

# Triode Dick's Page

## Goliath

Single ended 211 amplifier

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### Goliath?

Why build an amplifier with a 211 triode? Power output? No, not really. There are other ways to do that. For comfort then? No, absolutely not. It is just the challenge to build something new with this classic 211.

I call this amplifier: Goliath. Like the mighty giant who, as a person, brought a lot of fear to peoples. The physics of the 211, or the VT4c, and even his brother the 845, are overwhelming. Tender overwhelming that is. When the glow appears, you can read the newspaper by the light they emit.

The 211 is a nice piece of work from the last century. 50years ago and



back, many transmitters were using modulators based on this little giant. Another target was the cinema amplifier. The development goes back as far as the twenties of the last century.

There was a time nobody wants to have them, these 211 triodes. But Japanese builders were continuously applying this tube. They even applied much larger transmitter tubes. Then... the Ongaku became big news in 1988. Developed and build by Hiroyasu Kondo from Audio Note Japan. Kondo San hit the audio scene with this amplifier. The price was as high as an average middle class house in those days. This was a unique happening, in respect to quality and price. Unfortunately Kondo San has created a precedent. Other manufacturers thought: If Kondo can do that, so can we. The one after the other over the top priced amplifier appeared at the audio front. The prices of Loudspeakers, Phono- and CD players exploded to immense heights. Sometimes understandable, sometimes ridicules. Kondo personally winds the silver Output Transformers of his amplifiers. He selects and pairs all components on hearing. There are worse cases than Kondo with his amplifiers.

Will my Goliath (just as his name-giving example) slung down by a David? (2A3, 45,...) Now I know that won't happen. This Goliath is somewhat assertive against small opponents. "Are there 211 users?" I asked the readers in my column some time ago. I've received a nice couple of replies. More than I expected. Not one identical design. The differences in building are stunning. The 211 and his brother 845 make many applications possible. Guys, thank you! (Sorry there were no replies from girls with a 211 Amp)

## Reflecting on...

The Goliath 211 amplifier is playing at my home now for 2 years, and grew slowly to an extraordinary beautiful tube amplifier. Some problems with rectifying the power supply of the end tube, delayed publication. There is also some holding back because of the use of very high voltages. In the case of the Goliath where its 211 end tube is running on a 1000 Volts, it must be 120% save... On the other hand, you have to be even careful with an Amp running on 500 Volts. More than



enough for Fireworks or even worse....

Whatever tube circuit you are working on: work concentrated and don't overestimate your knowledge and skills!

After these words the Goliath goes public... I already received a lot of questions about it. The interest from tube lovers for the 211 tubes is above average, as it appears. Is it worth it? You bet!

## Beam me back Scottie...

It was the end of November 2000 when the idea about this amplifier sneaked into my tube life. Sneaked? Yes indeed, because I had no plan what so ever to build a 211 single ended amplifier. I was at the time delighted with my Big C and Caesar amplifiers. But as it happens, some things can't be stopped.... It seems to be pre destined. Something like: 'Dick my boy, you really have to build your 211 Amp one of these day and now is a good time to start.....'

It all began at the market of the Historic radio club at Doorn, the last of that year. I walked along a stand with some old stuff and noticed 2 beautiful Johnson jumbo tube sockets, perfect for an 845 and... indeed, the 211. These old Johnson's are of such a nice quality. I also like to use them in the old UX4 shape, especially for the 300B types. But after looking and touching it, I put it back and walked away. I'm not very fond of stock parts; I had enough 'stuff' at home. Just before I went home, I walked again along that particular stand. The Jumbo sockets where strangely enough still there and as it happened I asked the owner about the price. That price of \$5 was so sympathetic that I couldn't resist buying them (nowadays it would cost probably \$10) and put them in my bag. 'Nice to trade, was my thought...)

## Lets dance ...

A week later, I surfed the local e-market site. And hey, what was that? A pair of Tango X10 output transformers. Only the price was high (not to expensive, just a lot of money). The advert was just publicized. Somewhat shaking the tree I placed a bid at the rate of half the price. An hour later I already received a mail from the Tango owner. I could purchase them for somewhat above my bidding price. Hey, that was something else and suddenly the X10's where plain cheap. A one-time opportunity it seems. I went to the seller the same day.... before a clever friend of family member could talk some sense in him. A nice guy it pointed out to be, a great music lover, but enormous disappointed and frustrated about his D.I.Y. audio hobby, not in the last place by his 'friends' at

the audio club. The man had a lot of agitation in his head and was continuously busy thinking about the things he could improve in the quality of the sound of his Amp. He knew it sounded very good, but time after time his fellow club members triggered his agitation. A disease that's widespread in the world of D.I.Y. audio. At a point in time he could choose for a doctors prescription or some other heavy impact solution. The poor man solved the problem by ending his D.I.Y. hobby in a rigid way: removing all the sellable parts from the chassis and put the rest in the disposal container. The transformers, the valuable Tango's, were placed at the e-market site. He also had a pair of 211 triodes for me. For a small amount they went home also. That was the next opportunity. I thought they where Chinese tubes, not that bad as some people want to do believe us. I will come back on that later on. But no, they where USA RCA 211's. They are not only very fair in music reproduction, but also rare and because of that very expensive. All these things together couldn't be a coincidence, I HAD to build a 211 single ended amplifier.

The man I spoke you about above, went well. I received a mail from him stating that he would build an Amplifier soon.

## It's becoming something...

Searching for other components then. At first there was some hurry, because my brother switched his job and he was the one who always delivered me the copper chassis I needed. His new job would make an end to his well-appreciated work in respect to my amplifiers. It was clear at the beginning that the chassis for the 211 giants had to be huge, not in the last place due to the weight of the transformers. They had to be monoblocks with a chassis of 3 mm thick copper. Because of the size of the parts, it was not possible to make normal sized Amplifiers, so I had to come up with some tricks to save some space. If the cabinets became too big, I couldn't place them in my (already large) audio rack. I could save a lot of space by moving the terminals to the top. As a result of that the cabinet could be a lot deeper. The power cord got a right-angled plug. This solution is seamlessly usable for all my amplifiers. There was also something to win in expanding the width and height of the cabinet. So, everything could get a nice place. The PIO capacitors in the PSU take a lot of space, but with the height of this cabinet it's no problem to place them. The PSU transformer is a big jerk. For a part it's a result of the special winding method, from which a low capacity between the primary and secondary winding layers was derived, to get a supply that's as clean as it could possibly be, before it feeds the amplifier. There are several static screens used between the windings. What's not going thru, gives no problems afterwards. A resonating and humming transformer is a



source of agitation also, that's why the transformer is wound with a low induction. The disadvantage? They are extremely heavy. But hey, it becomes a hernia-stimulating amplifier surely. One kilo more or less is not that important.

Further there were a quad of 15 Henry ligament core chokes, two for each channel, with a beautiful low ohms resistance for the end tube power supply. The Pre stage got a six-room choke. In that same period of time, I found the PIO's for the PSU. These are problematic components when used at a very high voltage. They're not for sale every where. There are enough high voltage capacitors used by transmitting guys, but most of them are so huge, I can't use them. Do look around on markets and Radio Shacks. An alternative for instance is an ASC MKP in oil capacitor. Put two 30uF caps in series and both bridged with a 470K/2Watt resistor. Other beautiful (new) caps can be found by Icar and Epcos (former Siemens). Nowadays production. And of course the Black Gate WKZ, who plays its role somewhat later.

I've made a separate PSU for the pre-stage / driver because of practical reasons. I used the AZ1 rectifier and a CLC filter with oil capacitors. When using a full bridge rectifier, there must be an extra high voltage winding for the driver circuit. The already large transformer would be enormous. My Flemish audio friend Walter sends me a nice couple of Sprague Vitamin Q oil Caps of 10uF/600Volt and in addition to that, a pair of GE 8uF/1000Volt oil caps. Brand-new in box... I will drop of my chair one of these days with so much luck.

All the other capacitors came out of the trade circuit and from earlier mentioned e-market places. Especially the first cap right behind the high voltage rectifier has a big job to do. I used a 2uF/1500uF Aerovox type there. This buffer capacitor leaves a distinct ripple on the rectified voltage. The rectifying bridge, build from 4 direct heated tubes, tempers the pace to full action after switching on. It takes about 45 seconds before the voltage is at its top. After the first choke it's becoming a lot friendlier. First an 8uF TLC oil capacitor and direct after the second choke a 10uF GE pio. This combination gives a clean voltage and a silent amplifier. I measure less then 1mV~ rest hum at the loudspeaker terminals. The pre-stage had to do it originally with an 8 en 15uF Cap and a choke of 10 Henry. I changed this later by applying a 20H choke. I will come to that later.

## Never change a winning team...

The driver stage was well known. That would be the 'one and only' 'mu-stage' ...no crap. The same stage that's doing so much beautiful work in the Big C and the new Atilla amplifiers. The drivers in these amplifiers and in the Goliath are

more or less identical, so: 'Never change a winning team'... Only the last two are more tuned at a higher untransformed output voltage. A thing to remember is the large amount of Miller capacity that results from using a 211 tube. This Miller capacity had to be overcome by the driver, which controls the end tube. In order to do that you need a firm driver. A rag of a driver results in a rag of an Amplifier. To drive a 211 end tube with an ECC83 or 6SL7 (or something like that), gives the same result as driving a Mercedes with a Citroën 2CV engine under the hood. It moves, but that's the only positive thing you can say about it.

The first test went very respectable. The 227/D3a Mu-stage had no problem with this power tube, what's less obvious than you think. There is not much voltage needed for maximum output, what's the benefit of a 10x gain. But because of the Miller syndrome, you make a high cut-off filter before you know it. Not very desirable. The Amplifier (in respect to its bandwidth) has more than enough problems handling the (for the 211 necessary) 10K primary output transformer.

In practice, you see a lot of output transformers for this type of amplifier that cut off the high frequencies much too early. The most of these output transformers won't perform above 20Kc. And I have seen worse.... Much too tight. For my purpose, the Tango is one of the best there is: 35 Kc at -3dB is no problem for this classic.

An output transformer with a primary winding of 10K is less easily made with a larger bandwidth as it is for a 300B output transformer with an RA of 3K5. The winding capacity is very critical at a 10K transformer. When you use a driver / power tube combination in addition to that which is filtering high frequencies by itself, you have build a very limited circuit. In this era of SACD and DVD-A we want something more than that. And it suits the quality of the amplifier well.

The Mu-stage driver in coalition with the 211 shows its limitation far above the natural garbage in the high frequencies range of the output transformer. And that you can hear: a very powerful full-blooded easy listening sound reproduction accompanied with a great transparency. I was instantly impressed about the possibilities of this brave tube.

## Some ripples in the mirroring water...

Ware the rectifiers. I had the easy accessible and obtainable Svetlana 6D22S Shanghaied as candidates. According to the specs they had enough capacity left to suit my needs. It went well for a month and I began to be more and more pleased about the quality of this 211 tube Amp. Till.... a rectifier began to spark

internally; Bzzzzbzzzzz, and I had to witness a Russian version of St. Elmo's fire. Could happen to anybody.... New tube placed and yes, everything was playing again without the visual spectacle. Till the next day.... bzzzbzzzbzzz..., but now a different tube. Exchanged again and somewhat less enthusiastic it went well for a couple of hours. I had not enough tubes to replace them at that rate. So, I tried another 8 new tubes, to overcome a possible bad batch, but within a day it went wrong again. Amplifier switched off and parked it on a shelf in my hobby room. I first had to determine a strategy....

## The other components...

The resistors in this amplifier are mainly carbon types. Alan Bradley's for instance. Most of it I collected in the past years. But if I had to build this amplifier today, I would surely use the new production carbon types, which I also applied in the Atilla and Cleo V. A real discovery and a sincere audiophile resistor for a normal price, which is in quality no less than the well-known 'VIR' resistors (Very Important Resistor).

For the coupling capacitors, I started with an Auricap and a Vitamin Q. At first the sound was somewhat brute, what's normal with a new amplifier with all new components. After a week everything began to "glow out" and the sound became sweeter. Somewhat later it became even too much. So I replaced the Vitamin Q by a second (1uF) Auricap. This capacitor couples the driver to the power tube. From that moment on, everything fell on his place. I like it so much, that I didn't change a thing since then.

## And even the impossible became possible ...

I talked to Wil Blaauw of AE (the transformer manufacturer) when the amplifier was playing for a while and I was telling him in an enthusiastic way about my Goliath amplifier. 'Yes', he said, 'but that output transformers...'  
'What about them?', I replied, 'These are more or less the best and most beautiful transformers there are for a 211 amplifier'. But Wil said: 'I make you a pair amorphous, with silver secondary windings, that will perform even better than these Tango's...'

It took a little bit more than a week before they were delivered. The good man didn't make them at a low pace.... I started the same week although there was (sound wise) really no need for it.

I made it just so, that the exact mounting position of the Tango could be used, without any need for extra drill holes etc. I could place the Tango's back in no

time. To keep the pace in this story: the AE amorphous output transformers never leaved their place. They are not only sounding better, they are technically at least of the same level as the Tango's X10 if not better. They have more bandwidth than the praised Tango's and that is was the last thing I expected.

## What? Still more to come?...

The next step was rather rigorous; all chokes were exchanged with amorphous core types. A very big investment, I admit. But after the rebuild there was no doubt in my mind: the amorphous chokes are doing it more beautiful.

To be exact: I don't use terms like "100% better", "the old situation was completely crap" and so on. I keep everything in normal proportions. My conclusion: if you want a really good choke: use a standard ligament core and even a good winded EI core is not a wrong choice. But if you want a choke that is extremely good: think about the amorphous chokes. It will cost you a few bugs, but I found it well spend in this amplifier. If you look and see what is spend for other upgrades, I can tell you that this is a realistic spending in an amplifier like the Goliath, what will cost you a lot of money anyway.

## Back to the future...

The most recent change is inspired on the experience I picked up building the Attila. That's somewhat funny, because the Attila's design is based on the experience I picked up building the Goliath (like the use of amorphous chokes etc.) and now vice versa. The PSU got an after treatment. In the driver section I replaced a relative small 15uF oil cap to a double parallel switched 47/47uF Black Gate WKZ, a capacitor from which musical qualities I'm very impressed. The PSU is getting super tight and very quiet. The last capacitor in the end stage got a double capacitance too. Because of the extra space in the driver PS, it was easy to build in, what resulted in a beautiful ascending capacitance of the PS. These changes are really upgrades. Black Gate WKZ in the end stage? That could give probably more benefits. It will mean serial switching, what will be very expensive, but I never say never... ☺

Once again it seems that nice, but relatively not so much progress giving changes, cost a lot of money when you already arrived at a certain level with your equipment ...

## Different Power Tubes ...



I've got RCA, United and GE 211's myself. The first two are more rare than the General Electric's, which are produced much longer. The United is even very scarce and because of that excessive in price. The pair I own is made in WW-II (1940-1945) Next to these USA tubes I also tested some recent Chinese production, still manufactured and reasonable in price. I can tell you that this tube is much better than I thought it would be. The tube is looking good and kept the character of the old Americans. The outer limit is reached somewhat earlier as in the USA types, what reduces the power a little bit, but the Chinese tube produces a level of sound quality, where most of the 300B tubes would have a problem. And all that for 50 euro a piece.

The United 211 is my favorite, with a close finish for the RCA's. The GE is a fraction less subtle in reproduction, but also a winner. I own a whole array of 300B triodes and they sound each individually different. Not one is like the other. What strikes me is that this widespread in sound character can't be found in 211 tubes. I don't know if it's the thoriated Tungsten heater/cathode, the graphite anode or the way this tube is build. But what a nice tube this 211....

## And something about rectifier tubes ...

The used EY500A seems to be harder to be found as his brother the PY500A. The tubes are identical with exception of the heater voltage. The PY needs 42 volts to glow, a curious value that's not much used. It has its benefits: the heater current is only 300mA. On the power transformers is a tap for the EY500A as well as for the PY500A. Using the last, you have to connect the heater connections parallel on the taps of the power transformer. Using the EY500A the tubes will be connected in pairs to the 6,3 volt taps, to prevent an unnecessary high current. There are also tubes without the 'A' behind the type code. They could be used in a normal way, but need an extra resistor. You can find info about this in the tubes datasheet.

I use AZ1 mesh tubes in the pre-stage myself. Of course you can also use the normal types. Do you see RGN1064 or AZ11 tubes somewhere? They are identical to the AZ1, with exception of the tube socket. Be sure to make your choice before you make a hole in the chassis.