SMALL-SIZE POWER SUPPLY UNIT DEVELOPING A 20 kV OUTPUT VOLTAGE

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A small-size power supply unit having an output of 200 W *and developing a* 20 kV *output voltage has been described. It has been built around a voltage converter without input transformer.*

In this paper, a power supply unit having an output of 200 W and built around a voltage converter without input transformer has been described.

Electric circuit of the power supply unit (Fig. 1) is built around a half-bridge inverter,[1] in which peak voltage on each transistor is no more than power supply voltage (U_s)

$$U_s = \sqrt{2}\, U_l ,$$

where U_l = 220 V is the line voltage.

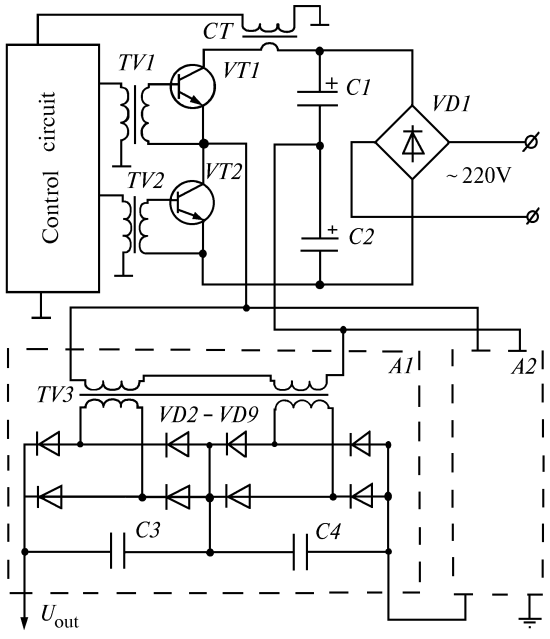

FIG. 1. Electric circuit of the power supply unit: A_1 and A_2 are the high-voltage blocks, C_1 and C_2 are the K50-7 *capacitors (*185 V *and* 500 μF*), C_3 and C_4 are the* KVI-3 *capacitors (*10 kV, 3300 pF*), CT is the current transformer, TV*1 *and TV*2 *are the control-circuit transformers, TV*3 *is the high-voltage transformer, VD*1 *is the* KTs402A *bridge rectifier,* VD2-VD9 *are the* KTs106G *diodes, and* VT1 *and* VT2 *are the* KT841B *transistors.*

Voltage no more than $U_s/2$ is applied to a primary transformer coil. Variations of loading (γ) on transistors allow us to regulate the output parameters of the power supply unit

$$U_{out} = n\,\gamma U_s/2,$$

where $n = W_1/W_2$ is the transratio being equal to the ratio of the numbers of turns in secondary and primary coils. The use of transformer oil as insulator to develop high voltage leads to additional service inconvenience in comparison with epoxy resin insulation. Dividing the transformer into two separate ones and sectioning coils, we can develop up to 10 kV on each high-power voltage block without oil as insulator. Design of such transformer is shown in Fig. 2. Stack of the KTS106G diodes connected in a bridge rectifier[1] allow the converter to be operated at frequencies up to 10 kHz.

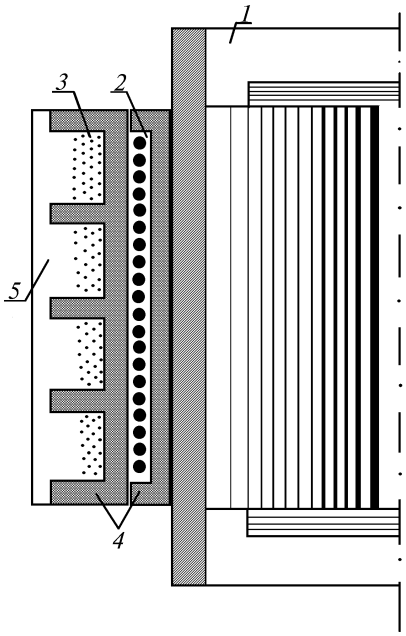

FIG. 2. Transformer design: 1) core, 2) and 3) primary and secondary coils, 4) fluoroplastic coil forms, and 5) epoxy resin insulation.

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The converter control circuit is built around the KR1114EU4 specialized chip. It provides soft triggering of the converter, protection of power transistors against collector current jumps, and adjustable pause between pulses. The multipurpose KR1114EU4 chip can operate with input voltage from 7 to 40 V, allows the commutation frequency to be adjusted up to 200 kHz, and provides the output current up to 200 mA. This makes it possible to decrease essentially overall dimensions and mass of the power supply unit.

The operating model of the power supply unit has 200 W output power, its output voltage is regulated in the range 12–20 kV, its overall dimensions are 300×230×12 mm^3, and its mass is about 1 kg.

The device can be used as a dc high-power voltage supply unit. This device also may be used in schemes of pumping of small-size pulsed gaseous lasers (nitrogen, excimer, and so on) to protect them from the interference.

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REFERENCES

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