HV Soft-start circuits

The initial current to a filter capacitor chain is quite high since the rectifier diode(s) output sees an initial near-short-circuit until the caps are partly charged. The output current should be limited until the capacitors are at least partially charged.

Two ways to limit this current are: (1) Install a Varistor in the transformer's primary AC line, and (2) Use a "soft start" circuit in the transformer's primary AC line.

Old methods, such as putting a 50 ohm resistor in the secondary circuit, after the rectifier are not as good as the above methods.

If the diodes and transformer are highly robust with respect to the normal output current, then method (1) is easiest. If these are not robust, then (2) is probably better.

A shortcoming of the varistor as a current limiter is that it must be cold when the HV is switched on, in order to limit the current. If the HV is switched on, then off and then on again, the varistor might not have cooled enough to properly limit the current the second time the HV is switched on.

Microwave ovens contain a soft-start control relay with a usual current rating of 16 amperes at 250 VAC. The microwave oven circuit board containing the relay also has a small transformer, diodes, and cap that supplied a bit of power to activate the relay coil. Remove the excess circuitry including the discrete transistors controlling the relay, bypass the relay's transistor control connection and test the board.

Using a variac, we see that relay closed when about 60 volts was supplied to the board. That could be extended upwards by adding a resistor in series with the relay board's AC input. A 15 - 25 watt 25 ohm resistor should limit the turn-on surge.

The relay closes to bypass these power resistors after the transformer primaries climb above 60 volts or other selected point. Experiment with the resistor value to determine what works best in your circuit.

A HV supply using two 1200 watt microwave oven transformers with both the primaries and secondaries wired in series will provide a secondary output of approximately 2000 volts AC. A bridge rectifier will then provide a full-wave HV output and a simple varistor can be used in the primary AC line since these transformers have robust primaries when two are wired in series. The cooling-down aspect of the varistor must be remembered, however.