No. 865,574. PATENTED SEPT. 10, 1907.

J. F. DIRZUWEIT.

RECORDING AND REPRODUCING SOUNDS.

APPLICATION FILED APR. 29, 1907.

3 SHEETS—SHEET 1.

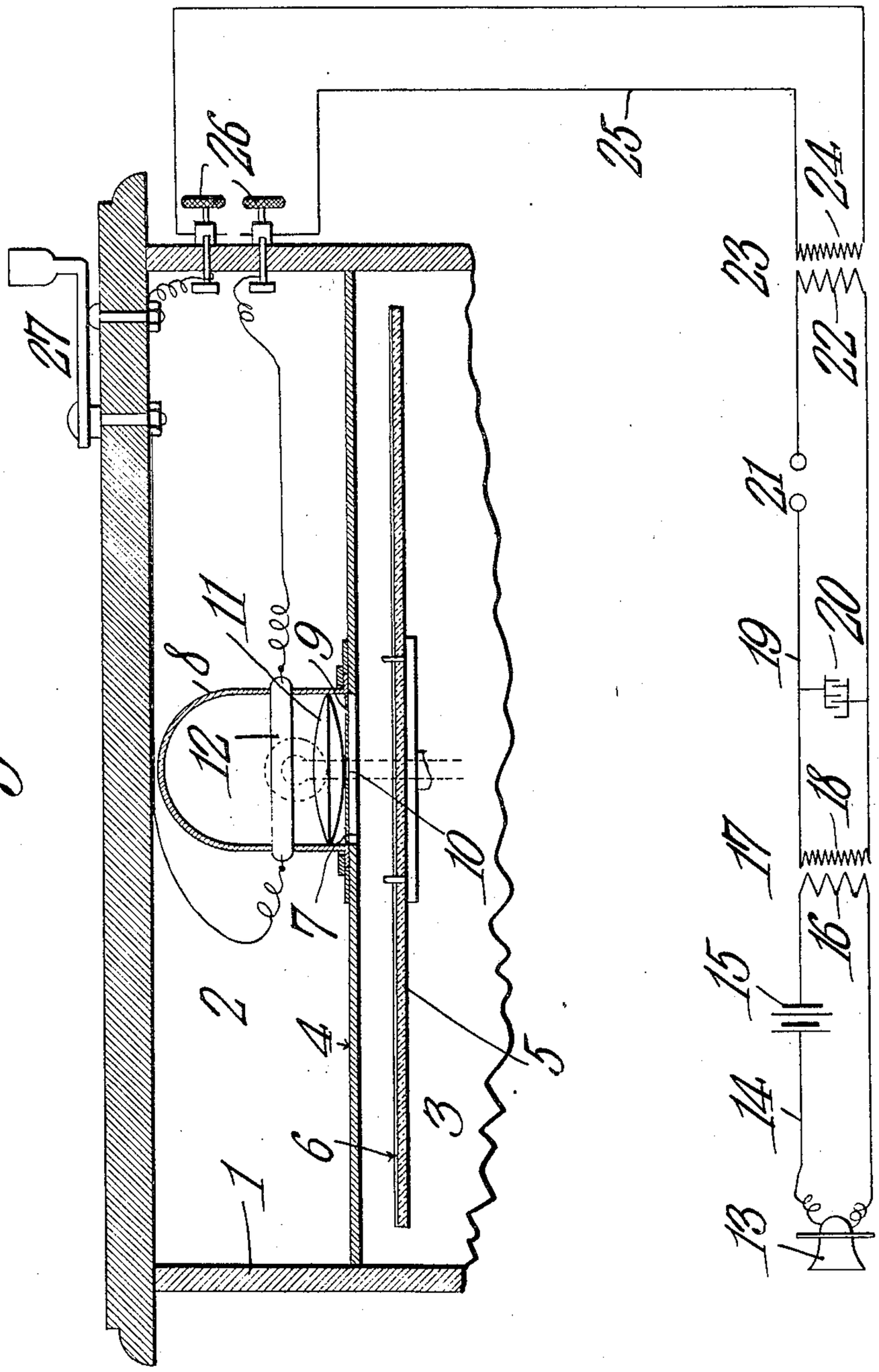

Fig. 1.

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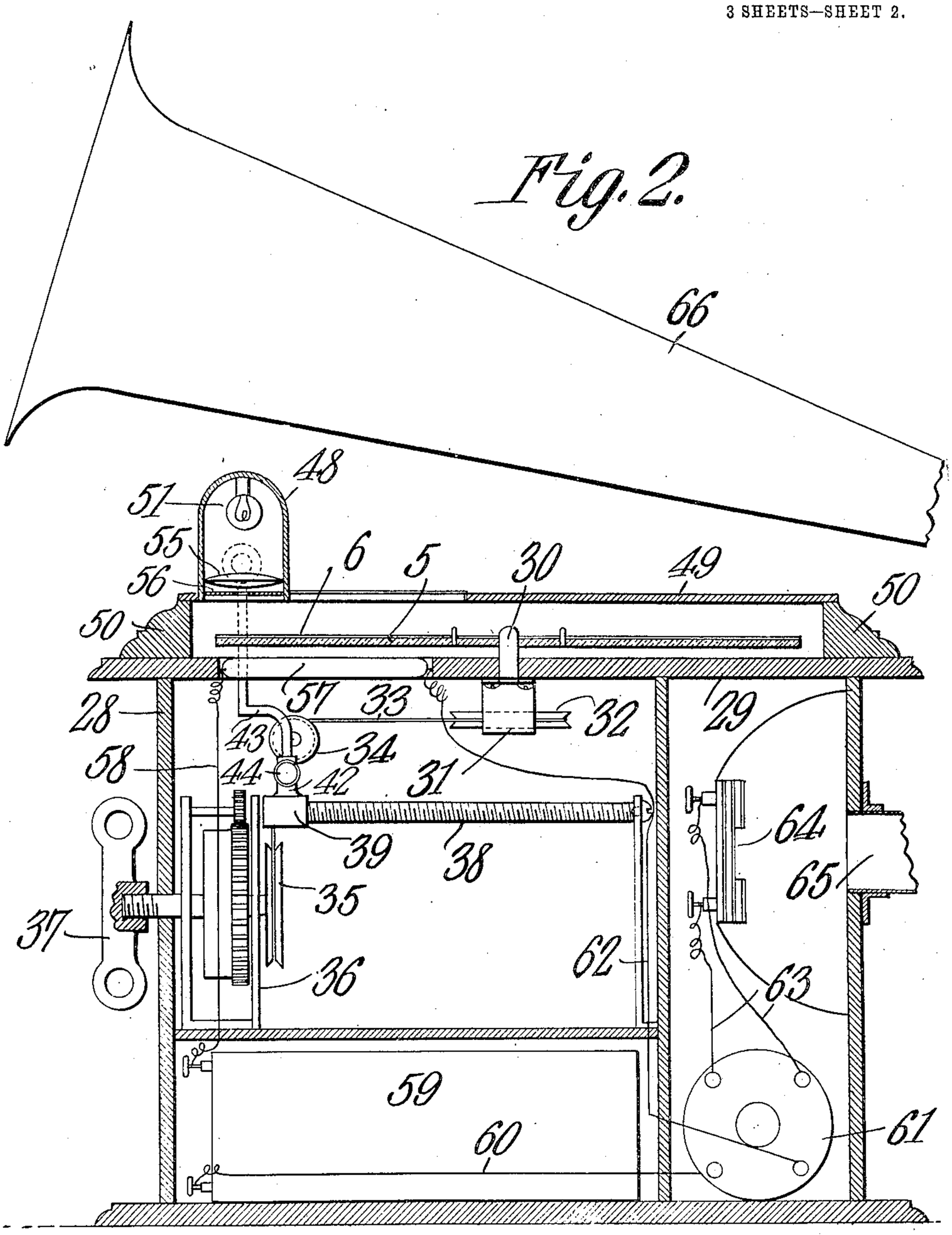
3 SHEETS—SHEET 2.

Fig. 2.



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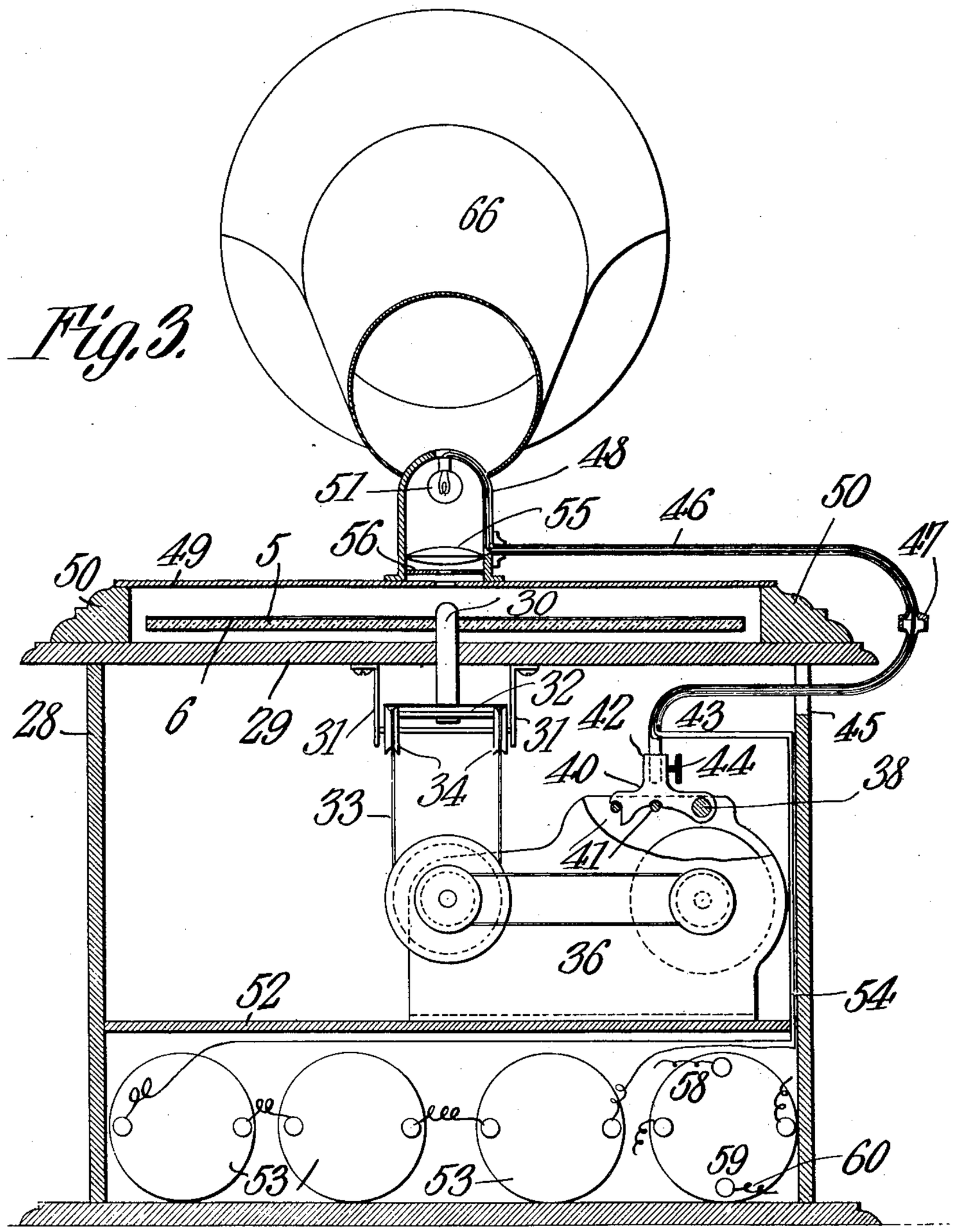
3 SHEETS—SHEET 3.

Fig. 3.



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RECORDING AND REPRODUCING SOUNDS.

No. 865,574. Specification of Letters Patent. Patented Sept. 10, 1907.

Application filed April 29, 1907. Serial No. 370,898.

To all whom it may concern:

Be it known that I, JOHN F. DIRZUWEIT, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Improvement in Recording and Reproducing Sounds, of which the following is a specification.

This invention has reference to improvements in recording and reproducing vocal and other sounds.

The object of the invention is to produce a photographic record of sounds by electro-actinic means and to reproduce the recorded sounds by luminous rays varied in intensity in accordance with a photographic record of the sounds and producing by these variations in luminosity electric vibrations which, in turn, set up air vibrations corresponding to the recorded sounds.

The recording of the sounds is performed photographically by first setting up electric vibrations in a suitable charged circuit and then transforming these electric vibrations into light vibrations, the intensity of which are varied in accordance with the original sounds. These variable light vibrations are transmitted to a movable sensitive film in such manner as to impinge thereon so as to produce, when the film is properly developed, a line the light transmitting properties of which vary in proportion to the variations of the original sound waves. Structurally considered, this portion of the invention comprises a sensitive microphonic transmitter suited to strong currents. Included in the microphonic circuit is the coarse wire winding of a suitable transformer and the secondary circuit of this transformer is included in a circuit across which is branched a condenser and in which is included a spark gap and the primary coil of a high tension transformer. The secondary coil of the high tension transformer is closed through a Tesla tube which, when active, radiates highly actinic rays. These rays are gathered by a suitable lens and projected as a bundle of small area upon a photo-sensitive film otherwise protected against actinic light. With such a structure electric vibrations are set up by the sounds uttered against or otherwise reaching the microphonic transmitter and these electric vibrations are ultimately transformed into light radiations from the Tesla tube, which light radiations vary in accordance with the sound waves impinging against the microphone. Consequently, the photo-sensitive film is affected by the light in direct proportion to the intensity thereof and when the film, after being subjected to the light, is developed there appears thereon a light-obstructing line varying in light-obstructing properties in accordance with the original sounds acting on the microphone.

The invention comprises in conjunction with the recording of sounds, as set forth the reproduction of sounds from such a photographic record, and this reproduction is made by passing a light-beam through the photographic record and thereby obstructing the light-beam to an extent depending upon the density of said record and its light-obstructing properties. This light-beam of varying intensity is caused to act upon a suitable selenium cell which, in turn, controls a charged electric circuit including a telephonic receiver. This latter is located in a suitable resonator or sound-amplifier by which the sound waves produced by the receiving diaphragm are amplified to a sufficient extent to become distinctly audible to a considerable distance.

The invention therefore consists, first, in the recording of sounds photographically by the varying intensity of a source of light in accordance with sound waves, and then in reproducing such record by varying the light coming from a constant source of light by the interposition of the record in the beam of light, and converting the light variations into sounds through the intermediary of an electric circuit the resistance of which is varied by the variable light-beam all as set forth in the claims.

The invention will be fully understood from the following detailed description taken in connection with the accompanying drawings forming part of this specification, in which,—

Figure 1 is a longitudinal section of so much of a recording machine constructed in accordance with my invention as is necessary for the understanding thereof, with electric circuits coacting therewith shown diagrammatically; Fig. 2 is a central section, with parts in elevation, taken through a reproducing machine constructed in accordance with my invention; and Fig. 3 is a section through the structure of Fig. 2, at right angles to the section shown in Fig. 2 and also having parts shown in elevation.

Referring to the drawings, and more particularly to Fig. 1, there is shown a suitable casing 1 having an upper compartment 2 and a lower compartment 3 divided by a horizontal partition 4. In the lower compartment there is suitably mounted a rotatable table or tablet-carrier 5 upon the surface of which there is secured a photo-sensitive film 6. In the particular instance shown in the drawing this photographic film 6 is in the form of a disk and the carrier 5 is also a disk, and preferably the carrier disk is made of glass, though it is possible to make it of some other transparent material. Obviously, the photographic film may be made in the form of a long web mounted upon suitable carriers instead of being in the form of a disk, but as the production of a photographic record of sounds upon a disk or upon a strip, in itself, forms no part of the present invention, it is not deemed necessary to show the strip in the drawings

It will, of course, be understood that the sensitive film 6 is protected within the compartment 3 against the action of actinic light except as hereinafter described. The partition 4 is provided with an opening 7 radially disposed with relation to the disk 5, and covering this opening is a box or shell 8 arranged to slide along the opening 7 in a radial path with relation to the disk 5 by means which will be hereinafter described with reference to Figs. 2 and 3. The lower end of the box 8 is closed by a diaphragm 9 having a small central perforation 10, shown greatly exaggerated in the figure. Within the box 8, above the diaphragm, is a suitable lens 11 and above the lens 11 is a Tesla tube 12.

Suitably located with reference to the parts just described is a microphonic transmitter 13 which should possess great sensitiveness and be adapted to heavy currents. This microphonic transmitter 13 is included in the usual circuit 14 which also includes a battery 15 and the coarse wire coil 16 of a transformer 17. These parts may all be of the usual type used in telephonic transmission and need no particular description. The secondary coil 18 of the transformer 17 is included in another circuit 19, which circuit is bridged by a condenser 20 of suitable capacity. Beyond the condenser the circuit 19 includes a spark gap 21 and the primary coil 22 of a high-tension transformer 23. The secondary coil 24 of the transformer 23 is included in a circuit 25, the terminals of which are connected to the terminals of the Tesla tube 12, and for convenience the circuit 25 may include binding posts 26 fast on the casing 1 and a suitable switch 27, also carried by the casing 1. By this latter means the tube 12 may be thrown into and out of action at will and the binding posts 26 permit the location of the major portion of the circuits exterior to the casing 1.

Now, let it be assumed that the switch 27 is closed and that the table 5 with the film 6 is being steadily rotated by any suitable source of power such as a spring motor, and that the box 8 is being fed radially across the film 6 from the outer edge thereof toward the center. Under these conditions let it be supposed that sounds are uttered or otherwise produced in front of the microphone 13. Variations of current corresponding to the sound vibrations are immediately set up in the microphone circuit. These variations of current are, as is well understood, transformed into alternating currents in the circuit 19 which includes the secondary circuit 18 of the microphonic transformer 17. The alternate charging and discharging of the condenser 20 produces currents which pass the spark gap and thus set up in this condenser circuit electrical oscillations of great rapidity. This causes in the circuit 25 electrical oscillations of very high tension and great rapidity which are manifest in the tube 12 in the form of light, and this particular form of light has great actinic power. The rays emanating from the tube 12 are gathered by the lens 11 and transmitted to the diaphragm 10 in the form of a minute bundle of great intensity where it impinges upon the film 6. No attempt has been made in the drawing to show the proper distances of the tube, lens, diaphragm and film, but it will be understood that in practice these parts are all properly proportioned for the purpose. Now, the actinic rays emanating from the tube 12 are not of constant power but vary in accordance with the sounds acting on the microphone 13, and, therefore, these rays act upon the film 6 in proportion to their intensity. The result is that when the film 6 is developed the resultant line which, as will be understood, is in the form of a spiral upon said film, is made of deposited silver varying in density in accordance with the actinic strength of the light which has reached it. It may be noted that in accordance with this invention the initial light source is varied in accordance with the original sound waves.

When the sensitive film has been properly exposed to the light it is removed from the casing 1 under the proper non-actinic light conditions and either removed from the support 5, if the latter be opaque, or the support and film both are removed from the machine if the support be of glass or other transparent material, and the photographic record of the sounds is developed in the usual manner. The record as produced is in the form of a spiral light-obstructing line upon a transparent base or in a transparent film, the light-obstructing powers of said line varying in accordance with the intensity of the light emanations from the tube 12, which light emanations vary in accordance with the variations of the original sound waves. To reproduce such a sound record I have devised the structure shown in Figs. 2 and 3, to which reference will now be had. In these figures there is shown a casing 28 similar to the casing 1 of the structure shown in Fig. 1 with, however, certain modifications of the interior which will appear further on. Extending upward through the top 29 of the casing there is an upright shaft 30 mounted at its lower end in suitable bearings 31 fast on the under side of the top 29 of the casing, and this shaft carries a pulley 32. The upper end of the shaft 30 is constrained to receive and retain a transparent, disk-shaped table or support 5 having thereon a developed photographic film upon which a sound record has been produced in the manner already described. The shaft 30, and sound record thereon, is rotated by means of a cord or strap 33 passing over pulleys 34 suitably mounted within the casing and thence to a drive pulley 35 under the control of a suitable spring motor 36, properly mounted and secured within the casing 28. The spring of this motor is put under tension by means of a winding-key 37 exterior to the casing 28. The motor 36, by suitable gearing, gives rotative movement to a feed-screw 38 upon which there is mounted a nut 39 which, as is usual in phonographs or similar machines, may be of the half-nut type. This nut 39 forms part of a carriage 40 which may be guided upon rods 41. The upper end of the carriage is provided with a socket 42 to receive the end of a bracket 43 held to the carriage by a suitable thumb-nut or set-screw 44. This bracket 43 extends upward from the socket 42 and then is bent horizontally and passed through a slot 45 in one side of the casing 28 below the top 29 thereof and then this bracket, outside of the casing, is bent upwardly, as shown. To the upper end of the bracket 43 there is secured an arm 46 by means of a suitable coupling 47. This arm 46 is suitably bent so as to first rise from the coupling 47 and then extend horizontally across the top of the machine, and is connected at its other end, remote from the coupling 47, to a shell 48, shown as bell-shaped but which may be otherwise shaped if so desired. The base of this shell rests upon a platform 49 elevated by suitable end and

side supports 50 to a suitable distance above the top 29 of the casing to form a chamber in which is inclosed the sound record support 5 with its film surface 6. For convenience the support 5, which in this particular instance is of glass or other transparent medium, with the photographic film 6 thereon, will hereinafter be referred to simply as the sound record tablet.

Since, as will hereinafter appear, the sound record tablet should be protected from light except that which is transmitted to it in a manner to be described, the platform 49 may be of opaque material and be provided with a radial opening along which the shell 48 is made to travel in a straight line which is radial with reference to the sound record tablet 5 and which movement of the shell 48 is caused by the feeding of the bracket 43 and its arm 46 by the nut 39 and feed-screw 38, all as will be readily understood.

While not so shown in the drawings, it will be understood that a suitable sliding cover or protection will be provided to prevent the entrance of light through the slot in the platform 49 except where the shell 48 covers it.

Within the shell 48 there is located a light source 51 which may be, as shown, an incandescent electric lamp. In order to provide current for this lamp, there may be located in the bottom portion of the casing 28 under a partition 52 supporting the driving mechanism a number of cells 53 of battery which may for convenience be of the type known as dry batteries. Conductors 54 leading from the batteries may be carried to the bracket 43, and entering the same be carried through said bracket, which may be made hollow for the purpose, and through the arm 46 and thereby ultimately reach the lamp 51. For the purposes of this portion of the invention the source of light should be constant, and for all practical purposes a lamp as described, fed from batteries in the manner set forth, will be sufficient.

The lamp 51 is located at the upper end of the opaque shell 48 and below this lamp there is located a suitable lens 55 with a perforated diaphragm 56 below the same and having its opening coincident with the slot through the platform 49. The parts are so proportioned that the light from the lamp is gathered by the lens and strikes through the tablet 5 and upon a selenium cell 57 secured in the top 29 of the casing 28. This cell 57 is sufficiently long and so located as to extend radially beneath the tablet for a distance sufficient to embrace the radial extent of the longest record which may be produced upon the record tablet. One terminal of this cell 57 is connected by a conductor 58 to one pole of a suitable battery 59, the other pole of which is connected by a conductor 60 to one terminal of the coarse wire coil of an inductorian 61. The other terminal of the coarse wire coil of the inductorian 61 is connected by a conductor 62 to the other end of the selenium cell 57. The fine wire coil of the inductorian 61 is connected by conductors 63 to the coil of a telephonic receiver 64, whch may be of any suitable type and is simply indicated in the drawings. This telephonic receiver 64 is located opposite the small end 65 of an amplifying horn 66, which may be suitably supported upon the casing but which mounting is not shown in the drawings for want of room.

With a structure such as has been described with reference to Figs. 2 and 3, the operation of reproducing a sound record made by the apparatus set forth with reference to Fig. 1 is as follows: The motor is set in operation after the tablet 5 has been placed in position, which latter act may be performed by making the portion of the structure covering the tablet removable. By coupling the battery 53 to the lamp 51 by a suitable switch, not shown, or otherwise, the lamp is made to glow steadily. A light beam is directed by the lens 55 through the tablet 5 and on to the selenium cell 57. Now, as is well known, the resistance of selenium is varied by the effect of light directed against it. By causing the light-beam to be intercepted by the photographic record upon the tablet 5, the amount of light reaching the selenium cell is varied in direct proportion to the density of the photographic sound record in the film 6 of the tablet 5. Consequently, the current flowing through the coarse wire coil of the inductorian 61 is varied in accordance with the variations in the light-beam transmitted through the record tablet 5. The result is that the telephonic receiver 64 is likewise affected by the varying impulses reaching it and the diaphragm of this receiver imparts to the surrounding air vibrations in accordance and commensurate with the rate and amplitude of vibration of the diaphragm of the telephonic receiver. Since these vibrations are in accordance with the sounds originally produced in front of the microphonic transmitter 13, there are, therefore, sounds produced by the action of the receiver diaphragm upon the air and these sounds pass through the amplifying horn 66 and are emitted therefrom in intensified form clearly audible for a distance from the amplifier 66 corresponding to the loudness of the produced sounds.

I claim:—

1. The method of recording and reproducing sounds consisting in forming a photographic record of the sounds by directing actinic rays emanating from a source thereof upon a photo-sensitive surface and varying the amount of said emanations by and in accordance with the sound waves, then developing the photo-sensitive surface, then interposing the sound record so produced in the path of a constant beam of light, setting up in an electric circuit electric variations by and in accordance with the variations of the transmitted light-beam, and producing by said electric variations air vibrations corresponding to the original sounds.

2. The method of recording and reproducing sounds consisting in setting up in an electric circuit electric variations corresponding to the initial sound waves, producing thereby corresponding actinic radiations, subjecting a photo-sensitive surface to said actinic radiations, then developing said photo-sensitive surface to produce a sound record, then producing variations in a beam of light of constant intensity by passing the same through said sound record, then setting up in an electric circuit electric variations by and in accordance with the variations in intensity of the transmitted beam of light, and producing by said including the aforesaid source of actinic rays and in inductive relation to the second circuit.

3. The method of recording sounds consisting in forming a photographic record of the sounds by directing actinic rays emanating from a source thereof upon a photo-sensitive surface and varying the amount of said emanations by and in accordance with the sound waves.

4. The method of recording sounds consisting in setting up in a charged electric circuit variations corresponding to the sound waves, producing actinic radiations by and in accordance with said electric variations, and directing said actinic radiations upon a photo-sensitive surface.

5. The method of recording sounds consisting in pro-

ducing in a charged electric circuit current variations corresponding to the sound waves, producing by said current variations groups of electric pulsations corresponding in frequency and duration to the original sound waves, producing by said groups of electric pulsations actinic rays varying in duration and intensity in accordance with the original sound waves, and subjecting a photo-sensitive surface to said actinic rays.

6. A sound recording apparatus comprising a carrier for a photo-sensitive surface, a source of actinic rays in operative relation to said photo-sensitive surface, an electric circuit including said source of rays, means for charging said circuit, and means for producing variations of the electric current in said circuit by and in accordance with sound waves.

7. A sound recording apparatus comprising a carrier for a photo-sensitive surface, a source of actinic rays in operative relation to said photo-sensitive surface, a charged electric circuit, a microphonic transmitter included therein, another electric circuit in inductive relation to the first-named circuit and including a spark gap, a condenser bridged across the second circuit, and a tertiary circuit including the aforesaid source of actinic rays and in inductive relation to the sound circuit.

8. A sound recording apparatus comprising a photo-sensitive surface and a source of actinic rays movable relative one to the other, and means for exciting said source of actinic rays by and in accordance with sound waves.

9. A recording apparatus comprising a suitable carrier for a photo-sensitive surface, a Tesla tube movable with relation to the photo-sensitive surface, means connected with said Tesla tube for producing actinic emanations therefrom by and in accordance with sound waves, and means for directing said emanations progressively along said photo-sensitive surface.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

JOHN F. DIRZUWEIT.

Witnesses:
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OSIAS DRESNEY.