Lambs knowledge of the rewards of commercial ventures there had to be a parting of the ways. However finding the story behind the missing SSB report is more difficult. The facts are the Lamb report did exist, it was presented to the ARRL board in 1934. This is confirmed by the side-bar in the October 1935 issue. Warner as board secretary would have to read the report. There was interest in SSB in the early thirties. The articles in *"R9"* magazine and *IRE Proceedings* along with the ARRL board request for the report affirm the interest.

According to the three *"R9"* articles there were at least six single sideband stations on the ham bands in the early thirties. Theory behind SSB was well known and appears in engineering texts in the twenties and thirties, check any Termans for complete descriptions of SSB transmitters and receivers. Construction of a sideband transmitter could be done with the available components. If you check the Nichols, WØTQK, article in January 1948 *QST*, you will find he used nothing that was not available in 1933. Those components would have been larger, heavier, and less efficient. Possibly it would have required more homebrewing of some components. Ham SSB gear would have employed low frequency LC filters in 1934, the same as WØTQK in 1948. Crystal filters were used by the AT&T SSB stations but were generally unavailable to amateurs. Phasing was known, but the lack of wide band audio phase shift circuits would have prevented the use of this type generation. One of the stations operating SSB in 1934 was Ray Dawley, W6AJF, who was technical advisor to *"R9"* and Frank Jones, editor of *"Radio"* magazine. Two years later Dawley later became editor of *"Radio"* magazine and of *Editors and Engineers Radio Handbook*, all published on the West Coast.

The reason for the lack of wide spread use of SSB in the thirties, as given by Warner in the January '48 *QST* was the lack of receiver stability. According to the Warner editorial the "years of fearing that our receivers weren't stable enough to permit the use of single side-

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

Part Four, Conclusion

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The next morning, Thursday, December 12, 1901, a strong wind dictated use of a kite instead of a balloon. The first kite sent aloft broke away, as the balloon had the day before. Kemp observed that had he been positioned differently, "I should have gone with it as its speed was like a shot out of a gun" (Bussey, 2000, p. 49). The crew was able to keep a second kite up. It looped, bobbed, dove, and righted itself while they struggled to extend it to about 400 feet. The erratic height and length of the aerial compromised prospects of keeping the syntonic system in resonance. Marconi, for that reason turned to Solari's mercury coherer, across which he attached a telephone receiver and battery connected in series (see Figure 9). The Branly/Lodge coherer with its syntonic mechanisms, relay, tapper, and inker accessories, which Marconi had so painstakingly developed, were "out the window." The good news was that the untuned coherer and telephone receiver combination would be more likely than the latter to copy the Poldu signal should it be very weak. The bad news was that Marconi would not acquire ostensible proof via inker tape that the Poldu signal had really been heard.

The different items of receiving equipment that Marconi brought with him to Signal Hill are shown in Figures 10-15: the greatly improved Branly/Lodge coherer, (Figure 10); the Morse inker, (Figure 11); the mercury coherer, (Figure 12); the telephone receiver, (Figure 13); the Billy coil, (Figure 14); and a kite, (Figure 15).

According to statements by both Kemp and Marconi, the crew kept the kite aloft for three hours and "at 12:30 pm, 1:10 pm, and 2:20 pm the prearranged signals from Poldu were received . . . " (Bussey, 2000, pp. 49-50). Only Marconi and Kemp heard them on the 12th—no one else was in the room. The signals were heard again on Friday, December 13th, but reception was relatively brief and too indistinct to be confirmed with any certainty. Marconi discontinued the tests on Saturday, December 14, 1901, because of harsh weather.

A noteworthy question arises as to the nature of the signal to which Marconi and Kemp listened on December 12 and 13, 1901. Did they hear with the telephone receiver three "dots" signifying the letter "S" or merely three clicks? The formation of a "dot" should have produced in the telephone receiver a "click-buzz-click," briefly spaced, for each of the three code elements of the letter "S," that is, a total of six clicks bracketing three buzzes, respectively. Merely listening to three clicks would signify nothing intelligible. Credible biographers emphasize that Marconi heard three dots; they ignore whether he also heard clicks (Jolly, 1972; Kreuzer & Kreuzer, 1995; Vyvyan, 1933). In contrast, (Wellman, 1952, p. 33) says Marconi heard "three fast clicks in the receiver." Jacobs (1961, p. 31) states "the three faint clicks heard in the telephone receiver was the Morse letter

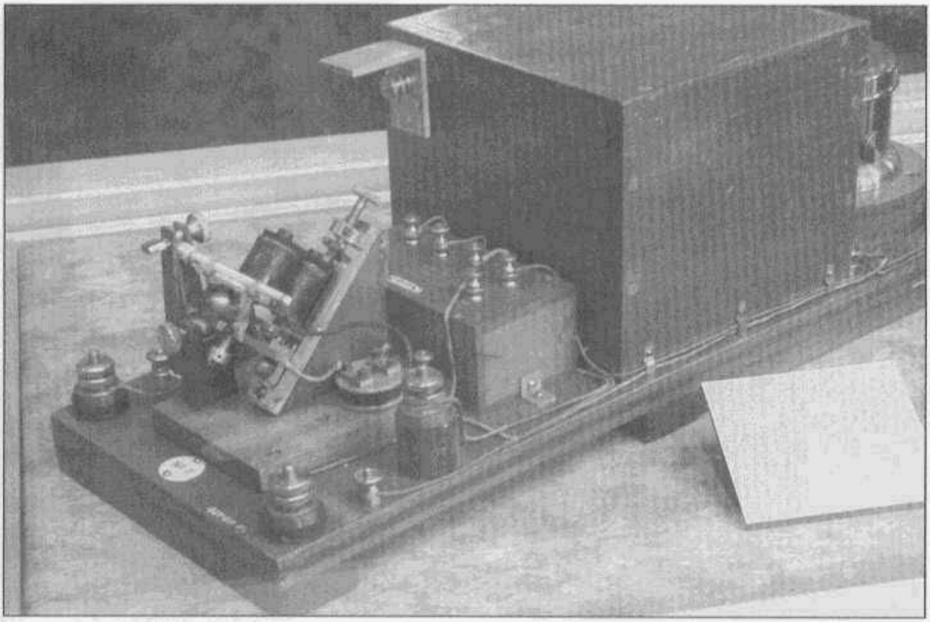

Figure 10. Branly/Lodge coherer.

"S," and Tarrant (2001, p. 56) reports that Marconi "heard three faint clicks in the receiver designating in Morse Code the letter 'S.'" Bussey (2000, p. 49) quotes Marconi as saying "'unmistakably, the three sharp little clicks corresponding to three dots, sounded several times in my ear . . .'"

Marconi himself may be our best authority. The sharpest, strongest sound emanating from a mercury coherer whenever an electric wave is received is that of the onset click in the telephone receiver. Given the ferocious local storms, the buzz and offset click accompanying each first click may have been virtually masked by random atmospheric noise. Marconi acknowledges that each click was faint, but the fact that clicks were sent rhythmically in sets of three and that he and Kemp probably heard each buzz almost imperceptibly indicates that they assumed correctly that they were listening to dots corresponding to the Morse letter "S."

A second query, and perhaps the most puzzling, deals with Marconi's strange laxity in establishing confirmation of the signals from Poldu. The importance of the event to his Company and to him cannot be overestimated. He regarded it as a defining moment in the seven years that he had devoted to improving wireless technology. His Company had invested about $250,000 in the experiment. He had convinced it that he would establish a transatlantic wireless system, and the Poldu to Signal Hill transmissions revealed that the system would be possible. Although many physicists and mathematicians believed that signals travel in a straight line across the horizon, his data proved them wrong. But the only evidence that he possessed, besides his own word, was Kemp's corroboration. His Morse inker would have provided definite proof, except that horrendous weather did not permit him to use the coherer to which it was attached. Why then, on December 12, when he and Kemp heard

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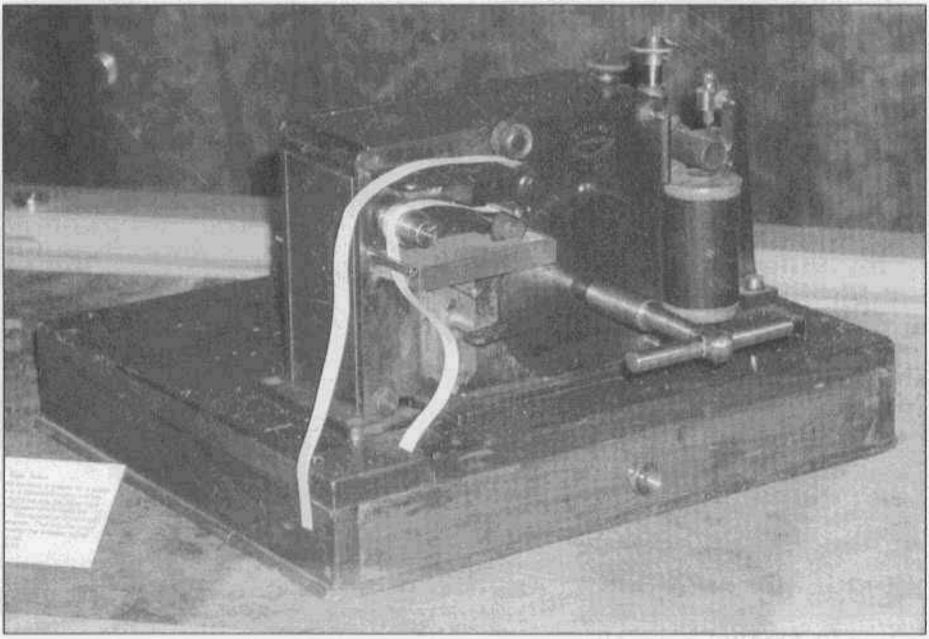

Figure 11. Morse inker.

the clicks reasonably well, did they not call others to come inside and listen? One certainly did not have to be familiar with the Morse code to discern three rhythmic clicks in a telephone receiver. Where was his photographer, members of his team of technicians, etc.? An opportunity for strong proof bolstered by additional witnesses was at hand, but Marconi neglected to take advantage of it.

On December 14, 1901, Marconi released the news that the Poldu signal had been heard in Newfoundland. The media throughout the world was unsurprisingly ecstatic. Marconi basked in the attention. He shrugged off critics who argued that all he heard was random atmospheric electrical noises, and, perhaps in too euphoric a mood, he informed Newfoundland authorities that he intended to construct a wireless station as powerful as the one at Poldu on either Signal Hill or a nearby Cape. He would be leaving his assistants to erect a tower and prepare the site for the installation of a transmitter. As Marconi's plans approached pretentious proportions, the Anglo-American Telegraph Company of Newfoundland, which held a monopoly on telegraph enterprises in the Colony, decided belatedly that it did not want Marconi around. On December 16, 1901, the Telegraph Company informed Marconi that it had obtained an injunction that required him to cease experimenting in Newfoundland.

Marconi's legal problems in Newfoundland, however, failed to impede his progress. On December 24, 1901—less than three weeks after he had arrived in Newfoundland—he sent Paget with the apparatus that he had used on Signal Hill to England, where it was set aside for one-hundred years. He departed St. John's a few days later for Ottawa, where he obtained from the Canadian government a grant to build a wireless station at Glace Bay, in northeastern Nova Scotia. After signing contracts in Canada, he left for New

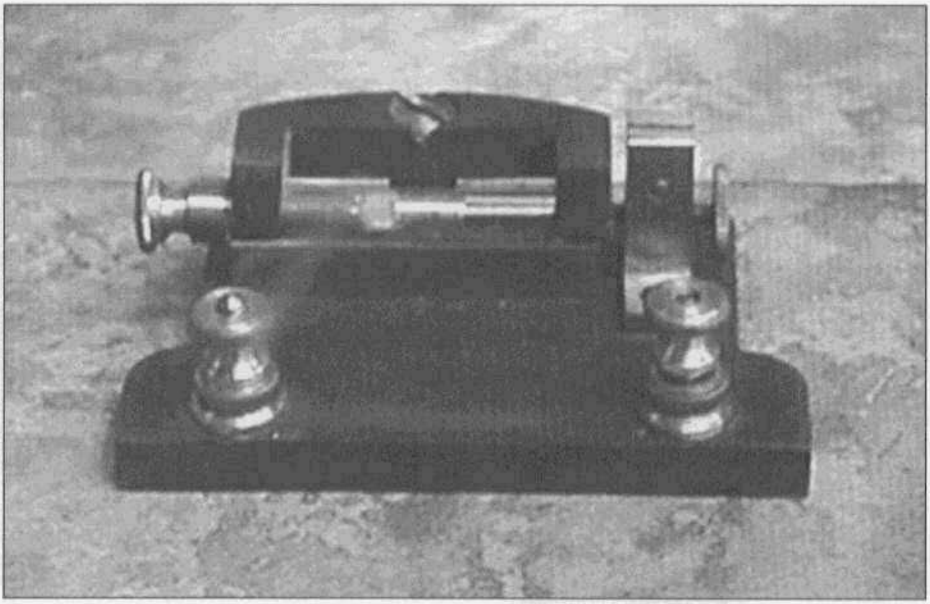

Figure 12. Mercery Coherer

York City where on January 13, 1902, he was guest of honor at a gala dinner of the American Institute of Electrical Engineers. Over 300 distinguished guests feted the 27-year-old, applied-scientist to celebrate his momentous success in advancing wireless technology. The roster of dignitaries who paid tribute to Marconi included Charles Steinmetz, Elihu Thomson, Alexander Graham Bell, Michael Pupin, and Frank Sprague (Bussey, 2000; Jolly, 1972; Kreuzer & Kreuzer, 1995).

Thomas Edison and Nikola Tesla were absent conspicuously from the dinner. Although both sent congratulatory telegrams, each had responded less than positively upon first learning of Marconi's transatlantic triumph. Edison had characterized the event in the press as a "newspaper fake;" however, he recanted shortly thereafter, saying that he had faith in Marconi's integrity and that his word was sufficient for accepting his claim. Tesla, in contrast, nurtured a simmering hostility toward Marconi, whom he contended was infringing upon his patents. One afternoon, in mid-December 1901, Tesla and a friend were taking a stroll. "`Looks like Marconi got the jump on you,'" said the friend. "'Marconi is a good fellow,' replied Tesla. 'Let him continue. He is using seventeen of my patents'" (Cheney, 1981, p. 161). Tesla eventually sued Marconi in 1915; as Cheney (1981, p. 181) reports, "the war of wireless patents was waged back and forth for decades, and little wonder that confusion ensued."

Marconi's stature in history

When Marconi died prematurely in Rome from heart disease on July 20, 1937, radio broadcast and commercial stations world wide paused transmitting for a moment of respectful silence. Hugo Gernsback published a glowing eulogy to Marconi a few weeks after his death. Gernsback, pioneer editor of such twentieth-century radio publications as *Electrical Experimenter, Radio Craft, Radio News*, and *Shortwave Craft*, etc., is rightfully acknowledged to have been the foremost radio

continued next page

Figure 13. Telephone Receiver

belief in himself to think that a new and untried system of transmitting electromagnetic waves over almost 2,000 miles of curved ocean surface was within the realm of even a remote possibility. That took more than courage. It was really a supreme heroic gesture, and it is probably for this one outstanding accomplishment, more than any other, that the world is paying homage to the dead inventor today" (Gernsback, 1937, p. 197). Finally, Gernsback said that Marconi "was able to make his genius helpful to others, as no other man had done upon so wide a scale. Never before has the lifetime of a single man been so identified with a change in the conditions of life on the globe, of which he was the most conspicuous creator" (Gernsback, 1937, p.203).

journalist of the era. Gernsback exulted from his editorship that Marconi "will no doubt go down in history . . . as great or greater than any other benefactor who ever lived" (Gernsback, 1937, p. 197).

Gernsback insisted that the world owed Marconi a staggering debt. He was responsible for saving tens of thousands of lives that would have perished in the sea. Further, through his contributions to wireless, and later the radio age, he "brought to life not only a huge industry, but has brought all humans closer together, . . . and lately in broadcasting has given the human voice wings such as it never before dreamt of having" (Gernsback, 1937, p. 197).

Gernsback also declared: "It should not be forgotten that it took a tremendous amount of courage and

Gernsback was predisposed to wild gyrations of hyperbole, as readers of his publications are aware. However, in this instance, Marconi's biographers share uniformly an equally strong reverence for him. All the biographic portraits, of which I am aware, are written in hagiographic style, that is, as if Marconi qualifies for sainthood. Their data are comprised of interviews and sketchy diaries obtained from colleagues, Marconi's speeches and interviews, and secondary sources such as company documents and correspondence. Accounts and details of Marconi's numerous experiments are virtually nonexistent. What is known about his formative years is largely hearsay. Emilo Segre, a 1959 Nobel Laureate in physics, stated recently that "Marconi was interested in Patent Applications, not scientific papers, and

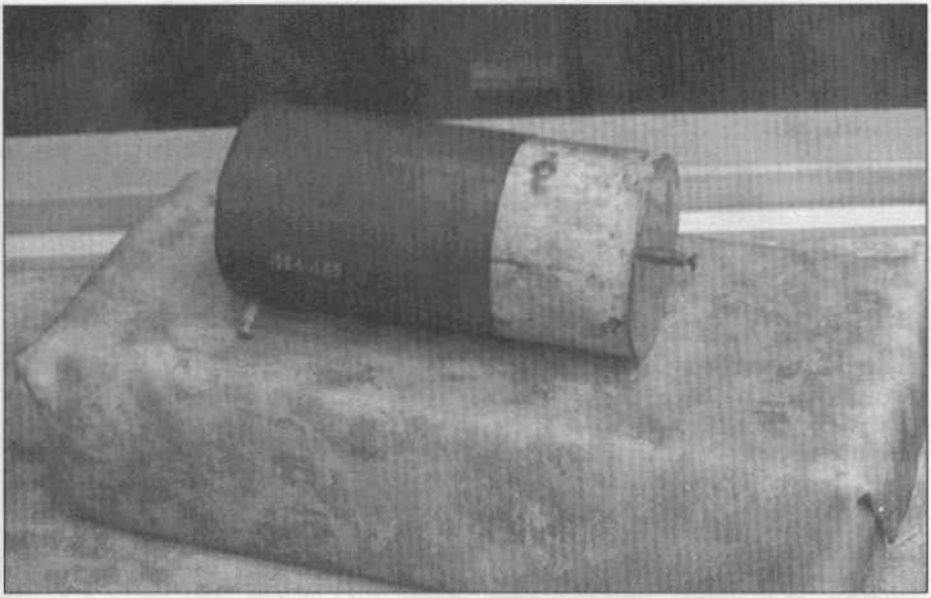

Figure 14. Billy Coil

for this reason he was rather secretive about his procedures, a habit that has presented additional difficulties for anyone trying to reconstruct his way of methodology" (from Masini, 1995, p. 10).

Fortunately, as Marconi's fame spread, especially subsequent to the late 1890s, he realized that both he and his achievements would someday be of significant historical value, so he surrounded himself with photographers wherever he went. Facts and events associated with Marconi tend to be embellished and biased toward keeping a halo hovering brightly over his image, but the voluminous photographs furnish an antidote to the intrusive fiction.

After idolization is peeled away from depictions of Marconi's personal and professional life, the substratum exposed still suggests that he exemplifies the characteristics of a highly creative person. On the one hand, his upbringing shaped his native intelligence to reflect an inquisitive, exploratory, visionary mind. His self-training in the applied and technical aspects of physics led him to see solutions to problems whereas others saw dead-ends. Moreover, Marconi's creativity reflects a genius of endeavor; he attacked problems with such prodigious vigor that he was always a step ahead of his competitors; no issue seemed insurmountable to him and fear of failure seemed not in his constitution.

On the other hand, truly creative persons are those who find ways to express themselves in ways that will have profound impact upon society. Marconi's professional career spanned 43 years, from 1894 to 1937. The transatlantic event in 1901 represented for the twenty-seven year-old incremental progression only seven years into a fast-paced, professional life that produced a Nobel Prize in 1909, and a Company that rose during his lifetime to dominate worldwide marketing in maritime electronics. Marconi was extraordinarily successful in focusing his genius zealously in a

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The Dennison Twinplex

a modern Twinplex with built-in power supply

by Bob Dennison, W2HBE
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The Twinplex is a famous one-tube receiver which first appeared in *Short Wave Craft* magazine in 1933. It aroused a great deal of interest amongst the readers of that magazine. Here was a set that employed only a single tube but gave the performance expected of a two-tube set. That set employed a type '53 tube 'which contained two triodes in a 7-pin glass envelope. The '53 was designed to give 10 watts output when used as a class-B power amplifier. A half-year later, another article in SWC described a Twinplex using a '19 tube. The '19 was also designed to be a class-B power amplifier but this tube was aimed at the farm battery radio. The power level here was only 2 watts. Suddenly, the popularity of the Twinplex exploded.

In the November 1934 *QST*, W6KFE described a cigar-box set using a '19 tube. He mentioned that the set worked better than several other '19 sets he had previously seen described elsewhere. Later, in *QST* for August 1936, this same author wrote in to say that several people had shown interest in his set and that he had now modified it to use a '53 tube. He used a 45 volt B battery and gave coil data for four ham bands. That same issue of *QST* introduced the 6E6 tube—a 7-pin twin-triode designed for class A amplifiers. I don't know if anyone built a Twinplex using this tube, but it probably would have been better than either the '19 or '53.

The June 1937 *QST* ran an article on a battery operated portable station in which the receiver used a '19 tube — probably inspired by the Twinplex.

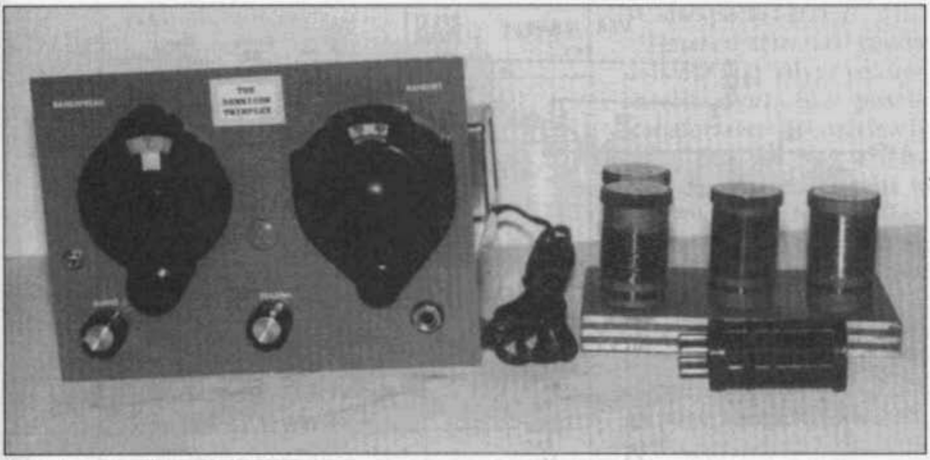
The Frank Jones Radio Handbook for 1937 describes a simple receiver using one '19 tube. This set featured an "Airplane" dial and had an audio transformer between the detector and the amplifier. Jones did not call it a Twinplex but it surely was.

The 1942 ARRL handbook shows a 1-tube set using a 6C8-G tube complete with AFT and designed to operate using a 45 volt B-battery. They did not call it a Twinplex. The 6C8-G has a mu of 36 so it was obviously copied from its Twinplex progenitors.

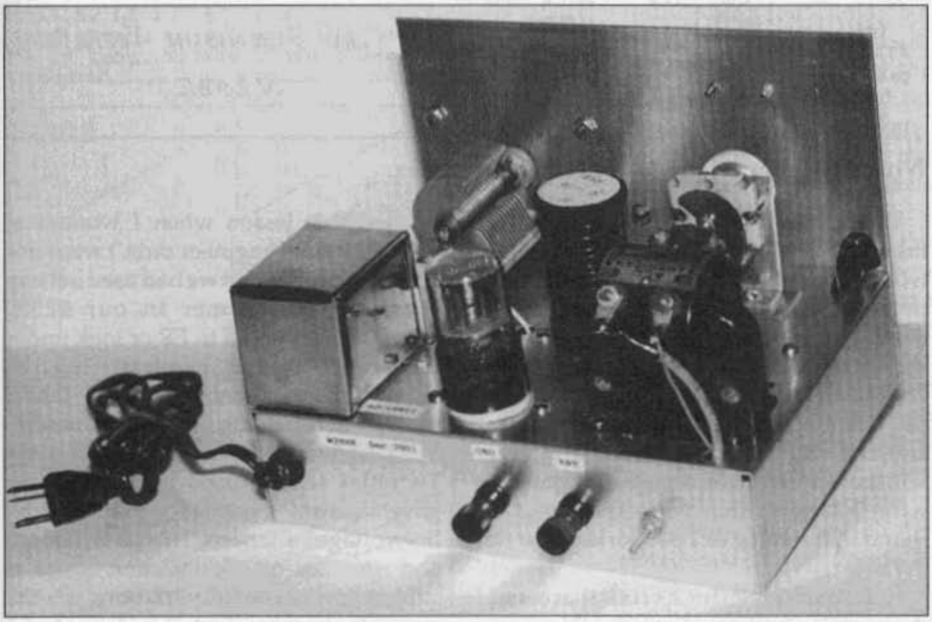
Electric Radio authors WA6VVL and NR5Q both have built the '19 Twinplex and endorse it. In ER #70 (Feb. 1995) I described my version of the Twinplex which I called the Simplex. It used a 1G6-GT tube which is a twin-triode designed primarily for class-B use but it has a much lower power level making it a more suitable choice. The RC-14 RCA tube manual even gives data for class-A operation.

In 1998, Lindsay Publications, Inc. offered a booklet entitled "How To Build the Twinplex Regenerative Receiver." They included the 1934 version using the '19 tube and a more modern version using the 6SL7 tube. The latter set used a separate AC power supply.

Last year, I discovered the 12AH7-GT tube and realized that it would be a very good choice for a Twinplex set. With a 1:3 AFT it would have the same voltage gain as a 6SL7 but could deliver considerably more power to the headphones. The 12AH7-GT was developed in 1941 at the start of WW II. New "old stock" tubes are available for just $3. I ordered two tubes and started searching for components.



Frontview of the Twinplex



Top-rear view of the Twinplex

Final wiring is shown in the schematic. It didn't start that way. At first, regeneration was controlled by a 100 pF variable capacitor at pin 3 of L2. But this set just would not behave. Weeks went by and various circuits were tried. Eventually, one strange clue led to solving the problem. Some of the coils were very difficult to insert and some worked only after considerable manipulation. I wondered—could it be the 4-prong coil socket? After all, it was a Millen isolantite socket—well known to be the ultimate. And there were so many heavy leads soldered onto that socket—it sure wouldn't be fun changing it. Eventually, in desperation, I changed the socket to one made by Amphenol—a plain amber colored plastic job. That cured the problem!

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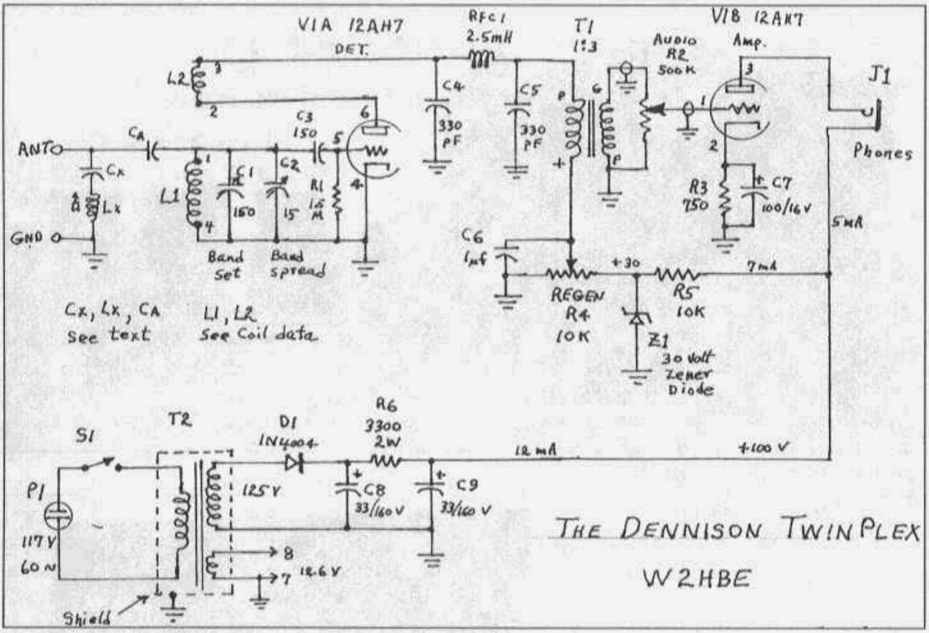


Wiring diagram of the AC operated Twinplex.

Then came a series of nuisance items that had to be solved. Often, fixing one would undo the solution to the previous problem. I had to add a wave-trap to eliminate interference from a local BC station on 1020 kHz. I used a North Hills 200-500 uH coil at Lx and made Cx = 68 pF. Then C_A required much study. Your antenna will differ from mine and you will have different BC stations to contend with. I suggest that you experiment. I found that a value of 2 pF worked best in my set.

Coil data is given for six coils that cover the range from 460 kHz to 30 MHz. You may have to adjust the number of tickler turns so that the detector just starts to oscillate when the detector plate voltage is about 22 volts. The coils for the two highest frequency bands were wound on ribbed forms.

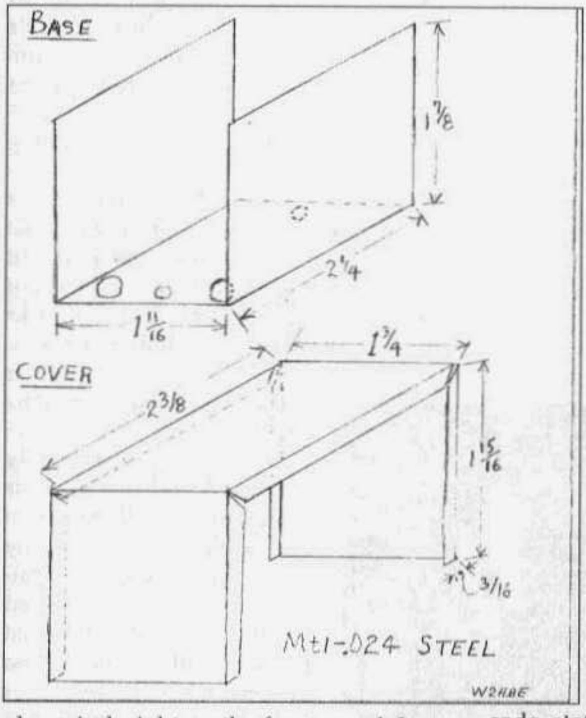
A friend (W2PUA) gave me a vintage audio transformer. If you must use a modern transformer, just be sure it doesn't have a big yellow label on it showing the manufacturer's name. Peel this off. I learned this lesson when I worked at RCA. My chief engineer didn't want our customers to see that we had used a cheap brand-X transformer in our $2500 amplifier. Try an ad in ER or look under the tables at the next hamfest.

Did I hear someone ask "Is that a modern zener diode in a Twinplex set?" Yes, Charlie, it is. Back in the old days, the Twinplex sets all used batteries. These gave a constant voltage—unaffected by line voltage variations. This set is modern and operates off the AC line which is subject to occasional variations. So the zener diode is justified. It is cheap and a worthwhile investment.

And I heard someone say—"Hey, W2HBE never puts B+ on the headphones!" Well, in my first layout I had a 5H choke in the plate circuit and a .47 uF capacitor and a 220 K resistor—just like in most of my previous sets. Then I decided that a Twinplex should be as simple as possible. So I took the choke out. The holes in the chassis show where it was. Now I have +100 volts on the

COIL	L1	L2	FREQ. range MHz
1, Brn	165 turns No. 30E	14 turns No. 30E	.47 – 1.0
2, Red	90 turns No. 28E	9.25 turns No. 28E	1.0 – 2.2
3, Orn	41.2 turns No. 22E	6.25 turns No. 26E	1.86 – 4.0
4, Yel	20.2 turns No. 22E	3.25 turns No. 26E	3.75 – 8.5
5, Grn	10.2 turns No. 22E	4.1 turns No. 24E	8 – 16
6, Blu	4 turns No. 22E	3.1 turns No. 24E	15 – 30

All coils wound on 1¼" dia coil forms. Forms for 5 & 6 are ribbed-others are smooth. On coil 5, L1 is 1½" long, on others L1 is 1¼" long except coil 1 which is bank-wound and is 1" long. Ticklers are close-wound 1/8" below L1.



phone jack right on the front panel. Just don't use the old style Weston phone plug with its exposed terminals. A modern phone plug will protect you. I have a pacemaker and don't relish getting an unexpected shock.

I guess that by now you've noticed that silver-colored shield over the power transformer. As originally built, this set had a hum problem. Many attempts to eliminate the hum failed. Something had to be done. I tried pieces of iron but nothing helped. I know that some of you will yell "bloody murder" when I tell you how I finally killed the hum. Look on page 34 of ER, May 2000. In that set (which I called the MM-1) there was a high-inductance plate choke in a handsome nickle-plated case. I decided to sacrifice the choke and use its shield. I cut off both mounting ears and then drilled holes for the transformer mounting screws and leads. That shield did a perfect job of eliminating the hum. If you want to make a similar shield, I've included a sketch to help you design your shield.

If you've read any of the above mentioned articles on Twinplex receivers that others have built, you know that they all claim fantastic results. I can assure you they do not exaggerate. If you decide to build a Twinplex, you will not be disappointed. It will reward you with many happy hours as you listen to both domestic and foreign short wave broadcasts, amateur radio stations, various religious broadcasts, hi-speed code stations, time signals, the WWV frequency standards and many mysterious signals that defy description. Have fun and be sure to tell Electric Radio about it. **ER**

The 19 Twinplex Revisited

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Tustin CA 92780
dave_ishmael@qscaudio.com

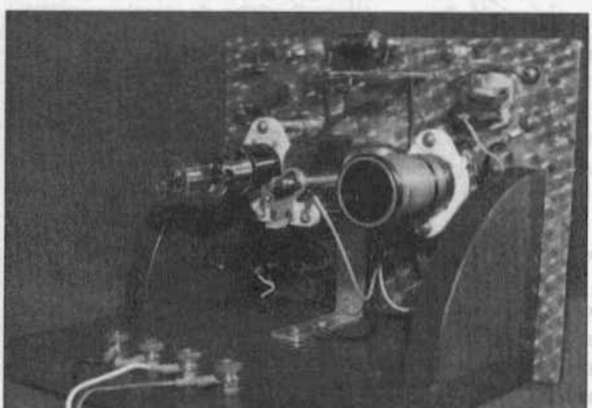
The original "19 Twinplex" was described by J.A. Worcester, Jr., in his Mar.'34 *Short Wave Craft* article "The "19" TWINPLEX Makes 1-Tube Perform as 2". There was nothing remarkable about the construction. It was built on a U-shaped aluminum chassis and used an aluminum front panel. Other than the fact that it did use the new 19 dual-triode, the construction and circuitry were typical of the construction articles found in *Short Wave Craft* every month.

The 19 Twinplex got the attention of N.H. Lessem, Chief Radio Engineer, Radio Trading Co. He built the original and it cost him "$15.00 and some odd cents for the component parts." He then decided that the 19 Twinplex "could be constructed at a price more compatible with "deflated" pocketbooks". The results of his cost-cutting efforts was described in his Jun.'34 *Short Wave Craft* article The "Unimount-Twinplex", built for $4.95 and using but 10 inches of hook-up wire.

The Radio Trading Co. ad for the 19 Twinplex also appeared in the Jun.'34 issue of Short Wave Craft on pg. 112. The $4.94 price included all the parts, two coils, a single headphone, but no 19 tube. For an additional $3.95, you could buy the complete accessories for the Twinplex which included one type 19 tube, two No. 6 dry cells, and two 45 VDC "B" batteries. Additional plug-in coils were $0.45/ea.

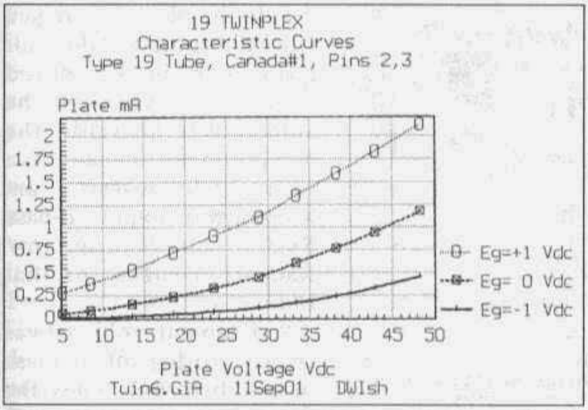
Although the first Radio Trading Co. ad for the "Unimount-Twinplex" appeared in Jun.'34, it was "missing" in Radio Trading Co.'s 1935 Radio and Short Wave Treatise Catalog No. 28, (although the "53" Twinplex was still being advertised). It is the N.H. Lessum "Unimount-Twinplex" that adorns so many Lindsay Publication front and rear covers. Bruce Vaughn, NR5Q, built his version of the Unimount-Twinplex using Lindsay's book, and Bruce's Twinplex captured my imagination when he e-mailed me the photos of his Twinplex.

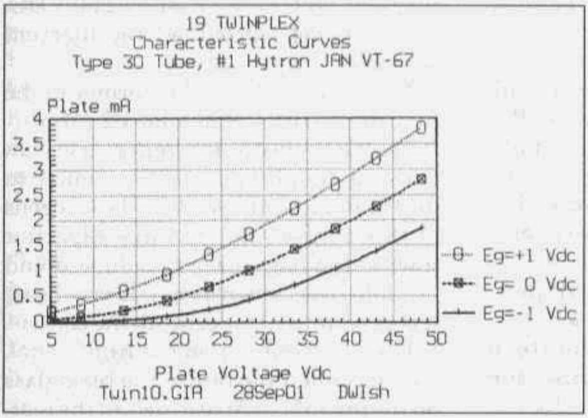
In my previous article, after building my Twinplex, I was extremely impressed by the Twinplex's performance. To repeat, I was just dazzled that a 1-tube radio could perform this well. The performance of the Twinplex just "knocked my socks off"!!! The word "incredulous" came to mind. The fact that I was "just dazzled" by the performance of the Twinplex was primarily because I had my ten year old plexiglass Doerle regen for comparison, and my plexiglass regen's performance was anemic compared to that of the Twinplex. Just plain and simple—no contest.



Top-rear view of the author's Twinplex

To many, this amount of praise seemed undeserved, and I received a few e-mails aimed in that direction. After all, there were so many similarities





between the two regens that their performance had to be pretty similar:

* front-ends were similar.
* the same battery pack was used for both.
* the same coil set was used for both.
* both used a 2-tube design: the plexiglass used two type 30's while the Twinplex used a type 19 dual-triode.

What I decided to do was to determine why the Twinplex was such a "hot" performer compared to the plexiglass Doerle regen that I had built ten years before. Using eBay and several other sources, I acquired a quantity of eight type 19 tubes (sixteen triode sections, six different manufacturers) and a quantity of twelve type 30 tubes (seven different manufactures). I tested each one on my TV-7D/U tube tester, and ran the DC plate characteristics of each tube from 0- 50 VDC at 0 VDC grid voltage. I used a Heathkit IP-20 regulated power supply that has the ability to increase the voltage in 5 VDC switched-steps. This provided some consistency from tube-to-tube and made the runs much quicker. I also ran several 19's and 30's from 0-50 VDC at -1.0, 0, and +1.0 VDC grid voltages so that I could graph their plate characteristics. I then tested each tube in place for relative detector and audio gains. Because my Twinplex had hard-wired the sections for either detector or audio amp, I did not rewire the Twinplex so that all sixteen available sections could be tested as a detector (or audio amp).

Here are some of the observations I made during the month of running the tests on the 19 Twinplex and the plexiglass regens:

1. The 19 tube has a calculated mu (μ) of 20.2 while the 30 tube is 9.1. The mu is the amplification factor for the tube. The calculated mutual conductance is 575 μmhos and 875 μmhos respectively.

2. As a detector in the Twinplex, the range of measured detector gains using the 19 tube was 2.6:1. What was interesting about measuring detector gains, is that I got to experience the differences in detector performance using eight different type 19 tubes. The regeneration point was different for each tube as was the regeneration characteristics, the way it "felt". I was very surprised about how variable the regen characteristics were from tube-to-tube. The maximum detector gain was tough to measure because it required the back 'n forth fine-adjust-

continued next page

Ad for 19 Twinplex from Jun.'34 *Short Wave Craft.*

ment of the main tuning vernier and the regeneration control. I used an oscilloscope to measure the P-P signals and it was interesting watching the regen characteristics vs tube. I used a Heathkit IG-102 RF signal generator at 1 MHz as a signal source.

3. As an audio amp in the Twinplex, the range of audio gain was 1.3:1.

4. A "figure of merit" for each 19 tube was arrived at by multiplying the relative detector gain of sect. 1 by the audio gain of sect. 2. The range in the calculated "figure of merit" was 2.9:1. A used engraved-base Ken-Rad was selected as the best performing 19 tube. This three-to-one difference between the eight tubes can be measured, and more importantly, you can hear the difference in the headphones.

5. There's very little correlation between the TV-7D/U readings and detector gain. However, TV-7D/U readings and the measured DC and AC gains had the highest correlation.

6. As a detector in the plexiglass regen, the range of detector gains for the type 30 tube was 1.68:1. The same differences in detector performance and regen characteristics noted in the Twinplex were true in the plexiglass.

7. As an audio amp in the plexiglass, the range of audio gain was 1.22:1.

8. In the plexiglass regen, since the audio and detector gains can be measured separately, tubes can be selected to provide the maximum overall gain. As a result of these tests, I am keeping three engraved-base RCA Cunningham/ Radiotron tubes for that radio.

9. Filament voltage was critical during all of these tests so before each test, the filament voltage was set to 2.00 VDC. Two "D" cells provided the filament supply.

10. The interstage transformer in the plexiglass had a measured 1:2 ratio.

11. The plexiglass regen uses an antenna coupling capacitor similar to the Hammarlund Type EC. Many regens of this period mounted this capacitor toward the rear of the breadboard and in some cases when a chassis was used, it was mounted underneath the chassis. Few were mounted on the front panel. So, I mounted the one in the plexiglass on the breadboard base toward the rear. In discussing this with Bruce, NR5Q, via e-mail, I decided to use a front panel mounted antenna coupling capacitor on the Twinplex. When peaking the broadcast band coil in the Twinplex, I estimated that the antenna cap was near 30-40 uuF. I looked at the antenna coupling cap in the plexiglass and it didn't look like it could max out at 30-40 uuF. I set the plexiglass up again and discovered that it wasn't quite peaked, and that I had to torque it a bit more (it's a compression-type cap) to get it peaked. I went back to the Twinplex and went through all six of the coils and quickly discovered that one-setting of the antenna coupling cap wasn't even close. I needed to adjust the antenna coupling for each coil. In fact, as I went up in frequency, the value of the antenna cap decreased. The one thing I learned in

building the Twinplex and comparing it to the plexiglass is that all my future regens will have a front panel-mounted antenna coupling cap and that it will probably have a knob.

12. The one thing that made it easier to compare apples-to-apples was the use of the same coil set. I just didn't want to add another variable. However, if you want to roll your own coils, Jim Fred, Antique Radio Laboratories in Cutler, IN makes some very nice generic 4-, 5-, and 6-pin plug-in coil forms. They are made from grade XX phenolic, are tan in color, and about $6/ea., plus shipping. If you own a Knight Kit Ocean Hopper and coil set, these coils can also be used for the Twinplex. As a point of interest, Bruce, NR5Q, wound his own coil and optimized it for 20-30-and 40 meters.

So, after all this testing, graphing, etc., why WAS the Twinplex so much "louder", more impressive, than the plexiglass?? The simplest answer is "it's the tubes stupid". The type 19 tube that initially went into the Twinplex was a NIB from Antique Electronic Supply and made in Canada. Its "figure of merit" was the 2nd highest measured, just under that of the Ken-Rad that I eventually selected. On the other hand, the Hytron type VT-67 30's were also NIB from Antique Electronic Supply (ten years ago) and were among the lowest gain of the twelve tested ("duds" from a performance perspective). In addition, the antenna coupling cap in the plexiglass was not quite peaked for an additional loss of gain. Even though the 19 tube's gain is twice as high as the 30, the plexiglass uses a 1:2 interstage transformer which pretty well offsets the 19's increased gain. Now that the tubes have been selected for optimum performance, both radios work pretty much the same. I suspect that if I had built 62 regens like Bruce, NR5Q, has, I wouldn't have been "jumping up and down" over the performance of the Twinplex. Then again, if I hadn't, I wouldn't have spent a month trying to figure out why. Bruce's comment about his Twinplex probably says it all: "Twinplex...it works—after a fashion. Nothing to compare with my other radios. Perhaps it is working as it should."

There's one thing to keep in mind concerning these results—both these (simple) regens use one stage of audio amplification to drive the headphones. Not only is the sensitivity of the headphones critical, but so is the overall gain of the radio. Neither regen has multiple audio stages and an audio gain control to compensate for differences in detector and/or audio gains—what you hear is what you get. I can't emphasize enough having a sensitive pair of "cans" to use with these regens, and my Baldwin Type "C" fill the bill pretty well when used with the Twinplex.

One more item needs to be addressed, and that is the performance of the Twinplex in the amateur bands. It was the most asked question in the e-mails and letters from the original article. I spent quite a bit of time in the listening mode in the 80/40/20M bands, and while the Twinplex did OK, the tuning rate using the 200 uuF (or even 140 uuF) main-tuning cap is just way too fast, even with that 4" National N vernier dial. If you are anticipating building one of these for amateur service, you need to incorporate a bandspread system. Or, if you just want to use a smaller value of plate tuning capacitor, you will surely need to wind your own coils optimized for your band(s) of choice and the value of tuning capacitor that is selected. There have been many articles written for "bandspreading" these regens:

1. J.A. Worcester, Jr., the author of the original Twinplex, followed that article with "The CONSTANT Band-Spread TWINPLEX" in the July '34 *Short wave Craft*. For those of you that have been

continued on page 29

Carl Yaffey,K8NU in his hamshack surrounded by some great looking vintage gear.

Marv Pratt, KAØSKK, with hisB&W 5100 transmitter and SX-101 receiver. ***Photo by Orlin Jenkins, KØOJ.***

VINTAGE NETS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Collins Collector Association Monthly AM Night: The first Wed. of each month on 3880 kHz starting at 2000 CST (0200 UTC). All AM stations are welcome.

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 4PM Eastern time hosted by John, KB9AT; Gary, KG4D; Jeff, WA8SAJ and Evan, K8SQG.

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.

<u>**Wireless Set No. 19 Net:** Meets the second Sunday of every month on 7.270 +/- 25 kHz at 1800Z (3760 +/- 25 kHz alternate). Net control is Dave, VA3ORP.</u>

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

Mighty Multi-Elmac 75 meter AM net: Every Tues eve at 8 PM EST. NCS is Mike, N8ECR

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

The Big Rig Project, an 813 Transmitter

(details of all the decks)

by Tom Marcellino, W3BYM
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Rockville, MD 20853
W3BYM@arrl.net

Part Two

High voltage supply

Layout of the large power supply components utilized all the space in the lower section. Besides being large these parts are heavy. In fact too heavy for the thin steel bottom so a 3/4" thick piece of plywood was installed to add support and give high voltage isolation. Isolation is important when dealing with aged transformers and chokes. With unknown conditions of the internal insulation, it's always a good idea to float these parts.

The front panel contains the Variac, high voltage ON light, primary voltage contactor (behind the panel) and the primary tap switch. Although it appears that the Variac is panel mounted it actually is resting on the plywood because of its weight.

The circuit for the supply is nothing spectacular being very straight forward. Two diode stacks were used rated for 1 amp at 14 KV PRV each. These were mounted to a small piece of insulated board with right angle brackets to the plywood. The transformer and choke are mounted to the plywood using short lag screws. Another piece of insulated board was fashioned to rest on the inverted choke and mounted to its end flange. The large 30 uF filter capacitor was then mounted to this board using automotive hose clamps. The types of wire used were discussed in Part 1. It is very important to make very good connections. Remember to use adequately insulated wire for the primary and secondary areas in the supply.

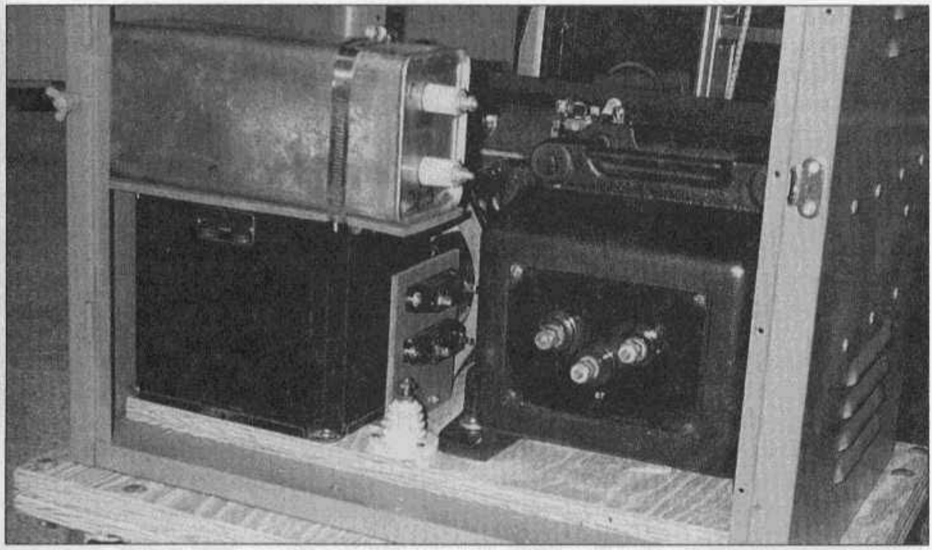
Another safety measure used was wiring the filter choke in the center tap lead of the high voltage transformer. This is a very common practice placing a low potential on the choke but my research revealed no reference for this practice. The large filter capacitor is shown on the HV schematic but it physically resides on the control deck chassis. The input voltage to the HV transformer is controlled by a 15A Variac which is fed from a DPDT 25A contactor. The coil for the contactor is controlled by the exciter antenna relay voltage. When this contactor closes, HV is applied to the PA and modulator decks. The speech amp deck is powered up all the time.

Control deck

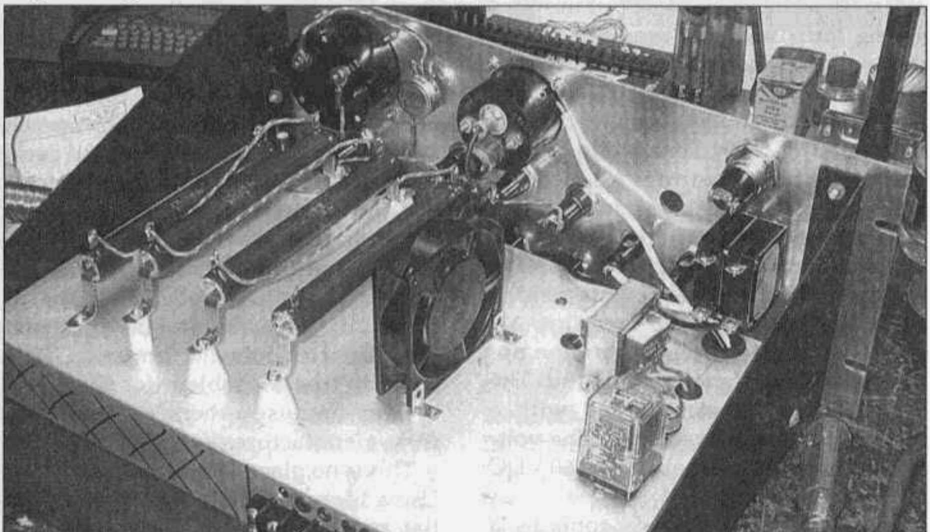
The control deck serves several important functions. It contains all the fuses to protect the different decks. All the switching for power control with associated indicator lamps plus a spare switch and lamp for expansion. The large HV bleeders are mounted on this chassis. The primary AC line voltage and HV DC meters are on this panel. The system warm-up time delay circuits and bypass switching are in this deck.

The entire rig is fused with two 15A slow blows. This is fed with a 120 VAC 20A service that has a breaker in the house panel of 20A. The only reason this rig was built with the 120 VAC input was the fact that the HV transformer required this voltage.

After the two 15A fuses there is a large 25A DPST panel mounted circuit breaker with a toggle switch. I chose



High voltage installation



Control deck and bleeder resistors

this type of switch not for its circuit breaker feature but for its ruggedness because it will be used the most. The power to the entire rig is controlled with this one switch—a desirable feature.

From the output of this breaker, the sub-circuits are further fused at lower amperage. A separate AC power strip is mounted in the PA cabinet and fused and controlled (switched) on the control deck. All the electronics on the control deck are separately fused including the time delay, bleeder fan, and lamp

continued next page

transformer. Notice the diode in the secondary of the lamp transformer. This lowers the voltage to all lamps on this deck thereby providing a very long life. The fan for the bleeders wasn't absolutely needed. This fan has two primaries: 220 VAC and 110 VAC. The purpose here was to move a little air across the hot bleeders so its 220 VAC primary was used.

Selection of the bleeders was calculated to be about 10% of the average load pulled from the HV power supply. Therefore using 2000 VDC and an average load current of 500 mA, the bleeder current would be 50 mA. The bleeder resistance then would be 40K ohms. The bleeder power dissipation would be 100 watts. I was able to find four resistors rated at 10K ohms and 100 watt each. These were put in series giving four times the required power dissipation. Like I said the fan wasn't needed but to stir up the air a bit.

It was also good to mount the HV meter on this deck close to the bottom end of the bleeder string. All bleeders were mounted on ceramic standoff insulators except the bottom one. It used metal mounting brackets because the voltage is low. A 1.5K, 5 watt resistor servers as the HV detector resistor. A 1 mA meter with a series calibration pot provided the HV metering circuit. The cal. pot was panel mounted with a locking nut for convenience. The voltage is relatively low being only 60 VDC at the 1.5K tie point.

The rear of the chassis contains a single large barrier strip with dual screw terminals for all power connections. The main AC power feed terminates into a twist lock female cable connector and plugs into a recessed chassis mounted mating socket. The HV from the power supply was fed from the positive cap terminal directly to the bleeder stack.

Operation of both these units has been absolutely trouble free. The Variac is very handy for tune-up operations. Setting it to 70% with the primary tap in the 2500 VAC position gives 2000 VDC for the PA and modulator decks under load. By turning the Variac down to about 40%, the DC voltage is then 1400 volts and used for tuning the rig. Under actually operation with modulation peaks the HV does drop a bit from 50 to 100 volts. The AC line voltage also flickers on hard modulation peaks. Admittedly the HV supply isn't rock hard but comparable with others I'm told.

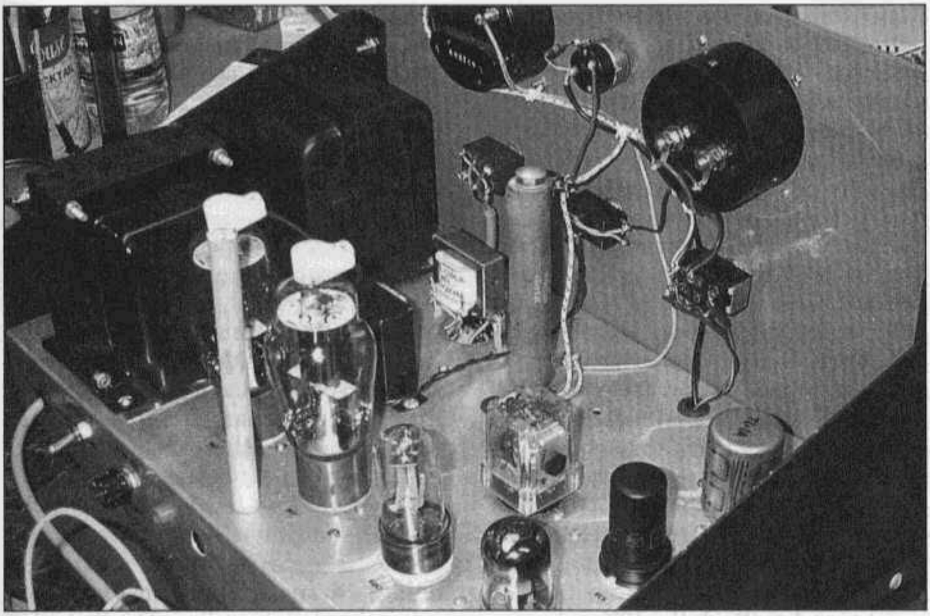
Speech Amp - Driver

The speech amp-driver was built into the deck that resides in the bottom of the PA cabinet and the modulator deck was put into the HV cabinet. There were many reasons for this decision the main one being the size and weight of the mod deck. It worked best in the stacked cabinet on top of the HV cabinet. This gave the maximum support for the weight. This also meant long cables were needed from the output of the speech amp-driver connecting to the mod deck.

The audio system was designed for 600 ohm input. This was done to make it compatible with commercially available audio equipment. The mic-to-grid transformer, model TL-1A, was from an Altec mixer and its exact specifications are unknown. This shouldn't be a problem for the home brewer because others are available from manufactures such as UTC.

This is no place to cut corners on cost. Use a high quality transformer with a flat response over a wide frequency range. Typical impedances will range from 600 ohms to 50K to 100K ohms for the grid. The use of shielded wire is mandatory. I like to use miniature coax like RG-174.

Octals were chosen for the tube line up over 7 & 9 pin miniatures purely for the reason that I hadn't built anything in a number of years using this style of tube. The 6SL7 dual triode is comparable to a 12AX7 and the 6SN7 dual triode is



Speech amp/driver

comparable to a 12BH7. 807s were selected for the push-pull cathode follower over say a pair of 6L6s for no other reason except that I think the tube with the plate caps look nifty. The five pin sockets were the issue here. They were difficult to find and mine were swapped for a few high voltage transistors with Dee, W4PNT.

The use of a cathode follower isn't new as a driver for Class B modulators. As a matter of fact they have seen much service in Hi-Fi audio applications over the years. I first saw it in the 1959 15th Edition of the *Radio Handbook*, published by Editors and Engineers, Ltd. What's unique about this driver circuit is the use of a common audio output transformer. I just happen to have a 10 watter with a 10K ohm CT primary and an 8 ohm secondary. These values aren't critical. A 12 watter with 8K to 15K CT primary and 16 ohm secondary will work just as well. The primary of the transformer is connected between the two 807 cathodes and it doesn't pass any audio. That's an important point to remember. It does however serve three functions. It provides a path for the cathode returns of the 807s. It provides a path for the grid return for the 813s and it serves as a audio choke keeping the audio above ground at the driver cathodes.

The 8 ohm secondary serves well at the feedback winding though a dropping resistor to the speech amp cathode resistor. In my case variable feedback control was installed and also the ability to disconnect the feedback. These were satisfied with the 10K feedback pot and shaft series switch. A value between 5 and 10K will optimize the system.

All components associated with each tube should go to a single point ground system. In my case I used a piece of #12 solid copper wire formed into a large "L" shape coming close to each tube socket and mounted on insulated standoffs every few inches. After attaching all components needing a ground to this wire, including the shield braids to and from various parts, the

continued next page

heavy wire is then grounded to a single point—the mic input ground. When a system of this type is used AC chassis currents are not coupled into the amplifying stages.

Since the feedback winding is floating, it must be phased correctly. For negative feedback you want to pass out-of-phase voltage back to the first stage cathode. The following method is suggested. Use a 50K ohm resistor in place of the 10K pot for this temporary test. Pick a side of the winding and ground it to the single point ground wire. Take the other wired connected to the 50K ohm resistor and attach it to the cathode of the first stage. If the output gain measured at the 807 cathode increases, the phase of the winding is incorrect and must be reversed. If the gain decreases, the phase is correct and you can remove the 50K resistor and reattach the 10K pot.

The biasing resistors for the first half of the 6SL7 and the 6SN7 phase inverter are critical to the output symmetry. For test purposes I connected the driver cathodes to a 4K ohm 5 watt resistor—the mod deck was in the rack and not connected. With audio applied to the input a dual channel scope was set to monitor both cathodes. By changing the values of the two biasing resistors, the best output symmetry can be determined. The correct resistor values allow the output waveform the same amplitude and shape both positive and negative to the zero axis.

Various B+ voltage levels were tried on the entire speech amp-driver and on individual tubes. The 350 VDC gave the best results. Higher potentials only stressed the parts more and didn't increase the performance. The final performance measured within 1.5 dB from 70 Hz to 8 kHz. Separate bias adjustments were provided for the 807 drivers to compensate for mismatched tubes. This is easy to set up and works as follows. With the bias controls set to maximum bias, about -90 VDC, reduce the bias to each tube while watching the 807 plate current. Each tube is adjusted for 15 mA of resting current for a total of 30 mA. This also was found not to be critical. Total current values between 20 to 30 mA are acceptable. The thing to remember is to set each to the same current value.

A few comments concerned with good performance and construction techniques need to be mentioned. The innocent power transformer—is it fully inclosed or one of the half shell variety? It should be fully inclosed and mounted on top of the chassis. The other type with an open bottom shell exposed to under the chassis is less desirable and will couple low level voltages to the chassis. Additionally the power transformer should be mounted at right angles to any audio transformers to minimize their coupling. The center tap of the filament transformer should be grounded. The two filament wires should be twisted and routed directly to the heater pins of the various tubes. Do not use the chassis for a filament return and do not route high impedance audio wires next to or bundled with the filaments wires.

The front panel of this deck contains two meters, one for the B+ and one for the total 807 driver current. During operation the B+ meter will flicker about the 350 volt level and the plate current will rise from the 30 mA idle to 60-80 mA depending on voice peaks. The bias adjust controls, mic gain, feedback ON-OFF and level, plus an audio phasing control are on the front panel. I also found it helpful to install two jacks connected to the driver cathodes for monitoring the actual waveforms when the deck was installed into the system. The audio phase switch is useful to compensate for the wiring of different external audio equipment and microphones. There is definitely a difference in audio performance when switching between the two phases. One will generally be better than the other.

The power supply for this deck was constructed around two transformers. The secondary winding of 400-0-400 at 200 mA worked well with the choke input filter. A large bleeder resistor of 7.5K ohms at 100 watts was used to increase the voltage regulation. A reverse connected filament transformer served well as the source of bias voltage. The bias voltage is regulated with a 100 volt zener diode and two 25K ohm pots serve as adjustments for the grids of the 807 drivers.

Input and output connections were again made using a rear mounted screw terminal barrier strip. This made more sense for the input because it provided a shorter path to the external audio gear. During operation with full modulation, RF was creeping into the audio. This was cured using 100 pF bypass capacitors on all input, output and AC input lines.

Modulator Deck

The modulator deck (parts) as described in Part 1 were a real hamfest find. I had fully intended to simply tear the hamfest treasure down and rebuild it. The one problem was determining the specifications for the driver transformer. Many avenues were researched to no avail. This was about the time when it was suggested to use a triode connected pair of 813s for the modulators. Actually this was a smart direction to go because it reduced the part count. A driver transformer was no longer necessary and a bias transformer and circuit wasn't needed either since the 813s would be operated at zero bias. So it was a double win win situation. Reference to the triode connected configuration is in the previously referenced Handbook, page 662.

The modulation transformer used is a Kenyon model 442 rated for 600 watts. Fortunately it is a multi-match and offers numerous primary and secondary connections. Again based on the reference, the primary impedance was set to 18K ohms. That was the maximum available from this transformer. I did try different ratios of primary to secondary ending up with an 8K ohm secondary or 2.25:1. Ratios of 3:1 down to 2:1 were tried and all work fine giving good results.

The filament transformer is 10 VAC rated for 10 Amps. It is important when dealing with power tubes to use a transformer having the correct current rating. If you use a higher current rating, then current inrush issues must be addressed and that may entail more parts and circuitry.

The front panel of the mod deck contains two meters, one for the filament voltage and one for cathode current. I had to cut the "window" for the 813s very large because the original panel was reused. It had a meter located right in the center and a large one inch lamp bezel just below. My preference would have been to cut two smaller windows like you see on the PA deck.

Completion of this deck took some extra time because it was completely finished using the 810s for the modulator tubes then had to be re-configured for the 813s. This change involved a new sub chassis to raise the level of the 813s because the window had already been cut. The window material is a decorative 0.020" thick perforated aluminum sheet available from the local Home store. I chose this over tempered glass because I wanted maximum ventilation to the tube. These tubes don't require a blower or fan of any type. They would probably do well even without the front window.

During operation the cathode idle current is 50 mA with 2000 volts applied to the plates. The plate current will peak into the 200 to 300 mA area with 100% modulation and the filament voltage also flickers which is just the line voltage dropping a bit. The reason for the

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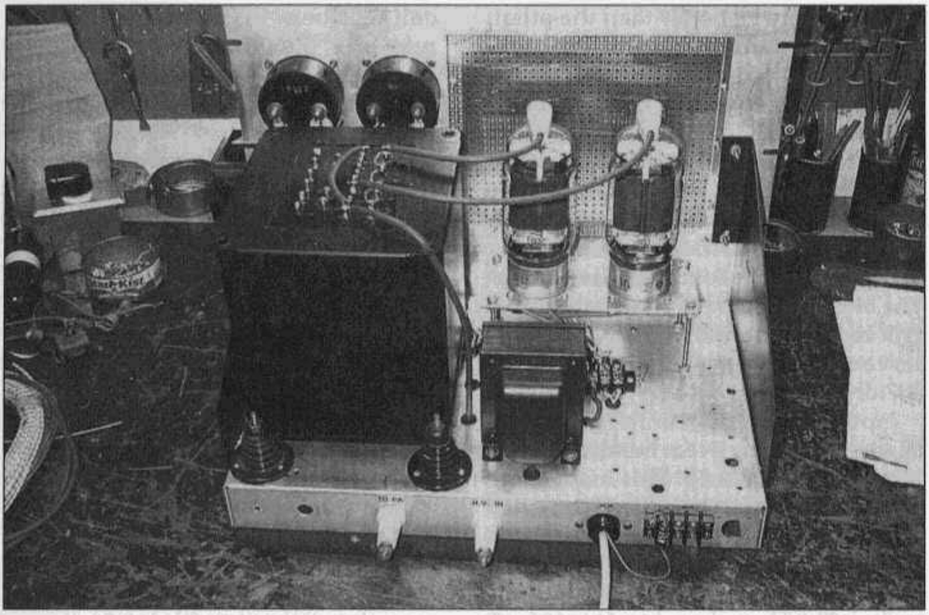

Modulation deck

filament voltage metering is one of having to fill the large hole with something. It was originally intended to read the 810 bias voltage. So having nothing else to measure there were no other options.

PA Deck

The PA for this project uses a pair of parallel connected 813s. This tube was selected because of its great track record over the years and the circuit design would be minimal because it existed in many references. The biggest challenge, as stated in Part 1, was playing chassis chess with the large components. If I had eliminated the front panel windows for this deck as well as the mod deck, the layouts would have been greatly simplified. But having tube viewing windows is a must for all home brewers. Seeing those 10V-10A filament pairs sitting in their sockets producing that warm glow just makes it all worth while.

Part placement in an RF environment is critical and you want to keep the parts as close as possible. This will permit the shortest runs for the connections. Invariably there will be one or two runs that just have to be longer than you want. That happened on this project with the addition of the 160 meter tank coil. The only place left for the coil was on top of the B&W 850 tank. So using some copper plated steel plumbing strap, the connection inductance was minimized. For all other RF connections, heavy solid copper was used for its rigidity.

Much time was expended working up the input tuned circuits. I ended up having the 40 and 75 meter coils one piece of coil stock with a tap for 40. The one for 160 needing higher inductance was wound on a separate form. The input tuning capacitor can be a low voltage unit—a BC cap with narrow spacing would work fine.

The grid bias is developed using the grid leak method. A 6K ohm at 10 watt resistor will give -190 volts when using a grid current of 30 mA. Using the grid leak bias method eliminates another bias transformer and a few parts but doesn't offer any protection for the PA tubes in the event of loss of RF drive. Therefore the 6W6 screen clamp tube was installed. Under normal operation with 30 mA of grid drive this tube is cut off. With no RF drive the tube conducts heavily and pulls the screen down. During this cycle of operation the cathode current meter will read 100 mA and the PA tubes are protected.

Both the grid and plate current metering take place in low voltage circuits while the screen current meter was placed directly in the screen lead of the 813s. By placing the plate current meter in the center tap of the filament transformer, you must keep in mind that in addition to reading the plate current, this meter also reads the grid and screen currents for both tubes. These three meters were mounted on the front panel and banana jacks were installed below these to measure the grid bias and screen voltage.

The screen voltage for the 813s was derived from several high power resistors in series. The actual value of resistance is 43K ohms with 250 watts of dissipation. With 2000 volts on the plates, the screen current will be 40 mA. Higher screen current up to 80 mA for the pair is acceptable.

Selection of the plate tuning and loading capacitors is based on the DC plate voltage used and the fact that it will be plate modulated. The spacing in particular for the tuning capacitor is vastly different if the rig is operating only on CW compared to plate modulated. In this case the plate spacing for the tuning capacitor using 2000 VDC would be 0.1" for CW. This spacing must be increased to 0.25" minimum for plate modulation. The loading capacitor is a much different situation. Since the output of the pi network is a low impedance of 50 ohms, the voltage will be low. A standard small spacing broadcast variable will do fine. I had a 5 gang unit with 400 pF per gang. The break down voltage for this type of capacitor is typically 500-1000 VDC. Both of these tuning capacitors were fitted with panel mounted 6:1 Jackson drives. This isn't absolutely needed but sure gives the tuning a velvet feeling. My drives needed pointers and I made two using clock hands purchased from the local craft store.

Of course they needed a change in color from that dull black, so I repainted them with a bright red.

The B&W 850A is a very nice piece of hardware. Besides having the tank coils it has the built-in band switch which for me was one less part to worry about finding. This tank has coils for operating on 80, 40, 20, 15, and 10 meters. I was only interested in the 80 and 40 features not planning on using this transmitter on the higher bands. The first thing I did was remove the 10 meter coil that was hanging out it the breeze. The wiper of the switch was then modified by rotating the wiper to an open position and an additional B&W contact was installed. Adding the extra coil for 160 completed the modified tank allowing the transmitter to operate on 160-80- and 40 meters. If you do plan on using one of these tank assemblies, remember that the control shaft is RF hot.

I found this out when I used a ceramic coupling with a metal shaft going through the panel. The ceramic coupling arced on modulation peaks. I cured the problem, and should have done it in the beginning, by changing the coupling to another ceramic unit and installing a fiberglass shaft.

The under chassis RF wiring is equally as important as the above chassis RF wiring. For the input connections use #16 plated buss wire making very straight and direct runs. RF bypass capacitors on the filaments are the disc types and mounted right at the sockets. The screen bypass capacitors should be a low inductance type like a large postage stamp mica. These too must be mounted right to the socket pins. The

continued next page

output coupling capacitor should be specially selected. This capacitor should be rated for at least 20 KV and have the ability to carry high current. I used two 0.001 uF connected in parallel.

The tube manuals recommend grounding the metal base of the 813. This was accommodated in a rather nifty way. Two wiper arms from a small DPDT relay along with some solder lugs grounded the base quite well. You may have to shape the arm after soldering to the lug. The lug is screwed to a socket mounting bolt and the object is to give the arm slight tension with a rubbing action when inserting the tube.

RF shielding is another very important issue to deal with. Again the local Home store furnished all the supplies. I used the same perforated aluminum as used for the panel windows. Right angle aluminum pieces were cut to form the frame. All the pieces individually are not very sturdy but when all sections are screwed together a very rugged enclosure is produced. When you get to this step purchase a box of 100, 6/32 x 1/2" sheet metal screws. Place them about 2" apart for best results. For access to the tubes, a rectangular opening was cut above the tubes and another piece of the same material cut one inch larger on all sides was screwed in place. A plus from using the rack cabinets like I did is that the tops are hinged. Therefore changing tubes is a simple matter.

Final tune up is standard once you have the correct grid voltage and drive current. The exciter is a restored Johnson Navigator running a 6146 in the final with low plate voltage. This transmitter was intended as a low power 20 watt CW rig but works well in driver service. Typical drive requirement is 10 watts to produce a 350 watt output resting carrier from the pair of 813s. The final is loaded to 230 mA and adding the grid and screen currents, the cathode meter will read 300 mA. With 2000 volts on the PA plate and 230 mA, the power input is 460 watts. This yields an efficiency of 76% which lies within the normal expected range of 70-80% for Class C operation.

The antenna relay terminals of the Navigator provide 120 VAC in the transmit mode. This voltage energizes the HV contactor which in turn supplies the HV to the modulator and PA deck. The time delay is placed in series in one side of the line between the exciter and HV contactor. The speech amp and driver deck is powered on all the time from the main circuit breaker. Receiver muting is accomplished using the external contacts on a Dow Key antenna relay. This is an extremely basic and trouble free method used to transfer between receiver and transmitter.

The goal for completion of this Big Rig project was to have it operational on January 1, 2002. After 3 and one half months of design and fabrication this goal was met and the new year was brought in with a bang. Yes, a bang. I had prearranged this event with several of the 40 meter AMers and did get to talk about 30 minutes before the sparks started flying from the PA and the control deck main fuse let go.

Besides being very disappointing, debugging a home brew project is part of the process. What had happened was the plate RFC let go. The RFC was a single diameter solenoid wound type. A spare variable diameter National type rated for this power lever was installed. So far that problem has been cured. Evidently I had some serious series resonances occurring. The next exciting event was a failure in a Millen 1000 watt in-line low pass filter. After taking it apart, a large chassis mounted capacitor had arced over putting a direct short on the feed line. I've elaborated on these various events just to point out the areas that could be effected when dealing with high power.

The Big Rig transmitter is now

operational and getting very good signal and audio reports. I have even returned the fire extinguisher to its rack! Yes, the project was a complex and time consuming adventure but worth every hour spent. Now when someone ask "what rig are you using?", I just take on a big grin and tell them to get prepared for an Old Buzzard transmission.

When I come into the shack and hit the circuit breaker, the room fills with the glow of the quad 813s. After the time delay event a buzz is heard as the relay pulls in. Turning the exciter to transmit, the massive HV contactor slams shut then you hear the hum of the big plate iron as you watch all the meters snap to position. Start talking and watch the modulation current peak while watching the rest of the meters wiggle and jiggle.

I hope you enjoyed reading these articles as much as I enjoyed designing, building, operating and writing about the project. The rewards and satisfaction of successfully completing this home brew project will be the topic of many discussions and will last for many years to come. **ER**

Twinplex Revisited from page 17

asking about bandspreading the Twinplex, this article is a must. Send me a #10 SASE and I will send you a copy or e-mail me and I'll send it as a *.jpg files. This version of the Twinplex adds a 1:3 interstage transformer, so headphone volume should be even higher than the original.

2. Bob Dennison, W2HBE's version of the Twinplex in the Feb.'95 ER utilizes a bandspread cap and Bob provides all the coil-winding data.

3. Bruce Vaughan, NR5Q's "Ultimate Regenerative Receiver" in the Feb.'02 ER utilizes a somewhat standard bandspread scheme, a 20 uuF bandspread cap in parallel with a 140 uuF main tuning (bandset) cap. Bruce spends a couple of paragraphs discussing "band spread" tuning.

I want to thank everyone that has taken the time to write or e-mail me about the Twinplex article, and especially those that took the time to send additional Twinplex-related articles. I again want to thank Bruce, NR5Q, for his inspiration and help in making this project possible, and I have long ago lost count of all the Twinplex and regen e-mails that Bruce and I have traded.

My closing comment from the original article is still just as valid today as it was last year: "Building the Twinplex gave me a new respect for regenerative radios and provided me with a new "benchmark" for future projects. In addition, this radio was fun to build. I haven't had this much fun building a project in several years." **ER**

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2. "Unimount-Twinplex", N.H. Lessem, Chief Radio Engineer, Radio Trading Co., Short Wave Craft, Jun.'34, pg. 91.
3. "Duo-Amplidyne - Ideal 1-tube Set for the Beginner", George W. Shuart, W2AMN, Short Wave Craft, Jun.'34, pgs. 74-75. This article appears to be a near-clone of the original Mar.'34 Twinplex article.
4. "The Constant Band-Spread Twinplex", J.A. Worcester, Jr., Short Wave Craft, Jul.'34, pgs. 142-143, 178.
5. "The Simplex Short Wave Radio", Bob Dennison, W2HBE, Electric Radio, Feb.'95, issue #70, pgs. 12-15,37.
6. "A One-Tube Wonder The Twinplex", David W. Ishmael, WA6VVL, Electric Radio, Sep.'01, issue #148, pgs. 12-17,42.
7. "The Ultimate Regenerative Receiver - Part 3, Conclusion", Bruce Vaughan, NR5Q, Electric Radio, Feb.'02, issue #153, pgs. 10-17, 32-34.

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

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Episode 10

Pioneers of Radio

Pioneers of those industries based upon the physical sciences tend to be of a colorful nature. It would appear that freethinking, rugged individuals, often with an eccentric personality are attracted to new, highly advanced technologies. Radio and Television appears to have had more than its share of such people. They run the gamut from A to Z, from E.H. Armstrong to Vladimir Zworykin. Between A and Z you will find dozens of other colorful pioneers such as Powel Crosley, Atwater Kent, McMurdo Silver, Philo Farnsworth, Nikola Tesla, and Lee deForest.

Thanks to the internet we can now read biographies of these famous men any time we desire. Unfortunately, recorded history often seems to omit many small things, things when viewed in retrospect add dimension to the grand picture. With this in mind, I would like to tell you a true story—a story about a day I spent with one radio and TV manufacturing pioneer, Curtis Mathes.

Mr. Mathes, like hundreds of others, helped build and shape the radio and TV industry, yet little has been written about him. My visit occurred about forty years ago, and certain allowances must be made for errors in my memory. To assure accuracy of this story I went to the Curtis Mathes web page and attempted to check out certain details. I'm sorry to say that I found the web page of little help. So here is the story as I remember it...

Christmas Eve, 1965: Ours was a small store in which the entire family participated when the need arose—and it arose like an irritated giant every Christmas Eve. I lived in dread of this day from year to year. This year, 1965, was one to remember. The rush started soon after opening at 7:00 am, and built up to a form of bedlam about mid-afternoon. The entire available crew was onboard for the biggest selling day of the year. Our crew this day consisted of my Dad, my wife Mary, son Mike, floor salesman Neil, all four repairmen, and a deliveryman. This was before the days of discount houses, electronic stores, or any serious competition. If a customer wanted to make pictures of their Christmas festivities, if they wanted anything in the home entertainment business repaired, if they wanted a photographic or electronic gift, there was a very good chance we would see them on Christmas Eve. Forget lunch, forget a cup of coffee or a cold drink, forget going to the bathroom—there simply was no chance to take a break. Past experience told us that around 4:00 pm the big rush would began to taper off, and by 5:00 pm only an occasional customer would be in the store. Streets filled with Christmas shoppers only two hours before would now be all but deserted—an ideal time for a robbery. We always closed up shop promptly at five on Christmas Eve.

Slightly past mid-afternoon I walked to the office in the rear of the store. Mary, my wife and book keeper, was filling out a contract for a customer buying a large Magnavox stereo, to be delivered immediately of course.

"Mary," I said, "I've got to take a ten minute break—I'm near the end of my rope. Cover for me while I grab a cup of coffee at the drive-in next door."

Without looking up from her work she waved me out the door.

Five minutes later Mary came in the door of the drive-in. My coffee, still too hot to drink, was sitting in front of me untouched. "A man from the Curtis Mathes home office is on the phone, he says it's important that he talk to you immediately. I tried to stall him a few minutes, but he insists on speaking to you now—he's holding."

I mumbled my favorite four-letter word, left a quarter on the table for my coffee, and returned to my office.

"Bruce," said the gentleman from Curtis Mathes, "We are having a dealers meeting in Benton, Arkansas December 26, at the Mathes plant. The meeting starts at 8:00 am. Only our best dealers are invited, but let me put it this way, Mr. Mathes says that invited dealers who do not attend, are no longer Curtis Mathes dealers."

"But he can't be serious," I said. "I'd have to travel Christmas Day and miss Christmas with my family."

"That's the way it is," he said. "If you want to continue selling Curtis Mathes electronics and air conditioners, be there. This is a two-day meeting. We plan to tour the Benton plant before noon, and then leave Benton and drive as quickly as possible to Dallas. We are supposed to be at the Dallas facility by 2:00 pm, though I doubt many of us make it that fast. Our meeting in Dallas will be short, we will knock off at 5:00 pm and drive to Athens for the main feature of this dealer conference. The Athens meeting will be long, from 8:00 am until Mr. Mathes finishes his visit with dealers, and he loves to talk. You can return home on the 28th. Drive your own car and bring your own money. The company is not furnishing transportation, food or lodging."

This bit of news came as no surprise-I'd been a C-M dealer too long to expect any perks from the company.

The C-M Company was not noted for lavish entertainment of dealers, however I must admit they fed us a nice luncheon at the plant in Athens.

I did not want to travel alone and there was no way that both Mary and I could or would leave the kids alone on Christmas day. One of my repairman was a fifty-five year old bachelor, he agreed to attend the meeting with me.

We left before noon, about mid-morning on Christmas day. I wanted to arrive in Benton and find lodging before darkness. We checked into a small motel near the C-M plant and left an early call. I suspected that we needed to eat a good breakfast before going to the plant. I knew with such an impossible schedule, lunch if any would be a hamburger while driving.

The most impressive thing about the Benton, Arkansas facility was that they were able to produce attractive radio and TV sets in a plant so utterly unattractive. After four hours at this facility we left in a hurry for the plant in 'Big D.'

I was especially interested in touring the Dallas plant. I knew this plant was manufacturing one of C-M's first solid state TV's.

In 1965 any TV that sold for less than $100.00 did not remain on the dealers floor very long. In September, just in time for the Christmas season, Curtis Mathes brought out a line of portable 12 inch TV's, available in no less than six different colors, with a list price of only $89.95. The bad news was that it cost the dealer $78.00 plus freight. No profit, but a chance to bring a lot of people into the store and a good salesman could often 'sell a customer up.' I placed an order for several and received one or two. The TV seemed to work OK and of course I wanted more. Calls to the factory proved to be a waste of time. Some days I would be told to expect a dozen

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sets in two weeks, sometimes I would be advised that the company was so backlogged with orders that no delivery date could be promised.

We drove above the speed limit all the way to 'Big D,' and found the Mathes facility near the downtown area. Obviously the factory building had been there since long before the 'Roaring Twenties.' I learned a lot at the Dallas plant, and enjoyed the chance to see some of the problems manufacturers went through in their struggle to keep abreast of this rapidly changing art.

Our small group of 10 or 12 dealers entered the Dallas plant through the offices. The plant offices, three or four in number, were like the rest of the plant; crowded, cluttered, and in need of janitorial service. We walked directly through the busy offices and entered a large, cavernous room filled with strange looking equipment. Almost immediately I discovered why my long past due order for C-M 12 inch portable TV's had not been filled.

The entire south wall of this large room looked like a flower garden in bloom. Crude, unfinished shelving, obviously constructed as cheaply and quickly as possible was completely filled with red, blue, yellow, green, white, and black, portable TV sets. I would estimate that at least 150 to 200 sets were in the shelves, practically all operating, and all tuned to the same Dallas station. Here and there could be found a set that had lost sync, was completely dead, or had some strange looking patterns floating across the screen. In a small room shielded with wire mesh, four or five technicians labored over cluttered workbenches, each trying to restore one of the little TV sets to operating condition. Their test equipment was adequate for the intended job I'm sure, but not up to the standards of the average TV service shop. As soon as a repairman finished a job they returned the little TV to the shelves, replacing one of the defective TV's with one they had just finished repairing.

Workers were perfectly willing to discuss various operations and problems within the plant with the group of dealers. We were told that the 12 inch portable was one of the very first TV's Mathes had produced with PC boards and solid state components. It was to have been a TV largely assembled by machines. A number of problems arose immediately. The machine that inserted components into the PC board often malfunctioned. Parts, including the PC boards were broken, leads missed holes, and finally when the board was soldered with one majestic sweep through the soldering machine, a lot of connections were less than perfect. In the end, a technician had to go through many of the sets and hand solder all connections just to be sure the set was ready for shipping. Production was a fraction of what it should have been.

Where many dealers had arrived disappointed and perhaps angry with the C-M Company for not delivering portables for the Christmas trade, we left in sympathy with our supplier. Suddenly our problems seemed small in comparison to those of Mr. Mathes.

There seemed to be no cabinet making facilities at Dallas. I got the impression, though no one at the plant told us, that the Dallas plant was primarily for R and D. Solid state was just beginning to take over the industry and Mathes realized he must keep up with the changes that were imminent. I was quite impressed with some of the equipment in the plant. I remember one machine that reminded me of old fashioned cream separators once found in most farm houses in the early part of the 20th century, only it was much larger and more complicated.

The machine had a large bowl shaped metal hopper on the top. A worker dumped in a box of hundreds of resistors and turned the machine on. The hopper started vibrating as the 1/2 watt resistors danced their way to the outer perimeter of the hopper, lined up in a neat row then dropped through a small opening only to emerge seconds later neatly spaced between two strips of masking tape. When the machine completed its operation the resistors were in a roll ready for installation in another imposing machine that cut and bent the ends of the resistor leads, and inserted the resistors in their proper place on a PC board. The latter machine was not operating correctly.

There were troubles galore with assembly of the new solid state portable. Damaged parts and broken PC boards littered the floor. It was obvious that converting from point to point wiring of vacuum tube circuits to PC boards and solid state components was going to take a lot of work and experience. From all appearances it would also be expensive.

Perhaps the high-point of the day was when we were called into the office and allowed to call home on the new direct dial telephone system. Recently installed, the new equipment was unfamiliar to both visiting dealers and C-M office employees. I remember it took several attempts to make our calls. We did not know about such things as area codes and prefix numbers. However, it was a thrill for all of us to try out this new telephone system.

We completed our meeting at Dallas about 5:30, and got in our cars and headed for Athens, about 100 miles southeast. It was almost 9:00 pm when we were finally settled in a motel room. I thought back over the past three days...There was that killer day on Christmas Eve, followed by a 250 mile trip over a winding two lane road on Christmas Day, then a 6:00 am call on the 26th, a busy half day at Benton, and our breakneck drive to Dallas with not enough time for a quick hamburger, the Dallas meeting, and then another hundred mile drive to Athens. We discussed going out for something to eat but we were both exhausted and too tired to eat. We got a coke and candy bar from the motel dispensing machines, took a quick shower and fell into bed.

I suppose most readers are curious as to why any dealer would value a line of merchandise highly enough to endure such demands as C-M often made upon its dealer organization? The answer is really quite simple. In the early sixties C-M made one of the most saleable products in the industry. Their electronics was about average but their cabinetry—and this is what the customer looks at—was among the best available. For example C-M had a nice maple finish console TV with early American styling that retailed for $189.95. You can get a glimpse of this very same set today by going to the C-M homepage on the Internet. This was about the price you could expect to pay for a competitor's product in a black metal table model cabinet. C-M dealers could knock other dealers dead if a customer was looking for style, workmanship, and price. I maintained two showrooms for electronics. My original building was the C-M product store, while adjoining next door was my Magnavox Home Entertainment Center. Magnavox was not fond of the arrangement, but I told them that if one of the lines had to go it would be theirs; and I valued my Magnavox line very highly.

Next month we will finish this story of our tour of the 'flagship' C-M plant at Athens, a truly beautiful facility, and of our visit with Mr. Mathes, one of the most interesting people I've had the pleasure of knowing. ER

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

Modulation Transformer Protection for AM Transmitters

circuits for the Johnson Valiant, Ranger, Viking 500, Viking II, Collins 32V-3, KW-1, and Heathkit Apache

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How would you like to fully modulate your plate modulated AM transmitter without fear of destroying your modulation transformer? I haven't yet destroyed one, but on the rare occasion a spark would arc the gap in my KW-1 or Viking 500, I cringed.

As anyone who has ever had to replace a modulation transformer knows, they can be difficult to find and costly to replace. Partially shorted modulation transformers can also cause all sorts of difficult-to-diagnose troubleshooting problems. While we are lucky Peter Dahl is there to wind replacements, now there is a simple, inexpensive circuit you can add to any plate-modulated transmitter that will protect your existing modulation transformer. For just a few dollars and twenty minutes of your time, you can add this circuit and begin experiencing the joy of fully modulating without fear.

The circuit in this article is often referred to as a negative modulation limiter, but technically, it isn't a limiter (it's an impedance protector. I've seen several different circuit configurations, but I prefer this one for its simplicity and the absolute level of protection to the transformer it provides (especially when compared to low-level clippers/limiters). There's also nothing in the high voltage path to adjust, making it a mod anyone can tackle. Alas, the circuit uses solid-state diodes, which may offend some purists. You could, of course, implement it with vacuum tubes, but most transmitters don't have the room. Adding a few solid-state devices is also a "no-holes" mod that is easily reversible.

Modulation Transformer Failure

The transformer-destroying event in an AM transmitter occurs when negative modulation peaks exceed one hundred percent. The RF final tube goes into cutoff, removing the load from the modulation transformer (leaving you with the equivalent of an automotive spark coil. And spark and arc it will! When the load is removed from the secondary of a transformer, collapsing magnetic fields induced by transients on the primary of the transformer can produce very high voltages across the unloaded secondary.

Engineers solved this problem in larger transmitters by providing a spark gap across the secondary of the modulation transformer, allowing the high voltages to arc across the gap before dancing destructively around inside the transformer. The crude spark gap provides some protection, but it doesn't always do the job. And few transmitters in the less than 150-watt input class have even this level of protection, hence their vulnerability.

Interestingly, the modulation transformer is most at risk when the transmitter is only lightly loaded. Under these conditions, the modulator is easily able to drive the RF stage past cutoff. But when the RF final is loaded to its rated current, a marginal or weak modulator may not be able to drive the voltage across the modulation transformer sufficiently negative to present a danger.

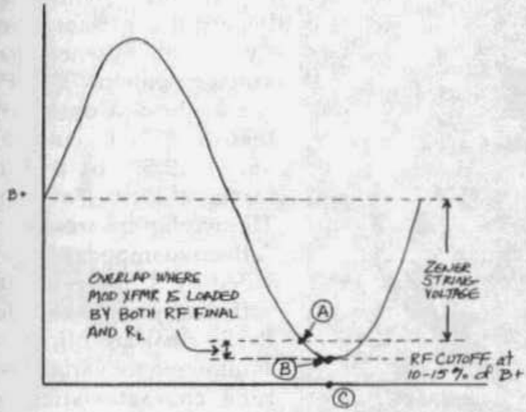

Figure 1. Output of modulation transformer.

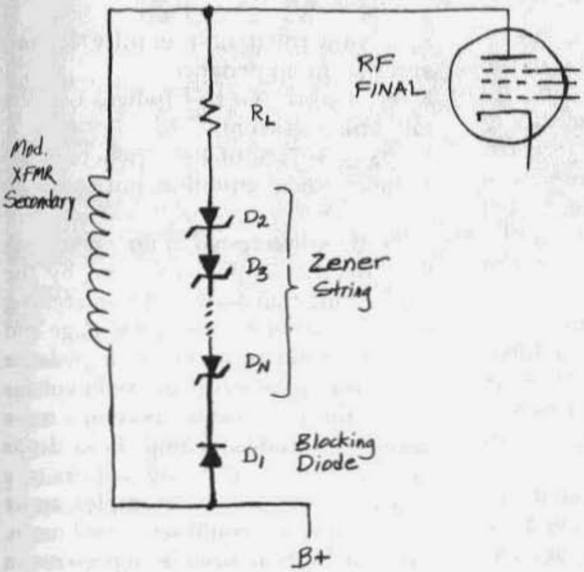

Figure 2. Modulation limiter circuit. The zener voltage is usually set to about 75% of B+. R_L = 33.3% of the modulating impedance.

The circuit described in this article is a solid-state "spark gap" that will keep the modulation transformer loaded at all times, even when the modulator attempts to drive the transmitter beyond 100% modulation. For those not interested in theory, jump to the end of the article where I have presented values to use for popular Johnson, Collins and Heathkit transmitters.

Circuit Overview

For a brief review of a plate-modulated transmitter, take a look at Figure 1, which shows the output of the "high side" of the modulation transformer. The audio modulation adds and subtracts to B+, with voltage peaks reaching nearly twice B+. 100% modulation is reached when the RF stage cuts off, which, for most transmitter designs, occurs when negative audio peaks drive the plate voltage to a low of approximately 10-15% of B+ (for purposes of this article, I will use a figure of 12.5% of B+).

Now take a look at the generalized negative modulation circuit shown in Figure 2, which is composed of R_L, blocking diode D_1, and zener diode string D_2 through D_N. In operation, circuit components are selected so that R_L is placed across the transformer when negative modulation peaks exceed 100%, while above this threshold, R_L remains out of circuit. R_L thus provides a load on the modulation transformer when the RF stage cuts off. With a load always on the secondary, destructively high voltages won't be generated.

To understand the action of the circuit, first consider the positive portion of the audio cycle. Note that during this half of the cycle, the top of the transformer is always positive *relative to B+*. In this case, blocking diode D_1 remains reverse biased keeping R_L out of the circuit.

Now consider the negative half of the

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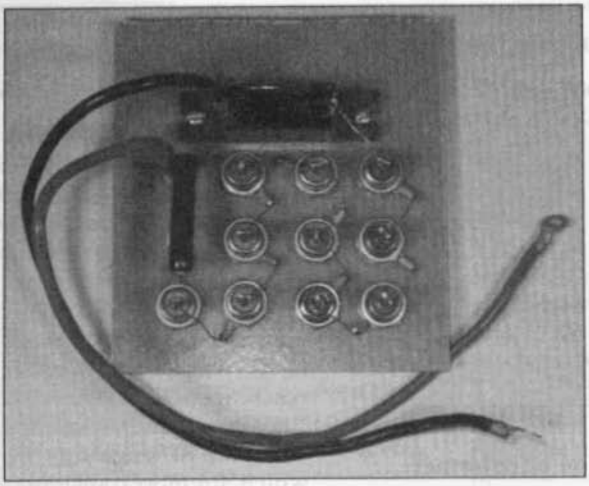

Figure 4. Limiter for KW-1.

audio cycle. During this portion of the audio cycle, the output of the transformer swings negative *relative to B+*. Blocking diode D_1 becomes forward biased, but until the waveform produces a voltage across the transformer that is sufficiently negative so as to exceed the zener string breakdown voltage, the zener diode string remains reverse biased, keeping R_L out of circuit. Once the zener string reaches its breakdown voltage (at point A in Figure1), R_L is placed across the transformer, where it remains until the waveform again rises above point A.

One benefit of the circuit is that it will provide protection regardless of how you load the PA. Even a lightly loaded transmitter will be fully protected.

Design Considerations

The trick is to select the zener string voltage so that they begin conducting well *before* the RF final cuts off, bringing R_L into circuit. Since operating conditions and voltages vary, it is important to design in an "overlap." The overlap is that portion of the negative going waveform during which the transformer is loaded by both R_L and the RF stage (between points "A" and "B" in Figure 1). After experimenting with a number of different transmitters, I've found a zener string voltage of about 75% of B+ works best. Considering that the RF tube cuts off at about 12.5% of B+, this leaves a 12.5% "overlap." The overlap ensures that the "effective impedance" provided by R_L has fallen to a sufficiently low value before the RF final cuts off, as well as allowing for variations in tube characteristics and variations in B+. Here are the equations you'll need:

R_L = one third of the fully loaded modulating impedance

$R_L = (.333)((B+) \div I_P)$ (where I_P is the rated plate current)

$V_{ZenerString}$ = 75% of B+ (where B+ is actual at 0% modulation, not nominal)

For those interested in understanding the effective impedance seen by the modulating transformer, it is interesting to note that the *fixed* zener voltage and *fixed* R_L result in a *varying* impedance versus transformer voltage. As the voltage across the transformer becomes more negative, the effective impedance drops during the period the zeners are conducting. Pick some examples, apply Ohm's Law and you'll see what I mean. At point "A" in figure 1, R_L represents an infinite impedance to the transformer. From point "A" to "B" the effective impedance drops from infinity to about 200% of the fully loaded modulating impedance. By the time the waveform reaches point "C" the effective impedance will have dropped to about 125% of the modulating impedance. Between points "A" and "B", the high effective impedance provided by R_L adds only a little extra loading to the modulator (this small "negative cycle loading" effect is discussed later in this article).

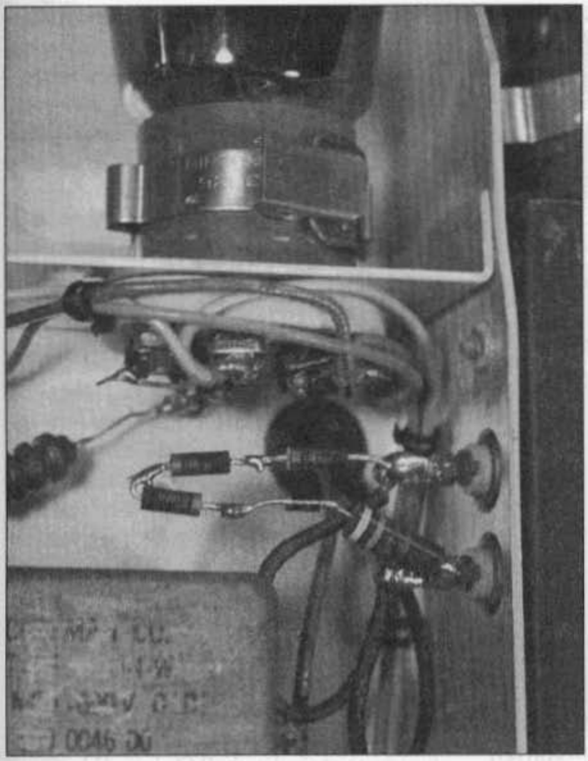

Figure 3. Limiter temporarily installed in a 32V-3 for testing.

An R_L of 33% of the modulating impedance represents a good compromise over a wide range of operating conditions, negative modulation peaks, impedance required to protect the transformer, and instantaneous surge currents. I typically use a 1-watt resistor for 50-100-watt output rigs, a 2-watt resistor for 110-150-watt output rigs, and a 5-watt resistor for 350-watt output rigs such as the Viking 500. My Collins KW-1 got a 10-watt unit. The wattage ratings are overkill. Even when badly over modulating these rigs, R_L remains cold (as do the diodes since they conduct only a very small percentage of the time).

Measure the high voltage supply at the modulation transformer under fully loaded operating conditions and 0% modulation. Thanks to today's higher power line voltages, you will probably find that it is substantially above its nominal rating. When designing your own circuit, make sure to start with the actual B+, not the manufacturer's stated nominal value.

Tables 1 and 2 list readily available diodes. Care must be taken when selecting blocking diode D_1, as it must be chosen so that its reverse breakdown voltage is not exceeded during positive modulation peaks. Allied Electronics (800-433-5700 or www.allied.avnet.com) carries a good stock of diodes from which you can make up the required zener string. When choosing values to make up a zener string, remember that more overlap is better (i.e. less zener voltage).

	V_{Zener}	Watts
1N5360B	25V	5W
1N5369B	51V	5W
1N5378B	100V	5W
1N5380B	120V	5W
1N5383B	150V	5W
1N5386B	180V	5W
1N5388B	200V	5W
NTE5285A	100V	50W(DO5 case)
NTE5291A	150V	50W(DO5 case)
NTE5296A	200V	50W(DO5 case)

Table 1. Zener diodes available at Allied (for D_2 through D_N in figure 2). Use 5W zeners for transmitters with less than 375 watts RF output (500 watts input). Use 50W zeners for kilowatt transmitters such as the KW-1.

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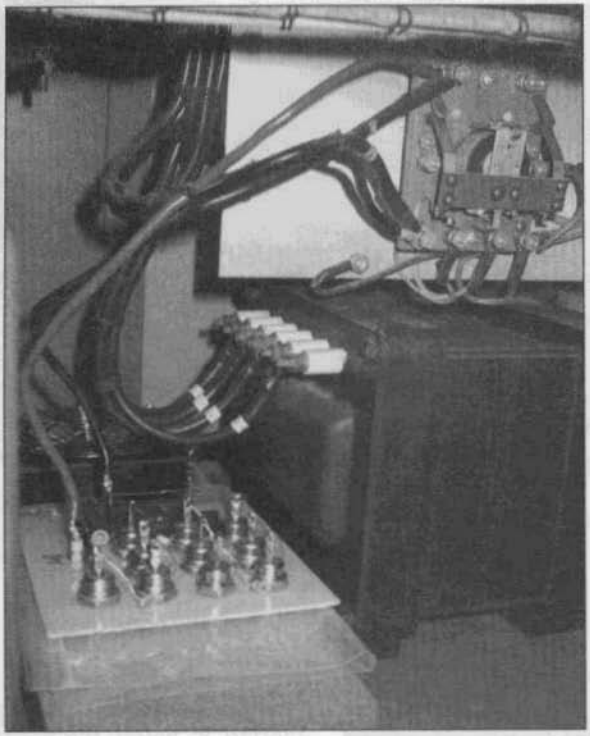

Figure 5. Limiter temporarily installed in KW-1.

PIV	I_{MaxAvg}	Style	
NTE517	15 kV	550 mA	Wire leads
NTE525	2 kV	1A	Wire leads
NTE548	12 kV	750mA	Lugs

Table 2. Blocking diodes available at Allied (for D_1 in Figure 2).

False claims

While this "negative peak limiter" will protect your modulation transformer and also provide a small amount of negative cycle loading, I have seen a number of claims regarding peak limiters that are rather dubious. It has been claimed that a limiter will allow you to crank up the modulator (if it has sufficient power) to achieve higher positive modulation peaks, without producing splatter because the negative peaks are "limited." The argument goes something like this: When the negative peak is clipped, the power being transmitted at that moment is nearly zero—so the distortion products created by the limiter will be unnoticeable because there are very few RF watts associated with them.

This argument is bunk. A clipped waveform contains unwanted harmonics, even if only one peak is clipped or limited. Increasing the positive modulation peaks above 100% while clipping the negative peaks produces distortion. It *will* sound louder running "120% modulation," but you will still create splatter and audio distortion in the process. If you doubt this, run a Fourier transform analysis on a sine wave with just one peak clipped! Only to the extent that the negative peak limiter produces "softer" clipping by virtue of the small amount of negative cycle loading will splatter be reduced.

"Negative cycle loading" effect

The intent of the circuit in this article is to *protect your modulation transformer*, not to provide lots of negative cycle loading in order to make your signal sound louder. In fact, I've designed in only a small amount of negative cycle loading (i.e. the 12.5% "R_L overlap" between point "A" and point "B" in figure 1 is relatively small). It would be possible, of course, to increase the negative cycle loading by increasing the "R_L overlap." Using a zener string voltage of 50% of B+ would move point "A" up the sine wave, producing an overlap of 37.5% (using an assumed RF cutoff of 12.5%). If your modulator were powerful enough, this would allow the positive peaks to exceed 100% before the negative peaks begin limiting (ideally somewhere just above the zero carrier point). However, if you do this, you *must* accept that you are distorting the audio wave.

In addition to preferring a cleaner signal, I have chosen to minimize the negative cycle loading of the circuit presented in this article for a very practical reason. The modulators in most commercial transmitters just don't have enough extra juice when fully loaded to gain much advantage from substantial negative cycle loading. If you think you'll get "150% AM modulation," by using negative cycle loading in your fully loaded stock Viking II—dream on!)The modulator just *ain't* big enough! You might gain a few percent—hardly worth the effort.

If you are after a louder signal, first consider using an outboard audio compressor. If you still want to use negative cycle loading, consider doing it in the low level circuits, and use the circuit in this article primarily to protect the modulation transformer. As you can tell, there are many considerations and many different ways to approach this subject and I can only briefly touch on some of them in this short article.

Circuits for popular transmitters

Table 3 contains circuit values for several popular transmitters. The Collins 32V series transmitters present a special case because its high voltage supply is switchable between 600 and 700 volts (but the HV supply on my fully loaded 32V-3 at 115 VAC ran nearly eighty volts higher than its nominal rating). To accommodate the range of high voltage from the two switch settings, I used a zener string value of 67% of B+ (at the high switch setting). The greater overlap at the high switch setting provides protection even when the switch is set to the lower voltage setting.

Can you say "extra beefy?" A brute modulation limiter for the KW-1 is pictured in Figure 4. Normally, I just solder the components together in a long string, bending them into a convenient configuration for soldering. For the KW-1, I broke with this practice and built the limiter on a piece of printed circuit card stock. ER

	B+ (V)	I (mA)	Mod. Imped.	R_L
32V series **	780	220	3.6K	1.2K
KW-1	2,600	400	6.5K	2.1K
Viking II	675	230	2.9K	1.0K
Valiant	720	330	2.2K	750Ω
Viking 500	2,200	300	7.3K	2.4K
Vkg Ranger	540	130	4.2K	1.4K
Apache	800	220	3.6K	1.2K

D_1	Total Zener String V	Zener String Components
NTE525	520	(2)-1N5388 + (1)-1N5380
NTE548	1,950	(9)-NTE5296 + (1)-NTE5291
NTE525	500	(2)-1N5388 + (1)-1N5378
NTE525	550	(2)-1N5388 + (1)-1N5383
NTE517	1,650	(8)-1N5388 + (1)-1N5369
NTE525	400	(2)-1N5388
NTE525	600	(3)-1N5388

Table 3. Circuit values for Collins, Johnson, and Heathkit transmitters. B+ is actual under full load, 0% modulation (not nominal). R_L = 33.3% of the modulating impedance (see text for wattage ratings). ** More "overlap" is allowed for Collins 32V transmitters by using a zener string of 67% of B+ to accommodate the switched HV supply.

Marconi from page 9

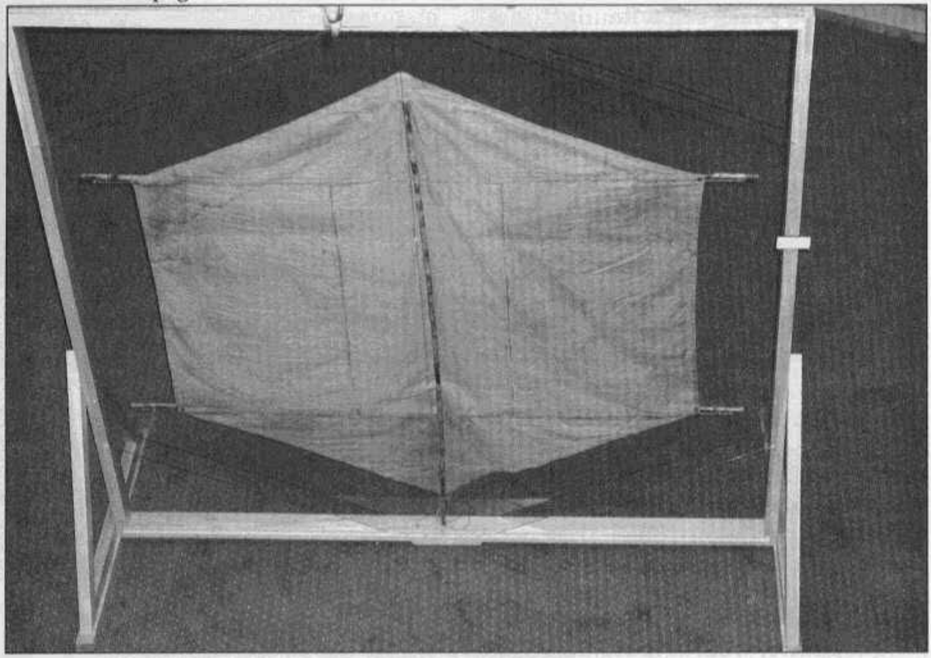

Figure 15. Kite

particular technological niche-electronics—one that he helped prosper from inconspicuous beginnings into a practical usefulness that influenced major aspects of twentieth-century culture and brought about immeasurable benefits to humankind.

Creativity, of course, often spawns excesses. Marconi claimed in patents that he had "invented," but his endeavors represented integration, innovation, and application. He brazenly and deliberately lifted ideas and experimental models from analytic laboratory scientists, and he patented them shamelessly on the premise that he had improved upon them, which precipitated extensive litigation with the original inventors. Marconi's biographers suggest that modesty was one of his cardinal traits; perhaps so, yet part of his deference may have been his manner of deflecting the wrath of the scientists whom he angered.

The transatlantic signal sent from Poldu to Signal Hill occurred ironically with apparatus that Marconi had not even improved upon; Fleming had designed the spark-gap transmitter, Vyvyan had built it, and Solari had furnished the mercury coherer. Is history really warranted in recording the happening as "a supreme heroic gesture"? Is it more realistic to view the event as a transitional experiment in Marconi's well-calculated, step-by-step strategy to corner the wireless market? The retrospective review presented here points to a negative response to the first query and an affirmative answer to the second. Marconi himself saw the transatlantic test as an experiment and he was definitely the moving force behind it, as he was of countless experiments that he had instigated earlier and would promote for thirty-six more years. Encomiums have showered upon him for 100 years. The preponderance of evidence on which they are based supports those who assert that he "is justly called the inventor of radio-telegraphy" (Hogan, 1924, p. 12). It does not support anyone who lauds Marconi as the inventor of radio. **ER**

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Postscript:

I am indebted to George H. Fathauer, Paul T. Finell, W7EFQ, and Lee O. Heflinger, W6WZV, for helping me as I prepared this manuscript. The topics of spark-gap transmitters and coherers are today among the most arcane and perplexing in the history of electronics. These distinguished electronic scientists drew upon their vast theoretical and practical knowledge to help me deduce the probable conceptual perspectives and methodologies of our forbears. I thank them gratefully for the insights that I have attained. I am responsible, nevertheless, for the interpretations and assertions made herein.

1934 Single-Sideband Report from page 3
band" was the reason no one used it. This reasoning leaves me wondering what the hams were using for receiving on the West Coast in 1934. I have two receivers from that time period, a 1932 Hammarlund Comet Pro superhet, and a 1933 National SW-3 regen. The Comet Pro is a fine SSB receiver, which I have used many times on 40 meter SSB. Surprisingly the National SW-3 is usable even up on 20 meter SSB. It requires a careful hand when tuning, but is still much better than many low priced post WW II receivers. I would love to see Jim Lambs evaluation of receivers in the "practical aspects" of ham operation which was one of the areas he investigated for the board in the 1934 report.

Now for the guess work. Did the competition between Dawleys magazines and Handbook and Warners ARRL publications have any bearing on the missing report? Dawley and the West Coast publications had a heavy commercial intertwining, with no connection to any amateur organization, especially the ARRL. This was against K.B. Warners often-voiced ideals for *QST*. Dawley was a well-educated engineer who jumped on the SSB wagon early on. Warner was a self-educated ham of long standing (1915) who was principally interested in traffic handling. He was employed as an accountant prior to WW I. He enlisted in the Army and based upon his radio knowledge was sent to Officers Candidate Radio School at Columbia University. He was commissioned a 2nd Lt. in 1918. In his position as *QST* editor Warner must have relied upon the *QST* staff for technical guidance.

Put Lamb in the middle of this and you have Warners chief advisor, Lamb, saying that Dawleys West Coast SSB was a great improvement and doable on the ham bands. Warner probably had trouble understanding all the technical details of SSB as presented by Lamb. Then add in Dawley ignoring the ARRL and pushing SSB in his magazines and you have a probable reason for the SSB report being pulled from *QST*.

We will probably never know the truth, even if somewhere there is a copy of the Lamb report. It would make great reading and hopefully the text will show up somewhere someday. There had to be many copies for the ARRL Board. It would appear that one was in existence in 1948 when *QST* ran its first SSB articles. The most fun however about the whole affair is that the controversy Warner started in 1948 favoring SSB over AM appears to be a complete reversal of his 1935 stand. I wonder how many of us have reversed our opinions of SSB versus AM through the years. Therefore, to Kenneth B. Warner, Ray L. Dawley and James J. Lamb, never fear. This generation will carry forth the AM-SSB Banner of Controversy into the 21st Century. ER

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WANTED: I am rebuilding several old pieces of military equip & need the following parts: For BC610E I need 250th, 100th, TU61 1.5-2.0 MHz, PA tank coil C-455 (1.0-1.5 Mhz) & C-454 (1.5-2.0 MHz) both w/variable links; for Hammarlund SP600JX I need all front knobs including red ones, & signal strength meter; for Heath DX 100 I need 1625 tubes & manual; for NMA-5 field strength meter I need antenna AS-385/U, loop probe MX-822/U, tripod CADV-10545 & measurement scales 15-125 Mhz dipole; main signal strength meter; misc components I need 304TL tube sockets, BC-375/191 tuning units, VT201 tubes for same, ART-13, vacuum relay & some misc RF parts, T-13 carbon microphones & connectors for same; a wide range of 274-N/ARC-5 components unmodified as I am trying to put together the installation for the P-38 Lightning fighter of WW II fame. AC5TW, NM, (800) 984-9814 during MST business hours.

WANTED: Any info relating to ASB-8 Airborn Radar set. Pete Deierlein, KD2LN, 6257 Perryville Rd., Chittenango, NY 13037. (315) 687-5456, p.deierlein@worldnet.att.net

WANTED: Manual copy for Scott SLRM. Bill Bayerd, KC7TTK, POB 10515, Yakima, WA 98909. (509) 930-8349

WANTED: Manual for Knight VFO. W3MNE, 1598 Brimfield Cir, Eldersburg, MD 21784.

WANTED: Heath p/s HP-24 or HP-14 for HA-14. **FOR SALE:** Heath GW-22 & parts list for Eldico R-104, S-119 & P-109. Cliff, WA9SUE, WI, (608) 625-4527 after 6 pm.

WANTED: Plate xfmr, modulation xfmr, modulation choke, orig manual for Collins 20K broadcast xmtr. James True, N5ARW, POB 6299, Hot Springs, AR 71902. (501) 318-1100 wrk; 318-1844 res, n5arw@boatanchor.com

WANTED: Looking for a Knight T-150A that I modified in the '60s. I added a one-tube reactance modulator behind the VFO. It was enclosed in PC board material which was soldered together. Does anyone have this T-150A? Ed Santavicca, AA8TV, OH, (216) 521-6093. aa8tv@aol.com

WANTED: Waveforms, Inc (or Dumont) audio oscillator, good condx preferred ($100), defective also OK. Charles Graham, K2GVE, 4 Fieldwood Dr., Bedford Hills, NY 10507. (914) 666-4523

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WANTED: Info on B&W 852 bandswitching tank coil. Ed McKie, KB5GT, MS, (662) 746-2256. kb5gt@hotmail.com

WANTED: Schematic Bearcat III scanner; (1) 1930s ARRL or Radio Handbook; MFJ 971 tuner. Matt Biehl, K2MAC, 174 Lincoln Blvd., Kenmore, NY 14217. (716) 876-3259

WANTED: FT-243 xtals between 7.245 & 7.283 MHz. Bill Smitherman, 9401 Hwy 67, E. Bend, NC 27018. (336) 699-8699

WANTED: Tube tester, Sencore TC162 or B&K 747. Need schematic diagram for B&K 707 tube tester for calibration purpose. Have 707 users manual or Hicok 799 schematic to trade for 707 diagram or will purchase. Allan Lurie, W9KCB, 605 E. Armstrong Ave., Peoria, IL 61603. (309) 682-1674

WANTED: Art-13 xmtr, vac relay for same; manual for TS-497B signal generator. Lee, N2UDF, lcarroll@post.com

WANTED: National NTE CW xmtr in working condx. I love National. Sylvia Thompson, 33 Lawton Foster Rd., Hopkinton, RI 02833. (401) 377-4912. n1vj@arrl.net

FOR SALE: OEM Heath belts - $2.50 each shpd; or 10+ for $2 each shpd. Send check or money order. Roberta Hummel, 202 Midvale Dr., Marshall, WI 53559

FOR SALE: Manuals for old ham gear of the '30s to the '70s. Check WEB Catalog www.hi-manuals.com

FOR SALE/TRADE: Misc. parts, tubes, for tube gear. Sandy Blaize W5TVW, 40460 Edgar Traylor Rd., Hammond, LA 70403. ebjr@i-55.com

FOR SALE: Vintage equipment at the K8CX Ham Gallery Classified Ads section. Visit the largest Antique QSL Card Gallery http://hamgallery.com

NOTICE: T-368 Registry. For info w2zr@aol.com. Subscribe to the T-368 & BC-610 reflector at: http://groups.yahoo.com/group/T-368_BC-610

FOR SALE: Lots of old radio & related books. Eugene Rippen, WB6SZS, www.muchstuff.com

FOR SALE: Strong steatite antenna insulators. Lengths from two to fifteen inches. SASE for list. John Etter, W2ER, 16 Fairline Dr., East Quogue, NY 11942. (516) 653-5350

FOR SALE: Please visit www.radioworld-online.com. We have ham gear, tubes, parts and so much more!. Carl A. Blomstran, POB 890473, Houston, Tx 77289

FOR SALE: E.F. Johnson Viking I, parting out or sell all outright - $100. Mike Grimes, K5MLG, 3805 Appomattox Cir., Plano, TX 75023. (972) 867-6373, grimesm@flash.net

FOR SALE: Collins late R-389, very clean, working, covers, manual - $2500 cash. PU only. Stuart T. Carter II, W4NHC, 680 Fernwood Dr., Melbourne, FL 32904. (321) 727-3015

FOR SALE: Older type electronic parts & hardware; free vintage flyer. Mail order since 1954. Bigelow Electronics, POB 125, Bluffton, OH 45817

FOR SALE: VM parts, new boxed electron tubes, new Heathkit parts, new panel meters. Norm, 1440 Milton St., Benton Harbor, MI 49022

FOR SALE: Build your own "Midget" bug replication by KØYQX, ca 1918, featured by K4TWJ in CQ Magazine, May, '98. 10 detailed blueprints. FAX (507) 345-8626 or e-mail<bugs@mnic.net>

FOR SALE: Parts, tubes, books, ect. Send two stamp SASE or email for list. Wayne LeTourneau, POB 62, Wannaska, MN 56761. wb0cte@arrl.net

FOR SALE: Tubes. We specialize in early receiving & collector tubes & tube related books. Send for free catalog or see www.fathauer.com. George H. Fathauer & Assoc., 688 W. First St. Ste 4, Tempe, AZ 85281. (480) 968-7686, tubes@qwest.net

FOR SALE: Collins restoration. Everything inside & out to make it as Art Collins built it. 50 yrs experience. W9OJI / N4PZ, IL, (815) 734-4255 or N4PZ@aol.com

FOR SALE: Collins S-line and A-line repair. FCC licensed, many years of experience. lal@metrocast.net, (207) 457-9257

FOR SALE: GE Sideband Slicer - $30; Millen GDO - $85; Millen Antenna Bridge - $75. FREE LIST! Richard Prester, 131 Ridge Rd., West Milford, NJ 07480. (973) 728-2454, rprester@warwick.net

FOR SALE: Heath EU40A HV bench sply - $70; Hallicrafters S-38, works - $70. Ron, MI, (517) 374-1107.

FOR SALE: S-38 - $40. Les Mathews, NJ, (856) 218-8838.

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

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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: Panel refinishing: Johnson Ranger sets - $250; Valiant sets - $300; Johnson 500 sets - $300; Collins R390(A), front side - $125, both sides - $225; Hammarlund HQ-180 series panel & bezel - $200, cab add $100. http://w4pnt.8k.com. Dee Almquist, 534 W. Main St., Waynesboro, VA 22980. (540) 249-3161 Cell: (540)480-7179

FOR SALE: Tubes, 7 or 9 pin, used - 50¢ ea; tested OK, others; Galena xtal radios, or parts. L. Gardner, 458 Two Mile Creek Rd., Tanawanda, NY 14150. radiolen@aol.com

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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

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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

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FOR SALE: I am making aluminum plate and grid connectors for T series tubes. If interested contact Alan Price at fixr7526@cs.com

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

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FOR SALE: Motorola base station, "Private Line Radio" w/2 mobile units. Bill Coolahan, 1450 Miami Dr. NE, Cedar Rapids, IA 52402. (319) 393-8075

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

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

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

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

WANTED: Bird Element 250H; also, 419 or 419A base for EV-664 mic. Harold, K4HCA, GA, (706) 754-7388, k4hca@alltel.net

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

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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

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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

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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

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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

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

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WANTED: 1950's Popular Electronics; 1961-65 Heathkit catalogs & Radio-TV Experimenter. John Curtis, WØCAR, 3146 S. Franklin St., Englewood, CO 80110. (303) 781-8027, w0car@arrl.net

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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

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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

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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: Meter for 275 Matchbox; Sams AR-14,15,16 and Range knob for HP-8640B, J.R. Linden, K7PUR, Cave Creek, AZ. (480) 488-5205, jrlinden@usa.net

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WANTED: BC-187 & BC-188 (p/o SCR-179), MP-37 mount, MT-461/ARR-15 mount. Joseph Pinner, 818 Hill St., Kingston, TN 37763. (865) 376-0996, kc5ijd@sprintmail.com

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FOR SALE: Heath HD-1250 dip meter, solid state - $45; Heath IG-102 signal generator - $35. + shpg. Ken, TX, (254) 772-7307.

FOR SALE: Millen VFO 90711. This beautiful, very rare VFO is offered at only - $395. Don, W7KCK, OR, (503) 289-2326.

FOR SALE: AN/UPM I radar test set w/manual - $150; (2) 3B28 - $20. Robert Martin, 111 Bancroft, Rochester, NY 14616. (716) 663-4182

FOR SALE: Westinghouse size 3x3 new ceramic rotary SW, 2 sections, 8 contacts each 30A - $45. Joe, W6CAS, CA. (916) 731-8261.

FOR SALE: QST complete yrs 1928, 1929, 1939-43; ICOM IC-745, 720A; Drake R-4 rcvr. Make offer. Roger Higley, W8CRK, OH, (513) 451-1096.

FOR SALE: Callbook collection: SASE only, no postcards, sacrifice - BO. **WANTED:** Orig Valiant I manual. Louis L. D'Antuonio, WA2CBZ, 8802 Ridge Blvd., Brooklyn, NY 11209. (718) 748-9612

MESSAGE: Builders of NR5Q "Ultimate Regenerative " rcvr per Dec, Jan, Feb ER. Fair Radio carrier monitor is NOS, mint, cheap, contains ideal pwr xfmr & other "new" '50s vintage components. For more info: Bob Ryan, 1000 S. Gilbert St. Apt 132, Hemet, CA 92543.

FOR SALE: Aerovox (round cans) A24-762 (6602) 22000MFD 40 DCWV red POS, used, circuit closed (2) - $45; tube tester Heath mod, TC-2 chart, good - $20; Philips red table mod BX815A - $50; amplifier, HP mod 450A - $65; Ray Jefferson mod 5000M w/ mic @9 OKLA City - $25. Bernie Samek, 113 Old Palmer Rd., Brimfield, MA 01010. (413) 245-7174, fx 245-0441

FOR SALE: Collins radio estate sale includes: 75S-3B (WE), 32S-3 (WE), 516F-2 (WE), 312B-4, KWM-2/A (RE) w/ CP-1 Xtal Pack. 30L-1 (WE), 516F-2 (WE) and 51S-1 (WE). Both pwr splys are in orig cabinets. There are cabinets for all of the equipments. Included also are two 35R-1 Collins rack mounts & Astatic D-10 mic. All equipment is in exc cosmetic condx and in working order. $4,200 + shpg for everything. Lloyd, w3qt@arrl.net

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FOR SALE: Collins 75A-4, high 5xxx serial number, one filter and spkr - $975+ship. Ed Sauer, 787 N. Peterman Rd., Greenwood, IN 46142. (317) 881-1483

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: Drake L-4 no pwr sply - $250; Heath Mohawk great condx - $300. **WANTED:** Collins 75A4. Bob Braza, W1RMB, MA, (508) 222-5553.

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

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

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

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

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

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

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: Homebrew AM xmtr 300 to 500 watts, reasonable distance for Atlanta PU. Dave, K4JRB, GA, (770) 448-0588 or thompson@mindspring.com

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

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

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

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

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

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

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

WANTED: VFO such as Heath VF-1, EICO, etc. Dennis Olmstead, WB9EMD, 431 Ridgewood, Glen Ellyn, IL 60137. (630) 469-0531, wb9emd@aol.com

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

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

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

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

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

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

WANTED: National SW-3 model 1, version 3. Uses 32-32 30 tubes. Dean Showalter, W5PJR, 72 Buckboard Rd., Tijeras, NM 87059. (505) 286-1370

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

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

WANTED: Clean fully functional w/manuals Swans FC76, FS1 and WM2000A . Contact C6ANI @ c6anirumcay@hotmail.com

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

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

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

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

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

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

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

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

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

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

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

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The Collins KWM-2 Video 4 hours - $89.95. Highly detailed video on operation, rebuilding, alignment, troubleshooting and neutralizing of this classic! A must for anyone who owns and operates a KWM-2/2A. Printed documentation included.

The Collins 75S-3/32S-3 Video 3.5 hours - $74.95. An in depth examination of the most popular version of the S-Line. Operation, modification, alignment, neutralizing and more! Much of this information applies to all versions of the S-Line!

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The Collins Amateur Radio Equipment Video Spotter's Guide 1 hour, 40 minutes - $24.95. Close to 90 individual pieces of Collins Radio equipment are shown in the video. Examples of some of the gear covered are: KW-1, KWS-1, 30K-1, 20V-3, 75A-4, KWM-2, S-Line, KWM-1, 30S-1, 30L-1, KWM-380 and much more!

The Collins KWS-1 Video 2 hours - $39.95. This video is the perfect companion to the 75A-4 video for owners of the "Gold Dust Twins"! Butch Schartau, KØBS, shows you how to operate, maintain and repair your KWS-1. Watch as Butch goes through the entire alignment and neutralization process, as well as showing you how to properly operate this famous transmitter.

The Collins 75A-4 Video 4 hours - $89.95. This video is four hours of information on how to repair, maintain and restore this classic receiver. Butch Schartau, KØBS, guides you through all aspects of keeping your own 75A-4 running like a top.

R-390A Video 7 hours - $109.95. Here it is! Long awaited by serious "boatanchor" enthusiasts! The ultimate receiver now has the ultimate video to go along with it. R-390A expert Chuck Rippel, WA4HHG, covers an absolutely incredible array of information in this "heavy duty" video. This video looks at operation, its modules, circuit description, front and rear panel details, complete mechanical and electrical alignment, PTOs, performance evaluation, modifications, troubleshooting and restoration. There is nothing like this video available today, at any price!

R-390A Addendum Video - $49.95. Another 3 hours and 40 minutes of R-390A information from Chuck Rippel, WA4HHG

SP-600-JX Video 4 hours - $89.95. Chuck Rippel, WA4HHG, takes us through all aspects of the SP-600-JX—repairs, restoration and modifications. This video is a must for any newcomer attempting to work on the SP-600.

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ER Bookstore, 14643 County Road G, Cortez, CO 81321

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

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

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

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

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

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

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

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

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

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

FOR SALE: FT-757GX; FP-757HD; FC-757AT; Heath SB-301, SB-401, SB-600, SB-620, HD-16; SB-300-4 converter; Heath mobile HP-13 sply; Heath DX-60A; WACOM duplexer WP652 4 cavity; WP-653 6 cavity; Midland 513 xcvr, Xmtrs. 2 meter AM SCR-522 rack mounted, 300 watt amp uses 4X150, 811s modulator, pwr splys; T-13A VHF AM 140 to 150 MHz; Gonset II 2 meter; Motorola Vibrosponders pwr sply: RA61A, PRI 120/240VAC, fil & HV 350; Knight PA model 93, 30 watt, final 6L6Gs; Astatic mic JT8D; freq counters: BC-221; Davis CTR-2-500 Mc; Xtals: 100 CR-68U 5650 to 8650 kc; 16 FT-241A; 10 CRV-60042, send for list; tubes TX & RX over 500, send for list; 1-177D tube tester; QSTs 1939 thru 1994; (1) VC-100 VAC capacitor 100 mmfd, 20,000 volts; (1) VAC capacitor 12 mmfd 20,000 volts; (2) VC-12-32 Eimac 20,000 volts; (1) GL-1L33 VAC capacitor 100 mmfd 7.5 KV; (2) Johnson, dual section, 100 mmfd 7 KV, .175 GAP, cat# 100-DB-7; (1) Bud 160 meter, 75 watt coil, 5-pin, plug-in, end link; (1) ea National plug-in (4 pins in line) xmtr coils, 75 watt, end link, 80M, 40M, 20M, 10M; (1) National PB-10 plug-in base & shield, 5-pin; (1) Barker & Williams, 160 HDVL coil, center opening for swinging link 1KW, never used, needs repairs; (2) Hammarlund plug-in 5-pin; (1) ea Barker & Williams 80TVL, 40TVL, 20TVL, 10TVL, 250 watt coils, center opening for swinging link, never used, 80 meter coil needs repairs due to age; (1) mounted center link & socket for the above. Will sell in one lot. Lowell Dunham, W8YKS, 215 E. Lemon Creek Rd., Berrien Springs, MI 49103. Phone/Fx (616) 471-2406

FOR SALE: Quinton 30 to 50 mc RF deck, single 4-400 in the final. Great for parts or to put on 10 or 6 meters - $75; accompanying pwr sply 2600-3000 VDE w/diagram - $75. U-shp. Herman Gibbs, KD8PD, WCWS 90.9 FM, Box C-3177, The College of Wooster, Wooster, OH 44691. (330) 263-2212

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The front displays the logo from the cover of ER (the tube outline, Electric Radio, and 'celebrating a bygone era'). The back has "Real Radios Glow in the Dark" (used with the permission of Classic Radio).The T-shirts are U.S. made by Hanes and come in S-M-L-XL-XXL . The color is just a little lighter than the cover of ER - $15 del. ($16 for XXL)

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