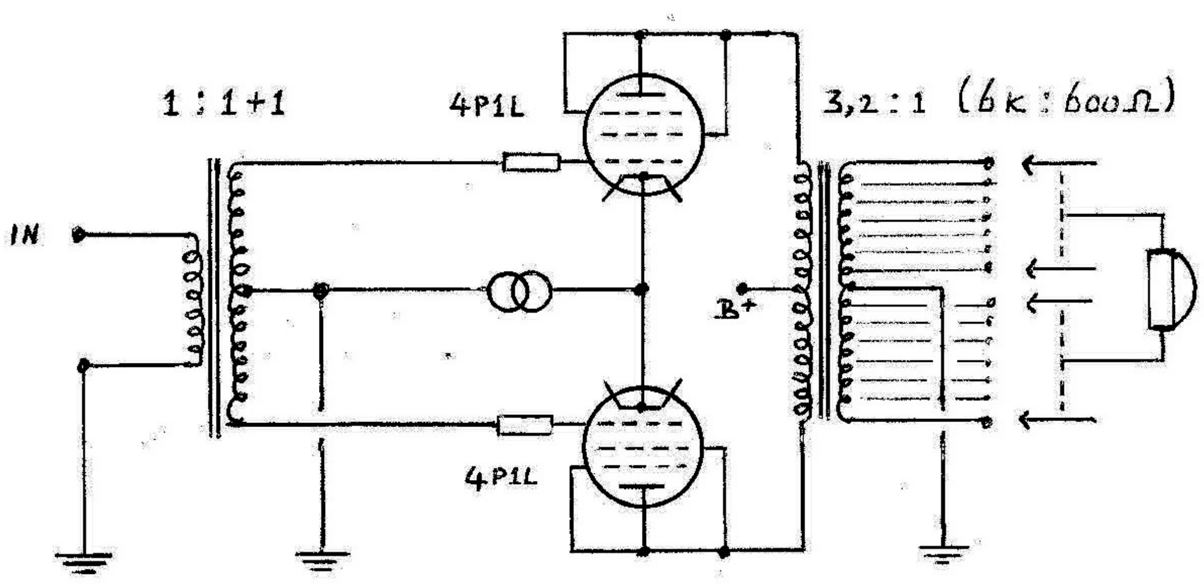
MY TAKE ON A DHT HEADPHONE AMPLIFIER

Introduction

As you may know I am a transformer winder (Tribute Audio Transformers).
In order to wind high quality transformers it is necessary to know how a given transformer behaves in a tube stage.
Especially during the first years of my winding career I breadboarded all kinds of tube stages (line amplifiers, driver stages, output stages, dac output stages and so on) in an attempt to optimize transformers for a particular application, technically as well as sonically.
In my opinion two elements are of major importance in audio transformers: winding technique and core material/geometry.
In the past we have already seen high quality transformers as far as winding technique is concerned; examples are Partridge output transformers, Macintosh unity coupling output transformers, Peerless output transformers, and others.
The majority of these transformers however used EI cores, at best M6 grade (in the good old days by the way Macintosh used c-cores as their prime goal at that time was quality).
Decades ago, with the introduction of semiconductors, tube production and development disappeared in the world outside the former Soviet Union, other East European countries and maybe China.
Influenced by developments in telecom, power plant technology and switch mode power supply technology (to name a few of the most important sectors) however there has been a steady evolution of core material for these particular applications, and it happened that some of these new materials had the potential to bring improvements to audio transformers.
Well known are permalloy core transformers, which when I am right entered the market from Japan by companies like Tango and Tamura.
More recent are core materials like amorphous alloy (iron or cobalt based), and amorphous alloys with a nanocrystalline structure.
It is good to realize that none or hardly any of these core materials were specifically developped for audio transformers. Silicon steel in its different grades is for 50/60 up to 400 Hz power transformers, and as already indicated the modern materials which some of you call "exotic" are developments for non audio applications.
Some of these "exotic" materials happen to have properties which make them very well suited for high quality tube amplifiers, for large signal (interstage and output transformers) as well as small signal applications (MC step up transformers, line level transformers, inductive volume controls).
The major difference between silicon steel and these "exotic" materials is in permeability (permalloy and nanocrystalline having very high permeability) and eddy currents (the very thin laminate amorphous alloys bettering everything else).
Check for yourself what "permeability" and "eddy current" means; it takes too long here to explain.
An other small signal application where high quality core material will bring improvement is in a headphone amplifier.
If you like a transparent and neutral sound from your SE 300B amp, amorphous core output transformers already bring an improvement over silicon steel output transformers.
Years ago I wanted to check how much better these new material cores actually are, and the best way to try was my Stax SR-5 electrostatic headphone. This headphone has nothing but a step up transformer between amplifier and headphone (HV bias very cleverly generated from the audio signal). So just one transformer, and no further influence from the outside world (room acoustics; background noise). The stock Stax transformer was a smallish EI, and my first attempt was a fine grade (0.05mm laminate) silicon steel c-core transformer with the same step-up ratio. This sounded better already. Next step an amorphous alloy c-core transformer, and a further improvement in terms

of transparency and dynamic behavior. No question: this transformer was a major improvement over the stock one, and I was convinced that for small signal applications the high permeability/low eddy current material was the way to go.
So, I think I made clear that also for a DHT headphone amplifier the use of high quality core material will pay off.
I read Regal's thread at this forum with interest, at the same time thinking about a design based on 4P1L tubes (I brought 8 of these nice tubes back from a recent visit to the Ukraine).
Please note that this design is for the well known 99% of headphones; HE-6 and AKG K1000 phones would require an additional gain stage.

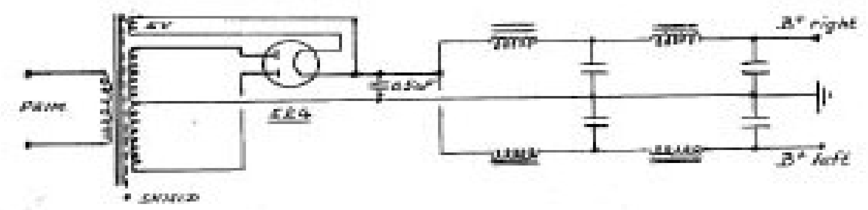
<u>My design</u>



Apart from the output transformer I do not claim to be original, and please note this design has not been built yet.
Very likely transformer winding ratios and load impedances need some experimentation.
My inspiration comes from the designs of Lynn Olsen and the late Allen Wright.
The input transformer is a 1:1+1 phase splitter; it is wound on a nanocrystalline toroidal core, and it is the same as used in Lynn Olsen's Karna amplifier.
The two 4P1L tubes work in push-pull class A; the cathodes see a common current source (or better "sink"?) like Allen Wright's PP 300B design. For this application I think there is enough headroom without the risk of the current sink running out of "steam" causing hard clipping.
Why push-pull? I want to maintain the high permeability of the output transformer in this design; with a single ended output stage the required airgap would impair permeability, and besides the SE topology would require an additional gain stage. A push-pull transformer will be smaller than an SE one which is good for winding capacitance and DC resistances.
This output transformer is rather special. Primary impedance ratio is 6k anode-anode with a 600 ohm load across the full secondary; at the same time it will function as an inductive volume control.
It will have a nanocrystalline cut c-core with a very minor airgap to withstand minor DC imbalance, at the same time maintaining permeability . This core material is also known as "Finemet".
The idea is this: the output transformer is basically 6k anode-anode (the 6k is not yet fixed), and 600 ohm secondary. Step down ratio therefore is 3,16:1. The secondary is center tapped to keep

everything symmetrical. I like the idea to drive a headphone with a balanced signal.
The secondary winding has a number of taps which, attached to a 24 position switch (Elma or a cheapo Chinese one), functions as volume control and impedance matching at the same time.
At maximum volume we have a 6k - 600 ohm ratio; one step down (a minus 3 dB tap) and we have already a 6k - 300 ohm ratio; 2 steps down gives 150 ohm, 3 steps down 75 ohm, and 4 steps down (minus 12 dB) gives a proper drive for a 38 ohm load. We can use all our further steps down to control the volume, at the same time having a 6k - 38 ohm ratio or better. In other words: in practice the tubes will always see a very high load impedance which is good for linearity.

Power supply



Why not keep it all direct heated with a 5R4 rectifier.
Semi choke input (0.5 uF) followed by two chokes to split the power supply for each channel.
Each channel an additional CLC.
Options for regulation (shunt?); this is just one example of many possible power supplies.
Cathode/filament supply by Rod Coleman.

Pieter
Tribute Audio Transformers