Sept. 22, 1925. 1,554,561

L. DE FOREST

SOUND REPRODUCING MECHANISM

Filed Aug. 2, 1919

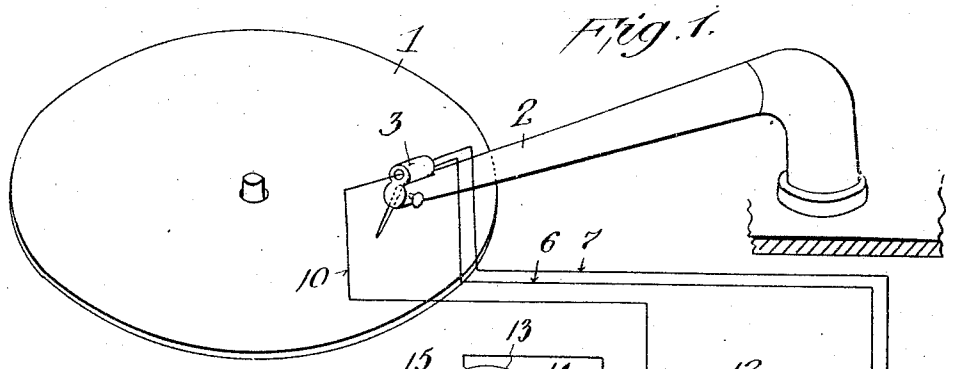


Fig. 1.

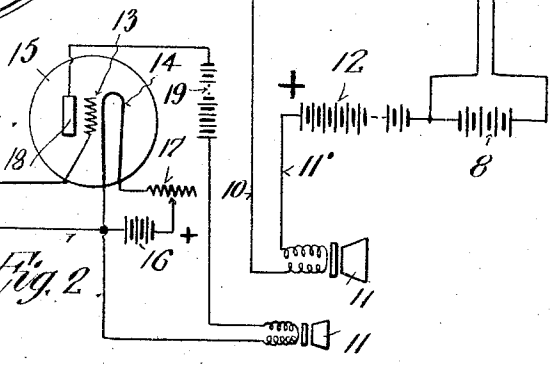


Fig. 2.

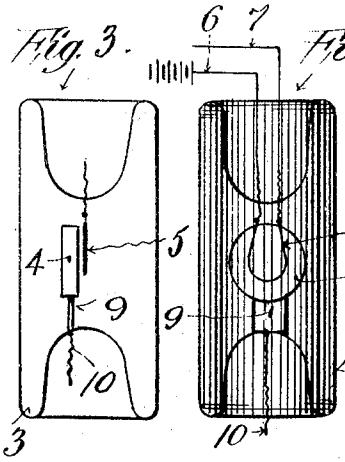


Fig. 3.

Fig. 4.

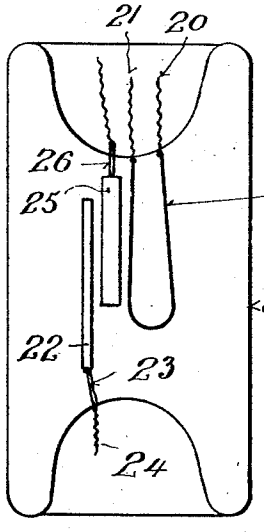


Fig. 5.

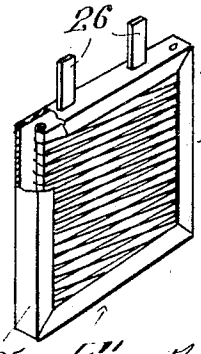


Fig. 7.

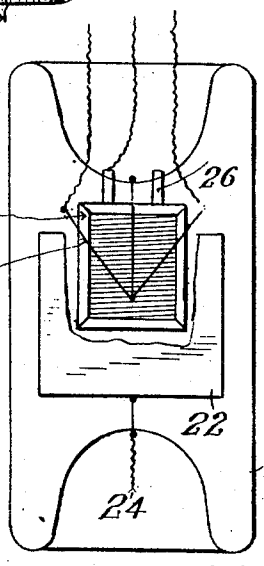


Fig. 6.

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Patented Sept. 22, 1925. 1,554,561

UNITED STATES PATENT OFFICE.

LEE DE FOREST, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, TO DE FOREST PHONOFILM CORPORATION, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF DELAWARE.

SOUND-REPRODUCING MECHANISM.

Application filed August 2, 1919. Serial No. 314,856.

To all whom it may concern:

Be it known that I, LEE DE FOREST, a citizen of the United States, residing at New York, county and State of New York, have made a certain new and useful Invention in Sound-Reproducing Mechanism, of which the following is a specification.

This invention relates to sound reproducing mechanism for reproducing sound from sound records, such, for example, as phonograph records, or the like.

The object of the invention is to provide means for reproducing from sound records the sound recorded thereon in a simple and efficient manner.

A further object of the invention is to provide means in a device of the character described whereby all parasitic noises and disturbances incident to the present methods employed for the reproduction of recorded sounds are eliminated.

A further object of the invention is to employ in connection with the reproducing of recorded sounds a thermionic electrical device.

A further object of the invention is to provide a thermionic device of novel construction and efficient operation for this and similar purposes.

Further objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location and relative arrangement of parts, and the electrical circuits associated therewith, all as will be more fully hereinafter set forth, as shown by the accompanying drawing, and finally pointed out in the appended claims.

Referring to the drawing:—

Fig. 1 is a diagrammatic view of a sound reproducing system embodying my invention.

Fig. 2 is a similar view of a slightly modified construction.

Fig. 3 is a diagrammatic view of the thermionic device shown in side elevation.

Fig. 4 is a front view of the same.

Fig. 5 is a similar view of a slightly modified construction taken in side elevation.

Fig. 6 is a front view of the same.

Fig. 7 is a detached detail view in perspective of one electrode member employed therein.

The same part is designated by the same reference character wherever it occurs throughout the several views.

In the reproduction of recorded sound, such for example, as is recorded on phonograph records, or the like, I have discovered that by using a thermionic device, either of special construction, or of the audion type, parasitic noises incident to the reproduction of sound from the sound record can be eliminated by using the movement of the reproducer in passing over the record, which movement, as is understood in the art, varies in accordance with the intensity and pitch of the sound recorded to control an electric repeating circuit, and in accordance with the circuit control to reproduce in a local circuit in the form of sound waves the movement of the reproducing device. It will be apparent that with this system inasmuch as the sound is produced in its ultimate reproduction by the movement of the reproducing device alone the parasitic noises now common in the reproduction of recorded sound, and due largely to the frictional contact of the reproducing device with the sound record, is completely eliminated. My invention may be carried out practically in this manner, and therefore while I have shown and will now describe by reference to the diagrammatic illustration of the principle of my invention, several different means for accomplishing this purpose, I wish it to be understood that my invention in its broad scope as defined in the claims is not to be limited to the particular forms selected for the purpose of illustration.

Referring to Fig. 1, I show diagrammatically at 1 a sound record, the form selected for illustration being that of the usual disk record, over which operates the tone arm 2, usual in phonograph, graphophone or sound record reproduction, carrying at its end in any suitable manner well known in the art, the needle 3, which follows the continuous groove in the sound record 1, and to which is imparted movement either vertically or horizontally, according to the type of sound record employed. This detail is immaterial, as the principle of operation of all sound recorders of this nature is to impart movement to the needle in accordance with the sound record, whether that movement be vertically over the hill and dale type of record, as it is called, or horizontally. In accordance with

my invention I mount on the end of the tone arm 2 the thermionic device 3, which may vary in construction in many respects. I have shown in Figs. 3 and 4 one construction selected for illustration, which consists of an evacuated vessel of any suitable material, preferably of glass, in which is located a plate electrode 4 and a filament electrode 5, which electrodes are separated from each other within the vessel. The filament electrode is provided with two leads 6 and 7, which are connected to the opposite terminals of a suitable source of current 8, controlled in any desired manner as to strength, duration, etc., whereby the filament is heated to the required degree of incandescence for the most efficient operation of the device. The plate electrode 4 is mounted in the vessel 3 by means of a flexible member 9 to allow a vibratory movement of the plate member 4, which is made comparatively large and heavy relative to the filament electrode 5. The plate electrode is connected by a wire 10 through an electrically controlled sound reproducer illustrated at 11 to a source of current illustrated at 12, and from thence to the line 6 of the filament electrode. The sound reproducer 11 may be of any suitable type or form, for example, it may be a loud speaking horn or the ordinary telephone receiver. From the foregoing it will be seen that a continuous flow of current is secured within the vessel from the filament to the plate electrode, the principle of operation being long established in the radio or wireless art with no sound being produced by the horn or receiver 11. As soon, however, as the disk 1 is revolved in the usual well known manner causing vertical movement of the tone arm 2 relative to the horizontal plane of the disk where the hill and dale type of record is employed, the thermionic device 3 being positioned with the plane of the plate electrode parallel to the plane of the disk 1 in its mounting on the tone arm 2 the space between the electrodes 4 and 5 is varied in accordance with the up and down movement of the tone arm 2. This variation in space is emphasized by the drag effect secured to the weight of the plate electrode 4 and is wholly proportional to the vertical vibratory movement of the tone arm 2 with the result that the continuous flow of current through the thermionic device from the filament to the plate electrode thereof is interrupted or varied, causing current variations in the circuit extending between the plate electrode and the filament, which variations are reproduced in the horn 11 in the form of sound waves corresponding to the sound waves employed to form the record which in turn causes the variations in the circuit. If desired, a suitable amplifying device may be inserted in the plate filament circuit to amplify the current variations secured by the vibratory movement of the member 2, and in Fig. 2 I show such an amplifier, the same being illustrated in the nature of an audion amplifier of my invention well known and used throughout the world in wire and radio arts for amplification purposes. In this instance the wires 10 and 11 which connect the plate electrode with the filament electrode terminate in one coil of a transformer, the secondary coil of which has one terminal connected to the grid electrode 13, and the other terminal of which is connected to the filament electrode 14 of the audion 15 of the usual construction. The filament electrode 14 is heated by means of battery 16 and controlled through the resistance 17 in the usual well known manner. The plate electrode 18 of the audion 15 is connected with the battery 19 through the horn 11 to the filament 14 in the usual well known manner. By this arrangement the current variations set up in the line 10 and 11′ are fed into the grid filament or input circuit of audion amplifier 15 causing corresponding but greatly magnified variations in the plate filament or output circuit of the audion amplifier 15, in which output circuit is located the loud speaking horn or other electrical sound reproducing device.

I have also discovered that the same principle may be employed to the three electric audion construction as illustrated in Figs. 5, 6 and 7, in which instance I prefer to employ the grid electrode as the vibratory electrode rather than the plate electrode as illustrated in the two electrode thermionic devices. In Figs. 5 and 6 I show the vessel 3 evacuated in the usual manner with the filament electrode 20 provided with the two terminals 21 and 22 sealed through the vessel in the usual manner, and the plate electrode 22 rigidly supported as at 23 with the terminal thereof 24 sealed through the vessel in the usual manner. The grid electrode 25 in this instance is made comparatively large and heavy and is supported by the vessel as at 26 by flexible spring members. The grid electrode 25 is located between the plate and filament electrodes as is usual in the audion art. The device is located on the end of the tone arm in the manner hereinbefore described, the only difference being that instead of a single circuit connecting the plate and filament as in the form shown in Fig. 1, the grid and filament will be connected together and the plate and filament will be connected together through the battery and loud speaking horn in the manner hereinbefore described. From the foregoing it will be apparent that where the lateral wave type of sound record is employed it is merely necessary to turn device 3 in its mounting on the tone arm in such a manner as to cause the movable electrode, that is, electrode 4 in the form shown in

Figs. 3 and 4, and electrode 25 in the forms shown in Figs. 5, 6 and 7, to extend at right angles to the plane of movement of the tone arm 1, referring, of course, to the vibratory movement thereof, and not to the pivotal movement imparted thereto by the needle following the continuous groove of the sound record.

Many other modifications and changes in detail will readily occur to those skilled in the art without departing from the spirit and scope of my invention as defined in the claims, therefore, what I claim as new and useful and of my own invention and desire to secure by Letters Patent is,—

1. The combination with a sound record, of a member mounted to be moved by and in accordance with said record, an evacuated vessel associated with said member and containing therein a plurality of electrodes, one of said electrodes being mounted for movement, means for heating one electrode, means for moving said movable electrode by and in accordance with the movements of said member, and means controlled by the movements of said movable electrode for reproducing the recorded sounds.

2. The combination with a sound record, of a member mounted to be moved by and in accordance with said record, an evacuated vessel carried by and moved with said member, said vessel containing therein a plurality of electrodes, one of said electrodes being mounted for movement, means for heating one electrode, means for moving said movable electrode by and in accordance with the movements of said member, electric circuits for said electrodes, a translating device and a source of current included in one of said circuits.

3. The combination of a sound record and a thermionic device movably mounted and having electrodes therein, means for heating one of said electrodes, means for causing variations of space between said electrodes by and in accordance with the movements of said device, and means for translating said movements into audible vibrations.

4. The combination of a thermionic vessel movably mounted and a sound record for causing said vessel to move, separated electrodes contained in said vessel, one of said electrodes being of relatively great weight and mounted to respond to the movements of said vessel, and circuits for said electrodes.

5. A movable vessel containing therein a hot and a plurality of cold electrodes, means for imparting movement to said vessel to thereby cause one of said cold electrodes to respond by and in accordance with the movements of said vessel, and an electric circuit controlled by the movements of said movable electrode.

6. A vessel mounted to move by and in accordance with recorded sound and containing therein a hot electrode and an anode spaced therefrom, a movable conducting body interposed between said hot electrode and said anode, means for imparting movement to said conducting body by and in accordance with the movements of said vessel, an electric circuit controlled by the movements of said conducting body for causing flux variations therein, and means for translating said variations into audible vibrations.

7. A movable vessel containing therein filament, grid and plate electrodes, means for imparting movement to said grid electrode by and in accordance with predetermined, positive movements of said vessel for varying the effective distance between said electrodes and means for translating said electrode movements into audible vibrations.

8. A movable vessel containing therein filament, grid and plate electrodes, means for imparting predetermined movements to said grid electrode by and in accordance with positive and predetermined movements of said vessel, an electric circuit controlled by the movements of said grid electrode for producing current variations therein, and means for translating said variations into sound waves.

9. The method of reproducing recorded sound which consists in varying the space between the electrodes of a thermionic relay in accordance with the sound record, and utilizing the space variation caused between the electrodes of the thermionic relay to vary the strength of a constantly flowing current, and translating the current variation into sound waves.

10. The method of electrically reproducing recorded sounds, which comprises oscillating a thermionic vessel in synchronism with grooved inequalities on a sound record to thereby positively vary the space relations between electrodes in said vessel, and to utilize said electrode variations to induce varying current flux in an associated circuit for translating said current flux variations into audible vibrations.

In testimony whereof I have hereunto set my hand on this 24th day of July, A. D. 1919.

LEE DE FOREST.