THE HOLLOW STATE NEWSLETTER

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Editor's and Publisher's Corner

Hello again from hollow state land. As you can see, I'm still without a computer. So you'll have to excuse my by hand corrections. Note that on the mast head I made a mistake in the previous issue by reversing the first two digits of the post office box number. If you wrote me and had your letter returned, try again. It helps to use my name as part of the address instead of only The Hollow State Newsletter. Note also that we've reduced the price of the best of HSN nos. 1 - 4. If you want individual issues 1, 2, 3, and/or 4, please make it clear to Ralph.

This issue is mainly about the 51J-4. But we haven't forgotten about the R-390A. The lead article discusses R-390A audio impedance matching with 25 volt and 70.7 volt line transformers. If you've been suffering along with poor quality audio, run, don't walk, to the nearest Radio Shack and buy a 32-1031 70 volt line transformer, put together the impedance matching adapter described in the following pages, and sit back and enjoy the best audio you've ever heard from a communications receiver. Shortcuts like using a 120 VAC to 12 VAC transformer as described in a previous HSN are a distant second.

Excuse me, R-390A fans, but after the band 1 sensitivity fix (finally!) and fast attack - slow release AGC mods of this issue and the product detector mod of the next issue are done to a 51J-4, it is the finest all mode general coverage receiver of all time. But don't give up. I'm still trying to develop an AGC and product detector mod for the R-390A as good as these 51J-4 mods. I'm very close, but not quite there.

If you've read the 3 part R-390A article which appeared recently in Electric Radio and have been considering doing any of the mods described therein, I have one word of advice. Don't. For example, the AGC mod is not as good as the improved Cornelius AGC mod which appeared in HSN #23. And if you believe the R-390A does not work well with an 80 foot inverted L antenna connected to the unbalanced antenna input as claimed in part 1 of the ER article, then you have a defective R-390A. And if you believe the 52.7 dynamic range measurement given in part 2 of the ER article, then you'll be disbelieving the 80 to 85 dB dynamic range measurements reported by Sherwood Engineering, Ulrich Rohde, and me.

R-390A Audio Output Impedance Matching

Dallas Lankford, October 1990

Some people who use R-390As complain about hum, low audio output level, and poor frequency response. However, an R-390A has excellent audio quality and enough audio output power to drive you out of the room when used with an appropriate audio transformer which matches the 600 ohm audio output impedance to a speaker or headphones. The purpose of this note is to discuss appropriate audio impedance matching transformers for use with an R-390A.

The usual reason for hum and low audio output level with an R-390A is that low impedance headphones and a low impedance speaker, usually 8 ohms, are used without an audio transformer to match the 600 ohm audio output impedance to the low impedance load. A common cause of poor R-390A audio frequency response is the use of a military surplus LS-166 speaker. It has a built-in 600 to 8 ohm audio transformer and 8 ohm speaker, but the audio transformer has a limited frequency response of 350 to 3500 Hz. The LS-166 and similar speakers are designed for voice reception only.

The R-390A local audio output is rated as 500 milliwatts with less than 10% distortion into a 600 ohm load, and 1 milliwatt into a 600 ohm headset. The line output is rated as 10 milliwatts with less than 6% distortion into a 600 ohm balanced line. Measured maximum local audio output power before clipping is 1 watt into a 600 ohm load. Measured local audio frequency response is approximately flat from 100 to 10,000 Hz, and drops off slowly below 100 Hz and above 10,000 Hz.

One of the best ways to match the 600 ohm audio output impedance of an R-390A to low impedance headphones or a low impedance speaker is to use an audio line transformer. Line transformers come in two varieties - 25 volt line transformers, and 70.7 volt line transformers. They are designed for use with public address and audio distribution systems. The 25 volt line transformers are intended for use with amplifiers which have a 25 volt RMS maximum output, while the 70.7 volt line transformers are intended for use with amplifiers which have a 70.7 volt RMS maximum output. The 25 volt line transformers typically have primary taps with impedances which are multiples or fractions of 625 ohms (equivalently multiples or fractions of 1 watt). The 70.7 volt line transformers typically have primary taps with impedances which are multiples or fractions of 5000 ohms (equivalently multiples or fractions of 1 watt).

Currently I use a 25 volt line transformer, Stancor type A8089. The Stancor A8089 has primary taps marked 4, 2, 1, and 1/2 watt, and a secondary marked 8 ohms. Since the primary taps of a line transformer are often specified in watts, you will have to convert the watt ratings to ohms. For example, using the formula $R = V^2/P$, where R is the impedance in ohms, V is the voltage rating in volts RMS, and P is the power rating in watts, it follows that the 1/2 watt primary tap is $R = 625/0.5 = 1250$ ohms, and similarly that the 1, 2, and 4 watt primary taps are 625, 312, and 156 ohms respectively. For a 70.7 volt line transformer with primary taps of 10, 5, 2.5, 1.25, and 0.62 watts, the equivalent primary impedances can be calculated as 500, 1000, 2000, 4000, and 8000 ohms respectively.

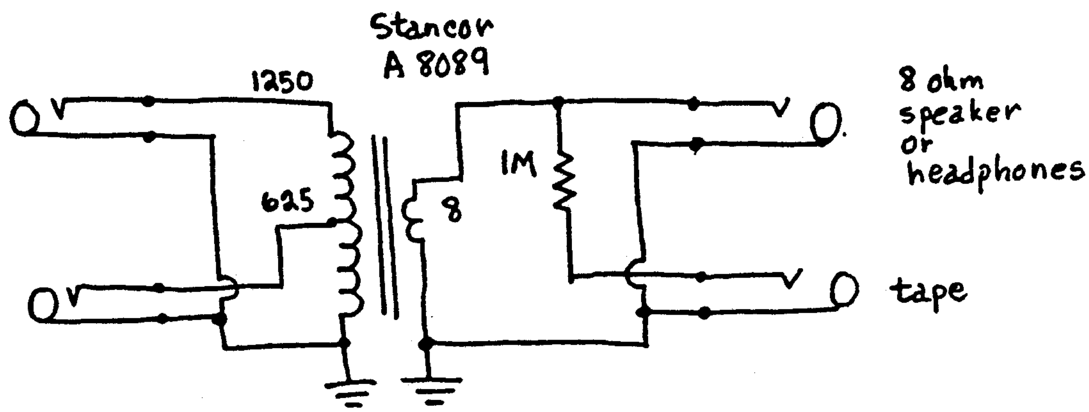
In my experience, it does not make any significant difference whether you match the R-390A 600 ohm audio output impedance with the 625 ohm primary tap of a 25 volt line transformer or the 500 ohm primary tap of a 70.7 volt line transformer. In fact, you can use a 1000 ohm or 1250 ohm primary tap of a line transformer; the only noticeable effect is a small decrease in maximum available audio output power

The Stancor A8089 transformer is no longer available from Fair Radio.for $3 plus shipping. Since Fair Radio has a $10 minimum order, if you are not ordering other items from them, you might prefer to use the Radio Shack 70 volt line transformer, catalog number 32-1031, for $5.95. The Radio Shack transformer has primary taps of 10/5/2.5/1.25/0.62 watts and secondary taps of 4/8/16 ohms.

My current audio impedance matching adapter is shown in the following schematic. I used both the 625 and 1250 ohm primary taps of the Stancor A8089. I cut off the two extra primary tap leads flush with the primary windings. A 1 meg ohm half watt resistor was used to provide a tape output. The transformer was mounted in a small metal box.with four standard 1/4 inch headphone jacks for input and output. Audio cables with standard 1/4 inch headphone plugs are used to connect the adapter to a speaker or to the headphone jack of the R-390A or other receiver. A homebrew audio cable with headphone plug on one end and lugs on the other end is required for connecting the adapter to the terminal strip on the R-390A rear panel. You should note that terminal 7 on the R-390A rear panel is audio ground. If you connect the mating audio cable incorrectly, you may experience a strong shock when handling the adapter box or audio plugs, or you may accidentally short circuit the R-390A audio output. For speaker use, the audio cable center conductor should go to terminal 6, and the audio cable braid should go to terminal 7 on the R-390A rear panel terminal strip.

The 625 ohm primary of my adapter is used with an R-390A. The 1250 ohm primary is used with the high impedance headphone jacks of other receivers, such as a Hammarlund HQ-180(A) or HQ-150.

Perhaps it is appropriate to mention here that I have observed unnecessary replacement of power supply electrolytics in two HQ-180A receivers, probably as a consequence of unsuccessful attempts to eliminate hum from headphone audio output. In one case, new electrolytic capacitors were dangled from the wiring which had been disconnected from the original metal can multi-section electrolytic. In another case, an intermittent loss of B+ power was traced to unsoldered connections at the multi-section electrolytic lugs; the unsoldered leads had been stuck back through the solder lugs without recrimping and resoldering them. After the careless and unnecessary tamperings had been repaired, and an audio impedance matching adapter was used, the headphone audio output of these two HQ-180As was excellent.



While I am on the subject of good audio from hollow state receivers, let me remind you of the Radio Shack Indoor/Outdoor 4" speaker in the ugly plastic case, catalog # 40-1227A, mentioned in a previous HSN. It is still the best speaker I've found for use with hollow state receivers. Has anyone tried the 6-1/2" catalog # 40-1248? For headphones it is hard to beat the Radio Shack Lightweight Monaural Headphones, catalog # 20-210A, provided you cut off the 1/8" plug and replace it with a standard 1/4" plug. (The 1/8" to 1/4" adapter supplied with the headphones introduces "static".)

51J-/R-388 Band 1 Mod And AGC Mod

Dallas Lankford, Summer 1990

In my article, "Collins 51J-4 Review," DX News 56, 1 (Mon., Oct. 3, 1988), pages 6-8, I mentioned that the Collins 51J- series and R-388 receivers were insensitive on band 1, and suggested a band 1 mod and AGC bias mod to improve band 1 sensitivity. However, in a subsequent article, "Collins 51J-4 Technical Notes," DX News 56, 13 (Mon., Dec. 26, 1988), pages 29-32, I recommended against those mods after I discovered they degraded dynamic range on all bands.

Recently, I took another look at the band 1 sensitivity issue. Previously I had remarked that a carefully aligned 51J-/R-388 series receiver is not seriously insensitive on band 1, but merely somewhat less sensitive than on the other bands. Specifically, typical sensitivity is 0.25 microvolts on bands 2-30 and 1.0 microvolt on band 1 (for a 10 dB S+N/N ratio and 6 KHz bandwidth). I knew that improving band 1 sensitivity slightly on band 1 would not make it possible to hear more and better DX. Nevertheless, uniform sensitivity is desirable because it simplifies optimization of antennas, which is an important factor in determining what DX you hear. Also, I was curious if band 1 sensitivity could be made about the same as for the other bands without degrading band 1 dynamic range. The solution turned out to be simple. Add a 10 pF 500 volt mica capacitor across C117; see the simplified schematic in Fig. 1.

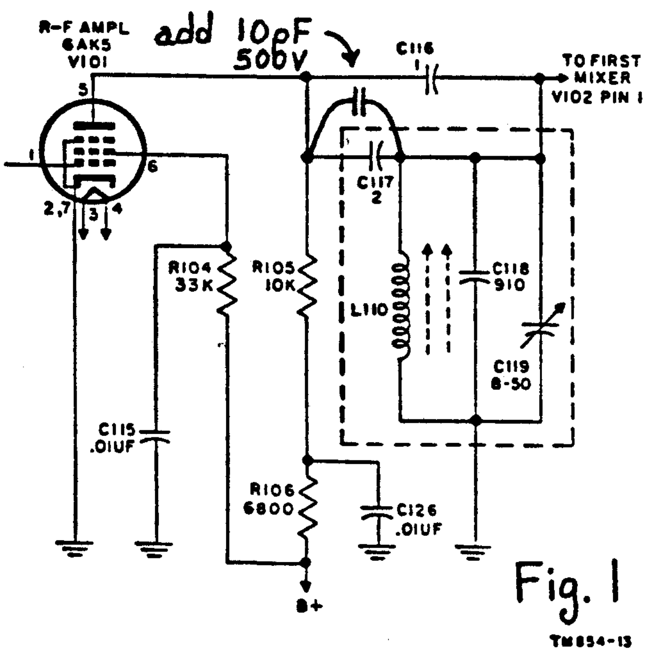


Fig. 1

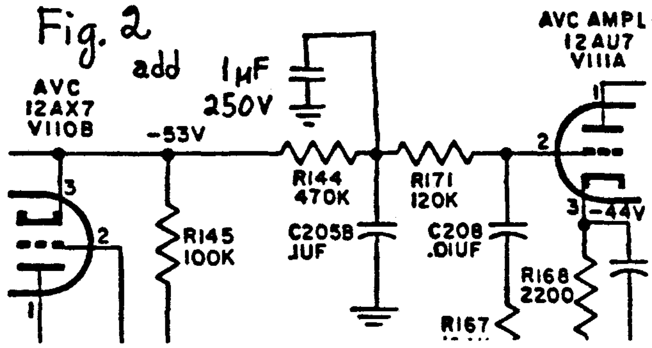
The simplified schematic in Fig. 1 is taken from an R-388 manual, but applies to all 51J- series receivers. The dashed line enclosing C117, L110, C118, and C119 is not accurate because those components are not contained in a shielded enclosure. In particular C117 is attached to solder lugs on adjacent bandswitch wafers. It is not easy to access C117 because of its position beside an L bracket and because of two insulated wires which pass through one bandswitch wafer and are soldered to lugs on the other bandswitch wafer above one end of C117. These two wires must be unsoldered, disconnected, and pushed out of the way to access one end of C117.

The dynamic range before and after this mod was the same - 73 dB (5 KHz spacing), which is 4 dB better than an NRD-525. Sensitivity was improved to 0.35 microvolts, which is almost the same as for band 2.

After using a 51J-4 for almost 2 years I must say that it has extremely poor AGC for such an otherwise fine receiver. The AGC suffers from the worst kinds of defects one could imagine - low frequency audio on the AGC line, which causes noticable audio distortion on very low frequency audio (below 100 Hz), and attack and release times which are not suitable for MW graveyard and SW DXing. Fortunately, there is a simple cure for both of these problems (if you don't care about SSB or CW). Add a 1 mF 250 volt capacitor across C205B; see the schematic fragment in Fig. 2. In the original circuit, the release time is determined by R144 and C205B according to the formula T = RC, where R is in ohms and C is

Farads (the result T is in seconds). Thus, the original release time is about 50 milliseconds. Adding a 1 mF capacitor across C205B increases the release time to about 550 milliseconds, which is satisfactory for MW and SW AM broadcasts. This mod does slow the attack time from about 5 milliseconds to about 50 milliseconds, which makes the receiver less suitable for SSB and CW. If you want both improved AM and SSB/CW AGC performance, you will need to do my fast attack and slow release AGC mod.

Fig. 2



51J-3/R-388, 51J-4 PTO Remarks

Dallas Lankford

In my opinion, much of the value of a 51J-3,4 or R-388 depends on the linearity and end point accuracy of the PTO. That this is not an idle concern is attested to by the December 1969 Ham Radio article, "New Life For The Collins 51J Receiver VFO," by William I. Orr, pages 36-41. As Orr observed, by the late 1960's some of these 70E-15 PTOs had aged so much that the end points could no longer be brought into alignment. His article describes a method for fixing this problem which involves removing one or more turns from the end point adjustment coil. However, when a PTO has spread that much, even after you have modified the end point adjustment coil so that the end points can be adjusted, the PTO linearity is almost certain to be out of specs (+/- 750 Hz). To overhaul the PTO correctly, a corrector stack alignment should be done. But Orr does not discuss that. Take my word for it... few people have the patience and determination to do a corrector stack alignment.

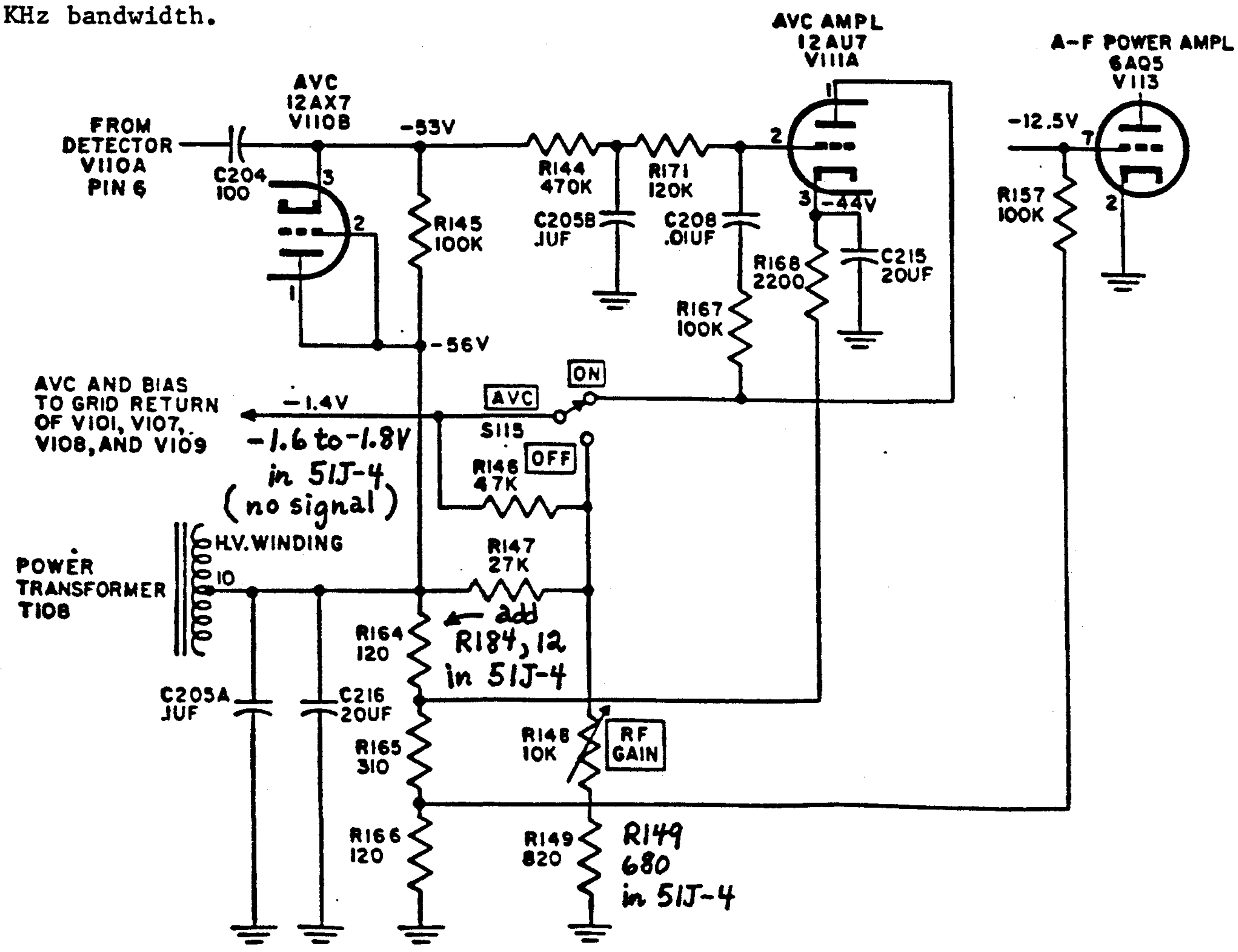
The bottom line is that if you simply must have a 51J-3,4 or R-388, you should not buy one sight unseen, but rather should personally inspect it and determine to your satisfaction that the end points are within, say, +/- 750 Hz and that all of the intermediate 100 KHz calibration points are within +/- 750 Hz. That is the only way you can be guranteed to get one with a good PTO. Of three 51J-4s which have passed through my hands, two had PTOs which were within the +/- 750 Hz spec. So there are some with "good" PTOs. If you are the gambling type, you could take a chance on a PTO which is slightly out of spec, say up to 3 or 4 KHz, and hope that an end point adjustment will bring it back into spec. (Here I mean the end points are out of spec no more than 3 or 4 KHz and the intermediate points are out of spec less than the endpoints.) If you take this approach, be forewarned that the end point adjustment slug has a lock nut which must be loosened before you adjust the slug. And if someone has been in there before you and forced the slot adjust end point shaft, it is just possible that the slotted tip of the shaft has been broken off by that someone. It is not necessary to remove the PTO to do an end point adjustment. You can fabricate two small right angle screwdrivers from 3-1/2" nails (0.148" diameter nails) and do the end point adjustment in situ with the aid of a dental mirror and a strong light.

A fascinating discussion of the 70E-15 PTO is contained in the Collins Instruction Book, Precision Tuned Oscillator 70E-15, part number 520 9887 00, 2nd Edition, 15 August 1959. If anyone has an original copy and would be willing to make me clear copies of Figures 5, 6, 7, and 8,I would greatly appreciate it. For additional information on 51J-3,4 and R-388 PTO end point alignment you may wish to send me two $1 bills (no checks please) and a SASE for my "51J-4 Technical Review" and one $1 bill and a SASE for my "More 51J-4 Technical Notes."

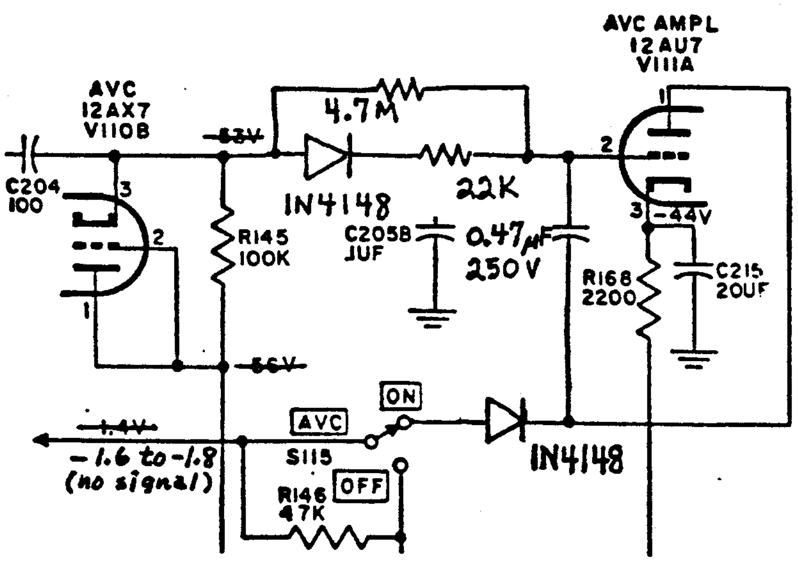
51J-4 Fast Attack - Slow Release AGC Mod

Dallas Lankford, Summer 1990

There are various approaches to modifying the 51J- series and R-388 receivers for SSB. Commander Paul Lee in his April 1961 CQ article, "The single tube product detector," pages 50-51, 118-119, described a 6BE6 product detector which is used in many of these mods. However, Lee discussed no changes to the AGC circuit, which is unsuitable for SSB. A variation of Lee's product detector was described by Wilfred Scherer in his December 1968 CQ article, "More on updated improvements for the 51J receivers," pages 64-69, 116. Scherer also presented a two part AGC mod which was supposed to provide fast attack and slow release. The first part of Scherer's mod introduced audio on the AGC line, which degraded AM audio quality. The second part cleaned up the audio on the AGC line, but slowed down attack time. In addition, Scherer's AGC mod suffers from bad overshoot, which manifests itself by a loud thump at the beginning of SSB transmissions. Yet another variation of Lee's product detector was described by William Orr in his February 1978 Ham Radio article, "Modifying the Collins 51J receiver for SSB reception," pages 66-69 (be sure to read Frisco Roberts' comments about motor-boating audio problems with the 6BE6 product detector on page 6 of the October 1978 issue of Ham Radio). Orr's AGC mod also suffers from bad overshoot and audio distortion in AM mode. Even worse, Orr recommended reducing the no-signal AGC line voltage bias to -1.4 VDC by changing R149 (820 ohms in the 51J-1,2,3 and R-388, and 680 ohms in the 51J-4) to a lower value. I did this in my 51J-4 and it reduced the dynamic range of my receiver by more than 15 dB on all bands. I presume that Orr got this idea from reading tube pin voltages in a 51J manual, or from Fig. 25 of the R-388 manual (TM 854) which I have reproduced below. Apparently the -1.4 VDC value is not correct, or else Collins discovered that the AGC line no-signal bias should be higher for improved dynamic range and changed the AGC line bias for 51J-4s. I believe the former is the case. In 51J-4s I have found that the no-signal AGC line bias voltage varies from about -1.60 to -1.80 VDC, and that with this bias range band 2-30 sensitivity is typically 0.25 microvolts for a 10 dB S+N/N ratio with a 6 KHz bandwidth.



After trying all of the AGC mods above, and finding them all unsatisfactory, I started over. I removed R144, R171, C208, and R167 and removed the wire connecting C205B to the junction of R144 and R171. Next, I added a 1N4148 diode shunted by a 4.7M resistor from the junction of C204, R145, and pin 3 of V110B to pin 2 of V111A, and a 0.47 mF 250 volt mylar capacitor from pin 2 of V111A to pin 1 of V111A; see the schematic fragment below.



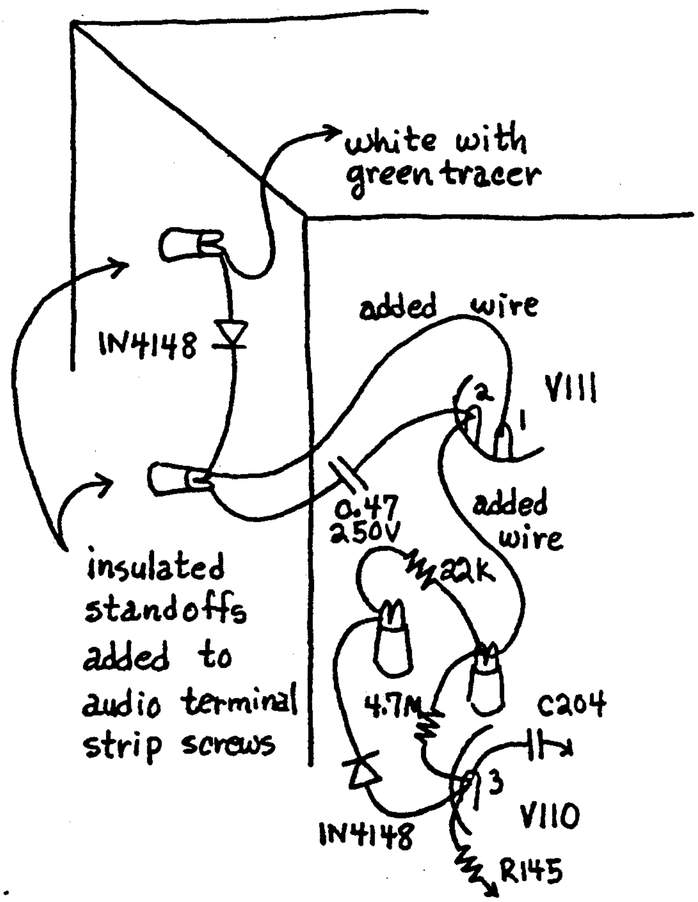
My initial circuit had rather bad overshoot, so I added a resistor in series with the diode. By trial and error I determined that 22K ohms was the best compromize between overshoot and my target attack time of 2 mS. With a 47K ohm resistor there was no overshoot at all signal levels, but the attack time at lower signal levels was slower (about 10 mS at the 20 dB level). With the 22K ohm resistor there was a slight amount of overshoot at the 80 dB level and above, while the attack time at all signal levels was 3 mS or faster. After several hours of listening I discovered that at low signal levels (near 0 dB) the AGC line was driven positive relative to the no-signal bias voltage by noise pulses and very weak signals. Another 1N4148 diode was added past the junction of pin 1 of V111A and the 0.47 mF capacitor to eliminate this annoying quirk. Occasionally the meter still deflected below 0, but not nearly as often or as much as before.

If other diode types are substituted for the 1N4148 diodes, it is essential that they have a very high back resistance. The 1N4148 diodes I used were from a Radio Shack package marked 1N914, so presumably 1N914 diodes would be suitable. The 1N914 has a reverse current rating of 0.025 microamps at the maximum voltage rating of 70 volts, which is equivalent to a back resistance of 3000M ohms.

I have already mentioned that the attack time of my AGC mod is 3 mS or better at all signal levels. An interesting feature of my AGC mod is that its release time is variable, and depends on the signal level. By definition, the release time of an AGC circuit is the time required for the AGC line voltage V to change to 37% of the difference between V and the no-signal AGC line voltage when a signal is suddenly removed from the antenna input. The release time of my mod varies from about 400 mS for 0-20 dB signal levels, to 800 mS for 40 dB signal levels, up to 1.2 seconds for 60-100 dB signal levels. It is not difficult to see why the AGC release time is variable: the AGC line voltage varies from about -1.6 VDC with no signal to about -9 VDC for a 100 dB signal, while the voltage at pin 3 of V110B varies from about -65 VDC with no signal to about -56 VDC for a 100 dB signal; thus the 0.47 mF capacitor requires more charge change for release of a strong signal.

The only complaint I have about my AGC mod is that the S-meter pins for a few seconds when the 51J-4 is first turned on. The temporary excessive voltage / current is not serious, less than twice the full scale voltage / current. Nevertheless, I turn the power switch to STAND BY for about 15 seconds to avoid pinning the S-meter.

In a sequel to this note I will describe the product detector I built for my 51J-4. Together with my AGC mod it makes a 51J-4 one of the finest all mode receivers ever made.



The layout of my AGC mod is sketched here. Two existing insulated standoffs which had been used as tie points for removed components were used as tie points for one of the diodes, the 4.7M resistor, and the 22K resistor. Two new insulated standoffs were added as tie points for the other diode. The insulated wire (white with green tracer) was moved from pin 1 of V111A, and two new short lengths of insulated wire were used to complete the circuit. Because of space limitations I found it convenient to mount the 0.047 mF capacitor as shown.

I presume that this AGC mod will also work for 51J-1,2,3 and R-388 receivers. It might be necessary to change the value of the 22K resistor to some other value if overshoot is experienced or if the attack time is not 3 mS or faster. A scope should be used to measure the attack time and observe the attack trace for possible overshoot.

In the article mentioned above, O warned against using a resistor larger than 2M in the grid circuit of V111. As the 12AU7 ages, oxide may migrate from the cathode to the grid, causing grid emission, which can alter the operating characteristics of the 12AU7 and cause the AGC to function improperly. In my opinion, if the AGC begins to operate incorrectly, then replacement of the 12AU7 may be indicated. In fact, grid emission by any AGC controlled tube (the 6BA6 IF amp tubes, etc.) can alter the AGC line voltage and cause a receiver to function improperly. So I don't consider this is an issue unless you are such a tightwad that you want tubes to last forever.

The variable release time aspect of my AGC mod caused me some concern at first. AGCs are not supposed to function that way (at least I don't know of any that do). But after hours of listening to SSB, I can't find anything objectionable about the variable release time. When I was developing the AGC mod with an external prototype board (Radio Shack # 276-175) and test lead clips, returning the 0.47 mF capacitor to ground caused popping. The popping may have been due to the external prototype and long leads. So if you don't like the idea of a variable release time AGC, you can try returning the 0.47 mF capacitor to ground with a temporary solder joint, and move it to pin 1 of V111 if you experience popping. With the 0.47 mF capacitor returned to ground, the release time should be reasonably constant at all signal levels, about 400 mS. However, the faster release time may cause annoying pumping on stronger SSB signals.

I don't consider this to be the final or even the best 51J/R-388 AGC mod. I stopped development when I had something acceptable.

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Publisher's And Editor's Corner

First, a BIG THANK YOU to everyone who donated any amount of cash to The Hollow State Newsletter. Both smaller and larger amounts were greatly needed and greatly appreciated. Ralph and I are happy to report that The Hollow State newsletter is now solvent again.

Although I had intended to finish our discussion of the 51J-4 with this issue by including an excellent product detector mod which makes the 51J-4 maybe the best all band, all mode receiver of all time, instead I have decided to make this an all R-390A issue and return to the 51J-4 product detector mod in the winter. Several reasons motivated this decision, not the least of which was the receipt of some good new R-390A information from Shaun Merrigan.
I believe you will find Shaun's discovery that Maynard's ILO is not compatible with my latest SSB/AGC mod quite interesting, and his solution for this problem equally interesting. Shaun also gives us another way to add a Q-multiplier to the R-390A, one which appears quite easy to do. But the one I liked best was Shaun's discovery of the cause and cure of "thunderstorms" in the R-390A audio output with no antenna connected. I have encountered this problem before, but was never able to identify and cure the problem. Congratulations Shaun!

Let me add a few remarks about the R-390A AGC and BFO mods which are included in this issue. When I finished my first version of the mod and showed it to Wally Chambers, K5OP, it turned out that Wally was already doing something similar. After that, we worked together so closely on the project that I don't even remember who is responsible for what parts of the mod. I would suggest that if names are to be attached to the mod, then it should be referred to as the Chambers-Lankford AGC/BFO mod. Of course, I am entierly responsible for the contents of the article and any inaccuracies or errors. We hope that the article is free of typos, and we believe that the mod can be done with superb results to any IF deck. If you have an EAC IF deck, be sure to read the note at the end of the article. In fact, you may want to do the EAC variant to your IF deck (even if it is not an EAC) because it is simpler.

MAYNARD'S ILO INCOMPATIBLE WITH LANKFORD'S LATEST SSB/AGC MOD: Upon modifying an IF subchassis and AGC switch according to Lankford's latest SSB/AGC mod (this issue, Ed.) which works extremely well, it was found that (because my R-390A includes Maynard's ILO mod, Ed.) the strong SSB signal handling performance of the R-390A was severely degraded. Very noticeable audio distortion was noted on strong SSB signals, especially the 80m ham band, and as a result, I had to "ride" the RF gain control.

The solution was to add a switch (in my case mounted on a small L-shaped piece of aluminum, held down by the carrier meter pot adjustment nut) so that I could switch the ILO in and out. I might add that this mod is useful in any case because it permits the ILO to be switched in and out for alignment and calibration purposes. For example, with the ILO switched in, the BFO will lock to the xtal calibrator and you could be 300 Hz or more off frequency. Of course, the main purpose of the switch is to have available both Maynard's ILO feature for AM synchronous detection, and Lankford's mod for superb SSB performance. (Shaun Merrigan)

Q-MULTIPLIER FOR R-390A: January 1965 CQ magazine, pages 37-38, suggests connecting a Q-multiplier as follows: inner conductor to pin 5 of V502 (the plate of the second IF amp) and shield to nearest ground. I tried this and found it to work well. If you use miniature coax, you can route the coax through the access hole in the top of the IF subchassis (the hole which passes the wires to the carrier meter zero adjust pot and IF gain adjust pot), so no drilling is required. (Shaun Merrigan)

R-390A THUNDERSTORM NOISE: One of the R-390As I worked on had a bad noise problem which sounded like a nearby thunderstorm was raging with no antenna connected. I traced it to the IF subchassis by disconnecting the output of the RF deck (P213 and P218) and by switching AF decks. Within the IF deck I used "Freeze-it" and found the culprit, an intermittent mica capacitor, after about 10 minutes work. I replaced the mica cap with an identical one from my "parts unit", and all was well. (Shaun Merrigan)

This is a wonderful discovery which Shaun has made. I had an intermittent "thunderstorm" problem in an IF deck which I never was able to isolate. For a while I suspected a bad tube, but repeated efforts to isolate the bad tube failed. It never occurred to me that I might have a bad or intermittent mica capacitor. Now I know what to do if I ever encounter the problem again. However, let me add that some of these "thunderstorm" problems are bad tubes, so you should check for bad tubes first before you proceed to try to isolate a bad or intermittent mica cap. (Ed.)

R-390A WON'T TURN OFF?: When you turn your R-390A FUNCTION switch to the OFF position, do your dial lights remain on? If so, then you have a worn micro-switch (which is part of the S102 function switch assembly). The only permanent cure is to drop the front panel, unsolder the two wires to the microswitch, remove the microswitch, gently pry the side plate off the microswitch (held on by 4 small screw-like, but unthreaded and unslotted, pieces of metal), and refinish the microswitch contacts. This is akin to refinishing the points of an automobile. GC makes a burnishing tool which can be used, or you may use different grits of wet-dry sandpaper, starting with #400, then #600, then finer grits (which you can make by sanding a piece of metal with #600 until it is "well used"). The idea is to make the contact surfaces of the switch flat and smooth again. After years of use, repeated arcing has roughed up the surfaces so much that finally one arc causes the surfaces to literally weld together. An 8X lupe is probably essential for inspection of your work. (Shaun Merrigan & Dallas Lankford)

CHAMBERS-LANKFORD AGC/BFO MOD: This AGC/BFO mod is not perfect. The SLOW attack time is 6 mS, which causes some distortion, pops, and clicks on the initial syllables of SSB transmissions. These are not eliminated even with a product detector. Some additional distortion is contributed by the BFO mod, which is not a product detector. But it is a relatively simple mod, and gives excellent results for the amount of effort involved. For CW it is outstanding. In any case, it is better by far than any other SSB mod which has been done before. Wally and I have some ideas about how to speed up the slow attack, and I have an excellent product detector waiting in the wings, so we hope to eventually arrive at the outstanding SSB performance which the R-390A is capable of. (Wally Chambers & Dallas Lankford)

R-390A AGC And BFO Mods

For Improved SSB And CW

Dallas Lankford

Two things prevent an R–390A from performing well on SSB and CW signals – unsuitable attack and release times for SSB and CW, and low BFO amplitude at the diode detector.

The usual way to demodulate SSB or CW is with a product detector. There are two ways to add a product detector to an R–390A. The BFO circuit can be converted to a product detector as described by Capt. Paul Lee in his 1968 *CQ* article, "Modifying the R–390A receiver for SSB," pages 55-58; see also a variation using relay switching which includes the R–390A noise limiter function with the product detector as described by Eugene Hubbell in his 1974 *Ham Radio* article, "Improving the R–390A product detector," pages 12-15. Or an external product detector can be connected to the R–390A 455 KHz IF output, such as one of the military sideband converters, a Hammarlund HC–10 converter, or a home built product detector like the one described by Alan Nusbaum in his November 1985 *Ham Radio* article, "External product detector improves receiver performance," pages 107-111.

However, there are disadvantages to these approaches. Lee's product detector requires that an R–390A mainframe be rewired, which means that you cannot use that mainframe without a specially modified IF subchassis. In addition, the noise limiter is bypassed, and Hubbell reported that there was a regenerative effect which occurred at the BFO frequency, resulting in a peak in the audio response. Hubbell implemented Lee's mod with a relay, which eliminated the regenerative effect. He also expanded Lee's mod by making the noise limiter operational with the product detector. But Hubbell's mod requires a special Potter and Brumfield relay (type PW5LS, 2 mA, 10K ohm coil) which now costs about $100 retail, and the relay must be mounted in a 7 pin miniature socket added to the IF subchassis. Hubbell's approach can be implemented with an ordinary low voltage relay, but then you will have to provide additional low voltage, high current, DC for the relay coil, and use a BJT to switch the relay on and off with the switched 200 volt B+ line. There is hardly enough space to mount the necessary additional components. The military SSB converters are almost always large and heavy, and generally use many tubes (CV-157: 44 tubes, 125 lbs.; CV-1982: 23 tubes, mostly nuvistor, 30 lbs.). I have been told that there is a small solid state SSB converter made by McGee Industries, but I have never seen one. The Hammarlund HC-10 converter (only 10 tubes) requires precise frerquency alignment for whichever sideband you want to use, or a wider than necessary R-390A bandwidth if you want to switch sidebands quickly. If you use a wider than necessary R-390A bandwidth, then adjacent QRM activates the R-390A AGC and degrades the performance of the HC-10. Finally, none of these product detector mods or add-ons does anything about the unsuitable R-390A attack times and release times for SSB and CW.

For SSB an attack time of 2 milliseconds (mS) is often stated as optimal, while release times of 500 mS for fast SSB release and 2 seconds (S) for slow SSB release are considered suitable. My goal was to modify the R-390A AGC in such a way that attack times for all three AGC speeds (FAST, MED, and SLOW) were about 2 mS, and the MED and SLOW release times were about 780 mS and 2 S respectively.

My starting point was Cornelius' AGC mod, which speeded up attack times for FAST and MED. The original Cornelius AGC mod removed R545, replaced R546 with a back pointing diode, and replaced R547 with a 10K ohm resistor. I developed a better variant of Cornelius' AGC mod by leaving R545, R546, and R547 unchanged, and adding two back pointing diodes, one across R546, the other across R547.

To improve the SLOW attack time, it was necessary to redesign the SLOW AGC circuit. In the SLOW AGC position, C551 is connected across the plate and grid of V506A. By unsoldering the wire at pin 1 of V506A (which connects lug 8 of S107 and pin 1 of V506A) and resoldering it to a convenient nearby ground lug (pin 8 of V506), the SLOW attack time problem was mostly solved. But with this change the SLOW and MED attack and release times are identical. So a new capacitor C1 was inserted from lug 9 of S107 to ground (after removing the original ground connection). Now in the MED position C1 is in series with C551, which permits the MED release time to be adjusted to a smaller value than the SLOW release time.

I don't like modifying an R-390A mainframe as a matter of general principle. However, the addition of C1 does not prevent using an unmodified IF subchassis. The MED release time with an unmodified IF subchassis will not be as slow as with an unmodified mainframe, but that is hardly noticeable.

At this point in my experiments the SLOW release time was about 500 mS, but a slow release time of 2 S was desired. I tried adding additional capacitance in parallel with C551, but that caused a slower SLOW attack time (and the SLOW attack time was already too slow at about 10 mS). To make the SLOW release time slower without increasing the SLOW attack time, R547 was removed (leaving only the back pointing diode in place of R547). I learned the hard way that this diode <u>must</u> have a very high back resistance, and that 1N34A and 1N270 germanium diodes are not suitable. A 1N4148 or 1N914 is suitable because they have a reverse leakage current rating of 0.025 microamps at the maximum rated voltage of 75 volts, which works out to a back resistance of about 3000M ohms. Thus, the AGC capacitors are forced to discharge through the 1.77M ohm combined resistance of R201 and R234 (a voltage divider for the 6DC6 RF amplifier grid AGC voltage).

After R547 was removed the SLOW release time was too slow, about 3.7 S. To adjust the SLOW release time to about 2 S, C551 was replaced with C2. My final AGC mod is shown on the following simplified schematic. I used a scope to measure the release times, and confirmed that the release times can be calculated from the conventional $T = R \cdot C$ time constant formula (when R is in megohms and C is in μF, T is in seconds). So it is easy to select the values of C1, C2, and even C548 for whatever release times you desire. The time constant formulas are as follows: $T_{FAST} = 1.77 \cdot C548$, $T_{MED} = 1.77 \cdot \left(C548 + \frac{C1 \cdot C2}{C1 + C2}\right)$, and $T_{SLOW} = 1.77 \cdot (C548 + C2)$.

For unchanged C548 (= 0.1 μF), C1 = 0.47 μF, and C2 = 1.22 μF, the measured and computed release times were about 180 mS, 780 mS, and 2.3 S for FAST, MED, and SLOW respectively.

Replacing C551 by the smaller capacitance (1.22 μF) had the beneficial effect of speeding up the SLOW attack time to about 6 mS. The MED and FAST attack times were about 3 mS and 1 mS respectively. The SLOW attack time is not quite as fast as I wanted, but it is the best that can be done without more substantial modifications.

Like the Cornelius mod, my AGC mod increases AGC line voltage, which causes higher carrier level meter readings and reduces the signal levels at the diode detector, thus reducing audio output. The reduced audio output is not a problem because an R–390A has plenty of reserve audio gain. The increased carrier level meter readings should not be a problem for most R–390As. But if the meter pins on strong signals, there are two cures. Unsolder one of the meter leads and add one ohm resistors one at a time until the meter no longer pins on strong signals. The carrier level meter has a very low internal resistance, about 17.4 ohms nominal, so a small additional resistance will cause a large change in meter readings. The other cure is to replace R524 (680 ohms nominal) by a larger resistor. The best solution here is to add a 500 ohm, 2 watt, ten turn, wire wound resistor in series with R524. In effect, this adds a meter sensitivity adjustment. The reduced signal levels at the diode detector has the beneficial effect of reducing distortion on SSB and CW.

The improvement in SSB quality caused by reduced signal levels at the diode detector, the difficulty of converting an R–390A BFO circuit to a product detector, and the defects of add-on converters motivated me to examine the possibility of further improving the diode detector for SSB and CW. In his May 1956 *QST* article, "Reception with product detectors," Murray Crosby, W2CSY remarked that proper reception of SSB may be obtained with a diode detector provided the signal amplitude entering the diode detector is less than or equal to the BFO amplitude.

I added a 47 pF 500 volt mica capacitor in parallel with the 12 pF BFO injection capacitor C535, and was pleased that most of the residual SSB distortion was eliminated. But when I measured the signal and BFO amplitudes I was surprised that a 50 dB unmodulated RF signal produced a 4 volt peak signal at the diode detector, and that the BFO was already 12 volts peak with the 12 pF injection capacitor alone.

Wally Chambers, K5OP provided the answer to this perplexing situation. In the 49th (1972) and 54th (1977) editions of *The Radio Amateur's Handbook*, page 239, it is said that the BFO signal amplitude should be 5 to 20 times greater than the strongest SSB or CW signal at a diode detector if distortion is to be minimized. The addition of a 47 pF capacitor across C535 increased the BFO amplitude at the diode detector to about 25 volts peak, which makes the BFO amplitude about 6 times greater than a 50 dB unmodulated RF signal. There is apparently some room for additional improvement. Wally suggested that replacing R530, the 22K ohm BFO plate resistor, with a 12 mH choke might further increase the BFO output, but I have not tried that. The 22K ohm BFO plate resistor is a large 1 watt resistor which is difficult to remove, and there is not much space underneath or beside the BFO bellows coupler for a 12 mH choke.

For Capacitors C1 and C2 I used 250 volt mylar, radial leads. For a 1.22 μF capacitor I used a 1 μF capacitor and a 0.22 μF capacitor in parallel. I used 1N4148 diodes from a Radio Shack package marked 1N914.

To add C1 you will need to remove the R–390A front panel. Unsolder and remove the end of the insulated stranded wire, nominally white insulation, at pin 9 of S107. Clip one or more loops of cable lacing which secure the white wire to determine if the other end is connected to lug 1 of the LIMITER potentiometer R120. If so, the white wire may be removed completely. Tie the loose end(s) of the cable lacing. If desired or necessary, use new cable lacing to tie new loops where the old loops were removed. If the white wire does not terminate at pin 1 of R120, or if you do not want to remove the white wire, you can add a small insulated 4-40 standoff to the top screw of S107. If there are not enough screw threads to mount the insulated standoff securely, you will have to remove the nut and/or lock washer. And if the nut and screw threads are painted with varnish, you may have to remove S107 from the front panel to access the screw head. A hot soldering iron tip can be used to soften the varnish so that the nut can be removed without stripping the screw head or rounding off the nut (they are small and nominally brass).

R546 is usually connected to pin 1 or 2 of socket XV509 and to an insulated standoff. It is easy to add a diode across R546. The cathode lead of the diode can go to either pin 1 or pin 2 of XV509, and the anode lead of the diode goes to the insulated standoff.

R547 is usually connected to pin 2 of socket XV506 and to an insulated standoff. How easy it is to remove R547 depends on the order in which the other wires are mounted on the insulated standoff. You may have to temporarily remove other wires to access the R547 lead. Be careful uncrimping the lead of R547 at pin 2 of XV506. It is easy to break a tube socket lug. The cathode lead of the diode goes to the insulated standoff, the anode lead to pin 2 of XV506.

C551 is not removed from the IF subchassis, and one lug of C551 is used as a tie point. Remove C548. One end is usually connected to a ground lug beside XV509, the other end to one of the C551 lugs. Save C548 in case you want to undo my mod. Unsolder and remove the end of the insulated stranded wire, noninally white with blue and black tracers, attached to the same lug of C551 to which C548 was attached. Take a 4.5 inch length of insulated, stranded, tinned, #22 wire, strip 0.5 inch of insulation from one end, strip 1 inch of insulation from the other end, remove the solder from the lug of C551 to which C548 was <u>not</u> attached (this lug of C551 should have attached to it an insulated stranded wire which is nominally white with blue and red tracers), run the short stripped end of the stranded wire through this lug of C551, crimp it, and solder it. On the metal panel beside C551 there are two Phillips head screws which mount ground lugs in adjacent compartments. Remove the screws and reverse them. Mount two small insulated 4-40 standoffs on the screw ends. If there are not enough threads to securely mount the insulated standoffs, you will have to use longer screws. Mount C2 on the two insulated standoffs, attach the free end of the wire removed from C551 (white with blue and black tracers) to one standoff, add a 0.1 μF, 250 volt, mylar capacitor running from that same standoff to the ground lug from which C548 was removed (this 0.1 μF capacitor replaces C548), attach the free end of the new stranded wire added to the other lug of C551 to the other insulated standoff, and resolder or solder all remaining added or changed lugs.

To add a 47 pF capacitor across C535 you must remove the BFO PTO bellows coupler. The spline set screws in the bellows coupler are painted with varnish. To remove them without stripping the splines, use a 45 watt 900 degree soldering iron to soften the varnish. Apply the hot iron tip directly to a set screw for about 30 seconds, and then apply reasonable pressure with a spline wrench. If the set screw does not release with reasonable pressure, apply the hot iron tip again for about 30 seconds.

You may wonder why Collins did not design the R–390A AGC this way and save us all the trouble of modifying the AGC for fast attack and slow release. And why did they use the Miller effect circuit for the SLOW AGC circuit? After all, the Miller effect SLOW release circuit in an R–390A has the disadvantage of being slow (200 mS) attack. I learned what I believe is the answer quite by accident: reliable SLOW release.

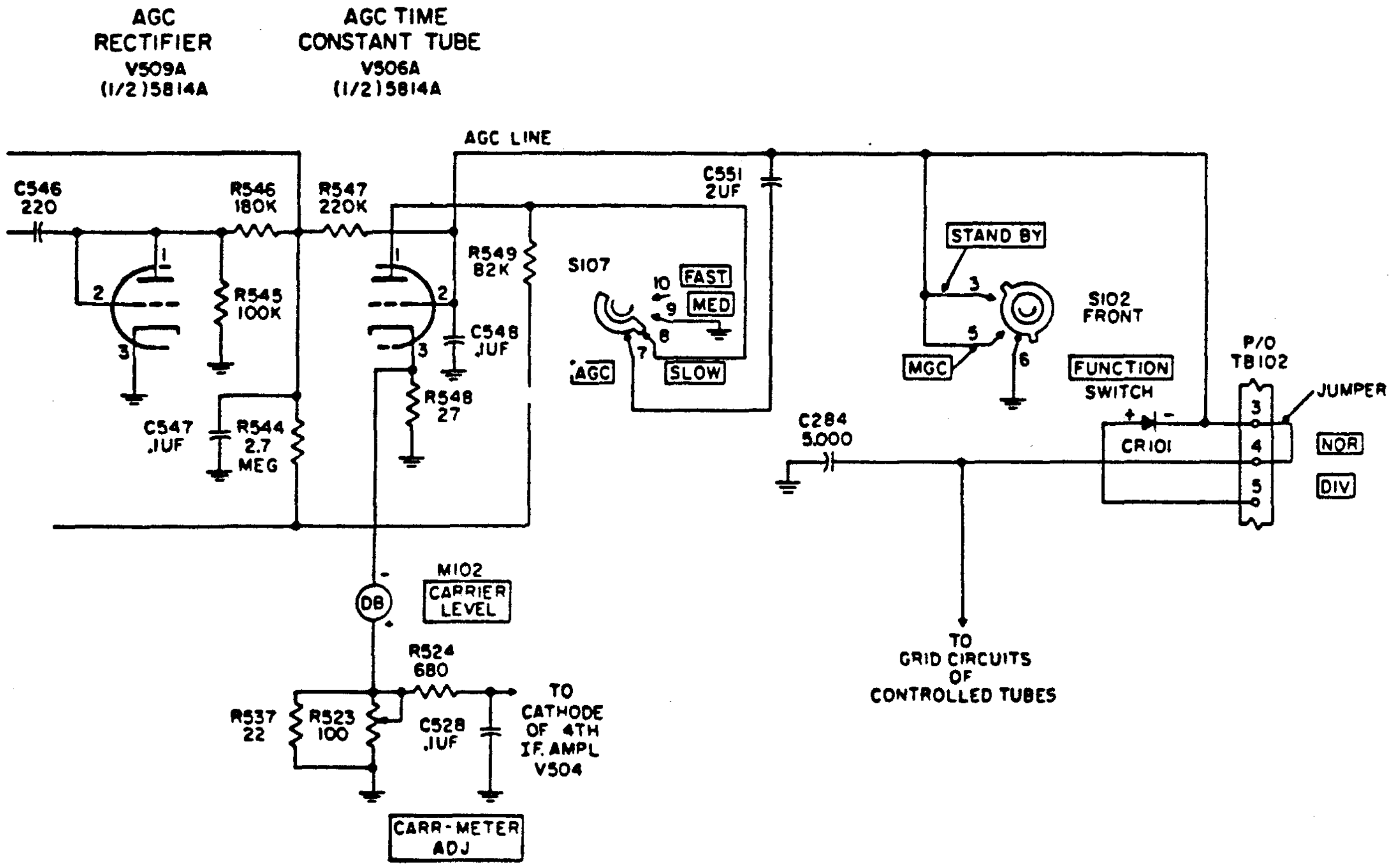
As I was developing my AGC mod, I discovered to my amazement that the SLOW release time got faster as the R–390A warmed up. I first noticed this effect by observing the carrier level meter. Did I imagine it? No. Scope measurements confirmed that the SLOW release time gradually decreased from about 2 S shortly after turn on from a cold start to about 500 milliseconds after 30 minutes. The cause was traced to a gassy 1st IF amplifier tube. It appears that Collins used the Miller effect SLOW AGC circuit because it is not effected significantly by gassy AGC controlled tubes.

That's the bad news. The good news is that it is relatively easy to determine if a gassy tube is degrading the SLOW release. Merely observe the carrier meter descent rate when you tune quickly away from a calibrator marker shortly after you turn on the R–390A from a cold start, and then observe the descent rate about 30 minutes later. If the descent rate is noticably faster, then one or more gassy tubes may be the cause. The most likely candidates are the 1st, 2nd, and 3rd IF amplifier tubes. One of these three tubes was gassy in two out of three IF subchassis I have modified. Naturally, these bad tubes tested good on a tube tester. The RF amplifier and three mixer tubes are also candidates, as well as the 4th IF amplifier, AGC amplifier, and perhaps the AGC time constant tubes.

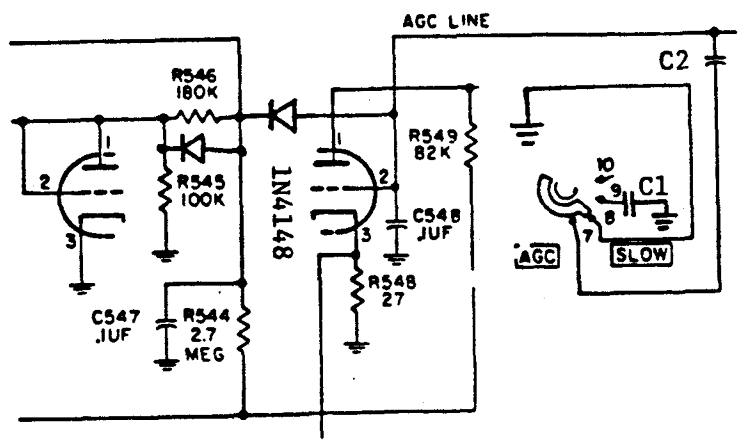
I was concerned that my AGC mod should not degrade the excellent AM performance of an unmodified R–390A. It does not. In two modified IF subchassis I included a 330K ohm resistor in series with the diode which replaced R547 and a switch across the resistor. In effect, this provided switched attack times, slow attack for AM and fast attack for SSB and CW. After considerable listening I have concluded that there is little benefit to switched attack times. A few listeners, like me, may hear a small amount of very low frequency (below 50 Hz) audio distortion on AM signals using the FAST AGC speed with fast attack with the 455 KHz IF output feeding an AM synchronous detector followed by a hi fi amplifier. But most listeners will not notice any difference between fast and slow attack. If you have no interest in SSB or CW, there is hardly any reason for you to do my mod because it does not improve AM performance. Of course, with the original R–390A AGC it is annoying that the carrier meter pins for several seconds when switching between SLOW and MED. That does not happen with my mod.

I would like to express my appreciation to Wally Chambers, K5OP for sharing his experiences modifying R–390A AGCs, and for discussing many of the ideas in these mods.

R-390A AGC Circuit Before Modification



After Modification



NOTE: In some IFs, especially EACs, it will be virtually impossible to do this mod beacuse of wiring layout. In that case, leave C551 as is, and insert a 2 mF or 2.2 mF, 250 volt mylar capacitor between pin 8 of S107 and ground (instead of grounding pin 8). The attack and release times are almost exactly as with the more complex mod.

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Publisher's and Editor's Corner

Excuse me, everyone, including Ralph, for being so late with issue number 28. I had every intention of last year being a "normal" 4 issue year, but it just didn't happen. As I have said before, sometimes our normal jobs and activities take priority over our hobby activities. And please remember that Ralph and I do not get any pay or make any profit from the newsletter.

The main topic of this issue is the long awaited product detector for the 51J-4. It is not an easy mod, but well worth the effort.

My how time flies when you are having fun! Come next fall I will have been editing HSN for 7 years. That is a long time folks, and I have been thinking that it might be a good idea to try to find someone new to take on the job of editing HSN. Ralph has also mentioned that in a year or two he might like to turn over the publishing job to someone new. Any volunteers for either of these jobs? I would like to exchange letters, and perhaps a few phone calls with anyone interested in either position. I don't intend to drop out of the hobby, but as I have grown older with the passing years I find that I would like to take life a bit slower. But don't worry. There is still a lot of life left in me. Wally and I are planning to do a definitive article on rebuilding R-390A PTOs, and I have just recently figured out how to open and fix most defective R-390A meters.

Short Contributions

R-390A AGC/BFO Mod: (We get letters. Ed.) Dallas, I have performed your AGC/BFO mod to one of my R-390A's. I wanted to let you know that I am very pleased with the results. Your (and don't forget Wally's, Ed.) many hours of work involved in this mod are much appreciated here. I modified a pretty hot EAC unit. With a good outside antenna I can run the RF gain full on even for strong SSB/CW stations. In my opinion, the audio is only slightly below a receiver with a product detector and good AGC. The side effects I have noticed are a slight reduction in audio (as you mentioned) and that the noise limiter control seems to kill the audio when you advance it much beyond the 11 o'clock position. I do not remember my noise limiter doing this before. (Byron Tatum, WA5THJ)

R-390A AGC Problem and Fix: An R-390A of mine would work nicely for about 10 minutes from a cold start, then the receiver would exhibit distortion and blocking, which worsened as the unit heated up. A check of the AGC voltage on the rear panel revealed lower than normal AGC voltage (typically -4 to -7 VDC compared to "good" AGC voltage of -8 to -15). I went to work on the IF subchassis by measuring the resistance between pin 6 of J512 and ground, measuring 1.5 Meg (it should have read infinity). I suspected a leaky capacitor, but all candidates were OK. After isolating all of the AGC tie-ins on the IF deck (I assume you unsoldered the AGC line at various points, Ed.), the mechanical filter assembly was identified as the culprit. However, its bypass capacitor (C512) was OK. The only remaining possibility was one of the mechanical filters (AGC voltage is applied to V502 through the coils of all mechanical filters). To find the bad mechanical filter, I had to unsolder all leads on both terminals (of each mechanical filter) at the "AGC end" of the mechanical filters. The resistance between either terminal and the filter case should be infinity. For the 8 KHz filter, the "cold" resistance was 1.5 Meg, and when heated to 145 degrees with a hair dryer, the resistance was 300 K ohms. The 8 KHz filter sounded fine in use with the RF gain control reduced to eliminate overload. I hope this saves someone a lot of time. (Byron Tatum, WA5THJ) This gets my vote for the "strange problem and outstanding fix" of the year award. (Ed.)

TV-10B/U Tube Tester Problems and Fix: As I said many moons ago in the special issue on test equipment, the TV-10 is, in my opinion, one of the best tube testers around. Recently I bought a 10B sight unseen, thinking it would be more or less like the 10A which I already had. It was supposed to be in good electrical condition, but, of course, it wasn't. After several weeks of working on it, I believe I finally have it fixed, and you may be interested in my experiences. The most common problem with military tube testers is that often the 7 and/or 9 pin miniature tube sockets are literally worn out (from 1000's, maybe 100,000's of tube insertions and removals). This 10B had already had the 9 pin socket replaced at some point in the past, but with an incorrect type of 9 pin socket and with poor solder work. So the first order of business was to remove the botched repair, and do it right. After that was done, it was discovered that some pins of the 9 pin socket were shorting (as indicated by the SHORTS lamp glowing continuously when the FUNCTION SWITCH was in several of the SHORTS TEST positions 1 through 5), with no tube in the socket. This problem was traced to several bent lugs on the under side of the LOCTAL socket which had brought those lugs into contact. One can imagine any number of ways that the lugs could have been bent. Nothing extraordinary here, just the usual "gorillas" at work. While I am on the subject of sockets, I should mention that the 9 pin socket I used for this repair was a Fair Radio used 9 pin socket. I have learned the hard way that many of the brand new tube sockets you can buy at ham fests or from electronics suppliers are worthless: the lugs don't take solder properly, the contacts don't hold up well under repeated use, etc. After replacing the 9 pin socket and bending the LOCTAL socket lugs away from each other, I tested some tubes. Meter readings were not stable with either 7 or 9 pin tubes, and some of the 7 pin contacts pulled part way out of the 7 pin socket when a 7 pin tube was removed from the socket. So I replaced the 7 pin socket, and looked around for the cause of the unstable meter readings. In many tube testers, like the TV-10 and TV-7, the screen voltages (high and low) are obtained from variable taps on an 8500 ohm or 9500 ohm 10 watt wire wound power resistor. Inspection of this resistor in the 10B revealed that under one of the variable taps the turns of wire had been broken. The quickest and easiest fix for such a problem is to use 9 or 10 Radio Shack 1000 ohm 1 watt resistors in series mounted on a Radio Shack "proto PC board" cut down to a smaller size with hand nibblers, with small holes drilled in the end so you can use cable lacing to tie the assembly to a nearby cable bundle. Some test lead clips were used to determine the proper tap positions before soldering the wires (which previously went to the power resistor variable taps) to the new resistor assembly. At first that seemed to have fixed the unstable meter reading problem, but then the problem returned. For a while I thought there was a problem with the contacts of the red mutual conductance button, because it seemed that the meter needle could be made to move around by wiggling the red button (while the red button was pressed, with a 6BA6 tube under test in the 7 pin socket). I burnished the mutual conductance push button contacts, but that didn't help. I even squirted the contacts with some R-5 DeOxIT (a new high tech deoxidizer a friend sent me), but alas, to no avail. So it was "back to the drawing board." Curiously, I had noticed that when 9 pin tubes were tested, meter readings were stable. It was only when 7 pin tubes were tested that the meter needle meandered all over the place. What did it mean? Part of my problem was that I had no 10B manual, and was using a 10A manual. While the 10A and 10B are similar, they are not identical. Was I missing something? I measured the operating voltages per the 10A manual, and they seemed rock solid stable (although, perhaps, the plate voltage was a bit high). I studied the 10A schematic, but saw nothing that could accound for this curious problem. Finally, I considered the 9 pin socket replacement which had been done previously. If that person was dumb enough to use the wrong type of socket, could he have thrown away some parts, like ferrite beads slipped over the bare wire adjacent to some of the tube socket lugs? My 10A had ferrite beads slipped over the hook-up wire adjacent to just about every tube socket lug. The 10B had virtually no ferrite beads. Could it be that parasitic oscillation was causing the meandering meter readings for 7 pin tubes under test? It was worth a try. I had plenty of Amidon FB-101-64 ferrite beads which I use for suppressing parasitic oscillation in FET amps, and they were about the same size as the ferrite beads used in the 10B. First, I added a ferrite bead to the pin 1 (grid) lug lead. The problem remained. Next I added a bead to the screen lead, but still the problem remained. Finally, I added a bead to the plate lead (pin 7), and the meandering meter reading problem was gone! (Oops. I should have added that pin 6 was the "screen lead" above.) It would appear that one or more ferrite beads were removed and discarded during some previous attempted repair. Naturally, I don't know how many beads were removed, or from which wires (at which lugs) they were removed. Knowing what I know now, I would recommend that an Amidon FB-101-64 ferrite bead be used at each lug of the 7 and 9 pin miniature tube sockets. That may be overkill, but it certainly won't cause any problems. (Dallas Lankford)

HSN Index: Thank you Geoff Greer for compiling a detailed index for issues 1 through 24/25. The index is 5 pages, single spaced headings, each heading identified by issue number and page number. Geoff has provided us with a very convenient way to locate topics in our growing collection of HSN. And he has kindly given permission for HSN to sell copies of his index. If you want a copy, send Ralph $2 (address at top of front page) and he will gladly send you a copy post paid. (Ed.)

R-3XX Relay Problems: I thought I should write and let you know that I tried the relay problem fix for my R-391 which was described in HSN #24/25. It works very well, except that here in Australia a 25 ohm 25 watt dropping resistor is not an off the shelf item. One has to be specially made (for about $22). (John O'Sullivan) Thank you for letting us know that the mod worked well. John also said that Richard Parker was quite helpful in providing him with additional information. Has anyone had any problems with R-390A relays yet? (Ed.)

51J-4 Product Detector Mod

Dallas Lankford

As hollow state buffs know, the Collins 51J-4 is a classic tube type communications receiver. It was and still is one of the finest AM receivers ever built. Two things prevent it from being outstanding for SSB and CW - it has no product detector, and the AGC attack and release times are not suitable for SSB and CW. The purpose of this note is to describe how to convert the BFO circuit to a product detector. I have already discussed a suitable AGC circuit change in my article "51J-4 fast attack - slow release AGC mod."

Several articles have been written about the 51J and R-388 receivers which describe how to convert the BFO circuit to a product detector and modify the AGC circuit for fast attack and slow release. But none of them apply directly to the 51J-4, and all of the AGC mods, except mine, suffer from one or more serious problems, especially bad overshoot which manifests itself by a loud thump at the beginning of SSB trandmissions.

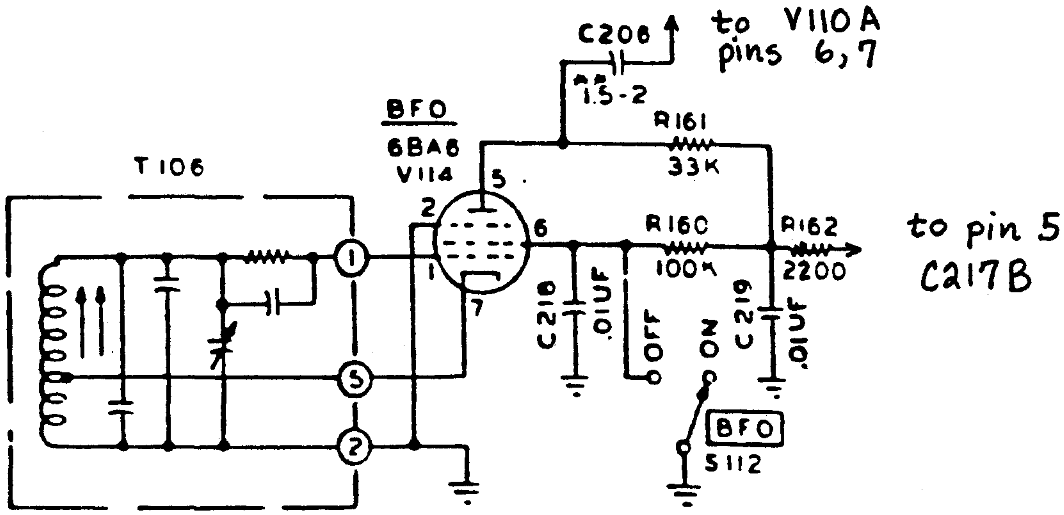


Fig. 1 — 51J-4 BFO Circuit

The 51J-4 BFO circuit is shown above in Fig. 1. I intended to convert the BFO circuit into the product detector described by William Orr in his February 1978 Ham Radio article, "Modifying the 51J receiver for SSB reception," pages 66-69, but a remark by Wilfred Scherer in his December 1968 CQ article, "More on updated improvements for the 51J receivers," pages 64-69, 116, caused me to use different component values. Scherer said that with a 56K plate and 2.2K screen resistors as recommended by Commander Paul Lee in his April 1961 CQ article, "The single tube product detector," pages 50-51, 118, 119, strong BFO harmonics were found at every 500 KHz point up to 7 MHz. The original 51J-4 screen resistor, R160, was 100K, 1 watt, so I decided not to change its value to 22K as suggested by Orr, but leave it as is because Scherer used a 330K screen resistor. The original 51J-4 plate resistor, R161, was 33K. Since I had to uncrimp and disconnect one end of R161 at pin 5 of V114 in order to access and remove C206, I decided to remove and completely replace R161 with a 47K, half watt resistor, about the same as suggested by Orr, and about half the value used by Scherer. In addition, I used an inductive pi network low pass filter instead of the resistive network used by Orr, Scherer, and Lee. The 1 mH choke and 560 pF input and output capacitors were what I had on hand. For a 2.5 mH choke you should use 220pF capacitors, and for a 5 mH ch use 100 pF capacitors.

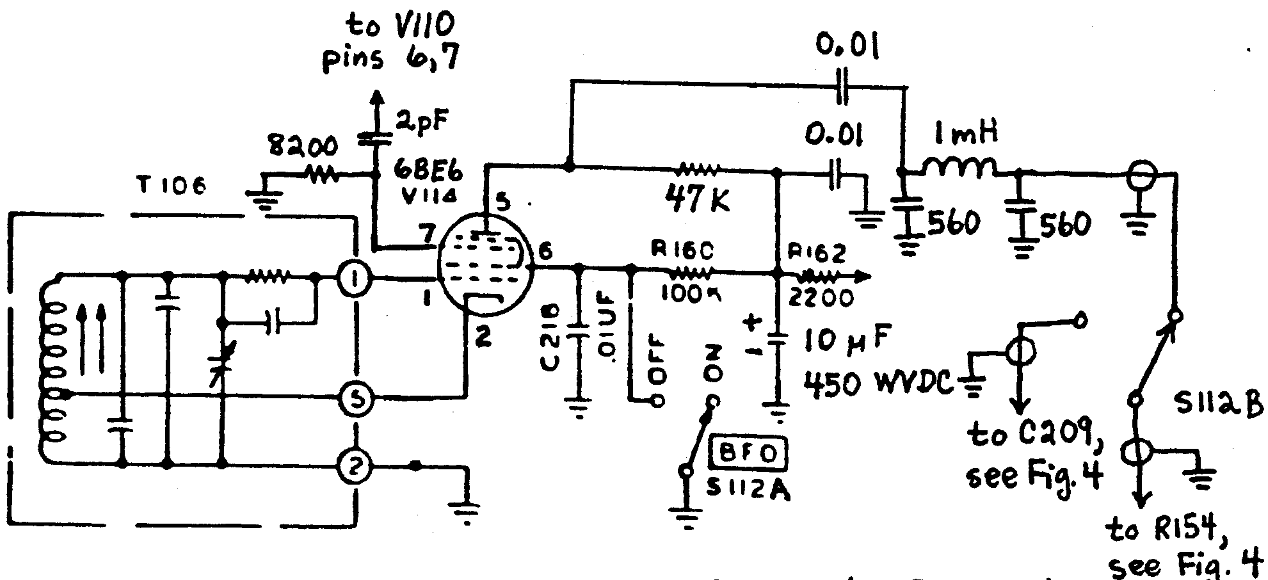


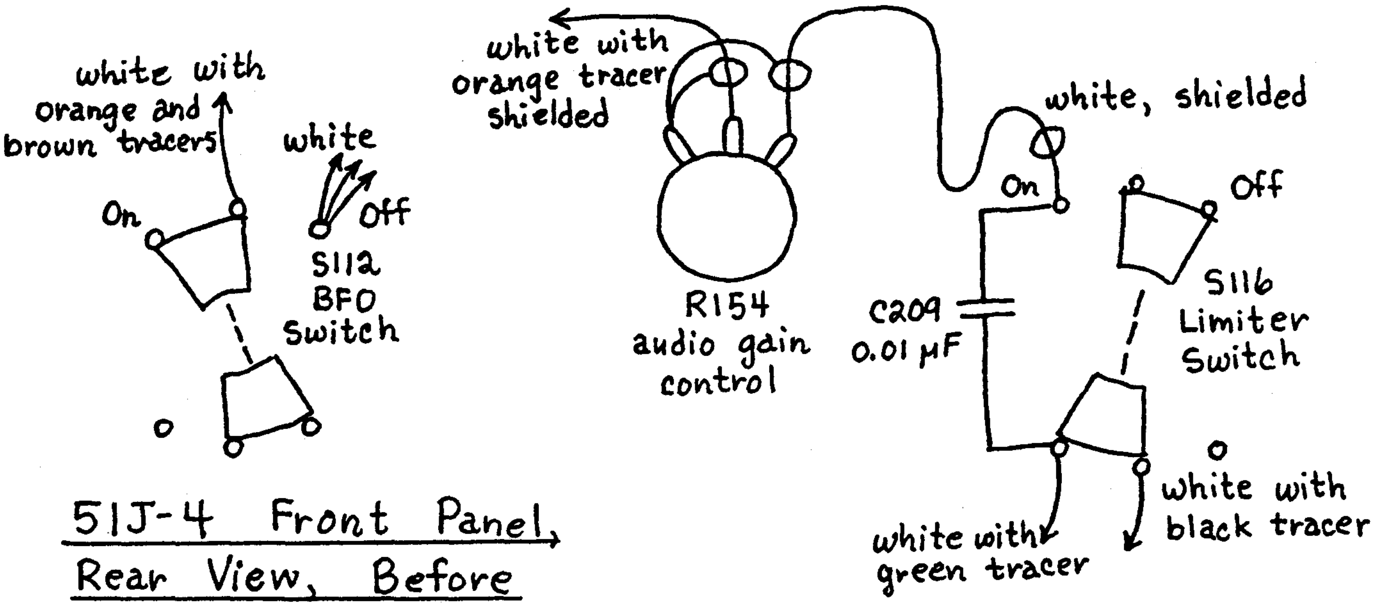
Fig. 2 — 51J-4 Product Detector

(Note: I neglected to mention in the article that I used a 0.01 1KV disc ceramic capacitor in parallel with the 10 mF electrolytic which replaced C219.)

The product detector I used is shown above in Fig. 2. Orr advised that the 6BE6 oscillator voltage at pin 1 should not exceed 10 volts peak to peak. With the 100K screen resistor I used, the oscillator voltage at pin 1 is about 8 volts peak to peak. The audio output level of the 6BE6 product detector can be adjusted by varying the capacitor and resistor voltage divider at pin 7 of the 6BE6. I used a 2 pF capacitor because that is what I had on hand. Orr, Scherer, and Lee used a 5 pF capacitor. I determined the value of the 8200 ohm resistor by trial and error. I wanted the audio levels to me more or less equal when I switched between AM and CW. For a 5 pF capacitor, start with a 3300 ohm resistor, and increase it or decrease it for more or less audio output.

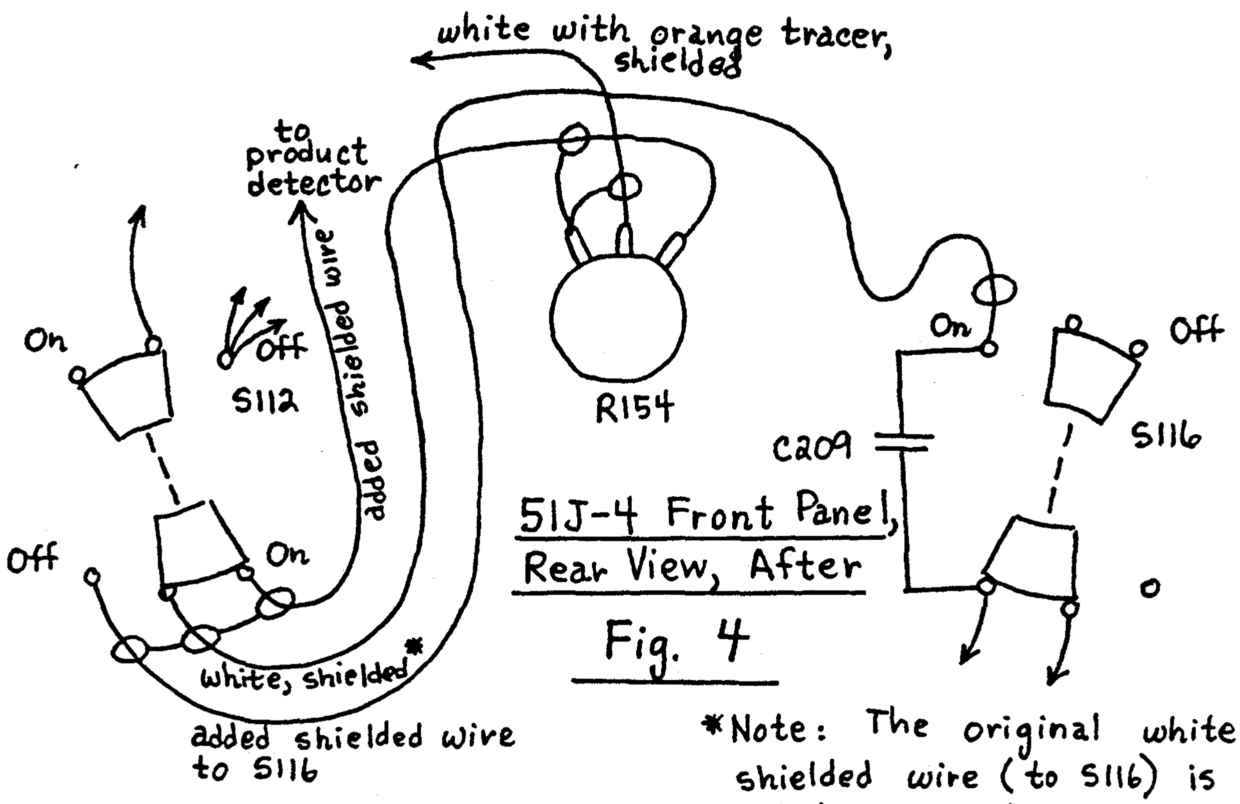
Notice the 10 mF 450 WVDC electrolytic capacitor which replaced C219, 0.01 mF. All of the previously mentioned articles said nothing about replacing C219 by a 10 mF electrolytic. Fortunately, I had done my homework and had found the comments by Frisco Roberts in the October 1978 issue of Ham Radio, page 6. Roberts said that after he added Orr's product detector to his 51J receiver, the audio output motor-boated at higher audio gain control settings. He determined that the motor-boating was caused by B+ hash (presumably he meant B+ ripple). So I was not surprised when my product detector motorboated. Following Roberts' suggestion, I replaced C219 by a 10 mF electrolytic and the problem went away. In my opinion, you should not even consider using a 6BE6 product detector without this 10 mF electrolytic.

According to gossip, many hams have tried one of these 6BE6 product detectors in their 51J or R-388, and were not satisfied with the result. Perhaps they experienced motor-boating and were not informed of Roberts' diagnosis and cure for that problem. Perhaps they experienced strong BFO harmonics up to 7 MHz and were not aware of Scherer's diagnosis and cure for that problem. Perhaps they got unsuitable audio output level from the product detector and did not know to vary the capacitor and/or resistor at pin 7 of the 6BE6. Perhaps my LC low pass filter avoids problems I did not encounter with the RC low pass filter used by Orr, Scherer, and Lee. Perhaps I got lucky with my component layout and did not encounter problems experienced by others. Or perhaps many hams were not satisfied with the AGC mods suggested by Orr and Scherer. (I wasn't.) The bad overshoot of the AGC mods described by Orr and Scherer is enough to turn anyone off.



51J-4 Front Panel,
Rear View, Before

Fig. 3



51J-4 Front Panel,
Rear View, After

Fig. 4

*Note: The original white shielded wire (to S116) is not long enough to reach S112.

Before describing the layout of the product detector, let me explain how the switching between AM and SSB/CW is done. In all 51J-4s I have seen, the BFO switch, S112, has an unused section which I have labeled S112B in Fig. 2; see Fig. 3 for a rear view of the front panel before modification. If you will study Fig. 4 and the 51J-4 schematic, you will see that S112B is used to switch between the output of the noise limiter for AM and the output of the product detector low pass filter for SSB/CW.

To access the BFO and limiter switches and audio gain control, the 51J front panel must be removed. You should do this part of the product detector mod first in case the switches are not of the type I have drawn in Fig. 3 and Fig. 4. If the switches are not of the type I have drawn, you will need to obtain similar switches. You should observe that there is not much clearance behind the front panel, so not any switches will do. If the wire tracer colors are not as I have shown, you will have to determine how your 51J is wired. At least I have given you a starting point. When I rewired my front panel, I cut all the wiring harness lacing, ran my new wires along the existing wiring bundles, and relaced the modified bundles with new lacing. The three shielded ends at S112 were soldered together and tied down with cable lacing. The shielded wire to the product detector was run along the taped cable bundle which branches just inside the front panle and runs along the side panel to the rear compartment. I temporarily removed the filter chokes from the side panel (but did not unsolder them) to access the taped cable bundle along the side panel. I used plastic cable ties to secure the product detector shielded wire to the taped cable bundle. I made a right angle turn in the product detector shielded wire where the taped cable bundle makes a T intersection in the rear compartment, and brought the product detector wire out beside the plug-in electrolytic capacitor bracket near the BFO coil. The shielded end of the shielded wire to the product detector was grounded at the low pass filter near the 6BE6 product detector; see Fig. 5. One of the cable clamps on the front panel will have to be replaced with a larger clamp. The original clamps are #1 Tinnerman clamps, so you will need a #2 Tinnerman clamp if you want to preserve the appearance of your 51J-4. The #2 clamp is larger than necessary, and I used a small piece of rubber to make a tight fit.

The product detector layout is shown in Fig. 5. Any component or wire removed from a lug was replaced with a new component or wire. In particular, I removed the 2 pF BFO coupling capacitor, the 33K plate resistor, the 0.01 mF screen bypass capacitor, the 0.01 mF bypass capacitor from the insulated standoff to ground, all wires from the tube socket to the BFO coil, and the ground wire from the center post of XV114 to pin 2. I wired my 51J-4 slightly different than shown. I used a Teflon insulated wire from pin 5 of V114 to the insulated standoff at the low pass filter, and I ran this wire under the filament wires at pin 4 and between that tube socket ground lug and pin 3, under the wire from pin 3 to the ground lug. If you cannot obtain insulated, stranded, Teflon wire, you should run the wire from pin 5 to the insulated standoff as I have shown (in case the screen bypass capacitor ever needs to be replaced, soldering iron heat applied to the ground lug could damage the insulation). Some consideration should be given to the order in which new components are added. I installed the 47K resistor first, and then installed the 2 pF capacitor above the 47K resistor (since a 2 pF capacitor is more likely to fail than a 47K ohm resistor). The 0.01 mF screen bypass capacitor was curved away from the tube socket as shown so that the component density would be less, and so that the tube socket pins could be accessed more easily. I also found it convenient to remove the 0.01 mF capacitor from the plug-in electrolytic capacitor bracket to V113 while dressing the ends of the wire and shield of the shielded wire to the front panel.

When using the product detector for SSB, the BFO frequency will need to be offset to one side or the other of center frequency depending on whether USB or LSB is desired. You can measure the -20 dB points of the 3 KHz filter using the S-meter and a calibration signal and remember the appropriate setting of the BFO frequency control. Rough tuning of an SSB signal is done with the KCS knob, and fine tuning with the BFO PITCH knob.

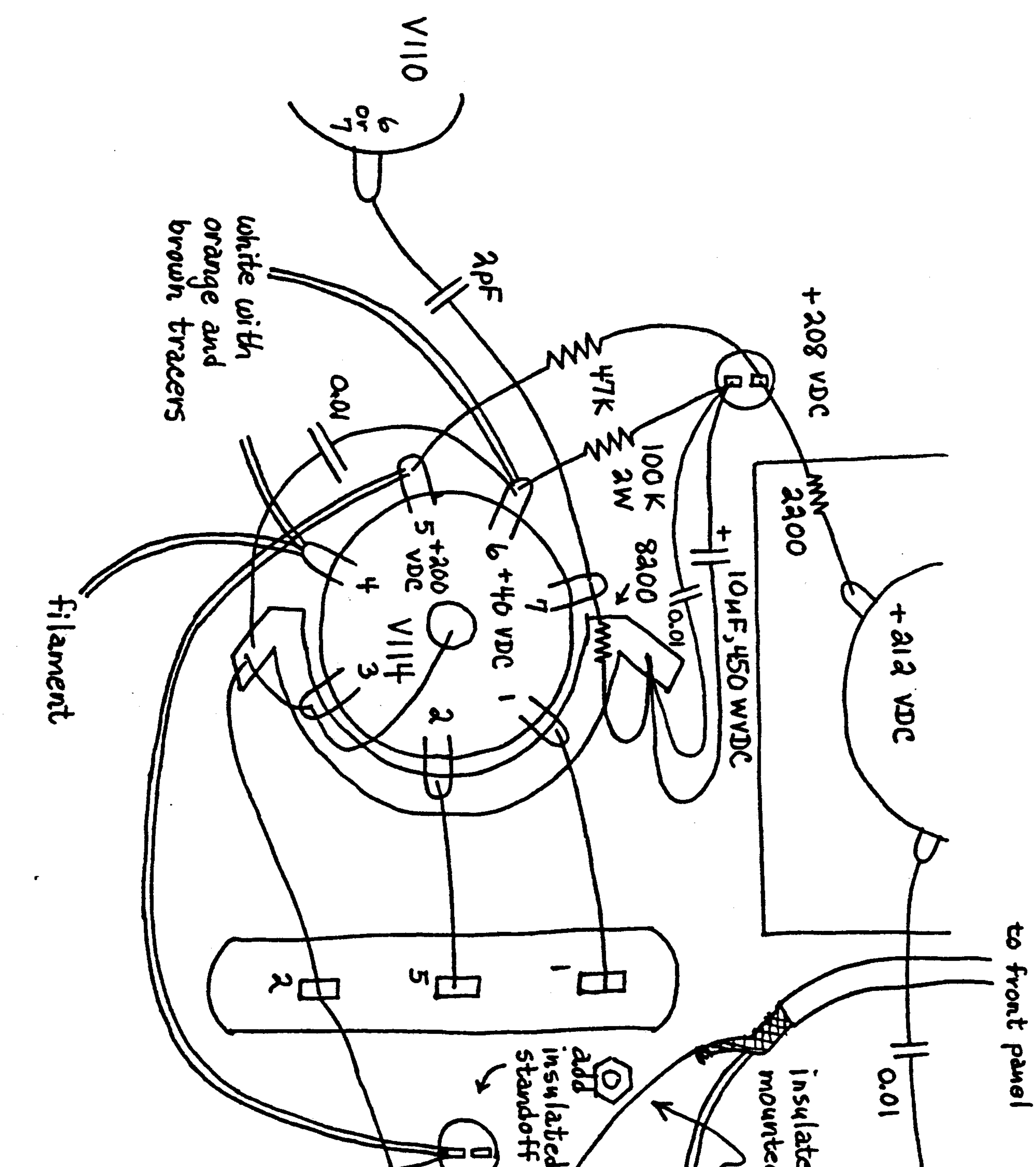


Fig. 5 — Product Detector Layout

THE HOLLOW STATE NEWSLETTER

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Editor's And Publisher's Corner

Excuse me for the long delay in getting out HSN # 29. Last year was a very bad year for me, beginning with a two month ordeal in April for what should have been a simple CA/CH replacement, and ending with gum surgery followed by a bad virus in December.

Please note Ralph's new address above (below the masthead).

Ralph and I are still planning to fold up HSN with issue # 30 unless someone volunteers to take over editing and publishing. Actually, we need two volunteers because it is unlikely that anyone would want to do both. Any takers? If not, we will cease publication with the next issue, and refund all remaining subscriptions.

This issue is devoted to R-390A alignment. If you are already experienced with R-390A's, then these notes alone should suffice. If not, you should supplement these notes with one or more of the R-390A maintenance manuals TM 11-956A, TM 11-5820-358-35, and NAVSHIPS 0967-063-2010 (or NAVSHIPS 93053 Vols I, II, III).

Many months ago Ralph sent me a list of equipment he has for sale. Because of the long delay in writing up HSN # 29, I expect some of the equipment has been sold. Nevertheless, here is a list: R-390A, HQ-180C, 422 scope, new URM-25D signal generator, Pro-2005 scanner, Central Electronics sideband slicer, Central Electronics Q-multiplier model DQ, Radio Shack DX-440 multi-band portable with MW loop, misc. R-390A parts, R-392, R-392 parts (tubes, IF deck, etc.), BC221 frequency meter, URM-32A frequency meter, Heathkit SB620 scanalyzer, Hammarlund HC-10. Write Ralph at his new address above for details, and be sure to include an SASE.

Dallas left some room for me. I will stay on as publisher for awhile and I think we may have an editor, Reid Wheeler of Olympia WA may do the editing job. We are going to need help from the membership if HSN is going to hang in there. We need articles and stuff on tube gear. So lets hear from you out there.......73.......Ralph....................

R-390A Alignment, Dallas Lankford, January 1993

Before aligning R-390A tuned circuits, alignment of the Veeded Root counter, cams, RF bandswitch gears, antenna trimmer, and PTO should be inspected, and, if necessary, realigned.

To determine if the Veeder Root counter (the MCS/KCS counter; see Fig. 1) is aligned (1) turn the ZERO ADJ knob clockwise until the clutch is disengaged, i.e., until the digit wheel of the Veeder Root counter does not move when the KCS knob is turned through its zero adjust range (about 14 KHz), (2) set the KCS knob at about the center of its zero adjust range, and (3) turn the ZERO ADJ knob fully counter clockwise to engage the clutch. The KCS knob should be left in the center of its zero adjust range for the remaining checks and alignments. Next, (4) turn the KCS knob throughout its entire range, from one limit of the 10 turn stop to the other. An aligned Veeder Root counter should read about xx-965 and xx+035 at the stop limits. In other words, the 1000 KHz tuning range of an R-390A has about 70 KHz of over range, and the over range should be divided equally between the two ends of the 1000 KHz tunin g range.

When an R-390A is tuned to 07+000 the cam tips should align with the lines on the front plate of the RF subchassis as shown in Fig. 2.

The RF bandswitch gears should also align as shown in Fig. 2.

If the Veeder Root counter reads within 3 or 4 KHz of xx-965 and xx+035 at the stops, and the cams align within 3 or 4 KHz of 07+000, then they need not be realigned. But if they are'off more then 3 or 4 KHz, then you should consider realigning them.

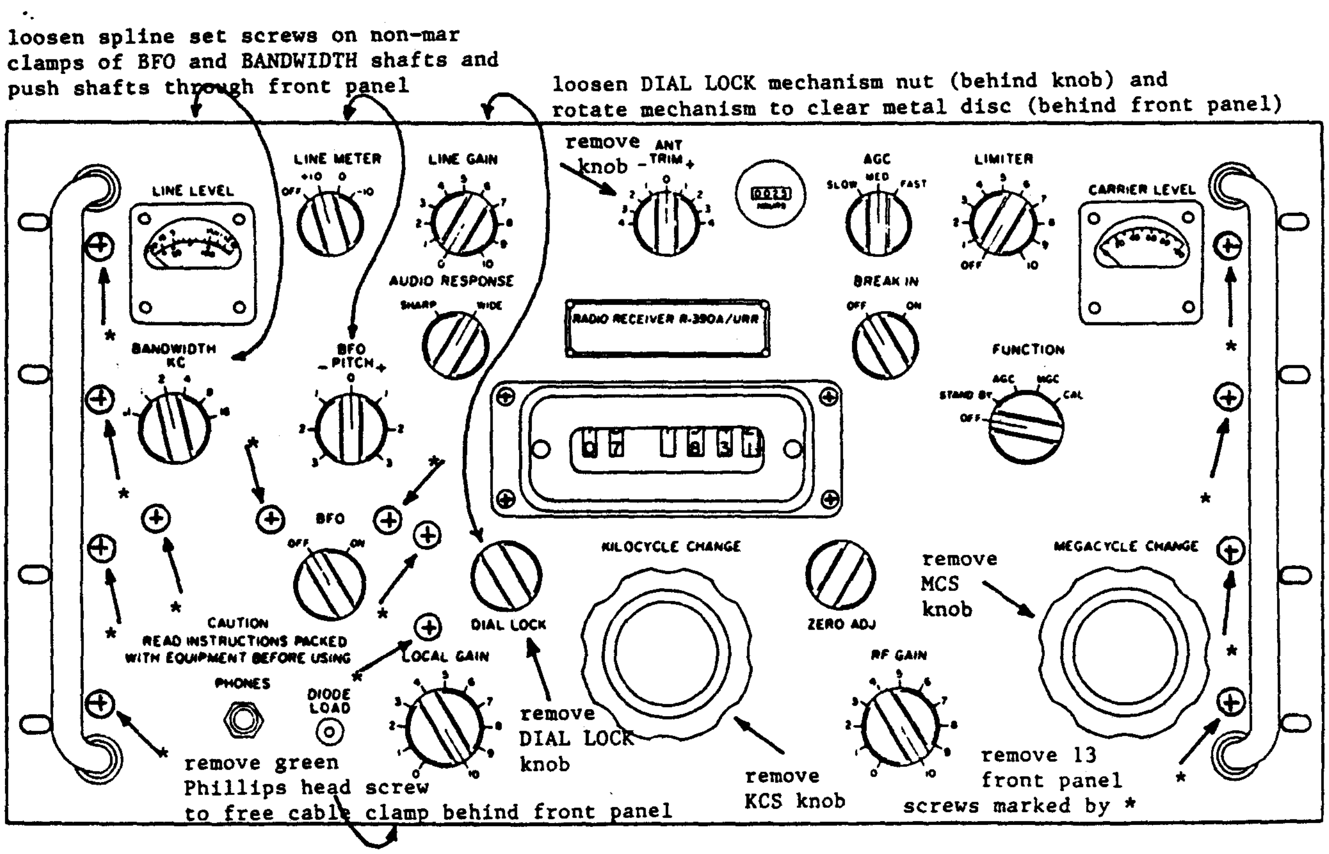

FIG. 1 Front Panel Removal

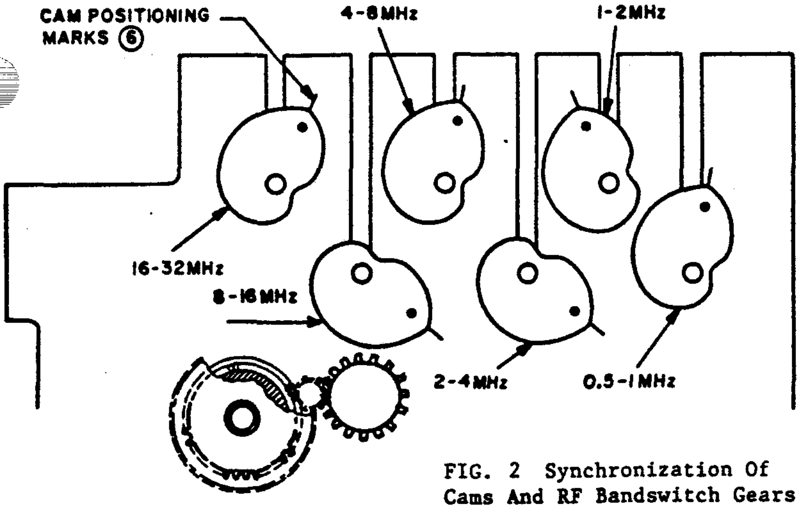

FIG. 2 Synchronization Of Cams And RF Bandswitch Gears, Frequency Set At 7+000

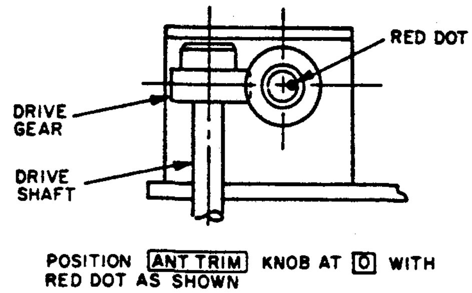

FIG. 3 Synchronization Of ANT TRIM

The Veeder Root counter and cams alignments are interrelated. Changing the alignment of the Veeder Root counter changes the alignment of the cams, and vice versa. Also, each cam can be aligned independently of the other cams by loosening the non-mar clamp on the gear in front of the cam.

Because the Veeder Root counter and cams alignments are both dependent and independent, there are many ways they could have gotten out of alignment, and thus it is difficult to specify all ways to realign them. Nevertheless, here is a generic realignment of the counter and cams which should work in most cases.

If all of the cam tips align at the same frequency, and the difference between the cam tips alignment and 07+ stop is about 35 KHz (example: cam tips align at 07+015 and 07+ stop is at 07+050), then loosen the non-mar clamp on the right side bevel gear of the Veeder Root counter, and reset the digit drum of the counter to read 07+035 with the KCS knob at the 07+ stop. The bevel gear can be accessed by removing the counter cover plate which is attached to the front panel by 4 Phillips head screws; see Fig. 1. After tightening the non-mar clamp on the bevel gear, turn the KCS knob through its range to make sure that the bevel gear is not binding and that there is no backlash in the digit drum. If there is binding or backlash, loosen the non-mar clamp, reposition the bevel gear, tighten the clamp, and check for binding or backlash again. Repeat until binding and backlash are eliminated or minimized.

If all of the cam tips do not align at the same frequency, remove the front panel (see Fig. 1), set the KCS knob to the 07+ stop, align the Veeder Root counter to 07+035, set the KCS knob to 07+000, and for each cam loosen the non-mar clamp on the gear in front of the cam, set the cam tip to its alignment line, and tighten the non-mar clamp. It may be necessary to remove the associated rack tension springs when aligning a cam tip.

If all of the cam tips align at the same frequency, but the frequency difference between cam tip alignment and 07+ stop is not 35 KHz, then you can either realign the counter and cams as described above, or pull the gear on the KCS shaft and reposition it so that the frequency difference is 35 KHz (be sure to observe the amount of tension on the split gear before removing it, and reinstall it with the same amount of tension).

The RF bandswitch alignment is also shown in Fig. 2. The 4 teeth on the large gear should point straight down (they can be seen from underneath). The only sure way to determine if an RF bandswitch is out of synchronization and to realign an unsynchronized RF bandswitch is to use a known good RF subchassis for comparison. Both RF subchassis should be removed from their respective R-390A's so that the positions of the bandswitch waffers can be compared as the MCS shaft is turned through its entire range.

Synchronization of the xtal oscillator (attached to the RF subchassis) also requires a known good RF subchassis for comparison. It is unlikely that either the RF bandswitch or xtal osc. will be unsynchronized, and so I have not given many details about how to realign them. In both cases an obvious clamp is loosened, the shaft repositioned, and the clamp tightened. And in both cases several attempts may be needed to get it right.

Alignment of the ANT TRIM is shown in Fig. 3. Two set screws behind the gear drive are loosened to realign the antenna trimmer. Often the red paint of the "red dot" has flaked off, and there is only a small dimple (like a center punch mark) where it was. Do not tighten the set screws too tight, otherwise the bakelite insulation between the gear drive and antenna trimmer shaft may be crushed, which may cause the AGC line to be shorted to ground through R201.

If the PTO end points are aligned (tuning from xx-000 to xx+000 changes the received frequency by exactly 1000 KHz), then the PTO can be synchronized by adjusting the Oldham coupler; see Fig. 4. Before synchronizing the PTO, check the BFO and CAL alignments as follows. Set the BANDWIDTH to 2, FUNCTION to CAL, and tune any calibrator signal so that it is in the center of the filter passband. (For example, suppose that as you tune below the calibrator signal near xx 500, the carrier level meter falls by 10 dB at xx 498.6, and as you tune above it falls by 10 dB at xx 501.2, then the filter center is about (498.6 + 501.2)/2 = xx 499.4.) Turn the BFO on, loosen the BFO tuning shaft clamp, and rotate the BFO PTO shaft for zero beat while holding the BFO knob at 0 (12 o'clock). Tighten the BFO shaft clamp. Next, set BANDWIDTH to 16, change the FUNCTION switch to AGC, and zero beat to WWV (5, 10, or 15 MHz, whichever is stronger). Change the FUNCTION switch back to CAL and zero beat by turning the CAL ADJ slot adjustment on the rear panel. If the calibrator will not zero beat, you probably have a defective 200 KHz calibrator xtal (which should be replaced). Set the Veeder Root counter to xx 000. (For example, let's say you

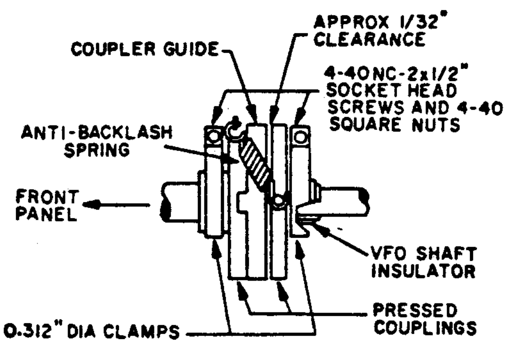

FIG. 4 Oldham Coupler Clearance And Details

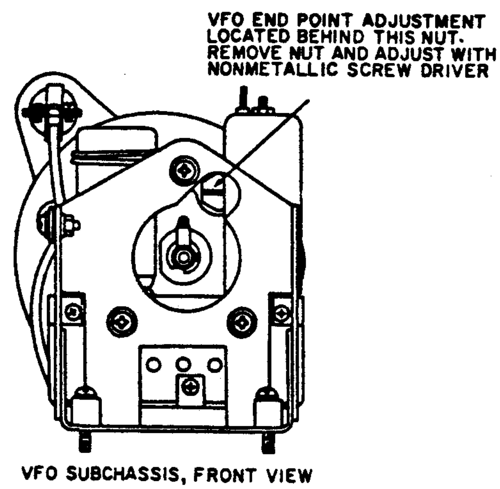

FIG. 5 PTO End Point Adjustment

were tuned to WWV 15, and the counter read 15 003.8. Then you would set the counter to 15 000 and hear a 3.8 KHz het with the BFO.) Loosen the clamp on the front panel side of the Oldham coupler, and turn the Oldham coupler for zero beat while holding the KCS knob to keep the frequency indication at xx 000. Tighten the clamp.

PTO end point alignment for non-Cosmos PTO's has been described in detail in HSN # 6. For Cosmos PTO's, end point alignment is the same, except that the end point adjustment access hole is covered by a screw instead of a slotted hex nut, and the screw is hidden completely behind the inductor shield; see Fig. 5. If the end point alignment of a Cosmos PTO is done with the PTO in place, care should be taken not to make contact with inductor support wires because some of them carry +250 VDC or higher, which can kill you. Usually the end points of a PTO have spread (expanded) so that turning the KCS knob through 1000 KHz changes the received frequency by more than 1000 KHz. In that case, you turn the end point adjustment slug clockwise to bring the range back to 1000 KHz. The exact amount you will need to turn the slotted shaft of the slug depends on the amount of adjustment remaining (i.e., on the position of the slug inside the coil, which you can't see). Try one turn and observe how much the spread is reduced. If the range is reduced to less than 1000 KHz, turn the slug counter clockwise on the next try. After several tries, you should have the range back to 1000 KHz, unless the end point adjustment range has been mostly used up before you started. In that case, if you are adventurous, you can take the PTO apart and remove one turn from the end point adjustment coil. But don't move any wires around inside the inner "can," don't take a turn off the big coil (the main tuning coil), and don't take a turn off the Cosmos "corrector coil." After the end points are aligned, you will need to resynchronize the PTO as described in the previous paragraph above because end point alignment moves both end points.

After having checked the alignment of the Veeder Root counter, cams, RF bandswitch gears, antenna trimmer, and BFO, the R-390A RF tuned circuits can be aligned as follows. Basically, the idea is to use the R-390A xtal calibrator and carrier meter instead of a signal generator and volt meter. Fig. 6 is a line drawing of the RF subchassis Utah-shaped cover plate which already contains most of the information you need. In addition, I have sketched the locations of T207 and T208. Remove the Utah-shaped cover plate, and peak the inductors and trimmers at the frequencies indicated with the FUNCTION switch set in the CAL position. In use the 4 KHz or 8 KHz bandwidth; it doesn't matter which. The order in which you align the coils does not matter. It is good practice to align the inductor first, and then the trimmer. Adjust each inductor and trimmer at least twich. If there is any significant improvement on the second pass, adjust them a third time (or more if necessary). The inductors should be adjusted with a # 8 Bristol multiple spline screwdriver. Xcelite makes a nice set, 99-PS-60, which includes the 99-X5 extension. The ceramic trimmer capacitors may be adjusted with a small screwdriver or alignment tool, but any metal shaft should be insulated (say, with insulating tape) so that you don't ground the high voltage B+ which is present on the metal slot of some of the trimmers. T207 and T208 may be adjusted with a small screwdriver. For best results, the antenna coils T201-T206 should be aligned with a 50 ohm source signal generator connected to the balanced antenna input through a UG-971/U twinax to C connector adapter and a UG-636A/U C to BNC connector adapter. But if you don't have a signal generator, or you are in a rush, you can use the CAL approach for them too. If you align an R-390A which has not been aligned in many years, some of the ceramic trimmers may be nearly "frozen." Firm

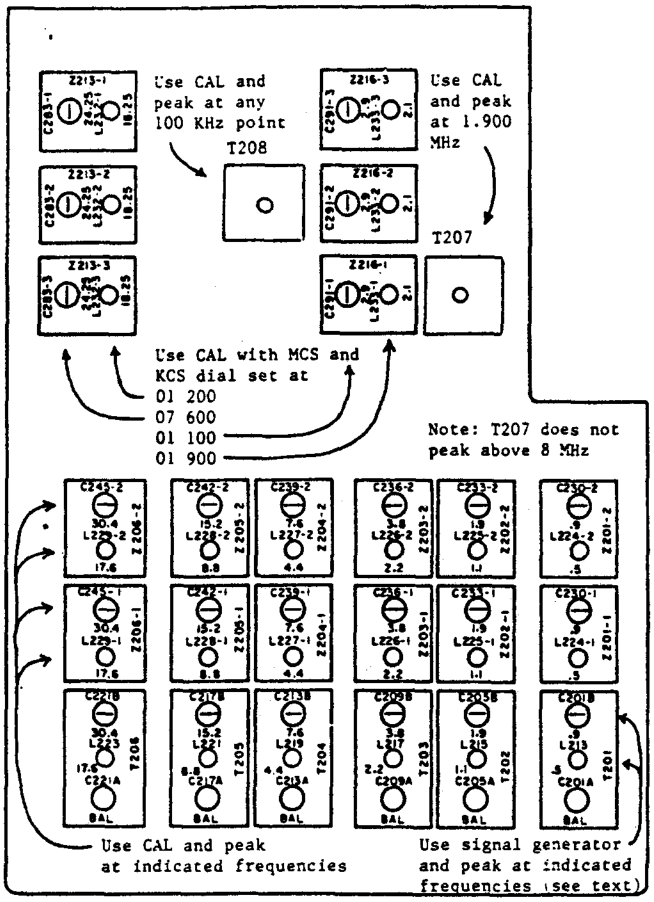

FIG. 6 RF and Variable IF Alignment

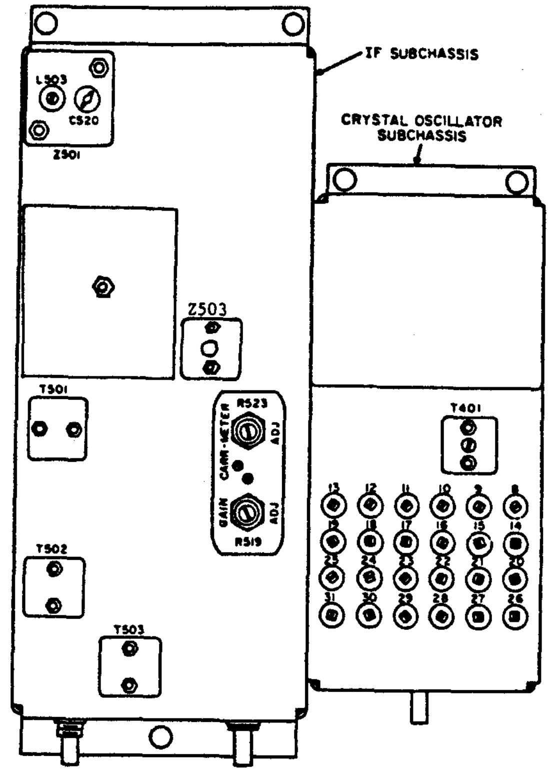

FIG. 7 Xtal-Osc. and IF Alignment

screwdriver torque will usually break them free with an audible "snap." However, if loss of signal level is observed after breaking the trimmer free, you should remove the coil (remove the rack and slugs for that coil set to access the # 4 Phillips head screw at the bottom of the bakelite coil form, and unplug the coil assembly), remove the coil assembly shield, and inspect the underside of the ceramic trimmer assembly to see if the metal base has rotated during "unfreezing" and shorted to one of the metal coil supports.

After the RF subchassis has been aligned, each of the ceramic crystal oscillator trimmers should be peaked. Tune to any CAL signal in the band indicated above the trimmer (see Fig. 7) and peak the signal. Not shown in Fig. 7, eight of the trimmers can be peaked in either of two bands: 0-17, 1-18, 2-19, 3-20, 4-21, 5-22, 6-23, 7-24. After peaking such a trimmer in one band, you do not need to peak it again in the other band. Peak T401 (also marked T207).

Alignment of the IF subchassis is usually unnecessary. But if you insist on aligning it, get yourself a set of TV Alignment Tools from Radio Shack, catalog no. 64-2223. The white hex alignment tool may be used to peak the AGC IF transformer Z503. Do not meddle with the IF transformers T501 - T503. They are stagger tuned, and their peaks are very broad. Even if they are somewhat out of alignment, it will not matter. The red alignment tool with metal tip is suitable for aligning trimmers (provided the metal shaft is insulated to avoid shorting RF trimmers; see above). The mechanical filter trimmers may be accessed by removing the shield on top of the chassis, and disconencting the shafts to the front panel knobs, releasing the green quick release screws, and tilting the IF subchassis up far enough to access the trimmer holes in the side of the chassis. I'll let you discover for yourself which trimmer peaks which filter. Don't mess with the crystal filter inductor L503 or trimmer C520 unless you have to replace the 455 KHz xtal, and then consult the manual for alignment. The IF gain may be adjusted by R519, a slot adjust pot with lock nut. The manual provides detailed instructions for setting the pot. My approach is to set the IF gain for minimum, i.e., the slot adjust is rotated fully clockwise. However, in one R-390A the IF gain adjust pot was marked 10K (correct), but measured 20K (incorrect) at minimum gain (maximum resistance). So I always measure the resistance of the IF gain adjust pot to be sure it is about 10K when the slot adjust is fully clockwise. Some of these 10K pots measure a bit less, say 8.5K, which is OK. Just don't go over 10K. The carrier meter zero adjust R523 is the only flakey feature on an R-390A. It is virtually impossible to zero a carrier meter with R523, and even if you do succeed in zeroing a meter (with no signal), the meter will not hold zero (because the pot wiper setting is so critical). There is only one solution to this problem. Replace R523 with a 10 turn pot, Clarostat 73JA 100 ohm 2 watt wire wound. Instead of reusing the original 22 ohm 1 watt R537 which shunts the original R523, or trying to locate another 22 ohm 1 watt resistor (with leads which are too large to use effectively with a 73AJ), get a 10 ohm 1 watt resistor at Radio Shack, catalog # 272-151 (it has smaller leads), and use it. After doing this mod, before turning on your R-390A and pinning the carrier meter while you are setting the meter zero, adjust the shunted pot to about 5 ohms (the nominal value for meter zero). The 73JA usually does not insert easily unless you use a circular file to remove a small amount of metal from the rim of the pot mounting hole. And the 73JA usually does not mount well unless you grind a nut thinner and run the thin nut all the way down on the pot threads (the diameter of the pot mounting base is too small). A nice finishing touch is to use a lock nut assembly, Miller 10061. The finished mod is professional both in performance and appearance. It is one of the few mods worth doing to an R-390A.

The 1956 R-390A manual TM 11-856A has a stage gain chart for signal inputs at the balanced antenna input and test points E208 - E211 which is useful for trouble shooting a defective RF subchassis. The stage gain test for signal input at the balanced antenna input is also useful for identifying a defective RF subchassis, and sometimes for other problems. The test involves injecting a signal at the balanced antenna input and for each band determining the signal generator output required to produce -7 VDC at the DIODE LOAD terminal (terminal 14) on the rear panel with R-390A FUNCTION switch set to MGC, BANDWIDTH set to 8, RF gain control fully clockwise, BFO switch OFF, and all other controls in normal operating position. Peak ANT TRIM for each measurement, and tune the signal for maximum voltmeter reading. TM-856A states that with this test setup the signal generator output required to produce -7 VDC at the diode load terminal should be less than 4 microvolts. You should use a precision 50 ohm source signal generator, and the calibration should be checked before doing this test. I use a rebuilt URM-25D which I check with a Tek 453 mod H scope. To check the calibration of a 50 ohm source signal generator, connect the output of the signal generator to a 50 ohm non-inductive resistor, set the output of the signal generator to 100,000 microvolts, and measure the voltage across the resistor. The voltage should be 280 millivolts peak-to-peak. I use a UG-971/U connector (twinax to C) and UG-636A/U (C to BNC) to connect the URM-25D to an R-390A balanced antenna input (through a short length of coax with BNC connectors). The signal generator output required to produce -7 VDC at the DIODE LOAD varies from one R-390A to another. For example, a 1956 Motorola (14-PH-56) required 3.0, 3.5, 2.0, 3.5, 1.0, and 2.0 microvolts at 0.5, 1.5, 7.5, 8.5, 16.5, and 26.5 MHz respectively, while a 1967 EAC (FR-36-etc.) required 2.0, 3.5, 3.5, 2.5, 2.0, and 2.0 microvolts respectively. Another 1967 EAC required 1.0 microvolts at most frequencies, with a few as high as 1.5 microvolts, and a few as low as 0.5 microvolts. There are sometimes variations within a band.

For example, one EAC in the 7 MHz band required 7.0, 3.5, and 6.5 microvolts for -7 VDC at DIODE LOAD at 7.000, 7.500, and 7.999 MHz respectively. On the other hand, the 1956 Motorola required 3.0, 2.0, and 2.0 respectively. I don't know whether this indicates a problem with the EAC in the 7 MHz band, but I am inclined to think not because the EAC 7 MHz band sensitivity was a uniform 0.45 microvolts for a 10 dB S+N/N (AM mode, 4 KHz BW), while the Motorola 7 MHz band sensitivity was a uniform 0.55 microvolts for a 10 dB S+N/N. However, another EAC which required about 4.0 microvolts for -7 VDC at DIODE LOAD at 0.5, 1.5, 7.5, 8.5, 16.5, and 26.5 MHz was defective (a defective LIMITER control which I found by turning the limiter control on and off while doing the DIODE LOAD test). So it is not always trivial to identify a defective R-390A with this test. As a general guideline, if 2.0 microvolts or less is required at several widely spaced frequencies to produce -7 VDC at DIODE LOAD, the R-390A under test is probably OK, while if 3.0 microvolts or more is required at most frequencies, then there may be a problem.

Another useful performance check is to measure the sensitivity for a 10 dB S+N/N ratio. The only equipment you need is a precision signal generator, such as a URM-25D. The R-390A LINE LEVEL meter, LINE METER switch, and LINE GAIN control are used to measure the noise and signal power. Conenct the signal generator to the balanced antenna input through a UG-971/U and UG-636A/U as described above, set the BANDWIDTH to 4, BFO to OFF, RF gain control fully clockwise, and all other controls in normal operating position. Set the signal generator to any frequency in the R-390A tuning range, tune the signal generator signal for maximum carrier meter indication (peak ANT TRIM), and reduce the signal generator output to about 0.4 microvolts unmodulated. Set the LINE METER switch to 0 and adjust the LINE GAIN control for a reading of -10 on the LINE LEVEL meter. If no reading is obtained with maximum gain, reduce the LINE GAIN setting, change the LINE METER switch to -10, and adjust the LINE GAIN for a reading of -10 on the LINE LEVEL meter. Change the signal generator to 400 Hz modulation at 50% modulation, and adjust the signal generator output for a reading of VU on the LINE LEVEL meter. The signal generator output is now the 10 dB S+N/N sensitivity (for a URM-25D you will have to switch back to unmodulated CW to read the microvolts output from the 25D meter). An R-390A typically has between 0.4 and 0.5 microvolt sensitivity for a 10 dB S+N/N in AM mode for a 4 KHz BW using this method of measurement. When the sensitivity is measured using an external speaker and voltmeter connected across the speaker, the sensitivity tends to be somewhat better, about 0.3 microvolts. I don't know why. Perhaps the R-390A LINE METER is not as accurate as a precision voltmeter. Or perhaps the voltmeter I have been using to measure R-390A sensitivity is not as accurate as the R-390A LINE METER. In any case, this provides a quick and easy check of R-390A performance, provided the LINE METER circuits are not defective.

As a final performance check, disconnect all antennas, set the FUNCTION switch to AGC, set BANDWIDTH to 8, BFO to OFF, LIMITER to OFF, RF gain fully clockwise, frequency to 5.500 MHz, and all other controls in normal operating position (AUDIO RESPONSE set to WIDE). Adjust ANT TRIM for maximum noise. You should hear a definite increase in noise as you rotate the ANT TRIM. What you are doing is peaking the R-390A front end noise. Set the LINE METER switch to -10 and LINE GAIN control fully clockwise. The LINE LEVEL meter should read no less than UV. Set the LINE METER switch to 0 and LINE GAIN control fully clockwise. The LINE LEVEL meter should read no more than UV.

Similar RF alignment and noise performance checks were published by Charles A. Taylor in his article "R-390A Alignment Chart" in DX News 48, 25 (May 11, 1981), pages 25-28. The other alignment procedures discussed in this article were developed by me and other HSN subscribers.

THE HOLLOW STATE NEWSLETTER

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All submissions for possible publication in *HSN* should be sent to Reid at his address below. The editor and publisher assume no responsibility for the accuracy or safety of untested modifications or the reliability of suppliers of services, parts, or equipment mentioned in *HSN*.

Editor's And Publisher's Corner

First, please note Ralph's new address above.

Next, and I know this will please many of you, we have a new editor, Reid C. Wheeler. I am delighted too, of course, that <u>HSN</u> will not cease with this issue. I asked Reid to write a short paragraph to introduce himself, and have included his introduction below. I hope that many of you who have been thinking of sending a short (or long) contribution to <u>HSN</u> will take a few minutes from your busy schedule and sent that contribution to Reid. There may be enough material on hand for two or three more issues, but Reid will surely need your help if <u>HSN</u> is to continue.

Finally, let me say what a pleasure it has been to edit <u>HSN</u> these last eight years for issues 11 - 30, and especially to have met so many fine people.

Welcome To Our New Editor: Reid C. Wheeler

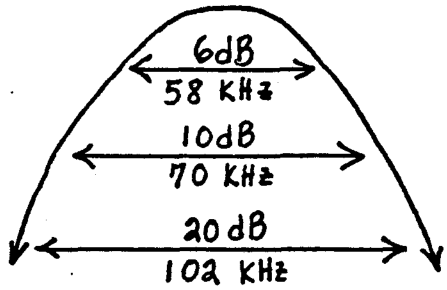
It is my pleasure to soon be assuming the editorship of HSN beginning with #31 later this fall. I certainly hope, with all of your help and contributions, I can do as good a job as Dallas has. Gratefully, Ralph Sanserino will continue to handle the publishing. My primary goal is to make HSN address <u>your</u> needs, interests and desires; suggestions are always welcome. Background: I'm a 50-year old, married civil engineer working for a small state agency. My work is all administrative which has permitted me to keep up fairly well with computer technology. My combination shack/workshop is well filled with hollow state equipment including two R-390A's (a Stewart-Warner and an EAC), a National NC-183T, and my first multi-band receiver, a Hallicrafters S-38E. All my test equipment (scope, signal generators, VTVM, etc. are tube-type as well. Electronics and radio have been hobbies since high school and I never seem to get tired of building, repairing or modifying most anything electronic. My main love is BCB DXing and I am presently the Western DX Forum editor for IRCA's <u>DX Monitor</u>. I hope to hear from many of you soon - we'll talk again in HSN #31. My address is 5910 Boulevard Lp SE, Olympia, WA 98501-8408. If calling, your best chance is between 6 pm and 9 pm PLT most any evening at (206) 786-1375. Reid

Collins Torsion Mechanical Filter For The R-390A

Dallas Lankford

Recently while studying the feasibility of adding a noise blanker to the R-390A, I made a surprising (to me) discovery. For the non-crystal filter bandwidths, i.e., for the 2, 4, 8, and 16 KHz mechanical filter bandwidths, the 3rd order intercept (ICP3) and hence the 3rd order dynamic range (DR3) of an R-390A is determined mainly by the 1st IF amp, not by the front end as it should be.

The non-crystal filter bandwidth of an R-390A at pin 1 of V501, the grid of the 1st IF amp, is shown at right. When the front end selectivity is included, at lower frequencies (say, below 5 MHz) the non-crystal filter bandwidth at pin 1 of V501 is somewhat narrower. But in any case, for non-crystal filter bandwidths, the R-390A is quite broad up to the mechanical filters following the 1st IF amp. In other words, the R-390A was designed as a CW receiver, and AM was added as an afterthought.



Typical R-390A Selectivity At Pin 1 Of V501, 2 KHz BW Or Greater

Suddenly in a flash, a number of published statements which had seemed incorrect to me were explained. How had Sherwood gotten such uniform dynamic range measurements for the R-390A at 20, 10, and even 5 KHz tone spacings? My measurements using mechanical filter bandwidths were not nearly as uniform as his. Apparently he used the 0.1 or 1.0 KHz crystal filter bandwidths! And how did Rohde get a -4 dBm ICP3 for the R-390A? I never got better than aboput -12 dBm in the MW band using mechanical filter bandwidths. And in the SW bands I got much worse, typically about -24 dBm. Again, apparently he used one of the crystal filter bandwidths. To confirm my suspicions, I made extensive ICP3 measurements using the 0.1 crystal filter BW and got quite uniform ICP3 values at all frequencies and at various tone spacings, from 5 to 20 KHz. With the 1.0 KHz crystal filter BW, the 5 KHz tone spacing ICP3 drops off quite a lot to as low as -22 dBm for a Motorola I measured. That still translates into a DR3 of 74 dB. By contrast, with the 2 KHz BW the Motorola measured -52 dBm ICP3 and 54 dB DR3 for 5 KHz tone spacing. It appears that I made a mistake in a earlier HSN where I gave much higher values as typical. Or perhaps there is substantial variation from one R-390A to another. When some of the values I quoted in a draft of this article were questioned by Denzil Wraight, I could not reproduce my earlier measurements on an EAC of mine because I had modified it with a mechanical filter as described below. And when I measured the ICP3 and DR3 of a Motorola R-390A, I got lower values than I thought I got with my previously unmodified EAC. The most accurate statement I can make at present is that there is some variation from one R-390A to another, and perhaps substantial variation in ICP3 and DR3. In any case, the general trend is clear. The R-390A has significantly better 3rd order IMD performance in the 0.1 and 1.0 BW's than the 2, 4, 8, and 16 BW's, and the R-390A 3rd order IMD performance declines as frequency increases for the 2, 4, 8, and 16 BW's.

Further measurements revealed that RF voltages as high as 20 volts RMS can be present at the input to the R-390A mechanical filters when a weak signal is tuned near a strong signal. The maximum rated input of an R-390A mechanical filter is 5 volts RMS. It is remarkable that the R-390A mechanical filters routinely withstand 4 times their maximum rating. However, this may account for some of the occasional mechanical filter failures in R-390A's.

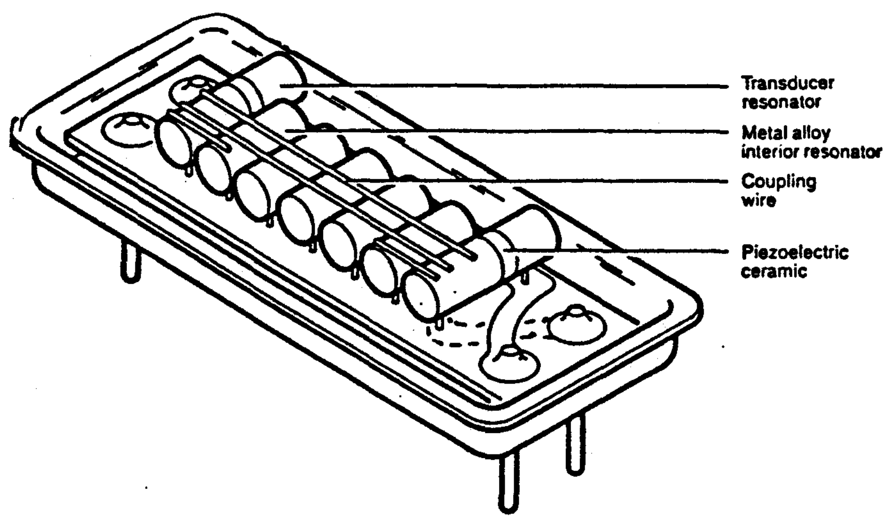
I have often wished for a 6 KHz BW filter for the R-390A, so this seemed like an ideal opportunity to kill 3 birds with one stone: add a mechanical filter immediately after the 3rd mixer which would provide (1) a 6 KHz BW while retaining the 4, 2, 1.0, and 0.1 BW's, (2) improve the non-crystal filter ICP3 and 3rd order dynamic range within about 50 KHz of the tuned frequency, and (3) protect the R-390A mechanical filters from excessive signal levels.

Of course, this is easier said than done. I am sure I am not the first person to contemplate adding a filter after the 3rd mixer. The problem is space. There is not much spare room in the small compartment where such a filter would naturally be installed. An R-390A N-type filter is too large to fit. An FA type Collins filter would barely fit, but try finding an F455FA60 at a reasonable price. Six years ago Collins priced them at $290 for one. An FD filter is the same size as an FA filter, but an FD filter requires other components for impedance matching because the FD filters are 2000 ohms source and load.

Nevertheless, I began prototyping with an FD58 to verify the feasibility of such a mod. Those results are related in my hand written notes "Collins FD mechanical filter for the R-390A." The FD58 circuit never progressed beyond breadboard form, with the filter and impedance matching components sitting on a small piece of wood on top of the RF deck, with connections made via wires running through a spring hole and via a tube test socket. However, the FD58 breadboard circuit permitted me to confirm the feasibility and desirability of such a mod.

Meanwhile, the search continued for a suitably small filter. Ceramic filters were considered, but rejected because of the difficulty of obtaining ceramic filters with uniform specs. I could get high quality, tightly speced ceramic filters directly form Murata of NTKK, but I would have to order about 100 filters for about $2000. I could not see myself going into the filter peddling business just to get a few small, tightly speced, 6 KHz BW filters. And what good is a mod if others can not easily reproduce it?

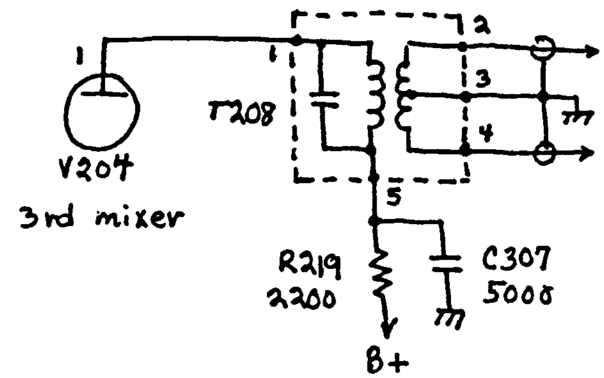
Fortunately, Collins came to the rescue with their low cost series of torsion mechanical filters. I did not know much about Collins torsion mechanical filters when I ordered them; only that they were small, about the size of a 16 pin IC, that they cost $76.81 each, and that the 6 dB and 60 dB specs were good, namely 5.5 KHz min. and 11 KHz max. respectively. for the AM filter.



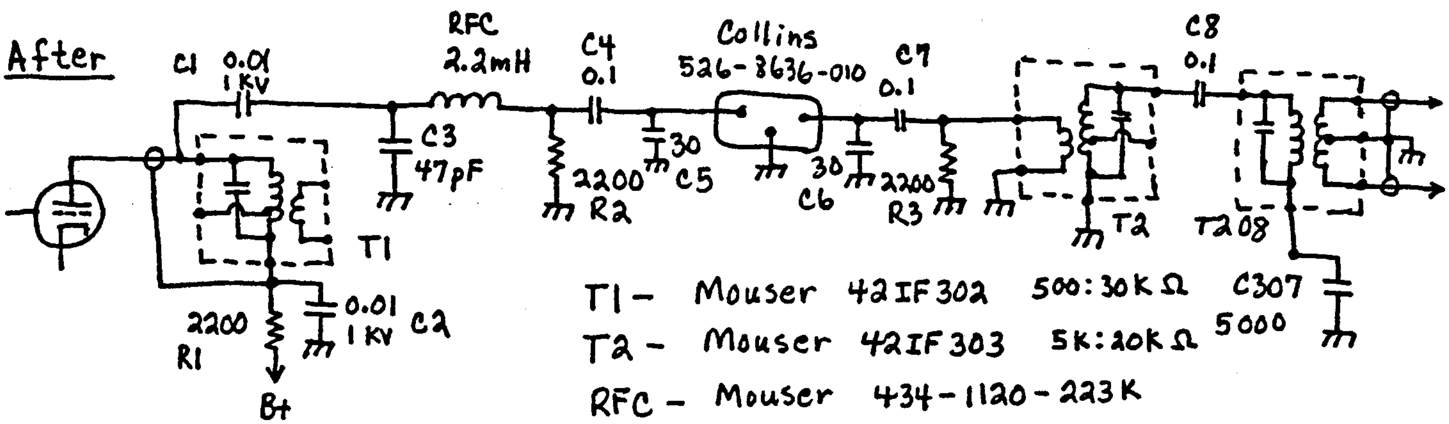
I also knew that the Collins torsion mechanical filters were 2000 ohms source and load, so that impedance matching would be required. I guessed correctly that the same impedance matching circuit I used for the FD58 would work for the torsion filter, and because the torsion filter was much smaller than an FD filter, that everything would fit inside the 3rd mixer compartment.

Before and after schematics of the mod are shown below. A PC board layout is also given below.

Before



After



T1 – Mouser 42IF302 500:30KΩ

T2 – Mouser 42IF303 5K:20KΩ

RFC – Mouser 434-1120-223K

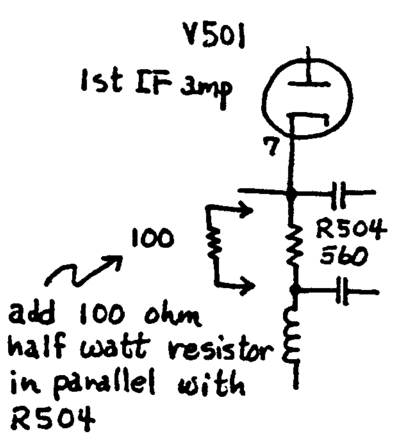
R1 – half watt
R2, R3 – 1/4 watt } Radio Shack

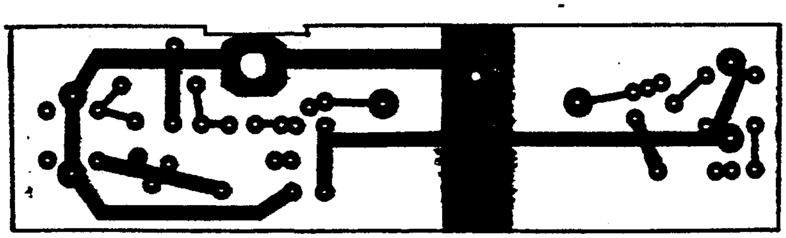
C4, C7, C8 – 0.1, 50V monolithic (RS 272-109)

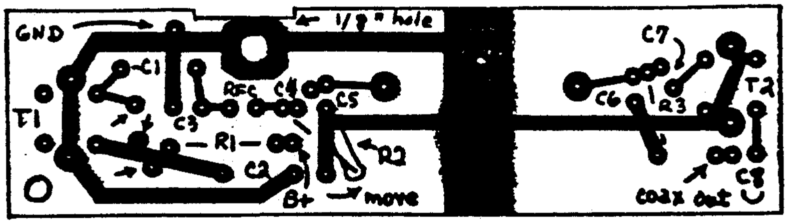
C3, C5, C6 – small 50V ceramics

C1, C2 – 0.01, 1KV (see text)

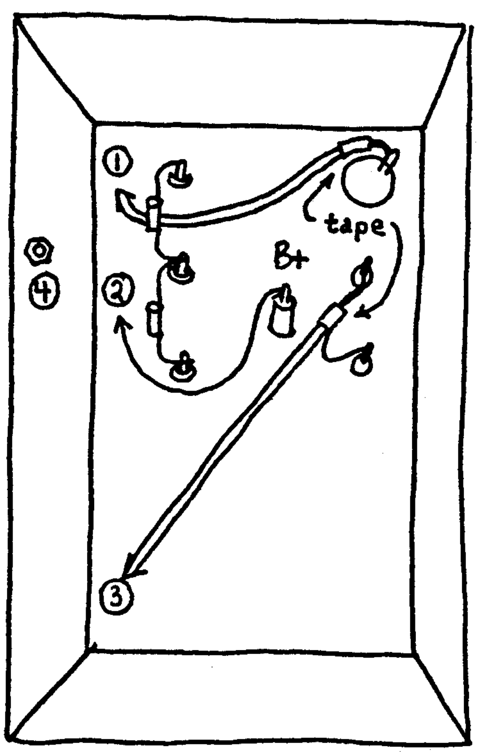
Note that R219 has been removed from the R-390A.



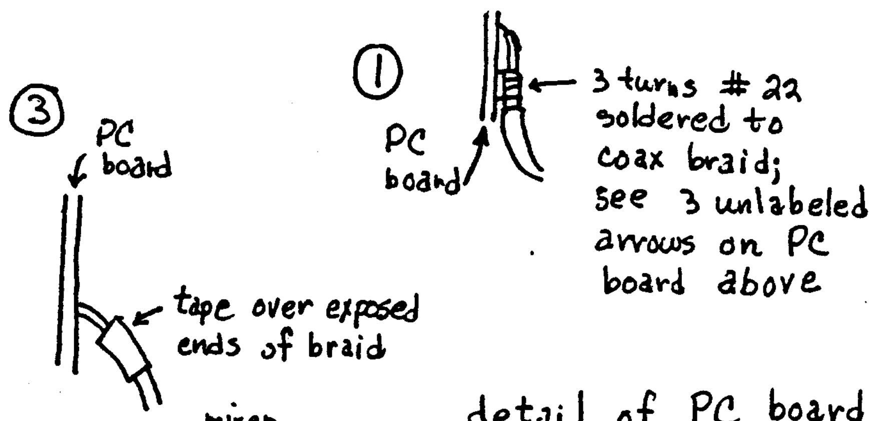


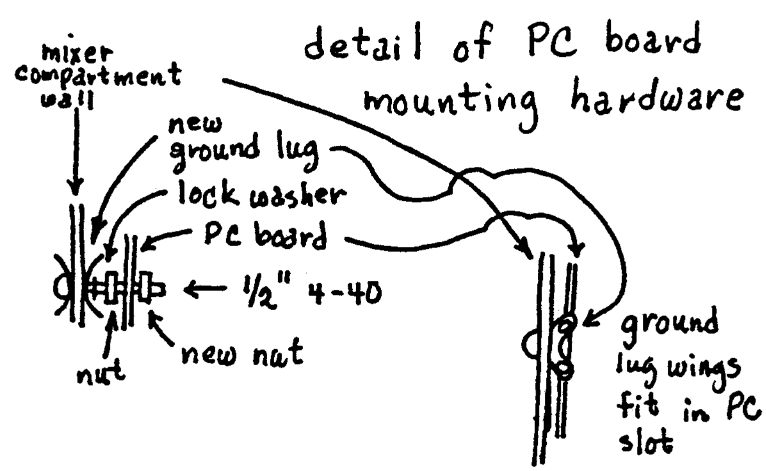


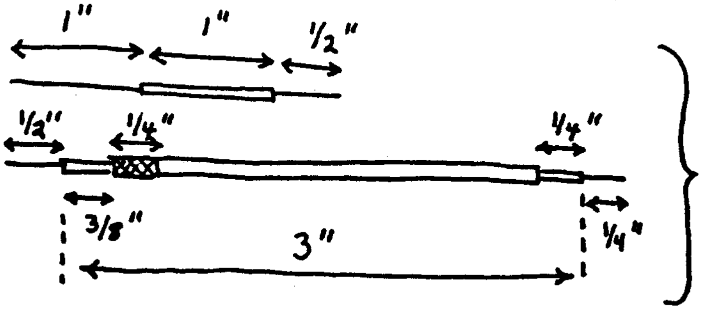
Another view of the PC board with information on the parts layout is given above. The 1/8 inch hole in the ground trace at the top is for mounting the PC board with a 4-40 screw in the side of the mixer compartment; see (4) in the simplified mixer compartment diagram below. The shallow notch in the PC board above the mounting hole is to clear the ground lug which is part of the mounting arrangement; see below. The two holes in the bottom corners of the PC board are for nylon bolts and nuts which are used as standoffs to prevent the bottom of the PC board from accidentally shorting to the metal side of the mixer compartment. For mounting, the existing 4-40 screw is removed and replaced by a 1/2 inch long 4-40 screw. Also, an R-390A type ground lug is added. An exploded detail of the PC board mounting arrangement is given below. The miniature ccax from mixer tube to PC board (1), the stranded insulated wire from standoff (B+) to PC board (2), and the miniature coax from T208 to PC board (3) are shown in simplified form below. Most of the R-390A parts have been omitted from the sketch for clarity. The miniature coax and wire run underneath all R-390A parts and connecting wires. Some details for attaching the miniature coax to the PC board are also given below. The PC board layout can be improved by moving the trace and pad for one end of R2 as shown above.



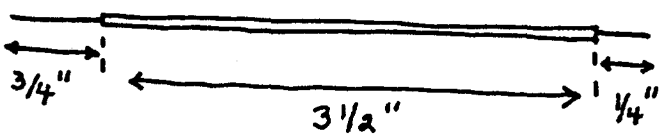
simplified mixer compartment



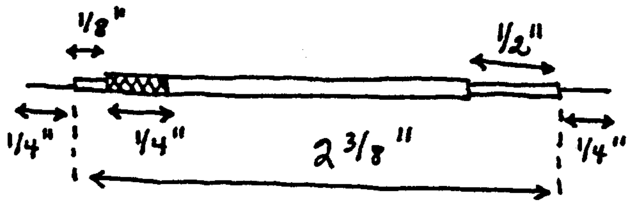




to R-390A IF transformer from PC board



white with red tracer, to B+ lug from PC board



to R-390A mixer from PC board

Lengths of the miniature coax and lead dressing are given above. Actually, I used Teflon insulated shielded hookup wire which is sturdier than miniature coax. Exposed edges of braid were taped with Scotch 27 Glass Cloth Electrical Tape, 1/2 inch wide, available from Amidon. It is important not to introduce shorts, especially around the mixer tube socket where high voltages are present.

The transformers T1 and T2 are standard (SUMDA) miniature 455 KHz IF transformers. T1 is a 500:30K ohm, 22:1 turns ratio, while T2 is a 5K:20K ohm, 6:1 turns ratio. I did not know if T1 would safely carry 200 - 300 VDC, so I tore one apart and examined the internal construction. It looks like it would carry 1000 VDC. I also did not know if the current rating of T1 was adequate for the mixer current. So after 20 hours of use I removed T1, tore it apart, and inspected the coil. There was no evidence of internal heating. However, I <u>cannot guarantee</u> the safety or reliability of this transformer, only that it appears to be safe and reliable. Consequently, I assume no responsibility or liability for this mod. The primaries of both transformers are tapped, and the pin-out on one side of each consists of three pins. The middle pin was cut off with miniature diagonal cutters to simplify mounting the transformers. This pin should not be cut off too close to the insulated base; otherwise the transformer primary may open.

C1 and C2 must be 0.01, 1000 volt disc ceramics, and C2 must be small enough to clear internal R-390A parts. With a different PC board layout, C2 could be placed at the end of the PC board beside T1, and then the size of C2 would not be critical. Naturally I discovered this after the PC board was etched as I attempted to install the PC board.

The trace for mounting R2 should be moved slightly as shown, or the leads of R2 can be curved slightly so that R2 does not cover the B+ wire hole.

R2 and R3 may be omitted for a slight increase in signal throughput. They are artifacts of the breadboard version where I tried different circuit variations to minimize passband ripple. They are also the preliminary steps in developing a diode switched multi-filter board.

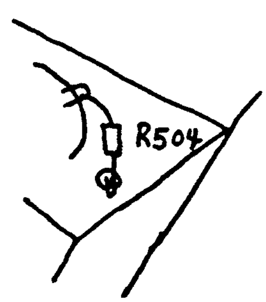
RFC and C3 form an L matching network to match the high impedance of the mixer and T1 to the 2000 ohm source required by the filter. You may use 2000 ohm resistors for R2 and R3 if they are handy, but don't expect any noticable improvement.

There is some signal leakage past the filter with the Mouser radial lead choke specified. To eliminate all signal leakage, you should use an Amidon FT-50-43 ferrite toroid core (mu = 850, A_L = 0.52 microHenrys per turns squarred, L = 0.52 t^2 microHenrys) with 62 turns of #30 enameled copper wire. The signal leakage was discovered after the PC board was etched. A different PC board layout is required for correct toroid mounting.

When the R-390A 8 KHz BW filter is used, the 80 dB BW with the Mouser choke is 10.5 KHz, so there is really no need for the toroid choke when the AM torsion filter is used. It might be worthwhile to use the toroid choke if the 2.5 KHz BW SSB torsion filter is used for this mod.

The Collins low-cost torsion filters are truly remarkable. Low cost does not mean cheap, either in appearance or performance. The torsion filters are small, about the size of a 16 pin dual in-line IC. The case is metal, while the bottom is epoxy fiberglass PC board construction, apparently plated through, with press-fitted pins. I can attest to the fact that the pins are well-attached because I have removed and reinstalled some of them several times. Some torsion filters are assembled with standard low-temperature solder. In that case, the solder around the bases of the pins will flow up inside the case if the filter is soldered or unsoldered upside down. You can fix that by holding the case rightside up, applying the hot iron tip to the pin for a moment, and the solder will flow back out. Then desoldering braid can be used to restore the pins to original. As I have said many times before, ChemWik Lite 0.100 desoldering braid is the only desoldering braid which really works well.

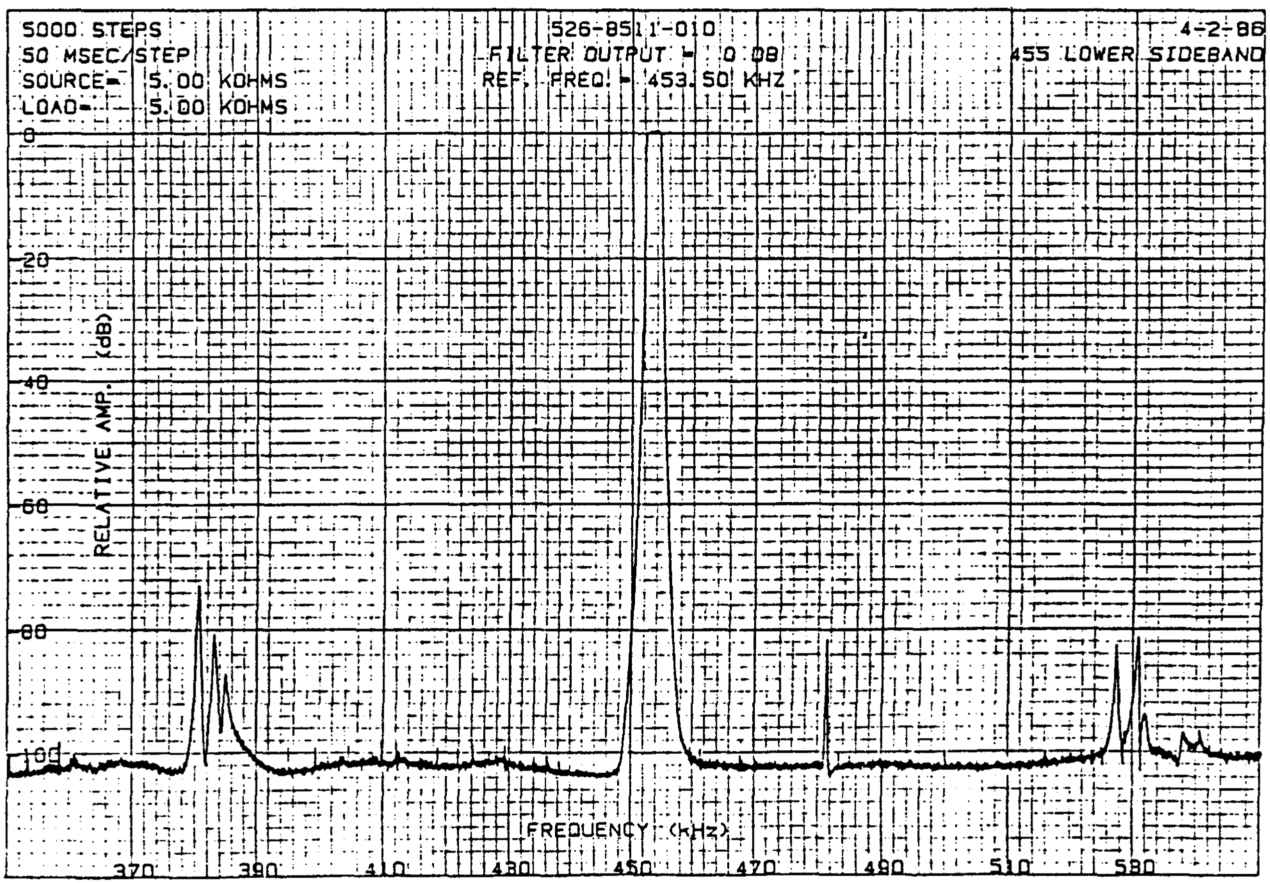
My original PC board had a small copper foil barrier fitted into a slot cut across the center of the PC board and soldered to the ground plane. My current PC board has no such barrier because careful measurement revealed it was unnecessary, at least for the AM filter.



The torsion filters are low loss, but the L matching network adds additional loss, enough loss to slightly desensitize the 390A. Fortunately, this loss can be mostly recovered by adding a 100 ohm half watt resistor in parallel with R504, the 1st IF amp cathode resistor. One end of R504 is attached to a lug on the end of the bandswitch waffer, the other end to an insulated feedthrough; see the sketch at right. Use desoldering braid to remove excess solder from the lug and feedthrough, form a small loop in one end of the 100 ohm resistor lead (Radio Shack half watt works well), push the loop onto the feedthrough using the tip of a screwdriver blade (the loop should be tight enough to hold the resistor in place as you solder it), solder the feedthrough connection, and connect and solder the other end of the 100 ohm resistor at the bandswitch waffer lug.

To install and tune the filter, first remove the 390A RF deck, remove R219, and remove the insulated wire (white with blue tracer) from pin 1 of V204 to T208. Next install a long length of insulated wire at the B+ insulated standoff, and a long length of mini-coax at T208, and bring these two wires through the rack spring hole in the mixer compartment. Reinstall the RF deck. Use a tube test socket to extend V204. Place a 6 inch by 6 inch piece of 1 inch thick wood on top of the RF deck. Attach the completed PC board. Turn on the R-390A, inject a signal generator signal (or tune a CAL marker) and peak T208, T2, and T1 in that order. Disconnect the PC board, remove the RF deck, and reinstall the PC board in the mixer compartment (remove the temporary mini coax from T208 and install the final mini coax, and trim the stranded insulated wire from the B+ insulated standoff to an appropriate length, about 3 1/2 inches long). The mini coax at the input side of the PC board should be the same as was used for the outboard tuneup. The PC board ground connection is a short length of #24 tinned solid copper wire from the PC board ground pad to the ground lug. Reinstall the RF deck, and repeak T208.

The low-cost torsion filters are available in AM, 6 KHz BW, part no. 526-8636-010, SSB, BW 2.5 KHz, part no. 526-8635-010, and CW, BW 0.5 KHz, part no. 526-8634-010. Shape factors are typically slightly under 1:2, and the filters are capable of ultimate attenuation in excess of 100 dB. You should contack Bob Johnson, Principal Engineer, Filter Products, Rockwell International, 2990 Airway Avenue, Costa Mesa, CA 92626, phone (714) 641-5311 for prices and availability of these filters. The attenuation characteristics of a similar low-cost, 8 resonator, torsion filter are shown below. The spurs between 370 KHz and 390 KHz, at about 480 KHz, and about 530 KHz are normal for mechanical filters. Even the spur at about 480 KHz will be attenuated to below 100 dB by an ordinary 455 KHz IF transformer, so these spurs are of no consequence unless the torsion filter is the only selectivity in your IF. This is, of course, not the case with an R-390A.



HOLLOW STATE NEWSLETTER

"For lovers of vacuum tube radios"

Editor
REID WHEELER
5910 BOULEVARD LP SE
OLYMPIA WA 98501-8408

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Winter 1993

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HSN is produced and published by and for the community of those who appreciate the fine accomplishments of the manufacturers of 'top of the line' vacuum tube communication radios and auxiliary equipment. Originally created by a group of R-390 users, *HSN* has expanded to include industrial, military and consumer grade receivers by Collins, Hammarlund, National, Hallicrafters and others. *HSN* includes tips, modifications, alignment and restoration advice, product reviews, parts, tubes and service sources, and subscriber buy/sell information - all provided by subscribers and friends of *HSN*.

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EDITOR'S AND PUBLISHER'S CORNER

As your new editor, this is my first 'stab' at putting together a complete newsletter (or any other wide-spread publication) and I hope it lives up to your expectations. Comments and suggestions, **as well as contributions**, are requested.... By now you should have had a chance to examine the new index sent recently to all current subscribers. In addition to adding material from this and future issues, are there any other important items or references that might be added? Admittedly, it's heavy on the R-390 stuff, but that's been the heavy emphasis in *HSN* from day one.... Please look this issue over closely ... it's really **your** newsletter and it must reflect **your** interests.

From our publisher, Ralph Sanserino --- Ralph has asked me to add a couple of things: It's important that **all** checks or money orders for subscriptions, back issues, etc. be made out to him. *HSN* is not the publication of some formal 'club' which has officers, bank accounts, etc. Everyone, especially those who provide the materials for publication and not just the editor and publisher, are volunteers. To keep our costs down, Ralph handles the money personally rather than incur the extra expense of a commercial account. In addition: The new *HSN Index* was mailed in mid-December to all current subscribers. If you didn't receive yours, drop Ralph a line and one will be sent post-haste.

Happy Holidays Ralph

****

Paul Tice from Coopersburg, PA sends us his suggestions for ...

CLEANING AND LUBRICATING THE R-390A GEAR TRAIN

A detailed stripping to clean and lubricate the R-390A gear train is a task that I would not want to do, but when 25+ years of dust and hardened lubricants started to get into the works,I had to do something.

I have had great success with a product called **CRC Lectra-Motive Cleaner**. It is available in both spray cans and gallon containers, and is available at NAPA auto parts stores. I bought a gallon of the stuff, put it into a refillable sprayer, and washed off all of the moving parts. It is NOT like tuner cleaner, and leaves no residue and should not be sprayed into the PTO or other controls.

Once the gear train is cleaned, it needs to be lubricated and I used a product called **COMPU-LUBE**. It is Teflon-based and does not appear to harden in use. It also penetrated like crazy so be very sparing in its application. It is available from Flouramics, Inc. (103 Pleasant Ave., Upper Saddle River, NJ 07458; 1-800-922-0075 or in NJ 201-825-8110). They also produce several other interesting products, but since they are NASA suppliers, they are not cheap. It is about $10 for a one-ounce bottle, but it really works.

I cannot stress enough that these products are *different* from many conventional materials and you should read the label instructions carefully before you use them.

****

Alan is a new subscriber to *HSN* but not to tube technology. He has been published in *The Audio Amateur* and *Radio Age*. Excited enough to buy a set of back issues, he offers us....

PROFESSIONAL TEST GEAR ON A BUDGET

Alan Douglas, Box 225, Pocasset, MA 02559

Good test equipment, like good radios, used to be very expensive. If you grew up with a Hallicrafters or Knight-kit receiver, you probably also made do with Heathkit or Eico test gear. But times have changed. Now you can buy the finest radios ever made for peanuts. Likewise, you can own real test equipment. I won't claim that vacuum-tube test gear is better than the modern stuff, but it can be just as good, if you don't mind the size and weight, and the fact that it uses (horrors!) tubes.

Commercial users must recalibrate their equipment every six months to a year. This considerable expense quickly exceeds the original price of the instruments, especially if factory repairs or replacement parts are needed, so it's not surprising that large companies dump perfectly good equipment. Also, government contracts come and go, as do the companies themselves. When they do, their loss can be your gain.

RF GENERATORS

RF generators can be pretty simple. Ham shacks, cellar workshops, even TV service benches are full of them. Sure, a Heath will put out a signal for aligning your radio, and is perhaps all you need. But it is a real pleasure to own a generator that puts out a clean signal, stays where you set it, and has a calibrated output with no leakage. It's the difference between tuning a Hallicrafters S38 and a Hammarlund SP600. Yes, a Hewlett-Packard 606A does handle as smoothly as an SP600. Jeez, if H-P ever made receivers ... well, they did, actually, but called them wave analyzers or selective voltmeters. But most of them were not hollow-state, so that's another story. Back to business.

My first signal generator was a Lafayette ("you pays your money, and they're laughing yet") made in Japan. It worked all right, in conjunction with an LM frequency meter to tell where you were. But when Bill Slep advertised TS413/U generators for about $100, I bought one. It arrived in its original shipping trunk, and has worked more or less flawlessly for 20 years. Its weak points: the dial could be more accurate (it does have a crystal calibrator though), it will only modulate to 50%, and it is calibrated into an open circuit. On the plus side, being able to read output and modulation simultaneously on two meters is really convenient.

I had no immediate plans to replace the TS413/U, but a friend asked me to find him an RF generator at the Deerfield flea market on my semi-annual pilgrimage. I came across a scrap-metal dealer with a pallet full of URM-25Ds that had seen better days. Since I was his first customer I picked out the three best ones in matching brands (Trad Television, whoever they were) and with the most lid accessories, figuring I could make one good one from the three, and paid him $50. He'd probably have sold me the whole two dozen for $100 but I didn't know I wanted them. In any event, I did assemble one complete generator when I got home, for my friend, and another one which I kept for myself, and the third one needed some noisy pots cleaned but it worked, too. The URM-25 is well-made, compact, and nice to use. Its defects include its compactness, which makes it hard to service, and the single meter for both RF output and audio modulation that requires constant switching back and forth. But the calibrated output make up for everything. As previously noted in HSN, it uses odd dial lamps (but I already had some from old aircraft instruments) and the meters may stick (mine didn't, but a bit of masking tape or a toothpick should remove the offending rust particle or whatever, if you can borrow the use of a stereo microscope). There is a URM-26 series of generators that looks superficially like the URM-25, but covers 4 to 400 MHz.

The ultimate vacuum-tube RF generator is the Hewlett-Packard 606B. It's big, no question, but the panel space is necessary for the large dial and the two meters. It's beautifully made and a joy to use, has better specs than the receivers you'll be calibrating, and needs no exotic tubes. 606As turn up everywhere now, for $100 or so. The B model has an auxiliary RF output for a frequency counter, and a little tweaker control for setting the output to the last .0000 (you know how it is, when you're watching a digital display). 1968 prices were $1350 and $1550 for the 606A and B models.

Incidently, a frequency counter can be used with the TS-413/U or URM-25D, both of which have high-level BNC output jacks on the front panel. The only thing to watch is that leakage from the coax cable doesn't interfere with low level measurements.

FREQUENCY COUNTERS

If I might sneak in a word about counters: the only sensible course nowadays is to buy a modern instrument, but if you just like the older ones, I suggest the H-P 5245 counter. It has all the "advantages" of vacuum-tube equipment -- size, weight, and a noisy fan -- but is completely transistorized. Seriously, its big advantage is the Nixie readout, visible from across the room. The 5245 is easy to use, accurate, and cheap. I bought mine from a test-equipment dealer at Deerfield for $20 (its marked price!) because it had a bent switch shaft and broken knob. I took it home, bent the shaft straight again, swapped the knob with one on the back panel, and presto. A resistor in series with the fan quiets it considerably. If you're paying very much for a 5245, you should plug it in and verify that it reads 10000.000 in self-check mode. If it does not, the mischievous digit module can be moved over to the extreme left where you'll never use it, but be warned. The 5246 is a budget version with fewer operating modes (and, if they weren't installed as options, fewer digits and a less-accurate crystal standard). Both models will work fine without plug-ins and are complete in themselves. The plug-ins improve sensitivity (to 1 mV, 5261 video amp) or extend the frequency range beyond 50 Mhz (5253 converter, but don't buy one with a sluggish tuning dial).

AUDIO GENERATORS

An audio oscillator is perhaps less useful than an RF generator (unless you do audio design or servicing) and the RF models do have uncalibrated audio outputs at 400 and 1000 Hz. But if you want something better, you can hardly go wrong with a Hewlett-Packard 200CD, 5Hz - 600 Khz. I don't know how many millions of these things they made, but it's right up there. They work well, last forever, and are cheap at flea markets, typically $30. There are other models that look the same, with different frequency coverage, and there are rack-mounted versions, but the 200CD is most common. It has no output attenuator; that's a separate box, an H-P 350D, 0-100 dB in 1 dB steps, 600 ohms.

OSCILLOSCOPES

If you're in the market for a scope, the new ones are really bargains, and getting cheaper all the time. But if ya gotta have a tube model, then buy Stan Griffiths' book on Tektronix scopes and study up (available from Antique Electronics Supply). He's hot on 535s and 545s, which I find a bit bulky (the first word that came to mind was humongous). I use a 506, with a 561A (essentially identical) for backup and because it came with a plug-in I wanted. I also have a T912 congealed-state model that I don't like very much but it was cheap. Hewlett-Packard and others also made scopes but Tek parts and plug-ins are much easier to find.

CAPACITANCE BRIDGES

Yeah, you can buy hand-held digital capacitance meters now that run rings around the old ones, and if all your capacitors were perfect and you only needed to know their value, great. But .... capacitors aren't perfect. Definitely not the ones in old radios, the kind you want to replace if bad, but leave alone if they're good. You'd also like to check your replacement stock, especially if they came from a flea market or have been around for a long time. That means leakage as well as capacitance value. An ohmmeter will give a vague indication of leakage, at a low voltage. There were at least a couple dozen hobbyist or servicemen's capacitance bridges made by Sprague, Heath, Eico, etc. that incorporated a leakage test at high voltage, usually a magic eye tube (by the way, they're called bridges because they use a circuit similar to a Wheatstone bridge). At least one military model, the ZM-3A/U made by Shallcross, also had a leakage test. This ZM-3 is easy to spot across a parking lot, with its red, yellow, and green panel and the entire operating manual printed on it. A friend of mine swears by his.

Laboratory bridges measure capacitance and dissipation and will catch leaky capacitors even though they don't measure leakage directly. They also measure inductance (and Q) and resistance. The granddaddy of RLC bridges is the General Radio 650A from the 1930s. It works but is a real clunker to use. Its replacement, the 1650A or B, was much smaller and more convenient, and very popular. It's self-contained and battery-powered. Trouble is, no one gets rid of them, so they're not cheap. Except the one I bought for $40 and I found out why, soon enough, though it works fine now. The very best RLC bridge, in my opinion, is the Hewlett-Packard 4260A (designed, if not made, in Japan) which cost $1780 in 1982. While it's tethered to the AC power line, it takes less bench space and is much faster to use. The first one I bought, at an Antique Wireless Association flea market, looked as if it had been in the middle of a food fight, though the seller assured me it worked (they all do, but it actually did). The second, for a friend who fell in love with mine, looked much better, and was also guaranteed to work (it didn't even come close, but eventually I won the battle). I'm still looking for a third (gotta do something about all those friends!).

To make accurate leakage measurements, and to re-form electrolytics before using them, I built my own tester. Essentially it's a variable power supply, 0 to 700 V at 10 mA, with a 100 μA meter shunted to 1 mA and 10 mA. The design was published in Radio Age in August 1993, and I'll be glad to send a copy of the article for an SASE.

QUESTIONS AND ANSWERS FROM OUR READERS

This section will present questions from subscribers for which responses are solicited. If you can help in providing answers, suggestions or just plain good advice - please send them to the editor for inclusion in the next issue of HSN.

Ans. R-390A antenna relay voltage

In HSN #24/25, a question was raised at to the voltage applied to the coils of K101, the antenna relay. In MY R-390A that was manufactured by EAC sometime in 1968, the relay is marked 20 VDC and measures 19.5 VDC on my meter. The simplified schematic diagram on page 7 of TM 11-5820-358-35 also indicates that 20 VDC is what the relay needs. [Paul Tice]

??? SSB converters / R-390A

I have been wondering for some time about the various SSB converters that are designed for use with the R-390A. Since I can tune SSB by using the BFO, what are they good for? [Paul Tice]

??? GENESIS OF MANUFACTURERS & ORDER NUMBERS / R-390A

Is their anyone who could provide exact definitions of each R-390A order number-related differences and modifications? I think it is a known fact that there are certain differences in R-390A's made by different companies, and considering that even not all of these order numbers have been listed so far, a lot of detailed information is lacking when someone is offered a 'brand new' R-390A ... it is almost impossible to find out what hybrid monster you may be purchasing ... [Gordon von Campe]

??? FSK converter / R-390A

Fair Radio Sales sometimes advertises a FSK converter for RTTY. Has anyone ever used one of these? Is there an interface to allow the R-390A to supply RTTY to a computer? [Paul Tice]

??? 12AT7 for 5814 / tube substitution / R-390A

While testing some spare tubes by substitution, I noted that a few of the locations that were marked for 5814's had 12AT7's in them. When I replaced all the 12AT7's with 5814's I noted a great loss of gain. Apparently the 12AT7 gives an improvement over the 5814, but only in some locations; in others the 5814 appears the best choice. All the tubes that I used were known to be new. [Paul Tice]

Ans. First, lets review where the 5814A is used in the R-390A: looking at my NAVSHIPS technical manual, it is used as V205 (Calibration Oscillator and 100-KHz Cathode Follower); V506 (Detector and AGC Time Constant); V507 (Limiter); V509 (AGC Rectifier and IF Cathode Follower); V601 (1st AF Amp and AF Cathode Follower) and as V602 (Local AF Amp and Line AF Amp). Referencing my 1963 General Electric **Essential Characteristics** manual, lets compare some important specs (also my GE manual states that the 'A' suffix indicates a later version than the 5814. An 'A' version can be substituted for the plain 5814, but not vice-versa. The R-390A calls for the 5814A, so lets compare on that basis):

	5814A	12AT7
Basic parameters:		
Classification by construction	Medium-Mu Twin Triode	High Frequency Twin Triode
Maximum plate volts	330	300
Capacitance (picofarads)		
Input	1.6	2.2
Output	0.5/0.4	1.2/1.5
Grid-Plate	1.5	1.5
(5814A values w/o shield)		

In Class A amplifier operation, the 12AT7 has 1-1/2 more plate resistance, twice the mutual conductance, and 3 times the amplification factor.

I'm certainly no tube engineer, but it appears that where not used as an amplifier, there probably isn't a lot of difference (but the 12AT7 may result in increased distortion where used as an impedance transformer, but I don't know enough theory to tell you if or where). For amplification, the 12AT7 is certainly 'hotter'. So ... depending on which locations were using the 12AT7, what comes through the headphones could be quite different from 'specifications'.

In *HSN* #7, the 12AT7, -7A and -7AW are suggested as (non-standard) substitutes. Likewise in *HSN* #12, a reader has (apparently) used 12AT7's in the audio output (V602) for increased audio gain. Personally, I'm pretty much a purist on this and normally use only what's specified. I do, however, keep some of the substitutes on hand for an emergency. Incidently, my GE manual indicates the 5814A is a "5 Star" special 12AU7 (what GE calls "special-quality tubes for critical applications". My 1971 Allied **Tube Substitution Handbook** doesn't call out the 12AU7 or -7A version as a 5814A substitute but I have tried them and they appear to work OK - the specs are pretty close across the board. I am also quite willing to 'stand corrected' by more expert knowledge on this ... any takers?? [the Editor]

??? <u>5749 for 6DC6 / tube substitution / R-390A</u>
I substituted a 5749 tube for the 6DC6 RF amp [in an R-390A], and promptly pinned the carrier meter. Strong local stations now come in without an antenna. Does the 5749 actually work this much better, or is it just having a strange effect on the meter? Why was this tube not used in the original circuit? [Paul Tice]

Ans. Gleaning the back issues of *HSN*, some of the substitutes used for the 6DC6 are the 6BA6 (definite RF gain noted over the 6DC6), 6HQ6, 6HJ6, 6BJ6, 6BJ6A, 6GM6, 6662, and the 6BZ6 (Dallas Lankford has reviewed the Collins engineering report on the R-390A; sez the 6BZ6 may be used for the RF amp). My 1971 Allied substitution book also calls out the 6AW6, 6CB6, 6CF6, 6DE6, and the 6DK6 in addition to those already mentioned. Of course, the 6BA6W (the "W" indicates rougher duty) and the 5749 are interchangeable (again, my GE manual notes the 5749 is the "5 star" special 6BA6). Others' experience with the 5749/6BA6 matches yours - more gain and pinning the carrier meter. I have no idea why it wasn't used in the original circuit ... can anyone add some insight? [the Editor]

SHORT SUBJECTS

<u>BOOKS & CATALOGS</u> - The November 93 issue of **Electronics Now** contains an ad for the PROMPT Publications **Tube Substitution Handbook** (First edition, 1992) carried by one of our old favorite data sources, Howard W. Sams & Company. It's a little 'pricey' at $16.95 (plus your state's sales tax and shipping costs) but it does claim to list "all known vacuum tubes" and its 149 pages of small print (a quick scan to the 3TF7 shows what we have been hearing for years - they're ain't none. Its the only one I've seen that even <u>lists</u> the 3TF7!). If you're interested, call Sams at 1-800-428-7267 and ask for item #61036. There is a cheaper one available through another good parts source, **Antique Electronic Supply** (6221 S. Maple Ave., Tempe, AZ 85283). Their 1994 catalog offers one for a mere $7.95 plus sales tax (AZ only), $2 handling and UPS shipping. Minimum order is $10.00 but once you see what's offered, this shouldn't be a problem! Having ordered from them several years ago, I still get their annual catalog without additional charge - I believe there still is an initial cost of $2. There is no '800' number for them but if you can't wait, call (602) 820-5411. Of particular interest is the availability of new 3TF7's ($30.00), 6Z5W's ($7.50), and A.P. Jacobi's **Ballast Tube Handbook** including his substitution guide for $10.95 (last mentioned in HSN #19. Apparently he has made a deal with AES.) [the editor]

<u>R-390A</u> / <u>MORE ON ANTENNA CONNECTIONS</u> - Having finally tired of using small finish nails and alligator clips (I must admit a feeling of shame in stooping to such desperate measures), I was able to get an appropriate adapter for the balanced input jack (J104) from our esteemed publisher, Ralph (and I just realized that I still owe you for it!!). This is the UG-970/U which mates to a PL-259 UHF connector suitable for an unbalanced antenna feed. This connector (a handy, right-angle one) seems to be the most common one used and is called out in the NAVSHIPS Technical Manual (Chapter 8). There are also UG-type adapters for connection to type C adapters/connectors as well as balanced antennas. Further discussion on this is contained in HSN #4 and an excellent source of various RF connectors, **The R.F. Connection**, in HSN #19. I have stumbled onto another source but the purchaser must be willing to do a little shop work. **Mendelson Electronics Co., Inc** (MECI), 340 East First Street, Dayton, OH 45402 is offering Twin-Ax Chassis Mount Male (with wire leads) connectors (No. 240-1219F) for the ridiculous sum of 89 cents each. I purchased a bag-full of 'em on pure speculation and they fit the J-104 perfectly. Their periodic flyer also contains much other weird and unusual stuff... and its a good thing 'cause the minimum order is $20.00 plus tax (Ohio only) and UPS + $2 shipping. Check it out and get a free flyer by calling

1-800-344-4465. I've been successful in making an adapter for BNC cables using a 35mm film canister appropriately drilled at each end, solder lugs and a little hookup wire. [the editor]

FED SOURCES - MANUALS Some government institutions from which equipment manual photocopies can be purchased include:

National Technical Information Service (NTIS); 5285 Port Royal Rd., Springfield, VA 22161, Attention: Defense Publications or 1-800-555-NTIS.

Center for Legislative Archives
National Archives
Washington, DC 20408 or 202-501-5350

US Army Military History Institute
Carlisle Barracks, PA 17013-5008 or 717-245-3611

Call or write for details of ordering, copy costs and mailing.

BRISTOL SCREWS - While 'rooting' through the HSN correspondence files, found some interesting info concerning the fluted, multiple spline Bristol wrenches and screws: Apparently the term "Bristol" is not a generic name but the name of a company no longer in business. They, and one other company, manufactured multiple spline products for a short time, mostly for the military and some electronic applications, but they weren't popular and never caught on. [Joe Bunyard] And as all of you with an R-390A must deal with the Bristol set screws, occasionally it might be a good idea to check for loose set screws on all couplers and gears. If your receiver is not tracking correctly through the bands, a loose screw may have allowed slippage of the gear train-cam alignment system. Check and correct using the Fifth Echelon procedures of the Technical Manual [Wayne Heinen] *(It would certainly appear that preventing this problem would be a lot easier than fixing it - the editor)*

WANTED TO BUY / SELL / TRADE / WHATEVER

This section is reserved for HSN subscribers in good standing (i.e., you're paid up according to Ralph) looking to connect with HSN readers for mutual benefit. All deals are between individuals; HSN does not evaluate the accuracy of any statements or claims herein. No 'business' ads, please. Items printed will be on the basis of available space.

FOR SALE Subscriber Joe Barry in Bend, OR has a Stewart-Warner R-390A for sale. $250 negotiable. Sez good condition with meters (no extra parts; no case). Joe travels a lot on the West coast and a personal delivery might be possible; otherwise shipping (and costs) will be between Joe and the purchaser. If interested call him at (503) 385-3152.

WANTED Your editor is looking for a Heath GD-125 'Q' Multiplier w/ or w/o manual. Also schematic, specifications, alignment info (photocopy OK) for Hallicrafters SX-107 receiver. Write (or call (206) 786-1375) if you can help.

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HOLLOW STATE NEWSLETTER

"For lovers of vacuum tube radios"

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HSN is produced and published by and for the community of those who appreciate the fine accomplishments of the manufacturers of 'top of the line' vacuum tube communication radios and auxiliary equipment. Originally created by a group of R-390 users, *HSN* has expanded to include industrial, military and consumer grade receivers by Collins, Hammarlund, National, Hallicrafters and others. *HSN* includes tips, modifications, alignment and restoration advice, product reviews, parts, tubes and service sources, and subscriber buy/sell information - all provided by subscribers and friends of *HSN*. All articles and information shared through this newsletter may be reprinted only with permission of the author.

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EDITOR'S AND PUBLISHER'S CORNER

Please note that publisher Ralph Sanserino now has a post office box for all *HSN* subscription/reprint mail. Make all checks/money orders payable to him, not HSN!!!!

Apparently you all have found the new Vol 1-30 Index useful...at least I have not received any comments on it. A few errors have been discovered tho - on page 1, add 23-5 to the AN/FRR Receiver reference; on page 6 change the references for R-725 and R-1230 from 24-5 to 16-5. I expect that the index will be periodically updated, probably after Vol 33. Please send me any suggestions, additions or corrections that will make it more useful to you.

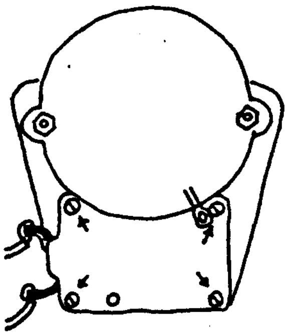
A bit of good news from our publisher - Ralph has found a yet cheaper copying source and the price of reprints has been reduced to $1.00 each. Also note (see Short Subjects) that Dallas Lankford's rebuild notes for the URM-25D signal generator are now available as *HSN*'s first technical reprint ... very good stuff for the technically oriented.

Look for Volume 33 around late summer/early fall.

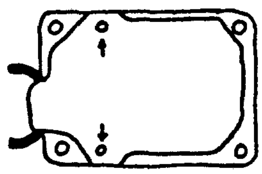
****

Editor emeritus Dallas Lankford provides a followup regarding <u>really</u> repairing the FUNCTION microswitch, or ....

R-390A WON'T TURN OFF (AGAIN) ?



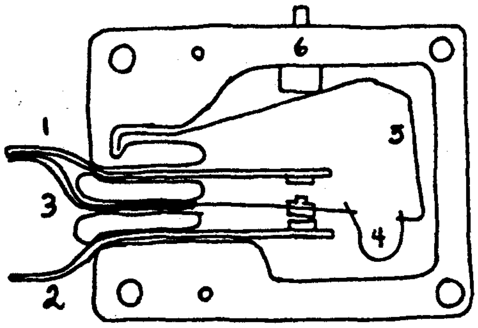
FUNCTION Switch



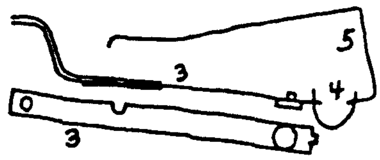
Microswitch

Yep. The first attempted fix, described in <u>HSN</u> 27, was not permanent for my otherwise trusty old 1956 model Motorola. As before, the symptom of the worn microswitch was the dial lights remaining on with the FUNCTION switch set to OFF. And as before, I removed the front panel (see <u>HSN</u> 29) to access the rear of the FUNCTION switch (see sketch at left). And as before, I used ChemWik Lite 0.100 desoldering braid to remove the solder from the two microswitch lugs. Be careful not to touch the hot iron tip to other wires (not shown). The two wires to the microswitch lugs are, maybe, #18 insulated, and not very flexible. Use the hot iron tip to straighten the bends in the wires, and keep the hot iron tip on the wires to aid in pulling the wires through the lug holes without breaking strands. Next remove the four slotted screws, indicated by arrows, and remove the microswitch. If you are lucky, the four flat washers behind the microswitch will be stuck to the FUNCTION switch frame with lock-tite (a varnish-like substance). If not, collect and remove the flat washers, and save them for when you reassemble the microswitch.

When you have removed the microswitch, you will observe two flat metal studs, indicated by arrows above, which attach a plastic cover plate to the side of the microswitch. If you slip the sharp edge of a small knife blade under the edge of the plate near the metal studs, the wedging action of the knife blade will lift the plate and studs slightly, enough to slip a very thin screwdriver blade under the edge to continue the wedging action. By using a succession of larger screwdriver blades (none of them very large), you can remove the plate and studs without damaging the plate, studs, or body of the microswitch. When the plate is removed, the interior of the microswitch should resemble the sketch below.



Microswitch, Interior View



Some Details Of Microswitch

The microswitch has six removable parts, numbered 1 through 6 on the sketches above. Parts 1 and 2 are thick metal plates with small discs attached to them. Part 3 is a thin copper alloy plate. These three parts function similar to the points of an automobile distributor, making and breaking contact for 120 VAC. Parts 4, 5, and 6 move the flexible part 3 to turn the R-390A on and off. Part 6 is a miniature lifter, which is controlled by a cam attached to the shaft of the FUNCTION switch. In the sketch above, the switch is shown in the ON position. When the FUNCTION switch is rotated to the OFF position, the cam raises the lifter, which causes internal parts 4 and 5 to move the end of part 3 to the OFF position (end of part 3 resting against end of part 1). Although both microswitches were manufactured by Robertshaw, the lengths of parts 3, 4, and 5 were different for two switches I examined. Also, the semicircle cutout on part 3, which determines how part 3 can be inserted into the case, was on opposite sides for the two switches. This means that for one switch, the small diameter point of part 3 faced the "hot" point on part 2, while for the other switch, the large diameter point faced the "hot" point on part 2. Although I did not try it, it would seem that part 3 can be made reversable by using a small file to file a semicircle into the other side of part 3. Parts 1 and 2 for the switches I observed were reversable; i.e., they has semicircles on both sides. The semicircles mate with small half-cylinders (not shown) at the bases of the mounting slots (apparently to assure proper alignment of the parts).

Part 4 can be removed by using miniature needle nose pliers to slip the end of part 4 off the end of part 3. Part 4 has slots on both ends; parts 3 and 5 have tabs which mate with the slots. After part 4 is removed, part 5 lifts (or falls) out, and then part 6 may be removed. Use a hot soldering iron tip to remove any residual solder from part 3 where it touches part 1, and use the iron tip to move the double end of part 3 away from the end of part 1. With a right angle dental probe slipped under the inside end, and your finger on the outside end, slowly and gently "wiggle" part 2 out of its mounting slot. Apply the hot iron tip to the outside end of part 3 for about 10 or 15 seconds, and then grasp part 3 with miniature needlenose pliers near the inside edge of the mounting slot, and try to "wiggle" part 3 gently but firmly. If part 3 does not move, apply the hot iron tip again, this time for maybe 15 or 20 seconds, and try wiggling part 3 again. In this way you should be able to extrace part 3 without damaging it. Do <u>not</u> pry on part 3 with a dental probe ot other miniature pry bar; part 3 is very delicate, and easily damaged.

With a small piece of #1200 wet-dry (automotive) sandpaper placed on a flat piece of wood or metal, sand the points of parts 2 and 3 until all evidence of pitting is removed. Then polish the points using "used" areas of the # 1200 sandpaper. Making these small points flat again is difficult, and maybe not even desirable. I opted for slightly curved surfaces, so that the refinished points would touch at one point. My theory (untested) is that as arcing evaporates metal from the points surfaces, a small, more-or-less flat circular, area would grow on the surfaces of the points (as opposed to small pitted "holes" which would grow if the surfaces were initially flat). If the point of part 2 was so deeply pitted that after sanding not much point surface was left, you can reverse parts 1 and 2 as I did for one switch. It may be possible to reverse part 2, if a small semicircle can be filed into the other side, and if the bent lug end can be bent into an opposite curve without breaking the lug end. I did not try that.

To reassemble, reverse the removal steps above. Use a small but perfectly flat screwdriver blade to seat part 3 completely. You may have to remove parts 2 and/or 3, and install them again to get the points to align properly. For one switch, part 4 touched (or nearly touched) part 2 when the switch was in the OFF position, which would cause the switch to be ON in the OFF position. By bending parts 4 and 5 as shown in the "Interior View" sketch, parts 2 and 4 had plenty of clearance in the OFF position. I also bent part 2 (down) slightly so that the points were parallel.

****

Rummaging thru Dallas' material stockpile, we have another 'adventure of the tube testers' with a 1989 article by G.W. Murphy of Scottsville, NY....

HICKOK 539B TUBE TESTER

Here are some comments regarding the above model to supplement the information in *HSN 21* on tube testers:

Model #: Hickok 539B - circuit dates to 1955; full manual with operational data, a section on ballast tubes not found in the tube charts, and circuit diagrams; roll chart (his roll chart is dated 10-1-65).

<u>Specs</u>.

Dimensions: 17w x 7.75h x 18.5d Weight: 29 lbs.

Power: 117 volts, 60 cps. Test voltage adjustable by rheostat in the AC line and AC meter. Line voltage check also possible. Normal test voltage is 100 volts.

Tubes: Type 83 and 5Y3 rectifiers.

Lamps & Fuses: #81 line fuse lamp; #47 pilot; NE-51 in tube short test circuit.

Sockets: 7 and 9 pin miniature, 7 & 8 pin subminiature, loktal, octal, 4 to 7 pin standard type, and a pilot lamp test socket.

Meters: transconductance in ranges 0-600, 3000, 6000, 15000, 30000, 60000 with scales for rectifier, diode, voltage regulator checks, and ohms up to 50 megohm used in leakage tests. Polarity reverse switch for testing of some uncommon types.

Miscellaneous: Roll chart on the chassis. Sockets for tubes having grid or plate cap type contacts. Noise test using a radio receiver externally as noise detector. Plate and filament current can be measured using external meters via banana plug contacts on the panel. Self-bias resistors and bypass caps can be used in cathode circuits via similar connections on the panel.

Gas test for grid current down to about 0.1 μamp.

This instrument dates to 1955 and was obtained for $15.00. It has features that sound similar to the TV-10A/U described in *HSN 21*, but does not contain the solid-state rectifier mentioned in that article. It does not have individually adjustable settings for plate or screen voltage, only a high-low setting which provide 175/135 and 75/60 volts for these two elements.

When obtained, this unit has been dormant for years and was filthy. Both tubes worked, but the 83 developed some internal cloudiness on the envelope at first, which cleared after about 1 hour's use, and this tube still is OK. (The type 83 is a mercury vapor rectifier, but it looks physically like a high-vacuum rectifier. There is no mention in the tube charts or 539B manual of any precautions in use of this tube regarding filament preheating such as is usually required for higher powered mercury vapor rectifiers used in transmitter power supplies. Perhaps the initial cloudiness is normal for this type rectifier, but I have no basis for comparison.) The sockets and selector switches were pretty grimy and took a long time to clean up using TV tuner spray cleaner and gentle scrubbing. The numerical and alphabetical indicators on some of the switches had been twisted loose and required straightening and bonding into position with epoxy glue. A number of minor repairs such as replacing missing screws, paint touch-up, rewiring two disconnected tube sockets, cleaning rheostats, resoldering some loose joints, replacing dried out meter glass gaskets, were needed. I also replaced the AC line cord with a polarized unit, hot side of the line to the power switch. I checked the grid bias and AC line meters using a good VOM and they were very close. The ohmmeter section of the large transconductance meter was only fairly accurate, but a small point.

The manual with this unit is fair at best, and not too well written. It contains no information on trouble shooting, but there was a separate circuit diagram included. Some sections seemed to be afterthoughts, and a section on gas checks was modified and inserted as an addendum. There is a large (and to me useless) section on ballast tube checking. Our little favorite from the R-390A is not listed either. There is no information on calibration, despite the fact that there are calibration adjustments in the circuit.

The roll chart on this unit was cranky to operate and was chewing up the edges of the chart, so I scrapped it and made a separate folding chart out of the roll, which is about 17 feet long. It can be folded up so it's reduced to 12 fold-out sections of about 17 inches and fits well in a manila folder.

The rectifier tubes dissipate a fair amount of heat under the chassis, so I cut two side by side 3.5 in. square apertures through the wooden case, opening them into the accessory compartment near the top end of the panel and screened them with aluminum screen. They open into the case close to the rectifiers.

If anyone substitutes other rectifiers for the two standard tubes using other than straight subs, now sockets and/or rewiring may be needed. Also, check out how the tubes should be oriented per the manufacturer's suggestions, as I understand it, to give best mechanical support to the hot elements which were generally designed to operate vertically. The probably won't be necessary as the 5Y3 is common and I've had no trouble finding spare type *#'s. It would be easy to go solid state with this, too, but I suspect it would cause some problems with calibration so I don't plan to do this. (If another type rectifier is used for the type 83, perhaps it would be a good idea to check the transconductance of a few tubes to set a standard, since the voltage drop (power loss) of mercury vapor rectifiers is less than comparable high-vacuum types and could lead to some change in the DC output supplied during testing.)

I picked up the last several type 81 lamps at an auto accessory shop. They are 6.5 volts/1.02 amp rated (I blew out the original immediately by twiddling the line voltage adjustment. I now have it marked to the approximate correct position to avoid this.) I also made up a small cardboard cursor to help read the tube data charts. It is very easy to go astray on these charts and enter the wrong settings, as the charts are crowded and closely spaced. I also made up a short table of commonly tested tubes to avoid endless thumbing through the large charts.

I have seen and used a Hickok Model 580A tube tester that sounds similar to the TV-2 described in *HSN 21*. It is all solid state and has multiple settings for the element potentials and somewhat easier to use metering and test procedures.

Overall, one could survive without a tester. I have made up a chart of the measured characteristics of the tubes actually in use in my receivers, so at least I have a comparison base to go on if problems develop. Unless defects are obvious, substitution is still probably the best procedure.

QUESTIONS AND ANSWERS FROM OUR READERS

This section will present questions from subscribers for which <u>responses are solicited</u>. If you can help in providing answers, suggestions or just plain good advice - please send them to the editor for inclusion in the next issue of HSN.

Ans. In my response to Paul Tice's ??? on substituting the 5749/6BA6W for the 6DC6 (*HSN #31*), some further insight has been received from Dallas Lankford. He has done some research on this - actual measurements show this substitution does worsen the third order intercepts (ICP3) and will degrade the receiver's sensitivity and reduce the dynamic range. The 6BZ6 substitution does appear to be the only one that doesn't have any measurable undesirable side effects. Use the 6DC6 or the 6BZ6; the 6BA6 is suitable for an <u>emergency</u> substitute only while you're looking for another 6DC6 (or 6BZ6). [the Editor]

??? No new questions this issue...

SHORT SUBJECTS

<u>MORE $ DATA ON THE 3TF7</u> - It's probably too late, but the **Fair Radio Sales** ad in the January 1994 issue of **Electric Radio** shows the 3TF7 ballast tube (unused) for $17.50 + shipping. If you have been following the prices on this hard-to-get item, this is a real bargain and will not last long! Call them at (419) 227-6573. To provide some perspective, long time subscriber and contributor Joe Bunyard in a recent discussion with an Amperite rep has discovered the price of <u>new</u> 3TF7's are now $150 ... and this is not a typo! If you have been putting off getting a spare, this might be the time to get serious. The general availability of tubes at reasonable prices is not getting better. [courtesy Dallas Lankford]

<u>TUBE SOURCE UPDATE</u> - From time to time in *HSN* there have been references to **Daily Electronics Corp.** in Compton, CA as an excellent source for tubes of all types. If you haven't already heard, they have moved to Vancouver, WA. During a recent business trip in that fair city I found the time to make

a visit to their new facility located in a small commercial park and to personally visit with owner Jim Grimes. The business is doing well and he adds that Southern California just wasn't the place he wants to raise his family. His stock is all new stuff with the 3TF7 available for $25 plus shipping (+ 7.25% sales tax WA residents only). Checks and money orders only, no credit card sales. You can call for prices, etc. at 1-800-346-6667 (or 206-896-8856 and fax 206-896-5476). The mailing address is 10914 NE 39th St #B-6, Vancouver, WA 98682.

<u>POT PROBLEMS</u> - The RF GAIN, LOCAL GAIN and LINE GAIN linear potentiometers (RV4N's) on the R-390A invariably are badly worn by the time the receiver gets into your hands and you should be considering making some replacements. The original supplier in the '50s and '60s, Allen-Bradley (bought out recently by Clarostat) made the best ones. Apparently only Clarostat makes 'em now ... and that's the problem. One of Dallas's associates, Russell Scott, who builds phasing units using the same 2500 ohm, 2 watt units which are purported to be the milspec equivalent is finding the new Clarostat's aren't up to the expected standard. The end-point areas are not smoothly linear - as the control is rotated from the 'stop' nothing happens, then suddenly 'kicks in'. Furthermore, they are wearing out <u>far</u> before the 100,000 rotations spec. Clarostat has suggested that Russell buy the higher quality unit in their Model 380 C1 series; he has some on order to try out, and as we get more information it will be passed on. (Clarostat also has an even higher quality Model 485 series, rated at 1,000,000 rotations.) In the meantime, you might consider haunting the local hamfairs - perhaps some of the Allen-Bradley ones may still be around. Dallas also indicates that he has worked out a method of evaluating these pots in-circuit and has promised to send it to me for a later publishing. [the Editor]

<u>INTERMITTENT OUTPUT VARIATIONS</u> - I recently was plagued with an intermittent output variation on my EAC R-390A. For no apparent reason, the output would suddenly drop off drastically and mysterioully return. I pulled all the tubes and they tested good. Next was the 'pencil test' (using a pencil or equivalent), gently tapping components <u>and</u> <u>connectors</u>. The problem was in the coax cabling and connectors between the IF and RF decks. As it was explained to me, these miniature BNC-type connectors (I have never yet been able to determine an Amphenol or other manufacturer's equivalent) have the center conductor soldered in but the braid or shield is a friction fit via the screw-on bushing. In my case, the braid on one of the connectors was loose - a simple tightening of the bushing sufficed. This 'easy' fix only applies to the EAC units as they use a white nylon bushing instead of the full metal units and the braid connection can be easily examined. The metal ones are much more difficult to disassemble. Of course if the problem was a break in the center connector in which case the entire connector must be taken apart and rebuilt. [the Editor with help from Dallas Lankford]

<u>R-725/URR</u> - Subscriber Dave Metz has recently acquired a direction-finding version of the R-390A which was used by NSA (National Security Administration??). According to a section of the TM he sent (TM 11-5825-231-24) the R-725 is a basic R-390A with a six-stage IF subchassis. It was used in the ARMY TRD-15 direction finder set with 4 to 8 receivers and a trailer load of other equipment and an array of antennas spread out in a 150-foot circle. By measuring doppler phase shift they could get line of bearings. The reason for the receiver not being a straight 390A was that the mechanical filters in the 390A create a phase shift that will introduce errors in the doppler shift. Therefore, they resurrected the older 390 IF strip with the 6 IF stages. [Wally Chambers also provided a short blurb on this unit in *HSN 16*]

<u>CABINET OPTIONS FOR THE R-390A</u> - We all know the difficulties in finding a cabinet for the R-390A. New subscriber Doug DeWeese (Tacoma, WA) has discovered that the Heath TX-1 Apache

transmitter and companion RX-1 receiver cabinet will, with only slight modification, fit the R-390A. If you can lay your hands on one of these venerable 'Green Machines' for a good price, you might consider cannibalizing it for the cabinet (hopefully it would be a 'parts only' unit).

URM-25D SIGNAL GENERATOR REBUILD NOTES AVAILABLE - As a follow-on to the signal generator material in *HSN 21*, Dallas Lankford has provided a 10-page set of rebuild notes for the URM-25D. These notes include info on the AC power input filter; removal and overhaul of the modulation (audio) subchassis, buffer amplifier subchassis, and calibration oscillator subchassis; rebuilding the step attenuator; and calibration and alignment data. Rather than devote an entire issue and then some to this, Dallas' originals have been forwarded to our publisher, Ralph Sanserino, who will provide them as requested for $1.00.

BETTER AUDIO FROM THE R-390A - Subscriber James Tabola (Waco, TX) provides his experience with audio improvements... "The 70.7 volt line transformer mentioned in *HSN #26* is the way to go. It's readily obtainable and it's cheap. Mine was $5.95 at Radio Shack. In *HSN #26* the primary taps are already calculated, but you should check the transformer yourself with an ohmmeter. I was suprised at the values I got. The 10 watt tap was 500 ohms, 5 watt was 625 ohms, 1.25 watt was 1200 and 0.62 watt tap was 4000 ohms ... of course the 5 watt tap worked great. This particular transformer was made in China. Is the quality this far off? While I was at Radio Shack I noticed they had a speaker & enclosure on sale for $16.95. It has a 5 inch, full response speaker, valnut simulated case. It measures 8 x 10, 4 inches deep, catalog #40-914. The back is removable which sometimes is not the case on stereo speakers. I put the transformer and a toggle switch in line so I can turn the speaker off when using headphones. Needless to say, without a doubt this is the best sounding speaker setup I have ever heard on shortwave. Music on medium wave and short wave is fantastic. All this for $24."

TUBE LIFE EXTENSION - Charles Harrison of Lincoln, RI suggests that to conserve old components, refrain from shocking them with line voltage. His R-390A and other hollow state receivers are run through a variable transformer (Variac) enabling line voltage to be increased slowly. Radios are warmed as gently as you please depending on their age and length of time they have been operative.

WANTED TO BUY / SELL / TRADE / WHATEVER

This section is reserved for HSN subscribers in good standing (i.e., you're paid up according to Ralph) looking to connect with HSN readers for mutual benefit. All deals are between individuals; HSN doe not evaluate the accuracy of any statements or claims herein. No 'business' ads, please. Items printed will be on the basis of available space.

CORRESPONDENCE FROM CHILE - *HSN* has received correspondence from a Thomas McManus in Conception, Chile. A self-professed "lover of Collins tube receivers" (he has a 51S-1), he also is looking for an R-390A to purchase for DXing the USA BCB. He states he has a copy of the R-390A Army Technical Manual but wants copies of all the technical corrections. If you can help, write to him at Ainavillo 678, Conception, Chile.

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HOLLOW STATE NEWSLETTER

"For lovers of vacuum tube radios"

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<u>SUBSCRIPTIONS</u>: $5 for 4 issues (3 issues published per year).
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<u>INDEX</u>: Issues 1 through 30 (8 pages - topics by Issue/Page number) - $1.00
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HSN is produced and published by and for the community of those who appreciate the fine accomplishments of the manufacturers of 'top of the line' vacuum tube communication radios and auxiliary equipment. Originally created by a group of R-390 users, *HSN* has expanded to include industrial, military and consumer grade receivers by Collins, Hammarlund, National, Hallicrafters and others. *HSN* includes tips, modifications, alignment and restoration advice, product reviews, parts, tubes and service sources, and subscriber buy/sell information - all provided by subscribers and friends of *HSN*.

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CONTENTS

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EDITOR'S AND PUBLISHER'S CORNER

It's now the heat of a Pacific Northwest summer (mid 80's) and it's hard to force myself to sit at the computer and create this volume. Summer has been a busy time for me - catching up on a ton of yard work as well as straightening up the old shack for another season (it's BCB DXing that initially got me into this!). A couple of short items: In *HSN #32*, the Short Subject "Pot Problems" article mentions a Russell Scott - it's Scotka. The phone number for NTIS in #31 should be 1-800-553-NTIS. Publisher Ralph has also asked me to clarify the ID number related to renewals. At the beginning of your address label there is a number. This number is the volume number through which you are paid up. On this issue, if your number is 33 (or lower), it's time to renew. Also note that we have reduced the cost down to 4 issues for $5.00, even tho we publish only 3 per year. I would also like to express my appreciation to the many subscribers who have responded to my request for articles and short subjects - sorry I didn't have room for all of them. Your participation is essential!

Please note that the number at the top of your mailing label is the number of the issue for which you are paid up. When that number is the same as the issue number, please renew.

FEATURE ARTICLES

Walter has been working with R390A's for a long time. Many readers have asked about the contract/order numbers so he has graciously provided the latest 'genesis' of the R390A series, some of which was published earlier in Electric Radio....

CONTRACT/ORDER NUMBERS - R390A

Walter M. Chambers, PO Box 241371, Memphis, TN 38124-1371

Over the last 20+ years I have had about 120 R390A's pass through my hands and I began to make notes on the name plate data after I noticed so many different manufacturers. Maybe I can help clear up the order number confusion.

The name plates almost always list the "order number". Most of these order numbers were taken from the name plates of receivers that I have owned or worked on. The following is my reconstruction of the orders:

YEAR	MANUFACTURER	ORDER NUMBER
1954	Collins	14214-PH-51
1954	Motorola	363-PH-54
1954	Collins	375-PH-54
1955	Collins	08719-PH-55
1956	Motorola	14-PH-56
1958	Motorola	14385-PH-58
1959	Stewart-Warner	42428-PC-59
1960	Stewart-Warner	20139-PC-60-A1-51
1960	Electronic Assistance Corp.	23137-PC-60
1961	Capehart Corp.	21582-PC-61
1962	Amelco, Inc.	35064-PC-62
1963	Teledyne/Imperial	37856-PC-63

YEAR	MANUFACTURER	ORDER NUMBER
1963	Stewart-Warner	DA-36-039-SC-81547
1966	Communication Systems	FR-11-022-C-4-26418 (E)
1967	Electronic Assistance Corp.	FR-36-039-N-6-00189 (E)

I also have another number for Stewart-Warner that I cannot verify: DA-36-039-SC-2-48984. I did not list Clavier DAAG05-67-C-0016 because all I have is a brand new crystal deck (this may have been a spare parts contract like order number DAAB-07-77-C-0116 for BFO's, PTO's, etc.). In the case of the 1967 Electronic Assistance Corp., there is a different "contract" - DAAB05-67-C0155. This tells us it was for the Navy in 1967. Likewise, the 1963 Stewart-Warner number is an order number for the Signal Corp. I am not absolutely sure about the 1966 Communication Systems order as all I have of this set are two I.F. decks, an unfinished R.F. deck, two crystal oscillator decks and a Veeder Root counter manufactured for Communications Systems.

I believe some of the first R390A models were made on the 1951 Collins order 14214-PH-51 (I have R390A serial number 105 built on this order number and the internal parts are code dated Nov. 1955). According to Collins reports, they delivered prototypes of the R390A to the Signal Corps in Feb. and March of 1955. Production of the R390A started in 1955, but they made the first R390A on order number 14214-PH-51. (They also made the R389, R390, and R391 on the same purchase order number. Do not confuse this number with the very similar 11424-PH-51-53 which was for the R391 only - notice the same digits in a different order)

It was Signal Corps policy to order 5,000 each on the receiver contracts at that time. So far as I know, all of the contracts that I have listed were for 5,000 units except for the first order (14214-PH-51) which produced probably only 3 or 4 hundred, and the last Electronic Assistance Corp contract which was for 10,000 units. There were about 70,000 R390A's made. A lot of them were left in Viet Nam, a lot were sold in Japan and Germany; maybe half of the total production.

I would appreciate hearing from readers who may have additional or different information than that shown.

****

Subscriber Walter Opdycke of Ypsilanti MI brings us an interesting alternative for SSB converters...

TECHNICAL MATERIAL CORPORATION'S RECEIVING MODE SELECTOR MSR-9 (CV-1758/URR)

Walter N. Opdycke

There has been great interest in past issues of **HSN** about the inadequacies of the R-390A in SSB reception. Commercial converters such as the Hammarlund HN-10, government converters such as the CV-158 and the CV-1982 and conversion modifications have all been discussed in past issues.

One converter which has never been mentioned is the TMC MSR-9 (CV-1758/URR). This converter when hooked up to the R-390A or similar receiver, can give improved reception of CW, MCW, FSK, and SSB signals. It does this through the use of a special IF filter unit and a frequency bandspread oscillator (i.e., a product detector). It is sideband selectable and for superior stability a crystal oscillator can be switched in. It uses 12 tubes of common types such as the 12AX7 and 6BE6. It fits a standard 19" rack with 5.25" of panel space and weighs about 24 lbs. The construction layout and manual are all typically military in appearance.

Compared with the CV-158, it has many advantages. It is lighter by about 100 lbs. It takes up much less rack space - the CV-158 is larger than the R-390 itself. It uses less tubes and is less complex. The design is about 10 years newer as well - the MSR-9 was designed around 1963. Compared with the CV-1982, it is not quite as sophisticated but comes in the same size package and weight. The surplus MSR-9 is superior to the CV-11982 in that it uses common (i.e. cheap) tubes as opposed to expensive and hard to get nuvistors. These nuvistors can cost up to $30 while the most expensive tube on the MSR-9 is under $10.

I bought an example of the MSR-9 last summer just to see if it really helped SSB reception. It did. SSB signals were much cleaner and less distorted. The improvement was not tremendous but noticeable. The AGC worked well. The controls on the MSR-9 give one a lot of options for receiving.

I am not all that impressed overall, however. This is because the MSR-9 displayed the following drawbacks:

1. The audio response was generally degraded especially on AM signals. The output was a prodigious 2 watts but to me it sounded like the sound was coming out the end of a cardboard tube. True, the SSB signals sounded a touch better but since I primarily listen to AM, the cost outweighed the benefits.

2. Tuning was tedious if you are using the phenomenal mechanical IF filters of the R-390A. It seem like you are constantly twiddling knobs to get the best reception. You can put the R-390A selectivity on 8 or 16 KHz and use the MSR-90 filters (the details of which are not given in the manual) and tuning is fairly easy. However, I prefer to use the superior Collins filters.

3. While the R-390A in tandem with the MSR-9 gives you more flexibility, it is also quite a complex system.

4. My biggest problem with this or any of the other SSB surplus converters is that once hooked up, the R-390A is brain dead after the third IF. I just can't stand to think of all those well designed circuits doing nothing by generating heat.

For most people using the R-390A for AM signals with an occasional tour of the ham bands, the R-390A is fine by itself and needs no modification. Use MGC and vary the RF control for best results. If you listen to a lot of SSB then consider doing the R-390A AGC and BFO Modification described by Dallas Lankford in volume 27 of **HSN**. It is simple, elegant and doesn't make a Zombie of half your radio. If you listen almost exclusively to SSB or other alphabet soup-type signals, then one of the surplus converters might be worth it. If that is the case, the MSR-9 is a good choice.

****

QUESTIONS AND ANSWERS FROM OUR READERS

This section will present questions from subscribers for which responses are solicited. If you can help in providing answers, suggestions or just plain good advice - please send them to the editor for inclusion in the next issue of HSN.

??? Does anyone know how to adjust the small trimmer capacitors that are part of the antenna primary tuned circuits of the R-390A? (T201 & T204) These capacitors are mentioned briefly in the technical manual but no information regarding adjustment can be found there. [Gerald Murphy]

??? Is there any published information on the alignment procedure for the Cosmos VFO's with the 3 separate sub-miniature alignment screws? It seems that the center screw is the end-point adjuster, while the other two appear to be linearity adjustments to correct tracking errors over the 1 MHz range of the VFO. [Neil Clyne]

??? Para 73, p 114 of the Army 390A service manual describes the procedure for setting R519, the preset IF gain control in the cathode of the 3rd IF amp, to provide -7 VDC 2nd detector output for an unmodulated input of 150 μV into J513 at 455 KHz. According to figure 60 of the manual, the resistance to ground from the cathode pin of V503 under these conditions is stated to be 300Ω, which infers that the preset resistance of R519 is 200Ω. In practice, I have noticed that the preset resistance of R519 falls into the range of either 300-500Ω or 2k-3kΩ, which must affect the gain of this stage substantially; although I have not checked this out myself, I wonder if these 2 different gain positions correspond to stagger-tuning or fixed-tuning of the IF amp? Any ideas, anyone? [Neil Clyne]

Ans. Some more followup on the 6DC6 RF amp tube substitution (see #31): Gerald Murphy [Scottsville NY] sent me a copy of page 22 of a Collins engineering report which goes into great detail on the reasons for selecting the 6DC6 as well as other 'front end' tubes. In short, the 6DC6 (closely followed by the 6BZ6) provides the best combination of low noise, adequate gain, low cross modulation and good AGC control. Neil Clyne [Middlesex UK] also notes that the cathode and g3 pins on the 5749 are reversed from the 6DC6. The result in the cathode is grounded leaving the original cathode bias resistor and RF gain control attached to g3. Undoubtably there will be plenty of gain but a far greater tendency to cross-modulate and other problems

Ans. As a followup to the 'what good are SSB converters' (see #31), John O'Sullivan [Queensland, Australia) writes "...from my experience with the CV157, it is an excellent tool in cases of poor reception conditions. With AM reception one can switch from USB to LSB in cases of adjacent channel interference. With its own independent carrier, all kinds of fading are under better control, and the audio is far better than that of the R390A. Any drift in transmitter or receiver is taken up by the automatic frequency control. All in all it's a good addition to the shack if you don't mind the weight (100 lbs - I've got it mounted in a cabinet on big casters). Certain adjustments have to be made if you want to use another R390 - this takes time; also the fan is a bit noisy." Neil Clyne [Middlesex, UK] adds his observations: "My own feeling is that unless you're a masochist, there is little advantage to be gained by using an external converter - particularly if your set contains the AGC/BFO mods described in *HSN #27* which in my experience make the R390A very user-friendly on SSB. Best use for the CV157 is an emergency shack heater; it would also be better than most other things I have here for holding the shack door closed in a gale!" *[I'm sure that this won't be the end of the issue - ed.]*

SHORT SUBJECTS

POT PROBLEMS - CONTINUED - As a followup on the pot situation, the current Newark catalog shows Clarostat peddling Allen-Bradley type J pots, but now, of course, under the Clarostat brand and for triple the price I previously paid in the mid 1980's, namely $22.72 each in small quantities. They have a $25 minimum order. Credit cards are accepted. Orders are supposed to be placed through local branches and there are dozens of them. I'll list a Dallas TX number (actually Richardson TX), 214-235-1998, and they can give you a regional number if they won't fill your order. There are no 800 phone numbers. The pots you want for the R-390A are the 2500 ohm (two) and 5000 ohm (one) values:

	Newark Cat #	Type	Mil #	Unit Price
2500 ohm	10F464	JA1N056S252UA	RV4NAYSD252A	$22.72
5000 ohm	10F466	JA1N056S502UA	RV4NAYSD502A	$22.72

To test for worn pots (and I can guarantee yours will be worn unless they have been replaced) connect an ohmmeter across the outer lugs of the line gain control: the reading should be about 1250 ohms ($\pm$ 20%) for new/good pots (If you connect one lead of the ohmmeter to the center lug, which is the wiper, then the meter reading will depend on the local gain control setting.) The local and line gain controls are wired in parallel, so the resistance you measure is approximately half the two resistances of the two pots. The two pots have worn unevenly, so this is really not a good test for determining worn pots. If the resistance measurement is above 2000 ohms, you probably have at least one badly worn pot, and both should be replaced. For the RF gain control, set the control to zero (minimum gain) and measure the resistance across the outer lugs: it should be 5000 ohms ($\pm$ 20%). A measurement of 10,000 ohms would be an indication of a badly worn RF gain control. (The center lug, wiper, is wired to one of the outer lugs, so you have to set the control to zero to measure the full resistance. Other settings of the RF gain control will give other resistances between minimum and maximum resistance.)

I'll write a short note later about replacing these pots. If you are not very skilled at overhauling and repairing R-390A's, don't even try this! Find someone who does first-class repair work to do it for you. [Dallas Lankford]

R-390A GOES 'POP-POP-POP...'? A mysterious popping sound in the audio - I worked on this problem longer than I would like to admit. I had heard similar pop-pop-pop before. In the past it was always a tube in the RF path, maybe the RF amp, a mixer, or even an IF amp or detector tube. My usual approach, replacing tubes (first, one at a time, and then replacing all detector, IF amp, mixer, and RF amp tubes), failed. So it must not be a tube, I thought. I disconnected P213 and P218, i.e., disconnected the RF deck, and injected a 455 KHz signal at J518. No more pop-pop-pop... was heard. The problem must be in the RF deck, I thought, so I removed that RF deck and put in another - no change. Two bad RF decks??? Unlikely, but I couldn't think of anything else. Oh well, the popping wasn't very noticeable and you could hardly hear it with an antenna connected, so I forgot about it for a couple of months until I was measuring reciprocal mixing. There again was the pop-pop-pop... Quite noticeable with the R-390A tuned about 50 KHz away from a strong signal generator signal. All the RF deck tubes were replaced again, but the popping remained. What was it? I thought about it almost every day. A bad silver mica capacitor?

Unlikely, because two RF decks has the pop. Finally, it occurred to me that the popping could be coming in on the plate or screen DC voltage at the RF amp or one of the mixer tubes, and that the popping could be due to arcing in the OA2 regulator tube or one of the 26Z5W rectifier tubes. I replaced the OA2 first and the popping went away. After several 'quiet' hours, I put the old OA2 back in ... and the pop-pop-pop returned. Case closed! [Dallas Lankford]

R-390 POWER CONNECTORS - AC line power connectors for the R-390 (not the R-390A!) are available from Fair Radio Sales as Cable CX-2583 for $7.50. This cable's original application was for the T-195/GRC-19 transmitter, so you have to remove the heavy gauge cable from the connector and solder your own line cord in. Unlike the elusive connector for the R-392, the R-390 power connectors are a four-pin female early GRC/VRC style common to a number of other military radio and electronic items of the Korean War era. [Geoff Fors]

HAMMARLUND SUPER-PRO VARIATIONS - The original Super-Pro was designated the "COMET" PRO and was produced in many variations from 1932 until 1935. The "COMET" prefix was then dropped and the SP-10 Super-Pro was introduced. The SP-10 was produced from 1936; following the SP-10 were the SP-110 and variations. The SP-110 then evolved into the SP-150, SP-210-X, SX, LX, etc. The WW2 versions were the BC-779 (SP-200) and many others. In 1946 the SPC-400X was introduced in several versions for the military and amateur markets. In 1950 the ULTIMATE SUPER-PRO was announced, the famous SP-600 and its many variations which would take too much time and space to list. One notable model was the SP-600JX-21A which had a product detector, separate usb, lsb, cw and am switch, 22 tubes vs. 20 in all other SP-600's. The SP-600 continued to be sold until 1973. I have in my possession a September 1953 issue of *Radio & Television News* which shows a picture of the 10,000th SP-600 coming off the end of the production line. In those "wide open" days of defense spending, the Signal Corps and US Navy routinely ordered 10,000 receivers at a time. It's quite possible that more than 50,000 SP-600's were produced. [Les Locklear]

R-390A LOCAL/LINE AUDIO USAGE - The local audio output (local gain control) is rated at 500 mw output into 600 ohms and provides output to the headphone jack on the front panel. I had been using the local audio to drive my speaker with a matching transformer. Unfortunately, the headphone jack does not open up the speaker when the phones are plugged in. To remedy this I decided to put the speaker on the line audio output (line gain control) and use the local audio just for the headphones. The line audio output is only 10 mw, not enough to drive a speaker very well. The R390A schematic shows that the only significant difference between the two channels is a 14 db attenuator on the line audio output. By merely snipping one end of R113 in the attenuator circuit, located on the resistor board near the top of the front panel, full output is available to drive a speaker. Now either channel can drive a speaker. This mod makes the line level meter reading erroneous but this should not be a problem for most users. [Fred Cunningham]

PUBLICATIONS OF INTEREST

"ELECTRIC RADIO" - Another fine publication for vacuum tube radio enthusiasts is the monthly magazine **Electric Radio**. To quote, "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." The main thrust is vintage AM ham gear but the extensive classified ads section is a real delight! If you're looking to buy/sell or swap parts, equipment, manuals, etc for hollow state gear, you owe yourself a subscription (and you get a free, 25-work ad once a month, too!). Recently increased annual rates for this 50-odd page treasure are: US-2nd class, $28; US-1st class; $38; Canada; $39 U.S. and overseas; $70 U.S. Information requests and subscriptions to ER, P.O.Box 57, Hesperus, CO 81326 or phone/fax (303) 247-4935.

"FINE TUNING" - For the dedicated SWLer, there is probably no finer set of reference material than the series of **Fine Tuning Proceedings**. For hollow state receiver fans, this compendium contain lots of stuff of interest including receiver reviews (R-390A, HQ-150, HQ-180A, 51-J4, Racal RA-17) and bits of history such a pieces on the evolution of the Halli S-38's, the SX38 and the National HRO's. Also lots on antennas, antenna tuners, audio filters, PLL and synchronous detectors, tape recorders, filters, etc. for the serious SWLer. These 'Proceedings' were published annually from 1988 thru 1991 and now biennially (I expect to see the 93-94 issue soon). So....if you use that hollow state receiver for more than a paperweight, you might find these useful. Each issue has been priced at $19.95 + $2 shipping (US) but, like everything else, costs could be rising. For information (and back issue availability) write Fine Tuning Special Publications, c/o John Bryant, RRT #5 Box 14, Stillwater, OK 74074.

"COMMUNICATION RECEIVERS - THE VACUUM TUBE ERA: 50 GLORIOUS YEARS" - Raymond Moore has recently released the Third Edition of this fine compendium of vacuum tube receivers. Changes from the popular Second Edition include better photos, more military sets, and an expanded history section. A very fine, 125-page book. If you are a collector or roam the hamfests, this should be in your library! Several publications are advertising this book - one I know for sure is thru "Electric Radio" (see above for address) for $19.95 plus $3 shipping (CO residents add sales tax).

CATALOGS - The latest **Fair Radio** catalog (WS-94) is out with it's usual huge variety of surplus gear including, of course, R-390's, R-390A's, and R-392's as well as replacement assemblies and parts. Fair Radio Sales Co., PO Box 1105, Lima OH 45802 or call 419-223-2196/227-6573. Another interesting new and surplus parts supplier is **All Electronics**. Prices are reasonable and service is good. Order a free catalog by writing All Electronics, PO Box 567, Van Nuys CA 91408-1567 or call 818-904-0524.

WANTED TO BUY / SELL / TRADE / WHATEVER

This section is reserved for HSN subscribers in good standing (i.e., you're paid up according to Ralph) looking to connect with HSN readers for mutual benefit. All deals are between individuals; HSN doe not evaluate the accuracy of any statements or claims herein. No 'business' ads, please. Items printed will be on the basis of available space.

WANTED - Source for the plug-in electrolytic capacitors for the R-390A; Airborn wideband VHF/UHF panoramic receivers of ARR8-A or -B series made by Dynamic Electronics NY (R355/6/7/8,R553). [Neil Clyne, 78 Halford Road, Ickenham, Uxbridge, Middlesex UB10 8QA, UK]

WANTED - HP606B RF Generator for $100. [John O'Sullivan, 32 Hawthorn Grove, Marcus Beach, Queensland 4573, Australia]

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HOLLOW STATE NEWSLETTER

"For lovers of vacuum tube radios"

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HSN is produced and published by and for the community of those who appreciate the fine accomplishments of the manufacturers of 'top of the line' vacuum tube communication radios and auxiliary equipment. Originally created by a group of R-390 users, *HSN* has expanded to include industrial, military and consumer grade receivers by Collins, Hammarlund, National, Hallicrafters and others. *HSN* includes tips, modifications, alignment and restoration advice, product reviews, parts, tubes and service sources, and subscriber buy/sell information - all provided by subscribers and friends of *HSN*. All articles and information shared through this newsletter may be reprinted only with permission of the author.

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CONTENTS

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EDITOR'S AND PUBLISHER'S CORNER

#33 has been issued but has not appeared to generate much in the way of enthusiastic new articles or commentary. I still have a fair supply of material - some new, some old - but I am hoping to get some comprehensive, technical stuff from you veterans of the hollow state era, especially regarding overhauling and major renovations. As the age of the hollow state equipment increases so does the age of those who grew up with them. Please consider sharing your knowledge with our subscribers... and if you know someone who just might become a contributor, share your *HSN's* with him (or her).

Like many other seasoned R-390A owners, Mr. Taylor has been around these beloved units many years and currently works for the VOA in North Carolina. He has graciously granted reprinting permission for this updated article which was originally made available thru the International Radio Club of America and the National Radio Club, both MWDX publications....

R-390A ALIGNMENT CHART & OPTIMIZATION

Charles A. Taylor

(Reprinted courtesy of the author)

(excluding 455 KHz, fixed-frequency IF)

1. Initial Setup - Set all front-panel controls as follows:
   - A. FUNCTION switch : CAL
   - B. BREAK IN switch : X
   - C. LIMITER control : OFF
   - D. AGC switch : FAST
   - E. ANT TRIM : "0"
   - F. LINE GAIN : CCW
   - G. AUDIO RESPONSE : WIDE
   - H. BFO PITCH : "0"
   - I. BANDWIDTH KC : 8
   - J. BFO ON/OFF switch : OFF
   - K. LOCAL GAIN : CCW
   - L. DIAL LOCK : CCW
   - M. ZERO ADJ. : CCW
   - N. RF GAIN : CW
   - O. MEGACYCLE CHANGE: X
   - P. KILOCYCLE CHANGE: X

   X = irrelevant; CCW = counter clockwise

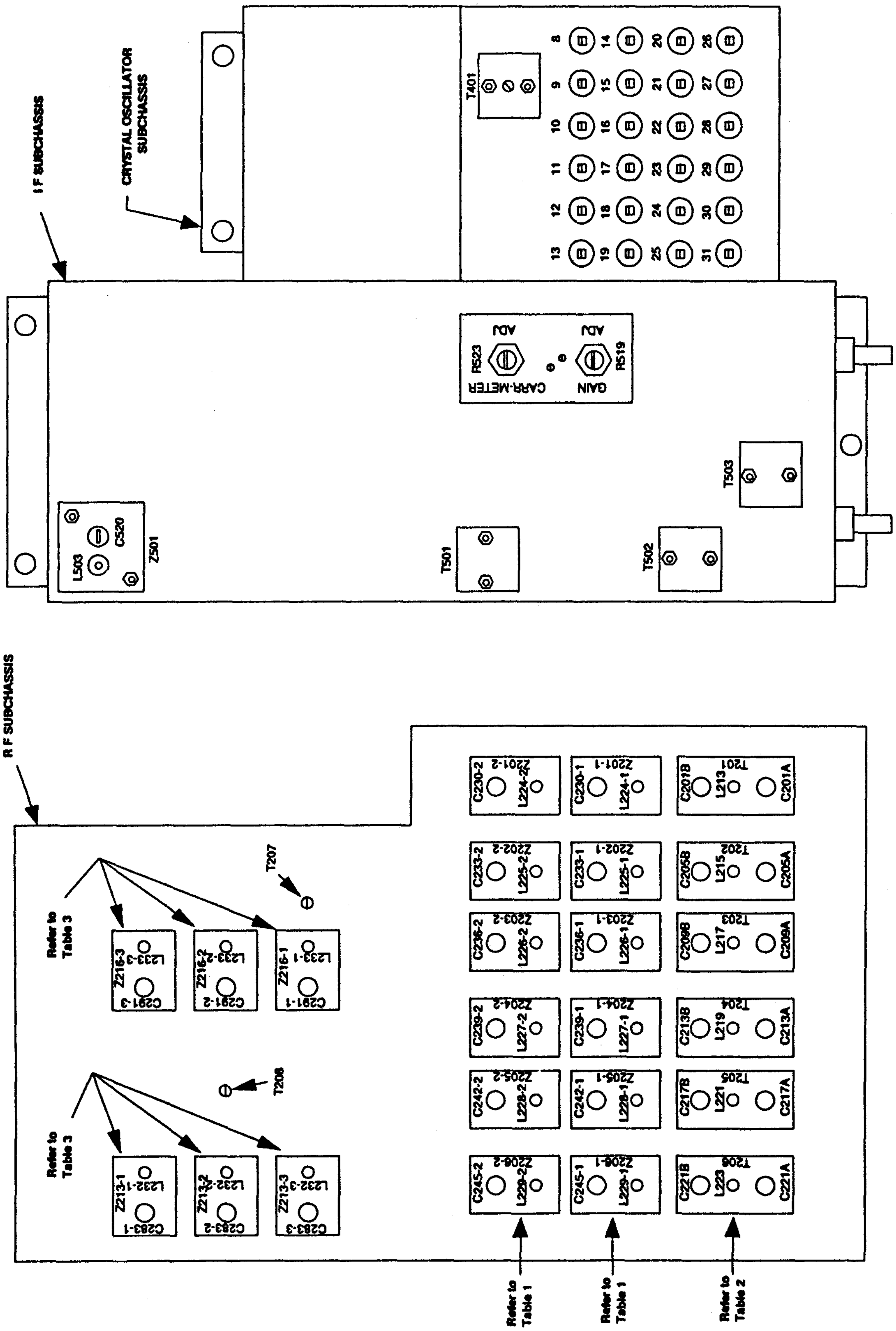
2. Allow about 30 minutes warmup before proceeding. *A small, insulated screwdriver and the appropriate Bristol wrench will be necessary.*

3. Set receiver in turn to each frequency specified below, in column A of Table 1. Adjust the corresponding inductors (L-) specified in column B of Table 1, and then the corresponding trimmer capacitors (C-) specified in column C of Table 1. Rock the KILOCYCLE CHANGE back and forth for a maximum indication on each frequency on the CARRIER LEVEL meter. Refer to Chart 1 for the location of adjustments *(Charts 1 and 2 are on page 3).*

Table 1

A (khZ)	B	C
600	L224-1 L224-2	
900		C230-1 C230-2
1100	L225-1 L225-2	
1900		C233-1 C233-2
2200	L226-1 L226-2	
3800		C236-1 C236-2

A (khZ)	B	C
4400	L227-1 L227-2	
7600		C239-1 C239-2
8800	L228-1 L228-2	
15200		C242-1 C242-2
17600	L229-1 L229-2	
30400		C245-1 C245-2



Charts 1 & 2 - Adjustment Points on RF and IF Subchassis/Crystal Oscillator

4. Set the receiver FUNCTION switch to AGC. Assure that the regularly used antenna is connected to the receiver input.

5. Received signals are used to make the following alignment. Reception of a relatively stable-intensity signal is indicated for alignment, so it may be necessary to seek such a signal at a frequency slightly at variance with those specified in the following Table 2, however, the alternate chosen frequency should not differ from the specified frequency by more than 10%. When aligning on alternate frequencies, chose a HIGHER alternate frequency when aligning inductors (L-), and choose a LOWER alternate frequency when aligning capacitors (C-).

   NOTE: A signal generator may be used to good effect in the following alignment. Do not make a direct connection from the signal generator to the antenna wire. Using a few feet of wire connected directly to the generator's output, radiate a signal at the frequencies specified in the following Table 2 to the receiving antenna. Use the least output from the generator that just produces a usable indication on the CARRIER LEVEL meter. Note that Table 1 adjustments may be "touched up" (as may all following adjustments in all tables) using the radiated signal from the generator.

Table 2

A (khZ)	B	C
600	L213	
900		C201B
1100	L215	
1900		C205B
2200	L217	
3800		C209B

A (khZ)	B	C
4400	L219	
7600		C213B
8800	L221	
15200		C217B
17600	L223	
30400		C221B

6. Set the receiver FUNCTION switch to CAL, the align the inductors and capacitors specified in Table 3.

Table 3

A (khZ)	B	C
1300	L232-1 L232-2 L232-3	
7300		C283-1 C283-2 C283-3

A (khZ)	B	C
1900	L233-1 L233-2 L233-3	
1100		C291-1 C291-2 C291-3

7. Set the receiver KILOCYCLE CHANGE to any 100 KHz calibration point between 500 KHz and 7900 KHz, and align the following adjustments: **T207** and **T208**.

8. Referring to Chart 2, set the receiver KILOCYCLE CHANGE and MEGACYCLE CHANGE controls for a dial reading of 8100 KHz, and adjust the trimmer labeled "8" on the Crystal Oscillator subchassis for a peak indication on the CARRIER LEVEL meter. Next, tune the receiver to 9100

KHz, and likewise adjust the trimmer labeled "9". Then, tune the receiver to 10100 KHz and adjust the trimmer labeled "10". Continue this to 31100 KHz for the trimmer labeled "30". Note that the trimmer labeled "17" also aligns the 00 MHz band, the trimmer labeled "16" also aligns the 01 MHz band, and so on. Therefore, those bands are aligned in the above procedure.

9. Rotate the RF GAIN control fully CCW. Loosen the locking nut on the CARR-METER adjustment potentiometer, R532, on the IF subchassis. Using a flat-blade screwdriver, rock R532 back and forth across its present setting about ten times. This is to clear the pot of noise and dirt. Then, carefully reset this pot such that the CARRIER METER comes to rest on zero. This will probably require several tries.

NOTES:
R519 (GAIN ADJ) on the IF subchassis is not critical to adjust, and generally only needs to be readjusted when the set is retubed. An approximately correct setting can be made thusly: (set up)

A. FUNCTION switch : AGC
B. BREAK IN switch : X
C. LIMITER control : OFF
D. AGC switch : X
E. ANT TRIM : X
F. LINE GAIN : fully CW
G. AUDIO RESPONSE : WIDE
H. BFO PITCH : X
I. BANDWIDTH KC : 8
J. BFO ON/OFF switch : OFF
K. LOCAL GAIN : CCW
L. DIAL LOCK : CCW
M. ZERO ADJ. : CCW
N. RF GAIN : CW
O. MEGACYCLE CHANGE: 05
P. KILOCYCLE CHANGE: 500
Q. LINE METER switch: -10
R. DISCONNECT ALL ANTENNAS
X = irrelevant

With all controls thusly set, adjust the ANT TRIM control for a peak reading on the LINE LEVEL meter. What is being registered at this stage is "front end" noise of the set. The reading should be no less than "VU" on the -10 to VU scale of the LINE LEVEL meter (note that "VU" is to the right - upscale - of the physical center of the meter scale). It should also be no more than "VU" on the LINE LEVEL meter with the LINE METER set to "0". R519 (GAIN ADJ) may be varied to bring the indication within this range. BEFORE varying the setting of R519, however, carefully SCRIBE A MARK ON THE POT TO INDICATE PRESENT POT SETTING! The pot can then be returned to its former position.

If you are unable to attain a "VU" reading on the LINE LEVEL meter with the LINE METER set to -10, and after adjusting R519, this probably indicates a need to retube the receiver. Note, however, that if the set has been functioning normally otherwise, don't be quick to test tubes. Refer the set to someone who has some experience on these rigs.

Depending on the characteristics of your longwire antenna, once your R-390A is optimized for that antenna, you may find that the set "front end" does not resonate exactly for such as an amplified loop. This is evidenced by the lack of a sharp, well-defined peak in signal and noise level when the ANT TRIM control is rotated. Since most amplified loops are tuned, and possess considerable "Q", this shouldn't be a problem (as far as cross-modulation is concerned). It is therefore advantageous to optimize your R-390A for the antenna that will be most likely to induce cross-modulation in your set.

QUESTIONS AND ANSWERS FROM OUR READERS

This section will present questions from subscribers for which responses are solicited. If you can help in providing answers, suggestions or just plain good advice - please send them to the editor for inclusion in the next issue of HSN.

??? Regarding the URM-25 signal generator - were there A, B or C models? How many contractors made D models, other than Trad Television? My URM-25F was made by New London Instrument Co. and is a total redesign. The only code dated component seems to be 1955. Is this right? My J Model, made in 1968, is practically a carbon copy of a D. Why did the Navy abandon the F, which was considerably improved over the previous D model? Because New London was out of business and had lost the tooling? Or was the D really better? [Alan Douglas, Pocasset MA]

??? Why did the US military adopt carbon pots with reverse log tapers for the RF gain control in [R-390A] receivers? (by way of comparison, the British Racal RA17/117 have wirewound linear pots in this position which seem to give little trouble.) [Neil Clyne, Middlesex UK]

??? After performing the AGC/BFO mod on several R-390A's [see HSN #27], I tried it on a R-390. Even after temporarily reinstating the grid leak in the RF stage (corresponding to R201/R234 in the R-390A), the AGC performance did not equal that of the R-390A. I suspect that the AGC bias was possibly excessive but I did not research the problem further and later returned the R-390 AGC system to standard. Has anyone else tried these AGC mods on an R-390? [Neil Clyne, Middlesex UK]

SHORT SUBJECTS

BALKY MODULATION OSCILLATOR IN THE URM-25 - Does your URM-25 modulation oscillator not work at one of the two frequencies? Do you have to kick-start it with the front-panel pot and then back off to an on-scale reading? Does it only work with a really hot 12AU7?

There are two feedback paths working at "cross purposes": negative feedback through the front-panel pot, and positive feedback through a T network. At one magic frequency the positive feedback is supposed to peak and overpower the negative allowing the oscillator to run. But if the two R-C networks in the T aren't exactly alike, it never peaks.

The cure is to pad one network until it's just equal to the other. Since neither frequency in my URM-25J was working, I found it easier to parallel C160 (1000 pf mica) with a 39 pf mica, though trimming the precision resistors would probably have been better (resistors are switch-selected for each frequency, capacitors are the same for both). In any event, slightly reducing the value of one or more T-network components should bring everything back to normal. It would be a good idea to watch the waveform on a scope, and trim for the least distortion, too; it can get pretty bad if you twiddle the wrong component.

Incidently, those pesky black molded paper .1 and .2 mf capacitors were absolutely perfect in my unit, made in 1968. That was not the case in the 1952-vintage model I sometimes use. [Alan Douglas, Pocasset MA]

MORE ON RELAY SUPPLY RECTIFIERS - Back in HSN #24/25, I noted some correspondence regarding replacement of unserviceable or worn-out copper-oxide relay rectifiers CR801 in the R398/390 by silicon bridge units, then fitting a 25 Ω 25W voltage dropper to absorb the excess voltage apparently produced by this new arrangement. One correspondent was having difficulty in finding a suitable resistor. Why not keep things simple? Having met with, or installed silicon bridges in place of the original CR801 in several 390's over the last 3 years, I have yet (touch wood - *an apparent reference to our American 'knock on wood' - editor*), to burn out any relays in these sets despite not having fitted a voltage dropper. The DC produced by this system is pretty rough, with a high AC component, and I would guess that on load, the effective DC voltage available is not much higher than that produced by the original rectifier. [Neil Clyne, Middlesex UK]

IMPEDANCE VS RESISTANCE - A followup to "BETTER AUDIO FROM THE R-390A" (*HSN #32*): Using the 5-watt tap of a 70.7 volt line transformer to match the 600 ohm R-390A audio output impedance is a pretty good match. Actually, the 5-watt tap is also the 1,000 ohm impedance tap which is different from the 625 ohm resistance value. The ohm meter will only measure resistance; as the transformer is essentially a large inductor, the impedance of which is dependent upon the frequency of the applied voltage. As the frequency goes up, the difference between impedance and resistance also increases. Consult a basic electronics book for more details. [courtesy Dallas Lankford]

R-390A WEAK SENSITIVITY ON SOME BANDS - If, after alignment and tube testing, your R-390A still has weak or no sensitivity on some bands, check the applicable crystal on the main crystal oscillator deck under the oven cover. I have found that although a suspected crystal tested good in a crystal tester, it failed to oscillate in the R-390A and knocked the associated band or bands out of commission. Weak sensitivity or no sensitivity on bands below 8 mHz is often caused by a faulty crystal located in the round plug-in oven which also houses the calibration crystal. That crystal is only used for the bands below 8 mHz, so everything above that will be normal. Substitution with a known good crystal seems to be the only reliable test. Finally, if the crystal oscillator subchassis has every been removed, don't rely on the megacycle numbers which show through the hole on top to tell you what position the switch is set to. Make sure the wafer switch wiper is directly aligned with the contact fingers for a particular megacycle setting before reinstalling the chassis, and try to avoid any movement of the shaft when reattaching the shaft coupling from the megacycle switch gear train. [Geoff Fors]

NAMEPLATE SCREWS - The small screws which hold the front panel nameplates of the R-390, 390A, 388, 392 and SP-600 military receivers are not likely to be found at your local hardware emporium. I have found that one source of these screws is a defunct 360K floppy disk drive, full height, from an old IBM PC type computer. Most computer repair shops have piles of these old drives, removed due to failure or upgraded with more advanced replacements, and they can usually be had for the asking. Careful disassembly will reveal several of the needed nameplate screws as well as other useful screws, washers, springs, clips and so forth. [Geoff Fors]

AN ALTERNATIVE TO THE UG-970/U CONNECTOR - An alternative to the UG-970/U (which connects an antenna cable with the SO-236 connector to J-104 on the R-390A) makes use of the UG-421. The threads of the PL-258 barrel connector will mate with the UG-421. With a little ingenuity in routing the ground wire, it should work. If you are looking for the UG-421, contributor Paul Tice says write him at 5992 Beverly Hills Road, Coopersburg PA 18036.

<u>AGC TIME CONSTANT CAPACITORS</u> - While currently operating two R-390A's, one with the *HSN #27* AGC/BFO mods and one without, the modified set recently started to produce excessively long release times (over 10 sec. in the 'long' position), while the AGC action itself did not seem very effective. Acting on a hunch I removed P112 from the IF unit and checked across pins 4 and 13 of J512 with a digital capacitance meter. I followed this up with an analog ohmmeter measurement which confirmed my suspicions - C551 (the 2μF time-constant capacitor) was reading less than 500K DC resistance at an applied potential of 9V! As it is well-nigh impossible to physically extract this capacitor from the IF amp without causing damage, I simply snipped off the terminals and left it in situ, replacing it with a 2μF, 250V polycarbonate tied to a nearby cableform. It doesn't look very elegant, but normal AGC operation has been restored. [Neil Clyne]

<u>HAMMARLUND SPC-10 CONVERTER</u> - The SPC-10 converter was specifically designed for use with the SP-600. It can be used with any receiver having an IF output between 450-500 khz. When used with any other receiver, the sidebands become reversed, i.e., USB becomes LSB, etc. The owners manual explains this. I believe the SPC-10 is the best accessory that can be used with the SP-600. The SPC-10 was produced in the mid 1960's. Most of the production was purchased by the military and the FAA. [Les Locklear]

PUBLICATIONS OF INTEREST

<u>"FINE TUNING" - PART 2</u> - In *HSN #33* I indicated that the 93-94 "Proceedings" were expected. Well, it's actually entitled "Proceedings 1994-95" and is now available for $20.50 + $4 shipping in North America - back issues are also available. Good stuff!

WANTED TO BUY / SELL / TRADE / WHATEVER

This section is reserved for HSN subscribers in good standing (i.e., you're paid up according to Ralph) looking to connect with HSN readers for mutual benefit. All deals are between individuals; HSN doe not evaluate the accuracy of any statements or claims herein. No 'business' ads, please. Items printed will be on the basis of available space.

<u>Wanted</u> - Hallicrafters SX-117 and Hammarlund HC-10. Non-workers ok, but must be complete and clean. Shipping to San Diego required. Contact Lloyd Anderson, 19A Tui Glen Rd, Birkenhead, Auckland 10, New Zealand. Ph (64-9)480-5652 or Fax (64-9)415-6683 (call collect OK).

<u>Wanted</u> - Info on a R-649A receiver built by Hallicrafters for the US Coast Guard. Need schematic and alignment info. Leonard Meeks, 2265 Komo Mai Dr., Pearl City HI 96782.

<u>Wanted</u> - Hammarlund HC-10 in good condition. Jon Williams, 5877 Carvel Ave., Indianapolis IN 46220.

<u>Help available</u> - Subscribers who may have WW2 German radios (such as the Telefunken E-52) and are in need of technical information, schematics, etc. are invited to write to Neil Clyne, 78 Halford Road, Ickenham, Uxbridge, Middlesex UB10 8QA, UK.

FLASH - The 3-cent postal increase just announced will not have any effect on the HSN subscription price!

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HOLLOW STATE NEWSLETTER

"For lovers of vacuum tube radios"

Editor
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Spring 1995

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PERRIS CA 92572-1831

SUBSCRIPTIONS: $5 for 4 issues (3 issues published per year).
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HSN is produced and published by and for the community of those who appreciate the fine accomplishments of the manufacturers of 'top of the line' vacuum tube communication radios and auxiliary equipment. Originally created by a group of R-390 users, *HSN* has expanded to include industrial, military and consumer grade receivers by Collins, Hammarlund, National, Hallicrafters and others. *HSN* includes tips, modifications, alignment and restoration advice, product reviews, parts, tubes and service sources, and subscriber buy/sell information - all provided by subscribers and friends of *HSN*.

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CONTENTS

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EDITOR'S AND PUBLISHER'S CORNER

New materials continue to come in - thanks to all of you who have, and continue, to contribute. I still have some good stuff for future issues such as Dallas Lankford's 'Mod 3' for the R-390A mechanical filter bank, an update of the 51J-4 product detector and a switchable AGC article, and a meter option for the R-390A for the non-purist owner. I am also working on updating the *HSN Index* which will incorporate issues 31 thru 35 for distribution later this year. The *HSN* subscriber list and the finance picture both remain healthy; we should have no problems in remaining viable for the foreseeable future.

R-390A FILTER - MOD 2

Dallas Lankford
(1-12-94; rev 1-18-94)

Several things caused me to rethink my R-390A torsion filter mod. *[see HSN 30]* First, I never liked the idea of modifying the RF chassis because any repairs or adjustments to the mod require removal of the RF chassis, a time consuming process. Second, any changes to the mod, such as developing a noise blanker, would be difficult for the same reason. And third, trouble-shooting the RF chassis could require removal of the mod, which, again, would be difficult.

A much better place for adding such filters is at J518 and J513, where the 455 KHz output of the 1st IF transformer (on the RF chassis, following the last mixer) enters the IF chassis (see Figure 1). But when I did the first filter mod, I did not know the output impedance of the 1st IF transformer, so I could not develop suitable impedance matching for filters which might be installed at that point. Subsequently, I read in the Collins R-389/R-390 Engineering Report that the output impedance of the 1st IF transformer was 1000 ohms. Except for the tube differences, the R-390A last mixer, 1st IF transformer, and following crystal filter appeared to be similar to the R-390 circuits. So assuming a 1000 ohm output impedance for the R-390A 1st IF transformer, I developed impedance matching broadband transformers for 2000 ohm source and load filters, implemented my design, and found that it worked as well as my first filter mod. This mod, called mod 2, is shown in Figure 2.

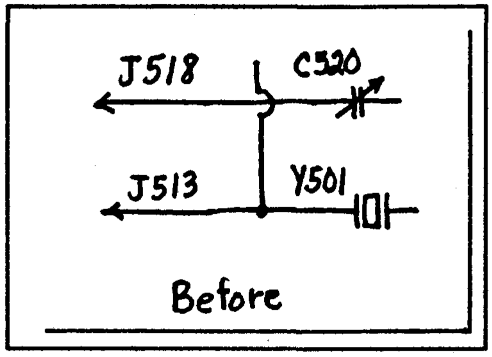

Figure 1

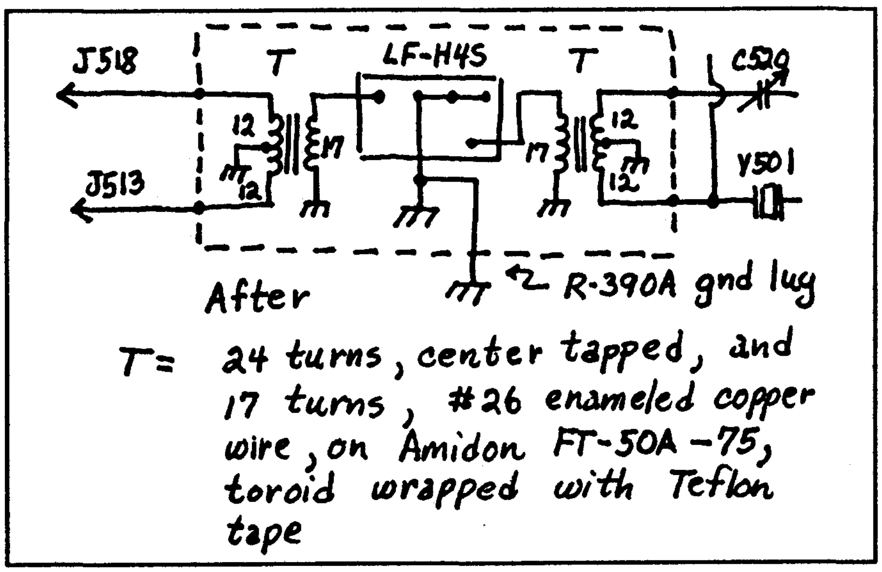

Figure 2

There is not much available space in the crystal filter compartment of the IF chassis, so I decided to use a tiny LF-H4S ceramic filter. The total number of parts required was four: the filter, two broadband matching transformers, and a PC board. Everything fit neatly on the tiny 5/8 by 1-9/16 inch PC board as shown in Figure 3.

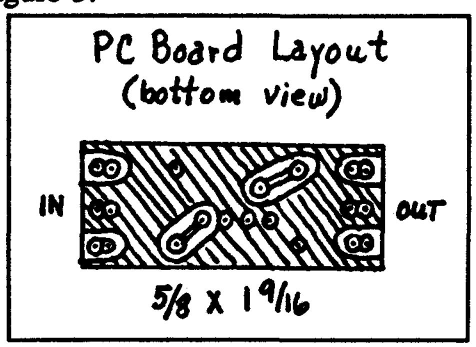

Figure 3

And like the first mod, signal loss was restored by adding a 100 ohm half watt resistor in parallel with R504 to increase the gain of the 1st IF amp (see Figure 4).

As with the first mod, and for the same reasons, close-in (within +/- 100 KHz) dynamic range of the R-390A is improved for non-crystal filter bandwidths, with more improvement as signal spacing becomes closer. For one RF chassis, the 20 KHz spacing ICP3 at 1.6 MHz was improved from -12 dBm to +2 dBm. For another RF chassis, the improvement was even greater, to +10 dBm. Apparently there is considerable variation in the potential ICP3 improvement from one RF chassis to another. A third RF chassis was tested, and the improvement in ICP3 was to +2 dBm. So it seems that +2 dBm is typical of the ICP3 improvement.

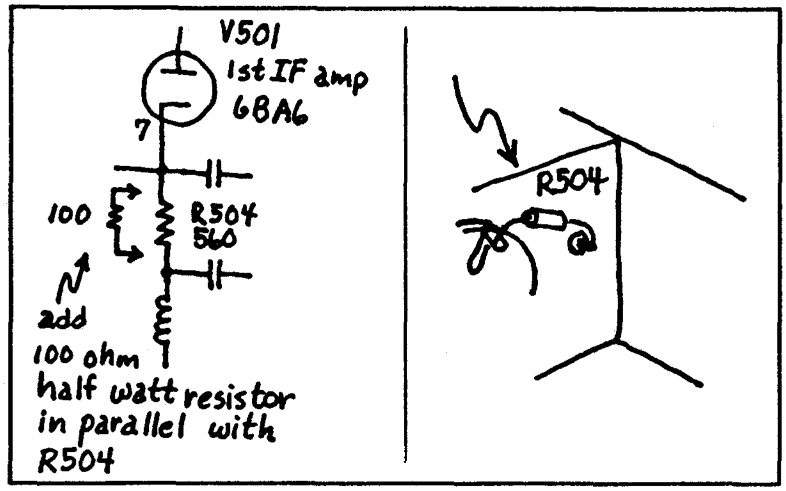

Figure 4

It appears feasible to use a Collins torsion filter for this mod,but a larger PC board, more parts, and a different mounting arrangement would be required. For these reasons, a torsion filter was not used.

The measured attenuation characteristics of a typical LF-H4S ceramic filter are shown in Figure 5. The solid line is for a stand-alone LF-H4S measured in a carefully constructed test fixture with BNC connectors

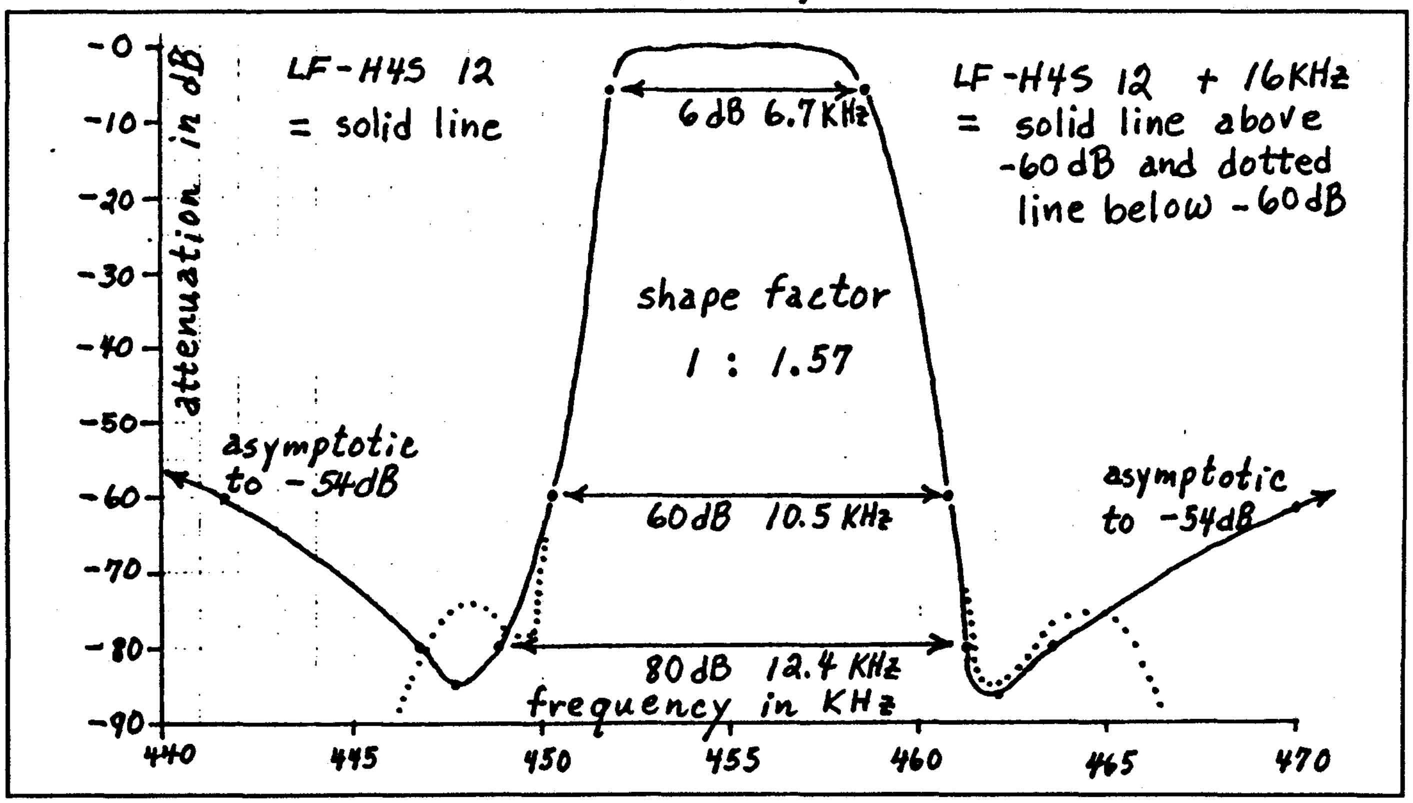

Figure 5

and RF tight input and output chambers. An LF-H4S installed in an R-390A and cascaded with a 16 KHz bandwidth R-390A filter is shown by the dotted continuation below the -60 dB attenuation points. Above -60 dB attenuation there was no difference between the stand-alone LF-H4S and the installed LF-H4S cascaded with the 16 KHz BW R-390A filter. As can be seen, there is remarkably little signal leakage around the installed LF-H4S filter despite the rather long (2.5") leads from the output of the LF-H4S matching transformer to the input of the crystal filter. I had considered using miniature coax in place of these two open wire leads, but these measurements demonstrate that there would be little gained by using miniature coax. My ultimate plan is to remove the 16 KHz BW filter anyway, and to use the 8 KHz BW filter cascaded with the LF-H4S, in which case the humps on each side of the LF-H4S notches will be eliminated by the 8 KHz filter skirts. As can be seen from Figure 5, the stand-alone attenuation of the LF-H4S filter leaves something to be desired below about 447 KHz and above about 462 KHz, namely, the attenuation comes back up from deep notches to about -54 dB. However, when cascaded with other filters, as is done in this R-390A mod, the attenuation characteristics of the LF-H4S below about 450 KHz and about above 460 KHz are of little concern because the following filter takes over. When you use the 8 KHz R-390A BW in combination with the LF-H4S you get an outstanding 6 KHz nominal BW. Gone are the annoying 5 KHz hets which you normally get with the R-390A 8 KHz BW when tuning the SW bands. The 4 KHz and 2 KHz R-390A BWs perform about the same as before. In every way this mod is as good as the previous mod using the 6 KHz Collins torsion mechanical filters. Actually, it is better, because it is simpler to implement, and no alignment is required other than adjusting the R-390A 1st IF transformer for maximum signal with a stable signal tuned to the center of the LF-H4S passband.

The toroids must be mounted upright (as apposed to flat) on the PC board; otherwise the finished PC board will not fit into the available space (see Figure 6). The transformer lead lengths should be kept as short as possible to minimize signal leakage by re-radiation. The 5/8 inch length of the wires from J513 and J518 to the PC board and the 2-11/16 length of the wires from the PC board to the crystal filter are the lengths of the insulation, not counting additional wire length for making the connections to lugs and the PC board. The input wires should be soldered to J513 and J518 first, the PC board slipped onto those two wires and soldered. The input wires are curved into a semicircle so that the bottom of the PC board is directly above J513 and J518. Then the output wires are soldered to the crystal filter lugs, and the remaining connections to the PC board are made.

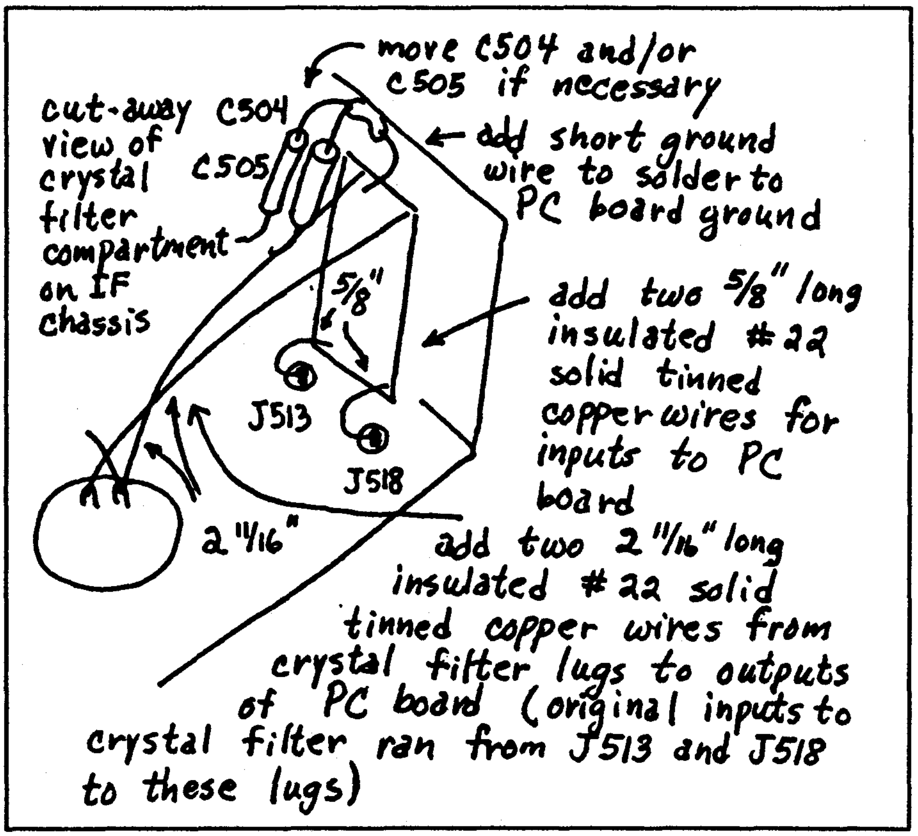

Figure 6

[LH-H4S ceramic filters are available from Kiwa Electronics, Attn: Craig Siegenthaler, 612 S 14th Ave, Yakima WA 98902, (509)-453-5492 for about $15.]

R-390A CONTRACT ORDER - AN UPDATE

Les Locklear
1122 36th St, Gulfport MS 39501-7116
[an earlier version of this article was published in Electric Radio #71]

Last fall a friend purchased an R-390A with the following contract number, N00024-84-C-2027, serial no. 2 manufactured by Fowler Industries for Avondale Shipyards (located west of New Orleans, LA). This R-390A was manufactured in 1984!

After many long distance calls by the owner and myself to Avondale Shipyards, San Diego Shipyards Electronics Repair Facility, Veedor Root Co., Walter Chambers and others the following information was revealed.

Fowler Industries was located in Port Jervis, NY. The R-390A's were built for Avondale Shipyards, which had a cost-plus contract with the US Navy. According to a Veedor Root Co. representative, they shipped the mechanical/digital frequency counters to Fowler Industries in 1983 and 1984. No records exist of how many counters were shipped, so it would be difficult to find out how many R-390A's were built on this contract. The counter assembly is a discontinued item. Fowler Industries is no longer in business. A very heipful technician at the San Diego facility checked his computer listing and said Fowler Industries was previously Clavier Corp.

Wally Chambers said that the US Navy still uses R-390A's aboard ships larger than a frigate, mainly due to the extremely high RF fields which tend to wilt the front ends of solid state receivers. A quick telephone call to the LBTF (Land Based Test Facility) at Ingalls Shipbuilding in Pascagoula, MS confirmed this, as recent construction of the USS Boxer (an LHD) had R-390A's installed.

The 1984 R-390A is identical to other R-390A's, but the mechanical filters were manufactured by a company named Dittmore-Freimuth Corp. They began manufacturing mechanical filters when the Collins patent expired. In 1968, Dittmore-Friemuth also manufactured R-390A's on contract DAAB05-68-C-0040 *[this info courtesy Dennis Gibbs]*.

Via an associate of Wally Chambers comes the absolute latest - in 1960, the US Naval Signal Intelligence Station in Germany received three new R-390A's. Upon uncrating, a most unusual nameplate was noted; they bore the name of the famous ladies cosmetic manufacturer, Helena Rubenstein. As this person had worked on R-390A development at Collins, he got the following story from a friend there: In the late 1950's, Helena Rubenstein became interested in securing lucrative government contracts. At that time, the US Navy was buying R-390A's in small quantities while the Signal Corps was doing the same in larger numbers. Helena Rubenstein successfully bid on an 80-unit US Navy contract. Like the dog who chased the Volkswagen, they went to Collins for assistant and made a deal for Collins to produce the units but to put on the Helena Rubenstein nameplate. As of yet I still don't have any dope on the contract number.

For years I have heard that 13 manufacturerss built R-390A's. However, after adding Fowler, Dittmore-Freimuth and Helena Rubenstein to the list brings the count to 12 different manufacturers.

With the above information, the contract/order number genesis list is as follows:

YEAR	MANUFACTURER	ORDER NUMBER
1954	Collins	14214-PH-51
1954	Motorola	363-PH-54
1954	Collins	375-PH-54
1955	Collins	08719-PH-55
1956	Motorola	14-PH-56
1958	Motorola	14385-PH-58
1959	Stewart-Warner	42428-PC-59
1959 +/-?	Helena Rubenstein [Collins]	** Unknown **
1960	Stewart-Warner	20139-PC-60-A1-51
1960	EAC	23137-PC-60
1961	Capehart Corp.	21582-PC-61
1962	Amelco, Inc.	35064-PC-62
1963	Teledyne/Imperial	37856-PC-63
1963	Stewart Warner	DA-36-039-SC-81547
1966	Communications Systems	FR-11-022-C-4-26418 (E)
1967	Clavier Corp.	DAAG05-67-C-0016
1967	EAC	FR-36-039-N-6-00189 (E)
1968	Dittmore-Freimuth Corp.	DAAB05-68-C-0040
1984	Fowler Industries	N 00024-84-C-2027

There were so many spare contracts let that I wouldn't even try to attempt to list them.

This information should lend come credence to the rumors that have circulated for years that R-390A's were still being manufactured into the 1980's.

This article would not have been possible without the invaluable assistance and information from Wally Chambers who is a "vault" of knowledge on R-390A's, and last, but certainly not least, Victor Hatharasinghe, the proud owner of the "shiny, like new" 1984 R-390A. Had he not purchased this receiver or asked questions, this information may have gone undiscovered.

Anyone who has any additional information, especially on the Helena Rubenstein contract, please feel free to contact me.

One more item: I am expecting information on the availability and details on a **1985** 2-part R-390A manual set. Word is the Naval Publication Center in Arlington VA has, and is selling, this manual which is likely an updated reprinting and possible restructuring of the NAVPERS manual which most of us are familiar with. With post-1967 sets still in use and some additional factory modifications, it was probably provident for the newer manual to be published. The numbers for the two volumes are EE125-AB-OMI-010 and EE125-AB-OPI-010; no prices yet and I don't have the address.

QUESTIONS AND ANSWERS FROM OUR READERS

This section will present questions from subscribers for which responses are solicited. If you can help in providing answers, suggestions or just plain good advice - please send them to the editor for inclusion in the next issue of HSN.

??? Does anyone know how the National Company's serial number system worked; and whether it can be used to date receivers? Also have a restorable SuperPro which has lost its nameplate. Its a table model with dust cover, aluminum front panel w/black crackle finish with the usual 'SuperPro' legend, white 0-5 signal strength meter (not backlit), separate RF, IF and audio gain controls plus tone control, uncalibrated BFO, glass UX-base tubes and a 'bolt-on' crystal filter assembly. Came with an ancient, yellowing schematic plus notes for Models SP-10 and SP20-X. Serial number engraved on chassis is 843. Can anyone identify? [Neil Clyne, Middlesex, UK]

Ans. Although not in the Q/A column, reader Gerald Murphy (Scottsville NY) respondes to the AGC Time Constant Capacitors article (HSN #34, pg 8) - "Please refer to HSN #9, pg 4, for a more sophisticated repair of this problem which preserves all the original component positions and is not difficult to complete". *[Can't disagree with Mr. Murphy on this one - ed.]*

SHORT SUBJECTS

SP-600 SERIAL NUMBERS [from Alan Douglas] This is right up there with trivial pursuits, but I've been curious how many SP-600s were really made, when, and for what purposes. After collecting a few numbers from friends, I find that they are consecutive and they match the code dates on the electrolytics almost perfectly. So it should be possible, by adding more numbers and data, to determine exactly how many SP-600s wre made for which contracts or as civilian models. Any perhaps to figure out what the JX-numbers mean, which is not explained in the manuals or advertising. I would welcome postcards with trhe relevant information, which I'll compile for the next HSN. Or, for an SASE, I can send a current copy of the list.

I realize it's a drag (to put it mildly) to remove and SP-600 from its cabinet or rack, just to read off the code dates under the chassis, and since (so far) the dates seem to match the serial numbers anyway, I'd be happy to receive any information on your receivers (or your friends') even if it doesn't contain the code dates.

Serial	Code	Dates	JX-	Military Model if any, or other info
3488	8-52		JX14	R-274C/FRR SN7604 Order 3376-Phila-52
3594	2-51	5-51	JX7	civilian, in cabinet

6125	1-52	1-52	JX6	R-274B
9202	10-52	12-52	JX6	R-274B/FRR SN1292CHC NObsr-52039
9836	9-52	10-52	JX14	R-542
13629	4-53	10-53	JX17	diversity
15188	3-54	3-54	JX6	R-274B
17913	3-55	4-55	JX17	
20468	9-59	11-59	JX21	
20992	8-60	5-61	JX17	
22016	3-62	6-64	VLF31	VLF model

The first serial number is on the interior plate, the second one on the panel. Note the military plate for SN 9202: "CHC" is the Navy code for Hallicrafters, isn't it? Did Hammarlund subcontract for Hallicrafters? Why didn't Hallicrafters simply supply R-274/FRR (SX-73) receivers, a better set in many ways (but not all)? I'd particularly like to see info on SP-600s with low serial numbers. *[you may correspond with Mr. Douglas via Box 225, Pocasset MA 02559]*

<u>TUBE PIN AND SOCKET CLEANING</u> - In relating his story of bringing a near-dead Racal RA117 back to life, subscriber Neil Clyne suggests that "a judicious squirt of switch-clean lubricant down each tube socket, followed by reinsertion of the tube and juggling it around in the socket to clean the pins. Seemingly, high-voltage and heater supplies can get through a fair amount of crud on a tube socket, but not low-level RF or IF signals". Sounds reasonable to me.

PUBLICATIONS OF INTEREST

<u>"ELECTRIC RADIO" - SOME SUGGESTED REPRINTS</u> - Subscriber Joe Ursini of Euclid, OH writes to suggest several back issues of ER would be of use to R-390A owners: #24 (April 91) 'History, development and electrical design of the R-390A'; #25 (May 91) 'Mechanical design and service hints of the R-390A'; #26 (June 91) 'R-390A modifications, AGC mods, I.F. amp mods, R.F. subchassis mods'; #30 (Oct 91) 'Collins linear PTO - development and manufacture'; #31 (Nov 91) 'Collins linear PTO - maintenance'. Back issues are $3.00 each from ER [PO Box 57, Hesperus CO 81326]. *Readers should also look to back issues of HSN for R-390A PTO service and various other mods, especially AGC mods - opinions differ [ed.]*

WANTED TO BUY / SELL / TRADE / WHATEVER

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<u>Wanted</u> - R-390A; EAC model in good condition. HQ-180<u>A</u> manual, original or copy but not HQ-180 one with 180A addendum sheets. [Jeff Hambright, 65 Summit Rd, Sparta NJ 0787, 201-729-8015]

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HOLLOW STATE NEWSLETTER

"For lovers of vacuum tube radios"

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5910 BOULEVARD LP SE
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Summer-Fall 1995

Publisher
RALPH SANSERINO
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CONTENTS

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EDITOR'S AND PUBLISHER'S CORNER

Work on this issue began in June - I don't dare wait as time is precious. As 'promised' in the #35 editorial remarks, both Dallas Lankford's *MOD 3* and *51J-4* articles made it in. I have also just finished the new Vol 1 thru 35 index and have sent it to Ralph for distribution soon. Inquiries and items for publication consideration are still welcome - the backlog materials are starting to get a little thinner. I'm especially looking for items for the "Publications of Interest" section -- plus hearing some answers to the "Questions and Answers" section. For those who occasionally call me, my new phone number here is (360)-786-6756 - pre-paid/early evenings only please.

Reid

R-390A FILTER - MOD 3

Dallas Lankford

(1-1-95)

If you have done my "Collins Torsion Mechanical Filter For the R-390A" mod (**DX News** Vol 61, No 2 - Oct 11, 1993, pgs 23-27; or **Hollow State Newsletter** No 30, pgs 2-8), or have done my improved and simpler "R-390A Filter Mod 2" (to appear in **DXN**, **DXM**, and **HSN**), then my latest R-390A filter mod may be just the thing you have been waiting for.

The purposes of the previous two R-390A filter mods were to establish a 6 KHz BW as the widest BW for the R-390A and at the same time to provide a 6 KHz bandwidth for the R-390A, to increase the R-390A close-in 3rd order intercepts for all non-crystal filter bandwidths, and to protect the R-390A mechanical filters from excessive RF levels due to very strong nearby signals.

The disadvantage of those mods is that the 8 KHz and 16 KHz BW positions of the from panel BW switch provide the same 6 KHz BW. Wouldn't it be nice, I thought, if the 16 KHz mechanical filter was replaced with a 3 KHz BW filter? That would provide 2, 3, 4, and 6 KHz bandwidths for such a modified R-390A, which would be as many bandwidths as a DXer could reasonably wish for. The down side here is that the bandwidths would not be in sequential order, but I just wasn't up to the task of shifting the 8 KHz mechanical filter to the 16 KHz position, the 4 KHz filter to the 8 KHz position, and then installing the 3 KHz filter in the newly vacated 4 KHz position. Anyone who has fiddled around with the R-390A mechanical filters in the IF subchassis knows that such a project would not be a weekend project.

For a 3 KHz filter, I decided to use one of Kiwa Electronics (Craig Siegenthaler, 612 South 14th Avenue, Yakima, WA 98902, phone (509) 453-5492) CLF-D2-K filters. Putting this 3 KHz ceramic filter into an R-390A IF subchassis in place of the 16 KHz mechanical filter turned out to be a toughie. Two problems were encountered: reducing signal levels into the ceramic filter (the ceramic filter has much less loss than R-390A mechanical filters when properly impedance matched), and signal leakage. To equalize signal throughput, a resistor divider network was used ahead of the ceramic filter; see the "After" schematic - Figure 2. To eliminate signal leakage, a flange was fabricated from 0.015 inch copper sheet (copper gutter stock, available at sheet metal shops), tinned, and assembled with two etched PC boards so that the ceramic filter input and output pins were isolated from each other by the flange. The flange was made approximately the same size as an R-390A mechanical filter flange, so that the ceramic filter assembly could be bolted (just like an R-390A mechanical filter) into the vacated 16 KHz IF subchassis hole. The flange, with ceramic filter passing through it, also acts as an RF barrier to help shield the input and output impedance matching transformers T1 and T2 from each other.

As can be seen from the "Before" (Figure 1) and "After" (Figure 2) schematics, the 16 KHz mechanical filter was removed with C507 (51 pF) still attached to the mechanical filter pins. The other 51 pF fixed value (silver mica) capacitor was left in place, attached to the lugs of C571, the output 50 pF variable ceramic trimmer.

This is the "natural" way to remove a mechanical filter from an R-390A IF subchassis in preparation for doing a filter mod using tuned primary impedance matching transformers, as I did. Consequently, a 300 pF silver mica capacitor was added (in parallel) to the lugs of C564 (the input 50 pF variable ceramic trimmer) to permit the primary of T1 to be tuned to resonance at 455 KHz using C564, and a 250 pF silver mica capacitor (actually 180 pF paralleled with 62 pF) was added (in parallel) to the lugs of C571 (the output 50 pF variable ceramic trimmer) to permit the primary of T2 to be tuned to resonance at 455 KHz using C571; see Figure 2.

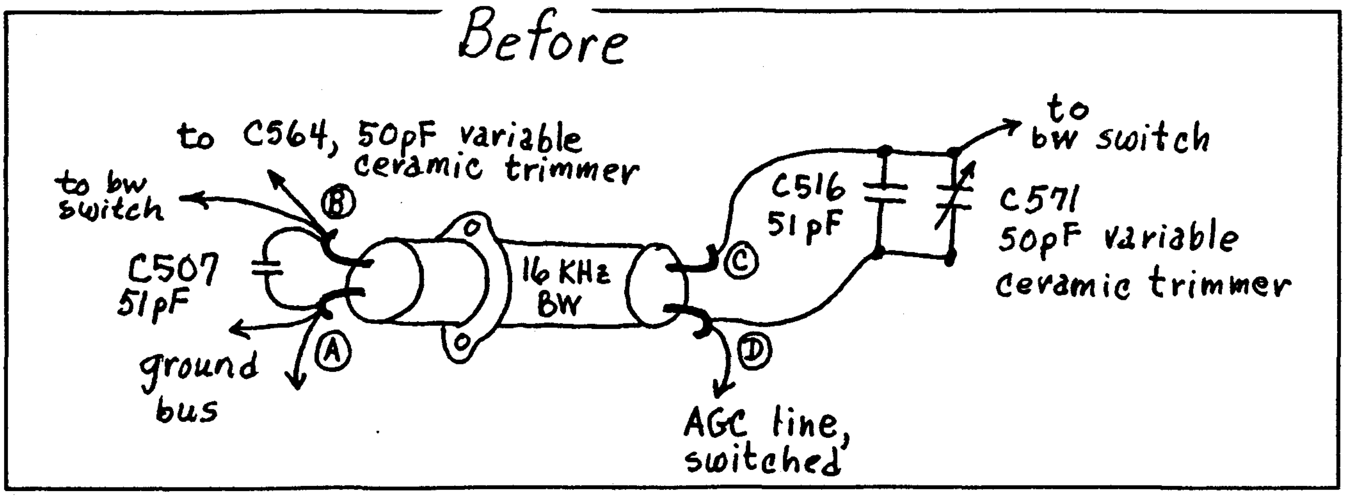


Figure 1

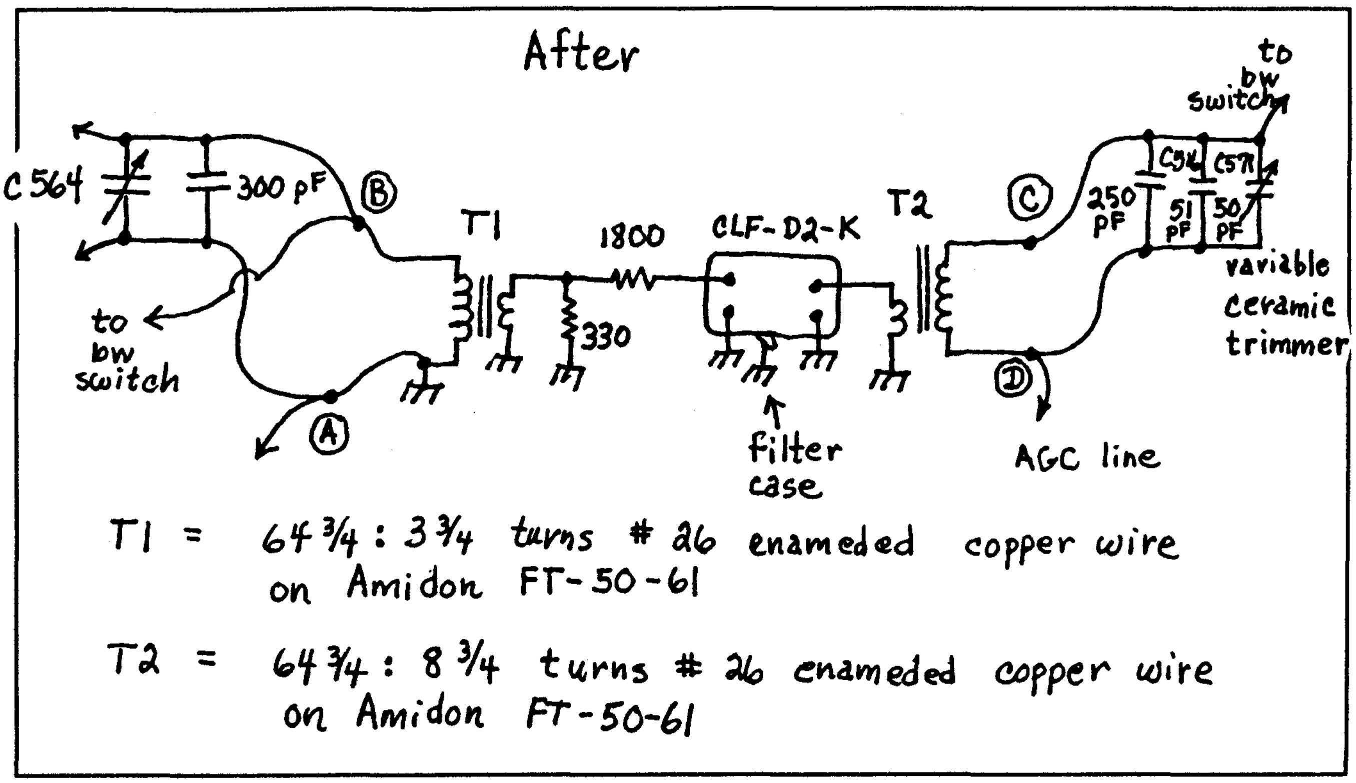


Figure 2

A PC board layout of the filter mod is given in Figure 3. The PC board was etched, and then cut along the dashed line. The short part extends below the IF chassis, and the longer part extends above the IF

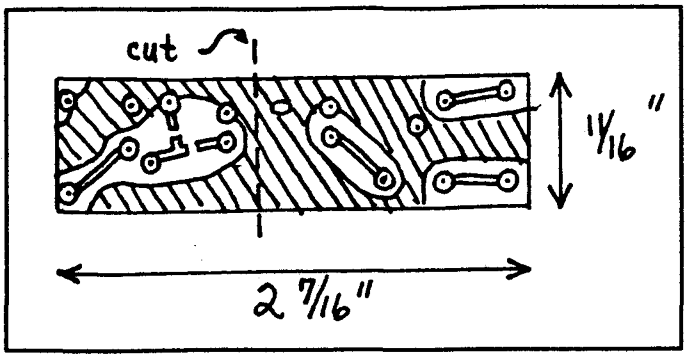


Figure 3

chassis. The ceramic filter was soldered to one of the PC board pieces (it does not matter which one), and then the unsoldered end of the ceramic filter was "Chinese puzzled" through a small rectangular hole in the flange, after which the ground plane of the PC board with filter attached was soldered to the flange. Next, the other PC board piece was inserted onto the unsoldered ceramic filter pins and then soldered at the pins, and along the ground plane and flange boundary. Finally, the remaining parts of the filter were soldered to the completed PC board and flange assembly, the completed assembly was mounted in the vacant mechanical filter hole, the remaining wires were attached (points A, B, C, and D on the schematics - Figures 1 and 2), and the 250 pF and 300 pF fixed silver mica capacitors installed at the lugs of the variable ceramic trimmers. To simplify installation, small pins about the same size as the mechanical filter pins were press-fitted and soldered to the two pairs of PC board pads at each end of the PC board. To conserve space, 330 ohm and 1800 ohm surface mount resistors were used (the PC board is laid out for surface mount resistors).

To align the ceramic filter input and output transformers, the variable ceramic trimmers C564 and C571 must be adjusted. Set the bandwidth shaft to the 16 KHz position, remove the mechanical filter cover (if not already removed), and with the R-390A tuned to a steady signal (one of the 100 KHz calibration points will suffice), adjust C571 (the top trimmer) for maximum signal. To adjust C564 (the side trimmer), tilt the IF subchassis so that C564 is accessible through one of the circular cutouts in the side panel.

During testing of the filter mod, it was observed that signal levels through the ceramic filter slowly decreased for about an hour or so while the R-390A came up to operating temperature. This problem was traced to a "drifty" C516 (the 51 pF silver mica capacitor across the pins of the variable ceramic trimmer C571). Replacement of C516 cured this problem.

The inductance of 64-3/4 turns of #26 enameled copper wire can vary considerably from one Amidon FT-50-61 toroid to another, so it may be necessary for you to vary the value of the 250 pF or 300 pF capacitor (or both) to permit T1 and T2 to be tuned to resonance at 455 KHz. If you do not get two peaks when you adjust them, that is an indication of failure to achieve resonance, in which case you will have to tinker with the value of the 250 pF or 300 pF capacitor (or both).

Is this filter mod worth the effort? Probably not. In fact, this mod is very close to, if not, and "emperor's new clothes" mod because I have yet to find a listening situation where the 2 KHz or 4 KHz BW does not work about equally well. At best, I would not expect to find more than one or two dX situations a month where this mod makes any observable difference. And as for making something hearable that was not hearable before, it'll never happen.

QUESTIONS AND ANSWERS FROM OUR READERS

This section will present questions from subscribers for which <u>responses are solicited</u>. If you can help in providing answers, suggestions or just plain good advice - please send them to the editor for inclusion in *the next issue of HSN.*

??? For those of you on the Internet or other services -- how about sending in some info on good sources, etc for info exchange and related stuff? [George Ross at george.ross@canrem.com]

??? Has anybody tried one of the new digital audio processors (i.e. JPS Communications NIR-10 or equivalent model made by MFJ) on the audio of a 390A? [George Ross, 127 Centre St. West, Richmond Hill, Ontario L4C-3P6]

??? In my EAC R390A (s/n 3592) I have replaced the 6DC6 RF amp with the 6GM6. It appears to work quite well but there is a bit of distortion with the RF gain wide open. I am now thinking of changing the cathode and grid resistor values to make it more linear. This mod was done due to poor antenna and is strictly for those down in the mud stations. Comments? [George Ross, address above]

??? As the R-390/390A doesn't do so well on SSB, many of us look around for an outboard converter such as the Hammarlund HC-10. Most that I have seen at the local hamfests are in pretty poor condition and expensive ($150 +/-). As I own both an HQ-170C and HQ-180C I began thinking ... if the HC-10 is essentially the IF and AF sections of an HQ-180 and if the HQ-170 (except for its ham band only coverage) is identical to/sort of/like/close to/has the same knobs as the 180, it seems to me that all I need to do is break into the 170 somewhere after the RF stage, dump the 390's IF output in there, stick in a simple switch to disconnect the 170's RF section and voila, instant HC-10, convertible at the flick of a switch back to a fully functional HQ-170 receiver. Simple, right? or am I missing something here? [Robert Bukovsky, 929 North 4th St., Reading PA 19601]

SHORT SUBJECTS

LANKFORD/CHAMBERS AGC MOD ON THE R-390 - SOME FEEDBACK [Dave Metz] I preface these observations on audio quality only as I do not have the necessary equipment to measure the attack and release times. As the AGC circuits appear to be almost identical between a 390 and a 390A, I thought I would give it a try. Basically, it works very well on slow but is worse on medium and fast. Using the R-390 schematic #'s: put a diode across R-556, replaced R-557 with a diode and put 47 pf cap across C-536. I then disconnected the parallel combination of C-547 and C-546 and put a .22 mfd in parallel with one of them to get the desired 1.22 mfd. At that point, I reinstalled the IF chassis to see how it worked and discovered that the slow seemed excellent with no distortion on even the strongest of SSB signals. I then proceeded to change the AGC switch as per the 390A mod. Unfortunately that introduced noticeable distortion on the slow with the med and fast even worse. So... I changed the switch back to original and just accepted the excellent slow for SSB. However, before changing back I temporarily removed R-555 (100K) as per the earlier Cornelius mod. Result: I could not tell the difference with my ears either way with respect to that resistor. In the end, I put the switch back to original and left R-555 disconnected at one end. Finally, I put the IF gain pot about half way between the stops. I am highly pleased with the performance on slow and would highly recommend this minor change to make SSB sound great without riding the RF gain all the time. There is one anomaly that I discovered. R-554 coming off Z-503 is schematically 2.2K. In four IF decks, the installed value was 470 ohms (and looked original). I temporarily removed this resistor and used a substitution box to experiment. It seemed that the 470 sounded much better than the 2.2K or any other value for that matter.

51J-4 SWITCHABLE AGC [Dallas Lankford - 1/95] When I originally developed my 51J-4 AGC mod (see *HSN #26*), I had hoped to replace the original AGC switch with a multi-section rotary switch to obtain multiple release times. Unfortunately, there is very little space between the 51J-4 front panel and the metal plate which is part of the gear assembly, and most rotary switches require more space than is available. Recently I found that one type of R-390A LINE METER switch would barely fit if the ends of the bandswitch wafer mounting screws were filed flush with the mounting nuts. This particular R-390A LINE METER switch is unlike most such switches I have seen, namely smaller than others, and completely enclosed in plastic. The usual R-390A LINE METER switches are too large for this mod.

A sketch of this new 51J-4 AGC circuit (and the original) is given in the figure on page 7. The MED release time is approximately the same release time as my original circuit, while the FAST release time is about 5 times faster, and the SLOW release time is about 2 times slower. As with the original mod, the S-meter is pinned briefly when the receiver is turned on, but the meter over-voltage is only about 50% beyond full scale meter indication, and is not harmful to the meter. The meter is also pinned briefly when changing among FAST, MED, and SLOW, but is not harmful for the same reason as above. The placement of the 1N4148 diode in the AGC line following pin 1 of V111 was moved to the new AGC switch to make the space above the audio output terminal strip on the chassis rear available for an added terminal strip for mounting the 0.47 mF MED and 1.0 mF SLOW release time capacitors. While I have not measured the attack and release times of the FAST and SLOW positions, on-the-air listening tests have revealed no problems. I was a bit concerned that the 22K ohm resistor which was chosen to minimize overshoot for the MED time constant would perhaps not be satisfactory for faster and slower time constants, but no overshoot has been observed in the FAST or SLOW positions. In fact, the FAST release time is ideal when multiple SSB signals with wide signal strength variation are present on the same frequency. And the SLOW release time is useful for improving audio quality of strongly fading AM signals in the SW bands and on MW graveyard frequencies. If you can find an appropriately small rotary switch, this mod is well worth doing.

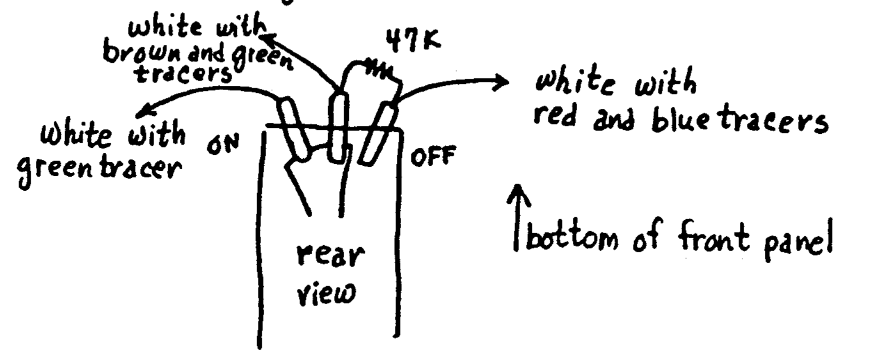
51J-4 PRODUCT DETECTOR UPDATE [Dallas Lankford] In *HSN #28* I remarked that I used a 2pF coupling capacitor from pins 6,7 of V110 to pin 7 of the 6BE6 (see Fig. 2 of that article) and an 8,200 ohm resistor from pin 7 of the 6BE6 to ground in order to equalize the audio levels between AM and SSB modes. Recently, after doing my fourth 51J-4 product detector modification, I found that in some 51J-4's, the 2 pF/8,200 ohm combination is not optimal. To achieve equalization of audio levels between AM and SSB modes for this fourth 51J-4, a variable 1-10 pF ceramic trimmer was used, and the required value turned out to be about 4 pF. Apparently there is enough variation from one 51J-4 to another to make it desirable to use a variable 1-10 pF ceramic trimmer in place of the fixed 2 pF ceramic capacitor so that audio levels between AM and SSB can be equalized.

MORE R-390 TIPS - FAN, REDUCED POWER VOLTAGE, RECTIFIER, LINE FILTER [Dave Metz] Other tidbits with respect to the 390's: I routinely add a 3" muffin fan to cool those red hot 6082's in the power supply. By removing the big round electrolytic just behind the face and replacing it with a newer vintage cap with is very small, there is enough room. Because I usually use 110v fans and they are too noisy at full voltage, I add a 1 mfd cap in line with one side of the power line and that slows it down to just a quiet speed that is barely audible. The only additional item is to take a 25v ct Radio Shack transformer, wire it as an autotransformer to then run the receiver on about 110v instead of the 123v that

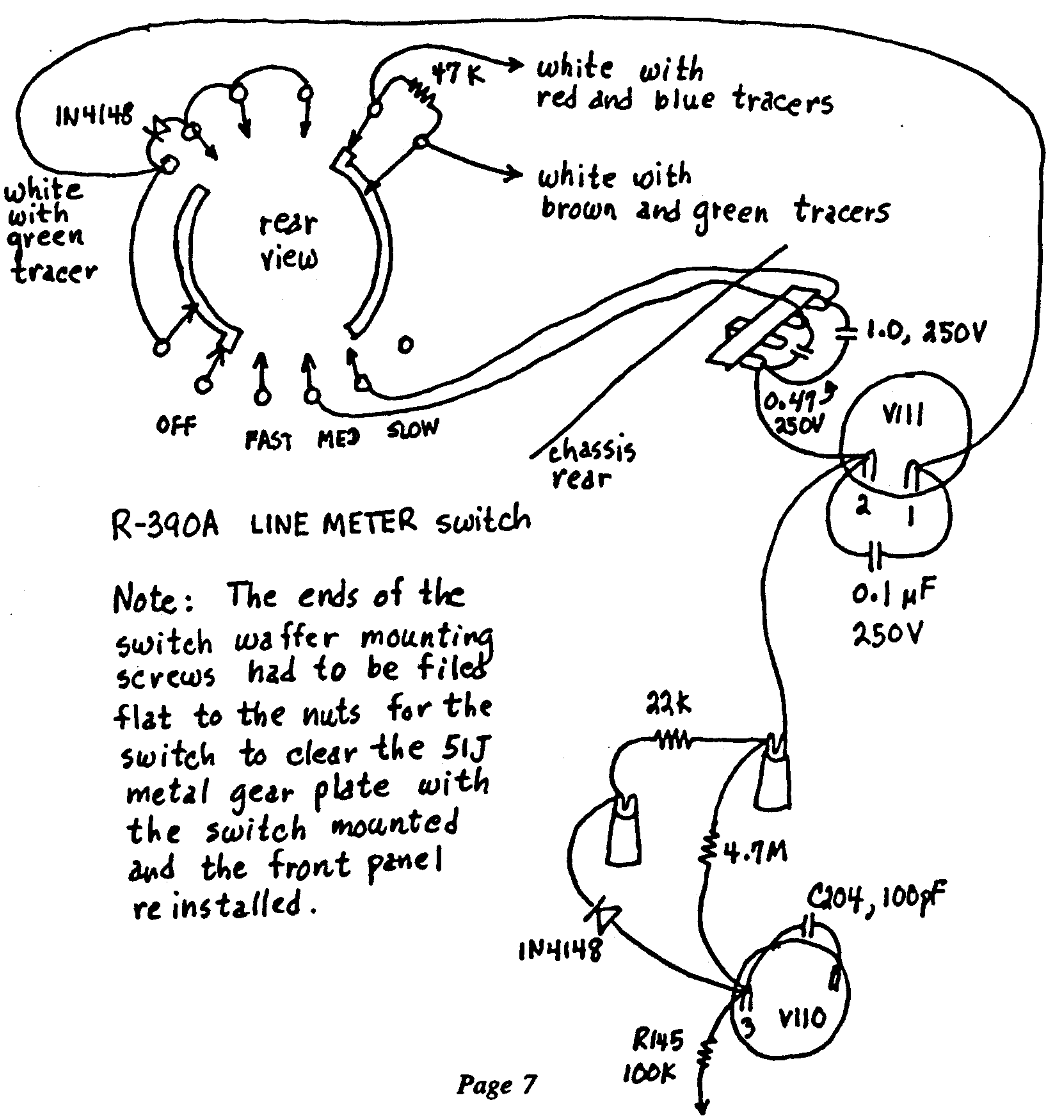
[continued on page 8]

51-J4 Switchable AGC figure - Lankford

Original 51J / R-388 AGC Switch



Modified 51J / R-388 AGC Switch



Note: The ends of the switch waffer mounting screws had to be filed flat to the nuts for the switch to clear the 51J metal gear plate with the switch mounted and the front panel reinstalled.

is my usual line voltage *[editor note: if you try this, remember that you are working with line voltage and current that is dangerous. Appropriate shielding, enclosure and careful connections with UL-approved components are a must! My best advice is to pay a few bucks at almost any hamfair for a ready-to-go Variac-type unit.]* Because the power supply transformer doesn't have other primary taps, I feel this is mandatory to keep the voltages in the safe range and even a little less. This is non-intrusive as it is outboard of the receiver. I also replaced the metallic rectifier in the power supply with a (gasp!) solid state bridge rectifier. Finally, I usually remove the big AC line filter on the back panel for safety reasons (though I save it to reverse the "operation".) I am morally against this kind of "alteration" but they are all leaky and tend to trip the GFI on my bench as a result. So, from a safety standpoint, I think safety outweighs my purist instincts.

<u>CABINET FOR SP-600</u> [Les Locklear] Premier Metal Products, who made the original SP-600 cabinets for Hammarlund, has a cabinet with a hinged top lid, louvered side & rear panels, and in the original charcoal gray 'wrinkle' finish - Part # DCR-18100 - $110.52 + $10 shipping. They have plants on the east and west coast. The original cabinet with the square perforations on the cabinet sides $ top cover is available as a non-standard, modified cabinet for $350!! They no longer have the dies for the perforating equipment. To sum it up, order DCR-18100 in color 561 (charcoal gray); other colors are available. Write to Premier at 381 Canal Place, Bronx NY 10451 and ask for Catalog #1193 - it's on pg 32.

PUBLICATIONS OF INTEREST

<u>"POPULAR ELECTRONICS' - DYNAMIC RECEIVER SPECS</u> - For those of you who with somewhat less technical background as some of our contributors, the August 1995 issue of *Popular Electronics* has a nice explanation of both the <u>1-db compression point</u> and the <u>third-order intercept point</u> with illustrations in Joe Carr's "Ham Radio" column.

WANTED TO BUY / SELL / TRADE / WHATEVER

This section is reserved for HSN subscribers in good standing (i.e., you're paid up according to Ralph) looking to connect with HSN readers for mutual benefit. All deals are between individuals; HSN does not evaluate the accuracy of any statements or claims herein. No 'business' ads, please. Items printed will be on the basis of available space. **Please send all 'ads' to the editor - Ralph just passes them on to me!**

<u>For Sale</u>: Central Electronics 200V - $275; 600L - $400, both in VG condition. <u>Wanted</u>: T-368 transmitter and or manuals, also Amelco or same size R-390 black front panel ID tag. [Ed Deptula, KA3OTT, PO Box 751, Havertown PA 19083-0751; (609) 435-8975]

<u>Wanted</u>: Manual for RACAL RA-217, 1217 or 6217 Receiver; Foreign professional tube tester (such as British AVO CT-160); older catalogs from Marconi, Rohde & Schwartz, Siemens, Telefunken. [Geoff Fors, POB 342, Monterey CA 93942; (408) 373-7636, Fax (408) 373-2345]

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HOLLOW STATE NEWSLETTER

"For lovers of vacuum tube radios"

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HSN is produced and published by and for the community of those who appreciate the fine accomplishments of the manufacturers of 'top of the line' vacuum tube communication radios and auxiliary equipment. Originally created by a group of R-390 users, *HSN* has expanded to include industrial, military and consumer grade receivers by Collins, Hammarlund, National, Hallicrafters and others. *HSN* includes tips, modifications, alignment and restoration advice, product reviews, parts, tubes and service sources, and subscriber buy/sell information - all provided by subscribers and friends of *HSN*.

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EDITOR'S AND PUBLISHER'S CORNER

As I am assembling #37, I've taken a close look at my backlog materials for future issues and am not pleased with the amount, and especially the quality, of what's remaining. #37 has just about used up the rest of the 'good stuff' and new submittals have been abysmally scarce! Remember: *HSN* is **your** newsletter... and I print what **you** send me... so let's hear from you soonest! On another note, I'm looking into creating another 'selected reprints' (otherwise known as 'the best of') covering issues 1 thru 12 or so. Much of the earliest material has been superseded or is obsolete and it's probably *[continued on page 8]*

USING A FUNCTION GENERATOR TO SWEEP-ALIGN CRYSTAL FILTERS

Alan S. Douglas

There's nothing like a sweep generator for aligning IFs and especially crystal filters. The usual method of aligning for a peak only tells you nothing about the filter's skirts or symmetry; you can get there by plotting point by point across the bandpass, but to do a plot every time you twiddle an adjustment would take forever. With a sweeper, you can watch the bandpass change as you work.

Unfortunately most readily-available sweep generators were designed for TV servicing. They're apt not to go down to 455 kHz, and if you feed a higher-frequency signal into the antenna input, you'll have a hard time knowing just where the center frequency is (though if you have a crystal filter, you start wherever it happens to be, and align your IF to suit it, so you don't necessarily need to know the exact frequency).

A more serious problem with the TV sweepers is their sweep speed, always set by the line frequency, 60 Hz or maybe 30 Hz. Even 30 Hz is too fast for a sharp filter, and will produce a distorted passband display on the scope. If the weep works in both directions, as it will if it's a sine wave sweep, the two traces will not be superimposed; this is an indication that what you're seeing is not the true response. You <u>can</u> align a filter under these conditions, but it would be better to slow down the sweep.

One possible solution is to use a modern function generator as a sweeper. Most of these instruments will put out 455 kHz with a sawtooth (linear) sweep and will run as slowly as you want (the limit is CRT phosphor persistence). Oddly enough, you don't want to use the "sweep" function on these generators. This works by sweeping between fixed "stop" and "start" frequencies, while what you want is a fixed center frequency and variable sweep width around this center point. Then you can always find your center frequency by reducing the sweep to zero temporarily and reading a frequency counter. It also makes a alignment of the different bandwidths much simpler when you can instantly expand the sweep width to completely fill the CRT screen.

What you want is the "FM" function, modulated by a triangle wave. Since this sweeps in both directions, you can see right away if you're sweeping too fast for the filter bandwidth (the two traces will no longer be superimposed). And your center frequency always remains the same. Now it turns out that not every function generator has FM capability. One that does is the Hewlett-Packard 3312, a fairly popular model that sold for $1000 new (their current model is the 33120 - $1500). I haven't made a search to see what other currently-available models have FM, but lots of companies make function generators and there have been articles in the electronics magazines on homebrew ones, too.

I bought a Texscan VS-50 sweeper at a flea market that will sweep at low speeds and does work at 455 kHz. Some of their models will not go down to zero frequency (look at the main tuning dial before you buy) so beware; they were really intended for VHF.

THE RACAL RA.17 COMMUNICATIONS RECEIVER

Terry Robinson

This is an English-made receiver designed to receive frequencies within the range of 0.98 - 30 MHz. It's about the size of the R-390A but it weighs up to 44 kg for the 'table' model. The circuitry consists of 23 valves, arranged in a "Wadly-Loop" configuration. The receiver is constructed of die-cast aluminum, except for the front panel which is constructed of 0.32mm steel. As in all such receivers, the RA.17 is designed to last for decades under all conditions. Technical details are as follows:

Valves: Crystal oscillator - 6AM6; Harmonic generator - 6AM6; RF amplifier - 6688; Harmonic mixer - 6AS6; First and second VFO's - 6AM6; 3 - 37.5 MHz amplifiers - 6AM6; First and second mixers = 6688; third mixer - 6BE6; calibrator - 6BE6; First and second IF amplifiers - 6BA6; IF output - 6BA6; AVC - 6AL5; BFO - 6AM6; Detector/noise limiter - 6AL5; Audio output - 6AM6; AF output - 6AM6; rectifier - GZ33 *(the rectifier valve was replaced by semiconductor diodes in later production runs)*

Frequency readout is by means of a "digital" dial (for MHz) and a 'film' scale for kilohertz. The scale is approximately 152 cm long with 15.25 cm corresponding to 100 kHz. There are dial markings every 1 kHz. The 'dial' is calibrated every 100 kHz and the pointer is moved horizontally with the aid of a milled cursor slide. The kilohertz dial is lit with two, easily obtainable, torch bulbs.

Selectivity: Six bandwidths are offered. They are, at -6 and -66 dB: 100 Hz/1.2 kHz, 300 Hz/1.7 kHz and 750 Hz/2.1 kHz (crystal). 1.2 kHz/7 kHz, 3/12 kHz and 8/19 kHz (L/C). Bandwidths of 5, 6.5 and 13 kH were available on the receivers I used.

Sensitivity: The sensitivity (for 20 dB S/N) is 3.5 μV (AM) and 1μ (CW). Not as good as the '390A, but not too bad for a receiver designed in 1957.

Stability: After a three-hour warm-up, < 150 Hz at a constant temperature. Later designs achieved <50 Hz after only 1½ hours.

There are two AVC times - short = 25/200mS and long = 200mS/1S. AF outputs of 3Ω (maximum 50mW) and 600Ω (maximum 10mW) are provided. A tiny (6.35cmm) loudspeaker is located on the front panel. A meter on the front panel indicates input or output signal levels.

Brief circuit details: An input signal between 0.98 and 30 MHz is fed, via an RF amplifier (and a low-pass filter), to the first mixer (M1) where the signal is mixed with the output from a variable frequency oscillator (VFO1). This oscillator covers a frequency range of 30.5 to 69.5 MHz. When mixed with the input ranging from 0.98 to 30 MHz, an output in the frequency band 39.5 to 40.5 MHz is obtained from M1. This band of frequencies passes thru the first IF bandpass filter.

The output from a 1 MHz crystal oscillator is connected to a harmonic generator. The harmonics derived from this stage are passed thru a 32 MHz low-pass filter and mixed with the output from VFO1 in a mixer stage (M4). This mixer provides an output at 37.5 MHz which is amplified before being passed thru a bandpass filter tuned to 37.5 MHz with a bandwidth of 300 kHz.

The first IF is mixed with the 37.5 MHz output in Mixer M2 to provide an output in the frequency range of 2-3 Mhz (second IF). VFO drift, within the limits of the 37.5 MHz filter bandwidth, does not affect the frequency stability of the receiver. A change in this oscillator frequency will alter the frequency within the first IF to the same extent and in the sense as the nominal 37.5 MHz output of the band-pass filter, the third and final IF of 100 kHz.

In use: The kilohertz knob has a silky, but dead, feel that puts the stiff R-390A gears to shame! Despite the "poor" sensitivity figures I quoted earlier, the receiver is probably as sensitive as the R-390A. Connected to a good aerial, it is able to receive transmissions that most hobbyists (with their non-professional receivers) can only dream about. I've been told that the RA.17 is more sensitive than the R-390A but where the latter wins is in the tuneable front-end. Racal had to design band-pass filters for the RA.17 because of cross-modulation effects, etc. Audio quality is 'rough' (maximum distortion = 5%) - here, the R-390A wins hands down!

The SSB performance is abysmal. An adapter is required. The R-390A is superior. Adapters were also available to extend the coverage down to 10 kHz. Unfortunately, because of the final IF, only Racal adapters can be used.

The receiver is more difficult to service than the R-390A. The 'sub-chassis' type of construction is sorely missed. However, the front panel (and associated knobs) is particularly easy to remove. And the lack of all the R-390A gears helps. After a great deal of searching, we were able to obtain a manual from: Mauritron Technical Services, 8 Cherry Tree Road, CHINNOR, Oxfordshire, OX9 4QY, England. It's not nearly as comprehensive as the military ones but the photos of the interior are large and detailed. Many 'typos' were seen - doesn't anyone check these things? The reprint quality (a photocopy) was only fair.

Overall, the Racal RA.17 is an excellent set, but the R-390A is better!

HQ-180 SERIES RECEIVER SENSITIVITY TEST

Dallas Lankford

Here is an easy test to determine if your HQ-180 series receiver is performing well with regard to sensitivity. This test is similar to a test described in the NAVSHIPS 1970 manual for R-390A's. The basic idea is to use the built-in 100 kHz crystal calibrator as a standard signal source, and the S-meter as an indicator of sensitivity. The problem with this method for '180's is that there were at least four different S-meter circuits in various production runs of '180's, and that S-meters in individual '180's can be set to have different sensitivities. Fortunately, the AVC voltage is approximately uniform for all '180's in my experience, so that you can use a high impedance DC voltmeter (10 megohms or higher) to do the initial test, and calibrate your individual S-meter. It is not necessary to remove your '180 from its cabinet because the AVC voltage can be measured at one of the rear accessory sockets - consult your manual for the correct socket and pin location.

Control settings of your '180 can significantly effect readings, so be sure to take readings with controls set according to the chart following. Attaching an antenna or ground can substantially lower readings while using narrower bandwidths or UPPER or LOWER can greatly raise readings, e.g., in the 1 kHz bandwidth, AVC voltages on the lower bands can approach -10 volts DC. Remember that AVC voltage is negative, and connect your voltmeter accordingly. I generally connect the negative lead of my voltmeter to the receiver ground, the positive lead to the AVC line, and use the reverse polarity setting of my voltmeter. (Oops, out of order: the AVC SLOW and MEDIUM setting also effect AVC voltage.)

This test will often detect "bad" tubes which will test good on a tube tester. If the AVC voltage is not at least -6 volts DC, I would strongly suspect one or more bad tubes. I found a "bad" tube in one of my

'180's using this test, and when the tube was replaced, the '180 had much less overload problems. In fact, I would suspect that much of the '180's reputation for overloading is caused by "bad" tubes which test good on tube testers. Speaking of tubes, it is worth the effort to locate and buy seven and nine pin tube pin straighteners. GC makes a good, inexpensive 7/9 combination tube pin straightener. If you have never used one you will be pleasantly surprised. Tubes go back into their sockets <u>much</u> easier with straightened (aligned) pins. One more thing - I generally set my '180's S-meter so that the strongest signals give maximum S-meter readings. For late model '180's this is about 60 dB over S-9, and in earlier models about 45 dB over S-9. The S-meter readings in the chart below are for late model '180's. Finally, the test is really not correctly named because reading depend not only on the RF, MIXER, and IF circuits, but also on the 100 kHz crystal calibrator, AVC, and S-meter amp circuits. So when replacing tubes to try to bring readings up to where they should be, don't forget to first try replacing the 6BZ6 100 kHz calibrator, the 6BV8 and 6AV6 tubes of the AVC circuits, and the 12AU7 meter amp tube. When replacing tubes, first try replacing one tube at a time. This usually succeeds, but when more than one tube is "bad" you may have to replace two tubes at a time in all combinations, three tubes at a time in all combinations, etc., until you cure the problem. As the '180 manual states, "weak" or "bad" tubes are the cause of the <u>vast</u> majority of '180 receiver problems. And the test I have described here is often the only way to determine and cure such problems.

SENSITIVITY TEST

Controls <u>must</u> be set as follows for the sensitivity test:

NOISE LIMITER - OFF
AVC - FAST
SEND/RECEIVE/CAL - CAL
AF - comfortable listening volume (use either speaker or headphones)
RF (gain control) - fully clockwise (white pointer about 6:30 o'clock)
BANDSPREAD - 100
SIDE BANDS - BOTH
SELECT KCS - 3
AM/SSB/CW - AM
VERNIER TUNING - 0 (red pointer at 12 o'clock)
BFO - not applicable
SLOT FREQ - +5 KCS (red pointer at 9 o'clock)
TUNING RANGE MCS (band) - per chart following
MAIN TUNING - per chart below
ANTENNA (trimmer) - adjust for maximum S-meter reading

<u>NO ANTENNA OR GROUND CONNECTED TO RECEIVER</u>

For more accurate determination of sensitivity test, connect a FET VOM or other high impedance voltage measuring device as follows: positive lead to pin 2 of rear socket (AVC voltage), negative lead to ground screw on antenna terminal of receiver, set to DC voltage 10 volt maximum scale, and set reverse polarity switch to reverse (AVC voltage is negative).

HQ-180 SERIES RECEIVER SENSITIVITY TEST - SETUP CHART

BAND	MAIN TUNING	S-meter readings in dB over S-9	AVC voltage (negative)
1	0.6	about 60	6.4
1	1.0	about 60	6.6
2	1.1	about 60	5.0
2	1.9	about 60	5.5
3	2.3	about 60	5.9
3	3.8	about 60	5.8
4	4.4	about 60	5.2
4	7.6	about 60	5.8
5	8.8	about 45	4.2
5	14.7	about 50	4.4
6	17.3	about 5	2.5
6	28.8	about 10	2.8

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QUESTIONS AND ANSWERS FROM OUR READERS

This section will present questions from subscribers for which responses are solicited. If you can help in providing answers, suggestions or just plain good advice - please send them to the editor for inclusion in the next issue of HSN.

Ans. In response to George Ross' RF amp tube question in #36, veteran member Alan Douglas sent me some material on low RF tubes from the Feb 1966 *QST* (which, of course, I can't reproduce here). Alan also comments: "The 6EH7 seems to have been the preferred tube. It would take a socket change or an elaborate adapter to use one in the R-390A, and I've never tried it. I did use some of the others (6GU5, 6GM6, 6JK6) following suggestions in the June 1991 *Electric Radio*, but was not at all impressed; performance was little if any better, and the carrier-level meter calibration was all screwed up. I went back to the 6DC6. Incidently the recommended mixer modifications were even worse, severely degrading the off-channel signal rejection, and I went back to the stock mixer circuit, too. This was in a 1956 Motorola, checked in a 1954 Motorola by using plug-in adapters for the mods. Later contract R-390As might, of course, perform differently."

??? I have yet to hear of an SP-600 under serial 1130, and the next number is 3488. Where did all the early SP-600's go? [Alan Douglas]

SHORT SUBJECTS

<u>PTO LINEARITY - 51J3 VS R-390A</u> [Wally Chambers] The difference in linearity between the 51J3 PTO and the R-390A PTO comes down to one outstanding difference - the R-390A PTO has been cooked to death by the 45-watt heater that surrounds it (the heat loss from the R-390A PTO operated at a temperature of 100 °F surrounded by 0 °F in the lower R-390A chassis area is about 14 BTU/hr. The heater generates about 154 BTU/hr - if the thermostat sticks, the PTO can go up to 800 °F at room temperature.) The heat from this oven physically distorts the coil form. The heat also vaporizes the grease and oil in the two internal bearings, especially the exposed bearing down in the coil. When you open an R-390A PTO you will notice the oxidized oil deposited on everything. On the other hand, an opened 51J3 (or R-392) PTO, the surfaces will all be bright and new looking. Most R-390A's that I have seen are off by 4 kHz to over 16 kHz. You can adjust the end point but the PTO will still be far from linear.

I strongly believe that the oven should be removed from the R-390A PTO whenever you work on it, otherwise the PTO may be damaged by the accidental engagement of the heater switch. The best thing for HSN readers to do is cut and tape the heater switch wires at the rear of the chassis.

<u>STRAIGHTENING A BENT R-390A KCS CHANGE SHAFT</u> [Shawn Merrigan] An R-390A purchased "as is" from Fair Radio had a bent KCS (vfo) change shaft which wobbled visibly when rotated. This caused binding at the bushing in the gear plate and at the front panel bushing. The result was a hard to turn KCS change control. I could have simply loosened the front panel bushing lock nut slightly, allowing the shaft and bushing to float, but I decided to do the right thing and replace the shaft. This is a fairly straightforward job, but there are a couple of things to watch, and keeping them in mind will help:

1. A taper pin indexes the dial lock hub and gear to the KCS change shaft. This pin has to come out to remove the shaft. Drive the pin out from the narrow side! This is a small taper pin.
2. A larger taper pin holds the ten-turn stop assembly on the KCS change shaft. This pin must also be driven out from the narrow side. Look for the smaller of the two holes in the ten-turn stop end block (looks like a big thick washer) and drive the pin out from that side.
3. When driving out the pins, particularly the larger one, counterbalance the shaft with a large mass so you will not bend it. Use WD-40 to loosen the pin and tap gently.

In fact, I wound up straightening out the old shaft using machinist's V-blocks and a brass drift. I then polished the shaft to remove any burrs and blew out the taper pin holes with WD-40 to prevent binding. The runout of the straightened shaft was very small and, after re-assembly, there was no binding evident and the shaft turned smoothly.

<u>R-390A PTO PARTS CHEAP</u> [Shawn Merrigan] A good source of mechanical parts to repair an ailing R-390A PTO is the much cheaper T-195 VFO ($10.95 from Fair Radio); not all parts are directly interchangeable, but many are. I had a Motorola PTO which had very poor resetability, and was very jumpy when fine tuning. I came to the intuitive conclusion that the spring holding the follower assembly to the compensation stack was probably gone (this was found to be correct upon examination). When I opened up the PTO I found that all the mechanical parts were very badly corroded; the rubber o-ring at the top end of the can was so brittle it snapped into several pieces when I tried to remove it! Obviously the seal had gone years before and the salt air had done its damage. Well, I had a spare T-195 unit so I decided to see what parts I could put into the Motorola, just to make it useable. As it happens, the front and rear bearings fit right in, the o-ring fits, and the compensation stack roller assembly fits. You have to do a little work to get the old assembly off the slug and put the new one on, but it can be done. In fact,

I removed the compensation stack from the T-195 and tried it in the Motorola. It fits fine, but it is slightly longer than the Motorola, so you have to drill a hole in the aluminum member that the stack is attached to in order to mount it. I did this on a drill press to get a reasonably accurate hole. The rear plate (that mounts the rear bearing) bolts right in, and even has a hole to loosen the correction stack lock stud. The thread pitches of the two threaded shafts are different so the slugs cannot simply be swapped; this would change the inductance anyway, so you are better off to change the follower assembly as mentioned before. The quality of the parts in this T-195 unit was excellent and they were like brand new. After putting the whole thing together, I was pleasantly surprised at how well it worked. There is an endplay problem with the threaded shaft that results in some resetability troubles, but I feel this could be taken acre of by using the correct shims on the shaft. My main point in doing this was to see if an otherwise useless PTO could be made to function. With a bit more effort I could probably bring it up to spec.

PUBLICATIONS OF INTEREST

Nothing new this issue ... but we're always looking for your contributions.

WANTED TO BUY / SELL / TRADE / WHATEVER

This section is reserved for HSN subscribers in good standing (i.e., you're paid up according to Ralph) looking to connect with HSN readers for mutual benefit. All deals are between individuals; HSN does not evaluate the accuracy of any statements or claims herein. No 'business' ads, please. Items printed will be on the basis of available space. **Please send all 'ads' to the editor - Ralph just passes them on to me!**

<u>WANTED</u> - Hammarlund HC-10 converter in excellent or better condition. [Rick Krzemien; (510) 687-2719]

<u>FOR SALE</u> - 6688 tubes in military boxes, $2 each. Also an HC-10 cabinet, panel & chassis in decent shape, cheap if you've got a creative use for it. And two Sideband Slicers, an A and a B; offers entertained, reasonable or otherwise. Letters preferred over phone calls. [Alan Douglas, Box 225, Pocasset, Mass. 02559]

<u>EDITOR'S AND PUBLISHER'S CORNER (CONTINUED)</u>

time for a general housecleaning. Of particular interest is obtaining <u>current</u> sources of /URR manuals and reprints. If you know of current sources for the R-388, R-390A, R-392, SP-600 and other military gear manuals <u>or</u> you are willing to sell photocopies of your own manuals, please drop me a line. With the continuing aging of these venerable receivers, and the general tendency for suppliers to recycle stuff that isn't moving, the manual source issue isn't getting any better. Your assistance will be appreciated. And once again, my new phone number is (360) 786-6756. Prepaid, early evenings only please... otherwise leave a message and I'll get back to you ASAP.

Dave

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