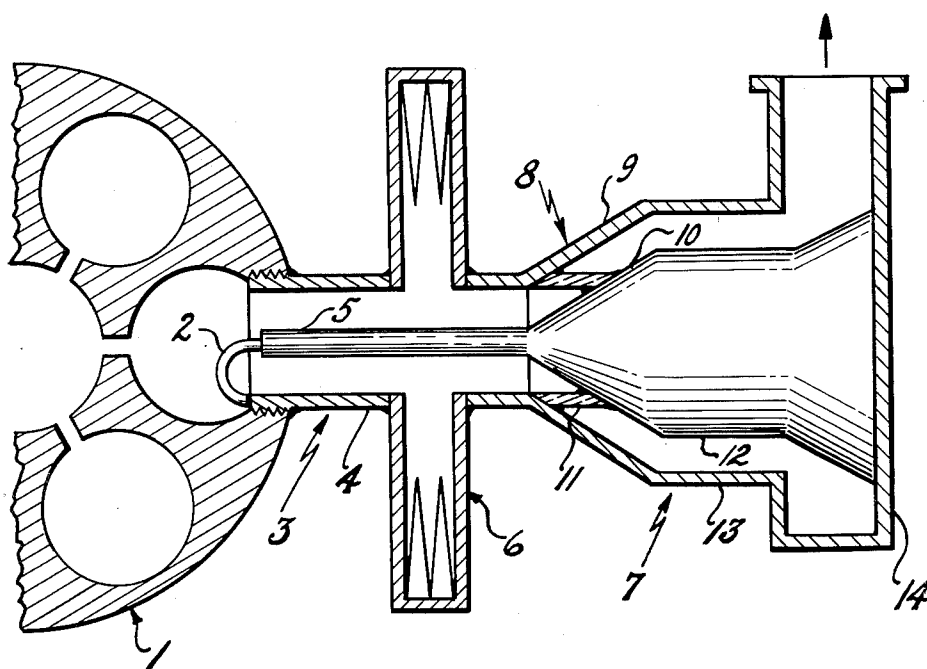


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MICROWAVE GENERATOR
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MICROWAVE GENERATOR

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4 Claims. (Cl. 315—39)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the United States Government for governmental purposes without payment to me of any royalty thereon.

The present invention relates to a microwave tube generator and more particularly, to a microwave tube generator arranged to reduce the amount of harmonic and spurious emission therefrom.

In the prior art, reflective low pass filters have been utilized in combination with a tube proper such as klystron, magnetron, platenetron, etc. The aforementioned combination thereof resulted in high currents because of tuned circuits, which at moderate output powers, caused heating with resulting contamination of the tube proper, or voltage breakdown within the filter.

Another limitation in the prior art in relation to microwave tube generators resided in the voltage breakdown of its output coaxial line which coupled harmonic and spurious emission into its load. In the past, the elimination of harmonic and spurious frequencies resulted in subjecting the tube (generator or amplifier) proper to impedance discontinuities, i.e., high standing wave ratios with resulting microwave voltage breakdown or overheating from high currents.

The present invention provides a tube generator such as a klystron, magnetron, platenetron, etc. having an output coaxial line integrated therewith. Energy is generated in the tube proper and is coupled out into aforesaid coaxial line which has the smallest diameter possible consistent with the power to be generated. The diameter of the line is selected to be small in order to confine not only the basic fundamental operating frequency to the TEM mode but also to confine the harmonic and spurious frequencies to the TEM mode.

The coaxial line has branch placed therein which is comprised of a dissipative filter in the form of a waveguide. Since the harmonic and spurious generated frequencies are confined to the TEM mode, the dissipative filter is particularly effective in absorbing them.

There is also provided a transition from the aforementioned small output coaxial line to a larger coaxial line. A tube seal is located at the transition area. The tube seal permits placing the tube proper, the small output coaxial line, and the dissipative filter in the tube's vacuum. This provides maximum protection for voltage breakdown.

An object of the present invention is to provide a novel microwave tube generator to substantially reduce the amount of harmonic and spurious emission emanating therefrom.

Another object of the present invention is to provide a microwave tube generator having integrated therewith an output coaxial line with a branched dissipative filter, all being within the vacuum of the tube proper.

Yet another object of the present invention is to provide a microwave tube generator having integrated therewith a coaxial output line whose dimensions are selected to confine the frequencies therein to the TEM mode and a waveguide dissipative filter traveling out from aforesaid coaxial line.

Still another object of the present invention is to provide a microwave generator with an integrated output

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coaxial line having dimensions serving to confine the generated energy to the TEM mode, aforesaid coaxial line having a dissipative filter to reduce harmonic and spurious frequencies and having a transition from the output coaxial line to a larger coaxial line wherein the transition area is provided with a seal so as to include aforesaid output coaxial line and dissipative filter in the vacuum of the microwave generator.

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention itself, however, together with further objects and advantages thereof may best be understood by reference to the following description when taken in conjunction with the accompanying drawing illustrating one embodiment of the invention.

In the drawing, microwave generator 1 is shown from which is derived radio frequency energy. Loop 2 couples the energy into coaxial transmission line 3 which is comprised of outer conductor 4 and inner conductor 5. The dimensions of coaxial line 3 are selected so that it has the smallest diameter possible consistent with the power to be generated and is chosen to be small in order to confine not only the basic fundamental operating frequency to the TEM mode but also to confine the harmonic and spurious frequencies to the TEM mode.

It is to be noted that outer conductor 4 is connected to microwave generator 1 so as to make it vacuum tight. Dissipative, waveguide, low-pass filter 6 is formed by circumferentially flanging outer conductor 4 at spaced points thereby providing a vacuum tight chamber enveloping coaxial line 3. Coaxial transmission line 7 is larger than coaxial line 3 and is connected thereto by tapered transition coaxial line 8, which is comprised of outer conductor 9 and inner conductor 10. Tube seal 11 is in the form of a cylinder and is located between outer conductor 9 and inner conductor 10 and serves to maintain the vacuum within microwave generator 1, coaxial line 3 and waveguide 6.

Coaxial transmission line 7 is comprised of inner conductor 12 and outer conductor 13. Inner conductor 12 extends into waveguide 14 and provides a transition from coaxial line 7 to output waveguide 14 which in turn supplies radio frequency energy to a load.

In the operation of the preferred embodiment of the present invention, coaxial transmission line 3, waveguide 6 are within the vacuum of microwave generator 1 thus providing maximum protection for voltage breakdown. Radio frequency energy is generated in microwave generator 1 and is coupled into coaxial transmission line 3 by way of coupling loop 2. Coaxial line 3, because of its preselected dimensions, confines the fundamental operating frequency, the harmonic and spurious frequency of the generated energy to the TEM mode thus permitting the dissipative filter in the form of waveguide 6 to become most effective in removing the harmonic and spurious frequencies coupled therein. Tube seal 11, as hereinbefore described, serves to include waveguide 6 and coaxial line 3 in the vacuum of microwave generator 1.

The fundamental operating frequency signal is transmitted along coaxial line 3 into coaxial line 7 by way of tapered transition coaxial line 8. Transition coaxial line 8 permits the electric field to become perpendicular to cylinder type tube seal 11. From coaxial line 7, the fundamental operating frequency signal is fed into a load by way of waveguide 14. The coaxial to waveguide transition from coaxial line 7 to waveguide 14 is conventional and is as shown and described in Radiation Laboratory Series, volume 9, pages 314-361, published by McGraw-Hill Book Company, Inc. in 1948. Thus

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the microwave generator is presented with a matched termination for harmonic and spurious frequency signal as well as for the fundamental. The harmonic and spurious frequency signals are eliminated without subjecting the microwave generator to impedance discontinuities, i.e., high standing wave ratios with resulting microwave voltage breakdown or overheating from high currents.

While a particular embodiment of the invention has been shown and described, modifications may be made. It is intended in the appended claims to cover all such modifications as falls within the true spirit and scope of the invention.

What is claimed is:

1. A microwave generator comprising an electron discharge device, said device generating radio frequency energy, a coaxial transmission line being so dimensioned in diameter as to restrict the propagation of energy therein exclusively to the TEM mode and said coaxial transmission line having an inner and outer conductor, said outer conductor being connected to said electron discharge device to form a vacuum tight seal, means, including said inner conductor of said first coaxial transmission line, to couple said generated energy directly from said electron discharge device into said coaxial transmission line, a waveguide dissipative filter to absorb the harmonic and spurious frequency signals in said coaxial transmission line, said waveguide enveloping said coaxial transmission line, and means to seal said coaxial transmission line at the output thereof to include said waveguide and said coaxial transmission line in the vacuum of said electron discharge device.

2. A vacuum sealed microwave generator comprising an electron discharge device, said device generating radio frequency energy, a first coaxial transmission line being so dimensioned as to restrict the propagation of energy therein exclusively to the TEM mode and said first coaxial transmission line having inner and outer conductors with said outer conductor joined to said device to form a first vacuum tight seal, means to couple said generated energy directly from said electron discharge device into said first coaxial transmission line, a dissipative waveguide filter enveloping said first coaxial transmission and flanged therefrom to form a vacuum tight seal, said waveguide operating to absorb the harmonic and spurious signal present in said first coaxial transmission line, a second coaxial transmission line having inner and outer conductors and being larger in diameter than said first coaxial transmission line, a third coaxial transmission line being tapered so as to interconnect said first and second coaxial transmission line, said third coaxial transmission line and operating as a transition therebetween permitting the electric field therein to become perpendicular having inner and outer conductors, a coaxial seal between said inner and outer conductors of said third coaxial transmission serving to include said first coaxial transmission line and said waveguide filter in the vacuum of said electron discharge device, and transitional means to couple said radio frequency energy from said third transmission line to an output waveguide for distribution to a matched load.

3. A vacuum sealed microwave generator comprising an electron discharge device, said device generating radio frequency energy, a first coaxial transmission line having

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inner and outer conductors with said outer conductor joined to said device to form a first vacuum tight seal, said first coaxial transmission line having the diameter arranged to confine the radio frequency energy therein exclusively to the TEM mode, means to couple said radio frequency energy directly from said electron discharge device into said first coaxial transmission line, a dissipative waveguide filter enveloping said first coaxial transmission line to absorb the spurious and harmonic frequencies resulting from said generated radio frequency energy, a second coaxial transmission line having a diameter larger than said first coaxial transmission line, a third coaxial transmission being tapered to interconnect said first and second coaxial transmission line, and a coaxial seal in said third coaxial line operating to place said first coaxial line and operating as a transition therebetween permitting the electric field therein to become perpendicular, and said dissipative waveguide filter in the vacuum of said electron discharge device.

4. A vacuum sealed generator comprising an electronic discharge device generating microwave energy, a succession of four transmission lines, the first transmission line being a first coaxial line being so dimensioned as to restrict the propagation of energy therein exclusively to the TEM mode and having inner and outer conductors with said outer conductor joined to said device to form a first vacuum tight seal, means including said inner conductor to couple said microwave energy into said first transmission line, a dissipative waveguide filter enveloping said first transmission line and flanged therefrom to form a vacuum tight seal, said filter suppressing harmonic and spurious frequencies transmitted thereto resulting from said TEM mode, the third transmission line being a third coaxial line having inner and outer conductors and being larger in diameter than said first transmission line, the second transmission line being a second coaxial line being tapered so as to interconnect said first and third transmission lines and operating as a transition therebetween permitting the electric field therein to become perpendicular, said second coaxial line having inner and outer conductors, a cylindrical seal between said inner and outer conductors of said third coaxial line serving to include said first transmission line and said waveguide filter in the vacuum of said electronic discharge device, a fourth transmission line being a waveguide for transmission of said microwave energy to a load, and transition means to couple said microwave energy from said third transmission line to said fourth transmission line.

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