AUTOMATIC FORMING OF ELECTROLYTIC CAPACITORS

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The forming of electrolytic capacitors requires them to be slowly charged while limiting the current to avoid excessive power dissipation within the capacitor. This is a time consuming process which we sometimes tend to hurry, to the detriment of the capacitor. The unit described herein is the result of the need to reform a quantity of N.O.S. 16µfd capacitors without constant attendance. The author put together (with clip leads) a temporary unit using a TV horizontal output tube as a constant current source, some external power supplies, and a multimeter for voltage and current readings. In operation, the dc power supply is set to the voltage required at the capacitor and the unit automatically maintains the preset current limit. As the capacitor charges, the voltage rises while maintaining a constant current, until the current falls below the limit. As the current continues to fall, the unit will continue to raise the voltage until it is at, or near, the level of the power supply.

DESCRIPTION

The regulator uses a TV horizontal output tube (6BQ6 or equal) functioning as a constant current pentode. See schematic. In a tetrode or pentode, the anode current remains essentially constant regardless of the anode to cathode voltage. This fact, combined with the use of cathode bias, provides the regulation limiting feature.

At 400 volts and 1 mA of capacitor current, the voltage drop through the pentode is less than 10 volts. This represents less than a 3% error, therefore, the only voltage metering required is at the dc supply.

Only the regulator section and a suggested current metering scheme are shown, as many

collectors already have the necessary power supplies and/or components. The regulator can be constructed as a separate unit, or, combined with power supplies, metering, and controls.

With the circuit constants shown, the tube cannot be harmed by operating without anode voltage. This means that the unit can be operationally turned on and off by simply turning off the dc power supply.

CONSTRUCTION

The final design of units built from this article can be so varied that only critical areas will be commented upon. Power supplies used can be anything from half-wave units to fully regulated power supplies, but, ripple should be held to less than 10%.

CAUTION: Consideration must be given to the fact that you have a capacitor that is fully charged, and when the unit is turned off there is no indication of the charge. The capacitor should be discharged through a 25K, 12 watt, resistor to avoid destruction of the capacitor. This could be accomplished automatically with a normally closed relay.

The resistors in series with the screen and control grid are to prevent parasitic oscillations and should be installed immediately at the tube socket. No capacitors should be used on the tube side of these resistors. Also, no capacitance should be added across the regulator output.

Instead of the value shown for the cathode bias pot, a combination of fixed resistors and a lower value pot could be used. This adjustment should be set with 600 volts input and the capacitor terminals shorted. I have elected to use 10 mA for this setting, but it could be set lower if desired. The limit current will drop to about 8.5 mA at 100 volts input when set to 10 mA at 600 volts.

The dc power supply for the anode of the regulator needs to be variable over the range of voltages required for the capacitors being formed. It needs to provide at least 10 mA dc over the entire voltage range. It should have some bleeder current to prevent the capacitor from acting as an input filter, and raising the voltage, when it is fully charged.

The dc power supply for the anode must include a means of indicating the voltage. As pointed out earlier, this will be the only voltage reading necessary.

The power supply for the screen grid needs to provide a fairly well regulated voltage in the range of 45 to 55 volts. The current drain on this supply will vary from near zero to about 8 mA. The supply should be zener regulated, or be designed for higher current with at least 15 mA of bleeder current. In operation the output of this supply floats up to 600 volts off ground, so be sure the transformer secondary has adequate insulation and the core is grounded.

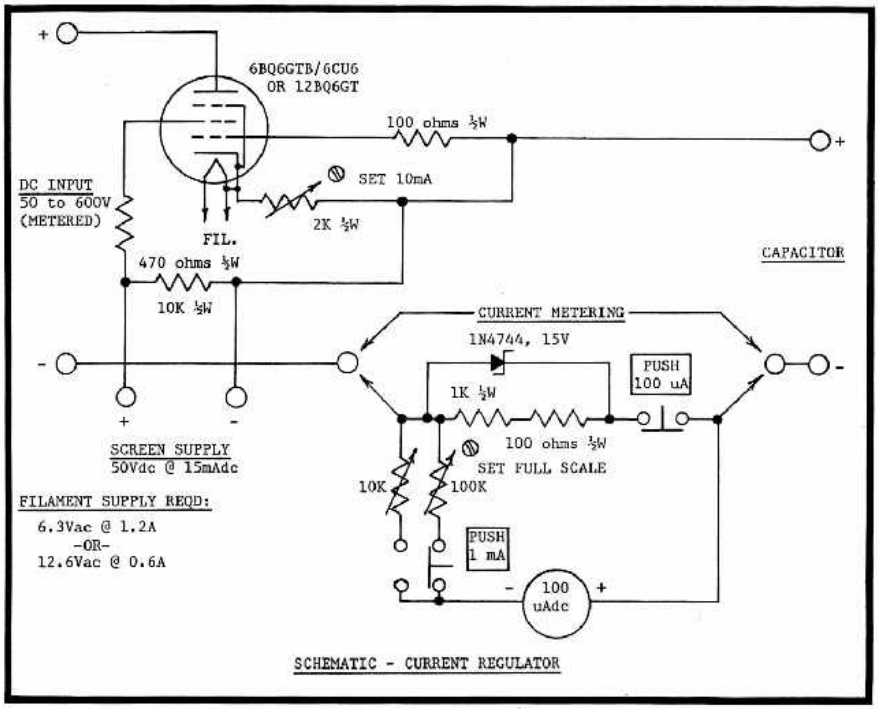
The only special requirements for the filament transformer is for the secondary to withstand 600 volts. Be sure to remember to tie the transformer core to ground.

The current metering shown is only one of many possible schemes to monitor the current. In my original setup I used a Triplet #630 VOM. Due to the current limiting built into the regulator, very minimal meter protection is required.

OPERATION

Operation of the unit is extremely simple, as described earlier. Allow the filament/s and screen supply to warm up, turn on the anode power supply, and set the voltage required.

If you wish to measure the voltage at the capacitor while it is being charged, a 20,000 ohm/volt, or higher, will not upset the system, except to add to the indicated current. But remember - the voltage could raise and wipe out your meter if you leave it on a lower range.



When the capacitor is finished, ***REMEMBER TO DISCHARGE IT*** before disconnecting. It is always a good idea to manually discharge the capacitor, even if there is an automatic device, because relays can fail.

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