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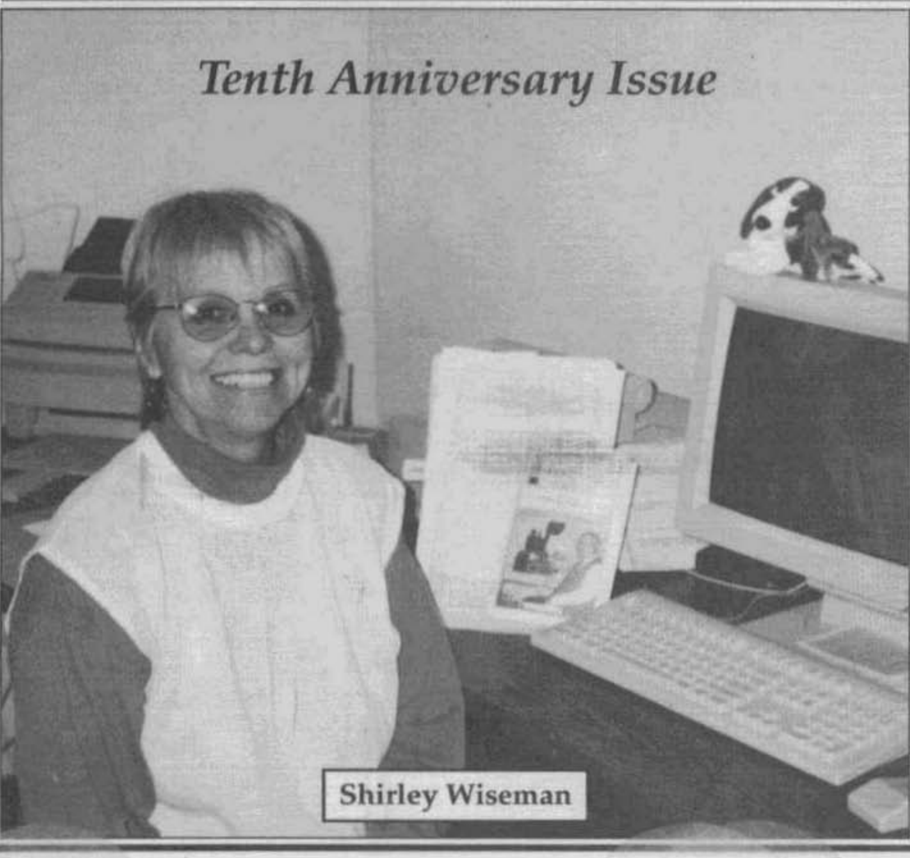
ELECTRIC RADIO

celebrating a bygone era

Number 120 April 1999

Tenth Anniversary Issue



Shirley Wiseman

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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:

Walt Hutchens, KJ4KV; Bill Kleronomos, KDØHG; Ray Osterwald, NØDMS; Dave Ishmael, WA6VVL; Jim Hanlon, W8KGI; Chuck Penson, WA7ZZE; Dennis Petrich, KØEOO; Bob Dennison, W2HBE; Dale Gagnon, KW1I; Rob Brownstein, K6RB; Don Meadows, N6DM; Lew McCoy, W1ICP; Kurt Miska, N8WGW; Warren Bruene, W5OLY; Brian Harris, WA5UEK; Thomas Bonomo, K6AD and others.

Editor's Comments

With this issue we complete the first ten years of Electric Radio. I don't know if I'll be here in 2009 celebrating our 20th anniversary (I'll be 67 then, probably too darn old for this job) but hopefully someone younger, brighter and more energetic will have taken over and ER will go on and on and on. I hope that's the way it goes. It's a comforting thought.

Besides Shirley, who has been my mainstay, I have to acknowledge that ER owes its existence to all the writers that have contributed articles over the years. I want every contributor to know that I truly appreciate what they have done for me and for ER. Nothing has made me more proud about ER than the quality of writing it contains and I feel blessed to have been associated with so many truly great writers.

I think this is a good issue, worthy of being our 10th anniversary issue. To cram in as many good articles as I could I've postponed our annual index to next month. I think that's the way it will be from now on. The index will be in the May issue each year.

Already I'm preoccupied with VFD although it's still almost 3 months away. We'll definitely be back in southeast Utah, at Muley Point, where we were last year. Cap Allen, WØXC, (CW Op par excellence) will be back with us and we'll also be joined this year by Fred Chandler, KFØOW, who will be bringing his big homebrew mobile station down. Any vintage ops who can possibly make it are invited to come have VFD with us. Call me for further information.

Lastly, I have to announce our annual back issue deal. This year we're offering all 10 years for $240 delivered. And if you purchase them in the next month or so I'll include a copy of Hiram Percy Maxim by Alice Clink Schumacher, a book that I'm sure you will enjoy.

ER #120... and counting. N6CSW

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Cover: Shirley Wiseman, ER Office Manager, at her desk. Without her Electric Radio could not have survived for ten years. It would have been impossible without her hard work, support and encouragement. N6CSW

Looking Back

by Lew McCoy, W1ICP
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When I went from Missouri up to the ARRL in Connecticut in 1948, I have to admit I had big stars in my eyes. I was getting a chance to work in my hobby and believe me, I was a real eager beaver ham. DX was my big thing but I had also gotten into traffic handling by running the Missouri Emergency Phone Net.

Ed Handy was the Communications Manager of the League and he had hired me. When I arrived in West Hartford it was on a Sunday and my car was loaded down. I even brought my rack and panel rig. I finally found Handy's house and he immediately took me over to meet Joe Moskey, W1JMY, who was to be my immediate superior. I found out later that Joe was going to be the Assistant Communications Manager—CW, while my title was Assistant Communication Manager—Phone. Joe had rebelled at his title so he was made Deputy Communication Manager. The reader has to understand ARRL Headquarters in those days—phone men were the curse of Amateur Radio. If one didn't operate CW, you never were one of the "boys".

When I met Joe I met a guy that was to become one of my closest and dearest friends. Joe was a real help in getting me started. His wife Norma, a ham whom he had met on 80 CW, was a charming gal. I always remember that day because Joe and Walt Bradley, another HQ man, were playing chess. (I just thought what a place, they play CHESS (!!!) on Sundays.)

Keep in mind that any phone man at HQ was like a pox on the place. The only guy who worked phone was Ed Tilton, W1HDQ, the VHF Editor. I think Ed was accepted simply because very few of the hams at HQ ventured above 80 meter CW. Don't misunderstand me, they were in general, a real friendly bunch with me and a group of real nice hams who worked for peanuts.

Budlong was the General Manager. Bud was not very friendly to a phone man coming in and I believe it was about two years before he acknowledged me. I could write a lot about Bud. He didn't have a great deal of enthusiasm for Ed Handy and the Communication Department. I think Bud thought it was a necessary evil.

One time I went Washington when I was doing the TVI work and met with George Sterling, who was one of the FCC Commissioners. George had asked me what I thought of a "beginner" Amateur license, five words per minute and so on. I told him that personally, I thought it was a very good idea. A couple of days later when I got back to Headquarters, Budlong called me into his office and raised hell with me for trying to represent the League with the FCC in Washington. I stood my ground and told him that a beginner's license was a damn good idea for Amateur Radio and that I was speaking personally to Sterling and not for ARRL. It wasn't long before Budlong got on my side in that argument.

A lot of the older time hams did not like Budlong but believe me, they just didn't understand him. He was a great amateur and did much for amateur radio. W1ICP

Ed.

Good news for 83 year old W1ICP. May 1, he will be getting married in Mesa, Arizona. On behalf of everyone we send our best wishes to Lew and his new bride, Claire.

Shirley and I plan to attend if we can possibly make it. In any case, we'll have a report of the wedding in the May issue of ER. N6CSW

AMI Update - April 1999

by Dale Gagnon, KW1I, President

AM Forum at the Dayton Hamvention

This year the forum has been scheduled for Sunday morning, May 16, 11:15 to 12:15 in Meeting Room #1 in the Hara Arena. After a short update on AM International we'll get into the main program, "The Buffalo AM Triangle". This will include a perspective why AM is alive and well in western New York. There will be pictures illustrating the sizable group of amateurs who are restoring classic amateur transmitters, building impressive homebrew projects, converting broadcast transmitters and mixing it with a lot of social interaction and fun. The program is being put together by Bruce (KG2IC), Tom (W2KBW) and Bill (K2LNU).

AM enthusiasts will be meeting again for dinner on Saturday evening, May 15 at 7:30 at Marion's Pizza, Exit 57 off Interstate 75. Bring pictures of your shack and your latest radio projects to pass around.

Update on the License Restructuring NPRM

William Cross of the Wireless Communication Bureau at the Federal Communications Commission reported that they have waded through the 2300 plus comments and reply comments submitted late last year and early this year. They are drafting documents at this stage, but still have a ways to go before the specifics of a Report and Order will be settled on. Bill says that this work will not be completed by the Dayton Hamvention, but he does expect to take some time in an FCC Forum there to talk about concerns raised in the comments. He expressed some doubt that the Report and Order would be out, even by July. He said he recently received a letter complaining about a decision the Commission made in 1951. He said that, similarly, letters will be written to the FCC for several decades based on what they do in this Report and Order, so they were taking the time to thoughtfully prepare.

Coming Events

AMI is discontinuing its sponsorship of the Armed Forces Day operating event. Though it is a great time to be on the air, response from the membership has been low. It is also the same weekend as the Dayton Hamvention which siphons off many potential classic military rig operators. Instead, plan to use your military boatanchors on Vintage Field Day on June 19,20. Another interesting event is this month, the Submarine Memorial Radio Room Reactivation on April 24,25. Over 25 submarines or submarine memorials will be on the air this weekend. I worked several submarines while I was HF mobile on last year's reactivation weekend. Unfortunately, most of the equipment in use will not be original Navy issue. For more classic equipment usage, plan to operate the "Ships on the Air" event, July 17,18. This event coordinated by Bob, W1QWT from "Radio Five" on the cruiser USS Salem in Quincy, MA included over 30 surface ships and submarines last year. The Collins Collector Association sponsors "theme weeks" for some of its nets. On February 4 I participated in a KW-1 night.

In March and April they have had AM nights. April 11-16 they are encouraging military and unique equipment to check in. May 2-7 is "your favorite Collins radio" week. Look for CCA net activity on Tuesday, 8:00 PM Central, 3805 kHz, Thursday, 8:00 PM Central on 3875 kHz, Friday, 8:00 PM Pacific, 3895 kHz. **ER**

Arthur Collins' 1925 Amateur Station

Part One, The Receiver

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Seventy five years ago, a fifteen year old Cedar Rapids boy named Arthur Collins built an amateur short wave station that would sustain communication with the MacMillan Arctic Expedition after the commercial stations had tried and failed. The receiver will be described in this issue and the transmitter in next month's ER for those who wish to build and own an early Collins station.

On October 6th, 1924, the Third National Radio Conference convened in Washington, DC. The Secretary of Commerce, Herbert Hoover, later to become President of the United States, opened his address with these statements:

"Nor have we overlooked in these previous conferences the voice or interest of the amateur, embracing as he does that most beloved party in the United States—the American boy. He is represented at this conference, and we must have a peculiar interest for his rights and interests. I know nothing that has contributed more to sane joy and definite instruction than has radio. Through it the American boy today knows more about electricity and its usefulness than all the grown-ups of the last generation."

Just six months earlier, a fifteen year old boy, Everett Sutton, 7DJ picked up the CQ of Tom Mix operating WNP on THE BOWDOIN, iced in at Refuge Harbor, North Greenland. This was the first MacMillan expedition to the Arctic. The radio signals of WNP had not been heard for more than six weeks. Mix later wrote "The next date on which we were able to break thru was April 14th, when, after over a month of vain attempts to raise someone, 7DJ answered a CQ and reported QSA. We worked for an hour without trouble, his signals being heard a couple feet from the phones and 7DJ copying our signals with only an occasional repeat. 7DJ was the last station we were able to raise, altho nightly watch was kept for about a month after this date." The equipment used at 7DJ was a one-tube receiver and five-watt transmitter constructed by Sutton.

Again in the Summer of 1925, another fifteen year old boy, Arthur Collins, 9CXX of Cedar Rapids, Iowa, would provide the only communications between the second MacMillan Arctic expedition and its sponsor, for twenty-two straight days. Working on a wavelength of 19 meters, young Collins operated daily from 8 AM to 5 PM handling a great volume of traffic, both personal and official messages, and articles for the newspapers. The National Geographic Society, sponsor of the expedition, sent and received numerous messages through the equipment constructed by a fifteen year old boy.

Armstrong Perry, a writer for *Radio Age Magazine,* decided to visit Cedar Rapids to see the station that young Arthur Collins had built. The story of his visit may be found in the November 1925 edition of that magazine. The April 1926 issue follows with a construction article which describes the receiver that Collins used. Two transmitters with

The author with his replicas of Arthur Collins' 1925 receiver and transmitter. Note how he is tuning the receiver with a pencil to reduce hand capacitance.

three configurations are described in the May 1926 issue. Both of these articles were written by fifteen year old Arthur Collins.

It was these articles that prompted me to make replicas of the equipment. Last November, I was fortunate to host a tour for the Collins Collector's meeting in Dallas, Texas. The receiver and transmitter described in part 1 and part 2 of this article were displayed along with other prewar equipment. As a result, several calls, e-mails, and letters were received asking for more details about the construction of this equipment. First, let me say there is nothing new or special about the circuits that Collins used. The circuits are well documented in *QST* and other books available at the time. There are innovations relating to parts and layout.

For my purposes, operation of the equipment is secondary. However, the receiver and transmitter are functional. The person who duplicates this equipment will need to make some early decisions regarding parts. Some readers may wish to use more readily available parts to hasten the project along. The parts originally used by Mr. Collins are very difficult, but not impossible to find. There will be some parts sources listed at the end of this article.

The receiver about to be described was built by young Collins in the spring of 1925. It was an exciting time to be a Radio Amateur. John Reinartz and Fred Schnell had made their historic two way contacts with the famous Leon Deloy, operator of French 8AB. Permission to use the shortwave bands (without special licenses) was granted by the Radio Conference of 1924. The harmonically related bands were 200 to 150 meters (1500 to 2000 kilocycles), 85.6 to 75 meters (3500 to 4000 kilocycles), 42.8 to 37.5 meters (7000 to 8000 kilocycles), 21.2 to 18.7 meters (14,000 to 16,000

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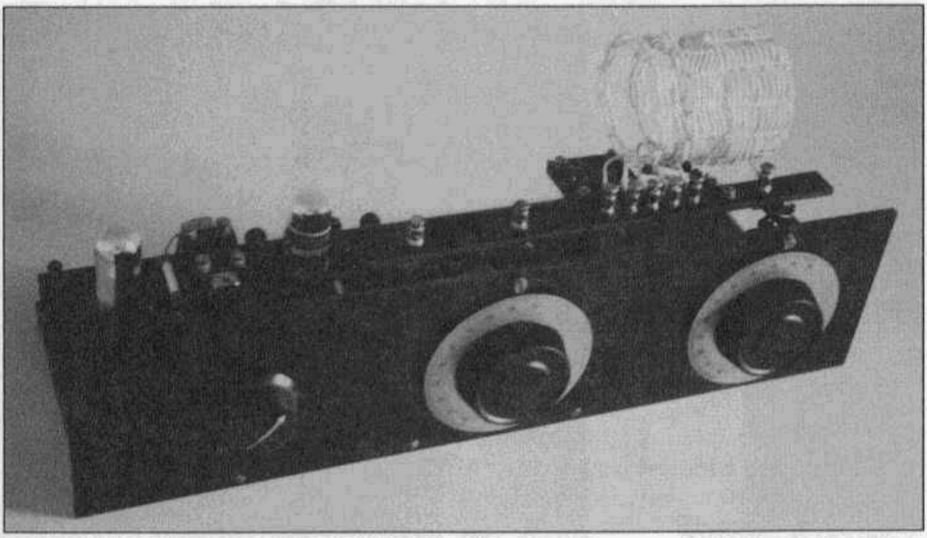
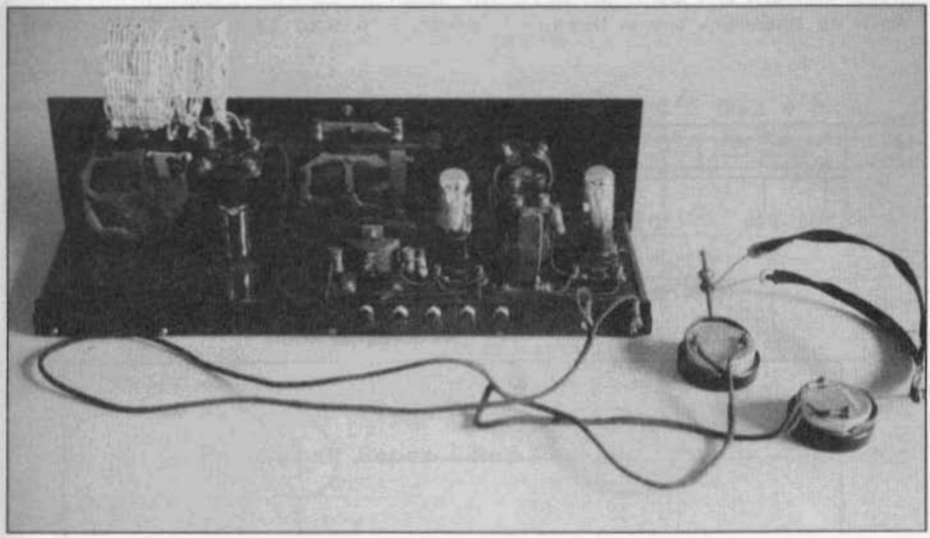


Front view of the receiver

kilocycles), and 5.3 to 4.7 meters (56,000 to 64,000 kilocycles). The Zedders and Aussies were communicating almost daily with many North American amateurs. The rush to operate in the new bands was met with many setbacks. Circuits that functioned very well at 200 meters were erratic and hard to control when tuned to the 19-21 meter band. Young Collins explained that receivers with several radio frequency amplifiers which worked well at wavelengths above 200 meters, were not very usable on the shorter wavelengths. A receiver for short waves must be low loss to be efficient. Collins eliminated everything from his circuits that was not necessary. Many of the parts that were advertised as "low loss" proved to be otherwise. Fewer parts meant lower loss. His receiver had a single detector followed by one or more audio amplifiers. If a weak signal could be detected, he relied on his audio stages to amplify it up to a usable level. His antenna system (a problem due to opposition) was coupled very loosely to the detector. In fact, the antenna was a single wire thrown out of an upper story window into a tree. Mr. Collins' parents had built a new colonial style home and outside antennas were not welcome. Two 30-foot supports were later added to the roof after the MacMillan contacts were made. The receiver did not use a connection to the ground.

Assembling the Receiver

The schematic and parts list identifies the original parts used by the Collins receiver. The UV-99 tubes were chosen for the detector and audio stages. These tubes fit a small shell socket with a bayonet slot. The UX-99 fits the standard four-contact socket. The builder will need to determine which type of tube is available, then choose a socket that matches. Mr. Collins did not use a socket with the detector tube. He soldered directly to the pins on the tube, which was inverted. After soldering in a few tubes and not finding a good performer, the decision was made to add a standard 4-pin socket to my receiver. Type 30 tubes can also be used in the receiver. Do not mix type 30 and UV-99 tubes in the receiver, since the filament voltages for the two are not the same. On the terminal board drawing,



Rear view of the receiver with 'Dixie Cannonball' headphones attached.

you will find a layout for the detector socket. The base was removed from my socket and its pins were attached to the terminal board. Your socket may not match the hole pattern shown, so check it out. A two-inch diameter hole (beneath the detector tube) cut through the baseboard can also be seen. The detector tube may be removed easier through this hole. An extra binding post has been added to the receiver rear panel. It isolates the plate voltage on the plate of the first audio stage from the plate voltage on the second stage. These are the only modifications made to the original design.

The Bremer-Tully so called "condensers" were advertised as low loss variables, but their frictional bearings are rough and difficult to keep in adjustment. The 7-plate main tuning condenser mounts on the right side of the front panel. The 11-plate variable is the regeneration control and mounts in the center of the panel. This can be seen in the receiver's rear view photograph. Notice that one variable is mounted vertically while the other is in a horizontal position. Hopefully, the length of the mounting strips have been adjusted so that the terminal board will be level. Starting with the first hole on the left hand side of the terminal board, fasten the longest mounting strip to the board, using E1. Mount E2 through E7 to the next six holes. Be sure that the holes in the binding post faces the front of the receiver. Mount the shortest mounting strip to the eighth hole with a brass screw and nut. Finally, mount E7 and E8 to the last two holes on the terminal board. It is helpful to completely wire the terminal board before mounting it to the variable condensers. The receiver is wired with No. 20 gauge "push back" wire. Solder is used to mount R1 to C3. All other connections are made with screws.

Before mounting the terminal board to C1 and C2, fasten the front panel to the baseboard using No. 4 brass flat head wood screws. Mount E9 and E10 on the rear panel. Next mount E11 through E15 to the rear panel. Now, mount the rear panel to the base board using No. 6 brass wood screws.

Mounting locations for parts used in the audio stages are not shown on the

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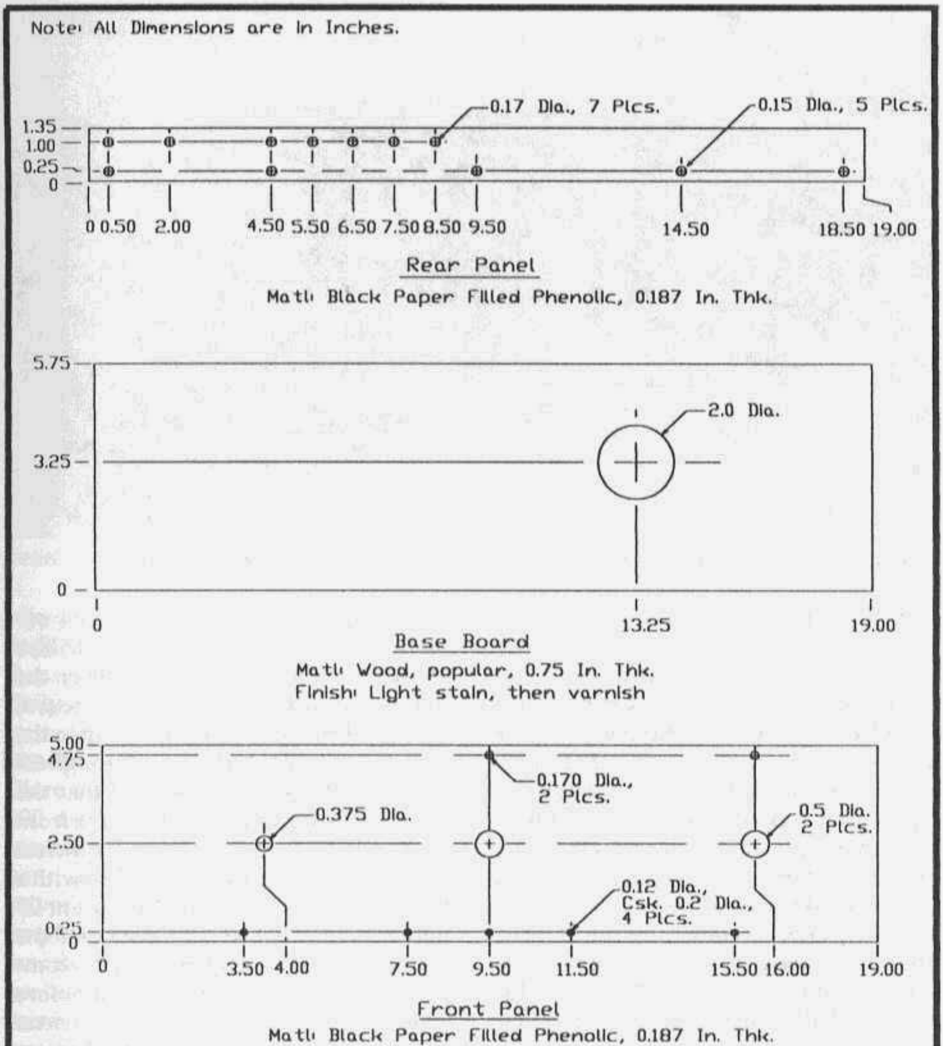
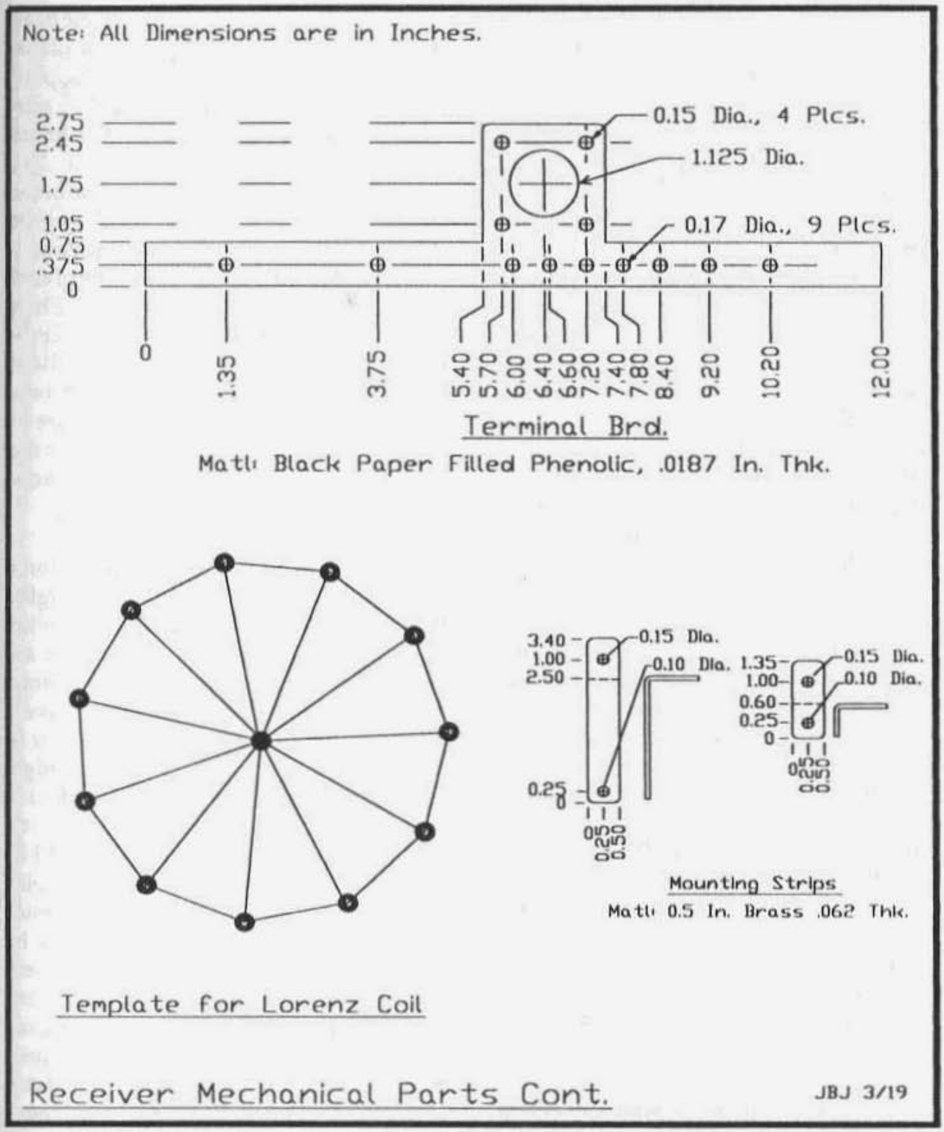


baseboard drawing. Position transformer T1 so that its frame is in line with the back of C2 and is centered between C2 and the rear panel. It should be possible to place a wire about 3 inches in length between the stator connection on C2 (left rear view) to the input terminal of T1. Place the tube sockets for V2, V3, and transformer T2 on the baseboard. Align them in a straight line with T1, spaced equally apart. Mount the tube sockets with No. 4 wood screws and the transformers with No. 6 wood screws. Wire the audio stages according to the schematic. Don't forget to place R2 on the secondary terminals of T1.

Mount the terminal board to the back of C1 and C2. Use care in connecting the filament wires to the socket. One side of



Receiver Mechanical Parts Cont.

the filament is connected to the ground bus on the terminal board. Make sure that ground on the terminal board is carried through to the ground side on the audio stages. Otherwise, the filament wires will be shorted together. It might be best to see the filaments in each tube light up before connecting the "B" batteries to the binding posts. The rheostat is in series with one side of the filaments. When a three-volt battery is used, the rheostat should be set to its minimum resistance. If type 30 tubes are used it is better to set the rheostat to maximum resistance, then adjust for 2.0 volts on the filaments.

Coils

The inductors or "coils" used in the receiver were Lorenz type, better known as "basket weave". There was a lot of

continued next page

debate in the 20s about which type of coil was best. While the Lorenz had lower distributed capacity it was eventually recognized that solenoid type coils with the proper length to diameter ratio were just as good. Mr. Collins suggested that either type could be used in the receiver. A coil form template is included in the drawings. It will not be the proper size after this article is reduced for print. Place a copy of the template on a small board and extend the radial lines out to 1.5 inches. The finished coil should be about 3 inches in diameter. At the end of the lines, mark and drill straight through the board with a drill size just smaller than the diameter of the nails that you are using. Push eleven nails through the backside of the board. Use No. 14 gauge double cotton covered wire for winding the coils. The coils are wound on the form by weaving the wire through alternate nails. While the coil is still on the form, tie the winding together at four or five places with a strong string. Place a little glue on the ends of the strings after trimming them to size. The grid coil should have 24 turns for the 80 meter band. The tickler coil will need 3 turns and the antenna coil will require 5 turns. For 40 meters, the grid coil needs 12 turns, and for 20 meters, use 6 turns. The number of turns for the tickler and antenna coils is the same for all wavelengths. Wind all coils in the same direction. Be sure to leave enough lead length to mount the coils on the binding posts connections on the terminal board. Some detector tubes may require more turns on the tickler coil. After all, we are using tubes that are older than 75 years. Mount the 80 meter coil set on the receiver. Two positions exist for the antenna coil. With the antenna coil mounted at the furthest position from the tickler coil, the receiver will be more selective.

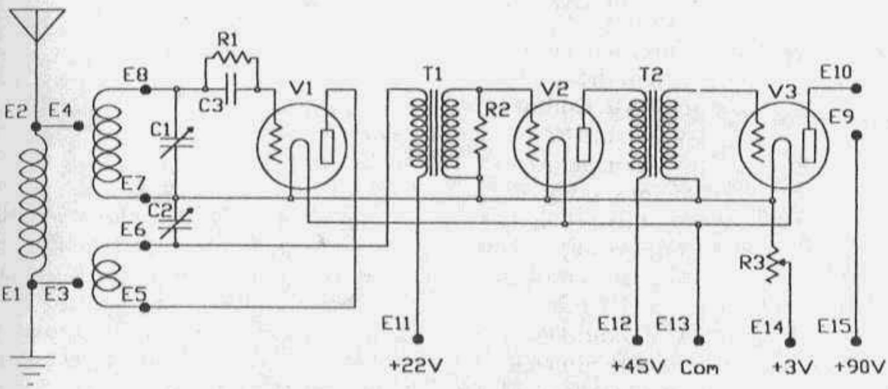
Parts

Black phenolic panels can be found at most plastic supply houses. Plastic dealers usually have cut off pieces available at reduced prices. The wood (poplar) comes in various sizes and can be purchased at most lumber yards. The brand is Wey/Choice by Weyhauser. Try "Play Things of the Past" for some of the difficult electrical parts. You may be required to purchase a catalog at a nominal cost. The catalog is worth every cent if you like to build antique radios. Their address is: 3552 West 105th St., Cleveland, OH 44111. Another excellent source of parts is "Antique Electronic Supply", Tempe, AZ. Also, be sure to look in the cardboard boxes under the tables at your local hamfest or radio convention flea markets.

Operation

In the words of Mr. Collins, don't expect to hear Timbuctu the first night. It will take time to become familiar with the operation of this receiver. Two afternoons were spent tinkering before any signals were heard on my receiver. Double check to see that the receiver is wired correctly. Connect a pair of high impedance headphones to E9 and E10. Carefully connect the "B" batteries to E11 through E15. The negative lead is connected to E13. Two 1.5 volt "D" cells are connected in series for the filaments. A filament switch was not included in the original receiver, but may be added external to the receiver.

Slowly turn the regeneration control, C2, back and forth until a whistling sound is heard in the headphones. If the detector does not slide into regeneration, try reversing the connections to the tickler coil. The space between the tickler and grid coils may be adjusted by pushing the tickler coil back and forth by hand. Loosely connect the antenna to the receiver. Slowly tune C1 to see if signals can be heard. Experience will teach that AM signals come in just below the point of regeneration. CW and SSB signals are heard just above this point. You will find the receiver to



Receiver Schematic and Parts List

C1	Bremer-Tulley "Lifetime" Condenser 150 M.M.F.D 7 Plate
C2	Bremer-Tulley "Lifetime" Condenser 250 M.M.F.D 11 Plate
C3	Dublier Micon Type 642 .00025 M.F.D
E1-E10	Crosley Binding Post No.1
E11-E15	EBY Binding Post Ensign "H"
R1	Allen-Bradley 5 Megohm
R2	Allen Bradley .1 Megohm
R3	Keystone Rheostat 0-16 ohms .5 Amp. (With knob)
T1	General Radio 231A Amplifying transformer
T2	Jefferson Amplifying Transformer No.41
V1,V2,V3	UX-99 Vacuum Tubes
Misc.	Bakelite Panel, Baseboard, #20 Push Back Wire Brass hardware, 3 Ea. Tube sockets, 2 Ea. General Radio 4 In. Dials with Pointers

be very sensitive to hand capacity while tuning. Mr. Collins used a pencil eraser against the outside edge of the main tuning dial for fine tuning. This places some distance between the hand and receiver. The variable condensers in my receiver are worn and operation of the receiver is erratic. But signals on the 80 meter band have been heard from Europe and Australia at sunset and sunrise. The antenna used was a 4 Sq. vertical array.

So far, a power supply for the receiver has not been built, but one should be fairly easy to make. The schematic for a small switching supply is circulating around the boatanchor groups. That will be a project for another day. **ER**

Ed. Part two, The Transmitter, will appear in next month's issue.

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My Radio Experience in the Far North, Donald H. Mix, QST, November, 1924

The Elmac AF-67 Trans-citer

by Jim Hanlon, W8KGI
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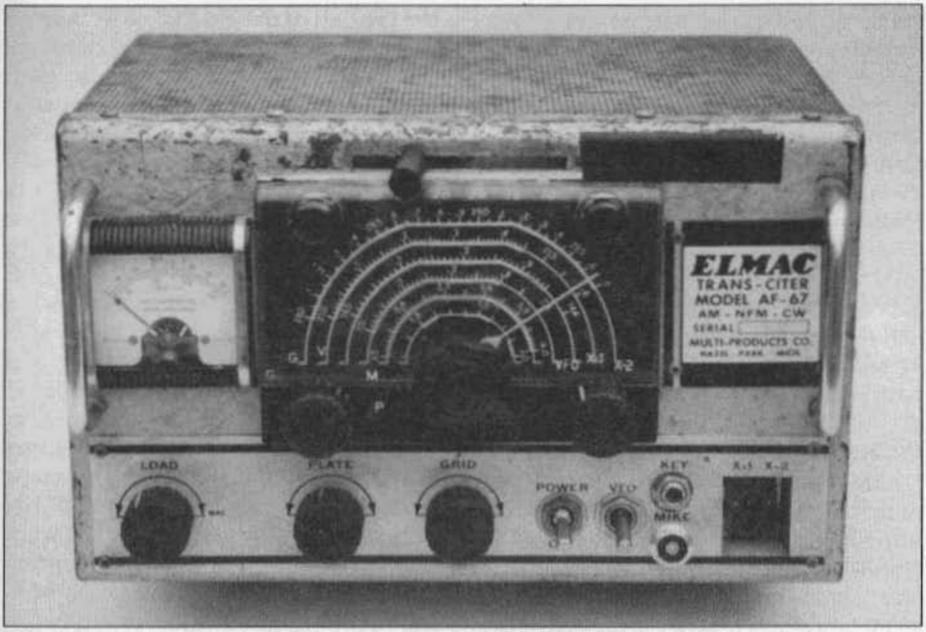
Elmac AF-67, serial number 1908, that is the subject of this article has been my friend for going on 41 years. I bought it and an SX-43, used from Steinburgs in Cincinnati in June of 1958 for 180 of my income tax refund dollars. My brother Bob had graduated from Ohio State that year, and he was taking his NC-173 and Lettine 240 that had been our station-away-from-home at the Alpha Sigma Phi house with him. I was in the market for something that would work fairly well and not take up too much room and the Elmac and SX-43 fit the bill quite nicely.

As I recall, the Elmac had been used as a mobile rig, mostly on 10 meters, by By Henry, W8CDY. It was a little scratched up around the cabinet, but it still worked well and the price was quite right for a bandswitching, 160 to 10 meter AM, FM and CW transmitter with a built-in VFO, high level 5881 modulators and a 6146 final.

I must admit that the SX-43 probably spent a lot more time playing background music from the AM and FM broadcast bands while I studied and wrote lab reports than it did playing 40 meter CW. But I did get the Elmac warm now and then while I was in school. It really helped out in one EE Communications Lab. My professor, Dean Davis, was W8LBE. When it came time to build a breadboard class C amplifier, he allowed as how I knew which end of a soldering iron to hold on to and how to build what was essentially a novice transmitter already since I was a ham, and he let me use the Elmac as my lab experiment. Using F. E. Terman's best techniques and RCA's characteristic curves for a 6146, I predicted such things as the conduction angle for the final amplifier and the resulting grid current, plate current under load, power output and overall efficiency. Measurements confirmed the theory quite nicely, except that the efficiency was lower on 80, 20 and 10 meters than it was on 160, 40 and 15. That's when I learned that a tapped coil pi-match network burned up power when part of the coil was just sitting out in the breeze. I was also able to measure the sidebands under AM and FM modulation. With AM and a sinusoidal modulation signal, there are of course just the upper and lower sidebands we are all familiar with. But with FM, there are theoretically an infinite number of sidebands, spaced by the modulation frequency, and spread out above and below the carrier. Their amplitudes are predicted by those mysterious Bessel Functions, and there are certain settings of deviation for which specific sidebands and even the carrier can be made to disappear. It was really neat to use one of the Lab's HRO-50's and to find each sideband right where it was supposed to be and of the predicted amplitude. Thanks to the Elmac, I really got a good feel for the realities of a lot of stuff that had been just exercises in mathematics up till then.

It was the summer of 1960 when I finally got a job away from home, and that meant I needed a car. Good old Dad came through with a 1960 Chevy Biscane 6, far more than I had dreamed of, and I put nearly 20K miles on it driving between Allentown, Pennsyl-



The Elmac Trans-citer Model AF-67, serial 1908. The lack of "Multi -Elmac" on the name plate suggests this is an early model.

vania where I was working for Western Electric and Columbus, Ohio where I had a special lady friend. The Elmac went with me in the Chevy, now paired with a PE-101 dynamotor, a Gonset Super 12 converter, and a Johnson Whipload 6 base loaded antenna.

In the June of '61 both that special lady and I graduated, and we got married in August. The Elmac followed along with us, now paired with my other old HRO-50 friend to an apartment in Columbus for a year while I got an MS, to another "garden" apartment in New Jersey for two and a half years where we added two daughters to the family and I worked for Bell Labs and went to more school, and finally back to Columbus again in 1965 where we proceeded to add a son and I finally got my Extra Class license and a Ph.D. The license and the degree were somewhat related, thanks to the Elmac. In the summer of 1966, I was studying for my general exams - basically I had to know everything about every course I had ever taken in Electrical Engineering, Mathematics and Physics. After a while, I was burning myself out in about an hour and a half of studying, so I would take a break with the Elmac and the HRO and get on the air. Since no one was using AM in 1967, the only thing I could do was to work CW. By the time September came, I was not only ready for my general exams, but my code speed was also well above 20 wpm and I aced the Extra Class exam as well.

The Elmac continued to be my one and only transmitter until we moved to Allentown, PA in 1968 and my wife gave me the $50 that she got from selling our gas dryer and, shanty Irishman that I am, I spent it right away on an Eldico SSB-100. By that time I had also acquired an HRO Senior from another Ohio State EE professor, Bob Higgy, W8IB, and though I did not realize it then I had already started on that terrible downward path of a boatanchor

continued next page

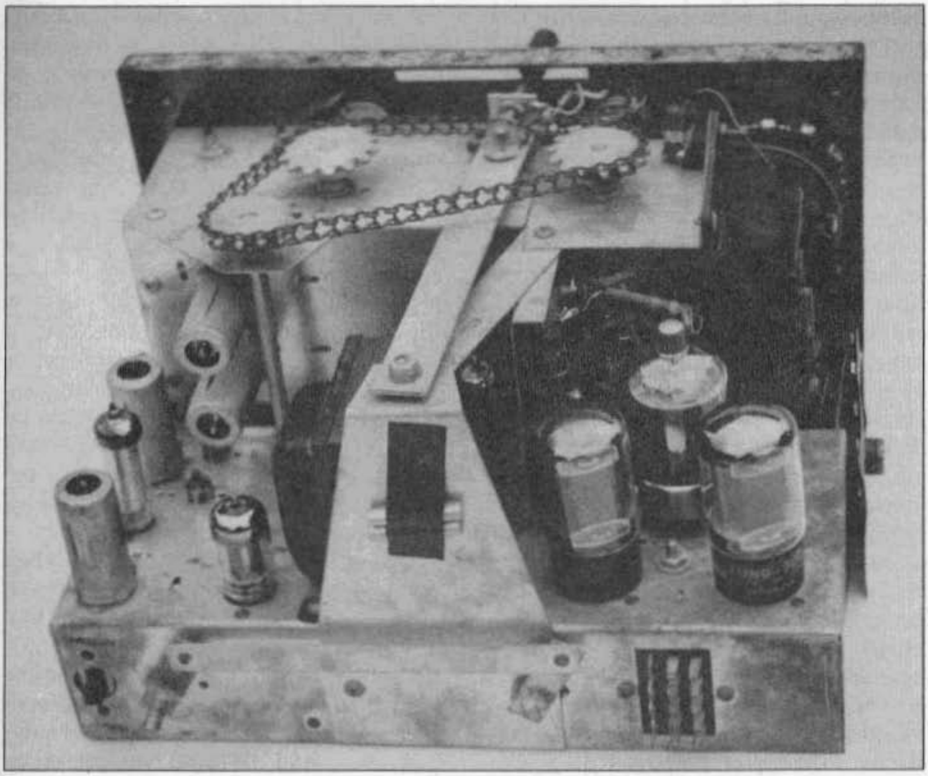
collector. We moved back to Columbus in 1970 for a job with Bell Labs, and I slowly added more "old junk" transmitters that other hams were almost throwing away to my growing collection. The Elmac was soon overshadowed by more powerful cousins like a Hallicrafters HT-20, a Collins 32V-3, a Globe King 275 and a Heath DX-100, but it has even until today always held a favorite spot among the shelves of active rigs that I keep on the air. After 41 years together, it's one of my better ham radio "friends" and I take care of it.

What's Inside the AF-67

Gus Undy, W8YNC, the 1953 designer of the AF-67, squeezed a lot of function into a box quite small for its day. The RF circuit consists of four stages, a 6AK6 Hartley VFO that runs either on 160 or 40 meters and whose B+ is regulated by an 0B2, a 6AG5 buffer stage that runs straight through on all band positions except for 10 meters where it doubles the oscillator output to 20, a 6AQ5 driver/multiplier, and a 6146 final that runs straight through on all bands. The 6AK6 also switches to a Pierce crystal oscillator (with the crystal connected between control grid and plate). The 6AQ5 buffer stage is broadbanded with slug tuned coils, and there is a tuning capacitor in the driver plate, labeled "Grid" on the front panel, that is used to adjust the drive to the 6146. An extra gang on that capacitor also tunes the 6AG5 plate when it doubles to 20. There is more than enough drive for the 6146 on every band, and the user is advised just to detune the driver to arrive at 2.5 to 5 mA. I long ago found out that more than 3 mA grid drive to a 6146 only increases harmonic output (TVI) and shortens tube life, and I don't like running the driver stage off resonance and hot, so I installed a drive-adjusting pot in the screen of the 6AQ5. Now I peak the 6AQ5 output and then set my pot to deliver desired drive. Its control is on the top, left of the vfo dial, in a spot that balances the audio gain control on the top, right. The 6146 plate tank is a typical pi-match, with three different coils each tapped once to cover the six bands. The AF-67 manual says that it can match unbalanced resistive loads from 50 to 300 ohms. By the way, I should also report that the VFO in my AF-67 is so stable that I notice essentially no drift after just a couple minutes of warm up.

The AF-67 is set up to work CW, with the cathodes of the buffer, driver, and final all tied together at the key jack and the vfo designed to run continuously. There is enough internal R/C filtering on the common cathode lead to shape the keyed waveform and avoid key clicks. I have long preferred to work QSK (break-in), so I included a mercury wetted reed relay to key the B+ feed to the oscillator as well. I use a time-sequenced keyer that turns the oscillator on before the following stages, and the result is a no-chirp, no-click, break-in signal. After a several years of use, the vfo does begin to develop a noticeable chirp. The only thing that cures it is a new 6AK6, so I keep a few extras in stock. The AF-67 includes a front panel switch to power up the VFO by itself for "spotting" purposes. When run in mobile service, B+ for this spotting feature was often tapped off the car radio supply.

The audio string of the AF-67 is also well implemented. The first speech amplifier stage is a 6AU6 that can be set with a back skirt switch to accommodate either a carbon or a crystal/dynamic microphone. A lot of the mobile rigs of that era used carbon mikes like the war surplus T17(B). They were mechanically rugged, and they also could stand in-car temperature excursions that would destroy a crystal mike. For AM, the 6AU6 feeds a 12AU7 driver with both triodes in parallel, in turn transformer coupled to the grids of push pull 5881's in class AB1. The secondary of



Inside the box, the VFO is in the shielded box up front, the final is on the right with the 5881 modulator tubes behind it, the modulation transformer is rear center, and the audio stages are on the left side. Note the three ganged, chain driven bandswitches and the two ganged AM/FM/CW switches on the rear outside wall of the chassis.

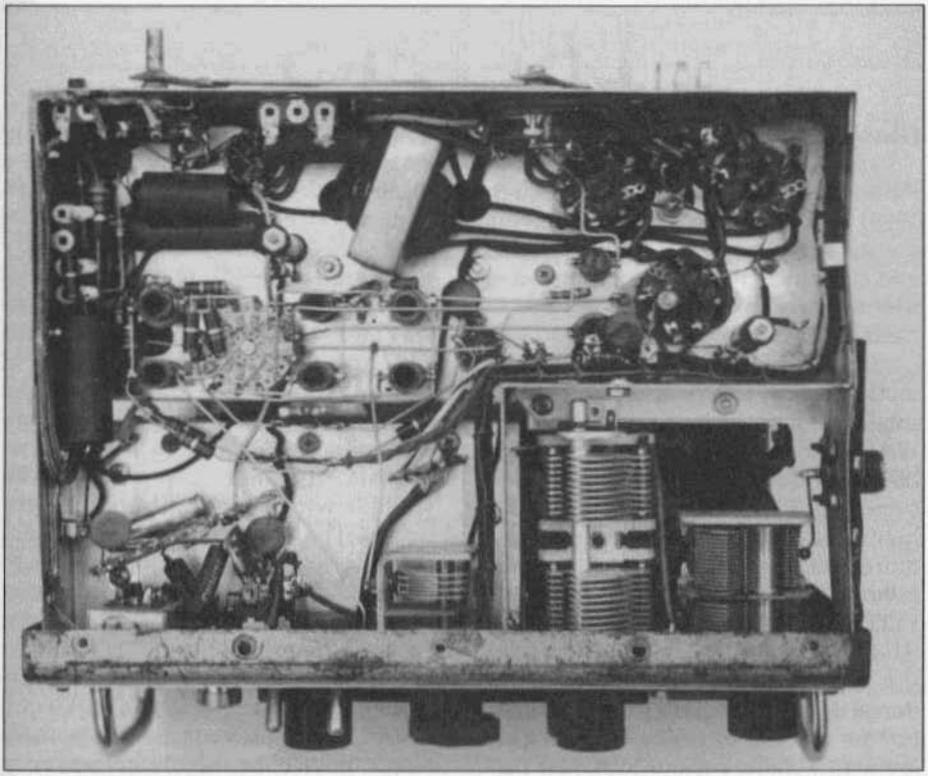
the modulation transformer is matched to the 5000 ohm load of the 6146 final, and it also has a 500 ohm tap that will deliver 40 watts of audio to the outside world if you want to use the AF-67 as an RF and AF exciter for your boatanchor KW final and modulator. This dual use as a Transmitter or an Exciter caused Elmac to coin the term "Trans-citer" for this rig. In addition, the output of the 6AU6 speech amplifier can be directed to a 6BJ6 reactance modulator connected to the plate of the VFO. The manual does not offer any suggestions on setting the FM deviation other than saying it's controlled by the audio gain. I do know from my OSU lab experience that the FM works well. I suppose you would just have to find someone with an NBFM detector in his receiver and set up the deviation until it sounded good.

Thus far, everything I've told you about the AF-67 has been the good news. The bad news is that the AF-67 is a TVI maker, and I've not yet been able to fix that problem. Back in 1952 people were just beginning to figure out how to design a rig to avoid TVI, and mobile operation was becoming a lot more popular because you were generally gone from a given neighborhood before the folks could figure out what was causing that garbage on their boob tube. Indeed, the manual reads as though

continued next page

there should be no trouble with TVI and the AF-67. "The MULTI-ELMAC Trans-citer's circuitry is such that harmonics falling in the TV channels are at a minimum. The power plug leads are bypassed and other critical circuits designed for maximum harmonic attenuation. Under normal operating conditions the usual low-pass filter in the antenna transmission line, a brute-force filter in the AC power line, and a good efficient ground to the Trans-citer cabinet is sufficient to maintain a harmonic attenuation of 100 dB down. Adequate shielding of stages and a completely shielded variable frequency oscillator make this possible." The truth of the matter is that there are a lot of open holes in the cabinet that are difficult to close and too many ways for the harmonics that class C stages invariably generate to get out. While the power plug leads are filtered, there is an open hole in the back of the cabinet where the power cable plugs in, so that the harmonics can easily flow across the chassis, over the top of the power plug, and out and down the cable where they can happily radiate. Also, the shaft of the AM/FM/CW switch that comes out the back of the cabinet is not grounded and it acts like a stub antenna as does the shaft of the bandswitch that comes out the top front. The coax output connector is on the left side of the chassis, and there is a nice, big slot in the cabinet that fits around it and lets the harmonics travel out and down the outside of the coax cable. And if that weren't enough, the meter case is plastic, it has no metal back shield, and the meter leads are not bypassed to ground. This leaves multiple paths for TVI to get out, and despite my best efforts at plugging these holes I've not yet been able to rid the AF-67 of TVI on 20, 15 and 10 meters. I tried TVI proofing the transmitter by closing up as many open holes as I could. I closed the hole around the RF output jack. I put a metal 35mm film can over the function switch on back and soldered a cover over the carbon/hi-Z mike switch. I soldered copper flange onto the power connector and screwed it down to the cabinet. I soldered a copper cover over the meter and bypassed both sides of it to ground. Still, nothing much helped. I couldn't figure out a way to shield the bandswitch lever. The best I could do was to attach a grounded pigtail where it leaves the cabinet. One of the advantages of writing these articles is that I get to revisit such problems as TVI. Just yesterday I sniffed around with a lead attached to the antenna of a little TV set, and the interference seems to be originating from the key lead and perhaps from the power lead. So I may give it one more try. It would be fun to be able to use the AF-67 on the higher bands. Have any of you AF-67 owners out there had any better luck with TVI in your rigs?

While I'm talking about "improvements," a few of you sharp eyed Elmac experts might notice a few more in the pictures. I had a 6146 develop a short from plate to ground one time, not an easy thing to do when you think about how the tube is built, and it took out the meter movement and the plate feed RF choke. I found a new choke, and I even got very lucky and found another meter of the right sensitivity whose movement exactly fit the Elmac meter case. But when I made those repairs, I also put a fuse in the B+ line to the 6146 plate and another in series with the meter. If you have sharp eyes, you can see the meter fuse up on the bracket that supports the right-hand, chain-driven bandswitch cog and the 6146 fuse just below the RF choke that is between the 6146 and the inside 5881 modulator tube. I also have two spare fuses taped to the bandswitch bracket in the rear. A 22.5 volt "photoflash" battery about the size of today's 9 volt transistor radio batteries originally supplied grid bias to the 5881's. I long ago pulled the bat-



Under the chassis. The final tune and load capacitors are shielded off from the low level stages.

tery and derived bias using a 22.5+/- volt zener diode in the 5881's common cathode lead. You can see that zener diode in the under chassis view, right between the two 5881 sockets, in the rear behind the final tune and load capacitors. Also in the under chassis view over just behind the microphone and key jack you can see several RF chokes and bypass capacitors that I put on those leads. If you look very carefully, you can also see a terminal strip, a small rectifier diode, and a larger electrolytic capacitor that provide DC power for the keying relay, just to the left of the round disc ceramic cap, that keys the VFO. Finally, you can see in the front panel view that I substituted an Amphenol microphone connector that mates nicely with my D-104 and JT-30 for the original three circuit jack.

If you're thinking of adding an AF-67 to your shack, you might want to know about its power supply. The rig needs an external supply of either 6 volts at 5.2 amps or 12 volts at 2.6 amps for the filaments, 250 volts at 75 mA for the low level stages, and 500 to 600 volts at 160 mA for the modulator and final. Elmac offered the 115 volt powered PS-2V supply and also the M1070 and M1071 units, which were vibrator packs that ran from either 6 or 12 volts DC and 115 volts AC. I suspect that most of the mobile AF-67's back in the 50's were powered from PE-101 or PE-103 dynamotors, so M1070's might be a little scarce. In my case the power supply from my 1952, 6AG7/6146 novice rig donated the HV transformers, chokes and filter capacitors that still run my AF-67.

There have been several good articles

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LETTERS

Dear ER

I read Bruce Vaughan's N5RQ [*Our Future Lies in the Past*, ER #119, March 1999] article with rapt awe, for he very accurately diagnosed the malaise that I had been suffering from. When I was first licensed in July 1995, I jumped in head first. It was like turning a child loose in a candy store. I worked every mode known, from packet to RTTY to satellite. I pulled all-nighters to get my WAS, to find that next contact, I was hooked. Oddly however, during the last 6 months I have started to enjoy the hobby less and less, even though I had more and more equipment. It seemed great to have a radio with DSP this, and LED that, but something was lacking. And therein lies the problem. I has lost the "magic of radio", willingly surrendered it, and even paid to sell it off, all for the wonder of technology. My enjoyment of radio became inversely proportional to the amount of radio gear I owned. Now my QSOs took place with the relative ease of a cell phone call, and the challenge, the allure, along with the magic, was gone. Fortunately, the cure for this malady was easy, at least for me. It consisted of "culling the herd".

I decided to sell off every bit of radio gear that I did not use at least once a week, especially the high tech units. And with the current market for boatanchor gear, that was not as painful as it sounds! I then committed to return to the real roots of radio, and operate only CW and AM. I have had more enjoyment in the last few months, just sitting in the basement listening to my 75A-4 and using my 40-year Johnson transmitter, than I ever had in the past 4 years with all the high tech gear. It was as if I had returned home, to my roots, and to the magic. The "Magic of Radio" is not something that can be bought, it must be learned. I recall my wonderment as a teenager hanging a piece of wire out the window, and listening to all of these far away places on my DX-160, it is now like those heady times once again. Today, the new amateur is sadly often "sold" radio as two-way intercom with their buddies. Teach CW, naw that's old fashioned, use FM instead. Indeed, the hobby has been dumbed down to the lowest common denominator. Obtaining a license is now almost a right, not a privilege. And we wonder why people drop out of the hobby. The answer is simple, we sold them defective goods instead of teaching them the magic, and we sold them a free cell phone. The time-honored concepts of elmering, and home brewing, and the rich legacy of AM and CW are looked upon as archaic, even backward. I now know the truth, and it is radio magic, not technology. From here on in I am committed to share the magic with every new amateur and leave the free calls to Ma Bell.

Bruce Howes, KG2IC

Dear ER

On Vintage Field Day, I am an "outside observer" in my advice and support. Only twice have I gone out to Field Day activities to aid others in set-up/take-down and to just see the equipment. I see a reduction in interest and participation in Field Day. This downturn has got to affect VFD.

So I urge you NOT to become discouraged in the slow upswing in interest in VFD. Keep on with VFD on the same fixed weekend in June. Do not forget to remind us to "put-out" the date and freqs on the nets. Even on the VHF nets there are a few of the boat anchor set.

Oscar Clinton, N5ZIH

VINTAGE NETS

California Early Bird Net: Saturday mornings at 8 AM PST on 3870.
California Vintage SSB Net: Sunday mornings at 8 AM PST on 3835
Southeast Swap Net: Tuesday nights at 7:30 ET on 3885. Net control is Andy, WA4KCY. 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 3:00 PM PT, 7 days a week and usually goes for about 2 hours. Net control varies with propagation.
Arizona AM Net: Meets Sundays at 3 PM MT on 3855. On 6 meters (50.4) this group meets at 8 PM MT Saturdays.
Colorado Morning Net: An informal group of AM'ers get together on 3876 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 Dennis, WA3YXN but sometimes it rotates to other ops. Saturday mornings on 1995 at 0500 ET. Will move to 3885 for summer.
Westcoast Military Radio Collectors Net: Meets Sunday mornings at 0930 local on 3975 + or - QRM, except the 1st Sunday of the month when the net meets at 2130 local. Net control is Tom, WA6OPE.
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. URL: http://www.crompton.com/wa3dsp/grayhair.html
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 at 0100Z Tuesday nights on 3805 and on Thursday nights on 3875.
Collins Swap and Shop Net: Meets every Tuesday at 8PM EST on 3955. Net control is Ed, WA3AMJ.
Drake Users Net: Another relatively new net. This group gets together on 3865 Saturday nights at 8 PM ET. Net controls are Criss, KB8IZX; Don, WZ8O; Rob, KE3EE and Huey, KD3UI.
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.
JA AM Net: 14.190 at 0100 UTC, Saturdays and Sundays. Stan Tajima, JA1DNQ is net control.
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 California Sunday Morning 6 Meter AM Net: 10 AM Sundays on 50.4. Net control 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. For hams who enjoy using AM, restoring and operating
Midwest Classic Radio Net: Saturday mornings on 3885 at 8AM Central time. Only AM checkins allowed. Swap/sale, hamfest info and technical help are frequent topics.
Boatanchors CW Group: Meets nightly at 0200Z on 3579.5 Mhz (7050 alternate). Listen for stations calling "CQ BA" or signing "BA" after their callsigns.
Wireless Set No. 19 Net: Meets the first Sunday of every month on 14.165 at 1900Z and 3760 at 2000Z. Net control is Dave, VA3ORP.
Beer Town Traders Net: On 3885, 5:30 Central Daylight Time on Saturdays.
Westcoast 40M AM Net: Sunday afternoons from 3-4 PM westcoast local time until 4-5 PM on 7160 +or- QRM.

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

The GPR-90 and the GSB-1

by Brian K. Harris WA5UEK
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brian.harris@sv.sc.philips.com

On Cadillacs

Following my father's example, I am partial to General Motors vehicles. While I have enjoyed the plush interior, smooth ride and V8 torque of many a rental, a top-of-the-line GM never graced my garage. Perhaps that will change when (if) I grow up and no longer worship `under 10 pounds per horsepower'. Until then I do enjoy what I call my `Cadillac Station', so named for its Coupe de Ville similarity. Indeed it's long, consuming nearly six feet of desktop. Likewise, its respectable power is accompanied by an abundance of features, quality workmanship, attention to detail and `driving comfort'. Did you notice I didn't say performance? Screeeeech! I am getting ahead of myself.

When arranging `Radio Central' I wanted an impressive display in the corner opposite the entrance, for this is where visiting eyes initially focus. My equipment choice for this operating position was, therefore, by no means accidental. That I fell in love with the much touted Central Electronics 100V/600L combination long ago made its selection a no-brainer. If you recall, that pair can cover 160-10 meters and operates nearly every mode known to man. What else could a person want? Since you asked, I wanted a receiving mate that would match the CE gear closely in frequency coverage, operating modes, vintage, quality and feel. From my gaggle of well-respected receivers, each one begging for the honor, I opted for a GPR-90, GSB-1 and matching speaker obtained courtesy of my friend, Bob K6VOI.

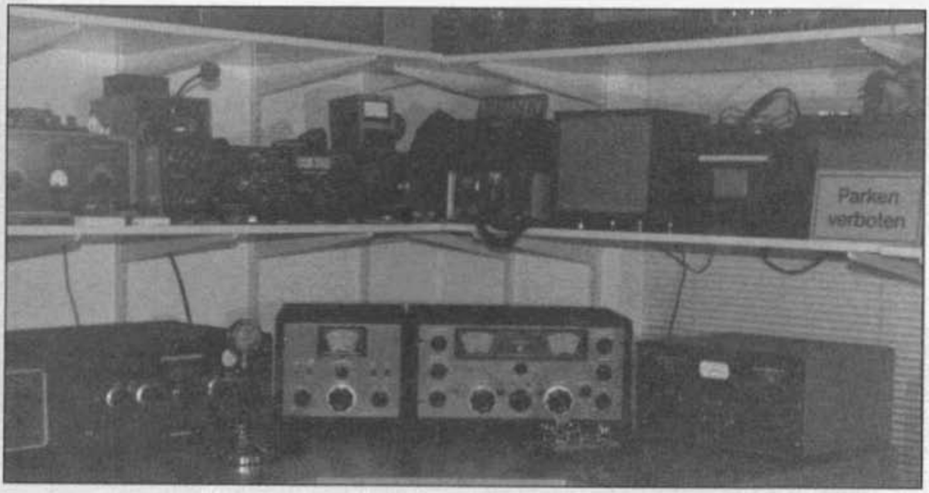
GPR-What?

The Technical Materiel Corporation (Mamaroneck, New York) brought their GPR-90 communications receiver to market in 1955 and kept it there eight years, at which point in stepped the short lived GPR-92. Although the manufacturer advertised heavily in ARRL handbooks and QST, their target market consisted of government and commercial communications facilities. By design, the GPR-90's component complement and construction quality more closely match that found in military receivers than in amateur receivers. Indeed, the unit was assigned the military number, R-825/URR.

Although the technical manual mentions amateur band coverage, GPR-90's were not popular in the amateur community, at least in their day. This may have been due to cost. A 1955 GPR-90 sold for $395 while a similarly featured HQ-160 in 1958 was but $379. By 1962, the GPR-90 (now with a crystal calibrator) had risen to $495, while the HQ-160 price remained unchanged. (Production dates and pricing from Communication Receivers by Moore.)

Technically Speaking

Like most general coverage receivers, the GPR-90 starts with the AM broadcast band and reaches slightly past 30 Mc. Commentary on the unusual front end design will be saved for later. The three lower bands (.54-1.4, 1.4-3.3, 3.2-5.6 Mc) are single converted to 455 Kc by the first mixer, a 6AU6. Between the first mixer and the first IF stage is a 6BA6 buffer. On the three higher bands (5.4-9.6, 9.4-17.8 and 17.3-31.5 Mc) a 6BE6 pentagrid converter is inserted



'Radio Central' in the author's hamshack. The GPR-90 and GSB-1 are in the center. On the left is a Central Electronics 100V and on the right is a CE 600L amplifier. Above the GPR-90 is its semi-rare matching speaker.

between the 6AU6 mixer and the first IF stage, while the 6BA6 buffer is bypassed and disabled. The first IF, in this case, is 3.955 Mc and the second IF remains 455 Kc. The 6BE6 converter uses a 3.5 Mc crystal to create its LO. On all bands the 6AG5 variable HF oscillator operates above the signal frequency.

Three ordinary 6BA6 IF amplifiers follow the crystal filter, which offers six selectivity positions having 6 dB bandwidths of .25, .50, 1.0, 1.5, 2.0 and 6.0 Kc (filter bypassed). The first two IF amplifiers receive AVC derived from one section of a diode connected 12AX7. RF gain control is also applied to the cathodes of the same two IF stages. When enabled, another 6AG5 acts as a BFO, injecting its signal into the grid of the third IF amplifier before both BFO and IF energies are passed to one half of a 6AL5 that serves as a detector. The other half of the 6AL5 forms a series noise limiter.

The unused half of the 12AX7 that generates the AVC amplifies the audio before sending it on to the 6V6 output stage. To improve the linearity of the audio chain, negative feedback taken from the secondary of the multiply tapped (600/16/8/4 Ohm) output transformer is applied to the cathode of the first audio amplifier. A selectable filter between the 12AX7 and the 6V6 can provide either a low pass function (about -3 dB @ 2.5 Kc) or audio peaking @ 1.2 Kc. The 10 dB bandwidth in the peaking mode is adjustable between 600 and 1600 cycles.

About That Front End

"They don't have any front end selectivity so don't try using one on 75 meters, specially at night", grumbled my friend, now SK, W5PTY. Obviously Ozona Bob was not fond of GPR-90's. Why he had a stack of them when I last visited him still perplexes me, however, I confess they weren't being used. Admittedly, the GPR-90 front end design differs from that of most receivers of its day but this is not necessarily negative. The first difference is its broadbanded input transformer, whose 75 and 300 Ohm inputs may be configured to support balanced or unbalanced feedlines. The second is its grounded-grid 6AB4 RF amplifier. The third difference, which annoyed `PYT perhaps theoretically

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The TMC GPR-90 is a handsome receiver.

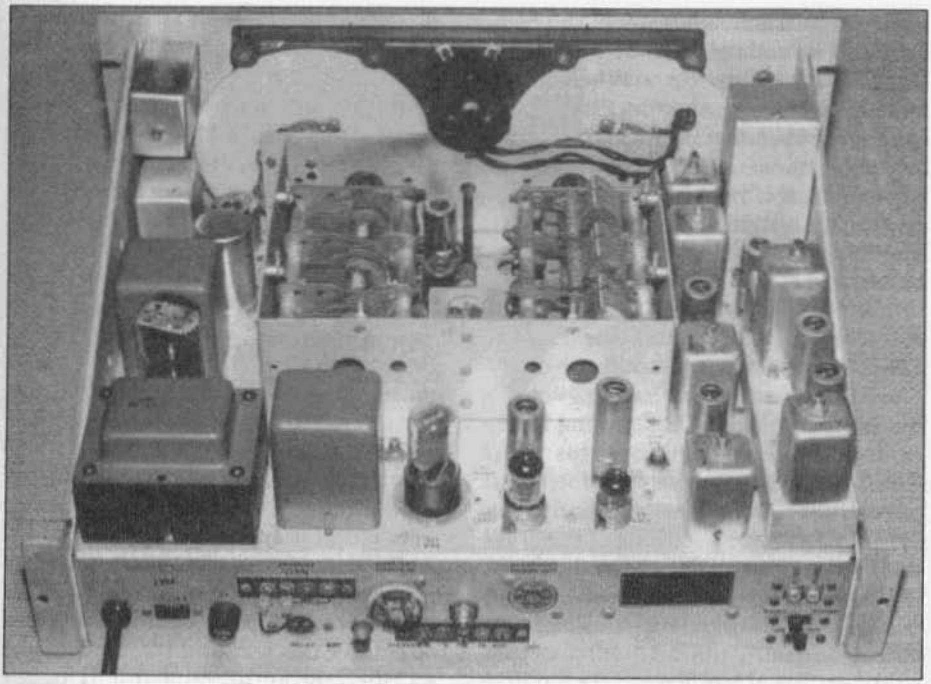
more than operationally, is the lack of resonant tuning in front of the 6AB4; specifically between the broadbanded input transformer and the 6AB4 cathode.

On the two lower bands, the 6AB4 is not used. In this case, RF signals are tuned on the grid and the plate sides of the 6CB6 RF amplifier. Since I don't do any weak signal work on 160 meters nor do I chase broadcast DX, the specified sensitivity of 5 microvolts (it's actually somewhat better than that) on these two bands is not an issue. On the four higher bands, the 6AB4 is inserted between the broadband input transformer and the 6CB6, increasing the sensitivity to about 1 microvolt (an R-390/A it's not). In this case the RF tuning remains only that associated with the 6CB6. To improve image rejection and noise figure, varying stages of high pass filtering are used in front of the 6AB4 RF amplifier, depending on which of the four upper bands is selected. Note: Deciphering the GPR-90 bandswitching arrangement in order to write this article was an exercise that made me better appreciate the simplicity of an HRO.

Physically Speaking

Capable of rack mounting, the GPR-90 has a standard 8-3/4" high, 19" wide front panel. The matching cabinet is 20" wide, 10" high and 15" deep. Together, they weigh 52 pounds. A hinged lid allows easy access to the top side of the chassis. The front panel paint is glossy medium grey and the dial bezel is glossy dark green with a grey-blue tint. Not nearly as dark, the cabinet's green wrinkle has a hint of grey. Red and white silk-screened lettering details the front panel. Overall, the paint quality rivals any I have seen.

The symmetrical front panel is pleasing, with its large main and band spread tuning knobs placed low and nearly equidistant from each other and the panel sides. These knobs have a feel similar to those of an NC-183D and there is more than enough bandspread to easily tune a CW or SSB station. Rotation of the bandswitch knob located between the tuning knobs could, however, replace the tin can opening rou-



A top chassis, rear view. The mechanical design and the quality of components of the GPR-90 are as good as any receiver ever built.

tine in an arthritis commercial. It takes significant effort and this is after lubrication of the entire assembly. Black faced and recessed, the S-meter is centrally located between the two frequency dials.

Other front panel controls are: XTAL PHASING, R.F. SELECTIVITY (actually this is IF selectivity), AUDIO GAIN, ANT TUNE, AUDIO SPREAD, RF GAIN, BFO PITCH and AUDIO SELECTOR. Additionally, there are five toggle switches that control the Send/Rcv function and enable the AVC, Noise Limiter and BFO and Crystal Calibrator. Two small knobs adjacent to the main tuning and bandspread knobs can be used to lock their associated dials.

There are at least three versions of the GPR-90. The earliest had no crystal calibrator. An interim model employed a calibrator mounted on the aluminum plate covering the ganged tuning capacitor. In the later version this function was fully integrated into the design.

The rear apron of the chassis contains an AC accessory outlet, fuse, relay connector, antenna terminal strip, speaker terminal strip, two power connectors, RCA jacks for IF output and phono input and two slide switches that enable/disable the phono input and external single sideband adapter.

In Operation

Although many agree the GPR-90 has great looks, I am often asked, "How well does it work?" To allay any fears that Ozona Bob's comment might have raised, I have experienced no front end overload conditions from either local broadcast stations or adjacent hams, of whom two live roughly 300 and 1200 feet away, and this includes operating 75 meters at night!

As an AM receiver, I give the GPR-90 high marks, the exception being operation on the highest band, where its ten-

continued next page

dency to drift is an annoyance. The crystal filter adequately handles QRM in crowded band conditions. When conditions permit, bypassing the filter yields excellent reproduction of high fidelity AM voice transmissions with the matching speaker which contains a 6-1/2" Jensen Concert driver. Apparently these matching speakers are few and far between so I feel fortunate to have one.

The GPR-90 also receives CW well, again unless you are on the highest band. There its drift reminds me of my Novice days when my hand never got too far from the SX-140K tuning knob. In an attempt to minimize this drift, K6VOI added a separate transformer to power the HFO filament constantly. The 250 and 500 cycle positions of the crystal filter combined with the audio peaking filter work well in a crowd. When using earphones, however, the loud pop associated with the activation of the peaking filter is unpleasant. This pop is a result of charging the capacitors in the filter that happens to reside in the plate circuit of the first audio amplifier. The reason why this filter was not installed on the grid side of the coupling capacitor escapes me.

The GPR-90's SSB performance is poorer than most product detector-less receivers. As usual, due to inadequate BFO injection, the RF gain must be reduced in proportion to the received signal strength to avoid distortion. Increasing the value of the BFO coupling capacitor is mentioned in the manual as a way to improve SSB reception. While doing so helps, it compounds a problem I have yet to solve in my receiver.

The problem is unwanted phase locking of the BFO to the most significant signal present in the IF bandpass. When dealing with a carrier, this manifests itself as the inability to smoothly achieve zero beat. As you approach zero beat, the BFO will suddenly phase lock to the carrier, causing zero beat to occur instantaneously. If you continue to tune through this now 'silent frequency window' towards and past the actual zero beat point, the received note will miraculously reappear on the other side at about the same pitch it was when it first disappeared. The width of this silent window can be from tens of cycles with weaker signals to a few kilocycles if the signal strength and RF gain control setting are both high. With judicious use of the RF gain control, however, the tuning of CW signals is not difficult. Decreasing the BFO coupling capacitor reduces, but does not eliminate, this phase locking tendency.

Initially I thought this behavior was specific to my receiver. Upon further investigation I learned of its presence in two others and its absence in a third. At this point I do not know if this malady is a result of alignment, component aging or something else. Should your GPR-90 behave this way and you are without a GSB-1, the addition of an FET buffer between the BFO and the last IF stage should provide the isolation necessary to stop the phase locking. While you are at it, unless your buffer provides gain, you ought to increase the BFO coupling capacitor to about 50 pF to improve the SSB demodulation. An important benefit of the buffer is the elimination of any distortion caused by the BFO trying to lock to the multitude of varying IF frequencies present in an SSB signal, the mathematical analysis of which would be mind boggling.

What's a GSB-1?

Knowing the SSB shortcomings of their GPR-90, as well as other receivers of the era, TMC introduced the GSB-1 Single Sideband Adapter around 1957. This unit duly compensates for the SSB inadequacies of its companion receiver and having one obviates the need for the modification discussed in the previous paragraph. Occupying just over half the volume of the GPR-90, the GSB-1 weighs 27 pounds, a result of its self-contained power supply. The cabinetry

The TMC GSB-1 sideband adaptor

and paint scheme perfectly match that of the GPR-90.

Signal flow through the GSB-1 is simple. A 455 Kc IF signal obtained from the receiver is first amplified by a 6BA6. The output of the 6BA6 feeds a 6BE6 converter that receives either a 438 or 472 Kc signal from a 6AG5, thus converting the 455 Kc energy to the 17 Kc range. The down converted IF signal goes to a band-pass filter having bandwidths of 2.5 Kc (-6 dB) and 3.5 Kc (-50 dB). The 438 and 472 Kc signals are continuously adjustable up or down by 3 Kc which allows the IF signal be moved around within the passband of the 17 Kc filter as required. Used in conjunction with the GPR-90 crystal filter this really helps deal with heavy QRM. A 6BE6 product detector converts the now-filtered 17 Kc IF signal to audio using a 17 Kc signal provided by a 12AU7 oscillator. The recovered audio passes through to a 3 pole low pass filter attenuating everything of significance above 5 Kc before it meets a 6AL5 peak noise limiter. The audio is then amplified by a one half of a 12AT7 and a 6AQ5 power amplifier. As in the GPR-90, the audio output transformer has taps of 600, 16, 8 and 4 Ohms. Improved AVC performance is provided by one half of a 12AU7 that amplifies the 455 Kc IF signal before a 1N34 rectifies it for feedback to the 6BA6 grid for gain control. The two AVC recovery speeds of about 0.5 and 0.125 seconds are front panel selectable as is the provision to disable the function.

The GSB-1 may be used with the GPR-90 in three ways. Its low level audio output can be applied to the GPR-90 phono input, allowing the use of its heftier 6V6 audio stage. This method requires manipulation of two switches on the back of the GPR-90 that enable the GSB-1 and the phono input. Another method is to parallel the secondaries of their output transformers while using a common speaker, thus eliminating the awkward reach. In the third method, individual speakers are merely driven separately by each unit.

Conclusion

If I could have but one receiver for amateur use, it would definitely not be a GPR-90, even if it had an accompanying GSB-1. Why? There are much better receivers available that cost less and take less space. On the other hand, mine will continue to be an integral part of my `Cadillac Station' unless something very spectacular comes along. That said, should one be available and you have the required desk space, you'll not likely regret the acquisition. Just don't forget to look for the more elusive GSB-1. **ER**

A Brief Interlude at W6BB

by Don Meadows, N6DM
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Whiskey Six Bravo Bravo—these phonetics for the club station located on the Berkeley Campus of the University of California touched rather well the 1950 life-style of the young university undergraduate. Whiskey indeed played a role now and then. Today the two Bravos hark back to the cheering enthusiasm constantly erupting during home football games when PAPPY Waldorf's men, coached to a level of excellence that acknowledged no concept of defeat, mastered all opposition and gave glory to the big university.

The humble community-college transfer student to the big university was elated. He found himself at age 20 in a new environment where new people, new ideas and new experiences almost daily stimulated a reshaping of prior reality. This new life made him thrive on the here and now. He took notes only in class. He was too busy otherwise to bother recording on paper other personal impressions, such as those relating to girls and radio, impressions part of his new life, impressions filed forever in memory. Only some impressions relating to radio will be treated here—recollections recorded as brief fragments extracted from a former time continuum.

The Berkeley Campus of the mighty University of California was known in 1950 for its excellence in football, in nuclear physics and in a couple other fields of lesser interest to the public. In that year, W6BB had achieved no excellence in contesting or in DXing feats; its existence was significant only to the small circle of its users.

W6BB was located in an upper-story room of the men's gymnasium, an edifice of solid masonry which abutted a large athletic field. Atop the building stood a three-element 20 meter beam. Its rooftop tower was about 20 feet tall. Pointed to the east, the beam's pattern bumped into the Berkeley Hills about a mile away. On HF, W6BB used a BC-610 transmitter attached to a Meissner Signal Shifter VFO. The receiver was a Hammarlund Super Pro. There were also several other units scattered about the shack. They looked like war-surplus VHF equipment and thus didn't arouse interest in the undergrad whose ham experience in 1950 had so far touched only the HF bands.

On the bands below 14 MHz, W6BB used a center-fed dipole fed by coax. Newcomers to the station accepted this statement by the older users on faith because it was impossible to see exactly where the coax cable ran. On the wall near a window was mounted a tank circuit from which a coaxial cable exited through the window and then disappeared. According to the older hams, the station regulars, this cable ran underground across the athletic field and terminated itself upwards into a wire strung between bleacher light poles on the athletic field's far side opposite to the station, too far away to be seen by the naked eye.

One of the regulars, a graduate student from the Republic of South Africa, commented that this antenna was always hard to load and never got out well. His English had an accent that the undergrad had never heard before, distinctly British yet somehow different, which the South African sometime later explained as the influence of Afrikaans, a dialect which he spoke at home, derived from Dutch. He said his random end-fed wire on 40 meters did a better job with 25 watts from his home town of Durban than the university's BC-610 into its faraway dipole across the playing field. Anyway, no one at W6BB that year seemed clear about which band this faraway dipole was cut for, or whether the feeder connection to the antenna was still intact. Perhaps this was one reason why all HF activity at W6BB seemed to focus on 20 meters.

In 1950 the sunspot numbers were still high enough to support regular DX contacts across the country and around the world on 20 meters. The shack at W6BB was usually busiest on Saturday mornings. The men's gym remained open in order to provide practicing athletes access to showers. Most students had no classes on Saturdays, so a few hams found this a prime time to utilize W6BB, especially since they could work Europeans on 20 meters during the morning opening from the West Coast.

It seemed that every time the new undergrad showed up at W6BB, the South African ham was already there, always ready to share his superior knowledge of the station based on his experience gleaned during his previous semester on campus. Other hams with even more seniority as users sometimes briefly monopolized the station with schedules on 20 AM phone with their home towns in the eastern States. Each schedule lasted only minutes because others were waiting in line. Every operator enunciated the station's old-style standard phonetic identification slowly and clearly at the beginning and end of each transmission: "Will-i-am 6 Ba-ker Ba-ker." No one seemed willing to just say "W6BB." Maybe the young, sophisticated schedulers feared that without phonetics they might betray their inexperience to the radio world that was surely listening. Maybe they feared that "BB" would be heard in the outside world as "Pee-Pee," a term nice people didn't then speak in public. While this went on, the undergrad and the South African quietly stood aside, watching and waiting.

One Saturday morning the undergrad entered the W6BB shack and found no one there except the South African, who was tinkering with a piece of test equipment. The BC-610 filaments and the Super Pro receiver had been turned on. The BC-610, as usual, was set up on the AM portion of 20 meters. The undergrad sat down and started tuning the CW portion of 20 meters on the Super Pro; CW was his familiar mode. He lacked funds at home to build a modulator. On that Saturday morning, 20 CW was wide open to Europe. It was a new experience for the undergrad whose home-station receiver was a Hallicrafters S-40A coupled to a center-fed Zepp antenna. Suddenly, he was hearing European stations robustly calling CQ or working stations up and down the CW band. At home, he heard such activity very faintly if at all, and his 807's 60 watts into his Zepp antenna had never connected with a European. But now he sat before a first-class receiver at W6BB together with the awesome power gain of the BC-610—ten decibels, now at his disposal. And he also wielded even more power gain through the 3-element beam. Oh, what ecstasy!

But the bonus feature of controlled antenna directivity almost escaped him. Glancing at the beam's heading indicator, he saw that the beam was pointed due east, directly into the Berkeley Hills. As the beam slowly rotated toward north, he heard the Europeans gain in strength but then gradually decrease as the beam passed through due north and began aiming west. The undergrad's vague understanding of great-circle propagation probably made clear to him why this was so. He made the beam head back toward the east and found that the Europeans peaked a few degrees east of north.

Being unfamiliar with the BC-610, he asked the South African how to peak the transmitter on the low end of 20, which the South African did gladly, probably flattered that someone required his expertise. He tweaked the controls of the BC-610 with cool confidence. The undergrad now set out to work Europeans on 20 CW, but not too rapidly because he had trouble copying

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Ten Years of Questions

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Over the years I've gotten many letters from readers with questions about the test procedures and equipment mentioned in my articles, and I've come to realize that many readers may not be familiar with these practices. In restoration or conservation of vintage radio equipment, measuring or optimizing receiver sensitivity is not something we are usually concerned with. However, there is a small minority of hams (all 5 of us) who are still building receivers, or modifying existing equipment for higher performance. In these cases, good information is required to finish the work. I have assumed that most ER readers are seasoned radio veterans who are familiar with the work. This has turned out to not necessarily be the case. This article will hopefully fill in some of the holes.

Probably the number one reader question is "what does ENR mean, anyway?" Well, equivalent noise resistance (ENR) is not a quantity that would ordinarily be measured at the bench. Instead it is a 'yardstick' that was designed over 50 years ago to compare the noise performance of tubes when used as amplifiers or mixers. The comparison was done in terms of current ratios and mutual transconductance.

In an ordinary resistor, random noise is produced by thermal agitation of molecules in the resistor's material during current flow. Random noise in a tube is frequently referred to as shot noise, or the noise produced when an electron, having been accelerated from the hot cathode, strikes the plate or something else in the envelope: a grid element, a support rod, a mica wafer, or whatever. Shot noise in a large glass-envelope triode can be very high if the cathode current is maximum because the electrons can reach high velocities. In energized pentodes and tetrodes there is a "space charge" of energetic particles (ions), which surround the screen and suppressor grids. Space charge cushions the impact of the electron stream, and reduces shot noise. This is why small-signal RF amplifier tubes with close-spaced frame grids are quieter.

The noise produced by a tube with a given transconductance at operating values of plate and screen current is expressed in terms of equivalent thermal noise of an imaginary resistor in parallel with the grid circuit—hence "ENR". ENR is developed by an approximation. Assume that the resistance in the grid is increased from zero to some value that causes the power output of an amplifier to just double. Under this condition, the tube and the resistor contribute equal amounts of noise. The value of the resistor is the noise rating in ohms of the tube in the amplifier circuit. That's why we say a tube has "noise resistance". Because the noise voltages of the resistor and the tube add on a RMS (power) basis, one is able to state, for example, that amplifier "A" is 3 times quieter than amplifier "B". Because we are using RMS units, there is no possibility of peak voltages adding and influencing the results.

Fairly simple arithmetic was used to calculate ENR. There was the MIT method and the Radiotron method, designed by RCA. The differences are not significant. I use the Radiotron formulas because they are simpler. For triodes, ENR = 2.5/gm. For pentodes, ENR = (Ip/(gm X Ik)) X [2.5 + ((20 X Ig2) / gm)]. (X = multiplication, gm = transconductance, Ip = plate current, Ik = cathode current, Ig2 = grid #2 current). From these equations it becomes apparent that a high value of transconductance and a small value of screen current become desirable. This is exactly what is found in some of the high performance tubes made at the end of the era when ENR values around 200 or less were not uncommon, versus 20,000 to 30,000—or more—as seen in circuits of the 1930s. The use of the ENR may seem arbitrary, but it is useful in thinking about low-level RF input stages. For example, in a typical HF receiver front end, an extremely small signal is available from a fixed source resistance (your antenna) at the typical range of temperatures found on our planet. Nothing in conventional physics can be done to improve the signal-to-noise ratio with respect to the voltage drop across the antenna, as I showed in my article on the MacKay 3010 receiver [ER #94, February 1997]. However, the voltage increase seen across a tuned step-up antenna input transformer will make the signal/noise ratio very large with respect to the tube noise in the first stage, if the tube is quiet. If the ENR is low the tube only amplifies, and doesn't add detectable noise. This is one of the reasons why a receiver with a high-Q tracking front end always has a performance advantage over the band-pass input circuits which are now in fashion, especially with inefficient antenna systems.

Question number two has got to be "What is all this dynamic range stuff, and why should we care?" All I can answer is the first part! Dynamic range describes how a receiver behaves when you are trying to pick one signal out of many, and all the signal strengths are different and unpredictable.

The 2nd and 3rd order dynamic range numbers measure the level of interference created inside the receiver. They are not originally present at the input. Blocking is similar, but describes how a receiver acts in the presence of strong signals, which should be there, like your Kilowatt buddy 1/2 mile away!

2nd and 3rd order products are spurious signals created in any non-linear circuit element, sometimes deliberately as in the case of a mixer stage. If there is assumed to be two frequencies F1 and F2, separated by a given amount at the input to a receiver, second-order products are produced at F1 plus F2 and at F1 minus F2. Third-order products are produced at 2F1 plus F2, 2F1 minus F2, F1 plus 2F2, and at F1 minus 2F1. Second-order mixing products are stronger, but in good receivers they frequently fall outside the filter passband. Third-order products are a bigger problem because they can fall right in the IF passband.

Analysis of the function describing mixer action shows that there is an unlimited number of mixing products that could be produced. However, it is conventional to only be concerned with 2nd and 3rd order products as the others have levels which are so low so as to not be a problem in receivers of reasonable quality. It can also be shown that by describing receiver performance in terms of 2nd and 3rd order mixing products, the receiver is characterized for any number of input signals.

Blocking describes how a signal you want to receive decreases when a strong, nearby signal comes on the air. Blocking is a severe problem with many vintage receivers. In comparing dynamic range numbers, you have to be sure of the method of measurement, as there is no standard. Two people might measure the same receiver with the same equipment, get different numbers, and both be right! Unless one knows how the tests were done, and what the decibel numbers are referenced to, the results don't mean much. This fact has caused me problems with ER readers. One quick and easy way to improve both types of dynamic range problems, without modifying anything, is to simply make an external 10dB attenuator pad. Build it into a shielded box, and add a cut-out switch. When the attenuator is in-line, 3rd-order dynamic range will go up by 3 X 10dB, and blocking will be reduced by at least 2 X 10dB.

continued next page

"What kind of signal generator to get" is also among the top ten questions. Unless you are rich, the good old military URM-25D, E, or F are my favorites. They have their limitations, but there is much in their favor. Mine are stable soon after turning on, have a wide range of coverage, and have flexible internal modulations. Changes in output voltage don't change the output frequency. They are compact and don't take much space on the bench. Disadvantages are that they leak RF like crazy, and the output calibration is meaningless. For everyday work it doesn't need to be! For the times when level needs to be known, you'll have to terminate the generator with 50 ohms and measure the 100K µV output range with a calibrated scope. The desired output level can be reached with step attenuators, easily home built and calibrated. I've had 3 or 4 URM-25s over the years and usually there was one or more of the internal attenuator positions that didn't work, probably from rough use in the service. If you prefer something a little nicer, look for the HP-600 series generators. They can be found for a few hundred dollars and are probably worth it.

Other generator questions have concerned terminations. If a generator is rated for 50 ohms unbalanced output, then a receiver with a 50 ohm input is the proper generator termination. Do not use a feed-thru termination between the generator and the receiver unless you want all the levels to be down by 6 dB! I was also asked why a generator delivers maximum power when terminated in its characteristic impedance. I don't think the numeric solution would be generally interesting. It can be shown that the familiar equation P=I^2xR can be a function of the generator internal resistance and the load resistance. If the function is differentiated, power approaches maximum as terminating resistance approaches maximum.

I get probe questions, too, mainly of the variety "how does my probe change a circuit measurement, or why can't I measure the same voltage the book says?" In a DC circuit the probe impedance acts like a parallel resistance. If a grid circuit has maybe 470K across it, a 10M probe would reduce the grid resistor to the parallel combination of 10M and 470K. The situation is different in an AC circuit because the probe acts like parallel impedance at low frequencies or a complex combination of series and parallel impedance at high frequencies. You must know the rated capacitance of the probe in order to find reactance at the frequency of interest. Knowing reactance, the probe impedance is calculated from the formula for parallel impedance with a resistive component. Probes used to come with graphs showing probe impedance vs frequency; the manufacturer should be consulted in any case. At any rate, most RF probes have around 5 pF of capacity. Since this is relatively standard, any measurements you make should agree within 10% of what someone else measures, which is good enough. It also helps to remember that the book voltages and resistances are approximate, within about 10 to 20%.

Sometimes a circuit will stop working when it is measured. This is usually the case with oscillators. In many designs, conditions are established for maximum stability by using very light amounts of loop feedback. Direct connection of even a high-impedance probe will decrease feedback enough to cause the oscillator to quit. If this happens try clipping the probe around an insulated piece of wire in the circuit under test. This forms an extremely small capacitor that picks off enough of a signal to measure with results that will be consistent. (If the circuit is buried, remove the tube shield and try a loop of wire around the tube envelope. Clip the probe to the wire.) In the industry, special FET probes or cathode follower probes are used to reduce the shunt effects of probe capacitance but they are expensive and hard to find used for a good price.

What is the best way to measure small RF voltages? A good oscilloscope! Don't depend on RF probes used with VTVMs to measure small amounts of RF. Hand capacity can introduce large errors into the measurements. I've seen results vary 50% by just holding the probe differently. Invest in a good oscilloscope with at least 100 MHz bandwidth, get a good compensated probe, and learn how to use them. This investment will repay many times.

Now that sweep generators regularly appear on the used market, questions have had to do with the proper way to sweep tuned circuits. It is important to not overload the circuit under test with too much input signal. Overloading will distort the response curve. It is also important to use as slow a sweep speed as possible to avoid errors caused by waveform integration. (The tuned circuits tend to act like R-C filters.) A narrow crystal or mechanical IF filter might need a sweep speed as low as 1 cm. per second (and a storage scope) to show accurate passband details. To sweep an IF amplifier, connect the sweep output to the input grid of the first amplifier. I usually connect my detector probe to the input of the SSB detector stage, avoiding the plate circuit of the last amplifier altogether. Turn the receiver AGC off and RF gain fully on. Make the detector sensitivity as high as possible to start with, and use the minimum output possible from the sweeper to avoid distortion. Increase the sweeper output level until a reasonable trace height is obtained. It is usually real easy to see when you are overdriving the circuit. The response curve will start to show overshoot where the response curve transitions from vertical to horizontal, or the top of the curve will start to round off. Check the operator's manual to see if blocking capacitors are needed with the sweeper probes. Also, ordinary X1 scope probes make good sweep output probes.

With the right equipment it is not difficult to measure receiver sensitivity and compare it with the manufacturer's spec sheet. What is probably more interesting is to see what happens to that published figure when the receiver is actually in use, connected to your antenna system. Called effective sensitivity, this test is a good way to compare actual performance. In addition to a signal generator, you will need a 2-port combiner. These are easily made from torroid cores, see the references at the end of this article. What the combiner does is combine the receiver, the generator and the antenna at 50 ohms during the test so that the effects of adding the antenna can be measured, as outlined below:

1) The combiner will have ports for the antenna, the signal generator, and the receiver. Connect the dummy load to the antenna port, the generator and receiver ports to their ports.

2) Measure receiver sensitivity as explained above, and note the generator reading in dBm. If your generator only has a microvolt scale, determine dBm by dBm = 20 X LOG (generator reading in <u>volts</u> / .001).

3) Remove the dummy load and connect the station antenna. Measure the sensitivity again. Subtract this reading from the first reading. The result is dB of environmental degradation. To get effective sensitivity, subtract the sensitivity in this step from the sensitivity measured without the combiner. If you want a real surprise, compare a high-quality vintage rig to some imported rig! (To be honest, they are getting better than they were a few years ago.) **ER**

Further Reading

Standard Radio Communications Manual Kinley, Prentice Hall Electronics Library, 1985 edition. I hope this book is

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KOA's 50 KW Xmtr

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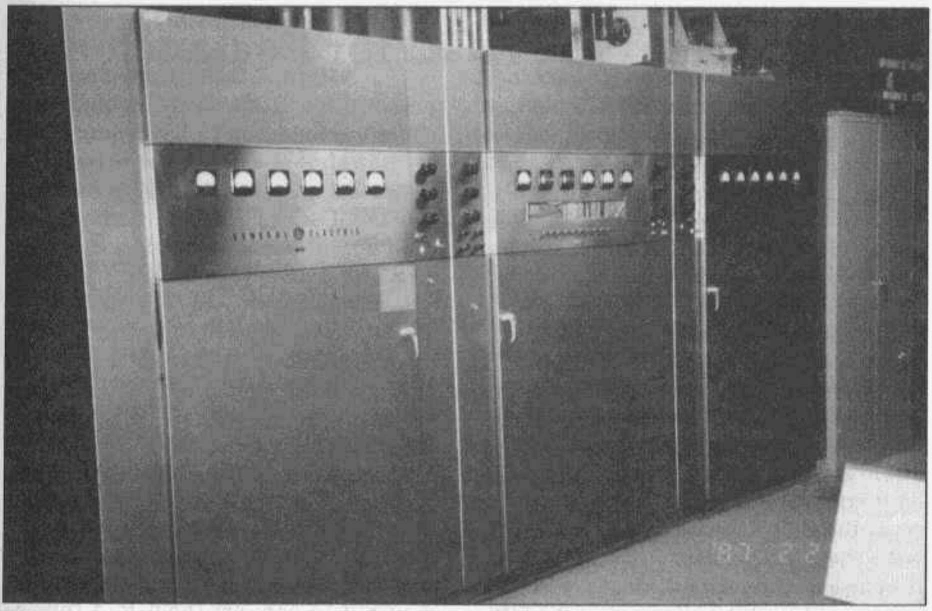
It's been ten years, eh? There certainly have been a number of changes in my own life since ER #1 hit the mailboxes, most of which account for my own recent non-presence here. Among other things, raising a pair of grade school children, purchasing a small ranch and other projects has certainly reset my priorities, but not my fondness for our venerated boatanchors. Fed up with corporate "right-sizing" at the electric utility where I was a telecom specialist, I chose to go back into broadcasting where I am currently the chief engineer for Boulder's 100 KW KBCO-FM and 5 KW KVCU-AM. These are exciting and busy times for many broadcast engineers. Many of us are involved in the transition to digital networking and facilities, changes as significant as those that implemented those huge networks of the glory days of radio in days gone by.

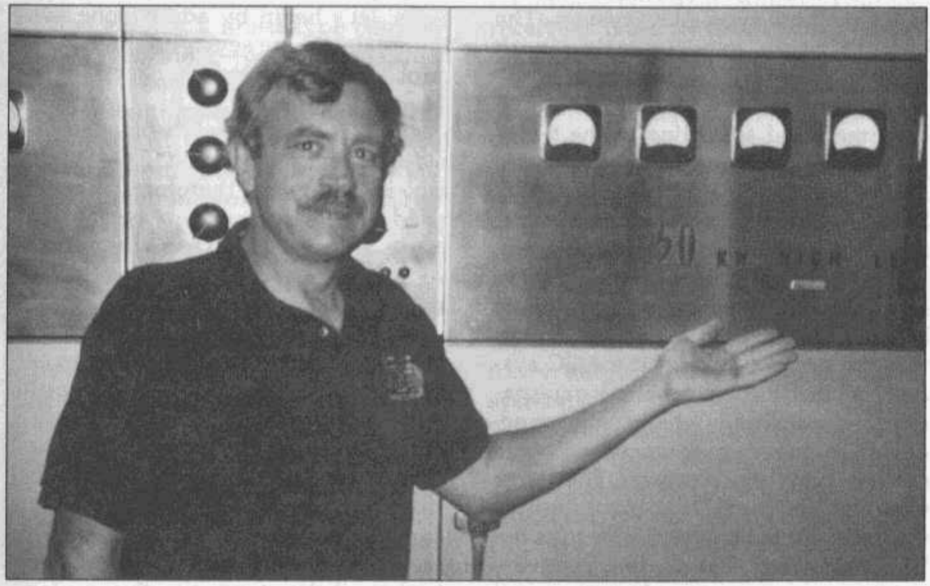
In spite of all the industry changes, one thing remains a constant—the RF plant and facilities need to hurl voices and music into the ether. I was recently involved in the decommissioning of one of the last 50 kilowatt plate modulated broadcast transmitters on the broadcast band, one used by the legendary KOA, 850 KC on your radio dial in Denver. In semi-retirement, largely used as a backup since 1976, the 50 KW General Electric finally needed to go to make room for a new digitally-modulated Harris DX-50 that would become KOA's new mainstay.

My comments here should really start with a history of Denver's KOA. First licensed in December, 1924, it originally went on the air with 2,500 watts on 325.9 meters (That's 920 Kilo "cycles" to you newcomers). Soon after, licensed power was increased to 12,500 watts, where matters stood until 1933, the year Federal authorities reorganized the stations on the AM broadcast band. In early 1934, KOA moved to new facilities some 20 miles east of Denver at Colfax Avenue and Tower road, QSYed to the newly allocated class 1 clear channel frequency of 850 KC, and increased power to 50 KW. The history of the GE transmitter begins in 1958 when an expansion of nearby Buckley Airfield for the military forced a move to the present site near the town of Parker, Colorado, southeast of Denver. As part of the move, the presently used 5/8 wavelength vertical and the GE 50 KW were installed by the then engineer, Lee Edelmeier. There were several unique aspects of that first installation that are of interest. In those pre-Heliax days, the tower-to-transmitter feedline was a form of "open wire", or virtual unbalanced coaxial arrangement consisting of an insulator-supported center conductor surrounded by a four grounded conductors in a foot square box arrangement. Several of the insulators still remain on top of their ten foot support poles. The transmitter was directly fed with 4,800 volt distribution voltage from the electric company, a plan that necessitated a diesel backup generator with a corresponding AC output voltage!

The overall design of the transmitter was, on paper, conventional, or as a friend put it, "Just like a Viking 1, but bigger". Of course, the items of main interest are the now obsolete king sized modulation transformer and reactor. Interestingly, the present modulation transformer was manufactured by Peter Dahl. GE used push-pull pairs of forced-air cooled glass insulated external anode Machlett/Raytheon 6427 triodes for both the RF finals and modulators. The drivers for the modulators were a push-pull parallel pair of 304TLs,



This 50 KW GE transmitter went on the air in 1958 at radio station KOA Denver.



The author with the GE 50 KW, which a friend described as "Just like a Viking I, but bigger".

making this the only commercial broadcast transmitter I'm aware of that incorporated my favorite all purpose bandblasting triode! The driver for the RF finals is a now obsolete and impossible to find external anode triode made by Westinghouse. The external transformers and power supply were housed in a

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Threshold-Type AGC for Boatanchors

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This article began life over a year ago as *"New Hope for your Heathkit Mohawk Part Four."* Really, though, it is about applying the principles of modern threshold-type AGC systems to old boatanchors. The circuits presented in this article are based upon the Mohawk, but that is simply because the Mohawk happened to be the rig I was working on at the time I decided to experiment with these principles. In short, it was the closest victim and the lucky winner.

You will find it quite easy to modify most old receivers to gain the benefits of a threshold-type AGC system. The idea to begin experimenting with threshold-type AGC systems came about as I used my Mohawk that had been modified according to the three-part article series published in Electric Radio [Part 1 - ER#103 November 1997; Part 2 - ER#104 December 1997; and Part 3 - ER#105 January 1998].

The modifications presented in these articles had indeed corrected a whole host of nasty AGC problems, yet I found that the performance of the AGC system still did not live up to my expectations—expectations which had been acquired using numerous other more modern tube-type receivers. There was something missing. Upon investigation, it turned out to be what I refer to as the *"threshold effect"* that modern receivers employed in their AGC systems—and old boatanchors did not—which accounted for the difference in performance. ("threshold effect' is my term for its modern radio engineer would probably call it something else).

Different manufacturers seem to have made the transition to this more modern type of AGC system at different times during the late 50s. Some manufacturers caught on to it sooner than did others. You will find that nearly all receivers manufactured before the mid-50s lack a threshold-type AGC system. My Collins 75A-1, and National HRO-50 and HRO-60 are good examples of receivers that still use the older linear-type AGC system, and they benefit greatly from the simple modification required to convert them to a threshold-type system.

So, let's begin by adding one more complaint to the seven original design problems presented in Part 1 of the Mohawk series:

#8 IF GAIN lacks the benefits of a threshold-type gain control. The IF GAIN control is linear and therefore cannot be used to effectively reduce background noise and static crashes without also reducing the audio level of desired signals.

Now to avoid a point of confusion, we should distinguish between receivers that have a single RF GAIN control, and those that have separate RF and IF GAIN controls. The gain of the RF and IF stages in most receivers is controlled from a single RF GAIN control. A few expensive receivers provided separate control of the RF and IF stages. Combining all the stages together under a single control was usually done to save cost. If your receiver has separate controls, the following discussion should only be applied to the IF GAIN control (as will be explained, in receivers with separate controls the RF GAIN should be implemented as a linear-type control).

Threshold-type AGC Benefits

A threshold-type AGC control system is employed in nearly every modern ham transceiver made today and is easily recognized by the fixed S-meter reading that increases as the RF GAIN control is reduced. Certainly one benefit of a threshold-type control is the fact that it provides visual feedback. Just one look at the S-meter will tell you how much the RF GAIN control has reduced the gain of the receiver. This visual feedback, however, is only a minor benefit provided by a threshold-type control. The primary benefit that is provided by a threshold-type AGC system is how the RF GAIN control can be used to reduce background noise and static crashes without decreasing the volume level of desired signals.

The RF GAIN control will, on receivers that employ a linear-type control, reduce everything—both signals and noise—in a completely linear fashion. From a listening perspective, the effect of using the RF GAIN control on these receivers is not much different from turning down the volume control. The primary use of the RF GAIN control in these receivers is to reduce overload on strong signals. It isn't very effective at eliminating background noise because it also tends to reduce the volume level of desired signals as well.

In contrast, in receivers that employ a threshold-type control, the RF GAIN control acts just like a threshold, or signal floor. Signals and background noise that fall below the manually set threshold are all reduced in direct proportion to the setting of the RF GAIN control. This is easily observed by noting that signals that fall just below the manually set threshold do not cause any movement of the S-meter, even though you can still hear them. Signals that are strong enough to exceed the manually set threshold voltage, however, will generate sufficient AGC voltage to further reduce the receiver's gain by an amount that exceeds the threshold. These strong signals will therefore cause the S-meter to kick above the manually set threshold.

The threshold-type system is inherently nonlinear. Below the manually set threshold, there is effectively no receiver AGC, while above it there is AGC.

Because of the threshold effect, the RF GAIN control can be effectively used to reduce background noise and static crashes, while allowing reasonably strong signals to come through without any noticeable reduction in volume. Receivers that use a linear-type AGC system cannot offer this advantage, because there is no threshold—all signals are reduced by the same amount.

Check a Few Receivers

Before proceeding further, take a moment to check out some of your old receivers. It is easy to tell which type of system has been employed, just by sitting in front of it. You do not even need to pull out a schematic. All you need to do is adjust the receiver's RF GAIN control (or the IF GAIN control if your receiver is equipped with separate controls) while observing the S-meter. If adjusting the RF GAIN control has no effect on the meter's reading other than to reduce the signal strength of incoming signals, then your receiver most likely employs a linear-type control system.

If, on the other hand, adjusting the RF GAIN control raises the S-meter a fixed amount as the RF GAIN control is reduced, then your receiver most likely employs a threshold-type control system. This simple check works because in most receivers the S-meter actually measures the AGC control voltage line (or its proxy) which feeds the RF and IF stage grids. The S-meter thus gives you a good clue as to which type of system has most likely been implemented in your receiver.

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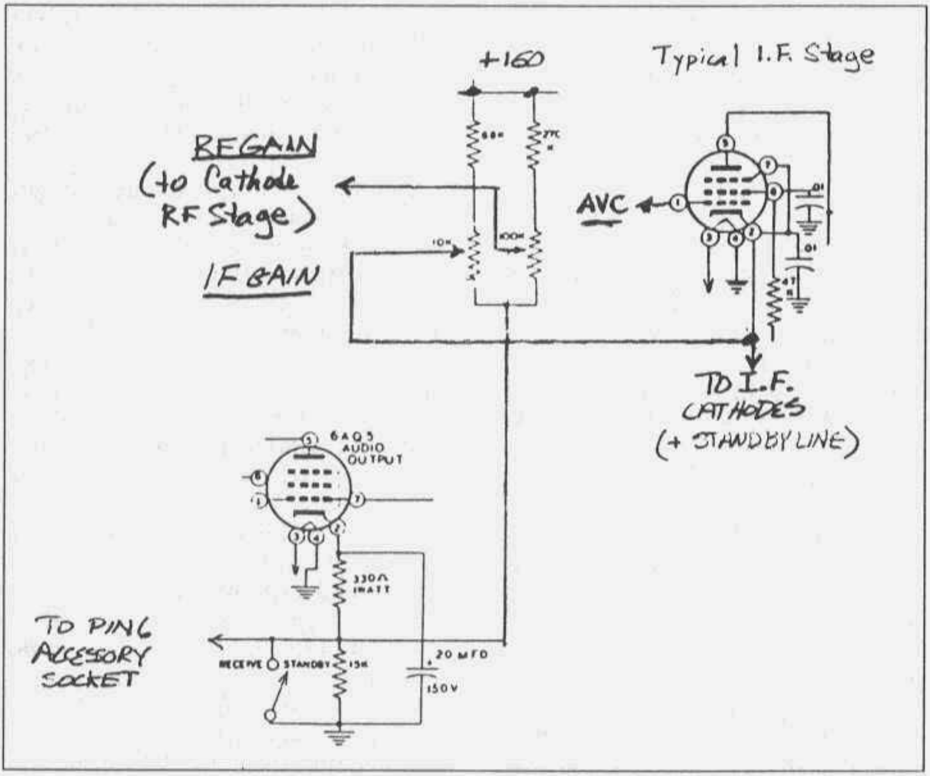

Figure 1. Stock Mohawk uses different tube elements to control stage gain. The problem is that this results in a logical "AND" function, so there is no signal threshold effect.

Common Circuit Implementations

There are two different approaches engineers have used over the years to implement the RF GAIN control. The primary difference between the two approaches lies in how the AGC control voltage and the manual control voltage are each fed to the RF and IF stages.

For purposes of the ensuing discussion, when the RF GAIN and AGC control voltages are each applied to a different tube control element, it is called a "*linear-type*" control. Accepted design practice until the mid-50s or so was to apply the RF GAIN control voltage to the cathodes of the gain stages, while applying the AGC voltage to the grids of those same stages. The effect of feeding the AGC and RF GAIN control voltages to different tube elements is that they combine within the tube in a linear manner with respect to their effect on the output of the stage.

The other way of implementing gain control in a receiver is to mix the DC control voltage from the RF GAIN control with the AGC control voltage from the AGC detector and then apply the mixed voltage to just one tube control element in each gain stage. This produces a "*threshold-type*" control system. Accepted design practice beginning sometime in the mid-50s was to apply the mixed control/AGC voltage to the grids of the gain stages (no control voltage is applied to the cathodes).

The effect of combining the AGC and RF GAIN control voltages and then feeding them to just one control element will depend entirely on how they are mixed. Most systems mix the voltages so that they will produce a non-linear response in the AGC system—and therein lies its distinct advantage. This type of system requires a few more components, but properly mixed, will produce the much-desired threshold effect.

Now, go back to your receiver, take out the schematic and look at the control voltages being fed to the IF stages. If the AGC voltage is fed to the grids, while the RF GAIN control is fed to the cathodes, your receiver employs the older linear-type AGC system. If the AGC and RF GAIN control voltages are mixed and then applied only to the grids of the gain stages, your receiver employs the more modern threshold-type system.

Think in Terms of Analog Logic

It is useful to think about the two different systems from the perspective of analog logic to help understand why the systems sound so different. First, consider the linear-type AGC system. The linear-type circuit described above produces a logical 'AND' within the gain control tubes themselves. In this case, the output is directly proportional to both the AGC voltage AND the manual RF GAIN control. Unless a signal is very weak, the receiver is always under the effect of the AGC voltage being generated.

Next, consider the threshold-type system. One of the most common and most desirable approaches produces a logical 'OR' circuit (there are many different ways to mix the AGC and RF GAIN voltages in a threshold-type system). In this case, the control voltage (and therefore the control voltage output) will be <u>either</u> the AGC voltage OR the threshold provided by the RF GAIN control, <u>whichever is greater</u>. The AGC control voltage has no effect below the manually set threshold. The beauty of this approach is that it can be implemented with a simple diode 'OR' gate as shown in Figure 3.

Threshold AGC For The Mohawk

OK, let's look at the implementation in the Mohawk as an example. Given the long list of its original shortcomings, one of the great ironies of the Mohawk design is that Heath chose to go to the added expense of offering separate RF and IF GAIN controls. Go figure. As might be expected, though, Heath's implementation did not really capitalize, like it could have, on the advantages that separate RF GAIN and IF GAIN controls can offer.

The problem is that both controls were implemented as linear-type control systems. Take a look at Figure 1 and you will see that the AGC control voltage was fed to the grids while the RF GAIN and IF GAIN control voltages were fed to the cathodes of their respective stages. The optimum implementation would have been to design the <u>IF GAIN as a threshold-type control</u> while leaving the <u>RF GAIN as a linear-type control</u>.

There are advantages of using a mixed configuration of different control systems for each gain control. First, as already discussed, a threshold-type control system will allow the IF GAIN control to offer the advantage of being able to reduce background noise and static crashes without reducing the volume of stations which exceed the threshold. Second, retaining a linear-type control system for the RF GAIN control comes in very handy when you are having a QSO with a ham who lives very close by and also with a third station who is just barely above the noise level. In this case, the RF GAIN can be used to cut down on front-end overload from the strong station (lets say at +60dB/S9), while allowing the weaker station to still be heard.

It is much more work to carry on a QSO of this type when using a receiver without separate RF and IF GAIN controls. It is often necessary to manually

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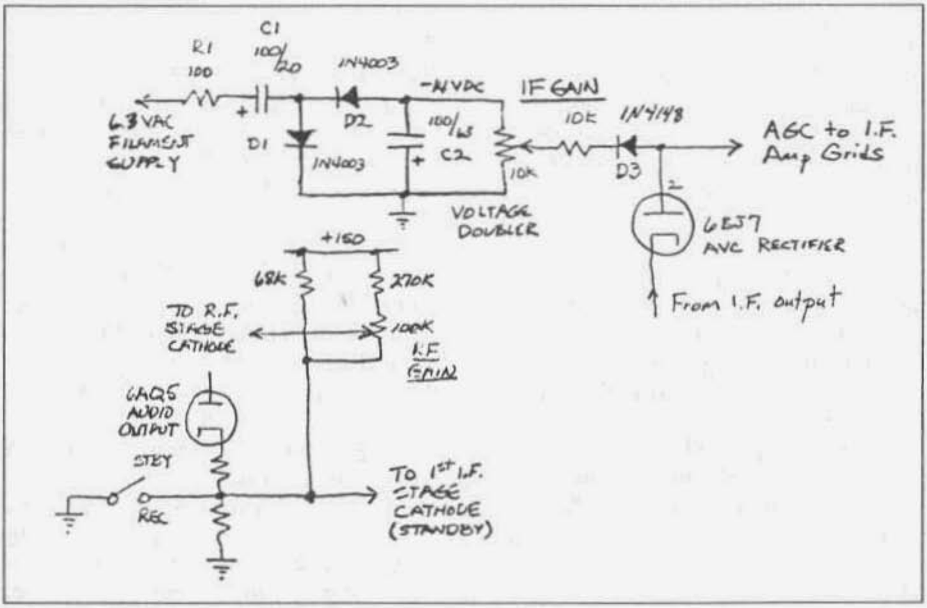

Figure 2. Modified Mohawk combines AGC and IF gain controls using a logical "OR" function to control only one tube element.

ride the RF GAIN control on a receiver which uses a single control system—decreasing it to cut down on overload from the strong station, but then opening it back up to allow the weaker station to be heard. The need to constantly ride the control can become quite tiresome in a long QSO.

Converting your Mohawk's IF GAIN to a threshold-type control, while retaining the RF GAIN's linear-type control system, will give you an extremely flexible receiver that will be able to handle virtually any mix of signal strengths in a QSO. The IF GAIN control can be used to reduce background noise, while the RF GAIN control can be used to reduce front-end overload from strong signals—giving you the best of both worlds!

Mohawk Mods

If you have already made the AGC mods described in the earlier parts of this article, you will be pleased to know that this will be an extremely easy mod to make. Figure 1 shows the RF GAIN and IF GAIN controls prior to modification. Note that the AGC and the manual control voltages each feed a separate tube element.

Figure 2 shows a threshold-type circuit that is composed of two distinct parts: a negative bias supply and a logical OR circuit. The negative bias supply is actually a voltage doubler, which consists of R1, C1, C2, D1 and D2. Using the filament supply of 6.3 VAC, it will provide about minus 14 VDC. On one half of the AC cycle, C1 charges up through D1 to about -7.7 volts. During the next half of the AC cycle, C2 charges up through D2 to about -14 volts.

The -14 volts being supplied by the voltage doubler is sufficient to substantially reduce the receiver's gain, but it is not large enough to completely cut off the RF and IF stages. It would have been nice to have more negative bias voltage to work with, but I did not feel it was worth the extra effort to build a voltage tripler or a completely separate supply. The signal threshold can be in-

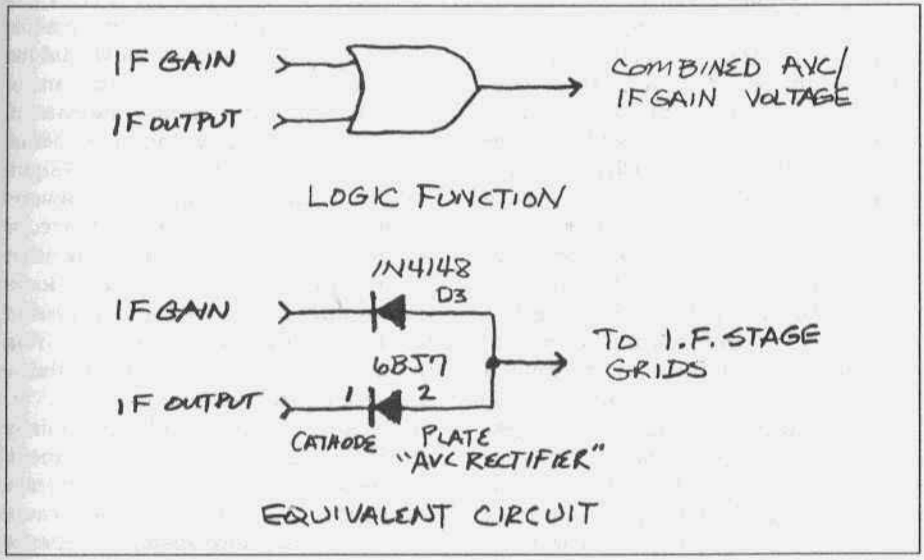

Figure 3. "OR" implementation uses original 6BJ7 detector diode and added solidstate diode.

creased to about +30dB/S9, which is really quite sufficient for nearly all types of listening situations.

The DC output of the IF GAIN control feeds diode D3, which is attached directly to the AGC line. As shown in Figure 3, it is diode D3, in conjunction with the 6BJ7 AGC detector diode, that forms the critical logical OR function. Whichever voltage is most negative, either from the IF GAIN control or the AGC detector, will prevail and be fed to the gain stages. This circuit is simplicity itself. Because the S-meter amp is attached to the mixed AGC line feeding the control grids, it will register the manual setting of the IF GAIN control.

Close observation of the above circuit will reveal that the RF front-end stage is a linear-type control system *only* with respect to the RF GAIN control. The other control voltage it receives is the mixed AGC/IF GAIN control voltage, rather then raw AGC. This was done to further enhance the threshold effect. Fortunately, this reduces circuit complexity as well.

Take note that the line which fed the cathode of the 1682 kc IF amplifier (and a section of the selectivity switch) from the wiper of the IF GAIN control is now tied directly to the standby switch circuit. When the receiver is put on standby, the cathodes of the 1682 kc IF amp and the audio output stage rise to about +40 volts, thereby cutting off these stages.

The negative bias supply can easily be built on one small terminal strip. As you make this mod, you will need to trace the wiring from the IF GAIN control and the Standby/Receive switch to make sure they are wired correctly.

Now It's Your Turn

The principles of threshold-type AGC systems can be applied to nearly all boatanchors with a noticeable improvement in performance and listenability. I have modified a number of receivers including my HRO-60 and I plan to modify my Collins 75A-1 just as soon as I find the time to finish rebuilding its RF deck (if you have ever had to do it, you know that it is truly a gruesome task). Consider publishing the threshold-type AGC mods you develop for your receiver in Electric Radio! **ER**

A Brief Interlude at W6BB from page 27
calls in the warble of stations calling him after his first contact had ended. He had answered a DJ station's CQ. This DJ station was an American military club station in occupied West Germany that also was using a BC-610 transmitter whose superior power placed it far above the peanut whistles of the European nationals. In 1950, European hams ravaged by the recent war did well to get on the air at all. Many of them used transmitters that were prewar relics, or ones newly homebrewed with scrounged parts. Sometimes the Europeans pressed cast-off military gear into service whose signals often wandered far from ideal purity and stability. Although their legal power limit was 150 watts or so, most ran considerably less. Almost always these signals were weak in California, if they were heard at all. Back then, a European contact with California was rarely taken for granted. Getting through thrilled operators on both ends of the circuit.

The undergrad tried to copy other calls from the warble of watery signals that were calling him. The DJ had been fairly easy. Now there was nothing to do but listen until a call could be copied distinctly. A station in London was the next contact, which was flawed because the undergrad in his excitement at being called by DX replied with his home call, not the call of the club station. Though quickly rectified, the error had cost time and limited the QSO to signal report and location. The London station had gotten weaker and repeats were necessary because the California sun was approaching noon. Finally, the young operator at W6BB heard another station calling him from France. He knew it was a French station because he copied F3-something, very weak, almost not there. He went back to the French station with signal report, name and QTH. But nothing came back. The clock on the wall was already past high noon. On the low end of 20 only white noise now prevailed.

The young operator had made notes on a yellow scratch pad. Now that the band was dead, he wanted to transfer the QSO times and data to the station log, as he did meticulously at home. Nothing resembling a log was in sight. Perhaps it was in a drawer somewhere. Maybe, due to its legal importance for the FCC, it was retained in some other secure location in the shack. While looking around, he noticed a wastebasket half full of scribbled yellow sheets from the same scratch pad, sheets containing notes by previous operators.

The South African, who'd been quietly tinkering with a piece of equipment, seemed glad to be called upon to resolve the young operator's dilemma because he could flaunt, once again, his superior knowledge of the station. There was no formal log beyond the wastebasket, it turned out. The South African, perhaps anticipating the young operator's surprise, explained with his old-timer's sophistication that W6BB had been there before the FCC was born. He continued, with a rising rhetorical emphasis, to maintain that UC Berkeley, being a cultural leader in the Western World, disdained nonsensical requirements of petty government bureaucrats. He said that such a university, dedicated to the pursuit of truth and knowledge, wielded a moral authority far superior to that of form-bound government FCC bureaucrats who required paper records that would remain unread both by themselves and by posterity.

The undergrad tore his inscribed sheet from the yellow scratch pad, folded it, and placed it not in the wastebasket but casually into his hip pocket. Perhaps he felt that this written record of his DX conquests that morning was important. The sheet was proof that he had abided by FCC logging rules. Also, it was documentary evidence that he had really worked Europe, although he knew he would never have QSL cards as the ultimate confirmation. **ER**

Ten Years of Questions from page 31

still in print. It is 400 pages of practical, useful information on test procedures for nearly any type of radio system.

Solid State Design For The Radio Amateur ARRL, any edition. The section on measurements has excellent information on construction of simple, accurate test equipment for evaluating all types of receiver performance. Highly recommended, even though readers may not be interested in 95% of the text!

QST July 1975, "*Measuring Receiver Dynamic Range*" by Wes Hayward (W7ZOI). Best article on dynamic range testing and measurement I've ever seen. Procedures in this article form the basis of the procedures I use.

KOA's 50 KW Xmtr from page 33

separate room from the main transmitter cabinet with room to room interconnects done with the shielded cable electric utilities use for direct burial distribution of 14 KV.

Wanting to dispose of the transmitter in an intact state, we made an effort to sell, or give the beast away. Our efforts met with no success; there was the issue of those 1950s era PCB tainted transformers and capacitors that may have remained. We had one offer to take it if we paid for shipment to Latin America-something that even us engineers weren't stupid enough to bring up to the general manager. So today, the remains of this fine example of American industrial engineering sit in a large Denver storage locker, but fear not—there's four of us ham-engineers working for Jacor Broadcasting, here in Denver, who are coming up with a secret plan in case QRM gets too bad on 3885... **ER**

A complete index of the entire 10 years of ER is available for viewing or downloading at the following website: http://www.qsl.net/n9oo

The Elmac AF-67 Trans-citer from page 17

about Elmac rigs previously in ER. In the February 1991 issue, Willis Seaman, W9FGJ describes some simple audio modifications that improve the passband and give the rig more of a hi-fi sound. In April of 1991, Don Winfield, K5DUT describes a simple modification that he developed to eliminate a deceased audio driver transformer. In July 1992, Lea Salter, K4VWD has a great article telling all about the Multi-Elmac company, from 1947 when they started off making marine radios, to their development of the A-54, AF-67 and AF-68 transmitters and their companion PMR-6A, PMR-7A and PMR-8A receivers, and finally to 1976 when they were bought out by the Stanley (Tool) Door Company for which they still manufacture garage door openers. There's also a great letter in the May 1994 issue from George Goldstone, W8AP, the corporate attorney, with some wonderful inside information about the people who made up Elmac and the development of their products.

So, the bottom line of all of this is that the Elmac AF-67 is definitely worth your picking up if you find one with the right price at the next flea market. You might call it the poor man's Ranger, since it has very nearly the same features except for a built-in power supply. You could even get lucky, find an Elmac M1070 power supply and decide to put the rig on the air from your car for the next ER vintage field day! Meanwhile, stay tuned. I have an AF-68 on my work bench and it promises to be even better than the AF-67 More on that later. **ER**

NOTICE

A last reminder to all those who are interested in Military Radio, that the Military Radio Collectors Group are holding their fourth annual meet, Friday and Saturday, April 30 and May 1 in San Luis Obispo, Calif. Contact Hank Brown, W6DJX, (805) 943-2027, for more information.

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FOR SALE: Radio books, magazines, catalogs, manuals (copies), radios, hifi, parts. Send 2 stamp LSASE. David Crowell, KA1EDP, 40 Briarwood Rd., North Scituate, RI 02857-2805. aq253@osfn.org

FOR SALE: KWM-2 fan bracket - $12 ppd. Dave Ishmael, WA6VVL, 2222 Sycamore Ave., Tustin CA 92780. (714) 573-0901.

FOR SALE: Small parts, transformers for projects and repairs of tube gear. Let me know your needs. Van Field, W2OQI, 17 Inwood Rd. Center, Moriches, NY 11934. (516) 878-1591 or wreck_and_rescue@juno.com

FOR SALE: RME 4350 rcvr, 160 thru 10, been using it on the air for 6 years, tired of looking at it, works exc. - $225. Rick, K8MLV/Ø, 1802 W. 17th St., Pueblo, CO 81003. (719) 543-2459

FOR SALE: NOS,UTC # F-7101 matching (600-8 ohms) xfmrs (2 W) - $13 ppd/dom/USA. ABEN, POB 4118, Jersey City, NJ 07304-0118,Avidov@aol.com

FOR SALE: A Drake R-7 rcvr, w/manual; Viking II w/manual. PU only. Gene, KB4YST, 2241 Idlewylde Dr., Louisville, KY 40206-2331. (502) 895-1705

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FOR SALE: Hallicrafters, RME, Gonset, others. Also some military, test equipment, VHF/RF amps, more. LASE, Don Jeffrey, POB 1164, Monrovia, CA 91017.

FOR SALE: Tubes, Penta Labs, 811A- $20.; 572B- $55.; 3-500Z- $170.; ZG also avail.(these are Amer. made); NOS 811A- $35.. Many other US NOS. VISA/MC. Dee, W4PNT, VA (540) 249-3161, soundnmind@rica.net

FOR SALE: Hallicrafters, Drake, Heathkit, Military, etc. Send e-mail request or SASE for list #2. Fenton Wood, 109 Shoreline Dr., Star Harbor, Malakoff, TX 75148. fenton@tvec.net

FOR SALE: BC610, BC614 speech amp, cables, coils and tuning units. Will deliver within reasonable distance - $800; Collins KWT-6 full unit & parts. Steve, Orlando, FL,(407) 699-9433.

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FOR SALE: Rare, black HRO 50R1, 7 coils, xtal cal, NBFM adapt, manual - $450. Jim, K7BTB, POB 5055, Parks, AZ 86018. (520) 635-2117

FOR SALE: 4CX1500B NIB - $300; 2 good pulls - $50 ea. Walter Treftz, N4GL, 3840 E. Laguna Lp., Hernendo, FL 34442. (352) 637-1755. garjen@montego.com

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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

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FOR SALE: Heath impedence bridge model IB-28, mint and working - $75. Marty, NJ, (609) 466-4519

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FOR SALE: Heathkit SB-104 w/SB-604 & HP-1144 PS, w/manual, needs work - $150 plus S&H. Marvin, 2957 Gaffney Rd., Richmond, VA 23237. (804) 275-1252, wa4toj@juno.com

FOR SALE: General Electric GL-5J29 radar tube $15 & postage. Mark Anderson ,N2TWW, 207 Fiddlers Elbow Rd., Greenwich, NY 12834. (518) 692-2593, mander3345 @aol.com

FOR SALE: BC-603D. Missing frame, spkr. Has knobs, dynamotor, untested - $25 plus shpg. Jim Clifford, KE4DSP, 108 Bayfield Dr., Brandon, FL 33511. (813) 654-7531 j.c.clifford@juno.com

FOR SALE: Old stuff: parts, antenna stuff, etc. K7FF Super-List of amateur stuff via e-mail: <k7ff@inreach.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: 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: A pair of antique spkrs, 12" coaxial, NIB w/Railway Express label & address label dated 12/1/59, price per spkr $59 "on label", Lafayette model SK-58. Herb, CT, (210) 623-8544.

FOR SALE: Heath HW100 & HW101, no pwr sply - $50 ea. WANTED: Hallicrafters HA-5 & Globe 755 VFOs. Robert Braza, N1PRS, 23 Harvard St., Pawtucket, RI 02860. (401) 723-1603

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FOR SALE: Adventurer fair - $35; TR3,/MS4/ PS manual, ex - $175, U-shp. Chuck, NZ5M, TX, (806) 798-1452.

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FOR SALE: Magazines: QST 1946-73 - $60, CQ 1947-73 - $50; 4-400A sockets - $12; ART-13 manual - $25. Tom Brent, Box 1552, Sumas, WA 98295-1552. (604) 826-4051

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WANTED: Howard radios of any type. Andy Howard, WA4KCY, 105 Sweet Bay Ln, Carrollton, GA 30116. wa4kcy@usa.net

WANTED: E. F. Johnson Co. HAMALOGs, unusual photos and information 1923-70. Bruce Hering, 41120 State Highway 13, Waseca, MN 56093. (507) 835-5619. bhering@efjohnson.com

WANTED: Top dollar paid for Winchester Radios and Winchester related items. Donald Daggett, 122 Hall Rd., Grahamsville, NY 12740. (914) 985-7249, wc2e@webtv.com

WANTED: Galaxy V accessories (F-3, DAC-35, SC-1, RV-1, etc); cabinet for 600L. Tom Hoitenga, K8NGV, GA, (770) 426-8682, hoitenga@bellsouth.net

WANTED: SW-3 Coils any band. Pre 1935 ham, pre 1925 broadcast, wireless equip. Mike Bald WD5GLW, (918) 492-7361, radiomb@aol.com

WANTED: Chrome trim strip for front panel of Collins 32V2. Travis, K5AVH, (903)792-2080, k5avh@slinknet.com

WANTED: AT-387, CW-293 and ST-124 for PRC-14; canvas and antenna reel for TBX-2. Joseph W. Pinner KC5IJD, 201 Ruthwood Dr., Lafaytte, LA 70503. kc5ijd@sprintmail.com

WANTED: Metal cabinet enclosure and a panel meter for the WRL Globe Chief #90 xmtr. James T Schliestett, W4IMQ, POB 93, Cedartown, GA 30125-0093. (770) 748-5968. imq@bellsouth.net

WANTED: Clock for my HQ180A, new or used in good condx. The same clock was used in the HQ170 and others. **FOR SALE:** KWM-2 with PM-2 pwr sply, CCA good-excellent - $575, would trade for good 30L1. George, W4BDG, Albuquerque, NM, (505)298-7347

WANTED: ITT Mackey marine 3010-C w/manual & Johnson AN/FRT-505. Ric, C6ANI, POB N4106, Massau NP, Bahamas.

WANTED: 1941 Summer/Fall Issue Radio Amateur Call Book. John, W8VBQ, 6015 Scotch Pine Dr., Milford, OH 45150.

WANTED: Manual & plug-in coil set for Central Electronics 10B. Butch Schartau, MN, (507) 282-2141, kabs@ibm.net

WANTED: Plate xmfr 1.8 to 2 kv ct @200 mA. John Campbell, KC7DQN, 1954 Tacoma Ave. S, Tacoma, WA 98402. (253) 274-9228

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: Military radios, USR-550/ARR-40 rcvr; Soviet xcvrs R-112, R-173. Leroy Sparks, W6SYC, 924 W. McFadden Ave, Santa Ana CA 92707-1114. (714) 540-8123

WANTED: Gearshift for Teletype Model 28, or complete machine with one. Ivan, WA6SWA, POB 248, Reno, NV 89504. (702) 329-7738, idh@cs.unr.edu

WANTED: Anyone having info on the Deltronic Corporation of Los Angeles, CA, please drop an email, letter or call. The company was in operation in the early 1950's. Thanks, George Maier, K1GXT, 64 Shadow Oak Dr., Sudbury, MA 01776. (978) 443-9659, gmaier@ultranet.com

WANTED: SW-3 coils any band; any early ham, spark or wireless equipment; early ARRL Handbooks. Mike Bald, WD5GLW, (918) 492-7361, radiomb@aol.com

WANTED: Manual for Navy model SP radar. Also, still looking for 1930s Navy radios and tubes! William Donzelli, 15 Gen. MacArthur Dr., Carmel, New York 10512. (914) 225-2547, william@ans.net

WANTED: A WW II U.S. Army M-209 Cryptograph machine. Al Gross, W8PAL, 12219 N.112 Ln., Youngtown, AZ 85363. (602) 814-6387 gross.al@orbital-lsg.com

WANTED: Hallicrafters R46B spkr. George Guler, WØOIR, 206 Alanhurst Way, Sun City Center, FL 33573. (813) 634-9489, gguler@ij.net

WANTED: R-389 Collins long wave rcvr, any condx; also BC1004C manual. Ron, MI, (517) 374 1107

WANTED: Hallicrafters HA-5 VFO mint condx only, with manual. Bob, KD9GI, (815) 332-9520, KD9GI@aol.com

WANTED: Dow-Key changeover relay w/110 volt coil; Amphenol T/R switch w/115 volt coil. Jim Roden, KD5GHO, (918) 836-9113 JRoden1013@aol.com

WANTED: TMC parts for a GPT-750 xmtr: modulator deck and other parts needed to restore my unit. If you can help please contact John Russo, KF2JQ, at (716) 839-1516 or jprusso@acsu.buffalo.edu

FOR SALE: Genuine new surplus: Unused R-390A cabinets #CY-979A/URR w/shock supports and misc hardware package - $305; top and bottom cover sets - $75. Mac McCullough, TX, (214) 324-4849, Fax - 324-4844

FOR SALE: Hallicrafter's manuals, copies starting at $5, some Johnson, WRL, others. SASE for list. DSM Diversified, 909 Walnut St., Erie, PA 16502.

FOR SALE: Vintage radio owners, retire the variac, new solid state SofStart available SASE. Rick Paradise, KE4OCO, 515 Wood Forest Ct. NE, Marietta, GA 30066-3519.

FOR SALE: Tube type kits for CW/AM. Vintage Radio Kit Co, 427 North Main St., Sharon, MA 02067. email us at CPCW-5@aol.com or visit our web site at: http://www.mnsinc.com/bry/vintage.htm

FREE: Please, visit my Vintage Radio site, loaded of BA pictures and information. http://www.geocities.com/SiliconValley/6992/ JOSE V. GAVILA (EB5AGV/EC5AAU) <eb5agv@amsat.org>

FOR SALE: Vintage radios on display, bought, sold, traded and repaired. Webpage - http://www.tiac.net/users/hobfact. Rick Galardi, W1DEJ, Boston, MA, (781) 485-1414, Fax 289-1717, hobfact@tiac.net

FOR SALE: Homemade heavy duty code key, fine workmanship - $35 ppd. L. Gardner, 458 Two Mile Creek Rd., Tonawanda, NY 14150. (716) 873-0447

FOR SALE/TRADE: Transmitting/rcv'ng 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 through 2000T for display. John H. Walker Jr., 11015 W. 126th Terr., Overland Park, KS 66213. (913) 782-6455, johnh.walker@alliedsignal.com

FOR SALE/TRADE: Manuals for Morrow, National, Pierson, Davco, Hallicrafters, Drake, Allied/Knight, Lafayette, Hammarlund & Mosley. NI4Q, POB 690098, Orlando, FL 32869-0098. (407) 351-5536

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@juno.com

FOR SALE: Join SPAM, the society for the promotion of AM. Lifetime certificate $1, SASE. W4CJL, 202 Baker Dr., Florence, AL 35630.

FOR SALE: Collins 30L1 owners new Cetron 811A's - $19; 32V owners Raytheon 4D32 - $19; major credit cards accepted. Don, W4CIT, FL, (352) 475-3306.

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.

FREE: Visit the KNIGHT-KIT web site at: http://www.mnsinc.com/bry/ham/knight.htm Exchange messages on our free bulletin board! http://pluto.beseen.com/boardroom/b/21532/ Brian Carling, AF4K

FOR SALE: Heath "SB" tuning knobs, new, P/N 462-906 - $18 ppd. **WANTED:** HP-117 VLF comparator. Kirk Ellis, KK4YP, 203 Edgebrook Dr., Pikeville NC 27863. (919) 242-6000 kirke@goldsboro.net

FOR SALE: American Bosch police radio pwr sply, knobs & dial plates for TBW-3. **WANTED:** BC348Q parts unit; R220 junker; SP600 junkers. Dean, MN, (612) 869-9264.

FOR TRADE: Two good RCA 833As for one Taylor 833A; also looking for Taylor 204A, 813, 875A. John H. Walker Jr., 11015 W. 126th Terr., Overland Park, KS 66213. (913) 782-6455, johnh.walker@alliedsignal.com

FOR SALE: B&W L-1001-A KW linear w/HB P.S. Gud condx - $225. PU or Hosstraders; HQ-215, 2 filters, matching spkr - $300 + UPS. Bob, NV1X, (802) 879-7235. bzinvt@together.net

FOR SALE: Rare Boulevard Electronics communications rcvr, see Moores book pg. 15 - accepting offers (HRO trades). Jim Leathem, K7BTB, POB 50355, Parks, AZ 86018-0355. (520) 635-2117

ELECTRON TUBES FREE Catalog, over 2,000 types in stock. **Electron Tube Enterprises,** Box 8311, Essex, VT 05451. (802) 879-1844, FAX (802) 879-7764

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

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: 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: Dial/clock covers. Send bezel, old or drawing, make/model, guaranteed satisfaction - $10 ppd. William P. Turner, WAØABI, 1117 Pike St., St. Charles, MO 63301. (314) 949-2210

FOR SALE: New Ranger I, Valiant I & Navigator plaster dials, 160-10 frequency no's in green, with all holes like original - $17.50 ppd. Bruce Kryder, 336 Sliders Knob, Franklin, TN 37067. (615) 794-9692

FOR SALE: Collins meatball lapel pin - $5.95 + $.75 S&H. George Pugsley, W6ZZ, 1362 Via Rancho Prky, Escondido, CA 92029

NOTICE: Pikes Peak Amateur Radio Assocation annual swapfest, Lewis-Palmer High School, Monument, Colorado. 1 May 1999. 0800-1400. Take I-25 to exit 158. Talk in on 146.970 (199 hz CTCSS). Call Bob Ryals, KI0GF with questions, (719) 265-9950

FOR SALE: 2 Collins Naval Xcvrs AN/URC32, 2-30 Mc 500W, manuals, spare modules - Best offer. Ken, VE7EHB, Kelowna, BC, Canada, (250) 764-8286.

FOR SALE: National NC101X w/spkr, clean - $350; NC183 w/spkr, fair - $100; ARRL: 1931 HB, 200 Meters & Down (1936- 1st ed); McElroy "Mac Osc", scarce - $150; Viking II xfmr set - $50; meter, knobs, L/C network, etc, trades for Hickok TV-3 or 539C. Offers + shpg. Rob, 24 hr voice mail, leave specific message, CA, (510) 845-2625.

FOR SALE/TRADE: SX100; NC40 w/spkr, very nice for 75A2, 75A3, SX42 w/spkr. Greg Yost, W8RCA, 744 Patterson Lk Rd, Pinckney, MI 48169. (734) 878-2465

FOR SALE: Globe Sidebander DSB100 - $80; Heath HR-10 - $90; Heath AC-1 - $55; Collins X455KF300 - $135. Wm Ernst, 16300 Campbell Rd., Comins, MI 48619. (517) 848-5002

FOR SALE: Sell/Buy/Wanted/Trade: Vintage equip at the "K8CX Ham Gallery." http://paradox2010.com/ham/ a free service.

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

FOR SALE: Dr. Radio repairs vintage ham gear. Steve Trimble, K5DJH, Box 73, Weston, TX 75097-0073. (888) 73-K5DJH. k5djh@texoma.net

FOR SALE: Collins 51J series drum overlay - $10 ea, specify which. Ron Hankins, KK4PK, 555 Seminole Woods Blvd., Geneva, FL 32732. (407) 349-9150

FOR SALE: Collins repair: FCC Licensed Technician, we repair the Collins Gray Line i.e. S-Line, KWM-2/2A etc. & other select models. Merle, W1GZS, FL, (352) 568-1676

FOR SALE: Radio BC733 complete w/manual & conversion info - $75; RCAF radio ARN5C - $25; multimeter ME 26 D/U - $40. Robert Martin, 111 Bancroft, Rochester, NY 14616. (716) 663-4182

FOR SALE: BC-342-N 1.5-18 Mc rcvr - $250; Watkins-Johnson 235-1000 Mc rcvr - $250. Gary, WA9IYF, 169 N. Ridge Rd., Versailles, IN 47042.

FOR SALE: SW-3 replacement coil forms; 4, 5, & 6 pin coil forms; WD-11 substitutes, WD-11 adapters & bases. SASE for literature. **WANTED:** Amphenol molded loctal tube sockets, any color, paying $1 ea for new. James Fred, 5355S 275 W, Cutler, IN 46920. (765) 268-2214

FOR SALE: 220V BC-610 I pwr sply - $300 PU only; HW100, pwr sply, spkr - $190; RAL-6 rcvr - $200. W7RBF, AZ, (602) 864-9987.

FOR SALE: Radio Magazine, 1936-1941, 102 issues - $3 ea; the lot $150 + shpg. Mike Bittner, 27215 Sunnyridge Rd., Palos Verdes, CA 90274. (310) 377-4797

FOR SALE: Homebrew dummy load, ammeter, HV capacitor, resistor, should handle 500W - $20 + UPS. RJ Eastwick, N2AWC, 400 N. Haddon Ave Unit 109, Haddonfield, NJ 08033. (609) 429-2477

FOR SALE: Gonset Communicator II 2 meter AC & batt - $29 + shpg. Henry Mohr, W3NCX, 1005 W. Wyoming St., Allentown, PA 18103.

FOR SALE: Complete guide to WWII military communications equip. At last a 112 pg collector guide including army aircraft, infantry, vehicle, navy aircraft, unit assignments, counter measures, etc - $15 + $2 domestic shpg or Dayton space 1348. Sam Hevener, W8KBF, 3583 Everett Rd., Richfield, OH 44286-9723. (330) 659-3244

COLLINS EQUIPMENT WANTED

Broadcast gear: 6P & 6R preamps, 6M, 6X & 6T monitor amps, 6Q preamp, 6N program amp, 6S-2 isolation amp, 6V & 6W monitor amp, 409U-1, 409T-1, 409T-2, 409T-3 pwr splys, & other parts for the 212B or 212A mixing boards, 159A & 499 rack mount assemblies, 62E vu panel, 82T-1 metering panel, 116F-1, 116E-3, 116E-4 program line EQ's, 268 attenuator panels, 209 on air sign, 112B-1 switch & fuse panel, 26J-1 auto-leveling amp, 213A transcription turntable, 55G-1 LF tuner, 30K-1, 30J & 32G transmitters, 66" & 72" racks & literature or catalogs, Daven 600/600 attenuators. **Call Joe Rose at (516) 874-3875 or e-mail wa2pjp@aol.com, or write to 276 Woodland Ave., Manorville, NY 11949.**

WANTED: Hallicrafters Village/Hamlet radios TR-5/TR-20 & Gonset Civil Defense 6m radios/ accessories, manuals also. Daniel Cahn, 3444 Greenwood Ave., Los Angeles, CA 90066. Fx/msg (310) 398-7159 or danielc411@aol.com

WANTED: E.H. Scott Philharmonic rcvr. EA4JL, Contact in the States, Kurt Keller, CT, (203) 431-6850.

WANTED: WW-2 Japanese military radio of any kind; Hammrlund PRO-310. Takashi Doi, 1-21-4, Minamidai, Seyaku, Yokohama, 246 Japan. Fax 011-8145-301-8069. taka-doi@a2.ctktv.ne.jp

WANTED: Any radio used by OSS (Office of Strategic Services) examples are SSR-1, SST-1 or other sets with an SS designation; also Zenith 6S222. Gary Cain, W8ZZZ, 202 W. 5th Ave., Shakopee, MN 55379. (612) 496-3794

WANTED: Broadcast gear; tube or solid-state, compressors, limiters, equalizers, microphones, consoles, micpreamps, recorders. Mike States, Box 81485, Fairbanks, AK 99708. (907) 456-3419 ph/fax or mstates@polarnet.com

WANTED: WWII SCR299 Base Station Radio Components to complete K51 vehicle restoration project. Need: BC-731 control box; T-50 mic; JB-49 or JB-69-A junction box; phone & spkr control panel; MP-47 mast base; FT389-A & FT388-A mountings; SW-199-A (Start-Stop) switch; CH-89 (Seat) chest; DR-4 reel mounts; various cords: CD-556, 558, 560, 562, 557, 559, 561, 563, 564, 565, 566; CO-316, 313, 314; TE-48 tool equip.; electric heater-Arvin Model 201 or Electromode Model AA-15; BC-610C back panel & shock mount; BC-614D top cover & shock mounts; EE-8 table side box; BC 614D I.D. tag & plate/output level meter; mount for BC-721; TM for SCR 585. What do you have? Any information would be gratefully appreciated! Bill Miller, RR 1 Box 35, Vincennes, IN 47591. (812) 882-2437, h; (812) 882-6690, w, fax 886-0573

WANTED: Miller AM tuner model 595, RCA Radiomarine Direction Finder model AR8712 & RCA rcvr model 18T service manuals. Al Kaiser, W3LEQ, 713 Marlowe Rd., Cherry Hill, NJ 08003-1551. (609) 424-5387

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: Old tube amps & xfmr's by Western Electric, UTC, Acro, Peerless, Thordarson; Jensen, JBL, EV, Altec, WE spkr's. Mike Somers, 2432 W. Frago, Chicago, IL 60645. (312) 338-0153

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

WANTED: Any military entertainment radio (Morale rcvr), manuals, accessories, or data plates. Henry Engstrom, KD6KWH, POB 5846, Santa Rosa, CA 95402. ph/fx (707) 544-5179

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: WW II Japanese, German, Italian radios & communication equip for display in intelligence museum. LTC William L. Howard, 219 Harborview Ln., Largo, FL 33770. (813) 585-7756, wlhoward@gte.net

WANTED: Copy of MIL-T-27A spec, RCA, Gates, Langevin B'cast gear. R. Robinson, 868 S. Main St., Plantsville, CT 06479. (860) 276-8763, richmix@erols.com

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

WANTED: Heath equip: Vacuum tube voltmeter V-6, AC voltmeter AV-2, Audio voltmeter AW-1 & Intemodulation analyzer IM-1. Pete Cullum, KØWRX, 1332 Harlem Blvd., Rockford, IL 61103. (815) 965-6677

WANTED: Manual for Racal RA-117. George Kraus, WØEUQ, 1822 S. 17th St., Grand Forks, ND 58201. (701) 775-8038, gkraus@gfherald.infi.net

WANTED: Anything related to Tecraft & Ameco, cheap stuff only; Tecraft pwr sply & manuals. Bud Fritz, N3SFE, 104 2nd St., Montgomery, PA 17752.

WANTED: Collins R389, 30K-, 310-, 399C-1, KW-1, HF80 i.e. HF8014, 851S-1, Hallicrafters SX-115. Richard, WAØAKG, NE, (402) 464-8682.

WANTED: Test equipment & tube audio amplifiers. Mike Nowlen, WB4UKB, 2212 Burgee Ct., Reston, VA 20191. mike@3dnet.com

WANTED: McKay Dymek radio literature & info. Gene Peroni, KA6NNR, POB 58003, Philadelphia, PA 19102. (215) 665-6182

WANTED: Collector/builder seeks lge & small vacuum tubes & vacuum tube collections, sockets, etc. Will pay good prices. Please call Marc, OR, (800) 330-2004.

WANTED: Cash for Collins: SM-1, 2, 3; 55G-1; 62S-1; 399C-1, 51S-1; 75S-3A, C32S-3A; any Collins equip. Leo, KJ6HI, CA, ph/fx (310) 670-6969, radioleo@earthlink.net

WANTED: Collins 310B3 any shape; 70E5A oscillator assembly; and Chicago 500W CMS-1, high level modulation xfmr. Jerry, W8EGD, CO, (303) 979-2323.

WANTED: Any type or make of an AM xmtr that was used in police cars & taxis. Ted Bracco, WØNZW, 203 Main St., Teutopolis, IL 62467. (217) 857-3351 ext 306

WANTED: 75A1 in good or better condx within reasonable driving distance of Dallas for inspection & transport. W5USM, TX, (972) 530-3116.

WANTED: Parts: HQ-145 coils, spkr parts for Hallicrafters PM-23, Comet Pro plug-in coils. Bill Coolahan, 1450 Miami Dr. NE, Cedar Rapids, IA 52402-2933. (319) 393-8075

WANTED: Gonset G-76 AC &/or DC pwr sply. Cliff Fleury, AI7Y, POB 1233, Goldendale, WA 98620. (509) 493-8203, fleury@gorge.net

WANTED: Watkins-Johnson or Communications Electronics Inc. info, catalogs, manuals or equipment. Terry O'Laughlin, WB9GVB, P.O. Box 3461, Madison, WI, 53704-0461, 608-244-3135

WANTED: Hallicrafters HT-1, HT-9, HT-31, 5-T, SX-11, SX-17, SX-25; Howard rcvrs; Harvey xmtrs. Ken Seymour, KA7OSM, 9115 SW 176th Ave., Beaverton, OR 97007. (503) 306-7439 24 hrs. ken.seymour@attws.com

WANTED: Manuals, manuals, manuals for radio-related equipment to buy or swap. Catalog available. Pete Markavage, WA2CWA, 27 Walling St., Sayreville, NJ 08872. (908) 238-8964

WANTED: Navy xmtrs: MQ, TCA, TCE, TCN, TCX, TDE; rcvrs: RAW, RAX, RBD, RBJ. Steve Finelli, 37 Stonecroft Dr., Easton, PA 18045. (610) 252-8211. navrad@enter.net

WANTED: Squires-Sanders SS-1R, SS-1T, SS-1V, SS-1S, see my web page tulsa.oklahoma.net/~wd5jfr. Hank, WD5JFR, OK, (800) 364-4265

WANTED: Information-WW2 TCS Radio System: Design, Manufacturing & Operation for article. Any help appreciated. Thanks. Greg Greenwood, WB6FZH, POB 1325, Weaverville, CA 96093. (707) 523-9122 (message) greg6fzh@aol.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: TMC GPT-750, TAC Tuner, GPR-90/92 & GSB-1. Alan Gray, W3BV, PA, (215) 795-0943.

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

WANTED: Info/manual copy of monoband xmtrs by Trio (early Kenwood) to match JR-500S rcvr; also info on matching pwr sply. Chuck Maas, WØIUH, 9917 Irving Ave S., Bloomington, MN 55431. (612) 888-7104

WANTED: Schematic &/or service info on Scott SCLRM marine radio. Willing to pay for it. Pete Anderson, W5VYV, 601 N. Turner St., Hobbs, NM 88240. (505) 392-8866

WANTED: Collins 651S-1 rcvr w/LEDs, manual. **FOR SALE:** Parts, books & manuals, list - $1. Joe Orgnero, VE7LBL, 1349 Leask Rd., Nanaimo, BC V9X 1P8, Canada. (250) 722-2707, joseph@pacificcoast.net

WANTED: Pwr sply info for National AGS, Vibroplex Zephyr, Johnson, KW Matchbox. Brian Roberts, K9VKY, 130 Tara Dr., Fombell, PA 16123. (724) 758-2688

WANTED: Manuals (originals only) for Hammarlund SP600-JX & Hallicrafters SX100. Taka, CA, (650) 697-6719

FOR SALE: Copies: Hard to find schematics for radios, also kit radios 1922-1950; manuals: test equip. ham gear. Contact me for prices, availability. Duane Ballew, KB7QZK, 6813 152nd St. Ct., NW, Gig Harbor, WA 98332. (206) 851-4505

FOR SALE: SASE for list of reconditioned gear. Ed Clink, WA9PFB, 1285 New Salem Church Rd., New Berlin, IL 62670

TRADE: My AN/PPN-2 Eureka Paratroop beacon for your wireless set (Canadian) 29A set. Leroy E. Sparks, W6SYC, 924 W. McFadden Ave., Santa Ana, CA 92707-1114. (714) 540-8123

FOR SALE: Military and commercial communications items: www.maxpages.com/murphyjunk. For up to date lists: murphy@cts.com. Mike Murphy's Surplus, 401 N. Johnson Ave., El Cajon, CA 92020. (619) 444-7717

FREE: Encyclopedia of Amateur Radio Equipment. Hundreds of photos & descriptions spanning over 80 yrs. http://www.aade.com/hampedia/hampedia.htm

FOR SALE: HW-101 w/mic, spkr, pwr sply - $111; BC-221 freq meter - $25; BC-221AK - $35; GRC-109 - $25 per unit or all for - $85; TS-173UR VHF freq meter - $30; AN/URR 44 Coast Guard rcvr, no BFO - $85; LM freq meter - $35; R-110 VHF FM rcvr, -38-55 MHz w/HB pwr sply & spkr - $55. John, CA, (626) 796-5920.

FOR SALE: Amateur Radio Texts & Handbooks, new condition. SASE for list. Bill Riley, W7EXB, 863 W. 38th Ave., Eugene, OR 97405-2375.

FOR SALE: NC-173, clean, works like new; RCA WV-98C Voltohmyst like new - $35, both + shpg. Ken, Waco, TX, (254) 772-7307.

FOR SALE: R390 FSK converter. CV-1066 tube construction w/builtin spkr and eye tube. Mounted in drawer case or rack mountable. 115VAC, NIB. w/ manual and pwr cord - $200; Collins ant. multicoupler, tube type, CU-168, 1 input to 5 outputs, N connectors, 115VAC, rack mountable x 8 inches, . 2-30 MHz, govt. overhauled in box w/pwr connector - $200 used, tested - may not be Collins - $140; Trimpak army green GPS used in Gulf War. LCD display, made by Trimble. Has internal ant. and an external is included also. Mil. style connector, rechargable battery and charger included. Tested, exc condx - $250; Harris RF 505A 100Kc - 30MHz solidstate decade tuned synthesized HF rcvr, rack mount x 5 inches high. 115VAC or 10-400DC. Builtin preselector and spkr w/Collins mech. filters, exc condx - $495 gntd; HP 8640B .5-512MHz sig gen, AM/FM pulse modulation, solid state, LED display, .1uv - 3v. 16 step attenuator, VG for signal substitution or rcvr sensitivity testing. In watertight case or rackmountable - $350 gntd; TA-838A Army field phone current issue. Touch tone w/ ringer in green case, w/ handset strap, 2 or 4 wire connection. Can be used as fully functional normal telephone. Requires 4 "C" batteries, NIB w/ manual - $80; TA-1/pt Army field phone, 2 wire connection w/ spring cord, resembles army handset. Has push to talk and magneto ringer buttons. Sound powered. NIB w/ watertight plastic box and manual - $40; HP 5328A freq counter DC - 512MHz. 3 channel high stablility time base. LED display. Period and avg capability - $200 gntd; TEK 7L12 specutrum analyzer 100Kc - 1800MHz, 300Hz resolution, plug-in works in 7000 series scopes, mainframe and 2 channel vertical amp included. Makes system also usable as a 2 channel 100 MHz O-scope - $900 gntd. Check or Money Order preferred, but can take any credit card. Willing to trade for solidstate mil. radios or surveillance equipment. For photos of equip. please see<www.angelfire.com/nc/tonysodradios>Tony Snider, 512 Princess Anne Rd., Virginia Beach, VA 23457. (757) 373-6161, Fax 426-6454

FOR SALE: No auctions here! Dayton space 3352. Collins, keys, bugs, tubes, old stuff. Real radios. Bob, WB2FOF. See you there.

FOR SALE: General Electric Ham News, 13 issues 1946-63 - $5; ARRL Handbook 1948, 52, 63, 68, surplus schematics handbook - $25 ea. Gary, MN, (612) 496-3794.

FOR SALE: Electric Radio collection, 100 magazines between #8-#118, excellent condx - $175 postpaid. Dave, W1DWZ, (508) 378-3619

FOR SALE: NIB TUBES: 5726/6AL5W - 50 cents; 2E26 - $2.50; 6DC6 - $2.75; 6AZ8 - $3. Pristine. Lowell, K6KC, (559) 227-1605, k6kc@lightspeed.net

FOR SALE: Johnson Viking II w/122 VFO & manual, very nice; Millen 92200 transmatch w/ manual, like new; BC-610 & Wilcox xmtr coils; military CU/45/MRQ-2 antenna tuner, similar to BC-939. John P. Tiedeck, WA2SDE, 212 Grandview Rd., Media, PA 19063. (610) 566-8049

FOR SALE: NC300 VG - $200 + shpg; NC303 VG - $300 + shpg, manual copies. Parting out: Collins 75A2, Gonset GSB100, Hammarlund HQ140X, HQ170A, Heath DX100, HW101, TX1, HRO50 (no coils), NC183, NC300, Viking II & 122. Abe, W3DA, DE, (302) 349-5389 by 10 PM EDST, please!

FOR SALE: Classic gear - SASE for list. **WANTED:** Vintage rigs. The Radio Finder, Joel Thurtell, 11803 Priscilla, Plymouth, MI 48170. Tel/Fax (313) 454-1890

FOR SALE: Books, all electronics related; 200 titles; SASE. Paul Washa, 4916 Three Points Blvd, Mound, MN 55364. watok@email.msn.com

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FOR SALE: Boatanchor paints; Heathkit Tech Journal Subscriptions; phone filters - call or write for free catalog. R&R Designs, 202 Midvale, Marshall, WI 53559. (800) 372-4287

FOR SALE/TRADE: Collins 208 U-10 auto tune amp, compelte, good Eimac 4CX10,000D, report, manuals, spare parts amp w/purchase - $7000 firm PU only; Trade for new diesel gen set 15-25 kw, 120/240 1Ø, 15 kw, or 30 re-connectable to 15 kw 1Ø; Lister, Perkins, others considered, full panel, main breaker, auto-start, safeties, exc regulation, warranty. John, WI, (715) 378-2466 after 8 pm CST.

FOR SALE: National HRO60R with A, B, C, D coils - $375 plus shpg. Doug, OR, (541) 367-6486.

FOR SALE: (2) 75A2s, exc electrical & physical condx - $375 ea; HT37 - $150; HT 44 - $150. Cohen, FL, (254) 776-7357 after 7 pm EST.

FOR SALE: Various military/vintage parts, tubes, gear. Dave, K9HDQ, IN, (765) 354-2884.

FOR SALE: RBZ rcvr & battery box - $200; TBX-5 in navy chest, complete other than manual - $1500. George, K1ANX, MA, (413) 527-4304.

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TUBE COLLECTORS GROUP FORMED: The new tube collectors associtation is now in operation. This is a non-profit, non-commercial organization of collectors & history enthusiasts focusing on all phases & vintages of tube design. The founding president of the group is Al Jones, W1ITX, who is known for his award winning tube collection. For more details & complimentary copy of the association's bulletin contact Al Jones, CA, (707) 464-6470, Ludwell Sibley, OR, (541) 855-5207, or mail request to POB 1181, Medford, OR 97501.

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WANTED: NC303 in exc condx, fairly priced, no dealers. Prefer PU in Syracuse area. Gerald Liccione, W2TPL, 118 Hiawatha Trail, Liverpool, NY 13088. (315) 457-7928

WANTED: For HRO National rcvr, plug-in block 5 blade. C.C. Burt, KC8FBR, MI, (517) 736-8020.

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WANTED: Original manual for RAK-7/RAL-7 rcvr, all wirewound controls, nameplates, 874 and 876 tubes. Sandy W5TVW, 417 Ridgewood Dr., Metairie, LA 70001. ebjr@worldnet.att.net

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

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