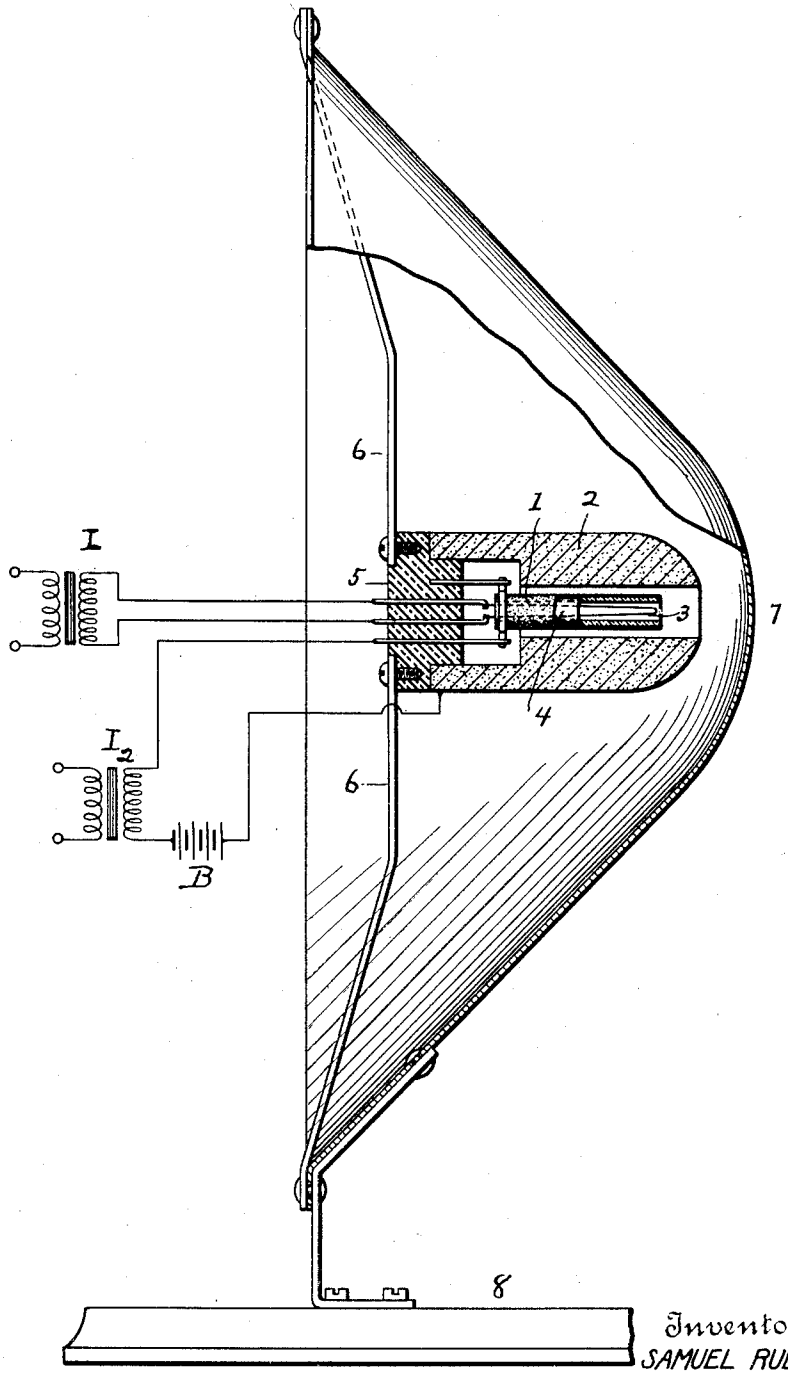
March 25, 1930. S. RUBEN 1,751,888

SOUND EMITTING DEVICE

Filed April 29, 1929



Inventor
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By his Attorney M. L. Stephens

Patented Mar. 25, 1930 1,751,888

UNITED STATES PATENT OFFICE

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SOUND-EMITTING DEVICE

Application filed April 29, 1929. Serial No. 359,163.

This invention relates to a sound emitting device and is a continuation, in part, of my prior and co-pending application filed April 8, 1922, under Serial Number 550,850; it also constitutes an improvement upon that described in my U. S. Letters Patent 1,702,951, issued February 19, 1929. An object of the invention is the provision of an efficient device for the production of acoustic vibrations with a minimum of distortion, by impressed electrical impulses; further objects will appear more fully hereinafter.

By the terms of my invention the device consists broadly, of a cylindrically shaped anode, an axially located cooperating alkaline earth oxide coated cathode having an equipotential discharge surface, a heater element for heating the cathode to emission temperature and a horn or other sound-directing body. With the discharge of a current of a suitable potential from the cathode when it is heated to emission temperature the air column within the annular space between the anode and the cathode is rarified, and is ionized by the current discharging therethrough. With variations in the ionization of the air column, by changes in the ionizing current through the gap, due to variations in audio frequency oscillations impressed upon the cathode-anode circuit, the air column contracts and expands responsively, the pressure variations at audio frequency or acoustic vibrations being directed out into the atmosphere by a horn or other sound-directing body from an opening in the annular space.

The device of my invention described in the patent referred to, is preferably operated with direct current and when small currents are desired; whereas, my present invention is particularly adapted to alternating current of high intensity. The chief functional difference between the device of my former invention and the present one lies in the methods of heating the cathode to an emission temperature; the latter is indirectly heated by a heater element. The heater element can be insulated from the cathode, as by use of a ceramic tube or, the cathode can be heated by radiation from a heater element suspended within the cathode. The plate potential in this device can be as low as 250 volts.

For a better understanding of the invention reference is made to the accompanying drawing showing one embodiment of my invention, in which 1, represents a cylindrical cathode having an outside surface coating of barium-strontium oxide, 2, a carbon anode and 3, a loop of resistance wire for heating the porcelain cylinder 4, with which cathode 1, is in surface contact over its outside area. Anode 4, is mounted on bakelite base 5, which is supported by metal arms 6. Sound directing member 7, is supported on base 8. Current for heating the heater element 3, is furnished through transformer I. B, is a battery for maintaining the potential in the cathode-anode circuit in which is the secondary of the transformer I_2.

In operation, as a heating current is discharged through heater element 3, and the thermally conductive electrically insulating cylinder 4, conducts the heat to oxide coated cathode 1, raising that element to an emission temperature, the air within the annular space is raised to about 900° C., causing a rarification of the gas and its expansion beyond the gap into the outer chamber of the device. A uniformly distributed current at about 250 volts, is discharged through the rarified gas which is thus ionized causing a further increase of temperature and expansion thereof. For higher current densities higher voltages should be used.

Audio frequency electrical oscillations impressed upon the input circuit represented by the audio frequency transformer I_2, produce corresponding vibrations in the ionizing current, causing expansions and contractions of the gas between the electrodes, the acoustic vibrations from the gas column thereby produced, being directed into the outer atmosphere by the sound-directing member 7.

What I claim is:

1. A sound emitting device comprising a gas-filled container having a sound opening, an anode, an indirectly heated cathode having an equipotential operating surface, means for discharging an ionizing current through the gas, means for producing acoustic vibra-

tions of the gas by varying the ionization of the gas responsively to audio signal currents, and, means for directing the acoustic vibrations from the sound opening, away from the device.

2. A sound emitting device comprising a gas-filled container having a sound opening, an anode, an indirectly heated cathode having an equipotential alkaline earth oxide coated operating surface, means for discharging an ionizing current through the gas, means for producing acoustic vibrations of the gas by varying the ionization of the gas responsively to audio signal currents, and, means for directing the acoustic vibrations from the sound opening, away from the device.

3. A sound emitting device comprising a gas-filled container having a sound opening, a carbon anode, an indirectly heated cathode having an equipotential operating surface, means for discharging an ionizing current through the gas, means for producing acoustic vibrations of the gas by varying the ionization of the gas responsively to audio signal currents, and, means for directing the acoustic vibrations of the gas from the sound opening, away from the device.

4. A sound emitting device comprising a gas-filled container having a sound opening, a carbon anode, an indirectly heated cathode having an equipotential operating surface extending axially with respect to the anode, means for discharging a thermionic current through the gas, means for producing acoustic vibrations of the gas by varying the discharge responsively to audio signal currents, and means for directing the acoustic vibrations from said opening away from the device.

5. A sound emitting device comprising a thermally insulating housing having a sound opening therein, an anode, a cooperating cathode having an equipotential operating surface, a heater element for indirectly heating the cathode, a circuit for heating the heater element, a circuit connecting the cathode and anode, and means for translating current variations in the cathode-anode circuit into acoustic vibrations of the atmosphere within the housing.

6. A sound emitting device comprising, in combination, an anode partially surrounding an annular gas-filled space, and arranged axially with respect to the anode, a cooperating, oxide coated cathode having an equipotential operating surface, and a heater element for heating said cathode, means for ionizing the gas within said space by discharging a thermionic current through the cathode-anode circuit, means for producing acoustic vibrations of the gas by varying said discharge responsively to audio frequency oscillations impressed upon the cathode-anode circuit, and means for directing the vibrations away from said space.

7. A sound emitting device having an anode partially surrounding an annular gas-filled space, a cooperating cathode having an equipotential discharge surface, and a heater element for heating the cathode arranged axially of the space, means for ionizing the gas in the space by discharging a thermionic current therethrough, means for producing acoustic vibrations of the gas by varying said discharge responsively to audio frequency oscillations impressed upon the cathode-anode circuit.

8. A sound emitting device comprising an annular gas-filled space partially surrounded by an anode, an alkaline earth oxide coated cooperating cathode having an equipotential operating surface, and a heater element for heating the cathode arranged axially of the space, means for ionizing the gas in the space by discharging a thermionic current therethrough, means for producing acoustic vibrations of the gas by varying said discharge responsively to audio frequency oscillations impressed upon the cathode-anode circuit.

9. A sound emitting device comprising an anode partially surrounding an annular gas-filled space, an alkaline earth oxide coated cathode having an equipotential operating surface, a heater element for heating the cathode, means for electrically insulating the cathode from the heater element, an opening at one end of the gas-filled space, means for ionizing the gas in the space by discharging a thermionic current therethrough, means for producing acoustic vibrations of the gas by varying said discharge responsively to audio frequency oscillations impressed upon the cathode-anode circuit, and means for directing vibrations of the gas away from said space.

In testimony whereof, I, SAMUEL RUBEN, have signed my name to this specification this 25th day of April, 1929.

SAMUEL RUBEN.