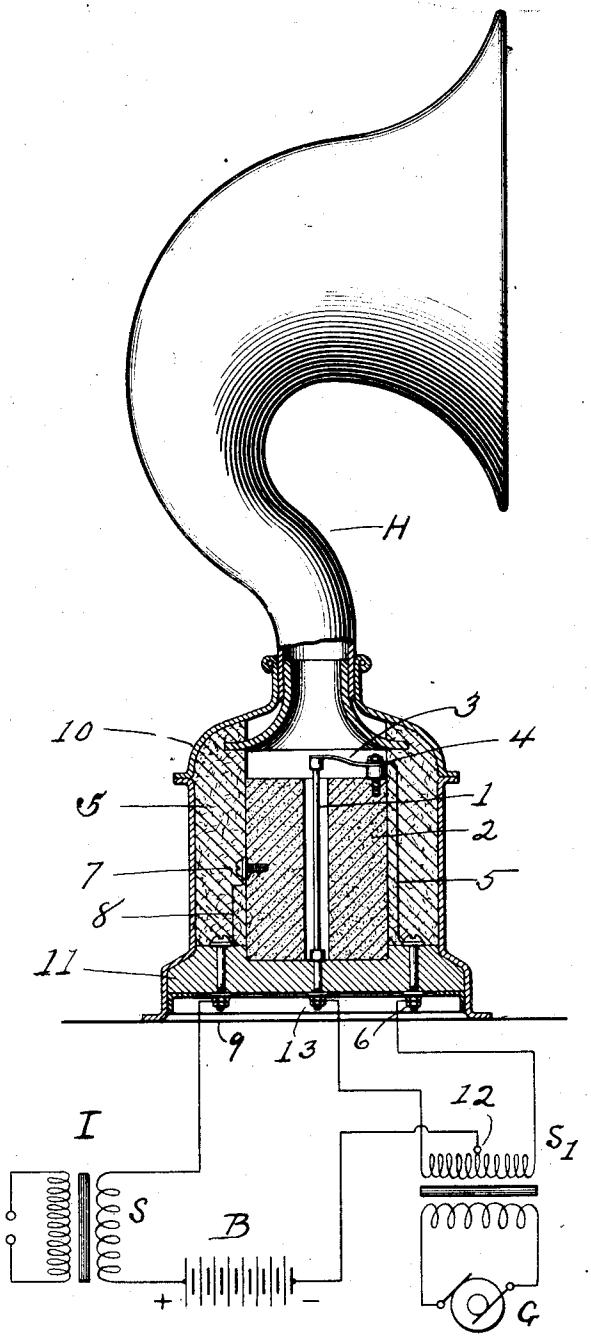
Feb. 19, 1929. 1,702,951

S. RUBEN

SOUND EMITTING APPARATUS

Filed July 13, 1927



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UNITED STATES PATENT OFFICE.

SAMUEL RUBEN, OF NEW YORK, N. Y.

SOUND-EMITTING APPARATUS.

Application filed July 13, 1927. Serial No. 205,525.

This invention relates to an improved sound emitting apparatus, and more particularly it relates to a device for producing sound waves in response to fluctuations in the electrical current discharging through an ionized air gap. This is a continuation in part of my prior and copending application filed April 8, 1922, under Serial No. 550,850.

The object of the invention is to provide an efficient device for the production of acoustic vibrations in response to audio-frequency oscillations impressed upon an electrical circuit.

Arc discharges have been used in the prior art devices for production of sound waves by the control of ionized air gaps; but localization of those discharges occurs causing continuous current variation and requiring excessive power to maintain a uniform arc discharge. These devices are, therefore, of only experimental value.

In the device of my invention there is an ionizing discharge from a heated cathode through an ionized gaseous field in a confined space in which pressure fluctuations occur with variations of field potential between the cathode and anode due to electrical oscillations impressed upon that circuit. Oscillations at audio-frequencies so impressed cause pressure variations or acoustic vibrations of the gas which are directed through the horn and are emitted as corresponding sounds.

Broadly my invention comprises three chief elements, the cathode or ionizer, and the anode, between which is a confined gas which expands with the expenditure of electrical energy by ionization and contracts from the more rarefied state as this is reduced, together with a horn or other means of directing the air pressure variations or sound waves from the ionized annular air gap. As the cathode is heated the gas becomes somewhat rarefied and varies in pressure with changes in the ionization discharge through it.

For a more complete understanding of the principles of my invention reference is made to the accompanying drawing which represents one embodiment thereof. Referring to the drawing, 1 is a cathode composed preferably of a platinum wire of large diameter, coated with a mixture of strontium and barium oxides, one end being connected in the heating and ionization circuits at 13; 2 is a carbon cylinder anode along the axis of which extends the cathode. The annular space between the cathode and anode contains a gas varying in pressure with the ionization changes due to oscillations impressed upon the cathode-anode circuit; 5 is a thermal insulation to prevent excessive temperature rise around the unit, due to the expenditure of the heating current and the ionization energy. The cathode 1 is held in position by spring 3, which also serves to connect the cathode by contacts 4 and 6 in the transformer, having a secondary S_1 circuit, the heating energy for which is supplied by generator G.

The anode is connected in the ionization circuit by contacts 7 and 9 and conductor 8. The cathode, anode and thermal insulation rest on lava base 11. At 10 is a metal covering for the entire device, except the horn. H is a horn or other means employed to direct the sound waves produced in the annular space by variations in the ionization of the gas in the gap and the resulting pressure fluctuations. The transformer in the heating circuit is tapped or connected to the negative terminal of the ionizing potential at the middle to minimize the potential difference between the cathode and anode caused by the cathode heating potential.

At I is a transformer, with secondary S, for superposing audio-frequency oscillations on the high potential direct current, which causes the variations in the ionization of the gap; at B is a source of direct current potential sufficient to ionize the annular gap. If desired, a potentiometer can be used across the heating transformer winding to obtain a neutral position of the filament and, while batteries are shown for obtaining the ionizing potential, other means, such as a device called B battery eliminator, composed of a rectifier and filter circuit, can be conveniently used.

In operation, as a heating current is supplied from generator G through the transformer secondary S_1, to the cathode 1, the air surrounding it in the annular space is heated to about 900° C., causing a diminution of density in that space and an expansion of gas beyond the gap into the outer chamber. By applying the direct current potential of about 800 volts across the annular space, ionization of the air in the gap occurs and a glow or uniformly distributed discharge by ionization results. The expenditure of this ionization energy in the gap causes further heating and further expansion.

By the application of audio-frequency electrical oscillations to the input circuit represented by the radio-frequency transformer I,

corresponding variations in the ionization current occur, causing equivalent gas expansions or contractions in the annular gap between the cathode and anode. These expansions and contractions cause the production of sound oscillations from the horn or equivalent wave-directing element, thus emitting sound.

What I claim is:

1. An electrical sound emitting apparatus comprising an annular space partially surrounded by a conducting material, constituting an anode in a circuit, a heater element located axially of the space, and constituting a cathode in said circuit, a sound opening connecting with the space, means for ionizing the gas in the space by discharging a thermionic current therethrough, means for varying said discharge responsively to audio-frequency oscillations impressed upon said circuit and means for externally thermally insulating one of said electrodes.

2. An electrical sound emitting apparatus comprising an annular space partially surrounded by a carbon anode, a heater element located axially of the space, and constituting a cathode in said circuit, a sound opening connecting with the space, means for ionizing the gas in the space by discharging a thermionic current therethrough, means for varying said discharge responsively to audio-frequency oscillations impressed upon said circuit and means for externally thermally insulating one of said electrodes.

3. An electrical sound emitting apparatus comprising an annular space partially surrounded by a conducting material, constituting an anode in a circuit, a heating element composed of a conducting material having a coating of an alkaline earth oxide, located axially of the space, and constituting a cathode in the circuit with said anode, a sound opening connecting with the space, means for ionizing the gas in the space by discharging a thermionic current therethrough, means for varying said discharge responsively to audio-frequency oscillations impressed upon said circuit and means for externally thermally insulating one of said electrodes.

4. An electrical sound emitting apparatus comprising an annular space partially surrounded by a carbon anode. a heater element, composed of a conducting material having a coating of an alkaline earth oxide, and constituting a cathode in the circuit with said anode, a sound opening connecting with the space, means for ionizing the gas in the space by discharging a thermionic current therethrough, means for varying said discharge responsively to audio-frequency oscillations impressed upon said circuit and means for externally thermally insulating one of said electrodes.

5. An electrical sound emitting apparatus comprising a gas filled container having a sound opening, a cathode composed of a conducting material having a coating of an alkaline earth oxide and an anode within said chamber arranged to effect ionization of the gas therein, the cathode extending axially with respect to the anode, means for discharging a thermionic current through said gas, means for varying the discharge in accordance with audio signal currents, and means for directing acoustic vibrations from said sound opening away from said apparatus.

6. An electrical sound emitting apparatus comprising a gas filled container having a sound opening, a cathode and a carbon anode within said container, means for discharging a thermionic current through said gas, means for varying the discharge in accordance with audio signal currents, and means for directing acoustic vibrations from said sound opening away from said apparatus.

7. An electrical sound emitting apparatus comprising a gas filled container having a sound opening, a cathode composed of a conducting material having a coating of an alkaline earth oxide, and a carbon anode within said container, the cathode extending axially with respect to the anode, means for discharging a thermionic current through said gas, means for varying the discharge in accordance with audio signal currents, and means for directing acoustic vibrations from said sound opening away from said apparatus.

8. An electrical sound emitting apparatus comprising a thermally insulating housing having a sound opening therein, a heater element constituting an ionizing electrode and a co-operating electrode composed of carbon situated within the housing, a circuit for said electrodes, a circuit for heating said ionizing electrode, and means for translating current variations in the circuit of said electrodes into acoustic vibrations of the atmosphere within the housing.

Signed at the city of New York, in the county of New York and State of New York, this 8th day of July, A. D. 1927.

SAMUEL RUBEN.