The present invention relates generally to electrical oscillation circuits adapted to generate waves of the frequency corresponding or similar to the frequency of the sound waves generated by various musical instruments and more particularly the invention relates to such circuits comprising an electric discharge device in which the electric discharge is of the negative glow type.

It has been found difficult heretofore in such oscillation circuits comprising a negative glow electric discharge device to generate waves of such frequency that high, medium or low notes of pure tone were produced by the audio-circuit to which the oscillation circuit is connected. A scratching sound was generated which was caused by the continual changes taking place in the electrical characteristics of the negative glow discharge and large gaps appeared in the frequency band of the oscillation circuit, these being particularly noticeable in the high frequency end of the band.

The object of the present invention is to provide a gaseous electric discharge device of the negative glow type useful in electrical oscillation circuits adapted to generate waves of the frequency corresponding to the frequency of the sound waves produced by a musical instrument in which the negative glow discharge has substantially constant electrical characteristics. Further objects and advantages attaching to the device and to its use and operation will be apparent to those skilled in the art from the following particular description and from the appended claims.

In accordance with these objects the invention comprises an electric discharge device of the negative glow type in which the electrodes are concentric, the cathode is the electrode of greater diameter and the discharge path between said electrodes is completely surrounded by electrically conducting material. The maximum frequency of the waves generated by an electrical oscillation circuit comprising an electric discharge device of the negative glow type, which may be satisfactorily employed for tone production, is increased from 5,000 cycles, which has been the maximum heretofore, to 15,000 cycles, when the negative glow lamp is made in accordance with this invention.

In the drawings accompanying and forming part of this specification an embodiment of the invention is shown in which

Fig. 1 is a sectional front elevation view of the negative glow electric discharge device the oscillation circuit incorporating said device being shown schematically.

Fig. 2 is an elevational view of a negative glow electric discharge device having a different structure useful in the present invention and Fig. 3 is a similar view of another electric discharge device useful in the invention.

Like numbers denote like parts in all views of the device. The circuit connections are indicated as the same in each of the different figures.

Referring to Fig. 1 of the drawings the oscillation circuit comprises a negative glow electric discharge device and a condenser 2 connected in parallel therewith. Leads 1 and 8 connect the electrodes 9 and 10 of said electric discharge device to the terminals 3 and 4 of a 110 or 220 volt direct current source. An audio-transformer 6 is connected into said lead 1 and a variable resistance 5 is connected into said lead 8. The above oscillation circuit is more or less standard and the electrical characteristics and values of the electric discharge device, the condenser 2 and the audio-transformer 6 are constant; the adjustment of variable resistance 5 controlling the generation of the electrical frequency desired. A jack 14 is connected to leads 12 and 13 of the audio-transformer 6 and the above oscillation circuit, adapted to generate waves of the desired frequency, is connected to a standard audio-circuit by jack 14.

The negative discharge device illustrated in Fig. 1 comprises a glass container 1 having a filling of discharge conducting gas therein, such as neon, and a rod shaped anode 10 and a cylindrical cathode 9 sealed therein, said electrodes 9 and 10 are concentric. The inner wall of said container 1 has a coating 11 of “getter” material, such as magnesium, and said coating 11 is electrically connected to said cathode 9 by lead 16. Having this structure the electrical characteristics of the negative glow discharge in said device are substantially constant which eliminates the scratching sound heretofore characteristic of such oscillation circuits when connected to an audio-circuit and the circuit is capable of generating waves of a frequency up to about 15,000 cycles, which are of satisfactory character for musical tone production.

The negative glow electric discharge device illustrated in Fig. 2 is used in the oscillation circuit when desired. In this electric discharge device a cage 17 of electrically conducting material completely surrounds the discharge path between said electrodes 9 and 10 and said cage 17 is electrically grounded by lead 18. A tab 19 containing “getter” material such as magnesium is attached to said cage 17. The structure of this
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electric discharge device is in other respects similar to that shown in Fig. 1 and its electrical operating characteristics are the same.

In Fig. 3 another type of negative glow useful in the invention is shown. In the device illustrated the coating 11 of "getter" material, such as magnesium, is connected by lead 20 as the cathode. A possible explanation of the substantially constant electrical characteristics of the negative glow discharge in the devices illustrated and described is that their mechanical resonance is so high that it does not disturb the electrical characteristics of the negative glow discharge. Another possible explanation is that the path of the electric discharge in the device is entirely surrounded by metal coating 11 or cage 17 so that wall charges on the inner walls of the container do not affect the starting voltage of the negative glow discharge. Wall or space charges of this nature have a very disturbing effect on the electrical characteristics of the negative glow discharge as is shown by touching an oscillating tube in which the discharge is not surrounded. The introduction of an oscillation tube in which the discharge is not surrounded by metal significantly changes the tone produced by the audio-circuit. The acceleration of the deionization of the gas by the metal wall 11 or cage 17 contributes to the extension upward of the frequency bands of the waves generated by the oscillation circuit while the mechanical rigidity of the electrodes contributes to the purity of tone of the notes generated by the audio-circuit connected to the oscillation circuit.

While we have shown and described and have pointed out certain features of the invention, it will be understood that various omissions, substitutions and changes in the forms and details of the devices illustrated and in their use and operation may be made by those skilled in the art without departing from the broad spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. The combination, in an oscillation generator adapted to generate frequencies corresponding to high, medium, and low notes in the musical scale, of a source of unidirectional potential, a negative glow electron discharge device comprising a body of electrically conducting material connected to one side of said source of potential; a second electrode connected to the opposite side of said source of potential, a resistance and a load device each included in circuit with said source and said electrodes, a condenser connected between said electrodes, electrodes comprising concentrically arranged cathode and anode, said cathode having greater diameter than said anode, and means within said discharge device comprising a surface of conducting material completely surrounding the space between said electrodes to render said oscillation generator operative over a continuous range of frequencies including frequencies corresponding to said high, medium, and low notes in the musical scale, and to remove undesired scratching sounds during the production of said notes.

2. The combination, in an oscillation generator adapted to generate frequencies corresponding to high, medium, and low notes in the musical scale, of a source of unidirectional potential, a negative glow electric discharge device having an electrode connected to one side of said source of potential and an electrode connected to the opposite side of said source, a resistance and a load device each included in circuit with said source and said electrodes, a condenser connected between said electrodes, electrodes comprising concentrically arranged cathode and anode, said cathode having greater diameter than said anode, means within said discharge device to render said oscillation generator operative over a continuous range of frequencies including frequencies corresponding to said high, medium, and low notes in the musical scale, and to reduce the production of undesired sounds during the production of desired frequencies corresponding to said notes, said means comprising a body of electrically conducting material connected to said cathode and completely enclosing the discharge between said electrodes.

3. The combination, in an oscillation generator of a source of unidirectional potential, a negative glow electric discharge device, having an electrode connected to one side of said source of potential and a second electrode connected to the opposite side of said source, a resistance and a load, each included in circuit with said source and said electrodes, said load including a musical sound producing device, a condenser connected between said electrodes, electrodes comprising concentrically arranged cathode and anode, said cathode having greater diameter than said anode, and means within said discharge device to reduce the production of undesired sounds by said musical sound producing device.

4. The combination, in an oscillation generator of a source of unidirectional potential, a negative glow electron discharge device, having an electrode connected to one side of said source of potential, and said electrodes, said load including a musical sound producing device, a condenser connected between said electrodes, said electrodes comprising concentrically arranged cathode and anode, said cathode having greater diameter than said anode, and means within said discharge device to reduce the production of undesired sounds by said musical sound producing device.

5. In an oscillation generator, the combination of a source of unidirectional potential, a negative glow electron discharge device having an electrode connected to one side of said source, and a second electrode connected to the opposite side of said source, a resistance and a load device each included in circuit with said source and said electrodes, a condenser connected between said electrodes, electrodes comprising concentrically arranged cathode and anode, and means within said discharge device to render said oscillation generator operative over a continuous range of frequencies including frequencies corresponding to said high, medium, and low notes in the musical scale, and to remove undesired scratching sounds during the production of said notes.

6. In an oscillation generator, the combination of a source of unidirectional potential, a negative glow electron discharge device having an electrode connected to one side of said source of unidirectional potential and an electrode connected to the opposite side of said source, a resistance and a load device each included in circuit with said source and said electrodes comprising concentrically arranged cathode and anode, means within said discharge device to render said oscillation generator operative over a continuous range of frequencies including frequencies corresponding to said high, medium, and low notes in the musical scale, and to reduce the production of undesired sounds during the production of desired frequencies corresponding to said notes, said means comprising a body of electrically conducting material connected to said cathode and completely enclosing the discharge between said electrodes.
electrodes, a condenser connected between said electrodes, said electrodes comprising a cathode and an anode, and a coating of electrically conducting material applied to and completely covering the inner walls of an envelope enclosing said electrodes, said anode being surrounded by said coating.

7. In an oscillation generator, the combination of a source of unidirectional potential, a negative glow electron discharge device having a cathode connected to one side of said source, and an anode connected to the opposite side of said source, a resistance and a load device each connected in circuit with said source and said cathode and anode, said anode being concentrically arranged within said cathode and said cathode and anode being surrounded by a body of conducting material conductively connected with said cathode.

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