Magnetron as high efficient heater

Research Project

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The project was started by Faraday Lab Ltd in January of 2006. The author of this idea is Mr. Vladimir I. Korobeinikov, St.Petersburg. His participation was agreed by Contract as 10% of the future patent.

Normal operation of magnetron use acceleration of electrons in electric field between cathode and anode and also curvation of trajectory of electrons due to axial magnetic field that can be provided by ring axial permanent magnets. The Lorentz force make electrons to change radial trajectory (line between cathode and anode) to curve line that is reason of HF radiation produced by magnetron. By increasing of permanent magnets field the magnetron mode of operation can be changed to make the trajectory of electrons more curved and to decrease anode current up to zero, Fig.1.

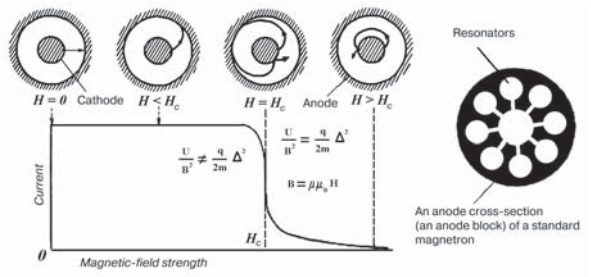

Fig.1

By this way it is possible to use emission electrons as method of bombarding of the cathode and to rise secondary emission and additional heating of the cathode. Additional energy also is produced due to acceleration of the electrons in electric field. In this case also there is high frequency waves but mainly the device is heater. Efficiency of this method can be very high since input is necessary for high voltage source only and its current is not important. Other important thing to increase output is the field of the permanent magnets, that is free of input power source.

Faraday Lab Ltd tested 3 types of magnetrons, which usually applied in home microwave ovens: 2M18, 2M219 and OM75P(31). The electrical connections Fig.2 were made by usual microwave oven method but we used possibility to change the anode voltage from zero to max value of the HV transformator.

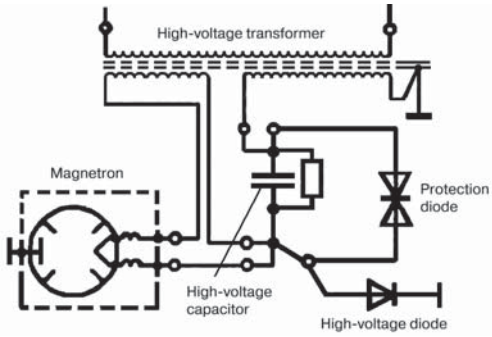

Fig.2

Powerful permanent magnets were delivered from ERGA factory, Kaluga city, Russia. Fig. 3 is graph made for the case of OM75P(31) magnetron testing with different permanent magnets. Difference between 4 curves of graphic charts

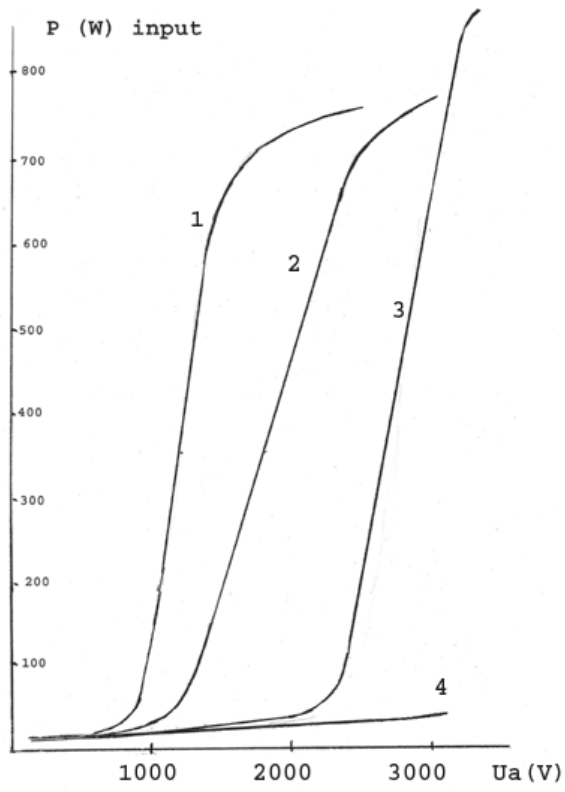

Fig.3

demonstrate changes of mode of operation of the magnetron. Curve 1 is the case of usual permanent magnets. In the case of more strong magnetic field (2,3) the anode current (input power) is started for bigger anode voltage Ua. Curve 4 is example of the case when the magnetic field prevent increase of the anode current and all electrons are coming back to cathode due to the Lorentz force. Note: the input power data here include losses for High Voltage transformator that is about 30-50W in any case.

Efficiency of heating was tested by the method of water heating, i.e. the magnetron was immersed into the water tank and during the test the temperature difference was measured. Input power was measured by digital wattmeter for sinus 50Hz 220VAC input (losses for HV transformator were not considered since it is the same power for any case of magnets and comparision can be made without this aspect).

Experimental data

1. Test of March 01, 2006. Magnetron 2M218 tested with its usual ceramic magnets.
T1=25.1C, T2=28.3C, dT=3.2 degrees
Time of experiment is 600 sec.
Mass is 8kg. Pin=234W Pheat=178W
K=178/234=0.76

2. Test of March 06, 2006. Magnetron 2M218 tested with ERGA magnets.
T1=16.4C, T2=28.8C,dT=12.4degrees
Time of experiment is 600 sec.
Mass is 8kg. Pin=841W Pheat=689W
K=689/841=0.82

2. Test of March 20, 2006. Magnetron OM75P(31) tested with its usual ceramic magnets (Fig.3 curve 1).
T1=19.5C, T2=24.5C, dT=5 degrees
Time of experiment is 300 sec.
Mass is 8kg. Pin=712W Pheat=556W
K=556/712=0.78

3. Test of March 22, 2006. Magnetron OM75P(31) tested with ERGA magnets (Fig.3 curve 2).
T1=5.8C, T2=9.8C, dT=4 degrees
Time of experiment is 600 sec.
Mass is 9kg. Pin=260W Pheat=250W
K=250/260=0.96

4. Test of March 22, 2006. Magnetron OM75P(31) tested with ERGA magnets (Fig.3 curve 3).
T1=9.8C, T2=20.2C, dT=10.4 degrees
Time of experiment is 900 sec.
Mass is 9kg. Pin=478W Pheat=433W
K=433/478=0.91

Conclusion

The experiments are proof of the principle and it can be patented as method of high efficient transformation of energy. Additional energy is result of acceleration of electrons in electric field between anode and cathode. The magnetic field here is used to decrease anode current (input power). Commercialization of the effect requires more developement works to design a new type of the vacuum tube, which is planned to be used as high efficient heater instead of usual role of magnetron as a HF waves generator.