Restoration of an Eko Viscount Reverb amplifier

WHEN IT ALL BEGAN

Some 18 years ago while I was throwing away some garbage in a junk yard I found this Eko Viscount Reverb laying in the mud. I saw the tubes inside and so I took it home thinking that sooner or later it might have become useful. A few months ago my 12 years old nephew felled in love with guitars and as a present for his birthday we all gave him a classic guitar. For the future he is thinking about an electric guitar. So after 18 years of waiting that old amplifier finally became useful!!!

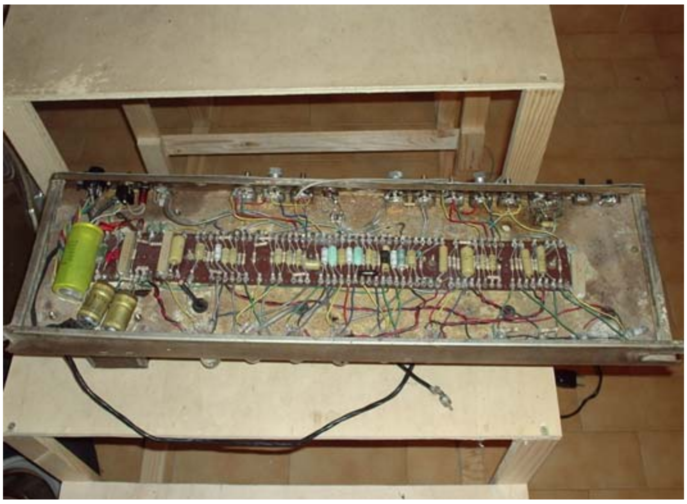
As you can imagine, when I took it from its storage it was a little dusty, I cleaned it and here are some pictures.

Front…

… and back

Inside

A couple of views of the electronics



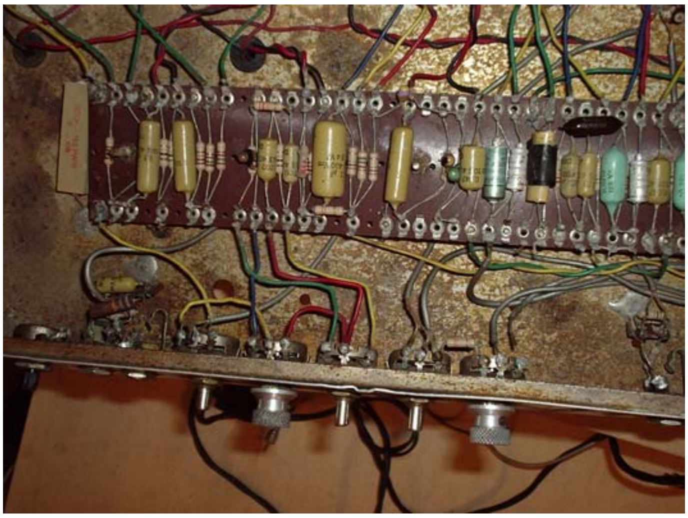
At the end of the restoration it will look much better, with fixed chassis and electronics and with new tolex for the outside.

CHANNEL 1 INPUT + VIBRATO CONTROLS

In this amp unfortunately all the wirings of the vibrato circuit have been cut away, only the tube and the components have been left on the board… luckily!!! Here are some close views of channel 1 input and of the two vibrato controls wired to the surrounding air.

Controls…

… and electronics



The two vibrato controls are not original, probably they have been changed because the original ones did not work anymore, but this seems strange to me, I would bet that the volume control, that are still the original ones, would fail sooner than these. Otherwise they have been changed because another electronic circuit was fitted inside this amp. This possibility seems to be much closer to reality also due to some modifications done to the chassis (holes and cuts). In this case I suppose that even the values of the controls fitted in the amp are not the correct ones.

A NICE HOLE!

And now something about cosmetics. Someone decided to add another input jack and then he/she removed it leaving a very nice hole just in the middle of the Viscount logo. Really attractive, isn't it? I'll try to reproduce the missing part.

SCHEMATIC DIAGRAM

The electronics of the Eko Viscount Reverb are not complicated apart from channel 1 that has also the vibrato and the reverb effects. For simpler reading I've divided the schematic in four sections:

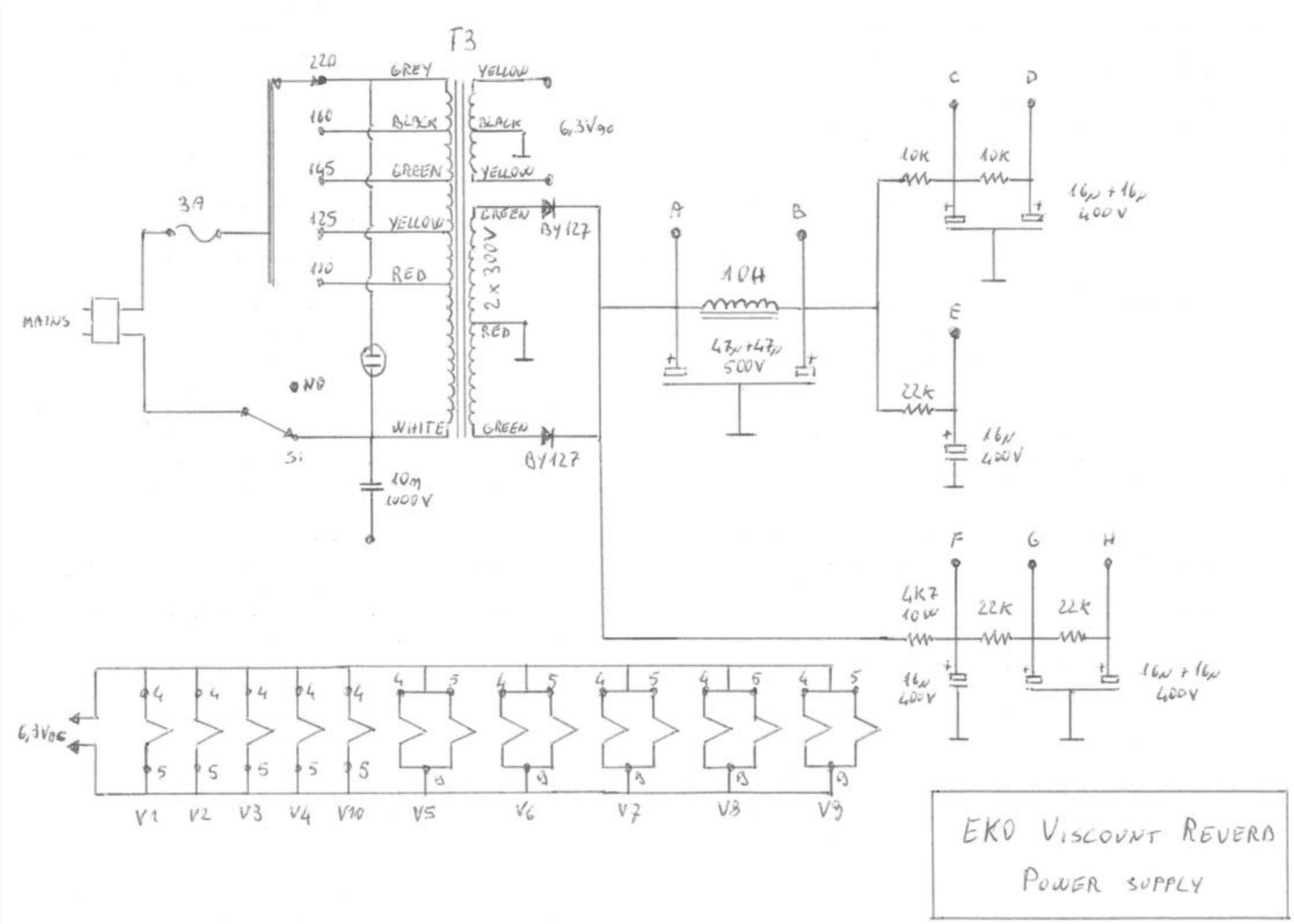
- Power supply
- Channel 1 (Canale 1)
- Channel 2 (Canale 2)
- Power amplifier

TUBE NAMING CONVENTION

I named the tubes starting from the first EL84 (V1) on one side going to opposite one where the ECL86 (V10) is placed. Here are the tubes, the names used in the schematic diagram and their function in the amplifier.

V1 – EL84 – power output
V2 – EL84 – power output
V3 – EL84 – power output
V4 – EL84 – power output
V5 – ECC83 – phase inverter and driver
V6 – ECC83 – low frequency oscillator and neon bulb driver (vibrato effect)
V7 – ECC83 – channel 1 second and third preamp
V8 – ECC83 – channel 2 first and second preamp
V9 – ECC83 – channel 1 first preamp; reverb first preamp
V10 – ECL 86 – reverb second preamp (triode); reverberation unit driver (pentode)

POWER SUPPLY



Let's begin with the simplest stage, the power supply. The mains power goes to the primary winding of the power transformer through a voltage selector and, of course, through the mains switch. The fuse is installed inside the knob of the voltage selector on the front panel. As you can see there is also a capacitor between the output of the mains switch and a pin installed on the chassis. This, if too much hum noise is experienced, can be connected to the chassis (ground). In many amplifiers of the 60's this was a common solution to hum noise, but actual safety regulation prohibit this kind of workaround. In such a way the chassis is partially connected to mains, but the chassis is also the signal ground and so also everything connected to the amplifier will be partially connected to mains: instruments and other electronic equipment. If that capacitor fails (i.e. short-circuits), ground is DIRECTLY connected to mains and so all the rest. VERY UNSAFE!!! I will definitely remove that capacitor and I will connect the chassis to ground (earth) with a 3 wires power cable (standard one). Ground connection should remove all hum noise.

The power transformer has two secondary windings:

- 6.3V, with a center tap connected to ground for hum balancing, that feeds the heaters;
- 2 x 300V (approximately) for the anodic supply (high voltage).

The high voltage is rectified by two solid state diodes (BY127) and then goes to two main filtering cells:

- an LC that feeds the power amplifier (point A anodes, point B screen grids), these are the points at highest voltage and lowest output impedance;
- an RC followed by other two feeding the reverb circuit (points F, G and H).

At the output of the LC we have other RC cells:

- one for the vibrato circuit (point E);
- two in series for the preamplification stages (points C and D)

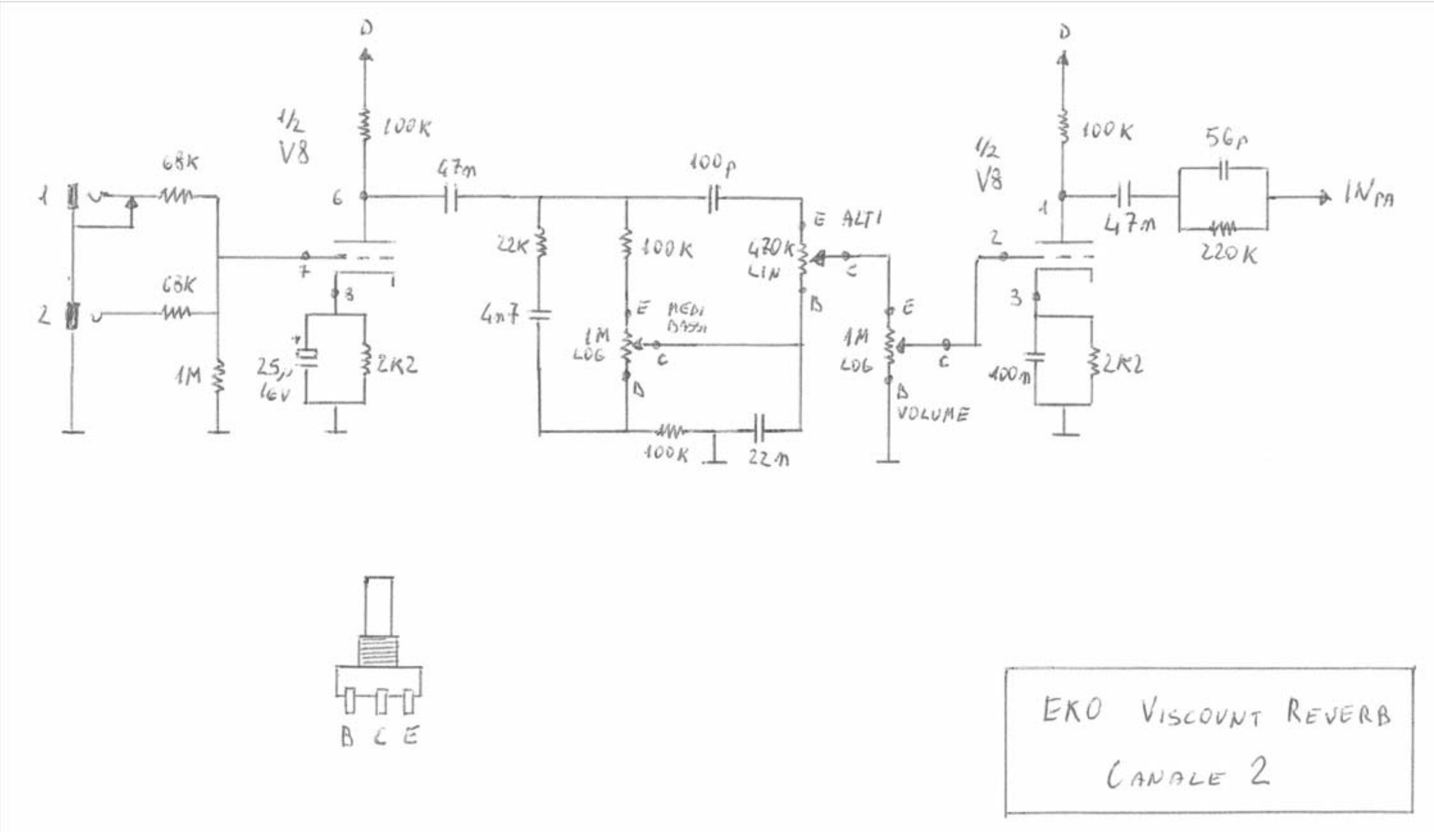
This is a very nice layout, every stage has its own decoupled power supply line, there is no mutual interference at power supply level. I like it very much!

And now a little note for restoration. All the electrolytic capacitors are “vintage”, mine are dated 2/67. It is suggestible to change all of them, this is true for every “over 30” electronic equipment. Old capacitors have the “nice” habit of short-circuiting and sometimes they even explode! In the occasion I will increase their values:

- the 47uF + 47uF 500V (points A and B) will be replaced by a 100uF + 100uF 500V;
- the 16uF + 16uF 400V (points C and D) will be replaced by a 50uF + 50uF 400V;
- the 16uF + 16uF 400V (points E and F) will be replaced by a 32uF + 32uF 400V;
- the 16uF + 16uF 400V (points G and H) will be replaced by a 32uF + 32uF 400V.

After the tests I decided to add a “pop suppressor” in parallel to the mains switch to avoid the “pop” when turning the amplifier off.

CHANNEL 2



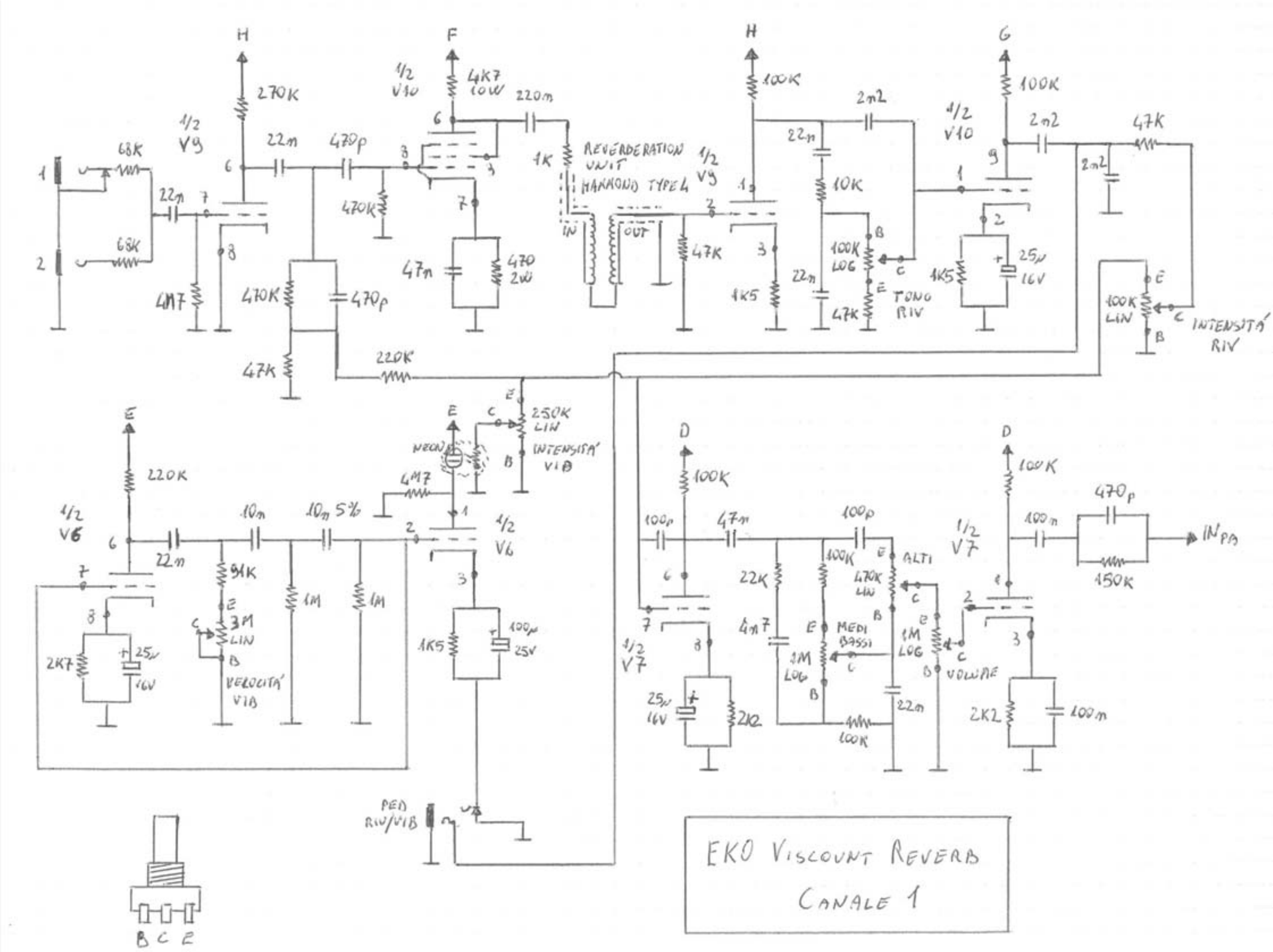
This stage is very simple, it has two gain stages with the tone and volume controls between them. There are two inputs:

- 1 high gain
- 2 low gain

The signal then enters the first gain stage, a standard common cathode circuit, then it goes into the passive tone control network. We have two separate controls, one for basses and mids, the other one for highs. The linearity of this network is for me a real pain in the neck: with both control knobs set to mid position the output is everything but linear. First of all the bass/mid potentiometer is not a linear one, but it is logarithmic, so at mid position, looking at the resistances from the cursor side, we have one half of roughly 150K and the other of 850K. This leads to not having a flat response at mid position. Actually the flattest overall (from signal input to power output) is achieved, in a simulation with the computer, with the bass+mid at minimum position and with the high slightly before the mid position. Moreover, moving the bass+mid control fully clockwise (maximum position) a hole of about 20dB is created around 700Hz. This means that when notes near that frequency (please don't ask me which notes!) are played with a guitar with such a setting of the tone controls cannot be heard at all. Well this is just a simulation, I will check as soon as I will have the amplifier working, but if it will be confirmed I will rework this network to have a more linear behavior.

The output of the tone control network is fed to the volume control then the signal another amplification stage similar to the first one but the decoupling capacitor paralleled to the cathode resistor this time is 100nF and not a 25uF as in the first stage. This leads to a different amplification for basses + mids and for the highs where the gain is higher. I suppose that this is the first attempt to make the overall frequency response more linear. Another attempt is found in the power amplifier stage. At the output of this stage we find a high frequency compensating network that goes to the power amplifier output. That's all for channel 2.

CHANNEL 1



Well it really looks complicated. This channel apart for amplifying the input signal it also adds the vibrato and the reverb effects. Let's see how it works. We have the usual high (1) and low (2) gain inputs that go to the first amplification stage. This one is a little different from the one employed in cannel 2. The bias of this stage is achieved through the grid current flowing in the 4.7M resistor connected between the grid and ground and decoupled from the input by the 22nF capacitor. This was a common way of biasing small signal tubes… well I've never been able to understand the benefits: compared to the usual common cathode layout we can only save one resistor. What a saving!!! But we gain more noise generated by the high value grid resistor. But this is how it was engineered, let's keep it this way. At the output of this stage we find a big mess! Well, not really. We have a passive divider that is connected to the vibrato circuit and also to the second amplification stage, then we also have a high pass filter that feeds the reverb circuit. Let's begin with this one. The reverb has three basic components: a power amplifier (1) that drives the reverberation unit (2) whose output feeds another amplification stage (3). The power amplifier is implemented using the power pentode contained inside the ECL86, it is connected in triode mode and the decoupling cathode capacitor is of relatively small value to have a higher gain at high frequencies: this is OK, it is part of the reverb effect. The reverberation unit is a 4 spring type, it is a Gibbs/Hammond type 4 unit (still in production as I've read in the internet). The output of this unit feeds an amplification stage that drives a passive tone control network, then we have another amplifier to regain what has been lost in the tone control circuit. The output goes both to the reverb/vibrato pedal (for enabling/disabling this effect) and also to the intensity (volume) control.

The other effect is the vibrato one. Actually it modulates a signal in accordance to a low frequency (adjustable) oscillator. All the circuit drawn is the original one, but the two potentiometers that set the speed/frequency and intensity where missing in my amplifier, so searching the internet for other amplifiers employing such an effect with the same circuit I deducted their values. The speed (velocità) control value is not critical, it just sets the frequency of the oscillator, if its value is too small the frequency will be slightly higher that the original one, on the other side if its value is too high the frequency will be lower then the original one. I preferred to have a slightly high value to achieve a wider frequency range. I also put in series to the potentiometer a resistor, this sets the highest frequency for the oscillator, in this case is around 12Hz. In this circuit we have two stages: the low frequency oscillator and the neon bulb driver, all implemented using one ECC83 (V6). I quote a very nice and detailed description of the oscillator I found in internet

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The vibrato oscillator is simply a phase shift oscillator. … What makes an oscillator? The answer is an amplifier with positive feedback. Negative feedback (180°), will reduce the gain of an amplifier. That is how opamps work. They are near infinite gain amplifiers and negative feedback is applied to "tame" the gain to the desired value. Another example of negative feedback is the PRESENCE control of a tube amp. It feeds back the output signal into the power amp input 180° out of phase, but only the low frequencies. This reduces the low frequency gain. Positive feedback causes oscillation. This is achieved in the circuit below by using three resistor capacitor networks. A pure capacitive network is a 90° phase shift. The series capacitor and shunt resistor network in this case provides about 60° of phase shift. Since the tube amplifier output to input is 180°, following the output with three 60° RC networks (3 x 60 = 180), results in 360° of phase shift, which is positive feedback. … The other part of the circuit is the tube that drives the opto-isolator. The opto-isolator is nothing but a neon lamp in heatshrink tubing with a light dependent resistor (LDR).

If the light is on, the resistance is low. If the light is off, the resistance is high. The LDR is shunted across the vibrato channel output, and effectively amplitude modulates the signal. The intensity control applies the LDR to the signal, or shunts it more to ground, causing less vibrato.

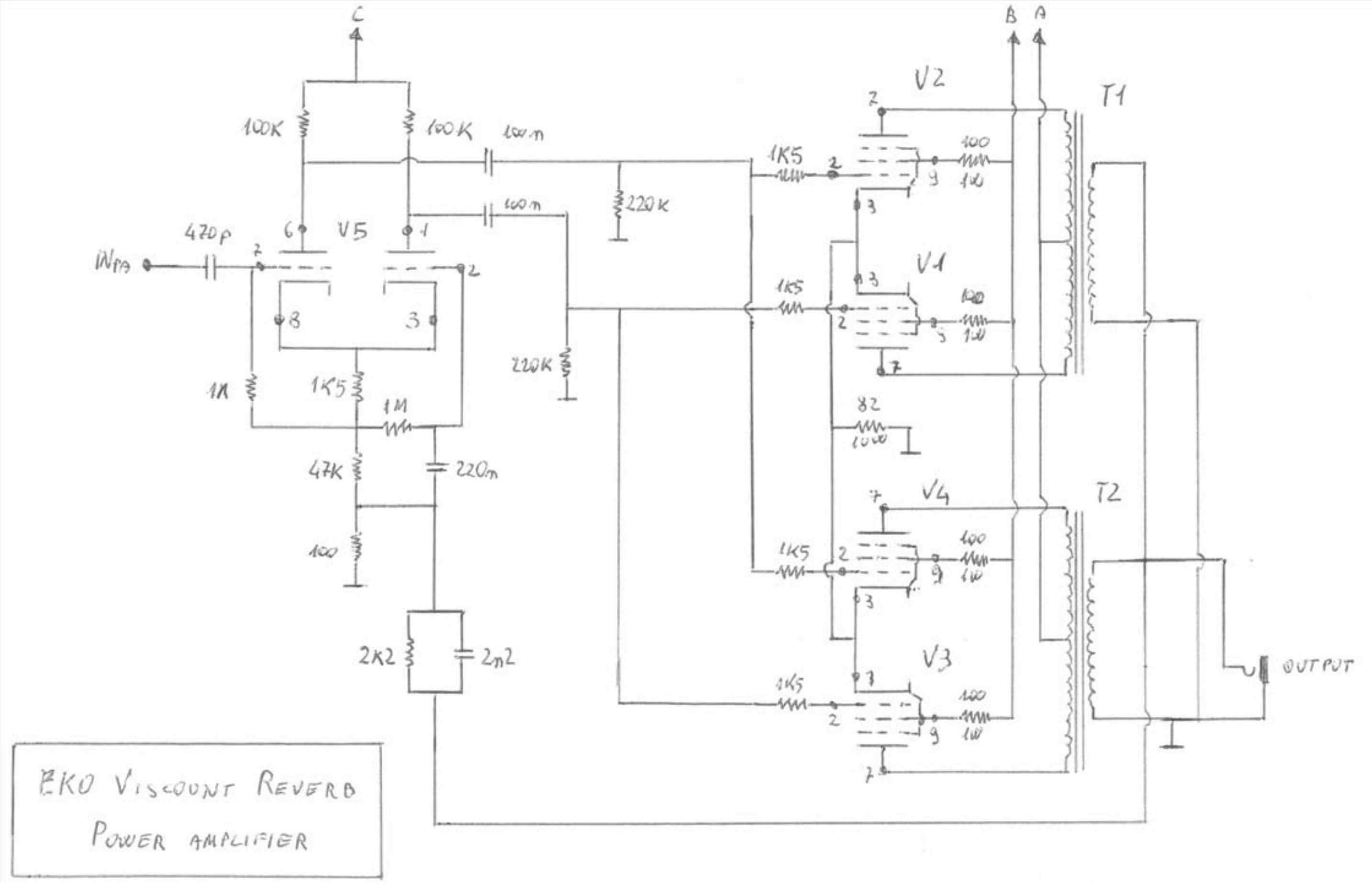
The network connected to the cathode of the neon bulb driver goes to the vibrato/reverb pedal, when it is ground connected (it is by default because of the switch installed in the front panel jack) current flows in the triode and, of course, even in the neon bulb, so the effect is engaged, when the network is not connected to ground (switch open) no current flows and the effect is disengaged. The LDR is connected to the intensity control whose cursor is linked to the first amplification stage output passive divider (part of the mess I was talking about before) and also to the output of the reverb effect where we have another passive divider. So the vibrato is applied to both the signal of the guitar and to the reverb. This looks correct to me. The impedance seen by the passive dividers is that of the LDR that continuously follows the oscillator, so also the attenuation of those passive dividers changes accordingly to the oscillator. Simple! The overall gain of this mess is approximately 1, no gain! So we have another amplifier, identical to the one employed in channel 2, apart from a little high frequency compensation at the input (the 100pF capacitor between the anode and the grid of the first triode) and the network at the output, probably compensating the different behavior of previous circuits.

A little note about the vibrato intensity control. The value of this potentiometer is critical because:

- it changes the amount of the effect added to the other signals (guitar sound and reverb effect);
- it affects the overall gain of the two stages, the lower the value, the lower the gain;
- the amount of the vibrato applied, independently from the knob position, is strictly dependant from its value, the lower the value, the lower the amount but with higher values setting the amount becomes difficult;
- moving the knob affects the overall gain of the two stages, the higher the value, the higher the interference.

I made some simulations and I chose its value (50K) taking in account the best balance between interference with the gain and the amount of effect in the working range of the LDR. Probably it is not the original value but it should work fine.

POWER AMPLIFIER



The signals coming from channel 1 and channel 2 preamplifiers are mixed at the input of this stage where we have a high pass filter, I suppose that is used not only to cut low frequencies, but also to compensate that funny behavior of the tone controls. The first amplification stage is a phase inverter (I call it a differential amplifier) whose outputs feed the output push-pull stages. We have an interesting implementation: instead of paralleling tubes two by two as it is usually done, here we have two identical independent output stages each using two EL84 and one transformer, the outputs of the transformers are paralleled. The output stage is pure pentode as in most cases (Vox, Marshall, Fender, etc.) and not ultralinear as in some Selmer amps of the same years. We also have negative feedback from output to input (the differential amplifier). It is quite a bit, so I suppose that this power stage has not a “soft clipping”, it keeps on singing at almost full power then it suddenly starts screaming. Vox AC30 and AC15 have no negative feedback. At the moment I can't tell you exactly if the output tubes are class A or class AB biased, for sure they are not class B because for this class of operation a fixed bias is needed and in this amplifier automatic polarization is used; most likely, reading the datasheet and considering the cathode resistor value, the polarization should be for class AB operation. There is another interesting feature of the output stage: all cathodes are connected to a single un-bypassed resistor. Well this can be done with class A push-pull output stages because the current flowing in that resistor is constant all over the working range of the output devices, as a consequence also the voltage drop across it is constant and therefore there is no need for a bypass capacitor… in theory, because this works only for devices with identical characteristics and in real life this does not happen even in the case of a strict selection of the devices. In class AB the current is approximately constant only with small signals (i.e. a few watts at the output), with higher signals the output tubes alternatively switch off (this is how class AB works) and the cathode current is not anymore balanced, it keeps changing and so does the voltage drop across the cathode resistor. This leads to a local negative feedback that decreases the gain of the stage and, at the same time, increases the output impedance and, of course the damping factor of the output stage (the basses usually become muddy). That’s why in class AB and class B output stages for audio use a bypass capacitor is always used, even for class A ones. If you take a look at a Vox AC30 schematic you will find the capacitor (250uF). This capacitor is employed also in the Eko Herald, Duke and probably also in the Zodiac. In my amplifier there is no clue of its previous presence, as soon as I will have the amp back working I’ll make some measurements and listening sessions and I’ll decide if it is necessary or not; by the way there is already a 470uF 63V capacitor waiting on the desk! There is a suitable place for it, it looks like that this amplifier was engineered to have it but someone decided not to install it!

RESTORATION HAS BEGUN! – THE INSIDE

POWER TRANSFORMER

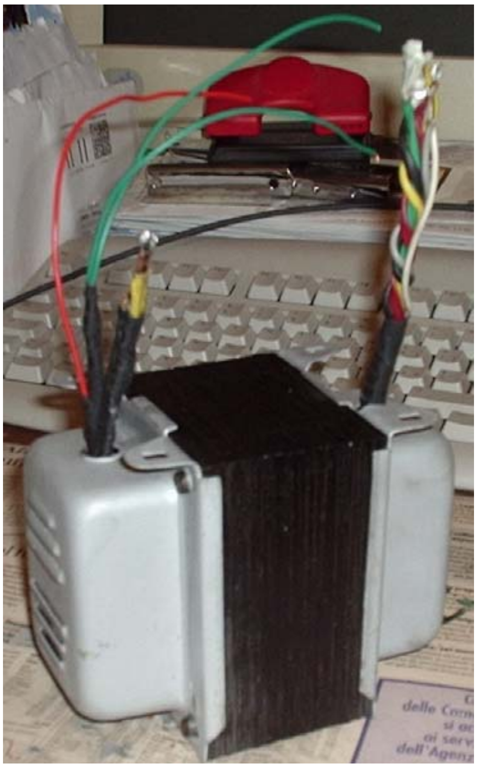
That’s how it looked before the plastic surgery.

After removing the case I had a surprise: the primary winding wires are OK…

… but not those of the secondary windings: look at the high voltage wires (two green and one red) almost completely without insulation! Also the low voltage wires (the yellow ones) are not in good condition.

No way! It can’t stay that way! I replaced and insulated those wires.

End of the job with the zinc painted shields replaced.



REVERBERATION UNIT

This is a Gibbs/Hammond type 4 spring reverberation unit, unfortunately at the moment I have no other information available about the exact model. The outside did not look nice at all, but fortunately the inside was in very good shape with no rust on the springs. I mechanically removed the rust with sand paper, then I painted the case with a zinc based paint and then I changed the RCA pins and the rubber noise insulators.

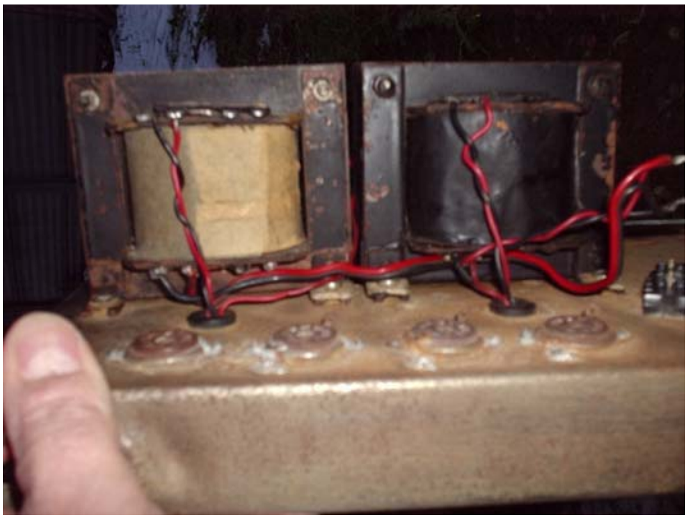
Before…


… and after

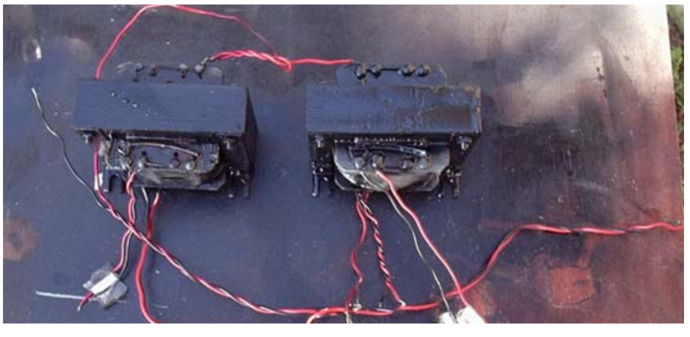
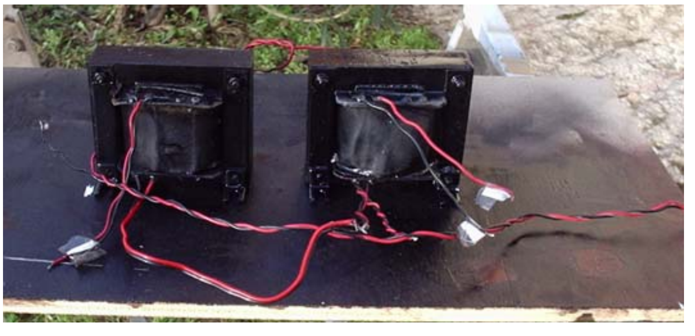

OUTPUT TRANSFORMERS

At the beginning it looked like no big job was necessary for them, only some cleaning and black paint, and that's what I did.

Before…

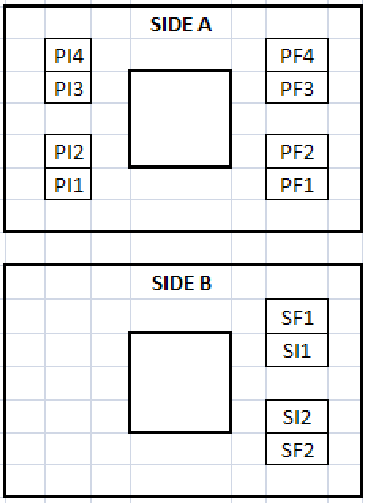



… and after

But when I switched the amplifier on I realized they had problems because I could not get anything more than a 9W. I tried first changing the power tubes, I swapped 2 new couples but I still could not get any further. Everything seemed fine, but it wasn't. After 30 minutes of measurements I decided to retest the transformers and I found that in both transformers one of the primary windings (there are four in each transformer) was interrupted. I fixed them but when I powered the amp again another primary winding blew up. Probably in all these years of far from perfect storage the insulating paint got damaged and the wires oxidized in some points, it was not possible to try to fix them again. I bought a new couple from an artisan in Milan specialized in transformers. By the way, I searched for the original part and it seems to be a Philips PK 508 12 (15W output power, 7 Ohm secondary, 8 KOhm plate to plate). It might be useful to attach the winding specifications of the original output transformer that should be common to all Eko production of the late sixties (Zodiac, Valet, Duke, Herald, Prince and of course Viscount) employing a push-pull of EL84 in the output stage.

SECTION	TERMINAL	TURNS	WIRE DIAMETER (mm)	INSULATOR BETWEEN LAYERS	DIRECTION	TOTAL TURNS
P1	PI1	204	0.22	THIN	CLOCKWISE A->B	1,710
		204		THIN	CLOCKWISE B->A	
		204		THIN	CLOCKWISE A->B	
		204		THIN	CLOCKWISE B->A	
		204		THICK	CLOCKWISE A->B	
		204		THIN	CLOCKWISE B->A	
		204		THIN	CLOCKWISE A->B	
		204		THIN	CLOCKWISE B->A	
	PF1	78		THICK	CLOCKWISE A->B	
S1	SI1	53	0.85	THICK	CLOCKWISE A->B	96
	SF1	43		THICK	CLOCKWISE B->A	
P2	PI2	207	0.22	THICK	CLOCKWISE A->B	1,707
		207		THIN	CLOCKWISE B->A	
		207		THIN	CLOCKWISE A->B	
		207		THIN	CLOCKWISE B->A	
		207		THIN	CLOCKWISE A->B	
		207		THICK	CLOCKWISE B->A	
		207		THIN	CLOCKWISE A->B	
		206		THIN	CLOCKWISE B->A	
	PF2	52		THICK	CLOCKWISE A->B	
P3	PI3	205	0.22	THIN	COUNTERCLOCKWISE A->B	1,670
		205		THIN	COUNTERCLOCKWISE B->A	
		205		THIN	COUNTERCLOCKWISE A->B	
		205		THIN	COUNTERCLOCKWISE B->A	
		205		THICK	COUNTERCLOCKWISE A->B	
		206		THIN	COUNTERCLOCKWISE B->A	
		205		THIN	COUNTERCLOCKWISE A->B	
		195		THIN	COUNTERCLOCKWISE B->A	
	PF3	39		THICK	COUNTERCLOCKWISE A->B	
S2	SI2	56	0.85	THICK	CLOCKWISE A->B	96
	SF2	40		THICK	CLOCKWISE B->A	
P4	PI4	205	0.22	THIN	COUNTERCLOCKWISE A->B	1,690
		205		THIN	COUNTERCLOCKWISE B->A	
		205		THIN	COUNTERCLOCKWISE A->B	
		205		THICK	COUNTERCLOCKWISE B->A	
		205		THIN	COUNTERCLOCKWISE A->B	
		205		THICK	COUNTERCLOCKWISE B->A	
		205		THIN	COUNTERCLOCKWISE A->B	
		205		THIN	COUNTERCLOCKWISE B->A	
	PF4	50		THICK	COUNTERCLOCKWISE A->B	



E-I CORE and INSULATOR SPECIFICATIONS	
CORE WIDTH (mm)	27.0
CORE DEPTH (mm)	32.0
CORE HIGHT (mm)	45.0
I WIDTH (mm)	96.0
I HIGHT (mm)	16.0
I THICKNESS (mm)	0.6
NUMBER OF PIECES	51.0
E WIDTH (mm)	96.0
E HIGHT (mm)	64.0
E THICKNESS (mm)	0.6
E INNER (mm)	32.0
NUMBER OF PIECES	51.0
INSULATOR THICK (mm)	
INSULATOR THIN (mm)	

CONNECTIONS		
SIDE A	PF1 + PF4	ANODE 1
	PF2 + PF3	ANODE 2
	PI1 + PI2 + PI3 + PI4	+V
SIDE B	SI1 + SF2	SPEAKER
	SF1 + SI2	SPEAKER

DIMENSIONS	
WIDTH (mm)	96
HEIGHT (mm)	80
DEPTH (mm)	27
DISTANCE BTW HOLES FRONT (mm)	80
DISTANCE BTW HOLES SIDE (mm)	55

INDUCTOR

Another fast and easy job: some cleaning, light rust removal plus transparent and insulating paint to avoid future rust. The insulation of the two wires was broken in some points, I fixed it with heat-shrinkable tube.

CHASSIS

The case and the chassis restorations are the biggest jobs of this project. First of all I removed all the electronics from the chassis: components board, front panel jacks, potentiometers, transformers, inductor and the two big electrolytic capacitors. Here are some pictures of the naked chassis.




The chassis was slightly bent in some places, probably because of the heat coming from the power transformer and from the output tubes or because of some hits during transports. I straightened it and then I removed the rust, first mechanically (sand paper) and then chemically with a first bath in phosphoric acid, also useful for rust proofing.

Some welds were needed to restore cut away parts and to fix the two wands between the front and the back sides.

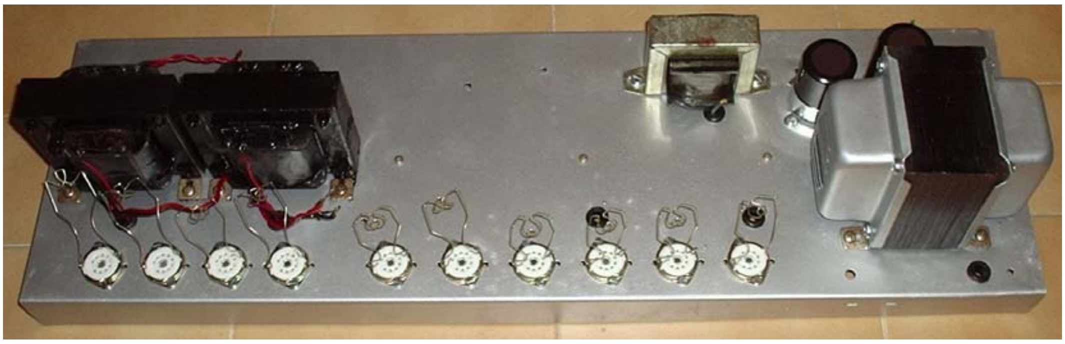
The chassis is now almost ready for the final work. One electrolytic capacitor needs a larger hole to fit its pins and four more holes for the clamps' screws of both capacitors. The original sockets are in such a bad condition that all need to be replaced: all retainers are missing and the silvered contacts have no more silver attached to them, only thick oxidation and rust. Sockets identical to the original ones (noval, bakelite, chassis mount with retainers) are no longer available, there are only the ceramic ones. I chose the type with normal contacts, because the gold plated ones have too little gold on them and this causes more problems than those the plating is supposed to solve.

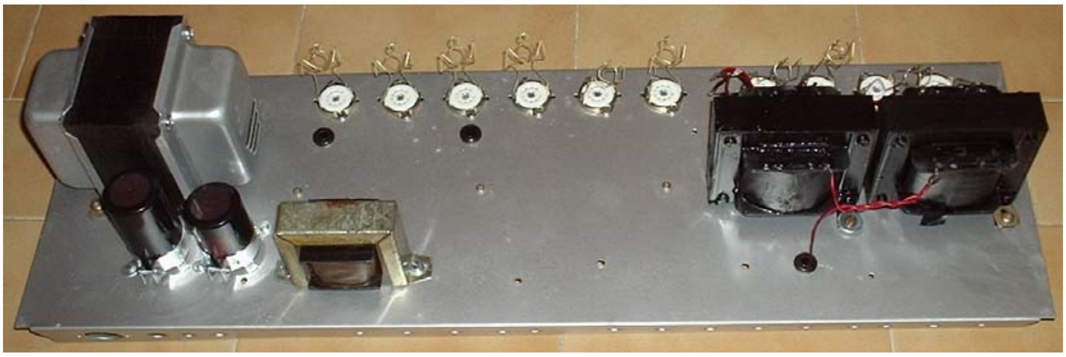
The new sockets need larger holes because they are bigger than the original ones and, due to the different orientation of the pins, new holes for the screws need to be drilled.

I'm taking the chassis back to the blacksmith to complete this job. After the restyling for further rust removal & proofing the chassis will spend some more hours in a phosphoric acid bath and it will be ready for the final finishing.

Originally the cassis was lightly chromed, but now all the chrome has been detached from it because of rust, bends & cuts, welds and holes enlargements. I think that the final look would have been horrible with the chrome back again and so the cost would not be justified. I painted it with a zinc based paint exactly as I've done with the power transformer and with the reverberation unit.

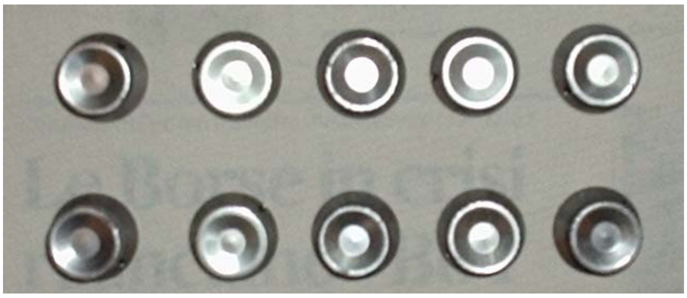
After the painting work I started reinstalling the components: irons, two big electrolytic capacitors and tube sockets with retainers.





KNOBS

Originally there were two knobs missing, those of the vibrato controls, and one more is almost gone while disassembling the amplifier: although I tried very hard I was not able to unscrew its screw, so I had to take it out of the potentiometer in a “hard” way. Luckily I found three knobs on eBay in a more than excellent shape! I then cleaned all of them and enlarged the holes to be able to fit them on the new potentiometers.



JACKS & POTS

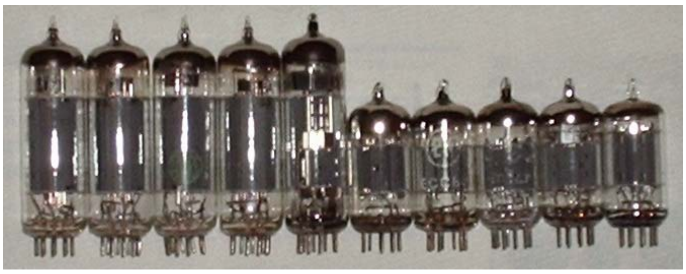
The potentiometers are all Alpha apart for one CTS for the vibrato speed control. I’m going to change the mains switch too because in the original one part of the chrome has gone away.

The jacks are all Switchcraft apart from the footswitch and the phones ones. You can foresee some add-ons I’ve already planned: this amp will have phones output and two jacks for the loudspeakers, obviously plugging the phones in will disable the loudspeakers, it’s a very little and super fast add-on that will make in home use more comfortable.

TUBES

It took me three hours of searching in my OOS (Old Old Stock) and testing using my AVO Mark III mutual conductance tube tester, but finally I have all the tubes for the amp tested and matched. The result is:

- three Telefunken ECC83 (one with long plates);
- one Siemens ECC83;
- one EK ECC83, it tested much stronger than the others and will be installed as the driver for the output stage;
- one unknown brand ECL86;
- four EL84/6P14P Reflector military Russian tubes.



The matching I've done for this amplifier, considering it is not audiophile/high end, is for me very satisfactory:

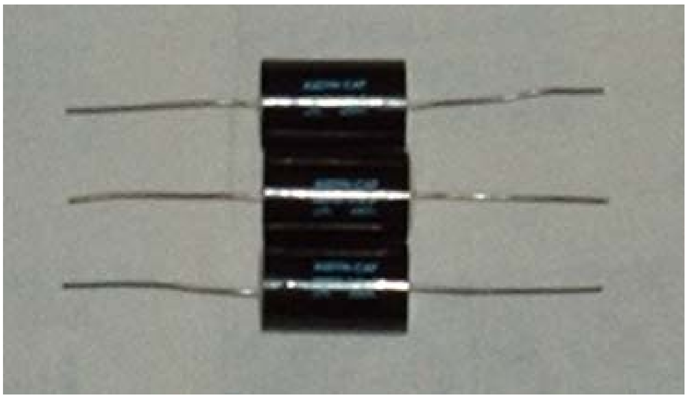
- ECC83 within +-3% for each section of each tube, +-5% between tubes;
- EL84 +- 5% between tubes.

A little note about tubes. I do not like brand new (chinese) tubes, they test and sound much worse then the old ones, no matter if they are NOS or used but in good condition. Nowadays NOS tubes have terrible prices, so brand new ones are the only choice for projects that are not "cost no budget". For my audio equipment I only use military grade Telefunken, Siemens, Mullard, Philips, Amperex and Tungsol tubes, in my opinion they are the very best; in the future I'll give a try to Russian NOS tubes, so far I only tried their equivalent to 6SN7 but I didn't like the result, red boxed low microphonic Tungsol are "miles away".

CIRCUIT BOARD

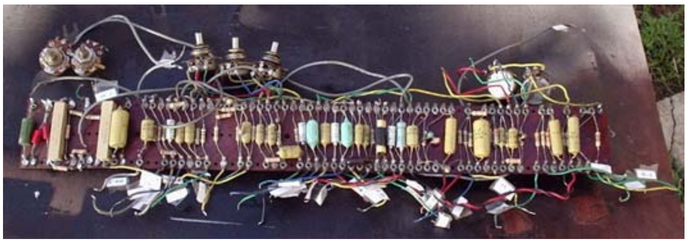
It's time to lay my hands on the electronic circuit board! While reverse engineering this amp I spent some time in testing all the resistors to place an order for all the electronic components. Apart from the "mustard" capacitors that will be tested with power applied to the amplifier, electrolytic capacitors, small capacitors (56pF, 100pF and 470pF), potentiometers, solid state diodes, shielded cables and out of tolerance resistors are all going to be replaced. Because of the increased filter capacitors values I decided to employ bigger diodes: BY255 rated 1300V 3A, stronger that the original BY127 rated 1250V 1A.

I decided also to replace the original coupling capacitors in the critical points: the reverberation unit driver and the output tubes. The others are not critical because, in case of leakage the maximum current flowing in the following tube is limited by both the anode and cathode resistors that have high values. If the coupling capacitor of the reverberation unit driver fails, the input stage of the reverberation unit would be blown away. On the other side if one of the coupling capacitors of the output tubes (those before the control grids) fails the current in two output tubes would raise dramatically leading to sure damage of the tubes and, in worst cases, of the output transformer too. These are definitely issues I want to avoid, so here we have brand new Audyn Cap capacitors waiting to be installed on the circuit board and also military grade paper in oil (PIO) and aluminum-teflon capacitors.

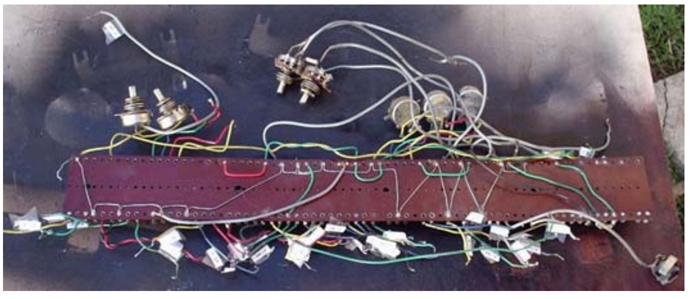


Let's take a look at the original circuit board. It's very well engineered and constructed, the layout is neat, especially the ground paths have no loops at all, not only considering the board itself, but also the shielded cables to and from the reverberation unit, to and from the front panel jacks (inputs and footswitch), to and from the controls (volume and tones), moreover the grounding is done at the output of the circuit, as it should be. There are tons of articles about grounding schemes to be used in audio equipment (CD players, amplifiers, etc.). An in depth look at this 1967 amplifier tells you all. Great school!

Front side…



… and back side

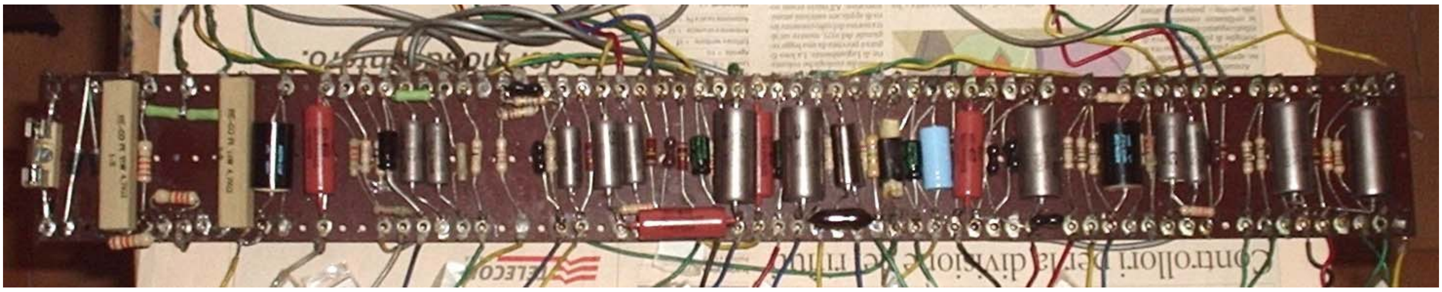


As you can see while disassembling the amplifier I put some stickers on all the cables I detached from the transformers and from the tube sockets: this will be of great help when I'll put everything back together because I will not have to continuously check the schematic diagram.

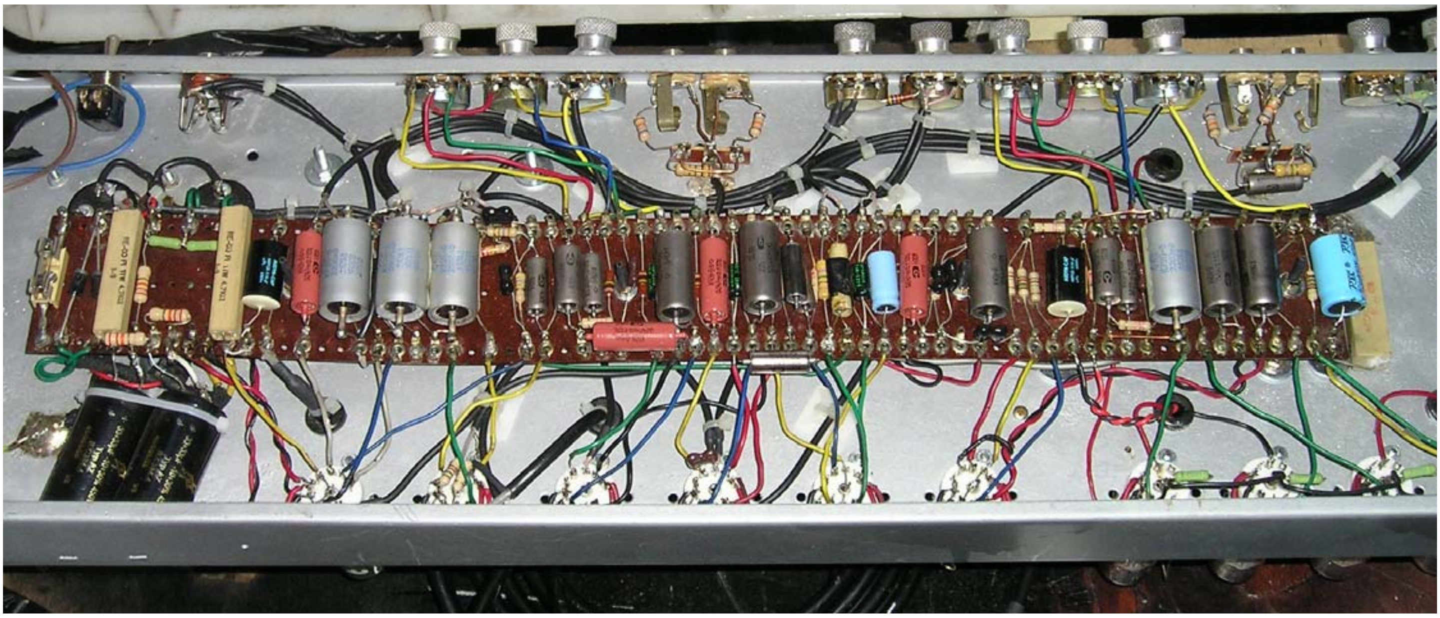
The replacements…

… and everything that was replaced!

After some time with the soldering iron in (and on!) my hands the job is almost done.

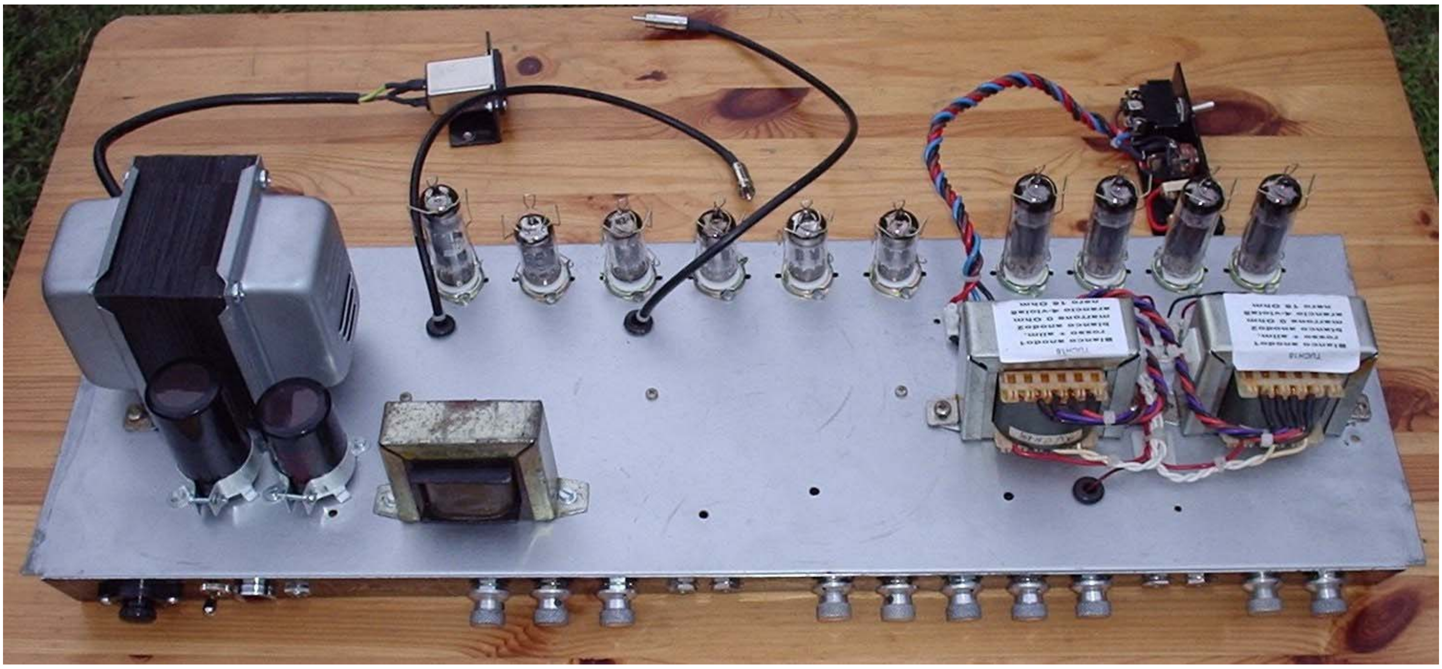


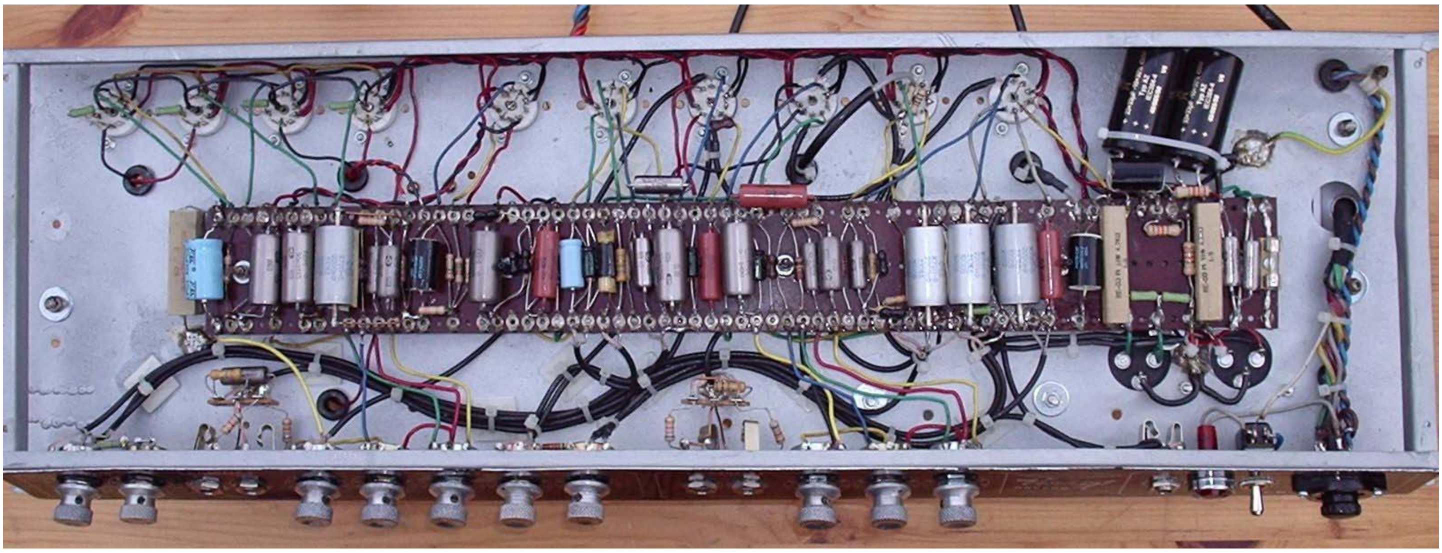
It took me many hours to refit the electronic board inside the chassis. It was not a mere “screw & weld”: I changed all the shielded wires rooted them as far away as possible from high voltages and from the AC heaters supply, then I fastened them with cable ties, I also finished their terminations with a heat shrinkable tubing. Not a very “vintage” solution but good for safety and trouble free operation. I again had some troubles with the “new” PIO and teflon capacitors: because of the diameter some of them were a little bit too “high” and it would have been difficult, if not almost impossible, to refit the chassis inside the cabinet, so I had to reposition other components in order to gather some space to correctly position them on the board. At the end I sprayed PCB insulating paint on both faces of the board. I have to admit that from time to time I stopped working to admire the job: I really like it!



In the internet, thanks to an extremely kind guy that patiently answered my requests I had the opportunity to view pictures of an Eko Prince Reverb and to check the components values of the vibrato circuit. My suppositions were almost all correct apart from the intensity control that is a 50K linear potentiometer and the resistor in series with the frequency (VELOCITA’) control that is 56K.

After 8 months finally the electronics are finished.

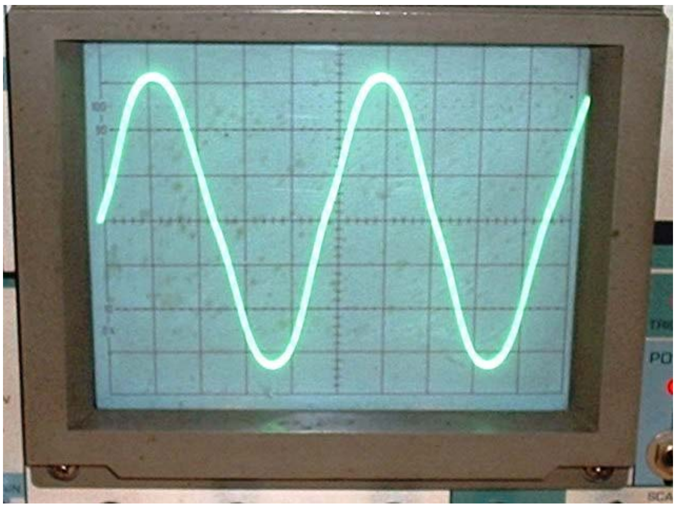




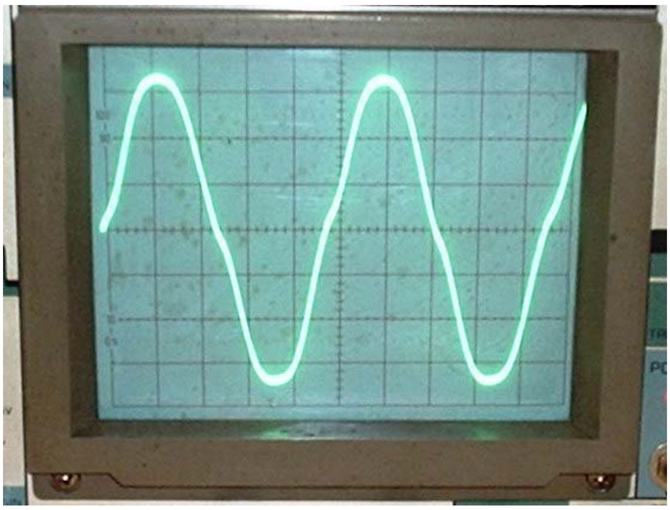
SOME TESTS

It’s time to connect the amplifier to the instruments and take a look at the performances. Here are a couple of shots.

One at the first signs of saturation, 25W/4 Ohm…



… and the other at approximately 10% THD while delivering 30W/4Ohm, I consider this its maximum power output.



WHAT WAS WRONG IN THE ELECTRONICS

Some jobs I've done to the electronics were more preventive than actually fixing. The substitution of the electrolytic capacitors is a good habit when you deal with vintage electronics and high voltages. I found some resistors out of tolerance (>15%) and other three were interrupted. Both the resistors of the reverberation unit driver had greater values leading to a lower gain and higher output impedance of this amplification stage; one resistor of the phase inverter of the power amplifier was interrupted so only a half of the output stage worked and the distortion was high. The most interesting thing was the interrupted 4.7M resistor of the neon driver of the vibrato effect: this prevented the circuit from working. This failure probably convinced the previous owner to internally install another circuit of which the only clue was the two different potentiometers installed in the chassis. Other issues came from the potentiometers. Although they were not interrupted and had a good mechanical movement their values were all out of specs. The 1M ones (volume and bass+mids) were between 800K and 1.3M and the 500K ones (treble) were about 800K, this would have prevented a good performance of the tone control network. Front panel jacks and tube sockets were far beyond any possible restoration, new ones were a must! All these issues may look like a disaster and in fact it almost is, but let's not forget where I found this amp (junk yard) and where it has been stored for 18 years: in a loft, humid, cold in winter and awfully hot in summer, definitely not a proper place for electronic equipment!

I could have stopped at this point but it would not have been good enough for me. The original tubes were in still good shape but I decided to change them with selected and matched ones, all apart from the ECL86. At this point my aim to have almost perfect electronics took control of my mind. Those 40 years old coupling capacitors made me think a lot, I was worried that sooner or later a failure would have been experienced. I have looked for some time for capacitors of the same brand, the so called "Mullard mustard", but I could only find used or NOS ones at high prices. In my opinion NOS is fine but it depends what we are referring to. It is for tubes, transformers, knobs, etc. but when we talk about passive components such as resistors and capacitors the scenario changes… dramatically! The characteristics of this type of components are not static, they change as time goes by. This is due to use, storage, humidity, temperature and age. The degree of such changes also depends on the quality of the components, meaning for example if they were produced according to standard specifications or to military ones. A NOS capacitor that has been properly stored, after many years might be like new. Unfortunately nobody can guarantee the "proper storage". A NOS capacitor that for example has been stored in a humid place with high changes of temperature might have capacitance out of tolerance, current leakings because the internal structure oxidized or it might fail after a few hours of use. Keeping all this in mind I decided to change the remaining capacitors too. I decided to install components with sonic characteristics similar to the original ones. The usual metalized film (MKP, MKT and so on) are of course out of the game; no NOS Mullard mustards stored in a nice "nobody knows where"… so what else? The answer is quite simple: military grade PIO russian capacitors, but only aluminum foil, no metalized paper, so I chose the K40Y-9 (aluminum-paper-oil) and the K72P-6 (aluminum-teflon) types, probably among the best capacitors for sonic performance. And here is their internal structure.

They are NOS… so what about what I've just written??? Well, first of all they are all military specs; they are air tight because glass sealed, so no air can go inside; they come from military surplus so there are many many many more chances that they have been properly stored than for those "found in the shop of an old TV technician that passed away" and, last but not least, the ones I bought have been made in the late '80s or early '90s, not 20 or 30 years earlier. This, in my honest opinion, is a huge difference and a good guarantee of many years of trouble free service. The only 220nF MKT Audyn Cap are the coupling capacitor of the reverberation unit and the one in the negative feedback loop.

RESTORATION CONTINUES – THE OUTSIDE

FRONT PANEL BADGE

This would have not been a tough work if that horrible hole would have not been drilled in to this badge.

Anyway, after a couple of nightmares I came to a solution. First of all I took the faded black paint back to its original black color. I used a thin polishing compound, in the next picture you can see the difference between the untreated (left) and the treated (right) paint.

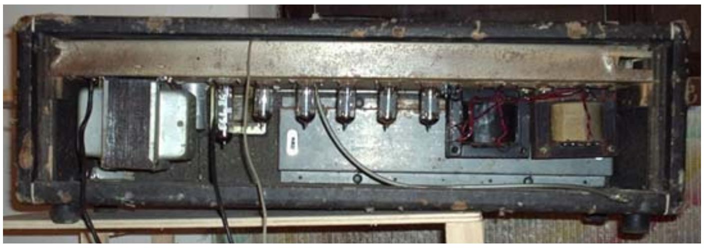
Now it's time to fix the hole. I cut a round piece of aluminum sheet of the exact measure and shape of the hole, with a hammer I fixed it in the hole then I finished the job with some resin. I chose this solution because there was no way to weld a sheet without damaging the paint and the writings around the hole. Here is the result, still to be painted.

Black paint…

… some artwork and transparent paint and the job is done!

CABINET

Now that the work on the electronics is finished it’s time to take care of the outside. The tolex was beyond restoration, there was no way to get it in a comparable shape of what will be inside.



First step is to remove the old tolex without damaging it in order to have cutting guidelines for the new pieces.

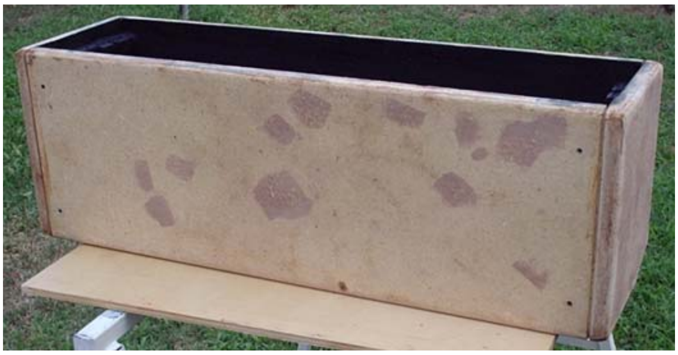
The old pieces…

… and the new ones.

Then it is the cabinet turn: I removed the old glue and filled all voids caused by use, cigarettes (!) and water with a wood filler, then I smoothened the surfaces with sand paper. The same for any other irregularity in the surface or edges, such as small gaps in box joints. The top of the cabinet was slightly bent, this is how I got it almost straight again.

Some black paint inside before the “sticky job”.

The result just before applying glue and tolex.



And here is the final result after replacing the logo badge, handle and feet.

I had also to rebuild the back side cover because it was missing. Here you can see the pieces…

… and the final result.

Having new transformers with 4-8-16 Ohm outputs that paralleled give the possibility of connecting 2-4-8 Ohm loudspeakers I decided to have a connector for phones (connected to the 2 Ohm output) and two jacks for loudspeakers connected to an impedance selector (4-8 Ohm).I installed everything on a panel to be screwed in the rear side.

Another facility I added is the IEC connector. Not vintage at all, but safer and more comfortable than the original fixed cable. Moreover, I used one with an EMI filter inside to have a cleaner supply.

The final result!

LOUDSPEAKERS

After 8 months of searches finally an ad came up: on sale a 2x12 Eko cabinet of the late sixties. I contacted the seller asking for photographs. Oh yes, it is the original one!!! It has only one loudspeaker and not original, it's a Jensen C12K. Well, not too bad, I already have two cones of the sixties waiting to be installed in a cabinet. Here it is when I received it.

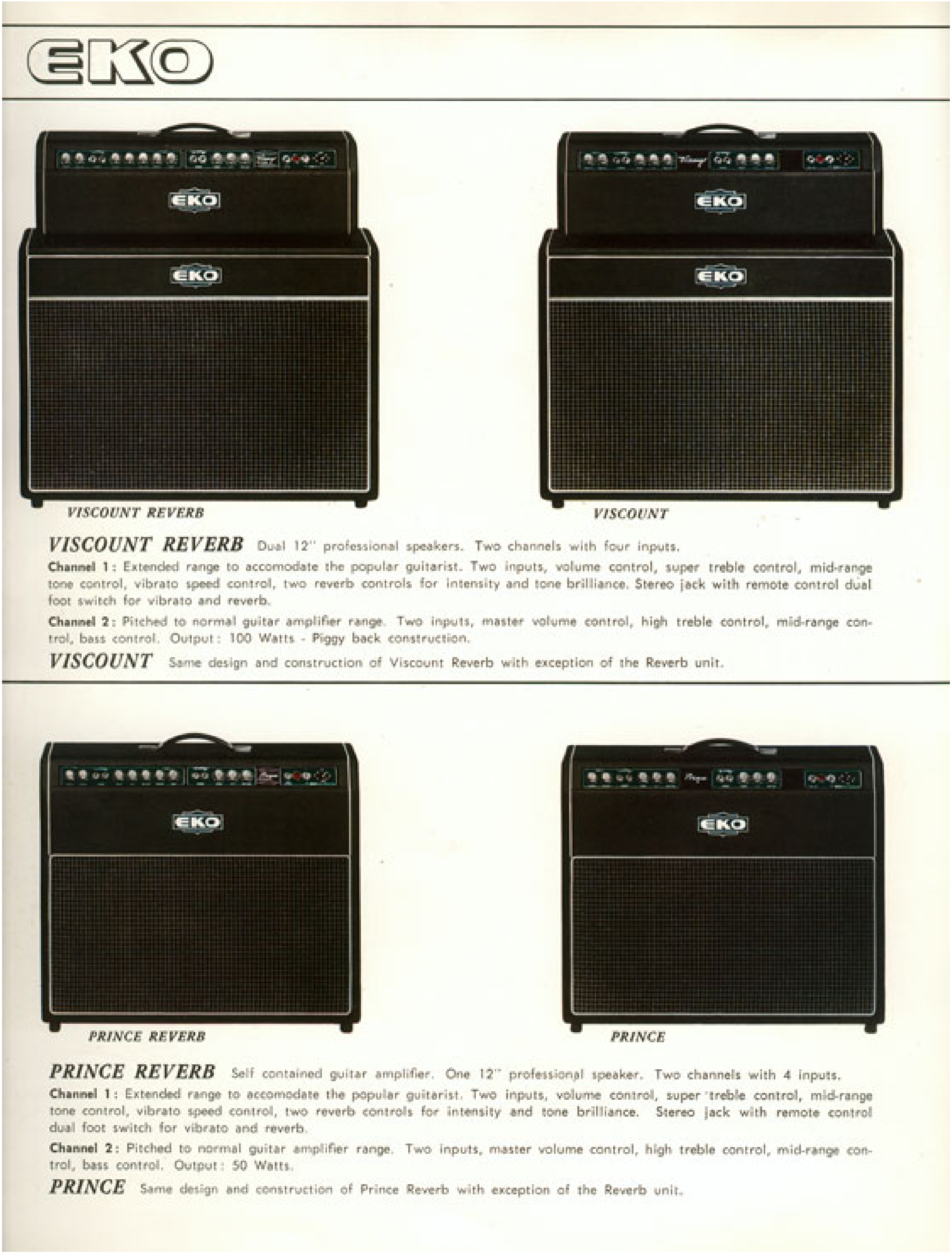
I removed the Jensen loudspeaker and installed mine. After a couple of days spent on restoring the tolex using some pieces cut from the one of the amplifier, new screws on the rear side, a new handle and here is the final result.

In the meantime something else happened. One day while parking my car near the office I saw a P.A. speaker case (only the cabinet, no cones nor the crossover network in it) laying on the ground. After 10 seconds it was in the trunk of my car. It was all painted with some sort of red paint that never dried and there was a rectangular hole on the top. Ugly indeed! Anyway, I took it home and began working on it. I removed all the corner protections, the handle and the jack plug. It took me a long time to remove the paint from the cabinet and from all the parts. The tolex was almost perfect, great! I only had to fix the hole and to cover it with some tolex. After three hours of work the cabinet was almost like new! During 2009 summer holidays a neighbor decided to clean up the cellar and gave me a pair of loudspeakers with a broken woofer. I didn't need the woofer, because it was too small (20 cm - 8"), but I used the crossover and the tweeter (a very nice one with aluminum horn). I drilled a hole for the bass reflex tube, I recovered the damping material from the loudspeakers and carefully fitted and fixed inside the cabinet, then I installed the crossover, the Jensen C12K woofer and the tweeter with its level control. I used a grill to protect the woofer. Here is the speaker for voice and/or acoustic guitar that cost me… €12,90 of paint thinner!

THE COMPLETE SYSTEM

WAS IT WORTH THE EFFORT?

That's a question I asked myself several times. When I decided to begin this project I thought that in about six months I would have finished everything. During this period I had some issues with the electronics (original schematic, output transformers, some components were difficult to find, etc.) that slowed me down. Then I decided to have the complete system almost as sold back in 1967, more searches to be performed that added to other things I had to do. At the end it took me almost two years to finish. So it's really difficult to answer the question. I have no idea of what should be the current quotation. I've seen some ads for the Prince Reverb ranging from €450 to €550, not restored, in a "as is" condition but anyway well kept. The Viscount with it's 2x12 loudspeaker was the top of the line in 1967 catalog, although not completely original (loudspeakers) and with the effects foot control still missing.


EKO

VISCOUNT REVERB

VISCOUNT

VISCOUNT REVERB Dual 12'' professional speakers. Two channels with four inputs.

Channel 1: Extended range to accomodate the popular guitarist. Two inputs, volume control, super treble control, mid-range tone control, vibrato speed control, two reverb controls for intensity and tone brilliance. Stereo jack with remote control dual foot switch for vibrato and reverb.

Channel 2: Pitched to normal guitar amplifier range. Two inputs, master volume control, high treble control, mid-range control, bass control. Output: 100 Watts - Piggy back construction.

VISCOUNT Same design and construction of Viscount Reverb with exception of the Reverb unit.

PRINCE REVERB

PRINCE

PRINCE REVERB Self contained guitar amplifier. One 12'' professional speaker. Two channels with 4 inputs.

Channel 1: Extended range to accomodate the popular guitarist. Two inputs, volume control, super treble control, mid-range tone control, vibrato speed control, two reverb controls for intensity and tone brilliance. Stereo jack with remote control dual foot switch for vibrato and reverb.

Channel 2: Pitched to normal guitar amplifier range. Two inputs, master volume control, high treble control, mid-range control, bass control. Output: 50 Watts.

PRINCE Same design and construction of Prince Reverb with exception of the Reverb unit.

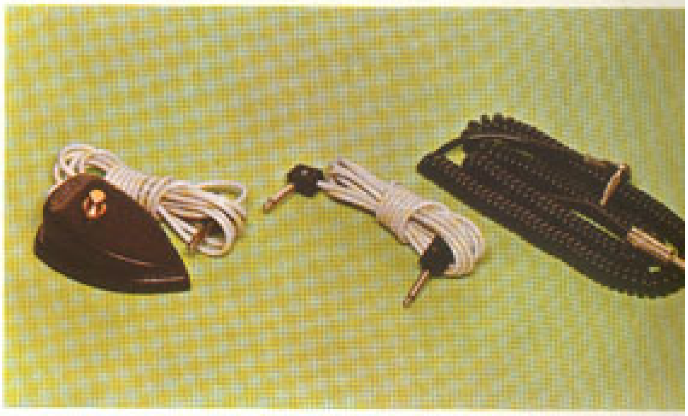
Amplifiers

SUPER DUKE

Designed for electric bass and electronic organ. **Specifications:** Two 12" heavy duty professional speakers. One channel with two inputs. Master volume control, high treble tone control, mid-range tone control, bass tone control. Output: 100 Watts. Piggy back design.

DUKE

Designed for electric bass and electronic organ. One 12" heavy duty professional speaker. One channel with two inputs. Master volume control, high treble tone control, mid-range tone control, bass tone control. Output: 50 Watts. Self contained.



VALET

For guitar. One 10" Hi-Fi speaker. One channel, 2 inputs, volume control, tone control, vibrato intensity control and vibrato speed control. Input jack for vibrato foot switch. Output: 30 Watts.

EKO makes a complete line of amplifier accessories including Reverb unit, curly cords, dual and single foot switches, covers for all amplifiers, foot pedal volume control, amp-dollies and "Y" cables.

I do not want to think at the money spent, but let me tell you that considering all the hours spent on this system… well I wouldn't do it again for anybody. For me it has been a pleasure doing it for my nephew and sharing this experience and information with anybody who is reading these notes. I hope they will be useful for anyone having troubles with this or other similar amplifiers.