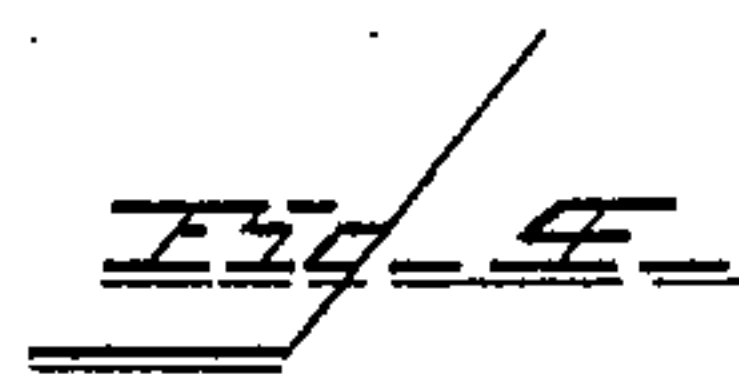
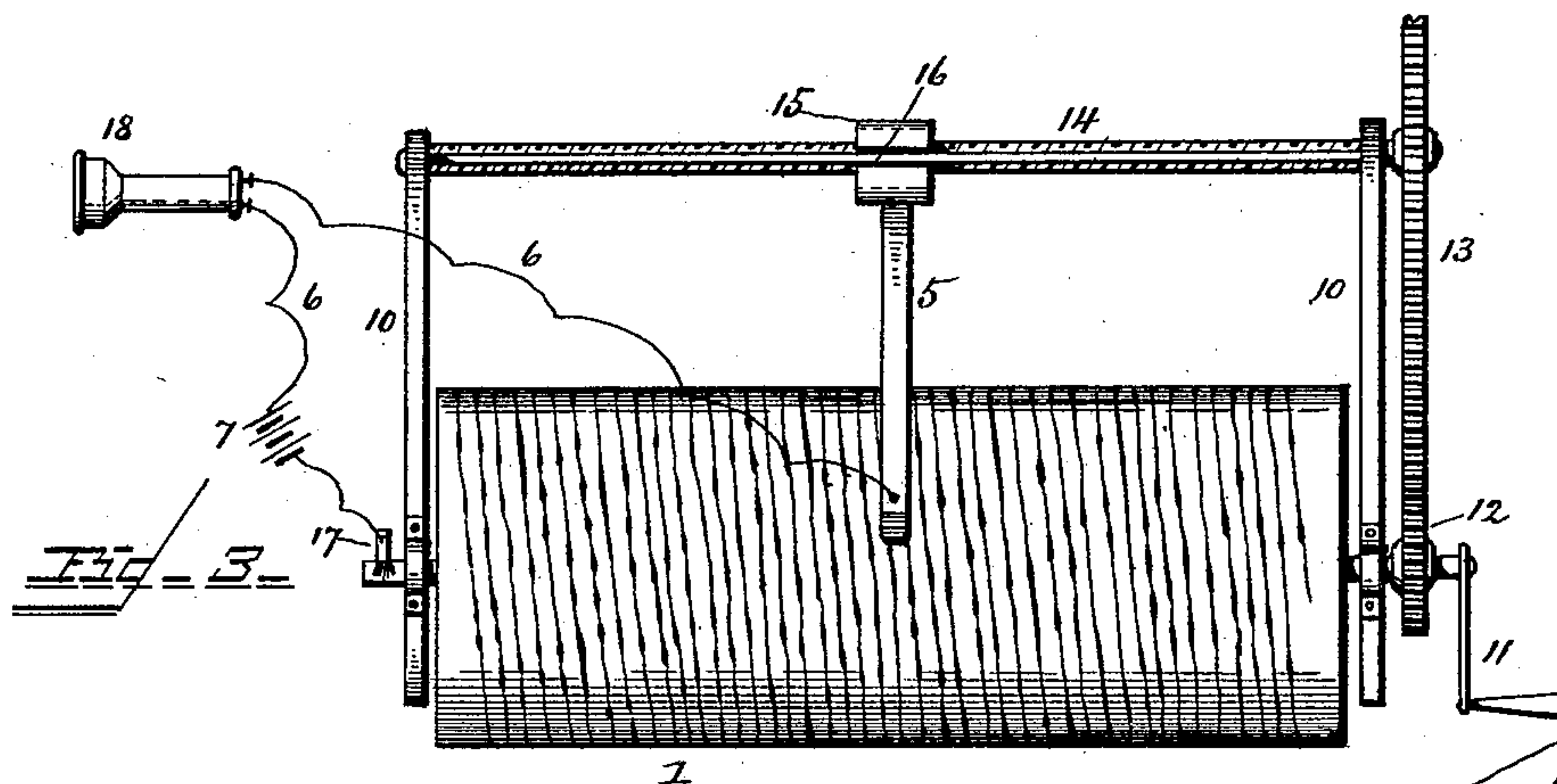
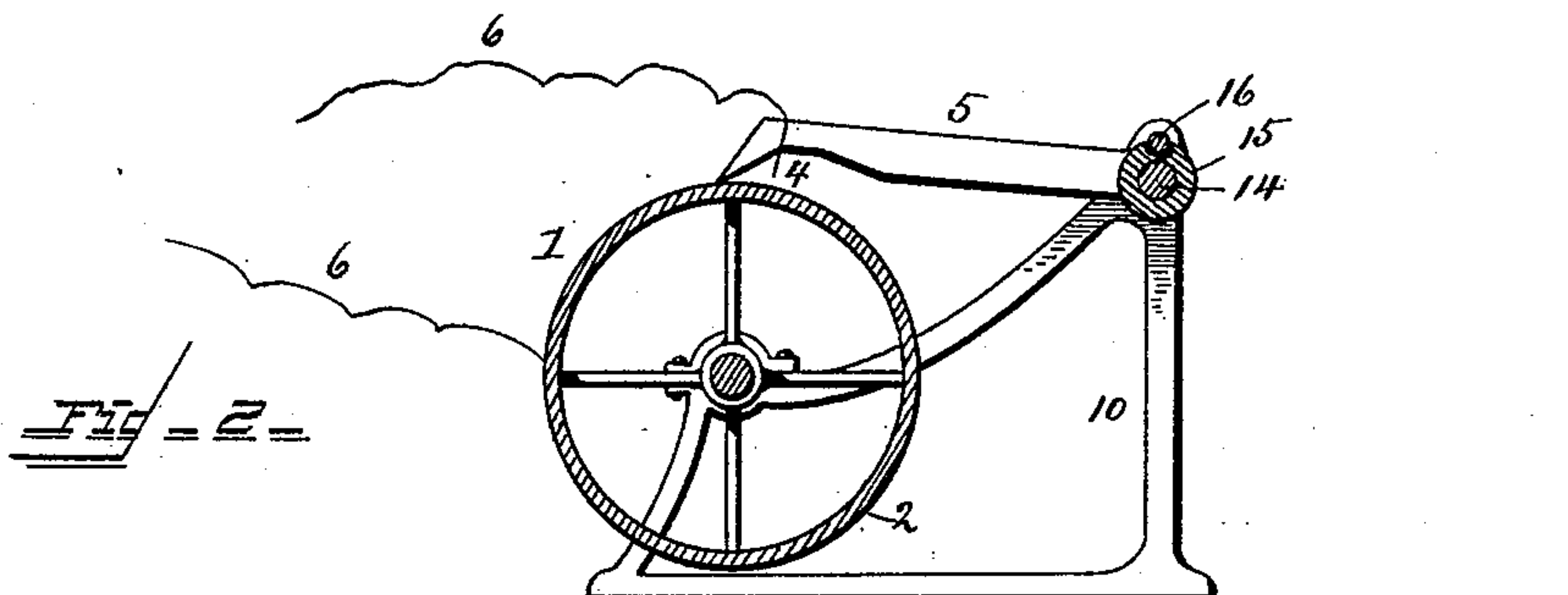
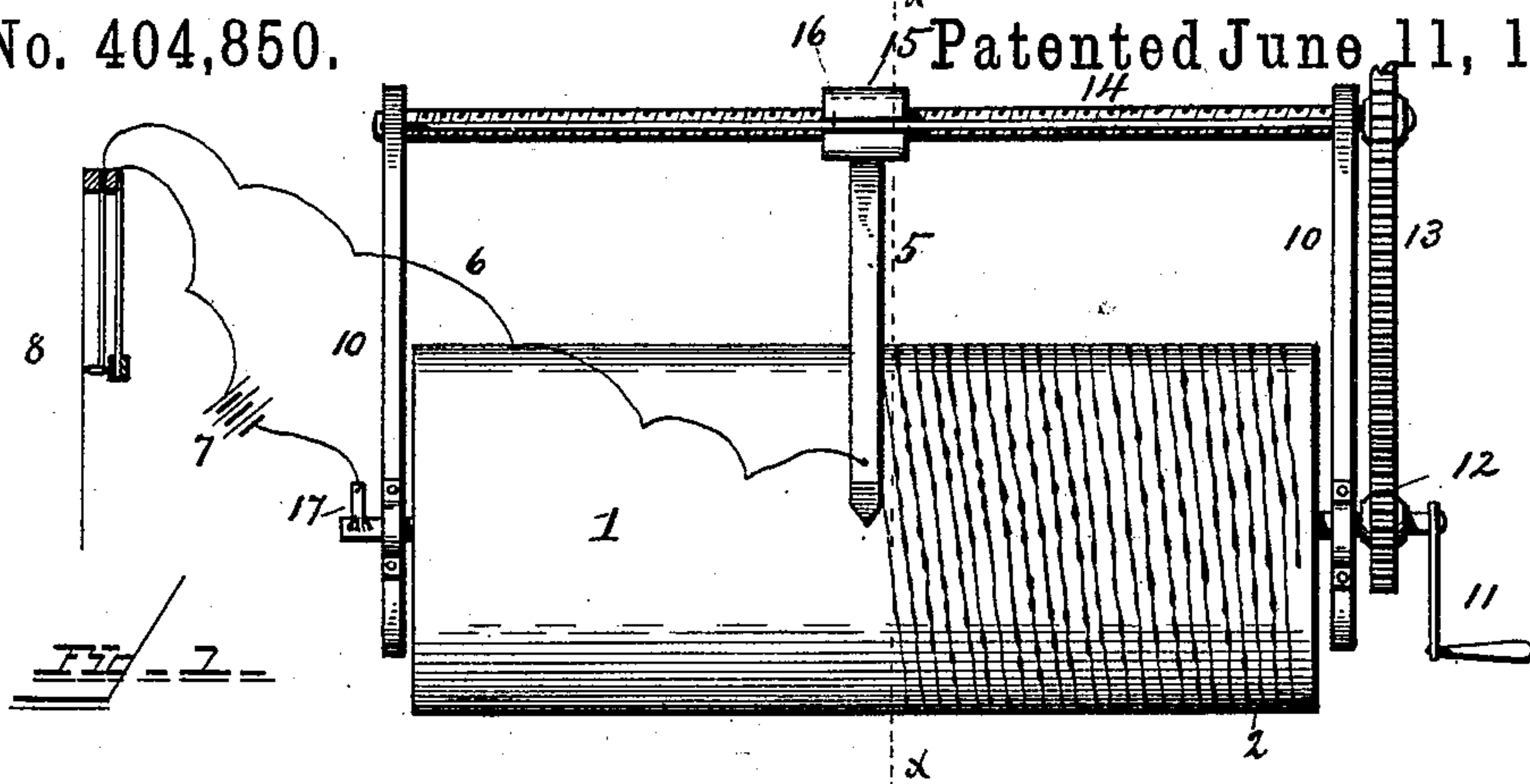


(No Model.)

G. W. LITTLEHALES.
METHOD OF RECORDING AND REPRODUCING ARTICULATE SPEECH AND
OTHER SOUNDS.

No. 404,850.

Patented June 11, 1889.



Witnesses

Albert Spiden.
Annie T. Craig

Inventor

George W. Littlehales.

By his Attorney

Joseph Lyons.

UNITED STATES PATENT OFFICE.

GEORGE W. LITTLEHALES, OF POTTSVILLE, PENNSYLVANIA.

METHOD OF RECORDING AND REPRODUCING ARTICULATE SPEECH OR OTHER SOUNDS.

SPECIFICATION forming part of Letters Patent No. 404,850, dated June 11, 1889.

Application filed August 8, 1888. Serial No. 282,260. (No model.)

To all whom it may concern:

Be it known that I, GEORGE W. LITTLEHALES, a citizen of the United States, and a resident of Pottsville, State of Pennsylvania, have invented certain new and useful Improvements in Method of Recording and Reproducing Articulate Speech or other Sounds, of which the following is a specification.

My invention has for its object the recording and reproducing of articulate speech or other sounds by a novel process, which is distinguished from other processes heretofore employed for this purpose in that it avoids the use of the sound-waves as an agent for embossing, engraving, or otherwise mechanically acting upon the record-surface in producing the record, and it also avoids the direct mechanical reaction of the record produced upon the reproducing medium in the reproduction of the recorded sounds.

In the ordinary phonograph sound-waves impinging upon a diaphragm are caused to move a blunt stylus into variable contact with a moving yielding record-surface—such as tin-foil—whereby the latter receives indentations of varying depth, which in the reproduction serve as a guide for the reproducing-stylus. By this method the mechanical resistance of the tin-foil, which increases disproportionately with the depth of indentation, renders it practically impossible to obtain an accurate record of all phases of vibration of the diaphragm. This feature of the phonograph has been changed in the so-called “graphophone” by employing a sharp stylus acting in the nature of a chisel or engraving-tool upon beeswax or other like material, whereby, in place of ill-defined indentations, sharp cuts of varying depth are produced; and the method of recording has been still further changed in the so-called “gramophone,” where the recording-stylus removes an undulatory line of even depth of a material which offers only very little resistance to the action of the stylus. In these three kinds of sound recorders and reproducers heretofore used the sound-waves act as a mechanical agent for indenting or removing more or less resisting material, and the amplitude of vibrations of the recording-diaphragm is thereby reduced and the vibrations otherwise

modified in form. In the reproduction of the sounds as recorded the reproducing-stylus is moved in frictional contact with the record-surface, and as a consequence, in addition to the undulations recorded, the stylus receives the impact of the minute irregularities of the record-surface, and the sounds reproduced are accompanied by a grating noise, which in a great measure obliterates the legitimate sounds which it is intended to reproduce. By my invention all these difficulties are avoided, the sounds are recorded without any mechanical action of the same upon the record-surface and are reproduced with purity and without extraneous disturbing noises. This result I accomplish in recording by causing the sound-waves to vary the strength of an electric current and by causing said current to variably change the electrical resistance of the record-surface by electrolytic action along a line determined by the construction of the apparatus employed. This electrolytic action takes place without mechanical reaction between the sound-receiving diaphragm and the record-surface. In reproducing I make use of the line of varying electrical resistance produced in recording for varying the strength of an electric current, which in turn reproduces the recorded sounds telephonically. All this will more fully appear from the following detailed description with reference to the accompanying drawings, in which some of the apparatus which I may use in my process are indicated; but it will be understood that in practicing my method I am not limited to the use of the particular apparatus herein shown and described, for the same may be greatly modified without in any way or manner departing from the fundamental idea of my invention.

Figure 1 is a plan view of an apparatus which is adapted for recording sounds in accordance with my invention. Fig. 2 is a vertical section of the same on line xx of Fig. 1. Fig. 3 is a plan view of the apparatus arranged for reproduction of the recorded sounds, and Fig. 4 is a view of a simple form of apparatus which may be used for demonstrating the principle of my invention.

Referring now to Fig. 1, the surface upon which the record is produced is there shown as a plate 1, which may be made of any metal

or of any other conductor of electricity, such as carbon, lined with metal foil. This record-plate is covered with a film 2, of any electrolyte, which, when subjected to the action of an electric current, furnishes as one of the products of electrolysis a substance having a comparatively high electrical resistance, either by itself or in chemical combination with the metal of the record-surface, or with other substances.

The record-plate may be made of copper, upon the surface of which a thin coat of silver or other metal is deposited. This surface is exposed to the action of vapor of iodine, bromine, or both, or to the vapor of other substances capable of forming an electrolyte with silver, or with such other metal as may first be used to coat the original surface. When a silver surface is used, and when the same is treated with iodine, this process must be performed in a dark room, or in a room from which all actinic rays are excluded, for the layer of iodide of silver, which is thus formed upon the surface of the record-plate, is not only a very delicate electrolyte, but is also, very sensitive to light. This layer of iodide of silver is represented in Fig. 4 as a disproportionately thick coat, (shown in dotted lines,) and is marked with the reference-numeral 3. It is supposed to cover the whole surface of the record-plate, although in the drawings it is only shown to cover about one-half of the plate, for reasons which will presently appear. The plate thus prepared is ready to receive the records of any sounds, and such record is produced in the following manner:

The point of a fine platinum wire 4 is fixed with relation to the record-plate 1, so as to dip into the layer of the electrolyte (in this instance iodide of silver) without touching the plate itself. This may be accomplished by attaching the wire to a bar or arm 5 of non-conducting material, as shown, which bar or arm bears, by gravity or otherwise, upon the plate 1, and thus holds the point of the platinum wire at an invariable distance from the surface of the plate, but yet immersed in the electrolyte. The platinum wire 4 constitutes one terminal of an electric circuit 6, the other terminal of which is formed by the plate 1. In the circuit 6 are included a battery 7 and a telephonic transmitter 8, which may be of the Blake type, as shown, or of any other preferred and suitable construction. If, now, the plate 1 is moved uniformly along in the direction of the arrow, the electric current of uniform strength, passing through the electrolyte, will decompose the latter, and the product or products of decomposition will form upon the plate a straight line of uniform thickness. If in this condition of the apparatus sound-waves of any kind, including articulate speech, are directed upon the diaphragm of the transmitter, the strength of the current will be varied in strict accordance with the undulations of the sound-waves,

as is well understood by those skilled in the art of telephony, and the amount of electrolytic action of the current, and consequently the thickness of the deposit upon the plate, will vary in accordance with said undulations. The deposit will thus be in the form of a vertically-undulating line, as shown at 9 greatly exaggerated, and will form the initial record of the sounds uttered against the diaphragm of the telephonic transmitter.

When the electrolyte used is iodide of silver, the whole process so far described must be performed in a dark room. In a similar room the record is then exposed to the action of vapor of mercury, or such other substance as may be found to have an electric conductivity greatly differing from that of the substance of the record-plate. If mercury be used, it is condensed in minute globules upon the decomposed parts in exact accordance with the amount of decomposition, as is well understood by those skilled in the art of daguerreotyping. The record then consists of a line of varying thickness of mercury and appears to the eye as a line of varying shades of light, as in a photographic picture. The record is then placed in a bath of hyposulphite of soda or some equivalent solution, which dissolves all those parts of the electrolyte which have not been decomposed in forming the record, whereby the latter is made to appear as an undulatory surface of mercury upon a polished surface of silver.

While the sound-record, consisting of a line of mercury of varying thickness, obtained by the process thus far described, is well adapted for reproducing the recorded sounds, it is sometimes desirable to have the record consist of a material of higher electrical resistance, and for this purpose the record-plate may be immersed in a solution that will act upon mercury but not upon silver. The compound of mercury thus formed always has higher electrical resistance than mercury alone, while the accuracy of the record is not thereby affected.

I am by no means restricted to the use of iodide or bromide of silver as the electrolyte. Numerous other compounds may be used with equal and even with greater advantage. I have found wet sodium chloride or common table-salt a good electrolyte to decompose and form a deposit upon a surface of tin, zinc, or copper. In sodium chloride (NaCl) the sodium (Na) and chlorine (Cl) are held together by a comparatively-weak chemical affinity. When the sodium chloride is electrolyzed, it appears that the chlorine, which is one of the most active chemical agents, immediately attacks the tin, zinc, or copper, forming a chloride of tin, zinc, or copper, and that the sodium displaces one atom of hydrogen in each molecule of the water in the solution, forming sodium hydrate, (NaH O,) which is highly deliquescent and absorbs the water surrounding the newly-formed chloride of tin, zinc, or copper, and aids in more permanently fixing the record

which is made by the action of the chlorine upon the metal.

The sodium chloride may be applied to the record-plate in solution and used before drying, in the manner described with reference to Fig. 4, when iodide of silver is used; or the solution may be allowed to dry, and the fine film of salt thus deposited upon the plate may be wet and dissolved by water fed down upon the plate by means of the recording platinum wire, the upper part of which may for this purpose be covered by a wick which is kept constantly wet.

The record of sound-waves thus obtained by the varying electrolytic action of an electric current which is itself varied by sound-waves in the manner hereinbefore described is used for reproducing the recorded sounds in the following manner: The point of the platinum wire 4 is fixed in relation to the record so as to be either just out of contact with or to bear very lightly upon the same. If the point is out of contact with the record-line, a film of water, or slightly-acidulated water, is fed down by the wire, so as to bridge the space between the latter and the record-line. The plate is then moved under the point of the wire in the same manner as in recording; but in the circuit 6 6 a telephone-receiver is substituted for the transmitter 8. It will now be seen that as different parts of the record move under the point of the platinum wire the resistance of the circuit 6 6 will be varied in accordance with the thickness of the deposit upon these parts; and since the thickness of this deposit is in strict accordance with the undulations of the sound-waves originally uttered against the transmitter it is clear that the resistance of the circuit will be varied in accordance with said undulations and the original sounds will be reproduced in the receiver.

For experimental purposes the simple arrangement shown in Fig. 4 is quite sufficient; but for a more systematic practice of the invention an apparatus must be used that will admit of accurate work. In Figs. 1, 2, and 3 such apparatus is shown, but it may be greatly changed without in any way or manner departing from the principle of my invention. Figs. 1 and 2 show the apparatus arranged for recording. The record-surface 1 is there shown as a cylinder mounted in a frame 10, in which it can be rotated by hand by means of a crank 11, or by any suitable motor. Upon the shaft of the cylinder is keyed a pinion 12, which meshes with the teeth of a gear-wheel 13, carried by a shaft 14, which is arranged parallel with the cylinder and has its journal-bearings in elevated portions of the frame 10. This shaft 14 is screw-threaded between the bearings, and a nut 15, which is placed upon the shaft, carries the arm 5 of insulating material, which in turn supports the platinum wire 4. A thin rod 16, fixed between the sides of frame 10, extends parallel

with the screw-shaft 14 and passes through a notch formed in the outer surface of the nut 15, as is clearly indicated. By this arrangement, whenever the cylinder is rotated the screw-shaft will also rotate, and will move the nut along a straight line, the same being prevented from turning by reason of the rod 16, which has the relation of a spline or feather to the same. The arm 5 and the connected platinum wire are thus carried from one end of the screw-shaft to the other, and the wire 4, if sufficiently long, will mark upon the surface of the cylinder a helical line. The circuit of the transmitter 8 is completed by a brush 17, bearing upon a projecting portion of the shaft of the cylinder, as indicated.

In Fig. 3 the same apparatus is shown as arranged for reproduction. It differs from the arrangement in Figs. 1 and 2 only in that a telephone-receiver 18 is substituted for the transmitter, and that the point of arm 5 is cut off, so as not to touch the cylinder. The helical lines of varying breadth (shown upon the cylinders both of the recorder and reproducer) are intended to represent the record-lines of varying thickness, and consequently of varying resistance. The use of the apparatus for practicing my novel method of recording and reproducing sounds of all kinds is so clear from what has hereinbefore been said that it is deemed unnecessary to enlarge upon it. The materials of the cylinders will vary according to the electrolyte employed. If sodium chloride be used, the cylinder may be of any conducting material, and may conveniently be covered with tin-foil.

Having now fully described my invention, I claim and desire to secure by Letters Patent—

1. The method of producing a record of articulate speech or other sounds, which consists in producing permanent changes in the resistance of a conductor or partial conductor by and in accordance with a current of electricity varied by said speech or other sounds, substantially as described.

2. The method of producing a record of articulate speech or other sounds, which consists in producing permanent changes in the resistance of a conductor or partial conductor through the agency of an electrolyte decomposed and deposited thereon by and in accordance with a current of electricity undulated by the voice or by other sounds.

3. The method of producing a record of articulate speech or other sounds, which consists in changing the resistance of a conductor or partial conductor through the agency of an electrolyte decomposed and deposited thereon and acting chemically thereon by and in accordance with a current of electricity undulated by the voice or by other sounds.

4. The method of producing a record of articulate speech, which consists in causing a current of electricity undulated and controlled by the voice to decompose an electrolyte and

to deposit the products of the decomposition of the same upon a conductor or partial conductor.

5 The method of producing a record of articulate speech, which consists in causing a current of electricity undulated and controlled by the voice to decompose an electrolyte and to deposit the products of the decomposition of the same upon a conductor or partial conductor, the components of said electrolyte forming two or more compounds, one or more with said conductor or partial conductor to change the resistance of the same, and one or more of the remaining components of said electrolyte forming a drier to fix said record more permanently, substantially as described.

6 The method of producing a record of articulate speech, which consists in causing a current of electricity undulated and controlled by the voice to decompose an electrolyte and to deposit the products of the decomposition of the same upon a conductor or partial conductor, one or more components of said electrolyte forming a resisting compound and one or more forming a drying compound, substantially as described.

7 The method of recording and reproducing articulate speech, which consists in undulating a current of electricity by and in accordance with sound-waves, causing said current to change the resistance of a conductor or partial conductor in accordance with its undulations, and then causing the record so formed to undulate a telephonic current by

and in accordance with its varying resistance, substantially as described.

8 The method of recording and reproducing articulate speech, which consists in producing a record consisting of a line of varying conductivity by undulating a current of electricity by and in accordance with sound-waves, and then causing said record to change the resistance of an electric circuit.

9 The method of producing a record of articulate speech, which consists in undulating a current of electricity by and in accordance with sound-waves, causing said current more or less permanently to change, in accordance with its undulations, the resistance of a moving electric conductor or partial conductor.

10 The method of recording and reproducing articulate speech, which consists in undulating a current of electricity by and in accordance with sound-waves, causing said current to decompose an electrolyte, the components of which will act chemically upon a conductor or partial conductor to change its resistance, and then causing a telephonic current to be undulated by and in accordance with the varying resistance of said conductor.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GEORGE W. LITTLEHALES.

Witnesses:

JOSEPH LYONS,

ROBERT E. MORRIS.