

Patented Sept. 21, 1909.

934,601.

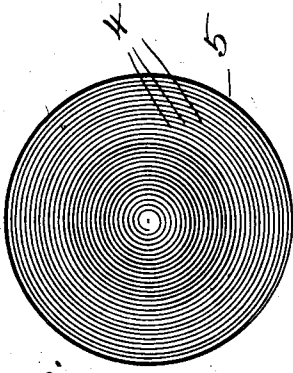


Fig. 3.

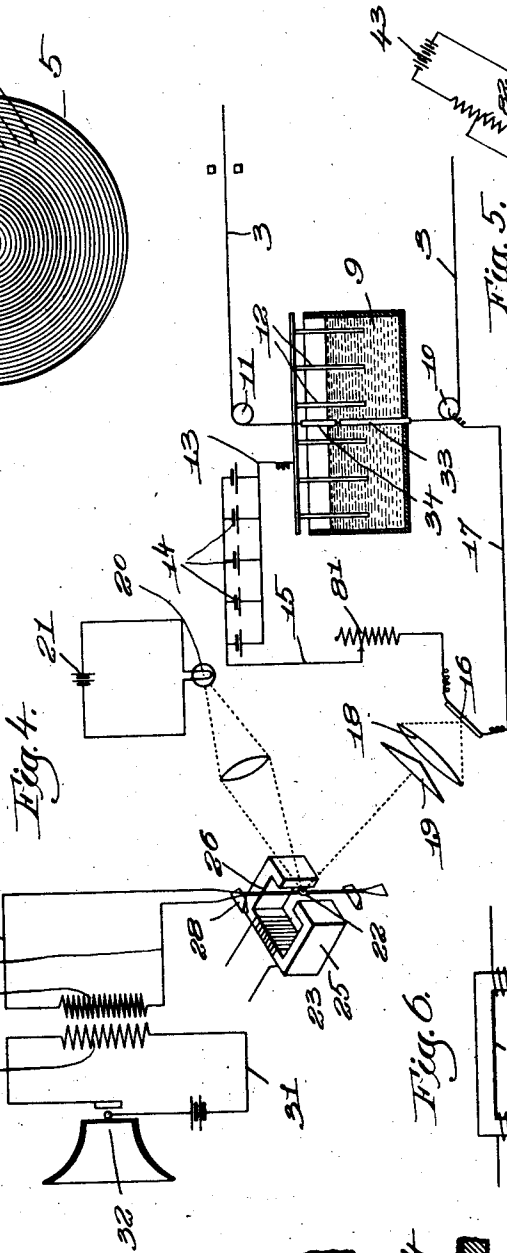


Fig. 4.

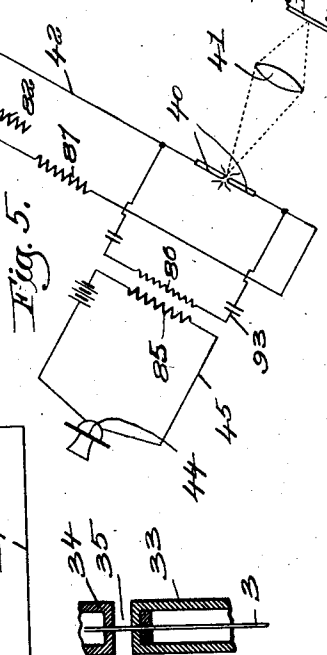


Fig. 5.

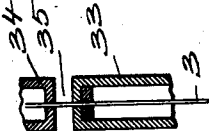


Fig. 6.

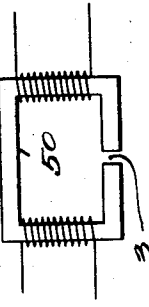


Fig. 7.

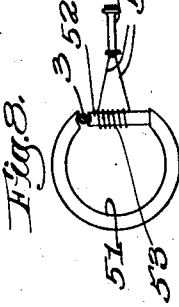


Fig. 8.



Fig. 1.

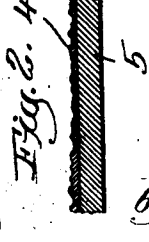


Fig. 2.

Witnesses:
Thomas Drummond
Fred. L. Grunlof

Inventor:
Percy W. Fuller,
by Henry & Company Attys.

UNITED STATES PATENT OFFICE.

PERCY W. FULLER, OF BOSTON, MASSACHUSETTS.

SOUND-RECORD.

934,601.

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

Application filed November 2, 1908. Serial No. 460,577.

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 Sound-Records, of which the following description, in connection with the accompanying drawing, is a specification, like numerals on the drawing representing like parts.

There are at present two well-known ways of making permanent records of sounds. One is by making an impression or groove in a body by means of a stylus which is attached to or actuated by a diaphragm that is set in vibration by the sounds to be recorded, and the other is by locally magnetizing successive points of a body by passing said body across the poles of a magnet in which the magnetic flux is varied in accordance with the sound vibrations to be recorded.

The first method above referred to of recording sounds produces a sound record such as is made by a phonograph or graphophone, and which consists of a body having a groove or impression representing the sound vibrations; and the second method above referred to produces a magnetic sound record such as is produced by the telegraphone.

The present invention has for its object to provide a sound record which differs from the above-mentioned sound records in that the record of the sounds is represented by a coating or deposit of material applied to a body, which coating or deposit has a characteristic that varies at different points thereof in accordance with the variations in the sound vibrations recorded. Such characteristic may be the thickness of the coating which represents intensity or amplitude of sound vibrations, or may be some other characteristic which represents pitch or quality.

The body on which the coating is applied may be a cylinder, a disk, a wire, or may have any other suitable shape or configuration, and may be made of any desired material, but will preferably be made of metal. The coating or layer which is applied thereto and which represents the sound vibrations is of a metal having magnetic properties and preferably will be one of the so-called iron group of metals. A metal like nickel which has good magnetic retentivity and can therefore be magnetized, or one like iron which has good magnetic permeability may be employed. Such coating may be applied to the

body in a variety of ways, although I prefer to apply it or deposit it on the body by the electro-plating process because by using this process the amount of metal deposited on different parts of the body and the manner of depositing it can be readily varied to correspond with variations in the sound vibrations to be recorded merely by varying the current through the electro-plating bath in accordance with the variations in such sound vibrations.

If the body on which the sound record is made is in the form of a wire, the deposit will be placed on the wire in the form of rings, the number of rings in a definite length of wire corresponding to the number of sound vibrations per unit of time, or, in other words, to the pitch of the sound record and the thickness of the rings corresponding to the amplitude of the sound vibrations or the intensity of the sound. If the body is in the form of a cylinder or plate, the deposit need not be in the form of rings but will have characteristics which vary according to the sound vibrations. When the sound record is in the form of a body having thereon a coating of magnetizable material, or material with good magnetic retentivity, such record may be made into a permanent magnetic sound record by subjecting the coated body to the action of a sufficiently strong magnetic field to magnetize the coating to saturation point, in which case there will be magnetism of different strengths at different points on the body, depending on the thickness of the coating at such points, and the sounds thus recorded can be reproduced from such a record by means of an ordinary telegraphone-reproducing apparatus. If, on the other hand, the material of the coating deposited on the body and representing the sound vibrations, is one having good magnetic permeability but incapable of being magnetized, the sound vibrations thus recorded can be reproduced by passing the body between the poles of a magnet, one of which has associated therewith an iron core about which is wound the coils of the circuit of a telephone receiver, for when the body is thus moved relative to the magnet, the density of the magnetic flux which flows from one pole to the other will vary, depending on the thickness of the coating at different points along the body, and the variation in the flow of the magnetic flux will cause a sufficient variation of the cur-

rent in the telephone receiver circuit to reproduce the sounds recorded on the body.

While there are a great variety of ways in which my improved record might be made, I have in the drawings illustrated a few ways only, such illustrations when taken in connection with the accompanying description, being sufficient to disclose fully the principle of the invention.

Referring to the drawings, Figure 1 is a view illustrating the principle of my invention when embodied in a sound record applied to a wire; Fig. 2 is a view showing the principle of my invention when the sound record is applied to a body in the form of a disk, both said Figs. 1 and 2 being more in the nature of diagrams than in the nature of actual illustrations of sound records; Fig. 3 is a plan view of a disk having my sound record applied thereto; Fig. 4 is a diagram view showing an apparatus by which my improved sound record may be formed on a wire; Fig. 5 is a diagrammatic view showing a different method of accomplishing the same end; Fig. 6 is a view showing the operation of permanently magnetizing the wire to form a magnetic sound record; Fig. 7 is a detail of the apparatus shown in Fig. 4; Fig. 8 shows diagrammatically a reproducing apparatus capable of reproducing a sound record when said record is represented by a coating of material having good magnetic permeability.

Referring to Fig. 1, 3 designates the wire or other body on which the sound record is made. The sound record is represented by a coating 4 which is applied to the body 3 and which varies in thickness at different points in accordance with the sound vibrations. Where the body is a wire, the coating or deposit 4 representing the sound record will preferably completely encircle the wire.

My improved record may also be formed on a disk 5, such as shown in Figs. 2 and 3, in which case the sound record would be in the nature of a ridge or line of material applied to or deposited on the disk in the form of a spiral, as shown in Fig. 3. Fig. 2 illustrates a section through the disk, which section is taken along the length of the line of deposit, said figure being for the purpose of illustrating the varying thickness of the coating or deposit 4. The body 3 or 5 may be of any suitable or usual material, but I will preferably use some non-magnetic material, such as copper, although other materials than copper might be successfully used, and my invention is not limited to the use of any particular substance for the body 3, 5. The material of the coating or deposit 4 may also be varied without departing from the invention, although I will preferably use either metal capable of being readily deposited by an electro-plating process and capable of being magnetized, such, for instance as nickel,

or a metal capable of being readily deposited by an electro-plating process and having good magnetic permeability, such, for instance, as iron.

In order to give a better understanding of a sound record embodying my invention, I will refer briefly to some ways in which such a record may be produced. The apparatus shown in Fig. 4 is similar to an apparatus illustrated in my co-pending application, Serial Number 430,451, filed May 2, 1908, in which I have claimed the method of making sound records. This apparatus comprises an electro-plating bath 9 through which the wire 3 is passed, said wire passing over the direction rolls 10 and 11. The arrangement shown in Fig. 4 is one adapted to deposit nickel or some similar metal on the wire 3, and 12 represents nickel anodes which dip into the electro-plating bath 9. These anodes are connected by wire 13 with a battery or other source of electricity 14, and said source of electricity is connected by a wire 15 with a selenium cell 16, said cell in turn being connected with the roll 10 by a wire 17. The circuit through the bath comprises the wire 13, anodes 12, the wire 3, roll 10, wire 17, selenium cell 16, and wire 15 (which may have a variable resistance 81 therein) back to the source of supply 14.

The selenium cell is situated at the focal point of a condensing lens 18, which lens is arranged to focus on the cell a light which varies in intensity in accordance with the sound vibrations to be recorded. As is well known, the electrical resistance of selenium varies in accordance with the amount of light to which the selenium is subjected, and by varying the amount of light which is thrown on the selenium cell 16, the amount of current which passes through the bath 9 will be varied, and, therefore, a varying amount of nickel will be deposited on the wire 3 as the latter is drawn through said bath.

There are many ways in which the intensity of the light thrown onto the selenium cell 16 may be varied to correspond with variations in the sound vibrations. The device shown in Fig. 4 makes use of a light of constant intensity, but varies the intensity of the light received by the selenium cell by means of a device known as a photographic wedge or tone chart 19, which is a transparent body having a progressively varying transparency from one portion to another. The device herein illustrated is least transparent at the center part and has the greatest transparency at the edges. Such source of constant illumination is illustrated by 20 and may be an electric light of any suitable construction connected with a battery or source of electricity 21. This light is arranged to direct a beam of light onto a mirror 22 of an oscillograph 23, the

beam of light being focused on the mirror by means of a condensing lens 24. The mirror is situated to reflect the beam of light onto the tone chart 19. The oscillograph shown may have any suitable or usual construction and herein comprises a magnet 25 between the poles of which extend the two wires 26 of a loop in a circuit 27, said wires passing over the knife edges 28 and having the mirror 22 secured thereto. The circuit 27 has in it the coils 29 of a transformer, the other coils 30 of which are in the circuit 31 of the telephone transmitter 32. When sound vibrations are received by the transmitter 32, the current in the circuit 31 will be varied in a well known manner, and the variations in this current will, through the transformer, cause similar variations in the current in the circuit 27. The mirror 22 will be deflected more or less, depending on the current variations in the circuit 27, and, therefore, the beam of light reflected from the mirror 22 will be displaced more or less on the tone chart, that depending on the character of the sound vibrations received by the telephone transmitter. The displacing of the beam of light on the tone chart results in changing the amount of light received by the selenium cell because of the varying transparency of the tone chart at different points. It will thus be seen that the current which passes through the bath of the electro-plating apparatus will vary in accordance with the variations of the sound vibrations received by the telephone transmitter, and such variations of the current through the electro-plating bath 9 will result in depositing more or less metal on the wire 3 as I have above stated.

In order to localize the deposit on the wire 3, I have shown protector tubes 33 and 34 through which the wire 3 passes and which are separated at 35 at a point within the bath so that the only portion of the wire 3 which is subjected to the action of the bath 9 is that within the space 35. With the device as herein illustrated the coating will be placed on the wire in the form of rings, the number of rings deposited per unit of time or per unit of length of wire depending on the pitch of the tone, and the thickness of the rings depending upon the intensity of the tone or amplitude of the sound vibrations.

The device shown in Fig. 4 will produce a sound record such as shown more or less diagrammatically in Fig. 1, that is, a wire body on which are deposited rings of metal of different thickness, the varying thickness of the rings representing the variations in the sound vibrations recorded.

In lieu of using the oscillograph and tone chart for varying the amount of light received by the selenium cell, I may employ the speaking arc, as shown in Fig. 5. In

this case, the speaking arc (which is of usual construction) is arranged so that a beam of light projected therefrom will be focused on the selenium cell by means of a condensing lens 41. The speaking arc comprises the two carbons 40 connected to a circuit 42 which is supplied with current from a source of current supply 43, and which may have therein a choking coil 87 and a variable resistance 82. 44 is a telephone transmitter, the circuit 45 of which has therein one coil 85 of a transformer, the other coil 86 of the transformer being in a circuit 93 which is so connected with the circuit 42 that the current of the circuit 93 will be impressed upon the current in the circuit 42.

The arc is maintained in a luminous condition by the source of electrical supply 43 and any variations in the current in the circuit 45 causes variations in the current in the circuit 93 which in turn causes a variation in the luminosity of the arc.

If the deposit or coating on the body 3 or 5 is iron, such iron coating may be deposited by the process known as acierage or steel facing. According to this process, the bath 9 is prepared by using a large sheet of iron for the anode and passing the current through the bath, which is simply a solution of sal ammoniac in water. After the current has passed through the bath for a suitable length of time, the solution becomes charged with iron and if a copper wire 3 is drawn through a bath thus prepared, an iron deposit will be formed on the wire.

Instead of using wire for the body, it is possible to use a disk such as shown in Figs. 2 and 3, in which case, of course, the electro-plating apparatus would be so arranged that the deposit would be made in the form of a line on the record.

Whenever the sound record is made by the electro-plating process, as above described, the material 4 deposited on the body will be in the form of an integral metal coating or layer.

Where the sound record is made by depositing nickel or some magnetizable material on the wire or other body, the record may be changed into a magnetic record by passing the wire between the poles of a magnet 50, as shown in Fig. 6, which is powerful enough to magnetize the magnetizable coating 4 to saturation point. When this is done, the intensity or degree of magnetism at different points along the wire will correspond to the thickness of the metal coating 4, and, therefore, a permanent magnetic record of the sound vibrations will result. The sounds thus magnetically recorded can be reproduced by means of an ordinary telegraphophone-reproducing apparatus which it is not necessary to illustrate herein. If, on the other hand, the coating which is applied to the wire or other body is of iron

which has good magnetic permeability, the sound record will be completed when the deposit is made. The sounds thus recorded may be reproduced by passing the wire or other body between the poles of a magnet 51, one of the poles of which magnet has associated therewith an iron core 52 about which are wound the coils 53 of the circuit 54 of a telephone receiver 55. The density 10 of the magnetic flux which flows from one pole to the other depends on the thickness of the iron coating on the wire, and, therefore, as the wire is drawn between the poles, a varying current will be set up in the circuit 54 which will cause a reproduction of 15 the sound vibrations by means of the receiver 55.

In the above I have not attempted to illustrate all the ways in which a sound record 20 embodying my invention might be made, nor all the forms such a sound record might assume. What has been shown and described is sufficient, however, to illustrate the principle of the invention which is expressed 25 in the following claims.

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

1. A sound record comprising a body having thereon an integral coating or layer of magnetized metal, which coating or layer has a characteristic other than its magnetic characteristic that varies to represent variations in sound vibrations.

2. A sound record comprising a body having placed thereon an integral coating or layer of one of the metals of the iron group which varies in thickness at different points to represent variations in sound vibrations.

3. A sound record comprising a body having deposited thereon so as to be in intimate and permanent contact therewith a layer or coating of one of the metals of the iron group, which layer or coating varies in thickness to represent variations in sound vibrations.

4. A sound record comprising an integral layer or coating of one of the metals of the iron group which varies in thickness at different points to represent the variations in the sound vibrations of which the layer constitutes a record.

5. A sound record comprising a body having thereon an electrolytically-deposited layer or coating of magnetized metal, which

layer or coating has a non-magnetic characteristic that varies to represent the variations in the sound vibrations recorded.

6. A sound record comprising a body having deposited thereon by electric action a coating or layer of one of the metals of the iron group, which layer or coating varies in thickness at different points to represent variations in sound vibrations.

7. A sound record comprising a body of non-magnetizable material having deposited thereon an integral coating or layer of metal which varies in thickness at different points to represent variations in sound vibrations.

8. A sound record comprising a body of non-magnetic material having deposited thereon by electric action an integral coating of metal which varies in thickness at different points to represent variations in sound vibrations.

9. A sound record comprising a body having deposited thereon by the electro-plating process an integral coating or layer of metal having magnetic properties, which coating or layer varies in thickness at different points to represent variations in sound vibrations.

10. A sound record comprising a body having thereon an integral coating or layer of metal having magnetic properties, which coating or layer has a characteristic other than a magnetic characteristic to represent variations in sound vibrations.

11. A sound record comprising an integral layer or coating of magnetized metal which varies in thickness at different points to represent variations in the sound vibrations of which the layer constitutes a record.

12. A sound record comprising a body having deposited thereon a coating or layer of metal magnetized to saturation point, which layer or coating varies in thickness at different points to represent variations in sound vibrations.

13. A sound record comprising a wire having a cross-wire corrugated magnetic face with the different corrugations varying in size to correspond to variations in the sound vibrations recorded.

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

PERCY W. FULLER.

Witnesses:

LOUIS C. SMITH,

THOMAS J. DRUMMOND.