CURRENT REGULATOR FOR VALVE SERIE HEATHER

Genere	DATA	Generalità	Note	Distribuzione
radio surplus	Feb 2015			Agz website

OVERVIEW

Many are those who revel in repairing and restoring old radios. Who specializes in the restoration static as the refurbishment of the cabinet or the mechanics and those who turn to the electronics. It is an activity that relaxes.

This note regards the power supply of the filaments of the valves, in particular those of the UxNN serie or designed for a filament current of 100 milliamperes.

Today they still build valves, but production lines cater mainly to generic models such as the double triode for audio hi-fi or the power tubes. To my knowledge, that series hasn't model still in production.

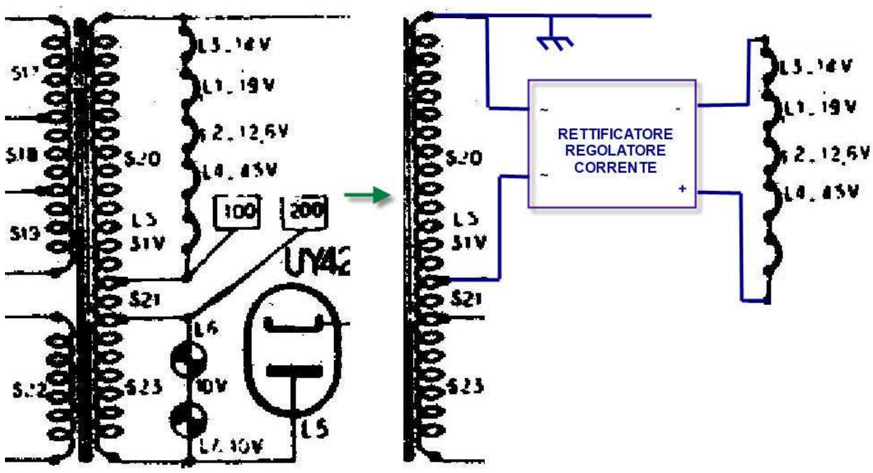
It is therefore desirable that the few that remain in circulation and mounted in the radio-receivers are safeguarded as much as possible. The pitfalls are many: the first is the power supply network that from 220 to a few years ago is now 230. The radios designed over the years' 50e 60s not all provided for a voltage change with the + -10 volt adjustment. Many even do not even have the change-voltage. Often the power supply is constituted by an autotransformer with tap calculated for the value of the sum of the voltages of the valves present. Series valves are typically U, ie UL41 etc.

Given the age of these valves, it isn't logical to subject them to torture with voltage exceeding the ratings, although the change is not great, about 5%. The answer I propose consists in feeding the valve series with a constant current of 100 mA. This allows to be not affected by the different mains voltage, even to be not affected by the variations or fluctuations of the same, and to have an ignition more delicate eliminating that flash of light typical of the cold valves. From power on to full operation, time it is longer, at least twice, I checked.

This last feature in the '50s would be considered bad, of course.

This circuit arrangement can really help increase the life of the tubes? In fact established practice is to switch on tubes with undervoltage filament for a short period, when they light up after a long time as for example if they are off in years. But if they are mounted in a radio who never feeds them with a VARIAC at mid voltage? The use of a simple circuit and easy to build can allow you to use this caution each time the receiver is switched on in an automatic way.

However I have'nt information from textbooks or statistical data that confirm a priori my idea. It is simple an hobby character experimentation.



 e-mail: alessandro@frezzotti.eu

The default value regulated current, however, leads to advantages. If one filament is short the current in the other valves it remains the same, saving them. Each valve adjusts the filament voltage based on the current, and the measurement with a simple DVM allows the assessment of the units particularly exhausted. In the event of a broken filament proceed shorting a valve at a time until you find the one hurt.

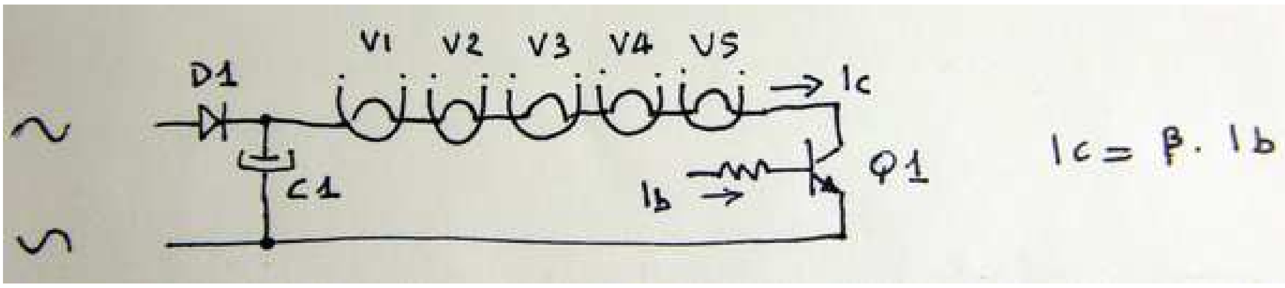
DESIGN DETAILS

I find it easier to design and realize a circuit which regulates the direct current, rather than alternate. This implies that the filaments will be supplied with direct current, after rectifying the previous power source. The addition of the rectifier increases the total power consumption, but to a minimum value. In essence, the consumed power remains the same.

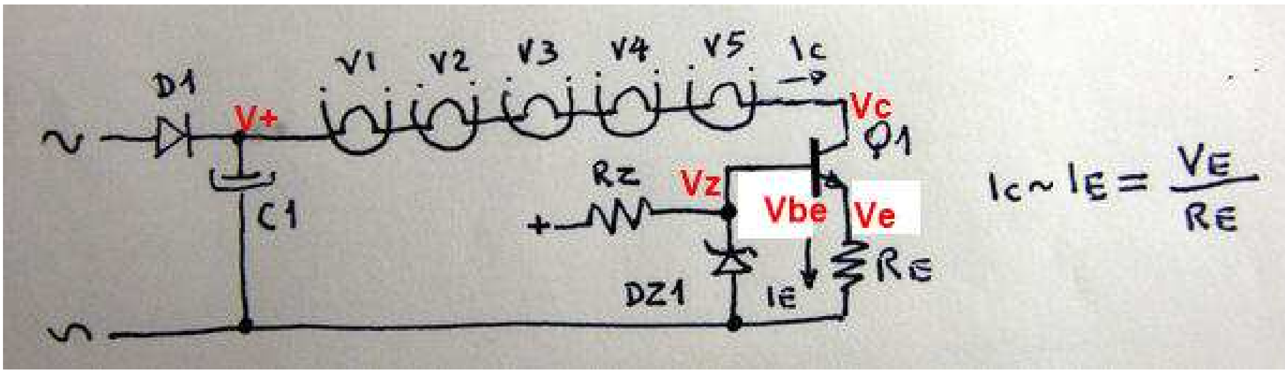
The series of valves example, UY42, UL41, UBC41, UF41, UCH81, used in test receiver (model Philips or SFER BF451 or RA455) requires a total voltage of 121.6 volts, (31 + 45 + 14 + 12.6 + 19), approximately 16.12 Watts.

The tests carried out with the filaments in continuous current show that the total power used is about 13 Watts, in practice the same.

The simplest circuit that I have to perform a current regulator is one employing a BJT that responds to the rule " collector current = beta X base current." Very simple but also critical to develop. The beta varies ...



An evolution, again simple, is a BJT with emitter resistance and constant voltage between the base and common. The Vbe voltage remains constant for small changes in Ic, the collector current is substantially equal to Vemitter / Remitter.



The emitter voltage follows the voltage on the base, removed Vbe which is constant, given the fact that Q1 is a power transistor (2SC4235) where Vbe can vary between 0.6 and 1V for very large current excursion, while 0.1A is a minimum value (about 10% of the maximum).

If all valves were shorted Q1 should dissipate all 12 watts, while in normal things it dissipates about 1 and a half Watt. At power on, with the valves which have a cold resistance lower than when fully operational, Q1 bears a peak dissipation while remaining always the current 100 mA. I used a heat sink for Q1 anyway.

Here is the summary of a measurement made on the circuit under test:

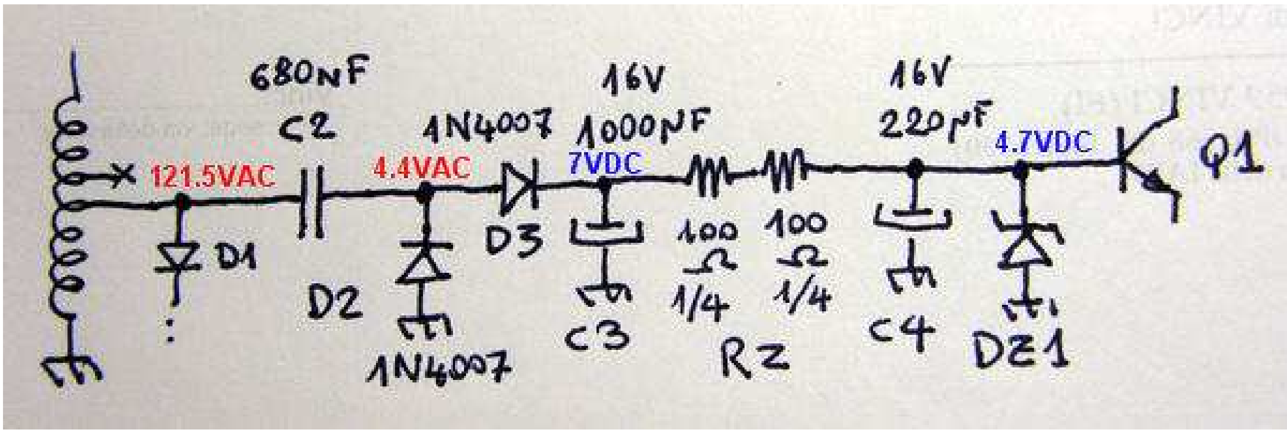
v+	vc	ve	vz	vbe	ie	re	wre	wcoll	wtot
130	13.9	3.848	4.486	0.638	0.096	40.5	0.36	1.32	12.35

V+ is the voltage on C1 and D1, Vc is at the collector of Q1. Ve and Vz are the voltages respectively of the emitter and base of Q1. Ie is the regulated current that flows in the tube filaments. Re is the emitter resistance of Q1, that is formed by three parallel resistors 120 Ohm ¼ W. Wre is 0.36 W in total.

The current is slightly below 100, it could be varied by choosing a different value of zener or with a different value of Re. I accepted the compromise using standard components.

To power the zener as efficiently as possible, I used a capacitive reactance divider that have no power loss. A non-polarized capacitor 680nF has a reactance of about 4700 ohms at 50 Hertz. This circuit does not heat.

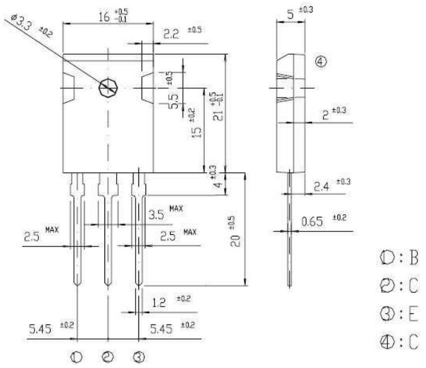
With an 121.5 VAC voltage on the secondary of transformer there are approximately 4.4 VAC at the junction of D2 and D3. They became approximately 7Vdc over C3 and 4.7V at the Zener diode terminals. There are about 11 mA which are distributed between the base current and the current in the zener.



The power for the Zener circuit amounts to less than 80 milliwatts.

COMPONENTI

For hobby type construction I use easily available and cheap components. Often from scrap, as for Q1 which was taken by a decommissioned PC power supply. It is a transistor with an exotic name (2SC ..) but rather generic, since they are many PC power supplies. Wanting to replicate the circuit is easy that by examining the first power supply scrapped that happens has a transistor of equivalent or similar performance.



Power BJT C4235: VCBO 1200 Vceo 800, IC 3A, Pt 80W, case MTO3P. Beta around 10. I mounted it on an aluminum fin also from scrap.

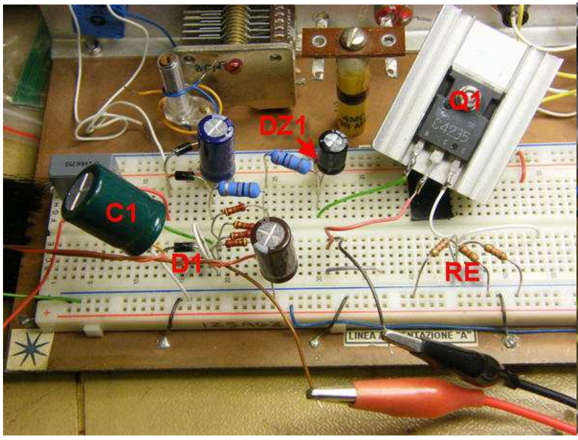
From a disused power supply they are recovered also diodes and electrolytic capacitors of large capacity and high voltage.

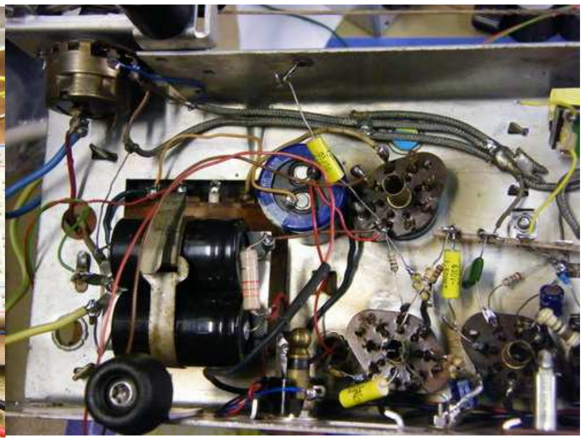
I try to avoid using of power resistors because they are expensive and difficult to find. When possible use parallel or series arrays of standard values, ¼ Watt.

The capacitor C2 is 680nF insulated from 250 Vac. It is a purchase from Tekkna but can be found by removing some surplus power supply, or an old CRT displays.

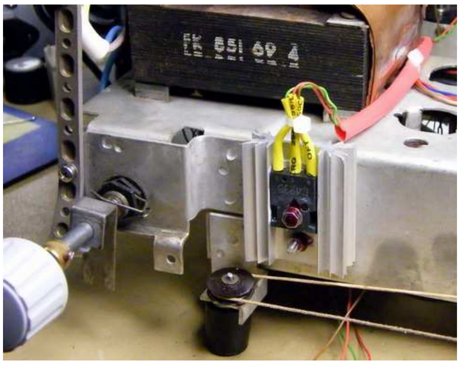
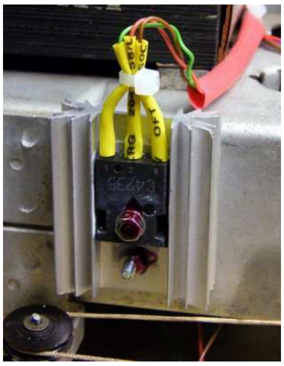
COSTRUZIONE

Left tests on breadboard. Right on test radio.

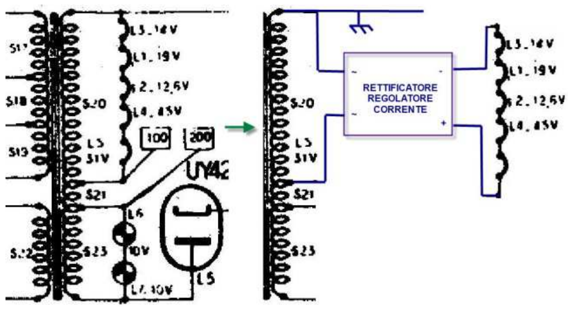




Next, from left, Q1 positioning, and pcb with remaining parts on the rear side of test radio.


The plate could also be built with SMD technology allowing a considerable reduction of dimensions.

The test radio that I used is a Philips or SFER RA455. It is used to make various experiments, missing of the cabinet. However it has the transformer (not auto-transformer) and then allows you to touch the frame without getting an electric shock.

The circuit object of this note, however, can also be used on models with autotransformer.

The final pattern shows a double filter cell voltage rectified. This is due to the need to eliminate the minimum ripple which annoys the measures. In the practice this additional filter it is not necessary.

 e-mail: alessandro@frezzotti.eu

Have fun, Alessandro Frezzotti

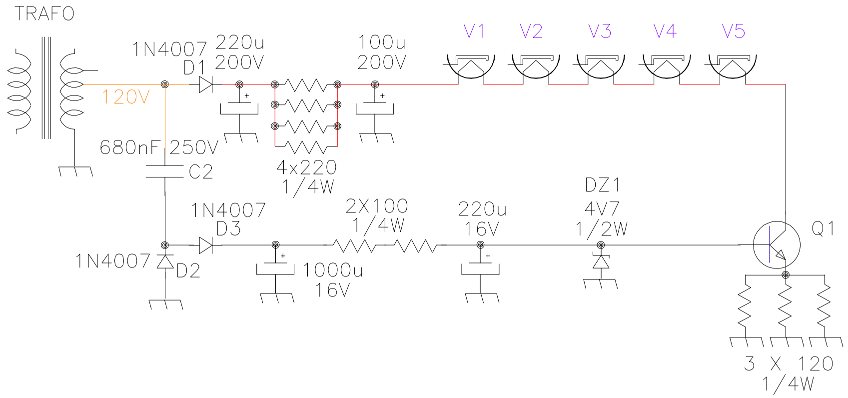
ELECTRIC DIAGRAM

Next page

REGOLATORE CORRENTE PER FILAMENTI VALVOLE

FEBBRAIO 2015

SCHEMA ELETTRICO



DISEGNO NON IN SCALA
C VALORI INTERI IN pF
C VALORI DECIMALI IN uF
R IN OHM DOVE NON INDICATO

FILE: IFILSERIE_0.DWG

Alessandro Frezzotti – IZ5AGZ – Castelfranco, Pisa – alessandro@frezzotti.eu