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Heathkit SB-200 Rebuild

Years ago I purchased a then old Heathkit SB-200 Linear Amplifier but sold it when I moved to the home I'm in now. Like many things in life, I regretted selling it but really had no idea for a 1K Watt amplifier at the time. I noticed these old amps being sold on eBay now and then and decided to see if I could get one to rebuild. It looked like a fun project and not then a little more power than the 100 Watts from my FT-890 would be nice.

So I set out bidding on auctions. It turns out that I found a unit not far from home and won the auction. I was worried about the shipping of one of these old and heavy amplifiers so I opted to drive out and pick it up. Turns out this unit was from Silent-Key, WA6AUD, and that he had built it back in 1965. He did a good job of assembling the amplifier and took good care of it. There are very few scratches on the Chassis and was relatively clean on the insides for something made 47 years ago. I think he would be happy that his Amp has found new life and did not go to the scrap heap.



The SB-200 as I got it after removing it from the case. Real clean front panel for the age.



Close up of the Meter side of the Amp. Only a few scratches on the Meter face.

First things first – This Amplifier though a relatively low power unit, has LEATHAL voltages under the cover. Don't me around with the electronics in a Tube Amplifier unless you know what you are doing. As a hardware Engineer, over th I have worked with high voltage and high current devices so I have a healthy respect for this type of hardware. Before turning it on, I removed the old light duty power cord and did not replace it until the end of the rebuild removing any of getting 'Zapped' by accident. I then pulled the tubes and boxed them for safe keeping. Then I gave the unit a con checkout for signs of arching and burnt components. Finding none, I then removed the knobs, meter, and front panel started the cleaning process.

With all of the parts on order I set out to clean the chassis and case. Light soap and hot water is all that is needed to the knobs and hinged case. The hinged case was a little dirty from 47 years of use but had hardly a scratch on it, no repainting needed. I decided to leave the radio in the original HeathKit turquoise green colors as it was painted at th factory as the paint is in such nice condition. I also like to keep a working antique looking original. I do admit a nice Chassis and face panel would look nice too...



The case is very clean with hardly a scratch. For now I'll leave it in the original HeathKit color.



The original RCA plug had been replaced, but the replacement is worn out now.

Knowing that over the last 47 years since this unit was assembled that there must be modifications and improvement I set out on the web to research it. One of the best places to start looking for any project like this is to look for a Yah Group. This is where the experts and newbies can be found. As expected there is a group called "HeathKit_HFAmps" joined. Here you can find the real experts on these old tube amps.

The list of things that I came up with that needed to be done were:

- Deep clean the chassis, switches and electrical components
- Polish the plastic meter face
- Replace the HV Power supply Caps or better yet, replace the voltage doubling power supply
- Install a T/R control circuit for solid state radios
- Add a soft start circuit for the main AC power
- Replace the T/R relay
- Add a secondary fuse for the HV power supply
- Add protection diodes to the Meter

- Wire for 110VAC operation as I don't have 220VAC in the shack

In my quest to learn about what can be done to restore this old amp I found a company that supplies modern replacement kits for improving and fixing older model RF Amps. So to make life easy I ordered their Power Supply Module kit – PM Soft Start kit – SS-201, Soft Key Kit – SK-201, and replacement T/R Relay. While I was making the order, I also purchased the 2 replacement electrolytic caps that are used separate from the high voltage supply. Their web page is: <http://www.harbachelectronics.com/>



The original power supply with old dry caps and heat stressed components. When I removed it, I unsoldered the meter connections so I did not need to damage the old PCB.



The new HV PCBA in place. The caps are smaller in size with greater values. I added heat-shrink to the transformer leads to help protect the old insulation..



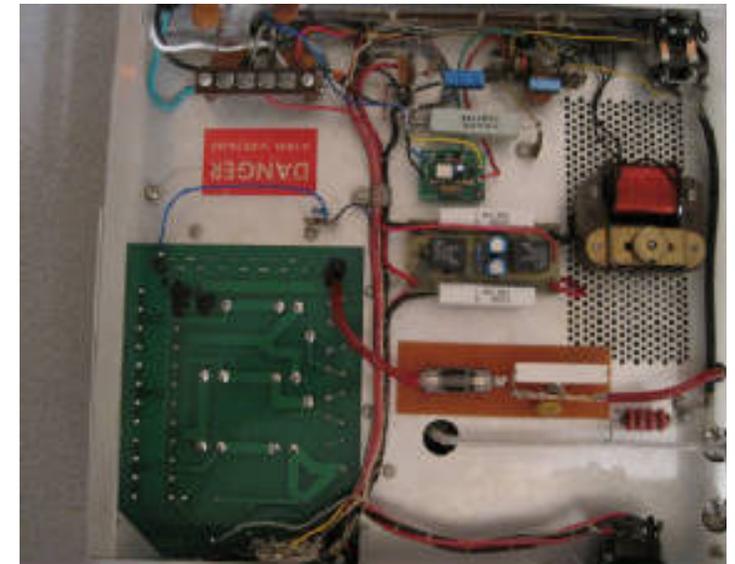
The original T/R Relay was warn out. The contacts were badly pitted . The original electrolytic caps were still there too.



The new Relay was installed with the new resistor for Volt operation. I also replaced the electrolytic caps w units.



The initial under chassis view with the old HV Power supply in



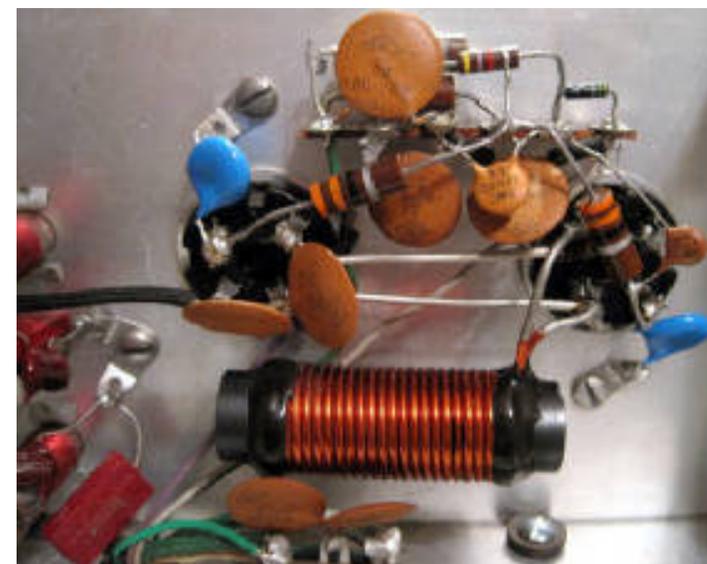
Final under chassis view with new HV power supply ar

place.



I left the original Exicter Input Section as it was wired when the Amp was built.

Start, Soft Key and HV Fuse.



New and larger Grid Caps were installed with short connections.

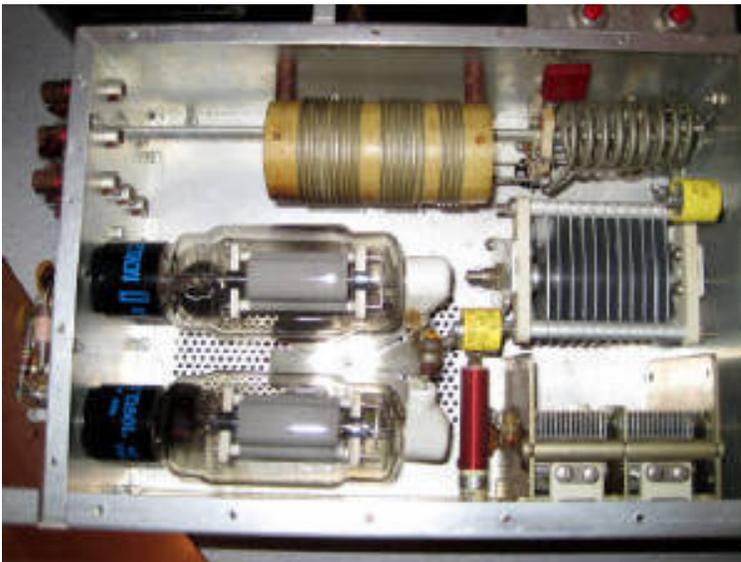
The Yahoo group experts recommended upping the size of the electrolytic caps used in the Harbache Electronics PM-2 to something a little larger. I opted to go from the 180uf/450VDC caps provided in the kit to 270uf/450VDC caps. That should help add the extra filter capacity for high voice peaks. I specked and purchased the caps from Digikey (Part N P11813)

I also found an interesting looking Upgrade Manual being offered by an eBay vendor and its cost was only \$10 so I put it. I had found much of the same information while searching the net, but it was worth the cost to me as the document was well made, printed on good quality paper and overall a nice document with all the information in one place.

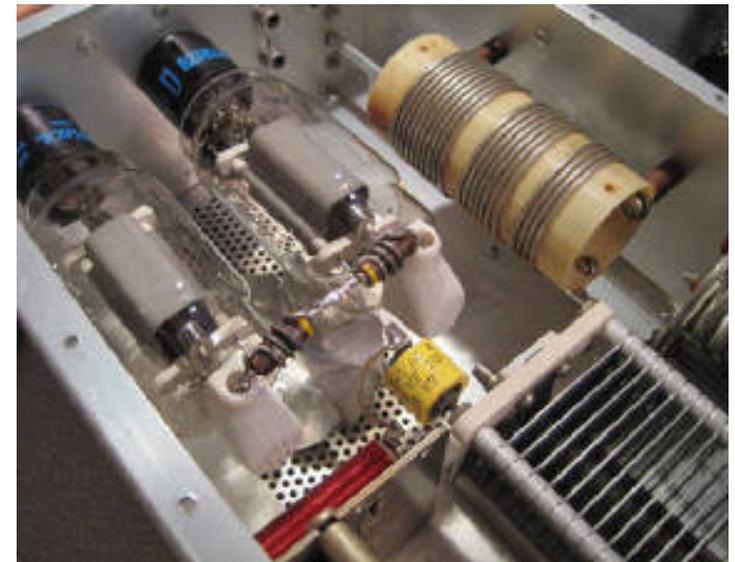
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Chassis and face panel would look nice too...

To clean the electronics compartments I started using spray electronic cleaner, but it was going to take more than just cans to do a good job so I opted for option B. I took out a midsized paint sprayer and filed and adjusted it for spraying Acetone. This is a chemical that you don't want to breathe or get on your skin, so I did this task out on the side yard with wind to my back. Using a brush and rags I would spray, brush, and rub the years of grime away. I was careful around sensitive areas like the transformer as its paint is acetone soluble. Any other part that I thought might be sensitive like plastic I removed prior to cleaning. After the Acetone wash, I used a lubricated electronic contact cleaner for all pots, switches. I wanted to make sure the rotary band switches and the rotary meter function switch were both clean and lubricated.



Original Tank view - It was just dirty from years of dust and grime. Some signs of heat stress on L6.



After a lot of cleaning the Tank area looks nice and clean. Re-soldered the joints for good measure.

Next was the reassemble process. Using guidance from the Yahoo Group and the Modification handbook I assembled add-on kits and integrated them into the amp. After considering the many documents I read about adding 'new and improved' parasitic filters to the Tank Circuits and so forth, I decided to rebuild this unit keeping to the original design mostly. I did add a fuse/resistor/cap to the HV power supply output and put larger Grid Capacitors on to replace the :

200pf parts.

The final step was the installation of a new heavy duty 3 prong 110 AC power cord. After the assembly but before reinserting the tubes and connecting the HV wire to the power supply, I cautiously turned the amp on, "Click" went the soft start, the fan was spinning (a drop of oil and it is working good as new) and the Meter was indicating 2350 volts. I then tested the new relay and Soft-Key circuit, all was working. I left it powered on for a few minutes and then turned it off and removed the plug. I watched the HV reading dissipate which took longer than I expected, but the new PS module has higher resistance bleed down resistors to make it a little more efficient, not a problem. Once reaching 0V I carefully turned it over and using a 'chicken stick' made sure the caps were all discharged, they were.



First Power On Test - No Smoke - Good News!



New Voltage reading - On the Polished Meter Face.

Everything looked OK after the first power on test. I then made the final connection; the HV lead from the Power Supply to the Fuse. I then inserted the Tubes and attached the Grid Caps. The next test was power on with Tubes. Again it looked to be working properly.

The final test is with an exciter driving the Amp into my Cantenna Dummy Load. Using my FT100D and a simple homebrew relay control cable I attached the Transceiver to the Amp. I set the power out to 5 Watts and FM mode on 40 Meters the radio which keyed the Amp with hardly any delay, again all looks to be working, or at least there was no smoke. I

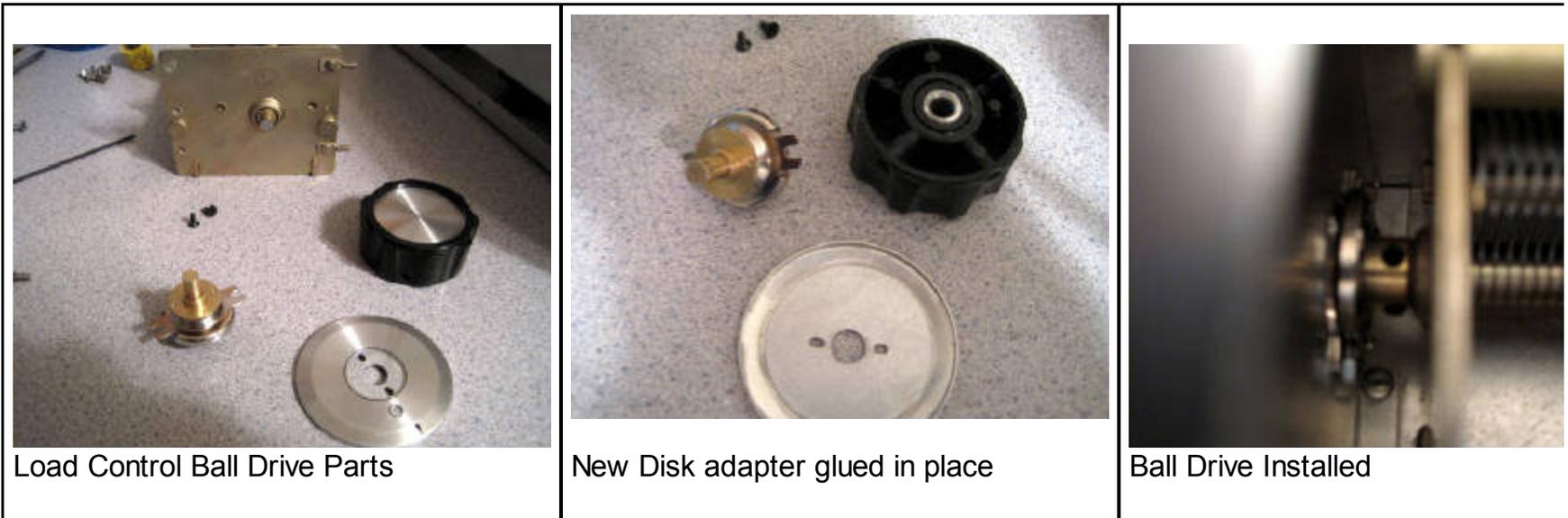
all the bands and was getting output on each one. My 1KW Cantenna was getting pretty warm so I stopped. The mc I put into the Amp was 50 Watts from the FT-100D in FM mode for these tests

During the initial testing I blew the 2 Amp protection fuse on the HV line. I found a bad solder joint in the Tank Circuit testing on 10 Meters, I don't know if this was ultimately the reason for the fuse 'pop' or if I just had too much Loading need to barrow a power meter that can handle the power this Amplifier produces so I can finish my off air testing. I have been watching the 115VAC power draw from the amp while testing. The most current I have drawn at a 50 Watt drive was a little over 9 Amps. At 100 Watts of drive the amp is pulling about 13 AMPS but only putting out about 500 watts to 15 and about 400 Watts on 10M. I think the tubes are getting week, they might be original still....

I found that the LOAD control was very sensitive so I tried something I saw on someone's webpage to improve the situation I added a planetary drive reduction assembly between the big green Heath kit knob and the LOAD variable capacitor. A cool part of this upgrade is that the Plastic Knob rotates at the normal speed, but the capacitor and metal indicating [the original knob turns at the reduced speed.

It took a little faith in my abilities as it meant doing a few modifications to the chassis, disassembling the original Knob cutting the shaft of the large capacitor. I ordered a 4511DAF 6M6 Ball Drive, Made by Jackson Bros, Item # 2509264 from Mainline Electronics Ltd in the UK. When it arrived I spent a little time thinking about how to get it installed and went to work.

First I modified the knob by cutting the metal indicator free of the plastic knob. I then cut small disk from thin aluminum drilled a center hole and hand machined elongated mounting holes to hold it to the Ball-Drive by using the ball drive mounting screws. Then using 5 minute epoxy I glued the adapter to the inside of the indicator disk. I then cut the Ball-Drive shaft to fit the depth of the plastic knob, that all fit nicely. The input side of the Ball-Drive is a metric size which is just smaller than the 1/4 inch shaft so I had to bore it out to fit the Capacitor shaft. I took an old 1/4 drill bit and using the bit took off the tip of the bit. The taper on the bit would keep the boring operation from going deep enough. Then I can wash the loose brass out of the newly expanded hole of the Ball-Drive.



The last step was to remove the LOAD capacitor and shorten it's shaft and to enlarge the hole that the shaft passed t to fit part of the body of the Ball-drive unit. It is a very tight fit but by sliding the LOAD capacitor back just a 1/16 of ; was able to fit the ball drive between the Capacitor and the inner chassis wall. The Ball-drive has a mounting flange able to get small 4/40 screws in place to hold it together. Finally I squeezed the Capacitor back into position and re-assembled the Amp.

I am extremely pleased with the look and feel of this modification. By just looking at the old Amp you cannot tell the mod has been done until you turn the LOAD control. The LOAD control is smooth and far easier to set. This addition worth the time and effort.

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