P. W. FULLER.

METHOD OF RECORDING SOUND VIBRATIONS.

APPLICATION FILED MAY 2, 1908.

**934,600.** Patented Sept. 21, 1909.

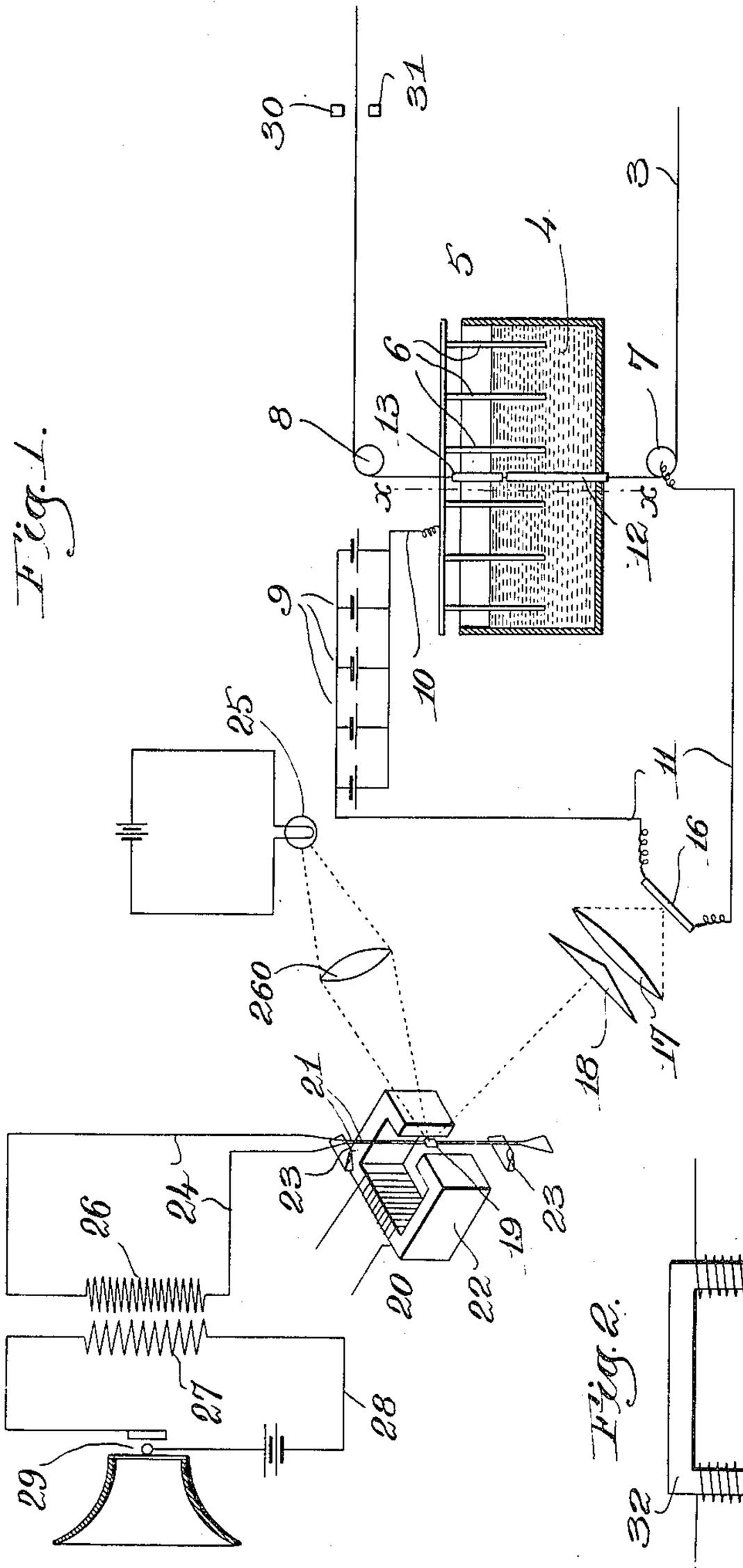


Fig. 1.

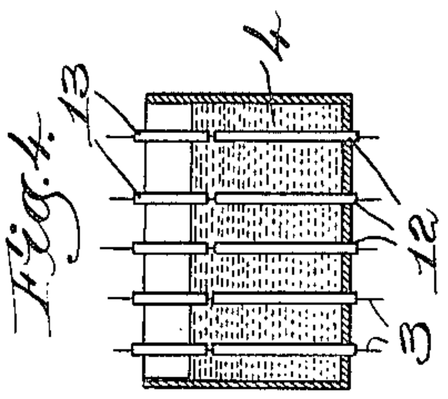


Fig. 4.

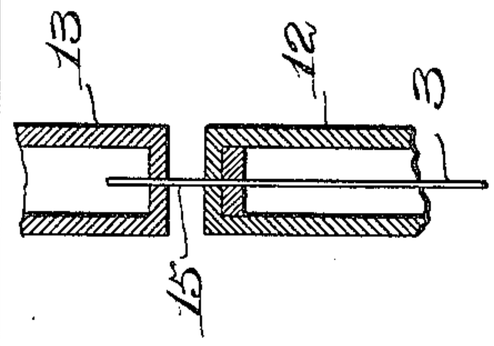


Fig. 3.

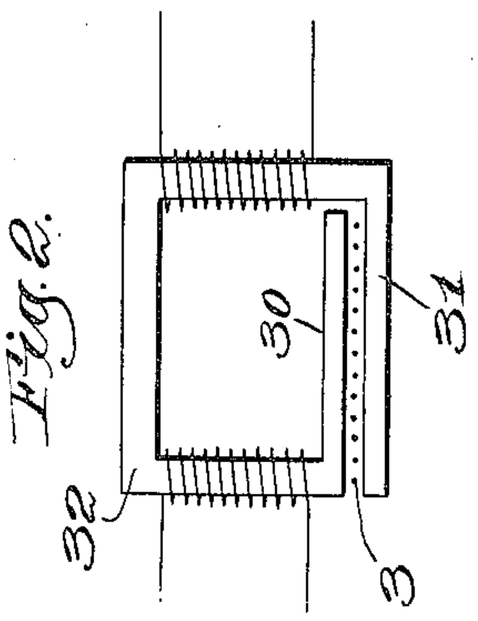


Fig. 2.

Witnesses.
Thomas L. Drummond.
Joseph M. Ward.

Inventor.
Percy W. Fuller.
by Crosby Gregory attys.

# UNITED STATES PATENT OFFICE.

PERCY W. FULLER, OF BOSTON, MASSACHUSETTS.

## METHOD OF RECORDING SOUND-VIBRATIONS.

934,600. Specification of Letters Patent. Patented Sept. 21, 1909.

Application filed May 2, 1908. Serial No. 430,451.

*To all whom it may concern:*

Be it known that I, PERCY W. FULLER, a citizen of the United States, residing at Boston, county of Suffolk, and State of Massachusetts, have invented an Improvement in Methods of Recording Sound-Vibrations, of which the following description, in connection with the accompanying drawing, is a specification, like numerals on the drawing representing like parts.

This invention has for its object to provide a novel method of recording magnetically sound vibrations so that they may at any time thereafter be re-produced.

It is a fact that when a body containing or coated with magnetizable material is magnetized, the intensity of the magnetism at any point on the body depends on the amount of magnetizable material at this point. I make use of this fact in practicing my improved method, which consists broadly in depositing on a wire, disk or other body, which is preferably of non-magnetizable material, a layer of magnetizable material which varies in thickness at different points along the wire or disk in accordance with the variations of the sound vibrations to be recorded, and then subsequently subjecting said wire or disk to the influence of a magnetic field strong enough to magnetize the magnetizable material to saturation point. Since said wire or disk has a layer of varying thickness of the magnetizable material thereon, the result of thus magnetizing it will be that said wire or disk will have at different points along its length magnetism of different strengths, (this being so because the magnetic strength at any point has a definite relation to the thickness of the magnetizable material on the body at this point,) and the completely magnetized wire or disk will represent a magnetic sound record. When a sound record thus made is passed over the poles of a telegraphone-reproducing apparatus, the sound vibrations thus magnetically recorded on the wire or disk will be reproduced in a well known manner.

While it is possible to carry out my method in a great variety of ways, I have shown in the drawings more or less diagrammatically one simple apparatus for accomplishing the desired result, it being understood, however, that I have not gone into detail of the construction of such an apparatus.

Figure 1 shows diagrammatically one apparatus for carrying out my improved method; Fig. 2 is a detail of a magnet for magnetizing the wire after the magnetizable material has been deposited thereon; Fig. 3 is a detail of the shield for protecting the wire from electrolytic action except at the point where the magnetizable material is to be deposited; Fig. 4 is a section through the electro-plating apparatus on the line *x*—*x*, Fig. 1.

In the drawings I have shown my method as it would be applied in recording sound vibrations on a wire, but I wish it understood that the method herein described can be carried out in recording sound vibrations on a plate, disk, cylinder or other body. I deem it preferable to use a body of non-magnetizable material, though my invention is not limited to the use of such a material.

For convenience sake I will hereinafter refer to the body on which the sound record is made as the wire, but I wish it distinctly understood that by using this term herein I do not limit myself to the use of a wire for carrying out my method.

In carrying out my method in the preferred way, I pass the wire on which the record is to be made through an apparatus adapted to electro-plate the wire with magnetizable material, such, for instance, as nickel, and I cause an amount of magnetizable material to be thus deposited on the wire at different points along its length which varies as the sound vibrations to be recorded vary.

In electro-plating an article, the amount of plating deposited thereon in a given time varies with the strength of the current used in the electro-plating bath, and I use this principle in securing the desired end by providing means whereby the strength of the current employed varies in accordance with the sound vibrations to be recorded. When this is done, the thickness of the coating deposited on the wire at different points (which thickness depends upon the strength of the current passing through the bath while those particular points of the wire are also passing therethrough) will vary in accordance with the variations in the sound vibrations to be recorded. While it is possible to secure variations in the current for the electro-plating bath in accordance with the variations in the sound vibrations to be recorded in a great variety of ways, I have chosen to illustrate herein one simple way which involves the use of an oscillograph

which is connected with the transmitter which receives the sound vibrations to be recorded. The oscillograph is arranged to reflect a beam of light from a uniform source of light, such as a Nernst lamp, onto a tone chart, photographic wedge, or other screen of varying transparency, and associated with said screen is a selenium cell adapted to receive the light transmitted through the screen. The amount of light which is thus received by the selenium cell at any instant depends upon the position on the screen into which the beam of light is reflected, and this in turn depends upon the sound vibrations. The selenium cell is in the circuit of the electro-plating bath and the resistance of this circuit is therefore varied in accordance with the variations of the resistance of the selenium cell and the latter in turn varies in accordance with the amount of light thrown thereon by the oscillograph. In this way an amount of magnetizable material may be deposited on the wire which varies in accordance with the variations in the sound vibrations.

Referring now more particularly to the drawings, 3 designates the wire on which the record is to be made. This wire is shown as passing through a bath 4 of an electro-plating apparatus 5. The anode or anodes 6 of the electro-plating apparatus are of some magnetizable material such, for instance, as nickel, and the wire 3 which is preferably of non-magnetizable material of good electrical conductivity, such, for instance, as copper, constitutes the cathode of the apparatus. The wire 3 is shown as passing over a guide roll 7 situated below the electro-plating apparatus and over another guide roll 8 above the same, said wire passing up through the bottom of the vessel containing the bath 4. The wire is drawn through the vessel by any suitable means (not shown), and as it passes through the bath 4 it will become electro-plated. The current for the electro-plating apparatus is generated from suitable batteries or other current-producing means 9 which are connected by a wire 10 with the anode 6. Said batteries or current-producing means are also connected by a wire 11 with the guide roll 7 over which the wire 3 passes so that the complete circuit for the apparatus comprises the batteries 9, wire 10, anodes 6, wire 3, roll 7 and wire 11. It is desirable that only a small portion of the wire 3 should be subjected to the action of the bath 4 at any single time, and I propose, therefore, to pass the wire 3 up through protecting tubes 12 and 13 which protect it from the action of the bath except in the small space 15 between said tubes. The circuit of the electro-plating apparatus has therein a selenium cell 16 of any suitable or usual construction which is preferably situated at the focal point of a condensing lens 17. Associated with this lens 17 is a screen 18, the transparency of which varies progressively from one point to another, said screen preferably being least transparent at the central portion thereof, but having the greatest transparency at the edges thereof. This screen is situated to receive a beam of light reflected from the mirror 19 of an oscillograph 20 of any suitable construction. This oscillograph is shown diagrammatically only in Fig. 1, and it comprises the usual mirror 19 carried by the wires 21 which extend between the poles of a magnet 22, said wires being shown as passing over knife-edge bearings 23. The wires 21 are in a loop forming part of a circuit 24.

25 designates a constant source of illumination such as a Nernst lamp, and 260 is a condensing lens arranged to focus the beam of light from the lamp 25 onto the mirror 19. Whenever the current in the circuit 24 varies the wires 21 and the mirror 19 will be deflected more or less according to the variations in the current and since the mirror is situated to receive the beam of light from the lamp 25 and reflect said light onto the screen 18 any deflection of the mirror will cause a displacement on the screen of the reflected beam of light. The current in the circuit 24 is arranged to be varied in accordance with variations in the sound vibrations of the sound to be recorded, and for this purpose the circuit 24 is connected with a telephone transmitter 29, this preferably being done through the primary 27 and secondary 26 of a transformer, the secondary 26 of the transformer being in the circuit 24, and the primary 27 of the transformer being in the telephone circuit 28 that includes the transmitter 29. Any sound vibrations received by the sound transmitter 29 will cause variations in the current in the telephone circuit 28, and such variations operate through the transformer 26, 27 to cause corresponding variations in the current in the circuit 24. These variations in the circuit 24 cause a corresponding vibration of the mirror 19 and thus the reflected beam of light is displaced on the screen 18, the displacement varying from one side to the other of the center in accordance with the sound vibrations received by the transmitter. The light which is transmitted through the screen 18 is received by the condensing lens 17 and focused onto the selenium cell 16 and the arrangement is such, as will be observed, that the amount of light received on the selenium cell 16 will vary in accordance with the variations in the sound vibrations received by the transmitter.

Since the resistance of the electro-plating apparatus 5 varies in accordance with the amount of light received by the selenium cell 16, it will follow that the amount of metal deposited on the wire 3 as the latter is

drawn through the bath 4 will vary in accordance with the variations in the sound vibrations received by the transmitter 29. After the wire 3 has been drawn through the bath 4, therefore, it will have on it a coating of nickel or other magnetizable material the thickness of which at different points along the wire varies in accordance with the variations in sound vibrations received by the transmitter 29.

After the wire has been drawn through the electro-plating apparatus, it is magnetized by a magnetic field of sufficient strength to magnetize the coating of magnetizable material to saturation. This may be done conveniently by passing it between the poles 30 and 31 of a magnet 32 having a uniform magnetic field. The extent to which the wire is magnetized at any point is determined by the amount of magnetizable material on the wire at this point and therefore when the wire has been completely magnetized it will have extended along its length amounts of magnetism which vary in accordance with the variations in the thickness of the magnetizable material, or, in other words, it will have along its length magnetism which varies in intensity at different points in accordance with variations in the sound vibrations received by the transmitter. In this way a magnetic sound record is produced which can be used in an ordinary telegraphone-reproducing apparatus for the purpose of reproducing the sounds received by the transmitter.

My method is adapted for making simultaneously a plurality of records of the same sound vibrations, for it is perfectly feasible to pass through the electro-plating apparatus a plurality of wires simultaneously, and if this is done, each wire will receive a similar coating of magnetizable material which varies in thickness in accordance with the variations in sound vibrations. To do this merely requires the placing in the bath of a plurality of the protecting tubes 12 and 13, as shown in Fig. 4, and running a wire through each one of these tubes. All of these wires could then be simultaneously magnetized by means of a magnet having the shape shown in Fig. 2 wherein the poles 30, 31 are of a sufficient length to permit a plurality of wires 3 to pass between them simultaneously.

It is not essential to my invention that the oscillograph method be employed for securing variations in the current through the electro-plating apparatus corresponding to variations in the sound vibrations to be recorded, for since I believe I am the first to provide any means for varying the amount of magnetizable material deposited on the wire by the variations in sound vibrations to be recorded, I desire to claim this feature broadly regardless of the apparatus employed for converting the energy of the sound vibrations into varying electrical energy adapted to vary the amount of material deposited on the wire. The oscillograph method, however, constitutes a convenient way of securing this end. Neither is it essential to my invention that the body on which the sound record is made should be in the form of a wire, although a wire has advantages over a disk, plate or other shaped body in the ease with which it may be manipulated and in the length of the record which may be readily placed thereon.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. The step in the method of producing sound records which consists in depositing on a body a layer of non-magnetized magnetizable material which varies in thickness at different points in accordance with the variations in the sound vibrations to be recorded.

2. The method of producing sound records which consists in depositing on a body a layer of magnetizable material which varies in thickness at different points in accordance with the variations in the sound vibrations to be recorded and then subjecting said body to a uniform magnetic influence to form a permanent magnetic record.

3. The steps in the method of producing a sound record which consist in depositing a layer of non-magnetized magnetizable material on a body and causing said layer to have a thickness which varies at different points on the body in accordance with the variations of the sound vibrations to be recorded.

4. The method of producing a sound record which consists in depositing a layer of magnetizable material on a body and causing said layer to have a thickness which varies at different points on the body in accordance with the variations of the sound vibrations to be recorded and then magnetizing said layer by means of a uniform magnetic field thereby to form a permanent magnetic record.

5. The steps in the process of producing a sound record which consist in passing a body through an electro-plating apparatus adapted to deposit thereon a layer of magnetizable material and causing the current through the apparatus to vary in accordance with the variations in the sound vibrations to be recorded.

6. The method of producing a sound record which consists in passing a body through an electro-plating apparatus adapted to deposit thereon a layer of magnetizable material and causing the current through the apparatus to vary in accordance with the variations in the sound vibrations to be recorded and then magnetizing said layer by

means of a uniform magnetic field to form a permanent magnetic record.

7. The steps in the process of producing a magnetic sound record which consist in converting the sound vibrations to be recorded into electrical energy and causing said electrical energy to deposit a layer of non-magnetized magnetizable material on a body.

8. The method of producing a magnetic sound record which consists in converting the sound vibrations to be recorded into electrical energy and causing said electrical energy to deposit a layer of magnetizable material on a body and then magnetizing said body by subjecting it to the influence of a uniform magnetic field thereby to form a permanent magnetic record.

9. The method of producing sound records which consists in depositing on a non-magnetizable body a layer of magnetizable material which varies in thickness at different points on the body in accordance with the variations in the sound vibrations to be recorded and then subjecting said body to the influence of a uniform magnetic field to form a magnetic record.

10. The step in the method of producing magnetic sound records which consists in passing a body through a liquid electrolyte and decomposing more or less of the electrolyte according to the variations in the sound vibrations to be recorded.

11. The step in the method of producing sound records which consists in passing a body through a liquid electrolyte and passing a current through said electrolyte which varies in accordance with the sound vibrations to be record-d.

12. The method of producing magnetic sound records which consists in passing a body through a liquid electrolyte, causing an electric current to pass through said electrolyte which current varies in accordance with the sound vibrations to be recorded whereby a layer of varying thickness is deposited on said body and then subjecting said body to a uniform magnetic influence.

13. The method of producing sound records which consists in passing a body of non-magnetizable material through an electrolyte and simultaneously passing a current through said electrolyte which varies in accordance with the sound vibrations to be recorded and subsequently subjecting said body to a uniform magnetic influence.

14. The process of making sound records which consists in depositing on a body a layer of magnetizable material which varies in thickness at different points of the body in accordance with the variations in the sound vibrations to be recorded and then magnetizing said layer to saturation point.

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

PERCY W. FULLER.

Witnesses:
BERTHA F. HEUSER,
THOMAS J. DRUMMOND.