

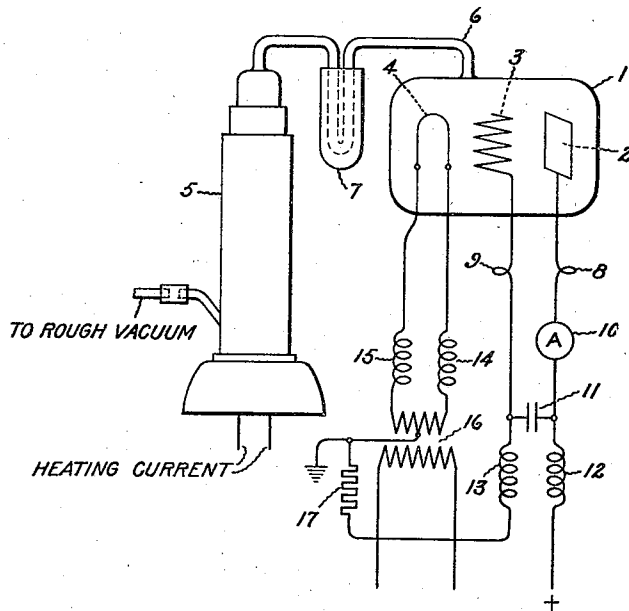
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METHOD OF EXHAUSTING VACUUM TUBES

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UNITED STATES PATENT OFFICE

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METHOD OF EXHAUSTING VACUUM TUBES

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The present invention relates to electric discharge devices and more particularly to a method for exhausting such devices.

While heretofore various methods have been employed to heat the electrodes of a discharge device during evacuation and thus cause removal of occluded gases, none of the former methods have provided means whereby a circulating current of appreciably greater value than that encountered in the usual or normal operation of the tube might be passed between the electrodes to heat the various parts of the tube during the evacuation process.

According to the present invention, I heat the electrodes, leads and seals by a high frequency circulating current which has a wave length of the order of five meters and is substantially independent of the current due to electron emission from the cathode. At this short wave length the interelectrode capacity permits the passage of a circulating current between the electrodes which is at least twice the value of currents normally encountered in the operation of the discharge device. In this manner the electrodes and especially the leading-in wires and seals may be heated during the exhaust to temperatures far in excess of the temperatures ordinarily encountered in the operation of the discharge device and as a result an unusually high degree of vacuum may be initially secured in the discharge device and this degree of vacuum may be maintained even under severe conditions of use, such, for instance, as are obtained when using the tube at the shorter wave lengths.

In carrying the present invention into effect, I connect the tube to be evacuated to a diffusion or other suitable exhaust pump and at the same time oscillate the tube by means of a short wave oscillatory circuit of such type and adjustment that the high frequency currents will be much larger than those normally encountered in practice.

The novel features which I believe to be characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, will best be understood from reference to the following specification when considered in connection with the accompanying drawing which shows diagrammatically one arrangement whereby my invention may be carried into effect.

Referring to the drawing, I have illustrated diagrammatically an electric discharge device comprising a receptacle or tube 1 and containing the usual anode 2, grid or control electrode 3 and filamentary cathode 4. A diffusion exhaust pump 5 is connected to receptacle 1 through a glass tube 6 which passes through the usual liquid air trap 7. A short wave, oscillating, resonant circuit is associated with the discharge device and comprises grid 3, anode 2, inductances 8, 9, an ammeter 10, and a large condenser or capacity unit 11. Radio frequency chokes 12, 13, 14 and 15 are inserted in the electrode leads. A source of comparatively low voltage alternating current is connected to a transformer 16 which supplies heating current to cathode 4, while a voltage of 500 volts or greater may be connected to the anode lead and ground. A grid leak resistor 17 connects the grid leading-in wire with the secondary winding of the transformer 16.

As thus arranged the oscillating circuit will be resonant at a frequency of about 60,000 kilocycles and will carry a current of very low power factor. With the pump 5 in operation, the circulating current flowing in the oscillatory circuit will vary from 5 amperes upwardly, depending on the size of the discharge device employed. The interelectrode capacity permits the use of circulating currents of the value and frequency indicated although currents of similar value and having relatively low frequencies could not be employed at voltages which would not endanger the tube.

The circulating current in the oscillatory circuit depends upon the capacity between the grid and anode and the high frequency voltage and is substantially independent of filament emission. For example, the circulating current may have a value of about 30 amperes while the electron current at the same time might not have a value greater than one ampere. Variations in the filament emission above normal operating value will not cause any appreciable change in the circulating current in the oscillatory circuit. The use of this large circulating current effectively removes all occluded gas from the various parts of the tube and permits the establishment of a very high degree of vacuum.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The method of exhausting an electric discharge device containing a pair of electrodes, which comprises connecting said pair of electrodes in a circuit resonant at a certain frequency and supplying current of that frequency to said circuit while the discharge device is connected to an evacuating pump.

2. The method of exhausting an electric discharge device comprising a grid, anode and a filamentary electrode adapted to be heated to incandescence, which comprises energizing the filament coupling the grid and anode together to form a high frequency oscillatory circuit and supplying current to said circuit, the value of said current being dependent upon the capacity between the grid and anode.

3. The method of exhausting an electric discharge device comprising a grid, anode and a filamentary electrode adapted to be heated to incandescence, which comprises rendering the filament electronically active, coupling the grid and anode together to form a high frequency oscillatory circuit and supplying current to said circuit, the value of said current being substantially independent of the electron current in the device.

4. The method of exhausting an electric discharge device comprising a grid, anode and a filamentary electrode adapted to be heated to incandescence, which comprises causing the filament to emit electrons, coupling the grid and anode together to form a high frequency oscillatory circuit and supplying current to said circuit, the value of said current being substantially independent of the current in the device due to filament emission but dependent upon the capacity between the grid and anode.

5. In the art of exhausting an electric discharge device comprising a grid, anode and a filamentary electrode adapted to be heated to incandescence, the method which consists in energizing the filament to produce electrons for reducing the impedance between

the grid and anode, then causing an alternating space current of high frequency to flow between the grid and anode while the device is being evacuated thereby to heat the electrodes and remove the occluded gases, the value of said alternating current being substantially independent of the electron current but dependent upon the capacity between the grid and anode.

In witness whereof, I have hereunto set my hand this 12th day of January, 1928.
OTIS W. PIKE.

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